POWER INVESTED.

Algonquin Power Co.
354 Davis Road
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T: 1-855-760-3011
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December 19, 2017

Mr. Aimann Sadik
Government of Saskatchewan
Senior Environmental Assessment Administrator
Ministry of Environment, Environmental Assessment Branch
4th Floor, 3211 Albert Street
Regina, Canada S4S 5W6

Re: Blue Hill Wind Energy Project
Environmental Impact Statement

Dear Aimann,

Algonquin Power Co. (Algonquin) is proposing to develop, construct and operate the Blue Hill Wind Energy Project (the Project) in an area between Herbert and Neidpath in southwest Saskatchewan. We are pleased to submit for approval the enclosed Environmental Impact Statement (EIS) in accordance with *The Environmental Assessment Act*. This EIS has been prepared in accordance with the Terms of Reference (TOR) as approved by the Ministry of the Environment on March 28, 2017.

The Project is located primarily on land in the Rural Municipalities (RMs) of Lawtonia and Morse, approximately 40 km east of Swift Current and 200 km west of Regina, Saskatchewan. The proposed Project will consist of a maximum of 56 wind-turbine generators (WTGs), depending on the final selection of the WTG model and manufacturer, and will include supporting infrastructure such as access roads, an underground fibre-optic communications network, an operations and maintenance building, an electrical collection system for the generated power (including overhead collector lines along RM road allowances), and a new 34.5-kV:138-kV substation.

The Proponent retained Stantec Consulting Ltd. to assist in the preparation of the EIS.

Algonquin has met the requirements of the *The Environmental Assessment Act* as detailed within this EIS. From the beginning of the Project, Algonquin has sought feedback from, and will continue to engage First Nations, Métis, the public (including local communities, non-governmental organizations [NGOs] and other stakeholders) and government (RMs, municipal, provincial and federal) and regulatory agencies.

If you have any questions or require any further information please do not hesitate to contact the undersigned at 905-465-4518.

Sincerely,

Sean Fairfield
Director of Project Planning and Permitting
Algonquin Power Co.

cc: Brandon Moore, Algonquin Power Co.
Chantal Eidem, Stantec Consulting
Neil Cory, Stantec Consulting

Blue Hill Wind Energy Project

Environmental Impact Statement

December 19, 2017

Prepared for:
Algonquin Power Co.
354 Davis Road
Oakville, ON, L6J 2X1

Prepared by:
Stantec Consulting Ltd.
75-24th Street East, Ste 100
Saskatoon, SK, S7K 0K3

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Executive Summary

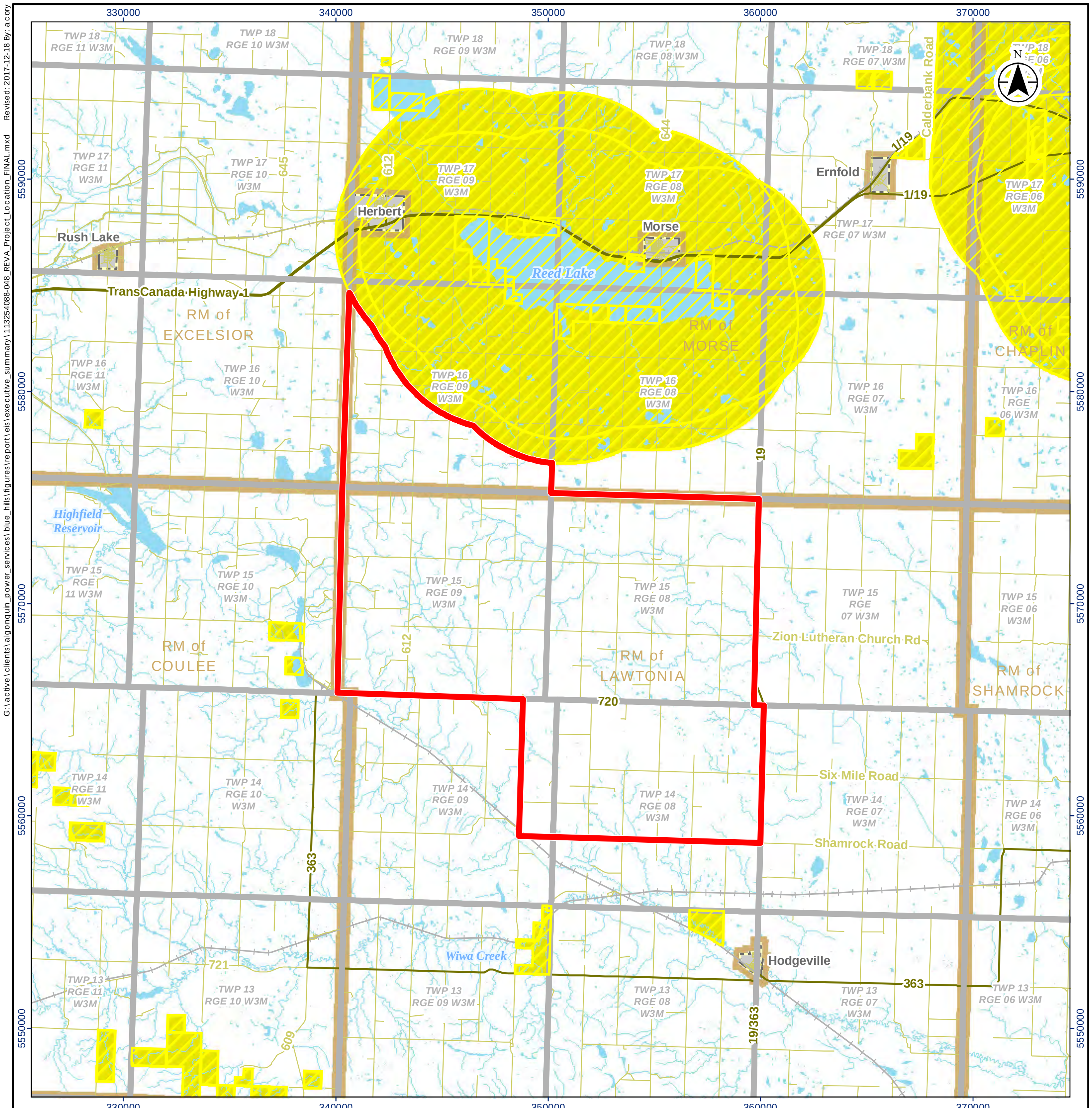
SaskPower has adopted a strategy to meet new load growth over the next several years using its Environmentally Preferred Power Strategy. This strategy is intended to encourage production of low-environmental-impact power, to utilize waste streams as a fuel source, to reduce SaskPower's carbon and other emissions, to monetize the value of low-environmental impact power and to add 'small-generation power' in step with SaskPower's local requirements. Under the Request for Proposal (RFP) (Inquiry CO/690) in 2011, SaskPower undertook a competitive process to procure up to 177 megawatts (MW) of wind power from one or more independent power producers. Algonquin Power (Algonquin) was selected in early 2012 through the SaskPower RFP process and has subsequently signed a Power Purchase Agreement with SaskPower for a 177 MW wind energy project. In early January 2017, SaskPower announced that the Blue Hill Wind Energy Project (the Project) would be developed to fulfill this need in an area between Herbert and Neidpath in southwest Saskatchewan (Figure EX-1).

Regulatory Framework

As part of the development of the Project and regulatory process, the Project would typically be subject to review by the Saskatchewan Ministry of Environment's (SKMOE) Environmental Assessment Branch (EAB) to determine if the Project is considered a "development" under the Saskatchewan *Environmental Assessment Act*. However, Algonquin requested to "opt in" to the formal environmental assessment process (i.e., self-declare that the Project is a 'development' under Section 2(d) of the *Environmental Assessment Act*) and forgo a Ministerial Determination for the Project. SKMOE EAB representatives confirmed this as being an option to Algonquin via conference call on December 19, 2016. As such, the Project is subject to an environmental assessment (EA) under Saskatchewan's *Environmental Assessment Act*.

To begin the regulatory review process for the Project, and as recommended by the SKMOE, Algonquin submitted a high-level Technical Project Proposal (TPP) and draft Terms of Reference (TOR) to the EAB for review on February 6, 2017. The purpose of the TPP was to give the SKMOE information about the Project, its location, and scoping of issues to be assessed as part of the environmental assessment process. Algonquin developed the draft TOR following the SKMOE's *Guidelines for the Preparation of the Terms of Reference* (SKMOE 2014a). Following EAB's review of the draft TOR, Algonquin addressed review comments to the satisfaction of the SKMOE and the final TOR was approved on March 28, 2017, and posted on the SKMOE's website.

This Environmental Impact Statement (EIS) is intended to fulfill requirements for an EA pursuant to the Saskatchewan *Environmental Assessment Act* and has been prepared to comply with the approved TOR set forth for this Project.



Project Area
Wind Energy Project Avoidance Zones
Rural Municipality
Major Road
Minor Road
Railway
Watercourse
Waterbody
Town/City
Township

0 3 6 Kilometers
1:275,000 (at original document size of 8.5x11)

Notes
1. Coordinate System: NAD 1983 UTM Zone 13N
2. Base features produced under license from the Government of Saskatchewan and the Government of Canada.
3. Avoidance Zones: SK Gov Rest Services, Accessed Nov 30, 2017.

Stantec Algonquin

Project Location
Near Herbert, SK

113254088-048 REVA
Prepared by acory on 2017-12-18
Technical Review by ceidem on 2017-12-18

Client/Project
Algonquin Power Co.
Blue Hill Wind Energy Project

Figure No.
EX-1

Title
Project Location

Project Description

The Project is located within the rural municipalities (RMs) of Morse and Lawtonia, approximately 10 km south of the town of Herbert, Saskatchewan (SK), and approximately 40 km east of Swift Current, SK. The Project will consist of approximately 49 to 56 wind turbine generators (WTG), each with a capacity between 3.2 MW and 3.7 MW (depending on the selected turbine type), and associated infrastructure, including access roads, electrical collector lines, an operation and maintenance building (O&M), and a substation. Construction of the Project is anticipated to begin in 2019 and the Project commissioned in 2020.

The Project area was selected due to its wind resources and avoidance of environmental constraints such as SKMOE's *Wildlife Siting Guidelines for Saskatchewan Wind Energy Projects* (SKMOE 2017a) avoidance zones, certain types of land cover (i.e., predominately cultivated), and sensitive features (e.g., historical occurrences of species at risk [SAR] or species of management concern [SOMC]). Within the Project area (the land generally within which the Project resides), the proposed Project layout (the land occupied by each Project component) was developed based on several siting factors including, but not limited to, wind resources, construction feasibility, landowner support, municipal setbacks, and setback distances for avoidance of sensitive features identified during environmental studies. Development and refinement of the Project layout has been iterative in order to progressively avoid or reduce potential environmental effects to the fullest extent possible.

For the purposes of the EIS, the final layout consists of a maximum of 56 WTGs (including seven contingency locations), access roads, collector lines, an O&M building, and three substation locations (one primary and two contingency locations). Contingency infrastructure represent possible alternate locations for Project components and are included to allow for design flexibility prior to or during construction. To be conservative, the maximum extent of the layout, including contingency infrastructure, has been used to describe the Project and to assess potential effects, including the potential spatial extent of disturbance. The Project layout is sited primarily on cultivated land and the construction footprint will be approximately 158 ha. The disturbance footprint during operation will decrease due to the reclamation of temporary workspaces and the narrowing of construction access roads from 25 m to 5 m.

Engagement

Engagement activities for the Project began in January 2017. Public engagement activities for the Project will continue through the regulatory, construction, and operational phases of the Project. To date, this process has included three rounds of engagement activities, creating opportunities to collect feedback and share information with those who may be affected by or have an interest in the Project. Targeted audiences for engagement activities include the public (individual landowners, local communities, non-governmental organizations), Indigenous communities, and government (RMs, municipal, provincial) and regulatory agencies. The engagement program has included public open houses (January 23-24, June 19-20, and September 27-28), in-person meetings, telephone calls, publication of newspaper notices, and the distribution of letters and notices to interested stakeholders. A compilation of issues and responses have been included in the EIS, as well as how Project feedback helped to influence the Project planning.

Environmental Assessment Scope

The EA focuses on Valued Components (VCs), the specific biophysical and socio-economic components that could be adversely affected by the Project, and that are of particular value or interest to regulators and other stakeholders. As outlined in the TOR, seven VCs were selected as the focus of this EIS:

- Acoustic Environment
- Vegetation and Wetlands
- Wildlife and Wildlife Habitat
- Heritage Resources
- Land and Resource Use
- Employment and Economy
- Community Services and Infrastructure

Existing ('baseline') environmental conditions were described for each VC. The existing conditions for the biophysical and socio-cultural and economic environment provide an overview of the setting for the Project, support an understanding of the receiving environment, and enable an understanding of how the current environmental conditions might be affected by the Project. Baseline information was limited to that which is necessary to assess the environmental effects of the Project and support recommendations for mitigation, monitoring and follow-up.

The environmental effects assessment included assessing the potential direct and cumulative effects of the Project on the environment, identifying any residual effects (i.e., those environmental effects that remain after the planned mitigation measures have been applied), and determining the significance of those residual effects. The assessment also involved the identification and assessment of potential effects of the environment on the Project.

Potential Project-related environmental effects are changes to the ecological, socio-cultural and economic environments that could be caused by a project or activity arising solely as a result of the proposed physical activities associated with the Project. Effects of the Project were evaluated in the context of the regulatory setting, issues identified through engagement activities, potential Project-VC interactions, and existing knowledge of wind energy developments. Residual environmental effects were characterized for each Project phase, where applicable, using specific criteria defined for each VC (i.e., direction, magnitude, geographic extent, duration, frequency, reversibility, and context).

A cumulative environmental effects assessment was also conducted. For each VC where there was a residual effect, a description was provided of how the Project and other existing and future (i.e., certain or reasonably foreseeable) projects might cumulatively affect the VC. Residual cumulative effects were characterized in consideration of planned site-specific mitigation.

The significance of both Project and cumulative effects was determined based on pre-defined criteria or thresholds (i.e., significance rating criteria).

Environmental Setting

The Project area is situated in the Mixed Grassland ecoregion with portions overlapping the Swift Current Plateau and the Chaplin Plain landscape areas (Acton et al. 1998) (see Figure EX-1). The Mixed Grassland ecoregion is a semiarid ecoregion generally characterized by natural vegetation communities containing spear grass, blue grama, wheat grass, with associated species of June grass and dryland sedges, among others. Approximately half the ecoregion is cultivated with annual crops; the remaining land is used for pasture and rangeland with remnant patches of natural vegetation communities undisturbed by agriculture and livestock production (Acton et al. 1998).

The Project area also lies within the Missouri Coteau of the Prairie Pothole Region, which is characterized by numerous depressional wetlands that contribute substantially to the regional biodiversity. The Canadian portion of the Prairie Pothole Region is identified as Bird Conservation Region 11, which contains 341 species of birds within its 467,000 km^2 area (EC 2013). There are also an estimated 51 species of mammals and 15 reptiles and amphibians in the southern grasslands of Saskatchewan (Acton et al. 1998). There are no large waterbodies within the Project area, though at a regional level it is located 5.0 km southwest of Reed Lake (with the nearest WTG being proposed 8 km from Reed Lake) and 4.5 km east of the Highfield Reservoir.

The Project area primarily consists of cultivated land (i.e., annual cropland) (73.3%), with some tame pasture (8.5%), hayland (7.7%), native prairie (5.4%), and water/wetlands (less than 3%). Within the Project area, there are no designated wildlife conservation lands. The nearest designated land (i.e., *Wildlife Habitat Protection Act* land) is located 1.6 km west of the Project area boundary. The Project area does not overlap any critical habitat defined by Environment and Climate Change Canada in species recovery strategies and it does not overlap any wind energy project avoidance zones identified by SKMOE (SKMOE 2017a). The nearest avoidance zone is associated with the Reed Lake Important Bird Area which is located 7 km to the north of the Project area.

VC Effects Assessment Results

Acoustic Environment

The acoustic environment VC assessment focused on assessing the Project noise effect at identified points of reception. In the absence of Saskatchewan noise guidance or regulations, the acoustic environment assessment used the Ontario Ministry of the Environment and Climate Change (MOECC) *Noise Guidelines for Wind Farms* (MOECC 2016) level of 40 dBA sound level limit (SLL) to determine a significant adverse effect threshold.

Noise emission levels of the WTG and substation transformer were used in the acoustic models to predict the Project noise effect at the receptors within the Local Assessment Area (LAA). The predicted SLL at all receptors within the LAA were at or below 40 dBA for all receptors within the LAA. As such, the residual Project environmental effects on acoustic environment are predicted to be not significant given no exceedance of the applicable guideline requirements.

Vegetation and Wetlands

The vegetation and wetlands VC assessment focused on plant species diversity (including native plant species and non-native invasive species), vegetation community diversity, and wetland area and function. Native plant species include SAR and SOMC. During rare plant surveys, no plant SAR or SOMC were observed within the “project footprint” or Project Development Area (PDA) and no plant SAR were observed within the LAA. Six plant SOMC were observed within the LAA and all of the occurrences were outside of the 30 m setback distance from the PDA. Locations of observed rare plants were used to inform the Project layout.

The PDA, a total area of 158.2 ha, is predominantly cultivated land (98.8 ha; 63% of the PDA) and avoids native prairie except for 0.6 ha (<1% of the PDA). Project components that intersect with native prairie consist of temporary workspaces, and collector line and access road rights-of-way (ROW) that follow municipal road allowances. The overlap is partly due to the coarseness of the land cover data; in reality, Project components will be sited to avoid native prairie where feasible, effectively reducing the 0.6 ha as close to zero as possible. Similarly, the PDA avoids wetlands where possible except for 4 ha (2.5% of the PDA). Similarly, Project components that intersect with wetlands mostly consist of temporary workspaces and ROWs associated with collector lines and access roads; through further refinements to the Project layout, the 4 ha will be reduced as much as possible by siting Project components to avoid wetlands where feasible.

Effects of the Project on vegetation and wetlands are generally expected to be adverse, but of low magnitude, limited to the PDA with some potential to extend into the LAA (e.g., wetland function), and reversible. This is largely a result of design and layout iterations that reduce overlap with plant SAR and SOMC, native vegetation types, and wetlands, as well as the use of additional mitigation measures where avoidance is not possible. The residual effects are unlikely to pose a threat to the long-term persistence or viability of a plant species (including plant SAR and SOMC), native vegetation types, or result in the permanent loss of wetlands that cannot be mitigated. With mitigation and environmental protection measures, the residual Project environmental effects on vegetation and wetlands are predicted to be not significant.

Wildlife and Wildlife Habitat

The wildlife and wildlife habitat VC assessment focused on habitat availability and mortality risk for wildlife (including SAR and SOMC). Suitable wildlife habitat was defined as native land cover classes (i.e., native prairie, shrubland, and wetland), as well as perennial cropland (i.e., tame pasture, hayland). A review of existing data sources provided information about potential and historical SAR and SOMC occurrences, sensitive features (e.g., perennial nests), and available habitat types (i.e., land cover classes) within the LAA and Regional Assessment Area (RAA). Wildlife surveys focused on detecting wildlife SAR and SOMC occurrences and documenting wildlife species occupancy in various habitat types. Locations of observed sensitive wildlife features (e.g., sharp-tailed grouse leks) were used to inform the Project layout. Wildlife surveys conducted in 2017 followed SKMOE-approved protocols and included: sharp-tailed grouse lek, raptor stick nest, diurnal bird movement, nocturnal bird radar, bat activity, breeding bird, burrowing owl, common nighthawk, short-eared owl, nocturnal amphibian, and yellow rail.

The PDA is sited primarily on cultivated land (63%). At baseline, 31.4% of the PDA is considered suitable wildlife habitat which consists primarily of tame pasture and hayland (28% combined). The PDA avoids native prairie and water/wetlands, where possible; these habitat types make up 0.4% and 2.9% of the PDA, respectively.

Five active leks were detected during field surveys. None of the leks overlap the PDA, as well as most of the 400 m activity restriction setback around the leks. There is one lek in SW-04-16-09-W3M whose 400 m setback overlaps with the edge of a temporary workspace; however, during construction, the siting of the temporary workspace will be adjusted as much as possible to be outside of the activity restriction setback. There are also two leks (SE-06-16-09-W3M and SW-16-15-08-W3M) whose 400 m setbacks overlap collector lines along existing municipal roads; construction activities at these locations will occur outside of the activity restriction period (March 15 to May 15) and be confined to the existing road ROW.

One Class IV wetland (NE-13-15-09-W3M) was identified as a northern leopard frog breeding pond during field surveys. The 500 m activity restriction setback around this feature overlaps the edge of a temporary workspace; however, during construction, the siting of the temporary workspace will be adjusted, as much as possible, to be outside of the activity restriction setback.

Diurnal bird movement surveys indicate that generally the Project area has similar movement rates to the terrestrial control site located north of the Centennial Wind Energy Project (WEP), and an order of magnitude lower movement rates than at the Reed Lake control site (outside the Project area). Similarly, nocturnal bird movement surveys using radar indicate that the Project area had movement rates approximately half of those at the Reed Lake control site, and lower than at the control site north of the Centennial WEP. Based on these surveys, there is no apparent dominant bird movement corridor through the Project area and collision risk during the day would likely be similar to the Centennial WEP.

Bat activity rates from acoustic surveys were generally low, with no migratory bat passes detected at the elevated detector in the spring, and an overall average of 0.1 migratory bat passes per detector night for the spring. There were 1.0 migratory bat passes per detector night overall during the August 1 to September 10 period, which is at the low-moderate threshold for migratory bat fatality risk according to Alberta Environment and Parks (ESRD 2013b).

With the application of recommended mitigation, the residual environmental effects on wildlife and wildlife habitat, due to changes in habitat availability and mortality risk from all Project phases (i.e., construction, operation and maintenance, and decommissioning), are not predicted to result in adverse effects to wildlife population sustainability within the RAA. This conclusion is supported by:

- the evaluation of effects to key species groups based on results of field surveys and a comprehensive literature review;
- the application of mitigation measures developed to avoid effects to SAR and SOMC; and
- the residual effects characterization for a change in habitat availability and a change in mortality risk.

Overall, residual Project environmental effects on wildlife and wildlife habitat are predicted to be not significant.

Heritage Resources

The heritage resources VC assessment focused on the Project's potential environmental effects on heritage resources (i.e., archaeological, cultural, paleontological, and architectural remnants of past human activity and natural history that may be visible on the ground surface or buried by soil and sediment). Based on a referral from the Heritage Conservation Branch (HCB), a heritage resource impact assessment (HRIA) was completed for the Project. During the HRIA, four previously undiscovered archaeological sites were recorded near the PDA. With the implementation of recommended mitigation measures approved by the HCB (i.e., avoidance), compliance with the *Heritage Property Act*, and implementation of environmental protection measures, no residual effects on heritage resources are anticipated and, correspondingly, no significant effects. The HCB responded to the mitigation outlined in the HRIA with a clearance letter on December 14, 2017, confirming acceptance of the mitigation.

Land and Resource Use

The land and resource use VC assessment considered agricultural land activities; oil, gas, and industrial activities; recreational and commercial harvesting activities; non-consumptive recreational activities (e.g., bird watching); surface water use; and ground water use. Effects of the Project on land and resources use are generally expected to be adverse, limited to the RAA, reversible, and of low magnitude except for changes to non-consumptive recreational activities, which is moderate, due to changes in the viewscape. The residual effects are unlikely to result in the permanent loss of agricultural production, pose a threat to the long-term viability of harvest and recreational activities or have a permanent impact groundwater use. With mitigation and environmental protection measures, the residual Project environmental effects on land and resource use are predicted to be not significant.

Employment and Economy

The employment and economy VC assessment focused on economy and labour supply and demand. With the implementation of mitigation measures and in consideration of existing conditions, Project expenditures, and resultant changes in employment, labour income, government revenue and contributions to provincial and federal gross domestic products, Project residual effects are assessed as being positive.

Community Services and Infrastructure

The community services and infrastructure VC assessment considered demands on local services and infrastructure, such as community services (e.g., accommodation, restaurants, etc.), health and emergency services (e.g., fire, police, ambulance, etc.), and transportation infrastructure. With the implementation of mitigation measures and given the context of the existing conditions, residual effects are not expected to exceed the capacity of community services and infrastructure or occur at a level where the quality of service provided will be decreased on a persistent and on-going basis. As such, the residual Project environmental effects on community services and infrastructure are predicted to be not significant.

Cumulative Effects

A cumulative effects assessment was completed for all VCs. The EIS concluded that Project-related residual effects, in combination with the potential residual effects of other past, present, or reasonably foreseeable future projects or physical activities, resulted in cumulative effects that are not significant for acoustic environment, heritage resources, land and resource use, and community services and infrastructure. Cumulative residual effects of past and current activities on vegetation and wetlands and wildlife and wildlife habitat within the RAA were already significant and, with the Project, will continue to be significant.

Effects of the Environment on the Project

Effects of the environment on the Project, while not identified as a VC, were assessed and included the sensitivity of the Project to variations in meteorological conditions (e.g., extreme heat and rainfall events) and to natural hazards. The Project will be designed, constructed, operated, and maintained relative to applicable regulations, codes, and standards. A component of these standards will include regular inspection during the construction and operation and maintenance of the Project. Based on a consideration of the mitigation strategies, past project experience, application of best management practices, no residual effects are expected; therefore, effects of the environment on the Project are not expected to be significant.

Accidents and Malfunctions

While not identified as a VC, the environmental effects of accidents, malfunctions and unplanned events were also assessed. These events during the life of the Project are anticipated to be minor. Implementation of on-site protocols, and the development and implementation of environmental protection and emergency response measures, as outlined in the Environmental Protection Plan (EPP) and Emergency Response Plan (ERP), will address potential effects such that they are avoided or limited. Taking this into consideration, potential residual effects from accidents, malfunctions, and unplanned events during construction and operation and maintenance are not considered significant.

Abbreviations

AAFC	Agriculture and Agri-Food Canada
ABEX	Decommissioning Expenditures
AEP	Alberta Environment and Parks
AER	Alberta Energy Regulator
BSC	Bird Studies Canada
CA	Census Agglomeration
CAPEX	Capital Expenditures
CD	Census Division
CLI	Canada Land Inventory
CMA	Census Metropolitan Area
COSEWIC	Committee on the Status of Endangered Wildlife in Canada
dBA	A-weighted decibel
DFO	Fisheries and Oceans Canada
DP	decommissioning plan
DU	Ducks Unlimited
EA	Environmental Assessment
EAB	Environmental Assessment Branch
EC	Environment Canada
ECCC	Environment and Climate Change Canada
EIS	Environmental Impact Statement
EPC	Engineering, Construction and Procurement

EPP	Environmental Protection Plan
ERP	Emergency Response Plan
ESRD	Alberta Environment and Sustainable Resource Development
ESRI	Environmental Systems Research Institute
FTE	full time equivalent
GDP	Gross Domestic Product
GIS	Geographical Information System
GPS	Global Positioning System
ha	hectare
HCB	Heritage Conservation Branch
HRIA	Heritage Resource Impact Assessment
IBA	Important Bird Area
IEC	International Electrotechnical Commission
IPCC	Intergovernmental Panel on Climate Change
ISO	International Organization for Standardization
km	kilometer
km/hr	kilometer per hour
kV	kilovolt
LAA	Local Assessment Area
m	meter
MBCA	*Migratory Bird Convention Act*
MBCS	Migratory Bird Concentration Site
MET	meteorological tower

MG	Mixed Grassland
MW	megawatt
MOECC	Ontario Ministry of Environment and Climate Change
n.d.	no date
NGO	Non-Governmental Organization
NHS	National Household Survey
NOC	National Occupational Classification
NTS	National Topographic System
NWG	North West Geomatics
O&M	operation and maintenance
ONAF	Oil Natural Air Forced
OPEX	Operational Expenditures
PDA	Project Development Area
PPPI	Public Pastures - Public Interest
RAA	Regional Assessment Area
RCMP	Royal Canadian Mounted Police
RFP	Request for Proposal
RM	rural municipality
ROW	right-of-way
SAR	Species at Risk
SARA	*Species at Risk Act*
SCADA	Supervisory Control and Data Acquisition
SES	Saskatchewan Environmental Society

SK	Saskatchewan
SKCDC	Saskatchewan Conservation Data Centre
SKMOE	Saskatchewan Ministry of Environment
SLL	Sound Level Limit
SOMC	Species of Management Concern
SOP	Standard Operating Procedure
SWF	Saskatchewan Wildlife Federation
TOR	Terms of Reference
TPP	Technical Project Proposal
USFWS	US Fish and Wildlife Service
UTM	Universal Transverse Mercator
V	volt
VC	Valued Component
WEP	Wind Energy Project
WHPA	*Wildlife Habitat Protection Act*
WMZ	Wildlife Management Zone
WSA	Water Security Agency
WTG	wind turbine generator

1.0 INTRODUCTION

Algonquin Power (Algonquin) is proposing to construct the Blue Hill Wind Energy Project (the Project), a 177 megawatt (MW) facility located in southern Saskatchewan within the rural municipalities (RMs) of Morse and Lawtonia (Figure 1-1). Algonquin has chosen to "opt in" to the formal environmental assessment (EA) process (i.e., self-declare that the Project is a 'development' in accordance with Section 2(d) of the Saskatchewan *Environmental Assessment Act*) and forgo a Ministerial Determination for the Project.

This document is intended to fulfill requirements for an EA pursuant to the Saskatchewan *Environmental Assessment Act*. This Environmental Impact Statement (EIS) has been prepared to comply with the terms of reference (TOR) prepared by Algonquin in accordance with the Saskatchewan Ministry of Environment (SKMOE)'s *Guidelines for the Preparation of the Terms of Reference* (SKMOE 2014a) and approved by the SKMOE on March 28, 2017.

1.1 PROJECT OVERVIEW

The Project is located approximately 10 km south of the town of Herbert, Saskatchewan (SK), and will consist of approximately 49 to 56 wind turbine generators (WTG) (depending on the selected turbine type) and associated infrastructure, including access roads, electrical collector lines and a substation. Each WTG will have a capacity between 3.2 MW and 3.7 MW; the final WTG selection will be influenced by several factors, including specific parameters of the local wind regime and economic (market and debt-financing) considerations at the time of procurement. The Project area encompasses 470 quarter sections; however, only approximately 62 quarter sections are expected to be used for the Project layout. The Project will not disturb entire quarter sections; only small amounts of land within each quarter section will be used to accommodate Project infrastructure. Construction of the Project is anticipated to begin in 2019 and commissioned in 2020.

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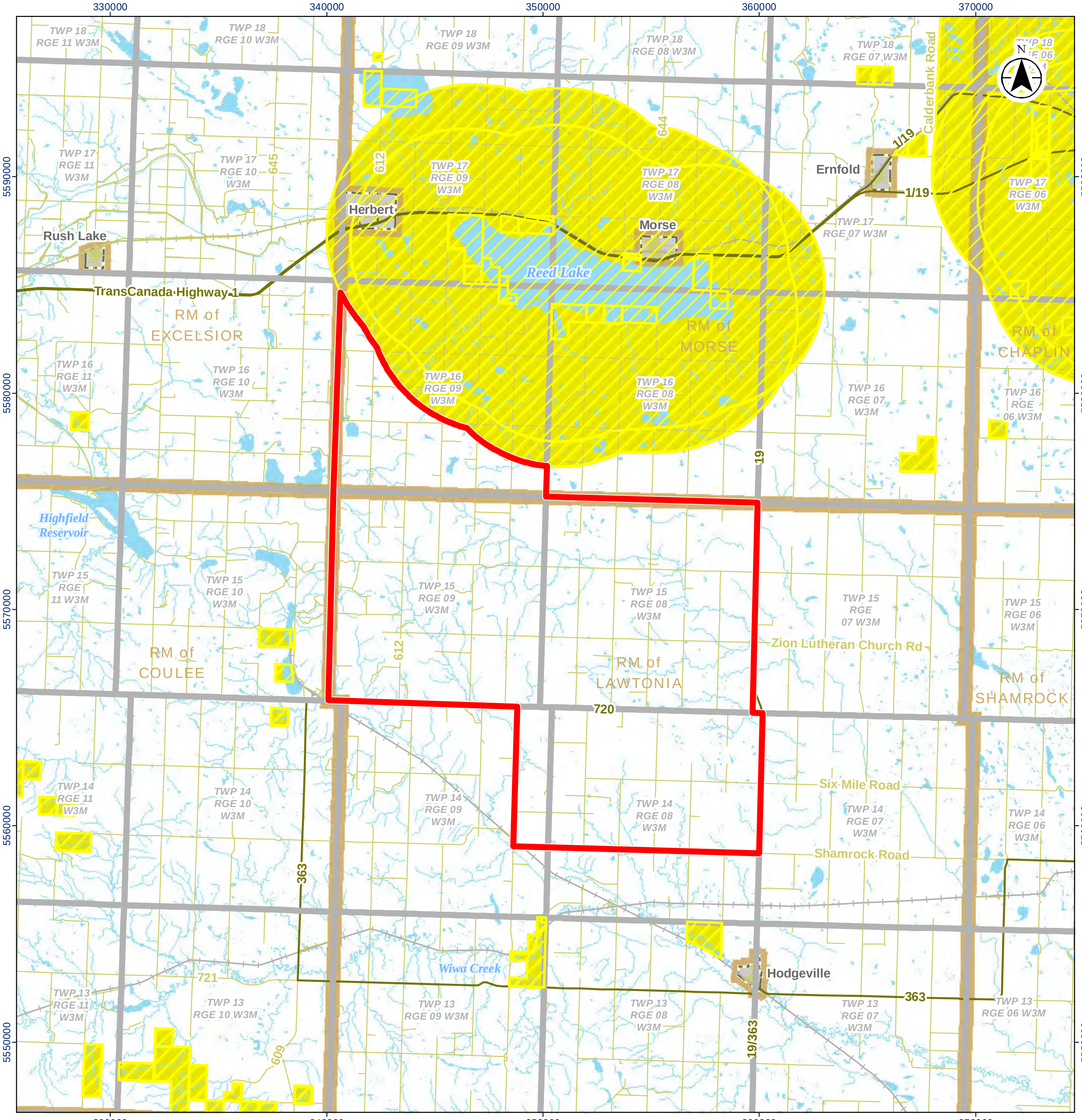

Project Area
Wind Energy Project Avoidance Zones
Rural Municipality
Major Road
Minor Road
Railway
Watercourse
Waterbody
Town/City
Township

0 3 6 Kilometers
1:275,000 (at original document size of 8.5x11)

Stantec Algonquin

Project Location
Near Herbert, SK

113254088-015 REVD
Prepared by acory on 2017-12-18
Technical Review by ceidem on 2017-12-18

Client/Project
Algonquin Power Co.
Blue Hill Wind Energy Project

Figure No.
1-1

Title
Project Location

Notes
1. Coordinate System: NAD 1983 UTM Zone 13N
2. Base features produced under license from the Government of Saskatchewan and the Government of Canada.
3. Avoidance Zones: SK Gov Rest Services, Accessed Nov 30, 2017.

1.2 PROJECT PROPONENT

Algonquin owns a direct or indirect equity interest in more than 34 clean energy facilities including wind, solar, hydroelectric and thermal.

Algonquin Power financed, constructed and currently operates two Saskatchewan wind facilities: 1) the Red Lily Wind Energy Project (16 WTGs, 26.4 MW) near Moosomin, Saskatchewan and 2) the Morse Wind Energy Project (10 WTGs, 25 MW) near Morse, Saskatchewan. Other wind projects in Algonquin Power's portfolio include:

- St. Leon (63 WTGs, 104 MW) and St. Leon II (10 WTGs, 16.5 MW) Wind-Energy Projects in St. Leon, Manitoba.
- St. Damase Wind-Energy Project (10 WTGs, 24 MW) near St. Damase, Quebec.
- Odell Wind-Energy Project (100 WTGs, 200 MW) in Cottonwood County, Jackson County, Martin County and Watonwan County, Minnesota.
- Shady Oaks Wind-Energy Project (71 WTGs, 109 MW) in northern Illinois.
- Senate Wind-Energy Project (75 WTGs, 150 MW) in Jack and Young Counties, Texas.
- Minonk Wind-Energy Project (100 WTGs, 200 MW) in Livingston and Woodford Counties, Illinois.
- Wind-energy projects in Ontario and Quebec (currently in planning and regulatory phase).

Algonquin has leveraged their extensive project development experience in the wind industry, including direct experience in a prairie environment, to plan this Project. Algonquin has an established corporate environmental policy. This policy states that Algonquin Power is committed to carrying out all operations in an environmentally responsible manner and in compliance with all applicable laws, regulations, and industry standards. This same ethic is applied to the development of their Projects.

1.2.1 Contact Information

The Algonquin representative for the Project is:

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Director, Project Planning and Permitting
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Oakville, ON L6J 2X1
Telephone: (905) 465-4518
Email: Sean.Fairfield@algonquinpower.com

1.3 REGULATORY FRAMEWORK

As part of the development of the Project and regulatory process, the Project would typically be subject to review by the SKMOE's Environmental Assessment Branch (EAB) to determine if the Project is considered a "development" under the Saskatchewan *Environmental Assessment Act*. However, Algonquin requested to "opt in" to the formal environmental assessment process (i.e., self-declare that the Project is a 'development' under Section 2(d) of the *Environmental Assessment Act*) and forgo a Ministerial Determination for the Project. As discussed via conference call with SKMOE EAB representatives on December 19, 2016, this was confirmed as being an option to Algonquin. This means that the Project is subject to an EA under Saskatchewan's *Environmental Assessment Act*.

To begin the regulatory review process for the Project, and as recommended by the SKMOE, Algonquin submitted a high-level Technical Project Proposal (TPP) and draft TOR to the EAB for review on February 6, 2017. The purpose of the TPP was to give the SKMOE information about the Project, its location, and scoping of issues to be assessed as part of the environmental assessment process. Algonquin developed the draft TOR following the SKMOE's *Guidelines for the Preparation of the Terms of Reference* (SKMOE 2014a). The draft TOR was reviewed by the EAB, as well as by multi-disciplinary experts from within the government. The interdepartmental review was coordinated by SKMOE. Algonquin addressed review comments to the satisfaction of the SKMOE at which time the final TOR was approved on March 28, 2017, and posted on the SKMOE's website and the Project website (http://www.bluehillwindproject.com/wp-content/uploads/2017/04/Technical-Project-Proposal-with-Terms-of-Reference-1.pdf). Concordance between the approved TOR and this EIS is provided in Appendix A.

The provincial EA process includes interdepartmental review of the EIS coordinated by the SKMOE's EAB. The Saskatchewan EA Review Panel is a panel of representatives from provincial departments and agencies that provides technical review, which provides the EAB with the multi-disciplinary expertise necessary to adequately evaluate and make decisions regarding the acceptability of the potential environmental effects associated with a proposed development (SKMOE 2014b).

When the EAB is satisfied with the adequacy, accurateness, and completeness of an EIS, a summary of the government's technical comments will be prepared by the EAB to provide information regarding potential environmental effects, the significance of those effects, the effectiveness of proposed mitigation measures and a discussion of any of Algonquin's conclusions with which the government disagrees (if applicable). These comments are intended to assist the public and the government decision-makers in reviewing the EIS and evaluating the environmental acceptability of the Project (SKMOE 2014b).

The EIS and technical review comments will then be released for a 30-day public review and comment period (SKMOE 2014b). After the review period, the EAB will submit the EIS, technical review comments, and public review comments, along with any other relevant information, to the Minister for consideration. The Minister can decide to approve the development, approve the development with terms and conditions, or refuse to approve the development (SKMOE 2014b). If approved, the Project can then proceed to the permitting and construction phases.

In addition to the EA requirements described above, the Project may or will also be subject to other federal and provincial legislative and regulatory requirements. Relevant legislation applicable to the Project are summarized in Table 1-1. This list is not intended to provide an exhaustive list of Project-related regulatory requirements.

Table 1-1 Overview of Other Regulatory Requirements

Legislation	Regulatory Authority	Relevance to the Project
Federal		
Species at Risk Act (SARA)*, 2002*	Environment and Climate Change Canada (ECCC)	The SARA protects species at risk (i.e., endangered, threatened or species of special concern) and their "critical habitat" (as defined under SARA) in Canada. SARA-listed species at risk occur within the Project area and the Project may interact with these species; however, the Project is not expected to affect "critical habitat" for these species. This EIS describes appropriate mitigation measures to avoid potential significant residual adverse environmental effects.
Migratory Birds Convention Act (MBCA) *and Regulations, 1994*	ECCC	The MBCA protects migratory birds (as defined under the Act), their eggs and their nests. The Act applies to all lands where migratory birds breed and nest. The Project may interact with migratory birds and this EIS describes appropriate mitigation measures to avoid potential significant residual adverse environmental effects (see Section 8.0).
Fisheries Act, 1985, amended 2013	Fisheries and Oceans Canada (DFO)	Under this Act, an authorization from DFO is required is any part of the Project results in serious harm to fish that are part of a commercial, recreational, or Indigenous fishery, or to fish that support it. However, this Project is not expected to interact with fisheries or fish supporting fisheries.

Table 1-1 Overview of Other Regulatory Requirements

Legislation	Regulatory Authority	Relevance to the Project
Provincial		
Water Security Agency Act	Water Security Agency	This Act provides for the protection of aquatic habitat from development or alterations to waterbodies or watercourses. This Project may interact with waterbodies or watercourses during construction; as such, Aquatic Habitat Protection Permits may be required under this Act.
Heritage Property Act, 1980	Saskatchewan Ministry for Parks, Culture and Sports	This Act is the primary statute for protecting, conserving and developing heritage property in Saskatchewan. The Project may interact with heritage resources and this EIS describes appropriate mitigation measures to avoid potential significant residual adverse environmental effects on heritage resources identified by a heritage resource impact assessment (HRIA) (see Section 9.0).
Weed Control Act, 2010	Saskatchewan Ministry of Agriculture	This Act designates weeds into three categories: Prohibited Noxious, and Nuisance. The objective of the Act is to promote early detection and eradication of these weeds. Observations of weeds listed under the Act have been documented in the Project area. This EIS describes appropriate mitigation measures to avoid interactions with and the spreading of listed weed species.
Wildlife Act, 1998	SKMOE	Plant and animal species at risk as defined in the *Wildlife Act*, are protected from being disturbed, collected, harvested, captured, killed, sold or exported without a permit. The Project may interact with species at risk listed in this Act. This EIS describes appropriate mitigation to avoid potential significant residual adverse environmental effects (see Section 8.0).
The Wildlife Habitat Protection Act (WHPA), *1992*	SKMOE	This Act protects wildlife habitat on Crown Land within the agricultural region. Permitting or crossing agreements may be required for any potential alteration to protected lands. However, the Project is not expected to interact with WHPA lands.
Municipal		
The Planning and Development Act, 2007	Rural Municipalities (RM)	The Act allows the RMs to address land use and development issues through the adoption of an official community plan and zoning bylaw. The Project will require development permits in RMs that have zoning bylaws.

Guideline documents, in addition to legislation, that were considered during the development of the Project include the *Wildlife Siting Guidelines for Saskatchewan Wind Energy Projects* (SKMOE 2017a) and the *Saskatchewan Activity Restriction Guidelines for Sensitive Species* (SKMOE 2017b).

1.4 APPROACH TO PROJECT PLANNING

Algonquin has used an iterative planning process to collect progressively more detailed information to assist with siting of facilities and to better understand the Project's potential effects and mitigation needs. On-going discussions with regulators have helped the EA team better understand their concerns and inform the Project-planning process and scoping of issues to be included in the EIS. All data collected have informed Algonquin's design, mitigation planning, and commitments outlined in the EIS.. Several such environmental design mitigations are outlined in Appendix B.

1.5 DOCUMENT LAYOUT

This EIS includes an examination and consideration of the potential effects that may result from the Project, with a focus on those elements defined in the TOR that are of particular concern to the SKMOE. This EIS has been organized to facilitate regulatory review by focusing on the information requirements outlined in the TOR.

- **Section 1.0** provides information on the client and summarizes the regulatory context.
- **Section 2.0** describes the Project need and location, and provides a detailed description of the Project components and activities through all phases.
- **Section 3.0** describes the purpose and objectives of the engagement program and the process used for public, government, and First Nation and Métis engagement. This section also includes a summary of comments received and Algonquin's responses.
- **Section 4.0** describes the overall approach and methods used for the EA and outlines the scoping of the assessment, including the selection of Valued Components (VCs).
- **Section 5.0** describes the general environmental setting for the Project.
- **Sections 6.0 to 12.0** identifies and evaluates the environmental effects of the Project on the selected VCs. It identifies the mechanisms for causing effects, provides high level mitigation measures for the potential effects, describes the residual (post-mitigation) effects, as well as cumulative effects and assesses the significance of the residual effects.
- **Section 13.0** describes those environmental conditions that could affect the Project during construction and operation.
- **Section 14.0** discusses unlikely events that could interact with the Project during construction and operation. This section includes a description of emergency response and mitigation procedures to address these situations.

- **Section 15.0** provides the overall summary and conclusions of any residual environmental effects determined during the assessment of the Project.
- **Section 16.0** provides a closure statement and signatures.
- **Section 17.0** provides a list of the references cited in this EIS.

Several appendices are included to support the EIS with more detailed information.

2.0 PROJECT DESCRIPTION

2.1 PROJECT NEED AND BENEFITS

SaskPower has adopted a strategy to meet new load growth over the next several years using its Environmentally Preferred Power Strategy. This strategy is intended to encourage production of low-environmental-impact power, to utilize waste streams as a fuel source, to reduce SaskPower's carbon and other emissions, to monetize the value of low-environmental impact power and to add 'small-generation power' in step with SaskPower's local requirements. Under the Request for Proposal (RFP) (Inquiry CO/690) in 2011, SaskPower undertook a competitive process to procure up to 177 MW of wind power from one or more independent power producers. Algonquin was selected in early 2012 through the SaskPower RFP process and has subsequently signed a Power Purchase Agreement with SaskPower for a 177 MW wind energy project. In early January 2017, SaskPower announced that the Project to be built to fulfill this need would be developed in an area between Herbert and Neidpath in southwest Saskatchewan.

The Project will generate direct benefits, namely job creation associated with the Project and revenue to the community and individual landowners through Project expenditures, tax, and lease payments.

The estimated construction and commissioning costs of the project are between $315M and $350M. After development and engineering, construction will require a minimum of 8 to 18 months to complete and will generate approximately 45-90 full-time equivalents (FTE) (i.e., one FTE equals one person working full time). In addition, the local expenditures on goods, services and accommodation will have a substantial effect on the local economy which could lead to tens of millions of dollars in indirect and induced economic benefits.

During operation, the Project is expected to employ approximately 7-15 FTEs directly and will require local goods and services estimated $800,000 annually in direct benefits to the local economy inclusive of wages and other payments. Included in the annual expenditures would be future property taxes and lease payments to landowners. In addition, the Project will provide another source of revenue to local landowners and further draw attention to the unique communities within the RMs of Morse and Lawtonia, benefiting the local tourist economy.

2.2 PROJECT LOCATION

The Project is located approximately 10 km south of the town of Herbert, SK, and approximately 40 km east of Swift Current, SK (see Figure 1-1). The Project is accessible from Highway 1 to the north and from Highway 19 to the east.

The Project area is defined as the overall planning area used in the ongoing evaluation and design phase of the Project. It was selected from one of many locations in Saskatchewan which were being evaluated by Algonquin for future wind energy opportunities due to proven wind resources. The regional context for the Project area is shown in Figure 2-1. As part of the planning process, a desktop constraints analysis and field reconnaissance survey was conducted on the Project area in October 2016 to identify environmental constraints (e.g., land cover, sensitive features, land designations, heritage resources, SKMOE's *Wildlife Siting Guidelines for Saskatchewan Wind Energy Projects* [SKMOE 2016] avoidance zones) that needed to be considered when siting infrastructure, as well as identify the next steps in the planning process (e.g., field surveys). Subsequently, target quarter sections (i.e., quarter sections owned by a private landowner that had signed an agreement with Algonquin) were identified within the Project area to further focus the collection of baseline information (e.g., field surveys) to inform Project siting. In May 2017, an updated version of SKMOE's *Wildlife Siting Guidelines for Saskatchewan Wind Energy Projects* (SKMOE 2017a) were released; the Project area was reviewed and found to be in compliance with the updated avoidance zones (see Figure 1-1). Avoidance zones shown in Figure 1-1 identify the designated environmentally sensitive areas that must be avoided (with or without a 5 km buffer depending on the designated area) by wind energy projects (WEP) (SKMOE 2017a).

Within the target quarter sections, the proposed Project layout was developed based on several factors including, but not limited to:

- Wind resource data and modelling
- Construction feasibility and costs
- Landowner support, land access, and municipal setbacks
- Anthropogenic and environmental setback distances
- Avoidance of sensitive features (e.g., wetlands, sharp-tailed grouse leks, native prairie) identified during environmental studies

Table 2-1 outlines the setback distances used to establish the Project layout. To assist with siting and to calculate setback distances, construction setbacks are based on the furthest extent of temporary workspace required for a WTG and, for operation, are based on the furthest extent of blade sweep. The setback distances used were derived based on Algonquin's experience, including setbacks for windfarm planning established by other regulatory jurisdictions, as well as relevant guidelines in Saskatchewan and municipal bylaws.

Table 2-1 Setback Distances Used to Guide Development of Project Layout

Feature	Setback Distance (m)
Wetland	100
Public Road	160
Rail	160
Transmission	185
Residence	500/800/1500/2000[1]
Building	400
Municipal Grid Road	100
Property Lines	160

NOTE

[1] RM of Morse does not have a prescribed setback distance from a residence in their zoning bylaw, therefore, the proponent is voluntarily using an 800 m setback.

RM of Lawtonia zoning bylaw prescribes the following setback distances: Section 3.29 (g)(ii) of the zoning bylaw discusses the minimum distance from a residence including:

1. *500 m (1,604 feet) for up to two towers, where the residence's owner is hosting the tower(s).*
2. *1500 m (4.921 feet) for up to two towers, where the residence's owner is not hosting the towers and from any neighbouring residences.*
3. *2,000 m (1.25 miles) for all residences, where three or more towers are combined in a quarter section. This applies to residences on the subject lands and on neighbouring properties.*

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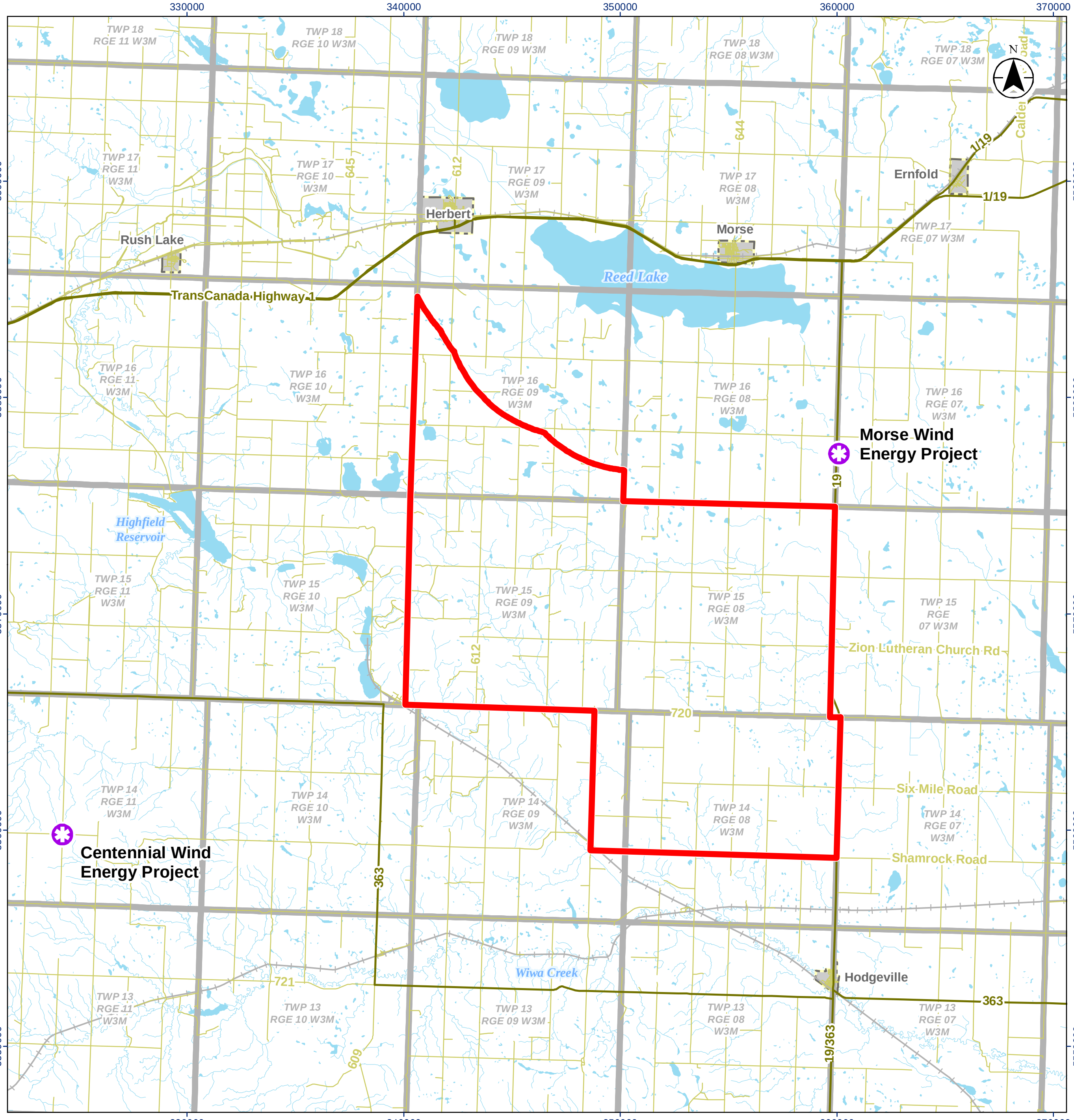


Existing Wind Energy Project

Project Area

Major Road

Minor Road

Railway

Watercourse

Waterbody

Town/City

Township

0 3 6 9 Kilometers

1:275,000 (at original document size of 8.5x11)

Stantec Algonquin

Project Location
Near Herbert, SK

113254088-046 REVB
Prepared by acory on 2017-12-18
Technical Review by ceidem on 2017-12-18

Client/Project
Algonquin Power Co.
Blue Hill Wind Energy Project

Figure No.
2-1

Title
Regional Setting

Notes
1. Coordinate System: NAD 1983 UTM Zone 13N
2. Base features produced under license from the Government of Saskatchewan and the Government of Canada.

Development and refinement of the Project layout has been ongoing to reduce or avoid potential environmental effects to the extent possible. The proposed Project layout has undergone numerous iterations taking into consideration the above listed factors. In addition to the information outlined in Table 2-1, field-verified land cover data was used to site infrastructure within the Project area to avoid native prairie wherever possible. Sensitive environmental features (e.g., sharp-tailed grouse leks, ferruginous hawk nests and rare plants) were detected within the Project area and the layout was progressively refined to take into account the location of these features and their activity restriction setbacks (SKMOE 2017b).

The Project layout presented in Figure 2-2, sited on approximately 62 quarter sections (4,028 hectares [ha]) of private land, is considered final for the purposes of the EIS and sufficient for understanding the scope and scale of potential effects. The Project layout will be subject to minor modifications as detailed engineering progresses to a finer scale. For example, further adjustments may occur such that access roads and collector lines overlap with existing truck-trails, existing cattle trails, property lines, etc., in order to further reduce potential effects. Minor modifications may be required prior to construction in response to details revealed in final Project financing. To allow for siting flexibility prior to construction, Algonquin developed siting buffers around the proposed Project layout, including:

- 250 m radius around each WTGs,
- 300 m x 300 m around substation,
- 50 m on either side of new access roads and collector lines

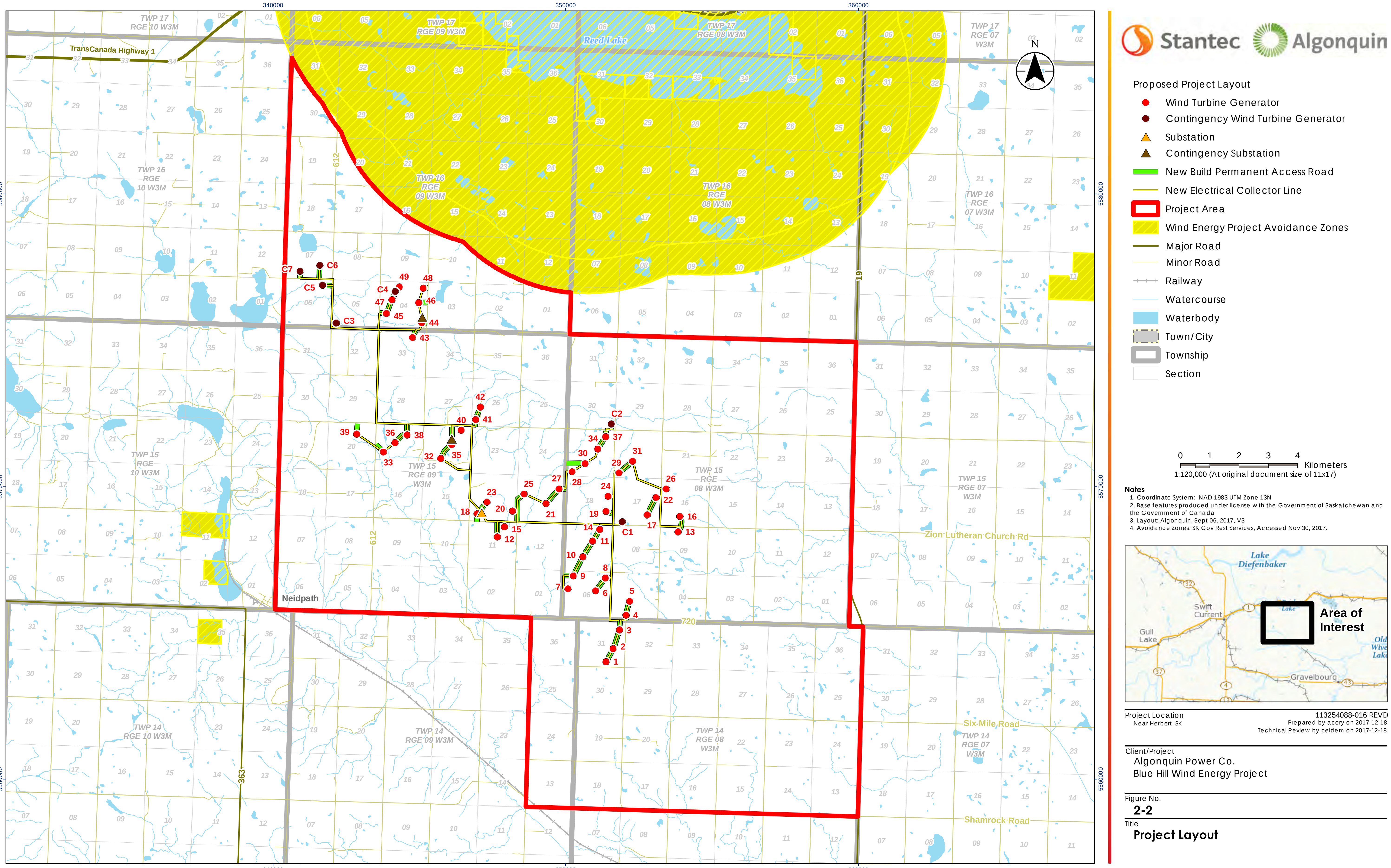
These buffers were incorporated into the design of those field surveys that typically focus on the Project layout (i.e., rare plant surveys and HRIA) so that a larger area was surveyed to detect the presence of sensitive features that need to be considered for siting infrastructure.

For the purposes of the EIS, the final layout consists of a maximum of 56 WTGs (including seven contingency locations), access roads, collector lines and three substation locations (one primary and two contingency locations). Contingency infrastructure show possible alternate locations for Project components and are included to allow for design flexibility prior to or during construction. To be conservative, the maximum extent of the layout, including contingency infrastructure, has been used to describe the Project and to assess potential effects, including the potential spatial extent of disturbance.

The construction footprint for the Project will be approximately 158 ha and is based on the assumptions outlined in Table 2-2; where a range of values is provided to be conservative, the highest value was used to create the footprint. The location of the temporary staging areas, offices, and parking are not known at this time; therefore, these components are not shown on Figure 2-2. However, they will be sited on previously disturbed cultivated land and their footprints have been incorporated into metrics presented in the EIS.

Table 2-2 Summary of Construction Project Footprint and Assumptions by Component

Component	Footprint Assumption
WTG foundation	10 m - 15 m diameter per WTG
WTG crane pad	15 m x 20 m per WTG
Temporary workspace around WTG (includes crane pad and laydown areas)	50 m - 75 m radius buffer per WTG
New permanent access roads	10 m - 25 m width during construction; reduce to 5m - 6 m width during operation
Collector lines - underground	5 m disturbance (width of machine) with a 1 m wide trench
Collector lines - overhead	5 m wide right-of-way (ROW) in existing road allowance
Temporary staging areas	2-4 locations; each a maximum of 5 ha
Temporary offices and parking	0.2 to 0.8 ha
Permanent O & M building	1 to 2 ha
Substation	75 m X 75 m



Notes

1. Coordinate System: NAD 1983 UTM Zone 13N
2. Base features produced under license with the Government of Saskatchewan and the Government of Canada
3. Layout: Algonquin, Sept 06, 2017, V3
4. Avoidance Zones: SK Gov Rest Services, Accessed Nov 30, 2017.

Project Location
Near Herbert, SK

113254088-016 REVD
Prepared by acory on 2017-12-18
Technical Review by ceidem on 2017-12-18

Client/Project
Algonquin Power Co.
Blue Hill Wind Energy Project

Figure No.
2-2

Title
Project Layout

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2.3 PROJECT ALTERNATIVES

Algonquin is active in the development and operation of renewable-power generation across North America and is exploring the potential for wind-energy projects at a number of locations in Saskatchewan and across Canada. When looking for prospective sites, several factors need to be evaluated before selecting a viable site. For Saskatchewan, these factors include:

- A stable wind resource resulting in an acceptable capacity factor
- Favourable transmission and load requirements
- Compliance with SKMOE's Wildlife Siting Guidelines for Saskatchewan Wind Energy Projects (SKMOE 2017a)
- Positive receptivity to the development of wind by local landowners (i.e., signed landowner option agreements) and the RMs

Alternative areas in the province were considered where wind-energy projects appear to have the potential attributes necessary to satisfy SaskPower's Environmentally Preferred Power Strategy requirements and where local communities have signed landowner option agreements for the placement of WTGs on private property. After consideration of candidate sites, Algonquin selected the Blue Hill Wind Project location.

2.4 PROJECT COMPONENTS

2.4.1 Wind Turbine Generators

The Project will consist of 49 to 56 WTGs, each with a capacity between 3.2 and 3.7 MW, for a total capacity of 177 MW. Final WTG selection will be influenced by several factors, including specific parameters of the local wind regime and economic (market and debt-financing) considerations at the time of procurement.

Each WTG consists of the following components: tower, nacelle, hub, rotor blades, controller and transformer (see Figure 2-3). The height of each WTG tower will be between 80 to 105 m from the foundation to the hub depending on final equipment selection. Each WTG consists of three blades (each approximately 40 to 68 m long) with a rotor diameter of approximately 80 to 136 m. The overall height of each WTG, from ground to top of blade height, will be approximately 120 to 173 m (see Figure 2-4). As discussed in Section 2.2, the dimensions of the largest WTGs that could be used have informed siting in order to provide a conservative approach.

The nacelle at the top of each tower houses the generator, gearbox (if required, depending on the type of WTG selected), bearings, couplings, rotor, transformer and auxiliary equipment (see Figure 2-4). Depending on the WTG type and design, a transformer may also be contained within the nacelle or situated external to the WTG at the base of the tower. A water-cooled system, which includes a radiator, dissipates heat from the generator. The radiator will contain a water- and ethylene-glycol mixture that will be tested annually. The gearbox (if required) will contain approximately 300 litres of oil (perhaps more if larger WTGs are utilized) that will be filtered during regularly scheduled maintenance and reused. The oil will only be replaced as needed, approximately once every four years. The gearbox (if required) is designed as a closed leak-proof system with gaskets to prevent fluid loss. The nacelle enclosure that houses the electro-mechanical components is constructed of reinforced fibreglass which is lined with sound-insulating foam, ventilated with internal electric lights for safety and to facilitate maintenance. The rotor blades are constructed of fibreglass and epoxy resin or carbon-fibre.

The tower will be constructed of tubular steel, with a diameter of approximately 4 to 5 m at the base (see Figure 2-4). An internal ladder from the ground to nacelle level is provided for maintenance access. Guy wires are not used for tower support. WTGs will be externally lighted in accordance with the requirements of Transport Canada.

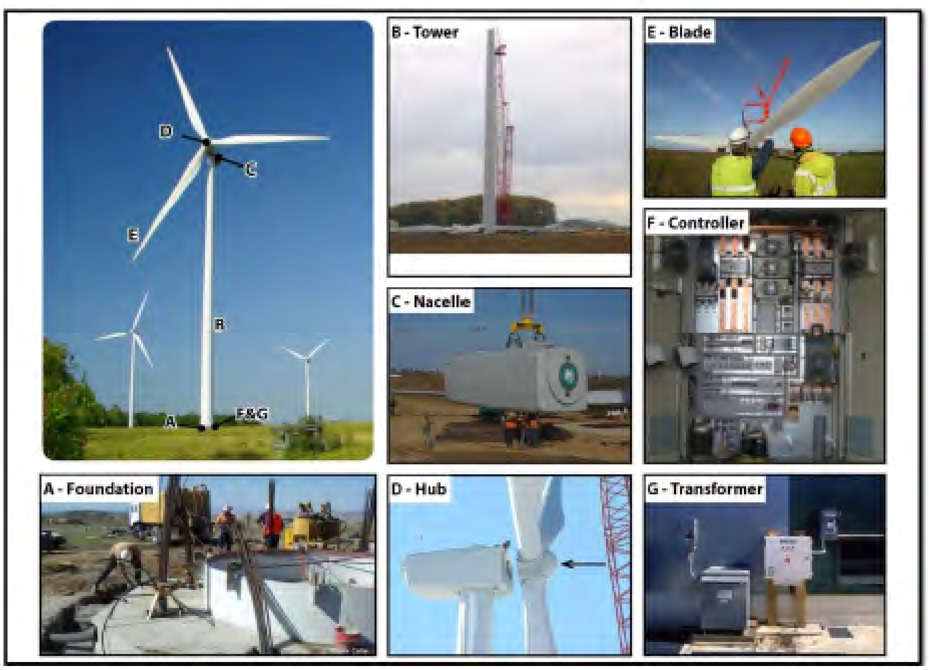


Figure 2-3 Wind Turbine Generator Components

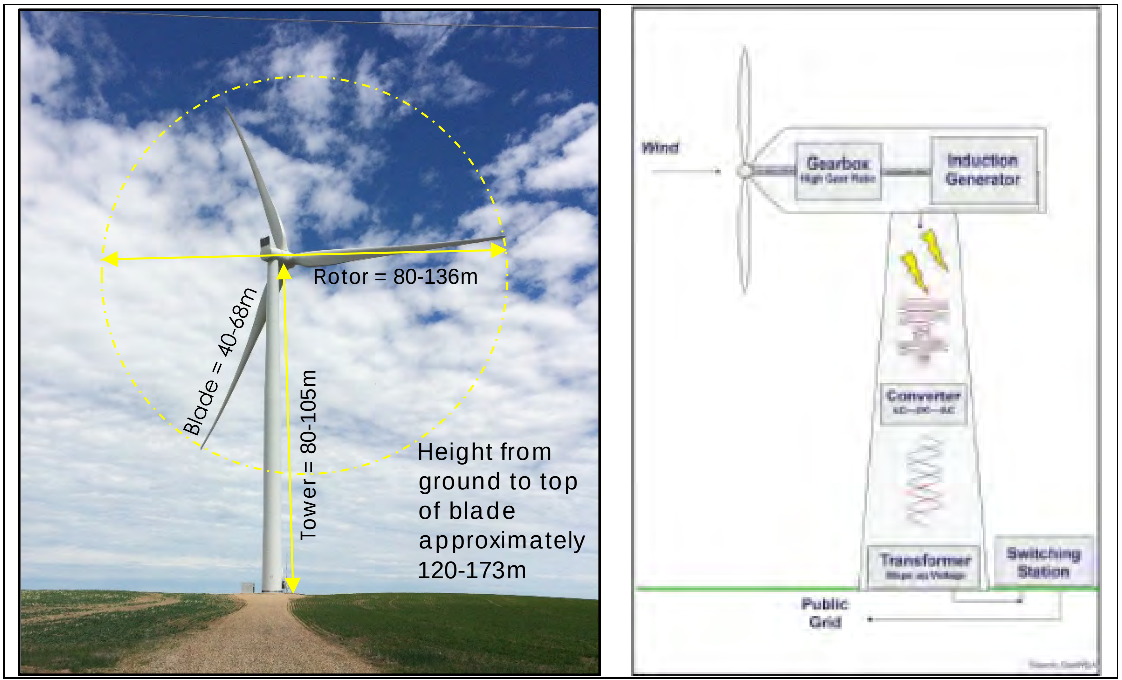


Figure 2-4 Wind Turbine Generator Structure

Each WTG will be supported by a reinforced concrete foundation, attached and bolted through a base plate. Dimensions, depth and type of foundation design will depend on local soil and subsurface geological conditions, wind loads to the selected WTG model, and other site-specific conditions. For the purposes of this document, WTG foundations were assumed to be similar in size to those constructed for the Red Lily Wind-Energy Project (near Moosomin, SK), approximately 2 m deep and 15 m in diameter (i.e., 177 m^2 total surface area). However, if WTGs chosen for this Project are larger than those utilized at the Red Lily project site, foundations could be deeper and larger.

2.4.2 Temporary Workspace around WTGs

Temporary workspace will be located around each WTG to accommodate laydown areas, crane operation and vehicle staging. The locations of these workspaces will be sited to avoid Crown land or other sensitive features (e.g., wetlands, native prairie); for example, the location may be skewed to one side or the other to be away from sensitive features. Temporary workspaces will only be needed during construction, during infrequent maintenance (e.g., turbine blades, WTG structure) or in the event of a malfunction. To be conservative, it has been assumed that the temporary workspace will be the area within a 50 to 75 m radius from the center of the WTG. A large portion of the temporary workspace will see limited impact with the majority of construction activity happening within 25 m of the WTG foundation. For example, most of the area outside of the 25 m will experience intermittent or light vehicle traffic and walking. The blades and other turbine components typically rest on the ground and extend into this areas until lifted by the crane into place. Crane pads, approximately 15 m x 20 m in size, will remain in place during operation. The remaining portion of the temporary workspaces will be reclaimed once construction is completed.

2.4.3 Electrical Collection System

The voltage of electricity produced by the WTG will be stepped-up from 690 V to 34.5 kV by a transformer located inside the nacelle or outside the tower at the base of each WTG (see Figure 2-4). The power will then be distributed through underground collector lines (on private land) and/or along overhead collector lines (located along existing municipal grid road rights-of-way [ROW] if allowed by municipal bylaws) to a new collector substation (approximately 75 m x 75 m). Underground collector lines will be buried using a well-established trenchless method, referred to as pipe-and-cable-laying ploughing (or "mole-ploughing"). The Project will require approximately 57 km of collector lines. Approximately 29 km (50%) of the collector lines are sited along municipal road ROWs within the Project layout; these collector lines may be placed overhead instead of underground but that has not yet been determined. For the purposes of the EIS, all collector lines are considered to be underground.

At the collector substation, power collected from WTGs will be stepped up from 34.5 kV to 138 kV and transported by overhead 138 kV transmission lines to the SaskPower Switching Station. SaskPower, the proponent of the interconnection line, has yet to locate this line. The overhead 138 kV transmission lines will take the newly generated power from the Project substation to the future SaskPower Switching Station. Approvals for system tie-in transmission lines and other transmission infrastructure will be completed by SaskPower under a separate approval process and are not considered as part of this Project.

A communication and data-collection fibre-optic cable will also be placed within the same ROW as the electrical collection system wherever possible. This will help to reduce the amount of land affected by the Project. Warning signage will be placed, as necessary, above any underground feeder cables.

Easements, if needed for electrical collection system ROW development, are normally secured through negotiation of an agreement with property owners and will be developed by Algonquin.

2.4.4 Permanent Access Roads

The Project will require the construction of approximately 20 km of permanent access roads to be used during the construction, operation and maintenance phases. During the construction phase, these roads will be approximately 10-25 m wide and capable of supporting heavy equipment including heavy lift cranes and transport vehicles. Once the construction phase is completed, roads will be reclaimed to a 5-6 m width, gravel, "low-profile" cross-section, used to service and maintain WTGs during the operation and maintenance phase.

2.4.5 Permanent Maintenance/Storage Facilities

Materials and equipment used during the operation and maintenance phase will be stored within an operation and maintenance (O&M) building and associated storage facilities. This building may be an existing building near the Project site or a new structure constructed within the Project area. This building and adjacent facilities (e.g., parking lot, storage yard) will require approximately 1-2 ha of land. The building footprint will be approximately 380 m^2 and is expected to include offices and a permanent holding tank/septic field for sanitary waste (if not connected to a local municipal sewer system). The collection and treatment of sanitary waste will follow appropriate regulations and guidelines. A gravel parking lot and adjacent storage yard, if not already in existence, will be constructed in the vicinity of the O&M building with sufficient parking available for Project staff and guests. A standard 2.4 m-high chain-link fence with locked gates may be constructed around the O&M storage yard as required. No fencing will be placed around the WTGs.

2.4.6 Temporary Offices and Laydown Areas

On-site temporary construction offices (i.e., ATCO trailers) will be placed on private land during construction and will likely occupy approximately 0.2 to 0.8 ha of annual cropland.

Laydown areas and a potential concrete batching plant area will also be sited on previously disturbed private land (e.g., cropland or existing yard). It is expected that there will be two to four laydown areas, each approximately 5 ha in size, to temporarily accommodate Project components prior to and during construction.

2.4.7 Meteorological Tower

The Project currently maintains one temporary 60 m meteorological (MET) tower to continuously monitor wind speed, wind direction, air temperature, air humidity, and other parameters. These data are captured and analyzed to help optimize the Project's operations plan. The temporary MET tower is anticipated to be removed once construction is complete and will be replaced with approximately two permanent hub-height MET towers to support ongoing operation.

2.5 PROJECT ACTIVITIES

The following sections describe the planned activities grouped in the three phases associated with the Project. All Project activities will comply with the *Saskatchewan Employment Act* (Government of Saskatchewan 2014) and the *Saskatchewan Occupational Health and Safety Regulations* (Government of Saskatchewan 1996).

2.5.1 Construction

Construction will require the following sequence of activity categories:

- Site preparation, including clearing and grading of access roads, WTG and substation locations, laydown areas, temporary workspaces, and O&M facilities
- Construction of WTG, substation, and O&M building foundations
- WTG and O&M building erection, and substation installation including interconnection with SaskPower infrastructure
- Installation of underground and overhead collector lines
- Reclamation and site landscaping of temporary Project components (e.g., laydown areas, construction facilities)

Details on construction activities are summarized in Sections 2.5.1.1 to 2.5.1.10.

2.5.1.1 Materials and Equipment

Project construction will require the following materials and resources:

- Concrete for the construction of the WTG, substation, and O&M building foundations.
- Granular material for the construction of access roads, laydown area(s), WTG and substation service areas, and O&M building facilities.
- Water for road dust control.
- Fuel and lubricants for the operation of heavy machinery, generators, and power tools.

Raw materials including granular materials, cement and water will be sourced locally to the extent feasible and will be the responsibility of the Engineering, Construction, and Procurement (EPC) contractor. Contractors working on behalf of Algonquin will be required to ensure that all resources used, and locations that resources may be extracted from, are located and managed in accordance with all applicable regulatory standards and industry best practices (e.g., borrow-source locations will undergo appropriate heritage resource screening; water withdrawals will be conducted in accordance with Water Security Agency permitting and approvals [if applicable]).

Delivery of materials and equipment to the Project site will be primarily by truck. However, some transportation of materials and equipment may occur by rail. Major equipment utilized for Project construction may include:

- Bulldozers, excavators, and backhoe(s) for earthmoving, excavation of foundations, and batching plant operation
- Dump trucks for transport of soils and aggregates
- Grader(s) for access road construction and maintenance
- Dump trucks for removal of excavated road and foundation material as well as delivery of road material
- Compaction roller(s) for compaction of temporary and permanent access roads
- Batching plant (if required) for the preparation of concrete on-site
- Cement trucks for delivery of concrete for foundations
- Tractor-trailers for delivery of heavy equipment, construction bulk materials, WTGs components, substation equipment, O&M building materials and equipment, construction trailers and other temporary and permanent equipment
- Crane for loading and offloading of equipment, erection of WTGs, and construction of substation and O&M building facilities
- ATCO trailers to house the temporary construction offices

The quantities and specifications of major equipment will depend on the Project construction logistics and schedule.

2.5.1.2 Site Preparation

Site preparation includes clearing and grading of each WTG site and new access road locations. The construction area at each WTG site, which is expected to be approximately 10,000 m^2, will include the foundation area, a crane pad adjacent to each foundation (approximately 15 m x 20 m per WTG), and a laydown area for blade assembly and storage of WTG components.

Two to four temporary laydown areas (each a maximum of 5 ha) will be established on previously disturbed land (e.g., existing yard or annual cropland) in proximity to construction activities. Following the completion of each WTG, temporary laydown areas around each WTG will be rehabilitated back to the original condition of the land.

2.5.1.3 Access Road Development

Project equipment and materials may will be transported by rail to the Morse or Herbert area, and subsequently transferred to trucks for delivery to the project site. Otherwise, equipment and material will be transported by truck only. Access to construction sites by transportation providers from various suppliers will avoid, to the extent feasible, any potential for damage to properties, lands, infrastructure, or any sensitive environmental feature at or near the construction site. Following construction, municipal grid roads will be restored to their pre-construction condition (if required).

Permanent Project area access will utilize the existing road network and infrastructure where practical. Permanent maintenance access roads to individual WTGs will be designed to minimize their footprint, avoid environmentally sensitive areas and intersect with existing municipal grid roads. During the construction phase, access roads will be approximately 10-25 m wide to accommodate the wide turning radius of large trucks, heavy equipment, transport vehicles, and construction equipment (e.g., cranes to erect WTGs). Post-construction, access roads will be reclaimed to approximately 5-6 m in width for future maintenance. Approximately 20 km of permanent access roads will remain during Project operation.

To reduce or avoid Project-related effects, access to construction sites will utilize existing municipal grid roads along section and quarter section lines to the maximum extent practical (see Figure 1-1). Permanent access roads will be constructed along section and quarter section lines, where appropriate. As portions of the Project will be developed on land that has limited existing municipal grid road access, some permanent access roads will be built using the network of pre-existing limited-use roads, ROWs, and farmer trails, to the maximum extent feasible. Movement of cranes from one WTG site to another will use access roads and collector line routes (already disturbed by plough-in equipment) established for the Project. In the event that cranes follow collector line routes that are not combined with an access road ROW, this will only occur in cultivated land.

The Project layout has been developed to avoid waterways that require stream crossings for new access road construction. Some upgrades to existing municipal grid road stream crossings (e.g., newer or larger culverts) may be required to accommodate movements of heavy construction equipment (e.g., wide loads, cranes). If stream crossings are needed, appropriate regulatory guidance and approvals will be obtained by the EPC contractor (e.g., construction timing, erosion-control procedures) and the location and specifics regarding stream/drainage crossing sites and stream crossing techniques and mitigation methods will be incorporated into the Project's Environmental Protection Plan (EPP).

Where excavation is required to construct permanent access roads, stockpiled topsoil will be separated and stored away from the subsoil. Subsoil and stored topsoil will then be used to restore land adjacent to the temporary 10-25 m-wide roads needed during construction to the permanent 5-6 m-wide roads.

A construction manager will control access to WTG sites during construction. It is anticipated that only those employees (and individuals approved by the construction manager) will be allowed access for safety and equipment-security reasons. Any damage to municipal or provincial roads as a result of transportation of Project equipment will be repaired to pre-construction conditions. Additional details of access management measures will be outlined in the EPP (see Appendix C) and will be revised, as required, by Algonquin and the construction contractor in consultation local stakeholders, including landowners.

2.5.1.4 Foundation Installation

The foundation for each WTG will be excavated using an excavator or large back hoe. Depending on site specific geotechnical conditions, WTG foundations are expected to be a minimum of 2 m in depth or more depending on the size of the WTG selected. Trucks will deliver concrete to be poured at the foundation site from either an existing concrete facility or a temporary mobile batching plant. Approximately 30-40 truck loads of concrete will be required for each foundation site. Foundations will need to cure for approximately two weeks.

During WTG-foundation construction, some excavated subsoil will be incorporated around the foundations as backfill. Excess excavated subsoil may be used either for final grading around the WTG towers or removed from the site. Excess topsoil may be feathered into the adjacent agricultural fields. Construction of WTG foundations will utilize temporary erosion-control measures to reduce siltation in any erosion-prone areas as outlined in the EPP (see Appendix C).

2.5.1.5 Turbine Assembly

Cranes will be used to erect and assemble WTG components at the turbine site. In some cases, matting and leveling around the WTG location may be required to stabilize the crane. The erection and assembly process typically takes two to four days (dependent on weather conditions) for a single WTG.

2.5.1.6 Electrical Collector Line System Installation

Underground collector lines will be installed using low-impact techniques (e.g., mole-ploughing) to help reduce effects on native prairie and other native vegetation types (e.g., tame pasture). Where collector lines follow municipal road allowances, overhead collector lines may be placed on poles; however, this has yet to be determined and for the purposes of the EIS, all collector lines are treated as underground.

The crossing of streams or drainage channels may be required for Project construction activities such as underground cable installation. The number, location and types of stream/drainage crossings required, if any, will be reduced where possible. Locations where electrical collector and fibre-optic communications cables must cross municipal grid roads will also be reduced to the maximum extent possible. Directional drilling of electrical collector and fibre-optic communication cables under roadways may occur when provincial roads are crossed or if municipal approval to disturb a road is not granted. Mole-plough methods and other low-impact techniques within pre-existing municipal grid road ROW will be used wherever feasible.

2.5.1.7 Fuel Storage

Up to 1,000 litres of diesel fuel may be stored at site during the construction phase. A mobile service truck will be used to refuel larger construction equipment (i.e., cranes, front-end loaders, backhoes, etc.).

The contractor will be required to site all fuel-storage and equipment-servicing areas a minimum distance of 100 m away from any waterbody. In the event that refueling takes place in areas less than 100 m away from a waterbody (e.g., crane refueling), the contractor will have secondary containment/spill prevention measures in place. At all times, the contractor will be required to have materials available at the construction sites to contain and recover fuel spills in accordance with provincial regulations (i.e., *The Environmental Management and Protection Act* [Government of Saskatchewan 2010a] and *The Environmental Management and Protection (Saskatchewan Environmental Code Adoption) Regulations* [Government of Saskatchewan 2015a]).

2.5.1.8 Transportation of Components

During construction, the estimated peak daily traffic volume to each WTG site is estimated to be approximately 30 to 40 trucks (depending on construction schedule). These trucks will be needed during temporary access road construction, foundation construction and erection of WTGs. The majority of this traffic will be associated with concrete pouring for foundations and will happen over a short period of time (i.e., a few days for each WTG foundation). Caution signage will be posted and if required flag-persons, as required by standard traffic safety controls, in the vicinity of construction activities to advise local traffic of the need for reduced speed limits. Travel routes will be determined to avoid conflicts with overhead lines.

2.5.1.9 Waste Management

Industry best practices will be used to properly reduce and manage waste during Project construction. The construction contractor will develop a waste management plan which complies with applicable legislation in the handling, storage, transport and disposal of waste. Waste materials generated during construction are expected to include domestic waste and industrial waste (both inert and hazardous). Construction sites will be maintained on a daily basis, with all waste materials placed in designated containers and transported to an appropriate off-site landfill, controlled materials, or recycle depot. Sanitary sewage generated from on-site mobile sanitary facilities will be collected by permitted sewage haulers and transported to a suitable and approved sewage disposal site for treatment and disposal.

Hazardous wastes and dangerous goods will be handled, transported and disposed of in accordance with applicable legislation including the Hazardous Substances and Waste Dangerous Goods Regulations under *The Environment Management and Protection Act, 2010* (Government of Saskatchewan 2010a), and in accordance with the procedures and mitigation measures described in the EPP (see Appendix C).

2.5.1.10 Post-Construction Reclamation

Upon completion of the construction work, topsoil will be replaced on disturbed areas, which will be revegetated with crops, pastures grasses or native prairie species, depending on the original vegetation present, as determined in consultation with landowners, where appropriate. Any land disturbed during foundation construction, and not required for Project operation, will be rehabilitated to the maximum extent needed and feasible by decompaction and the redistribution of reserved topsoil. Where necessary, revegetation and reseeding will be completed as per landowner specifications. In areas of native prairie, approaches to reclamation will include natural recovery where native prairie has experienced limited effects, or seeding with native species where areas have been more disturbed or where natural recovery has not been successful. Follow-up monitoring will identify these areas. Native prairie re-seeding will use locally sourced native prairie seed stocks (Government of Saskatchewan 2012). Specific methods for revegetation will be identified in the EPP (see Appendix C). Seed mixes will be determined in consultation with land owners/leasees.

2.5.2 Operation and Maintenance

2.5.2.1 Operation

The wind-energy facility can operate 24 hours per day, 365 days per year. However, WTGs will automatically shut down during unfavourable wind conditions or (infrequently) when an operational problem (e.g., mechanical, electrical, environmental) is detected. Selected WTGs may also be shut down periodically as SaskPower load requirements change, for regularly scheduled maintenance, or in special circumstances such as accommodating seasonal aerial crop spraying. The computerized control system of the WTGs automatically directs the nacelle and rotor to face into the wind and adjusts blade pitch to maximize wind-capture potential and power output.

The rotation speed of the WTGs will vary from approximately 10 to 20 revolutions per minute, depending on the make and model of WTGs selected for the Project. The computerized system will automatically shut down a WTG when mechanical problems are detected (e.g., low hydraulic pressure, high generator temperature) and in instances when ice buildup occurs on WTG blades. When an operational shutdown occurs, information is automatically reported via high-speed fibre-optic communication lines to the main computerized system (Supervisory Control and Data Acquisition [SCADA]) located in the O&M building. The SCADA system monitors and controls the operation of each WTG and the Project as a whole (i.e., all WTGs collectively). WTGs become operational above wind speeds of approximately 10 km/hr and automatically shut down when wind speeds reach approximately 90 km/hr to protect rotor and drive-train machinery from damage. It should be noted that these operational estimates are specific to each turbine manufacturer's model and specifications may vary, dependent on manufacturer and model.

The Power Purchase Agreement between Algonquin and SaskPower has a minimum term of 25 years, with a potential for extension should the parties come to an agreement. The Project has an economic/design life of approximately 25 years. At the end of its economic life or at some interval prior (e.g., at less than 25 years), the WTGs and ancillary facilities may be upgraded to extend the energy-production lifespan of the Project.

During Project operation, WTGs will be operated in accordance with good wind-energy practices and will comply with manufacturer's recommendations to maintain equipment warranties and achieve the expected operational life. WTGs will also be maintained in accordance with manufacturer's recommendations and serviced by trained wind-energy technicians.

2.5.2.2 Routine Maintenance

Routine maintenance activities are typically scheduled at six-month intervals or as specified by the WTG manufacturer, with specific maintenance tasks identified for each interval. WTGs will be individually removed from service for maintenance so as to minimize the disrupt ion of the supply of energy to SaskPower. Typical maintenance activity duration will be approximately one day utilizing two to three technicians.

Standard maintenance parts, equipment, and fills will be stored on-site at the O&M building and will include hydraulic hoses, electrical components, fittings, test equipment, gauges and lubricants. Additionally, large spare components such as blades, generators and gearboxes may be stored within the O&M maintenance yard. During operations, maintenance service vehicles such as service trucks and forklifts will also be located at the O&M building. Specialized equipment not required for routine operations or maintenance (e.g., cranes, snow-removal equipment) may be sub-contracted as needed.

Each WTG requires lubricants and coolants such as ethylene glycol for operation. These controlled liquids will be checked, analyzed, and periodically replaced as per manufacturer requirements. Some quantities of these liquids will need to be stored on-site at the O&M building.

To reduce or avoid the potential for harmful effects to people or to the environment, controlled liquids at site will be stored within secondary containment basins or vessels to manage spills and prevent runoff in accordance with regulations. Anticipated controlled liquids may include lubricants, coolants, solvents, cleaning supplies, and paints, which are similar to those used in the local agricultural industries.

Following all WTG maintenance work, work areas will be cleaned of all surplus materials, and controlled liquids. Cleaning equipment and rags will be removed and disposed of in an approved manner at a designated disposal facility. The cleanup protocol will be outlined in the EPP to ensure a safe operating environment and reduce or avoid the risk of fire. All transportation, handling and disposal of dangerous goods or hazardous wastes will be in accordance with the appropriate regulations.

Additional information regarding hazardous materials and fuel handling, use and storage will be described in the EPP (see Appendix C).

2.5.2.3 Unplanned Maintenance

Modern WTGs are reliable and designed to operate for a minimum of 25 years. However, in the rare event of component failure, a WTG may be out of service until the faulty component is repaired or replaced. Most unplanned maintenance events will involve small component failure (e.g., switches, fans, sensors), and can usually be repaired within a few hours by a single technician.

The Standard Operating Procedures (SOPs) and maintenance protocols developed by WTG manufactures are specific to the make and model of each WTG. These SOPs generally relate to training, safety of personnel and equipment, and emergency conditions such as fire and equipment malfunctions. Topics covered by SOPs may include:

- Health and safety for personnel
- WTG safety controlled entry and including signage
- Commissioning plans
- Operation, maintenance and service manuals including lockout procedures
- Functional description control system
- Functional description WTG data and grid monitoring

Standard operational SOPs for the Project may be modified to address site-specific issues and will be finalized prior to the commissioning and operation of the facility.

2.5.3 Decommissioning and Abandonment

The expected lifespan of WTGs is approximately 25 years, at a minimum. At the end of the life of the WTGs, they may be replaced or reconditioned, depending on future technology and the demand for wind power. Otherwise the equipment and/or Project site may be decommissioned. In the event that the Project is fully decommissioned, appropriate decommissioning plans, EPP and emergency response plans (ERP) would be generated in consultation with appropriate regulatory authorities.

2.5.3.1 Conceptual Decommissioning Plan

The conceptual decommissioning plan (DP) for the Project would be designed to return the Project site to pre-development conditions. All Project components would be dismantled and removed from the site and WTG pads would be removed to a depth of 1 to 1.5 m. The objective of Project decommissioning would be to restore lands disturbed by the Project to a condition consistent with previous land uses or new uses as may be determined in consultation with landowners (e.g., crop production, grazing, municipal grid road allowances and ditches).

Activities occurring during decommissioning would require temporary workspaces and the use of equipment similar to that used for Project construction (as described in Section 2.5.1). Construction mitigation measures and industry best management practices as outlined (and updated as appropriate) in the EPP would be utilized to the extent feasible.

The conceptual DP would be designed to be a dynamic approach to facilities management in that it would be continually reviewed and updated over the life of the Project to reflect changes and developments in technologies, Project design and regulatory requirements.

2.5.3.1.1 General Environmental Protection

During decommissioning and subsequent restoration activities, general environmental protection and mitigation measures would be implemented. Many activities during decommissioning would be comparable to the construction phase including the use of heavy equipment on site, restoring constructible areas around all Project infrastructure, and preparing staging areas. General mitigation measures, best management practices, as appropriate, erosion and sediment control, and noise mitigation, and contingency plans for unexpected finds and spills, would be outlined and provided in the EPP prior to decommissioning.

2.5.3.1.2 Pre-dismantling Activities

Prior to engaging in decommissioning works, Algonquin would develop a DP in accordance with SKMOE requirements at the time of decommissioning. Decommissioning and restoration activities would be performed in accordance with all relevant statutes and regulations in place at the time of decommissioning.

At the end of the Project’s useful life, it would first be de-energized and isolated from all external electrical lines. Prior to any dismantling or removal of materials and equipment, staging areas would be delineated at each WTG site, along access roads, MET tower location(s), along collector lines, along transmission lines, the substation property, O&M building, storage shed, and cable landing locations as appropriate. All decommissioning activities would be conducted within designated areas. This includes ensuring that vehicles and personnel remain within the demarcated areas. Work to decommission and remove the collector lines and transmission lines would be conducted within the boundaries of the municipal grid road allowance and appropriate private lands.

Crane pads or mats to accommodate dismantling, would be installed at each WTG location. These measures would be implemented with consideration of industry best industry practices, and will be determined by an environmental advisor prior to decommissioning.

2.5.3.1.3 Equipment Dismantling and Removal

2.5.3.1.3.1 Staging Areas

Temporary staging areas at each WTG site, along access roads, the MET tower locations, along collector lines, along transmission lines, the substation property, and O&M building, could be used for temporary storage of Project components, excavated foundations and for parking. These areas would not be excavated or graveled and would be restored to pre-existing conditions at the end of the decommissioning phase.

2.5.3.1.3.2 Wind Turbine Generators

The WTGs would be disassembled into their original component parts or broken for ease of removal and/or disposal. A heavy-lift crawler and mobile cranes would be used to carry out the reverse sequence of steps that occurred during WTG assembly, namely:

- Removal of the blades and hub
- Removal of the nacelle
- Decoupling and lowering the tower sections

The WTG components would be temporarily stored at the staging area at each WTG site until removed from the site by truck. Vehicle movement could follow the same routes used during the construction phase.

2.5.3.1.3.3 WTG Transformers

The small transformer associated with each WTG would be removed for resale, reuse, reconditioning, or disposal. If the transformer is not located in the nacelle it would be located on a concrete pad adjacent to the base of the WTG. In this situation the foundation of each transformer would be removed as per Algonquin's lease agreement with the landowner.

2.5.3.1.3.4 WTG Foundations

The WTG foundations would be broken, partially removed to a depth of approximately 1 to 1.5 m below grade and recycled or disposed of in accordance with the land agreements. This depth would enable normal agricultural practices to be conducted over the foundation areas. Concrete would be removed from the site by dump truck and recycled or disposed of in accordance with appropriate regulatory guidance and regulations.

2.5.3.1.3.5 Crane Pads

After WTG removal is completed, temporary crane pads would be removed; this includes the geotextile material beneath the pads and granular material. Granular and geotextile materials would be removed from the site by dump truck and recycled or disposed of in accordance with appropriate regulatory guidance and regulations.

2.5.3.1.3.6 Electrical Collector Lines

Underground collector lines on private property would be cut with the ends buried to a depth of approximately 1 m and left in place, in consultation with the landowner and in accordance with the land agreements. Any junction boxes would be removed. Underground collector lines, splice vaults and junction boxes installed in municipal grid-road allowances would be removed, if required by an agreement with the RM.

Any overhead collector lines and poles along public road allowances would be removed, if necessary, in consultation with the RM. In areas where overhead collector lines are supported by shared-use poles, only the collector lines would be removed, unless otherwise required by the shared-use agreement that would be developed with other users.

2.5.3.1.3.7 Pad-mount Transformers

Pad-mount transformers, located immediately adjacent to each WTG, and grounding grids would be removed, and the associated concrete foundation would be removed to approximately 1 m below grade, in accordance with the land agreements. All electrical system components would be removed from site by truck and recycled or disposed of in accordance with appropriate regulatory guidance and regulations.

2.5.3.1.3.8 Electrical Substation

The electrical substation would be dismantled as agreed to, or as necessary, in accordance with the land-lease agreement. The station components would be removed, and the concrete foundation would be removed to approximately 1 m below grade. All granular and geotextile materials would be removed from the site by dump truck. All electrical system components would be taken off-site by truck and recycled or disposed of in accordance with appropriate regulatory guidance and regulations.

2.5.3.1.3.9 Permanent Access Roads

All access roads would be removed, including culverts, the geotextile material beneath the roads and granular material. The access roads would be returned to a similar condition as prior to Project commencement. Excavated areas on agricultural land would be brought to grade with fill and topsoil to be taken from surrounding land. All materials would be removed from the site by dump truck and recycled or disposed of in accordance with appropriate regulatory guidance and regulations. Where the landowner sees it advantageous to retain access roads, these would be left in place as long as compliance with municipal regulations was proven. Culverts would be removed if requested by the landowner and approved by the RM, SKMOE and/or DFO, as appropriate.

2.5.3.1.3.10 Operations and Maintenance Facility

If a new O&M building is constructed, it is possible that the O&M building could remain in place, depending on the agreement with the landowner. If not, the O&M building would be dismantled as agreed to, or as necessary, in accordance with the land-lease agreement. The fencing would be removed, and the concrete foundation would be removed to approximately 1 m below grade. All granular and geotextile materials would be removed from the site by dump truck. All electrical system components would be taken off-site by truck.

2.5.3.1.3.11 Meteorological Towers

The MET towers would be disassembled and removed by truck from the site and reused, recycled or disposed of in accordance with appropriate regulatory guidance and regulations. Foundations would be partially removed to a depth of approximately 1 m below grade. The sites could be accessed using the same route as during the construction phase.

2.5.3.2 Reclamation

This section describes how the lands used for the facility components will be reclaimed to bring the site into a condition that is consistent with pre-development conditions. If agreed to with the landowner, it is possible that the site could be restored to a different land use.

2.5.3.2.1 Site-Reclamation Plan

At the time of decommissioning, a Site Reclamation Plan should be created based on the industry standards and best management practices at the time of decommissioning, and in consultation with landowners and the appropriate regulatory and government bodies.

2.5.3.2.2 Heritage Resources

Heritage resources which have the potential to be impacted by the removal of facility components would be reviewed with the Heritage Conservation Branch (HCB) of the Saskatchewan Ministry of Parks, Culture and Sport prior to removal. Mitigation and monitoring measures may also be required including plans for replanting and restoration and would also be reviewed and implemented in consultation with the HCB.

2.5.3.2.3 Agricultural Lands

Areas that would require excavations during decommissioning of the facility will have subsoil or clean fill added as necessary. Areas that may have compacted due to decommissioning activities would be restored using deep ploughing equipment. Topsoil would be added to similar depth as surrounding areas, where necessary. Imported topsoil would be of the same or similar soil type and texture as pre-construction conditions and/or adjacent lands and would be selected with input from the landowner. In areas that supported native prairie species, a native prairie seed source appropriate for the area will be utilized for reseeding. Areas would be graded to pre-construction conditions and restored appropriately, in consultation with the landowner.

2.5.3.2.4 Municipal Grid Road Allowances

Where Project infrastructure has been removed from roadside allowances, these areas would be seeded with quick growing native species to prevent topsoil erosion. The seed mixture would be determined at that time in consultation with the RM, the Saskatchewan Native Plant Society, native prairie restoration specialists and/or Saskatchewan Ministry of Agriculture. Erosion and sediment control measures would be left in place until seed is fully established, as determined by an environmental monitor.

If any underground collector lines require removal by request of the RM, the area would be rehabilitated to pre-existing conditions, as appropriate, in consultation with the RM and/or landowners.

2.5.3.2.5 Watercourse Crossings

Any proposed decommissioning works within or near watercourses would be discussed with the RM, SKMOE and/or DFO, as necessary, to determine any applicable guidelines, permitting, site-specific mitigation and/or remediation plans. It is envisioned that similar mitigation and monitoring measures implemented during construction would be used for the decommissioning of the Project. Measures are anticipated to include standard best management practices including erosion and sediment control during removal of the structures.

2.5.3.3 Institutional Control

In Saskatchewan, the concept of institutional control applies primarily to mine and mill sites. The Institutional Control Program (2005) applies to developments on provincial Crown lands. It is anticipated that for this Project, once decommissioning removal, and reclamation activities are completed, no infrastructure will remain that would require institutional control. The areas previously occupied by Project infrastructure will have been restored to their pre-development condition. If a permanent structure (e.g., the O&M building) is left intact, that structure will be the responsibility of the landowner who takes possession of the facility.

2.6 PROJECT WORKFORCE

2.6.1 Construction

Approximately 45 to 90 FTEs are expected to be required during the construction of the Project over the expected minimum 8 to 18 month construction period. Each component of Project construction will require workers with different skillsets and training depending on the task (e.g., road construction, foundation construction, erection of the WTGs) (see Table 2-3). The Project contractor will be selected through a competitive bidding process once approvals and permits are obtained to allow the Project to proceed to the construction phase. Employment for those in nearby communities, if qualified and competent, will be preferred.

Trades required during the construction phase may include other trades not listed Table 2-3, such as:

- Road construction and foundation excavation workers
- Pipefitters
- Drillers/trenchers
- Masonry workers
- Windsmiths

Table 2-3 Estimated Workforce During Construction

Job Title	Job Description	Approximate Number of Positions	Approximate Length of Employment (months)
Phase 1: Foundation Construction			
Carpenters	Form foundations for WTGs and substation equipment and build platforms as required.	6-18	6-8
General Labourers	Perform general labour, assist skilled tradesmen, cleanup, locate equipment and material.	30-60	10-18
Rebar Formers	Tradesmen that physically place and join the rebar steel in the engineered pattern of the WTGs' foundations with wire.	12-24	6-8
Electricians	Install underground and overhead electrical transmission collection systems and terminate at the padmount (or in the nacelle) transformers and substation. Install electrical equipment, run electrical cables and terminate at end devices and Motor Control Centre.	4-8	8-12

Table 2-3 Estimated Workforce During Construction

Job Title	Job Description	Approximate Number of Positions	Approximate Length of Employment (months)
Phase 2: Installation and Erection			
Offloading Riggers	Responsible for safe attachment of loads during any lifting activities.	12-18	6-8
Iron Workers	Responsible for the physical installation of tower sections, nacelle and blades. Using specialized tools, will torque all components together. Install substation structural steel.	12-18	6-8
Crane Operator	Operate lift crane and tailing crane and pickers used for moving equipment and materials.	6-12	6-12
Assistant Gear Operator (forklifts)	Operators of smaller mobilized equipment such as bobcats and forklifts used to move equipment around the construction site.	6-12	6-12
Cleanup Labourers	Labour used to clean up the site, receive materials and ship fixtures back to vendors.	6-18	6-8
Electricians	Install underground and overhead electrical transmission collection systems and terminate at the padmount (or in the nacelle) transformers and substation. Install electrical equipment, run electrical cables and terminate at end devices and Motor Control Centre.	6-12	6-12
Site Management			
Project Manager/ Superintendent	Overall responsibility for the entire Project. Must ensure that safety, cost, schedule and quality standards are met. Project Manager will also ensure appropriate contracts are in place.	1-2	10-18
Project Coordinator (on-site part time)	Responsible for assisting the Site Management Crew as needed.	1	10-18
Safety Coordinator	Responsible for ensuring all construction and site activities are conducted safely and properly.	1	10-18
Timekeeper/ Administrative	Ensure all timesheets are properly coded, filed and processed.	1	10-18
Field Engineer	Ensure technical integrity and that the finished product meets drawings and specifications.	1	10-18
NOTE: The information provided is an estimate and will vary, to some degree, with the needs/discretion of the contractor.			

2.6.2 Operation

Approximately 7-15 FTEs will be required in skilled positions for the operation and maintenance phase of the Project. The type of positions required for the on-site operation and maintenance of the facility include:

- WTG operation and maintenance engineers and technicians (i.e., 'windsmiths')
- Wind-energy facility manager/supervisor
- Administrative staff

Algonquin is committed to providing local communities with the job-opportunity information needed to encourage interest and to promote participation in the development and ongoing operation of the Project.

2.7 PROJECT SCHEDULE

The Project phases reviewed as part of the EIS consist of three phases: construction, operation and maintenance, and decommissioning. Currently, the Project is in the development stage which includes facility interconnection planning with SaskPower and undertaking aspects of Project permitting and approvals, environmental baseline studies, ongoing stakeholder consultation, zoning applications, detailed Project design, equipment procurement and finalizing Project financing.

Algonquin's schedule of key activities and milestones for the proposed Project are outlined in Table 2-4.

Table 2-4 General Schedule of Key Project Activities and Milestones

Project Phase	Project Schedule
Submission of Technical Project Proposal and Terms of Reference	February 2017
Terms of Reference Finalization and Approval	March 2017
Environmental Assessment (i.e., environmental studies, engagement)	October 2016 – October 2017
EIS Submission	December 2017
EIS Review and Approval[1]	Q1 2018 – Q2 2018
Permitting	Q3 2018 – Q4 2018
Anticipated Construction	2019 - 2020
Commercial Operation Date	Q4 2020
Operation	Q1 2021 and beyond

NOTE:
[1] These dates are an estimate of the time needed for review and approval by SKMOE.

2.8 ENVIRONMENTAL MANAGEMENT FRAMEWORK

Algonquin is committed to incorporating environmental management approaches and strategies into Project planning and execution so that the Project is compliant with regulatory requirements and avoids or reduces potential negative effects to the environment. Algonquin will consult with provincial regulators and the public to better understand the issues that are of most concern to them, as well as to understand requirements for the preparation of the EIS.

Algonquin has experience developing, operating and maintaining wind energy projects in Saskatchewan. This experience will be used in Project planning and proactive management of potential environmental effects. The application of environmental management tools to Project planning and execution will occur in several ways, including in the design and location of Project components, avoidance or mitigation of potential effects on remaining natural features (include committing to conducting pre-construction surveys), and through development of an EPP (see Appendix C).

A Project-specific EPP (see Appendix C) hasbeen developed and is based on the current layout of the Project. The EPP summarizes Algonquin's corporate commitments and regulatory requirements for the Project's environmental management and is intended to gather all environmental commitments into one document that can be used by project managers, contractors and regulators to manage Algonquin's commitments over the life of the Project. Specifically, the EPP details and expands on the commitments made in the EIS and regulatory requirements identified through subsequent permitting. Items outlined in the EPP include specific mitigation and monitoring measures with reference to the regulatory and permitting requirements, post-construction reclamation plans, monitoring and follow-up, and an emergency response plan. Monitoring and follow-up programs will be Project phase-specific and designed based on the potential effects that may occur during each phase. As activities and potential effects mechanisms are similar during construction and decommissioning, these follow-up and monitoring programs will be similar.

For potential effects during the operation phase of the Project, the EPP includes an adaptive management approach (see Volume 2 of the EPP in Appendix C) based on the SKMOE's draft Adaptive Management Guidelines (SKMOE 2017c). Adaptive management is a systematic process for continually improving management policies and practices by learning from the outcomes of previously employed policies and practices. A tiered approach to adaptive management can be an effective management tool in addressing any residual environmental effects by assessing effects, implementing a specific mitigation measure(s), reassessing effects and learning from previous measures, and adjusting mitigation measures if necessary.

2.9 ANCILLARY PROJECTS

2.9.1 SaskPower Connection

The proposed Project will interconnect with a SaskPower transmission line and switching station which has yet to be located and built. SaskPower will be responsible for designing, permitting, and constructing the Project transmission line from the Project substation to the SaskPower switching station.

3.0 ENGAGEMENT

Algonquin recognizes the importance of communication and engagement with stakeholders (including members of the public, community organizations, local businesses and other interested parties), government agencies and Indigenous communities as an integral aspect of any project that has the potential to affect the human and natural environment. Algonquin began the process of engagement in January 2017, and will continue to undertake public engagement activities for the Project through the regulatory, construction, and operational phases of the Project. To date, this process has included three rounds of engagement activities, creating opportunities to collect feedback and share information with those who may be affected by or have an interest in the Project.

In the context of this EIS, 'engagement' refers to two-way communication to share information and viewpoints, understand comments and interest, and address or resolve issues. Algonquin's approach to issue resolution has included providing multiple opportunities for comment on the Project throughout the EA process through a range of venues and methods, remaining flexible and accommodating changes where possible. Algonquin has endeavoured to provide information in a transparent manner, maintain open communication with interested parties, track questions and issues raised, and provide follow-up as appropriate.

This chapter provides an overview of the engagement process undertaken for the Project, including principles and goals of the process, the scope and adaptable nature of the process, key concerns, and outcomes resulting from engagement.

3.1 OBJECTIVES AND APPROACH

An engagement approach for the EA process was developed to allow Algonquin to identify those who may be affected by or have an interest in the Project with an opportunity to receive information about, and provide input into, the review and development of the Project. Engagement was initiated early on and continues throughout the development of the Project. The objectives of the engagement program planned for this Project were to:

- Provide the public, stakeholders, Indigenous communities, and other interested parties with timely and accurate information to facilitate a clear understanding of the Project;
- Gather and document issues, questions and concerns regarding the Project from interested parties;
- Gather input from interested parties on the scoping of issues to be included in the EIS;

- Gather information on traditional land use within the Project Area by Indigenous peoples; and
- Inform the public, stakeholders, Indigenous communities, and other interested parties on how public input informed planning, design, and mitigation decisions.

Additionally, Algonquin developed an Indigenous engagement program for the Project to help Algonquin to identify the current use of land and resources by Indigenous persons for traditional purposes that could be affected by the Project.

The objectives of the Indigenous engagement program were to:

- Inform Indigenous communities of the nature of the proposed Project and any potential environmental impacts, including short and long term plans;
- Identify and discuss potential adverse effects of the Project on First Nations and Métis' ability to exercise their right to hunt, fish and trap for food and carry out traditional uses;
- Provide opportunities for communities to ask questions and voice concerns;
- Provide feedback on how concerns were addressed as part of the EIS;
- Allow the Project to benefit, during design and planning, from access to first-hand knowledge of the environment surrounding the Project; and
- Help determine which aspects of the environment should be addressed as part of the EIS.

3.2 IDENTIFICATION OF INTERESTED PARTIES

3.2.1 Stakeholders

For this EIS submission, stakeholders are considered local and regional members of the public, or non-governmental organizations (NGO) affiliated with representing certain interests of members of the public. A preliminary contact list of potentially interested parties was compiled based on the following parameters:

- Individual neighbours (landowners, businesses, etc.) within 40 km of the Project
- All Villages, Towns, and Hamlets within 40 km of the Project
- All Cities within 100 km of the Project
- NGOs

Algonquin recognized that it was likely not possible to capture all potentially interested parties while compiling the preliminary contact list and the plan was therefore to begin the engagement process based on this preliminary list and expand as needed as additional parties were identified.

The following organizations were included on the initial list of NGOs potentially interested in the Project:

- Nature Saskatchewan
- Saskatchewan Environmental Society
- Ducks Unlimited Canada
- Saskatchewan Wildlife Federation
- Nature Conservancy Canada (Saskatchewan Region)
- Chaplin Nature Centre

Through the engagement process, the following organizations were identified as interested in the Project and subsequently added to contact list:

- Public Pastures – Public Interest (PPPI)
- Saskatchewan Stock Growers Association
- South of the Divide Conservation Action Program Inc.

3.2.2 Government and Regulatory Agencies

The Project is located within the RMs of Morse and Lawtonia. Accordingly, Algonquin has endeavoured to consult with representatives from the municipalities on a wide range of issues. Pursuing engagement with the RM keeps the administration aware of the Project as it progresses and the potential effects of the Project on the economy and community services and infrastructure. The RM served as a key local engagement point for providing input on issues related to land use planning and existing community services and infrastructure.

In addition to the two RMs within which the Project is located, Algonquin identified the RMs of Coulee and Rush Lake as RMs near the Project area that may have an interest in the Project. Algonquin has continued to circulate publicly available engagement materials to the four RMs and will continue to engage throughout the EA process, as well as through the life of the Project.

Algonquin has communicated Project information to the SKMOE through phone calls, meetings, and presentations. Additionally, invitations to the open houses have been extended to the Members of the Legislative Assembly of Lumsden-Morse (Minister of Agriculture) and Wood River (Minister of Highways and Infrastructure).

3.2.3 Indigenous Communities

A preliminary contact list of potentially affected Indigenous communities was compiled based on the following parameters:

- All First Nations located within 100 km of the Project
- All Métis Locals within 100 km of the Project

The goal of the Indigenous engagement plan was to begin with this preliminary list and expand as needed, based on results of initial engagement. The Indigenous communities identified based on these parameters are:

- Wood Mountain Lakota First Nation
- Nekaneet First Nation
- Maple Creek – Métis Local No. 12
- Willow Bunch – Métis Local No. 17
- Riel Métis Council – Métis Local No. 34
- Swift Current – Métis Local No. 35
- Assiniboia Métis – Local No. 86
- Prairie Dog – Métis Local No. 123
- Moose Jaw – Métis Local No. 160
- Regina Beach – Métis Local No. 29
- Queen’s City – Métis Local No. 34
- Rush Lake – Métis Local No. 91
- Outlook – Métis Local No. 155
- Plato/Bicklagh Métis Local No. 170
- Fiske/D’arcy Métis Local No. 85

3.3 ENGAGEMENT METHODS

Algonquin used a broad range of engagement tools throughout the EA to make information accessible and provide opportunities for participation and feedback by interested parties. The tools used are described in more detail in the sections below.

3.3.1 In-Person Meetings

Algonquin met with participating landowners, interested NGOs, municipal leadership, and government ministries and organizations throughout Project development. The objective of these meetings was to supplement information provided by other means, and allow Algonquin to focus attention on the specific comments and questions of a particular stakeholder or group.

3.3.2 Open Houses

Three rounds of drop-in format open houses were held in Hodgeville, SK and Herbert, SK to provide Project information to potentially interested members of the public, Indigenous communities, government and regulatory agencies, and NGOs. Representatives from Algonquin and Stantec were on hand to answer questions, address concerns and discuss various aspects of the Project.

The open houses were advertised in local newspapers, the Herbert Herald, Swift Current Prairie Post and Moose Jaw Times Herald, posted at local RM offices, community centres, grocery stores, and community bulletin boards. Invitations were distributed to residents of the RMs of Lawtonia, Coulee, Excelsior and Morse via Canada Post Neighbourhood Mail, and via direct mail and/or e-mail to identified NGOs, potentially affected Indigenous communities, and government or regulatory agencies. The open houses provided opportunities for the public to learn about the Project including project planning and development activities, ask questions or express concerns about the Project and meet the Algonquin project team. During each round of open houses, the same information was presented at two sessions in different locations (Hodgeville and Herbert) for the convenience of interested parties.

Attendance sign-in sheets were used to track the level of attendance at each open house. A series of poster boards was displayed at each information session providing general information about wind energy, Project-specific information, maps of the proposed Project area, proposed timelines and information on the EA process. Feedback mechanisms such as questionnaires were used to receive feedback and provide opportunity for follow-up.

3.3.3 Information Materials and Sources

Project information handouts and maps were made available to the public at open houses and online through the Project website.

3.3.4 Project Website and E-mail Address

An initial Project website was developed at www.bluehillswindproject.com, but was later updated following the change in Project name to Blue Hill. The current Project website is available at: www.bluehillwindproject.com. The Project website provides a widely accessible venue for interested parties to obtain Project information, including a Project summary, information on approvals and open houses, Project contact information, and related links for additional information. Open house information includes dates, times and location of open houses, as well as handouts, questionnaires and poster boards displayed or distributed during each session.

Algonquin also established a Project-specific e-mail address (BlueHill.WindProject@algonquinpower.com) to receive comments, collect feedback and answer questions related to the Project. The e-mail address with continue to be maintained throughout the regulatory review, construction, and operational phases of the Project.

3.3.5 Tracking and Documentation

Throughout the engagement process, contact information of interested parties was maintained in a database that was updated as required. Issues, concerns, comments, and questions have been, and will continue to be, logged in an engagement database for further consideration and/or action, where appropriate. The results of the engagement process are presented below.

3.4 SUMMARY OF ENGAGEMENT ACTIVITIES

3.4.1 In-Person Meetings

3.4.1.1 Stakeholders and NGOs

Algonquin met with landowners and representatives from NGOs at three points throughout the year in conjunction with the three rounds of public open houses (January, June and October). A fourth round of meetings with NGOs took place in November to discuss high-level results of surveys conducted as part of the EA.

Algonquin hosted group dinner meetings with potentially affected landowners on January 25, 2017 (invitation mailed via Express Post on January 12, 2017). Algonquin provided Project information and answered questions from landowners pertaining to general project information and timeline.

Table 3-1 provides a summary of in-person meetings held with NGOs throughout the year.

Table 3-1 Summary of In-Person Meetings with NGOs

NGO	Date	Purpose	Outcome
Ducks Unlimited (DU)	January 23, 2017	Project introduction	DU will evaluate the proposed Project area against known important waterfowl breeding/staging areas. DU acknowledged that there was not much native prairie or wetlands/water within the proposed Project area.
	November 23, 2017	Discussed project update	DU identified no issues with project location. Discussed high level field results and answered questions.
Saskatchewan Wildlife Federation (SWF)	January 24, 2017	Introductory Meeting	SWF is supportive of the project, interest in mitigation for mortality (some kind of penalty). General project overview provided.
	September 28, 2017	Discuss Project update	Discussed surveys completed as part of the EA, regulatory process, and proposed Project timelines.
	November 21, 2017	Discuss Project Update	SWF had interest in the key findings. Discussed high level field results and answered questions regarding material presented.
Saskatchewan Environmental Society (SES)	January 25, 2017	Introductory Meeting	Met with both SES and PPPI. Discussed the project at high level bringing meeting attendees up to speed on the project. Concern was stated regarding potential disturbance to native prairie grass.
	November 22, 2017	Discuss Project Update	Discussed high level field results and answered questions.
Nature Saskatchewan	January 23, 2017	Introductory project meeting	Algonquin and Nature Saskatchewan discussed the Stantec constraint fieldwork completed in the proposed Project area to date and identified that there is limited native prairie and wetland/water within the proposed Project area. Algonquin and Nature Saskatchewan also discussed the possibility of data sharing.
	September 27, 2017	Discuss Project update	Discussed surveys completed as part of the EA and timeline for regulatory process and proposed construction.
	November 23, 2017	Discuss Project update	Discussed high level field results and answered questions.

Table 3-1 Summary of In-Person Meetings with NGOs

NGO	Date	Purpose	Outcome
Chaplin Nature Centre	January 25, 2017	Introductory meeting	General discussion regarding project status. No concerns were raised.
Nature Conservancy Canada (SK Region)	January 24, 2017	Introductory Project Meeting	Algonquin and Nature Conservancy discussed the proposed project area. Desktop land use percentages were presented. Interest in post construction monitoring and prairie grass compensation.
Note: Tried to meet in November 2017; however, the organization had a time conflict because of annual meetings	September 27, 2017	Discuss Project update	Discussed parameters for Project siting, timelines, and Adaptive Management Plan. Plan to meet with NGOs and Stantec to review EA results in the early part of the public review process (2018).
Saskatchewan Stockgrowers Association	January 26, 2017	Introductory Project Meeting	Joint meeting with South of the Divide to learn about a potential conservation opportunity.
South of the Divide Conservation Action Program Inc.	January 26, 2017	Introductory Project Meeting	Joint meeting with South of the Divide to learn about a potential conservation opportunity.
	November 23, 2017	Discuss Project update	Discussed high level field results and answered questions
Public Pastures Public Interest (PPPI)	June 21, 2017	Discuss Project update	Algonquin and PPPI discussed the proposed Project timeline and studies completed to date as part of the EA. Algonquin indicated that there is approximately 7% native prairie in the proposed Project area and that no Crown land exists within the Project area. Algonquin discussed preliminary results of some surveys and indicated that the current plan is to have a Project layout in September for public review.
	September 26, 2017	Discuss Project update	Discussed constraints for project siting and the various parameters that are considered. Algonquin identified the surveys completed by Stantec as part of the EA and indicated that they could meet to discuss EA results once publicly available.
	November 22, 2017	Discuss Project Update	Discussed high level field results and answered questions.

3.4.1.2 Government and Regulatory Agencies

Throughout the EA process, Algonquin met with relevant government and regulatory agencies. Table 3-2 provides a summary of engagement with government and regulatory agencies to date.

Table 3-2 Summary of Government and Regulatory Engagement Activities Conducted for the Project

Organization	Date	Means of Engagement	Purpose/Key Topics
SKMOE	June 19, 2017	In-person meeting	Project introduction, including preliminary results from surveys completed for EA by Stantec. Preliminary proposed Project layout to provide direction for field surveys. Indigenous communities and NGOs invited to open houses. Avoidance zone update – updated shapefile provided by SKMOE. NGOs requested results prior to submission to regulatory. Certain NGOs indicated compensation for bird mortality
	November 23, 2017	In-Person meeting	Discussed general Project information to get newly assigned SKMOE representative up to speed.
RM of Chaplin	June 20, 2017	In-person meeting	Discussed follow up from previous proposed wind project and general Project information for the Blue Hill Wind Project.
RM of Morse	June 20, 2017	In-person meeting	800 m setback from turbines needs to be provided in Development Permit applications for the council to review
	Nov 14, 2017	In-person meeting	Algonquin representative presented general information on project and future SaskPower RFP
RM of Lawtonia	June 20, 2017	In-person meeting	Provide schedule of project and requirements Give notice ahead of the process Working with Saskatchewan Association of Rural Municipalities
	Nov 15, 2017	In-person meeting	Algonquin representative presented general information on project and future SaskPower RFP

3.4.1.3 Indigenous Communities

Invitations to the public open houses for the Project were mailed to Wood Mountain Lakota First Nation, Nekaneet First Nation, and 13 Métis Locals (Section 3.2.3). Follow-up phone calls were also made to the identified Indigenous communities and voicemail messages were left. None of these phone calls were returned. A representative from Swift Current – Métis Local No. 35 attended the public open houses in June and September.

3.4.2 Open Houses

3.4.2.1 Open House 1

The first Project Open House was held in two informal drop-in style sessions, one on January 23, 2017 in Hodgeville, SK and the second on January 24, 2017 in Herbert, SK. The same information was provided at each of the sessions for the convenience of attendees. The purpose of the first Open House was to provide preliminary project information regarding Project planning and development activities, as well as to provide an opportunity for the public to meet with the Project team.

The Open Houses were communicated to the public via an advertisement in the Prairie Post and Herbert Herald that ran on January 20, 2017. Prior to the Open House, 1,142 invitations were mailed via Canada Post Neighbourhood Mail to postal codes in Swift Current, Gouldtown, Herbert, Main Centre, Rush Lake, Hodgeville, Morse, Prairie View, Waldeck, McMahon and Neidpath. Posters advertising the events were posted at local community halls, businesses, notice boards and RM offices.

Fifteen people attended the first session in Hodgeville, SK, while thirty-one people attended in Herbert, SK. Questionnaires were distributed for attendees to provide feedback, ask questions, or identify concerns. Between the two Open House sessions, nine attendees completed the questionnaire. Of the attendees who completed questions, all nine felt that the Open House was helpful in understanding the potential effects of the proposed Project and indicated that after viewing the information provided at the Open House they were in support of the Project proceeding. When asked to rate the quality of supplementary information provided by representatives from Algonquin and Stantec when questions were posed, five responded 'excellent', three responded 'very good' and one responded 'adequate'.

The questions, comments and concerns identified via the questionnaires completed at the first Open House pertained to:

- Requests for further information regarding:
  - crew lodging through the life of the Project
  - location of the Project

- construction dirt work and aggregate supply
- specific details of the Project, including tower and transmission line locations, remuneration to landowners, and how existing lines are affected

- Comments in support of the Project included:
  - A local business owner felt the Project will boost the economy
  - "Good for the community"
  - "Green power, less carbon"
  - "Who can argue with clean energy"
  - A local landowner indicated that the Project generates another revenue stream for participants, creates jobs and diversifies the economy

3.4.2.2 Open House 2

The second round of open houses were also held as informal drop-in style information sessions in Hodgeville on June 19, 2017 and Herbert on June 20, 2017. The open houses were communicated to the public via an advertisement in the Prairie Post and Herbert Herald that ran on June 9 and 16, 2017. Invitations were again mailed via Canada Post Neighbourhood Mail to local postal codes and posters advertising the events were posted at local community halls, business, notice boards and RM offices.

Seventeen attendees were recorded at the first session in Hodgeville on June 19. Questions recorded during the open house included:

- General timeline for required documents from the RM of Lawtonia
- Number of jobs to local residents
- Project timeline

At the second session held in Herbert on June 20, 35 people attended. Questions recorded during the open house included:

- What is a Community Benefits Agreement?
- A comment was made that the location and set up of the Open House could have better accommodated seniors, i.e., additional chairs set up.

Between the two open houses, three attendees completed questionnaires. All three respondents indicated that the open house was helpful in understanding the potential effects of the Project and that they were in support of the Project. When asked if there was a particular subject about which they would like to receive additional information, one respondent indicated they would like additional environmental information. Another respondent commented that "the information was excellent and the team members were exceptionally knowledgeable".

3.4.2.3 Open House 3

The third Project open house occurred on September 27 and 28, 2017 in Hodgeville and Herbert respectively. The first session in Hodgeville was attended by 30 people, while 32 attended the second session Herbert. The open house in Herbert was also attended by a representative from the Swift Current Métis Local No. 35.

Two attendees completed the provided questionnaire. Both respondents indicated that the open house was helpful in understanding the potential effects of the Project, the quality of the information provided was 'Very Good' and that there was enough information provided. Both respondents also indicated that they were in support of the Project. When asked if there was a particular subject about which they would like to receive additional information, one respondent indicated they would like additional information regarding housing and meals for crews and the other requested topographic maps.

Questions recorded during the open house sessions included:

- Safety – speed limits, near children/during project
- Environmental – majority of migratory birds have not flown through Project area yet
- How do we regulate contractors?

3.4.3 Summary of Questions and Comments Raised During Engagement Activities

Table 3-3 summarizes the results of the engagement process to date.

Table 3-3 Summary of Results of Engagement to date

Group or Agency	Issue Raised	Proponent Response	EIS Section Reference
PPPI/ Saskatchewan Environmental Society/ Nature Saskatchewan	Potential effects on native prairie grassland	There are 0.6 ha of native prairie within the PDA. Proponent is trying to avoid construction in native prairie areas.	Sections 7.4.2 and 7.4.3
Saskatchewan Environmental Society/ Nature Saskatchewan	Setbacks	Algonquin is trying to adhere to provincial Activity Restriction Guidelines	Sections 8.2.2 and 8.4.2
Saskatchewan Wildlife Federation	Bird and bat mortality	Potential mitigation strategies to attempt to reduce bird/bat mortality were discussed, including changing turbine speed in various conditions.	Section 8.4.3
PPPI	Inadequate turbine lighting resulting in increased bird mortality	Turbine lighting will comply with Transport Canada lighting requirements	Section 8.4.3.3.2.
PPPI	Unidentified heritage features	Protocol for chance encounters of heritage resources is included in the EPP. In the event of a chance encounter, work will stop and assessment will be conducted in accordance with the HCB.	Appendix C, Volume 1
PPPI	Interruption to farming operations	Prior to construction, Algonquin will discuss with landowners to determine any areas of concern.	Section 10.4.2.2

3.4.4 Summary of Indigenous Engagement

The Project is located within Treaty 4 territory, signed in September 1874. The nearest First Nations to the proposed Project area are identified in Section 3.2.3.

It is acknowledged that the Project occurs within the traditional territories of these Indigenous peoples. However, neither of the First Nations responded to invitations to engage regarding the Project. Of the 13 Métis Locals identified within 100 km of the Project, Algonquin is aware of one representative attending open houses in June and September. No concerns were raised. No requests for additional engagement (e.g., in-person meetings, additional community specific open houses) were received by Algonquin.

4.0 ENVIRONMENTAL ASSESSMENT SCOPE AND METHODOLOGY

4.1 OVERVIEW OF THE APPROACH

An overview of the methods used to conduct the EA of the Project is provided in this section. This EIS has been completed to meet the requirements of the Saskatchewan *Environmental Assessment Act* and the approved TOR for the EIS. The EIS follows a structured approach that:

- Focuses on issues of greatest concern raised by regulators.
- Considers key issues raised by the public, stakeholders and Indigenous people.
- Integrates engineering design and programs for mitigation and follow-up into a comprehensive environmental planning process.

The assessment focuses on the identification and assessment of potential adverse environmental effects of the Project on Valued Components (VCs). VCs are elements of the biophysical, social, cultural, and economic environments that, if altered by the Project, may be of concern to regulatory agencies, Indigenous peoples, resource managers, scientists, key stakeholders and/or the general public.

Project-related environmental effects and cumulative environmental effects are assessed using a standardized methodological framework for each VC with standard tables and matrices to facilitate and document details of the evaluation. The residual Project-related environmental effects (i.e., those environmental effects that remain after the planned mitigation measures have been applied) are characterized using specific criteria that are defined for each VC (i.e., direction, magnitude, geographic extent, duration, frequency, reversibility, and context). The significance of the Project-related environmental effects is then determined based on pre-defined criteria or thresholds (i.e., significance rating criteria). If there is an identified potential for the residual environmental effects of the project to interact cumulatively with the residual environmental effects of other past, present, and future (i.e., certain or reasonably foreseeable) projects, these cumulative environmental effects are assessed.

The environmental effects assessment approach to be used in the EIS is shown graphically in Figure 4-1 and described in the sections below.

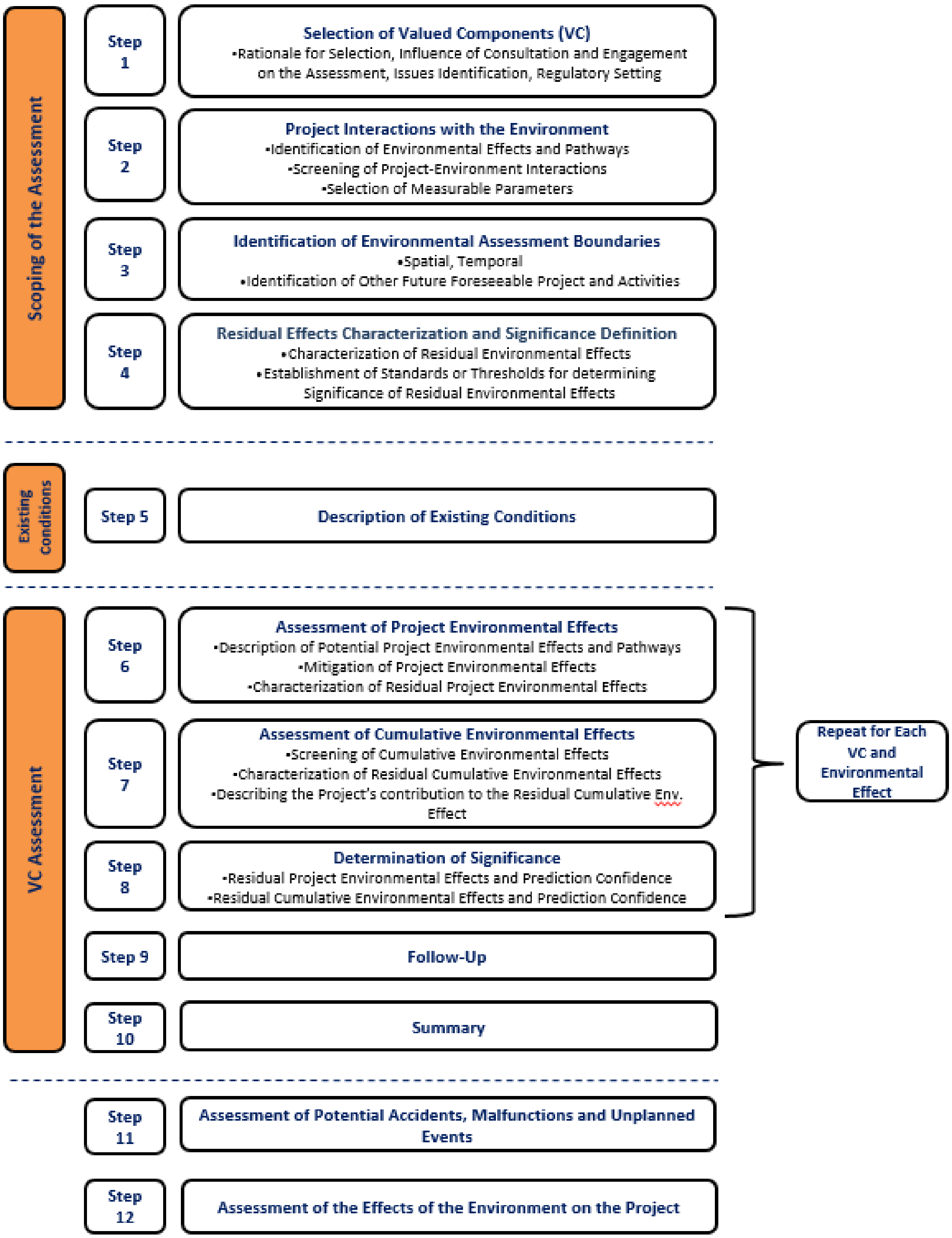


Figure 4-1 Overview of Environmental Assessment Method

4.2 SCOPING OF THE ASSESSMENT

4.2.1 Selection of Valued Components

VCs are important aspects of the ecological and socio-economic environments that are considered to be important from public, Indigenous, and/or scientific and technical perspectives. VCs are identified to focus the EA on those aspects of the environment that are valued and most likely to be affected by the Project and cumulative environmental effects.

The selection of VCs was carried out in consideration of:

- regulatory guidance and requirements, including the TOR approved by SKMOE
- issues raised by regulatory agencies, key stakeholders, Indigenous peoples and the public
- technical aspects of the Project (i.e., the nature and extent of Project components and activities)
- existing environmental conditions in the Project area and an understanding of potential Project-environment interactions and potential environmental effects
- an understanding of the sensitivity of the environmental aspects to disturbances typical of this type of Project
- experience and lessons learned from similar wind energy projects
- the professional judgment of the Project team

In consideration of this, seven VCs were selected reflecting the anticipated Project-environment interactions, and based upon an understanding of the biophysical and socio-economic environments associated with this Project. The biophysical and socio-economic VCs considered in this EIS are:

- Acoustic Environment
- Vegetation and Wetlands
- Wildlife and Wildlife Habitat
- Heritage Resources
- Land and Resource Use
- Employment and Economy
- Community Services and Infrastructure

Table 4-1 presents the VCs assessed in this EIS and the rationale for their selection, and also provides the rationale for excluding candidate VCs that were identified in SKMOE's *Guidelines for the Preparation of the Terms of Reference* (SKMOE 2014a). In general, candidate VCs were excluded because it was concluded that: 1) no effect would occur on the VC; or 2) potential environmental effects would be negligible and could be fully addressed with standard mitigation measures; or, 3) effects would be addressed through the consideration of particular interactions with other VCs.

Table 4-1 Selection of Valued Components

Environmental Component	Carried Forward as a VC?	Rationale for Selection
Atmospheric Environment	NO	The implementation of industry best practices and standard mitigation measures during construction will reduce the degree to which air quality is affected by the Project. As such, a change in air quality is expected to be negligible and air quality is not considered a VC for this Project.
Acoustic Environment	YES	Project activities and infrastructure (e.g., turbines, substation) have the potential to cause noise that may adversely affect the existing acoustic environment resulting in possible community annoyance. Therefore, acoustic environment is carried forward as a VC.
Geology	NO	Foundations for each WTG are not expected to adversely affect the geology of the Project area. The foundation design (i.e., dimensions, depth and type) will be based on a geotechnical evaluation of the site and construction of a foundation will incorporate industry best practices and standard mitigation measures.
Terrain and Soils	NO	With the implementation of industry best practices and standard mitigation measures (e.g., redistributing soils on the landscape, avoiding steep slopes), the potential for a change in terrain or soil loss is expected to be low or negligible. Therefore, terrain and soils is not considered a VC for this Project. Changes to terrain and soils as it relates to agricultural practices will be considered in the land and resource use VC.
Groundwater	NO	The Project is not expected to have substantive interactions that influence the quality and quantity of groundwater, so it is not included as a VC. However, groundwater as it relates to water wells and use is discussed in the land and resource VC. Groundwater as it relates to wetlands is considered in the vegetation and wetland VC.
Surface Water	NO	This VC relates to surface water (including streams, rivers, lakes, reservoirs) that may be used by humans (e.g., source of fire-protection water, potable water, etc.). There are no major rivers or lakes located within the Project area and, with the implementation of standard mitigation measures, the Project is not expected to have an effect on the water quality and quantity of the few streams located within the Project area. As such, surface water is not considered a VC for this Project. Surface water, as it relates to the biophysical environment, is considered through the vegetation and wetlands, and wildlife and wildlife habitat VCs.

Table 4-1 Selection of Valued Components

Environmental Component	Carried Forward as a VC?	Rationale for Selection
Aquatic Environment	NO	There are no fisheries resources, as defined in the *Fisheries Act*, in the PDA and no Project effects on fish and fish habitat are expected. As such, the aquatic environment is not considered a VC for this Project.
Vegetation and Wetlands	YES	Site preparation activities (e.g., clearing and grading) has the potential to cause changes to vegetation communities and plant species (including plant species at risk (SAR) protected under the *Species at Risk Act* [SARA] and species of management concern [SOMC]). There is also the potential for the Project to cause alteration or loss of wetland habitat. Vegetation and wetlands is therefore carried forward as a VC.
Wildlife and Wildlife Habitat	YES	The Project has the potential to result in the alteration or loss of habitat for wildlife (including SAR and SOMC) and has the potential to cause injury or mortality to wildlife. As such, wildlife and wildlife habitat is carried forward as a VC.
Biodiversity	NO	Biodiversity is inherently considered in relation to the vegetation and wetlands, and wildlife and wildlife habitat VCs. These VCs include an understanding of the number and type of species present and the range of habitats present, whether they are common species or habitats or SOMC. As such, efforts made to reduce effects of the Project on vegetation and wetlands and wildlife and wildlife habitat will also support efforts to conserve biodiversity.
Heritage Resources	YES	Heritage resources have potential to occur in the Project area. Project activities (e.g., clearing, excavation) could result in changes to the environment that have potential to affect heritage resources. Although the Project will be designed to avoid ground disturbance at sites where heritage resources are known to be located, there is potential for Project-related ground disturbance to occur where previously unrecorded resources may be present. As such, heritage resources is carried forward as a VC.
Land and Resource Use	YES	The Project has the potential to result in changes to the environment that could affect the current use of lands and resources (e.g., hunting, recreational use, agriculture) within the Project area. As such, land and resources use is carried forward as a VC.
Employment and Economy	YES	The expenditures and employment associated with Project activities will affect local, regional, and provincial economic conditions through all phases of the Project. As such, employment and economy is carried forward as a VC.
Community Services and Infrastructure	YES	Project-related requirements and the influx of Project personnel could increase the demand for local services and infrastructure, thereby potentially affecting the quality or availability of these amenities (positively and negatively) for local residents and other surrounding communities. As such, community services and infrastructure is carried forward as a VC.
Human Health and Safety	NO	This component is considered through other VCs such as acoustic environment and community services and infrastructure.

4.2.2 Identification of Assessment Boundaries

Consideration of environmental effects in this EIS is conceptually bound in both time and space. This is more commonly known as defining the spatial and temporal boundaries of the assessment. The spatial and temporal boundaries may vary among VCs, depending on the nature of the potential environmental effects. The spatial boundaries must reflect the geographic range over which the Project's potential environmental effects may occur. Spatial and temporal boundaries have been developed in consideration of:

- timing/scheduling of Project activities for all Project phases
- natural variations of each VC
- the time required for recovery from an environmental effect
- potential for cumulative environmental effects

4.2.2.1 Spatial Boundaries

The spatial boundaries for the Project to be assessed are defined below with respect to Project activities and components.

Project Development Area (PDA): The PDA encompasses the immediate area in which Project activities and components may occur. As such, the PDA represents the physical Project footprint and consists of the area of physical disturbance associated with WTGs, access roads, collector lines, substation, and temporary workspaces.

Local Assessment Area (LAA): The LAA encompasses the area within which environmental effects from Project activities and components can be predicted or measured with a reasonable degree of accuracy and confidence that allows for assessment. The definition of the LAA may vary for each VC and is provided in its respective section of the EIS.

Regional Assessment Area (RAA): The RAA is the area within which residual environmental effects from Project activities and components may interact cumulatively with the residual environmental effects of other past, present, and certain or reasonably foreseeable physical activities. The definition of the RAA may vary for each VC and is provided in its respective section of the EIS.

While not formally a spatial boundary for the assessment, the Project area represents the overall planning area used in the ongoing evaluation and design phase, and within which data was collected to provide information specific to siting Project infrastructure away from sensitive features.

4.2.2.2 Temporal Boundaries

Temporal boundaries identify when an environmental effect may occur in relation to specific Project phases and activities. The temporary boundaries are based on the timing and duration of Project activities and the nature of the interactions with each VC. The temporal boundaries for the Project include the following phases:

- **Construction:** Up to 1.5 years. Peak construction activity period associated with site preparation, construction (i.e., WTG installation, access road construction, collector line installation, substation construction), reclamation of temporary workspace and commissioning. The effects assessment will focus on peak construction activity period for each VC.
- **Operation and Maintenance:** From commissioning through the life of the Project (at a minimum approximately 25 years). The effects assessment will focus on peak operational activity period for each VC.
- **Decommissioning:** A two-year period at the end of the life of the Project, comprising the removal of above-ground facilities and a portion of the foundations, abandonment in place of underground collector lines and any associated reclamation activities. As part of decommissioning, certain components will be left in place as this approach usually results in fewer environmental effects.

4.2.2.3 Administrative and Technical Boundaries

Administrative and technical boundaries have been appropriately identified for each VC. Administrative boundaries include specific aspects of provincial and federal regulatory requirements, standards, objectives, or guidelines along with regional planning initiatives relevant to the assessment of the Project's potential for environmental effects. Technical boundaries include technical limitations for the evaluation of potential environmental effects of the Project, and may include limitations in scientific and social information, data analyses, monitoring programs or interpretive methods.

4.2.3 Significance Criteria

Rating criteria are specifically defined for each VC to provide the threshold for determining the significance of residual adverse environmental effects.

- in consultation with the appropriate regulatory agency for a particular VC (where applicable)
- using information obtained in issues scoping
- using available information on the status and characteristics of each VC

- using applicable regulatory documents, environmental standards, guidelines or objectives where available
- using the professional judgment of the EA Project team

These criteria or thresholds establish a level beyond which a residual environmental effect would be considered significant (i.e., an unacceptable change). Thresholds may be based on regulations, standards, resource management objectives, scientific literature, or ecological processes (e.g., desired states for wildlife habitats or populations). Where pre-established standards or thresholds do not exist, significance criteria have been defined qualitatively and justifications for the criteria provided.

Additional analysis criteria (i.e., direction, magnitude, geographic extent, frequency, duration, reversibility, and context) are also identified and defined for each VC to support characterization of the nature and extent of residual environmental effects.

4.2.4 Existing Conditions

Existing ('baseline') environmental conditions are described for each VC. In many cases, existing conditions expressly or implicitly include those environmental effects that may be or may have been caused by other present or past projects or activities that are or have been carried out. In focusing on VCs, the description of existing conditions is at a level of detail and scope that supports the assessment of environmental effects. Information is derived from available sources, and field study and reconnaissance or analysis conducted in support of the EA. In addition, the existing conditions for the biophysical and socio-cultural and economic environment are provided at a high level to provide an overview of the setting for the Project, to support an understanding of the receiving environment, and enable an understanding of how the current environmental conditions might be affected by the Project. As appropriate, the baseline data allow for understanding of trends and changing conditions in the environment. Baseline information is limited to that which is necessary to assess the environmental effects of the Project and support recommendations for mitigation, monitoring and follow-up.

4.2.5 Potential Project-VC Interactions

For each VC, a table is prepared to identify Project components and physical activities that may interact with the VC through the identified environmental effects. Table 4-2 provides an example of the format in which the information is presented.

Table 4-2 Potential Project-VC Interaction Example Table

Project Components and Physical Activities	Potential Environmental Effects	
	Effect 1	Effect 2
Construction		
Site preparation, including clearing and grading of WTG locations, access roads, and temporary workspaces	✓	✓
Installation of WTG foundations and turbine erection	✓	✓
Installation of collector lines and substation	–	✓
Reclamation and site landscaping	✓	✓
Operation and Maintenance		
Operation of WTGs and substation, including access road use	✓	–
WTG routine and unplanned maintenance	–	✓
Routine and unplanned maintenance of collector and substation infrastructure	✓	✓
Decommissioning		
Equipment dismantling, access removal, collector and substation removal	✓	✓
Site reclamation	–	✓
NOTES: "✓" = Potential interactions that might cause an effect. –- = Interactions between the Project and VC are not expected.		

Once interactions that are likely to have effects are identified, one or more measurable parameter(s) are selected to facilitate quantitative (where possible) and qualitative measurement of potential Project effects and cumulative effects. An example includes the spatial extent of wildlife habitat that may be affected. The measurable parameter that is selected must provide defensible and acceptable means to measure the change in condition of a VC between its existing condition and its condition during the selected timeframe (e.g., during construction or during operation). The degree of change in these measurable parameters is used to help characterize Project-specific and cumulative environmental effects and to evaluate the significance of those effects.

4.2.6 Assessment of Project-related Environmental Effects

Potential Project-related environmental effects are changes to the ecological, socio-cultural and economic environments that could be caused by a project or activity arising solely as a result of the proposed physical activities associated with the Project. Potential environmental effects can be classified as adverse, neutral or positive.

As discussed in Section 4.2.5, the potential environmental effects resulting from the interactions identified in the matrix table by a check mark require further assessment for each VC. The assessment includes:

- identification of environmental effects mechanisms (i.e., identification of the means by which the Project could result in an environmental effect on the VC)
- description of the mitigation measures proposed to reduce or eliminate potential environmental effects, including industry standards, best management practices and environmental protection measures
- identification and characterization of the nature and extent of residual environmental effects (i.e., those environmental effects that remain after the proposed mitigation measures have been applied) through application of specific analysis criteria (i.e., direction, magnitude, geographic extent, frequency, duration, reversibility, and ecological and socio-economic context)
- determination of significance

Residual environmental effects are characterized for each Project phase, where applicable. The specific criteria used in the characterization of residual effects are described in Table 4-3. Where possible, the magnitude, geographic extent and duration of potential effects of specific VCs were quantified. Where these characteristics could not be expressed quantitatively, they were described using qualitative terms that are defined specifically for each VC or potential environmental effect.

Upon completion of the evaluation of environmental effects, including cumulative environmental effects, the residual adverse environmental effects are assigned an overall rating of significance for each of the Project phases, as well as accidents and malfunctions for the Project overall. Where residual environmental effects are predicted, the level of confidence of occurrence is also given for each prediction.

Table 4-3 Characterization of Residual Environmental Effects on the Environment

Characterization	Description	Quantitative Measure or Definition of Qualitative Categories
Direction	The long-term trend of the residual effect	**Positive –** a residual effect that moves measurable parameters in a direction beneficial relative to baseline. **Adverse –** a residual effect that moves measurable parameters in a direction detrimental relative to baseline. **Neutral –** no net change in measurable parameters relative to baseline.
Magnitude	The amount of change in measurable parameters or the VC relative to existing conditions	**Negligible –** no measurable change **Low –** a measurable change but [expression of a degree of change relevant to that VC] **Moderate –** a measurable change but less than high **High –** a measurable change of [expression of a degree of change relevant to that VC]
Geographic Extent	The geographic area in which a residual effect occurs	**PDA – r**esidual effects are restricted to the PDA **LAA –** residual effects extend into the LAA **RAA –** residual effects interact with those of other projects in the RAA
Duration	The period of time required until the measurable parameter or the VC returns to its existing condition, or the residual effect can no longer be measured or otherwise perceived	**Short-term –** residual effect restricted to the duration of the activity or to the construction phase **Medium-term –** residual effect extends throughout construction and up to 10 years during operation, or throughout the operation phase alone **Long-term –** residual effect extends beyond decommissioning (>25 years)
Frequency	Identifies how often the residual effect occurs and how often during the Project or in a specific phase	**Single event –** residual effect occurs once **Multiple irregular event –** residual effect occurs sporadically and intermittently **Multiple regular event –** residual effect occurs repeatedly and regularly **Continuous –** residual effect occurs continuously
Reversibility	Pertains to whether a measurable parameter or the VC can return to its existing condition after the Project activity ceases	**Reversible –** residual effect is likely to be reversed after activity completion and/or reclamation **Irreversible –** residual effect is unlikely to be reversed
Ecological and Socio-economic Context	Existing condition and trends in the area where residual effects occur	**Undisturbed –** area is relatively undisturbed or not adversely affected by human activity **Disturbed –** area has been substantially previously disturbed by human development or human development is still present

4.2.7 Assessment of Cumulative Environmental Effects

Cumulative adverse environmental effects are assessed that are predicted to result from the Project's residual effects, in combination with the potential residual effects of other past, present, or reasonably foreseeable future projects or physical activities.

Existing environmental conditions reflect cumulative effects on the environment from past projects and activities, to which the Project may incrementally add effects. The focus of the cumulative effects assessment is on future conditions. Each VC section discusses briefly how current environmental conditions were created by past and present physical activities and resource uses in their respective RAA. From that, for each VC where there is a residual effect, a description is provided of how the Project and other existing and known future projects cumulatively may affect the VC. For each of these potential cumulative effects, the mechanisms are characterized by which they may occur and change the state of the VC within the RAA relative to existing conditions.

Two conditions must be met for the Project to act cumulatively with the residual environmental impacts of other activities:

- There are residual Project-related adverse effects on the VC; and
- These residual Project-related effects act cumulatively with adverse effects of other past, present, or reasonably foreseeable future projects or physical activities.

A Project and activity inclusion list was developed that identifies other past, present, and reasonable foreseeable projects and physical activities that have residual adverse environmental effects that could overlap spatially and temporally with Project residual effects (Table 4-4). Reasonable foreseeable projects and activities are defined as those that: (a) have been publicly announced with a defined project-execution period and with sufficient project details that allow for a meaningful assessment, (b) are currently undergoing an environmental assessment; or (c) are approved (and may still be in a post-approval permitting process). Table 4-4 presents the Project and Activity Inclusion List compiled for the VC-specific RAA that has the largest extent (i.e., Employment and Economy VC; see Section 11.1.4). Any past, present, and reasonable foreseeable projects and physical activities occurring in the portion of the Heritage Resources RAA (see Section 9.1.4) that does not overlap with the Employment and Economy VC were also included in Table 4-4; the RAAs for all other VCs were located entirely within the Employment and Economy RAA. From this list, each VC will present a Project and Activity Inclusion List that represents the past, present, and reasonable foreseeable projects and physical activities that occur within their respective RAA.

A search was conducted using available data and online databases for other existing and planned future projects and physical activities (SaskPower 2017, SKMOE 2017d). Specific projects and activities that were identified for inclusion in the cumulative effects assessment as of November 13, 2017, are provided in Table 4-4.

Table 4-4 Project and Activity Inclusion List

Type of Project/Activity	Specific Project/Activity	General Location	Description
Past and Present			
Agricultural Conversion	-	-	Historical and current agricultural conversion practices, including cultivation and seeding. Current land use in the employment and economy RAA is characterized by intensive cropland agricultural activities and some range-management practices. Intensive on-going agricultural activities include ploughing, seeding, pesticide/herbicide spraying, and harvesting.
Oil and Gas Developments	-	-	Historical and current oil and gas developments.
Power Generation, Transmission and Distribution	-	-	Historical and current power generation developments (e.g., electrical transmission lines, natural gas plants, wind and solar energy facilities).
Power Generation, Transmission and Distribution	Morse Wind Farm	Morse, SK	A 23 MW wind facility, located south of Morse, SK, owned by Algonquin and operated by Liberty Power.
Power Generation, Transmission and Distribution	Centennial Wind Farm	Swift Current, SK	A 150 MW wind facility, located southeast of Swift Current, SK, owned and operated by SaskPower.
Power Generation, Transmission and Distribution	Sunbridge Wind Farm	Gull Lake, SK	An 11 MW wind facility, located southeast of Gull Lake, SK, owned and operated by SaskPower.
Power Generation, Transmission and Distribution	Cypress Wind Farm	Gull Lake, SK	An 11 MW wind facility, located southwest of Gull Lake, SK, owned and operated by a partnership between Suncor Energy Inc. and Enbridge Inc.
Recreational Activities	-	-	Historical and current use of lands for recreational purposes, including recreational hunting and trapping.
Residential Developments	-	-	Historical and current use of lands for residential development.
Resource Extraction Activities	-	-	Historical and current resource extraction activities (e.g., gravel extraction, mining).

Table 4-4 Project and Activity Inclusion List

Type of Project/Activity	Specific Project/Activity	General Location	Description
Resource Extraction Activities	Belle Plaine Potash Solution Mine	Belle Plaine, SK	The Belle Plaine potash solution mine, operated by the Mosaic Company, produces potash that is used as fertilizer.
Resource Extraction Activities	Sodium Sulphate Mine	Chaplin, SK	Saskatchewan Minerals and Mining Inc. operates the Chaplin plant that produces natural sodium.
Road Developments	-	-	Historical and current road developments (e.g., highways, gravel roads).
Future			
Agricultural Conversion	-	-	Agricultural (e.g., ploughing, seeding, pesticide/herbicide spraying, harvesting) and range management (e.g., grazing of livestock) activities occur in rural areas throughout the employment and economy RAA and is expected to continue in the future.
Oil and Gas Developments	-	-	Oil and gas exploration will continue within the employment and economy RAA depending on market conditions and land access.
Power Generation, Transmission and Distribution	-	-	Power generation activities (e.g., electrical transmission lines, natural gas plants, wind and solar energy facilities) occurs throughout the employment and economy RAA and is expected to continue in the future.
Power Generation, Transmission and Distribution	SaskPower Blue Hill Interconnection Project	Proposed Blue Hill Wind Energy Project to SaskPower Switching Station	SaskPower transmission line to be built from Blue Hill substation to a SaskPower switching station. Location and design of transmission line and switching station are not known at the time of the EIS.
Power Generation, Transmission and Distribution	Pasqua to Swift Current 230 kV Transmission Line Project	Moose Jaw to Swift Current, SK	Approximately 160 km long 230 kV and 138 kV transmission lines connecting Pasqua Switching Station with Swift Current Switching Station. The 230 kV ROW will be 40 m wide and the 138 kV ROW will be 35 m.

Table 4-4 Project and Activity Inclusion List

Type of Project/Activity	Specific Project/Activity	General Location	Description
Power Generation, Transmission and Distribution	Chinook Power Station	Swift Current, SK	A 350 MW combined cycle natural gas facility that will support the integration of renewable power generation and provide replacement power for the retirement and/or refurbishment of conventional coal-fired plants.
Power Generation, Transmission and Distribution	Potential future gas plant	Belle Plaine, SK; Grand Coulee, SK; Kronau, SK; Moose Jaw, SK	A 350 MW to 700 MW natural gas plant (size to be determined). SaskPower is currently considering four different sites.
Recreational Activities	-	-	Recreational hunting and trapping activities on Crown land and on private land where permitted by the Crown/landowner and when in season occurs within the employment and economy RAA and is expected to continue into the future.
Residential Developments	-	-	Residential developments will continue within villages, towns and cities located in the employment and economy RAA.
Resource Extraction Activities	-	-	Resource extraction activities (e.g., gravel extraction, mining) will continue within the employment and economy RAA based resource availability and demand.
Road Developments	-	-	Road development and maintenance activities occurs throughout the employment and economy RAA and is expected to continue in the future.

4.2.8 Effects of the Environment on the Project

Effects of the environment on the Project, while not identified as a VC, were also assessed. These are considered effects that the environment may have on the Project. This includes the sensitivity of the Project to variations in meteorological conditions and to natural hazards. The effects of the environment on the Project are assessed in consideration of existing and future conditions and the potential Project interactions.

The discussion of each effect of the environment on the Project includes potential Project interactions and planned design and mitigation strategies for reducing the likelihood of a significant effect on the Project, such as specifying equipment most appropriate for the Project location and setting. For example, excess icing of turbine blades may occur during extreme freezing rain conditions; however operational protocols will allow for these types of events to be anticipated and for turbines to be shut down, limiting potential damage. Similar scenarios could be expected during extremely high wind events.

4.2.9 Accidents and Malfunctions

While not identified as a VC, the environmental effects of accidents, malfunctions and unplanned events were also assessed. This evaluation focused on events that are unlikely to occur during the lifetime of the Project based on the nature of the Project and the potential Project-related effects that may occur. The evaluation also considers that the events, if they were to occur, could result in significant environmental effects even if their likelihood of occurrence is low. Although these events are rare, Project design and construction and operational protocols will be developed so that appropriate response options are developed. This could include site preparation and management practices during construction, operational monitoring and response protocols during operation.

For example, a spill of hazardous liquids such as fuel has the potential to occur. The frequency of hazardous material releases to the environment can be reduced or avoided through planned design, equipment maintenance, routine inspections, proper fueling procedures, and other mitigation measures. In addition, the availability of equipment to properly respond to the event will also be planned.

4.2.10 Follow-up and Monitoring

Follow-up and monitoring measures are described in the EIS, where applicable, to verify environmental effects predictions and/or assess planned mitigation effectiveness. Additionally, potential 'compliance monitoring' to fulfill conditions of formal approvals or legal permits, have been described, as applicable and appropriate.

5.0 ENVIRONMENTAL SETTING

Section 5.0 provides a summary of the environmental context for the Project. The region described relates to the Project area defined in Section 2.2 and depicted on Figure 1-1. The Project area represents the overall area in which the Project was sited. Sections 5.1.1 through to 5.1.10 focus on the local aspects of the existing Project conditions, specifically those aspects that are expected to have the potential for change because of the Project.

5.1 EXISTING CONDITIONS

The Project area is situated in the Mixed Grassland ecoregion with portions overlapping the Swift Current Plateau and the Chaplin Plain landscape areas (Acton et al. 1998). The Mixed Grassland ecoregion is a semiarid ecoregion found in southwestern Saskatchewan and southeastern Alberta and forms part of the Great Plains of North America. The region is composed of upper Cretaceous sediments and is covered almost entirely by kettled, loamy glacial till, undulating to dissected, loamy lacustrine sediments, and hummocky sandy eolian deposits. Soils are mainly Brown Chernozemic and Solonetzic. It is generally characterized by natural vegetation communities containing spear grass, blue grama, wheat grass, with associated species of June grass and dryland sedges, among others. Scrubby tree species typically occur to a limited extent on shaded slopes of valleys and river terraces. Approximately half the ecoregion is cultivated with annual crops; the remaining land is used for pasture and rangeland with remnant patches of natural vegetation communities undisturbed by agriculture and livestock production. This ecoregion has not been modified to the same extent as the Aspen Parkland or Moist Mixed Grassland (Acton et al. 1998).

The Project area, which is mainly cultivated land, also lies within the Missouri Coteau of the Prairie Pothole Region, which is characterized by numerous depressional wetlands that contribute substantially to the regional biodiversity. The Canadian portion of the Prairie Pothole Region is identified as Bird Conservation Region 11, which contains 341 species of birds within its 467,000 km^2 area (Environment Canada [EC] 2013). There are also an estimated 51 species of mammals and 15 reptiles and amphibians in the southern grasslands of Saskatchewan (Acton et al. 1998).

There are no large waterbodies within the Project area, though at a regional level it is located 5.0 km southwest of Reed Lake (with the nearest WTG being proposed 8 km from Reed Lake) and 4.5 km east of the Highfield Reservoir.

Further details describing regional characteristics are outlined below.

5.1.1 Atmospheric Environment

The air quality conditions are typical of a rural, agricultural environment in Saskatchewan. The air quality is good with localized periods of decreased air quality mostly due to farming (e.g., dust from exposed fields and cultivation) and road traffic (e.g., dust, vehicle exhaust). Background noise levels relate mostly to environmentally-caused noise (e.g., wind) as well as noise due to farming activities and traffic.

5.1.2 Geology, Terrain and Soils

The bedrock underlying most of the Mixed Grassland ecoregion is marine sedimentary rocks of the Bearpaw Formation (Acton et al. 1998). The Bearpaw Formation sediments typically consist of clays and shales with some deposits of bentonite (Acton et al. 1998). The majority of the Project area is in moderate (43.6%) or gentle (32.6%) slope classes that would not limit the ability of Project construction (Natural Resources Canada 2000). Only a small portion (7.1%) of the Project area consists of steep slopes with none of the Project area classed as very steep slopes.

Soils in the Project area are primarily of the Chernozemic soil order (Ayres et al. 1985). The soil agricultural capability ratings for soils in the Project area range from Class 3 to 7 with Class 4 (i.e., severe limitations) having the highest amount at 79.5% (Canada Land Inventory [CLI] 1972). Moisture limitations (subclass M) is the most frequent primary limitation to agriculture within the Project area. Lesser, but notable, portions of the Project area are limited by topography (20.1%) and stoniness (12.6%) (CLI 1972).

5.1.3 Surface Water and Groundwater

The Project area is part of the Old Wives drainage basin in Saskatchewan (Acton et al. 1998). There are no major rivers or lakes located within the Project area; however, several wetlands occur (see Section 7.0). The groundwater bedrock aquifers in the Project area are associated with the Judith River and Bearpaw formations (Acton et al. 1998). In the Project area, the aquifer vulnerability index is extremely low for both formations (Water Security Agency [WSA] 2007a, 2007b).

5.1.4 Aquatic Resources

Within the Project area, there are no fish-bearing waterbodies or watercourses (HABISask 2017a).

5.1.5 Vegetation and Wetlands

The majority of the Project area terrestrial land cover consists of cultivated land (i.e., annual cropland) (73.3%), followed by tame pasture (8.5%), hayland (7.7%), and native prairie (5.4%). There is also a relatively small amount of developed, shrubland, and exposed/barren land. The native prairie is mainly found throughout the western portion of the Project area where the more variable topography (e.g., hills and ephemeral drainage coulees) creates challenges to agricultural practices and where soils are less suitable to crop production. The native prairie patches within the Project area are generally smaller remnant patches.

Based on the Agricultural and Agri-Food Canada (AAFC; 2015a) and CanVec (Natural Resources Canada 2016) datasets, wetlands and water combined represented less than 3% of the landscape in the Project area. Average wetland polygon and water polygon sizes of those identified within the digital layers available for the Project area were 0.3 ha and 1.2 ha, respectively. Most wetlands are located in the northern and eastern portions of the Project area where the landscape has less variable topography and is suitable for smaller wetland basin formation.

The AAFC and CanVec datasets tend to underrepresent the number of wetlands on the landscape. Smaller ephemeral (Class I), temporary (Class II) and seasonal (Class III) wetlands may not hold water at the time imagery used for land cover classification is taken and are often misclassified as terrestrial land cover. There were no historical records of plant SAR and SOMC within the Project area (HABISask 2017b, 2017c).

5.1.6 Wildlife

The majority of the terrestrial component of the Project area consists of cultivated land (73.3%) with interspersed patches of developed land, wetlands and water, native prairie, shrubland, tame pasture and hayland. While agricultural land cover does provide some habitat requirements for species that use crops as food, it is less useful for breeding of birds and other wildlife due to regular disturbance of agricultural machinery, which may destroy nests and disturb young animals. The areas of natural land cover (e.g., native prairie, wetlands, shrubland, tame pasture) could provide suitable habitat to a variety of wildlife species, though there is limited extent of large contiguous blocks of suitable habitat for grassland-dependent species, such as burrowing owls (*Athene cunicularia*), ferruginous hawks (*Buteo regalis*) and Sprague's pipits (*Anthus spragueii*). Based on AAFC (2015a) there is a small portion (2.8%) of the Project area that contain wetlands and waterbodies. These would serve as habitat for waterfowl, some species of waterbirds, and amphibians, as well as water sources for terrestrial wildlife species.

The Project area does not overlap any critical habitat defined by Environment and Climate Change Canada in species recovery strategies. It also does not overlap any portions of identified Terrestrial Wildlife Habitat Inventory areas (Hart et al. 1979). This inventory database was one the earliest efforts by the Government of Saskatchewan to identify areas of importance to wildlife species of management concern and game species, and are based on land cover and habitat associations.

The Project area does not overlap any wind energy project avoidance zones identified by SKMOE (SKMOE 2017a). The nearest avoidance zone is associated with the Reed Lake Important Bird Area (IBA) which is located 7 km to the north of the Project area. Reed Lake is an IBA for staging migratory aquatic and shorebird species. There are no IBAs or large bodies of aquatic habitat directly south of the Project. The nearest IBA south of the Project area is Grasslands National Park located over 100 km away, and which is an IBA for terrestrial species. Therefore, the Project area is not situated between IBAs and in a potential regional movement corridor of birds.

Within the Project area there are no designated wildlife conservation lands. The nearest designated land (i.e., WHPA land) is located 1.6 km west of the Project area boundary.

The land cover within the Project area potentially serves as habitat for a variety of mammal, bird, amphibian, reptile, and invertebrate wildlife species typically found in the Mixed Grassland ecoregion. Wildlife SAR and SOMC in the Mixed Grassland ecoregion are included as SAR and SOMC mostly due to loss of natural land cover, particularly native prairie, that provides essential habitat to sustain populations. The portions of native prairie in the Project area (5.4%), predominantly in the southwest, may provide habitat for grassland-dependent SAR and SOMC, such as ferruginous hawks, Sprague's pipits, burrowing owls, and chestnut-collared longspurs (*Calcarius ornatus*). Reed Lake to the north of the Project area provides habitat for resident and migrant shorebird, waterbird and waterfowl, including SAR and SOMC, during migration or as a destination for breeding purposes.

There is potential for one resident bat SAR in the Project area, the little brown myotis (*Myotis lucifugus*), as well as several migratory species that may pass through the Project area between their breeding and wintering grounds. Within the Project area, nine historical occurrences of wildlife SAR and SOMC were found, all birds, six of which consisted of ferruginous hawks (*Buteo regalis*) (HABISask 2017b, 2017c). The remaining birds included barn swallow (*Hirundo rustica*), loggerhead shrike (*Lanius ludocivianus excubitorides*) and long-billed curlew (*Numenius americanus*).

5.1.7 Heritage Resources

Within the Project area boundary, there are four recorded heritage resources including two artefact/feature combinations, one artefact scatter and one possible burial (which is designated as a Site of Special Nature).

Of the 470 quarter sections entirely or partially in the Project area, 202 were identified as heritage sensitive. These quarter sections were found mainly in the western portion of the Project area where there is a greater abundance of unbroken land.

5.1.8 Land and Resource Use

The primary land use within the Project area is agriculture (89.6%) in the form of cropland, pasture and hayland for livestock production (AAFC 2015a). Natural land cover types (i.e., not used for anthropogenic purposes) combined, including terrestrial native vegetation and water or wetlands, represents a smaller proportion of the land (8.4%). There is also a small area (1.9%) of developed land, which largely represents roads and rural residential developments.

With the exception of two quarter sections, all land within the Project area is privately owned and do not have special designations or easements. There are two adjacent quarter sections (SE and SW-16-14-08-W3) of crown land located within the Project area along the southern edge that are used for pasture and hayland (HABISask 2017a).

There are six abandoned oil or gas well within the Project area, but no active wells or planned drilling activities (Saskatchewan Ministry of Economy 2017). There are 94 groundwater wells identified within the Project area that may be used as residential or livestock water sources (WSA n.d.a).

There are no named surface water bodies within the Project area that provide recreational or commercial value, such as boating or fishing.

Reed Lake is a popular location for migratory bird viewing, however, the Project area is located 7 km from the Reed Lake IBA boundary and will not affect the public's ability to use this lake for recreational purposes.

In addition to the roads identified within the Project area, there are two numbered roads where the Project may be visible by passing motorists. These include:

- Route No. 363, which passes 1 km from southwest boundary of the Project area
- Highway No. 1 approximately 2.3 km north of the Project area boundary

5.1.9 Employment and Economy

The Project area overlaps two RMs, Morse (No. 165) and Lawtonia (No. 135). The population of the RM of Morse, exclusive of towns, was 401 in 2011, which is a 7.8% reduction from the 2006 census count of 435. The RM of Lawtonia, however, saw a 22% population increase from 2006 (n = 356) to 2011 (n = 434) (Statistics Canada 2016).

There are no communities located within the identified Project area. Nearby communities and the closest major centers are Herbert, Morse, Hodgeville and Swift Current (Statistics Canada 2016).

5.1.10 Community Services and Infrastructure

With the exception of agricultural infrastructure, there are no industrial developments within the Project area. The nearest high-voltage transmission line to the Project traverses the northernmost quarter section of the Project area. Throughout most of the Project area there is a network of developed grid roads. There are also several numbered provincial roads, including:

- Route No. 720, which transects the Project area in the southern portion
- Route No. 612 that transects the western portion of the Project area
- Highway No. 19 directly adjacent to the east boundary of the Project area

6.0 ASSESSMENT OF POTENTIAL EFFECTS ON ACOUSTIC ENVIRONMENT

The Acoustic Environment is a VC because activities during construction, operation and maintenance, and decommissioning of the Project will generate noise. For the purposes of the EIS, noise is considered unwanted sound and has the potential to affect the health and well-being of humans. This section of the EIS defines and describes the scope of the assessment of potential effects on the acoustic environment and focuses on human receptors at residential locations during the operation and maintenance phase.

Noise effects on wildlife are assessed in Section 8.0.

6.1 SCOPE OF ASSESSMENT

6.1.1 Regulatory and Policy Setting

There is no wind power generation noise regulation in the Province of Saskatchewan. As such, in the absence of provincial guidance or regulations, assessment of the acoustic environment in the EIS uses the Ontario Ministry of the Environment and Climate Change (MOECC) *Noise Guidelines for Wind Farms* (MOECC 2016) level of 40 dBA sound level limit (SLL) to determine a significant adverse effect threshold. The SLL of 40 dBA for a Class 3 area is the most stringent in the guideline. A Class 3 area is defined as a rural area with an acoustical environment that is dominated by natural sound having little or no road traffic, such as a small community and agricultural area. The entirety of the PDA and LAA is considered to be a Class 3 area in this assessment.

Other relevant assumptions appropriate for a prairie environment were also used during modeling of the potential acoustic effects and are stated in the Noise Impact Assessment (see Appendix E).

6.1.2 Consideration of Issues Raised during Engagement

To date, no concerns related to the acoustic environment have been raised during engagement with regulators, stakeholders, community members and Indigenous groups.

6.1.3 Potential Effects, Pathways and Measurable Parameters

The key issues and concerns pertaining to the acoustic environment assessment are potential effects from Project activities that may result in a change in the existing acoustic environment.

The measurable parameter for noise used for assessing change in the existing acoustic environment is the one hour equivalent sound level ($L_{eq,1HR}$). Table 6-1 summarizes the potential effect, measurable parameter(s), and rationale for their selection.

Table 6-1 Potential Effects, Effects Pathways and Measurable Parameters for Acoustic Environment

Potential Environmental Effect	Effect Pathway	Measurable Parameter(s) and Units of Measurement
Change in existing acoustic environment	Project noise emission can have potential annoyance effects on human receptors	A-weighted one hour equivalent sound pressure level $L_{eq,1HR}$ (dBA)

6.1.4 Boundaries

6.1.4.1 Spatial Boundaries

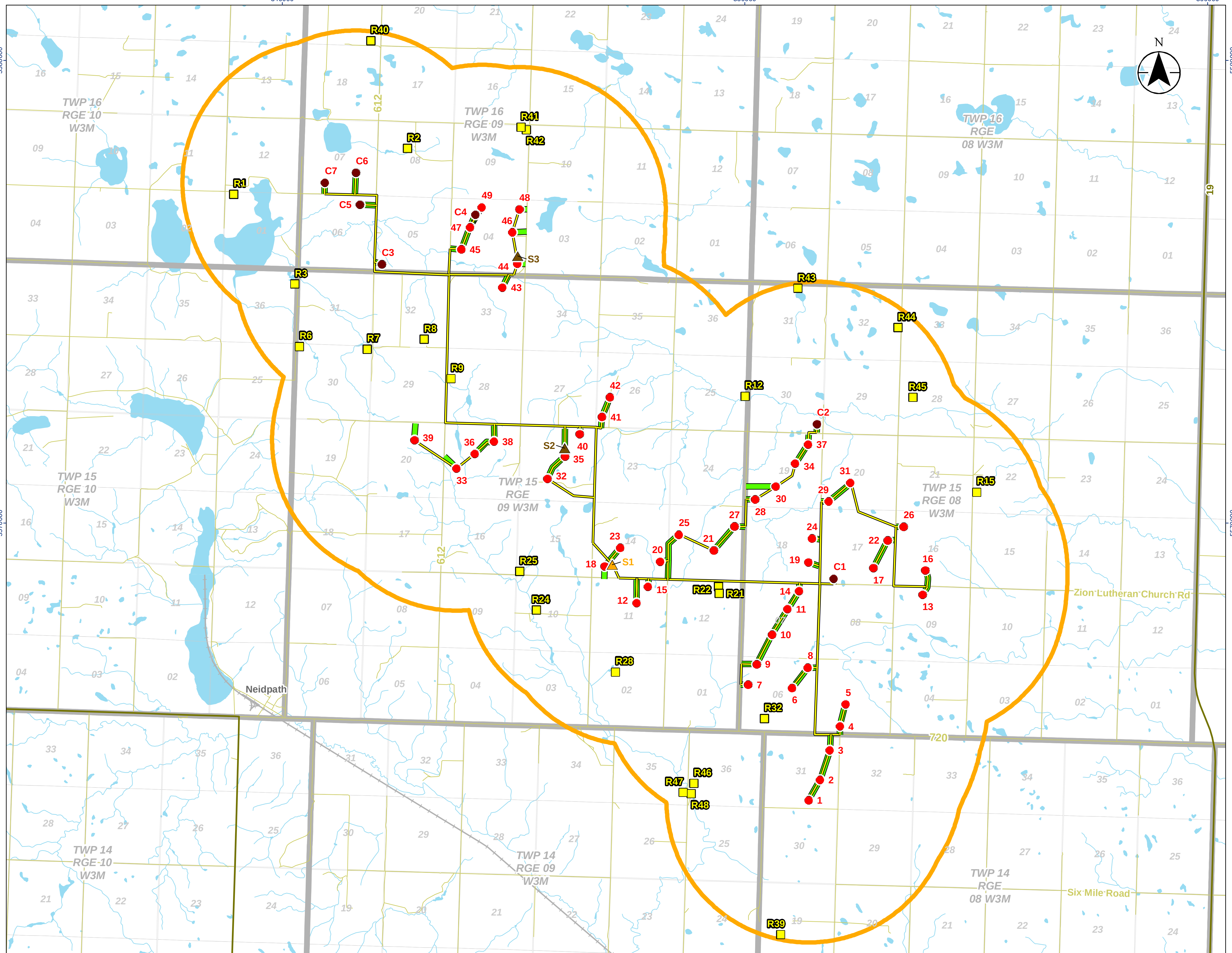
The spatial boundaries for the acoustic environment assessment are as follows:

Project Development Area (PDA): The PDA is represented by the physical Project footprint and consists of the area of physical disturbance associated with Project components, i.e., WTGs, access roads, collector lines, substation and temporary workspaces.

Local Assessment Area (LAA): The LAA is defined as a 3 km buffer around the Project PDA as this area encompasses Project-related noise emissions. This boundary was determined, based on professional judgement and a conservative approach, to be a sufficiently large area to capture all receptors that may be affected by the Project.

There is no Regional Assessment Area (RAA) defined for the acoustic environment as the MOECC *Noise Guidelines for Wind Farms* (MOECC 2016) considers Project-only noise effects; therefore, there are no cumulative noise effects to consider and the LAA is sufficient for the assessment of potential effects on the acoustic environment.

There are 25 residential receptors identified within the LAA. Figure 6-1 shows the receptor locations, Project layout (i.e., locations of WTGs, substations, access roads and collector lines), and LAA.



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Stantec Algonquin

- Noise Receptor
- Noise Local Assessment Area

Proposed Project Layout

- Wind Turbine Generator
- Contingency Wind Turbine Generator
- Substation
- Contingency Substation
- New Build Permanent Access Road
- New Electrical Collector Line
- Major Road
- Minor Road
- Railway
- Watercourse
- Waterbody
- Township
- Section

0 0.85 1.7 2.55 3.4 Kilometers

1:85,000 (At original document size of 11x17)

Notes

1. Coordinate System: NAD 1983 UTM Zone 13N
2. Base features produced under license with the Government of Saskatchewan and the Government of Canada
3. Layout: Algonquin, Sept 06, 2017, V3
4. Receptors: Field Validated by Stantec/Algonquin, 2017

Project Location
Near Herbert, SK

113254088-027 REVE
Prepared by acory on 2017-12-18
Technical Review by jchui on 2017-12-18

Client/Project
Algonquin Power Co.
Blue Hill Wind Energy Project

Figure No.
6-1

Title
Noise Local Assessment Area and Receptor Locations

6.1.4.2 Temporal Boundaries

Temporal boundaries have been established by determining the period of time over which the effects of the Project are to be considered. Each of the Project phases is defined as follows:

- **Construction:** Up to 1.5 years. Peak construction activity period associated with site preparation, construction (i.e., WTG installation, access road construction, collector line installation, substation construction), reclamation of temporary workspace and commissioning.
- **Operation and Maintenance:** From commissioning through the life of the Project (at a minimum approximately 25 years).
- **Decommissioning:** A two-year period at the end of the life of the Project, comprising the removal of above-ground facilities and a portion of the foundations, abandonment in place of the collector lines, and any associated reclamation activities. As part of decommissioning, certain components will be left in place as this approach usually results in fewer environmental effects.

The Project operation and maintenance phase is included in the acoustic environment assessment.

6.1.4.3 Administrative and Technical Boundaries

There are no established or regulated administrative and technical boundaries for completing a noise assessment for a wind project in Saskatchewan. In this absence, an overall approach to the noise assessment is used as described in Section 6.1.1.

6.1.5 Residual Effects Characterization

Terms used to characterize the residual environmental effects on acoustic environment are summarized in Table 6-2.

Table 6-2 Characterization of Residual Effects on Acoustic Environment

Characterization	Description	Quantitative Measure or Definition of Qualitative Categories
Direction	The long-term trend of the residual effect	**Positive –** a residual effect that moves measurable parameters in a direction beneficial to acoustic environment relative to baseline. **Adverse –** a residual effect that moves measurable parameters in a direction detrimental to acoustic environment relative to baseline. **Neutral –** no net change in measurable parameters for the acoustic environment relative to baseline.
Magnitude	The amount of change in measurable parameters or the VC relative to existing conditions	**Low –** Project noise level below or equal to the noise guideline sound level limit of 40 dBA at the receptor **High –** Project noise level above the noise guideline sound level limit of 40 dBA at the receptor
Geographic Extent	The geographic area in which a residual effect occurs	**PDA –** residual effects are restricted to the PDA **LAA –** residual effects extend into the LAA
Duration	The period of time required until the measurable parameter or the VC returns to its existing condition, or the residual effect can no longer be measured or otherwise perceived	**Short-term –** residual effect restricted to construction phase **Medium-term –** residual effect extends through the operation and maintenance phase **Long-term –** residual effect extends beyond the life of the project
Frequency	Identifies how often the residual effect occurs and how often during the Project or in a specific phase	**Single event –** occurs once throughout assessment period **Multiple irregular event –** occurs at no set schedule **Multiple regular event –** occurs at regular intervals **Continuous –** occurs continuously
Reversibility	Pertains to whether a measurable parameter or the VC can return to its existing condition after the project activity ceases	**Reversible –** the residual effect is likely to be reversed after activity completion and reclamation **Irreversible –** the residual effect is unlikely to be reversed
Ecological and Socio-economic Context	Existing condition and trends in the area where residual effects occur	**Undisturbed –** area is relatively undisturbed or not adversely affected by human activity **Disturbed –** area has been substantially previously disturbed by human development or human development is still present

6.1.6 Significance Definition

A significant adverse environmental effect on acoustic environment is Project noise level that exceeds the noise guideline sound level limit of 40 dBA at any receptor within the LAA.

6.2 EXISTING CONDITIONS FOR ACOUSTIC ENVIRONMENT

The existing acoustic environment condition is quantified by the ambient sound level at a receptor location. Ambient sound level at a receptor within the LAA can vary from location to location, depending on the time of day, level of local activities, and proximity to traffic infrastructure.

6.2.1 Methods

Permanent or seasonal residential dwellings are considered as receptors. Based on information available from Algonquin and field observations by Stantec staff, 25 receptors were identified within the LAA.

The MOECC noise guideline does not provide any guidance related to the ambient sound level for receptors in different area classifications. However, the noise guideline *Directive 038: Noise Control* from the Alberta Energy Regulator (AER 2007) and Health Canada's *Guidance for Evaluating Human Health Impacts in Environmental Assessment: Noise* (Health Canada 2017) provide an estimation of ambient sound level based on qualitative description of community characteristics and population. Information provided in the Alberta and Health Canada noise guidelines is used to provide an understanding of ambient sound levels in a rural environment similar to the LAA.

6.2.2 Results

The Alberta noise guideline recommends daytime ambient sound levels of 45 dBA and nighttime ambient sound level of 35 dBA for areas similar to Class 3 (i.e., rural) defined in the MOECC guideline. Daytime is the time period from 7:00 AM to 10:00 PM and nighttime is from 10:00 PM to 7:00 AM.

The Health Canada noise guidance recommends a day-night equivalent sound level (L_{dn}) of 45 dBA for a quiet rural area. The L_{dn} is a 24-hour time-averaged sound level, which includes a +10 decibels adjustment during the nighttime as a penalty for sounds occurring during the night period. As such, the L_{dn} value of 45 dBA from the Health Canada noise guidance is consistent with the daytime ambient sound level recommended by the Alberta noise guideline and is likely representative of the existing acoustic environment in the LAA.

6.3 PROJECT INTERACTIONS WITH ACOUSTIC ENVIRONMENT

Table 6-3 identifies, for the potential effect, the project physical activities that might interact with the VC and result in the identified environmental effect. These interactions are indicated by a check mark and are discussed in detail in Section 6.4, in the context of effects pathways, standard and project-specific mitigation/enhancement, and residual effects. A justification for no effect is provided following the table.

Table 6-3 Project-Environment Interactions with Acoustic Environment

Physical Activities	Environmental Effects
	Change in Existing Acoustic Environment
Construction	
Site preparation, including clearing and grading of WTG locations, access roads and temporary workspaces	–
Installation of WTG foundations and WTG erection	–
Installation of collector lines and substation	–
Reclamation and site landscaping	–
Operation and Maintenance	
Operation of the WTGs and substation, including access road use	✓
WTG routine and unplanned maintenance	–
Routine and unplanned maintenance of collector and substation infrastructure	–
Decommissioning	
Equipment dismantling, access removal, collector and substation removal	–
Site reclamation	–
NOTES: ✓ = Potential interaction – = No interaction	

Construction phase noise emissions are expected to be transient in nature and occur only for short intervals. These interactions will be addressed through standard industry and best management practices. As such, construction-related noise effects are not carried forward in this assessment.

Maintenance activities associated with the WTG operation are also expected to be short and transient in nature. Therefore, noise effects due to maintenance activities are not carried forward in the assessment.

Activities associated with decommissioning are considered to have negligible interaction with the acoustic environment. The type of equipment required for the decommissioning process is expected to be similar to the requirement for the construction phase, thus noise effects exceeding acceptable levels are not expected. Noise effects during the decommissioning activities can be managed to acceptable levels using best management practices and, as a result, no further assessment is warranted for decommissioning activities.

6.4 ASSESSMENT OF RESIDUAL ENVIRONMENTAL EFFECTS ON ACOUSTIC ENVIRONMENT

Project effects on the acoustic environment are evaluated by modelling the Project noise effect during operation and comparing predicted sound levels to thresholds. Only the WTGs and substation noise emissions during operation are assessed, as described in Section 6.3, because they are the project components that emit noise. The analytical methods used to assess this effect are described and the residual effects characterization is provided.

6.4.1 Analytical Assessment Techniques

The Project includes the operation of 49 WTGs and one substation. As a conservative approach, seven contingency WTGs and two contingency substations are considered for the operation phase. Therefore, a maximum of 56 WTGs and three substations are included in the project assessment for each VC. For the purpose of the acoustic environment assessment, and to be conservative, all WTGs are assumed to be Vestas model V136 3.6 MW with serrated blades with a hub height of 105 m. The WTGs will be operating in the standard P01 mode. The substation transformer is assumed to be a 200 MVA transformer operating in Oil Natural Air Forced (ONAF) mode.

The noise emission levels of the WTG were based on manufacturer's information. The transformer noise emission levels were based on acoustic engineering literature (Crocker 2007). Noise emissions were used in the acoustic models to predict the Project noise effect at the receptors within the LAA. Noise prediction was conducted using Cadna/A acoustic modeling software (DataKustik 2017), based on the internationally accepted sound propagation algorithms (International Organization for Standardization [ISO] 1993, 1996).

The predicted sound levels at all receptors within the LAA are compared to the SLL prescribed in the MOECC noise guideline (MOECC 2016). The SLL is at or below 40 dBA for all receptors within the LAA.

Details on the noise emission levels and modelling input are presented in the Noise Impact Assessment (see Appendix E).

6.4.2 Change in Existing Acoustic Environment

6.4.2.1 Project Pathways

In the operation phase, noise emitted from the WTGs and substation may result in a change in the existing acoustic environment within the LAA.

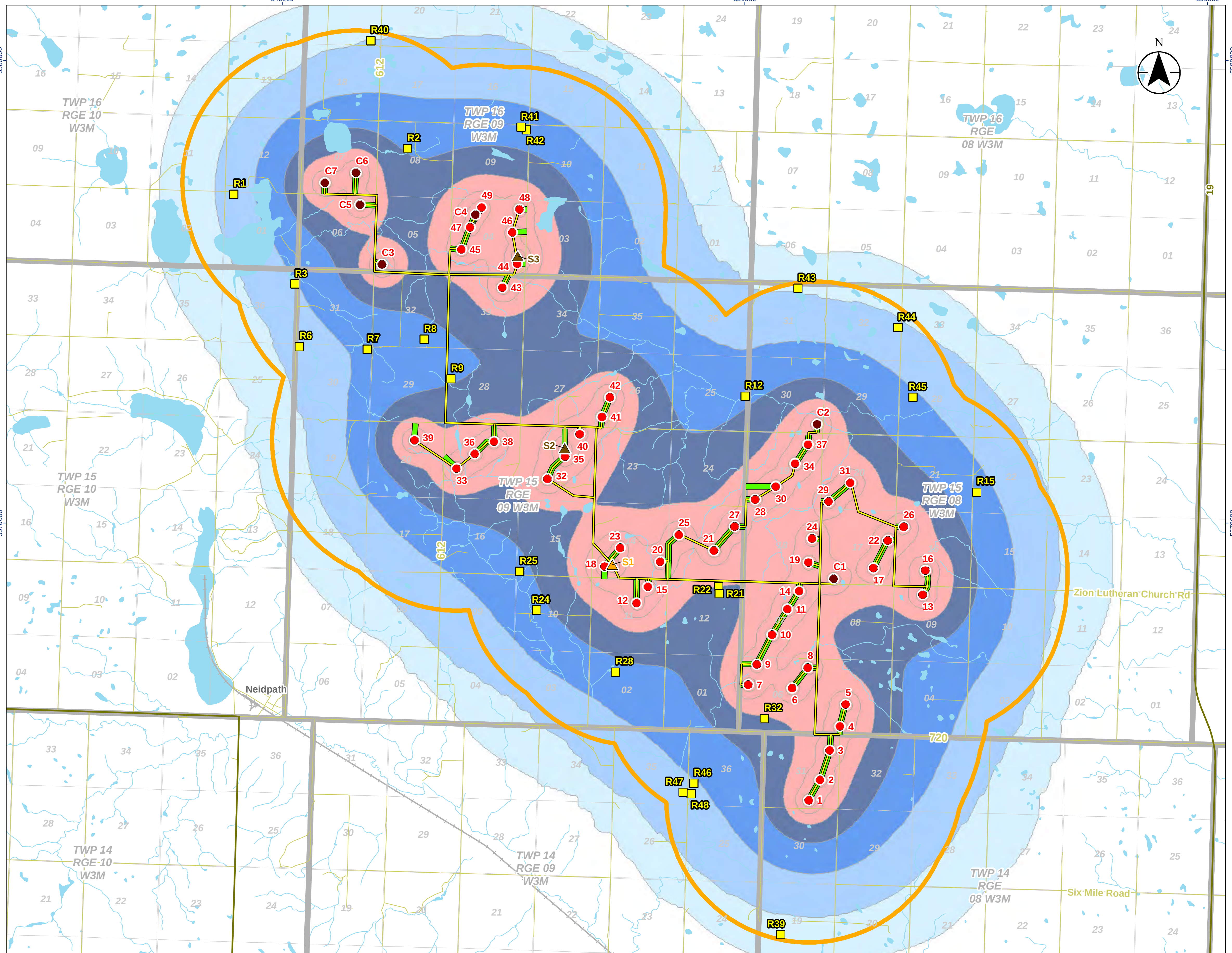
6.4.2.2 Mitigation

Several mitigation measures (see Sections 2.2 and 2.8) have already been implemented as part of the design and siting of the Project.

6.4.2.3 Project Residual Effect

Table 6-4 summarizes the predicted Project noise level ($L_{eq,1HR}$) at all receptors within the LAA. Figure 6-2 presents the Project only noise contour results within the LAA. The acoustic model assumes that all WTGs and substation transformers are operating continuously during both the daytime and nighttime period; therefore, prediction results are the same for both periods. R22 is the receptor location with the highest predicted noise level of 40.0 dBA, it is located approximately 800 m from the closest WTG (ID#21). The results indicate that the Project noise effect is at or below the SLL of 40 dBA at all receptor locations.

- Direction is **neutral**
  - There will be no net change in measurable parameters for the acoustic environment relative to baseline.
- Magnitude is **low**
  - The Project noise level is below or equal to the noise guideline sound level limit of 40 dBA at each receptor.
- Geographical extent is the **LAA**
  - The residual effects on the acoustic environment extend into the LAA.
- Duration is **medium-term**
  - The residual effect extends through the operation and maintenance phase.
- Frequency is **multiple irregular events**
  - The effect occurs at no set schedule.
- The effect is **reversible**
  - The effect on the acoustic environment is reversed when the activity ceases.
- Ecological and socio-economic context is **disturbed**
  - The area has been substantially previously disturbed by human development.



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Stantec Algonquin

- Noise Receptor
- Noise Local Assessment Area

Noise Contour
- 20 to 25 dBA
- 25 to 30 dBA
- 30 to 35 dBA
- 35 to 40 dBA
- Greater than 40 dBA

Proposed Project Layout
- Wind Turbine Generator
- Contingency Wind Turbine Generator
- Substation
- Contingency Substation
- New Build Permanent Access Road
- New Electrical Collector Line
- Major Road
- Minor Road
- Railway
- Watercourse
- Waterbody
- Township
- Section

0 0.85 1.7 2.55 3.4 Kilometers

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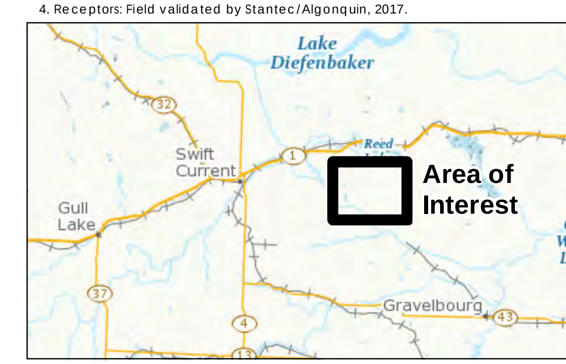
Notes
1. Coordinate System: NAD 1983 UTM Zone 13N
2. Base features produced under license with the Government of Saskatchewan and the Government of Canada
3. Layout: Algonquin, Sept 06, 2017, V3
4. Receptors: Field validated by Stantec/Algonquin, 2017.



Project Location
Near Herbert, SK

113254088-028 REVE
Prepared by acory on 2017-12-18
Technical Review by jchui on 2017-12-18

Client/Project
Algonquin Power Co.
Blue Hill Wind Energy Project

Figure No.
6-2

Title
Predicted Leq Noise Contour Map - Project Only

Table 6-4 Project Noise Level at all Receptors within the LAA

Receptor ID[1]	Predicted Noise Level (dBA)
R22	40.0
R32	39.6
R21	39.4
R9	34.9
R2	34.7
R12	34.1
R25	34.3
R8	33.9
R24	33.9
R28	33.6
R42	32.5
R41	32.4
R15	31.7
R7	31.4
R45	30.6
R3	29.9
R46	29.6
R48	28.9
R47	28.3
R6	27.1
R1	27.0
R44	26.0
R40	25.1
R43	24.6
R39	22.6

NOTE:

[1] Receptors R43 and R47 were identified by examining satellite imagery and were not field verified.

6.4.3 Summary of Project Residual Environmental Effects

Table 6-5 summarizes the Project residual environmental effects on the acoustic environment.

Table 6-5 Project Residual Effects on Acoustic Environment

Residual Effect	Residual Effects Characterization							
	Project Phase	Direction	Magnitude	Geographic Extent	Duration	Frequency	Reversibility	Ecological and Socio-economic Context
Change in Existing Acoustic Environment	O	N	L	LAA	MT	IR	R	D

KEY

See Table 6-2 for detailed definitions

Project Phase
C: Construction
O: Operation and Maintenance
D: Decommissioning

Direction:
P: Positive
A: Adverse
N: Neutral

Magnitude:
L: Low
H: High

Geographic Extent:
PDA: Project Development Area
LAA: Local Assessment Area

Duration:
ST: Short-term;
MT: Medium-term
LT: Long-term

N/A: Not applicable

Frequency:
S: Single event
IR: Irregular event
R: Regular event
C: Continuous

Reversibility:
R: Reversible
I: Irreversible

Ecological/Socio-Economic Context:
D: Disturbed
U: Undisturbed

6.5 ASSESSMENT OF CUMULATIVE ENVIRONMENTAL EFFECTS ON ACOUSTIC ENVIRONMENT

There are no cumulative noise effects from past projects and activities because the effects cease after the activities are completed and there is no temporal overlap with Project noise. The overall cumulative noise level at some receptors within the LAA may increase as a result of current and reasonably foreseeable future projects and activities. However, there are no quantitative limits in the MOECC noise guideline that are applicable to the overall cumulative noise level. The noise guideline is applicable to the Project only. Therefore, the assessment of cumulative effects is not carried forward.

6.6 DETERMINATION OF SIGNIFICANCE

6.6.1 Significance of Project Residual Effects

The residual environmental effects on acoustic environment are predicted to be not significant given no exceedance of the applicable guideline requirements.

6.6.1.1 Project Contribution to Cumulative Effects

The Project may result in a cumulative change in noise level at some receptors within the LAA. However, the noise effects at all receptors within the LAA meet the SLL recommended in the MOECC noise guidance.

6.7 PREDICTION CONFIDENCE

Overall, prediction accuracy depends on several factors, including the accuracy of the noise source data and the accuracy of the sound propagation algorithm.

The Cadna/A model predicts outdoor noise in accordance with ISO 9613 (ISO 1993, 1996), as well as several international and European acoustic standards. The ISO 9613 sound propagation algorithms have a published accuracy of ± 3 dB over source receiver distances between 100 and 1,000 m. The accuracy for distances up to or over 1.5 km is not stated. The ISO 9613 model also produces results representative of meteorological conditions enhancing sound propagation (e.g., downwind and temperature inversion conditions). These conditions do not occur all the time; therefore, model predictions are expected to be conservative.

Conservative assumptions regarding the Project include the following:

- Contingency WTGs and substation locations included in the noise modelling
- Application of manufacturer information that includes engineering design safety factor

- Downwind conditions exist 100% of the time
- All normally operated equipment operates at full capacity during the daytime and nighttime period

6.8 FOLLOW-UP AND MONITORING

The Project will not result in operation noise effects that are expected to exceed the limits prescribed in the MOECC noise guidance. Therefore, no follow-up and monitoring programs are proposed.

7.0 ASSESSMENT OF POTENTIAL EFFECTS ON VEGETATION AND WETLANDS

7.1 SCOPE OF ASSESSMENT

Vegetation and wetlands was selected as a VC because the Project activities have the potential to change plant species diversity (including native plant species and non-native invasive species), vegetation community diversity, and wetland area and function. Native plant species including species at risk (SAR) and plant species of management concern (SOMC), native vegetation types, and wetlands are important to the function of natural ecosystems. They also provide habitat for wildlife (see Section 8.0), maintain biodiversity, and support human activities such as recreational activities (see Section 10.0).

7.1.1 Regulatory and Policy Setting

7.1.1.1 Federal Regulatory Requirements

The *Species at Risk Act* (SARA) is one part of a three-part Government of Canada strategy for the protection of plant SAR (Government of Canada 2002), and applies to all species listed on Schedule 1 and their critical habitat, as designated in SARA species recovery plans. The other two parts of this strategy include commitments under the National Accord for the Protection of SAR (Government of Canada 1996) and activities under the Habitat Stewardship Program for SAR (Government of Canada 2017a), which protect SAR on federal land and focuses on SAR recovery projects. The Committee on the Status of Endangered Wildlife in Canada (COSEWIC) assesses and designates the status of species, including plants, and recommends this designation for legal protection under SARA (COSEWIC 2017). Under SARA, it is forbidden to kill, injure, harass, destroy the residence of, destroy the critical habitat of, capture or take an individual designated as *extirpated*, *endangered*, or *threatened* on federally-regulated lands or designated critical habitat elsewhere. On lands under provincial authority, SARA goals are typically reflected through provincial legislation, policy, and guidelines.

7.1.1.2 Provincial Regulatory Requirements

The Wildlife Act (Government of Saskatchewan 1998) provides protection for listed plant SAR and the *Wild Species at Risk Regulations* (Government of Saskatchewan 1999) lists plant species as *endangered* or *threatened,* which all have a setback of 300 m year-round according to the Saskatchewan Activity Restriction Guidelines for Sensitive Species (SKMOE 2017b).

The Saskatchewan Conservation Data Centre (SKCDC) ranks plant SOMC based on their extirpation risk as S1 (critically imperiled/extremely rare), S2 (imperiled/very rare), and S3 (vulnerable/rare to uncommon) (SKCDC 2017a), which all have a setback of 30 m year-round (SKMOE 2017b).

The *Weed Control Act* (Government of Saskatchewan 2010b) lists select non-native invasive species as prohibited, noxious, or nuisance weed species. Landowners must notify the occupants and municipality, or the weed inspector for the municipality, if any weed species are detected and agree to control or eradicate the weed occurrence(s) (Government of Saskatchewan 2010c). The regulatory objective is to prevent invasion to uninfected areas (Brenzil 2010). Some municipalities have developed lists of additional plant species that must be eradicated or controlled within their jurisdictions beyond those listed by the *Weed Control Act*.

The Saskatchewan WSA manages wetlands in Saskatchewan through policies described in the *Environmental Management and Protection Act* (Government of Saskatchewan 2010a). Alteration to the configuration of the bed, bank, or boundary of any river, stream, lake, creek, marsh, or other watercourse or water body in Saskatchewan, including removal of any material or vegetation, requires an Aquatic Habitat Protection Permit from the WSA prior to construction.

7.1.2 Consideration of Issues Raised during Engagement

During engagement meetings with NGOs, concerns were raised regarding the potential effects of the Project on native prairie and having adequate setbacks to protect sensitive vegetation areas. These concerns were addressed during meetings with PPPI, the Saskatchewan Environmental Society and Nature Saskatchewan and are summarized in Table 3-3 of Section 3.4.3. Discussed further in Section 7.4.2, Algonquin is currently adhering to provincial guidelines by siting the Project outside of the 30 m setback for plant SOMC as outlined in the Saskatchewan Activity Restriction Guidelines (SKMOE 2017b). The assessment of potential residual environmental effects on vegetation community diversity is discussed in Section 7.4.3.

7.1.3 Potential Effects, Pathways and Measurable Parameters

Project activities could affect plant species diversity including plant SAR and SOMC, vegetation community diversity including native vegetation types, and wetland area and function. Plant SAR include species listed federally by SARA and COSEWIC or provincially by the *Wildlife Act*. Plant SOMC include species provincially ranked S1, S2, and S3 by the SKCDC.

The loss of native vegetation types is a concern for maintaining biodiversity, particularly SAR and SOMC, and wildlife habitat. For the purpose of this assessment, native vegetation types are defined as native prairie, tame pasture, shrubland, wetlands, drainages, and broadleaf forest. Tame pasture was included in native vegetation types because it is potential habitat for plant SOMC and it can contain an understory of native plant species. Due to the lack of native vegetation remaining in Canada, any loss of native vegetation is correlated with an increase in the number of SAR per ecozone because of the loss of habitat (Kerr and Deguise 2004). Moreover, the amount of native vegetation remaining in the prairies is limited with over 97% of the prairie ecozone modified by permanent human land uses (Kerr and Deguise 2004). The major cause of the historical loss of native vegetation is agricultural conversion (Kerr and Deguise 2004). Threats to continuing survival or recovery of SAR and SOMC include non-native invasive species invasion, woody plant species encroachment, lack of grazing, changes in fire regime, and modification from human activity including recreation (Henderson 2011).

The Project is in the Prairie Pothole Region which is characterized by numerous ephemeral to semi-permanently flooded wetlands scattered across the landscape due to the shallow depressions remaining after glaciers receded. Wetlands provide important ecological functions, wildlife habitat, potential habitat for plant SAR and SOMC, and potential socio-economic values.

Effect pathways and measurable parameters for each potential environmental effect in the assessment of vegetation and wetlands are presented in Table 7-1.

Table 7-1 Potential Effects, Effects Pathways and Measurable Parameters for Vegetation and Wetlands

Potential Environmental Effect	Effect Pathway	Measurable Parameter(s) and Units of Measurement
Change in plant species diversity	• Direct loss or alteration of SAR and SOMC arising from vegetation clearing and ground disturbance • Introduction and/or spread of non-native invasive plant species through vegetation clearing and equipment/vehicle use	• Number and location of occurrences and population attributes of federally- or provincially-listed plant SAR and SOMC • Number and location of occurrences and population attributes of non-native invasive plant species
Change in vegetation community diversity	• Direct loss or alteration of native vegetation types arising from vegetation clearing and ground disturbance	• Areal extent (ha) of native vegetation types (i.e., native prairie) lost or altered
Change in wetland area and function	• Direct loss or alteration of wetland area and function from vegetation clearing and ground disturbance	• Areal extent (ha) of wetlands (by class) lost or altered

7.1.4 Boundaries

7.1.4.1 Spatial Boundaries

The spatial boundaries for the vegetation and wetlands assessment are defined by areas that could be directly or indirectly affected by the Project:

- **Project Development Area (PDA):** The PDA is represented by the physical Project footprint and consists of the area of physical disturbance associated with Project components, i.e., WTGs, access roads, collector lines, substation, and temporary workspaces.
- **Local Assessment Area (LAA):** The LAA consists of the PDA and a 300 m buffer, which is the largest setback for SAR and SOMC according to the Saskatchewan Activity Restriction Guidelines for Sensitive Species (SKMOE 2017b). The LAA is the area in which the Project activities could have direct or indirect effects on vegetation and wetlands.
- **Regional Assessment Area (RAA)**: The RAA consists of the PDA and a 10 km buffer. The RAA was considered large enough to characterize regional vegetation and wetland patterns on the landscape and to assess the Project's contributions to cumulative effects. In addition, this RAA is consistent with that of the wildlife and wildlife habitat VC (see Section 8.0).

See Figure 7-1 for the vegetation and wetlands spatial boundaries.

7.1.4.2 Temporal Boundaries

The period during which effects on vegetation and wetlands are assessed within each of the Project phases is defined as follows:

- **Construction:** Up to 1.5 years. Peak construction activity period associated with site preparation, construction (i.e., WTG installation, access road construction, collector line installation, substation construction), reclamation of temporary workspace and commissioning.
- **Operation and Maintenance:** From commissioning through the life of the Project (at a minimum approximately 25 years).
- **Decommissioning:** A two-year period at the end of the life of the Project, comprising the removal of above-ground facilities and a portion of the foundations, abandonment in place of the collector lines, and any associated reclamation activities. As part of decommissioning, certain components will be left in place as this approach usually results in fewer environmental effects.

Project Development Area

Vegetation and Wetlands Local Assessment Area

Vegetation and Wetlands Regional Assessment Area

Major Road

Minor Road

Railway

Watercourse

Waterbody

Town/City

Township

0 3 6 Kilometers

1:250,000 (at original document size of 8.5x11)

Stantec Algonquin

Notes

1. Coordinate System: NAD 1983 UTM Zone 13N
2. Base features produced under license from the Government of Saskatchewan and the Government of Canada.
3. Project Development Area based on Algonquib layout Sept 06, 2017, V3.

Project Location
Near Herbert, SK

113254088-018 REVF
Prepared by acory on 2017-12-18
Technical Review by ceidem on 2017-12-18

Client/Project
Algonquin Power Co.
Blue Hill Wind Energy Project

Figure No.
7-1

Title
Vegetation and Wetlands Assessment Areas

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7.1.4.3 Administrative and Technical Boundaries

Administrative boundaries to the assessment of Project effects on vegetation and wetlands are as follows:

- The federal SARA and regulations (Government of Canada 2002)
- Federal recovery plans, action plans, and management plans for SAR
- The provincial *Wildlife Act* (Government of Saskatchewan 1998), the *Wild Species at Risk Regulations* (Government of Saskatchewan 1999), the *Weed Control Act* (Government of Saskatchewan 2010b), and the *Weed Control Regulations* (Government of Saskatchewan 2010c)
- Provincial species rankings from the SKCDC (SKCDC 2017a)
- Wildlife siting guidelines for Saskatchewan Wind Energy Projects (SKMOE 2017a) avoidance zones
- Saskatchewan Activity Restriction Guidelines for Sensitive Species (SKMOE 2017b)
- Provincial Species Detection Survey Protocols for Rare Vascular Plant Surveys (SKMOE 2017e)

7.1.5 Residual Effects Characterization

Terms used to characterize the residual environmental effects on vegetation and wetlands are summarized in Table 7-2.

Table 7-2 Characterization of Residual Effects on Vegetation and Wetlands

Characterization	Description	Quantitative Measure or Definition of Qualitative Categories
Direction	The long-term trend of the residual effect	**Positive** - an increase in the number and distribution of plant SAR and SOMC, expansion of area of native vegetation types, decrease in number and distribution of non-native/invasive plant species, or increase in wetland area and function **Adverse** - a decrease in the number and distribution of plant SAR and SOMC, decrease in area of native vegetation types, increase in number and distribution of non-native/invasive plant species, or decrease in wetland area and function **Neutral** - no net change in measurable parameters from baseline conditions and trends

Table 7-2 Characterization of Residual Effects on Vegetation and Wetlands

Characterization	Description	Quantitative Measure or Definition of Qualitative Categories
Magnitude	The amount of change in a measurable parameter or variable relative to existing conditions	**Negligible** - no measurable change in vegetation and wetland measurable parameters **Low** - Project is unlikely to have a measurable effect on the number and distribution of plant SOMC, native vegetation types, non-native/invasive species, or wetland area and function in the LAA, although temporary shifts in distributions might occur. **Moderate** - Project has an effect on the number and distribution of plant SOMC, native vegetation types, non-native/invasive species, or wetland area and function in the LAA, but it is unlikely to have a measurable effect in the RAA **High** - Project has any effect on SAR. Project has an effect on the number and distribution of plant SOMC, native vegetation types, non-native/invasive species, or wetland area and function in the RAA
Geographic Extent	The geographic area in which a residual effect occurs	**PDA** - residual effects are restricted to the PDA **LAA** - residual effects extend into the LAA **RAA** - residual effects interact with those of other projects in the RAA
Duration	The period of time required until the measurable parameter or the VC returns to its existing condition, or the residual effect can no longer be measured or otherwise perceived	**Short-term** - residual effect restricted to the duration of the activity **Medium-term** - residual effect extends through construction and up to 10 years during operation, or throughout the operation phase alone **Long-term** - Effect extends for the life of the Project and beyond closure
Frequency	Identifies how often the residual effect occurs and how often during the Project or in a specific phase	**Single event** - effect occurs once throughout the assessment period **Multiple irregular event (no set schedule)** - effect occurs sporadically (and intermittently) throughout assessment period **Multiple regular event** - effect occurs repeatedly and regularly throughout assessment period **Continuous** - effect occurs continuously
Reversibility	Pertains to whether a measurable parameter or the VC can return to its existing condition after the project activity ceases	**Reversible** - the residual effect is likely to be reversed after activity completion and reclamation **Irreversible** - the residual effect is unlikely to be reversed

Table 7-2 Characterization of Residual Effects on Vegetation and Wetlands

Characterization	Description	Quantitative Measure or Definition of Qualitative Categories
Ecological and Socio-economic Context	Existing condition and trends in the area where residual effects occur	**Undisturbed** - area is relatively undisturbed or not adversely affected by human activity **Disturbed** - area has been substantially previously disturbed by human development or human development is still present

7.1.6 Significance Definition

An overall determination of significance is made for the Project residual effects on vegetation and wetlands after mitigation measures are implemented. No specific provincial or federal regulations set thresholds for determining the significance of environmental effects on vegetation and wetlands. Consequently, for this assessment, criteria for the determination of significance include:

- Effects that threaten the long-term persistence or viability of a plant species (including SAR and SOMC) in the RAA, including effects that are contrary to or inconsistent with federal (including recovery strategies and critical habitat) and provincial management objectives.
- Effects that threaten the long-term persistence or viability of native vegetation types in the RAA, including effects that are contrary to or inconsistent with federal (including recovery strategies and critical habitat) and provincial management objectives.
- Effects that result in a permanent loss of wetland area and function that cannot be mitigated

7.2 EXISTING CONDITIONS FOR VEGETATION AND WETLANDS

This section establishes baseline vegetation and wetlands resources in the PDA, LAA, and RAA. These resources include plant SAR and SOMC, non-native invasive species, native vegetation types (as represented by land cover classes), and wetlands. The Project is located predominantly within cropland. This section will outline the methods and results of both the desktop review and field surveys.

7.2.1 Methods

7.2.1.1 Desktop Review

7.2.1.1.1 Plant SAR and SOMC

A desktop search and review of available information was completed prior to field surveys to determine survey locations, inform plant SAR and SOMC survey methods, and provide historical information on plant SAR and SOMC with the potential to occur within the PDA, LAA, and RAA. The following data were searched:

- Review of other Saskatchewan wind regulatory applications
- SAR Public Registry (Government of Canada 2017b)
- SKCDC HABISask Tool (HABISask 2017a)
- SKCDC Tracked Vascular Plant Taxa by Ecoregion (SKCDC 2017b)

The SKCDC HABISask database was searched for historical occurrences of plant SAR and SOMC both prior to field surveys and once the Project layout was finalized.

7.2.1.1.2 Non-Native Invasive Plant Species

The Government of Saskatchewan *Weed Control Act* (Government of Saskatchewan 2010b) and *Weed Control Regulations* (Government of Saskatchewan 2010c) designate some plant species as prohibited, noxious, or nuisance species (see Table 7-3). An *iMap*Invasives database search was conducted for historical occurrences of non-native invasive species within the PDA, LAA, and RAA (*iMap*Invasives 2017).

Table 7-3 Non-Native Invasive Species Designation Definitions

Provincial Designation	Definition[1]
Prohibited	Prohibited species pose a significant economic and/or environmental threat, and are absent or very rare. The regulatory objective for these weeds is early detection and eradication upon discovery in consultation with the weed inspector and the Ministry of Agriculture.
Noxious	Noxious species are locally established within a limited area. The regulatory objective is to prevent invasion to uninfected areas.
Nuisance	Nuisance species are widely established, but may spread easily from one area to the next. The regulatory objective for these species is to address the underlying reason for their occurrences and to take measures to reduce their long-term effect.
NOTE: [1] Brenzil 2010.	

7.2.1.1.3 Land Cover Mapping

The initial desktop mapping was completed in November 2016 based on a reconnaissance survey in the fall of 2016. The AAFC (AAFC 2015a) annual crop inventory was used as a base for desktop mapping. The land cover classes were based on the AAFC classes (AAFC 2015b) and modified to suit this assessment (see Table 7-4). Land cover mapping was used to select survey locations, determine potential habitat for plant SAR and SOMC, and aid in Project siting. The land cover polygons were refined, where possible, using the following data sources:

- Bing Maps ® (2013 image)
- Environmental Systems Research Institute (ESRI) World Imagery (2013 image)
- Google Earth ® (2016 SPOT image)
- Ortho imagery (North West Geomatics [NWG] 1 m resolution) (2005 image)
- SGIC Flysask 2008-2011 (composite image)

The land cover mapping was checked in the field during the rare plant surveys and corrected in September 2017. The mapping was expanded to include not only the PDA and LAA, but also the wildlife LAA.

Due to the large size of the RAA (PDA plus 10 km buffer), land cover mapping was only completed for the wildlife LAA (PDA plus 1 km buffer) within the RAA. AAFC (2015a) data were used for the area located outside of the wildlife LAA to complete the data set for the RAA. It should be noted that the AAFC dataset does not divide tame pasture and hayland (it is grouped under pasture/forages). Moreover, it is our experience that the AAFC dataset under-represents the area covered by wetlands.

Table 7-4 Land Cover Classification modified from AAFC Definitions

Class	Description[1]
Broadleaf	• Tall woody perennial species, greater than 10 m tall, predominantly broadleaf (deciduous) forests or treed areas. • E.g., trembling aspen (*Populus tremuloides*), balsam poplar (*Populus balsamifera*).
Cultivated	• Seeded annual species, usually a monoculture • E.g., wheat, canola, lentils, mustard, flax.
Developed	• Land that predominately built up or developed and vegetation associated with these land covers. This includes road surfaces, railway surfaces, buildings and paved surfaces, urban areas, industrial sites, mine structures, golf courses, etc.
Drainage	• Flowing water, may be seasonal drainages
Dugout	• Man-made wetland, functions as a Class V wetland for wildlife
Exposed Land/Barren	• Land that is non-vegetated and non-developed.
Hayland	• Seeded annual or perennial species cut for hay • E.g., alfalfa, clover.
Native prairie	• Dominated by native grass species, may include some shrubland cover • E.g., needlegrasses (*Hesperostipa* spp., *Nassella viridula*), wheat/wildrye grasses (*Pascopyrum smithii*, *Elymus* spp., *Leymus* spp.)
Pasture/Forages[2]	• Periodically cultivated, includes tame pasture and hayland.
Shrubland	• Predominantly woody perennial species. • E.g., alder (*Alnus* spp.), willow (*Salix* spp.), Saskatoon (*Amelanchier alnifolia*), chokecherry (*Prunus virginiana*), hazelnut (*Corylus cornuta*), dogwood (*Cornus sericea* ssp. *sericea*), silverberry (*Elaeagnus commutata*), rose (Rosa spp.), and snowberry (*Symphoricarpos occidentalis*).
Tame pasture	• Dominated by either intentionally seeded or invaded non-native perennial species; i.e., grasses and legumes, with an understory of native species. Generally ploughed at one point in time. Used for grazing. • E.g., alfalfa (*Medicago sativa*), smooth brome (*Bromus inermis*), crested wheatgrass (*Agropyron cristatum*)
Water[2]	• Waterbodies (e.g., lakes, reservoirs, rivers, streams, salt water, etc.)
Wetland	• Land with a water table near/at/above soil surface for enough time to promote wetland or aquatic processes (hydrophytic vegetation, poorly drained soils i.e. glyesols, etc.). • See classifications in Table 7-5.

NOTES:
[1] Definitions are based on AAFC (2015b).
[2] These land cover classes are based on AAFC (2015a) data only.

7.2.1.1.4 Wetland Mapping

Desktop mapping of wetland extent and class was completed for the PDA, LAA, and wildlife LAA to create a base data layer for wetlands, determine field survey locations, and identify potential constraints for siting. Wetlands were classified according to the *Classification of Natural Ponds and Lakes in the Glaciated Prairie Region* (Stewart and Kantrud 1971) (see Table 7-5). Available imagery, dominant vegetation, and water permanence were used to make a conservative estimate of the wetland class and boundary. This process may not identify every wetland because wetlands less than 0.04 ha in size were not identified during desktop wetland mapping. Additional potential wetlands could possibly be present in cultivated portions of the Project area that may have been plowed or planted and, therefore, were not identified in the desktop analysis. Wetland classes and boundaries were reviewed and interpreted at a 1:3,000 scale using the following data sources:

- Bing Maps ® (2010 and 2013 images)
- ESRI World Imagery (2011, 2013, and 2014 images)
- Google Earth ® (2016 SPOT image)
- Ortho imagery (NWG 1 m resolution) (2005 image)
- SGIC Flysask 2008-2011 (composite image)

Dugouts were mapped because of their potential for providing wildlife habitat, but are not included in the Stewart and Kantrud (1971) classification. Dugouts are defined as human-constructed wetlands typically used as a livestock or household water source and are not regulated as wetlands.

Drainages were mapped because of their abundance on the landscape, but are not included in the Stewart and Kantrud (1971) classification. Drainages were largely seasonal flowing water that occurred in low-lying areas connecting wetlands on the landscape. They were mapped because they are potential habitat for plant and wildlife SOMC.

Table 7-5 Stewart and Kantrud (1971) Wetland Classification System

Wetland Class	Central Zone	Description
Class I – ephemeral ponds	low prairie zone	Ephemeral ponds occur in small swales and contain species such as Kentucky bluegrass (*Poa pratensis*).
Class II – temporary ponds	wet meadow zone	In freshwater temporary ponds, the central wet meadow zone is the deepest part of the wetland area and is usually dominated by western wheatgrass (*Pascopyrum smithii*) and foxtail barley (*Hordeum jubatum* ssp. *jubatum*).
Class III – seasonal ponds	shallow marsh zone	Seasonal ponds are wetlands with a shallow marsh zone dominating the deepest part of the wetland area. These ponds are frequently surrounded by a ring of willows with a wet center containing sedges (*Carex* spp.).
Class IV – semi-permanent ponds	deep marsh zone	In semi-permanent ponds and lakes, the deep marsh zone dominates the deepest part of the wetland area. Common cattail (*Typha latifolia*) and bulrushes (*Scirpus* spp.) are typical emergent species.
Class V – permanent ponds	permanent open water zone	The permanent open water zone dominates the deepest part of the wetland area and is devoid of emergent vegetation.
Class VI – alkali ponds	intermittent-alkali zone	The intermittent-alkali zone is the deepest part of the wetland area. This zone may be devoid of emergent vegetation or beaked ditch grass (*Ruppia maritima*) may be present.

7.2.1.2 Field Surveys

7.2.1.2.1 Rare Plant Surveys

Rare plant surveys, for both SAR and SOMC, were conducted in both the early-blooming (May 29-June 14, 2017) and late-blooming season (July 24-August 15, 2017), and followed the SKMOE's *Species Detection Survey Protocol: 20.0 Rare Vascular Plants* Surveys (SKMOE 2017e). Prior to the designing the field surveys, Stantec contacted a representative from the SKCDC to verify the survey requirements for the new SKMOE rare plant protocol (2017e) (Vinge-Mazer 2017a, pers. comm.). The surveys targeted areas of potential plant SAR and SOMC habitat within the PDA and siting buffers (see Section 2.2). Siting buffers around the PDA were included to allow for the identification of rare plants beyond the PDA in case minor alterations to infrastructure siting as required during the finalization and construction of the Project. The siting buffers consisted of:

- 250 m radius from WTGs,
- 300 m x 300 m substation,
- 50 m on either side of new access roads and collector lines

An additional 30 m setback for plant SOMCs was surveyed as per the *Saskatchewan Activity Restriction Guidelines for Sensitive Species* (SKMOE 2017b). As per the SKMOE protocol (2017e), prior to conducting the surveys a total of 73 transects were randomly stratified using ArcGIS throughout suitable habitat (i.e., native prairie, tame pasture, and wetlands) to capture 3-5% of the suitable habitat within the Project layout (including siting buffers) and rare plant setback. Transects were spaced a minimum of 10 m apart. All transects were visited in both the early and late-blooming seasons. The belt transects were oriented to follow the infrastructure. In accordance with the survey protocol (SKMOE 2017e), teams of two qualified personnel conducted the survey together for each belt transect that was five meters wide and ranged in length from 200 m to 1,000 m. Transect search speed was no faster than 4 km/h. Data were collected using FLINT dataloggers (FLINT S Series [Model S812]). Data was uploaded to a Stantec program called VINES (Vegetation Inventory Notation and Ecological Surveys, Version 6.0.3.7 [Software]). Data collected included UTM coordinates collected with hand-held global positioning system (GPS) units of the start and end of the transect, the legal subdivision, environmental conditions, and a complete vascular plant species list including characterization of occurrences of weed species listed by the *Weed Control Act* (Government of Saskatchewan 2010b). When a plant SAR and SOMC was detected, data were collected including the UTM coordinates, the number of individuals of the SAR or SOMC, area occupied, and representative photos of the plant and surrounding habitat.

7.2.1.2.2 Vegetation Community Surveys

During the late rare plant survey, the vegetation communities were assessed using the *Rangeland Health Assessment for Native Grassland* (Saskatchewan Prairie Conservation Action Plan 2008) and the *Saskatchewan Rangeland Ecosystems: Ecosite Guide* (Thorpe 2014). The rangeland health assessment was used as a tool to document pre-disturbance conditions and identify high risk areas for siting infrastructure (e.g., native prairie). The vegetation community was assessed at the start of 60 of the 73 transects located on four different ecosites: loam, saline overflow, meadow and marsh, and sub-irrigated and overflow. Thirteen of the transects were not included as they did not contain vegetation communities that differed from the adjacent transect in the same quarter section.

Most of the infrastructure was sited within loam ecosites. The ecosites were identified prior to the late rare plant survey and then confirmed in the field. A one m^2 quadrat was used to determine the ecosite using the soil series and range ecosite map. To verify the ecosite, the plant species cover in the quadrat was compared to the reference community described in the *Saskatchewan Rangeland Ecosystems: Ecosite Guide* (Thorpe 2014). The reference community (cited as community "A") refers to a potential plant community that would be expected under ungrazed or lightly grazed conditions (Thorpe 2014). The vegetation communities range in their structure and species composition due to their disturbance history (e.g., grazing, non-native invasive plant species invasion, and fire) (Thorpe 2014). The percent cover of all vascular plant species was documented for each quadrat and photographs were taken of each quadrat.

7.2.1.2.3 Wetland Surveys

Wetland surveys were conducted in conjunction with the late rare plant surveys from July 24 to August 15, 2017, as this is the optimal time period for plant species identification to aid in wetland classification. The wetland surveys were completed on a sub-set of wetlands within the LAA to confirm or correct the desktop mapping. Of the 166 wetlands within the LAA, approximately 30% of the wetlands were chosen to be field verified. Results from the field verification where used to correct and update the wetland mapping for the LAA. Wetland classification followed the Stewart and Kantrud (1971) classification. The dominant vegetation that covered greater than 5% of the central zone was used to determine wetland class of the overall wetland (see Table 7-5). Photographs of each wetland were taken, the wetland boundary was confirmed, and the wetland class was verified.

7.2.2 Results

7.2.2.1 Desktop Review

7.2.2.1.1 Plant SAR and SOMC

There were no historical SKCDC records of plant SAR and SOMC in the PDA or LAA (HABISask 2017b, 2017c).

7.2.2.1.2 Non-Native Invasive Species

There were no historical *iMap*Invasives records of non-native invasive plant species in the PDA or LAA (*iMap*Invasives 2017).

7.2.2.1.3 Land Cover Mapping

The PDA is predominantly cultivated land (63% of the PDA) followed by hayland (20% of the PDA), tame pasture (8% of the PDA), and developed (6% of the PDA). The PDA avoided native prairie except for a small portion, 0.6 ha (<1% of the PDA), with potential for further avoidance once project engineering is finalized. The PDA avoided wetlands where possible, except for a small portion, 4 ha (2.5% of the PDA); similarly, wetlands may be further avoided during refinement of the Project layout.

The vegetation in the LAA is predominantly cultivated land (61% of the LAA) followed by hayland (14% of the LAA), tame pasture (11% of the LAA), native prairie (5% of the LAA), and wetlands (5%) (see Table 7-6). See Figure 7-2 for the land cover in the LAA and Figure 7-3 for the land cover in the RAA.

Table 7-6 Land Cover Classes within the PDA, LAA, and RAA[1]

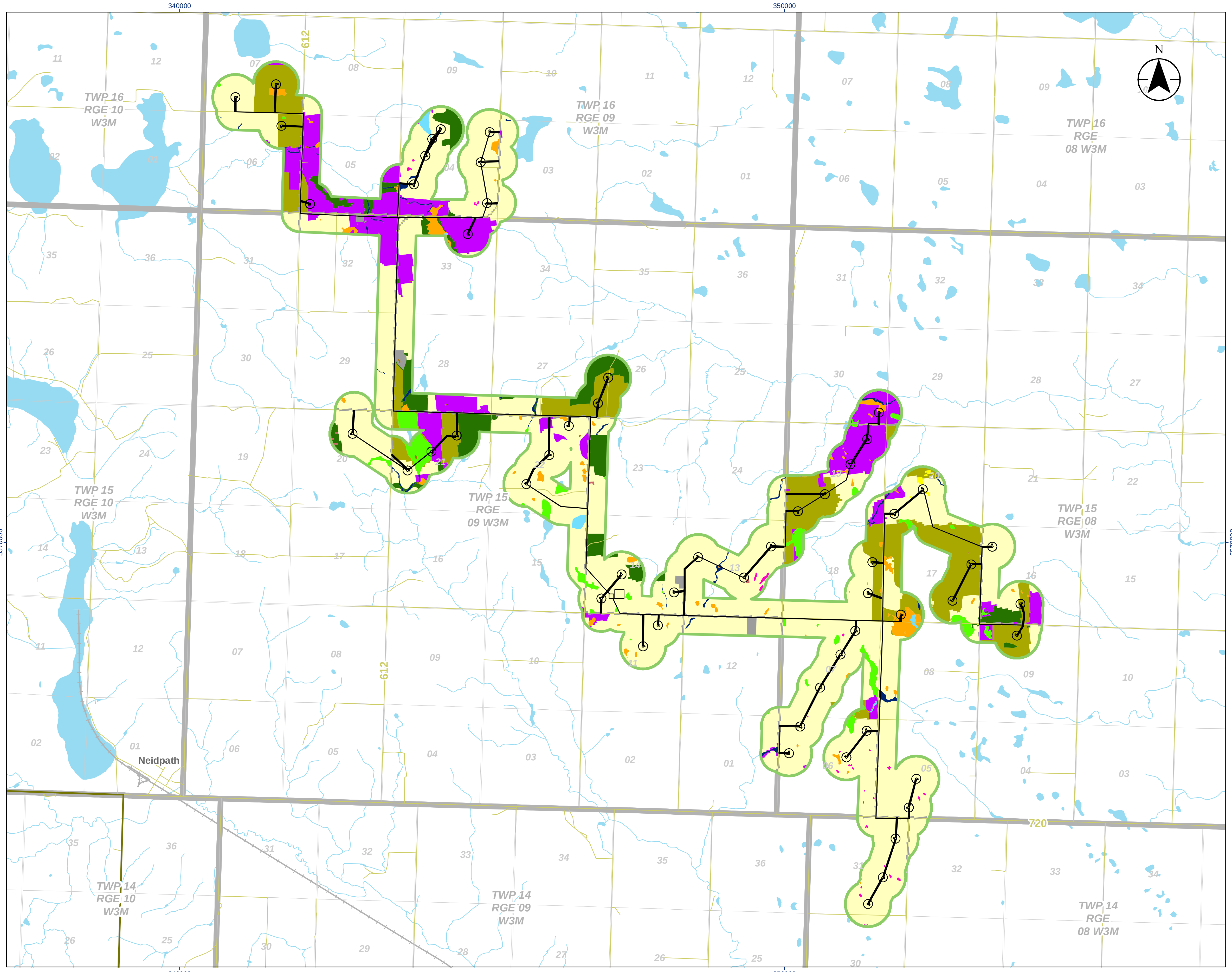
Land Cover	PDA		LAA		RAA	
	Area (ha)	Proportion (%)	Area (ha)	Proportion (%)	Area (ha)	Proportion (%)
Broadleaf	0.0	0.0	0.0	0.0	1.4	0.0
Cultivated	98.8	62.5	2,167.6	61.1	52,995.0	67.5
Developed	9.9	6.3	117.2	3.3	1,486.3	1.9
Drainage	0.4	0.3	23.4	0.7	107.4	0.1
Dugout	0.0	0.0	1.3	0.0	5.6	0.0
Exposed Land/Barren	0.1	0.1	1.4	0.0	214.1	0.3
Hayland	31.4	19.8	496.2	14.0	796.8	1.0
Native Prairie	0.6[2]	0.4	183.4	5.2	4,559.7	5.8
Pasture/Forages	n/a	n/a	n/a	n/a	13,673.4	17.4
Shrubland	0.1	0.1	2.5	0.1	103.9	0.1
Tame Pasture	12.9	8.2	393.9	11.1	1,026.2	1.3
Water	n/a	n/a	n/a	n/a	2,238.0	2.8
Wetland	4.0[3]	2.5	163.3	4.6	1,347.5	1.7
Total	158.2	100.0	3,550.4	100.0	78,555.4	100.0

NOTE:

[1] Land cover mapping was not completed for the RAA. However, the land cover mapping was completed for the wildlife LAA (PDA plus 1 km buffer) within the RAA. AAFC (2015a) data were used for the area located outside of the wildlife LAA to complete the data set for the RAA. The AAFC dataset does not divide tame pasture and hayland (it is grouped under pasture/forages). Moreover, it is our experience that the AAFC dataset under-represents the area covered by wetlands.

[2] Project components that intersect with native prairie consist of temporary workspaces, and collector line and access road ROWs that follow municipal road allowances. The overlap is partly due to the coarseness of the land cover data; in reality, **Project components will be sited to avoid native prairie where feasible, effectively reducing the 0.6 ha as close to zero as possible.**

[3] Project components that intersect with wetlands mostly consist of temporary workspaces and ROWs associated with collector lines and access roads; through further refinements to the Project layout, the 4 ha will be reduced as much as possible by siting Project components to avoid wetlands where feasible.



Land Cover

- Class 1 - Ephemeral Wetland
- Class 2 - Temporary Wetland
- Class 3 - Seasonal Wetland
- Class 4 - Semi-Permanent Wetland
- Class 5 - Permanent Wetland
- Drainage
- Dugout
- Cultivated
- Developed
- Exposed Land/Barren
- Hayland
- Native Prairie
- Shrubland
- Tame Pasture

- Project Development Area
- Vegetation and Wetlands Local Assessment Area
- Major Road
- Minor Road
- Railway
- Watercourse
- Waterbody
- Town/City
- Township
- Section

0 0.65 1.3 1.95 2.6 Kilometers

1:65,000 (At original document size of 11x17)

Notes

1. Coordinate System: NAD 1983 UTM Zone 13N
2. Base features produced under license with the Government of Saskatchewan and the Government of Canada
3. Project Development Area based on Algonquin layout Sept 06, 2017, V3
4. Landcover: Mapped wetlands by Stantec and field validated AAFC (2015).

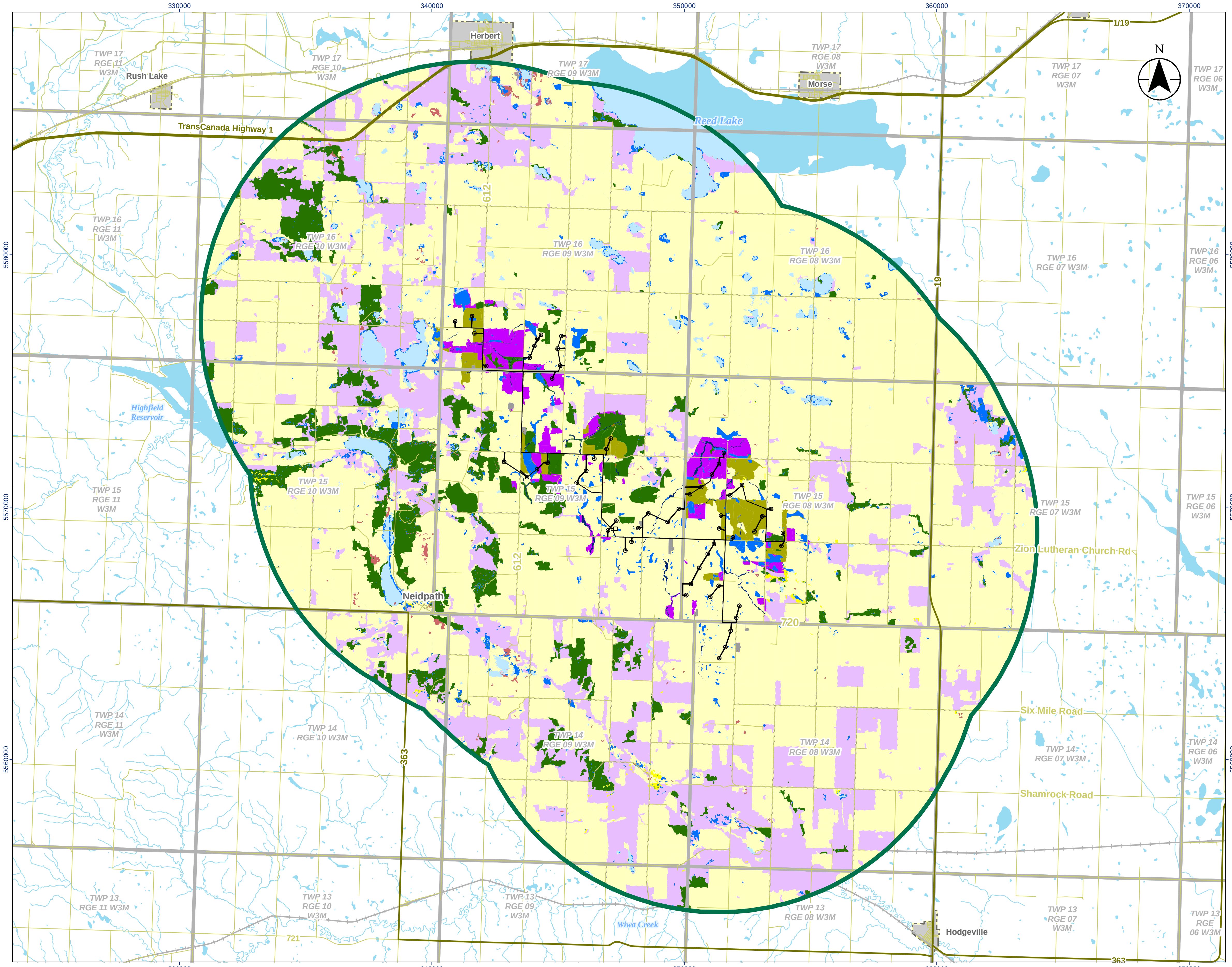
Project Location
Near Herbert, SK

113254088-019 REVE
Prepared by acory on 2017-12-18
Technical Review by ceidem on 2017-12-18

Client/Project
Algonquin Power Co.
Blue Hill Wind Energy Project

Figure No.
7-2

Title
Land Cover in the Vegetation and Wetlands Local Assessment Area



Stantec Algonquin

Land Cover

- Broadleaf
- Cultivated
- Developed
- Drainage
- Dugout
- Exposed Land/Barren
- Hayland
- Native Prairie
- Pasture/Forages
- Shrubland
- Tame Pasture
- Water
- Wetland

- Project Development Area
- Vegetation and Wetlands Regional Assessment Area
- Major Road
- Minor Road
- Railway
- Watercourse
- Waterbody
- Town/City
- Township

0 1.5 3 4.5 6 Kilometers

1:155,000 (At original document size of 11x17)

Notes

1. Coordinate System: NAD 1983 UTM Zone 13N
2. Base features produced under license with the Government of Saskatchewan and the Government of Canada
3. Project Development Area based on Algonquin layout Sept 06, 2017, V3
4. Landcover: Mapped wetlands by Stantec, AAFC 2015.

Project Location
Near Herbert, SK

113254088-038 REVD
Prepared by acory on 2017-12-18
Technical Review by ceidem on 2017-12-18

Client/Project
Algonquin Power Co.
Blue Hill Wind Energy Project

Figure No.
7-3

Title
Land Cover in the Vegetation and Wetlands Regional Assessment Area

7.2.2.1.4 Wetland Mapping

Of the 166 wetlands mapped within the LAA, 14 wetlands intersect the PDA, which occupy 4 ha (2.5%) of the PDA (see Table 7-7). Project components that intersect with wetlands mostly consist of temporary workspaces and ROWs associated with collector lines and access roads; through further refinements to the Project layout, the 4 ha will be reduced as much as possible by siting Project components to avoid wetlands where feasible. The dominant class of wetland within the PDA was class II temporary ponds (2.8 ha) followed by class III seasonal ponds (1.1 ha). A sub-set of wetlands were field verified (see Section 7.2.2.2.4).

Table 7-7 Wetland Classes within the PDA and LAA

Wetland Class	PDA			LAA		
	No. of Wetlands	Area (ha)	%	No. of Wetlands	Area (ha)	%
Class I – ephemeral ponds	0	0.0	0.0	29	5.4	0.2
Class II – temporary ponds	10	2.8	1.8	74	63.2	1.8
Class III – seasonal ponds	3	1.1	0.7	40	83.1	2.3
Class IV – semi-permanent ponds	1	0.1	0.0	6	11.4	0.3
Class V – permanent ponds	0	0.0	0.0	1	0.2	0.0
Class VI – alkali ponds	0	0.0	0.0	0	0.0	0.0
Dugout	0	0.0	0.0	16	1.3	0.0
Total	**14**	**4.00**	**2.50**	**166**	**164.60**	**4.60**

7.2.2.2 Field Surveys

7.2.2.2.1 Rare Plant Surveys

A total of 73 belt transects were surveyed during both the early and late rare plant surveys within the LAA (see Appendix F). Two hundred and ninety-one vascular plant species were observed during the surveys (see Appendix G.1). Of the species observed, no plant SAR or SOMC were observed within the PDA. Six plant SOMC were observed at 27 locations within the LAA and all of the occurrences were outside of the 30 m setback distance from the PDA (see Table 7-8 and Appendix F and G.2). No plant SAR were observed within the LAA. All of the site and plant SOMC data were submitted to the SKMOE according to permit requirements. It should be noted that the Hooker's Townsend (*Townsendia hookeri)* that was observed had flowered and senesced; therefore, species confirmation is probable but not confirmed. In addition, the provincial rank of plains rough fescue (*Festuca hallii*) was updated from an S5 to an S3 on a November 27, 2017 (SKCDC 2017c); therefore, the exact locations of the occurrences were not documented during the rare plant surveys because this species was not considered an SOMC at that time. Plains rough fescue was observed along 15 transects in the LAA, all of which are located outside of the 30 m setback distance from infrastructure (see Appendix F).

Table 7-8 Plant SOMC Observed during 2017 Rare Plant Surveys

Scientific Name	Common Name	Provincial Rank[1]	UTM 13U		Legal Land Description	Distance from PDA (m)	No. of Individuals or Groups[2]	Approx. Area (m^2)
			Easting	Northing				
Festuca hallii[3]	plains rough fescue	S3	353899	5568710	SW 16-15-08 W3M	39	1	<1.0
Festuca hallii[3]	plains rough fescue	S3	347401	5569588	SW 14-15-09 W3M	80	1	<1.0
Festuca hallii[3]	plains rough fescue	S3	346723	5571488	NE 22-15-09 W3M	49	1	<1.0
Festuca hallii[3]	plains rough fescue	S3	344700	5571798	NE 21-15-09 W3M	50	1	<1.0
Festuca hallii[3]	plains rough fescue	S3	344744	5572080	NE 21-15-09 W3M	52	1	<1.0
Festuca hallii[3]	plains rough fescue	S3	344763	5572169	SE 28-15-9 W3M	33	1	<1.0
Festuca hallii[3]	plains rough fescue	S3	346612	5572186	SE 27-15-09 W3M	102	1	<1.0
Festuca hallii[3]	plains rough fescue	S3	346592	5572294	SE 27-15-09 W3M	209	1	<1.0
Festuca hallii[3]	plains rough fescue	S3	346846	5572522	SW 26-15-09 W3M	136	1	<1.0
Festuca hallii[3]	plains rough fescue	S3	347080	5573002	NW 26-15-09 W3M	208	1	<1.0
Festuca hallii[3]	plains rough fescue	S3	342129	5575334	NW 32-15-09 W3M	90	1	<1.0
Festuca hallii[3]	plains rough fescue	S3	344458	5575438	SE 04-16-09 W3M	70	1	<1.0
Festuca hallii[3]	plains rough fescue	S3	344531	5576967	NE 04-16-09 W3M	179	1	<1.0
Festuca hallii[3]	plains rough fescue	S3	344490	5576985	NE 04-16-09 W3M	159	1	<1.0
Festuca hallii[3]	plains rough fescue	S3	344221	5577072	SW 09-16-09 W3M	189	1	<1.0
Myosurus minimus	least mousetail	S3	350945	5571085	NE 19-15-08 W3M	87	300	240.0
Myosurus minimus	least mousetail	S3	351887	5569642	NW 17-15-08 W3M	247	10	1.0
Myosurus minimus	least mousetail	S3	350978	5571543	NE 19-15-08 W3M	203	100	332.5
Myosurus minimus	least mousetail	S3	350969	5571411	NE 19-15-08 W3M	94	10	31.8
Myosurus minimus	least mousetail	S3	350747	5571127	NE 19-15-08 W3M	223	75	80.6
Myosurus minimus	least mousetail	S3	351777	5569685	NW 17-15-08 W3M	73	250	2,103.1

Table 7-8 Plant SOMC Observed during 2017 Rare Plant Surveys

Scientific Name	Common Name	Provincial Rank[1]	UTM 13U		Legal Land Description	Distance from PDA (m)	No. of Individuals or Groups[2]	Approx. Area (m^2)
			Easting	Northing				
Orobanche ludoviciana ssp. *ludoviciana*	Louisiana broomrape	S3	344674	5571944	NE 21-15-09 W3M	78	1	1.0
Paronychia sessiliflora	low whitlowwort	S3	353894	5568765	SW 16-15-08 W3M	50	1	<1.0
Paronychia sessiliflora	low whitlowwort	S3	344712	5571515	NE 21-15-09 W3M	207	1	<1.0
Paronychia sessiliflora	low whitlowwort	S3	344771	5571688	NE 21-15-09 W3M	130	1	<1.0
Ranunculus cardiophyllus	heart-leaved buttercup	S2	353559	5568739	SW 16-15-03 W3M	101	23	100.0
Townsendia hookeri	Hooker's Townsendia	S1	344849	5571676	NE 17-15-09 W3M	208	1	1.0

NOTES:

[1] Provincial rank from the Taxa List: Vascular Plants (SKCDC 2017c).

[2] Plants that have a clumping or mat forming growth form were counted in groups instead of individuals; in this table, least mousetail and low whitlowwort were counted as groups.

[3] Plains rough fescue locations are the start UTM coordinates of the transect; at the time of the survey, this species was ranked an S5 and therefore specific locations, number of individuals, and area were not collected. The SKCDC updated this species rank to an S3 on November 27, 2017.

7.2.2.2.2 Vegetation Community Surveys

The vegetation communities found in areas of suitable habitat for SAR and SOMC (i.e., native prairie, tame pasture, and wetlands) were located in the Mixed Grassland (MG) ecoregion mostly on loam ecosites (LM). The communities ranged from similar vegetation communities to the reference community (i.e., community "A", which is lightly grazed/ungrazed native prairie) to severely altered vegetation communities dominated by non-native invasive species (see Table 7-9). The reference community on a loam ecosite is dominated by porcupine grass (*Hesperostipa curtiseta*) and northern wheatgrass (*Elymus lanceolatus* ssp. *lanceolatus*) (Thorpe 2014). An example of a community with severe alteration from the reference community was tame pasture dominated either by crested wheatgrass (*Agropyrum cristatum*) with some native grasses, or smooth brome (*Bromus inermis*), which is a community that is not yet described by Thorpe (2014). Several ecosites were located in saline wet meadows (WMDSA) and were dominated by Nuttall's salt-meadow grass (*Puccinellia nuttalliana*), alkali grass (*Distichlis spicata*) and foxtail barley (*Hordeum jubatum* ssp. *jubatum*). See Table 7-9 for a list of the vegetation communities observed during the 2017 late rare plant survey.

Table 7-9 Vegetation Community Results from 2017 Late Rare Plant Surveys

Site	LLD	Easting	Northing	Vegetation Community Abbreviation[1, 2]	Vegetation Community Definition
T103	NE-21-1509 W3M	344711	5571515	DMG-TH-A	Northern wheatgrass (*Elymus lanceolatus* ssp. *lanceolatus*) – needle and thread grass (*Hesperostipa comata* ssp. *comata*)
T101s	SE 07-15-08 W3M	343827	5575465	MG-LM-A	Porcupine grass (*Hesperostipa curtiseta*)– northern wheatgrass
T11	SE 04-16-09 W3M	344459	5575441	MG-LM-A	Porcupine grass – northern wheatgrass
T27	NE 21-15-09 W3M	344744	5572077	MG-LM-A	Porcupine grass – northern wheatgrass
T5	NW 04-16-09 W3M	344312	5576964	MG-LM-B	Porcupine grass – northern wheatgrass – sedge (*Carex* spp.) – pasture sage (*Artemisia frigida*)
T7	NE 04-16-09 W3M	344580	5576887	MG-LM-B	Porcupine grass – northern wheatgrass – sedge – pasture sage
T34b	NE 21-15-09 W3M	344684	5572027	MG-LM-B	Porcupine grass – northern wheatgrass – sedge – pasture sage
T34b	NE 21-15-09 W3M	344698	8871798	MG-LM-B	Porcupine grass – northern wheatgrass – sedge – pasture sage
T37	NE 22-15-09 W3M	346729	5571736	MG-LM-B	Porcupine grass – northern wheatgrass – sedge – pasture sage

Table 7-9 Vegetation Community Results from 2017 Late Rare Plant Surveys

Site	LLD	Easting	Northing	Vegetation Community Abbreviation[1, 2]	Vegetation Community Definition
T77	NW 26-15-09 W3M	347078	5572994	MG-LM-B	Porcupine grass – northern wheatgrass – sedge – pasture sage
T4	SW 09-16-09 W3M	344457	5577034	MG-LM-C	Needle and thread grass – northern wheatgrass
T26	SE 28-15-09 W3M	344603	5572173	MG-LM-C	Needle and thread grass – northern wheatgrass
T42	SW 14-15-09 W3M	347657	5569579	MG-LM-C	Needle and thread grass – northern wheatgrass
T70	SW 16-15-08 W3M	353515	5568740	MG-LM-C	Needle and thread grass – northern wheatgrass
T79	NW 26-15-09 W3M	347198	5573097	MG-LM-C	Needle and thread grass – northern wheatgrass
T21	NW 32-15-09 W3M	342234	5575387	MG-LM-D	Needle and thread grass – sedge – pasture sage
T15	NE 33-15-09 W3M	344773	5575107	MG-LM-D	Needle and thread grass – sedge – pasture sage
T29	NW 21-15-09 W3M	343657	5571373	MG-LM-E	Pasture sage – needle and thread grass – northern wheatgrass
T28	NW 21-15-09 W3M	344283	5571717	MG-LM-E	Pasture sage – needle and thread grass – northern wheatgrass
T71	SW 16-15-08 W3M	353672	5568827	MG-LM-F	Blue grama (*Bouteloua gracilis*) – pasture sage – June grass (*Koeleria macrantha*)
VC-T18	SW 05-16-09 W3M	342449	5575695	MG-LM-G	Crested wheatgrass (*Agropyron cristatum* ssp. *pectinatum*) – native grasses
T59	SW 19-15-08 W3M	351579	5570314	MG-LM-G	Crested wheatgrass – native grasses
T72	SE 16-15-08 W3M	354124	5569167	MG-LM-G	Crested wheatgrass – native grasses
T32	SW 21-15-09 W3M	343957	5571337	MG-LM-nyd	Smooth brome (*Bromus inermis*)– native grasses (not yet described)
T22-RH	NW 33-15-09 W3M	343656	5574435	MG-LM-nyd	Smooth brome – native grasses (not yet described)
T27	NW 21-15-09 W3M	343902	5572137	MG-LM-nyd	Smooth brome – native grasses (not yet described)
T26	NW 21-15-09 W3M	344175	5571455	MG-LM-nyd	Smooth brome – native grasses (not yet described)

Table 7-9 Vegetation Community Results from 2017 Late Rare Plant Surveys

Site	LLD	Easting	Northing	Vegetation Community Abbreviation[1, 2]	Vegetation Community Definition
T12	NW 33-15-09 W3M	344339	5575357	MG-LM-nyd	Smooth brome – native grasses (not yet described)
T16	NE 33-15-09 W3M	344863	5575157	MG-LM-nyd	Smooth brome – native grasses (not yet described)
T78	SW 26-15-09 W3M	346806	5572251	MG-LM-nyd	Smooth brome – native grasses (not yet described)
T80	SW 26-15-09 W3M	347077	5572570	MG-LM-nyd	Smooth brome – native grasses (not yet described)
T81	SW 26-15-09 W3M	347115	5572511	MG-LM-nyd	Smooth brome – native grasses (not yet described)
T44	NW 18-15-08 W3M	350055	5570224	MG-LM-nyd	Smooth brome – native grasses (not yet described)
P1	SE 30-15-08 W3M	351152	5572283	MG-LM-nyd	Smooth brome – native grasses (not yet described)
T49-P5	SE 30-15-08 W3M	351385	5572267	MG-LM-nyd	Smooth brome – native grasses (not yet described)
T52	SE 30-15-08 W3M	351457	5572023	MG-LM-nyd	Smooth brome – native grasses (not yet described)
T101s	SE 07-15-08 W3M	351541	5567345	MG-LM-nyd	Smooth brome – native grasses (not yet described)
T55	SE 30-15-08 W3M	351614	5572042	MG-LM-nyd	Smooth brome – native grasses (not yet described)
P3	SE 30-15-08 W3M	351641	5572411	MG-LM-nyd	Smooth brome – native grasses (not yet described)
T66	SW 17-15-08 W3M	351828	5568698	MG-LM-nyd	Smooth brome – native grasses (not yet described)
T25	NW 21-15-09 W3M	343963	5571527	MG-SUBSA-C	Alkali grass (*Distichlis spicata*)-sedge
T49-P2	SE 30-15-08 W3M	351442	5572410	MG-SUBSA-C	Alkali grass - sedge
T50-P4	SE 30-15-08 W3M	351481	5572286	MG-SUBSA-C	Alkali grass - sedge
T75-RH	SE 27-15-09 W3M	346717	5572400	MG-TH-C	Needle and thread grass – blue grama – June grass
T105-RH	SE 27-15-09 W3M	346626	5572351	MG-TH-C	Needle and thread grass – blue grama – June grass
T31	NW 21-15-09 W3M	344019	5571365	MG-UPSA-B	Blue grama – northern wheatgrass – slender wheatgrass (*Elymus trachycaulus* ssp. *subsecundus*)
T46-11	NE 19-15-08 W3M	350934	5571445	PEZ-SUB- B	Smooth brome

Table 7-9 Vegetation Community Results from 2017 Late Rare Plant Surveys

Site	LLD	Easting	Northing	Vegetation Community Abbreviation[1, 2]	Vegetation Community Definition
P3b	SE 30-15-08 W3M	351505	5572475	PEZ-SUB-A	Kentucky blue grass (*Poa pratensis*)
T50-P6	SE 30-15-08 W3M	351445	5572209	PEZ-SUB-A	Kentucky blue grass
T63	NW 17-15-08 W3M	351711	5570156	PEZ-SUB-B	Smooth brome
T46-9	NW 19-15-09 W3M	350681	5571189	PEZ-SUB-B	Smooth brome
T47	NE 19-15-08 W3M	350932	5571259	PEZ-SUB-B	Smooth brome
T23	NW 21-15-09 W3M	343674	5572065	PEZ-WMDSA-E	Nuttall's salt-meadow grass (*Puccinellia nuttalliana*) – salt grass – foxtail barley (*Hordeum jubatum* ssp. *jubatum*)
T24	NW 21-15-09 W3M	344109	5571610	PEZ-WMDSA-E	Nuttall's salt-meadow grass – salt grass – foxtail barley
P18	SE 35-15-09 W3M	348405	5573700	PEZ-WMDSA-E	Nuttall's salt-meadow grass – salt grass – foxtail barley
P16	NW 25-15-09 W3M	348615	5573137	PEZ-WMDSA-E	Nuttall's salt-meadow grass – salt grass – foxtail barley
P17	NW 25-15-09 W3M	348623	5573018	PEZ-WMDSA-E	Nuttall's salt-meadow grass – salt grass – foxtail barley
T48-7	NE 19-15-08 W3M	350995	5571198	PEZ-WMDSA-E	Nuttall's salt-meadow grass – salt grass – foxtail barley

NOTES:

[1] Vegetation communities are defined in Thorpe (2014). An example of a vegetation community abbreviation for a reference community in the mixed grassland on a loam ecosite is MG-LM-A. Vegetation communities that are altered from the reference community are given abbreviations (e.g., B, C, D, etc.).

[2] Legend:

DMG – dry mixed grassland
LM – loam
MG – mixed grassland ecoregion
n.y.d. – not yet described (community has no data in Thorpe [2014])
PEZ – prairie ecozone
SUB – subirrigated and overflow
SUBSA – saline subirrigated and overflow
TH - thin
WMDSA – saline wet meadow

7.2.2.2.3 Non-native Invasive Plant Species

There were 16 non-native invasive species observed during the 2017 rare plant and wetland surveys that included 12 noxious and 4 nuisance species (see Appendix F). No prohibited species were observed. The observed non-native invasive species were found in 640 locations within the LAA (see Appendix F). A breakdown of weed species and occurrences can be found in Table 7-10.

Table 7-10 Non-Native Invasive Plant Species Observed during 2017 Rare Plant and Wetland Surveys in the LAA

Provincial Scientific Name	Provincial Common Name	Weed Designation[1]	Number of Occurrences within the LAA[2]
Artemisia absinthium	absinthe	Noxious	9
Bassia scoparia	kochia	Noxious	24
Cirsium arvense	Canada thistle	Noxious	137
Convolvulus arvensis	field bindweed	Noxious	1
Crepis tectorum	annual hawksbeard	Noxious	58
Elymus repens	creeping wild rye	Nuisance	31
Hesperis matronalis	Dame's rocket	Noxious	8
Hordeum jubatum ssp. *jubatum*	fox-tail barley	Nuisance	99
Iva axillaris	poverty-weed	Nuisance	32
Lactuca serriola	prickly lettuce	Noxious	23
Salsola kali	Russian-thistle	Noxious	1
Silene noctiflora	night-flowering catchfly	Noxious	1
Sonchus arvensis ssp. *arvensis*	field sow-thistle	Noxious	102
Sonchus asper ssp. *asper*	spiny-leaved annual sowthistle	Noxious	8
Tanacetum vulgare	tansy	Noxious	2
Taraxacum officinale ssp. *officinale*	common dandelion	Nuisance	104
Total			**640**

NOTES:

[1] Weeds are designated under the *Weed Control Act* (Government of Saskatchewan 2010b).

[2] Number of occurrences based on number of transects where the weed was observed.

7.2.2.2.4 Wetland Survey

A total of 65 wetlands were surveyed within the LAA. The wetland survey results were used to confirm or update the wetland mapping and classification and inform additional mapping of the LAA and wildlife LAA for the assessment (see Table 7-7 and Appendices F and G.2).

7.3 PROJECT INTERACTIONS WITH VEGETATION AND WETLANDS

Table 7-11 identifies, for each potential effect, the physical activities that might interact with vegetation and wetlands and result in the identified environmental effect. These interactions are indicated by a check mark and are discussed in detail in Section 7.4, in the context of effects pathways, standard and project-specific mitigation/enhancement, and residual effects. A justification for no effect is provided following the table.

Table 7-11 Project-Environment Interactions with Vegetation and Wetlands

Physical Activities	Environmental Effects		
	Change in Plant Species Diversity	Change in Vegetation Community Diversity	Change in Wetland area and Function
Construction			
Site preparation, including clearing and grading of WTG locations, access roads and temporary workspaces	✓	✓	✓
Installation of WTG foundations and turbine erection	✓	✓	✓
Installation of collector lines and substation	✓	✓	✓
Reclamation and site landscaping	✓	✓	✓
Operation and Maintenance			
Operation of WTGs and substation, including access road use	–	–	–
WTG routine and unplanned maintenance	–	–	–
Routine and unplanned maintenance of collector and substation infrastructure	–	–	–
Decommissioning			
Equipment dismantling, access removal, collector and substation removal	✓	✓	✓
Site reclamation	✓	✓	✓
NOTES: ✓ = Potential interaction – = No interaction			

Project activities during the operation and maintenance phase are not anticipated to affect plant species diversity, vegetation community diversity, or wetland area and function. Therefore, there are no anticipated effects from Project activities during the operation and maintenance phase, and no further consideration is given to this phase in the assessment of residual effects on vegetation and wetlands.

7.4 ASSESSMENT OF RESIDUAL ENVIRONMENTAL EFFECTS ON VEGETATION AND WETLANDS

7.4.1 Analytical Assessment Techniques

Effects of the Project on vegetation and wetlands were quantitatively assessed by calculating the number and area of plant SAR and SOMC, native vegetation types, and wetland area that would be affected by the Project activities. The potential of the Project to introduce non-native invasive plant species was assessed using a qualitative approach based on literature review and professional experience with non-native invasive plant species mitigation implemented on past projects.

7.4.2 Change in Plant Species Diversity

7.4.2.1 Project Pathways

7.4.2.1.1 Construction

Vegetation clearing and ground disturbance within the PDA during construction could remove identified or unidentified occurrences of SAR and SOMC. In addition, the vegetation clearing, ground disturbance, or site reclamation within the PDA during construction could cause the introduction or spread of non-native invasive plant species. As non-native invasive plant species are generalists, they can invade disturbed areas and out-compete native plant species.

7.4.2.1.2 Decommissioning

Ground disturbance during decommissioning could cause an introduction and/or spread of non-native invasive plant species.

7.4.2.2 Mitigation

Standard industry practices, avoidance measures, and Project-specific mitigation measures will be implemented during construction and decommissioning. Avoidance of plant SAR and SOMC is a best practice. Based on the 2017 field surveys, known occurrences of plant SOMC were avoided by Project siting and Project components were outside of the 30 m setback for plant SOMC outlined in the Saskatchewan Activity Restriction Guidelines (SKMOE 2017b). Generally, mitigation, monitoring, and follow-up will consist of monitoring weeds and minimizing the footprint area required for Project construction.

Mitigation for change in plant species diversity includes the following:

- Vehicles and personnel will stay within the defined Project construction area.
- A spill response plan will be developed and staff will be trained on appropriate procedures and will keep emergency spill kits on site.
- To reduce the potential for the introduction of non-native invasive species, all equipment should arrive at the Project site free of soil or vegetation debris.
- Stockpiles left for longer than 30 days will be covered or stabilized by seeding, sodding, mulching or equivalent.
- Locations of noxious and prohibited weeds within the Project construction area will be documented and presented to the Contractor, and staked for avoidance.
- Access routes will avoid known prohibited and noxious weed populations.
- Best management practices will be used during transportation activities, such as cleaning transportation vehicles between loads and tarping loads to reduce material falling from loads, etc. (Saskatchewan Forage Council 2011).
- Where active reclamation is deemed necessary by a qualified environmental monitor, sites on native vegetation types will be re-revegetated to their pre-disturbance condition.

Mitigation measures to address non-native invasive species are also outlined in Volume 1 of the EPP in Appendix C.

7.4.2.3 Project Residual Effect

7.4.2.3.1 Construction

Plant SAR and their designated critical habitat were not identified in the PDA or LAA during desktop review or field surveys; therefore, they are not anticipated to be affected by the Project.

There were no plant SOMC occurrences identified within suitable habitat in the PDA during the desktop review or field surveys. Six plant SOMCs were identified within the LAA, which were avoided by Project siting. All plant SOMCs within the LAA are greater than 30 m away from the PDA so indirect effects are not anticipated. Therefore, plant SOMCs are not anticipated to be affected by the Project.

Sixteen non-native invasive plant species listed under the *Weed Control Act* were identified in the PDA during field surveys. Canada thistle (*Cirsium arvense*) and perennial sow thistle (*Sonchus arvensis*) were the most common species found. These species invade native vegetation communities, especially in low-prairie wetland zones. Anthropogenic disturbance can create habitat for non-native invasive species in areas of native vegetation types. These non-native invasive species can have indirect effects on plant species diversity. Therefore, reclamation of the PDA will be completed as quickly as possible to reduce the potential for non-native invasive plant species to invade, establish, or spread following construction. In addition, monitoring will be completed to determine the effectiveness of mitigation.

Based on a conservative assessment, potential residual effects on plant species diversity during construction are characterized as follows:

- Direction is **adverse**
  - The effect is a possible decrease in plant species diversity within the LAA through the loss of unidentified occurrences of plant SOMC or the increase in non-native invasive species.
- Magnitude is **low to moderate**
  - The Project may have a measurable effect on unidentified occurrences of plant SOMC or weed propagation within the PDA with the potential to extend into the LAA.
- Geographical extent is the **PDA/LAA**
  - Direct effects to unidentified occurrences plant SOMC will be confined to the PDA, but indirect effects from non-native invasive species could extend into the LAA.
- Duration is **long-term**
  - Duration of effects from non-native invasive species will continue into operation, while effects on plant SOMC will last beyond decommissioning.
- Frequency is a **single event**
  - Unidentified occurrences of plant SOMC or the spread of non-native invasive species will be affected once, during the construction period.
- The effect is **reversible**
  - The effect is likely to be reversed after Project decommissioning and reclamation.
- Ecological and socio-economic context is **disturbed**
  - Approximately >80% of the LAA and RAA consists of existing disturbance from agricultural activities (i.e., cultivated, hayland, and tame pasture land cover types) as well as other permanent facilities and all-weather roads (i.e., developed land cover type).

7.4.2.3.2 Decommissioning

Decommissioning activities should have a minimal effect on plant species diversity in the LAA as the activities will be restricted largely to the PDA. Moreover, no plant SAR or SOMC were observed within the PDA or within the 30 m setback from the PDA. Vegetation management will be continued during decommissioning; therefore, the invasion and spread of non-native invasive species should be mitigated.

Based on a conservative assessment, potential residual effects on plant species diversity during decommissioning are characterized as follows:

- Direction is **adverse**
  - The effect is a potential decrease in plant species diversity within the LAA through the loss of unidentified occurrences of plant SOMC, but the possible increase in non-native invasive species.
- Magnitude is **low**
  - The Project is unlikely to have a measurable effect on plant SOMC; however, the Project may alter the number and location of non-native invasive species within the PDA.
- Geographical extent is the **PDA**
  - Direct effects to plant SOMC will be confined to the PDA, but indirect effects could extend into the LAA.
- Duration is **long-term**
  - Duration of effects from non-native invasive species will be throughout decommissioning, while effects to plant SOMC will last beyond decommissioning.
- Frequency is a **single event**
  - Unidentified occurrences of plant SOMC or the spread of non-native invasive species will be affected once during decommissioning.
- The effect is **reversible**
  - The effect is likely to be reversed after Project decommissioning and reclamation.
- Ecological and socio-economic context is **disturbed**
  - Approximately >80% of the LAA and RAA consists of existing disturbance from agricultural activities (i.e., cultivated, hayland, and tame pasture land cover types) as well as other permanent facilities and all-weather roads (i.e., developed land cover type).

7.4.3 Change in Vegetation Community Diversity

7.4.3.1 Project Pathways

7.4.3.1.1 Construction

Vegetation clearing and ground disturbance within the PDA during construction could cause a loss or alteration of native vegetation types. Specifically, construction of the WTG foundations, access roads, collector lines, substations, and disturbance from activities in the temporary workspaces could cause a change in the aerial extent of native prairie, tame pasture, shrubland, wetlands, and drainages within the PDA.

7.4.3.1.2 Decommissioning

During decommissioning, site reclamation of areas of native vegetation types within the PDA with native plant species seed mixes could result in an increase in native vegetation types in the LAA.

7.4.3.2 Mitigation

Standard industry practices, avoidance measures, and Project-specific mitigation measures will be implemented during construction and decommissioning.

Mitigation for change in vegetation community diversity includes the following:

- Prior to construction in native prairie, the boundaries of the vegetation clearing will be staked in the field. The Construction Contractor will ensure no construction disturbance occurs beyond the staked limits and that edges of sensitive areas adjacent to work areas are not disturbed.
- Dust control measures will be implemented along access roads within areas of native vegetation types.
- Where active reclamation is deemed necessary by a qualified environmental monitor, sites on native vegetation types will be re-revegetated to their pre-disturbance conditions using appropriate Certified No. I seed (Canada Seed Growers' Association) unless it is not available for a chosen reclamation species.
- Provincial regulators should be consulted in the selection of native plant seed mixes.
- Prior to the start of construction activity, the topsoil/seedbank will be stripped and preserved, then reapplied in suitable rehabilitation areas post-construction.

Mitigation measures to address changes in vegetation community diversity are also outlined in Volume 1 of the EPP in Appendix C.

7.4.3.3 Project Residual Effect

7.4.3.3.1 Construction

Of the 766 ha of native vegetation types within the LAA, 18 ha will be affected by the Project, of which approximately 16.1 ha (see Table 7-12) will be temporarily affected due to certain Project components associated with construction of infrastructure (i.e., temporary workspaces). The temporary effect to native vegetation types includes a temporary loss of 0.6 ha of native prairie; however, the temporary Project components (i.e., temporary workspaces, access roads) will be sited to avoid sensitive features including native prairie which will further reduce the area potentially affected. The below ground collector lines will temporarily affect 0.2 ha of native prairie. The remaining 1.9 ha of native vegetation types will be affected by long-term Project infrastructure (i.e., WTG foundations, crane pads, permanent access roads). Therefore, construction will have a low to moderate magnitude and long-term effect on vegetation community diversity until decommissioning (see Table 7-12).

Construction of the Project will result in an increase in developed land from 9.9 ha to 158.3 ha (0.2% of the RAA) (see Table 7-12 and Table 7-13). The area of developed land in the application case includes 121.4 ha of land in temporary workspace, access roads and staging areas, as well as 36.9 ha in long-term land cover change (i.e., new-build access roads, WTG foundations, crane pads, collector lines, and substation) (see Table 7-12). Temporary workspace will not likely be cleared; however, using the conservative approach it is assumed that the entire PDA will be cleared of vegetation. Moreover, not all portions of the temporary workspace will experience the same intensity of disturbance. For example, with a typical WTG, the disturbance will be largely within 25 m from the WTG foundation therefore areas outside the 25 m will be less impacted by construction. The temporary workspace beyond the 25 m from the WTG is predominantly used for the laydown of the blades. The layout at each WTG site will be modified given the site constraints so the orientation of the temporary workspace and amount of native vegetation types affected will be reduced or avoided where possible.

After the application of standard mitigation measures, potential residual effects on native vegetation types during construction are characterized as follows:

- Direction is **adverse**
  - The effect is a decrease in the areal extent of native vegetation types within the PDA.
- Magnitude is **low to moderate**
  - The Project will have a measurable effect on the native vegetation types within the PDA with the potential to extend into the LAA.
- Geographical extent is the **PDA**
  - Direct effects to native vegetation types will be confined to the PDA.
- Duration is **medium/long-term**
  - Duration of effects on native vegetation types at temporary workspaces and access roads will continue into operation, while native vegetation types at permanent infrastructure sites (e.g., WTGs, access roads) will have effects lasting post-decommissioning.
- Frequency is a **single event**
  - The native vegetation types will be affected once, during the construction period.
- The effect is **reversible**
  - The effect is likely to be reversed after Project decommissioning and reclamation.
- Ecological and socio-economic context is **disturbed**
  - Approximately >80% of the LAA and RAA consists of existing disturbance from agricultural activities (i.e., cultivated, hayland, and tame pasture land cover types) as well as other permanent facilities and all-weather roads (i.e., developed land cover type).

Table 7-12 Area of Land Cover Classes Disturbed by the Project

Land Cover	Existing Conditions in the LAA	Project Component (PDA)																
		Turbine Foundation		Crane Pad		Below Ground Collector Lines		New Access Roads[1]		New Temporary Access Roads[1]		Substation		Temporary Workspace		Staging Areas, Offices & Parking, O&M Building		Total Area in the PDA
		Area (ha)	% of the LAA	Area (ha)	% of the LAA	Area (ha)	% of the LAA	Area (ha)	% of the LAA	Area (ha)	% of the LAA	Area (ha)	% of the LAA	Area (ha)	% of the LAA	Area (ha)	% of the LAA	Area (ha)
Cultivated	2167.6	2.6	0.1	1.1	<0.1	6.4	0.3	7.8	0.4	24.6	1.1	0.6	<0.1	53.5	2.5	2.3	0.1	98.8
Developed	117.2	0.0	0.0	0.0	0.0	7.8	6.7	0.5	0.4	1.6	1.4	0.0	0.0	0.0	0.0	0.0	0.0	9.9
Drainage	23.4	0.0	0.0	0.0	0.0	0.1	0.0	0.1	0.0	0.2	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.4
Exposed Land/Barren	1.4	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.1	7.1	0.0	0.0	0.1
Hayland	496.2	0.8	0.2	0.4	0.1	2.2	0.4	2.7	0.5	8.6	1.7	0.0	0.0	16.8	3.4	0.0	0.0	31.4
Native Prairie	183.4	0.0	0.0	0.0	0.0	0.2	0.0	<0.1	0.0	0.1	0.0	0.0	0.0	0.3	0.0	0.0	0.0	0.6
Shrubland	2.5	0.0	0.0	0.0	0.0	<0.1	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.1	0.0	0.0	0.0	0.1
Tame Pasture	393.9	0.4	0.0	0.2	0.0	1.3	0.0	0.9	0.0	3.0	0.1	0.0	0.0	7.1	0.2	0.0	0.0	12.9
Wetland	163.3	0.2	0.0	<0.1	0.0	0.5	0.0	0.1	0.0	0.4	0.0	0.0	0.0	2.8	0.1	0.0	0.0	4.0
Total for Native Vegetation Types[2]	766.6	0.5	0.0	0.2	0.0	2.1	0.0	1.2	0.0	3.7	0.5	0.0	0.0	10.3	1.3	0.0	0.0	18.0
Total Land Cover	3550.4	4.0	0.1	1.7	0.0	18.5	0.3	12.1	0.3	38.5	1.1	0.6	0.0	80.6	2.3	2.3	0.1	158.2

NOTEs:

1 Access roads to the substation have not been sited yet; these will be sited on cultivated lands and will be less than 200 m in length depending on the chosen substation location.

2 Native vegetation types are defined as native prairie, tame pasture, shrubland, wetlands, and drainages.

Table 7-13 Change in Land Cover in the RAA

Land Cover Type	Amount of Habitat Available		Change from Baseline Case	
	Baseline Case (ha)	Application Case (ha)	Area (ha)	Percent (%)
Broadleaf	1.4	1.4	0.0	0.0
Cultivated	52,995.0	52,896.2	-98.8	-0.2
Developed	1,486.3	1,644.5	158.2	10.6
Drainage	107.4	107.0	-0.4	-0.4
Dugout	5.6	5.6	-0.0	0.0
Exposed Land/Barren	214.1	214.0	-0.1	-<0.1
Hayland	796.8	765.4	-31.4	-3.9
Native Prairie	4,559.7	4,559.1	-0.6	-<0.1
Pasture/Forages	13,673.4	1,3673.4	0.0	0.0
Shrubland	103.9	103.8	-0.1	-0.1
Tame Pasture	1,026.2	1,013.3	-12.9	-1.3
Water	2,238.0	2,238.0	0.0	0.0
Wetland	1,347.5	1,345.9	-4.0	-0.3
Total	**78,555.4**	**78,567.6**	**n/a**	**n/a**

7.4.3.3.2 Decommissioning

Decommissioning activities will have effects on native vegetation types similar to that of the construction phase. Equipment used to decommission the site and remove infrastructure will result in some ground disturbance, which will affect the vegetation communities that have re-established post-construction.

Post-decommissioning, the infrastructure (e.g., WTGs, new access roads) will be removed and the land returned to its previous land cover class (or in consultation with the landowner), either through natural processes or assisted through mitigation.

With mitigation, it is expected there will be an increase in the areal extent of native vegetation types within the LAA that is comparable to its state prior to construction. However, the effects during decommissioning will be adverse while the long-term results post-reclamation will be neutral. Based on the above, potential residual effects on vegetation community diversity during decommissioning are characterized as follows:

- Direction is **adverse**
  - There will be an increase in native vegetation types post-decommissioning.

- Magnitude is **low**
  - The areal extent of native vegetation types reclaimed post-decommissioning is small in the context of the LAA.
- Geographical extent is the **PDA**
  - Direct effects to native vegetation types will be confined to the PDA.
- Duration is **long-term**
  - Post-decommissioning native vegetation types will be reclaimed.
- Frequency is a **single event**
  - Vegetation community diversity will be affected once during decommissioning.
- The effect is **reversible**
  - The post-decommissioning vegetation types could be reversed.
- Ecological and socio-economic context is **disturbed**
  - Approximately >80% of the LAA and RAA consists of existing disturbance from agricultural activities (i.e., cultivated, hayland, and tame pasture land cover types) as well as other permanent facilities and all-weather roads (i.e., developed land cover type).

7.4.4 Change in Wetland Area and Function

7.4.4.1 Project Pathways

7.4.4.1.1 Construction

Vegetation clearing and ground disturbance in the PDA during construction could result in a change in wetland area and function. Based on the conservative approach of this assessment, it is assumed that vegetation will be completely removed within the PDA. During construction, clearing could have direct effects on wetland function by altering the vegetation structure surrounding wetlands; for example, wetlands with trees or shrubs along the margin would be converted to a graminoid and forb cover. This could have a direct effect on wetland function as it could decrease the interception and uptake of water, and increase runoff velocity. In addition, vegetation clearing has the potential to alter wetland function as habitat for both wildlife and plant species. In concert, these effects could reduce water quality. In addition, the construction of infrastructure could have indirect effects on wetland function through an increase of impervious surface area and a change in surface water run-off.

7.4.4.2 Mitigation

Standard industry practices, avoidance measures, and Project-specific mitigation measures will be implemented during construction.

Mitigation for change in wetland area and function will include the following:

- Maintain 100 m setbacks from wetlands, where possible.
- Maintain existing vegetation buffers around water bodies, where possible.
- Submit notifications and applications to regulators for wetland effects, as required, with the appropriate lead time.
- Complete work during dry or frozen ground conditions to lessen soil compaction.
- If working in saturated soils during non-frozen ground conditions, use equipment and techniques that distribute ground pressure (e.g., swamp mats, geofabric and padding, corduroy) to avoid soil compaction and admixing.
- Use silt fencing and direct surface runoff away from wetlands and waterbodies.
- Restrict water taking during periods of extremely low flow.
- Refueling or fuel storage activities will occur at least 100 m from wetlands.
- Minimal alteration to surface water drainage patterns and installation of culverts as required to maintain flows.
- Install properly designed and sited culverts in water crossings, along roads and permanent facilities to maintain pre-disturbance surface run-off as much as possible.
- Clean up wetlands in such a manner that compaction and rutting are reduced.
- Use natural re-vegetation for wetlands in native vegetation types.

Mitigation measures to address changes in wetland area and function are also outlined in Volume 1 of the EPP in Appendix C.

7.4.4.3 Project Residual Effect

7.4.4.3.1 Construction

Approximately 4.0 ha of wetlands will be intersected by the PDA, which represents 2.4% of the wetlands in the LAA (see Table 7-12). Of the 4.0 ha of wetlands affected, 0.4 ha will be directly affected by permanent infrastructure (i.e., WTGs and access roads) until decommissioning, while 0.5 ha of wetlands will be directly affected by underground collector lines, which will be reclaimed post-construction. There are 3.2 ha of wetlands located within temporary workspace and access roads that may be indirectly affected, but they will be avoided as much as possible as the infrastructure will be sited in order to avoid sensitive features such as wetlands. Based on the conservative approach, it is assumed that full vegetation clearing will occur within the PDA.

There is the potential for the Project to indirectly affect wetlands through changes in interception and uptake of water, increase runoff velocity, loss or alteration habitat for both wildlife and plant species, change in water quality, increase in impervious surfaces, and change in surface runoff. However, wetlands were largely avoided during Project siting and setbacks and site-specific mitigation will address these potential direct effect mechanisms and reduce indirect effects to wetlands.

After the application of standard mitigation measures, potential residual effects on wetland area and function during construction are characterized as follows:

- Direction is **adverse**
  - The effect is a decrease in the areal extent of wetlands within the PDA.
- Magnitude is **low to moderate**
  - The Project will have a measurable effect on wetlands within the LAA, but it is unlikely to have a measurable effect in the RAA.
- Geographical extent is the **PDA/LAA**
  - Direct effects to wetland area and function will be confined to the PDA, but indirect effects could extend into the LAA.
- Duration is **medium/long-term**
  - Duration of effects to wetlands within temporary workspaces will continue into operation, while wetlands affected by permanent infrastructure sites will have effects lasting post-decommissioning.
- Frequency is a **single event**
  - Wetland area and function will be affected once, during the construction period.
- The effect is **reversible**
  - The effect is likely to be reversed after Project decommissioning and reclamation.
- Ecological and socio-economic context is **disturbed**
  - Approximately >80% of the LAA and RAA consists of existing disturbance from agricultural activities (i.e., cultivated, hayland, and tame pasture land cover types) as well as other permanent facilities and all-weather roads (i.e., developed land cover type).

7.4.4.3.2 Decommissioning

Decommissioning activities will have a similar level of effect on wetlands in the temporary workspaces as that of the construction phase. Equipment used to decommission the site and remove infrastructure will result in some ground disturbance, which will affect the wetlands that have been reclaimed post-construction.

Post-decommissioning, the infrastructure (e.g., WTGs, new access roads) will be removed and any wetlands that were present prior to construction will be reclaimed, either through natural processes or assisted through mitigation.

With mitigation and reclamation, it is expected there will be an increase in the areal extent of wetlands within the LAA that is comparable to its state prior to construction. However, the effects during decommissioning will be adverse while the long-term results post-reclamation will be neutral. Based on the above, potential residual effects on wetland during decommissioning are characterized as follows:

- Direction is **adverse**
  - There will be an increase in wetland area and function post-decommissioning.
- Magnitude is **low**
  - The areal extent of wetlands reclaimed post-decommissioning is small in the context of the LAA.
- Geographical extent is the **PDA**.
  - Direct effects to wetland area and function will be confined to the PDA.
- Duration is **long-term**
  - Post-decommissioning, wetlands will be reclaimed.
- Frequency is a **single event**
  - Wetland area and function will be affected once during decommissioning.
- The effect is **reversible**
  - The post-decommissioning wetland area and function could be reversed.
- Ecological and socio-economic context is **disturbed**
  - Approximately >80% of the LAA and RAA consists of existing disturbance from agricultural activities (i.e., cultivated, hayland, and tame pasture land cover types) as well as other permanent facilities and all-weather roads (i.e., developed land cover type).

7.4.5 Summary of Project Residual Environmental Effects

Table 7-14 summarizes the residual environmental effects on vegetation and wetlands.

Table 7-14 Project Residual Effects on Vegetation and Wetlands

Residual Effect	Residual Effects Characterization							
	Project Phase	Direction	Magnitude	Geographic Extent	Duration	Frequency	Reversibility	Ecological and Socio-economic Context
Change in Plant Species Diversity	C	A	L/M	PDA/LAA	LT	S	R	D
Change in Plant Species Diversity	D	A	L	PDA	LT	S	R	D
Change in Vegetation Community Diversity	C	A	L/M	PDA/LAA	MT/LT	S	R	D
Change in Vegetation Community Diversity	D	A	L	PDA	LT	S	R	D
Change in Wetland area and Function	C	A	L/M	PDA/LAA	MT/LT	S	R	D
Change in Wetland area and Function	D	A	L	PDA	LT	S	R	D

KEY

See Table 7-2 for detailed definitions

Project Phase
C: Construction
O: Operation and Maintenance
D: Decommissioning

Direction:
P: Positive
A: Adverse
N: Neutral

Magnitude:
N: Negligible
L: Low
M: Moderate
H: High

Geographic Extent:
PDA: Project Development Area
LAA: Local Assessment Area
RAA: Regional Assessment Area

Duration:
ST: Short-term;
MT: Medium-term
LT: Long-term

N/A: Not applicable

Frequency:
S: Single event
IR: Irregular event
R: Regular event
C: Continuous

Reversibility:
R: Reversible
I: Irreversible

Ecological/Socio-Economic Context:
D: Disturbed
U: Undisturbed

7.5 ASSESSMENT OF CUMULATIVE ENVIRONMENTAL EFFECTS ON VEGETATION AND WETLANDS

The Project residual effects described in Section 7.4 are likely to interact cumulatively with residual environmental effects from other physical activities (past, present and reasonably foreseeable). The resulting cumulative environmental effects are assessed. This is followed by an analysis of the project contribution to cumulative effects. Future projects and activities that are reasonably foreseeable are defined as those that (a) have been publicly announced with a defined project execution period and with sufficient project details that allow for a meaningful assessment, (b) are currently undergoing an environmental assessment or (c) are in a permitting process.

The assessment of cumulative effects is initiated with a determination of whether two conditions exist:

- the Project has residual environmental effects on the VC and
- the residual effects could act cumulatively with residual effects of other past, present, or reasonably foreseeable future physical activities

If either is not met, the assessment of cumulative effects concludes with a statement that further assessment of cumulative effects is not warranted because the Project does not interact cumulatively with other projects or activities.

7.5.1 Project Residual Effects Likely to Interact Cumulatively

Table 4-4 in Section 4.0, Environmental Assessment Scope and Methodology, presents the project and physical activities inclusion list, which identifies other projects and physical activities that might act cumulatively with the Project. Where residual environmental effects from the Project act cumulatively with residual effects from other projects and physical activities (Table 7-15), a cumulative effects assessment is undertaken to determine their significance.

Table 7-15 Interactions With the Potential to Contribute to Cumulative Effects

Other Projects and Physical Activities with Potential for Cumulative Environmental Effects	Environmental Effects		
	Change in Plant Species Diversity	Change in Vegetation Community Diversity	Change in Wetland Area and Function
Past and Present Physical Activities and Resource Use			
Agricultural Conversion	✓	✓	✓
Oil and Gas Development	✓	✓	✓
Power Generation, Transmission, and Distribution	✓	✓	✓
Morse Wind Farm	✓	✓	✓
Recreational Activities	–	–	–
Residential Development	✓	✓	✓
Resource Extraction Activities	✓	✓	✓
Road Development	✓	✓	✓
Project-Related Physical Activities	✓	✓	✓
Future Physical Activities			
Pasqua to Swift Current 230 kV Transmission Line Project	✓	✓	✓
SaskPower Blue Hill Interconnection Project	✓	✓	✓

NOTES:
✓ = Other projects and physical activities whose residual effects are likely to interact cumulatively with Project residual environmental effects.
– = Interactions between the residual effects of other projects and residual effects of the Project are not expected.

Environmental effects identified in Table 7-15 as not likely to interact cumulatively with residual effects of other projects and physical activities (no check mark) are not discussed further. The assessment of the cumulative environmental effects that are likely to result from the Project in combination with other projects and physical activities are discussed in subsequent sections.

7.5.2 Change in Plant Species Diversity

7.5.2.1 Cumulative Effect Pathways

Past and present activities, and future projects in the RAA (see Table 7-15) have the potential to act cumulatively where other projects also affect the number and location of plant SAR, plant SOMC, and non-native invasive species. Cumulative effects arising from the overlap of future projects occur through mechanisms similar to that which occur during construction (e.g., equipment/vehicle use, vegetation clearing, ground disturbance, etc.). For example, such effects can come as a result of impacts to habitats supporting high plant species diversity (including plant SAR and SOMC) or as a result of weed propagation despite use of best available mitigation.

7.5.2.2 Mitigation for Cumulative Effects

Rare plant surveys have been completed in support of the Project which has resulted in greater confidence of the locations of and potential for plant SOMC to occur in the Project footprint. The Project will implement a suite of mitigation measures to address Project-specific effects on plant species diversity. Few opportunities exist for a coordinated approach to further mitigate effects in conjunction with other future projects due to the geographic separation or specific construction timing of other projects.

7.5.2.3 Cumulative Effects

The RAA is already heavily impacted to a high magnitude due to past conversion of native vegetation types to agricultural land uses with 68.5% being considered cultivated or other types of agricultural lands. The potential habitat for plant SAR and SOMC is largely limited to native vegetation types, which are limited in the RAA. The conversion of native vegetation types, including native prairie, has led to an increase in plant species becoming SAR and SOMC. There were no plant SAR or plant SOMC in the PDA or within 30 m of the LAA based on the rare plant surveys conducted in 2017. However, it is likely that there are plant SAR and SOMC occurrences throughout the RAA. The Project and future activities have the potential to affect the number and location of plant SAR and SOMC in the RAA; however, proper mitigation through avoiding native vegetation types through siting and following setbacks will reduce this residual effect.

Additionally, a number of non-native invasive species were recorded during rare plant surveys for the Project and indicate that these plants have likely spread throughout the RAA. This may also add to the threats to plant SAR and SOMC in the RAA. The Project and future activities, even with mitigation, increase the possibility for non-native invasive species to spread.

The Project has minimal areas that could support levels of high plant species diversity because of past impacts and fragmentation on the landscape. Other development projects in the area, such as the Pasqua to Swift Current 230 kV Transmission Line and the Blue Hill Interconnection project will likely contribute in a further reduction of species diversity.

7.5.3 Change in Vegetation Community Diversity

7.5.3.1 Cumulative Effect Pathways

Past and present activities, and future projects in the RAA (see Table 7-15) have the potential to act cumulatively where other projects also affect native vegetation types. Cumulative effects arising from the overlap of future projects occur through mechanisms similar to that which occur during construction (e.g., equipment/vehicle use, vegetation clearing, ground disturbance, etc.).

7.5.3.2 Mitigation for Cumulative Effects

The Project will implement a suite of mitigation measures to address Project-specific effects on vegetation community diversity. Few opportunities exist for a coordinated approach to further mitigate effects in conjunction with other future projects due to the geographic separation or specific construction timing of other projects.

7.5.3.3 Cumulative Effects

The RAA is already heavily impacted due to past agricultural land uses. The remaining native vegetation types including native prairie, shrubland, tame pasture, and wetlands occur in areas that are considered marginal for agricultural uses, difficult to develop (e.g., steep slopes), or in areas with protected designations. Based on the magnitude categories defined in Table 7-2, the existing land use activities have had a high magnitude effect on native vegetation types in the RAA through the loss in areal extent in comparison to pre-development levels. Agriculture is considered a key threat that factors in to a plant SAR and SOMC's risk of extirpation (SKCDC 2017a).

The Project has minimal additive effects to the loss of native vegetation types with 18.0 ha (with approximately 6,000 ha in the Project area) expected to be impacted during construction. Of this amount, only 1.9 ha of native vegetation types are expected to be affected long-term due to permanent infrastructure. Short-term loss of native vegetation types will be minimized through avoidance, mitigation measures, and reclamation.

Other development projects in the area, such as the Pasqua to Swift Current 230 kV Transmission Line and the Blue Hill Interconnection project will contribute to a further reduction of native vegetation types. The proposed location for the Pasqua to Swift Current Transmission Line is known (SaskPower 2016) and this project will likely affect a mixture of disturbed and native land cover types. It is understood that the Blue Hill Interconnection Project will have similar types of effects pathways related to changes in vegetation community diversity. However, at the time of EIS writing, details (e.g., location and ROW width) of the Blue Hill Interconnection project are unknown and, as a result, changes in land cover due to this future project could not be quantified. As such, only the Pasqua to Swift Transmission Line project is carried forward to quantify a cumulative change in vegetation community diversity in the RAA. Effects on native vegetation from this project (inclusive of wetland and water land cover classes) are expected to be 187 ha representing 0.8% of the native vegetation in the RAA. In combination with the Project, the total change in native vegetation amounts to 205 ha or 0.9% of the RAA.

7.5.4 Change in Wetland Area and Function

7.5.4.1 Cumulative Effect Pathways

Past and present activities, and future projects in the RAA (see Table 7-15) have the potential to act cumulatively where other projects also affect the areal extent of wetlands. Cumulative effects arising from the overlap of future projects occur through mechanisms similar to that which occur during construction (e.g., equipment/vehicle use, vegetation clearing, ground disturbance, etc.).

7.5.4.2 Mitigation for Cumulative Effects

The Project will implement a suite of mitigation measures to address Project-specific effects on wetland area and function. Few opportunities exist for a coordinated approach to further mitigate effects in conjunction with other future projects due to the geographic separation or specific construction timing of other projects. However, it is assumed that other proposed projects will likely site or route their projects to avoid effects to wetland area and function due to the constructability issues associated with building in these areas.

7.5.4.3 Cumulative Effects

The RAA has 4.7% of wetlands with a very small proportion being affected by the Project. Wetlands in the RAA have already been affected to a high magnitude due to the conversion of land to agricultural uses. Other future projects such as the Pasqua to Swift Current 230 kV Transmission Line and the Blue Hill Interconnection project will likely have some effects on wetlands. The proposed location for the Pasqua to Swift Current Transmission Line is known (SaskPower 2016) and this project will likely affect a mixture of disturbed and native land cover types. It is understood that the Blue Hill Interconnection Project will have similar types of effects pathways related to changes in wetland area and function. However, at the time of EIS writing, details (e.g., location and ROW width) of the Blue Hill Interconnection project are unknown and, as a result, changes in land cover due to this future project could not be quantified. As such, only the Pasqua to Swift Transmission Line project is carried forward to quantify a cumulative change in wetland area and function in the RAA. The portion of the Pasqua to Swift Current Transmission Line that traverses the vegetation RAA only intersects with 14 ha of wetlands amounting to 0.4% of wetlands in the RAA. In the cumulative case, a total of 18 ha and 0.5% of wetlands in the RAA will be affected.

7.5.5 Summary of Cumulative Effects

Table 7-16 summarizes cumulative environmental effects on vegetation and wetlands.

Table 7-16 Residual Cumulative Effects

Residual Cumulative Effect	Residual Cumulative Effects Characterization						
	Direction	Magnitude	Geographic Extent	Duration	Frequency	Reversibility	Ecological and Socio-economic Context
Residual Cumulative Change in Plant Species Diversity							
Residual cumulative effect	A	H	RAA	LT	C	I	D
Contribution from the Project to the residual cumulative effect	The Project will result in the loss of 18.0 ha of native vegetation types, which are potential habitat for plant SAR and SOMC and represents a potential loss of 0.2% plant SAR and SOMC habitat in the RAA. All previously identified plant SOMC occurrences will be avoided by the Project. This estimate may be reduced even further through additional avoidance planning once final engineering is completed.						
Residual Cumulative Change in Vegetation Community Diversity							
Residual cumulative effect	A	H	RAA	LT	C	I	D
Contribution from the Project to the residual cumulative effect	The Project will result in the loss of 18.0 ha of native vegetation, which represents a 0.2% reduction in native vegetation types in the RAA. This estimate may be reduced even further through additional avoidance planning once final engineering is completed.						
Residual Cumulative Change in Wetland Area and Function							
Residual cumulative effect	A	H	RAA	LT	C	I	D
Contribution from the Project to the residual cumulative effect	The Project will result in the loss of 4.0 ha of wetland area, which represents a 0.3% reduction in wetlands in the RAA. This estimate may be reduced even further through additional avoidance planning once final engineering is completed.						

KEY

See Table 7-2 for detailed definitions

Direction:
P: Positive
A: Adverse
N: Neutral

Magnitude:
N: Negligible
L: Low
M: Moderate
H: High

Geographic Extent:
PDA: Project Development Area
LAA: Local Assessment Area
RAA: Regional Assessment Area

Duration:
ST: Short-term;
MT: Medium-term
LT: Long-term

N/A: Not applicable

Frequency:
S: Single event
IR: Irregular event
R: Regular event
C: Continuous

Reversibility:
R: Reversible
I: Irreversible

Ecological/Socio-Economic Context:
D: Disturbed
U: Undisturbed

7.6 DETERMINATION OF SIGNIFICANCE

7.6.1 Significance of Project Residual Effects

Effects of the Project on vegetation and wetlands are generally expected to be adverse, but of low magnitude, limited to the PDA with some potential to extend into the LAA (e.g., wetland function), and reversible (see Table 7-14). This is largely a result of design and layout iterations that reduce overlap with plant SAR and SOMC, native vegetation types, and wetlands as well as the use of additional mitigation measures where avoidance is not possible. The residual effects are unlikely to pose a threat to the long-term persistence or viability of a plant species (including plant SAR and SOMC), native vegetation types, or result in the permanent loss of wetlands that cannot be mitigated.

With mitigation and environmental protection measures, the residual environmental effects on vegetation and wetlands are predicted to be not significant.

7.6.2 Significance of Cumulative Effects

The existing land base in the RAA has been extensively and permanently modified through agricultural conversion from its original state and, to a lesser extent, industrial and residential development (Acton et al. 1998).

Overall, based on the magnitude and significance definitions described in Sections 7.1.5 and 7.1.6, the effects on the vegetation and wetlands VC are already high in magnitude and significant. With the addition of the Project effects in conjunction with other foreseeable projects, the cumulative effects will remain significant.

7.6.2.1 Project Contribution to Cumulative Effects

The Project will result in the loss of 18 ha of native vegetation, including wetlands, during construction representing 0.2% of the remaining native vegetation in the RAA. Some of these effects will be reduced during operation as the project footprint becomes smaller due to reclamation of laydown areas and the narrowing of access roads. Much of the Project's contribution to cumulative effects will be reversible upon completion of construction. Therefore, the Project's contribution to cumulative effects is not expected to measurably affect the amount of native vegetation and wetland types in the RAA.

7.7 PREDICTION CONFIDENCE

Based on the information compiled during field surveys, data analyses, and understanding Project activities, the predicted confidence in the assessment of project residual effects on vegetation and wetlands is moderate to high. There is some uncertainty regarding the exact distribution of native vegetation in the RAA due to the coarseness of the existing spatial data for the RAA. There is a moderate to high level of confidence in the number and location of plant SOMCs detected within the PDA as the lack of detection of plant SAR and SOMC does not preclude their presence in the PDA. There is a high level of confidence in the effectiveness of the proposed mitigation measures.

7.8 FOLLOW-UP AND MONITORING

An environmental monitor will be used to determine the effectiveness of mitigation, including those implemented to reduce or avoid effect on vegetation and wetlands. Resource specialists (e.g., vegetation ecologists) may be used to monitor construction activities in sensitive areas (e.g., plant SOMC locations) and will assist with staking sensitive areas prior to vegetation disturbance. Monitoring will also be used to evaluate the success of vegetation management and reclamation activities.

No follow-up programs are being proposed for this Project.

8.0 ASSESSMENT OF POTENTIAL EFFECTS ON WILDLIFE AND WILDLIFE HABITAT

8.1 SCOPE OF ASSESSMENT

Wildlife and Wildlife Habitat is considered a VC because it is of aesthetic, economic, and recreational importance to Canadians (Filion et al. 1993). Furthermore, wildlife is a critical component of functional natural ecosystems. Changes in wildlife abundance or diversity might alter ecosystem function, resulting in negative implications to environmental cycles and decreasing the ability of humans to use and enjoy natural resources or to benefit from ecological goods and services. As environmental systems are interrelated, changes in other VCs (e.g., Vegetation and Wetlands) could affect wildlife abundance and habitat availability.

The wildlife and wildlife habitat VC represents a broad range of wildlife species and habitats that are known to occur or have potential to occur in the vicinity of the Project. The number of wildlife species potentially found at or near the Project is typical of the broader ecoregion, with the majority of these species being common and abundant. The scope of this assessment includes all wildlife species, but focuses on species at risk (SAR) and other species of management concern (SOMC) (see Section 8.1.3 for definitions), and their habitat. For the purposes of the assessment, suitable wildlife habitat includes native land cover classes (i.e., native prairie, shrubland, and wetland), as well as perennial cropland (i.e., tame pasture, hayland) which is an anthropogenic land cover. Effects of the Project were evaluated in the context of the regulatory setting, issues identified through engagement activities, potential Project-VC interactions, and existing knowledge of wind-energy facility development.

8.1.1 Regulatory and Policy Setting

8.1.1.1 Federal Legislation

Some wildlife species in Canada are afforded federal protection through the *Migratory Birds Convention Act* (MBCA) and/or the *Species at Risk Act* (SARA).

8.1.1.1.1 Migratory Birds Convention Act

The purpose of the MBCA (Government of Canada 1994) is to protect and conserve migratory bird populations, individuals, and their nests within all lands in Canada. All migratory species listed under Article I of the MBCA are protected (e.g., sparrows, ducks, geese, grebes, woodpeckers, wrens, sandpipers, cranes), with the exception of select families not listed under Article I and exempt from the MBCA (e.g., hawks, eagles, crows, pelicans, cormorants, grouse, owls, cowbirds). Several of the species not listed under Article I are protected under provincial legislation and/or guidelines.

The MBCA is the enabling statue for the *Migratory Birds Regulations* (Government of Canada 2016). Section 6 of the *Migratory Birds Regulations* states that without the authorization of a permit, the disturbance, destruction, or taking of a nest, egg, nest shelter, eider duck shelter, or duck box of a migratory bird, or possession of a migratory bird, carcass, skin, nest, or egg of a migratory bird are prohibited. As there are no authorizations to allow construction-related effects on migratory birds and their nests, best management practices (BMPs) should be followed to take reasonable measures to avoid incidental take of migratory birds.

8.1.1.1.2 Species at Risk Act

SARA (Government of Canada 2002) is one part of a three-part strategy that the Government of Canada has implemented to protect wildlife SAR in Canada and applies to wildlife species listed in Schedule 1 of SARA, their residences and designated critical habitat. This three-part strategy also includes commitments under the National Accord for the Protection of Species at Risk (Government of Canada 1996), and activities under the Habitat Stewardship Program for Species at Risk (Government of Canada 2017a). The COSEWIC assesses and designates the status of species and recommends this designation for legal protection under SARA (COSEWIC 2017).

SARA serves to prevent the extirpation or extinction of wildlife species and to provide recovery strategies for species that are *extirpated*, *endangered* and *threatened* due to human activity and to manage species of *special concern* so they do not become *threatened* or *endangered*.

Under SARA, it is forbidden to kill, injure, harass, destroy the residence of, destroy the critical habitat of, capture or take an individual designated as *extirpated*, *endangered*, or *threatened* on federally-regulated lands or designated critical habitat elsewhere. On lands under provincial jurisdiction, SARA goals are typically reflected through provincial legislation, policy, and guidelines.

8.1.1.2 Provincial Legislation

The province of Saskatchewan regulates wildlife and their habitat under *The Wildlife Act* (Government of Saskatchewan 1998), the Saskatchewan *Wild Species at Risk Regulations* (Government of Saskatchewan 1999) and the *Wildlife Habitat Protection Act* (WHPA; Government of Saskatchewan 1992).

The purpose of the Saskatchewan *Wildlife Act* is to "protect wild species at risk, which are any native wild species that have been designated and listed as *extirpated*, *endangered*, *threatened*, or *vulnerable*." Section 51(1) of the Act states that one may not:

- "kill, injure, possess, disturb, take, capture, harvest, genetically manipulate or interfere with or attempt to do any of those things to any designated species;

- export or cause to be exported form Saskatchewan any designated species;
- traffic in any designated species”

The Saskatchewan *Wildlife Regulations* provide for the protection of wildlife features in section 6(1) where it states that “no person shall, without a license for the purpose, kill, disturb or molest any wildlife or the den, house, nest, dam or usual place of habitation of any wildlife protected under the Act or under the *Migratory Birds Convention Act*.”

The *Wildlife Habitat Protection Act* (WHPA) protects Crown lands that are designated as wildlife habitat lands. It prohibits alteration unless exempted from the regulations or authorized by the responsible minister.

8.1.1.2.1 Additional Guidance

Additional guidance is available through government guidelines and the Saskatchewan Conservation Data Centre (SKCDC). Guidance on the siting of WEPs to consider sensitive wildlife areas is provided through the *Wildlife Siting Guidelines for Saskatchewan Wind Energy Projects* (SKMOE 2017a). Disturbance setback distances and seasonal activity restriction guidelines for Saskatchewan wildlife species are provided in the *Saskatchewan Activity Restriction Guidelines for Sensitive Species* (SKMOE 2017b).

Species conservation rankings are provided by the SKCDC (Appendix H.1). The SKCDC uses a standardized procedure set forth by NatureServe (Faber-Langendoen et al. 2012) to provide a conservation status ranking for all wildlife species found in Saskatchewan (SKCDC 2017d, 2017e).

8.1.2 Consideration of Issues Raised during Engagement

Concerns regarding the potential effect of the Project to wildlife were raised during engagement with the public and NGOs. Members of the public asked questions about potential effects to wildlife, especially birds, during public open houses. One attendee completed a questionnaire during the third open house and noted that the majority of migratory birds had not flown through the Project area yet. Where possible, Algonquin representatives addressed questions and concerns regarding potential effects to wildlife with attendees at the open houses. A discussion of the potential residual Project effects on mortality risk is included in Section 8.4.3.

During meetings with NGOs, concerns were raised about bird and bat mortality, adequate turbine lighting to reduce bird strikes, and adequate setbacks during construction. Algonquin addressed these concerns during meetings with the NGOs, and the issues and responses are summarized in Table 3-3 of Section 3.4.3. Algonquin will try to adhere to provincial Activity Restriction Guidelines for setback, comply with Transport Canada lighting requirements and consider potential mitigation strategies to reduce bird and bat mortality.

8.1.3 Potential Effects, Pathways and Measurable Parameters

The Project has the potential to affect wildlife and their habitat through changes in habitat availability, and mortality risk. The focus of the assessment is to determine whether the Project will result in an adverse residual environmental effect on wildlife and wildlife habitat and to assess the significance of each effect with regard to viability of local or regional populations after considering appropriate mitigation measures. The assessment of potential effects on wildlife and wildlife habitat focuses on wildlife SAR and SOMC.

Wildlife SAR are defined as species listed under Schedule 1, Schedule 2, or Schedule 3 of the federal SARA as *endangered, threatened* or *special concern* (Government of Canada 2002).

Wildlife SOMC are defined as provincially legislated SAR and other species identified in federal and provincial tracking lists and activity restriction guidelines, including species:

- Listed in *The Wildlife Act* of Saskatchewan as *endangered, threatened* or *vulnerable* (Government of Saskatchewan 1998);
- Listed by the COSEWIC as *endangered, threatened* or *special concern* (Government of Canada 2017b), but not yet listed under SARA;
- Assigned a ranking of S1 or S2 (or a combination of these rankings) by the SKCDC (SKCDC 2017d, 2017e); and,
- Included in the Saskatchewan Activity Restriction Guidelines for Sensitive Species (SKMOE 2017b).

See Appendix H.1 for federal and provincial ranking definitions.

A list of the potential SAR and SOMC that may interact with the Project and are used in this assessment, along with their status under various federal and provincial legislation and guidance, is found in Appendix H.2. Their specific habitat associations based on land cover types available in the RAA are defined in Appendix H.3.

Potential environmental effects, measurable parameters and the rationale for inclusion of each parameter in the assessment of wildlife and wildlife habitat are presented in Table 8-1.

Table 8-1 Potential Effects, Effects Pathways and Measurable Parameters for Wildlife and Wildlife Habitat

Potential Environmental Effect	Effect Pathway	Measurable Parameter(s) and Units of Measurement
Change in habitat availability	Loss or degradation of native landcover types (i.e., native prairie, shrubland, wetland) and/or perennial land cover (i.e., tame pasture, hayland) will reduce the capacity of the landscape to support wildlife. The area potentially affected by the Project will be put in the context of the PDA, LAA, and RAA (see definitions below) and will provide a measure of the relative magnitude of effect within those assessment areas.	Area (ha) of direct habitat loss for native land cover
	Project activities (e.g., blade movement and noise) may result in disturbance of wildlife on the landscape, thus leading to a decrease in habitat quality and use. This measurable parameter will be assessed qualitatively.	Sensory disturbance
Change in mortality risk	A qualitative/quantitative assessment of direct mortality risk due to the Project provides an estimate of the predicted exposure and threats to wildlife that may result in loss of individuals from a population. Direct mortality may arise from a variety of Project activities (e.g., vegetation clearing, vehicle traffic, collisions with Project infrastructure such as WTGs).	Change in direct mortality risk
	A qualitative assessment of indirect mortality risk due to the Project provides an estimate of the predicted exposure and threats to wildlife that may result in loss of individuals from a population. Indirect mortality involves changes in landscape features or communities that result in increased predation or mortality rates to wildlife.	Change in indirect mortality risk

8.1.4 Boundaries

8.1.4.1 Spatial Boundaries

The following spatial boundaries are defined for the wildlife and wildlife habitat assessment of the Project with respect to Project activities and components:

Project Development Area (PDA): The PDA encompasses the immediate area on which Project activities and components may occur. As such, the PDA represents the physical Project footprint and consists of the area of physical disturbance associated with WTGs, access roads, collector lines, substation, and temporary workspaces.

Local Assessment Area (LAA): The LAA encompasses the area for the assessment of effects on wildlife species and wildlife habitat and includes the PDA plus a 1 km buffer to account for the maximum activity restriction setback distance established by the SKMOE for potential SAR (i.e., ferruginous hawk [*Buteo regalis*]) (SKMOE 2017a). The LAA was established to consider the area in which the proposed Project activities could have direct or indirect effects on wildlife and wildlife habitat.

Regional Assessment Area (RAA): The RAA includes the PDA plus a 10 km buffer. The RAA was used to determine the significance of Project-specific effects on wildlife and wildlife habitat from a regional context, as well as to assess where Project-specific effects overlap with effects of past, present, and reasonably foreseeable future activities (i.e., cumulative effects).

Wildlife assessment areas are shown on Figure 8-1.

8.1.4.2 Temporal Boundaries

The period during which effects on wildlife and wildlife habitat are assessed for each Project phase is defined as follows:

- **Construction**: Up to 1.5 years. Peak construction activity period associated with site preparation, construction (i.e., WTG installation, access road construction, collector line installation, substation construction), reclamation of temporary workspace and commissioning.
- **Operation and Maintenance**: From commissioning through the life of the Project (at a minimum approximately 25 years).
- **Decommissioning**: A two-year period at the end of the life of the Project, comprising the removal of above-ground facilities and a portion of the foundations, abandonment in place of underground collector lines and any associated reclamation activities. As part of decommissioning, certain components will be left in place as this approach usually results in fewer environmental effects.

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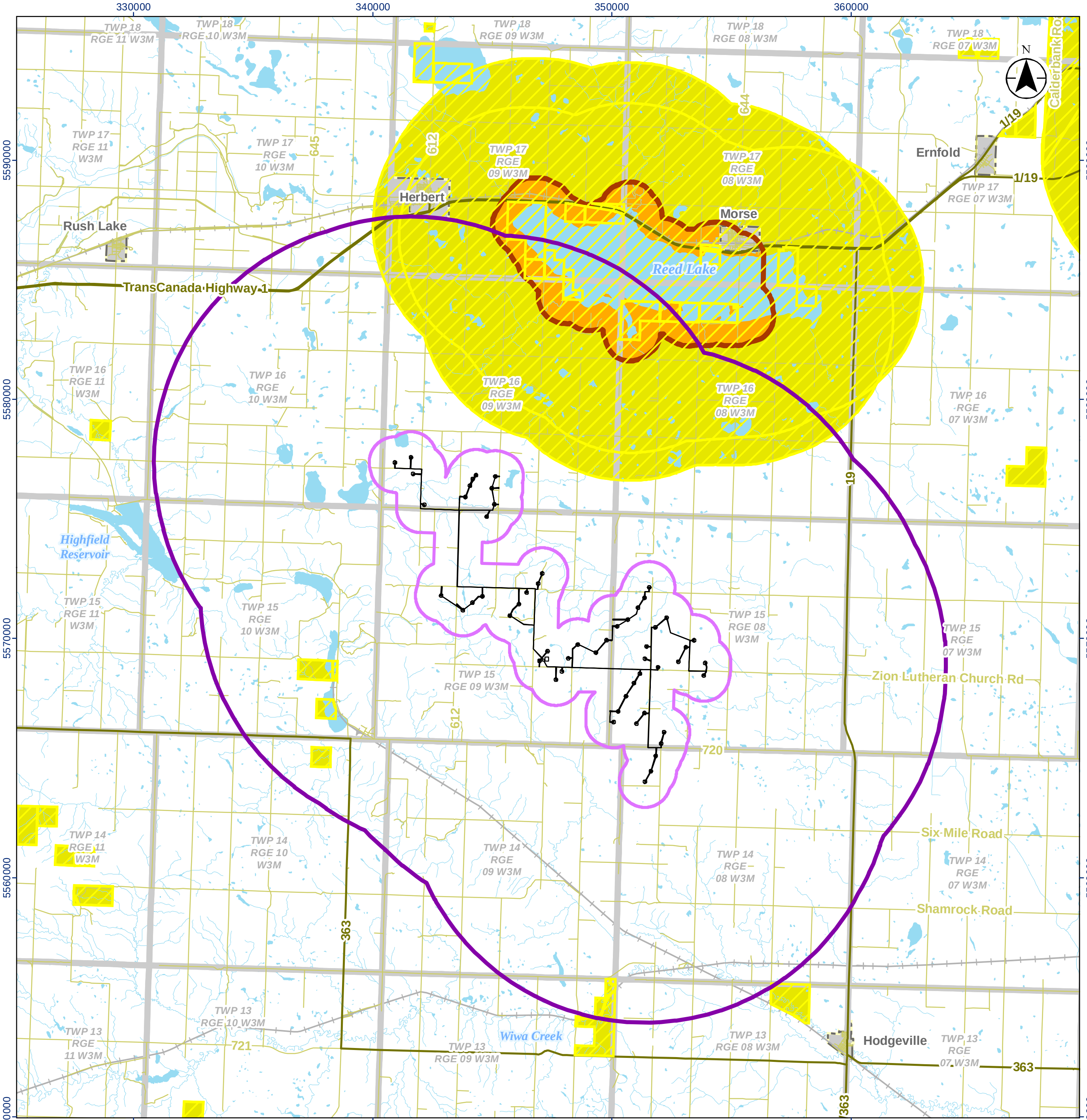


Project Development Area
Wildlife Local Assessment Area
Wildlife Regional Assessment Area
Important Bird Area of Canada
Wind Energy Project Avoidance Zones
Major Road
Minor Road
Railway
Watercourse
Waterbody
Town/City
Township

0 3 6 Kilometers
1:250,000 (at original document size of 8.5x11)

Notes
1. Coordinate System: NAD 1983 UTM Zone 13N
2. Base features produced under license from the Government of Saskatchewan and the Government of Canada.
3. Project Development Area based on Algonquin layout Sept 06, 2017, V3.

Stantec Algonquin

Project Location
Near Herbert, SK

113254088-020 REVF
Prepared by acory on 2017-12-18
Technical Review by ceidem on 2017-12-18

Client/Project
Algonquin Power Co.
Blue Hill Wind Energy Project

Figure No.
8-1

Title
Wildlife Assessment Areas

8.1.4.3 Administrative and Technical Boundaries

Administrative boundaries to the assessment of Project effects on wildlife and wildlife habitat are as follows:

- The federal SARA and regulations (Government of Canada 2002)
- Federal recovery plans, action plans, and management plans for SAR
- The provincial *Wildlife Act* (Government of Saskatchewan 1998) and *Wild Species at Risk Regulations* (Government of Saskatchewan 1999), and the *WHPA* (Government of Saskatchewan 1992).
- Provincial species rankings from the SKCDC (SKCDC 2017a)
- Wildlife siting guidelines for Saskatchewan Wind Energy Projects (SKMOE 2017a) avoidance zones
- Saskatchewan Activity Restriction Guidelines for Sensitive Species (SKMOE 2017b)
- Provincial Species Detection Survey Protocols for wildlife field surveys (SKMOE 2014c, 2014d, 2014e, 2014f, 2015a, 2015b)

8.1.5 Residual Effects Characterization

Residual Project-related environmental effects were evaluated considering direction, magnitude, geographic extent, frequency, duration, reversibility, and ecological and socio-economic context (see Table 8-2).

Table 8-2 Characterization of Residual Effects on Wildlife and Wildlife Habitat

Characterization	Description	Quantitative Measure or Definition of Qualitative Categories
Direction	The long-term trend of the residual effect	**Positive –** an effect that moves measurable parameters in a direction beneficial to wildlife and wildlife habitat relative to baseline. **Adverse –** an effect that moves measurable parameters in a direction detrimental to wildlife and wildlife habitat relative to baseline. **Neutral –** no net change in measurable parameters for Wildlife and Wildlife Habitat relative to baseline.

Table 8-2 Characterization of Residual Effects on Wildlife and Wildlife Habitat

Characterization	Description	Quantitative Measure or Definition of Qualitative Categories
Magnitude	The amount of change in measurable parameters or the VC relative to existing conditions	**Negligible –** no measurable change in wildlife and wildlife habitat measurable parameters. **Low –** Project is unlikely to have a measurable effect on abundance of wildlife in the LAA, although temporary local shifts in distribution might occur. **Moderate –** Project has an effect on the abundance and distribution of wildlife in the LAA, but is unlikely to have a measurable effect on the abundance of wildlife in the RAA. **High –** Project has an effect on the abundance of wildlife in the RAA.
Geographic Extent	The geographic area in which a residual effect occurs	**PDA –** residual effect restricted to the PDA **LAA –** residual effect extends into the LAA **RAA –** residual effect extends into the RAA
Duration	The period of time required until the measurable parameter or the VC returns to its existing condition, or the residual effect can no longer be measured or otherwise perceived	**Short-term** - residual effect restricted to the duration of the activity **Medium-term -** residual effect extends through construction and up to 10 years during operation, or throughout the operation phase alone **Long-term -** residual effect extends for the life of the Project and beyond decommissioning
Frequency	Identifies how often the residual effect occurs and how often during the Project or in a specific phase	**Single event -** residual effect occurs once throughout the assessment period **Multiple irregular event (no set schedule) -** residual effect occurs sporadically (and intermittently) throughout assessment period **Multiple regular event -** residual effect occurs repeatedly and regularly throughout assessment period **Continuous -** residual effect occurs continuously over the assessment period
Reversibility	Pertains to whether a measurable parameter or the VC can return to its existing condition after the project activity ceases	**Reversible –** residual effect is likely to be reversed after activity completion and/or reclamation **Irreversible –** residual effect is unlikely to be reversed
Ecological and Socio-economic Context	Existing condition and trends in the area where residual effects occur	**Undisturbed –** area is relatively undisturbed or not adversely affected by human activity **Disturbed –** area has been substantially previously disturbed by human development or human development is still present

8.1.6 Significance Definition

An overall determination of significance is made for the combined Project residual effects on wildlife and wildlife habitat for all Project phases (i.e., construction, operation and maintenance, and decommissioning) after mitigation is implemented. A significant adverse residual effect is defined as one that threatens the long-term persistence or viability of a SAR or SOMC in the RAA, including effects that are contrary to or inconsistent with federal (including recovery strategies and critical habitat) and provincial management objectives.

8.2 EXISTING CONDITIONS FOR WILDLIFE AND WILDLIFE HABITAT

This section addresses wildlife and wildlife habitat resources. This section outlines the methods and results of both the desktop review and field surveys completed in 2017.

8.2.1 Methods

8.2.1.1 Desktop Review

Existing information from provincial and federal databases, satellite imagery and literature sources were reviewed to determine known occurrences of wildlife SAR and SOMC, as well as their life history requirements, and habitat available in the RAA. The following data sources were reviewed:

- SKCDC wildlife database (historical wildlife SAR and SOMC observations and sensitive wildlife habitat features; HABISask 2017b, 2017c)
- COSEWIC status reports (Government of Canada 2017b)
- Species at Risk Public Registry recovery strategies and action plans (Government of Canada 2017b)
- Birds of North America Online database (Cornell Lab of Ornithology and the American Ornithologists' Union 2017)
- IBAs in Canada Online Database (Bird Studies Canada [BSC] and Nature Canada 2017)
- eBird online database (http://ebird.org/ebird/explore)
- Land cover data from the AAFC (AAFC 2015a) databases
- Satellite imagery such as ESRI World Imagery (ESRI 2017) and Google Earth (2017)
- Publicly available GIS spatial layers of protected lands. The Saskatchewan Representative Area Network spatial layer includes protected private and public lands (e.g., Ducks Unlimited project areas, conservation easements, provincial parkland, national parks, provincial community pastures, *Wildlife Habitat Protection Act* (WHPA) lands, and migratory bird sanctuaries) (HABISask 2017a).

8.2.1.2 Wildlife Habitat Availability

Desktop review of data sources provided information about potential and historical SAR and SOMC occurrences, sensitive features (e.g., perennial nests), and habitat types present within the LAA (i.e., land cover classes). Historical records, species ranges, life history requirements, and land cover available in the RAA were used to compile a list of potential SAR and SOMC that may interact with the Project (see Appendix H.1). Wildlife habitat availability was evaluated based on the land cover classes described in Table 7-4 (see Section 7.2.1.1). Because land cover classes represent broad habitat types (i.e., at a coarse scale), a habitat association approach was used to estimate habitat availability. Specifically, each land cover class was evaluated to determine whether or not it provided suitable habitat using knowledge of seasonal habitat requirements for each SAR and SOMC (see Appendix H.2).

Information from existing data sources was incorporated into a GIS database and was used to identify the types of wildlife surveys required (i.e., target SAR and SOMC) and their target locations (i.e., areas with suitable habitat). The land cover in the PDA and LAA was mapped using field verified polygons and the RAA was mapped using the AAFC (2015a) dataset. Section 7.2.1.1.3 describes methods for desktop land cover mapping and provides land cover definitions (see Table 7-4), and Photos 1 through 10 in Appendix G.2 provide examples of representative land cover in the LAA.

8.2.1.3 Field Surveys

Wildlife surveys were conducted in 2017 and focused on detecting wildlife SAR and SOMC occurrences and documenting wildlife species occupancy in various habitat types (e.g., native prairie, cultivated) across the landscape. At the time of field survey planning, the Project layout was not available; however, target quarter sections had been identified within the Project area (see Section 2.2). As such, wildlife surveys were planned to target areas of suitable wildlife habitat within the target quarter sections to identify sensitive features and characterize the wildlife community. These survey locations are shown on Figure 8-2 and results from these surveys were used to inform the Project layout. Suitable habitat was determined based on field-verified land cover information from the 2016 field reconnaissance survey. As wildlife surveys were conducted, locations of observed sensitive wildlife features (e.g., ferruginous hawk nest, sharp-tailed grouse lek) with spatial activity restrictions were communicated to Algonquin for use in planning the Project layout.

As the Project progressed, the Project layout was refined and finalized for the purposes of the EIS. As a result, some wildlife survey locations are not within the final wildlife LAA, which is determined based on the Project layout (see Table 8-3). As such, SAR and SOMC observed at survey locations outside the LAA are not included in the results (see Section 8.2.2). The exception was bird movement surveys. Since bird movement surveys describe the movement across the landscape all sites located within the Project area were included in the analysis (one site fell approximately 400 m outside the LAA). All wildlife species observed during 2017 field surveys are listed in Appendix H.4.

Wildlife surveys followed the Saskatchewan Government species detection survey protocols (SKMOE 2014c, 2014d, 2014e, 2014f, 2015a, 2015b), Alberta Environment and Parks (AEP) survey protocols identified by SKMOE (ESRD 2013a) or internal Stantec Standard Operating Procedures where the SKMOE protocols were not available (e.g., bird movement surveys). For surveys where no SKMOE or AEP protocol was available, the survey protocol executed was reviewed and approved by SKMOE prior to conducting field surveys. An SKMOE scientific research permit was obtained prior to conducting wildlife surveys (permits #17FW070) and data reported to the SKMOE in accordance with permit conditions.

Table 8-3 Wildlife Surveys Conducted During the 2017 Field Season

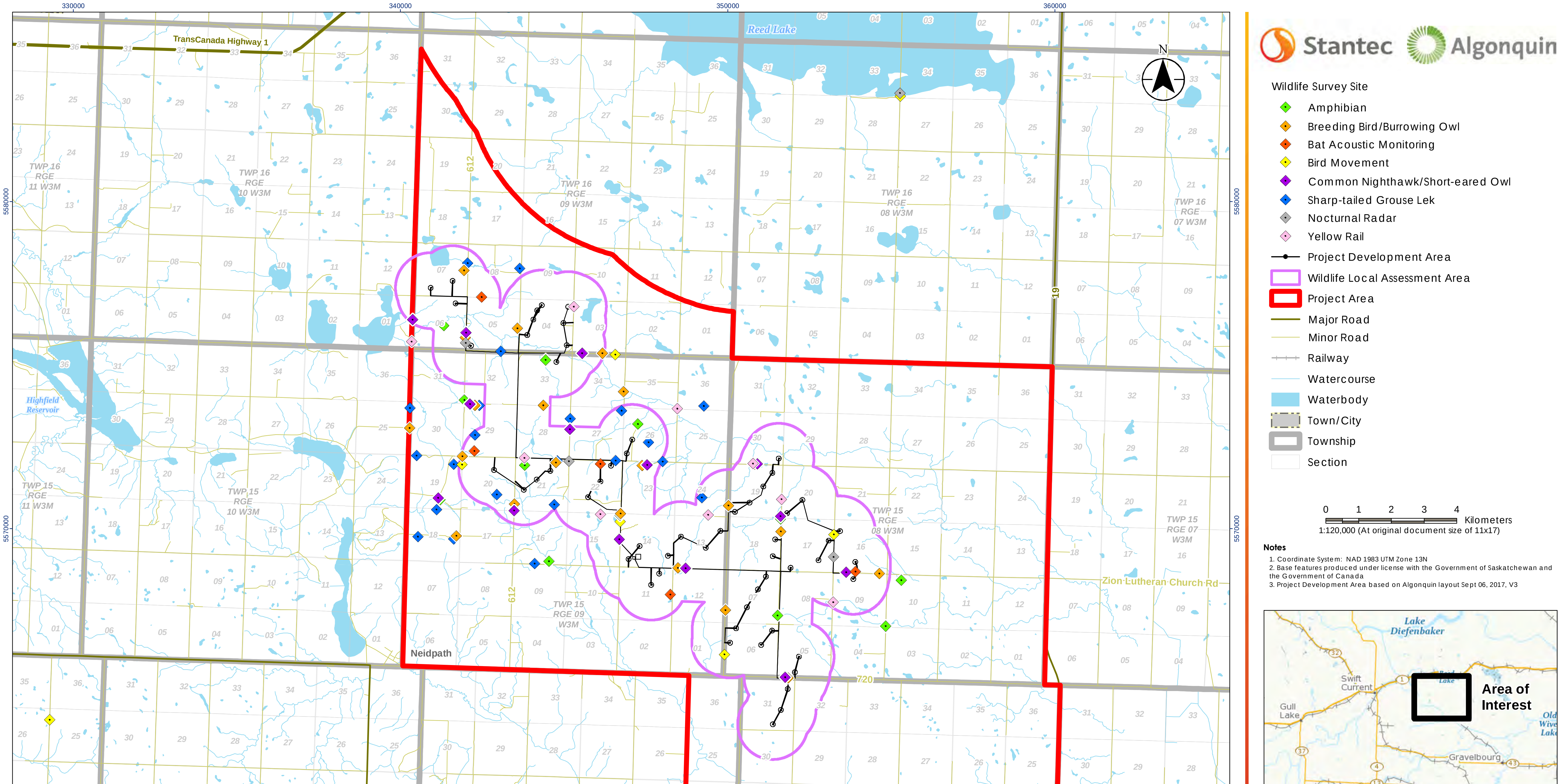
Field Survey	Total Number of Survey Locations[1]	Number of Survey Locations in LAA
Sharp-tailed Grouse Lek	24	12
Raptor Stick Nest[2]	-	-
Diurnal Bird Movement[3]	8	6
Nocturnal Radar[3]	5	5
Acoustic Bat	6	6
Breeding Bird and Burrowing Owl	21	17
Common Nighthawk and Short-eared Owl	13	11
Nocturnal Amphibian	13	8
Yellow Rail	9	7

NOTES:

[1] Survey locations within target quarter sections.

[2] All quarter section within Project area searched for raptor stick nest, no specific number of survey locations.

[3] Surveys targeted bird movement across landscape; includes 6 sites in the Project area and 2 control sites outside the Project area, all results included in analysis.



Notes

1. Coordinate System: NAD 1983 UTM Zone 13N
2. Base features produced under license with the Government of Saskatchewan and the Government of Canada
3. Project Development Area based on Algonquin layout Sept 06, 2017, V3

Project Location
Near Herbert, SK

113254088-026 REVF
Prepared by acory on 2017-12-18
Technical Review by jmdevink on 2017-12-18

Client/Project
Algonquin Power Co.
Blue Hill Wind Energy Project

Figure No.
8-2

Title
Wildlife Survey Locations

8.2.1.3.1 Sharp-tailed Grouse Lek Surveys

Sharp-tailed grouse (*Tympanuchus phasianellus*) lek surveys were conducted in early spring (April) to detect the presence of leks (i.e., traditional dancing grounds used by sharp-tailed grouse during mating season). Lek surveys were conducted at specific point count locations targeting native prairie and tame pasture.

Two survey visits were conducted between early April and late April. Surveys began one half hour before sunrise and concluded three hours after sunrise, and were conducted when there was no precipitation and winds were less than 20 km/h. At each site, there was a two-minute waiting period upon arrival to allow disturbance associated with site access to subside. This was followed by a five-minute observation period during which the observer scanned the horizon with binoculars looking for grouse. If a lek was observed, the number of male and female grouse were recorded as well as information about the surrounding habitat (ESRD 2013a).

8.2.1.3.2 Raptor Stick Nest Surveys

Raptor stick nest surveys were conducted in the early spring (April) before tree leaf-out to identify potential raptor nest sites. Surveys were conducted throughout the Project area to reflect the activity restriction setback for ferruginous hawk (SKMOE 2017b).

Two survey visits were conducted between early April and late April following sharp-tailed grouse lek surveys on the same days. Nests found during the first visit that could not be confirmed as active (i.e., no adults or young were observed at the nest) were re-checked during the second visit and any new observations recorded. Surveys were conducted during daylight hours when visibility was good (i.e., no precipitation or fog). Observers walked through all accessible quarters (i.e., landowner permission was granted) with suitable habitat and scanned all trees looking for stick nests. If land was not accessible then observations were made from the nearest road. If a stick nest was found, the observer documented the presence of adults and/or young, behaviour (e.g., defensive display or feeding young), and the size of the nest, location, and habitat (ESRD 2013a).

8.2.1.3.3 Spring and Fall Diurnal Bird Movement Surveys

Bird movement surveys were conducted to document species, flight path (i.e., height and direction) and habitat use during peak migration in the spring and fall. Surveys were conducted at six sites (Sites 1-6) within in the Project area. An additional two sites were intentionally located outside the Project area as control sites (Site 7 and 8) to provide a comparison of bird movement rates as control sites. Site 7 was located near Reed Lake to document bird movement at a major bird stop-over site, an area where high bird activity is expected. Site 8 was located north of the Centennial WEP to survey bird movement in a typical terrestrial agricultural landscape in Saskatchewan.

A total of three spring bird movement survey visits were conducted between mid-April and mid-May and four fall bird movement survey visits were conducted between early September and late October at each site (see the Bird Movement Technical Report in Appendix H.5 for more details). Each survey consisted of a 30-minute observation period where observations of birds in flight were recorded out to a 1 km radius from the survey point, where possible. In cases where there were visual obstructions preventing a full 1 km radius survey area, the percent of the survey area was recorded and the data corrected in relation to the proportion of the full survey area. Surveys targeted three distinct bird groups: waterbirds (e.g., pelicans, grebes), shorebirds (e.g., knots, plovers) and waterfowl (e.g., ducks, geese) combined, songbirds (e.g., sparrows, blackbirds), and raptors (e.g., hawks, eagles). Waterbirds, waterfowl and shorebirds were surveyed twice each visit (i.e., 1 hour total), once in the early morning a half hour before sunrise to one hour after sunrise and once in the evening one hour before sunset to a half hour after sunset. Songbirds were surveyed twice each visit in the morning between sunrise and 11:00 hr; due to an overlap with the waterbird window in the morning, one survey in the morning was a combined 30 minute waterbird/songbird survey. Raptors were surveyed twice (i.e., 2 concurrent 30 minute surveys) each visit in the middle of the day between 11:00 hr and 18:00 hr. For all birds observed within a 1 km radius during the movement survey, the species, number of individuals, flight path and behavioural data (e.g., flapping, perched, soaring) were recorded. Observations made beyond the 1 km radius were recorded as incidentals.

8.2.1.3.4 Spring and Fall Nocturnal Bird Radar Surveys

Three nocturnal bird radar survey sites were located in the LAA. Two additional control sites were established, one near Reed Lake and the other north of the Centennial WEP. Fewer sites were completed for radar surveys because they capture a larger radius (1.5 km radius) than do diurnal movement surveys (1 km radius), and tend to capture more migration movements, which are likely less variable across the landscape than diurnal bird movements.

Two visits at each site were completed in May to capture spring migration, and two survey visits were conducted between mid-August and early September to capture fall migration. Radar surveys were primarily targeting shorebird and passerine migration periods. Surveys were conducted during times with no precipitation between sunset and sunrise (~21:00 hr to 05:00 hr). Each season was split into two survey periods to account for the staggered arrival of shorebirds, passerines and some waterbird species.

Radar target (a single or group of birds in flight) data were collected with the radar in horizontal and vertical orientation. For horizontal target data, the radar operator managed the radar display and the data recorder plotted the flight path on a Trimble Navigation Ltd. Geo7X datalogger with a display that mirrored the radar display. For vertical target data, the radar operator measured the height when a target was first observed entering the detection cone and where it disappeared. The resulting minimum and maximum flight heights were recorded using the datalogger. Data recorded for each target included: target size (small, medium, large, or super large) number of individuals per target, guild and, where possible, species identification.

To relate radar target data to migrants potentially flying over the Project area, target calibration (based on visual observation of shorebirds and other species) was conducted in the evening at nearby wetlands immediately prior to nocturnal surveys. Target calibration involves the comparison of bird observations prior to sunset by one observer against what is observed by the radar. These comparisons allow for the validation of target size against number of birds in a group and species groups (refer to the Bird Movement Technical Report in Appendix H.5 for more details).

8.2.1.3.5 Acoustic Bat Activity Surveys

The bat activity surveys for the Project followed methods provided in the *Wildlife Directive for Alberta Wind Energy Projects* (Government of Alberta 2017), the *Bat Mitigation Framework for Wind Energy Development* (ESRD 2013b), and Lausen et al. (2010). Acoustic bat surveys were conducted during the spring monitoring period (May) and fall monitoring period (mid-July through mid-October) to determine bat activity rates. Proponents are required to report on data and bat mortality estimates in comparison to the *Bat Mitigation Framework for Wind Power Development* (ESRD 2013b), which states a fall monitoring period of August 1 to September 10. For this report, data was analysed for both the full fall monitoring period (i.e., mid-July to mid-October) and the period stated by ESRD (2013b) (i.e., August 1 to September 10).

A total of six AnaBat SD1 CF Bat Detectors (Titley Electronics) were installed at five sites within the Project area. Two detectors were installed on the Project's MET tower; one at a low elevation (2 m; MET1 Low detector) and one at a high elevation (approximately 43 m; MET1 High detector). The elevated detector was installed to provide information on bat activity within the turbine rotor-swept altitude, as ground (i.e., Low) detectors only reliably collect data on bats travelling from ground level up to approximately 30 m in height (Titley Scientific 2015). Ground level detectors (Ground 1, 2, 3 and 4) were installed at four additional ground sites to better understand the spatial distribution of bat activity in the Project area. To maintain consistency in data collection and allow data comparison, the four ground detectors were installed using the same parameters (i.e., height, orientation, and detector settings) as the MET Low detector. The ground sites were sited throughout the Project area to provide coverage in locations similar to where turbines might be constructed. All detectors were placed in the same locations during the spring and fall survey periods (see Appendix H.6 for more details).

Manual identification using AnalookW was used to complete analysis of the dataset. Considering the bat species in Saskatchewan and the inability to identify all bat passes to species due to call quality and overlapping call parameters between species, the following five groupings were used for species classification in this study when individual species classification was not possible (see Appendix H.6 for more details):

- **Low frequency bat**: includes big brown bat (*Eptesicus fuscus*), silver-haired bat (*Lasionycteris noctivagans*), and hoary bat (*Lasiurus cinereus*)

- **High frequency bat**: includes eastern red bat (*Lasiurus borealis*), long-eared bat (*Myotis evotis*), little brown myotis (*Myotis lucifugus*), and western small-footed bat (*Myotis ciliolabrum*)
- **Big brown bat or silver-haired bat**
- **Eastern red bat or little brown myotis**
- ***Myotis* species**: includes long-eared bat, little brown myotis, and western small-footed bat

8.2.1.3.6 Breeding Bird Surveys

Breeding bird surveys were conducted to document the presence of bird species, particularly SAR and SOMC, and their associated habitat. Surveys targeted representative habitat within the LAA including native prairie, tame pasture, hayland, and cultivated lands so that abundance could be assessed across the LAA based on habitat type.

Three survey visits were conducted between the last week of May and the end of June, spaced seven to 10 days apart. Surveys were conducted between sunrise and no more than four hours after sunrise under appropriate environmental conditions as outlined by the SKMOE (2014c) with modified temperature (air temperature above 0ºC) and wind speed (winds not greater than 20 km/h) thresholds due to common environmental conditions during the spring in southern Saskatchewan (i.e., wind above 12 km/h and temperatures below 7ºC). At each survey location, there was a two-minute waiting period upon arrival to allow disturbance associated with site access to subside. This was followed by a five-minute observation period during which all birds detected by sight and/or sound were recorded. Detection efforts were focused on a 100 m radius from the centre point of the survey location. Birds detected outside the 100 m radius were recorded as incidental observations. For each observation point, the habitat composition within the 100 m radius was recorded.

8.2.1.3.7 Burrowing Owl Surveys

Burrowing owl (*Athene cunicularia*) surveys were conducted in conjunction with the breeding bird surveys to detect the presence of burrowing owls and active burrows.

Three survey visits were conducted in the spring concurrently with breeding bird surveys between the last week of May and the end of June. Surveys were conducted between sunrise and no more than four hours after sunrise, under appropriate environmental conditions as outlined by the SKMOE (2014d) with modified temperature (air temperature above 0ºC) and cloud cover (any percent cloud cover) thresholds due to time restraints and common environmental conditions during the spring in southern Saskatchewan (i.e., temperatures below 22ºC and high cloud cover). At each site, observers performed a three-minute scan of the surroundings for burrowing owls. If burrowing owls were detected during the first three minutes, the survey continued silently for a second three-minute period. If no burrowing owls were detected, a burrowing owl call was broadcast for three minutes while observers continued to scan for owls. After the broadcast was completed, a silent one-minute scan of the landscape was performed. After the survey was complete, the location of any detected owls was approached to determine whether a nest or roost burrow was present for which any indications of recent activity (e.g., presence of pellets) were noted.

8.2.1.3.8 Common Nighthawk and Short-eared Owl Surveys

Common nighthawk (*Chordeiles minor*) and short-eared owl (*Asio flammeus*) surveys were conducted concurrently. Surveys targeted representative habitat within the LAA including native prairie, tame pasture, hayland, and cultivation.

Three survey visits were conducted between the last week of May and the end of June spaced approximately 10 days apart. Surveys were conducted between 1 hour before sunset and 30 minutes after sunset, under appropriate environmental conditions (i.e., winds less than 20 km/h and no rain) as outlined by the SKMOE (2015a, 2015b). At each site, observers performed a three-minute scan of the surroundings for common nighthawk or short-eared owl. If no common nighthawk were detected, a common nighthawk call was broadcast for three minutes while observers continued to scan for common nighthawks and short-eared owls.

8.2.1.3.9 Nocturnal Amphibian Surveys

Nocturnal amphibian surveys were conducted to detect potential breeding ponds for northern leopard frog (*Lithobates pipiens*), great plains toad (*Anaxyrus cognatus*), plains spadefoot (*Spea bombifrons*), and Canadian toad (*Anaxyrus hemiophrys*).

Five survey visits were conducted between mid-April and mid-June. For each target species, three survey visits covering the peak calling season where conducted (totaling five visits due to overlap in the peak calling season between species). The peak calling season for northern leopard frogs is between mid-April and mid-May, great plains toad and plains spadefoot toad is between early May and early July, and Canadian toad is between mid-May and mid-June. Surveys were conducted from 30 minutes after sunset until 0100, under appropriate environmental conditions (i.e., winds less than 20 km/h and precipitation no more than a light rain) as outlined by the SKMOE (2014e). At each site, there was a two-minute waiting period upon arrival to allow disturbance associated with site access to subside. This was followed by a three-minute observation period during which all calls heard where recorded using an abundance index outlined in the survey protocol (SKMOE 2014e) and species identified.

8.2.1.3.10 Yellow Rail Surveys

Yellow rail (*Coturnicops noveboracensis*) surveys targeted wetlands with suitable breeding habitat (i.e., wetlands with abundant grass like emergent vegetation).

Three survey visits were conducted between end of May and end of June spaced at least four days apart. Surveys were conducted during the peak calling period between 2300 and 0300, under appropriate environmental conditions (i.e., winds less than 20 km/h and no precipitation) as outlined by the SKMOE (2014f). At each site, observers performed a five-minute passive survey followed by a three-minute call playback survey if no rails were detected during the initial five-minute silent period. An additional two minutes of passive survey followed the call playback interval.

8.2.1.3.11 Incidental Wildlife Observations

Any wildlife SAR and SOMC observed incidentally during field surveys (i.e., not observed during a specific targeted survey) were recorded.

8.2.2 Results

The following section summarizes wildlife observations and wildlife habitat conditions in the PDA, LAA, and RAA, as determined through a review of existing information (desktop review) and field surveys.

8.2.2.1 Desktop Review

A search of the SKCDC database returned eight occurrences of SAR and SOMC within the RAA: seven bird SAR and one mammal SOMC. None of these historical occurrences overlapped the PDA, and ferruginous hawk was the only SAR with historical records at two locations in the LAA (see Table 8-4). No SAR critical habitat was found within the LAA (Harder 2016; pers. comm.).

Table 8-4 SKCDC Historical Occurrences of Wildlife SAR and SOMC within the PDA, Wildlife LAA and RAA

Common Name	Scientific Name	No. of occurrences within PDA	No. of occurrences within Wildlife LAA[1]	No. of occurrences within Wildlife RAA[2]
Birds				
Barn swallow	*Hirundo rustica*	0	0	1
Burrowing owl	*Athene cunicularia*	0	0	7
Ferruginous hawk	*Buteo regalis*	0	2	11
Loggerhead shrike	*Lanius ludovicianus excubitorides*	0	0	4
Long-billed curlew	*Numenius americanus*	0	0	1
Piping plover	*Charadrius melodus circumcinctus*	0	0	1
Sprague's pipit	*Anthus spragueii*	0	0	1
Mammals				
American badger	*Taxidea taxus taxus*	0	0	5

NOTES:
[1] Does not include records found within the PDA.
[2] Does not include records found within the PDA or LAA.
SOURCE:
Data obtained from HABISask 2017b, 2017c.

8.2.2.2 Wildlife Habitat Availability

The Project is located in the Mixed Grassland ecoregion, a semiarid climate, dominated by open grasslands with few trees, of which approximately 50% is under cultivation (Acton et al. 1998).

As described in Section 8.2.1.2, land cover was mapped in the PDA and LAA using field verified data and the RAA was mapped using the AAFC dataset. Due to the two different datasets used, some of the land cover categories differ between the PDA, LAA, and RAA as the AAFC dataset does not differentiate between hayland and tame pasture or classify wetlands. To make comparisons between the various project spatial boundaries, the land cover data for wetlands (Class I through VI), drainage, and dugout are identified here as water/wetland, the same as it is presented in the RAA (see Table 8-5). Similarly, the land cover of tame pasture and hayland are not split by the AAFC and are mapped together as 'pasture/forage'; as such, they are identified as a single land cover type in the PDA, LAA, and RAA (see Photos 1 through 10 in Appendix G.2 for representative land cover in the LAA). More detailed classification for water/wetlands and pasture/forage are provided for the PDA and LAA in Table 8-6.

A total of 30 wildlife SAR and 39 wildlife SOMC have the potential to occur within the RAA (see Appendix H.2). Cultivated lands, which provide suitable habitat for five SAR (e.g., long-billed curlew [*Numenius americanus*] and barn swallow [*Hirundo rustica*]) and five SOMC (e.g., nine-spotted lady beetle [*Coccinella novemnotata*] and western tiger salamander [*Ambystoma mavortium*])), currently represent the largest proportion of the PDA (62.5%), LAA (61.3%), and RAA (67.5%). Combined, tame pasture and hayland are the second most abundant land cover type in the PDA (28.0%), LAA (20.6%), and RAA (19.7%). Tame pasture provides suitable habitat for 16 SAR (e.g., burrowing owl and Sprague's pipit [*Anthus spragueii*]) and 15 SOMC (e.g., lark bunting [*Calamospiza melanocorys*] and American badger [*Taxidea taxus taxus*]), while hayland provides suitable habitat for 10 SAR (e.g., bobolink [*Dolichonyx oryzivorus*]) and 13 SOMC (e.g., lark bunting, sharp-tailed grouse).

The PDA is primarily sited on previously disturbed lands (i.e., land that has been previously broken such as cultivated land, tame pasture, hayland). At baseline, 31.4% of the PDA is considered suitable wildlife habitat which consists mostly of tame pasture and hayland (28% combined). The PDA avoids native prairie and water/wetlands where possible as shown by the relatively small amount of these habitat types in the PDA (0.4% and 2.9%, respectively) compared with the LAA (8.5% and 7.1%, respectively) (see Table 8-5). Native prairie and water/wetland provide suitable habitat for the largest number of SAR and/or SOMC. Seventeen SAR (e.g., bobolink and chestnut-collared longspur [*Calcarius ornatus*]) and 16 SOMC (e.g., plains hog-nosed snake [*Heterodon nasicus*] and big brown bat) have the potential to occur in native prairie; 21 SAR (e.g., yellow rail and northern leopard frog) and 48 SOMC (e.g., great blue heron [*Ardea herodias*] and black tern [*Chlidonias niger*]) have the potential to occur in water/wetland (see Appendix H.2).

Table 8-5 Land Cover Classes within the PDA, LAA, and RAA

Land Cover Class	PDA		LAA		RAA	
	Area (ha)	Proportion (%)	Area (ha)	Proportion (%)	Area (ha)	Proportion (%)
Water/Wetlands	4.4	2.9	628.2	7.1	3,698.5	4.7
Developed	9.9	6.3	205.5	2.3	1,486.3	1.9
Exposed Land/Barren	0.1	0.1	3.0	0.0	214.1	0.3
Cultivated	98.8	62.5	5,424.2	61.3	52,995.0	67.5
Pasture/Forage	44.3	28.0	1,823.0	20.6	15,496.4	19.7
Native Prairie	0.6	0.4	753.3	8.5	4,559.7	5.8
Shrubland	0.1	0.1	7.0	0.1	103.9	0.1
Total[1]	**158.2**	**100.3[1]**	**8,844.2**	**100.0**	**78,553.9**	**100.0**

NOTE:
[1] Proportion over 100% due to rounding errors in land cover classes.

Table 8-6 Subdivision of Water/Wetlands and Pasture/Forage Within the PDA and LAA

Land Cover Class	PDA		LAA	
	Area (ha)	Proportion (%)	Area (ha)	Proportion (%)
Water/Wetlands				
Class I – Ephemeral Wetland	0.0	0.0	36.5	0.4
Class II – Temporary Wetland	2.8	1.8	148.0	1.7
Class III – Seasonal Wetland	1.1	0.7	230.2	2.6
Class IV – Semi-Permanent Wetland	0.1	0.1	38.6	0.4
Class V – Permanent Wetland	0.0	0.0	31.6	0.4
Class VI – Alkaline Wetland	0.0	0.0	30.3	0.3
Drainage	0.4	0.3	107.4	1.2
Dugout	0.0	0.0	5.6	0.1
Pasture/Forage				
Hayland	31.4	19.8	796.8	9.0
Tame Pasture	12.9	8.2	1,026.2	11.6

No designated lands (e.g., Private Conservation Lands, WHPA lands, etc.) overlap with the PDA or LAA, as the Project was sited to avoid such lands. Within the RAA, there are 29 quarter sections of private and public designated lands, a Migratory Bird Concentration Site (MBCS), and an IBA (i.e., Reed Lake) (see Table 8-7).

WHPA lands, Private Conservation lands, and Fish and Wildlife Development Fund lands are areas that are protected or managed by the province. MBCSs are important staging and feeding areas where birds often concentrate while migrating between their summer breeding and overwintering grounds. IBAs are sites that support threatened bird species, and/or large groups of birds, and/or species with restricted range or habitat requirements (BSC and Nature Canada 2017). Reed Lake is designated as an IBA and as a Site of Hemispheric Importance by the Western Hemisphere Shorebird Reserve Network. The lake supports a significant number of staging waterfowl and shorebirds during spring and fall migration (BSC and Nature Canada 2017).

Table 8-7 Designated Lands within the PDA, LAA, and RAA

Key Areas of Wildlife Habitat	Number of Quarter Sections in the PDA	Number of Quarter Sections in the Wildlife LAA[1]	Number of Quarter Sections or Features in the Wildlife RAA[2]
Fish and Wildlife Development Fund Land (quarter sections)	0	0	8
Private Conservation Land (quarter sections)	0	0	5
WHPA Land (quarter sections)	0	0	16
Migratory Bird Concentration Site (MBCS)[3]	0	0	1
Important Bird Area (IBA)[3]	0	0	1

NOTES:
[1] Does not include records found within the PDA.
[2] Does not include records found within the PDA or LAA.
[3] MBCS and IBA are not recorded as quarter sections, the number represents 1 MBCS or 1 IBA (i.e., Reed Lake).

8.2.2.3 Field Surveys

8.2.2.3.1 Sharp-tailed Grouse Lek Surveys

Sharp-tailed grouse lek surveys were conducted at 12 sites in 2017 on April 11-12 and on April 25-26. A total of five active leks (i.e., multiple males were observed drumming at one location with females present) were recorded during targeted surveys and as incidentals in the LAA (see Appendix F). None of the leks overlap the PDA, as well as most of the 400 m activity restriction setback around the leks (see Appendix F). There is one lek in SW-04-16-09-W3M whose 400 m setback overlaps with the edge of a temporary workspace; however, during construction, the siting of the temporary workspace will be adjusted as much as possible to be outside of the activity restriction setback. There are also two leks (SE-06-16-09-W3M and SW-16-15-08-W3M) whose 400 m setbacks overlap collector lines along existing municipal roads; construction activities at these locations will occur outside of the activity restriction period (March 15 to May 15) and be confined to the existing road ROW.

8.2.2.3.2 Raptor Stick Nest Surveys

Raptor stick nest surveys, targeting ferruginous hawk (*Buteo regalis*) nest, were conducted in 2017 on April 11-12 and April 25-26. No active ferruginous hawk nests were observed in the LAA. Two active great horned owl (*Bubo virginianus*) nests and one active red-tailed hawk (*Buteo jamaicensis*) nest were observed in the LAA.

8.2.2.3.3 Spring and Fall Diurnal Bird Movement Surveys

Spring and fall bird movement survey results are presented in detail in the Bird Movement Technical Report (see Appendix H.5), with a summary of findings presented below. Survey locations are presented in Appendix F.

In the spring, survey visits were conducted between April 12 and 16, April 28 and May 1, and May 16 and 17, 2017. In the fall, survey visits were conducted between September 5 and 7, September 19 and 21, October 1 and 5, and October 17 and 18, 2017. Within the Project area, a total of 2,096 observations were made in the spring and 85,867 observations in the fall (Table 8-8). The highest recorded observations were songbirds (989 individuals, 47.2%) in the spring and waterfowl (83,749 individuals, 97.5%), primarily large flocks of snow geese, in the fall. Fall staging snow geese (*Anser caerulescens*), often observed flying in large flocks of several thousand individuals, represent 85.8% of the waterfowl observation. The abundance of snow geese in the Project area, typical of the prairies during fall migration, dominated fall observation numbers in the Project area and at the Reed Lake control site relative to other species. Data were therefore treated with and without snow geese to provide a more comprehensive understanding of risk. Snow geese, despite their overabundance in the Prairies (Environment and Climate Change Canada [ECCC] 2016), have not been observed in fatality monitoring reports (BSC et al. 2017).

Within the Project area, Sites 1 and 3 had the most observations in the spring (480 and 778 individuals, respectively) and Sites 4 and 5 had the most observations in the fall (39,387 and 24,268 individuals, respectively). For the control sites, Site 7 had the highest number of observations of all sites in the spring (5,642 individuals), which was an order of magnitude higher than the Project area sites; Site 8 had a similar number of observations (376 individuals) in the spring to the average (349 individuals) of the Project area sites (Table 8-8).

In the fall, Site 4 had the most observations (39,387 individuals). However, when snow geese observations are removed, as a few large flocks can greatly influence overall bird numbers, Site 7 again had the highest number of observations by an order of magnitude (Table 8-8). There were generally more bird movements at most sites within the Project area compared to the control site north of the Centennial WEP. This again was driven largely by waterfowl other than snow geese.

Overall, beyond Reed Lake having consistently higher numbers of bird movements, other than snow geese, there were no clear patterns in bird movement rates (i.e., sites with movement rates consistently an order of magnitude higher) when considering the spring and fall together.

Table 8-8 Summary of 2017 Diurnal Bird Movement Survey Results

Species Group[1]	Number of Individuals Observed							
	Site 1	Site 2	Site 3	Site 4	Site 5	Site 6	Site 7[2]	Site 8[2]
Spring Survey Period								
Waterfowl[3]	41	27	274	27	164	29	964	37
Waterbird[4]	77	1	57	0	44	31	4,002	2
Shorebird[5]	25	19	212	23	3	8	433	7
Raptor	10	8	10	7	4	6	3	11
Songbird	327	74	225	101	74	188	240	319
Spring Total	**480**	**129**	**778**	**158**	**289**	**262**	**5,642**	**376**
Fall Survey Period								
Waterfowl	470	8,227	8,837	39,226	23,377	3,612	20,296	177
Waterfowl without snow geese	395	1,645	2,252	3,129	2,504	124	9,836	177
Waterbird	0	0	1	0	0	0	2,184	0
Shorebird	0	0	0	0	0	1	130	0
Raptor	2	1	8	4	2	3	4	5
Songbird	262	161	398	157	889	229	232	123
Fall Total	**734**	**8,389**	**9,244**	**39,387**	**24,268**	**3,845**	**22,846**	**305**
Fall Total without snow geese	**659**	**1,807**	**2,659**	**3,290**	**3,395**	**357**	**12,386**	**305**

NOTES:

[1] Only targeted species observed during the appropriate timing interval are included (i.e., ducks are only counted if observed during the waterbird interval). All other observations were counted as incidentals and included in Appendix H.4.

[2] Control sites located outside of the Project area.

[3] Waterfowl group includes species such as ducks, geese and swans.

[4] Waterbird group includes species such as pelicans, grebes, gulls, terns and herons.

[5] Shorebird group includes species such as knots, plovers and sandpipers.

[6] Songbird group includes species such corvids, passerines, gamebirds.

During the spring bird movement surveys, five SAR (long-billed curlew [*Numenius americanus*], western grebe [*Aechmophorus occidentalis*], ferruginous hawk, barn swallow, and Sprague's pipit) and one SOMC (red-necked phalarope [*Phalaropus lobatus*]) were recorded. Sprague's pipit and red-necked phalarope were both recorded in the Project area and at Site 7 and ferruginous hawk was only observed within the Project area; the remaining species were only observed at Site 7 (i.e., control site near Reed Lake).

During the fall bird movement surveys, three SAR (horned grebe, western grebe, and barn swallow) were recorded at Site 7. No SAR or SOMC observations were recorded within the Project area.

8.2.2.3.4 Spring and Fall Nocturnal Bird Radar Surveys

Spring and fall nocturnal bird radar survey results are presented in detail in the Bird Movement Technical Report (see Appendix H.5) with a summary presented below. Survey locations are presented in Appendix F.

Spring surveys were conducted between May 5 and 10 and May 26 and 31, 2017 and fall surveys from August 12 and 17 and September 6 and 11, 2017. Within the Project area (Sites 1, 3 and 5), a total of 6,498 targets (i.e., horizontal and corrected vertical targets combined) were observed during both spring and fall (Table 8-9). Approximately 65% more targets were recorded during spring (4,042) compared to fall (2,454) and approximately 40% more vertical targets (i.e., targets recorded when the radar was in the vertical orientation) (3,802) were recorded compared to horizontal targets (i.e., targets recorded when the radar was in the horizontal orientation) (2,694). The majority of targets were observed at night (vs. dusk and dawn) during fall (89%), while a lower proportion of targets were observed at night during spring (70%). Dusk and dawn refer to the periods of 30 minutes after sunset and before sunrise, respectively. The distribution of targets varied seasonally among the three sites, with the highest number of targets in the spring recorded at Site 3 (1,880) and the highest number of targets in the fall recorded at Site 5 (1,282). Site 1 had the highest number of targets combined for both seasons (2,328; spring – 1,469, fall – 859). Therefore, there was no clearly discernible movement rate pattern within the Project area that would warrant an avoidance in siting Project turbines or infrastructure.

Table 8-9 Number of Targets Recorded during 2017 Nocturnal Radar Survey

Site ID	Spring		Fall		Combined Seasons		
	Horizontal	Vertical	Horizontal	Vertical	Horizontal	Vertical	Total
Project Area							
Site 1	639	830	475	384	1,114	1,214	2,328
Site 3	644	1,236	186	128	830	1,364	2,194
Site 5	376	318	374	908	750	1,226	1,975
Total	**1,659**	**2,383**	**1,035**	**1,419**	**2,694**	**3,804**	**6,498**
Control Sites							
Centennial	617	1,204	576	1,496	1,193	2,700	3,893
Reed Lake	960	649	664	563	1,624	1,212	2,836
Total	**1,577**	**1,853**	**1,240**	**2,059**	**2,817**	**3,912**	**6,729**

More targets were recorded at both control sites (i.e., Reed Lake and Centennial Wind Project) compared to sites in the Project area (Table 8-9). The highest number of targets was recorded at the site near the Centennial WEP (3,893 total; spring – 1,821; fall – 2,072), with approximately 40% fewer targets recorded at the site near Reed Lake (2,836 total; spring – 1,609; fall – 1,227). As with sites in the Project area, more targets were recorded at control sites during spring and more vertical targets were recorded compared to horizontal targets. At both control sites, a higher proportion of targets were recorded at night (vs. dusk and dawn) during fall compared to spring.

Approximately 90% of targets recorded in the Project area were small (e.g., passerines), indicating the movement of individual birds or groups of a few small birds. Very large targets (e.g., large flocks of waterfowl), were not observed during nocturnal radar surveys (see Appendix H.5 for target size definitions and examples). The number of medium and large-sized targets was similar during spring (368) and fall (317) surveys. The highest number of medium and large-sized targets was recorded at Site 3 during spring and Site 1 during fall.

The number of medium and large-sized targets was greater at the site near Reed Lake compared to the site near the Centennial WEP in both spring and fall. In addition, more medium and large-sized targets were recorded near Reed Lake compared to those recorded at sites within the Project area. This suggests bird species and group sizes were more similar between the Project area and control site near the Centennial WEP than compared to the Reed Lake control site.

8.2.2.3.5 Acoustic Bat Activity Surveys

Spring and fall acoustic bat survey results are presented in detail in the Pre-Construction Bat Monitoring Report (see Appendix H.6) with a summary presented below. Survey locations are presented in Appendix F.

During the spring monitoring period (May 1 to May 31, 2017), migratory bat activity rates for all detectors ranged from 0 to 0.2 migratory bat passes per detector night, with an average of 0.1 migratory bat passes per detector night (Table 8-10). During this same monitoring period, total bat activity rates (i.e., both migratory and non-migratory bats) ranged from 0 to 0.3 total bat passes per detector night, with an average of 0.1 total bat passes per detector night. The Ground 1 detector recorded the highest levels of both total and migratory bat activity in the Project area, with 0.3 total and 0.2 migratory bat passes per detector night, respectively. This was likely due to the proximity of the detector to treed shelterbelts. The MET 1 High detector recorded no bat passes and Ground 2 recorded only one bat pass during the spring monitoring period (Table 8-10).

During the full fall monitoring period (July 15 to October 15), migratory bat activity rates for all detectors ranged from 0.3 to 0.9 migratory bat passes per detector night, with an average of 0.5 migratory bat passes per detector night. During the August 1 to September 10 Alberta monitoring period (ESRD 2013b), migratory bat activity averaged 1.0 bat passes per detector night (Table 8-10). Migratory bat activity peaked in early August with a range of 1.17 to 2.17 migratory bat passes recorded between August 5 and August 12, 2017, and again in late August, with a range of 2.5 to 4.0 migratory bat passes recorded between August 23 and August 26, 2017.

Table 8-10 Summary of 2017 Acoustic Bat Activity Surveys

	Detector						
	Ground 1	Ground 2	Ground 3	Ground 4	MET 1 High	MET 1 Low	Average[2]
Spring							
Total[1] Bat Passes Per Detector Night	0.3	0.0	0.1	0.1	0.0	0.1	0.1
Migratory Bat Passes Per Detector Night	0.2	0.0	0.1	0.1	0.0	0.1	0.1
Fall							
Total[1] Bat Passes Per Detector Night from July 15 to October 15	1.4	0.5	0.4	0.7	0.8	0.7	0.7
Migratory Bat Passes Per Detector Night from July 15 to October 15	0.9	0.3	0.3	0.5	0.8	0.6	0.5
Total[1] Bat Passes Per Detector Night from August 1 to September 10	2.5	0.7	0.6	1.3	1.6	1.3	1.3
Migratory Bat Passes Per Detector Night from August 1 to September 10	1.7	0.4	0.4	1.0	1.5	1.1	1.0

NOTES:

[1] Total refers to migratory and non-migratory bat passes.

[2] Average bat pass per detector night for all detectors, based on total bat passes per night divided by number of functioning detectors.

The most common species or species grouping in the Project area during the spring and fall monitoring periods was the big brown (*Eptesicus fuscus*)/silver-haired (*Lasionycteris noctivagans*) grouping, followed by the *Myotis* species group. The big brown/silver-haired bat group was recorded consistently throughout both the spring and fall monitoring periods. In the spring, *Myotis* species were recorded at the beginning and end of the monitoring period (i.e., in early and late-May) and in the fall they were detected mainly in the first portion (i.e., late July to early September) of the monitoring period.

The highest levels of bat activity during both the spring and fall monitoring periods were observed at Ground 1, which was located approximately 150 m south of treed shelterbelts, which could potentially provide roosting habitat, followed by Ground 4, which was located approximately 600 m east of an abandoned farmstead, which could also provide roosting habitat. Ground 1 also had the highest observations of *Myotis* species in the spring and fall monitoring period.

8.2.2.3.6 Breeding Bird Surveys

Three survey visits of breeding bird surveys were conducted at 17 point count locations (see Appendix F) in 2017 on May 27-28, June 8-10, and June 22-23. The dominant land cover (i.e., greater than 75% of the total habitat), within a 100 m radius of the point count centre, was recorded at each site. Of the 17 sites surveyed, 7 were cultivated, 4 mixed cultivated and perennial (e.g., 50% cultivated and 50% hayland), 2 mixed native and perennial (e.g., 60% native prairie and 40% hayland), 2 tame pasture, 1 native prairie, and 1 hayland.

A total of 32 species and 513 individuals were recorded during the breeding bird surveys (Table 8-11). Four SAR (Sprague's pipit, Baird's sparrow [*Ammodramus bairdii*], barn swallow, and bobolink) (Table 8-11 and Appendix F) were observed and, with the exception of barn swallow, all are typically grassland-associated species (see Appendix H.3).

Site 21, a survey point in cultivated land, contained part of a Class IV wetland where many wetland-dependent species were recorded including mallard (*Anas platyrhynchos*), gadwall (*Mareca strepera*), northern pintail (*Anas acuta*), northern shoveler (*Spatula clypeata*), blue-winged teal (*Spatula discors*), lesser scaup (*Aythya affinis*), great blue heron (*Ardea herodias*), sora (*Porzana carolina*), American coot (*Fulica americana*), and killdeer (*Charadrius vociferus*). Eighteen bird species were recorded in cultivated lands excluding the 10 wetland-dependent species; 17 species were recorded at mixed cultivated and perennial sites (Table 8-11). Sites with perennial land cover (i.e., mixed perennial, tame pasture, and/or hayland) recorded 11 species.

Table 8-11 Avian Species Observed within the LAA during 2017 Breeding Bird Surveys

Common Name[1]	Scientific Name	No. of Individuals Observed per Land Cover[2]					
		Native Prairie	Tame Pasture	Hayland	Cultivated	Mixed Perennial[3]	Mixed Cultivated and Perennial[4]
Blue-winged teal	*Spatula discors*	0	0	0	28*	0	0
Northern shoveler	*Spatula clypeata*	0	0	0	6*	0	0
Gadwall	*Mareca strepera*	0	2	0	6*	0	0
Mallard	*Anas platyrhynchos*	0	0	0	10*	0	0
Northern pintail	*Anas acuta*	0	0	0	5*	0	0
Lesser scaup	*Aythya affinis*	0	0	0	2*	0	0
Gray partridge	*Perdix perdix*	0	0	0	2	0	0
Sharp-tailed grouse	*Tympanuchus phasianellus*	0	0	0	0	0	2
Mourning dove	*Zenaida macroura*	0	0	0	1	0	0
Sora	*Porzana carolina*	0	0	0	1*	0	0
American coot	*Fulica americana*	0	0	0	10*	0	0
Killdeer	*Charadrius vociferus*	0	0	0	2*	0	1
Wilson's snipe	*Gallinago gallinago*	0	0	0	1	1	2
Willet	*Catoptrophorus semipalmatus*	2	0	1	2	0	0
Great blue heron	*Ardea herodias*	0	0	0	1*	0	0
Western kingbird	*Tyrannus verticalis*	0	0	0	1	0	0
Eastern kingbird	*Tyrannus tyrannus*	0	0	0	3	2	1
Horned lark	*Eremophila alpestris*	2	9	2	51	0	8
Barn swallow	***Hirundo rustica***	**0**	**0**	**0**	**0**	**0**	**10**
American robin	*Turdus migratorius*	0	0	0	2	0	0
Sprague's pipit	***Anthus spragueii***	**5**	**0**	**0**	**2**	**1**	**0**

Table 8-11 Avian Species Observed within the LAA during 2017 Breeding Bird Surveys

Common Name[1]	Scientific Name	No. of Individuals Observed per Land Cover[2]					
		Native Prairie	Tame Pasture	Hayland	Cultivated	Mixed Perennial[3]	Mixed Cultivated and Perennial[4]
Clay-colored sparrow	*Spizella pallida*	2	5	5	8	5	15
Vesper sparrow	*Pooecetes gramineus*	2	4	2	9	1	4
Savannah sparrow	*Passerculus sandwichensis*	5	5	2	17	5	12
Grasshopper sparrow	*Ammodramus savannarum*	2	3	1	4	4	2
Baird's sparrow	***Ammodramus bairdii***	**7**	**7**	**4**	**0**	**6**	**2**
Le Conte's sparrow	*Ammodramus leconteii*	0	0	0	0	0	2
Bobolink	***Dolichonyx oryzivorus***	**0**	**1**	**5**	**3**	**0**	**4**
Western meadowlark	*Sturnella neglecta*	3	7	3	20	8	14
Red-winged blackbird	*Agelaius phoeniceus*	0	6	6	21	10	7
Brewer's blackbird	*Euphagus cyanocephalus*	0	0	0	13	0	12
Brown-headed cowbird	*Molothrus ater*	1	1	1	9	6	13
Total		**31**	**50**	**32**	**240**	**49**	**111**

NOTES:

[1] Bold names indicate an SAR and/or SOMC.

[2] To accurately document breeding birds in a prairie environment, the following breeding bird survey data was excluded from the final dataset: a) pelicans, cormorants, geese, gulls, terns, raptors, and corvids because these species have large territories or habitually feed far from their breeding territory; b) duplicate observations between the 1st and 2nd five-minute survey period to avoid double counting; c) unknown species; d) all fly-by observations; and e) observations located outside the 100 m observation radius; these observations are considered incidentals.

[3] Habitat was mixed perennial cover (i.e., tame pasture and/or hayland).

[4] Habitat was mixed perennial cover and cultivated (i.e., hayland and annual crop).

* Individuals in cultivated observed at a Class IV wetland at Site 21.

8.2.2.3.7 Burrowing Owl Surveys

Three survey visits of burrowing owl surveys were conducted at 17 point count locations (see Appendix F) in 2017 on May 27 -28, June 8-10, and June 26-27. No burrowing owls or burrows were detected during targeted surveys or as incidental observations.

8.2.2.3.8 Common Nighthawk and Short-eared Owl Surveys

Three survey visits of common nighthawk and short-eared owl surveys were conducted at 11 sites (see Appendix F) in 2017 on May 29-30, June 9-10, and June 26-27. No common nighthawks or short-eared owls were observed during targeted surveys. One short-eared owl was observed as an incidental during amphibian surveys on April 20 and another one on May 1 (see Appendix F).

8.2.2.3.9 Nocturnal Amphibian Surveys

Five survey visits of nocturnal amphibian surveys were conducted at eight sites (see Appendix F) in 2017 on April 20-21, May 1-2, May 18-19, May 29-31, and June 9-10. One northern leopard frog was detected calling from a Class IV wetland during targeted surveys (NE-13-15-09-W3M, see Appendix F); this wetland is considered a northern leopard frog breeding pond based on this observation. The 500 m activity restriction setback around this feature overlaps the edge of a temporary workspace; however, during construction, the siting of the temporary workspace will be adjusted, as much as possible, to be outside of the activity restriction setback.

Two additional northern leopard frogs were observed as incidentals during vegetation surveys (NW-21-15-09-W3M; see Appendix F). No Canadian toad, great plains toad, or plains spadefoot were observed during targeted surveys or as incidentals.

8.2.2.3.10 Yellow Rail Surveys

Three survey visits of yellow rail were conducted at seven sites in 2017 on May 29-31, June 9-10, and June 26-27 (see Appendix F). No yellow rails were detected during targeted surveys or as incidental observations.

8.2.2.3.11 Incidental Wildlife Observations

A total of 11 SAR and two SOMC were observed as incidentals during wildlife and vegetation surveys in 2017 within the LAA (Table 8-12 and Appendix F).

Table 8-12 Incidental Wildlife SAR and SOMC Observed in the LAA during 2017 Field Surveys

Common Name	Scientific Name	No. of Individuals
Amphibian		
Northern leopard frog	*Lithobates pipiens*	2
Birds		
Ferruginous hawk	*Buteo regalis*	3
Peregrine falcon	*Falco peregrinus anatum*	1
Short-eared owl	*Asio flammeus*	1
American bittern	*Botaurus lentiginosus*	1
Common nighthawk	*Chordeiles minor*	1
Loggerhead shrike	*Lanius ludovicianus excubitorides*	1
Barn swallow	*Hirundo rustica*	18
Sprague's pipit	*Anthus spragueii*	9
Chestnut-collared longspur	*Calcarius ornatus*	4
Baird's sparrow	*Ammodramus bairdii*	12
Bobolink	*Dolichonyx oryzivorus*	13
Mammals		
American badger	*Taxidea taxus taxus*	1

8.3 PROJECT INTERACTIONS WITH WILDLIFE AND WILDLIFE HABITAT

Table 8-13 identifies, for each potential effect, the physical activities that might interact with the VC and result in the identified environmental effect. These interactions are indicated by check mark and are discussed in detail in Section 8.4, in the context of effects pathways, standard and project-specific mitigation/enhancement, and residual effects. A justification for no effect is provided following the table.

Table 8-13 Project-Environment Interactions with Wildlife and Wildlife Habitat

Physical Activities	Potential Environmental Effects	
	Change in Habitat Availability	Change in Mortality Risk
Construction		
Site preparation, including clearing and grading of WTG locations, access roads, and temporary work spaces	✓	✓
Installation of WTG foundations and turbine erection	✓	--
Installation of collector lines and substation	✓	✓
Reclamation and site landscaping	✓	✓
Operation and Maintenance		
Operation of WTGs and substation, including access road use	✓	✓
WTG routine and unplanned maintenance	✓	✓
Routine and unplanned maintenance of collector and substation infrastructure	--	✓
Decommissioning		
Equipment dismantling, access removal, collector and substation removal	✓	✓
Site reclamation	✓	✓
NOTES: ✓ = Potential interaction – = No interaction		

8.4 ASSESSMENT OF RESIDUAL ENVIRONMENTAL EFFECTS ON WILDLIFE AND WILDLIFE HABITAT

8.4.1 Analytical Assessment Techniques

Change in habitat availability through direct habitat loss was assessed quantitatively by calculating the amount of land cover within the LAA that will change as a result of the Project. While habitat is species-specific, land cover classes deemed as suitable wildlife habitat were used as a general metric to represent habitat for SAR and SOMC based on known habitat characteristics and field surveys (see Appendix H.3). No SAR critical habitat was identified within the LAA (Harder 2016; pers. comm.); therefore, effects of the Project to this designated habitat was not considered further.

Areas that would be rehabilitated as a result of access road narrowing (25 m to 5 m) post-construction, and areas that would naturally recover (collector line plough lines) following completion of construction were included in the calculation of overall net habitat loss to be conservative.

The assessment of indirect habitat loss through decreased use or availability was based on scientific literature that examined wildlife response to disturbance, with particular focus on construction activity (e.g., noise, light, vehicle traffic) and operation of WTGs.

Mortality risk was assessed differently for birds and bats. Alberta's *Bat Mitigation Framework for Wind Power Development* (ESRD 2013b) guideline were used for the assessment of mortality risk to bats given similarities in species and landscape (there are no such Saskatchewan-specific pre-construction guidelines). Baerwald and Barclay (2009) reported a statistically significant relationship between migratory bat activity rates at 30 m above ground and corrected fatality rates observed at wind farms in southern Alberta with turbines greater than 65 m height. The relationship ($r^2 = 0.31$, $P = 0.023$) was relatively weak and based on a sample size of only five WEPs (Baerwald and Barclay 2009); thus, a high degree of uncertainty remains on the actual mortality rates of a WEP based on 69% of the variance in mortality rates remaining unexplained by these models.

These guidelines apply a correlation of one bat pass per detector night to four bat fatalities per turbine per year, based on the findings of Baerwald and Barclay (2009), and designate the following potential risk categories for bat mortality:

- Low risk – less than 1 migratory bat pass per detector night
- Moderate risk – 1-2 migratory bat passes per detector night
- High risk – greater than 2 migratory bat passes per detector night

Observed bat activity rates (expressed as migratory bat passes per detector night) for the LAA were compared to the above guidelines to assess the potential change in mortality risk for bats due to Project development.

Predicting bird mortality rates from strikes with WEPs, especially on a species-specific basis, is challenging and has been described as indicative at best, rather than a true quantification (Madders and Whitfield 2006, USFWS 2012). Such an assessment has generally not been attempted for WEPs because of current uncertainties related to:

- Changes in bird movement patterns from pre- to post-construction to avoid turbines;
- Species-specific movement patterns and use of areas during the nocturnal period;
- Species-specific collision susceptibility rates; and
- Effects of site-specific environmental variables (e.g., wind and fog) that influence collision susceptibility.

In a review of effects of wind energy developments on birds and bats, Rydell et al. (2012) summarized results from a study which noted that 62% of observations from 91 bird species showed that individuals changed either direction or altitude of flight when encountering WTGs. d'Entremont et al. (2017) also noted that flight altitudes of nocturnal migrant birds also increased in a WEP area. As such, the assessment of change in mortality risk for birds was semi-quantitative and based on characterization of current conditions in the Project area and available information (such as described above) from similar developments.

8.4.2 Change in Habitat Availability

8.4.2.1 Project Pathways

Habitat availability refers to the existence of conditions suitable for the life requirements of wildlife. As such, availability of suitable habitat is important to the persistence of wildlife species at both a local and regional scale. Habitat change can occur:

- directly through the removal or disturbance of habitat due to construction activities,
- indirectly through changes in habitat effectiveness caused by sensory disturbance (i.e., from WTG operation), or avoidance of the PDA (e.g., disturbance from vehicles along roads), or
- from fragmentation of habitat through land cover changes that divide and segregate patches of suitable habitat.

8.4.2.1.1 Construction

8.4.2.1.1.1 Direct Habitat Loss

Loss of natural vegetation (e.g., native prairie, shrubland and wetlands) and other suitable habitat (i.e., pasture/forages) due to construction activities (e.g., vegetation clearing, grading of WTG locations, access road construction) has the potential to result in direct habitat loss for wildlife. Access roads and WTGs are primarily sited on cultivated lands, which have a low potential to support wildlife.

Construction may also decrease habitat availability for breeding, foraging, and overwintering wetland-associated species through direct loss of wetlands or effects to wetland function.

8.4.2.1.1.2 Sensory Disturbance

Temporary sensory disturbance associated with construction activities (e.g., noise, light) has the potential to result in indirect habitat loss for species sensitive to such an effect (Habib et al. 2007). Responses vary depending on species and individuals and might include elevated heart rate (i.e., stress), loss of productivity, or habitat or nest abandonment resulting in changes in distribution and local abundance. For example, some amphibians are sensitive to noise and vibrations (Narins 1990), as well as artificial lighting (Longcore and Rich 2004, Chepesiuk 2009); male sharp-tailed grouse have shown intolerance to human activity near leks (Baydack 1986), and ferruginous hawks have deserted nests in areas near increased human activity (White and Thurow 1985). Through reduction in the area of habitat suitable for reproduction, sensory disturbance can affect breeding success (Bayne et al. 2008, Francis and Barber 2013).

8.4.2.1.2 Operation and Maintenance

8.4.2.1.2.1 Direct Habitat Loss

Direct habitat loss is not expected to occur during operation and maintenance, though effects from construction (i.e., habitat loss due to long-term project components) will continue into operation where Project infrastructure has converted suitable habitat land covers to developed lands. Regrowth of vegetation will occur at temporary workspace locations during operation and maintenance, thereby reducing the total amount of habitat lost.

8.4.2.1.2.2 Sensory Disturbance

Indirect habitat loss may continue to affect wildlife habitat availability during operation through sensory disturbance. Operating facilities (i.e., WTGs and substation) will emit noise and light during operation that may result in reduced use of adjacent areas by wildlife (Habib et al. 2007, Bayne et al. 2008, Francis and Barber 2013, Read et al. 2014). Similarly, noise from vehicles during maintenance operations can result in temporary disturbance of wildlife using areas adjacent to access roads. The behaviour of birds and other wildlife are known to be influenced by noise

(Francis et al. 2009), though Brumm (2004) reported that birds may adapt behaviourally to noise disturbance by increasing their song volume. The Swedish EPA (Rydell et al. 2012) reported that operational WEPs have no effect on the behavior of mammals as they adapt to the new structures on the landscape.

Wildlife behavioural changes associated with wind-energy facilities appear to be species- and site-specific. Studies in the United States and Europe have found avoidance distances of 0 to 800 m depending on the season and species (Kingsley and Whittam 2005, Drewitt and Langston 2006). One study on nesting grassland birds found lower densities within 0 to 180 m of turbines with densities decreasing by more than 50% within 50 m of the turbines (Leddy et al. 1999). Another study on nesting grassland birds observed displacement behaviour in seven songbird species with displacement generally occurring within 100 m of WTGs and extending up to 300 m, depending on the species (Shaffer and Buhl 2015).

Results from other studies suggest that wind farms do not affect bird distribution (Powlesland 2009, Niemuth et al. 2013).

The noise associated with WTGs may also affect the quality of adjacent wetland habitat for wetland-dependent amphibian and birds (e.g., northern leopard frog, yellow rail). Frequent noise from operating WTGs may prevent breeding calls from being heard (e.g., rails and amphibians), which may result in reduced reproductive success and site abandonment (Narins 1990, Habib et al. 2007).

The extent to which turbines affect the distribution of birds may be related to the existing background level of disturbance. As the LAA is primarily an agricultural landscape, a disturbance area of 200 m from WTGs was selected based on the above literature to represent the area that would likely have reduced habitat suitability for nesting birds.

8.4.2.1.3 Decommissioning

8.4.2.1.3.1 Direct Habitat Loss

During the decommissioning phase, direct habitat loss is only expected within temporary workspaces. Project infrastructure, including WTGs, substation, and access roads, will be decommissioned and removed from the Project area. Once decommissioning is complete, disturbed areas will be revegetated thereby increasing the amount of habitat available for wildlife.

8.4.2.1.3.2 Sensory Disturbance

Effect mechanisms for indirect habitat loss during decommissioning activities will be similar to those during construction. Sensory disturbance from decommissioning activities may cause temporary behavioural changes in wildlife, potentially leading to abandonment of breeding and/or wintering residences. Also, wildlife may be temporarily displaced from areas adjacent to access roads and Project infrastructure due to noise and lights emitted by vehicles and decommissioning equipment.

8.4.2.2 Mitigation

Project-specific mitigation measures, along with standard industry practices, best management practices, and avoidance measures, will be implemented during all Project phases to reduce potential effects on wildlife habitat.

Direct habitat loss will be reduced through mitigation measures employed during construction to reduce loss of native vegetation types (as described in Section 7.4.2.2). Indirect habitat loss due to sensory disturbance will be mitigated by timing construction outside of the bird nesting season (April 26 to August 15) (ECCC 2017) and following any additional timing and setback restrictions as outlined in the SKMOE Activity Restriction Guideline (SKMOE 2017b).

If construction cannot avoid the nesting season, vegetation clearing activities will be occur prior to the bird nesting season and pre-construction surveys (e.g., nesting bird surveys) will be completed by a qualified environmental monitor prior to the start of construction activities. If an active nest is found, Algonquin will consult with the SKMOE to identify appropriate mitigation measures, such as species-specific setback distances and activity timing restrictions as outlined by the SKMOE (2017b).

8.4.2.3 Project Residual Effect

8.4.2.3.1 Construction

8.4.2.3.1.1 Direct Habitat Loss

Site preparation (i.e., clearing of vegetation, grading of WTG locations, access road construction and temporary workspaces) and installation of collector lines are the Project activities that will result in a direct loss of wildlife habitat (see Table 8-13).

In total, 158.2 ha (between two and three quarter sections in size) will be disturbed during construction, of which 9.9 ha is existing developed land. Of this total area, 119.1 ha will be reclaimed following construction, leaving 39.2 ha (24.8% of PDA) of land with long-term land use changes (Table 8-14). The majority of the land cover affected by the Project construction is cultivated (62.4%) and developed land (6.3%) (Table 8-14), which provide less suitable habitat for wildlife SAR and SOMC (see Section 8.2.2.2).

Construction activities will affect only 0.6 ha of native prairie (with a potential to be reduced further once final design is completed), 12.9 ha of tame pasture, and 31.4 ha of hayland, (Table 8-14). The loss of approximately 9.1 ha (5.7% of PDA) of these habitat types will be considered long-term (i.e., WTG foundations, crane pads, access roads) and the remaining 35.8 ha will be a temporary loss (i.e., temporary workspaces, installation of collector lines) and will be reclaimed upon completion of construction activities. These land cover types are suitable habitat for grassland-dependent SAR and SOMC (e.g., ferruginous hawk, Sprague's pipit, American badger, plains spadefoot toad). The amounts of native prairie (0.1% of LAA), tame pasture (1.3% of LAA), and hayland (4.0% of LAA) habitat disturbed in the PDA represents a small reduction in available suitable upland habitat in the LAA (2,576.3 ha) (see Table 8-15).

Construction activities, primarily in cultivated lands, will result in the loss of 4.3 ha of water/wetland habitat of which 0.9 ha is considered permanent (see Table 8-14). The remaining 3.4 ha will be reclaimed upon completion of construction activities. Project components that intersect with wetlands mostly consist of temporary workspaces and ROWs associated with collector lines and access roads; through further refinements to the Project layout, the 4.3 ha will be reduced as much as possible by siting Project components to avoid wetlands where feasible. The amount of water/wetland habitat (4.3 ha; 0.05% of LAA) lost in the PDA represents a small reduction in available water/wetland habitat in the LAA (628.2 ha) (see Table 8-15). Water/wetland provide suitable habitat for wetland-dependent SAR and SOMC such as northern leopard frog, horned grebe, and yellow rail.

Overall, construction of the Project will directly affect 1.7% of the land within the LAA.

Table 8-14 Area of Project Components by Land Cover Class in PDA

Land Cover	WTG Foundations	Crane Pad	New Access Roads[1]	Substation Footprint	Operation and Maintenance Building	Below Ground Collectors	Temporary Workspace[2]	Staging Areas, Offices and Parking	Total
Water/Wetland	0.1	0.0	0.2	0.0	0.0	0.6	3.4	0.0	**4.3**
Developed	0.0	0.0	0.5	0.0	0.0	7.8	1.6	0.0	**9.9**
Exposed Land/Barren	0.0	0.0	0.0	0.0	0.0	0.0	0.1	0.0	**0.1**
Cultivated	2.6	1.1	7.8	0.6	2.0	6.4	78.0	0.3	**98.8**
Tame Pasture	0.4	0.2	0.9	0.0	0.0	1.3	10.1	0.0	**12.9**
Hayland	0.9	0.4	2.7	0.0	0.0	2.2	25.4	0.0	**31.6**
Native Prairie	0.0	0.0	0.0	0.0	0.0	0.2	0.4	0.0	**0.6**
Shrubland	0.0	0.0	0.0	0.0	0.0	0.0	0.1	0.0	**0.1**
Total	**4.0**	**1.7**	**12.1**	**0.6**	**2.0**	**18.5**	**119.1**	**0.3**	**158.2**

NOTES:

All areas in hectares.

[1] Access roads to the substation have not been sited yet; these will be sited on cultivated lands and will be less than 200 m in length depending on the chosen substation location.

[2] Temporary workspaces were created by buffering permanent structures by 60 m plus temporary access road workspace.

Table 8-15 Change in Land Cover Classes in the LAA between Baseline and Application

Land Cover	Amount of Habitat Available in LAA		Change in Available Habitat in LAA	
	Baseline (ha)	Application (ha)	Area (ha)	Percent (%)
Water/Wetland	628.2	623.8	-4.3	-0.7
Developed	205.5	354.0	148.3	72.3
Exposed Land/Barren	3.0	2.9	-0.1	-3.3
Cultivated	5,424.2	5,325.4	-98.8	-1.8
Tame Pasture	1,026.2	1,013.3	-12.9	-1.3
Hayland	796.8	765.2	-31.4	-4.0
Native Prairie	753.3	752.7	-0.6	-0.1
Shrubland	7.0	6.9	-0.1	-1.4
Total	**8,844.2**	**8,844.2**	**0.1[1]**	**N/A**

NOTE:
[1] Total does not equal zero due to rounding of values. The absolute value is 0.

8.4.2.3.1.2 Sensory Disturbance

Sensory disturbance due to construction activities will largely be mitigated through construction timing to avoid sensitive periods such as the bird nesting season, or where they occur near wildlife features (e.g., sharp-tailed grouse leks). Given that most of the Project components occur in land cover that is less suitable as wildlife habitat (i.e., cultivated or developed land), and where there are existing commercial agricultural activities, the additional disturbance from Project construction will not result in a change that is as incrementally large as if the Project was developed in a pristine landscape.

After the application of standard mitigation measures, potential residual effects on habitat availability during construction are characterized as follows:

- Direction is **adverse**
  - There will be direct and indirect habitat loss.
- Magnitude is **low**
  - The relative footprint of the Project is small; the change in suitable wildlife habitat within the LAA is an average of 0.6% for all land cover types combined (except cultivated and developed land; see Table 8-15). In addition, there are remaining native land cover classes (e.g., native prairie, water/wetland) available within the LAA, which will help offset the effects of a loss of these habitat types. As such, the Project is unlikely to have a measurable effect on the abundance of wildlife (including SAR and SOMC) in the LAA; however, temporary local shifts in distributions might occur.

- Geographical extent is the **LAA**
  - Direct habitat loss will be confined to the PDA; however, indirect effects (i.e., sensory disturbance) will extend into the LAA.
- Duration is **short-term to long-term** (depending on habitat type and Project component)
  - Effects on habitat availability from construction activities and noise (i.e., sensory disturbance) within the PDA will largely cease after construction (i.e., short-term). In areas of suitable wildlife habitat, the effect is expected to extend until reclamation of vegetation occurs post decommissioning within the PDA, and is therefore long-term.
- Frequency is a **single event**
  - Habitat loss will occur once during construction site preparation and installation of aboveground facilities.
- The effect is **reversible**
  - The effect is expected to return to baseline conditions after decommissioning.
- Ecological and socio-economic context is **disturbed**
  - Approximately >80% of the LAA and RAA consists of existing disturbance from agricultural activities (i.e., cultivated, hayland, and tame pasture land cover types) as well as other permanent facilities and all-weather roads (i.e., developed land cover type).

8.4.2.3.2 Operation and Maintenance

8.4.2.3.2.1 Direct Habitat Loss

No new direct habitat loss is expected as a result of operation and maintenance activities. However, long-term direct habitat loss arising from construction phase activities described above will continue into operation within the PDA.

8.4.2.3.2.2 Sensory Disturbance

Sensory disturbance to birds will decrease with increasing distance from WTGs. In Shaffer and Johnson (2008), where densities of grassland species was measured prior to construction then during operation, effects extended to approximately 200 m from WTGs for two grassland songbirds (grasshopper sparrow and clay-coloured sparrow), while two species of songbirds (western meadowlark and chestnut-collared longspur) and one shorebird (killdeer) showed no change in density. In the literature, the distance at which songbirds experience an effect from sensory disturbance varies, but as a precautionary approach to estimate the effects of sensory disturbance, a distance of 200 m from WTGs was used for this assessment. Assuming a lower density of grassland songbirds within 200 m of WTGs, the Project would result in the reduction of habitat availability of approximately 15.8 ha of native prairie, 61.5 ha of tame pasture, and 132.7 ha of hayland. These areas represent approximately 2.1%, 6.0%, and 16.6% of their respective land cover classes in the LAA. Sensory disturbance effects are not expected to extend to the nearby IBA (i.e., Reed Lake), which is located approximately 7 km from the PDA.

After the application of standard mitigation measures, potential residual effects on habitat availability during operation and maintenance are characterized as follows:

- Direction is **adverse**
  - There will be indirect habitat loss related to sensory disturbance (e.g., noise and vehicle movement) associated with operation of the WTGs.
- Magnitude is **low**
  - Siting of WTGs away from native prairie and sensitive wildlife features is expected to limit the indirect loss (i.e., sensory disturbance) of available habitat for wildlife (including SAR and SOMC) during operation and maintenance.
- Geographical extent is the **LAA**
  - Operational activities will be restricted to the PDA; however, sensory disturbance will extend into the LAA.
- Duration is **long-term**
  - Effects on habitat availability from sensory disturbance during operation will continue for the life of the Project and cease after decommissioning.
- Frequency is **continuous**
  - Effects on habitat availability from sensory disturbance have the potential to occur continuously during operation of the WTGs.
- The effect is **reversible**
  - Residual effects on habitat availability from sensory disturbance will cease after decommissioning and are expected to return to baseline conditions.
- Ecological and socio-economic context is **disturbed**
  - Approximately >80% of the LAA and RAA consists of existing disturbance from agricultural activities (i.e., cultivated, hayland, and tame pasture land cover types) as well as other permanent facilities and all-weather roads (i.e., developed land cover type).

8.4.2.3.3 Decommissioning

Change in habitat availability during the decommissioning phase will be minimal. Residual effects will be limited to sensory disturbance and temporary local shifts of wildlife within LAA during the removal of WTG structures and reclamation activities (see Table 8-13). Sensory disturbance and fragmentation will be similar during the decommissioning phase as the construction phase for most species. Adherence to recommended activity timing restrictions and setback distances (SKMOE 2017b) will reduce the risk to SAR and SOMC during decommissioning.

After the application of standard mitigation measures, potential residual effects on habitat availability during decommissioning are characterized as follows:

- Direction is **adverse**
  - There will be indirect habitat loss due to sensory disturbance associated with decommissioning activities.
- Magnitude is **low**
  - Adherence to recommended timing and setback restrictions is expected to limit the effects (i.e., sensory disturbance) on habitat availability during decommissioning. As such, the Project is unlikely to have a measurable effect on the abundance of wildlife (including SAR and SOMC) in the LAA.
- Geographical extent is the **LAA**
  - Decommissioning activities will be restricted to the PDA; however, sensory disturbance will extend into the LAA.
- Duration is **short-term**
  - Residual effects are not expected to persist longer than the decommissioning phase.
- Frequency is a **single event**
  - Residual effects will occur once during decommissioning of the Project.
- The effect is **reversible**
  - Residual effects will cease at the time of decommissioning and are expected to return to baseline conditions.
- Ecological and socio-economic context is **disturbed**
  - Approximately >80% of the LAA and RAA consists of existing disturbance from agricultural activities (i.e., cultivated, hayland, and tame pasture land cover types) as well as other permanent facilities and all-weather roads (i.e., developed land cover type).

8.4.3 Change in Mortality Risk

8.4.3.1 Project Pathways

Construction, operation and maintenance, and decommissioning of the Project may increase wildlife mortality risk through a number of direct mechanisms, including interactions with equipment during construction (i.e., fatalities resulting from the destruction of habitat features [e.g., active nests]) and through collisions with infrastructure (i.e., WTGs). Indirect mechanisms include potential disturbance and shifts in predator-prey interactions (e.g., increased use of infrastructure by perching raptors), changes in behaviour causing reduced fitness and reproductive success, and abandonment of nests and young.

Direct effect pathways during construction and indirect effect pathways during all phases are generally considered a lower mortality risk compared to the direct pathways, through collision mortality, during operation of a WEP. Therefore, more emphasis will be placed on the latter pathway for this assessment.

8.4.3.1.1 Construction

8.4.3.1.1.1 Direct Mortality Risk

Project activities that will result in the clearing of vegetation and potential collisions with wildlife in the PDA are those that have the potential to cause increased direct mortality risk (see Table 8-13). Erection of WTGs is not likely to cause direct mortality to wildlife as these activities will occur on areas previously cleared of vegetation and prepared for WTG construction.

Project construction has the potential to result in increased direct mortality risk for wildlife. In particular, clearing of vegetation can result in the destruction of migratory bird nests, raptor nests, snake hibernacula, amphibian overwintering areas, as well as breeding areas, den sites and burrows for various wildlife species. Ground-nesting birds are particularly vulnerable during construction activities in open fields throughout breeding periods primarily through the destruction of nests.

There is also increased mortality risk due to potential vehicle collisions in the LAA. One species group of interest are reptiles and amphibians that may undergo daily movements or seasonal migrations through the PDA and across roads in the LAA. In addition, snake mortality can occur because they tend to bask on roads where there is often increased solar exposure. Granivorous birds using roads to obtain grit for digestion may also be at increased risk of collision as a result of the Project (Bishop and Brogan 2013). Low-flying birds and bats may be exposed to increased mortality risk through interactions with Project facilities, construction equipment and vehicles during migration (Johnson et al. 2003, Machtans et al. 2013).

Amphibians and other aquatic species face increased mortality risk from wetland loss if wetlands cannot be avoided during siting of WTGs and access roads. Construction through or adjacent to wetlands used for breeding or overwintering could result in disturbance or changes in water levels and chemistry, which could negatively affect overwintering frogs.

8.4.3.1.1.2 Indirect Mortality Risk

Several mechanisms could result in indirect mortality of wildlife associated with the construction phase of the Project, and are related primarily to disturbance on the landscape. Changes in behaviour because of disturbance can result in increased predation. The increase in access roads may also improve access for mammalian predators of ground-dwelling birds (Winter et al. 2000, Kingsley and Whittam 2005).

Behavioural changes related to disturbance can be caused by increased activity, noise and nighttime illumination from construction. In addition, some wildlife species (e.g., amphibians) might move from cover (i.e., behavioural change) because of disturbance from noise and vibration, putting them at greater risk of predation and mortality from exposure. However, some studies have suggested that noise pollution may actually benefit the survival and reproductive success of some species (Francis et al. 2009). Disturbance from construction activities may also displace wildlife species into areas adjacent to the Project which may contain lesser quality habitats depending on a species' habitat requirements and dispersal abilities. Displacement of wildlife may result in increased energy expenditure potentially reducing an individual's survival and reproduction (Powlesland 2009).

8.4.3.1.2 Operation and Maintenance

8.4.3.1.2.1 Direct Mortality Risk

During the operation and maintenance phase of the Project, the primary mechanism for direct wildlife mortality is collision of birds and bats with towers, nacelles, and revolving blades of WTGs (see Table 8-13). The understanding of effects of wind turbine collisions on birds and bats is improving from a growing number of international studies (Rydell et al. 2012, Zimmerling et al. 2013, Erickson et al. 2014, Zimmerling and Francis 2016). The findings of selected studies relevant to the Project are discussed in Appendix H.7.

Direct mortality during operation and maintenance can also occur through collisions with maintenance vehicles. However, this is likely lower than during the construction phase because operational maintenance will occur only periodically.

8.4.3.1.2.2 Indirect Mortality Risk

In grassland areas where natural perches are not common, the addition of infrastructure such as WTGs and collector line poles can facilitate hunting and sometimes even nesting by corvids and raptors that would otherwise be absent or in low densities (Slater and Smith 2010). An increase in the local populations or redistribution of these predatory species can in turn lead to declines in prey, including smaller birds as well as mammals, amphibians, and reptiles (Richardson et al. 2017). Conversely, in areas where the availability of existing perches is not a limiting factor for corvids or raptors (i.e., such perches are common), the addition of new perches does not increase predation risk. Instead, the sensory disturbance associated with the Project may result in a decline in the local density of some of these species, and a concurrent reduction in predation pressure for their prey (Francis et al. 2009).

8.4.3.1.3 Decommissioning

8.4.3.1.3.1 Direct Mortality Risk

During the decommissioning phase, few activities could interact with wildlife to cause direct mortality, though there is potential where activities will result in increased road traffic (see Table 8-13). As with the other Project phases, vehicle collisions will be one limited potential effect mechanism. Decommissioning activities at WTGs and substation sites and along access roads could result in additional collisions, thereby increasing the risk of direct mortality. Decommissioning of WTGs may require temporary workspaces; there is a potential risk for direct mortality through destruction of nests if clearing of temporary workspaces occurs during the breeding season.

8.4.3.1.3.2 Indirect Mortality Risk

The effect mechanisms capable of causing a change in indirect mortality risk of wildlife during the decommissioning phase are similar to those during construction, including potential disturbance and displacement of wildlife and behavioural changes leading to increased predation.

8.4.3.2 Mitigation

8.4.3.2.1 Direct Mortality Risk

Mitigation to reduce or avoid the potential for change in mortality risk as a result of a WEP begins at the planning phase (Marques et al. 2014). Siting of projects to avoid features likely to be associated with higher mortality risk is the first step, followed by studies to understand local patterns of habitat use and movement of wildlife, particularly birds and bats. This process was completed as part of the development of the proposed Project (see Section 2.2).

In addition to mitigating project effects through planning, other protective measures may be implemented during construction and operation, as warranted by site-specific conditions. These commonly include standard industry practices for reducing mortality risk to birds and bats, such as increased cut-in speeds (i.e., the wind speed at which turbines begin operating), greater turbine spacing to allow passage of birds and bats, and lighting designs to reduce attractiveness to birds (Arnett et al. 2008, Baerwald 2008, Horn et al. 2008, Marques et al. 2014). The need for adaptive mitigation measures will be determined through post-construction mortality monitoring. Detailed information on mitigation measures is provided in Appendix C.

8.4.3.2.2 Indirect Mortality Risk

Mitigation options are limited to reduce or avoid a change in mortality risk through indirect pathways, such as increased predation. The use of perch deterrents on poles along overhead collector lines (if present) can, however reduce the use of these structures by raptors and corvids, particularly in areas of low natural perch abundance (Slater and Smith 2010, Richardson et al. 2017). This mitigation will be applied in areas where determined appropriate (an absence of natural perches) by environmental monitor(s).

8.4.3.3 Project Residual Effect

8.4.3.3.1 Construction

During the construction phase, some effect mechanisms (e.g., vehicle collisions) could occur throughout the PDA. However, the likelihood of Project activities interacting with wildlife is greater in areas where land cover is more suitable as habitat for wildlife. These would represent areas of native prairie, shrubland, tame pasture, hayland, and wetlands.

Mitigation measures implemented during Project pre-planning/siting and construction will reduce mortality risk for SAR and SOMC inhabiting the LAA during the proposed construction period. For instance, mortality risk to SAR and SOMC during construction will be reduced through construction timing as well as the implementation of seasonal timing restriction and setback distance guidelines (if active habitat features are observed). Reduced speed limits for vehicles travelling within the PDA and installation of signage where specific wildlife concerns have been identified are also expected to reduce mortality risk to SAR and SOMC.

Direct and indirect mortality risk to avian SAR and SOMC will be low due to the construction schedule and the low abundance of SAR and SOMC relative to the breeding period. Early in construction, birds migrating through or using the PDA may collide with vehicles; however, this will be reduced due to mitigation by reduced vehicle speeds (Bishop and Brogan 2013).

After the application of standard mitigation measures, potential residual effects on mortality risk during construction are characterized as follows:

- Direction is **adverse**
  - There is a slight increase in mortality risk because of the increased volume of vehicle traffic and heavy equipment along roadways.
- Magnitude is **low**
  - Application of mitigation, including pre-construction surveys and the implementation of recommended seasonal timing restriction and setback distance guidelines, are expected to limit mortality risk to SAR and SOMC during construction. As such, any increase in mortality risk is unlikely to have a measurable effect on the abundance of wildlife (including SAR and SOMC) in the LAA.
- Geographical extent is the **LAA**
  - Mortality risk will largely be restricted to secondary roads within the LAA.
- Duration is **short-term**
  - The duration is short term because increased mortality risk is limited to the construction phase.
- Frequency is **multiple irregular events**
  - Increases in traffic during construction, which is temporary, will occur as irregular, multiple events.
- The effect is **reversible**
  - Mortality risk from construction effects mechanisms is expected to decline to baseline levels once construction activities have ceased.
- Ecological and socio-economic context is **disturbed**
  - Approximately >80% of the LAA and RAA consists of existing disturbance from agricultural activities (i.e., cultivated, hayland, and tame pasture land cover types) as well as other permanent facilities and all-weather roads (i.e., developed land cover type).

8.4.3.3.2 Operation and Maintenance

Direct mortality risk pathways causing effects to wildlife during the operation and maintenance phase are well understood (see Appendix H.7 for results of a literature review), and relevant mitigation measures have been identified for the Project (see Appendix C). The following summarizes the key information basis for the assessment of operational residual effects of the Project on wildlife mortality:

- **Avoidance Zone**: The Project is located outside the closest avoidance zone, as identified in SKMOE's *Wildlife Siting Guidelines for Saskatchewan Wind Energy Projects* (SKMOE 2017a) (see Section 2.2), and approximately 7 km from the Reed Lake IBA.
- **SAR and SOMC:** Locations where wildlife SAR and SOMC features were observed in the Project area during wildlife surveys were avoided during siting of turbines (see Appendix F). SKMOE activity restriction setback distances (SKMOE 2017b) to Project components were met for most features observed in the LAA; where setbacks are not met, temporary workspaces will be adjusted as much as possible during construction to be located outside of a sensitive feature setback.
- **Sensitive Environmental Features:** The Project is not located within a sensitive environmental feature (e.g., within a river valley), or in a path between two features (e.g., directly between two IBAs), that may cause an elevated risk in collision mortality for birds due to relatively high movement rates.
- **Bat Data:** Bat activity rates from acoustic surveys were generally low, with no migratory bat passes detected at the elevated detector in the spring, and an overall average of 0.1 migratory bat passes per detector night for the spring. There were 1.0 migratory bat passes per detector night overall during the August 1 to September 10 period, which is at the low-moderate threshold for migratory bat fatality risk according to AEP (ESRD 2013b). See Appendix H.6 for more details. There were no bat SAR out of 85 bat fatalities at the Centennial WEP in 2006 or 2007 (Golder Associates 2008), nor out of 43 bats found at the Morse WEP between 2015 and 2017 (Golder Associates 2017). The proportion of bat SAR fatalities in Alberta, where wind projects are also in open agricultural or grassland areas, is very low (0.5%) compared to elsewhere in Canada (9.5%) (BSC et al. 2017).
- **Bird Movement Data:** Nocturnal movement surveys using radar indicate that proportions of birds moving within the rotor swept area was similar among Project and control sites. Results also indicate that the Project area had movement rates approximately half of those at the Reed Lake control site (outside the Project area), and lower than at the control site north of the Centennial WEP. See Appendix H.5 for more details.

  Spring diurnal bird movement surveys indicate that the Project area has similar movement rates to the terrestrial control site located north of the Centennial WEP, and an order of magnitude lower rates than at the Reed Lake control site. Fall surveys indicated similar results to those from the spring when large flocks of snow geese were not included in analyses, though slightly higher in the Project area than the control site north of the Centennial WEP, but lower than the Reed Lake control site (see Appendix H.5 for more details). As such, collision risk during the day would likely be similar to the Centennial WEP.

The Centennial WEP to the southwest of the Project had annual bird fatality rates (8.8 birds/turbine; 4.9 birds/MW) lower than the Saskatchewan average (10.1 birds/turbine; Zimmerling et al. 2013), but higher than the average rates for Alberta (4.5 birds/turbine). The Morse WEP to the east of the Project had similar annual bird (8.6 birds/turbine; 3.8 birds/MW) and bat (13.3 bats/turbine; 5.8 bats/MW) fatality rates to the Centennial WEP. As such the collision mortality risk as a result of the Project is expected to be below average compared to other WEPs in Saskatchewan and likely similar to the Centennial and Morse WEPs.

- **Scientific Literature:** Mortality risk from WEPs is primarily the result of collisions of birds and bats with wind turbines, including towers, nacelles, and revolving blades (BSC et al. 2017). Risk can be largely mitigated through siting of projects and operational mitigation such as increased cut-in speeds and lighting to reduce attractiveness to birds (Kingsley and Whittam 2005, Arnett et al. 2008, Horn et al. 2008, Marques et al. 2014). Reviews of mortality surveys consistently show that small passerines account for the majority of bird fatalities, while waterfowl are rarely affected (Erickson et al. 2014, BSC et al. 2017). Birds that are actively migrating tend to fly far above the rotor swept area of wind turbines, and many species have demonstrated active avoidance of wind energy facilities (Rydell et al. 2012, d'Entremont et al. 2017). Among bats, migratory species account for the majority of mortalities, with a distinct peak in risk in late summer and when wind speed is below 6 m/s. (Arnett et al. 2008, BSC et al. 2017). Further details are summarized in Appendix H.7.
- **Dominant Land Cover:** The wildlife and wildlife habitat LAA consists primarily of cultivated or developed land cover (63.6%; Table 8-5), which is typically less suitable as habitat for wildlife than natural land cover types (e.g., native prairie, wetlands).
- **Vehicle Collisions:** Direct mortality from collisions with maintenance vehicles will likely contribute to low mortality risk (e.g., single annual fatalities). The risk would be similar to personal or commercial vehicles traveling on Saskatchewan's rural roads. This will not result in a measurable change at the Project level.
- **Indirect Mortality**: Compared to direct mortality pathways, the contribution of indirect mortality pathways from the Project to residual effects on change in mortality risk to wildlife will be minimal. The direction of the effects is likely negative as the Project may increase the potential number of perching structures for raptors within the Project LAA.

After the application of standard mitigation measures, potential residual effects on mortality risk during operation and maintenance are characterized as follows:

- Direction is **adverse**
  - There is a predicted increase in mortality risk, primarily from collisions by wildlife with WTGs.
- Magnitude is **low to moderate**
  - Taking into account site-specific mitigation, magnitude is expected to be mostly low, though occasionally it may rise to moderate. The increased mortality risk is not expected to affect population abundance of migratory species.
- Geographical extent is the **RAA**
  - Mortality risk will increase for local wildlife populations and for migrants passing through the Project area. Therefore, the extent is the RAA, reflective of the larger movements of bird and bat species relative to the Project area and the influence of other natural and human landscape features (see Section 8.5.3 for further discussion on a cumulative effects basis).
- Duration is **long-term**
  - The effects will continue through the life of the Project, but not after decommissioning.
- Frequency is **multiple irregular events**
  - Mortality risk will fluctuate seasonally, primarily as a function of birds and bats migrating through the LAA each spring and fall.
- The effect is **reversible**
  - Mortality risk is expected to decline to baseline levels after decommissioning.
- Ecological and socio-economic context is **disturbed**
  - Approximately >80% of the LAA and RAA consists of existing disturbance from agricultural activities (i.e., cultivated, hayland, and tame pasture land cover types) as well as other permanent facilities and all-weather roads (i.e., developed land cover type).

8.4.3.3.3 Decommissioning

Change in wildlife mortality risk during the decommissioning phase will be minimal because human interaction with wildlife species will be limited to locations of existing physical structures and their immediate surroundings, and vehicular activity will be restricted to existing trails and roads. Consideration of the seasonal timing restriction and activity setback distance guidelines, and Project activity mitigations (e.g., speed limits) will reduce or avoid the risk to SAR and SOMC if and when required during decommissioning.

After the application of standard mitigation measures, potential residual effects on mortality risk during decommissioning are characterized as follows:

- Direction is **adverse**
  - There is a slight increase in mortality risk because of the increased volume of vehicle during removal of Project facilities.
- Magnitude is **low**
  - Application of mitigation, including implementation of recommended seasonal timing restrictions and setback distances, are expected to limit mortality risk to SAR and SOMC during decommissioning. As such, any increase in mortality risk is unlikely to have a measurable effect on the abundance of wildlife (including SAR and SOMC) in the LAA.
- Geographical extent is the **LAA**
  - Mortality risk will largely be restricted to secondary roads within the LAA.
- Duration is **short-term**
  - The effect is not expected to persist longer than the timing decommissioning activities.
- Frequency is **multiple irregular events**
  - Increases in traffic during decommissioning will occur as irregular, multiple events.
- The effect is **reversible**
  - Mortality risk is expected to decline to baseline levels after decommissioning.
- Ecological and socio-economic context is **disturbed**
  - Approximately >80% of the LAA and RAA consists of existing disturbance from agricultural activities (i.e., cultivated, hayland, and tame pasture land cover types) as well as other permanent facilities and all-weather roads (i.e., developed land cover type).

8.4.4 Summary of Project Residual Environmental Effects

In summary, effects of the Project on wildlife and wildlife habitat tend to be adverse, but of low magnitude in all Project phases (see Table 8-16). The geographical extent of effects is generally limited to the LAA, though a change in mortality risk during operation and maintenance may extend further into the RAA. The frequency and duration ranges from irregular short-term events to continuous long-term effects. All effects of the Project on wildlife and wildlife habitat are predicted to be reversible following decommissioning of the Project.

Table 8-16 Project Residual Effects on Wildlife and Wildlife Habitat

Residual Effect	Residual Effects Characterization							
	Project Phase	Direction	Magnitude	Geographic Extent	Duration	Frequency	Reversibility	Ecological and Socio-economic Context
Change in Habitat Availability	C	A	L	LAA	ST/LT	S	R	D
	O	A	L	LAA	LT	C	R	D
	D	A	L	LAA	ST	S	R	D
Change in Mortality Risk	C	A	L	LAA	ST	IR	R	D
	O	A	L/M	RAA	LT	IR	R	D
	D	A	L	LAA	ST	IR	R	D

KEY

See Table 8-2 for detailed definitions

Project Phase
C: Construction
O: Operation and Maintenance
D: Decommissioning

Direction:
P: Positive
A: Adverse
N: Neutral

Magnitude:
N: Negligible
L: Low
M: Moderate
H: High

Geographic Extent:
PDA: Project Development Area
LAA: Local Assessment Area
RAA: Regional Assessment Area

Duration:
ST: Short-term;
MT: Medium-term
LT: Long-term

N/A: Not applicable

Frequency:
S: Single event
IR: Irregular event
R: Regular event
C: Continuous

Reversibility:
R: Reversible
I: Irreversible

Ecological/Socio-Economic Context:
D: Disturbed
U: Undisturbed

8.5 ASSESSMENT OF CUMULATIVE ENVIRONMENTAL EFFECTS ON WILDLIFE AND WILDLIFE HABITAT

The project residual effects described in Section 8.4 are likely to interact cumulatively with residual environmental effects from other physical activities (past, present and reasonably foreseeable). The resulting cumulative environmental effects are assessed. This is followed by an analysis of the project contribution to cumulative effects. Future projects and activities that are reasonably foreseeable are defined as those that (a) have been publicly announced with a defined project execution period and with sufficient project details that allow for a meaningful assessment, (b) are currently undergoing an environmental assessment or (c) are in a permitting process.

The assessment of cumulative effects is initiated with a determination of whether two conditions exist:

- the Project has residual environmental effects on the VC, and
- the residual effects could act cumulatively with residual effects of other past, present, or reasonably foreseeable future physical activities

If either is not met, the assessment of cumulative effects concludes with a statement that further assessment of cumulative effects is not warranted because the Project does not interact cumulatively with other projects or activities.

8.5.1 Project Residual Effects Likely to Interact Cumulatively

The project and physical activities inclusion list, which identifies other projects and physical activities that might act cumulatively with the Project, are presented in Table 4-4 of Section 4.0, Environmental Assessment Scope and Methodology. Where residual environmental effects from the Project act cumulatively with residual effects from other projects and physical activities (Table 8-17), a cumulative effects assessment is undertaken to determine their significance. Note that both the SaskPower Pasqua to Swift Current 230 kV transmission line and Morse Wind Farm each only partially overlap the RAA. For the purpose of this cumulative effects assessment all of the Morse Wind Farm was included in the assessment, while the portion of the Pasqua to Swift Current transmission line falling within the RAA was included.

Table 8-17 Interactions With the Potential to Contribute to Cumulative Effects

Other Projects and Physical Activities with Potential for Cumulative Environmental Effects	Environmental Effects	
	Change in Habitat Availability	Change in Mortality Risk
Past and Present Physical Activities and Resource Use		
Agricultural Conversion	✓	✓
Oil and Gas Development	✓	✓
Power Generation, Transmission, and Distribution	✓	✓
Morse Wind Farm	✓	✓
Recreational Activities	–	✓
Residential Development	✓	✓
Resource Extraction Activities	✓	✓
Road Development	✓	✓
Project-Related Physical Activities	✓	✓
Future Physical Activities		
Pasqua to Swift Current 230 kV Transmission Line Project[1]	✓	✓
SaskPower Blue Hill Interconnection Project	✓	✓

NOTES:

✓ = Other projects and physical activities whose residual effects are likely to interact cumulatively with Project residual environmental effects.

– = Interactions between the residual effects of other projects and residual effects of the Project are not expected.

[1] SaskPower 2016.

Environmental effects identified in Table 8-17 that are not likely to interact cumulatively with residual effects of other projects and physical activities (no check mark) are not discussed further. The assessment of the cumulative environmental effects that are likely to result from the Project in combination with other projects and physical activities are discussed in subsequent sections.

8.5.2 Change in Habitat Availability

8.5.2.1 Cumulative Effect Pathways

Cumulative effects arising from past, present and future activities have similar effects mechanisms as effects arising from the Project. These mechanisms would be captured under similar measurable parameters, which include the direct loss of natural land cover (e.g., native prairie, wetlands, shrubland), and sensory disturbance, though the magnitude of specific mechanisms may vary among activities (e.g., direct habitat loss vs. sensory disturbance).

8.5.2.2 Mitigation for Cumulative Effects

To mitigate the cumulative effects of the Project and existing or future activities, the following measures will be taken:

- Where possible, use of existing roads will reduce the length of new road constructed for access to WTG sites.
- Vehicles and construction equipment will travel along high use roads when possible to reduce the relative increase in road traffic and disturbance to wildlife. In other words, wildlife will be less disturbed with an increase in road traffic where there is already a higher rate of use because they would be more habituated to the disturbance than roads that have low traffic rates.

8.5.2.3 Cumulative Effects

The current landscape (i.e., the RAA) in which the Project is proposed is a mixture of disturbed (e.g., cultivated) and native land cover classes capable of supporting sustainable wildlife populations of most species from the ecoregion. Based on magnitude definitions presented in Table 8-2, existing land use activities have collectively had a high magnitude effect, as they have altered wildlife habitat abundance and distribution in the RAA from pre-development levels. Specifically, past and present activities have resulted in the conversion of approximately 54,481.3 ha of land (i.e., cultivated and developed land cover type) and up to 69,977.7 ha of land when including tame pasture/hayland land covers in the RAA (see Table 8-18). This represents 69.3% or 89.1% of the terrestrial area within the RAA, respectively.

Direct loss of habitat through changes in land cover from natural land cover types to agricultural or developed land cover types, and indirect loss through sensory disturbance from physical activities, affect individual species in specific manners depending on their habitat requirements and life-histories, which may or may not have resulted in population level effects. However, the threatened population status of two SAR (i.e., ferruginous hawk and Sprague's pipit), among other SAR and SOMC, has been directly linked to the loss of native prairie across their ranges, which overlap the RAA (COSEWIC 2008, EC 2012a).

There are two publicly disclosed future projects within the RAA: the Pasqua to Swift Current Transmission Line and the Blue Hill Interconnection project (see Table 8-17). The incremental effects of these projects could act cumulatively with Project residual effects through direct loss of habitat (e.g., native vegetation and wetlands) for wildlife, and indirect loss of habitat through sensory disturbance from equipment and traffic, and habitat fragmentation from linear developments. The proposed location for the Pasqua to Swift Current Transmission Line is known (SaskPower 2016) and this project will likely affect a mixture of disturbed and native land cover types. It is understood that the Blue Hill Interconnection Project will have similar types of effects pathways related to changes in direct habitat loss. However, at the time of EIS writing, details (e.g., location and ROW width) of the Blue Hill Interconnection project are unknown and, as a result, changes in land cover due to this future project could not be quantified. As such, only the Pasqua to Swift Transmission Line Project is carried forward (below) to quantify a cumulative change in habitat availability in the RAA.

To determine the approximate area of each land cover class directly affected by the future Pasqua to Swift Current Transmission Line project, publicly available information on the location and ROW (SaskPower 2016) were compared against the AAFC (2015a) dataset. Overall, the cumulative effects of the Project and the Pasqua to Swift Current Transmission Line project on wildlife habitat within the RAA is an anticipated change in approximately 509.5 ha of the current land cover and will result in an effect on approximately 0.6% of the RAA (see Table 8-18).

Much of this effect will be of short term duration on the landscape due to the nature of the effects for transmission line projects – i.e., where the construction footprint within the ROW is a small proportion, which is further reduced during operation. Moreover, half (53.0%; 269.8 ha) of the development in the future conditions case will occur on annually cultivated land (see Table 8-18). The remaining area is primarily on tame pasture or hayland (40.3%; 205.7 ha) with another 6.7% distributed among other land cover types. There will be a small area (11.6 ha; 0.25% of baseline conditions in the RAA) of native prairie affected, which is mostly due to the SaskPower Pasqua to Swift Current Transmission Line (see Table 8-18). While native vegetation, tame pasture/hayland and wetlands provide habitat for many SOMC, the small area of these land cover types affected by the Project and other projects or activities are not anticipated to threaten the long-term viability of wildlife populations within the RAA.

The Pasqua to Swift Current 230 kV Transmission Line project is an upgrade from an existing 138 kV line. Therefore, resident wildlife in the area may be habituated to the presence of similar infrastructure and effects on change in habitat availability of this project are expected to be partially accounted for under existing conditions with the current 138 kV line in place (Madsen and Boertmann 2008, Guinn 2013).

Table 8-18 Change in Land Cover Classes from the Baseline Case to the Future Conditions Case in the RAA

Land Cover	Habitat Available in RAA					
	Baseline		Change with Future Case		Project Contribution	
	Area (ha)	Percent (%)	Area (ha)	Percent (%)	Area (ha)	Percent (%)
Water/Wetland	3,698.5	4.7%	-18.7	-0.51%	-4.4	-0.12%
Developed	1,486.3	1.9%	509.5	34.28%	148.3	9.98%
Exposed Land/Barren	214.1	0.3%	-3.6	-1.67%	-0.1	-0.05%
Cultivated	52995	67.5%	-269.8	-0.51%	-98.8	-0.19%
Tame Pasture/Hayland[1]	15,496.4	19.7%	-205.7	-1.33%	-44.3	-0.29%
Native Prairie	4,559.7	5.8%	-11.6	-0.25%	-0.6	-0.01%
Shrubland	105.3	0.1%	-0.1	-0.09%	-0.1	-0.09%
Total	78,555.4	100.0%	-	-	-	-

NOTE:
[1] For the purposes of the cumulative effects assessment, these land cover types were combined because they are not separated in the AAFC (2015a) dataset.

8.5.3 Change in Mortality Risk

8.5.3.1 Cumulative Effect Pathways

Effect mechanisms that would result in a change in mortality risk to wildlife as a result of the projects and activities considered in this cumulative effect assessment are similar to the mechanisms assessed for Project residual effects. These consist of mechanisms that result in direct mortality (i.e., collisions with vehicles and Project infrastructure, and destruction of residences) and mechanisms that result in indirect mortality (i.e., changes in predator-prey communities and behavioural changes causing decreased survival).

The most important mechanism overall for Project-related wildlife mortality is the risk of wildlife collisions with turbines and infrastructure (i.e., transmission lines and WTGs) arising from the construction of above-ground structures within the RAA. The existing Morse Wind Farm would have the same pathways as the Project, given they are both WEPs. Transmission lines are also known to cause mortality of birds through collisions, and the species groups most commonly reported as fatalities include waterfowl, grebes, shorebirds and cranes (Rioux et al. 2013). Transmissions lines are estimated to be among the greatest sources of mortality to birds by human activities in Canada (Calvert et al. 2013).

8.5.3.2 Mitigation for Cumulative Effects

Mitigation measures proposed in Section 8.4.2.2 will reduce the overall effect of the Project on wildlife mortality risk. Mitigation measures to reduce the cumulative effect of the Project and other projects within the RAA could include coordinating to use similar road networks and laydown/staging areas to reduce the spatial extent of risk to wildlife mortality.

8.5.3.3 Cumulative Effects

The modified landscape of the RAA has already been and continues to be a source of mortality risk to wildlife. Agricultural practices, vehicle traffic on roads, and collisions with the existing transmission lines, the Morse Wind Farm, residential and commercial buildings, and other activities are known sources of mortality (Calvert et al. 2013). The occurrence of agricultural and resource activities in the RAA has already contributed to reductions in wildlife abundance of some species through habitat change (i.e., high magnitude effects), such as for burrowing owls (EC 2012b), though others have become more abundant, such as snow geese (USFWS 2017). Some species, such as horned lark, have expanded their range and populations as a result of agriculture (Beason 1995). Consequently, future projects (including the Project) will contribute to existing levels, though moderately, of mortality risk in the RAA of a species community that is different from the historical community.

The period of greatest risk to change in wildlife mortality for most projects included in the cumulative effects assessment is the operation and maintenance period when direct mortality effects due to collisions with infrastructure would occur. The existing Morse Wind Farm is known to have an estimated fatality rate of approximately 3.76 birds/MW/yr and 5.77 bats/MW/yr (approximately 86 birds and 132 bats annually), though no bird or bat SAR or SOMC fatalities were observed (Golder Associates 2017). The most common species observed as fatalities due to WEPs are passerines, and more specifically in the prairies tend to be species commonly associated with agricultural environments, such as horned larks (BSC et al. 2017). This species group is also the one most likely impacted by agriculture, the primary existing anthropogenic activity in the RAA. Within Bird Conservation Region 11 (the Prairie Pothole Region of Canada), estimates of fatalities for the five songbird species most likely affected by agricultural activities were as high as 267,000 young birds annually for a single species alone (Tews et al. 2013), which puts in context the scale of existing fatality rates in the prairies. Agricultural harvesting alone ranked 7th of all anthropogenic activities while wind energy in Canada ranked 19th. Indeed, the top ranking source of avian mortality in Canada was associated with feral cats, which are estimated to each kill approximately 24 to 64 birds annually in Canada (Calvert et al. 2013), which is equivalent to 3 to 8 times higher fatality rates than each turbine at the Morse Wind Farm. In other words, the Morse Wind Farm likely has an equivalent cumulative effect on bird fatalities as two feral cats on the landscape.

Within the RAA, the proposed SaskPower Pasqua to Swift Current 230 kV Transmission Line passes approximately 1 km to the northwest of Reed Lake. This future project will likely result in an increase in mortality risk, particularly to birds, though the incremental increase will not be as great for this project because of the existing 138 kV transmission line that the project will replace. Moreover, the species groups affected by the transmission line would likely differ from the Project; transmission lines tend to pose a greater risk to large-bodied birds as oppose to WEPs that tend to strike smaller birds more frequently. As such, there would be some cumulative effect of the SaskPower Pasqua to Swift transmission line with the Project, but would not likely result in a change in abundance of wildlife species in the RAA given this difference.

The location of the Blue Hill Interconnection project is currently unknown; however, it is assumed that this project will contribute to a change in mortality risk for birds, as is the case for the Pasqua to Swift Current transmission line. it is expected that SaskPower's siting practices will identify an appropriate route and additional mitigation measures to reduce or avoid collision risk from this project.

Overall, the cumulative residual effects of future projects, including this Project, after appropriate mitigation measures are implemented, within the RAA, to wildlife mortality risk are not anticipated to measurably change current wildlife abundance or the viability of wildlife populations in the RAA.

8.5.4 Summary of Cumulative Effects

In summary, this Project and other future projects will be contributing to cumulative effects on wildlife SAR and SOMC that have already been reduced in abundance in the RAA. Many of the SAR and SOMC discussed in this assessment are of management concern because of past pressures on their habitats, changes in habitat availability outside the RAA (wintering and distant breeding areas), and elevated mortality risks. The endangered or threatened population status of three SAR has been linked to changes in habitat availability or mortality risk across their ranges that include the RAA.

The footprints of future projects, including this Project, on suitable habitat will be small, relative to remaining habitat availability in the RAA, and because the Pasqua to Swift Current 230kV Transmission Line will result in the replacement of an existing transmission line. The effects of new projects, with mitigation, on habitat availability will be low relative to the extensive past land-use changes and existing activities, and are not expected to alter current wildlife abundance in the RAA.

The effects of new projects, with mitigation, on mortality risk will increase. However, existing land use changes due to past activities (e.g., agriculture) and infrastructure (e.g., the Pasqua to Swift 138 kV Transmission Line) are already evaluated to be a high magnitude within the RAA.

Cumulative effects of existing activities and future projects are characterized in Table 8-19, using the same characterization terms as those applied to residual Project effects.

Table 8-19 Residual Cumulative Effects

Residual Cumulative Effect	Residual Cumulative Effects Characterization						
	Direction	Magnitude	Geographic Extent	Duration	Frequency	Reversibility	Ecological and Socio-economic Context
Residual Cumulative Effect on Habitat Availability							
Residual cumulative effect	A	H	RAA	LT	C	I	D
Contribution from the Project to the residual cumulative effect	The Project contribution to a change in habitat availability will be a loss of 49.4 ha of suitable wildlife habitat, with an additional 210 ha of area affected through sensory disturbance, which is 1.1 % of the total area of suitable habitat in the RAA.						
Residual Cumulative Effect on Mortality Risk							
Residual cumulative effect	A	H	RAA	LT	C	I	D
Contribution from the Project to the residual cumulative effect	The Project will cause a change in mortality risk primarily through bird and bat collisions with turbines. The anticipated change would be substantially less than the risk from existing projects or activities in the RAA.						

KEY

See Table 8-2 for detailed definitions

Direction:
P: Positive
A: Adverse
N: Neutral

Magnitude:
N: Negligible
L: Low
M: Moderate
H: High

Geographic Extent:
PDA: Project Development Area
LAA: Local Assessment Area
RAA: Regional Assessment Area

Duration:
ST: Short-term;
MT: Medium-term
LT: Long-term

N/A: Not applicable

Frequency:
S: Single event
IR: Irregular event
R: Regular event
C: Continuous

Reversibility:
R: Reversible
I: Irreversible

Ecological/Socio-Economic Context:
D: Disturbed
U: Undisturbed

8.6 DETERMINATION OF SIGNIFICANCE

8.6.1 Significance of Project Residual Effects

With the application of recommended mitigation, the residual environmental effects on wildlife and wildlife habitat, due to changes in habitat availability and mortality risk from all Project phases (i.e., construction, operation and maintenance, and decommissioning), are not predicted to result in adverse effects to wildlife population sustainability within the RAA. This is supported by the analysis of the Project's residual effects as discussed in Section 8.4.

Overall, based on magnitude and significance thresholds defined in Sections 8.1.5 and 8.1.6, residual environmental effects of the Project are predicted to be not significant.

8.6.2 Significance of Cumulative Effects

The existing land base in the RAA has been extensively modified from its natural mixed grassland landscape through agricultural conversion and, to a lesser extent, industrial and residential development. These activities have resulted in sufficient loss of suitable habitat to cause some SOMC to be listed as extirpated, endangered, threatened or special concern.

Within the RAA, 67.5% (52,995.0 ha) of the area has been converted to annually cultivated lands, 19.7% to tame pasture/hayland (15,496.4 ha) with an additional 1.9% (1,486.3 ha) as developed lands (see Table 8-18). These relative values are similar within the PDA with 62.4% (98.8 ha) and 28.1% (44.5 ha) of lands converted to annual cropland or perennial cropland/hay, respectively (see Table 8-14).

The Project was evaluated in combination with two additional anticipated projects occurring within the RAA (see Table 8-17). Land cover metrics are unknown for the SaskPower Blue Hill Interconnection line for the Project, but the SaskPower Pasqua to Swift Current transmission line is anticipated to affect approximately 367.4 ha of land within the RAA (<0.5% of the RAA). The combined change in land cover (from non-developed to developed) from these projects was estimated at 509.5 ha land with 239.7 ha (47.0 %) of disturbance occurring on suitable habitat for wildlife SAR and SOMC (i.e., areas of tame pasture/hayland, native prairie, shrubland, exposed land/barren, and water/wetland). This area of suitable wildlife habitat accounts for approximately 0.3% of the total area of suitable wildlife habitat within the RAA (78,555.4 ha; see Table 8-18). The potential area of suitable native prairie and tame pasture/hayland habitat change in a 200 m buffer around WTGs due to sensory disturbance, 15.8 ha and 194.2 ha, respectively, accounts for a total of 0.3% and 1.3 % of these land cover classes, respectively, in the RAA.

Change in mortality risk within the RAA has increased through previous development and past and current activities and is considered to be significant and of high magnitude. Human activities and developments (e.g., vehicle traffic, agricultural activities, above-ground infrastructure) have increased the direct mortality risk to various wildlife species and groups at all life-stages (i.e., eggs, juveniles, adults). Overall, the residual cumulative environmental effects of the Project, past and present human activities, and proposed future conditions on change in mortality risk are considered to remain significant in the RAA compared to pre-development levels.

Changes in habitat availability and changes in mortality risk as a result of past and present activities, have resulted in wildlife population level effects in the RAA, though the addition of the Project and reasonably foreseeable future projects will not measurably change wildlife abundance and distribution from current baseline in the RAA.

Overall, based on magnitude and significance thresholds defined in Sections 8.1.5 and 8.1.6, cumulative residual effects of past and current activities on wildlife and wildlife habitat within the RAA will continue to be significant.

8.6.2.1 Project Contribution to Cumulative Effects

The Project's contribution to direct loss of suitable wildlife habitat is anticipated to be approximately 49.5 ha (see Table 8-18). Though the Project accounts for 29.1% of the future change in land use, it only accounts for 20.9% of the change in suitable habitat due to an avoidance of the land cover types considered suitable habitat. It also represents a 0.1% increase compared to historic land use change in the RAA. The overall direct loss of suitable habitat as a result of the Project is small (0.2%) relative to the total remaining area of suitable habitat available (24,074.0 ha; see Table 8-18). Including the expected indirect loss of wildlife habitat (210 ha), the change remains less than 2% of the total area affected by past, present and proposed future human activities. It is anticipated that much of the Project's contribution to this cumulative effect will be long-term, with continuous or multiple-irregular effects, and reversible upon the decommissioning. The Project's contribution to cumulative environmental effects is not expected to measurably affect the abundance or sustainability of wildlife currently residing in or migrating through the RAA.

The Project's predicted contribution to change in wildlife mortality risk is not accurately quantifiable due to several uncertainties previously identified. The increase in mortality, particularly to birds and migratory bats, is likely to have effects of low to moderate magnitude in LAA, but not affect abundance or sustainability of wildlife currently residing in the RAA. The proposed future transmission line developments will also likely result in an unpredictable increase in mortality risk to wildlife, and particularly to birds, though the incremental increase will be moderated by the fact that the Pasqua to Swift 230 kV Transmission Line will replace an existing 138 kV transmission line. Given the current activities and land use changes in the RAA, the incremental Project contribution to cumulative environmental effects is not expected to measurably affect the abundance or sustainability of wildlife currently residing in or migrating through in the RAA.

8.7 PREDICTION CONFIDENCE

Change in habitat availability due to direct loss of suitable wildlife habitat was quantified and is well understood for this Project. There is an increasing body of literature reporting on the indirect loss from sensory disturbance and habitat fragmentation, though studies on some wildlife SAR and SOMC are currently lacking. Field studies were conducted to determine the abundance and distribution of wildlife within the LAA, but there is uncertainty about these metrics within the larger RAA. It is likely that the wildlife community observed within the LAA is representative of the larger RAA in the terrestrial landscape as the land cover is similar.

Change in mortality risk to wildlife was assessed quantitatively and qualitatively for the Project. While there is a general understanding about the effects mechanisms from wind energy developments on mortality risk to wildlife, project and species-specific estimation of mortality is not possible. Fatality rates of the Project are likely to be similar to those of the Centennial and the Morse WEPs, as they are generally in similar landscapes and are found to the east and west of the Project.

Therefore, based on the understanding of the Project and effectiveness of proposed mitigation measures, prediction confidence in the assessment of Project residual effects and potential cumulative effects on wildlife and wildlife habitat is moderate to high for change in habitat availability and moderate for change in mortality risk.

8.8 FOLLOW-UP AND MONITORING

A series of general and specific mitigation commitments will be implemented to reduce or avoid potential effects on wildlife and wildlife habitat. Mitigation measures have focused on Project siting and design that have been applied through a progressive refinement of the turbine layout in response to sensitive wildlife habitat features identified during baseline surveys. Construction and post-construction environmental protection measures and monitoring will also be completed to verify predicted effects as part of the adaptive management process. These are comprehensively listed in Appendix C.

The GIS analysis identified that the Project layout overlaps a small area (0.6 ha) of native prairie. All WTGs have been sited off of native prairie; other Project components that intersect with native prairie consist of temporary workspaces, and collector line and access road ROWs that follow municipal road allowances. The overlap is partly due to the coarseness of the land cover data; in reality, these Project components will be sited to avoid native prairie where feasible, effectively reducing the 0.6 ha as close to zero as possible.

Follow-up studies will occur during the two-year post-construction phase of the Project, with the potential for long-term monitoring occurring every five years. The objective of the monitoring program will be to verify the accuracy of the predicted Project-related effects, particularly those related to direct mortality. Additional information on follow-up and monitoring is found in Appendix C.

9.0 ASSESSMENT OF POTENTIAL EFFECTS ON HERITAGE RESOURCES

This chapter discusses the Project's potential environmental effects on the Heritage Resources VC. Heritage resources are the tangible remains of past land use activities, are non-renewable, and are susceptible to loss or damage because of Project activities. The value of heritage resource sites is measured not only by the individual artefacts they contain, but also by:

- the information about the past that might be obtained from studying the objects.
- the spatial relationships of artefacts within sites.
- the context of artefact assemblages and sites across the landscape.
- the identity of artefacts and/or artefact assemblages within the cultural landscape.

Heritage resources are a VC based on provincial and federal legislated requirements, First Nation and Métis interest, scientific relevance and interest, and public concern.

9.1 SCOPE OF ASSESSMENT

9.1.1 Regulatory and Policy Setting

Heritage resources are the archaeological, cultural, paleontological, and architectural evidence of the past that the Project may potentially affect. The HCB of the Saskatchewan Ministry of Parks, Culture, and Sport (SMPCS) protects heritage resources through administration of the *Heritage Property Act* (Government of Saskatchewan 1980a). Examples of tangible remnants of past human activity and natural history that may be visible on the ground surface or buried by soil and sediment include:

- archaeological objects
- palaeontological objects
- any property of interest for its architectural, historical, cultural, environmental, archaeological, palaeontological, aesthetic, or scientific value

These resources include fossils, fossil assemblages, and traces left by ancient life; artefacts, such as stone tools; features, such as stone circles or building ruins; altered landscapes, such as trails; and the remains of food, in the form of clusters of butchered animal bone or accumulations of discarded commercial packaging. Culturally important spaces, such as ceremonial sites and medicinal plant gathering sites, as described by Indigenous Elders, are also considered as heritage resources and administered under the *Heritage Property Act* where appropriate.

A referral outlining the PDA and siting buffers was submitted to HCB on August 29, 2017. Siting buffers around the PDA were included to allow for the identification of heritage sites beyond the PDA in case minor alterations to infrastructure siting as required during the finalization and construction of the Project. The siting buffers consisted of:

- 250 m radius around each WTGs,
- 300 m x 300 m around substation,
- 50 m on either side of new access roads and collector lines

HCB reviewed the Project and replied on September 14, 2017 requiring an HRIA of portions of eight quarter sections that intersect with the PDA and siting buffers. Following completion of the HRIA on October 18 and 19, 2017, a heritage permit report was forwarded to HCB that outlined the methods and results of the assessment and mitigation recommendations based on findings.

Part V Section 63 of the Act outlines HRIA regulations. The Project's fulfillment of the requirements set out under the *Heritage Property Act* (Government of Saskatchewan 1980a), specifically Section 63, is determined at the discretion of HCB, with the provision that mitigation measures at specific sites required by the Minister are completed to their satisfaction. The HCB determines mitigation requirements primarily on individual site integrity and demonstrated scientific value, based on data collected during the HRIA. An HRIA of the Project was completed in October 2017.

9.1.2 Consideration of Issues Raised during Engagement

No traditional land and resources use information was available at the time of EIS application submission. However, Algonquin will continue to consider traditional knowledge information received during Project planning and detailed engineering design.

Community engagement activities held between January and September 2017 addressed heritage resources. During a meeting with PPPI, representatives of the organization raised concern regarding potential disturbance to unidentified heritage features. Algonquin has included a protocol for chance encounters of heritage resources in the EEP. In the event of a chance encounter, work will stop and assessment will be conducted in accordance with the HCB. This issue and response is summarized in Table 3-3 of Section 3.4.3.

9.1.3 Potential Effects, Pathways and Measurable Parameters

For this EIS submission, the assessment of potential effects on heritage resources focuses on change to heritage resource sites.

Potential effects pathways occur during the construction phase of the Project related to activities that require ground disturbance. Site preparation, including clearing and grading, of WTG locations, access roads, and temporary workspaces could disturb known or potential heritage sites by dislocating artefacts and features that are on or just beneath the ground surface. Vegetation removal could also create unstable soil environments and associated surface runoff that would result in the horizontal and vertical displacement of surface or shallowly buried artefacts. Installation of WTG foundations, collector lines, and substations could also disturb known or potential heritage sites. Post-construction reclamation and site landscaping could also disturb known or potential heritage sites by dislocating artefacts or features that are on or just beneath the ground surface. Construction vehicles could also inadvertently change a heritage resource site either through compaction or by altering the context of surface sites, such as a stone circle or stone cairn.

Change to heritage resources is characterized by a measurable change in site number, contents, or context resulting from Project-related activities, and is generally confined to the PDA. The number of existing, documented or recorded heritage resources provide an indication of the potential for Project interactions with heritage resources. Project interactions can adversely affect the qualities of heritage resources as measured by individual site integrity that affects perceived scientific value as well as cultural relevance to Indigenous communities.

Table 9-1 summarizes the potential effect, effect pathway, and measurable parameters used for the assessment of this effect.

Table 9-1 Potential Effects, Effects Pathways and Measurable Parameters for Heritage Resources

Potential Environmental Effect	Effect Pathway	Measurable Parameter(s) and Units of Measurement
Change to heritage resources sites	• Direct loss or alteration of a heritage resource site because of vegetation clearing and ground disturbance	• Number of heritage resource sites in PDA • Integrity of heritage resource sites in PDA

9.1.4 Boundaries

9.1.4.1 Spatial Boundaries

The spatial boundaries used in the assessment are:

Project Development Area (PDA) – The PDA is represented by the physical Project footprint and consists of the area of physical disturbance associated with Project components, i.e., WTGs, access roads, collector lines, substation, and temporary workspaces.

Local Assessment Area (LAA) – ground-disturbing physical construction activities are not expected to occur outside of the PDA. For this reason, an LAA with respect to heritage resources has not been defined and therefore the PDA is also considered the LAA.

Regional Assessment Area (RAA) – the RAA encompasses the PDA and is defined for interpretation of baseline conditions as the mixed grassland ecoregion of the Prairies ecozone confined to the Swift Current Plain landscape area that is a mixture of small morainic uplands and glaciofluvial plains (Acton et al. 1998).

Figure 9-1 illustrates the heritage resources assessment areas.

9.1.4.2 Temporal Boundaries

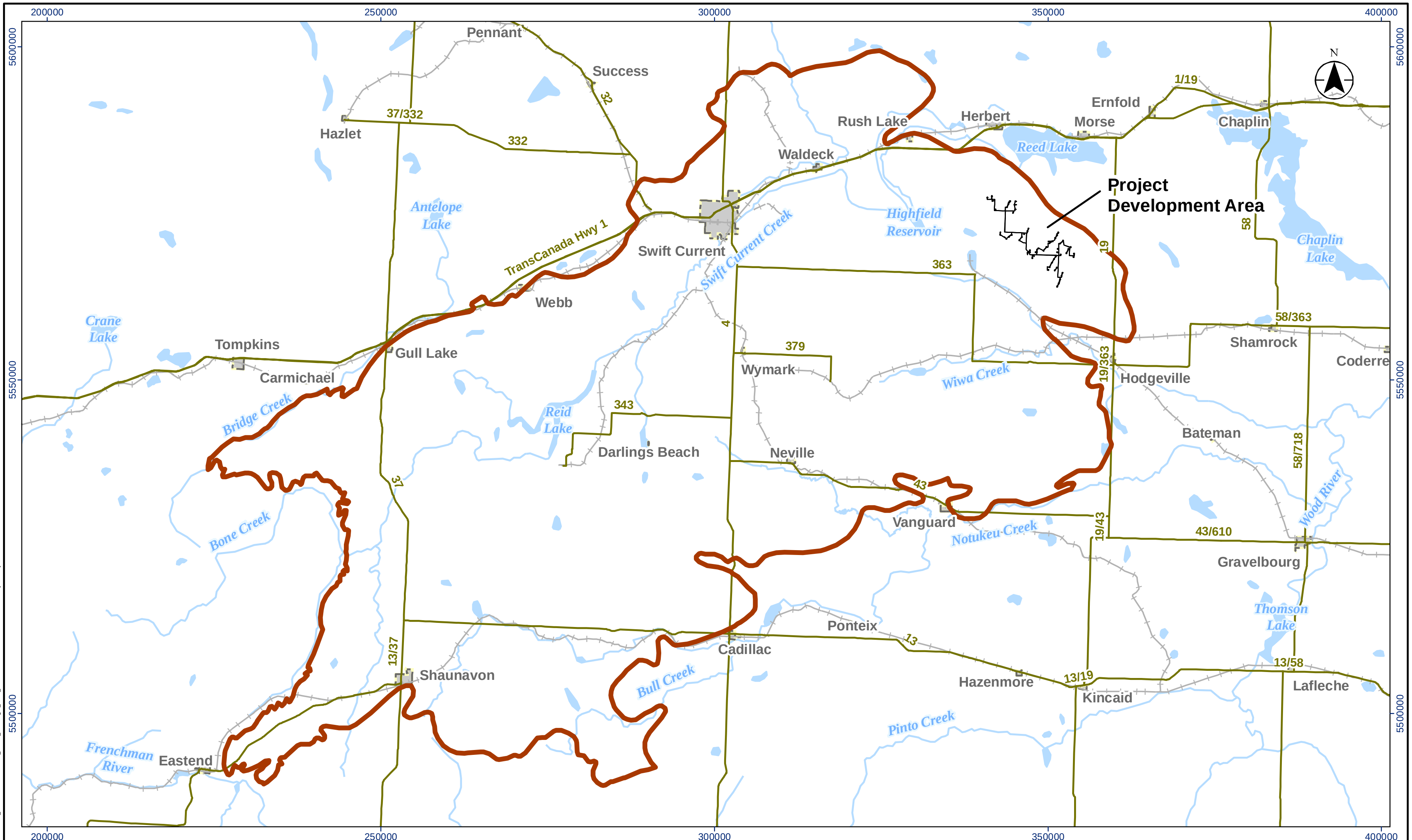
The temporal boundary of a Project effect is evaluated in relation to specific phases and activities. The temporal boundary is based on the timing and duration of Project activities and the nature of the interactions with heritage resources.

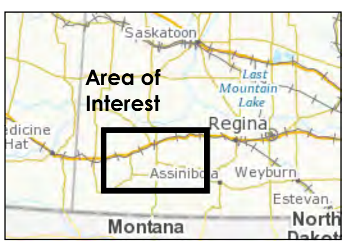
The period during which effects on heritage resources are assessed within each of these Project phases is defined as the following:

- **Construction:** Up to 1.5 years. Peak construction activity period associated with site preparation, construction (i.e., WTG installation, access road construction, collector line installation, substation construction), reclamation of temporary workspace and commissioning.
- **Operation and Maintenance:** From commissioning through the life of the Project (at a minimum approximately 25 years).
- **Decommissioning:** A two-year period at the end of the life of the Project, comprising the removal of above-ground facilities and a portion of the foundations, abandonment in place of underground collector lines and any associated reclamation activities. As part of decommissioning, certain components will be left in place as this approach usually results in fewer environmental effects.

While the duration of each Project phase reflects the complete time for a phase, effects from activities are considered during peak periods within to provide a conservative assessment of effects. The environmental effects of the Project on heritage resources will be greatest during the construction phase and will consist of short term surface and ground disturbance during WTG foundation and tower installation, installation of collector lines, access roads, and workspaces.

Potential effects on heritage resources are not expected to occur during operation and maintenance and decommissioning as no ongoing construction-type activities are anticipated to occur during these phases of the Project.





Heritage Resources Regional Assessment Area
Major Road
Railway
Town/City
Watercourse
Waterbody

0 10 20 Kilometers

1:850,000 (At original document size of 8.5x11)

Notes
1. Coordinate System: NAD 1983 UTM Zone 13N
2. Base features produced under license with the Government of Saskatchewan and the Government of Canada.
3. Regional Assessment Area based on Swift Current Plateau ecodistrict boundary, CanSIS, Ecological Framework.

Stantec Algonquin

Project Location
Near Herbert, SK

113254088-039 REVC
Prepared by acory on 2017-12-18
Technical Review by ceidem on 2017-12-18

Client/Project
Algonquin Power Co.
Blue Hill Wind Energy Project

Figure No.
9-1

Title
Heritage Resources Assessment Areas

G:\active\clients\algonquin_power_services\blue_hill\figures\report\eis\main_doc\113254088-039_REVC_Heritage_RAA_Final.mxd Revised: 2017-12-18 By: acory

9.1.4.3 Administrative and Technical Boundaries

The administrative and technical boundaries are as described in the HRIA scope administered by the HCB pursuant to Part V Section 63 of the *Heritage Property Act* (Government of Saskatchewan 1980a).

9.1.5 Residual Effects Characterization

Residual effects for heritage resources are characterized as either occurring or not. An adverse residual environmental effect on heritage resources occurs if it results in a permanent Project-related disturbance to, or destruction of, all or part of a heritage resource site that has not been subject to regulatory-determined mitigation. Such mitigation may include avoidance or excavation of the site to the satisfaction of the HCB. As a result, detailed residual effect criteria are not required.

9.1.6 Significance Definition

An adverse residual environmental effect on heritage resources is considered significant if it results in a permanent Project-related disturbance to, or destruction of, all or part of a heritage resource site that has not been subject to regulatory-determined mitigation.

9.2 EXISTING CONDITIONS FOR HERITAGE RESOURCES

This section provides a description of existing conditions for heritage resources as an overview of the setting for the Project, to support an understanding of the receiving environment, and to enable an understanding of how heritage resources might be affected by the Project. Inclusion of existing conditions information is limited to that which is necessary to assess the environmental effects of the Project on heritage resources and support recommendations for mitigation, monitoring, and follow-up. A summary of methods and results is presented below.

9.2.1 Methods

The HCB maintains a database of recorded heritage resources managed by National Topographic System (NTS) map sheets. The Project area is located within two NTS map sheets: 72J/03 and J/06. The HCB provided an inventory of previously recorded sites for these map sheets to contribute to baseline data. A search of the Saskatchewan Register of Heritage Properties for sites such as churches, cemeteries, school houses, and museums located in the PDA was also conducted. A Project description and location maps were forwarded to the HCB for review and determination of the requirement for an HRIA of the Project.

The HCB reviewed the Project referral based on the presence of recorded heritage sites within the Project area, the PDA's heritage potential, the extent of previous land disturbance, and Project scope. The HCB determined that there are areas of undisturbed hummocky native prairie near seasonal water sources in the PDA. The HCB considers this type of terrain to have moderate to high potential to contain heritage resources. Although no heritage resources have been previously recorded in the PDA, there are four known heritage resources previously recorded in the Project area. Therefore, the HCB required an HRIA of the Project identifying portions of eight quarter sections for field assessment.

Stantec obtained Saskatchewan Archaeological Resource Investigation Permit 17-188 from HCB to complete the assessment. Stantec used standard operating field methods to complete the HRIA. Stantec archaeologists completed the HRIA from October 18 to October 19, 2017. Each assessment location was examined by pedestrian reconnaissance within the PDA and siting buffers. Tests were placed in areas judged to be of higher archaeological potential. All tests were hand dug excavations 40 cm by 40 cm at surface and to various depths. Tracks, waypoints, and findings were mapped using a hand-held Garmin Montana GPS.

9.2.2 Results

There are four previously recorded archaeological sites within the Project area: EbNs-1, EbNt-2, EbNt-3, and EbNt-4. EbNs-1 is identified as a possible burial and is therefore designated as a Site of a Special Nature. EbNt-2 and EbNt-3 are both artefact/feature combination sites. EbNt-4, recorded in 1986 is a lithic scatter located on SW 27-15-09 W3M. Of the four artefacts reported at EbNt-4, two are unidentified points, one is a biface, and one an Oxbow knife. This indicates an occupation during the Middle Precontact Period, likely between 5,000 and 4,000 years B.P. There are no registered heritage properties in the PDA.

Most of the PDA is cultivated, reducing the importance of heritage resources by altering the vertical and horizontal provenience (place of origin) of the artefacts. However, the HCB identified portions of eight quarter sections within the PDA and siting buffers that required an HRIA. During the HRIA, four previously undiscovered archaeological sites were recorded near the PDA (Table 9-2).

Table 9-2 Summary of Archaeological Sites Recorded during the HRIA

Borden Number	Site Name	Site Type	Legal Location	Site Components	Proximity to the Turbine Foundation
EbNs-2	Blue Hill Petroglyph Site	Site of a Special Nature (Rock Art, Multiple Feature)	NW and SW 26-15-09 W3M	• Petroglyph • Stone Cairn • Stone Circle	• 220 m
EbNs-3	Blue Hill Stone Circle Site	Recurrent Feature	SE 27-15-09 W3M	• Four stone circles	• 258 m
EbNt-5	Fonger Site	Single Feature	NW 20-15-09 W3M	• 1 stone circle with central cairn	• 520 m
EbNt-6	Blue Hill Stone Cairn Site	Site of a Special Nature (Possible Burial and Recurrent Feature)	NE 04-16-09 W3M	• 1 possible burial • 3 stone cairns	• 200 m

9.3 PROJECT INTERACTIONS WITH HERITAGE RESOURCES

Table 9-3 identifies, for each potential effect, the physical activities that might interact with heritage resources and result in the identified environmental effect. These interactions are indicated by a check mark and are discussed in detail in Section 9.4 in the context of effects pathways, standard and project-specific mitigation/enhancement, and residual effects. A justification for no effect is provided following the table.

Table 9-3 Project-Environment Interactions with Heritage Resources

Physical Activities	Environmental Effects: Change to heritage resources sites
Construction	
Site preparation, including clearing and grading of WTG locations, access roads and temporary workspaces	✓
Installation of WTG foundations and turbine erection	✓
Installation of collector lines and substation	✓
Reclamation and site landscaping	✓
Operation and Maintenance	
Operation of WTGs and substation, including access road use	–
WTG routine and unplanned maintenance	–
Routine and unplanned maintenance of collector and substation infrastructure	

Table 9-3 Project-Environment Interactions with Heritage Resources

Physical Activities	Environmental Effects
	Change to heritage resources sites
Decommissioning	
Equipment dismantling, access removal, collector and substation removal	–
Site reclamation	–
NOTES: ✓ = Potential interaction – = No interaction	

Operation and maintenance, and decommissioning, will not interact with heritage resources as ground disturbing activities will occur on areas previously disturbed during construction.

9.4 ASSESSMENT OF RESIDUAL ENVIRONMENTAL EFFECTS ON HERITAGE RESOURCES

Construction activities can affect heritage resource sites through subsurface disturbance required for installation of Project components and by construction vehicle traffic.

9.4.1 Analytical Assessment Techniques

The evaluation of potential Project effects on heritage resources first compares the locational data of previously recorded archaeological sites, and archaeological sites found during the HRIA, to the PDA. The assessment then evaluates if those sites may be subject to direct disturbance by the Project.

9.4.2 Change to Heritage Resource Sites

9.4.2.1 Project Pathways

Clearing and grading during construction of the Project has the potential to dislodge shallowly buried artefacts and surface features such as stone circles or cairns. Removal of vegetation could create unstable soil environments and associated surface runoff that would result in the horizontal and vertical displacement of surface or shallowly buried artefacts. Installation of WTG foundations and turbine erection could disturb known heritage resource sites by altering the horizontal and/or vertical context of artefacts. Construction vehicle traffic could disturb surface or shallowly buried heritage resources.

9.4.2.2 Mitigation

Four archaeological sites were recorded during the HRIA. A summary of the sites and corresponding mitigation measures, as approved by the HCB, are summarized in Table 9-4.

Mitigation measures will be incorporated into the EPP. As well, the EPP outlines protocols for contacting the HCB in the event of chance discoveries during construction (see Volume 1 of the EPP in Appendix C).

The HCB responded to the mitigation outlined in the HRIA with a clearance letter on December 14, 2017. This letter confirms acceptance of the mitigation and is included in Appendix I.

Table 9-4 Summary of Proposed Mitigation Measures

Borden Number	Site Name	Legal Location	Proposed Mitigation Measures
EbNs-2	Blue Hill Petroglyph Site	NW and SW 26-15-09 W3M	Avoidance buffer of 200 m for permanent Project infrastructure and 100 m for temporary construction activities to protect the site from construction vehicles and construction disturbance.
EbNs-3	Blue Hill Stone Circle Site	SE 27-15-09 W3M	Staked 15 m buffer around the site to prevent vehicle disturbance during construction.
EbNt-5	Fonger Site	NW 20-15-09 W3M	None required. The Site is 565 m west of the west edge of the 250 m WTG buffer, therefore, there is no potential to disturb the site.
EbNt-6	Blue Hill Stone Cairn Site	NE 04-16-09 W3M	Avoidance buffer of 200 m for permanent Project infrastructure and 100 m for temporary construction activities to protect the site from construction vehicles and construction disturbance.

9.4.2.3 Project Residual Effect

With the implementation of recommended mitigation measures approved by the HCB, compliance with the *Heritage Property Act*, and implementation of environmental protection measures, no residual effects on heritage resources are anticipated.

9.5 ASSESSMENT OF CUMULATIVE ENVIRONMENTAL EFFECTS ON HERITAGE RESOURCES

With the implementation of mitigation measures determined by the HCB, compliance with the *Heritage Property Act*, and use of environmental protection measures, no residual and therefore no cumulative effects, on heritage resources are anticipated.

9.6 DETERMINATION OF SIGNIFICANCE

9.6.1 Significance of Project Residual Effects

With mitigation and environmental protection measures, Algonquin will be in compliance with the regulatory conditions set out by the HCB. Therefore, there are no residual environmental effects on heritage resources and correspondingly no significant effects.

9.6.2 Significance of Cumulative Effects

There are no Project residual effects; therefore, there are no cumulative effects.

9.7 PREDICTION CONFIDENCE

A conservative approach is taken in the evaluation of potential environmental effects on heritage resources. Prediction confidence is moderate based on the low number of previously recorded archaeological sites within the PDA and the size of the field assessment area relative to the PDA. As well, it is not possible for field methods used during an HRIA to guarantee that all heritage resource sites have been located. To address this, a protocol for chance discoveries is included in the EPP.

9.8 FOLLOW-UP AND MONITORING

No follow-up is recommended. The construction personnel and the environmental monitor will be educated on the process to report chance finds, should such features/artefacts be found.

10.0 ASSESSMENT OF POTENTIAL EFFECTS ON LAND AND RESOURCE USE

10.1 SCOPE OF ASSESSMENT

Land and resource use was selected as a VC because the Project has the potential to result in changes to the environment that could temporarily or permanently affect the current land and resource uses (e.g., hunting, recreational use, agriculture).

Land and resource use is linked with other VCs, including vegetation and wetlands, and wildlife. Where appropriate the VCs are referenced in relation to the effects assessment for land and resource use.

10.1.1 Regulatory and Policy Setting

The Government of Saskatchewan typically manages resources such as oil, gas and industrial dispositions; hunting; fur trapping licenses; and all uses of Crown land (e.g., grazing leases). Through the use of various guidelines, policies, and regulations, the development and use of resources are managed.

The RMs have authority over local development and land use planning on most lands within their boundary. The Project traverses two RMs in Saskatchewan: Lawtonia and Morse. Municipal administration has a direct role in governing land use since municipal plans and zoning by-laws prescribe the types of development that can take place within an RM.

Development permits are required to commence any development within the RMs. The Project will require development permits from the RMs of Lawtonia and Morse, as well as written consent from the landowners if development occurs in the RM of Lawtonia (Bylaw No. 2-2015). Additional requirements or agreements may be needed from the RMs for some aspects of the Project, including maintaining or upgrading municipal roads, building road approaches, and setbacks from sensitive lands and/or hazard lands.

10.1.2 Consideration of Issues Raised during Engagement

During engagement with NGOs, PPPI noted concern regarding interruption of farming operations during construction of the Project. Algonquin has committed to discussing any areas of concerns with landowners prior to construction. This issue is summarized in Table 3-3 of Section 3.4.3.

10.1.3 Potential Effects, Pathways and Measurable Parameters

The existing conditions for the Project were used to select potential effects. The potential effects, effects pathway and measurable parameters for land and resource use are described further in Table 10-1.

Table 10-1 Potential Effects, Effects Pathways and Measurable Parameters for Land and Resource Use

Potential Environmental Effect	Effect Pathway	Measurable Parameter(s) and Units of Measurement
Change in Agricultural Land Activities	• Limited access or prevented use of lands for seasonal farming operations • Decrease in agricultural production through change in available land • Modified soil agricultural capability class following construction or decommissioning	• Access to agricultural lands • Agricultural capability class
Change in Oil, Gas and Industrial activities	• Limited access or prevented use of oil, gas and industrial activities	• Access to existing or potential oil, gas and industrial developments
Change in Recreational and Commercial Harvesting Activities	• Limited access or prevented use of lands for harvesting activities • Decreased recreational harvesting activities due to indirect effects to vegetation and wetlands, and wildlife and wildlife habitat. Information on these effects has been provided in Section 7.0 and 8.0.	• Access for harvesting activities • Resource availability for harvesting activities
Change in Non-consumptive Recreational Activities	• Limited access or prevented use of lands for recreational activities • Change in viewscape	• Access for non-consumptive recreational activities • Visual aesthetics
Change to Surface Water Use	• Decrease in surface water quantity or quality for rural domestic and agricultural surface water use	• Quantity or quality of surface water used as a water source • Access to surface water used as a water source
Change to Ground Water Use	• Decrease in groundwater quantity or quality for rural domestic and agricultural groundwater use	• Quantity or quality of ground water used as a water source • Access to ground water used as a water source

10.1.4 Boundaries

10.1.4.1 Spatial Boundaries

The following spatial boundaries are defined for the land and resource use assessment:

Project Development area (PDA) – The PDA is represented by the physical Project footprint and consists of the area of physical disturbance associated with Project components, i.e., WTGs, access roads, collector lines, substation, and temporary workspaces.

Local Assessment Area (LAA) – The LAA consists of the PDA and a 1 km buffer around the PDA.

Regional Assessment Area (RAA) – The RAA consists of the PDA and a 5 km buffer around the PDA.

Land and resource use assessment areas are shown on Figure 10-1.

10.1.4.2 Temporal Boundaries

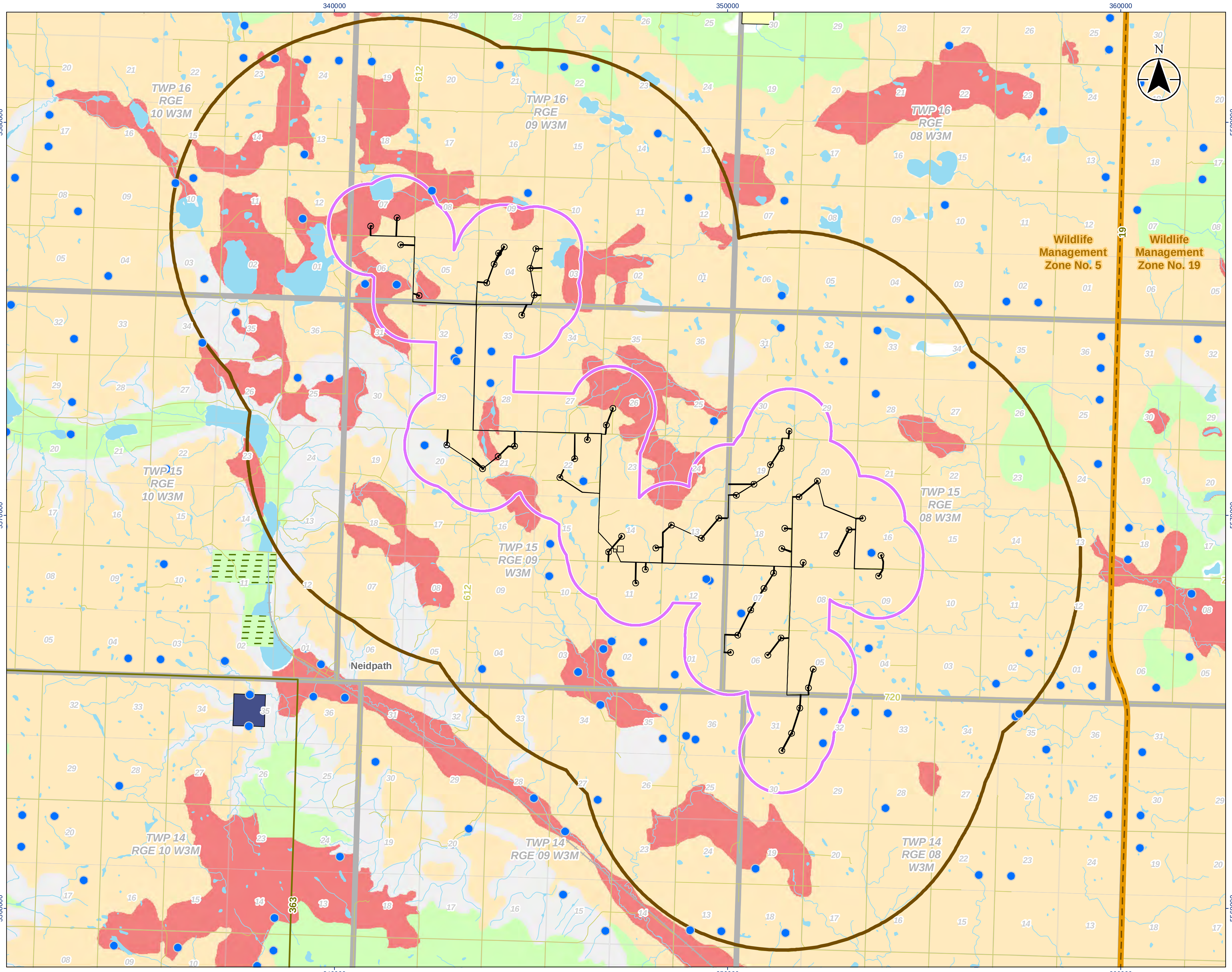
The period during which effects on land and resource use are assessed within each of the Project phases is defined as follows:

- **Construction:** Up to 1.5 years. Peak construction activity period associated with site preparation, construction (i.e., WTG installation, access road construction, collector line installation, substation construction), reclamation of temporary workspace and commissioning.
- **Operation and Maintenance:** From commissioning through the life of the Project (at a minimum approximately 25 years).
- **Decommissioning:** A two-year period at the end of the life of the Project, comprising the removal of above-ground facilities and a portion of the foundations, abandonment in place of underground collector lines and any associated reclamation activities. As part of decommissioning, certain components will be left in place as this approach usually results in fewer environmental effects.

10.1.4.3 Administrative and Technical Boundaries

Some aspects of administrative and technical boundaries for land and resource use are governed by specific acts and regulations, while other aspects are not subject to legislated boundaries. For example, in Saskatchewan, hunting and trapping is regulated by the *Wildlife Regulations, 1981* (Government of Saskatchewan 1981), which is governed under *The Wildlife Act, 1998* (Government of Saskatchewan 1998), and administered by the SKMOE. Hunting is regulated using provincial wildlife management zones (WMZs) within which there are restrictions and seasons for each species. For bird hunting and trapping, the province manages these activities through the Game Bird Districts and the Fur Conservation Areas (Government of Saskatchewan 2017a).

Other aspects are not subject to administrative and technical boundaries. The overall approach and context in which the land and resource use VC is assessed, is discussed in Section 10.1.1.



Water Wells

Fish and Wildlife Development Fund Land

Private Conservation Lands

Wildlife Habitat Protection Act Land

Wildlife Management Zone

Dominant Agricultural Capability

Moderately Severe Limitations

Severe Limitations

Very Severe Limitations

Perennial Forage Crop

Project Development Area

Land and Resource Use Local Assessment Area

Land and Resource Use Regional Assessment Area

Major Road

Minor Road

Railway

Watercourse

Waterbody

Township

Section

0 1 2 3 4 Kilometers

1:100,000 (At original document size of 11x17)

Notes

1. Coordinate System: NAD 1983 UTM Zone 13N
2. Base features produced under license with the Government of Saskatchewan and the Government of Canada
3. Project Development Area based on Algonquin layout Sept 06, 2017, V3
4. Agricultural Capability: SKSID v4, Water Wells: WSA 2016, Designated Lands: CARTS, 2016. WMZ, SK Gov Rest Services Accessed Nov 30, 2017.

Project Location
Near Herbert, SK

113254088-017 REVD
Prepared by acory on 2017-12-18
Technical Review by ceidem on 2017-12-18

Client/Project
Algonquin Power Co.
Blue Hill Wind Energy Project

Figure No.
10-1

Title
Land and Resource Use Assessment Areas and Baseline Features

10.1.5 Residual Effects Characterization

Table 10-2 provides a qualitative measure of the characterization of residual environmental effects for land and resource use.

Table 10-2 Characterization of Residual Effects on Land and Resource Use

Characterization	Description	Quantitative Measure or Definition of Qualitative Categories
Direction	The long-term trend of the residual effect	**Positive –** a residual effect that moves measurable parameters in a direction beneficial to land and resource relative to baseline. **Adverse –** a residual effect that moves measurable parameters in a direction detrimental to land and resource use relative to baseline. **Neutral –** no net change in measurable parameters for the land and resource use relative to baseline.
Magnitude	The amount of change in measurable parameters or the VC relative to existing conditions	**Negligible –** no measurable change **Low –** effect occurs that might or might not be detectable, but is in the normal range of variability **Moderate –** effect will result in a demonstrable change in land use pattern, but will not prevent activities from continuing elsewhere in the LAA **High –** effect will result in a demonstrable change that will either affect the sustainability of land and resource use and/or displace land use activities that cannot be accommodated elsewhere in the LAA
Geographic Extent	The geographic area in which a residual effect occurs	**PDA –** residual effects are restricted to the PDA **LAA –** residual effects extend into the LAA **RAA –** residual effects interact with those of other projects in the RAA
Duration	The period of time required until the measurable parameter or the VC returns to its existing condition, or the residual effect can no longer be measured or otherwise perceived	**Short-term –** residual effect restricted to the duration of the activity or to the construction phase **Medium-term –** residual effect extends through more than the duration of the construction Project phase, but less than the life of the Project **Long-term –** residual effect extends beyond decommissioning
Frequency	Identifies how often the residual effect occurs and how often during the Project or in a specific phase	**Single event** – residual effect occurs once **Multiple irregular event –** residual effect occurs sporadically and intermittently **Multiple regular event –** residual effect occurs repeatedly and regularly **Continuous –** residual effect occurs continuously

Table 10-2 Characterization of Residual Effects on Land and Resource Use

Characterization	Description	Quantitative Measure or Definition of Qualitative Categories
Reversibility	Pertains to whether a measurable parameter or the VC can return to its existing condition after the project activity ceases	**Reversible –** the residual effect is likely to be reversed after activity completion and/or reclamation **Irreversible –** the residual effect is unlikely to be reversed
Ecological and Socio-economic Context	Existing condition and trends in the area where residual effects occur	**Undisturbed –** area is relatively undisturbed or not adversely affected by human activity **Disturbed –** area has been substantially previously disturbed by human development or human development is still present

10.1.6 Significance Definition

A significant adverse residual effect for land and resource use is defined as one that, following application of mitigation, results in the following:

- the Project does not comply with established land use plans, policies, or by-laws.
- the Project will create a change or disruption that restricts or degrades present land use capability to a point where the activities cannot continue at or near current levels and where compensation is not possible.

10.2 EXISTING CONDITIONS FOR LAND AND RESOURCE USE

10.2.1 Methods

Baseline information for this assessment was collected from the following sources:

- Existing literature, such as government publications, land use surveys, regional studies, resource management plans, and land use plans (e.g., Canada Land Inventory Maps, AAFC 1973, Ayres et al. 1985)
- Websites for government and non-government agencies and organizations (e.g., Saskatchewan Hunters' and Trappers' Guide, Government of Saskatchewan 2017b)
- Provincial (e.g., Saskatchewan Water Security Agency, Saskatchewan Ministry of Environment Land's Branch for Representative Areas Network) and federal databases (Government of Canada water body and watercourse databases, national road network, and national hydro network), historical data, and relevant literature sources
- Planning documents from the RMs of Lawtonia and Morse
- Land cover data from Agriculture and Agri-Food Canada (AAFC 2015a)

- Vegetation and wetlands discipline dataset for land cover mapping (see Section 7.0)
- GeoSask to acquire information on rural and urban municipalities

Field data from vegetation and wetland, and wildlife disciplines were used to verify desktop findings.

10.2.2 Results

10.2.2.1 Land Ownership

All land in the PDA and LAA is privately owned; there are no Agricultural Crown land, Indian Reserves, *Wildlife Habitat Protected Act* land, Private Conservation lands and Fish and Wildlife Development Fund lands located within the PDA and LAA. Within the RAA, there are three Agricultural Crown land quarter sections in SE 23-15-10 W3M, NW 27-14-09 W3M and SW 16-14-08 W3M, located approximately 4 km from the PDA.

The PDA crosses two RMs, with the LAA intersecting an additional RM. Table 10-3 lists the RMs along with the main municipal land use plans and bylaws that are applicable to the Project.

Table 10-3 Rural Municipalities within the PDA and LAA

Rural Municipality	Spatial Boundary	Administration Centre	Land Use Policies/Plans	Zoning Bylaw/Other Bylaws
Lawtonia No. 135	PDA	Hodgeville, SK	N/A	RM of Lawtonia Zoning Bylaws No. 2-2015 (RM of Lawtonia 2015)
Morse No. 165	PDA	Morse, SK	N/A	RM of Morse No. 165 Basic Planning Statement Bylaw No. 65-2005 and RM of Morse No. 165 Zoning Bylaw No. 66-2005 (RM of Morse 2004a,b)
Excelsior No. 166	LAA	Rush Lake, SK	N/A (Hahn 2017, pers. comm.)	Interim Development Control Bylaw No. 4-2017 (RM of Excelsior 2017)

10.2.2.2 Agriculture

Land use in the PDA has been defined based on the land cover type. The PDA is predominantly cultivated land (63%) followed by hayland (20%), tame pasture (8%), and developed (6%) (see Table 7-6). The PDA avoided native prairie except for a small portion, 0.6 ha (<1% of the PDA), with potential for further avoidance once project engineering is finalized. Agricultural operations (e.g., crop production, hay production, cattle grazing, etc.) are the primary activities in the PDA. Agricultural operations in the PDA occur on cultivated land, hayland, tame pasture and native prairie. Privately-owned agricultural lands with cereal crops make up most of the cultivated land (Statistics Canada 2017a).

The soil agricultural capability ratings for soils in the PDA and LAA range from Class 3 to 6 (see Figure 10-1). The PDA only has 1% of the soil classified as Class 3, which is in the range of soils with the highest agricultural capability based on the Canada Land Inventory System. Class 4 is the dominant soil agricultural capability in the PDA (89%) and in the LAA (82%) (see Table 10-4). Class 4 soils have severe limitations due to general soil restrictions, topography, erosion, excessive stones, excess water, and moisture holding capacity (CLI 1972). Class 5 soils are the only soil class in the PDA to have a limitation due to salinity. Detailed information on soil limitations in the PDA and LAA are presented in Table 10-5 to Table 10-8.

Table 10-4 Soil Agricultural Capability Ratings within the PDA and LAA

Soil Agricultural Capability[1]	Proportion of PDA (%)	Proportion of LAA (%)
3 (moderately severe limitations)	1	0
4 (severe limitations)	89	82
5 (very severe limitations)	9	15
6 (perennial forage crops)	2	3

NOTE:
[1] Canada Land Inventory (CLI). 1972. Soil Capability Classification for Agriculture. Department of Economic Expansion. Ottawa, ON. Report No. 2.

Table 10-5 Slope Classes within the PDA and LAA

Slope[1]	Proportion of PDA (%)	Proportion of LAA (%)
Nearly level to level (0-0.5%)	20	16
Very gentle slopes (0.5-2.0%)	42	68
Gentle slopes (2.0-5.0%)	27	5
Moderate slopes (5.0-10%)	8	7
Strong slopes (10-15%)	2	3
Steep slopes (15-30%)	<1	1

NOTE:
[1] Natural Resources Canada 2000

Table 10-6 Water Erosion Potential within the PDA and LAA

Erosion Class[1]	Proportion of PDA (%)	Proportion of LAA (%)
Very High	4	13
High	16	4
Moderate	0	0
Low	74	71
Very Low	6	10
Unclassified	0	2

NOTE:
[1]Ayres et al. 1985

Table 10-7 Wind Erosion Potential within the PDA and LAA

Erosion Class[1]	Proportion of PDA (%)	Proportion of LAA (%)
High	4	7
Moderate	79	45
Low	17	46
Unclassified	0	2

NOTE:
[1]Ayres et al. 1985

Table 10-8 Stoniness Potential within the PDA and LAA

Stoniness[1]	Proportion of PDA (%)	Proportion of LAA (%)
Non-stony (0)	4	16
Slightly Stony (1)	20	15
Moderately Stony (2)	76	68
Unclassified	0	1

NOTE:
[1]Ayres et al. 1985

10.2.2.3 Oil and Gas and Other Industrial Activities

No oil and gas wells or pipelines occur in the PDA. Within the LAA, there are two abandoned Stratigraphic Test Wells that were completed back in the 1960s. There are no aggregate or mineral resource rights within the PDA or LAA.

10.2.2.4 Recreational and Commercial Harvesting Activities

The PDA intersects three harvesting boundaries in Saskatchewan which include WMZ 5 (see Figure 10-1), the South Game Bird District, and Southern Fur Conservation Area (Government of Saskatchewan 2017a); the latter two are not shown on Figure 10-1 as these areas cover the entire southern half of the Province of Saskatchewan. The season for harvesting activities of big game, upland bird game and migratory bird game for those boundaries are mainly from September to December, except for the spring white geese hunting season which occurs from March to June. The trapping seasons can be year around for species such as raccoon and coyote, but for the remainder of the species can range from October to April.

As of 2017, Saskatchewan WMZ 5 has 16 licensed migratory game bird outfitters valid to use the zone (Ackerman 2017, pers. comm.).

There are no watercourses or waterbodies with commercial or sport fishing potential within the PDA, LAA and RAA.

10.2.2.5 Recreational Use

In the PDA and LAA, all land is privately owned. The RAA is mostly privately owned land with only three quarter sections of Agricultural Crown Land (located approximately 4 km from the PDA). Given the low proportion of publicly owned land, the potential for non-consumptive recreational use effects would apply mostly to residents (i.e., land owners), people that request access to private land, or roadside use. This is reflected by the lands having a moderate to low recreational capability rating for the PDA (AAFC 1973). Recreational activities in the PDA and LAA may include hiking, nature study, and bird or wetland wildlife viewing (AAFC 1973). There are no trails for recreational use in the PDA or LAA.

The viewscape in the PDA is primarily a typical prairie agriculture scene and mostly consists of cultivated land or hayland. The LAA and RAA have a more equal mix of pasture, cropland and water features. Besides trees associated with residences and farmyards, tree occurrence is very random and sparse as shrubland makes up only 0.1% of land cover up to 10 km from the PDA (see Section 7.2.2.1.3). There is variable terrain in the PDA from mostly very gentle slopes (42%) to steep slopes.

10.2.2.6 Surface Water Users

There are no rivers or lakes that are used for human use or consumption within the PDA and LAA. There are no reservoirs or dugouts within the PDA. The LAA has no reservoirs, but does have 42 dugouts that provide surface water for private landowners.

Additional details related to surface water can be found in Section 7.0.

10.2.2.7 Groundwater Users

A review of water well records indicated the presence of 20 wells within 800 m of the PDA, of which 17 are used for withdrawl (see Table 10-9 and Figure 10-1). The wells have a mean depth of 40 m, with a minimum depth of 0 m and maximum depth of 94 m. (WSA n.d.b)

Table 10-9 Groundwater Wells within 800 m of the PDA

Purpose	Well Use	Location[1]		Land Location
		Northing	Easting	
Domestic	Withdrawal	5574173	343995	SW 33-15-09 W3M
Domestic	Water Test Hole	5574173	343995	SW 33-15-09 W3M
Domestic	Water Test Hole	5574173	343995	SW 33-15-09 W3M
Domestic	Withdrawal	5565017	352449	NW 32-14-08 W3M
Domestic	Withdrawal	5565017	352449	NW 32-14-08 W3M
Domestic	Withdrawal	5564209	352426	SW 32-14-08 W3M
Domestic	Withdrawal	5575873	341584	SE 06-16-09 W3M
Domestic	Withdrawal	5571782	342291	NW 20-15-09 W3M
Domestic	Withdrawal	5570868	346334	SE 22-15-09 W3M
Domestic	Withdrawal	5568342	349539	NE 12-15-09 W3M
Domestic	Withdrawal	5569052	353655	SW 16-15-08 W3M
Domestic	Withdrawal	5569052	353655	SW 16-15-08 W3M
Domestic	Withdrawal	5567513	350343	SW 07-15-08 W3M
Domestic	Withdrawal	5567513	350343	SW 07-15-08 W3M
Domestic	Withdrawal	5574196	343168	SE 32-15-09 W3M
Domestic	Withdrawal	5573369	343971	NW 28-15-09 W3M
Domestic	Withdrawal	5573369	343971	NW 28-15-09 W3M
Domestic	Water Test Hole	5574003	343054	SE 32-15-09 W3M
Domestic	Withdrawal	5573927	343108	SE 32-15-09 W3M
Domestic	Withdrawal	5568383	349453	NE 12-15-09 W3M

NOTE:
[1] When the exact location of a well is unavailable, locations are arbitrarily placed in the middle of the quarter section.

SOURCE: Water Security Agency, n.d.a

An 800 m buffer was used to capture all wells that may interact with the PDA. This is a conservative approach because the water well locations provided by WSA are not always exact locations, but rather the well is arbitrarily placed in the center of the quarter section when exact coordinates are not available (WSA n.d.b). The 800 m buffer is the length and width of a quarter section, therefore a buffer of 800 m is a conservative approach to identify wells that could interact with the PDA. This is a reasonable assumption to use until the location of the wells can be field verified.

10.3 PROJECT INTERACTIONS WITH LAND AND RESOURCE USE

Table 10-10 identifies, for each potential effect, the physical activities that might interact with the VC and result in the identified environmental effect. These interactions are indicated by a check mark and are discussed in detail in Section 10.4, in the context of effects pathways, standard and project-specific mitigation/enhancement, and residual effects. A justification for no effect is provided following the table.

Project activities during the all phases of development are not anticipated to affect oil, gas and industrial activities as there are no oil and gas wells or pipelines within the PDA and only abandoned Stratigraphic Test Wells in the LAA. Therefore, there are no anticipated effects from Project activities, and no further consideration is given to this pathway in the assessment of residual effects on land and resource use.

Project activities during the all phases of development are not anticipated to affect surface water use as there are no surface water sources used for domestic or agricultural use in the PDA and with the implementation of standard mitigation measures the Project is not expected to have an effect on surface water quality of quantity of the dugouts located in the LAA. Therefore, there are no anticipated effects from Project activities, and no further consideration is given to this pathway in the assessment of residual effects on land and resource use.

During construction, water will be sourced from an approved location outside of the PDA and the contractor will be responsible for obtaining the required permits for any water taking activities for the Project. During operation and maintenance, and decommissioning, the wells that intersect the PDA or are within 800 m of the PDA are not expected to be affected by the Project because no water taking is anticipated during those phases of development. Therefore, there are no anticipated effects during operation and maintenance and decommissioning, and no further consideration is given to this pathway during these phases of development in the assessment of residual effects on land and resource use. Groundwater as it relates to wetlands is considered in the vegetation and wetland (see Section 7.0).

Table 10-10 Project-Environment Interactions with Land and Resource Use

Physical Activities	Environmental Effects					
	Change in Agricultural Land Activities	Change in Oil, Gas and Industrial Activities	Change in Recreational and Commercial Harvesting Activities	Change in Non-consumptive Recreational Activities	Change in Surface Water Use	Change in Ground Water Use
Construction						
Site preparation, including clearing and grading of WTG locations, access roads and temporary workspaces	✓	–	✓	✓	–	✓
Installation of WTG foundations and turbine erection	✓	–	✓	✓	–	✓
Installation of collector lines and substation	✓	–	✓	✓	–	✓
Reclamation and site landscaping	✓	–	✓	✓	–	✓
Operation and Maintenance						
Operation of WTGs and substation, including access road use	✓	–	✓	✓	–	–
WTG routine and unplanned maintenance	✓	–	✓	✓	–	–
Routine and unplanned maintenance of collector and substation infrastructure	✓	–	✓	✓	–	–
Decommissioning						
Equipment dismantling, access removal, collector and substation removal	✓	–	✓	✓	–	–
Site reclamation	✓	–	✓	✓	–	–

NOTES:
✓ = Potential interaction
– = No interaction

10.4 ASSESSMENT OF RESIDUAL ENVIRONMENTAL EFFECTS ON LAND AND RESOURCE USE

The land and resource use activities that may be affected as a result of Project interactions, as indicated in Table 10-10, are:

- Change in agricultural land activities
- Change in recreational and commercial harvesting activities
- Change in non-consumptive recreational activities
- Change in ground water use

10.4.1 Analytical Assessment Techniques

Effects of the Project on land and resource use were qualitatively and quantitatively assessed using existing data in combination with professional experience. The amount of land physically disturbed as a result of Project activities and the remaining footprint after construction was determined using GIS and used to assess the magnitude of effect. The approach for each land and resource use potential effect is summarized below.

- **Change in Agricultural Land Activities** – was assessed by identifying the agricultural lands where access may be restricted or agricultural land removed from production. The assessment also made assumptions on the potential change in agricultural capability class of the soil as a result of the Project. This was assessed by discussing existing soil conditions and how admixing/topsoil loss, erosion and compaction/rutting would affect those soils.
- **Change in Recreational and Commercial Harvesting Activities** – was assessed by identifying the extent of potential recreational and commercial harvesting area that will have restricted access because of construction, throughout operation and maintenance, and decommissioning. Potential effects on habitat that could indirectly affect recreational and commercial harvesting have been examined in Section 7.0 and Section 8.0.
- **Change in Non-consumptive Recreational Activities** – was assessed by identifying potential access restrictions and qualitatively evaluating the change in visual aesthetics based on before and after scenarios.
- **Change in Ground Water Use** – was assessed by discussing the potential effects to wells within the PDA and up to 800 m outside of the PDA.

10.4.2 Change in Agricultural Land Activities

10.4.2.1 Project Pathways

The change in agricultural land activities in the PDA could occur through restricted access, loss in production, and change in agricultural capability.

Construction activities could temporarily restrict access to certain land areas used for agricultural activities or prevent the use of agricultural lands for seasonal farming operations. Seasonal farming activities may include seeding (spring and/or early summer), haying (spring and/or summer) once or twice a season, baling (summer and/or fall) and grazing (seasonal movement of cattle between pastures). These restrictions could affect agricultural production depending on the length and time of year of the restriction.

Ground disturbance within the PDA during construction and decommissioning will remove agricultural land from use. Reclaimed land following construction or decommissioning may have a modified soil agricultural capability class.

Construction activities have the potential to change the quality and the quantity of soil, measured as a change in soil agricultural capability, through admixing, topsoil loss, compaction, rutting and wind and/or water erosion. This can occur during construction activities that include soil stripping, excavation, grading and heavy equipment or vehicle traffic.

- **Admixing** - Topsoil loss during construction can occur through admixing of topsoil with subsoil. Admixing topsoil with subsoil can also reduce the soil agricultural capability because subsoil is less suitable for crop production. There are also specific areas of the PDA where salinity and stoniness is variable and admixing of those soils would adversely affect the topsoil that does not have the same characteristics. Topsoil should be stored separately from the subsoil or there is the potential for admixing.

  Admixing can also occur because of heavy equipment and vehicle traffic. When the soil becomes saturated the topsoil can be mixed in with the subsoil through wheels turning the topsoil into the subsoil.

- **Topsoil loss** – Topsoil loss can occur because of inadequate mitigation and management of topsoil stripping. Challenging stripping conditions can create potential for topsoil loss, these conditions could include: frozen conditions; variability in topsoil depth and/or; the colour change from topsoil to subsoil is not easily identified.

- **Compaction and Rutting** – Heavy equipment and vehicle traffic can cause soil compaction and rutting. Finer textured soil such as clay and increasingly wet conditions (including rainfall events or wetlands) work towards increased potential for compaction and rutting. Compaction affects the bulk density of soil decreasing the holding capacity for moisture and restricts root growth because of a change in air movement, infiltration, soil-water storage and soil drainage. The existing soil already has moisture limitations, the addition of compacting could decrease the agricultural capability of the soil because of reduced crop production potential. Rutting creates ridges in the soil allowing the opportunity for erosion, admixing and water runoff changes.

- **Wind and Water Erosion** – Site preparation activities (i.e., clearing, excavation, grading) provide opportunity for erosion of both topsoil and subsoil. Site preparation activities disturb the root structures of vegetation that help hold the topsoil in place and protect against erosion. Excavation and grading also expose subsoil which can be subject to erosion.

Lands for the permanent infrastructure will be required for the life of the Project. During the Project's lifecycle, these lands will be removed from their present land-use and the opportunity for other use of these lands will be precluded in these site-specific areas.

10.4.2.2 Mitigation

Mitigation to reduce the change in agricultural land activities within the PDA include the following:

- Landowners will be provided the location of Project infrastructure to minimize inefficiencies in agricultural operations.
- Landowners with Project infrastructure that reduce the agricultural production of their lands will be financially compensated through the individual land lease agreements.
- Communication of construction timelines with landowners and tenure holders that have a land agreement with Algonquin.
- Posting of appropriate signage in advance of Project activities to indicate access restrictions.
- Minimize ground disturbance to the extent feasible.
- Halt construction during extreme weather events (e.g., heavy rainstorms) to avoid rutting and compaction that could lead to topsoil loss or erosion.
- Halt construction when soil conditions become saturated or installing matting.
- Minimize vehicle traffic on exposed soil.
- Establish erosion and sediment control measures including;
  - Daily monitoring
  - Installation of silt fencing where soils with erosion potential occur.
  - A three-lift soil stripping process where required, such as saline or stony soil, instead of a two-lift process.
  - Minimize duration between stripping and excavation to mitigate against erosion.

  - Where possible, stockpiling soil should be avoided to reduce soil erosion.
  - Storing stockpiles of saline and stony soils separately.
  - Storing stockpiles of topsoil and subsoil separately and not placing subsoil directly on topsoil.
  - Stabilizing stockpiles left for longer than 30 days by covering or by seeding, sodding, mulching or equivalent.
  - Retain soil to use during rehabilitation and revegetation of disturbed areas not required for operation and maintenance.
  - Retain existing vegetation where feasible.
  - Avoid clearing slopes unless adequate erosion control measures are used.
  - Grade disturbed soil to a stable slope.
  - Restrict heavy machinery or traffic on slopes.
  - Redistribute of the stockpiled topsoil to disturbed areas not required during Project operation and maintenance.
- At the end of construction, the constructible area will be restored to pre-construction condition or an agreed to use in consultation with the landowner.
- At the end of the Project's useful life, the Project will be decommissioned and the land used during operations will be restored to pre-construction condition or an agreed use in consultation with the landowner.

Mitigation measures to address changes in agricultural capability are also outlined in Volume 1 of the EPP in Appendix C.

10.4.2.3 Project Residual Effect

10.4.2.3.1 Construction

Project construction will remove 143.8 ha of land from agricultural activities. This includes 98.8 ha of cultivated land, 31.4 ha of hayland, 12.9 ha of tame pasture and <1 ha of native grassland (see Section 7.2.2.1.3). Reclamation after construction is expected to return 126.4 ha (> 85 %) of the PDA back to agricultural use.

Mitigation measures outlined in the EPP will be used when handling soils such soil capability is expected to be maintained and no residual effects are anticipated from the Project on agricultural capability.

After the application of standard mitigation measures, potential residual effects on agricultural land activities during construction are characterized as follows:

- Direction is **adverse**
  - The use of agricultural land will be negatively affected.
- Magnitude is **moderate**
  - The PDA will be removed from agricultural activities during construction, but >85% of that land will be returned to pre-Project agricultural activities.
- Geographical extent is the **PDA**
  - The land outside the PDA will still be available for agricultural production.
- Duration is **short-term**
  - Construction will be up to 1.5 years.
- Frequency is a **single event**
  - Construction will occur once during the lifetime of the Project.
- The effect is **reversible**
  - Temporary construction areas will be restored to pre-construction condition or an agreed to use in consultation with the landowner.
- Ecological and socio-economic context is **disturbed**
  - Approximately >80% of the LAA and RAA consists of existing disturbance from agricultural activities (i.e., cultivated, hayland, and tame pasture land cover types) as well as other permanent facilities and all-weather roads (i.e., developed land cover type).

10.4.2.3.2 Operation and Maintenance

Permanent project infrastructure will be in place during the operation and maintenance phase. Approximately 17.4 ha of agricultural land, occupied by the WTGs, substation, and access roads, will be taken out of agricultural production for the operational life of the Project.

After the application of standard mitigation measures, potential residual effects on agricultural land activities during operation and maintenance are characterized as follows:

- Direction is **adverse**
  - The use of agricultural land will be negatively affected.
- Magnitude is **moderate**
  - The area occupied by the WTGs, substation, and access roads will be out of agricultural use during operation and maintenance.

- Geographical extent is the **PDA**
  - The land outside the operational footprint will still be available for agricultural production.
- Duration is **medium-term**
  - The area occupied by the WTGs, substation, and access roads will be out of agricultural use during operation and maintenance.
- Frequency is **continuous**
  - The area occupied by the WTGs, substation, and access roads will be out of agricultural use during operation and maintenance.
- The effect is **reversible**
  - At the end of the Project's useful life, the Project will be decommissioned and the land used during operations will be restored to pre-construction condition or an agreed use in consultation with the landowner.
- Ecological and socio-economic context is **disturbed**
  - Approximately >80% of the LAA and RAA consists of existing disturbance from agricultural activities (i.e., cultivated, hayland, and tame pasture land cover types) as well as other permanent facilities and all-weather roads (i.e., developed land cover type).

10.4.2.3.3 Decommissioning and Abandonment

Disturbance to agricultural lands will occur during decommissioning activities as Project infrastructure is being removed. Residual effects during decommissioning activities will be similar as those during construction until the Project infrastructure is removed and restoration has taken place. During decommissioning, land used for operations will be restored to pre-construction condition or an agreed use in consultation with the landowner.

After the application of standard mitigation measures, potential residual effects on agricultural land activities during decommissioning are characterized as follows:

- Direction is **adverse**
  - The use of agricultural land will be negatively affected until the land is restored.
- Magnitude is **low**
  - The operational footprint will be restored to pre-construction condition or an agreed use in consultation with the landowner.
- Geographical extent is the **PDA**
  - The land outside the PDA will still be available for agricultural production.
- Duration is **short-term**
  - Decommissioning will take approximately 24 months.

- Frequency is a **single event**
  - Decommissioning will occur once during the lifetime of the Project.
- The effect is **reversible**
  - The operational footprint will be restored to pre-construction condition or an agreed use in consultation with the landowner.
- Ecological and socio-economic context is **disturbed**
  - Approximately >80% of the LAA and RAA consists of existing disturbance from agricultural activities (i.e., cultivated, hayland, and tame pasture land cover types) as well as other permanent facilities and all-weather roads (i.e., developed land cover type).

10.4.3 Change in Recreational and Commercial Harvesting Activities

10.4.3.1 Project Pathways

The potential for recreational and commercial harvesting activities in the PDA and LAA are limited as most lands are under agricultural use and all land is privately owned. As a result, the potential effect applies mostly to private landowners or harvesters that request access to the private land.

The change in recreational and commercial harvesting activities in the PDA and LAA could include direct loss of harvesting areas, access restrictions and wildlife displacement from sensory disturbances. The PDA will have a direct loss of harvesting areas throughout all phases of the Project.

The Project will produce a change in noise within the PDA due to construction and decommissioning activities (e.g., heavy equipment, vehicles) that could temporarily displace wildlife in the PDA and LAA, thereby affecting harvesting activities. Given the agricultural setting and low magnitude of noise effects during operation, it is not expected that noise will cause a reduction in harvesting activities. Project effects on wildlife and wildlife habitat area assessed in Section 8.0.

10.4.3.2 Mitigation

Mitigation to reduce the change in recreational and commercial harvesting activities within the PDA include the following:

- Communication of the dates for specific Project phases and a well outlined Project layout to allow the landowners, lessees and outfitters to plan their harvesting schedule throughout the life of the Project.

- Minimize clearing to the extent feasible to reduce change in available habitat.
- Posting of appropriate signage in advance of Project activities to indicate access restrictions.

Mitigation measures to address changes in recreational and commercial harvesting activities are also outlined in Volume 1 of the EPP in Appendix C. Mitigation measures specific to vegetation and wetlands, and wildlife and wildlife habitat are described in Sections 7.0 and 8.0.

10.4.3.3 Project Residual Effect

10.4.3.3.1 Construction

Approximately 158.2 ha of harvesting area will be removed from use during construction of the Project. This constructible area makes up less than 0.01% of each of the WMZ No. 5., Southern Fur Conservation Area, and South Game Bird District. Reclamation after construction is expected to return 139.9 ha (88%) of the PDA back to harvesting area.

With the application of standard mitigation measures, potential residual effects on recreational and commercial harvesting activities during construction are characterized as follows:

- Direction is **adverse**
  - The area available for harvesting activities in the PDA will be reduced because of construction. There may also be a temporary displacement of wildlife due to sensory disturbance.
- Magnitude is **low**
  - The PDA overlaps a small portion of the larger harvesting boundaries, leaving more remaining harvesting area available compared to that restricted during construction. Sensory disturbance may temporarily move wildlife into other areas where harvesting may still take place.
- Geographical extent is the **LAA**
  - The Project construction will restrict access and area available for harvesting activities in the PDA and indirectly in the LAA through road access restrictions and sensory disturbance displacement.
- Duration is **short-term**
  - Construction will be up to 1.5 years.
- Frequency is a **single event**
  - The construction will occur once during the lifetime of the Project.

- The effect is **reversible**
  - At the end of the Project's useful life, the Project will be decommissioned and the land used during operations will be restored to pre-construction condition or an agreed use in consultation with the landowner.
- Ecological and socio-economic context is **disturbed**
  - Approximately >80% of the LAA and RAA consists of existing disturbance from agricultural activities (i.e., cultivated, hayland, and tame pasture land cover types) as well as other permanent facilities and all-weather roads (i.e., developed land cover type).

10.4.3.3.2 Operation and Maintenance

Approximately 18.3 ha of harvesting area, occupied by the WTGs, substation, and access roads, will be taken out of use for the operational life of the Project. The operational footprint occupies less than 0.01% of each of the WMZ No. 5., Southern Fur Conservation Area, and South Game Bird District.

With the application of standard mitigation measures, potential residual effects on recreational and commercial harvesting activities during operation and maintenance are characterized as follows:

- Direction is **adverse**
  - The harvesting area occupied by the WTGs, substation, and access roads will be unavailable for harvesting during operation and maintenance.
- Magnitude is **low**
  - The land used during operations takes up a small portion of the larger harvesting boundaries, leaving more remaining harvesting area available compared to that restricted during operations.
- Geographical extent is the **PDA**
  - The Project operation will restrict access and area available for harvesting activities in the PDA.
- Duration is **medium-term**
  - The harvesting area occupied by the WTGs, substation, and access roads will be unavailable for harvesting during operation and maintenance.
- Frequency is **continuous**
  - The harvesting area occupied by the WTGs, substation, and access roads will be unavailable for harvesting during operation and maintenance.

- The effect is **reversible**
  - At the end of the Project's useful life, the Project will be decommissioned and the land used during operations will be restored to pre-construction condition or an agreed use in consultation with the landowner.
- Ecological and socio-economic context is **disturbed**
  - Approximately >80% of the LAA and RAA consists of existing disturbance from agricultural activities (i.e., cultivated, hayland, and tame pasture land cover types) as well as other permanent facilities and all-weather roads (i.e., developed land cover type).

10.4.3.3.3 Decommissioning

Disturbance to harvesting activities will occur during decommissioning activities as Project infrastructure is being removed. Residual effects during decommissioning activities will be similar as those during construction until the Project infrastructure is removed and restoration has taken place. During decommissioning, land used for operations will be restored to pre-construction condition or an agreed use in consultation with the landowner.

After the application of standard mitigation measures, potential residual effects on harvesting activities during decommissioning are characterized as follows:

- Direction is **adverse**
  - The use of harvesting areas will be negatively affected until the land is restored. There may also be a temporary displacement of wildlife due to sensory disturbance.
- Magnitude is **low**
  - The operational footprint will be restored to pre-construction condition or an agreed use in consultation with the landowner. Sensory disturbance may temporarily move wildlife into other areas where harvesting may still take place.
- Geographical extent is the **LAA**
  - The Project construction will restrict access and area available for harvesting activities in the PDA and indirectly in the LAA through road access restrictions and sensory disturbance displacement.
- Duration is **short-term**
  - Decommissioning will take approximately 24 months.
- Frequency is a **single event**
  - Decommissioning will occur once during the lifetime of the Project.

- The effect is **reversible**
  - The operational footprint will be restored to pre-construction condition or an agreed use in consultation with the landowner.
- Ecological and socio-economic context is **disturbed**
  - Approximately >80% of the LAA and RAA consists of existing disturbance from agricultural activities (i.e., cultivated, hayland, and tame pasture land cover types) as well as other permanent facilities and all-weather roads (i.e., developed land cover type).

10.4.4 Change in Non-Consumptive Recreational Activities

10.4.4.1 Project Pathways

The potential for non-consumptive recreational activities in the PDA and LAA are limited as most lands are under agricultural use and all land is privately owned. As a result, the potential effect applies mostly to private landowners or recreational users that request access to the private land.

The change in non-consumptive recreational activities in the PDA could occur through access restrictions and alteration to viewscapes. The access restrictions apply to private roads in the PDA.

During the operation and maintenance phase of the Project, there is potential for recreational users in the LAA and RAA to view the construction and presence of the wind farm as a positive or negative impact on the viewshed in the area. These effects are subjective, and may be positive or negative depending on individual preferences. However, for the purposes of conducting a conservative assessment, presence of a wind farm is assumed to have a negative effect on visual aesthetics.

10.4.4.2 Mitigation

Mitigation to reduce the change to non-consumptive recreational activities includes the following:

- Communication of construction timelines with landowners and tenure holders that have a land agreement with Algonquin.
- Posting of appropriate signage in advance of Project activities to indicate access restrictions.

Mitigation measures to address changes in non-consumptive recreational activities are also outlined in Volume 1 of the EPP in Appendix C.

10.4.4.3 Project Residual Effect

10.4.4.3.1 Construction

Construction will affect access in the PDA and indirectly affect viewscape within the LAA and RAA.

Access will be restricted during construction and will encompass the PDA. After construction, access will be returned to pre-construction accessibility, with the exception of the location where Project components persist through operation and maintenance.

The visual effect of an individual WTG will be quite variable, with reduced chance of a change in visual aesthetics the further away the viewpoint is from the Project. Natural obstacles such as windbreaks and hills could partially or fully screen the view of the WTGs. The existing viewshed has an existing wind farm (i.e., Morse Wind Farm) at a distance; as such, some landowners and recreational users may already be accustomed to the sight of WTGs on the landscape.

With the application of standard mitigation measures, potential residual effects on non-consumptive recreational activities during construction are characterized as follows:

- Direction is **adverse**
  - Construction activities will reduce access and will be visible, potentially reducing the visual appeal of the landscape to a non-consumptive recreational user.
- Magnitude is **low**
  - The existing landscape does not have a lot of opportunity for recreational activities given most is under agricultural use and all land in the PDA and LAA is privately owned.
- Geographical extent is the **RAA**
  - The Project construction will restrict access in the PDA and may be visible up to and including locations in the RAA.
- Duration is **short-term**
  - Construction is approximately 1.5 years.
- Frequency is a **single event**
  - Construction will occur once during the lifetime of the Project.
- The effect is **reversible**
  - Locations for the temporary access roads, workspace, collector lines and construction office can be returned to pre-construction accessibility following construction reclamation.

- Ecological and socio-economic context is **disturbed**
  - Approximately >80% of the LAA and RAA consists of existing disturbance from agricultural activities (i.e., cultivated, hayland, and tame pasture land cover types) as well as other permanent facilities and all-weather roads (i.e., developed land cover type).

10.4.4.3.2 Operation and Maintenance

Operation and maintenance will affect access in the PDA and indirectly affect viewscape within the LAA and RAA.

Access will be restricted in the areas where Project components persist during operation and maintenance. The change in visual aesthetics will be similar as that during construction.

With the application of standard mitigation measures, potential residual effects on non-consumptive recreational activities during operation and maintenance are characterized as follows:

- Direction is **adverse**
  - Permanent Project components may reduce access and the operating WTGs will be visible, potentially reducing the visual appeal of the landscape to a non-consumptive recreational user
- Magnitude is **moderate**
  - The existing landscape does not have a lot of opportunity for recreational activities given most is under agricultural use and all land in the PDA and LAA is privately owned. There is potential for recreational users in the LAA and RAA to view the construction and presence of the wind farm as a negative impact on the viewscape; however, the existing viewshed already has an existing wind farm (i.e., Morse Wind Farm) at a distance; as such, some recreational users may already be accustomed to the sight of WTGs on the landscape.
- Geographical extent is the **RAA**
  - The Project operations will restrict access in the PDA and be visible up to and including locations in the RAA
- Duration is **medium-term**
  - The Project components persist through operation and maintenance and will be visible for a minimum of 25 years
- Frequency is **continuous event**
  - The Project operations will be visible continually during the operation and maintenance

- The effect is **reversible**
  - At the end of the Project's useful life, the Project will be decommissioned and the land used during operations will be restored to pre-construction condition or an agreed use in consultation with the landowner
- Ecological and socio-economic context is **disturbed**
  - Approximately >80% of the LAA and RAA consists of existing disturbance from agricultural activities (i.e., cultivated, hayland, and tame pasture land cover types) as well as other permanent facilities and all-weather roads (i.e., developed land cover type).

10.4.4.3.3 Decommissioning

Disturbance to recreational activities will occur during decommissioning activities as Project infrastructure is being removed. Residual effects during decommissioning activities will be similar as those during construction until the Project infrastructure is removed and restoration has taken place. During decommissioning, land used for operations will be restored to pre-construction condition or an agreed use in consultation with the landowner.

At the end of decommissioning the land use will be reclaimed back to baseline conditions, removing access restrictions and removing Project components from the viewscape.

With the application of standard mitigation measures, potential residual effects on non-consumptive recreational activities at the end of decommissioning are characterized as follows:

- Direction is **adverse**
  - Decommissioning activities will reduce access and be visible, potentially reducing the visual appeal of the landscape to a non-consumptive recreational user.
- Magnitude is **low**
  - The operational footprint will be restored to pre-construction condition or an agreed use in consultation with the landowner.
- Geographical extent is the **RAA**
  - The Project decommissioning will restrict access in the PDA and may be visible up to and including locations in the RAA.
- Duration is **short-term**
  - Decommissioning will take approximately 24 months.
- Frequency is a **single event**
  - Decommissioning will occur once during the lifetime of the Project.

- The effect is **reversible**
  - The operational footprint will be restored to pre-construction condition or an agreed use in consultation with the landowner.
- Ecological and socio-economic context is **disturbed**
  - Approximately >80% of the LAA and RAA consists of existing disturbance from agricultural activities (i.e., cultivated, hayland, and tame pasture land cover types) as well as other permanent facilities and all-weather roads (i.e., developed land cover type).

10.4.5 Change in Groundwater Use

10.4.5.1 Project Pathways

The change in groundwater use in the PDA and 800 m from the PDA could occur through temporary interruption of supply of well water from dewatering activities and inadvertent interception and potential damage to wells.

10.4.5.2 Mitigation

The mitigations to reduce the change to groundwater use within the PDA, the following mitigation at minimum will be followed:

- Confirm well locations prior to construction
- Complete a site-specific geotechnical investigation at each of the proposed wind turbine sites. In the event that groundwater is intersected, depth to groundwater will be recorded.
- Communicate key dates for specific Project phases and distribute a specific Project layout to allow the landowners and lessees (groundwater well licensees) to plan water use activities proactively

Mitigation measures to address changes in groundwater use are also outlined in Volume 1 of the EPP in Appendix C.

10.4.5.3 Project Residual Effect

10.4.5.3.1 Construction

Based on the groundwater levels identified in the review of water well records there is potential for some dewatering activities to be required when installing turbines during foundation excavation. There is potential to affect wells in close proximity (i.e., 100 m) of the construction site in the event that a shallow water bearing formation is intercepted during construction.

With the application of standard mitigation measures, potential residual effects on ground water use activities during construction are characterized as follows:

- Direction is **adverse**
  - Where wells directly interact with the Project or groundwater flows are changed, there could be an effect to ground water wells and use in the PDA and LAA.
- Magnitude is **low**
  - There are 17 withdrawal wells within 800 m of the PDA that may be affected by the Project construction.
- Geographical extent is the **LAA**
  - The Project construction may directly affect wells within the PDA and potentially indirectly effect wells in the LAA.
- Duration is **short-term**
  - Construction is approximately 1.5 years.
- Frequency is a **single event**
  - Construction will occur once during the lifetime of the Project.
- The effect is **reversible**
  - Groundwater table will recover to static conditions once pumping influence has been terminated because of natural groundwater inflow occurring within the aquifer system.
- Ecological and socio-economic context is **disturbed**
  - Approximately >80% of the LAA and RAA consists of existing disturbance from agricultural activities (i.e., cultivated, hayland, and tame pasture land cover types) as well as other permanent facilities and all-weather roads (i.e., developed land cover type).

10.4.6 Summary of Project Residual Environmental Effects

Table 10-11 summarizes the residual environmental effects on land and resource use.

Table 10-11 Project Residual Effects on Land and Resource Use

Residual Effect	Residual Effects Characterization							
	Project Phase	Direction	Magnitude	Geographic Extent	Duration	Frequency	Reversibility	Ecological and Socio-economic Context
Change in agricultural land activities	C	A	M	PDA	ST	S	R	D
Change in agricultural land activities	O	A	M	PDA	MT	C	R	D
Change in agricultural land activities	D	A	L	PDA	ST	S	R	D
Change in recreational and commercial harvesting activities	C	A	L	LAA	ST	S	R	D
Change in recreational and commercial harvesting activities	O	A	L	PDA	MT	C	R	D
Change in recreational and commercial harvesting activities	D	A	L	LAA	ST	S	R	D
Change in non-consumptive recreational activities	C	A	L	RAA	ST	S	R	D
Change in non-consumptive recreational activities	O	A	M	RAA	MT	C	R	D
Change in non-consumptive recreational activities	D	A	L	RAA	ST	S	R	D

Table 10-11 Project Residual Effects on Land and Resource Use

Residual Effect	Residual Effects Characterization							
	Project Phase	Direction	Magnitude	Geographic Extent	Duration	Frequency	Reversibility	Ecological and Socio-economic Context
Change in ground water use	C	A	L	LAA	ST	S	R	D

KEY

See Table 10-2 for detailed definitions

Project Phase

C: Construction

O: Operation and Maintenance

D: Decommissioning

Direction:

P: Positive

A: Adverse

N: Neutral

Magnitude:

N: Negligible

L: Low

M: Moderate

H: High

Geographic Extent:

PDA: Project Development Area

LAA: Local Assessment Area

RAA: Regional Assessment Area

Duration:

ST: Short-term;

MT: Medium-term

LT: Long-term

N/A: Not applicable

Frequency:

S: Single event

IR: Irregular event

R: Regular event

C: Continuous

Reversibility:

R: Reversible

I: Irreversible

Ecological/Socio-Economic Context:

D: Disturbed

U: Undisturbed

10.5 ASSESSMENT OF CUMULATIVE ENVIRONMENTAL EFFECTS ON LAND AND RESOURCE USE

The Project residual effects described in Section 10.4 are likely to interact cumulatively with residual environmental effects from other physical activities (past, present and reasonably foreseeable). The resulting cumulative environmental effects are assessed. This is followed by an analysis of the project contribution to cumulative effects. Future projects and activities that are reasonably foreseeable are defined as those that (a) have been publicly announced with a defined project execution period and with sufficient project details that allow for a meaningful assessment, (b) are currently undergoing an environmental assessment or (c) are in a permitting process.

The assessment of cumulative effects is initiated with a determination of whether two conditions exist:

- the Project has residual environmental effects on the VC and
- the residual effects could act cumulatively with residual effects of other past, present, or reasonably foreseeable future physical activities

If either is not met, the assessment of cumulative effects concludes with a statement that further assessment of cumulative effects is not warranted because the Project does not interact cumulatively with other projects or activities.

10.5.1 Project Residual Effects Likely to Interact Cumulatively

Table 4-4 in Section 4.0, Environmental Assessment Scope and Methodology, presents the project and physical activities inclusion list, which identifies other projects and physical activities that might act cumulatively with the Project. Where residual environmental effects from the Project act cumulatively with residual effects from other projects and physical activities (Table 10-12), a cumulative effects assessment is undertaken to determine their significance.

Table 10-12 Interactions With the Potential to Contribute to Cumulative Effects

Other Projects and Physical Activities with Potential for Cumulative Environmental Effects	Environmental Effects			
	Change in Agricultural Land Activities	Change in Recreational and Commercial Harvesting Activities	Change in Non-Consumptive Recreational Activities	Change in Groundwater Use
Past and Present Physical Activities and Resource Use				
Agricultural Conversion	✓	✓	✓	✓
Oil and Gas Development	✓	✓	✓	✓
Power Generation, Transmission, and Distribution	✓	✓	✓	✓
Morse Wind Farm	✓	✓	✓	✓
Recreational Activities	✓	✓	✓	✓
Residential Development	✓	✓	✓	✓
Resources Extraction Activities	✓	✓	✓	✓
Road Development	✓	✓	✓	✓
Project-Related Physical Activities	✓	✓	✓	✓
Future Physical Activities				
SaskPower Blue Hill Interconnection Project	✓	✓	✓	✓

NOTES:
✓ = Other projects and physical activities whose residual effects are likely to interact cumulatively with Project residual environmental effects.
– = Interactions between the residual effects of other projects and residual effects of the Project are not expected.

Environmental effects identified in Table 10-12 as not likely to interact cumulatively with residual effects of other projects and physical activities (no check mark) are not discussed further. The assessment of the cumulative environmental effects that are likely to result from the Project in combination with other projects and physical activities are discussed in subsequent sections.

10.5.2 Change in Agricultural Land Activities

10.5.2.1 Cumulative Effect Pathways

Past and present activities, and future projects in the RAA (see Table 10-12) have the potential to act cumulatively where other projects also affect agricultural lands. The Project will result in a loss of 143.8 ha of land from agricultural activities during construction. This area will be reduced during operations by >85% and reversed after decommissioning. Cumulative effects arising from the overlap of the SaskPower Blue Hill Interconnection project, from the Project substation to the SaskPower switching station, may occur through mechanisms similar to that which occur during construction, operation and maintenance and decommissioning.

Cumulative effects will include the loss of agricultural land from agricultural activities and access restrictions from Project activities and the loss of land and access from both overlap with the SaskPower Blue Hill Interconnection project. As the Project and the SaskPower Blue Hill Interconnection project move from construction to operations the cumulative effect to agricultural land activities will decrease because the operational footprint is smaller than the construction footprint. Disturbance to agricultural land activities will occur during decommissioning activities as the Project and the SaskPower Blue Hill Interconnection project are being removed. Residual effects during decommissioning activities will be similar as those during construction until all infrastructure is removed and restoration has taken place.

10.5.2.2 Mitigation for Cumulative Effects

The Project will implement a suite of mitigation measures to address Project-specific effects on agricultural land activities. Few opportunities exist for a coordinated approach to further mitigate effects in conjunction with other future projects due to the geographic separation or specific construction timing of other projects. Depending on timing, there may be an opportunity for the Project and the SaskPower Blue Hill Interconnection project to share laydown or staging areas therefore reducing the cumulative effects on land and resource use.

10.5.2.3 Cumulative Effects

A small portion of the agricultural land within the RAA is affected by the Project (0.5%; 143 ha). The SaskPower Blue Hill Interconnection project will likely have some effect on agricultural land activities; however, because its location is unknown, it is difficult to determine the extent to which this may occur.

10.5.3 Change in Recreational and Commercial Harvesting Activities

10.5.3.1 Cumulative Effect Pathways

Past and present activities, and future projects in the RAA (see Table 10-12) have the potential to act cumulatively where other projects also affect recreational and commercial harvesting activities. The Project will result in a loss of 158.2 ha of harvesting area during construction. This area will be reduced during operations by 88% and reversed after decommissioning. Cumulative effects arising from the overlap of the SaskPower Blue Hill Interconnection project may occur through mechanisms similar to that which occur during construction, operation and maintenance and decommissioning.

Cumulative effects will include the loss of land available for recreational and commercial harvesting activities and access restrictions from Project activities and the loss of land and access from both the Project and the SaskPower Blue Hill Interconnection project. As both of these projects move from construction to operations the cumulative effect to recreational and commercial harvesting activities will decrease because the operational footprint is smaller than the construction footprint. Disturbance to recreational and commercials harvesting activities will occur during decommissioning activities as both projects are removed. Residual effects during decommissioning activities will be similar as those during construction until the Project and both future projects' infrastructure is removed and restoration has taken place.

10.5.3.2 Mitigation for Cumulative Effects

The Project will implement a suite of mitigation measures to address Project-specific effects on recreational and commercial harvesting activities. Few opportunities exist for a coordinated approach to further mitigate effects in conjunction with other future projects due to the geographic separation or specific construction timing of other projects. As was described in Section 10.5.2.2, there may be opportunities to consolidate laydown and staging areas for both projects.

10.5.3.3 Cumulative Effects

A small portion of the recreational and commercial harvesting activities within the RAA is affected by the Project. Other future projects will likely have some effect on recreational and commercial harvesting activities; however, it is difficult to determine the extent to which this may occur.

10.5.4 Change in Non-Consumptive Recreational Activities

10.5.4.1 Cumulative Effect Pathways

Past and present activities, and future projects in the RAA (see Table 10-12) have the potential to act cumulatively where other projects also affect non-consumptive recreational activities. The Project, in combination with the SaskPower Blue Hill Interconnection project will change the visual landscape of RAA. Some recreational users will view visual effects of the projects as a positive indication that renewable energy is replacing fossil fuel based energy sources, while others may consider the combined visual effects of the projects as negative.

Cumulative visual changes resulting from the three projects remains uncertain, as the location for the SaskPower Blue Hill Interconnection project has not been finalized.

10.5.4.2 Mitigation for Cumulative Effects

While no actions are required to address stakeholders who view the changes as positive, the Project will implement a suite of mitigation measures to address Project-specific effects on non-consumptive recreational activities. Few opportunities exist for a coordinated approach to further mitigate effects in conjunction with other future projects due to the geographic separation or specific construction timing of other projects.

10.5.4.3 Cumulative Effects

A small portion of the non-consumptive recreational activities within the RAA is affected by the Project. The future projects will likely have some effect on non-consumptive recreational activities; however, it is difficult to determine the extent to which this may occur.

Cumulative effects on non-consumptive recreational activities are associated with a perceived negative effect on the viewshed, as the primarily rural and natural character of the area will include commercial scale wind turbines, and transmission line. Cumulative effects associated with non-consumptive recreational activities are expected to diminish to close to baseline conditions as people become accustomed to the wind turbines and transmission lines as part of the landscape.

10.5.5 Change in Groundwater Use

10.5.5.1 Cumulative Effect Pathways

Past and present activities, and future projects in the RAA (see Table 10-12) have the potential to act cumulatively where other projects also affect groundwater use. Cumulative effects arising from the overlap of future projects occur through mechanisms similar to that which occur during construction. For example, effects can occur should dewatering be required.

10.5.5.2 Mitigation for Cumulative Effects

The Project will implement a suite of mitigation measures to address Project-specific effects on groundwater use. Few opportunities exist for a coordinated approach to further mitigate effects in conjunction with other future projects due to the geographic separation or specific construction timing of other projects

10.5.5.3 Cumulative Effects

Should Project specific dewatering be required it is expected that the groundwater table will recover to static conditions once the pumping influence has been terminated because of natural groundwater inflow occurring within the aquifer system. The SaskPower Blue Hill Interconnection project will likely have some effect on groundwater; however, it is difficult to determine the extent to which this may occur.

10.5.6 Summary of Cumulative Effects

Table 10-13 summarizes cumulative environmental effects on land and resource use.

Table 10-13 Residual Cumulative Effects

Residual Cumulative Effect	Residual Cumulative Effects Characterization						
	Direction	Magnitude	Geographic Extent	Duration	Frequency	Reversibility	Ecological and Socio-economic Context
Residual Cumulative Change in Agricultural Land Activities							
Residual cumulative effect	A	L	RAA	LT	C	R	D
Contribution from the Project to the residual cumulative effect	The Project will result in a loss of 143.8 ha of land from agricultural activities during construction. This area will be reduced during operations by >85% and reversed after decommissioning.						

Table 10-13 Residual Cumulative Effects

Residual Cumulative Effect	Residual Cumulative Effects Characterization						
	Direction	Magnitude	Geographic Extent	Duration	Frequency	Reversibility	Ecological and Socio-economic Context
Residual Cumulative Recreational and Commercial Harvesting Activities							
Residual cumulative effect	A	L	RAA	LT	C	R	D
Contribution from the Project to the residual cumulative effect	The Project will result in a loss of 158.2 ha of harvesting area during construction. This area will be reduced during operations by 88% and reversed after decommissioning.						
Residual Cumulative Non-Consumptive Recreational Activities							
Residual cumulative effect	A	M	RAA	LT	C	R	D
Contribution from the Project to the residual cumulative effect	The potential for non-consumptive recreation activities in the PDA and LAA are limited as most lands are under agricultural use and all land is privately owned. There is potential for recreational users in the LAA and RAA to view the construction and presence of the wind farm as a negative impact on the viewscape. However, the Morse wind project, located near the Project area, was recently constructed and some landowners and recreational users may already be accustomed to the sight of WTGs on the landscape. The impacts to viewscape will be reversed after decommissioning.						
Residual Cumulative Groundwater Use							
Residual cumulative effect	A	L	RAA	LT	S	R	D
Contribution from the Project to the residual cumulative effect	The Project will result in little or no interaction with groundwater users. Conflicts with water wells will be avoided or, if they occur (e.g., as a result of dewatering), effects will be short-term and it is expected that the groundwater table will return to static conditions.						

KEY

See Table 10-2 for detailed definitions

Direction:
P: Positive
A: Adverse
N: Neutral

Magnitude:
N: Negligible
L: Low
M: Moderate
H: High

Geographic Extent:
PDA: Project Development Area
LAA: Local Assessment Area
RAA: Regional Assessment Area

Duration:
ST: Short-term;
MT: Medium-term
LT: Long-term

N/A: Not applicable

Frequency:
S: Single event
IR: Irregular event
R: Regular event
C: Continuous

Reversibility:
R: Reversible
I: Irreversible

Ecological/Socio-Economic Context:
D: Disturbed
U: Undisturbed

10.6 DETERMINATION OF SIGNIFICANCE

10.6.1 Significance of Project Residual Effects

Effects of the Project on land and resources use are generally expected to be adverse, limited to the RAA, reversible, and of low magnitude except for changes to non-consumptive recreational activities, which is moderate, due to changes in the viewscape. The residual effects are unlikely to result in the permanent loss of agricultural production, pose a threat to the long-term viability of harvest and recreational activities or permanent impact groundwater use.

With mitigation and environmental protection measures, the residual environmental effects on land and resource use are predicted to be not significant.

10.6.2 Significance of Cumulative Effects

With mitigation and environmental protection measures, the residual cumulative environmental effects on land and resource use are predicted to be not significant.

10.6.2.1 Project Contribution to Cumulative Effects

Much of the Project's contribution to cumulative effects will be reversible upon completion of construction except for changes to non-consumptive recreational users. The Project's contribution to cumulative effects will be completely reversed upon completion of decommissioning.

The Project's contribution to cumulative effects is not expected to measurably affect the amount of land and resource use in the RAA.

10.7 PREDICTION CONFIDENCE

Based on the information compiled during data analysis and understanding Project activities, the predicted confidence in the assessment of Project residual effects on land and resource use is moderate to high. There are some uncertainty regarding the exact locations of groundwater wells and local groundwater conditions since the WSA does not always provide exact well locations and because a geotechnical study has not yet been completed.

There is a high level of confidence in the effectiveness of the proposed mitigations.

10.8 FOLLOW-UP AND MONITORING

An environmental monitor will be used to determine the effectiveness of mitigation, including those implemented to reduce or avoid effect on land and resource use. Monitoring will be used to evaluate the success of reclamation activities.

No follow-up programs are being proposed for this Project.

11.0 ASSESSMENT OF POTENTIAL EFFECTS ON EMPLOYMENT AND ECONOMY

11.1 SCOPE OF ASSESSMENT

Employment and economy was selected as a VC because the Project will create employment and business opportunities, as well as generate government revenues, while also potentially contributing to limited labour shortages. Employment and economic factors are linked with other VCs, including land and resource use, and community services and infrastructure. Baseline conditions for the VCs listed above are incorporated, as appropriate, into the effects assessment for employment and economy.

11.1.1 Regulatory and Policy Setting

The scope of this section takes into consideration guidance provided by the final TOR outlined for the Project and the *Saskatchewan Environmental Assessment Act, 1980* (Government of Saskatchewan 1980b).

11.1.2 Consideration of Issues Raised during Engagement

During engagement, several people commented on the potential employment opportunities created by the Project and the potential boost to the local economy. These comments included:

- A local business owner felt the Project will boost the economy
- “Good for the community”
- A local landowner indicated that the Project generates another revenue stream for participants, creates jobs and diversifies the economy
- Number of jobs to local residents

The comments regarding potential effects on employment and economy were positive and included inquiries about potential employment and procurement opportunities.

11.1.3 Potential Effects, Pathways and Measurable Parameters

Potential effects of the Project were identified through engagement with the public and regulatory stakeholders, as well as Indigenous groups (see Sections 3.0 and 11.1.2), experience, and professional judgment (see Section 4.0). Table 11-1 summarizes the potential effects, effect pathways, and measurable parameters, for assessment of employment and economy. Measurable parameters were selected to provide a means of quantitatively and qualitatively assessing the expected change to existing conditions.

Potential environmental effects listed in Section 4.6.4 of the TOR have been refined from those presented in Table 11-1. Specifically, the potential environmental effects 'change in regional labour force' and 'change in regional business (i.e., Project's contribution to wage inflation)' identified in Section 4.6.4 of the TOR have been grouped into the potential environmental effect 'change in labour supply and demand'. Similarly, the potential environmental effects 'change in regional business (i.e., Project local and regional spending)', 'change in municipal government finances', and 'change in provincial economy' have been grouped into the potential environmental effect 'change in economy'. While potential environmental effects differ in name from those presented in the TOR and Table 11-1, the full scope of assessment inferred by the TOR is captured.

Table 11-1 Potential Effects, Effects Pathways and Measurable Parameters for Employment and Economy

Potential Environmental Effect	Effect Pathway	Measurable Parameter(s) and Units of Measurement
Chang in labour supply and demand	• Project-related employment	• Project-generated employment • Local unemployment rate • Labour availability (industry-based) • Project-generated income • Project contribution to wage inflation (qualitative)
Change in economy	• Project expenditures on goods and services	• Project local and regional spending • Project's contribution to gross domestic product (GDP) • Project-generated government revenue

11.1.4 Boundaries

11.1.4.1 Spatial Boundaries

Spatial boundaries have been further refined from those listed in Section 4.6.1 of the TOR. Specifically, the LAA has been updated to list the communities and RMs included in the assessment while the RAA has been adjusted from the Province of Saskatchewan to a more regionally-appropriate spatial scale.

Project Development Area (PDA): The PDA is represented by the physical Project footprint and consists of the area of physical disturbance associated with Project components, i.e., WTGs, access roads, collector lines, substation, and temporary workspaces.

Local Area Assessment (LAA): The extent of RMs in which the Project is located, and adjacent communities from which goods and services may be obtained. This includes the communities within the Swift Current Census Agglomeration (CA) 720 and the Moose Jaw Census Division (CD) No. 7.

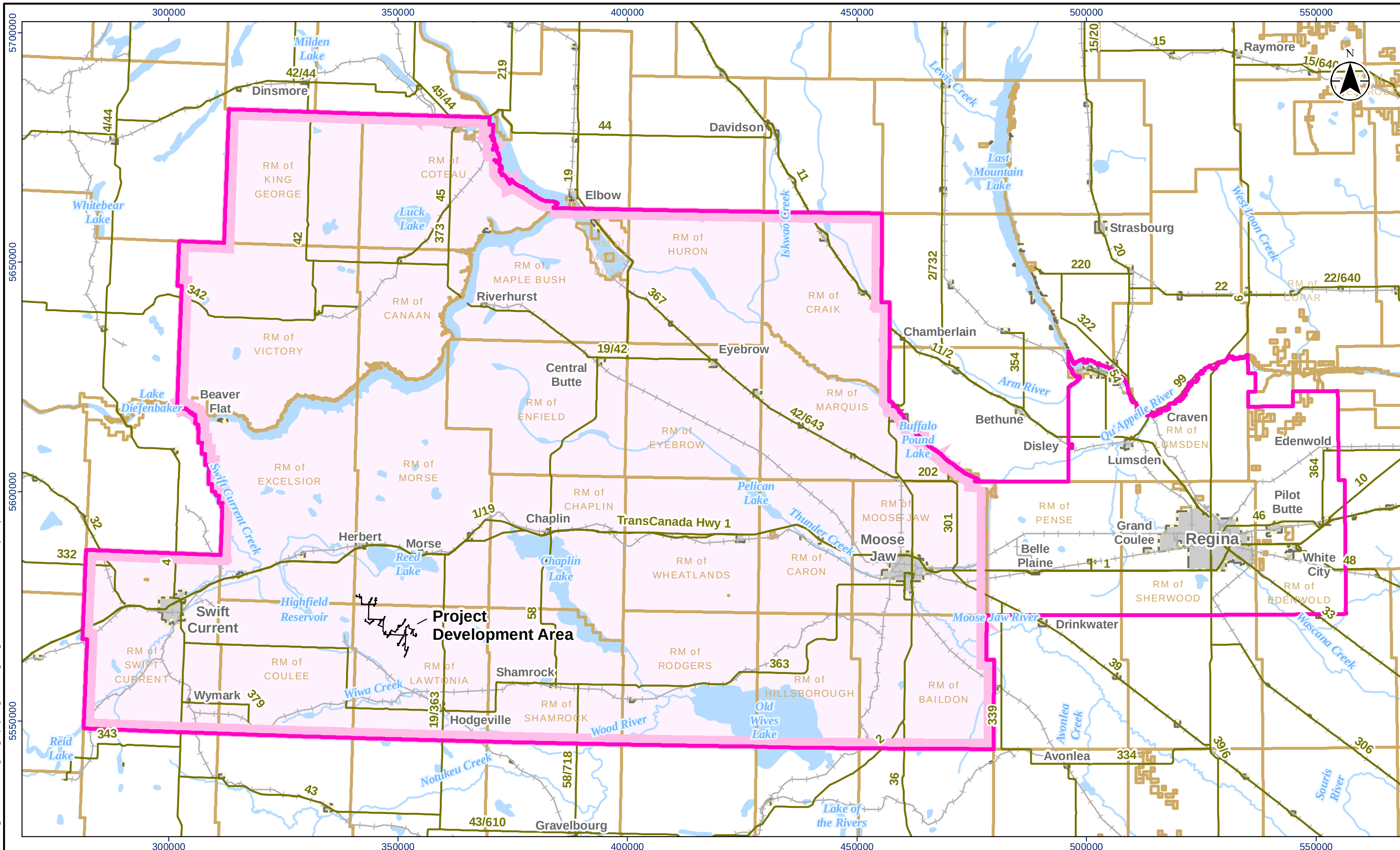
Regional Assessment Area (RAA): Includes the communities within the LAA and the Regina Census Metropolitan Area (CMA) 705.

See Figure 11-1 for the employment and economy assessment areas.

11.1.4.2 Temporal Boundaries

Temporal boundaries used in the assessment of employment and economy are as follows:

- **Construction**: Up to 1.5 years. Peak construction activity period associated with site preparation, construction (i.e., WTG installation, access road construction, collector line installation, substation construction), reclamation of temporary workspace and commissioning.
- **Operation and Maintenance**: From commissioning through the life of the Project (at a minimum approximately 25 years).
- **Decommissioning**: A two-year period at the end of the life of the Project, comprising the removal of above-ground facilities and a portion of the foundations, abandonment in place of underground collector lines and any associated reclamation activities. As part of decommissioning, certain components will be left in place as this approach usually results in fewer environmental effects.



Employment and Economy Local Assessment Area

Employment and Economy Regional Assessment Area

Rural Municipality

Major Road

Railway

Town/City

Watercourse

Waterbody

0 10 20 30 Kilometers

1:1,250,000 (At original document size of 8.5x11)

Notes
1. Coordinate System: NAD 1983 UTM Zone 13N
2. Base features produced under license with the Government of Saskatchewan and the Government of Canada.
3. Assessment Areas are based on RM boundaries within Census Agglomeration, Census Divisions and Census Metropolitan Areas.

Stantec Algonquin

Project Location
Near Herbert, SK

113254088-040 REVC
Prepared by acory on 2017-12-18
Technical Review by ceidem on 2017-12-18

Client/Project
Algonquin Power Co.
Blue Hill Wind Energy Project

Figure No.
11-1

Title
Employment and Economy Assessment Areas

G:\active\clients\algonquin_power_services\blue_hill\figures\report\es\main_doc\113254088-040_REVC_Employment_Assessment_Areas_FINAL.mxd Revised: 2017-12-18 By: acory

11.1.4.3 Administrative and Technical Boundaries

Administrative boundaries for the assessment of employment and economy include spatially defined boundaries of CAs, CDs, and CMAs as defined by Statistics Canada. Administrative boundaries align with spatial boundaries. At the time of writing, 2016 Census information was not available for, among others, education and labour.

Three technical boundaries constrain the assessment of employment and economy. The first set (cost estimates) relates to capital and operational expenditures used as input data for the estimation of economic impacts. The second set (availability, quality, and timeliness of baseline data) relates to the description of existing conditions. The third set (use of economic multipliers) relates to the assessment of residual and cumulative effects.

Cost estimates presented in the assessment are considered accurate to within -15% and +25%. This level of accuracy is appropriate for the purposes of estimating economic impacts within the context of the environmental assessment, but limits the accuracy (primarily related to magnitude) of predicted effects.

Regarding the availability, quality, and timeliness of baseline data, the assessment of employment and economy relies on Statistics Canada's Census of Population (Census) data. Census data is collected every five years and is the most comprehensive information on communities in the LAA and RAA. While most 2016 census topics have been released (e.g., population counts and income), the 2011 National Household Survey (NHS) is the most recent survey with information on Aboriginal persons, education and labour. Therefore, the census and NHS information presented in this section is either from 2016 or 2011.

Economic multipliers are used to estimate differing types of direct, indirect and induced economic impacts at the federal, provincial, regional, and local level. This approach is common in estimating economic impacts; however, based on the type of economic multiplier applied to the assessment (see Section 11.4.1) results are constrained by inherent model limitations (e.g., the static nature of multipliers used in the modelling process).

11.1.5 Residual Effects Characterization

Terms used to characterize the residual environmental effects on vegetation and wetlands are summarized in Table 11-2.

Table 11-2 Characterization of Residual Effects on Employment and Economy

Characterization	Description	Quantitative Measure or Definition of Qualitative Categories
Direction	The long-term trend of the residual effect	**Positive –** a residual effect that moves measurable parameters in a direction beneficial to employment and economy relative to baseline. **Adverse –** a residual effect that moves measurable parameters in a direction detrimental to employment and economy relative to baseline. **Neutral –** no net change in measurable parameters for employment and economy relative to baseline.
Magnitude	The amount of change in measurable parameters or the VC relative to existing conditions	**Negligible –** no measurable change from existing conditions **Low –** a measurable change on economic conditions is not substantial compared to other existing economic contributors **Moderate –** a measurable change on economic conditions is comparable to other existing economic contributors **High –** a measurable change on economic conditions is substantial compared to other existing economic contributors
Geographic Extent	The geographic area in which a residual effect occurs	**PDA – r**esidual effects are restricted to the PDA **LAA –** residual effects extend into the LAA **RAA –** residual effects interact with those of other projects in the RAA
Duration	The period of time required until the measurable parameter or the VC returns to its existing condition, or the residual effect can no longer be measured or otherwise perceived	**Short-term –** residual effect is restricted to the duration of the activity **Medium-term –** residual effect extends through construction and up to 10 years during operation, or throughout the operations phase **Long-term –** residual effect extends beyond the life of the project
Frequency	Identifies how often the residual effect occurs and how often during the Project or in a specific phase	**Single event** – occurs once **Multiple irregular event –** occurs at no set schedule **Multiple regular event –** occurs at regular intervals **Continuous –** occurs continuously
Reversibility	Pertains to whether a measurable parameter or the VC can return to its existing condition after the project activity ceases	**Reversible –** the residual effect is likely to be reversed after activity completion and reclamation **Irreversible –** the residual effect is unlikely to be reversed

Table 11-2 Characterization of Residual Effects on Employment and Economy

Characterization	Description	Quantitative Measure or Definition of Qualitative Categories
Socio-economic Context	Existing condition and trends in the area where residual effects occur	**Resilient** – the economy can assimilate the additional change **Not Resilient** – the economy is not able to assimilate the additional change because of having little tolerance to imposed stresses due to fragility or the economy being near a threshold

11.1.6 Significance Definition

A significant adverse residual effect of the Project on employment and economy will be determined using the following criteria:

- An adverse effect that is distinguishable from current conditions and trends; and cannot be managed or mitigated through adjustments to programs, policies, plans or through other mitigation

The residual effects assessment considers both positive and adverse effects after mitigation and other management measures are implemented. However, significance determination is made for adverse effects only.

11.2 EXISTING CONDITIONS FOR EMPLOYMENT AND ECONOMY

11.2.1 Methods

The description of existing conditions is primarily derived from Statistics Canada's 2011 NHS and 2016 census. Labour force and education information is limited to that available from the 2011 NHS information. Computation of LAA and RAA statistics was completed using the statistical software "R[1]" (see Appendix J).

[1] R is an open source programming language that is supported by the R Foundation for Statistical Computing. It is used by for a variety of statistical computing uses, including data mining and data analysis.

11.2.2 Results

11.2.2.1 Population

From 2011 to 2016 the population of the LAA increased 10.4% from 54,430 to 60,110. This increase was greater than the provincial average of 8.9%. The Aboriginal population of the LAA increased 46.9% between 2011 and 2016 from 1,610 to 2,365. This increase was also greater than the provincial average (11.0%). In 2016, the LAA represented 5.4% of the total provincial population while the Aboriginal population of the LAA represented 1.4% of the total provincial Aboriginal population. In 2016, 3.9% of the LAA population was Aboriginal. Table 11-3 provides summary population information for the LAA, RAA and Saskatchewan.

Table 11-3 Population Change 2011-2016

Location	Total Population			Aboriginal Population		
	2011 NHS	2016 Census	Percent Change (2011-2016)	2011 NHS	2016 Census	Percent Change (2011-2016)
Swift Current CA	17,045	18,536	8.7	475	720	51.6
Moose Jaw CD	37,385	41,574	11.2	1,135	1,645	44.9
LAA	54,430	60,110	10.4	1,610	2,365	46.9
Regina	207,215	236,481	14.1	19,785	21,650	9.4
RAA	261,645	296,591	13.4	21,395	24,015	12.2
Saskatchewan	1,008,760	1,098,352	8.9	157,740	175,020	11.0
NOTE: *Totals may not sum due to rounding.						
SOURCE: Statistics Canada 2017b						

11.2.2.2 Labour Force Activity

Labour force statistics for the LAA, RAA and Saskatchewan is presented in Table 11-4. In 2011, the LAA labour force aged 15 years and older (this age cohort is used for the description of all labour- and employment-related baseline information) was comprised of approximately 32,480 persons. At 73.6% the LAA participation rate (the active portion of the labour force measured as the percent of the population employed or looking for employment) was greater than the provincial average of 69.2%. The unemployment rate of the LAA was 1.7 percentage points lower than the provincial average at 4.2% compared to 5.9%.

Table 11-4 Total Labour Force Statistics, 2011

Location	Population (aged 15 years and older)	Labour Force	Participation Rate (%)	Employed	Unemployed	Unemployment Rate (%)
Swift Current CA	14,025	9,985	71.2	9,585	405	4.1
Moose Jaw CD	30,130	22,495	74.7	21,545	950	4.2
LAA	44,155	32,480	73.6	31,130	1,355	4.2
Regina	170,070	123,505	72.6	117,525	5,980	4.8
RAA	214,225	155,985	72.8	148,655	7,335	4.7
Saskatchewan	812,505	562,310	69.2	529,100	33,210	5.9
SOURCE: Statistics Canada 2013						

11.2.2.2.1 Aboriginal Labour Force Activity

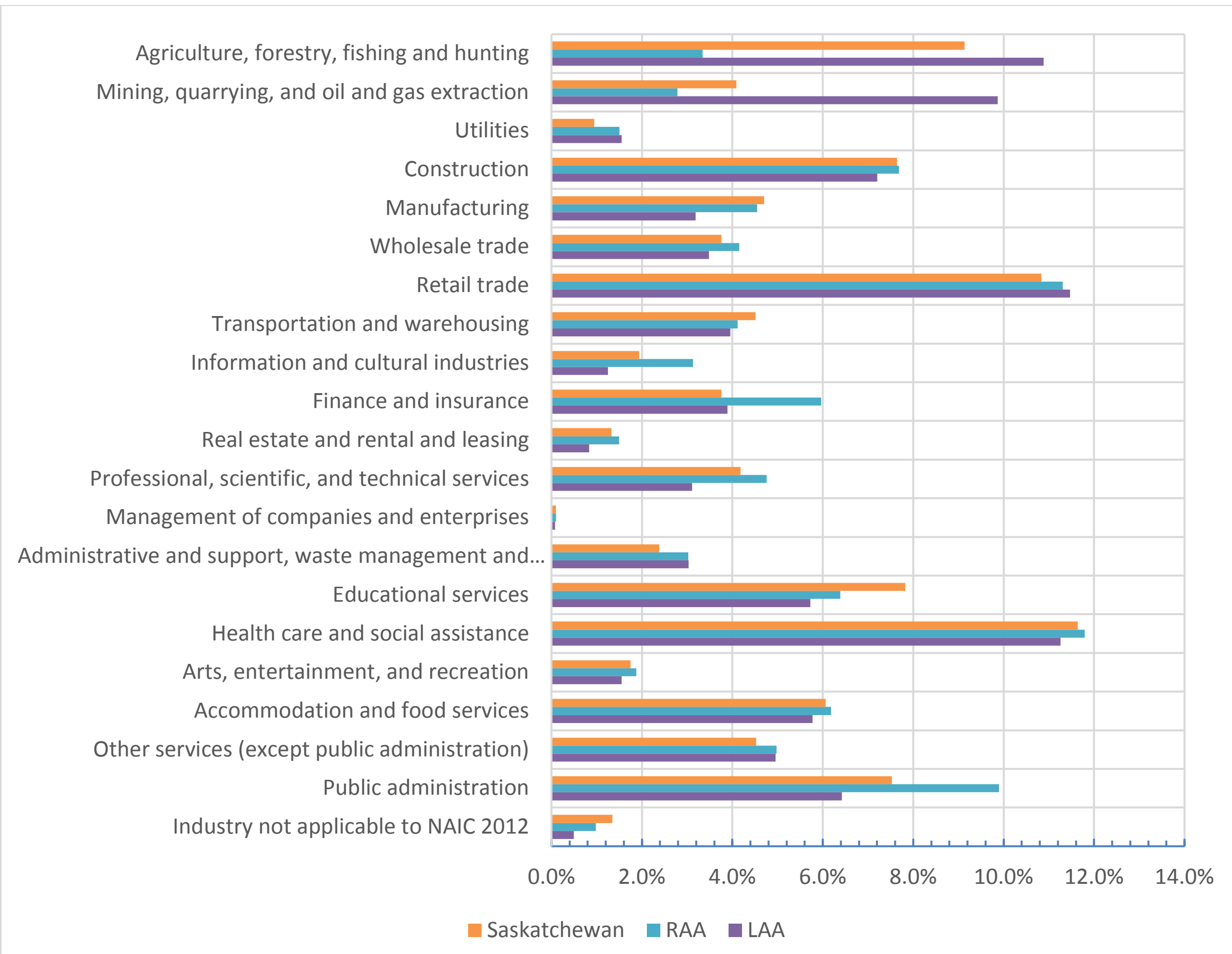
In 2011, the LAA Aboriginal labour force was comprised of approximately 805 persons representing 2.5% of the total LAA labour force (see Table 11-5). The LAA Aboriginal labour force participation rate was greater than that of the provincial average while unemployment rates were less. Compared to total labour force statistics for the LAA, the LAA Aboriginal participation rate was 8.7 percentage points less and the unemployment rate was 3.3 percentage points higher.

Table 11-5 Aboriginal Labour Force Statistics, 2011

Location	Population (aged 15 years and older)	Labour Force	Participation Rate (%)	Employed	Unemployed	Unemployment Rate (%)
Swift Current CA	390	315	80.8	285	25	7.9
Moose Jaw CD	850	490	57.6	455	35	7.1
LAA	1,240	805	64.9	740	60	7.5
Regina	13,005	8,985	69.1	7,895	1,090	12.1
RAA	14,245	9,790	68.7	8,635	1,150	11.7
Saskatchewan	103,960	58,515	56.3	48,635	9,880	16.9
Canada	1,008,580	618,085	61.3	525,100	92,985	15.0
SOURCE: Statistics Canada 2013						

11.2.2.3 Employment by Industry

Information on employment by industry is graphically presented in Figure 11-2 for the LAA and RAA. Information presented in Figure 11-2 is from the 2011 NHS because the 2016 census was unavailable at the time of writing. In 2011, 'agriculture, forestry, fishing and mining', 'retail trade', and 'health care and social assistance' industries employed the greatest percentage of the LAA labour relative to total employment and combined accounted for roughly one-third of the LAA labour force. In the RAA, as well as across the province, employment was greatest in retail trade', 'health care and social assistance', and 'public administration' industries. In the RAA and throughout the province employment in these industries accounted for roughly one-third of total area employment.



SOURCE: Statistics Canada 2013

Figure 11-2 Employment by Industry, 2011

11.2.2.4 Employment by Occupation

In 2011, 'sales and service' occupations accounted for the greatest percentage of LAA employment (21.3%) followed by 'trades, transport, and equipment operators and related' (18.9%) and 'management' (14.8%) occupations. In the RAA employment in 'sales and service' occupations accounted for the greatest percentage of employment (22.4%) followed by 'business, finance, and administration' (17.8%) and 'trades, transport, and equipment operators and related' (16.1%) occupations. A summary of occupational employment in the LAA, RAA and Saskatchewan is provided in Table 11-6.

At the provincial level employment was greatest among 'sales and service' occupations (21.1%); however, employment in 'trades, transport, and equipment operators and related' accounted for the second greatest percentage of employment (16.9%) followed by 'management' (14.4%).

Table 11-6 Total Labour Force Employment by Occupation, 2011

Occupation	LAA		RAA		Saskatchewan	
	Count	Percent	Count	Percent	Count	Percent
Business, finance, and administration	4,175	12.9	27,775	17.8	80,645	14.3
Education, law and social, community and government services	2,745	8.5	17,150	11	62,310	11.1
Art, culture, recreation, and sport	345	1.1	3,120	2.0	10,000	1.8
Trades, transport, and equipment operators and related	6,135	18.9	25,070	16.1	94,870	16.9
Natural resources, agriculture and related	2,640	8.1	4,180	2.7	26,390	4.7
Management	4,810	14.8	18,085	11.6	81,235	14.4
Natural and applied sciences and related	1,175	3.6	9,650	6.2	26,280	4.7
Health	2,280	7.0	10,700	6.9	38,800	6.9
Sales and service	6,925	21.3	34,900	22.4	118,755	21.1
Manufacturing and utilities	1,090	3.3	3,820	2.3	15,445	2.7
Occupation not applicable to NOC 2011	155	0.5	1,530	1.0	7,595	1.4
Total[1]	**32,475**	**100.0**	**155,980**	**100.0**	**562,325**	**100.0**
NOTE: [1] Totals may not sum due to rounding.						
SOURCE: Statistics Canada 2013						

11.2.2.5 Educational Attainment

In 2011, 28.7% of the population aged 15 years and older held a high school diploma (or equivalent), 37.7% had some form of education between the high school and university level, and 9.4% at and above the university level. Detailed information on educational attainment within the LAA, RAA, and Saskatchewan is presented for 2011 in Table 11-7.

Table 11-7 Educational Attainment, 2011

Educational Attainment	LAA		RAA		Saskatchewan	
	Total	Percent	Total	Percent	Total	Percent
No certificate, diploma, or degree	10,665	24.2	41,935	19.6	200,430	24.7
High school diploma or equivalent	12,650	28.7	63,980	29.9	228,755	28.2
Apprenticeship or trades certificate or diploma	7,105	16.1	24,350	11.4	98,820	12.2
College, CEGEP or other non-university certificate or diploma	8,150	18.5	34,325	16	127,295	15.6
University certificate or diploma below bachelor level	1,375	3.1	9,365	4.4	32,780	4.0
Bachelor's degree	3,035	6.8	29,575	13.7	90,720	11.2
University certificate, diploma, or degree above bachelor level	1,160	2.6	10,680	5.0	33,705	4.1
Total population[1]	**44,140**	**100.0**	**214,210**	**100.0**	**812,505**	**100.0**

NOTE:
[1] Totals may not sum due to rounding.

SOURCE: Statistics Canada 2013.

11.2.2.6 Individual Annual income (Before Tax)

In 2015, median total annual income in the LAA was $39,810 while annual employment income was $36,607 (see Table 11-8). These annual incomes were slightly less than RAA averages ($40,034 and $37,274, respectively) but higher than provincial averages ($38,299 and $36,612, respectively).

Table 11-8 Individual Annual Income (Before Tax), 2015

Location	Total Income		Employment Income	
	Median	Mean	Median	Mean
Swift Current CA	39,585	49,831	37,274	46,194
Moose Jaw CD	40,034	51,942	35,939	46,969
LAA	39,810	50,887	36,607	46,582
Regina	43,434	54,636	43,089	52,487
RAA	40,034	52,136	37,274	48,550
Saskatchewan	38,299	49,409	36,612	46,853

NOTE:
Total Income is the sum of monetary receipts including employment income (income form wages and salaries, tips, commissioning, and self-employment), income from investment sources, income from employer and personal pension sources, other cash income (e.g., child support payments and scholarships), and income from government sources (e.g., social assistance, child benefits, Old Age Security, and Canada Pension Plan).

SOURCE: Statistics Canada 2013.

11.3 PROJECT INTERACTIONS WITH EMPLOYMENT AND ECONOMY

Table 11-9 identifies, for each potential effect, the physical activities that might interact with employment and economy and result in the identified environmental effect. These interactions are indicated by a check mark and are discussed in detail in Section 11.4, in the context of effects pathways, standard and project-specific mitigation/enhancement, and residual effects.

Table 11-9 Project-Environment Interactions with Employment and Economy

Project Components and Physical Activities	Potential Environmental Effects	
	Change in labour supply and demand	Change in economy
Construction		
Site preparation, including clearing and grading of WTG locations, access roads, and temporary workspaces	✓	✓
Installation of WTG foundations and turbine erection	✓	✓
Installation of collector lines and substation	✓	✓
Reclamation and site landscaping	✓	✓
Operation and Maintenance		
Operation of WTGs and substation, including access road use	✓	✓
WTG routine and unplanned maintenance	✓	✓
Routine and unplanned maintenance of collector and substation infrastructure	✓	✓
Decommissioning		
Equipment dismantling, access removal, collector and substation removal	✓	✓
Site reclamation	✓	✓
NOTES: "✓" = Potential interactions that might cause an effect. –- = Interactions between the Project and VC are not expected.		

11.4 ASSESSMENT OF RESIDUAL ENVIRONMENTAL EFFECTS ON EMPLOYMENT AND ECONOMY

11.4.1 Analytical Assessment Techniques

The following techniques were used to assess change in labour supply and demand:

- Effects related to labour supply and demand were assessed by comparing the estimated available labour force within the LAA and RAA, with estimated labour demand related to the Project.
  - The available labour force within the LAA and RAA was estimated by multiplying the unemployment rate, from Table 11-4, with the LAA and RAA labour force by relevant occupations, from Table 11-6.
  - Project-related labour demand was estimated based on Project expenditures, by phase, and economic multipliers obtained from Statistics Canada's Interprovincial Input-Output Model (SCIPIOM), (available from Statistics Canada 2017c). See Appendix J for additional information on the estimation of Project-related labour.
  - Potential for wage inflation was estimated by comparing individual annual income in the LAA and RAA, from Table 11-8, with labour income per full-time equivalent, derived using Statistic's Canada multipliers.
- The potential change in economy was based on estimated effects on GDP and government revenue, during each project phase, which were derived using multipliers obtained from Statistics Canada's Interprovincial Input-Output Model (SCIPIOM), (available from Statistics Canada 2017c). See Appendix J for additional information on the estimation of Project-related GDP and government revenue.

11.4.2 Change in Labour Supply and Demand

11.4.2.1 Project Pathways

Effect pathways for change in labour supply and demand during construction, operation and maintenance, and decommissioning are as follows:

- Project expenditures on labour will result in direct employment
- Project purchases of goods and services from local and regional businesses could create indirect employment
- The purchase of consumer goods and services by individuals who are employed directly or indirectly by the Project could create induced employment

- Project demand for and compensation of direct labour could result in increased competition for and cost of labour (wage inflation)
- Project-related indirect and induced employment and labour income could result in increased competition for and cost of labour (wage inflation).

Detailed information related to Project capital expenditures (CAPEX), operational expenditures (OPEX), and decommissioning expenditures (ABEX) as well as related employment is provided in Appendix J.

11.4.2.2 Mitigation

As a mitigation and enhancement measure specific to change in labour supply and demand, Algonquin and its prime contractor will engage early in consultation activities to enhance employment and business opportunities associated with the Project.

11.4.2.3 Project Residual Effect

11.4.2.3.1 Construction

11.4.2.3.1.1 Project Workforce

The Project's peak construction workforce is estimated at approximately 45 to 90 FTEs. Of this peak construction workforce, approximately half (30 persons) are expected to be LAA and RAA residents with the remainder comprised of residents from other parts of Canada (outside Saskatchewan). It is estimated that one-third of the peak LAA/RAA workforce will be comprised of persons with positions related to the National Occupational Classification (NOC) 'business, finance, and administration' (e.g., administrators, financial analysts, security, housekeeping). The remaining two-thirds is estimated to be comprised of persons with positions related to the NOC 'trades, transport, and equipment operators' (e.g., electricians, crane operators, heavy equipment operators, and general labourers). Additional information on estimated direct, indirect, and induced labour associated with the Project is provided in Appendix J.

Table 11-10 compares the Project's estimated workforce demand from within the LAA and RAA, with the estimated labour availability by occupation class.

Table 11-10 Estimated Occupations Required During Construction (at Peak) and Estimated Labour Availability, LAA and RAA

Position by NOC	Project Demand for Labour		Estimated Labour Availability	
	LAA	**RAA**	**LAA**	**RAA**
Business, finance, and administration	5	10	175	1,481
Trades, transport, and equipment operators	10	20	258	1,436
Total	**15**	**30**	**433**	**2,917**
NOTE: Labour availability was estimated by multiplying area unemployment rates by baseline employment by occupation.				
SOURCE: Algonquin 2017; economic multipliers taken from Statistics Canada 2017c.				

From Table 11-10, the estimated available labour supply of persons with positions related to 'business, finance, and administration' and 'trades, transport, and equipment operators' exceeds Project demand for these positions. Since the available supply of labour within the LAA and RAA exceeds estimated Project demands is not expected that the Project will contribute to labour shortages; adverse effects are not expected. Through mitigation measures (see Section 11.4.2.2) such as early engagement, it is anticipated that local employment with the Project will be enhanced.

As the Project transitions from construction to operation and maintenance the peak LAA/RAA workforce will decrease from 30 persons to an estimated annual operations workforce of approximately 7-15 FTEs. While a loss of direct employment from construction to operation and maintenance will occur, the relatively short-term nature of Project construction is known and will be anticipated by workers who are employed by the Project. Labour income, skills and experience gained while employed with the Project will further offset adverse effects. In the case of gained skills and experience, these benefits of employment could improve qualifications for employment for future projects and opportunities.

11.4.2.3.1.2 Potential for Wage Inflation

Total domestic labour income associated with Project construction is estimated at $28 million. Direct employment accounts for approximately 41% ($11.4 million) of total labour income with indirect and induced employment accounting for the remaining 59% ($16.6 million). The average cost of Project direct labour is estimated at $134,117/FTE Canada-wide. The average cost of Project-associated indirect and induced labour is estimated at $58,378/FTE and $46,400/FTE respectively. Additional information on direct, indirect, and induced labour income associated with the Project construction is provided in Appendix J.

In comparison to baseline conditions the estimated cost of direct labour is 3.7 times greater than median employment income in the LAA and 3.6 times greater that the median employment income in the RAA. Likewise, the estimated cost of indirect labour is 1.6 times greater than employment income in the LAA and RAA, while estimated cost of induced labour is 1.3 times greater than baseline employment income in the LAA and 1.2 times greater than baseline employment income in the RAA. Because the cost of labour associated with the project is greater than baseline conditions the Project has the potential to contribute to wage inflation. However, because of the relatively short term duration of construction (1.5 years) and the small size of the Project workforce relative to the overall labour force within the LAA and RAA), no adverse effects on the cost of labour (i.e., wage inflation) are expected.

For the residual effect on labour supply and demand during construction, the direction is positive.

11.4.2.3.2 Operation and Maintenance

11.4.2.3.2.1 Project Workforce

The Project's annual operation and maintenance workforce is estimated at approximately seven persons. The operation and maintenance workforce is anticipated to be comprised of positions related to the NOCs 'management' (e.g., site supervisor), 'business, finance, and administration' (e.g., computer/network support), and 'trades, transport, and equipment operators and related' (e.g., electrical technicians, general maintenance/repairs).

It is Algonquin's preference to hire local workers. Because certain operation and maintenance positions require specialized training and experience Algonquin will implement measures (see Section 11.4.2.2) such as early engagement and investments in education, to increase the likelihood of local hires. Based on the small size of the operations workforce relative the size of the available labour force the Project is not expected to contribute to labour shortages; adverse effects are also not expected.

As the Project transitions form operation and maintenance into decommissioning the Project's workforce will increase from seven persons to an estimated peak decommissioning workforce of 30 persons. This transition will see an overall increase in direct employment; however, there is potential for the loss of direct employment among operation and maintenance personal not trained or skilled in decommissioning activities. Labour income, skills and experience gained while employed with the Project is anticipated to offset adverse effects related to this loss of direct employment. In the case of gained skills and experience, these benefits of employment could improve qualifications for employment for future projects and opportunities.

11.4.2.3.2.2 Potential for Wage Inflation

Annual labour income associated with Project operation and maintenance is estimated at $810,000. Direct employment accounts for approximately 89% ($720,000) of annual labour income with indirect and induced employment accounting for the remaining 11% ($90,000). The average cost of direct labour is estimated at $102,225/FTE Canada-wide. The average cost of indirect and induced labour is estimated at $45,017/FTE and $40,914/FTE respectively. Additional information on direct, indirect, and induced labour income associated with the Project operation and maintenance is provided in Appendix J.

In comparison to baseline conditions the estimated cost of direct labour is 2.8 times greater than median baseline employment income in the LAA. The cost of Project-associated indirect and induced labour is 1.2 and 1.1 times greater, respectively, than median baseline employment income in the LAA. Because the cost of labour associated with the project is greater than baseline conditions the Project has the potential to contribute to wage inflation. However, because of the small size of the Project workforce relative to overall LAA labour force adverse effects on the cost of labour (i.e., wage inflation) are expected to be negligible in magnitude.

For the residual effect on labour supply and demand during operation and maintenance, the direction is positive.

11.4.2.3.3 Decommissioning

11.4.2.3.3.1 Project Workforce

Conceptually, the Project’s peak decommissioning workforce is estimated at 30 persons. Considering the timing of decommissioning (estimated to occur a minimum of 25 years after construction; however, it may be longer), summary information regarding the estimated composition of the decommissioning workforce by occupation is not provided.

As with construction and operation and maintenance, it is Algonquin’s preference to hire local workers during decommissioning. While mitigation and enhancement measures proposed in Section 11.4.2.2 are anticipated to mitigate adverse effects and enhance beneficial effects, because decommissioning is estimated to occur 25-years (or longer) into the future confidence in the effectiveness of proposed mitigation measures is reduced. Similarly, because of the timing of decommissioning, the availability of the LAA and RAA labour force skilled in decommissioning-related occupations is also unknown. As such adverse effects are conservatively assessed as low in magnitude.

Following the completion of decommissioning direct employment with the Project will cease. While this loss of direct employment will occur the relatively short-term nature of Project decommissioning is known and will be anticipated by workers who are employed by the Project. Labour income, skills and experience gained while employed with the Project are anticipated to offset adverse effects. In the case of gained skills and experience, these benefits of employment could improve qualifications for employment for future projects and opportunities.

11.4.2.3.3.2 Potential for Wage Inflation

Total labour income associated with decommissioning is estimated at $12 million (2017 dollars) based on conceptual ABEX estimates. Based on conceptual employment estimates (see Section 11.4.2.3.3 – Project Workforce) the cost of Canada-wide labour is estimated at $103,000 for direct employment, $59,000 for indirect employment, and $41,000 for induced employment. Because decommissioning is estimated to occur 25-years into the future location-specific information on labour income is not presented.

Based on the timing of decommissioning, qualification of Project effects on wage inflation is limited. Compared to LAA and RAA baseline conditions the Project's cost of labour is greater than average employment income and as such the Project has the potential to contribute to wage inflation. However, as with construction and operation and maintenance, the relatively small size workforce and duration (estimated at two years) of decommissioning will reduce the overall magnitude of effects.

For the residual effect on labour supply and demand during decommissioning, the direction is positive.

11.4.3 Change in Economy

11.4.3.1 Project Pathways

Effect pathways for change in employment and economy during all Project phases (i.e., construction, operation and maintenance, and decommissioning) are as follows:

- Project expenditures on labour will contribute to federal and provincial GDP and government revenues
- Project purchases of goods and services from local and regional businesses will contribute to federal and provincial GDP and government revenues
- The purchase of consumer goods and services by individuals who are employed directly or indirectly by the Project will contribute to GDP and government revenue

Detailed information related to Project expenditures is provided in Appendix J.

11.4.3.2 Mitigation

As a mitigation and enhancement measure specific to change in economy, Algonquin and its prime contractor will engage early in consultation activities to enhance employment and business opportunities associated with the Project.

11.4.3.3 Project Residual Effect

11.4.3.3.1 Construction

11.4.3.3.1.1 Gross Domestic Product

Domestic capital expenditures (CAPEX) are predicted to generate $79.6 million in GDP, of which 45% ($35.7 million) will be generated in Saskatchewan and 55% ($43.9 million) within other parts of Canada. GDP effects are not calculated at the LAA and RAA level. Additional information on estimated direct, indirect, and induced GDP associated with the Project construction is provided in Appendix J.

11.4.3.3.1.2 Government Revenues

In total, it is estimated that $16.6 million in federal government revenue will be generated during Project construction through the collection of corporate income tax, personal income tax and sales taxes. Provincial government revenue (across Canada) is estimated at $13.6 million. Direct effects account for 46% of total federal government effects and 44% of provincial government effects. Government revenues realized in the province of Saskatchewan account for 35% of total federal revenues and 40% of provincial government revenues (across Canada). Additional information on estimated direct, indirect, and induced GDP associated with the Project construction is provided in Appendix J.

For this residual effect on the economy during construction, the direction is positive.

11.4.3.3.2 Operation and Maintenance

11.4.3.3.2.1 Gross Domestic Product

Expenditures on operations and maintenance (OPEX) are expected to generate $0.7 million annually in GDP all of which is estimated to be generated in Saskatchewan. GDP effects are not calculated at the LAA/RAA level. Additional information on estimated GDP associated with the Project construction is provided in Appendix J.

11.4.3.3.2.2 Government Revenues

Operation and maintenance activities are estimated to generate $0.4 million in federal government revenue and $0.3 million in provincial government revenue annually. Direct effects account for 50% of total federal government effects and 33% of total provincial government effects. The Project's annual contribution to municipal government revenue is estimated at $0.8 million (primarily property tax). Government revenues realized in the province of Saskatchewan account for 50% of total federal revenues, 67% of provincial government revenues (across Canada), and 100% of municipal government revenues. Additional information on estimated government revenue associated with the Project construction is provided in Appendix J.

For the residual effect on the economy during operation and maintenance, the direction is positive.

11.4.3.3.3 Decommissioning

It is estimated that expenditures during decommissioning (ABEX) could generate $35 million in GDP, all of which is estimated to occur in Saskatchewan. Direct effects are estimated to account for 63% ($22 million) of generated GDP, indirect effects 23% ($8 million), and indirect effects 14% ($5 million). GDP effects are not calculated at the LAA/RAA level. Since decommissioning is estimated to occur 25-years (or longer) into the future, at which time government tax rates will likely differ from those available at the time of writing, estimates of government revenue are not provided.

For the residual effect on the economy during decommissioning, the direction is positive.

11.4.4 Summary of Project Residual Environmental Effects

Table 11-11 summarizes the residual effects on employment and economy.

Table 11-11 Project Residual Effects on Employment and Economy

Residual Effect	Residual Effects Characterization							
	Project Phase	Direction	Magnitude	Geographic Extent	Duration	Frequency	Reversibility	Socio-economic Context
Change in labour supply and demand	C	P	N/A	N/A	N/A	N/A	N/A	N/A
	O	P	N/A	N/A	N/A	N/A	N/A	N/A
	D	P	N/A	N/A	N/A	N/A	N/A	N/A
Change in economy	C	P	N/A	N/A	N/A	N/A	N/A	N/A
	O	P	N/A	N/A	N/A	N/A	N/A	N/A
	D	P	N/A	N/A	N/A	N/A	N/A	N/A

KEY

See Table 11-2 for detailed definitions

Project Phase
C: Construction
O: Operation and Maintenance
D: Decommissioning

Direction:
P: Positive
A: Adverse
N: Neutral

Magnitude:
N: Negligible
L: Low
M: Moderate
H: High

Geographic Extent:
PDA: Project Development Area
LAA: Local Assessment Area
RAA: Regional Assessment Area

Duration:
ST: Short-term;
MT: Medium-term
LT: Long-term

N/A: Not applicable

Frequency:
S: Single event
IR: Multiple irregular event
R: Multiple regular event
C: Continuous

Reversibility:
R: Reversible
I: Irreversible

Socio-Economic Context:
R: Resilient
NR: Not resilient

11.5 ASSESSMENT OF CUMULATIVE ENVIRONMENTAL EFFECTS ON EMPLOYMENT AND ECONOMY

The project residual effects described in Section 11.4 are likely to interact cumulatively with residual environmental effects from other physical activities (past, present, and reasonably foreseeable). The resulting cumulative environmental effects are assessed. This is followed by an analysis of the project contribution to cumulative effects. Future projects and activities that are reasonably foreseeable are defined as those that (a) have been publicly announced with a defined project execution period and with sufficient project details that allow for a meaningful assessment, (b) are currently undergoing an environmental assessment or (c) are in a permitting process.

The assessment of cumulative effects is initiated with a determination of whether two conditions exist:

- the Project has residual environmental effects on the VC and
- the residual effects could act cumulatively with residual effects of other past, present, or reasonably foreseeable future physical activities

If either is not met, the assessment of cumulative effects concludes with a statement that further assessment of cumulative effects is not warranted because the Project does not interact cumulatively with other projects or activities.

11.5.1 Project Residual Effects Likely to Interact Cumulatively

Table 4-4 in Section 4.0, Environmental Assessment Scope and Methodology, presents the project and physical activities inclusion list, which identifies other projects and physical activities that might act cumulatively with the Project. Where residual environmental effects from the Project act cumulatively with residual effects from other projects and physical activities (Table 11-12), a cumulative effects assessment is undertaken to determine their significance.

The assessment of the cumulative environmental effects that are likely to result from the Project in combination with other projects and physical activities are discussed in subsequent sections.

Table 11-12 Interactions with the Potential to Contribute to Cumulative Effects

Type of Project/Activity	Change in Labour Supply and Demand	Change in Economy
Past and Present Physical Activities and Resource Use		
Agricultural Conversion	✓	✓
Oil and Gas Developments	✓	✓
Power Generation, Transmission and Distribution	✓	✓
Morse Wind Farm	✓	✓
Centennial Wind Farm	✓	✓
Recreational Activities	✓	✓
Residential Developments	✓	✓
Resource Extraction Activities	✓	✓
Belle Plaine Potash Solution Mine	✓	✓
Sodium Sulphate Mine	✓	✓
Road Developments	✓	✓
Project-Related Physical Activities	✓	✓
Future Physical Activities		
Pasqua to Swift Current 230 kV Transmission Line Project	✓	✓
SaskPower Blue Hill Interconnection Project	✓	✓
Chinook Power Station	✓	✓
Potential future gas plant	✓	✓

11.5.2 Change in Labour Supply and Demand

11.5.2.1 Cumulative Effect Pathways

Cumulative effect pathways for change in labour supply and demand are as follows:

- Reasonably foreseeable future projects and physical activities identified as having an interaction with the Project will create direct employment adding to cumulative direct employment effects within the RAA. These projects and physical activities will also result in indirect employment (because of cumulative purchases of goods and services from local and regional businesses) and induced employment (because of the cumulative purchases of consumer goods and services by individuals who are employed directly or indirectly by these projects and physical activities). Cumulative effects would occur during the construction (2019-2020), operation and maintenance (2021 to 2046), and decommissioning (2046-2048) phases of the Project.

- Cumulative demand for labour from reasonably foreseeable future projects may contribute to increased competition for and cost of labour (wage inflation). Cumulative effects would occur during the construction (2019-2020), operation and maintenance (2021 to 2046), and decommissioning (2046-2048) phases of the Project.

The contribution of past projects and physical activities on change in labour supply and demand is captured in the description of baseline conditions (Section 11.2) and the assessment of residual effects (Section 11.4.2).

11.5.2.2 Mitigation for Cumulative Effects

Implementation of proposed mitigation measures identified in Section 11.4.2.2 will reduce the Project's contribution to adverse cumulative effects on change in labour supply and demand. No additional mitigation measures are proposed for Project contributions to address cumulative effects on change in labour supply and demand. It is expected that future projects that require regulatory approval will be subject to similar mitigation through environmental assessment and permitting processes.

11.5.2.3 Cumulative Effects

The Project's contribution to cumulative effects on labour supply and demand is expected to be positive with the employment and compensation of regional workers. In the cumulative case, that of the Project as well as projects and activities listed in Table 11-13, cumulative expenditures on labour are expected to result in changes in employment and income; however, due to the size and diversity of the RAA's labour force (see Sections 11.2.2.2 through 11.2.2.4), changes in employment and employment income are expected to be minimal. In consideration of this socio-economic context and with the implementation of mitigation measures described in Section 11.5.3.3, as well as those anticipated to be implemented by proponents of reasonably foreseeable future projects and activities subject to regulatory review, cumulative effects are expected to be positive in direction. Adverse residual cumulative effects are not anticipated.

11.5.3 Change in Economy

11.5.3.1 Cumulative Effect Pathways

Cumulative effect pathways for change in economy are as follows:

- Expenditures on labour, and goods and services on the part of reasonably foreseeably future projects and physical activities identified as having an interaction with change in labour supply and demand have the potential to cumulatively affect direct, indirect, and induced business activity within the RAA and increase GDP in SK and Canada in 2018/2019 (during the Project's construction phase).

The contribution of past projects and physical activities on change in labour supply and demand is captured in the description of baseline conditions (Section 11.2) and the assessment of residual effects (Section 11.4.3).

11.5.3.2 Mitigation for Cumulative Effects

Implementation of proposed mitigation measures identified in Section 11.4.3.2 will reduce the Project's contribution to adverse cumulative effects on change in labour supply and demand. No additional mitigation measures are proposed for Project contributions to address cumulative effects on change in labour supply and demand. It is expected that future projects that require regulatory approval will be subject to similar mitigation through environmental assessment and permitting processes.

11.5.3.3 Cumulative Effects

In the cumulative case the Project will account for a minimal percentage of total capital expenditures associated with reasonably foreseeable projects within the RAA in 2019 (corresponds with overlapping periods of construction). Beginning in 2021, Project OBEX will begin to contribute to total cumulative expenditures within the RAA. The relative percentage of expenditures attributable to the Project is assumed to be minimal in comparison to regional trends. As currently estimated, Project ABEX would begin contributing to cumulative expenditures beginning in 2046. The relative percentage of expenditures attributable to the Project during decommissioning is assumed to be minimal in comparison to regional trends. Mitigation measures described in Section 11.5.3.2 are anticipated to enhance the Project's effects on the RAA economy.

Over the life of the Project regional cumulative expenditures on labour, equipment, materials, goods, and services will contribute to increased GDP (federal and provincial) and government revenue (federal, provincial, and municipal). Effects will be positive in direction.

11.5.3.4 Summary of Cumulative Effects

Table 11-13 summarizes cumulative environmental effects on employment and economy.

Table 11-13 Residual Cumulative Effects

Residual Cumulative Effect	Residual Cumulative Effects Characterization						
	Direction	Magnitude	Geographic Extent	Duration	Frequency	Reversibility	Ecological and Socio-economic Context
Change in labour supply and demand							
Residual cumulative effect	P	N/A	N/A	N/A	N/A	N/A	N/A
Contribution from the Project to the residual cumulative effect	The Project is estimated to account for a minimal percentage of estimated labour demand in 2019 through 2046 (coincides with construction through operation and maintenance and decommissioning).						
Change in economy							
Residual cumulative effect	P	N/A	N/A	N/A	N/A	N/A	N/A
Contribution from the Project to the residual cumulative effect	The Project accounts for minimal percentage of total capital expenditures associated with reasonably foreseeable projects within the RAA in 2019 in comparison to regional trends. Beginning in 2021, Project OBEX will begin to contribute to total cumulative expenditures within the RAA; these expenditures are also assumed to be minimal in comparison to regional trends. As currently estimated, Project ABEX would begin contributing to cumulative expenditures beginning in 2046. The relative percentage of expenditures attributable to the Project during decommissioning is assumed to be minimal in comparison to regional trends.						

KEY

See Table 11-2 for detailed definitions

Direction:
P: Positive
A: Adverse
N: Neutral

Magnitude:
N: Negligible
L: Low
M: Moderate
H: High

Geographic Extent:
PDA: Project Development Area
LAA: Local Assessment Area
RAA: Regional Assessment Area

Duration:
ST: Short-term;
MT: Medium-term
LT: Long-term

N/A: Not applicable

Frequency:
S: Single event
IR: Irregular event
R: Regular event
C: Continuous

Reversibility:
R: Reversible
I: Irreversible

Socio-Economic Context:
R: Resilient
NR: Not resilient

11.6 DETERMINATION OF SIGNIFICANCE

11.6.1 Significance of Project Residual Effects

With the implementation of mitigation measures and in consideration of existing conditions, Project expenditures (i.e., CAPEX, OPEX, and ABEX), and resultant changes in employment, labour income, government revenue and contributions to provincial and federal GDP, Project residual effects are assessed as being positive in direction. Adverse effects on labour supply and demand and economy are not predicated. As such, and in accordance with the significance definition provided in Section 11.1.6, a determination of significance is not made.

11.6.2 Significance of Cumulative Effects

In a scenario where projects identified in the cumulative effects case were constructed, the capital expenditures within the RAA would cumulatively affect labour supply and demand and contribute to increased government revenue and provincial and federal GDP. In consideration of existing conditions, the magnitude of potential regional expenditure in the cumulative case as well as resultant changes in employment, labour income, government revenue and contributions to provincial and federal GDP, cumulative residual effects are assessed as being positive in direction. Residual averse cumulative effects on labour supply and demand and economy are not predicated. As such, and in accordance with the significance definition provided in Section 11.1.6, a determination of significance is not made.

11.6.3 Project Contribution to Cumulative Effects

For change in labour supply and demand the Project is estimated to account for a minimal percentage of estimated labour demand in 2019 through 2046 (coincides with construction through operation and maintenance and decommissioning). For change in economy the Project accounts for minimal percentage of total capital expenditures associated with reasonably foreseeable projects within the RAA in 2019 in comparison to regional trends. Beginning in 2021, Project OBEX will begin to contribute to total cumulative expenditures within the RAA; these expenditures are also assumed to be minimal in comparison to regional trends. As currently estimated, Project ABEX would begin contributing to cumulative expenditures beginning in 2046. The relative percentage of expenditures attributable to the Project during decommissioning is assumed to be minimal in comparison to regional trends.

11.7 PREDICTION CONFIDENCE

The confidence in the conclusions made in this assessment are a function of the quality and quantity of baseline data, level of understanding of the effect mechanisms, assumptions made, and effectiveness of mitigation measures. There is a moderate degree of confidence in the assessment of adverse effects on labour supply and demand because of uncertainty about future economic conditions in the LAA/RAA. The extent of employment of local and regional workers will also depend on how many workers choose to respond to recruitment activities. Due to the use of multiple assumptions in estimating government revenue confidence is low to moderate. Because the significance conclusions made regarding residual effects on employment and economy are based on uncertainty, conclusions are made with a low to moderate level of confidence.

11.8 FOLLOW-UP AND MONITORING

No follow-up and monitoring is proposed.

12.0 ASSESSMENT OF POTENTIAL EFFECTS ON COMMUNITY SERVICES AND INFRASTRUCTURE

12.1 SCOPE OF ASSESSMENT

Community services and infrastructure is selected as a VC because activities during Project phases place increased demands on local services and infrastructure, such as community services (e.g., accommodation, restaurants, etc.), health and emergency services (e.g., fire, police, ambulance, etc.), and transportation infrastructure. This section of the EIS defines and describes the scope of the assessment of potential effects on community services and infrastructure.

12.1.1 Regulatory and Policy Setting

The scope of this section takes into consideration guidance provided by the final TOR outlined for the Project and the *Saskatchewan Environmental Assessment Act, 1980* (Government of Saskatchewan 1980b).

12.1.2 Consideration of Issues Raised during Engagement

During consultation and engagement, local residents, First Nations, regulators, and other interested parties were provided with the opportunity to express opinions, concerns or issues related to the Project. The nature of the comments received with regard to community development was generally positive and reflected an interest by individuals to provide services to the Project and gain economic benefits.

The assessment of potential effects on community services and infrastructure outlined in this section includes information on the potential effects of the Project on demands on infrastructure and services, and considers comments received during consultation.

12.1.3 Potential Effects, Pathways and Measurable Parameters

Potential effects, effect pathways and the measurable parameters used to characterize and assess effects on the community services and infrastructure VC are provided in Table 12-1.

Table 12-1 Potential Effects, Effects Pathways and Measurable Parameters for Community Services and Infrastructure

Potential Environmental Effect	Effect Pathway	Measurable Parameter(s) and Units of Measurement
Change in community services and infrastructure	• During construction of the Project there will be an increase of workforce that could increase demands for community services (e.g., restaurants) and draw on temporary accommodations (e.g., hotels, motels, or campgrounds) • During construction, the temporary workers and construction activities could lead to incidents that would increase the demand of services such as health, emergency and policing services. • During construction of the Project there will be an increase in transportation volume (transportation of materials, equipment and workers) that could increase the demand on the transportation infrastructure and potentially contribute to traffic accidents (e.g., collisions) that would draw on services such as health, emergency, and policing services.	• Population and workforce • Number of lodging units (e.g., hotel/motel rooms) • Restaurant capacity • Service provider (e.g., number of police officers) and infrastructure capacity (e.g., number of beds at the hospital) • Transportation network capacity • Change in traffic volumes and patterns

12.1.4 Boundaries

12.1.4.1 Spatial Boundaries

The following spatial boundaries are defined for the community services and infrastructure assessment:

Project Development area (PDA) – The PDA is represented by the physical Project footprint and consists of the area of physical disturbance associated with Project components, i.e., WTGs, access roads, collector lines, substation, and temporary workspaces.

Local Assessment Area (LAA) – The LAA consists of the PDA and the boundaries of all RMs traversed by the PDA. The LAA represents the area where direct and indirect effects on community services and infrastructure are likely to be the most pronounced or identifiable. Communities considered in the assessment include the RMs of Lawtonia and Morse. Due to their close proximity to the PDA and location on the TransCanada Highway, the Towns of Herbert and Morse are also included in the LAA.

Regional Assessment Area (RAA) – The RAA consists of the PDA, LAA and the following communities: the Village of Hodgeville, and the City of Swift Current.

See Figure 12-1 for the community services and infrastructure assessment areas.

12.1.4.2 Temporal Boundaries

Construction: Up to 1.5 years. Peak construction activity period associated with site preparation, construction (i.e., WTG installation, access road construction, collector line installation, substation construction), reclamation of temporary workspace and commissioning.

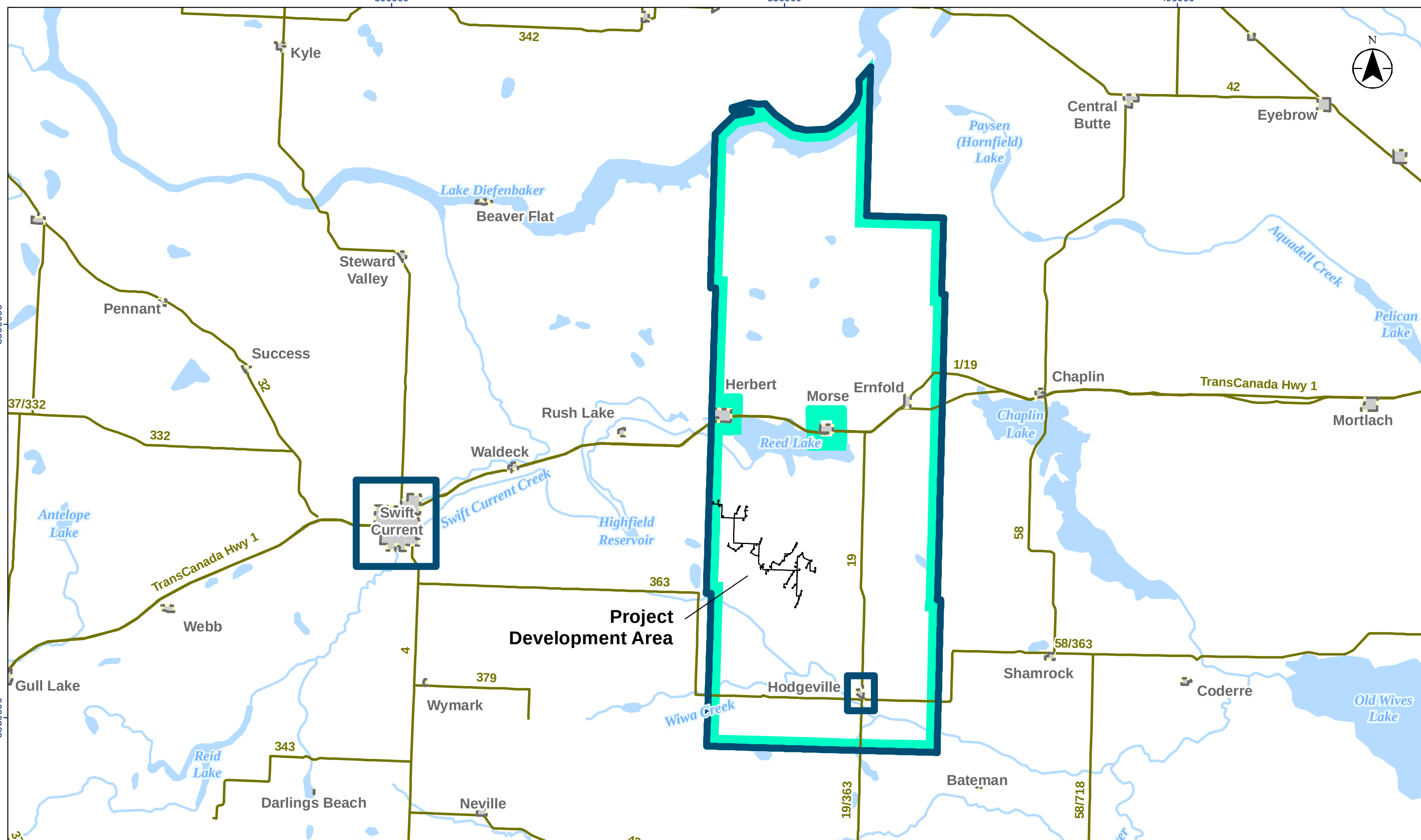
Operation and Maintenance: From commissioning through the life of the Project (at a minimum approximately 25 years).

Decommissioning: A two-year period at the end of the life of the Project, comprising the removal of above-ground facilities and a portion of the foundations, abandonment in place of underground collector lines and any associated reclamation activities. As part of decommissioning, certain components will be left in place as this approach usually results in fewer environmental effects.

12.1.4.3 Administrative and Technical Boundaries

The following administrative and technical boundaries apply to the assessment of community services and infrastructure:

- RM boundaries
- Local community boundaries
- Local and regional service boundaries for infrastructure and service providers (e.g., health, police, and emergency services)



Community Services Local Assessment Area

Community Services Regional Assessment Area

Rural Municipality

Major Road

Railway

Watercourse

Waterbody

Town/City

0 10 20 30 Kilometers

1:750,000 (At original document size of 8.5x11)

Notes
1. Coordinate System: NAD 1983 UTM Zone 13N
2. Base features produced under license with the Government of Saskatchewan and the Government of Canada.
3. Assessment boundaries based on RM boundaries.

Stantec Algonquin

Project Location
Near Herbert, SK

113254088-037 REVE
Prepared by acory on 2017-12-18
Technical Review by ceidem on 2017-12-18

Client/Project
Algonquin Power Co.
Blue Hill Wind Energy Project

Figure No.
12-1

Title
Community Services and Infrastructure Assessment Areas

12.1.5 Residual Effects Characterization

Table 12-2 provides a qualitative measure of the characterization of residual environmental effects for community services and infrastructure.

Table 12-2 Characterization of Residual Effects on Community Services and Infrastructure

Characterization	Description	Quantitative Measure or Definition of Qualitative Categories
Direction	The long-term trend of the residual effect	**Positive –** effect is positive compared to baseline conditions **Adverse –** effect is negative compared to baseline conditions **Neutral –** no net change in measurable parameters
Magnitude	The amount of change in measurable parameters or the VC relative to existing conditions	**Negligible –** no measurable change in the environmental effect that might or might not be detectable, but within the range of natural variability **Low –** effect occurs that might or might not be detectable, but is in the normal range of variability **Moderate –** effect occurs that is detectable, but at a modest level (e.g., nearing available capacity of infrastructure and services, affect the viability or displace public use of infrastructure and services) **High –** effect will result in a demonstrable change in community services and infrastructure
Geographic Extent	The geographic area in which a residual effect occurs	**PDA –** residual effects are restricted to the PDA **LAA –** residual effects extend into the LAA **RAA –** residual effects interact with those of other projects in the RAA
Duration	The period of time required until the measurable parameter or the VC returns to its existing condition, or the residual effect can no longer be measured or otherwise perceived	**Short-term –** residual effect restricted to the duration of the activity **Medium-term –** residual effect extends throughout construction and up to 10 years during operation, or throughout the operation phase alone **Long-term –** residual effect extends beyond decommissioning
Frequency	Identifies how often the residual effect occurs and how often during the Project or in a specific phase	**Single event –** occurs once **Multiple irregular event –** occurs at no set schedule **Multiple regular event –** occurs at regular intervals **Continuous –** occurs continuously

Table 12-2 Characterization of Residual Effects on Community Services and Infrastructure

Characterization	Description	Quantitative Measure or Definition of Qualitative Categories
Reversibility	Pertains to whether a measurable parameter or the VC can return to its existing condition after the project activity ceases	**Reversible –** the residual effect is likely to be reversed after activity completion and/or reclamation **Irreversible –** the residual effect is unlikely to be reversed or returned to baseline conditions
Ecological and Socio-economic Context	Existing condition and trends in the area where residual effects occur	**Low Context** —sparsely populated region with relatively few service centres **Moderate Context** —a mix of sparsely populated areas along with more populated, urban centres **High Context** —densely populated area with several urban centres

12.1.6 Significance Definition

A significant adverse residual effect of the Project on community services and infrastructure occurs when there is an exceedance of available capacity, or a substantial decrease in the quality of a service provided, on a persistent and ongoing basis, which cannot be mitigated with current or anticipated programs, policies, or mitigation.

12.2 EXISTING CONDITIONS FOR COMMUNITY SERVICES AND INFRASTRUCTURE

This section provides an overview of existing conditions for the LAA and RAA with respect to community services (e.g., accommodations); health, emergency, and social services; and transportation.

12.2.1 Methods

Describing the baseline setting relies upon the collection of data from a variety of sources, including:

- government sources, such as:
  - publicly available service provider information from responsible agencies (e.g., regional health authorities)
- industry sources, including motel accommodation and service providers

- key respondent interviews (e.g., municipal representatives, health and emergency service providers, service providers)
- consultation and engagement activities carried out by Algonquin

12.2.2 Results

12.2.2.1 Community Services

The Town of Herbert is located 10 km north of the Project. Accommodations available include a motel and seasonal campground. The Lone Eagle Motel has 12 rooms. The campground provides 11 full-service and 4 unserviced sites, where reservations are required well in advance (Gossweiler 2017, pers. comm.). The Herbert Family Restaurant and Highway Inn Restaurant have a seating capacity of 60 and 50, respectively (Da 2017, pers. comm.; Suthar 2017, pers. comm.). The Country Hill Catering can accommodate 30 people on site or provides mobile catering services for up to 700 people (Wiebe 2017, pers. comm.). The Klassen's Deli and Country Cut Meats provides soup and sandwich options for lunch as well as meat for purchase. Herbert also has the Six Star Grocery store (Makow 2017, pers. comm.).

The Town of Morse is located 14 km northeast of the Project and has the Morse campground with 10 full service sites for accommodations (Knight 2017 pers. comm.; Morse 2017). In addition, the Morse Apartments are available for both short and long-term rental and have 5 apartments, with 1, 2 and 3 bedroom options (Knight 2017 pers. comm., Landsmen 2017, pers. comm.). The Elkhorn Bar & Diner offers a beer parlour and restaurant with maximum seating capacity of 100 people and an additional 80-person capacity with the banquet room. They will accommodate a large group for supper if given notice (Adamson 2017, pers. comm.; Morse 2017). Morse also has the Morse Grocery store (Knight 2017, pers. comm.; Morse 2017).

The Village of Hodgeville is located 14 km southeast of the Project and has the Hodgeville campground and Hodgeville Skool Inn & Hub for accommodations. The Hodgeville campground has approximately 10 sites including 3 electrical sites (Funk 2017, pers. comm.). The Hodgeville Skool Inn & Hub has 6 rooms and 4 suites (Hodgevillehub 2017). The Coyote Kitchen has capacity for up to 100 people and is the only restaurant in Hodgeville (Wakefield 2017, pers. comm.). There is also a Co-op gas station and convenience store (Funk 2017, pers. comm.).

Swift Current (located 35 km west of the closest proximity to the PDA) offers numerous accommodation and restaurant services.

12.2.2.2 Health, Emergency and Social Services

Health, emergency and social services are discussed in the context of the RAA because this is the scale over which these services are offered.

Emergency 911 services for the Town of Herbert will dispatch ambulance services from Swift Current (located 47 km southwest of the Town of Herbert) and patients will be taken to Swift Current depending on the required treatment (Cornelson 2017, pers. comm.). The Town of Morse has a medical clinic which is open every Wednesday afternoon (Knight 2017, pers. comm.).

Table 12-3 describes the hospitals and health care facilities, including services and staff available located within the RAA.

Table 12-3 Hospitals and Health Care Facilities in the Regional Assessment Area

Community	Hospital/Medical Clinics	Services Available	Staff
Morse	Morse Medical Clinic	• Clinic hours	• One family physician
Herbert	Herbert and District Integrated Health Facility	• 6 acute care beds; 36 long-term care beds • Emergency care, outpatient procedures, home care • Laboratory and X-ray • Mental health, addictions, child & youth counsellor • Speech language pathology, dietician, physiotherapy	• Facility includes over 110 staff including full, part-time and casual nursing, administrative and support staff. • One family physician.
Hodgeville	Hodgeville Health Centre	• Home care • Laboratory • Mental health, addictions, child & youth counsellor • dietician, physiotherapy	• One family physician, one nurse practitioner
Swift Current	Cypress Regional Hospital and Swift Current Clinics	• 91 acute care beds • Emergency department, internal and general medicine, intensive care • Radiology • Obstetrics and gynaecology, pediatrics • Pathology	• Family Physicians • General Surgeon • Obstetrics/Gynecology • Pediatrician • Psychiatrist • Urologist • Opthalmology • Internist • Radiologist • Anesthesiologist
SOURCES: Cypress Health Region (CHR) n.d.; Herbert n.d.; Schmidt 2017, pers. comm.			

The closest Royal Canadian Mounted Police (RCMP) detachment is located in the Town of Morse. Staffing levels in the detachment consist of 1 sargent and 4 constables (Doyle 2017, pers. comm.; Knight 2017, pers. comm.). The RCMP detachment in Morse patrols the RMs of Morse, Chaplin, Enfield and Lawtonia.

The Town of Herbert, Town of Morse and Village of Hodgeville all have volunteer fire departments. The Town of Herbert has 15 volunteer fire fighters and 7 Emergency Medical Responders or first responders. The town has an ambulance that can bring supplies to emergencies, but cannot transport patients. The Town of Herbert has two fire trucks, including one for grass fires (i.e., a truck with a down spout specifically useful for ground fires) and shares the jaws-of-life with the Town of Morse (Cornelson 2017, pers. comm.). The Village of Hodgeville has two trucks available including a grass fire truck. The Village of Hodgeville also has 5 first responders available in an emergency situations (Funk 2017, pers. comm.).

Social and community services in the RAA are provided through municipal departments, provincial and federal government offices, and not-for-profit organizations.In Saskatchewan, the Ministry of Social Services provides child and family services; income support programs for low-income families, seniors and people with disabilities; social assistance programs for people out of work; and housing programs and services to support families and people with disabilities (Government of Saskatchewan n.d.).

The RAA is also host to social support programs provided by the not-for-profit and public sectors. The programs include counseling, education and literacy programs, food banks, and programs for a variety of needs, including youth and persons with disabilities. Many of these services are located in relatively larger centers, such as Swift Current. There are also a number of informal social support networks providing informal care for aging parents, child care, parenting support, and other supports.

12.2.2.3 Transportation

In the PDA, there are a total of 4 collector roads (all-season gravel roads) and 10 resource roads (seasonal backroads). Based on observations during the 2017 field program, several of these roads under current conditions did not hold up well during rainfall events; generally, most were not safe to drive until they had a chance to dry out. During fieldwork completed for the Project, it was observed that collector road 612 (primary direction of travel north-south) and 720 (primary direction of travel east-west) are major all-season gravel road and were still safe to drive even during very wet conditions.

The primary highways in the LAA that will likely be used to access the PDA are identified in Table 12-4.

Table 12-4 Primary Highways in LAA

Primary Highway	Descriptor	Primary Direction of Travel	Communities in Proximity	2015 Average Annual Daily Traffic
Highway 1 (TransCanada)	Four-lane divided roadway Major arterial highway	East-West	Herbert and Morse	5040
Highway 19	Two-lane roadway Minor arterial highway	North-South	Morse and Hodgeville	340
SOURCE: Government of Saskatchewan 2015b.				

12.3 PROJECT INTERACTIONS WITH COMMUNITY SERVICES AND INFRASTRUCTURE

Table 12-5 identifies, for the potential effect, the physical activities that might interact with the VC and result in the identified environmental effect. These interactions are indicated by check mark and are discussed in detail in Section 12.4, in the context of effects pathways, standard and project-specific mitigation/enhancement, and residual effects.

Table 12-5 Project-Environment Interactions with Community Services and Infrastructure

Physical Activities	Environmental Effects Change in Community Services and Infrastructure
Construction	
Site preparation, including clearing and grading of WTG locations, access roads and temporary workspaces	✓
Installation of WTG foundations and turbine erection	✓
Installation of collector lines and substation	✓
Reclamation and site landscaping	✓
Operation and Maintenance	
Operation of WTGs and substation, including access road use	✓
WTG routine and unplanned maintenance	✓
Routine and unplanned maintenance of collector and substation infrastructure	✓

Table 12-5 Project-Environment Interactions with Community Services and Infrastructure

Physical Activities	Environmental Effects: Change in Community Services and Infrastructure
Decommissioning	
Equipment dismantling, access removal, collector and substation removal	✓
Site reclamation	✓
NOTES: ✓ = Potential interaction – = No interaction	

12.4 ASSESSMENT OF RESIDUAL ENVIRONMENTAL EFFECTS ON COMMUNITY SERVICES AND INFRASTRUCTURE

12.4.1 Analytical Assessment Techniques

The Project-related effects assessment for effects to community services and infrastructure involves inherent uncertainties associated with availability of information, data analyses, and interpretation of data and information. Uncertainties are addressed by taking a conservative approach to the assessment that errs on the side of the Project having a greater effect on community services and infrastructure. For example, it is assumed that work crews will stay locally or regionally and will use local goods and services when available.

The assessment relies upon a variety of quantitative and qualitative methods, including:

- determining the magnitude, nature, and duration of effects as a result of Project activities
- industry sources, including other environmental assessments
- interviews with representatives from appropriate regulatory agencies and other organizations, local businesses and service providers to supplement baseline information
- reviewing input received through ongoing consultations by Algonquin with potentially affected communities

The assessment relies upon Project data, including timing, construction and operating workforce estimates, and other sources identified in Section 12.2.1.

12.4.2 Change in Community Services and Infrastructure

12.4.2.1 Project Pathways

The construction workforce of approximately 45 to 90 FTEs will increase the demands on community services and infrastructure at a local and regional scale. The workforce will have needs for services provided by establishments such as hotel/motels, campgrounds, convenient stores, gas stations, restaurants, and grocery stores. Those businesses will benefit through increased revenue potential (see Section 11.0). There will also be potential for increased demands on services such as policing, health care and emergency (e.g., firefighting). For example, due to the increased potential for workforce injuries during construction.

The in-flux of temporary workers during construction is expected to put the biggest demand on temporary accommodations for the community services offered in the LAA and RAA. A variety of temporary accommodations (e.g., motels, campgrounds) are available in the LAA and RAA to house temporary workers, although some may require advance reservations in order to accommodate workers, as most establishments experience increased occupancy during summer months and on weekends during winter months. Construction workers typically do not relocate their families for short-term work; therefore, housing availability in the LAA should not be affected by this Project. As well, as the construction workforce is temporary, little or no demand is expected on local services such as education, and social services in the LAA.

The emergency response services in both the LAA and RAA would have the capability and capacity to handle the in-flux of temporary workers, given three communities within 15 km of the Project all have emergency response teams, including the RCMP detachment in the Town of Morse.

The roads in the LAA are mainly gravel or seasonal back roads that can have reduced access during winter months or during wet conditions. Where necessary, certain roads may need to be modified to accommodate increased traffic and the ability to withstand large loads. Road access may be interrupted during construction because of road crossings, work adjacent to roadways, or the upgrading of roads.

During operation and maintenance only approximately 7-15 FTEs employees are required. There will no longer be a demand on temporary accommodations. There will be a shift to more permanent accommodations, but given the operation employees makes up 0.5% of the LAA population (see Section 11.2.2.1), it is expected the LAA can accommodate the change. The need for emergency services will continue during operation and maintenance, but should be at reduced level as compared to construction.

The decommissioning phase of the Project will have a temporary workforce anticipated to be half that of the construction phase. Changes in demands on community services and infrastructure during decommissioning are anticipated to be less than those experienced in the LAA and RAA during construction.

12.4.2.2 Mitigation

The mitigation measures outlined below are recommended to address the potential effects of the Project on changes in community services and infrastructure.

- Coordinate with emergency response providers in the area to facilitate appropriate communications, understanding, and cooperation. The intent is to link company emergency plans to plans maintained by other affected parties.
- Develop and implement an ERP for the Project that meets Project needs. The plan will address field health services, emergency call-out procedures, and fire response plans, and other concerns.
- Employ personnel trained in first response or higher to provide emergency first aid onsite.
- Have vehicles suitable for the transport of injured workers onsite.
- Train construction management team site staff in standard first aid.
- Equip the construction site with first aid and/or basic medical facilities.
- Establish a construction safety program for the Project. All activities for the Project, including health, safety and environmental performance will meet applicable laws and regulations (e.g., The *Saskatchewan Employment Act* [Government of Saskatchewan 2016] and *The Occupational Health and Safety Regulations* [Government of Saskatchewan 1996]).
- Implement standard mitigation measures contained in the EPP and ERP, including a fire suppression contingency plan and spill contingency plan.
- Consult and coordinate with local authorities, service providers and businesses with respect to worker accommodation and to identify potential accommodation service gaps or issues.
- Encourage construction workers to make use of campground sites and recreational vehicles for accommodation.
- Maintain an open dialogue with municipalities during the Project to review road conditions and any Project-related traffic issues.
- Endeavour to schedule material deliveries outside peak commuting periods.

- General contractor to communicate with local authorities with regards to traffic management plans for Project construction and implement a Traffic Control Management Plan for the Project.
- Confirm the Project construction schedule and road crossing procedures with local authorities before construction activities.

Mitigation measures to address changes in community services and infrastructure are also outlined in Volume 1 of the EPP in Appendix C.

12.4.2.3 Project Residual Effect

12.4.2.3.1 Construction

As the Project is not expected to result in a permanent or large increase in population, the increased demand can be accommodated with some changes to existing community services and infrastructure within the LAA and RAA.

Locally the Towns of Herbert and Morse have a number of services, including accommodations, restaurants, gas stations, and grocery store, 10 km and 14 km from the Project, respectively. For more selection in services, Swift Current is only another 35 km from the Project.

At peak construction, the workforce will be approximately 45-90 FTEs, of which a proportion of workers will require accommodations. It is assumed a proportion of the workers could be hired locally. The maximum capacity for accommodations in the LAA (specifically the Towns of Herbert and Morse) is 17 rooms and 25 campsites. As such, the construction workforce will likely put a strain on accommodation services in the LAA and workers will look for accommodations outside the LAA. In the RAA, accommodation capacity is 10 rooms and 10 campsites (with the exception of Swift Current). The availability of accommodations greatly increases in larger centers such as Swift Current.

The local and regional emergency services have the capacity to address the increase in population and provide adequate services as needed during all phases of the Project. The area is 911 serviced and the closest emergency services are 10 km away at the Town of Herbert. In addition, Algonquin will maintain first aid facilities at Project construction sites to deal with minor injuries; serious injuries will be dealt with by health facilities in the RAA. The incremental demand placed on emergency and medical facilities in the RAA is expected to be low.

As part of the ERP, Algonquin and the contractor will work with local emergency response services to ensure appropriate emergency response times are maintained. In accordance with provincial regulations, the General Contractor will be required to maintain trained workers versed in fire suppression systems at construction sites. Incremental demand placed on local firefighting services is expected to be low.

Police services in the RAA are anticipated to have the capacity to handle demands created by the short-term presence of a relatively small number of workers. The Proponent will maintain a zero tolerance for drug or alcohol use on its construction sites. These measures will help to reduce the need for police services during Project construction.

The biggest change to transportation infrastructure will come during the construction phase, as this period will have the biggest influx of traffic and will likely need road upgrades or add additional road access. Given most roads in the PDA are not major roads, there may be a number of roads restricted while being upgraded to meet the demands of the traffic for the Project. Although, once road construction is complete, the upgrades may improve accessibility in the PDA.

After the application of standard mitigation measures, potential residual effects on community services and infrastructure during construction are characterized as follows:

- Direction is **adverse**
  - There will be an increase in demand on community services and infrastructure, but are expected to be manageable with some changes to the existing baseline conditions (e.g., road upgrades).
- Magnitude is **moderate**
  - The capacity of existing community services and infrastructure in the LAA and RAA will be able to accommodate the extra demand from the construction workforce. The temporary workforce will likely need to look outside of the LAA for accommodations. The roads in the PDA may need to be upgraded to meet the demands of increased and heavy traffic.
- Geographical extent is the **RAA**
  - Residual effect is restricted to the RAA, specifically the communities of Herbert, Morse, Hodgeville and Swift Current as they are expected to provide community services and infrastructure for the Project.
- Duration is **short-term**
  - The residual effect will occur through construction of the Project.
- Frequency is **continuous**
  - The residual effect will occur continuously throughout the construction period.
- The effect is **reversible**
  - Demand on community services and infrastructure will be reduced after construction, but will not return to baseline levels until after decommissioning.

- Ecological and socio-economic context is **moderate**
  - The RAA is a sparsely populated area with the Towns of Herbert and Morse and Village of Hodgeville being the smaller communities. Swift Current is a larger more urban centre also located in the RAA.

12.4.2.3.2 Operation and Maintenance

During operation and maintenance, approximately 7-15 FTEs will be employed full-time. This workforce will have a neutral effect on community services and infrastructure in the LAA and RAA.

The employees will be permanent, no longer putting demands on temporary accommodations. The demand put on services, including restaurant, grocery store and gas stations will be manageable given the size of the workforce during operation and maintenance.

Emergency and health services in the LAA and RAA will continue to provide support, but is expected to be within the parameters of pre-Project conditions given the smaller workforce during operation and maintenance. Algonquin's continued zero tolerance for drug or alcohol use will help to reduce the need for police services during Project operation and maintenance (see Section 11.0). During operation and maintenance, the demands on road infrastructure will be similar to the pre-Project conditions.

With the application of standard mitigation measures, there are no residual effects on community services and infrastructure during operation and maintenance, as the direction of effect is neutral.

12.4.2.3.3 Decommissioning

The decommissioning phase of the Project will have similar residual effects as during construction (see Section 12.4.2.3.1). Although, the decommissioning effects are expected to be less than during construction as the size of the workforce is approximately half.

After the application of standard mitigation measures, potential residual effects on community services and infrastructure during decommissioning are characterized as follows:

- Direction is **adverse**
  - There will be an increase in demand on community services and infrastructure, but are expected to be manageable with little change from operational conditions.

- Magnitude is **moderate**
  - The capacity of existing community services and infrastructure in the LAA and RAA will be able to accommodate the extra demand from the decommissioning workforce with a moderate level of change. The temporary workforce may need to look outside of the LAA for accommodations. The roads in the PDA may require increased maintenance as use of transportation infrastructure will increase from the operational phase, including an increase of heavy loads.
- Geographical extent is the **RAA**
  - The residual effect is restricted to the RAA, specifically the communities of Herbert, Morse, Hodgeville and Swift Current as they are expected to provide community services and infrastructure for the Project.
- Duration is **short-term**
  - The residual effect will be throughout decommissioning of the Project.
- Frequency is **continuous**
  - The residual effect will occur continuously throughout the decommissioning period.
- The effect is **reversible**
  - Demand on community services and infrastructure will be returned to baseline conditions after decommissioning.
- Ecological and socio-economic context is **moderate**
  - The RAA is a sparsely populated area with the Towns of Herbert and Morse and Village of Hodgeville being the smaller communities. Swift Current is a larger more urban centre also located in the RAA.

12.4.3 Summary of Project Residual Environmental Effects

Table 12-6 summarizes the residual environmental effects on community services and infrastructure.

Table 12-6 Project Residual Effects on Community Services and Infrastructure

Residual Effect	Residual Effects Characterization							
	Project Phase	Direction	Magnitude	Geographic Extent	Duration	Frequency	Reversibility	Ecological and Socio-economic Context
Change in community services and infrastructure	C	A	M	RAA	ST	C	R	M
Change in community services and infrastructure	O	N	N/A	N/A	N/A	N/A	N/A	N/A
Change in community services and infrastructure	D	A	M	RAA	ST	C	R	M

KEY

See Table 12-2 for detailed definitions

Project Phase
C: Construction
O: Operation and Maintenance
D: Decommissioning

Direction:
P: Positive
A: Adverse
N: Neutral

Magnitude:
N: Negligible
L: Low
M: Moderate
H: High

Geographic Extent:
PDA: Project Development Area
LAA: Local Assessment Area
RAA: Regional Assessment Area

Duration:
ST: Short-term;
MT: Medium-term
LT: Long-term

N/A: Not applicable

Frequency:
S: Single event
IR: Irregular event
R: Regular event
C: Continuous

Reversibility:
R: Reversible
I: Irreversible

Ecological/Socio-Economic Context:
L: Low
M: Moderate
H: High

12.5 ASSESSMENT OF CUMULATIVE ENVIRONMENTAL EFFECTS ON COMMUNITY SERVICES AND INFRASTRUCTURE

The project residual effects described in Section 12.4 are likely to interact cumulatively with residual environmental effects from other physical activities (past, present and reasonably foreseeable). The resulting cumulative environmental effects are assessed. This is followed by an analysis of the project contribution to cumulative effects. Future projects and activities that are reasonably foreseeable are defined as those that (a) have been publicly announced with a defined project execution period and with sufficient project details that allow for a meaningful assessment, (b) are currently undergoing an environmental assessment or (c) are in a permitting process.

The assessment of cumulative effects is initiated with a determination of whether two conditions exist:

- the Project has residual environmental effects on the VC and
- the residual effects could act cumulatively with residual effects of other past, present, or reasonably foreseeable future physical activities

If either is not met, the assessment of cumulative effects concludes with a statement that further assessment of cumulative effects is not warranted because the Project does not interact cumulatively with other projects or activities.

12.5.1 Project Residual Effects Likely to Interact Cumulatively

Table 4-4 in Section 4.0, Environmental Assessment Scope and Methodology, presents the project and physical activities inclusion list, which identifies other projects and physical activities that might act cumulatively with the Project. Where residual environmental effects from the Project act cumulatively with residual effects from other projects and physical activities (Table 12-7), a cumulative effects assessment is undertaken to determine their significance.

Environmental effects identified in Table 12-7 as not likely to interact cumulatively with residual effects of other projects and physical activities (no check mark) are not discussed further. The assessment of the cumulative environmental effects that are likely to result from the Project in combination with other projects and physical activities are discussed in subsequent sections.

Table 12-7 Interactions With the Potential to Contribute to Cumulative Effects

Other Projects and Physical Activities with Potential for Cumulative Environmental Effects	Environmental Effects
	Change in Community Services and Infrastructure
Past and Present Physical Activities and Resource Use	
Agricultural Conversion	✓
Oil and Gas Development	✓
Power Generation, Transmission, and Distribution	✓
Morse Wind Farm	✓
Recreational Activities	✓
Residential Development	✓
Resources Extraction Activities	✓
Road Development	✓
Project-Related Physical Activities	✓
Future Physical Activities	
Pasqua to Swift 230 kV Transmission Line Project	✓
SaskPower Blue Hill Interconnection Project	✓
NOTES: ✓ = Other projects and physical activities whose residual effects are likely to interact cumulatively with Project residual environmental effects. – = Interactions between the residual effects of other projects and residual effects of the Project are not expected.	

12.5.2 Change in Community Services and Infrastructure

12.5.2.1 Cumulative Effect Pathways

Reasonably foreseeable future projects and physical activities identified as having an interaction with the Project will create an additional burden on community services and infrastructure within the RAA. For example, should it occur, the simultaneous construction of the Pasqua to Swift Current Transmission Line and the Project, along with other potential activities listed in Table 12-7, will result in an additive need for and stress on community services and infrastructure. During decommissioning additive effects will also occur albeit at a lower level.

12.5.2.2 Mitigation for Cumulative Effects

No additional mitigation measures are proposed for Project contributions to address cumulative effects on change in community services and infrastructure. Given the geographic separation and each project's unique needs, coordinated mitigation efforts are unlikely (e.g., consolidate and share project staging areas for equipment). It is expected that future projects that require regulatory approval will be subject to their own similar mitigation through a separate regulatory process or commitment to best management practices.

12.5.2.3 Cumulative Effects

Cumulative effects are expected to be moderate as overlapping projects will potentially compete for access to community services and infrastructure. Most cumulative effects will occur during construction and to a lesser degree during decommissioning.

12.5.2.4 Summary of Cumulative Effects

Table 12-8 summarizes cumulative environmental effects on community services and infrastructure.

Table 12-8 Residual Cumulative Effects

Residual Cumulative Effect	Residual Cumulative Effects Characterization						
	Direction	Magnitude	Geographic Extent	Duration	Frequency	Reversibility	Ecological and Socio-economic Context
Residual Cumulative Community Service and Infrastructure							
Residual cumulative effect	A	M	RAA	ST	IR	R	D
Contribution from the Project to the residual cumulative effect	The Project will result in additional use of community services and infrastructure during construction and decommissioning.						

KEY

See Table 12-2 for detailed definitions

Direction:
P: Positive
A: Adverse
N: Neutral

Magnitude:
N: Negligible
L: Low
M: Moderate
H: High

Geographic Extent:
PDA: Project Development Area
LAA: Local Assessment Area
RAA: Regional Assessment Area

Duration:
ST: Short-term;
MT: Medium-term
LT: Long-term

N/A: Not applicable

Frequency:
S: Single event
IR: Irregular event
R: Regular event
C: Continuous

Reversibility:
R: Reversible
I: Irreversible

Ecological/Socio-Economic Context:
D: Disturbed
U: Undisturbed

12.6 DETERMINATION OF SIGNIFICANCE

12.6.1 Significance of Project Residual Effects

With the implementation of mitigation measures and given the context of the existing conditions, residual effects are not expected to exceed the capacity of community services and infrastructure or occur at a level where the quality of service provided will be decreased on a persistent and on-going basis.

With mitigation and environmental protection measures, the residual environmental effects on community services and infrastructure are predicted to be not significant.

12.6.2 Significance of Cumulative Effects

At a worst-case, there may be multiple projects undergoing construction at or near the same time within the RAA. However, the contribution of the Project in conjunction with the other proposed projects is not likely to lead to an exceedance of the capacity of community services and infrastructure or occur at a level where the quality of service provided will be decreased on a persistent and on-going basis.

With mitigation and environmental protection measures, the residual cumulative environmental effects on community services and infrastructure are predicted to be not significant.

12.6.2.1 Project Contribution to Cumulative Effects

Given the relatively small construction workforce size the Project is expected to have a minimal contribution to cumulative effects. The relative contribution of the Project to effects on community services and infrastructure is not expected to affect the viability or sustainability of the VC.

12.7 PREDICTION CONFIDENCE

Prediction confidence related to potential effects on community services and infrastructure is moderate. There is some uncertainty as to how environmental effects from other projects and activities will overlap temporally and spatially with those of the Project. However, given Algonquin's previous experience developing wind projects, including the construction of the Morse wind project, coupled with the relatively small size of the construction workforce, effects on community services and infrastructure should be manageable.

12.8 FOLLOW-UP AND MONITORING

No follow-up or monitoring is required due to the use of proven mitigation measures for developing a wind energy project.

13.0 EFFECTS OF THE ENVIRONMENT ON THE PROJECT

Effects of the environment on the Project refer to the forces of nature that could affect the Project physically or hamper the ability to carry out the Project activities in their normal, planned manner. A significant adverse effect of the environment on the Project is considered to be an effect that would result in the interruption in schedule or service, or irreparable damage to Project turbines or infrastructure (i.e., those that are not technically or economically feasible to implement).

13.1 INTERACTIONS OF THE ENVIRONMENT ON THE PROJECT

The environment has the potential to affect the Project during all phases, including construction, operation and maintenance, and decommissioning. Specific potential effects are identified for these Project phases, with a focus placed on construction and operation and maintenance. Effects of the environment on decommissioning activities are expected to be similar to the construction phase activities, but to a lesser degree due to the smaller footprint of activities, fewer overall activities and shorter duration. The spatial boundaries within which effects of the environment on the Project are assessed are limited to the PDA. Environmental conditions outside the PDA where there is no Project infrastructure are not anticipated to result in direct effects on the Project.

Potential effects of the environment that were identified for the Project include:

- Severe weather, specifically including:
  - Extreme temperatures
  - Extreme precipitation (i.e., rain, snow, sleet)
  - Severe storms and lightning
  - Extreme wind speeds
- Wildfires

To reduce or avoid the risk of damage to Project facilities and interruption of service from potential environmental effects, several design and planning tools will be applied to the Project, including:

- Detailed site selection to avoid the potential for effects to occur (e.g., areas that could be subject to flooding)
- Construction scheduling to avoid severe weather
- Site-specific design and construction measures

- Timing and maintenance of inspection activities
- Selection of project components and equipment that are suitable for Saskatchewan weather conditions

Details on the potential effect mechanisms by which the environment may affect the Project, mitigation measures, and residual effects of each effect of the environment identified above are discussed below.

13.2 ASSESSMENT OF SEVERE WEATHER ON THE PROJECT

Severe weather is considered in wind energy development because it can affect both construction and operation and maintenance. For the purposes of this assessment, severe weather includes extreme temperatures (both hot and cold), heavy precipitation and the potential for flooding, snow and ice storms, severe storms and lightning, and extreme winds.

Changes in climate can also increase the frequency and severity of extreme weather events, though climate change itself was not considered as an effect mechanism. The United Nations Framework Convention on Climate Change defines climate change as "a change of climate which can be attributed directly or indirectly to human activity that alters the composition of the global atmosphere, and which is in addition to natural climate variability observed over comparable time periods" (Government of Canada 2010).

According to the Intergovernmental Panel on Climate Change (IPCC), the average global temperature is expected to rise by 1.1–3.7ºC over the next century (IPCC 2014). In Canada, a warming trend of +1.4°C was identified over the period of 1948 to 2007 (Government of Canada 2010). The increases are predicted to differ depending on the region, with the highest increases expected in the northern regions and south-central Prairies and are projected to be accompanied by an increase in severe weather events (e.g., flood, drought and storms) and a rise in sea levels (Lemmen et al. 2008). The frequency of days with multiple tornadoes in the United States has increased between 1974 and 2015, and will likely continue with increasing climate change (Moore 2017).

13.2.1 Potential Effects of Severe Weather on the Project

Potential effects of climate change on construction and operation and maintenance of the Project would be related to increases in the frequency of severe weather events, changes in temperature and changes in precipitation. It is anticipated that increases in extreme weather events could potentially affect the Project through damage to infrastructure (and a corresponding increase in unexpected maintenance due to storm damage) and interruptions to the regular operation and maintenance of WTGs. Any work interruption or infrastructure damage could have socioeconomic effects in terms of temporary reduction of revenue and employment. Changes in temperature could affect the freeze/thaw cycle possibly causing interruptions to regularly scheduled maintenance activities and potentially affecting WTG operation.

Severe weather is normally short-term and may cause the temporary suspension of specific activities until weather conditions abate. The effects of severe weather can generally be mitigated through adjustments to the timing of construction activities and operation of the facility.

13.2.1.1 Extreme Temperatures

Saskatchewan has variable climates and may experience extremely hot or extremely cold temperatures and may be influenced over time by climate change. Temperature records for the Canadian Prairies indicate increases in annual mean temperatures since the 1970s and projections indicate temperatures will continue to increase over time (Sauchyn and Kulshreshtha 2008). Southern Saskatchewan temperatures have increased by approximately 2°C between 1948 and 2012 (ECCC 2015). In addition, climate change models predict that short-term variability will be amplified, increasing the probability of large departures from normal conditions (Sauchyn and Kulshreshtha 2008).

During construction, activities will be halted if extreme temperatures result in safety concerns. Delays are expected to be of short duration. Extreme high temperatures will also increase the risk of wildfires (see Section 13.3). Extreme hot or cold temperatures are unlikely to negatively impact the WTGs or operation and maintenance of collector and substation infrastructure. No residual effects due to extreme temperatures on the Project are anticipated.

13.2.1.2 Extreme Precipitation Events

Saskatchewan experiences highly variable annual precipitation but generally has dry winters and summers, with slightly more precipitation in summer (EC 1990). While Saskatchewan is the driest province in Canada, its climate is characterized by precipitation that is irregular and unreliable over space and time (EC 1990). Incoming low-pressure disturbances can produce extreme moisture and wind events. Most of these storms are short lived but intense storms may produce enough precipitation to cause flooding and erosion. Warm spring conditions can cause fast snowmelt and run off which may also lead to flooding. Extreme precipitation events are expected to increase in frequency, duration, and magnitude because of climate change (IPCC 2007); this increasing trend in extreme precipitation events has been documented globally (Lehmann et al. 2015).

During above-freezing temperatures, extreme precipitation events and flooding could impact construction activities. Depending on the timing, location, type and magnitude of the precipitation, increased surface runoff could cause erosion and subsequent environmental effects on native vegetation and wildlife habitat.

Extreme precipitation events may affect construction activities requiring the use of heavy equipment such as road construction, installation of sub-surface collector lines and installation of WTG foundations through work interruptions causing schedule delays. Depending on the severity of the events, operational maintenance schedules may be affected.

During winter, warm weather and low-pressure systems interacting with cold Arctic air can cause extreme snowfall events and ice storms. Extreme snow events are characterized by intense cold, strong winds, and reduced visibility. Extreme snow events are most likely to occur during January and can occur between October and March, based on historical trends (EC 1990). These peak months may coincide with the main period of construction.

Ice buildup can occur when a specific condition of temperature and humidity exist and is highly dependent on local weather conditions (e.g., melting snow, air temperatures below 0°C, high humidity in the air). In Saskatchewan, this condition is most likely to occur during the winter months and during extreme weather events (e.g., ice storms, freezing rain). These conditions can cause WTGs to be subject to ice coating from freezing rain or interception of low clouds containing super-cooled rain. The WTG design being proposed for this Project have a solid conical tower design reducing the potential for ice buildup on the tower itself as there is no lattice or crevices where ice can accumulate.

Construction could be halted during an extreme snow event or ice storm if safety becomes a concern. During operation and maintenance, extreme snow events and ice storms could slow or delay maintenance activities. Controls exist for the WTGs such that they will shut down if excessive ice builds up. Extreme snow events and ice storms might also affect access to facilities during operation and maintenance.

In years of heavy snowfall accumulation, rapid warming during the spring thaw period may also cause flooding and erosion that could halt construction activities or affect turbines and infrastructure during operation and maintenance.

13.2.1.3 Severe Storms and Lightning

Severe storms, including severe thunderstorms, hail storms, and tornadoes, have the potential to adversely affect WTGs. These types of storms are not uncommon in Saskatchewan as evidenced by the 17 confirmed tornados in 2013 (CBC News – Saskatchewan 2014). Southern Saskatchewan has the highest predicted tornado occurrences in Canada (Cheng et al. 2013). Severe thunderstorms and hailstorms occur more frequently than tornadoes (SaskAdapt 2014). The incidence of severe storms including tornados is increasing (Moore 2017).

In western Canada, tornado frequencies increase with positive mean monthly temperature anomalies (Cheng et al. 2013). Therefore, under predicted climate change scenarios, it is reasonable to assume more tornadoes will occur (Etkin 1995). Tornadoes may cause damage to equipment but the risk is considered low. Delays, if they occur, are likely to be of short duration.

The Project will have specific emergency response, evacuation, and power outage contingency plans in place during construction and operation and maintenance to address tornadoes. Backup power generation will be available during operation and maintenance in the event of a power outage.

Lightning, often a part of severe thunderstorms, are a concern as lightning strikes on power supply systems can produce dangerous over-voltages and damage equipment. There is evidence that WTGs are vulnerable to lightning (Rodrigues et al. 2011). Severe storms and lightning have the potential to cause short delays during construction or operation and maintenance because of safety concerns and lightning has the potential to cause damage to infrastructure. To reduce the risk of damage from lightning strikes, WTGs will be equipped with lightning protection equipment and collector and substation facilities will be grounded according to provincial and national building codes. No residual effects due to severe storms and lightning on the Project are anticipated.

13.2.1.4 Extreme Wind Speeds

Extremely high wind speeds are occasionally experienced with severe weather events during unstable atmospheric pressure systems. May has the greatest average wind speed in Saskatchewan (EC 1990). High winds could result in the suspension of some construction activities (e.g., erection of towers and installation of nacelles, rotors and blades) or interruptions in the operation of WTGs resulting in short-term loss of energy generation capacity. Also, high winds could cause erosion leading to soil loss and lack of vegetation re-colonization. Delays, if they occur, are likely to be of short duration as the anticipated operational plans of the Project are based on site-specific long-term wind data and modeling that accounts for this variability.

13.2.2 Mitigation Measures for Severe Weather

Potential delays due to severe weather during construction and operation and maintenance are expected to be of short duration.

Approaches to help mitigate potential effects of the environment on the Project have been considered during Project development. In addition to design, installation, operation and maintenance according to applicable industry standards/certifications, several mitigations have been included to address the potential effects from extreme weather events. These measures include:

- Incorporating reasonable weather delays into construction schedule planning.
- Temporary work shutdowns.
- Contingency plans for severe weather effects.
- Additional personal protective equipment to protect workers.
- Adjusting construction schedule, if necessary.

- Reschedule maintenance and monitoring activities.
- Contingency plans for power outages (e.g., backup power generation).
- Specific emergency response and evacuation plan in case of tornado.
- Fire evacuation plan and control measures in case of lightning strikes.
- WTGs equipped with lightning protection systems and other infrastructure grounded according to building codes.
- Components of WTGs constructed of materials able to withstand damage from hail.
- WTGs designed to automatically shut down when ice load on the blades exceed predetermined thresholds.
- WTG blades designed to stop moving at wind speeds greater than 22.5 m/s.
- WTGs designed to withstand gusts up to 59 m/s.
- Structures designed to meet earthquake loads as per the Saskatchewan Building Code.

Mitigation measures are also outlined in Volumes 1 and 3 of the EPP in Appendix C.

13.2.3 Characterization of Residual Effects of Severe Weather on the Project

Due to the low frequency of extreme weather interacting with the Project that would lead to an interruption in schedule or service, or irreparable damage to Project turbines or infrastructure, and planned mitigation measures, no residual effects due to severe weather on the Project are anticipated.

13.3 ASSESSMENT OF WILDFIRES ON THE PROJECT

13.3.1 Potential Effects of Wildfires on the Project

There is potential for wildfires to interrupt construction and operation and maintenance. The severity of the effects associated with a fire depends greatly on the location and size of the event. Climate models indicate increases in areas burned in Canada during the last forty years as a result of climate change (Gillett et al. 2004). Temperature appears to be the most important predictor of area burned in Canada. Warmer temperatures are associated with increased burn area (Flannigan et al. 2005). Predicted increases in temperature and extreme weather events, such as lightning storms, due to climate change can be expected to increase the area affected by wildfire, lengthen fire seasons, and increase wildfire severity (Flannigan and Van Wagner 1991).

Wildfires, a common occurrence on prairie landscapes of southern Saskatchewan, have decreased over the years due to fire suppression in response to development. However, an increase in extreme temperature will result in an increased potential for wildfires (see Section 14.5

for a discussion on potential accidents and malfunctions related to vehicle and equipment use on native prairie during dry periods and extreme heat).

As the landscape of southern Saskatchewan is dominated by agricultural development, wildfires are often extinguished as quickly as possible to prevent property damage. Wildfires are also less frequent in agricultural land (e.g., cropland) than in grassland cover types. With the Project turbine and infrastructure sited primarily in cropland, the potential for wildfires to interact with the Project is very low.

While unlikely, a wildfire has the potential to affect construction or operation and maintenance. Construction activities may be temporarily suspended in the event of a wildfire. During operation and maintenance, wildfires may damage infrastructure and interrupt maintenance activities due to safety concerns. Any work interruption or infrastructure damage could have socioeconomic effects in terms of temporary reduction of revenue and employment. Wildfires could also have environmental effects on the biophysical environment through temporary loss of native vegetation and wildlife habitat. The Project will have emergency response procedures and a fire contingency plan in place during construction and operation and maintenance to address wildfires. Therefore, no residual effects due to wildfires on the Project are anticipated.

13.3.2 Mitigation Measures for Wildfires

Fire prevention, preparedness and response procedures will be developed and included in the ERP generated for the construction phase of the Project. Planned mitigation measures include:

- Implementing an ERP, including coordination with local first responders and provincial wildfire management agencies.
- Scheduling of activities to account for possible disruptions due to wildfires.
- Use and adherence to appropriate fire response protocols appropriate maintenance activities.
- Employ temporary work shutdowns, as required.

Mitigation measures are also outlined in Volumes 1 and 3 of the EPP in Appendix C.

13.3.3 Characterization of Residual Effects of Wildfires on the Project

Due to the small proportion of the Project occurring in natural land cover types (18 ha; less than 1% of natural land cover types in the RAA, and low probability of uncontrolled wildfire across the landscape, no residual effects of wildfire on the Project are anticipated.

13.4 SUMMARY RESIDUAL EFFECTS OF THE ENVIRONMENT ON THE PROJECT

Severe weather and wildfires have the potential to adversely affect the Project. Potential effects of the environment on the Project are anticipated to be mitigated or managed through measures identified above. These measures including environmental management, contingency planning, emergency response plans, and/or health and safety plans. Therefore, no residual effects of the environment on the Project are anticipated.

13.5 DETERMINATION OF SIGNIFICANCE FOR EFFECTS OF THE ENVIRONMENT ON THE PROJECT

A significant adverse effect of the environment on the Project is one that may cause interruption in schedule or service, or irreparably damage turbines or infrastructure. The Project will be designed, constructed, operated, and maintained relative to applicable regulations, codes and standards. A component of these standards will include regular inspection during the construction and operation and maintenance of the Project. Based on a consideration of the mitigation strategies outlined above, past project experience, and application of best management practices, no residual effects are expected; therefore, effects of the environment on the Project are not expected to be significant.

14.0 ACCIDENTS AND MALFUNCTIONS

The primary focus of this assessment is to provide a qualitative evaluation of potential effects on the environment attributable to accidents, malfunctions, and unplanned events that might occur during any phase of the Project. The assessment of accidents, malfunctions and unplanned events focuses on potential events that have a reasonable likelihood of occurring during the lifetime of the Project, or for those that could result in significant environmental effects even if their likelihood of occurrence is low. Based on this description and professional judgment, the following types of events were selected for consideration, namely:

- accidental spill of hazardous material
- ice throw
- WTG equipment failure
- fire
- vehicle accident

A conservative approach (i.e., one that overestimates risk) to potential accidents and malfunctions was used to avoid underestimating potential effects pathways. The consideration of accidents and malfunctions is provided as a framework to allow the preparation of ERPs.

The possible interactions between accidents and malfunctions and potential effects on valued components assessed in this EA are identified in Table 14-1.

Table 14-1 Potential Interactions Between Accidents, Malfunctions and Valued Components

Accidents and Malfunctions	Vegetation and Wetlands	Wildlife and Wildlife Habitat	Heritage Resources	Land and Resource Use	Community Service and Infrastructure
Accidental Spill of Hazardous Material	✓	✓	✓	✓	✓
Ice Throw					✓
WTG Equipment Failure				✓	✓
Fire	✓	✓	✓	✓	✓
Vehicle Accidents		✓			✓

14.1 ACCIDENTAL SPILLS OF HAZARDOUS MATERIAL

14.1.1 Potential Effects

The operation and maintenance of vehicles, heavy machinery and hand tools during construction and the maintenance of WTG components during operation and maintenance as well as decommissioning will require hazardous liquid materials, including:

- fuels (e.g., gasoline, diesel, and propane)
- lubricants (e.g., engine oil, transmission or drive train oil, hydraulic oil, gear oil, and lubricating
- grease)
- coolants (e.g., ethylene glycol)

Small spills (less than a few litres) of petroleum lubricants or fuels have the potential to occur during construction through refueling, leaks from machinery, or breaks in piping. These spills are typically localized and readily cleaned up by onsite crews using standard spill kit clean up equipment and materials. Larger spills could result from a vehicle accident that ruptures a fuel tank or transfer operations.

Liquids pose the greatest threat to the environment because of their ability to flow into porous material, such as soils, or flow into aquatic environments if not properly contained. Some liquids (e.g., lubricating oil) contain components that are toxic to vegetation, aquatic biota, and wildlife. Some of these materials are readily flammable or explosive. Antifreeze (e.g., ethylene glycol) is toxic to wildlife. A spill has the potential to affect agricultural activities, plants, vegetation communities, riparian habitat, wetland function, and wildlife and wildlife habitat. Further damage to soils, vegetation and wildlife habitat could occur during spill cleanup and reclamation. Spills can also affect land use if areas are temporarily off limits because of cleanup activities. Spills can also affect heritage resources if cleanup requires soil disturbance and physical activities.

The chemical and waste management plans in the EPP will outline spill prevention measures for all employees and contractors. The plan will provide direction for environmentally responsible handling, storage, and disposal of chemicals and wastes. Implementation of this plan will reduce the likelihood of spills into the environment, and reduce or avoid environmental effects to valued components.

In the unlikely event of a spill, measures outlined in the spill contingency plan in the EPP and ERP will be implemented to provide a rapid and coordinated response to the spill, thereby reducing effects to the environment. The spill contingency plan will contain steps for initial response, general spill containment procedures, and procedures for spills from vehicles, spills next to or into a watercourse or water body, and spot spills. The spill contingency plan will also include a spill scene checklist and regulatory reporting contacts.

14.1.2 Mitigation Measures

The EPP and ERP will identify protection and emergency response measures (including a spill contingency plan) to use if there is a spill of hazardous materials (see Volumes 1 and 3 of the EPP in Appendix C). Additional mitigation measures available to reduce potential effects from accidental spills of a hazardous material include:

- At all times, the General Contractor will be required to have materials available at the construction sites to contain and recover fuel spills (in accordance with *The Environmental Management and Protection Act* [Government of Saskatchewan 2010a) and abide by the *Occupational Health and Safety Regulations* (Government of Saskatchewan 1996).
- Chemicals stored at the O&M building will be held in on-site cabinets, tanks or drums equipped with secondary containment basins or vessels, to contain drips or small spills, and thereby prevent runoff of contaminants from the storage area in accordance with appropriate regulations (e.g., *Environmental Management and Protection Act, 2010* [Government of Saskatchewan 2010a]).
- Following all WTG maintenance work, the work area will be cleaned and all surplus lubricant- and grease-soaked rags will be removed and disposed of in a prescribed manner at a designated disposal facility. The spill contingency plan will be designed according to the EPP to ensure a safe operating environment and minimize the risk of fire. All transportation, handling and disposal of dangerous goods or hazardous wastes will be in accordance with the appropriate regulations (e.g., *The Dangerous Goods Transportation Act* [Government of Saskatchewan 1985]).
- Project staff with waste management and hazardous materials responsibilities will be educated according to regulatory requirements specific to the Project.
- Before construction kick-off, the contractor will be responsible for providing all spill response equipment and materials onsite or readily available.
- Personnel who will be handling waste materials will possess valid workplace hazardous materials information system training. All fuel truck drivers—and drivers transporting waste or chemicals—will have Transportation of Dangerous Goods certification. Procedures for safe loading and unloading of products will be followed.
- Hazardous materials and industrial wastes will be stored at least 100 m from a wetland, watercourse or water body.

14.2 ICE THROW

14.2.1 Potential Effects

Ice buildup on the WTG blades can occur during the winter months and during specific weather conditions (e.g., freezing rain) and can occur whether WTG blades are in motion or stationary.

Ice throw from a moving turbine rotor has the potential to affect a larger area. Garrad Hassan Canada (2007) estimated that only very high winds may cause ice fragments of any significant mass to be blown beyond 50 m of the base of a modern, stationary 2 MW WTG. Larger WTGs may throw ice proportionally further. Ice fragments that detach from the rotor blades would land in the plane of the wind turbine rotor or downwind. Throwing distance and flight trajectory of the ice fragments varies depending upon the rotor azimuth, rotor speed, local radius, and wind speed.

In terms of ice fall and throw it is important to note that the reality of ice buildup is likely limited to a few days per year. Morgan et al. (1998) noted that there has been no reported injury from ice thrown from WTGs, despite the installation of more than 6,000 MW of wind energy worldwide at the time of that study.

14.2.2 Mitigation Measures

Several mitigation measures are available to reduce potential effects from ice fall and shed. These include:

- Planned setbacks of WTGs from homes, property lines and ROWs will limit safety concerns.
- The WTGs proposed for this Project have a smooth conical tower design reducing the potential for ice buildup on the tower itself as there is no lattice or crevices where ice can accumulate.
- The performance of WTGs is monitored in real-time. Any discrepancies with respect to measured wind speed and WTG performance (e.g., as a result of ice buildup) are alerted to facility operators, which may trigger a visual inspection of the WTG. In addition, when the rotor becomes unbalanced due to a change in blade weighting (e.g., caused by ice buildup), the WTG brake is automatically applied to stop the blades from turning. Blades do not restart until the imbalance is removed (e.g., removal of the majority of ice). This design feature greatly reduces the potential for ice shed from WTGs on the few days per year when ice buildup may happen.
- Established protocols and procedures exist to educate operational staff of these circumstances and provide information regarding appropriate actions to follow when weather conditions are such that ice buildup could occur on WTG blades.
- During periods of significant icing, landowners will be informed of the potential for ice fall and shed.

14.3 WTG EQUIPMENT FAILURE

14.3.1 Potential Effects

Although unlikely, the potential exists for full or partial blade failure from a WTG, resulting in potential damage to the area where the detached blade material lands. In order to determine the potential for effects associated with general blade failure of WTGs, Garrad Hassan Canada undertook a review of publicly-available literature on wind turbine rotor failures resulting in full or partial blade failure (Garrad Hassan Canada Inc. 2007). Such events were found to be rare; therefore, data describing these events are limited.

The review confirmed that root causes of blade failure have been continuously addressed through developments in best practice in design, testing, manufacture, and operation; much of these developments have been captured in the International Electrotechnical Commission ("IEC") standards, to which all current large WTGs comply (Garrad Hassan Canada Inc. 2007), including those of the Project.

Wind turbine control systems are subjected to rigorous specification in the design standards for WTGs (IEC 61400-1) and exhaustive analysis in the certification process. WTGs with industry certification must have a safety system completely independent of the normal operational control system. In the event of a failure of one system, the other is designed to control the rotor speed.

Lightning protection systems for WTGs have developed significantly over the past decade and best practices have been incorporated into the industry standards to which all modern WTGs must comply. This has also led to a significant reduction in events where lightning causes structural damage.

Even in the rare event of a blade failure in modern WTGs, it is much more likely that the damaged blade would remain attached to the tower rather than separating (Garrad Hassan Canada Inc. 2007). Reviews of available information did not find any recorded evidence of injury to the public as a result of turbine blade or structural failure (Garrad Hassan Canada Inc. 2007; Chatham-Kent Public Health Unit 2008).

Given that accidents or malfunctions of WTGs are considered to be infrequent events, current design standards greatly assist in minimizing such potential, and that the event of structural failure would not extend beyond the setback distance, therefore the probability of WTG equipment failure is unlikely.

14.3.2 Mitigation Measures

Several mitigation measures reduce potential effects from WTG structural failure. These include:

- Planned setbacks of WTGs to homes, property lines and ROWs
- Design, install, operate, and maintain WTGs according to applicable industry standards/certifications
- WTG inspection and maintenance to identify structural faults
- Use of lightning protection systems
- Training and education of staff operating the control system
- Familiarizing local municipal emergency response staff with Project facilities
- Built-in control systems in WTGs to recognize high winds and control WTGs appropriately to reduce risk of damage

14.4 FIRE

14.4.1 Potential Effects

During construction or operation and maintenance there is a potential for fire to occur as a result of hot exhaust from vehicles or equipment over very dry prairie, or improper handling of flammable materials.

WTGs, transformers and other equipment utilized in the Project are designed to function reliably for the lifespan of the Project. As with any mechanical and electrical device, there is however a small potential for malfunctions to cause heating or sparking in sufficient quantity to ignite flammable materials, such as fiberglass or cable housing.

Project components are designed to reduce or avoid the risk of fires. Protection and control systems are engineered to include fire prevention and protection systems, including fuses and circuit-breakers, which are capable of detecting faults and promptly disconnecting defective parts or individual electrical equipment such as transformers, cables, and generators. These systems, along with fire detection equipment, also integrate with the facility's operating system such that a controlled and orderly shutdown of affected equipment will occur.

14.4.2 Mitigation Measures

Several mitigation measures are available to reduce potential effects from fires. These include:

- Modify working in specific areas during hot, dry weather conditions.
- Maintain and check vehicles.
- Implement fire prevention plan when operating vehicles in native prairie.
- Implement safe work practices and handling protocols for flammable materials.
- Maintenance of construction equipment and provision of fire response protocols.
- Design, install, operate, and maintain WTGs according to applicable industry standards/certifications.
- Use of fire prevention, detection and protection systems.
- Familiarizing local municipal emergency response staff with Project facilities.

Mitigation measures are also outlined in Volumes 1 and 3 of the EPP in Appendix C.

14.5 VEHICLE ACCIDENTS

14.5.1 Potential Effects

Vehicle accidents can result in serious injury or death to humans and wildlife, as well as damage to property. Frequency of vehicle traffic will be higher during construction relative to operations, when workers or equipment/supplies are in transit especially during hours of low visibility or high wildlife activity. During all phases of the Project, the likelihood of a vehicle accident is however expected to be low.

Wildlife mortality related to vehicle collisions is discussed in more detail in the wildlife and wildlife habitat assessment (see Section 8.0).

14.5.2 Mitigation Measures

Mitigation to reduce the risk of collisions will include:

- Reduce Project-related traffic during construction.
- Implement speed limits for specific areas of concern.
- Project-related vehicles will follow traffic, road-use, and safety laws.

Mitigation measures are also outlined in Volumes 1 and 3 of the EPP in Appendix C.

14.6 SUMMARY OF ACCIDENTS AND MALFUNCTIONS

Accidents and malfunctions during the life of the Project are anticipated to be infrequent and spatially limited relative to the Project area. Following the implementation of mitigation measures, the residual effects from a scenario would be adverse, low in magnitude, localized in extent, of short duration and reversible in nature.

Proper on-site protocols, and the development and implementation of environmental protection and emergency response measures, as outlined in the EPP and ERP respectively, will ensure potential effects from accidents and malfunctions are avoided or limited. Taking this into consideration, potential residual effects from accidents or malfunctions during construction and operation and maintenance are not considered significant.

15.0 SUMMARY AND CONCLUSION

15.1 SUMMARY

The purpose of this document is to fulfill the regulatory requirements for the Project as set out under Saskatchewan's *Environmental Assessment Act*. Specifically, this EIS has been prepared to comply with the TOR prepared by Algonquin in accordance with the SKMOE's *Guidelines for the Preparation of the Terms of Reference* (SKMOE 2014a) and approved by the SKMOE on March 28, 2017.

A summary of key findings and conclusions is presented below:

Project Development and Siting

- Using an iterative approach to development and siting has resulted in the Project being located in an agriculturally-dominated landscape; i.e., 83% of the PDA consists of previously disturbed land, such as cultivated or hayland.
- Based on the current layout, all but 0.6 ha of native grassland have been avoided. The Project components that intersect with native prairie consist of temporary workspaces, and collector line and access road ROWs that follow municipal road allowances. The calculated overlap is partly due to the coarseness of the land cover data; in reality, Project components will be sited to avoid native prairie where feasible, effectively reducing the 0.6 ha as close to zero as possible.
- The Project is in compliance with SKMOE's *Wildlife Siting Guidelines for Saskatchewan Wind Energy Projects* [SKMOE 2017a] and the nearest turbine is approximately 7 km from the Reed Lake IBA.
- The Project is sited away from natural features that could funnel wildlife movement toward the Project (i.e., no measurably influencing topographic, habitat or other landscape features are present).
- Sensitive environmental features (e.g., sharp-tailed grouse leks and rare plants) were detected within the Project area and the layout was progressively refined to take into account the location of these features and their activity restriction setbacks (SKMOE 2017b). As a result, in the majority of cases, the Project is in compliance with *Saskatchewan Activity Restriction Guidelines for Sensitive Species* (SKMOE 2017b), with the following exceptions that will be further mitigated through detailed construction planning:
  - There is one lek in SW-04-16-09-W3M whose 400 m setback overlaps with the edge of a temporary workspace; however, during construction, the siting of the temporary workspace will be adjusted as much as possible to be outside of the activity restriction setback.

- There are two leks (SE-06-16-09-W3M and SW-16-15-08-W3M) whose 400 m setbacks overlap collector lines along existing municipal roads; construction activities at these locations will occur outside of the activity restriction period (March 15 to May 15) and be confined to the existing road ROW.
- There is a Class IV wetland identified during field surveys (NE-13-15-09-W3M) as a northern leopard frog breeding pond. A 500 m activity restriction setback is applied to this feature and overlaps the edge of a temporary workspace; however, during construction, the siting of the temporary workspace will be adjusted, as much as possible, to be outside of the activity restriction setback.

Effects on SAR and SOMC

- With mitigation, there will be minimal to no potential effect on listed species due to direct habitat loss or indirect habitat loss during construction.
- With mitigation, there will be minimal to no potential effect on listed species due to Project operation.

Bird and Bat Occurrence and Movement Based on Project Field Data

- Nocturnal movement surveys using radar indicate that proportions of birds moving within the rotor swept area was similar among Project and control sites. Results also indicate that the Project area had movement rates approximately half of those at the Reed Lake control site (i.e., outside the Project area), and lower than at the control site north of the Centennial WEP.
- Spring diurnal bird movement surveys indicate that the Project area has similar movement rates to the terrestrial control site located north of the Centennial WEP, and an order of magnitude lower movement rates than at the Reed Lake control site. Fall diurnal bird movement surveys indicate similar results to those from the spring when large flocks of snow geese were not included in analyses. These results were slightly higher in the Project area than the control site north of the Centennial WEP, but lower than the Reed Lake control site. As such, collision risk during the day would likely be similar to the Centennial WEP, which is below average for Saskatchewan projects.
- There is no clear dominant bird movement corridor through the Project area based on diurnal and radar bird movement surveys.
- Bat activity rates from acoustic surveys were generally low, with no migratory bat passes detected at the elevated detector in the spring, and an overall average of 0.1 migratory bat passes per detector night for the spring. There were 1.0 migratory bat passes per detector night overall during the August 1 to September 10 period, which is at the low-moderate threshold for migratory bat fatality risk according to AEP (ESRD 2013b).
- The increased mortality risk is not expected to affect population abundance of migratory species.

Comparative Research from Literature and other Wind Projects

- Using peer-reviewed literature and available monitoring reports for other nearby wind facilities (i.e., Centennial and Morse wind developments) helps to put findings from the Project into better context. Evidence from literature suggests that the proposed landscape in which the Project occurs is not indicative of elevated mortality risk. Information from other approved projects suggests the Project is at a comparable level of mortality risk.

Mitigation Commitments

- Include use of Project-specific construction mitigation to limit the size of the Project footprint and effects on native vegetation and wildlife habitats.
- Use of buffers from key wildlife and rare plant features as per the *Saskatchewan Activity Restriction Guidelines for Sensitive Species* (SKMOE 2017b), except for the instances described above.
- Commitment to a robust monitoring and adaptive management program following SKMOE's draft Adaptive Management Guidelines (SKMOE 2017c).

15.2 CONCLUSION

The EIS has incorporated a robust methodology to scope potential effects and their pathways, acquire appropriate data (both field and desktop), analyze data, and discuss the expected levels of residual effects subsequent to implementation of mitigation. Using this process, the EIS concluded that Project-related residual effects on all VCs (acoustic environment, heritage resources, land and resource use, community services and infrastructure, vegetation and wetlands, and wildlife and wildlife habitat) resulted in residual and cumulative effects that are not significant. Cumulative residual effects of past and current activities on vegetation and wetlands and wildlife and wildlife habitat within the RAA were already significant and, with the Project, will continue to be significant.

In summary, the Project is expected to have residual effects that are manageable and allow for the appropriate development of the Project to help meet SaskPower's goal of increased levels of renewable energy in the province of Saskatchewan.

16.0 CLOSURE

This report has been prepared by Stantec Consulting Ltd. (Stantec) for the sole benefit of Algonquin Power Co. The report may not be relied upon by any other person or entity, other than for its intended purposes, without the express written consent of Stantec and the Proponent.

This report was undertaken exclusively for the purpose and limited to the scope expressed herein. This report cannot be used or applied under any circumstances to another location or situation or for any other purpose without further evaluation of the data and related limitations. Any use of this report by a third party, or any reliance on decisions made based upon it, are the responsibility of such third parties. Stantec accepts no responsibility for damages, if any, suffered by any third party as a result of decisions made or actions taken based on this report.

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The information provided in this report was compiled from existing documents, data collected during field studies carried out in support of the EIS, and data provided by the Proponent. This report represents the best professional judgment of Stantec personnel available at the time of its preparation. Stantec reserves the right to modify the contents of this report, in whole or in part, to reflect any new information that becomes available. If any conditions become apparent that differ significantly from our understanding of conditions as presented in this report, we request that we be notified immediately to reassess the conclusions provided herein.

Respectfully Submitted,

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APPENDIX A
CONCORDANCE TABLE

Appendix A CONCORDANCE TABLE

Table A-1 Concordance Between the Terms of Reference and Environmental Impact Statement

Terms of Reference	Environmental Impact Statement Section
1.0 INTRODUCTION	1.0 – Introduction
2.0 PROJECT OVERVIEW	2.0 – Project Description
2.1 Project Description	2.0 – Project Description
2.2 Project Boundaries	4.2.2 – Identification of Assessment Boundaries
2.2.1 Spatial Boundaries	4.4.4.1 – Spatial Boundaries
2.2.2 Temporal Boundaries	4.4.4.2 – Temporal Boundaries
2.3 Project Alternatives	2.3 – Project Alternatives
2.4 Ancillary Project	2.9 – Ancillary Projects
2.5 Regulatory Requirements	1.3 – Regulatory Framework
3.0 INDIGENOUS, PUBLIC AND REGULATORY ENGAGMENT	3.0 – Engagement; Appendix D – Engagement
3.1 Overall Objectives	3.1 – Objectives and Approach
3.2 Indigenous Engagement	3.2.3 – Indigenous Communities
3.2.1 Identification of Potentially Affected Indigenous Communities	3.2.3 – Indigenous Communities
3.2.2 Approach to Indigenous Engagement	3.1 – Objectives and Approach
3.3 Public and Regulatory Engagement	3.2.1 – Stakeholders; 3.2.2 – Government and Regulatory Agencies
3.3.1 Stakeholder Identification	3.2 – Identification of Interested Parties
3.3.2 Engagement Methods	3.3 – Engagement Methods
4.0 ENVIRONMENTAL ASSESSMENT	4.0 – Environmental Assessment
4.1 Overview of Approach	4.1 – Overview of Approach
4.1.1 Scoping of the Assessment	4.2 – Scoping of the Assessment
4.1.2 Existing Conditions	4.2.4 – Existing Conditions; 5.0 – Environmental Setting; see below for Existing Conditions for each VC
4.1.3 Assessment	4.2.6 – Assessment of Project-related Environmental Effects; 4.2.7 – Assessment of Cumulative Effects
4.1.4 Selection of Valued Components	4.2.1 – Selection of Valued Components
4.1 Acoustic Environment	6.0 – Assessment of Potential Effects on the Acoustic Environment
4.1.1 Spatial Boundaries	6.1.4 – Boundaries
4.1.2 Significance Criteria	6.1.6 – Significance Definition

Table A-1 Concordance Between the Terms of Reference and Environmental Impact Statement

Terms of Reference	Environmental Impact Statement Section
4.1.3 Existing Conditions	6.2 – Existing Conditions for Acoustic Environment; Appendix E – Acoustic Environment
4.1.4 Environmental Effects Analyses	6.3 to 6.6 – Assessment of Residual Environmental Effects on the Acoustic Environment; Appendix B – Commitments Register; Appendix C – Environmental Protection Plan
4.2 Vegetation and Wetlands	7.0 – Assessment of Potential Effects on Vegetation and Wetlands
4.2.1 Spatial Boundaries	7.1.4 – Boundaries
4.2.2 Significance Criteria	7.1.6 – Significance Definition
4.2.3 Existing Conditions	7.2 – Existing Conditions for Vegetation and Wetlands; Appendix F – Biophysical Map Atlas; Appendix G – Vegetation and Wetlands
4.2.4 Environmental Effects Analyses	7.3 to 7.6 – Assessment of Residual Environmental Effects on Vegetation and Wetlands; Appendix B – Commitments Register; Appendix C – Environmental Protection Plan
4.3 Wildlife and Wildlife Habitat	8.0 – Assessment of Potential Effects on Wildlife and Wildlife Habitat
4.3.1 Spatial Boundaries	8.1.4 – Boundaries
4.3.2 Significance Criteria	8.1.6 – Significance Definition
4.3.3 Existing Conditions	8.2 – Existing Conditions for Wildlife and Wildlife Habitat; Appendix F – Biophysical Map Atlas; Appendix H – Wildlife and Wildlife Habitat
4.3.4 Environmental Effects Analyses	8.3 to 8.6 – Assessment of Residual Environmental Effects on Wildlife and Wildlife Habitat; Appendix B – Commitments Register; Appendix C – Environmental Protection Plan
4.4 Heritage Resources	9.0 – Assessment of Potential Effects on Heritage Resources
4.4.1 Spatial Boundaries	9.1.4 – Boundaries
4.4.2 Significance Criteria	9.1.6 – Significance Definition
4.4.3 Existing Conditions	9.2 – Existing Conditions for Heritage Resources; Appendix I – Heritage Resources
4.4.4 Environmental Effects Analyses	9.3 to 9.6 – Assessment of Residual Environmental Effects on Heritage Resources; Appendix B – Commitments Register; Appendix C – Environmental Protection Plan
4.5 Land and Resource Use	10.0 – Assessment of Potential Effects on Land and Resource Use
4.5.1 Spatial Boundaries	10.1.4 – Boundaries

Table A-1 Concordance Between the Terms of Reference and Environmental Impact Statement

Terms of Reference	Environmental Impact Statement Section
4.5.2 Significance Criteria	10.1.6 – Significance Definition
4.5.3 Existing Conditions	10.2 – Existing Conditions for Land and Resource Use
4.5.4 Environmental Effects Analyses	10.3 to 10.6 – Assessment of Residual Environmental Effects on Land and Resource Use; Appendix B – Commitments Register; Appendix C – Environmental Protection Plan
4.6 Employment and Economy	11.0 – Assessment of Potential Effects on Employment and Economy; Appendix J – Employment and Economy
4.6.1 Spatial Boundaries	11.1.4 – Boundaries
4.6.2 Significance Criteria	11.1.6 – Significance Definition
4.6.3 Existing Conditions	11.2 – Existing Conditions for Employment and Economy
4.6.4 Environmental Effects Analyses	11.3 to 11.6 – Assessment of Residual Environmental Effects on Employment and Economy; Appendix B – Commitments Register; Appendix C – Environmental Protection Plan
4.7 Community Services and Infrastructure	12.0 – Assessment of Potential Effects on Community Services and Infrastructure
4.7.1 Spatial Boundaries	12.1.4 – Boundaries
4.7.2 Significance Criteria	12.1.6 – Significance Definition
4.7.3 Existing Conditions	12.2 – Existing Conditions for Community Services and Infrastructure
4.7.4 Environmental Effects Analyses	12.3 to 12.6 – Assessment of Residual Environmental Effects on Community Services and Infrastructure; Appendix B – Commitments Register; Appendix C – Environmental Protection Plan
4.8 Effects of the Environment on the Project	13.0 – Effects of the Environment on the Project
4.8.1 Spatial Boundaries	13.1 Interactions of the Environment on the Project
4.8.2 Significance Criteria	13.5 – Determination of Significance for Effects of the Environment on the Project
4.8.3 Existing Conditions	13.2 – Assessment of Severe Weather on the Project; 13.3 – Assessment of Wildfires on the Project
4.8.4 Environmental Effects Analyses	13.2 – Assessment of Severe Weather on the Project; 13.3 – Assessment of Wildfires on the Project; Appendix B – Commitments Register; Appendix C – Environmental Protection Plan
4.9 Accidents and Malfunctions	14.0 – Accidents and Malfunctions

Table A-1 Concordance Between the Terms of Reference and Environmental Impact Statement

Terms of Reference	Environmental Impact Statement Section
5.0 DECOMMISSIONING, RECLAMATION AND INSTITUTIONAL CONTROL	2.5.3 – Decommissioning
6.0 CONDITIONS MANAGMENT	Appendix B
6.1 Commitments Register	Appendix B
7.0 REFERENCES	17.0 – References

APPENDIX B
COMMITMENTS REGISTER

Appendix B COMMITMENTS REGISTER

Table B-1 Commitments Register for Blue Hill Wind Energy Project

ID	Commitment	Section in EIS	Condition in Approval	Permit # (if available)	Name and Section of Additional Report	Approving Agency/ Branch	Measure of Compliance	Commitment Status (met, not met, in progress)	Preventative or Corrective Action	Adaptive Action	Commitment Due Date	Actual Completion Date	Comments
1	Sound level limit will be at or below 40dBA at all receptors within the LAA	Section 5.0			N/A	N/A	• Design and siting of Project	Met	• If there are changes to the Project layout or turbines selected for the Project are different than those used in the Noise Impact Assessment, a new noise model will be run to determine the SLL at receptors and siting adjustments made if necessary.		Upon confirmation of the turbine selection and finalization of layout prior to construction		
2	Avoid plant SAR and SOMC during construction	Section 7.4.2.2; Appendix C, Vol. 1, Section 7.9.1			N/A	Saskatchewan Ministry of Environment (SKMOE)	• Construction activities will not occur within plant activity restriction setback guideline, unless previously discussed and approved by SKMOE	In progress	• No plant SAR have been detected during the 2017 rare plant surveys. • Current Project layout avoids locations of plant SOMC and the 30 m setback in accordance with the 2017 Saskatchewan Activity Restriction Guidelines for Sensitive Species. • Any changes to the Project layout will avoid known locations of plant SOMCs and the 30 m setback. If avoidance is not possible, SKMOE will be consulted.		Upon completion of construction activities		
3	Reduce or avoid introducing non-native invasive plant species from Project construction activities into the PDA.	Section 7.4.2.2; Appendix C, Vol. 1, Section 7.10			N/A	SKMOE	• Non-native invasive plant species are not introduced into the PDA, or are appropriately managed to prevent impacts to native vegetation communities	In progress	• General contractor field management representatives will confirm vehicles and equipment are free of soil and vegetative debris prior to entering the PDA. • Known populations of non-native invasive plant species within the PDA will be flagged for avoidance by the Environmental Monitor. • Post-construction, prohibited and noxious weeds in the PDA will be documented, reported to landowners and authorities, and a management plan developed in consultation with experts. • Stabilizing stockpiles left for longer than 30 days by covering or by seeding, sodding, mulching or equivalent.		Upon completion of construction activities		
4	Reduce or avoid impacting areas of native prairie by Project construction activities	Section 7.4.3.2; Appendix C, Vol. 1, Sections 7.2 and 7.9.1			N/A	SKMOE	• Maintain area of impact to within designated PDA	In progress	• Prior to construction in native prairie, the boundaries of the vegetation clearing will be staked in the field. If possible, construction activities will be modified to avoid native prairie. The Construction Contractor will ensure no construction disturbance occurs beyond the staked limits and that edges of sensitive areas adjacent to work areas are not disturbed.		Upon completion of construction activities		

Table B-1 Commitments Register for Blue Hill Wind Energy Project

ID	Commitment	Section in EIS	Condition in Approval	Permit # (if available)	Name and Section of Additional Report	Approving Agency/ Branch	Measure of Compliance	Commitment Status (met, not met, in progress)	Preventative or Corrective Action	Adaptive Action	Commitment Due Date	Actual Completion Date	Comments
5	Recover impacted areas of native prairie to similar pre-disturbance vegetation communities.	Section 7.4.3.2; Appendix C, Vol. 1, Sections 7.2 and 7.9.1			N/A	SKMOE	• Impacted areas have similar vegetation communities post-reclamation as pre-construction	In progress	• Where active reclamation is deemed necessary by a qualified environmental monitor, sites on native vegetation types will be re-revegetated to their pre-disturbance conditions using appropriate Certified No. I seed (Canada Seed Growers' Association) unless it is not available for a chosen reclamation species. The topsoil/seedbank will be preserved then reapplied during post-construction reclamation.		Upon completion of post-reclamation monitoring		
6	Reduce or avoid impacting wetlands by Project construction activities	Section 7.4.4.2; Appendix C, Vol. 1, Sections 7.4 and 7.5			N/A	Water Security Agency (WSA)	• Maintain area of impact to within designated PDA • Wetland protection measures are properly implemented	In progress	• Maintain 100 m setback from wetlands for Project infrastructure, where possible. • Maintain existing vegetation buffers around wetlands, where possible. • Submit notifications and applications to regulators for anticipated wetland effects, as required, with the appropriate lead time. • Use appropriate sedimentation and erosion control measures (e.g., silt fencing, swamp/mud mats) and direct surface runoff away from wetlands and waterbodies. • Minimal alteration of surface water drainage patterns and installation of culverts as required to maintain existing flows. • Refueling or fuel storage activities will occur at least 100m from wetlands. in the event that refueling takes place in areas less than 100 m away from wetlands, contractor will have secondary containment/spill prevention measures in place. • Environmental Monitor will confirm setbacks from wetlands and waterbodies.		Upon completion of construction activities		

Table B-1 Commitments Register for Blue Hill Wind Energy Project

ID	Commitment	Section in EIS	Condition in Approval	Permit # (if available)	Name and Section of Additional Report	Approving Agency/ Branch	Measure of Compliance	Commitment Status (met, not met, in progress)	Preventative or Corrective Action	Adaptive Action	Commitment Due Date	Actual Completion Date	Comments
7	Avoid sensitive wildlife features whenever possible	Section 8.4.2.2; Appendix C, Vol. 1, Section 7.9.2			N/A		• Approved activity restriction setbacks of sensitive wildlife features are respected	In progress	• Algonquin, with the assistance of the Environmental Monitor, will review proposed activities with the Construction Manager and will recommend site-specific impact management practices. • Conduct vegetation clearing activities outside the primary bird nesting season (April 26 to August 15) as per Environment and Climate Change Canada guidance (ECCC 2017). • Conduct construction in areas of native land cover types and perennial cropland outside the breeding bird period (April 26 to August 15; ECCC 2017). When not possible, conduct pre-construction surveys to identify the location and status of bird nests and other wildlife features. If an active nest is found, Algonquin will consult with SKMOE to identify appropriate mitigation measures, such as species-specific setback distances and activity timing restrictions. • Adjust temporary workspaces to avoid setbacks around identified sensitive features (including sharp-tailed grouse leks and northern leopard frog breeding pond). Where this is not possible, alternative mitigation options will be developed in consultation with SKMOE.		Upon completion of construction activities		

Table B-1 Commitments Register for Blue Hill Wind Energy Project

ID	Commitment	Section in EIS	Condition in Approval	Permit # (if available)	Name and Section of Additional Report	Approving Agency/ Branch	Measure of Compliance	Commitment Status (met, not met, in progress)	Preventative or Corrective Action	Adaptive Action	Commitment Due Date	Actual Completion Date	Comments
8	Reduce the amount of direct mortality of birds and bats during operation through adaptive management.	Section 8.4.3.2; Appendix C, EPP, Vol.2, Section 2.0			N/A		• Apply mortality thresholds as indicated in EPP Vol 2, Section 2.0. • Report mortality rates of birds and bats in both per MW and per turbine rates.	In progress	The following have already been, or will be, considered in development of the Project: • Turbine Design: turbines erected for the Project will only be current monopole designs. • Electrical Collection Lines: all electrical collector lines on private land will be buried to reduce potential fatalities that may occur with overhead collector lines. • Meteorological (MET) Tower Design: permanent MET towers erected to collect meteorological data during operation of the Project will be monopole design to reduce collision fatalities. • Infrastructure Setbacks: the design and planning of infrastructure locations has considered SKMOE (2017b) recommended activity restriction setbacks for sensitive species (e.g., wildlife features, rare plants). Where infringement of the guidelines may be necessary, evidence-based setbacks appropriate for the sensitive feature will be discussed with SKMOE for approval. • Appropriate Lighting: the most effective lighting technology determined to reduce or avoid attracting birds that meet Transport Canada Safety Regulations will be applied to the Project. • Cut-in Speeds: wind turbines will only operate when minimum cut-in wind speeds for selected turbine designs have been exceeded. • Turbine Spacing: the planned turbine spacing for the proposed Project will exceed 300 m, currently the permitting layout has a minimum turbine spacing at 408 m. • High Power Turbines: permitting is being sought for 56 wind turbine locations for the proposed Project; the number of turbines will depend on the turbine manufacturer and model to be considered. • Fencing: Fencing of the land in which turbines, substations or other infrastructure at the Project should be minimal so as to avoid collisions of birds. The only permanent fencing to be planned for the Project will be for the substation.	• A post-construction mortality monitoring program will be implemented for a minimum of 2 years following commissioning of the Project, with a potential to monitor at 5-year intervals starting on year 5 of Project operation depending on fatality rates observed in the first 2 years. Results of the mortality monitoring program will be provided to SKMOE. Should a substantive mortality event occur, a cause-effect analysis will be conducted and additional mitigation options will be considered. Should operational mitigation measures be required, the initial monitoring period may be extended beyond the initial 2 years after discussion with SKMOE, but will not extend beyond an additional 2 years to assess the effectiveness of additional mitigation measures. All results of the post-construction mortality monitoring program will be reported to SKMOE. • Increased Cut-in Speeds: if collision mortality at individual turbines or turbine clusters exceeds mortality thresholds, and analysis of event data suggests that collision risk is greatest at moderate wind speeds, then evaluation of reasonable cut-in speed increases may be considered in consultation with appropriate regulatory agencies. Increased cut-in speeds would apply to turbines or turbine clusters where higher mortality occurs and during high collision risk periods. • Periodic Shut-down of Turbines: if specific periods are identified where mortality rates exceed thresholds for bats, and following reasonable consultation with regulatory agencies, individual turbines or turbine clusters in areas where mortality rates exceed thresholds may be periodically shut down, during known periods of high bat abundance to reduce or avoid collision mortality.	Throughout Project operation		

Table B-1 Commitments Register for Blue Hill Wind Energy Project

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9	Avoid of known heritage resources in the PDA	Section 9.4.2.2; Appendix C, EPP, Vol.1, Section 7.11			N/A	Heritage Conservation Branch (HCB)	• Construction activities do not interact with known heritage resource sites	In progress	• A 200 m avoidance buffer for siting permanent Project infrastructure and a 100 m avoidance buffer for temporary construction activities will be established around heritage sites EbNs-2 and EbNt-6 by a professional archaeologist to protect them from construction vehicles and disturbance. • A 15 m buffer will be staked around heritage site EbNs-3 by a professional archaeologist to prevent vehicle disturbance during construction. • Algonquin, with the assistance of the Environmental Monitor, will contact the HCB of the Saskatchewan Ministry of Tourism, Parks, Culture and Sport if new heritage resources are discovered and work will be suspended at those sites.		Upon completion of construction activities		
10	Reduce impacts to agricultural land activities during construction	Section 10.4.2.2; Appendix C, EPP, Vol.1, Sections 7.1 and 7.18			N/A	SKMOE	• Construction activities have minimal interference with agricultural activities • Early communication with landowners	In progress	• Landowners will be provided the location of Project infrastructure to minimize inefficiencies in agricultural operations. • Landowners with Project infrastructure that reduce the agricultural production of their lands will be financially compensated through the individual land lease agreements. • Communication of construction timelines with landowners and tenure holders that have a land agreement with Algonquin. • Posting of appropriate signage in advance of Project activities to indicate access restrictions. • Potentially halt construction when soil conditions become saturated or installing matting. • Minimize vehicle traffic on exposed soil. • Establish erosion and sediment control measures.		Upon completion of construction activities		

Table B-1 Commitments Register for Blue Hill Wind Energy Project

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11	Reduce impacts to recreational and commercial harvesting activities, and non-consumptive recreational activities by Project construction activities	Sections 10.4.3.2 and 10.4.4.2			N/A	SKMOE	• Construction activities have minimal disturbance with recreational and commercial harvesting activities, and non-consumptive recreational activities • Early communication with landowners, lessees, and outfitters	In progress	• Communication of the dates for specific Project phases and a well outlined Project layout to allow the landowners, lessees, and outfitters to plan their harvesting schedule throughout the life of the Project. • Minimize clearing to the extent feasible to reduce change in available habitat. • Posting of appropriate signage in advance of Project activities to indicate access restrictions.		Upon completion of construction activities		
12	Reduce or avoid impacts to groundwater use by Project construction activities	Section 10.4.5.2; Appendix C, EPP, Vol.1, Section 7.8			N/A	WSA	• Construction activities do not interfere with groundwater use	In progress	• Confirm well locations prior to construction. • Complete a site-specific geotechnical investigation at each of the proposed wind turbine sites and record depth to groundwater , if encountered. • Communicate key dates for specific Project phases and distribute a specific Project layout to allow the landowners and lessees (groundwater well licensees) to plan water use activities proactively.		Upon completion of construction activities		
13	Create positive effects on local employment and business opportunities and reduce or avoid disruptions to local businesses.	Sections 11.4.2.2 and 11.4.3.2			N/A	N/A	• No compliance measures	In progress			Upon completion of construction activities; throughout operation and decommission ing		
14	Reduce or avoid impacts to community services and infrastructure	Section 12.4.2.2; Appendix C, EPP, Vol. 1, Section 7.16, and EPP, Vol. 2			N/A	N/A	• Adequate consultation with community services providers	In progress	• Coordinate with emergency response providers in the area to facilitate appropriate communications, understanding, and cooperation. • Develop and implement an ERP for the Project that meets Project needs. The plan will address field health services, emergency call-out procedures, and fire response plans, and other concerns. • Consult and coordinate with local authorities, service providers and businesses with respect to worker accommodation and to identify potential accommodation service gaps or issues.		Throughout all Project phases		

Table B-1 Commitments Register for Blue Hill Wind Energy Project

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15	Reduce or avoid traffic safety hazards, potential for accidents, and direct mortality from vehicle collisions.	Section 14.5.2			N/A		• Reasonable steps are taken to reduce or avoid traffic safety hazards, and potential for accidents	In progress	• The Environmental Monitor will confirm that traffic control procedures (i.e., signage indicating speed limitations) have been implemented within the PDA.	• Conduct a complete incident investigation following any traffic incident to determine if corrective action may be taken to prevent future events.	Upon completion of construction activities		

APPENDIX C
ENVIRONMENTAL PROTECTION PLAN

Blue Hill Wind Energy Project

Environmental Protection Plan

Volume 1 - Construction Phase

December 2017

Table of Contents

1.0 INTRODUCTION

As part of the Environmental Impact Statement (EIS) for the Blue Hill Wind Energy Project (the Project), Algonquin Power Co. (Algonquin) has committed to the development of an Environmental Protection Plan (EPP) to summarize Algonquin's corporate commitments and regulatory requirements for the Project's environmental management. The EPP is divided into 3 Volumes and a map atlas (included in the Exhibits section) outlining site-specific information.

Volume 1 of this EPP identifies the **Contractor responsibilities** with respect to environmental protection procedures during Project construction. Algonquin intends for the Contractor to use Volume 1 of this EPP, with reference to the Project EIS document, as guidance documents to support the implementation of appropriate site-specific environmental protection measures.

2.0 REGULATORY FRAMEWORK

The central elements of the regulatory framework, which creates the context for this EPP, are noted below (grouped by jurisdiction).

Federal:

Fisheries Act, 1985 (amended 2013);
Migratory Birds Convention Act, 1994 and Migratory Birds Regulations;
Species at Risk Act, 2002;
Canadian Environmental Protection Act, 1999.

Provincial:

The Environmental Assessment Act;
The Environmental Management and Protection Act, 2010 and Hazardous Substances and Waste Dangerous Goods Regulations;
The Dangerous Goods Transportation Act and Dangerous Goods Transportation Regulations
The Wildlife Act, 1998;
The Heritage Property Act;
The Saskatchewan Employment Act and Occupational Health and Safety Regulations, 1996;
The Planning and Development Act, 2007;
The Water Security Agency Act;
The Weed Control Act, 2010.

Municipal:

Municipal bylaws relating to land development are also applicable to this Project. Algonquin has worked with the RMs of Morse and Lawtonia such that the Project is in alignment with their respective development plan requirements.

3.0 PROJECT ACTIVITIES AND SCHEDULE

A proposed schedule of Project activities for the construction phase is provided in Appendix A. The timing of Project construction activities will be conducted such that effects to the environment are reduced or avoided (refer to Section 7.2 of this volume for timing of clearing, if required). However, the schedule is influenced by and subject to change depending on the timing of the receipt of Ministerial approval.

4.0 ENVIRONMENTAL MANAGEMENT – ROLES AND RESPONSIBILITIES

The responsibilities for Project environmental management are as follows:

Contractor Responsibilities:

A General Contractor will be assigned to construct the Project. The General Contractor will hire a Construction Manager. The responsibilities of the General Contractor Construction Manager ("Construction Manager") with respect to the EPP will be as follows:

- Responsible for implementing the Project EPP volume 2 and volume 3 (if applicable).
- Communicate environmental protection procedures outlined in the EPP to Contractor staff.
- Provide the most recent version of the EPP and parts therein at the construction site at all times during construction.
- Promote compliance with federal and provincial environmental legislation and municipal bylaws (see Section 2).

Owner Responsibilities:

Algonquin will retain the services of an "Environmental Support Specialist". The Environmental Support Specialist will:

- Be retained prior to construction start-up and will inspect construction works to support conformance with this volume of the EPP.
- Notify the General Contractor's Construction Manager and Owner's representatives of any environmental issues determined to be non-compliant with the EPP.
- Advise the General Contractor's Construction Manager on methods required to mitigate environmental issues should there be any uncertainty.
- Communicate environmental-related concerns of the General Contractor's Construction Manager to Algonquin's representatives.

The Owner will be responsible for communicating any alterations of the Project design or layout to the General Contractor's Construction Manager, including any updates to the EPP and parts therein.

5.0 CONTACTS AND REPORTING

The reporting matrix to be followed when communicating environmental issues for the purpose of confirming the EPP is provided in Appendix B. This matrix includes contact information which may be periodically updated and distributed to the Construction Manager.

6.0 PROJECT LAYOUT AND SITE-SPECIFIC CONDITIONS

The EPP Overview Map in the Exhibits, illustrates the Project layout as of December 2017. Should the Project layout be revised before or during Project construction, Algonquin will communicate the revised layout to the Contractor. The Project consists of a maximum of 56 wind turbine generators (WTGs), access roads, collector lines, an operation and maintenance building, and a substation. The EPP Overview Map also shows contingency locations for WTGs and the substation which have been included as part of the maximum Project layout in order to be conservative.

The draft EPP figures in the Exhibits represent a map atlas showing constraints within the Project area, including at each WTG, access road and collector line site. If additional constraint conflicts are identified, these figures will be updated. The environmental protection measures necessary to mitigate or avoid areas of interest with respect to any environmentally sensitive features are listed below in Section 7.

7.0 ENVIRONMENTAL PROTECTION MEASURES

The Construction Manager, assisted by the Environmental Support Specialist, will confirm that the following environment protection measures are applied to the construction of the Project facilities. Sensitive environmental features that require site-specific mitigation measures (e.g., revegetation of natural areas) are identified in the draft EPP figures in the Exhibits.

In addition, the EIS prescribes mitigation commitments during construction (as well as operation and decommissioning) which must be adhered to in order to be in compliance. These commitments have been used as a basis for development of the EPP.

7.1 PROJECT SITE ACCESS

Access to the Project Site during the construction phase of the Project will be limited to authorized personnel (e.g., Construction Manager, the Environmental Support Specialist, and other construction staff site manager). Appropriate signage will be posted in advance of Project activities to indicate access restrictions. Landowners may access construction areas on their land with prior authorization from the Construction Manager, providing they follow all environmental, health and safety procedures. Landowners will be advised in advance of construction activities on their property.

7.2 VEGETATION CLEARING AND SOIL STRIPPING

When clearing areas for construction, the following additional mitigation measures will be followed:

- If there is any construction in native prairie, which is very limited as per the EIS, the boundaries of the vegetation clearing will be staked in the field. The Construction Contractor will confirm that no construction disturbance occurs beyond the staked limits and that edges of sensitive areas adjacent to work areas are not disturbed.
- Construction activities will be timed to occur outside of the bird nesting season (April 26 to August 15) (ECCC 2017) and following any additional timing and setback restrictions as outlined in the SKMOE Activity Restriction Guideline (SKMOE 2017b).
- If construction cannot avoid the nesting season, vegetation clearing activities will be occur prior to the bird nesting season and pre-construction surveys (e.g., nesting bird surveys) will be completed by a qualified environmental monitor prior to the start of construction activities.
- Construction vehicles and personnel will stay within the defined Project construction area.
- Minimize clearing to the extent feasible.
- Avoid clearing slopes unless adequate erosion control measures are used.
- Grade disturbed soil to a stable slope.
- Stockpile cleared topsoil for redistribution at disturbed areas not required during Project operation.
- Stockpile material will be stored greater than 30 m from the edge of rare plant occurrences or, where not possible, cover the piles when not in use.
- Stockpiles left for longer than 30 days will be covered or stabilized by seeding, sodding, mulching or equivalent.
- Halt construction during extreme weather events (e.g., heavy rainstorms) to avoid rutting and compaction that could lead to topsoil loss or erosion.
- Prevent sediment from entering any nearby waterbodies by placing overburden or topsoil stockpiles well above the high-water mark.

7.3 ACCESS ROADS

Access roads will be sited, as best as possible, to reduce disruption to the following environmental features should they be present:

- Wetlands
- Drainage ditches
- Other waterbodies, such as potholes
- Soils with low weight bearing capacity
- Sensitive biological areas
- Cultural and historic resources
- Farmyards, shelter belts and fences

The following mitigation measures will be followed during construction:

- Dust control measures will be implemented along access roads when needed to suppress dust conditions.
- Access roads will maintain a 100 m setback from wetlands, where possible.
- Speed limits will be implemented for specific areas of concern.
- The Contractor will communicate with local authorities with regards to traffic management plans.

Landowners will also be further consulted regarding the location of access roads before construction begins.

7.4 STREAM CROSSINGS

The current Project layout does not anticipate the need for any stream crossings. Should the Project layout be altered or should environmental conditions of the Project site change during Project construction such that a stream crossing (or alteration to the configuration of the bed, bank, or boundary of any river, stream, lake, creek, marsh, or other watercourse or water body) be required, appropriate stream crossing procedures will be implemented by the Contractor in accordance with an Aquatic Habitat Protection Permit (AHPP). In addition to these requirements the following mitigation measures will be followed for any stream or water crossing:

- Construction equipment will only cross streams/drainage channels at established permanent and temporary crossings.
- Minimal alterations to surface water drainage pattern and installation of properly designed and sited culverts as required to maintain flows.

If required, the Environmental Support Specialist will inspect each stream crossing to confirm the specified mitigation measures are used. The Construction Manager and Environmental Support Specialist will confirm that standard operating procedures for stream crossings are followed.

7.5 WETLANDS

As described in the EIS, the Project design setback to wetlands is 100 m. However, the current Project layout will also be field-truthed in an effort to maintain 100 m setbacks from wetlands for access roads and collector lines, where possible. Standard industry practices, avoidance measures, and the Project-specific mitigation measures listed below will be implemented during construction.

- Maintain 100 m setbacks from wetlands for access roads and collector lines, where possible.
- Maintain existing vegetation buffers around water bodies, where possible.
- Submit notifications and applications to regulators for wetland effects, as required, with the appropriate lead time.
- Complete work during dry or frozen ground conditions to lessen soil compaction.
- If working in saturated soils during non-frozen ground conditions, use equipment and techniques that distribute ground pressure (e.g., swamp mats, geofabric and padding, corduroy) to avoid soil compaction and admixing.
- Use silt fencing and direct surface runoff away from wetlands and waterbodies.
- Restrict water taking during periods of extremely low flow.
- Refueling or fuel storage activities will occur at least 100 m from wetlands.
- Minimal alteration to surface water drainage patterns and installation of culverts as required to maintain flows.
- Install properly designed and sited culverts in water crossings, along roads and permanent facilities to maintain pre-disturbance surface run-off as much as possible.
- Clean up wetlands in such a manner that compaction and rutting are reduced.
- Use natural re-vegetation for wetlands in native vegetation types.

Site-specific mitigation measures will be implemented should any future alterations to the Project layout be required such that wetlands areas may need to be temporarily disturbed and the Contractor will work in accordance with an AHPP.

7.6 EROSION AND SEDIMENTATION CONTROL

Erosion and sediment control measures will be implemented prior to construction and maintained during the construction phase. The following procedures and mitigations will be used as directed by the Construction Manager, to control erosion and sedimentation:

- Daily monitoring
- Installation of silt fencing where soils with erosion potential occur
- Use a three-lift soil stripping process where required, such as saline or stony soil, instead of a two-lift process
- Reduce the duration between stripping and excavation to the extent feasible
- Avoid stockpiling soil to reduce soil erosion when practical
- Store stockpiles of saline and stony soils separately
- Store stockpiles of topsoil and subsoils separately and do not place subsoil directly on topsoil
- Stabilize stockpiles left for longer than 30 days by covering or by seeding, sodding, mulching or equivalent
- Avoid clearing slopes unless adequate erosion control measures are used.
- Grade disturbed soil to a stable slope
- Restrict heavy machinery or traffic on slopes.
- Retain existing vegetation where feasible
- Retain soil to use during rehabilitation and revegetation of disturbed areas not required for operation and maintenance
- Reduce vehicle traffic on exposed soil to the extent feasible
- Direct surface runoff away from wetlands and waterbodies

7.7 DRAINAGE PROTECTION

The Construction Manager will confirm that the following procedures are followed to maintain drainage protection:

- Reduce alteration to surface water drainage patterns and install culverts as required to maintain flows
- Install properly designed and sited culverts in water crossings, along access roads and permanent facilities to maintain pre-disturbance surface run-off as much as possible
- Stockpile any soil from excavations and trenches in an area where natural drainage will not be impeded
- Avoid and protect drainage ditches, field tiles and field drains

7.8 LOCAL WATER USE

Saskatchewan Water Security Agency (WSA) approval is required for the temporary use of any surface or ground water for road construction, firefighting or other construction purposes. Algonquin will discuss proposed work with owners of domestic wells and contact the Saskatchewan WSA (https://www.wsask.ca/About-WSA/Regional-Offices/) Moose Jaw office before commencing construction (contact: 306-694-3900). The regional office will be contacted in advance of any water withdrawals. Water withdrawals will be restricted during periods of low flow and Algonquin will advise the Contractor of restrictions regarding the use of domestic wells and surface waters, as required.

7.9 VEGETATION AND WILDLIFE

Field surveys conducted in 2017 in support of the EIS identified locations of sensitive features (e.g., sharp-tailed grouse leks, rare plants). In order to avoid disturbance, the appropriate activity restriction setbacks, in accordance with SKMOE's Activity Restriction Guidelines (SKMOE 2017b) have been applied to these features and are shown in the draft EPP figures in the Exhibits. Where there is potential to infringe on sensitive features, site specific mitigations will be developed by the Environmental Support Specialist and reviewed with SKMOE to determine the appropriate approach.

The following mitigation measures will be used to protect vegetation and wildlife at the site:

7.9.1 Vegetation

- Based on 2017 rare plant surveys, known occurrences of plant SOMCs are being avoided by the current Project layout. If previously undetected rare plants are found during construction, mitigation measures will be determined on a species-specific basis in consultation with rare plant ecologists, Algonquin, and SKMOE.
- Prior to the start of construction, the topsoil/seedbank will be stripped and preserved, then reapplied in suitable rehabilitation areas post-construction.
- If there is any construction in native prairie, which is very limited as per the EIS, the boundaries of the vegetation clearing will be staked in the field. The Construction Contractor will ensure no construction disturbance occurs beyond the staked limits and that edges of sensitive areas adjacent to work areas are not disturbed
- Rare plant areas will be fenced or staked prior to the start of construction.
- Use areas of non-native land cover (e.g., cultivated land) for temporary workspaces.
- Dust control measures will be implemented along access roads within areas of native vegetation types.
- Where active reclamation is deemed necessary by a qualified environmental monitor, sites on native vegetation types will be re-revegetated using appropriate Certified No. I seed (Canada Seed Growers' Association) unless it is not available for a chosen reclamation species. Provincial regulators should be consulted in the selection of native plant seed mixes.

7.9.2 Wildlife

- The Environmental Support Specialist will review proposed activities with the Construction Manager and will recommend site-specific impact management practices.
- Construction activities will be timed to occur outside of the bird nesting season (April 26 to August 15) (ECCC 2017) and following any additional timing and setback restrictions as outlined in the SKMOE Activity Restriction Guidelines (SKMOE 2017b).
- If construction cannot avoid the nesting season, vegetation clearing activities will occur prior to the bird nesting season and pre-construction surveys (e.g., nesting bird surveys) will be conducted by a qualified environmental monitor prior to the start of construction activities. If an active nest is found, Algonquin will consult with the SKMOE to identify appropriate mitigation measures, such as species-specific setback distances and activity timing restrictions as outlined by the SKMOE.
- Adjustments to temporary workspaces will be made to avoid setbacks around identified sensitive features (including sharp-tailed grouse leks, northern leopard frog breeding pond, and rare plants; see Exhibits). Where this is not possible, alternative mitigation options will be developed in consultation with SKMOE.
- Hunting and trapping will be prohibited within the Project area for Project personnel.

7.10 INVASIVE SPECIES

Mitigation measures for invasive species will be implemented for the construction phase of the Project. In addition, the following procedures and mitigation measures will be used as directed by the Construction Manager/ Supervisor, to control invasive species:

- To reduce the potential for the introduction of invasive species, all equipment should arrive at the Project site free of soil or vegetative debris.
- Locations of noxious and prohibited weeds within the Project construction area will be documented and presented to the Contractor, and staked for avoidance.
- Access routes will avoid known prohibited and noxious weed populations.
- The Environmental Support Specialist will review proposed activities with the Construction Manager and will recommend site-specific invasive species management practices.
- Best management practices will be used during transportation activities, such as cleaning transportation vehicles between loads and tarping loads to reduce material falling from loads, etc. (Saskatchewan Forage Council 2011).
- The potential for growth of prohibited and noxious weeds in the disturbed areas along access road right-of-way will be reduced by revegetation efforts in these disturbed areas. Erosion control (straw matting or bales) and any plant material to be used for revegetation will be free of prohibited and noxious weeds identified in *The Weed Control Act*. Restricted seed lists and acceptable revegetation mixtures (preferably locally sourced native seed, gathered and applied utilizing specialized machinery).
- Marshalling and storage yards will be kept free of weeds.

If, despite best mitigation efforts outlined above, prohibited weeds are inadvertently introduced during construction onto private landowner property, Algonquin will commit to the following action plan.

- Notify the landowner immediately. In addition, the Ministries of Agriculture and Environment will be contacted.
- The area will be flagged by company personnel, with the landowner present or represented.
- Monitoring of the area will be conducted at an appropriate schedule and frequency by Algonquin and the landowner with results documented. Additional corrective action will be taken, if necessary.

7.11 HERITAGE RESOURCES

The following mitigation measures for heritage resources will be implemented during construction:

- A 200 m avoidance buffer for siting permanent Project infrastructure and a 100 m avoidance buffer for temporary construction activities will be established around heritage sites EbNs-2 and EbNt-6 by a professional archaeologist to protect them from construction vehicles and disturbance.
- A 15 m buffer will be staked around heritage site EbNs-3 by a professional archaeologist to prevent vehicle disturbance during construction.
- If new archaeological, paleontological or historic artifacts are discovered during construction, work will be suspended at those sites. Discovery of such sites will be communicated immediately to Algonquin and the Environmental Support Specialist. Work will not resume at those sites until advised by Algonquin, and consultation with the Environmental Support Specialist, who will contact the Heritage Conservation Branch of the Saskatchewan Ministry of Tourism, Parks Culture and Sport.

7.12 SPILL RESPONSE PLAN

The Contractor will develop a spill response plan and train employees on appropriate procedures. The Construction Manager will provide guidance on other procedures to be followed including:

- Before construction kick-off, the Contractor will be responsible for providing all spill response equipment and materials onsite or readily available to contain and recover fuels and other fluids associated with construction machinery.
- Locate fuel storage and equipment servicing areas a minimum distance of 100 m from any wetland/ waterbody. In the event that refueling takes place in areas less than 100 m away (e.g., refueling large crane), the Contractor will have secondary containment/spill prevention measures in place.
- Hazardous materials and industrial wastes will be stored at least 100 m from a wetland, watercourse or water body.
- At all times, the General Contractor will be required to have materials available at the construction sites to contain and recover fuel spills (in accordance with The Environmental Management and Protection Act (Government of Saskatchewan 2010)
- Project staff with waste management and hazardous materials responsibilities will be educated according to regulatory requirements specific to the Project.
- Personnel who will be handling waste materials will possess valid workplace hazardous materials information system training. All fuel truck drivers—and drivers transporting waste or chemicals—will have Transportation of Dangerous Goods certification. Procedures for safe loading and unloading of products will be followed.
- Report spills of fuels or other contaminants to the Saskatchewan Environment Spill Reporting Line at (800) 667-7525.

7.13 LAYDOWN AREAS

The following environmental protection measures or other measures as authorized by the Construction Manager in consultation with the Environmental Support Specialist will be used at marshalling yards:

- Locate fuel storage and equipment servicing areas a minimum distance of 100 meters from any wetland/ waterbody.
- At all times, the General Contractor will be required to have materials available at the construction sites to contain and recover fuel spills.
- All handling and storage of materials will conform to safety guidelines and regulatory requirements.
- Fuel / spill containment materials must be available at the site to contain and recover fuels and other fluids associated with construction machinery.
- Report spills of fuels or other contaminants to the Saskatchewan Environment Spill Reporting Line at (800) 667-7525.

7.14 MATERIAL HANDLING AND STORAGE

The following material handling and storage procedures or other measures as authorized by the Construction Manager in consultation with the Environmental Support Specialist will be followed:

- Potentially hazardous materials will be stored and handled at dedicated areas in accordance with all regulatory requirements. All fuel storage and equipment-servicing areas will be located a minimum of 100 m away from any wetland/ waterbody; all handling and storage of materials will conform to safety guidelines and regulatory requirements.
- All hazardous materials will be labeled in accordance with applicable regulatory requirements.

- Hazardous materials will be stored in appropriate containment in accordance with applicable regulations.
- The Environmental Support Specialist will inspect storage areas regularly.
- Hazardous materials will be transported in accordance with the *Dangerous Goods Handling and Transportation Act*.

7.15 WASTE MANAGEMENT

All domestic and construction waste will be disposed of at an approved landfill. All hazardous waste will be disposed of to an approved hazardous waste disposal facility. All sewage and seepage from on-site sanitary facilities will be disposed in accordance with the Provincial Regulations.

7.16 EMERGENCY RESPONSE

Should an emergency situation occur, emergency response procedures and contacts are provided in an Emergency Response Plan (Volume 3 of the EPP).

7.17 ENVIRONMENTAL PROTECTION FOR URBAN AREAS

No WTGs or other infrastructure will be located within urban areas. Thus environmental protection measures for urban areas are not required.

7.18 ENVIRONMENTAL MEASURES FOR AGRICULTURAL LANDS

The Construction Manager, in consultation with the Environmental Support Specialist, will confirm that construction is carried out in a manner that reduces the potential for disruption to agricultural practices. Landowners will be consulted to confirm that construction activities do not excessively affect agricultural activities.

7.19 MAINTENANCE PRACTICES

Throughout the construction phase of the Project, the Construction Manager will confirm that regular inspections and appropriate maintenance of construction vehicles and equipment is conducted.

8.0 PROJECT SITE INSPECTION

Regular project site inspections will occur throughout the lifetime of the Project to confirm that the Project is being constructed and operated in compliance with applicable environmental regulations, municipal bylaws and in accordance with the EPP.

8.1 PRE-CONSTRUCTION INSPECTION

The Environmental Support Specialist will perform an initial pre-construction inspection to identify the environmental issues at the site. The Environmental Support Specialist will inform Algonquin, who will then pass along this information to the Construction Manager of these issues prior to beginning construction.

8.2 CONSTRUCTION PHASE INSPECTION

The Environmental Support Specialist will conduct periodic visits to the Project site during construction and will advise the site manager and Construction Manager of any outstanding environmental issues.

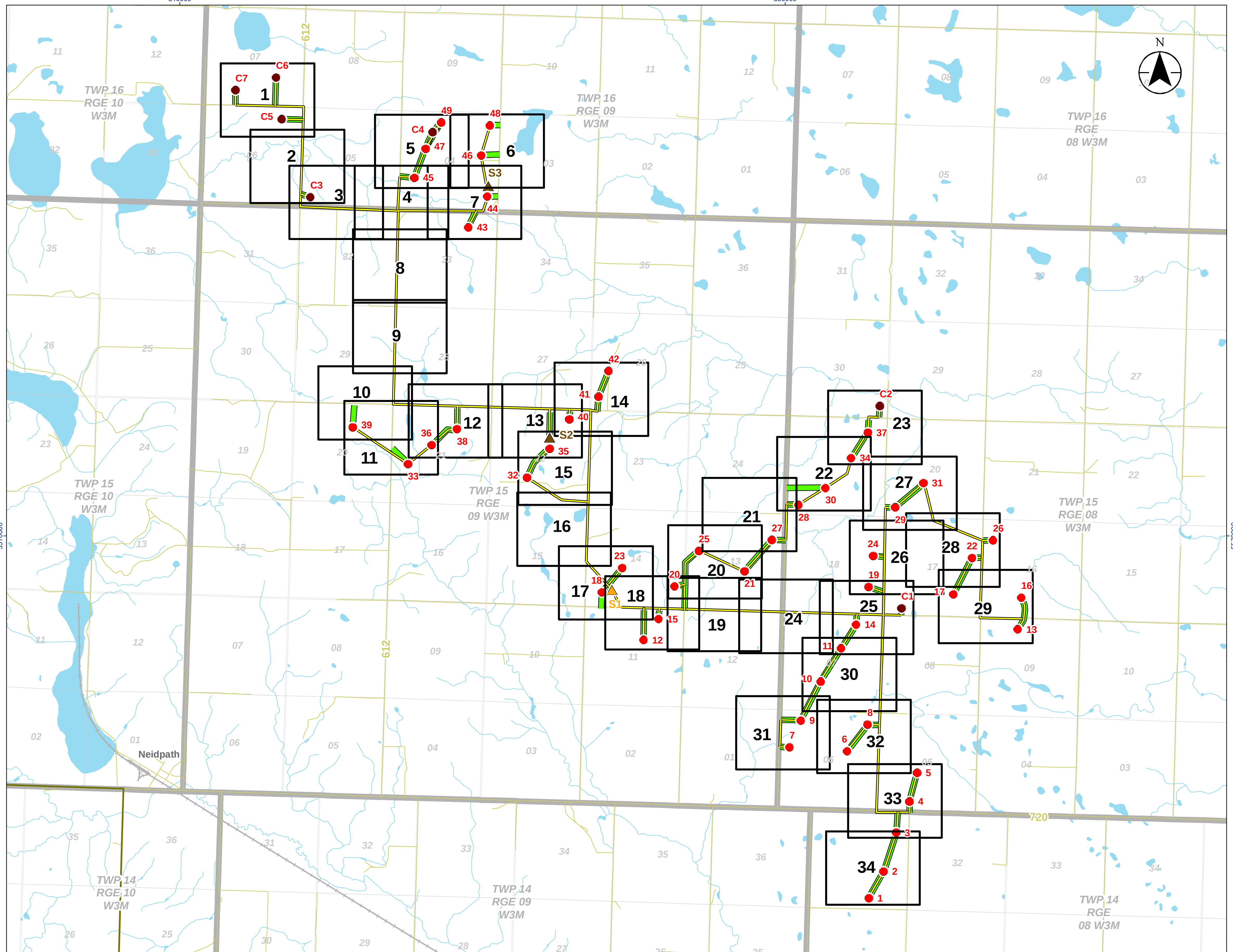
8.3 POST-CONSTRUCTION INSPECTION

After construction is completed, the Environmental Support Specialist will conduct a post-construction inspection.
Activities that will be performed by the Environmental Support Specialist include, but may not be limited to:

- Inspection of permanent stream crossings (if required).
- Inspection of areas that were revegetated to confirm that revegetation is occurring
- Monitoring erosion prone areas to confirm that stabilization procedures are effective.
- The Environmental Support Specialist will identify any areas requiring further attention and advise the Construction Manager of these issues.

Exhibits

Note: The draft EPP figures included in this Exhibits section are based on the maximum 56 turbine layout and are intended to demonstrate the mapping scale and approach to addressing site-specific features during construction. The final set of EPP figures will be based on the approved layout (with reduced number of turbines, if applicable). It is normal practice to update the EPP figures before and during construction as more site-specific information becomes available.



Stantec Algonquin

- EPP Mapsheet

Proposed Project Layout

- Wind Turbine Generator
- Contingency Wind Turbine Generator
- Substation
- Contingency Substation
- New Build Permanent Access Road
- New Electrical Collector Line
- Major Road
- Minor Road
- Railway
- Watercourse
- Waterbody
- Township
- Section

Disclaimer: The Project layout will be subject to minor modifications as detailed engineering progresses to a finer scale. For example, further adjustments may occur such that access roads and collector lines overlap with existing truck-trails, existing cattle trails, property lines, etc., in order to further reduce potential effects.

0 0.65 1.3 1.95 2.6 Kilometers

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Notes

1. Coordinate System: NAD 1983 UTM Zone 13N
2. Base features produced under license with the Government of Saskatchewan and the Government of Canada
3. Layout: Algonquin, Sept 06, 2017, V3

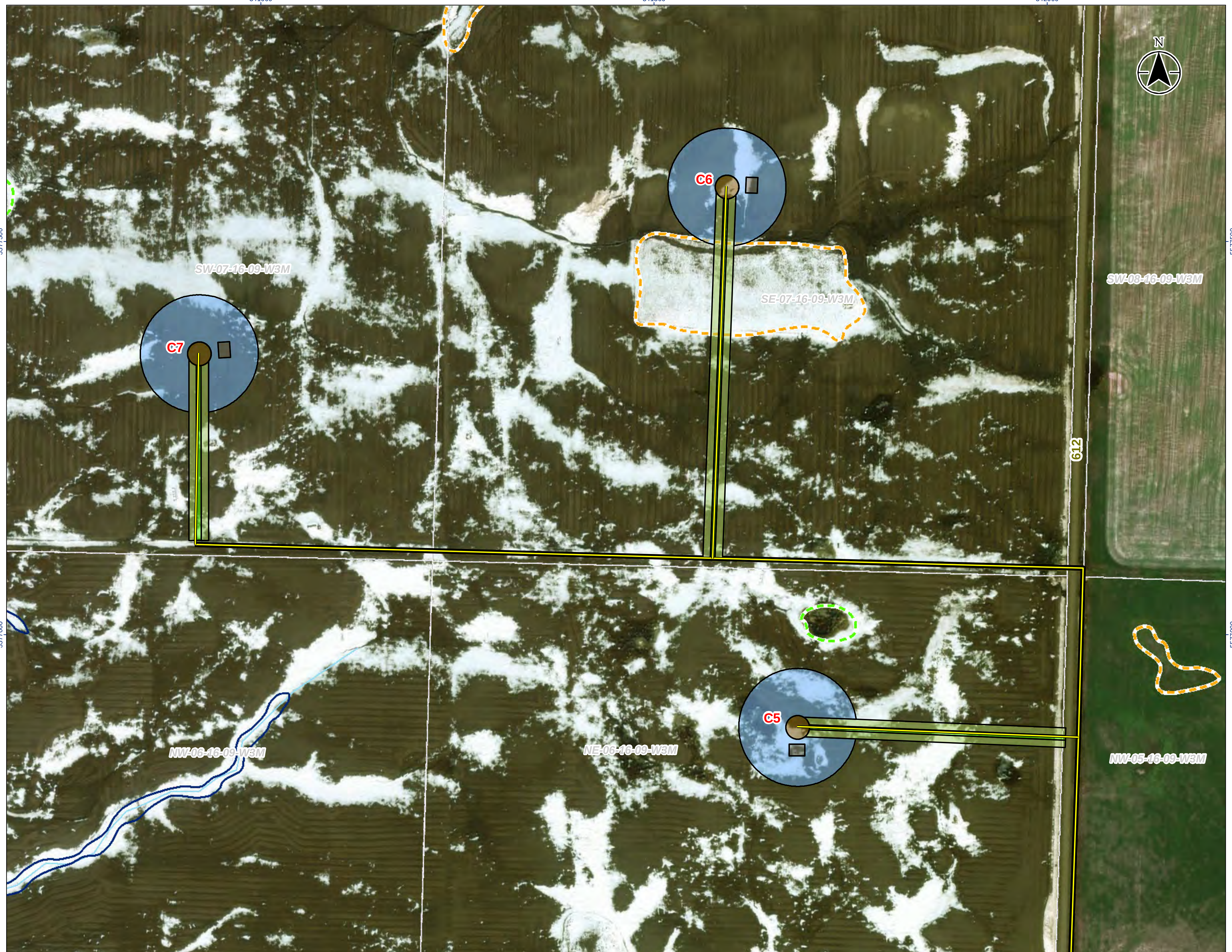
Project Location
Near Herbert, SK

113254088-047 REVC
Prepared by acory on 2017-12-18
Technical Review by ceidem on 2017-12-18

Client/Project
Algonquin Power Co.
Blue Hill Wind Energy Project

Figure No.
EPP - Overview

Title
Environmental Protection Plan - Sensitive Features and Setbacks



Stantec Algonquin

- Project Development Area
- Turbine Foundation
- Crane Pad - Permanent
- New Access Road - Permanent (Operation)
- New Access Road - Temporary (Construction)
- New Electrical Collector Line
- Temporary Workspace

Wetland/Drainage

- Class 2 - Temporary Wetland
- Class 3 - Seasonal Wetland
- Drainage
- Watercourse
- Quarter Section

Disclaimer: The Project layout will be subject to minor modifications as detailed engineering progresses to a finer scale. For example, further adjustments may occur such that access roads and collector lines overlap with existing truck-trails, existing cattle trails, property lines, etc., in order to further reduce potential effects.

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1:5,000 (At original document size of 11x17)

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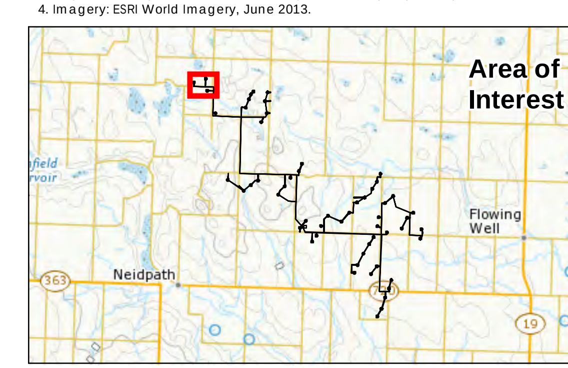
4. Imagery: ESRI World Imagery, June 2013.



Project Location
Near Herbert, SK

113254088-047 REVC
Prepared by acory on 2017-12-18
Technical Review by ceidem on 2017-12-18

Client/Project
Algonquin Power Co.
Blue Hill Wind Energy Project

Figure No.
EPP - 1

Title
Environmental Protection Plan - Sensitive Features and Setbacks

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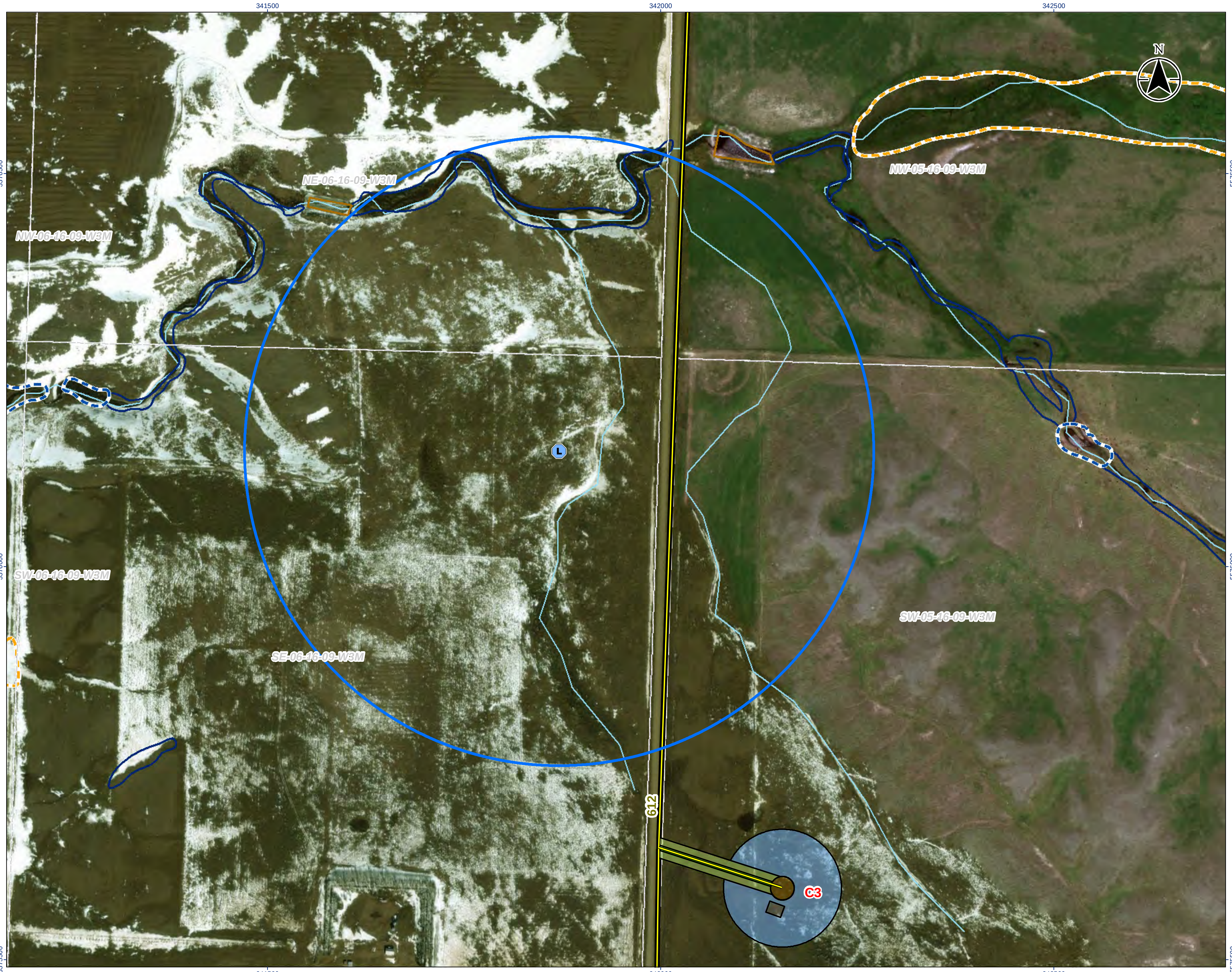

Stantec Algonquin

- Sharp-tailed Grouse Lek
- Sharp-tailed Grouse Lek Setback (400 m, March 15 to May 15)
- Project Development Area
- Turbine Foundation
- Crane Pad - Permanent
- New Access Road - Permanent (Operation)
- New Access Road - Temporary (Construction)
- New Electrical Collector Line
- Temporary Workspace

Wetland/Drainage

- Class 2 - Temporary Wetland
- Class 5 - Permanent Wetland
- Dugout
- Drainage
- Watercourse
- Quarter Section

Disclaimer: The Project layout will be subject to minor modifications as detailed engineering progresses to a finer scale. For example, further adjustments may occur such that access roads and collector lines overlap with existing truck-trails, existing cattle trails, property lines, etc., in order to further reduce potential effects.

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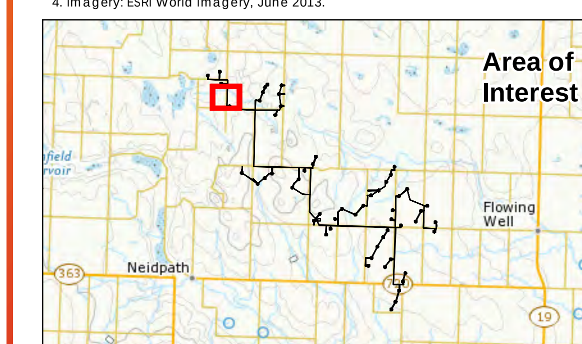


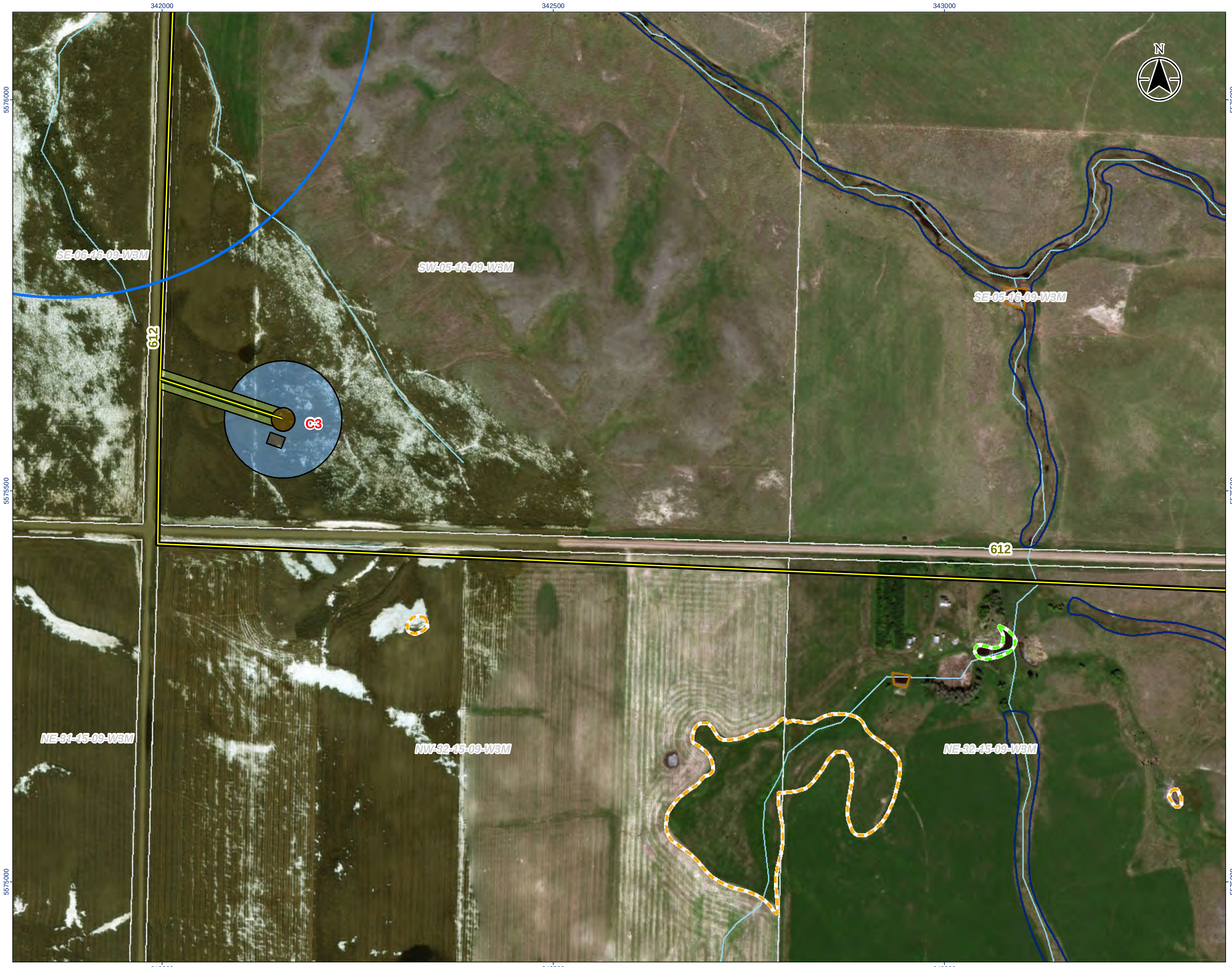
Project Location
Near Herbert, SK

113254088-047 REVC
Prepared by acory on 2017-12-18
Technical Review by ceidem on 2017-12-18

Client/Project
Algonquin Power Co.
Blue Hill Wind Energy Project

Figure No.
EPP - 2

Title
Environmental Protection Plan - Sensitive Features and Setbacks



Stantec Algonquin

- Sharp-tailed Grouse Lek Setback (400 m, March 15 to May 15)
- Project Development Area
- Turbine Foundation
- Crane Pad - Permanent
- New Access Road - Permanent (Operation)
- New Access Road - Temporary (Construction)
- New Electrical Collector Line
- Temporary Workspace

Wetland/Drainage

- Class 2 - Temporary Wetland
- Class 3 - Seasonal Wetland
- Dugout
- Drainage
- Watercourse
- Quarter Section

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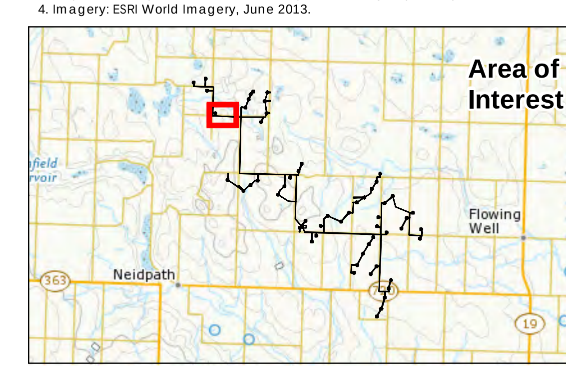
4. Imagery: ESRI World Imagery, June 2013.



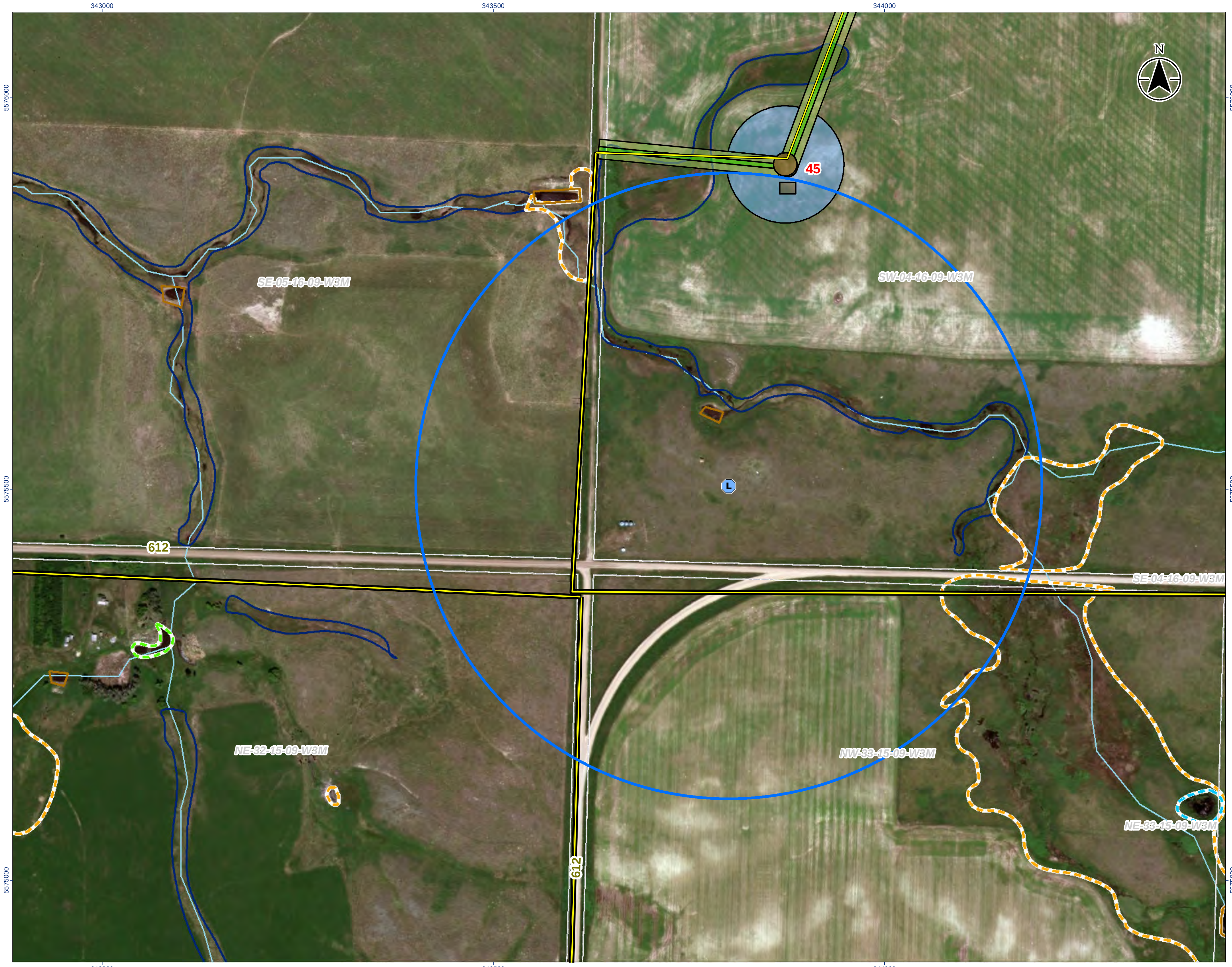
Project Location
Near Herbert, SK

113254088-047 REVC
Prepared by acory on 2017-12-18
Technical Review by ceidem on 2017-12-18

Client/Project
Algonquin Power Co.
Blue Hill Wind Energy Project

Figure No.
EPP - 3

Title
Environmental Protection Plan - Sensitive Features and Setbacks



Stantec Algonquin

- Sharp-tailed Grouse Lek
- Sharp-tailed Grouse Lek Setback (400 m, March 15 to May 15)
- Project Development Area
- Turbine Foundation
- Crane Pad - Permanent
- New Access Road - Permanent (Operation)
- New Access Road - Temporary (Construction)
- New Electrical Collector Line
- Temporary Workspace

Wetland/Drainage

- Class 2 - Temporary Wetland
- Class 3 - Seasonal Wetland
- Class 4 - Semi-Permanent Wetland
- Dugout
- Drainage
- Watercourse
- Quarter Section

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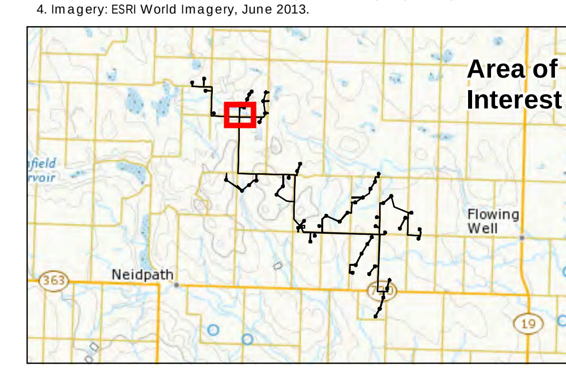


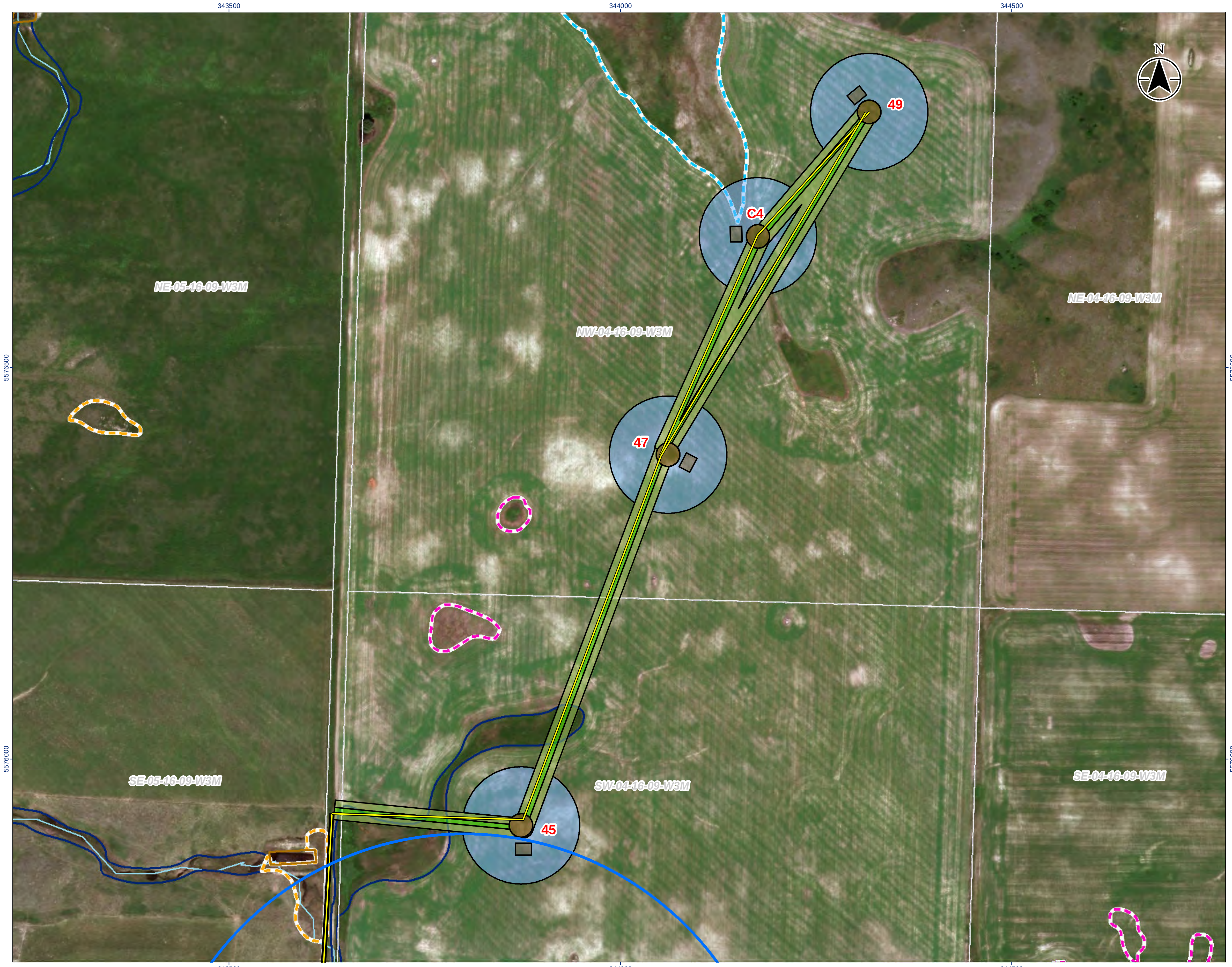
Project Location
Near Herbert, SK

113254088-047 REVC
Prepared by acory on 2017-12-18
Technical Review by ceidem on 2017-12-18

Client/Project
Algonquin Power Co.
Blue Hill Wind Energy Project

Figure No.
EPP - 4

Title
Environmental Protection Plan - Sensitive Features and Setbacks



Stantec Algonquin

- Sharp-tailed Grouse Lek Setback (400 m, March 15 to May 15)
- Project Development Area
- Turbine Foundation
- Crane Pad - Permanent
- New Access Road - Permanent (Operation)
- New Access Road - Temporary (Construction)
- New Electrical Collector Line
- Temporary Workspace

Wetland/Drainage

- Class 1 - Ephemeral Wetland
- Class 2 - Temporary Wetland
- Class 4 - Semi-Permanent Wetland
- Dugout
- Drainage
- Watercourse
- Quarter Section

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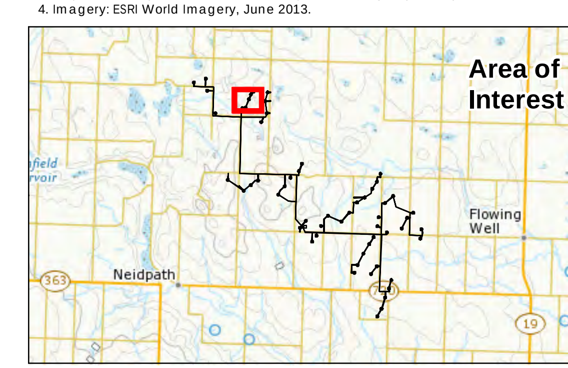

Project Location
Near Herbert, SK

113254088-047 REVC
Prepared by acory on 2017-12-18
Technical Review by ceidem on 2017-12-18

Client/Project
Algonquin Power Co.
Blue Hill Wind Energy Project

Figure No.
EPP - 5

Title
Environmental Protection Plan - Sensitive Features and Setbacks

- Contingency Substation
- Project Development Area
- Turbine Foundation
- Crane Pad - Permanent
- New Access Road - Permanent (Operation)
- New Access Road - Temporary (Construction)
- New Electrical Collector Line
- Temporary Workspace

Wetland/Drainage

- Class 1 - Ephemeral Wetland
- Class 2 - Temporary Wetland
- Class 3 - Seasonal Wetland
- Class 5 - Permanent Wetland
- Quarter Section

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0 50 100 150 200 Meters

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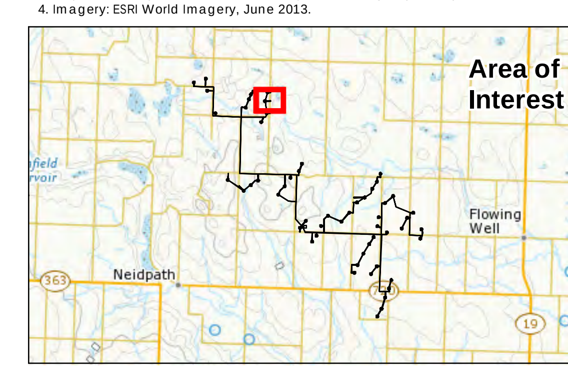

Project Location
Near Herbert, SK

113254088-047 REVC
Prepared by acory on 2017-12-18
Technical Review by ceidem on 2017-12-18

Client/Project
Algonquin Power Co.
Blue Hill Wind Energy Project

Figure No.
EPP - 6

Title
Environmental Protection Plan - Sensitive Features and Setbacks

Stantec Algonquin

- Sharp-tailed Grouse Lek Setback (400 m, March 15 to May 15)
- Contingency Substation
- Project Development Area
- Turbine Foundation
- Crane Pad - Permanent
- New Access Road - Permanent (Operation)
- New Access Road - Temporary (Construction)
- New Electrical Collector Line
- Temporary Workspace

Wetland/Drainage

- Class 1 - Ephemeral Wetland
- Class 2 - Temporary Wetland
- Class 3 - Seasonal Wetland
- Class 4 - Semi-Permanent Wetland
- Dugout
- Drainage
- Watercourse
- Quarter Section

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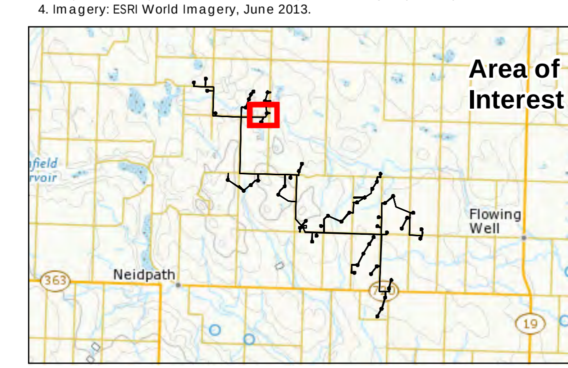

Project Location
Near Herbert, SK

113254088-047 REVC
Prepared by acory on 2017-12-18
Technical Review by ceidem on 2017-12-18

Client/Project
Algonquin Power Co.
Blue Hill Wind Energy Project

Figure No.
EPP - 7

Title
Environmental Protection Plan - Sensitive Features and Setbacks

Project Development Area
New Electrical Collector Line
Wetland/Drainage
Class 2 - Temporary Wetland
Dugout
Drainage
Watercourse
Quarter Section

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0 50 100 150 200 Meters

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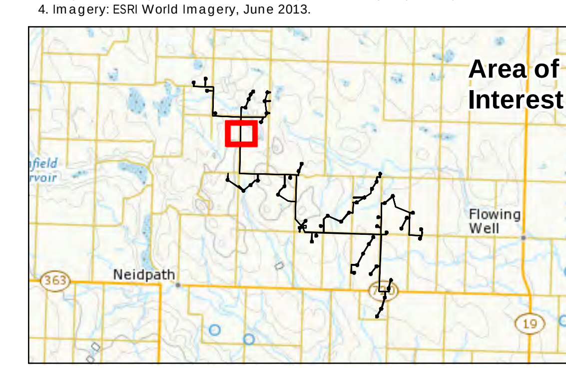

Project Location
Near Herbert, SK

113254088-047 REVC
Prepared by acory on 2017-12-18
Technical Review by ceidem on 2017-12-18

Client/Project
Algonquin Power Co.
Blue Hill Wind Energy Project

Figure No.
EPP - 8

Title
Environmental Protection Plan - Sensitive Features and Setbacks

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Stantec Algonquin

- Project Development Area
- New Electrical Collector Line

Wetland/Drainage

- Class 2 - Temporary Wetland
- Class 3 - Seasonal Wetland
- Dugout
- Drainage
- Watercourse
- Quarter Section

Disclaimer: The Project layout will be subject to minor modifications as detailed engineering progresses to a finer scale. For example, further adjustments may occur such that access roads and collector lines overlap with existing truck-trails, existing cattle trails, property lines, etc., in order to further reduce potential effects.

0 50 100 150 200 Meters

1:5,000 (At original document size of 11x17)

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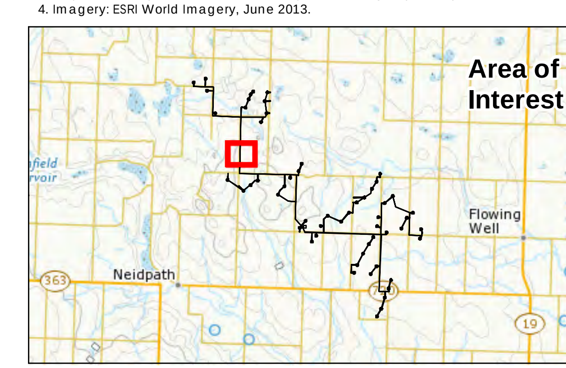

Project Location
Near Herbert, SK

113254088-047 REVC
Prepared by acory on 2017-12-18
Technical Review by ceidem on 2017-12-18

Client/Project
Algonquin Power Co.
Blue Hill Wind Energy Project

Figure No.
EPP - 9

Title
Environmental Protection Plan - Sensitive Features and Setbacks

Stantec Algonquin

- Project Development Area
- Turbine Foundation
- Crane Pad - Permanent
- New Access Road - Permanent (Operation)
- New Access Road - Temporary (Construction)
- New Electrical Collector Line
- Temporary Workspace

Wetland/Drainage

- Class 2 - Temporary Wetland
- Class 3 - Seasonal Wetland
- Drainage
- Watercourse
- Quarter Section

Disclaimer: The Project layout will be subject to minor modifications as detailed engineering progresses to a finer scale. For example, further adjustments may occur such that access roads and collector lines overlap with existing truck-trails, existing cattle trails, property lines, etc., in order to further reduce potential effects.

0 50 100 150 200 Meters

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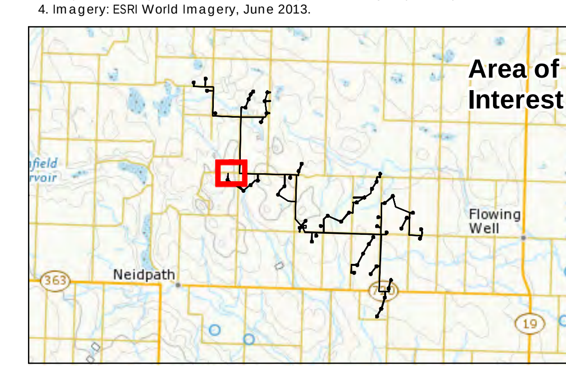

Project Location
Near Herbert, SK

113254088-047 REVC
Prepared by acory on 2017-12-18
Technical Review by ceidem on 2017-12-18

Client/Project
Algonquin Power Co.
Blue Hill Wind Energy Project

Figure No.
EPP - 10

Title
Environmental Protection Plan - Sensitive Features and Setbacks

Stantec Algonquin

- Project Development Area
- Turbine Foundation
- Crane Pad - Permanent
- New Access Road - Permanent (Operation)
- New Access Road - Temporary (Construction)
- New Electrical Collector Line
- Temporary Workspace

Wetland/Drainage

- Class 2 - Temporary Wetland
- Class 3 - Seasonal Wetland
- Dugout
- Drainage
- Watercourse
- Quarter Section

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0 50 100 150 200 Meters

1:5,000 (At original document size of 11x17)

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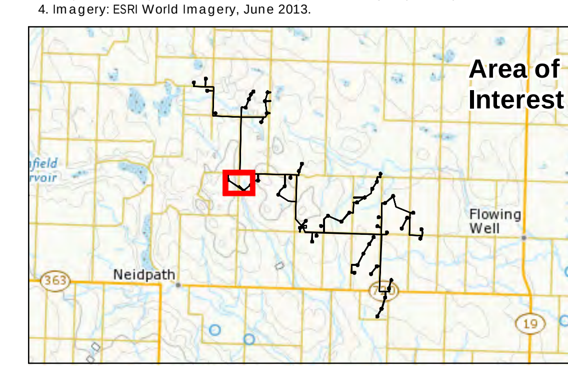


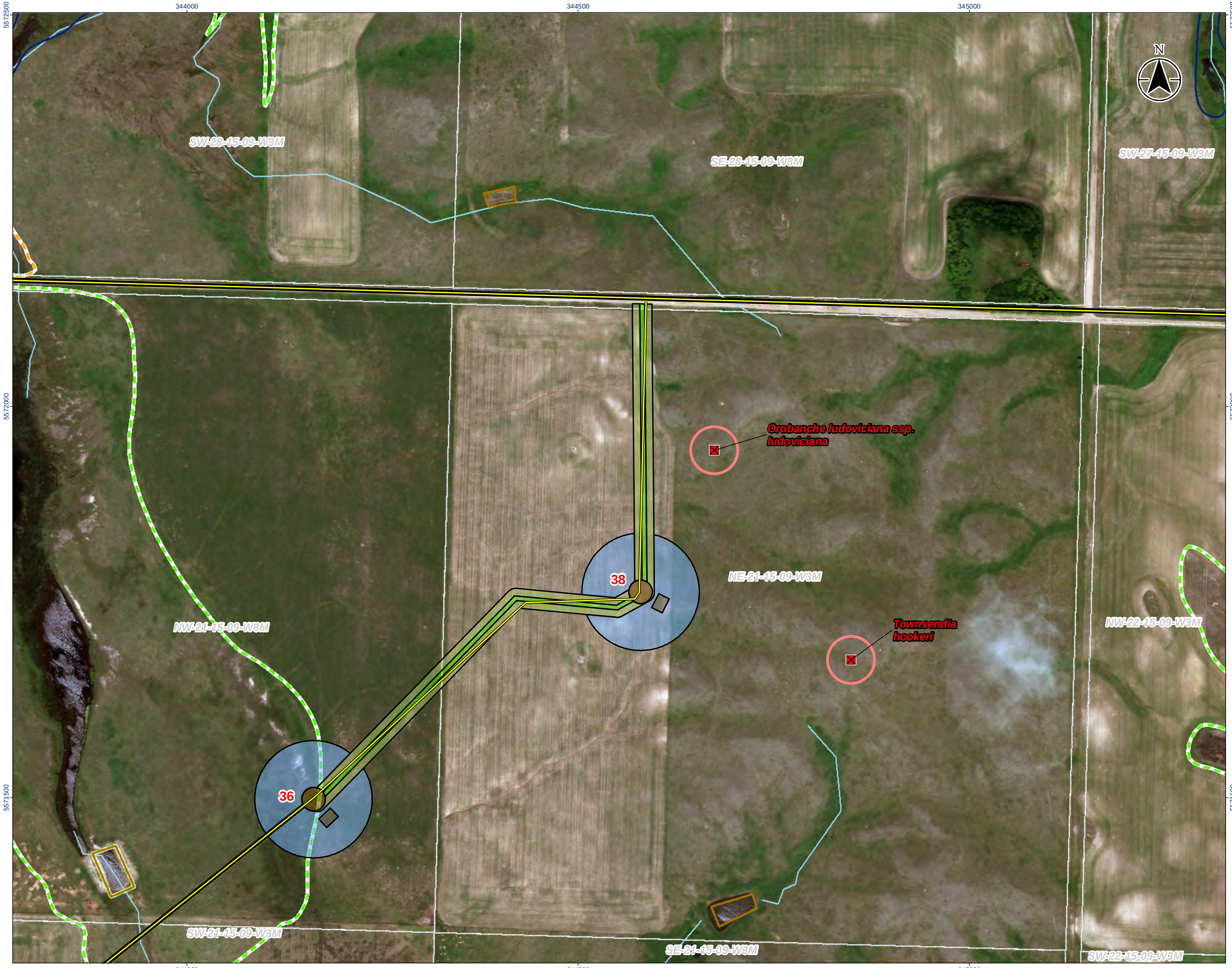
Project Location
Near Herbert, SK

113254088-047 REVC
Prepared by acory on 2017-12-18
Technical Review by ceidem on 2017-12-18

Client/Project
Algonquin Power Co.
Blue Hill Wind Energy Project

Figure No.
EPP - 11

Title
Environmental Protection Plan - Sensitive Features and Setbacks



Stantec Algonquin

- Rare Plant
- Rare Plant Setback (30 m)
- Project Development Area
- Turbine Foundation
- Crane Pad - Permanent
- New Access Road - Permanent (Operation)
- New Access Road - Temporary (Construction)
- New Electrical Collector Line
- Temporary Workspace

Wetland/Drainage

- Class 2 - Temporary Wetland
- Class 3 - Seasonal Wetland
- Dugout
- Drainage
- Watercourse
- Quarter Section

Disclaimer: The Project layout will be subject to minor modifications as detailed engineering progresses to a finer scale. For example, further adjustments may occur such that access roads and collector lines overlap with existing truck-trails, existing cattle trails, property lines, etc., in order to further reduce potential effects.

0 50 100 150 200 Meters

1:5,000 (At original document size of 11x17)

Notes

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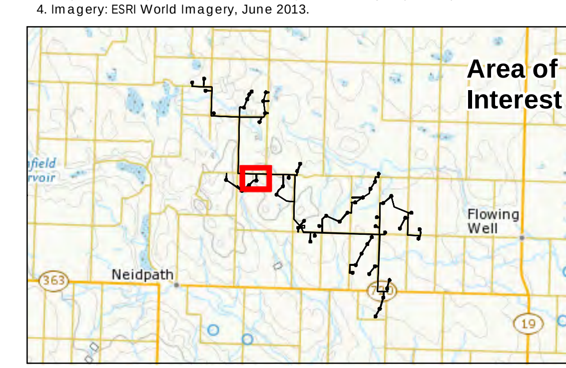
3. Project Development Area base on layout from Algonquin, Sept 06, 2017, V3
4. Imagery: ESRI World Imagery, June 2013.



Project Location
Near Herbert, SK

113254088-047 REVC
Prepared by acory on 2017-12-18
Technical Review by ceidem on 2017-12-18

Client/Project
Algonquin Power Co.
Blue Hill Wind Energy Project

Figure No.
EPP - 12

Title
Environmental Protection Plan - Sensitive Features and Setbacks

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Stantec Algonquin

- Contingency Substation
- Project Development Area
- Turbine Foundation
- Crane Pad - Permanent
- New Access Road - Permanent (Operation)
- New Access Road - Temporary (Construction)
- New Electrical Collector Line
- Temporary Workspace

Wetland/Drainage

- Class 2 - Temporary Wetland
- Class 3 - Seasonal Wetland
- Dugout
- Drainage
- Watercourse
- Quarter Section

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0 50 100 150 200 Meters

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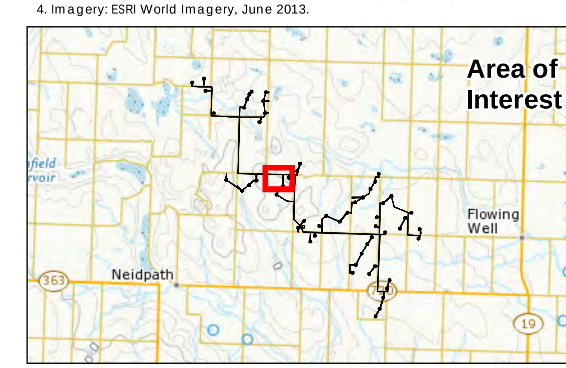

Project Location
Near Herbert, SK

113254088-047 REVC
Prepared by acory on 2017-12-18
Technical Review by ceidem on 2017-12-18

Client/Project
Algonquin Power Co.
Blue Hill Wind Energy Project

Figure No.
EPP - 13

Title
Environmental Protection Plan - Sensitive Features and Setbacks

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Stantec Algonquin

- Project Development Area
- Turbine Foundation
- Crane Pad - Permanent
- New Access Road - Permanent (Operation)
- New Access Road - Temporary (Construction)
- New Electrical Collector Line
- Temporary Workspace

Wetland/Drainage

- Class 2 - Temporary Wetland
- Dugout
- Drainage
- Watercourse
- Quarter Section

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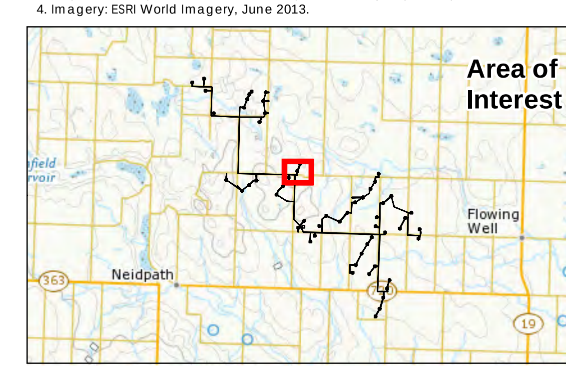

Project Location
Near Herbert, SK

113254088-047 REVC
Prepared by acory on 2017-12-18
Technical Review by ceidem on 2017-12-18

Client/Project
Algonquin Power Co.
Blue Hill Wind Energy Project

Figure No.
EPP - 14

Title
Environmental Protection Plan - Sensitive Features and Setbacks

Stantec Algonquin

- Contingency Substation
- Project Development Area
- Turbine Foundation
- Crane Pad - Permanent
- New Access Road - Permanent (Operation)
- New Access Road - Temporary (Construction)
- New Electrical Collector Line
- Temporary Workspace

Wetland/Drainage

- Class 2 - Temporary Wetland
- Class 3 - Seasonal Wetland
- Watercourse
- Quarter Section

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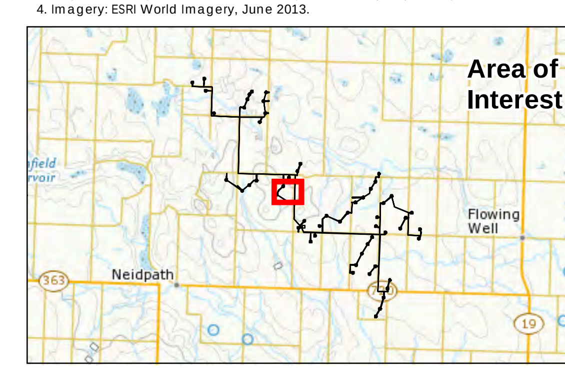

Project Location
Near Herbert, SK

113254088-047 REVC
Prepared by acory on 2017-12-18
Technical Review by ceidem on 2017-12-18

Client/Project
Algonquin Power Co.
Blue Hill Wind Energy Project

Figure No.
EPP - 15

Title
Environmental Protection Plan - Sensitive Features and Setbacks

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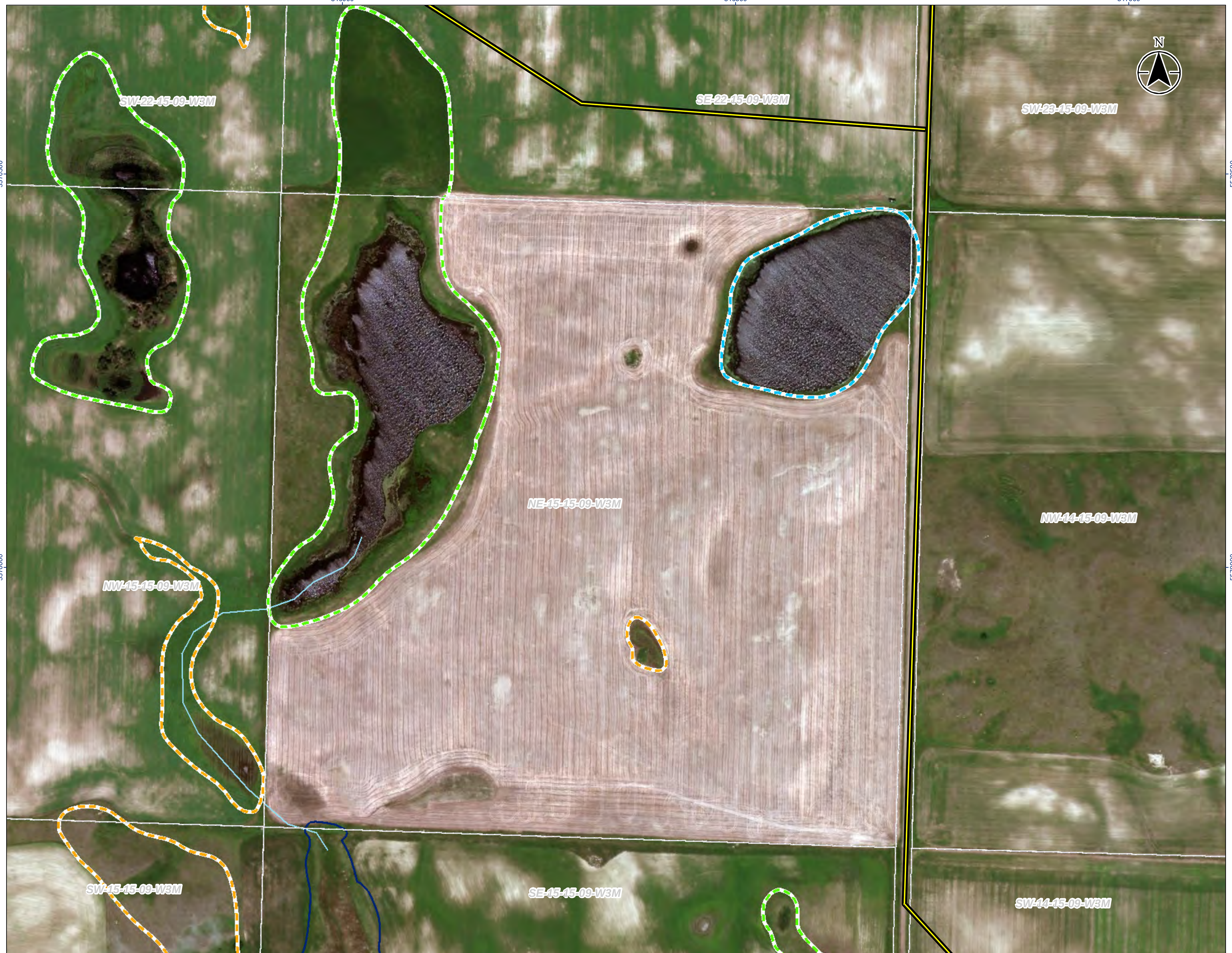

Project Development Area
New Electrical Collector Line
Wetland/Drainage
Class 2 - Temporary Wetland
Class 3 - Seasonal Wetland
Class 4 - Semi-Permanent Wetland
Drainage
Watercourse
Quarter Section

Disclaimer: The Project layout will be subject to minor modifications as detailed engineering progresses to a finer scale. For example, further adjustments may occur such that access roads and collector lines overlap with existing truck-trails, existing cattle trails, property lines, etc., in order to further reduce potential effects.

0 50 100 150 200 Meters
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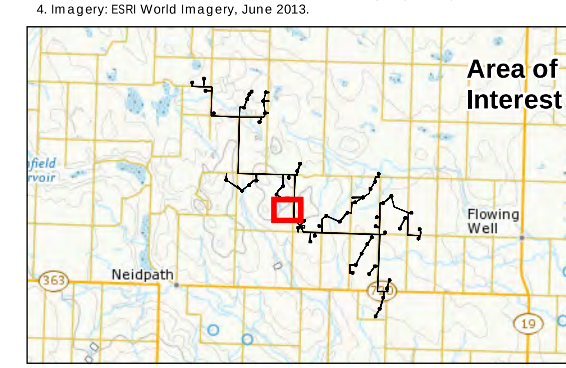

Project Location
Near Herbert, SK

113254088-047 REVC
Prepared by acory on 2017-12-18
Technical Review by ceidem on 2017-12-18

Client/Project
Algonquin Power Co.
Blue Hill Wind Energy Project

Figure No.
EPP - 16

Title
Environmental Protection Plan - Sensitive Features and Setbacks

Stantec Algonquin

- Substation
- Project Development Area
- Turbine Foundation
- Crane Pad - Permanent
- Substation - Main
- New Access Road - Permanent (Operation)
- New Access Road - Temporary (Construction)
- New Electrical Collector Line
- Temporary Workspace

Wetland/Drainage

- Class 2 - Temporary Wetland
- Class 3 - Seasonal Wetland
- Drainage
- Watercourse
- Quarter Section

Disclaimer: The Project layout will be subject to minor modifications as detailed engineering progresses to a finer scale. For example, further adjustments may occur such that access roads and collector lines overlap with existing truck-trails, existing cattle trails, property lines, etc., in order to further reduce potential effects.

0 50 100 150 200 Meters

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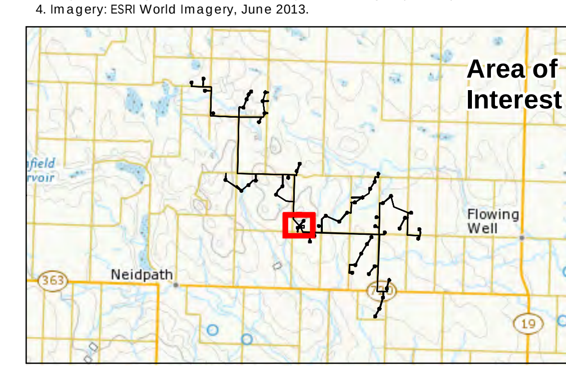


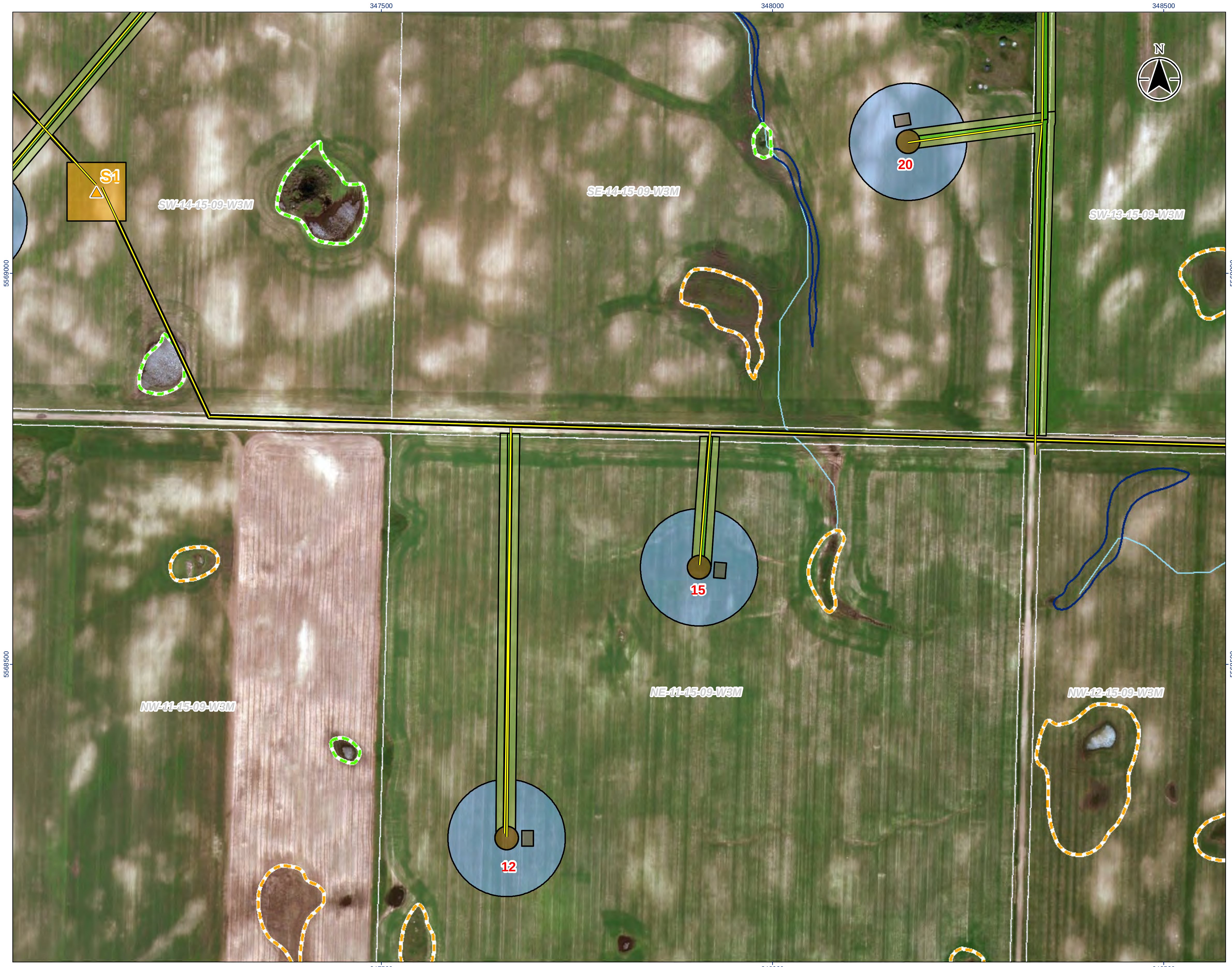
Project Location
Near Herbert, SK

113254088-047 REVC
Prepared by acory on 2017-12-18
Technical Review by ceidem on 2017-12-18

Client/Project
Algonquin Power Co.
Blue Hill Wind Energy Project

Figure No.
EPP - 17

Title
Environmental Protection Plan - Sensitive Features and Setbacks



Stantec Algonquin

- Substation
- Project Development Area
- Turbine Foundation
- Crane Pad - Permanent
- Substation - Main
- New Access Road - Permanent (Operation)
- New Access Road - Temporary (Construction)
- New Electrical Collector Line
- Temporary Workspace

Wetland/Drainage

- Class 2 - Temporary Wetland
- Class 3 - Seasonal Wetland
- Drainage
- Watercourse
- Quarter Section

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0 50 100 150 200 Meters

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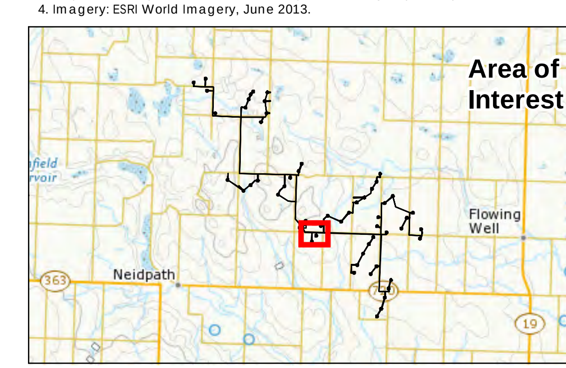

Project Location
Near Herbert, SK

113254088-047 REVC
Prepared by acory on 2017-12-18
Technical Review by ceidem on 2017-12-18

Client/Project
Algonquin Power Co.
Blue Hill Wind Energy Project

Figure No.
EPP - 18

Title
Environmental Protection Plan - Sensitive Features and Setbacks

Stantec Algonquin

- Project Development Area
- Turbine Foundation
- Crane Pad - Permanent
- New Access Road - Permanent (Operation)
- New Access Road - Temporary (Construction)
- New Electrical Collector Line
- Temporary Workspace

Wetland/Drainage

- Class 1 - Ephemeral Wetland
- Class 2 - Temporary Wetland
- Class 3 - Seasonal Wetland
- Dugout
- Drainage
- Watercourse
- Quarter Section

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0 50 100 150 200 Meters

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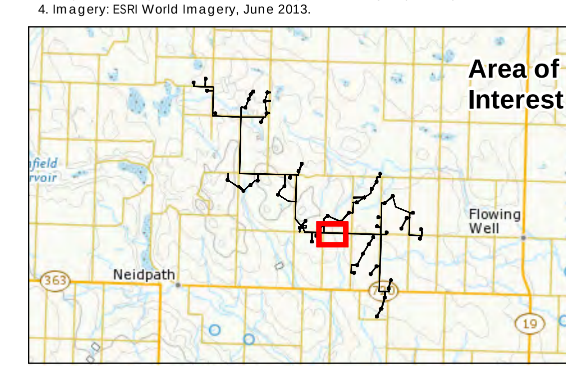

Project Location
Near Herbert, SK

113254088-047 REVC
Prepared by acory on 2017-12-18
Technical Review by ceidem on 2017-12-18

Client/Project
Algonquin Power Co.
Blue Hill Wind Energy Project

Figure No.
EPP - 19

Title
Environmental Protection Plan - Sensitive Features and Setbacks

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Stantec Algonquin

Northern Leopard Frog Breeding Pond Setback (500 m, Year round)

Project Development Area
Turbine Foundation
Crane Pad - Permanent
New Access Road - Permanent (Operation)
New Access Road - Temporary (Construction)
New Electrical Collector Line
Temporary Workspace

Wetland/Drainage

Class 1 - Ephemeral Wetland
Class 2 - Temporary Wetland
Drainage
Watercourse
Quarter Section

Disclaimer: The Project layout will be subject to minor modifications as detailed engineering progresses to a finer scale. For example, further adjustments may occur such that access roads and collector lines overlap with existing truck-trails, existing cattle trails, property lines, etc., in order to further reduce potential effects.

0 50 100 150 200 Meters
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Notes

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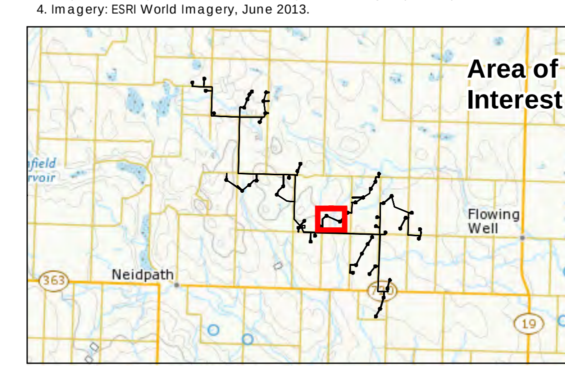


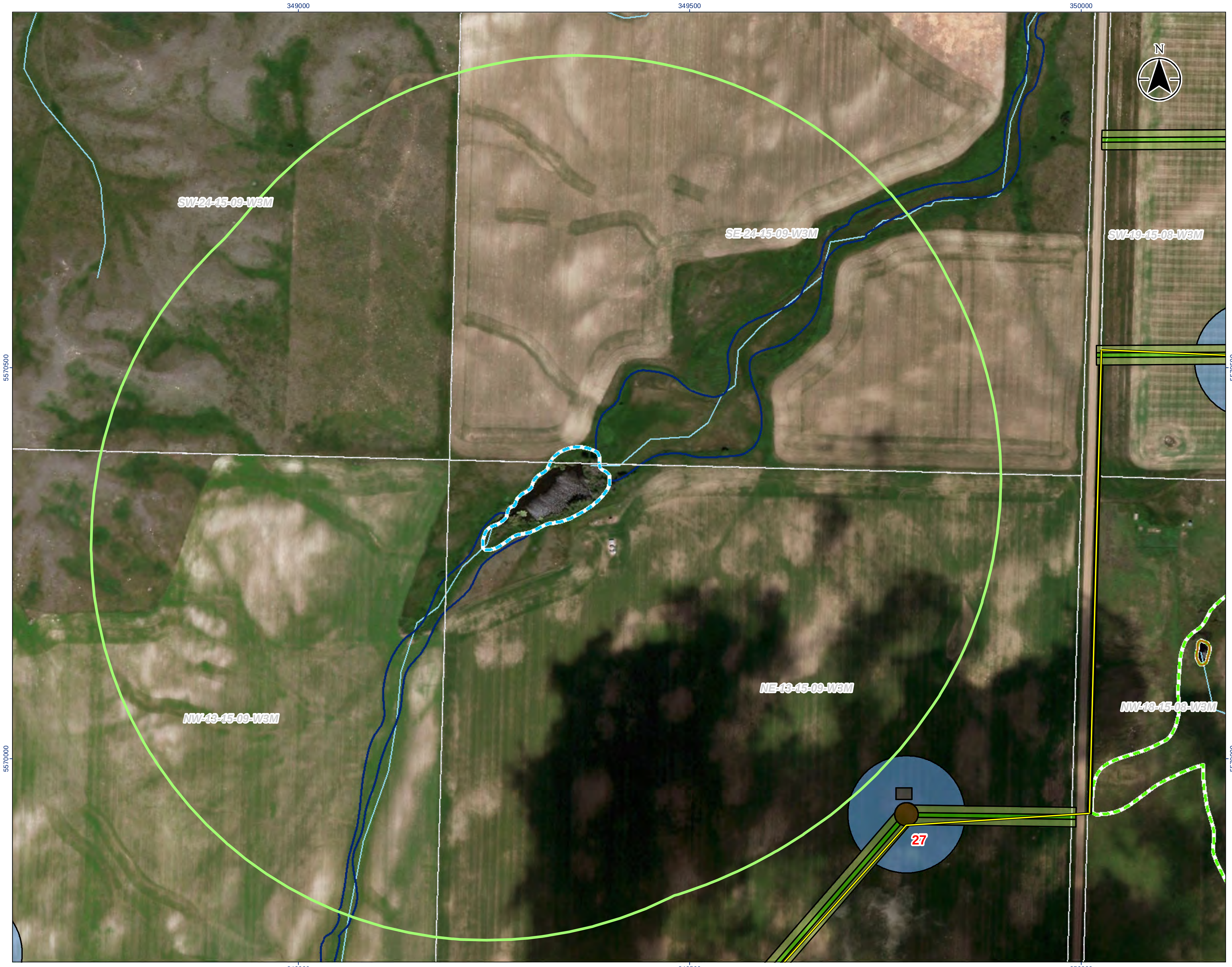
Project Location
Near Herbert, SK

113254088-047 REVC
Prepared by acory on 2017-12-18
Technical Review by ceidem on 2017-12-18

Client/Project
Algonquin Power Co.
Blue Hill Wind Energy Project

Figure No.
EPP - 20

Title
Environmental Protection Plan - Sensitive Features and Setbacks



Stantec Algonquin

Northern Leopard Frog Breeding Pond Setback (500 m, Year round)

Project Development Area
Turbine Foundation
Crane Pad - Permanent
New Access Road - Permanent (Operation)
New Access Road - Temporary (Construction)
New Electrical Collector Line
Temporary Workspace

Wetland/Drainage

Class 3 - Seasonal Wetland
Class 4 - Semi-Permanent Wetland
Dugout
Drainage
Watercourse
Quarter Section

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0 50 100 150 200 Meters

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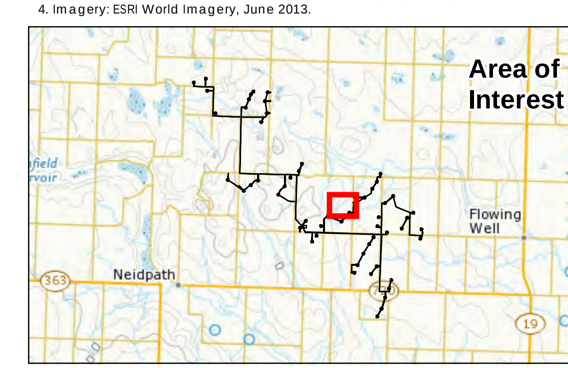

Project Location
Near Herbert, SK

113254088-047 REVC
Prepared by acory on 2017-12-18
Technical Review by ceidem on 2017-12-18

Client/Project
Algonquin Power Co.
Blue Hill Wind Energy Project

Figure No.
EPP - 21

Title
Environmental Protection Plan - Sensitive Features and Setbacks

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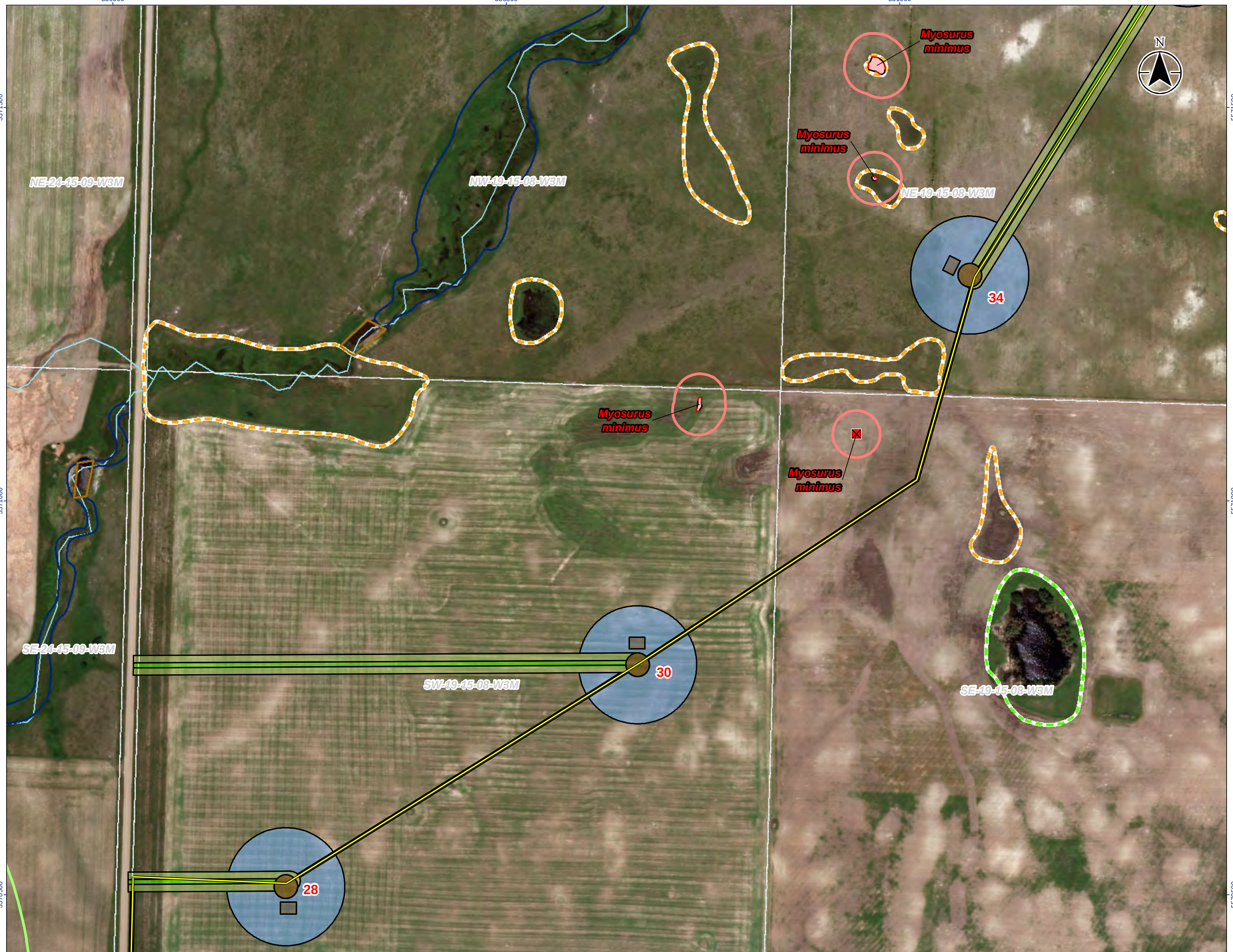

Stantec Algonquin

- Rare Plant
- Rare Plant Area
- Northern Leopard Frog Breeding Pond Setback (500 m, Year round)
- Rare Plant Setback (30 m)
- Project Development Area
- Turbine Foundation
- Crane Pad - Permanent
- New Access Road - Permanent (Operation)
- New Access Road - Temporary (Construction)
- New Electrical Collector Line
- Temporary Workspace

Wetland/Drainage

- Class 2 - Temporary Wetland
- Class 3 - Seasonal Wetland
- Dugout
- Drainage
- Watercourse
- Quarter Section

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0 50 100 150 200 Meters

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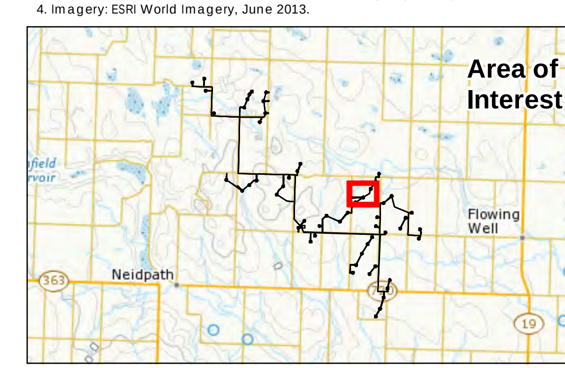


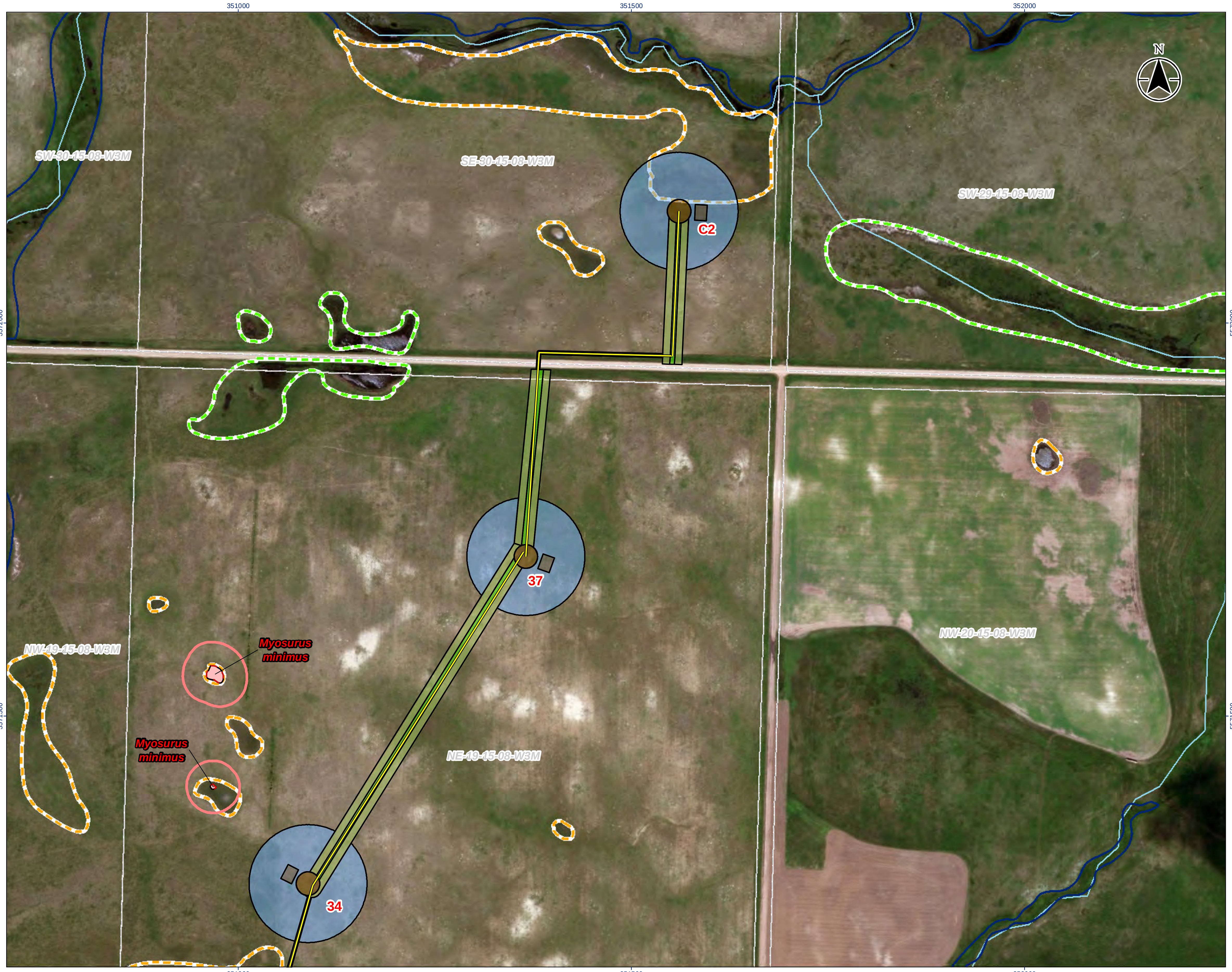
Project Location
Near Herbert, SK

113254088-047 REVC
Prepared by acory on 2017-12-18
Technical Review by ceidem on 2017-12-18

Client/Project
Algonquin Power Co.
Blue Hill Wind Energy Project

Figure No.
EPP - 22

Title
Environmental Protection Plan - Sensitive Features and Setbacks



Stantec Algonquin

- Rare Plant Area
- Rare Plant Setback (30 m)
- Project Development Area
- Turbine Foundation
- Crane Pad - Permanent
- New Access Road - Permanent (Operation)
- New Access Road - Temporary (Construction)
- New Electrical Collector Line
- Temporary Workspace

Wetland/Drainage

- Class 2 - Temporary Wetland
- Class 3 - Seasonal Wetland
- Drainage
- Watercourse
- Quarter Section

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0 50 100 150 200 Meters

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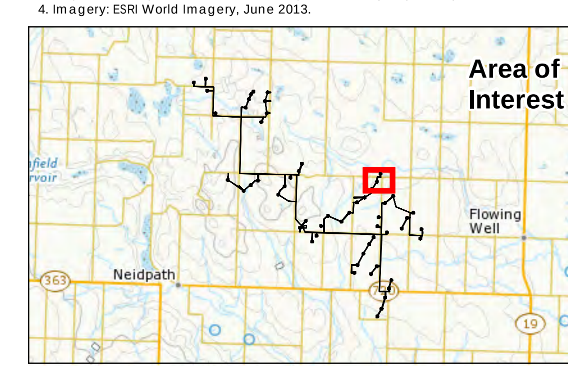


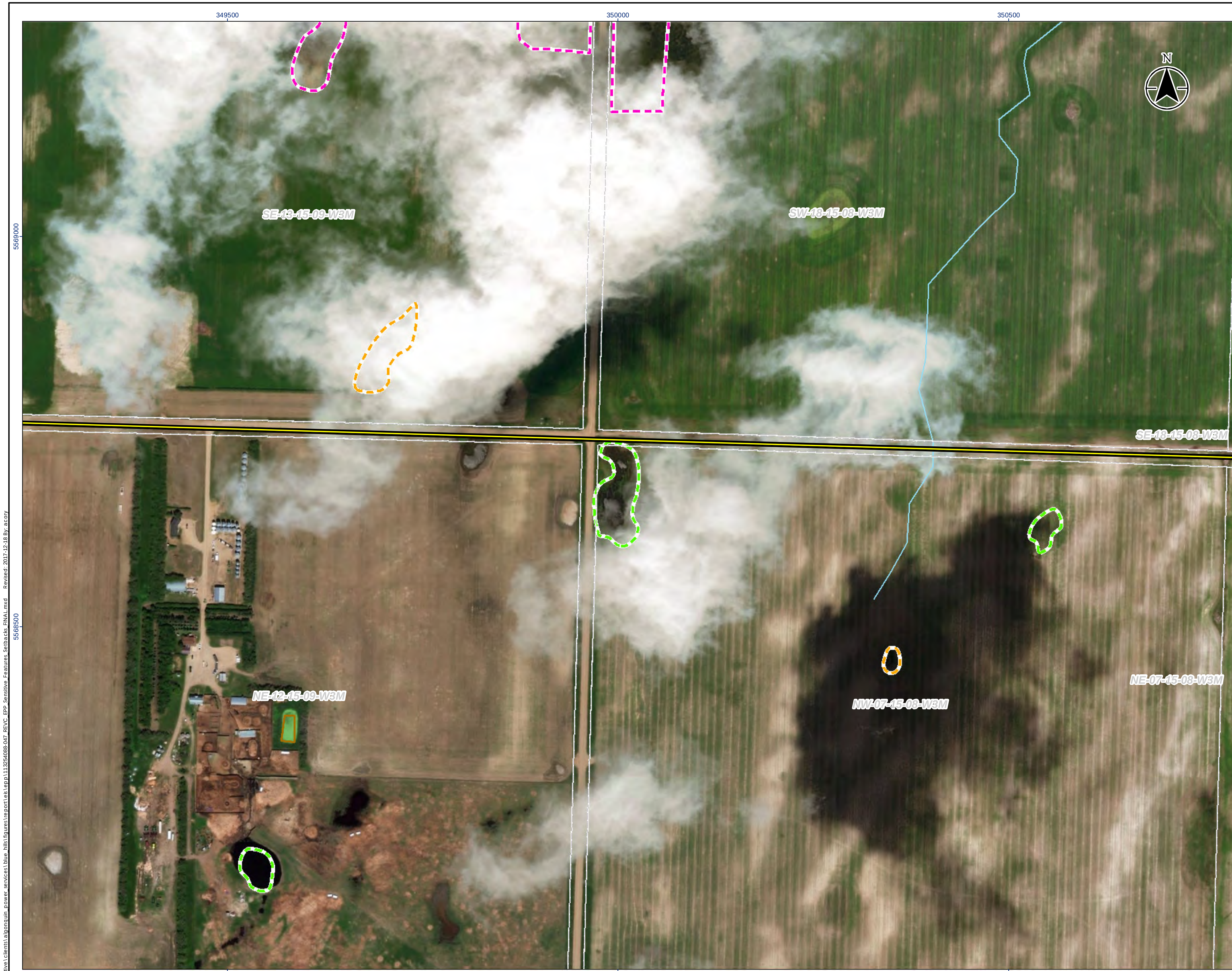
Project Location
Near Herbert, SK

113254088-047 REVC
Prepared by acory on 2017-12-18
Technical Review by ceidem on 2017-12-18

Client/Project
Algonquin Power Co.
Blue Hill Wind Energy Project

Figure No.
EPP - 23

Title
Environmental Protection Plan - Sensitive Features and Setbacks



Stantec Algonquin

- Project Development Area
- New Electrical Collector Line

Wetland/Drainage

- Class 1 - Ephemeral Wetland
- Class 2 - Temporary Wetland
- Class 3 - Seasonal Wetland
- Dugout
- Watercourse
- Quarter Section

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0 50 100 150 200 Meters

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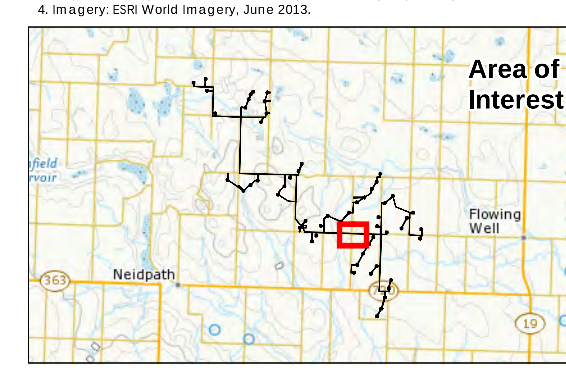

Project Location
Near Herbert, SK

113254088-047 REVC
Prepared by acory on 2017-12-18
Technical Review by ceidem on 2017-12-18

Client/Project
Algonquin Power Co.
Blue Hill Wind Energy Project

Figure No.
EPP - 24

Title
Environmental Protection Plan - Sensitive Features and Setbacks

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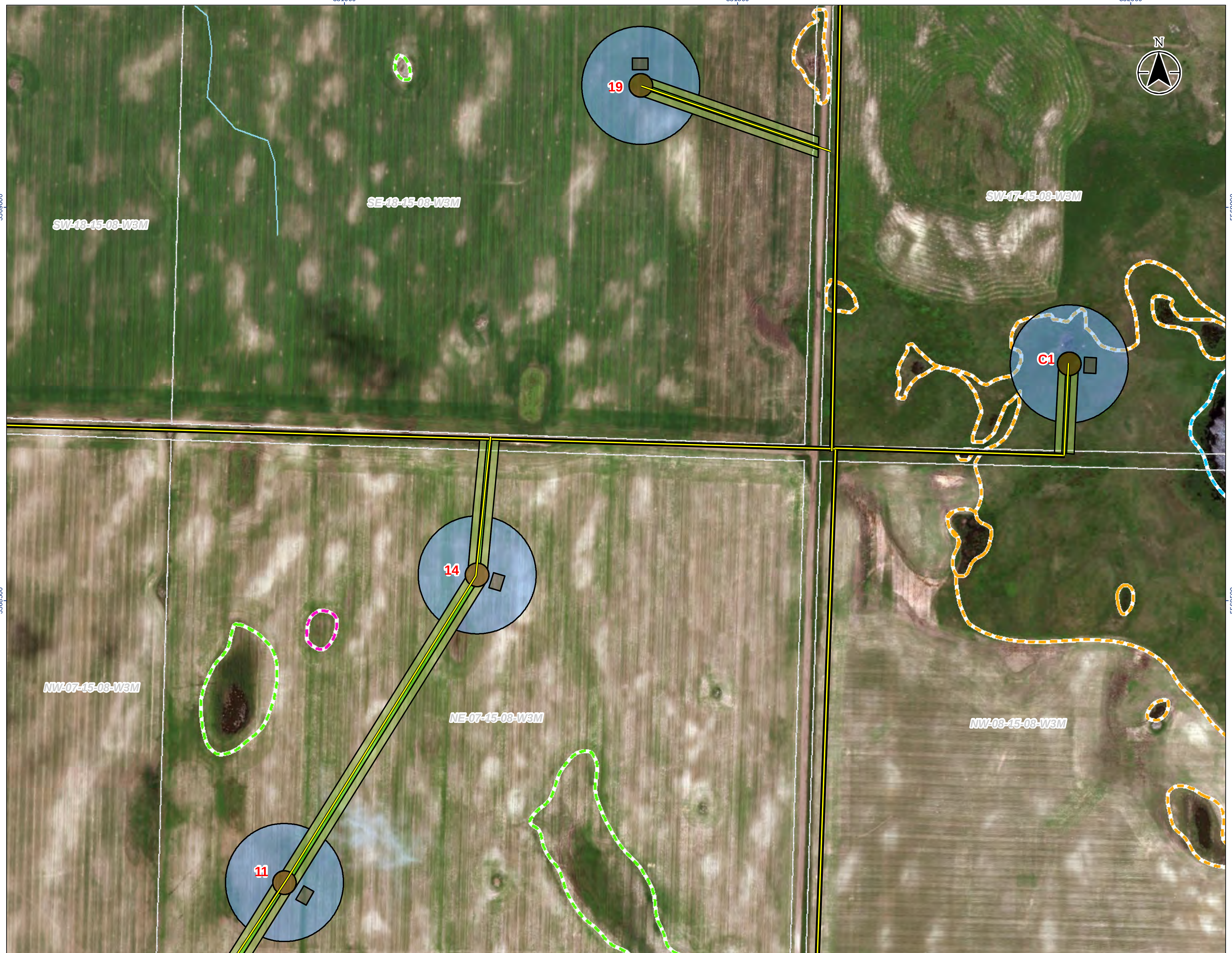

Project Development Area
Turbine Foundation
Crane Pad - Permanent
New Access Road - Permanent (Operation)
New Access Road - Temporary (Construction)
New Electrical Collector Line
Temporary Workspace

Wetland/Drainage

Class 1 - Ephemeral Wetland
Class 2 - Temporary Wetland
Class 3 - Seasonal Wetland
Class 4 - Semi-Permanent Wetland
Watercourse
Quarter Section

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0 50 100 150 200 Meters
1:5,000 (At original document size of 11x17)

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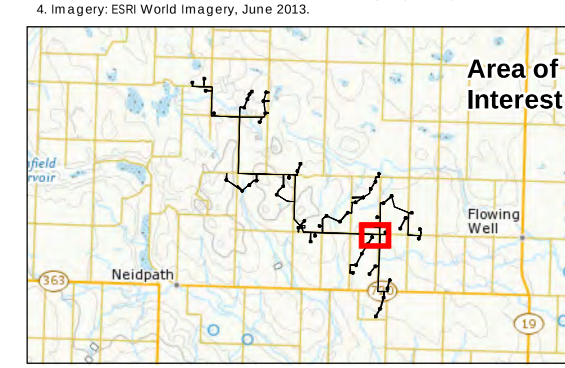


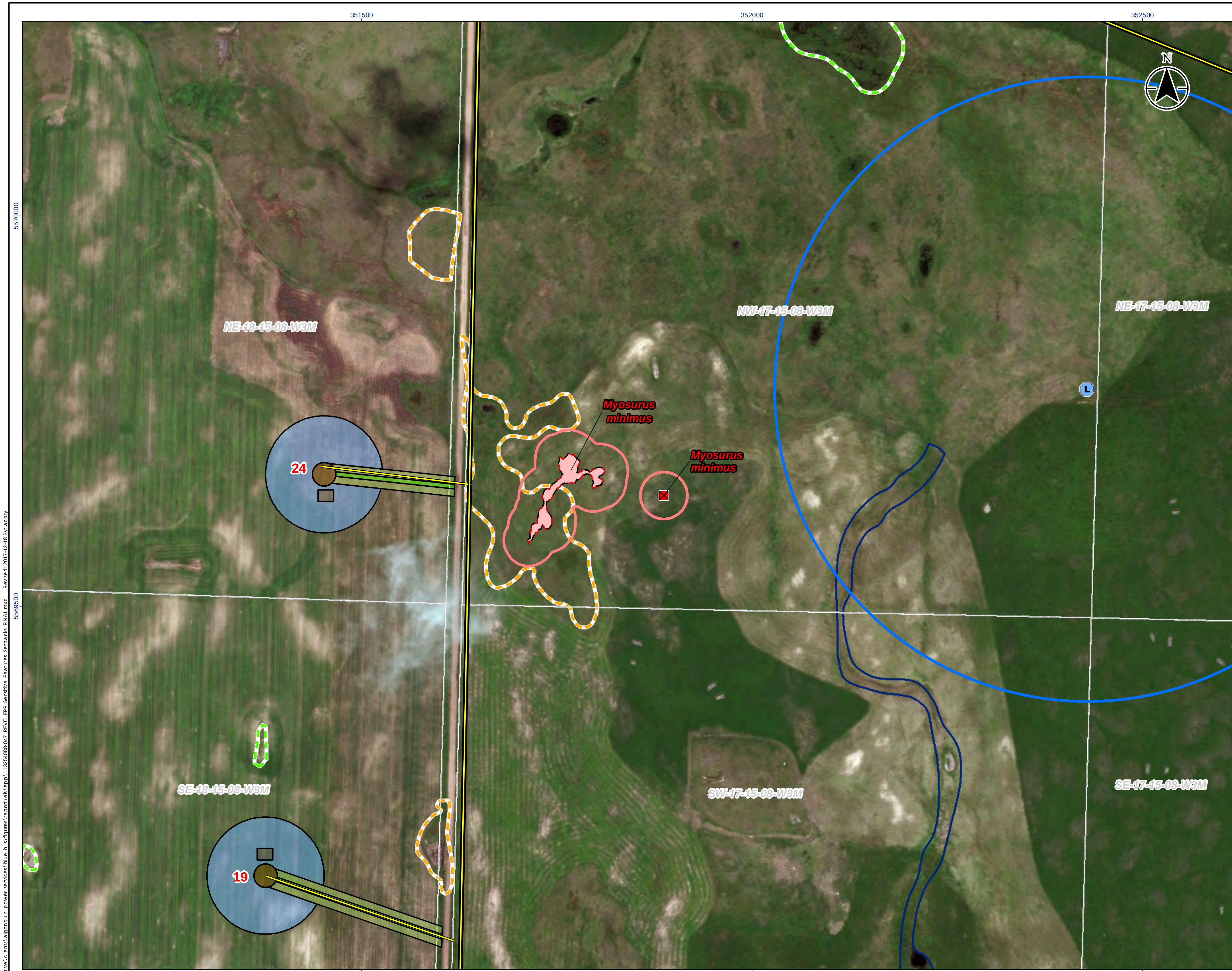
Project Location
Near Herbert, SK

113254088-047 REVC
Prepared by acory on 2017-12-18
Technical Review by ceidem on 2017-12-18

Client/Project
Algonquin Power Co.
Blue Hill Wind Energy Project

Figure No.
EPP - 25

Title
Environmental Protection Plan - Sensitive Features and Setbacks



Stantec Algonquin

- Sharp-tailed Grouse Lek
- Rare Plant
- Rare Plant Area
- Sharp-tailed Grouse Lek Setback (400 m, March 15 to May 15)
- Rare Plant Setback (30 m)
- Project Development Area
- Turbine Foundation
- Crane Pad - Permanent
- New Access Road - Permanent (Operation)
- New Access Road - Temporary (Construction)
- New Electrical Collector Line
- Temporary Workspace

Wetland/Drainage

- Class 2 - Temporary Wetland
- Class 3 - Seasonal Wetland
- Drainage
- Quarter Section

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0 50 100 150 200 Meters

1:5,000 (At original document size of 11x17)

Notes

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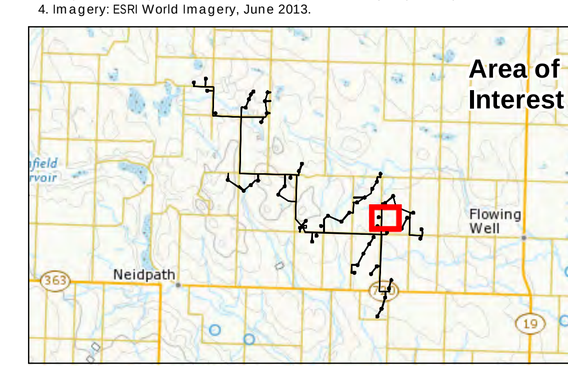
4. Imagery: ESRI World Imagery, June 2013.



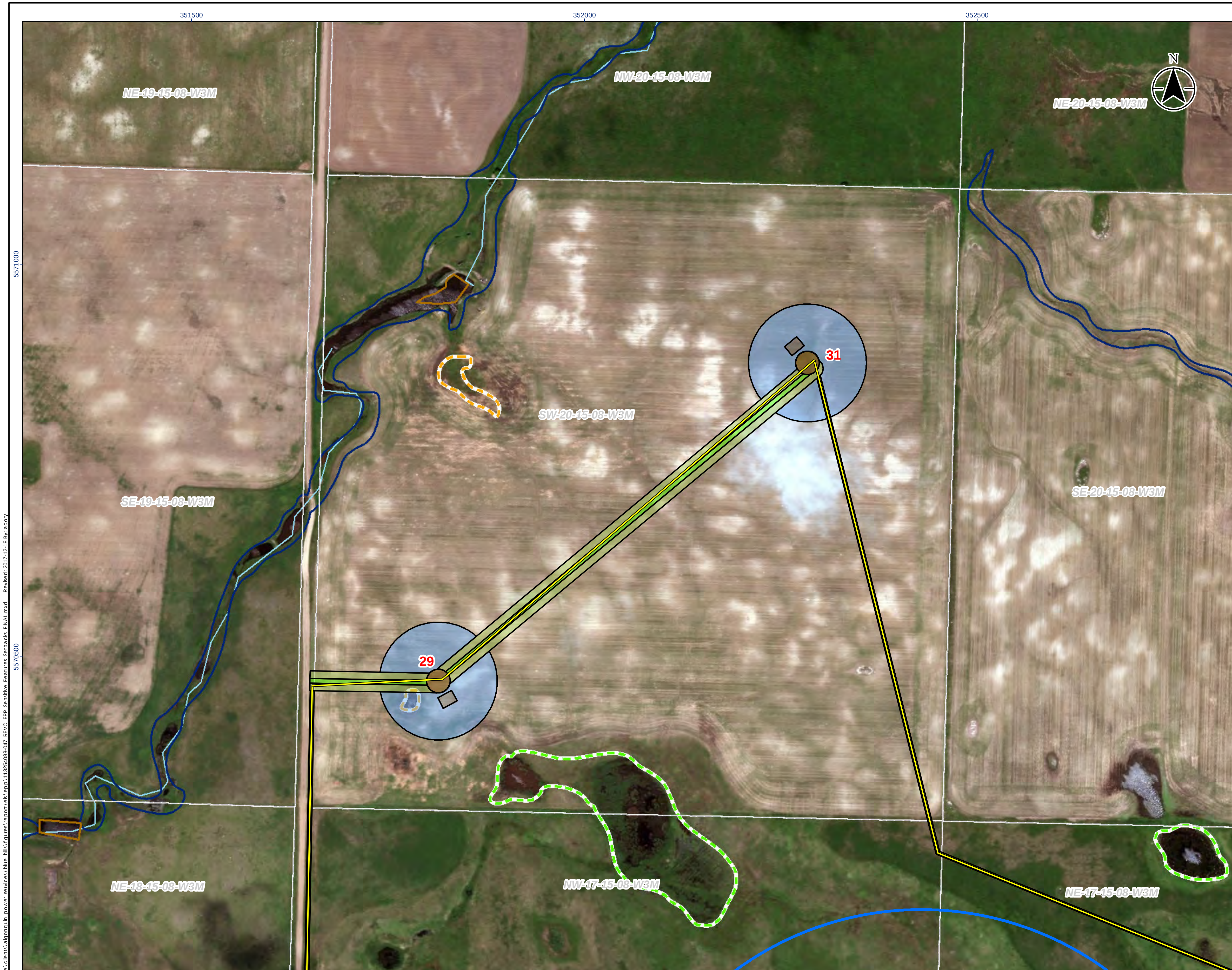
Project Location
Near Herbert, SK

113254088-047 REVC
Prepared by acory on 2017-12-18
Technical Review by ceidem on 2017-12-18

Client/Project
Algonquin Power Co.
Blue Hill Wind Energy Project

Figure No.
EPP - 26

Title
Environmental Protection Plan - Sensitive Features and Setbacks



Stantec Algonquin

- Sharp-tailed Grouse Lek Setback (400 m, March 15 to May 15)
- Project Development Area
- Turbine Foundation
- Crane Pad - Permanent
- New Access Road - Permanent (Operation)
- New Access Road - Temporary (Construction)
- New Electrical Collector Line
- Temporary Workspace

Wetland/Drainage

- Class 2 - Temporary Wetland
- Class 3 - Seasonal Wetland
- Dugout
- Drainage
- Watercourse
- Quarter Section

Disclaimer: The Project layout will be subject to minor modifications as detailed engineering progresses to a finer scale. For example, further adjustments may occur such that access roads and collector lines overlap with existing truck-trails, existing cattle trails, property lines, etc., in order to further reduce potential effects.

0 50 100 150 200 Meters

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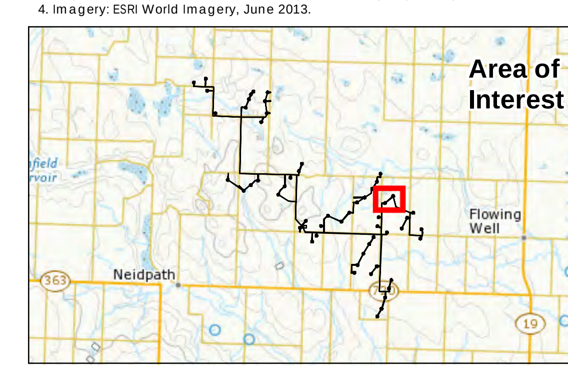

Project Location
Near Herbert, SK

113254088-047 REVC
Prepared by acory on 2017-12-18
Technical Review by ceidem on 2017-12-18

Client/Project
Algonquin Power Co.
Blue Hill Wind Energy Project

Figure No.
EPP - 27

Title
Environmental Protection Plan - Sensitive Features and Setbacks

Stantec Algonquin

- Sharp-tailed Grouse Lek
- Sharp-tailed Grouse Lek Setback (400 m, March 15 to May 15)
- Project Development Area
- Turbine Foundation
- Crane Pad - Permanent
- New Access Road - Permanent (Operation)
- New Access Road - Temporary (Construction)
- New Electrical Collector Line
- Temporary Workspace

Wetland/Drainage

- Class 3 - Seasonal Wetland
- Dugout
- Drainage
- Quarter Section

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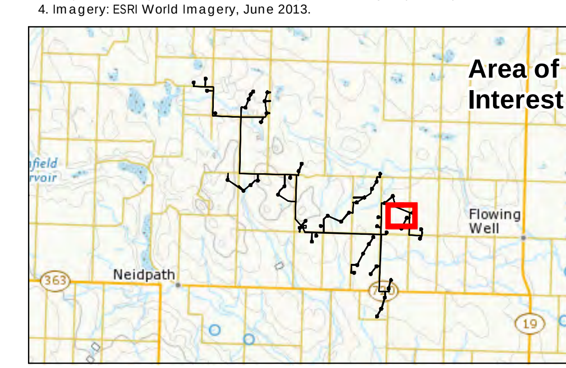

Project Location
Near Herbert, SK

113254088-047 REVC
Prepared by acory on 2017-12-18
Technical Review by ceidem on 2017-12-18

Client/Project
Algonquin Power Co.
Blue Hill Wind Energy Project

Figure No.
EPP - 28

Title
Environmental Protection Plan - Sensitive Features and Setbacks

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Sharp-tailed Grouse Lek

Rare Plant

Sharp-tailed Grouse Lek Setback (400 m, March 15 to May 15)

Rare Plant Setback (30 m)

Project Development Area

Turbine Foundation

Crane Pad - Permanent

New Access Road - Permanent (Operation)

New Access Road - Temporary (Construction)

New Electrical Collector Line

Temporary Workspace

Wetland/Drainage

Class 2 - Temporary Wetland

Class 3 - Seasonal Wetland

Watercourse

Quarter Section

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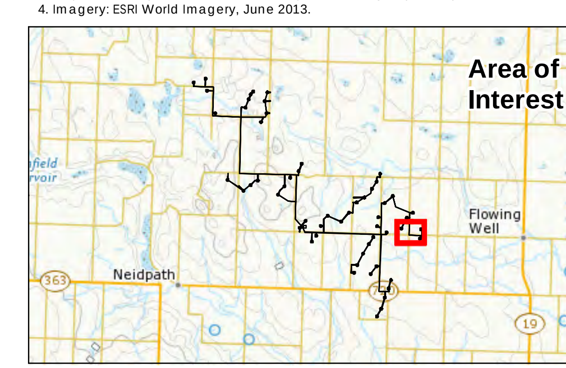


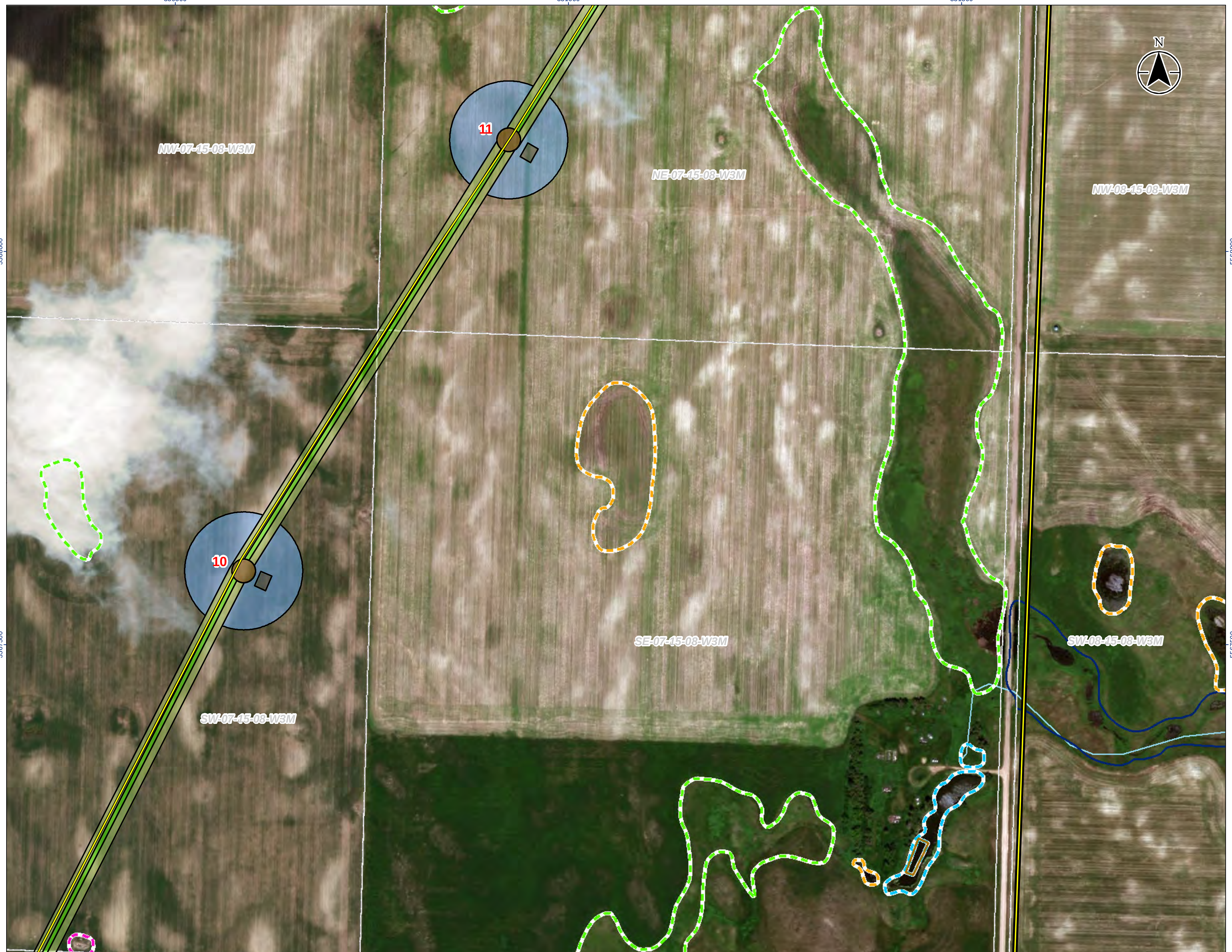
Project Location
Near Herbert, SK

113254088-047 REVC
Prepared by acory on 2017-12-18
Technical Review by ceidem on 2017-12-18

Client/Project
Algonquin Power Co.
Blue Hill Wind Energy Project

Figure No.
EPP - 29

Title
Environmental Protection Plan - Sensitive Features and Setbacks



- Project Development Area
- Turbine Foundation
- Crane Pad - Permanent
- New Access Road - Permanent (Operation)
- New Access Road - Temporary (Construction)
- New Electrical Collector Line
- Temporary Workspace

Wetland/Drainage

- Class 1 - Ephemeral Wetland
- Class 2 - Temporary Wetland
- Class 3 - Seasonal Wetland
- Class 4 - Semi-Permanent Wetland
- Dugout
- Drainage
- Watercourse
- Quarter Section

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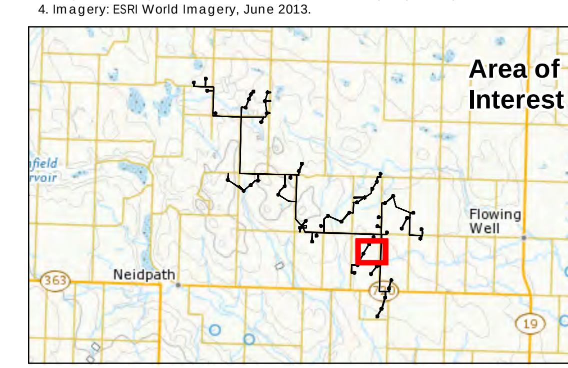

Project Location
Near Herbert, SK

113254088-047 REVC
Prepared by acory on 2017-12-18
Technical Review by ceidem on 2017-12-18

Client/Project
Algonquin Power Co.
Blue Hill Wind Energy Project

Figure No.
EPP - 30

Title
Environmental Protection Plan - Sensitive Features and Setbacks

Stantec Algonquin

- Project Development Area
- Turbine Foundation
- Crane Pad - Permanent
- New Access Road - Permanent (Operation)
- New Access Road - Temporary (Construction)
- New Electrical Collector Line
- Temporary Workspace

Wetland/Drainage

- Class 1 - Ephemeral Wetland
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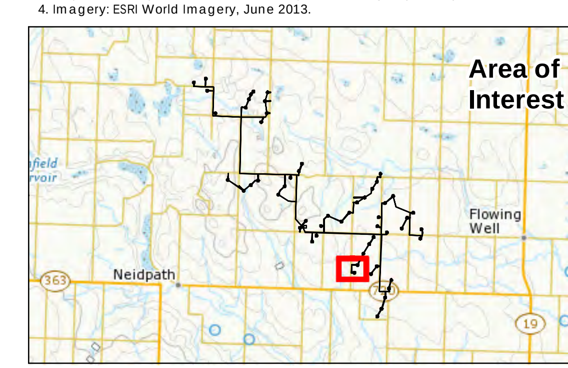

Project Location
Near Herbert, SK

113254088-047 REVC
Prepared by acory on 2017-12-18
Technical Review by ceidem on 2017-12-18

Client/Project
Algonquin Power Co.
Blue Hill Wind Energy Project

Figure No.
EPP - 31

Title
Environmental Protection Plan - Sensitive Features and Setbacks

Stantec Algonquin

- Project Development Area
- Turbine Foundation
- Crane Pad - Permanent
- New Access Road - Permanent (Operation)
- New Access Road - Temporary (Construction)
- New Electrical Collector Line
- Temporary Workspace

Wetland/Drainage

- Class 1 - Ephemeral Wetland
- Class 2 - Temporary Wetland
- Class 3 - Seasonal Wetland
- Class 4 - Semi-Permanent Wetland
- Dugout
- Drainage
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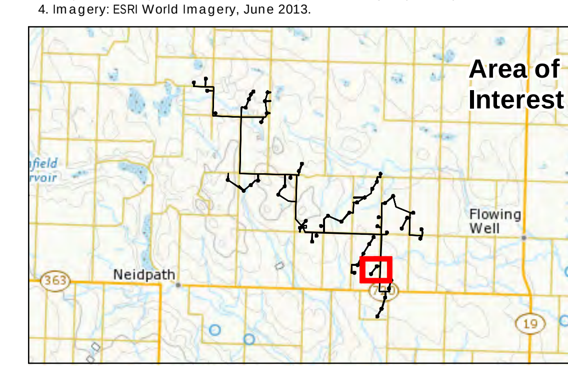

Project Location
Near Herbert, SK

113254088-047 REVC
Prepared by acory on 2017-12-18
Technical Review by ceidem on 2017-12-18

Client/Project
Algonquin Power Co.
Blue Hill Wind Energy Project

Figure No.
EPP - 32

Title
Environmental Protection Plan - Sensitive Features and Setbacks

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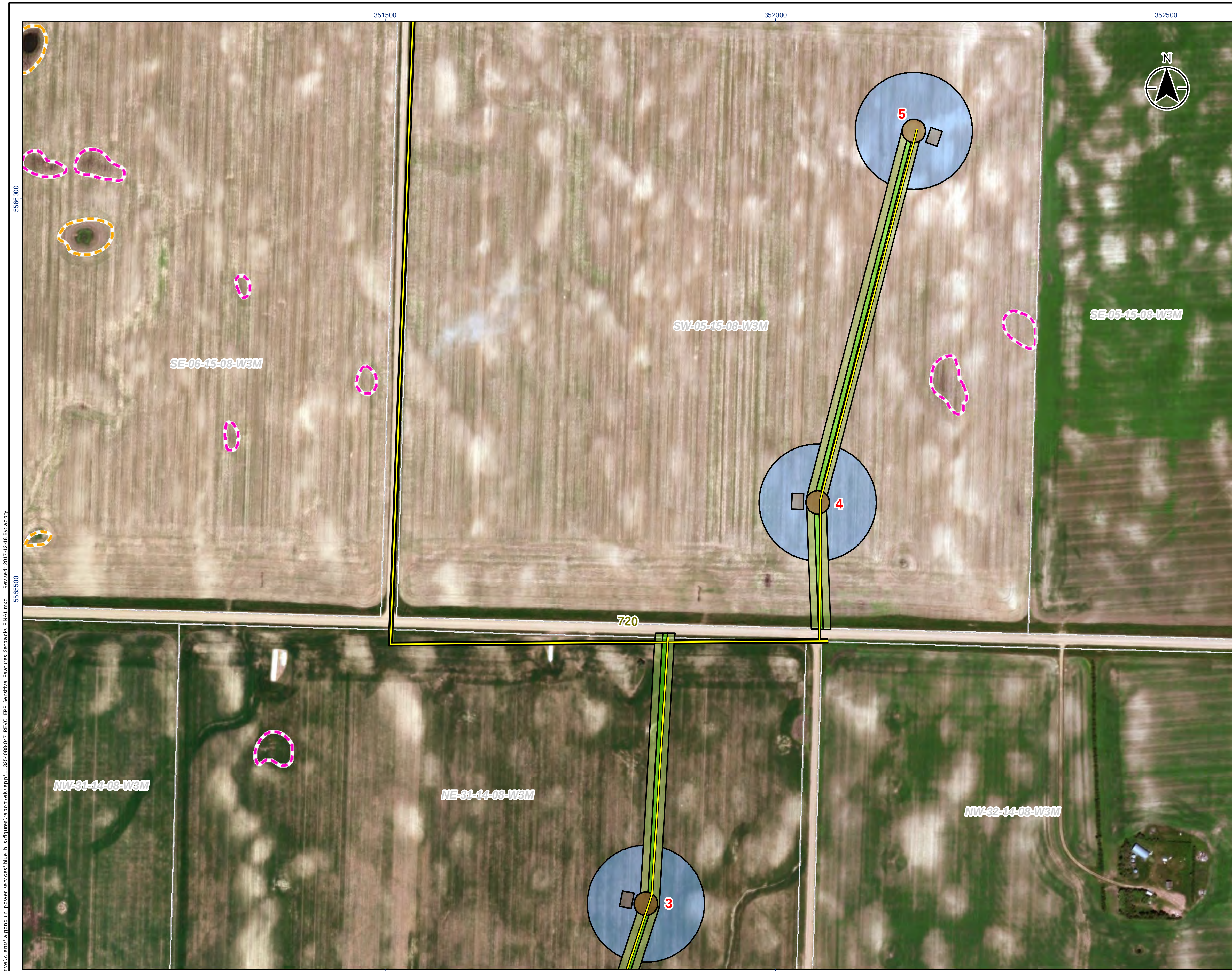

Stantec Algonquin

- Project Development Area
- Turbine Foundation
- Crane Pad - Permanent
- New Access Road - Permanent (Operation)
- New Access Road - Temporary (Construction)
- New Electrical Collector Line
- Temporary Workspace

Wetland/Drainage

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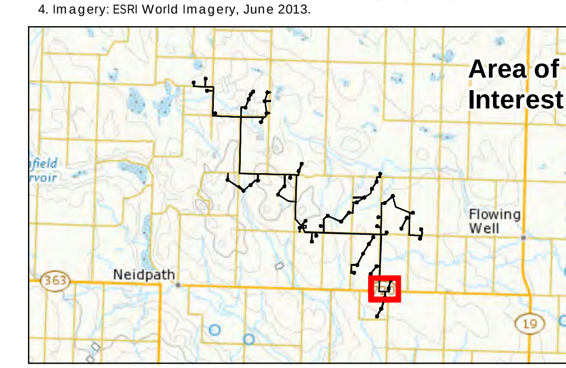

Project Location
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Client/Project
Algonquin Power Co.
Blue Hill Wind Energy Project

Figure No.
EPP - 33

Title
Environmental Protection Plan - Sensitive Features and Setbacks

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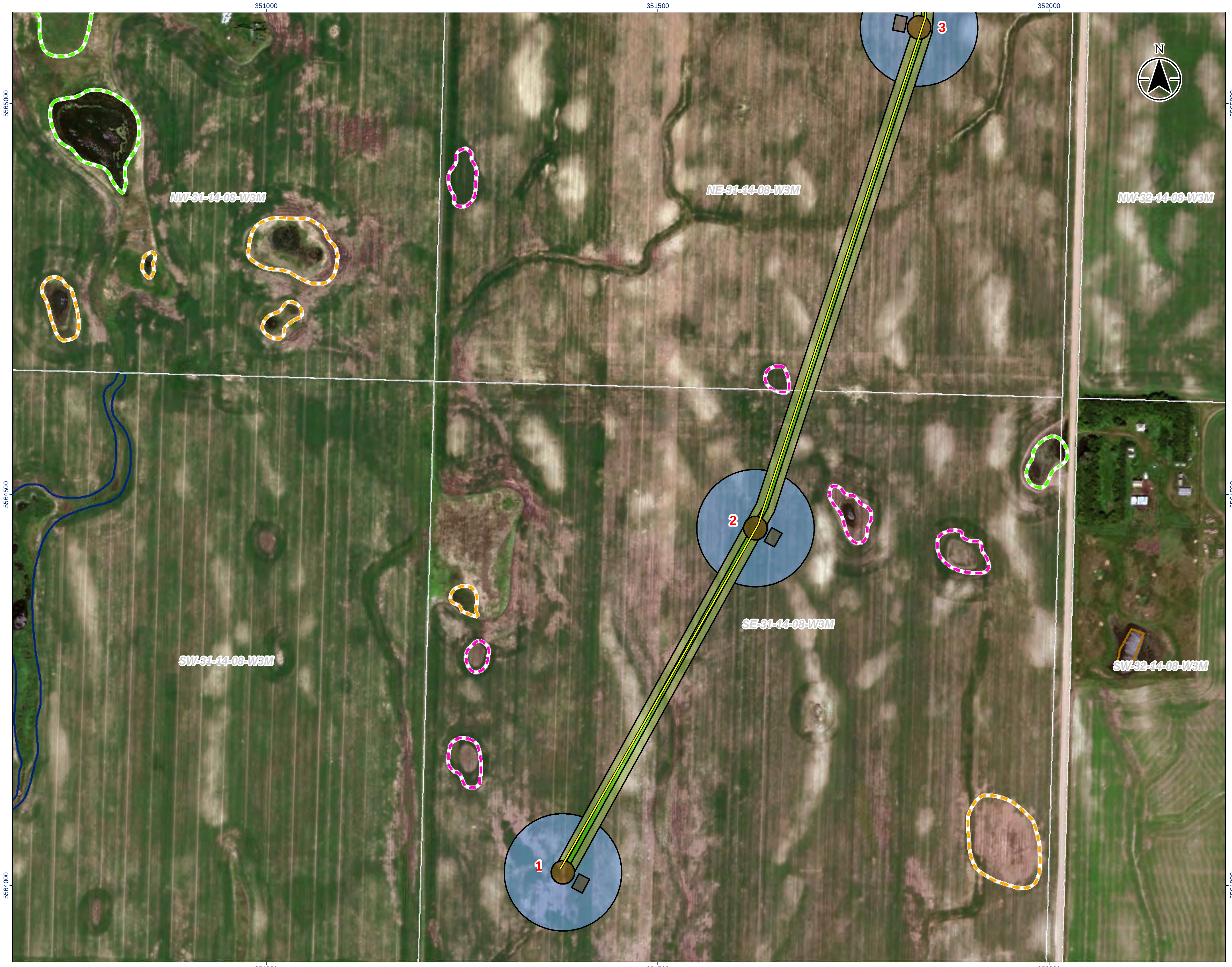

Stantec Algonquin

- Project Development Area
- Turbine Foundation
- Crane Pad - Permanent
- New Access Road - Permanent (Operation)
- New Access Road - Temporary (Construction)
- Temporary Workspace

Wetland/Drainage

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- Class 2 - Temporary Wetland
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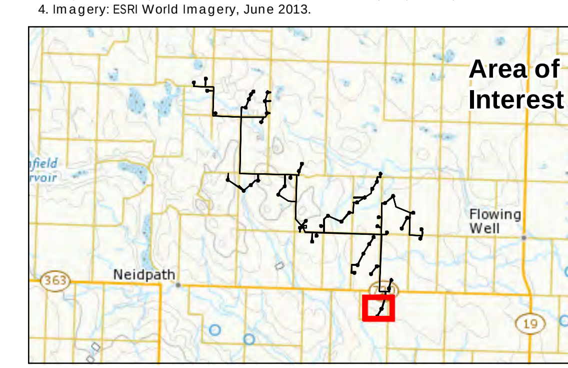

Project Location
Near Herbert, SK

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Technical Review by ceidem on 2017-12-18

Client/Project
Algonquin Power Co.
Blue Hill Wind Energy Project

Figure No.
EPP - 34

Title
Environmental Protection Plan - Sensitive Features and Setbacks

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Appendix A

Efforts will be made to schedule construction in areas of native land cover and perennial cropland outside the migratory bird nesting period (April 26 to August 15; ECCC 2017) as per Environment and Climate Change Canada guidance. This will avoid the primary migratory bird breeding period (when >10% of breeding activity occurs) for open habitat (ECCC 2017), and, in addition, will avoid sensitive periods for other wildlife species. When timing of construction in suitable wildlife habitat cannot avoid this sensitive period, pre-construction surveys will be conducted to identify site-specific sensitive features (e.g., bird nests, plant SOMC) and for which appropriate and reasonable prescriptive mitigation measures may be implemented during construction and operation and maintenance.

The schedule for construction is dependent on receipt of Ministerial approval; however, a high-level proposed schedule of Project activities for the construction phase is listed below:

- 2019/2020 Civil & Roads,
- 2020 Foundations,
- 2020 Turbine Erection,
- 2020 Commissioning
- 2020 Target Commercial Operation Date

Appendix B

Contacts and Reporting Matrix

Should heritage resources be discovered during construction, the following calls must be made to:

1. On-Site Algonquin Construction Manager – To Be Determined
2. Saskatchewan Heritage Resource Branch – 306 787-2817

Emergency Contact List

Organization	Telephone #
EXTERNAL	
ALL LOCAL EMERGENCY SERVICES - FIRE, POLICE, AMBULANCE	911
Saskatchewan Environment Spill Line	1-800-667-7525
INTERNAL ON-SITE	
On-Site Algonquin Construction Manager	TBD
Operations Manager	TBD
INTERNAL OFF-SITE	
Project Manager - Brandon Moore	O: 905-829-6372

Blue Hill Wind Energy Project

Environmental Protection Plan

Volume 2 - Adaptive Management Plan

December 2017

Table of Contents

1.0 Introduction

As part of the Environmental Impact Statement (EIS) for the Blue Hill Wind Energy Project (the Project), Algonquin Power Co. (Algonquin) has committed to the development of an Environmental Protection Plan (EPP) to summarize Algonquin's corporate commitments and regulatory requirements for the Project's environmental management. The EPP is divided into 3 Volumes and a map atlas (included in the Exhibits section) outlining site-specific information.

Volume 2 of this EPP presents the adaptive management plan for the Project and is intended to outline Algonquin's commitments to post-construction monitoring to support the implementation of appropriate site-specific environmental protection measures.

1.1 PURPOSE OF THE ADAPTIVE MANAGEMENT PLAN

The adaptive management process is a science-based process to address uncertainties in the potential effects of a project on valued components (VCs) of the environment, while allowing projects to proceed with development. This process starts at project conception to reduce and avoid potential effects on VCs of the environment. This process follows a stepwise approach where each of the following steps further refines a project design:

1. Project area selection: identifying a location on the landscape that meets large-scale avoidances of environmental features that could result in greater effects on VCs (e.g., siting a project outside avoidance zones)
2. Desktop analysis and fatal flaw assessment: using existing information about a potential project area allows for a more detailed understanding of the potential environmental constraints that could be affected by a project. This may include, but is not limited to:
    a. Existing land cover (e.g., the proportion of native prairie)
    b. Sensitive environmental features (e.g., migratory bird concentration sites)
    c. Historical occurrences of sensitive species (e.g., nesting locations of ferruginous hawks)
3. Field surveys: characterizing the existing environment of a proposed project area and to identifying current sensitive features on the landscape that have constraints allows for a better understanding of the potential effects of a project and to refine a project design to reduce or avoid those effects

Detailed information about these initial steps in the adaptive management process are provided in the Blue Hill Wind Energy Project Environmental Impact Statement (see Section 2.2). Following these pre-construction steps in the adaptive management process, this adaptive management plan (AMP) has been prepared to address adverse environmental effects that may result from the execution of the Project. The AMP must set out:

- Performance objectives in respect of the adverse environmental effects;
- Mitigation measures to assist in achieving the performance objectives; and
- A program for monitoring adverse environmental effects for the duration of the time that the Project is in operation, including a contingency plan to be implemented if any mitigation measures fail.

The Province of Saskatchewan is currently finalizing their Adaptive Management Guidelines for Wind Energy Projects (AM Guidelines), which are currently in their second draft form. These AM Guidelines form the basis of this AMP; however, other wind energy project guidelines were also considered in the development of the AMP where specific information was not provided in the AM Guidelines, and include:

- *Bats and Bat Habitats: Guidelines for Wind Power Projects (OMNR 2011a)*
- *Birds and Bird Habitats: Guidelines for Wind Power Projects (OMNR 2011b)*
- *Wildlife Guidelines for Alberta Wind Energy Project (2011)*
- *Alberta Bat Mitigation Framework for Wind Power Development (2013)*
- *Environment Canada (CWS) Protocols for Monitoring Impacts of Wind Turbines on Birds (2007)*

As well, the Project team has used their extensive experience and knowledge of industry precedent to develop this AMP. Note that this AMP may be amended based on the final SKMOE Adaptive Management Guidelines, however, these program adjustments must be reasonable. Discussions with the SKMOE would occur prior to any changes.

2.0 Post-Construction Monitoring of Bird and Bat Fatality

Post-construction fatality surveys at wind power projects can be used to assess the level of impact from operation of the facility, confirm the predictions of the environmental assessment are correct, and indicate if alterations or additional mitigation measures are required.

2.1 FATALITY THRESHOLDS

Most jurisdictions use a threshold approach to set performance objectives for operation of wind power facilities. Where bird or bat fatality rates do not meet these performance objectives (i.e., are above the threshold), mitigation steps are required.

The current draft AM Guidelines identifies three tiers (tier 1, 2 and 3) of management triggers based on fatality rates for wind energy projects (WEPs) in Saskatchewan (Figure 1). The fatality levels in each tier are based on fatality rates in post-construction monitoring reports from Alberta and from data presented in Erickson et al. (2014) for jurisdictions with similar ecoregions. Each tier has specific implications for reporting and management responses that follow through the AM process.

These tiers are based on a basis of fatalities per megawatt (MW), which enables wind developers to modify project designs (e.g., selecting fewer large turbines) to meet their power purchase agreement without being constrained by fatality tiers fixed on a per turbine basis. SaskPower awards power purchase contracts for wind projects on a per MW basis. As such, applying a threshold on a per MW basis would allow the province to determine potential cumulative impacts while issuing contracts. As requested by the Saskatchewan Ministry of Environment (SKMOE), bird and bat fatality monitoring results will be reported on a per MW and per turbine basis for comparison against other facilities and thresholds.

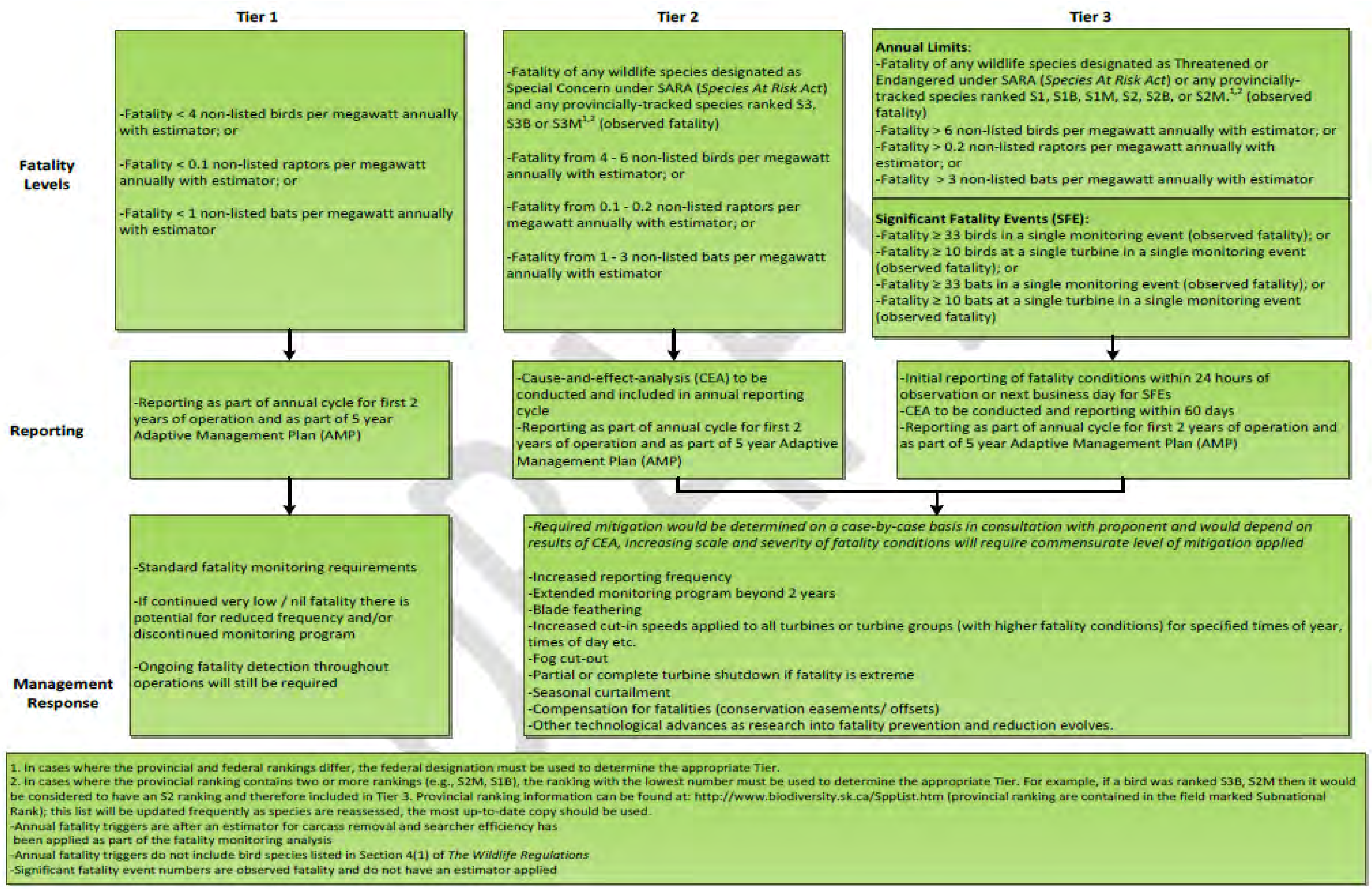

Figure 1 Draft Management Triggers for Bird and Bat Fatalities at WEPs in Saskatchewan (from SKMOE 2017)

2.2 POST-CONSTRUCTION MONITORING METHODS

Post construction bird and bat fatality surveys estimate bird and bat fatality from wind turbines and may identify species and specific periods with high fatality. This knowledge can be used to evaluate the success of mitigation measures, establish protocols for operational mitigation, and inform adaptive management.

Bird and bat fatality surveys identify the number of birds or bats killed per turbine over a known period of time (expressed as birds/turbine/year or bats/turbine/year). This value represents an estimate of bird and bat fatality adjusted for carcass removal rates, observer efficiency, and percent area searched. Standard methods for fatality surveys are identified below. Using the generating capacity of the turbines in the Project, these values are then converted to a per MW basis to compare against the management triggers identified in Figure 1 to determine if a cause-effect analysis (CEA) is required and if management responses are warranted.

Fatality monitoring also allows for the identification of significant fatality events (SFEs) as defined in the management triggers (Figure 1). Should a SFE occur, the reporting and other adaptive management steps will be completed under the guidance of the SKMOE.

Fatalities of birds and bats primarily occur during the period when migratory birds and bats are passing through the Project area and when resident bats are active. For Saskatchewan, this period will be the 26-week period between April 1st and October 3rd of each monitoring year (SKMOE 2017). To capture sufficient information on the Project's effects on bird and bat fatality, Algonquin will monitor for a minimum of two years following commissioning of the Project, with a potential to monitor one year at five-year intervals starting on year 5 to understand long-term changes in fatality rates, if required.

Parameters related to the fatality monitoring program, as well as the carcass removal trials and observer efficiency trials required to calculate corrected fatality estimates, are provided in Table 1, and further described in Section 2.2.1.

Table 1 Summary of Parameters for the Post-Construction Fatality Monitoring Program Components

Monitoring Component	Monitoring Parameter	Value	Comment
Fatality Monitoring	Duration (years)	2 to 6	SKMOE draft guidelines require monitoring on years 1 and 2, then possibly on years 5, 10, 15, 20; assuming a 25-year lifespan
	Number of turbines	15 to 19	Based on 30% of 49 to 56 turbines; same ones surveyed every time and every year
	Areal extent (m)	85	Half of turbine height (ground to blade tip), or 85 m, whichever is greater
	Transect spacing (m)	5	Distance between concentric circular transects
	Monitoring speed (km/hr)	2.4	Speed of observer walking
	Frequency (days)	7	Days between surveys of same turbines
	Number of weeks	26	Based on April 1 to Oct 3
Carcass Removal Trials	Turbines	-	One turbine in each land cover type that they are found
	Number of trials	3	One per season (spring, summer, fall)
	Number of carcasses	10 to 30	10 carcasses per visibility class (easy, moderate, difficult) max of 3 carcasses per turbine
	Duration (max days)	20	Check each week until gone or up to 20 days
Observer Efficiency Trials	Number of turbines	-	At least one trial in each habitat class; three carcasses per turbine
	Number of carcasses	20	Per observer
	Number of trials	3	One per season (spring, summer, fall)

2.2.1 Bird and Bat Fatality Monitoring

Requirements for post-construction fatality monitoring at the Project include:

- Post-construction monitoring (including fatality surveys, carcass removal and observer efficiency trials) will be conducted during the 26-week period when bats are active and when migratory birds are most abundant (April 1 – October 3) for the first 2 years of wind turbine operation, then possibly at five-year intervals starting on year 5 depending on the fatality rates observed in the first two years.
- Fatality surveys will be conducted at each monitored turbine once per week (7 day intervals) from April 1 – October 3, for a total of 26 survey visits.
- Bat and bird fatality surveys will occur at a sub-sample of at least 30% of turbines (minimum of 10).
- Turbines selected for monitoring will be representative of the different land cover types and the distribution of the turbine array within the PDA, and will be the same turbines monitored in all years for consistency. Wind turbines will be selected through a scientifically defensible approach (e.g., stratified-random selection).
- Should significant annual bird or bat fatality occur at the Project, a CEA will be conducted and additional mitigation options considered. Should additional operational mitigation measures be required, the initial monitoring period may be extended beyond the initial 2 years after discussion with SKMOE, but will not extend beyond an additional 2 years to assess the effectiveness of additional mitigation measures. In the case where an additional 2 years of monitoring be required to determine the effectiveness of adaptive mitigation measures (i.e., years 3 and 4 of operation), then the scheduled monitoring on year 5 of the long-term periodic monitoring will not be conducted.
- Between 15 and 19 turbines (30% of the 49 to 56 turbines that will be constructed) will be selected to cover representative areas throughout the Project location. The start date of the post-construction monitoring will be dependent on the commercial operation date of the facility. If full Project commissioning is delayed, post-construction monitoring of the partially completed Project will not be delayed for longer than 1 year.
- Each surveyed turbine will have a search area of 85 m radius or half the height of the blade-tip height, whichever is greater.
- Monitoring will be conducted, to the extent possible, between one hour after sunrise to one hour before sunset, in conditions of light breeze and no precipitation.
- Circular transects spaced 5 m apart will be walked by observers at a pace of approximately 2.4 km/hr
- The search area of each turbine will be mapped into visibility classes according to Table 2. Where the majority of the search area would not be searchable due to vegetation cover or other impediments (e.g., Visibility Class 4), these turbines will not be included in the sub-sample of monitored turbines.

Table 2 Visibility Classes and Defining Characteristics

Visibility Class	%Vegetation Cover	Vegetation Height
Class 1 (Easy)	≥90% bare ground	≤15cm tall
Class 2 (Moderate)	≥90% bare ground ≥25%	≤15cm tall
Class 3 (Difficult)	≤25% bare ground	≤25% > 30cm tall
Class 4 (Very Difficult)	Little to no bare ground	≥25% > 30cm tall

2.2.2 Carcass Data Collection

During the fatality monitoring program, the following data on detected bird and bat carcasses will be collected:

- All carcasses found will be photographed and recorded/labeled with species, sex (if possible), date, time, location (UTM coordinate), carcass condition, observer, injuries, ground cover, visibility class, and distance and direction to nearest turbine.
- Weather conditions including wind speed and precipitation.
- The estimated number of days since death, and condition of each carcass collected will be recorded in one of the following categories:
  - Fresh
  - Early decomposition
  - Moderate decomposition
  - Advanced decomposition
  - Complete decomposition
  - Scavenged
- Bird carcasses found during fatality monitoring will be collected and stored in a freezer and used in carcass removal or observer efficiency trials, assuming they are in reasonable condition.
- Carcasses of the following species found during bat fatality searches will be stored in a freezer and used in carcass removal or observer efficiency trials, assuming they are in reasonable condition:
  - *Lasionycteris noctivagans* (Silver-haired Bat)
  - *Lasiurus cinereus* (Hoary Bat)
  - *Lasiurus borealis* (Eastern Red Bat)
- Bird and bat carcasses will be collected under an SKMOE research permit, acquired prior to a given post-construction monitoring year.

2.2.3 Carcass Removal Trials

The level of carcass scavenging must be determined through carcass removal trials each year, as it varies from one project site to another depending on the scavenger community and abundance. The average carcass persistence time is a factor in determining the estimated bat or bird fatality rates.

Below are some important considerations for conducting carcass removal rate trials:

- Carcass removal trials will be conducted at least once a season (spring, summer, and fall) during the same period as the fatality surveys.
- A minimum of 10 carcasses per visibility class (see Table 2) will be used for each trial with a maximum of 3 carcasses per turbine, if possible.
- Carcasses will be monitored every 7 days in conjunction with carcass searches.
- To the extent possible, carcass removal trials will be conducted at turbines that are not part of the carcass search sub-sample.
- Carcasses will be placed before dusk and observers will wear gloves and clean rubber boots to avoid imparting human smell that might bias trial results (e.g., attract scavengers, etc.).
- Trials will continue until all carcasses are removed or to a maximum of 20 days (i.e., on the third carcass search visit).
- To avoid confusion with turbine related fatalities, trial carcasses will be discretely marked (e.g., clipping of ear, wing, fur; hole punching ear; etc.) with a unique identification so they can be identified as trial carcasses if they are moved by scavengers but not consumed, and GPS locations will be recorded.

- Carcasses used will be as fresh as possible since frozen or decomposed carcasses are less attractive to scavengers. If frozen carcasses are used, they will be thawed prior to beginning carcass removal trials.
- To the extent possible, bat carcasses will be used for at least one third of the carcass removal trials, and bird carcasses will comprise another third of the trial carcasses. Trials using other small brown mammal or bird carcasses (e.g., mice, brown chicks) may also be used when bird and bat carcasses are not available.

2.2.4 Observer Efficiency Trials

Observer efficiency is another important factor in creating an estimate of total bird and bat fatality. Observer efficiency trials require a known number of discretely marked carcasses to be placed around a wind turbine. Observers examine the wind turbine area, and the number of carcasses that they find is compared to the number of carcasses placed. Observer efficiency can vary considerably for each observer and from one site to another (varying by vegetation cover, terrain and season), and will be conducted as part of post-construction monitoring in each year of monitoring and for each person involved in carcasses searches during the year.

Below are some important considerations for conducting observer efficiency trials:

- Observer efficiency trials will be conducted at least once a season (spring, summer, and fall) during the same period as the bat fatality surveys.
- An independent 'tester' will control the trials and return to collect marked trial carcasses at the completion of the trials to determine the number of carcasses remaining and if any carcasses were scavenged or removed during the trial.
- Observer efficiency trials are to be conducted for each individual observer or team involved in searching for carcasses. The observer will not be notified when they are participating in an efficiency trial to avoid potential search efficiency biases.
- 20 carcasses per observer per season will be placed across all applicable visibility classes (see Table 2). The weighted average by proportion of visibility class per observer will be used for calculations.
- Trial carcasses will be placed prior to the regularly scheduled carcass observer.
- Trial carcasses are placed for one search period only and then removed and recorded by the 'tester'.
- Trial carcasses will be randomly placed within the search area and location (GPS coordinates) recorded so that they can be retrieved if they are not found during the trial.
- Trial carcasses will be discreetly marked (e.g., clipping of ear, wing, leg, fur; hole-punching ear; etc.) with a unique identification so that they can be verified as a trial carcass by the tester.
- To the extent possible, bat carcasses will be used for at least one third of the carcass removal trials, and bird carcasses will comprise the remaining trial carcasses. Trials using other small brown mammal or bird carcasses (e.g., mice, brown chicks) may also be used when bird and bat carcasses are not available.
- If frozen carcasses are used, they will be thawed prior to beginning observer efficiency trials.

2.2.5 Proportion Area Searched

Based on AM Guidelines, the search area will be a minimum 85 m or half the height of the blade tip, whichever is greater, from a wind turbine base. Since it may not always be possible to search the entire 85 m radius (because of the presence of thick or tall vegetation, steep slopes, active cultivation, etc.), the actual area searched during the fatality surveys will be calculated at each turbine, using a GPS. A map of the actual search area for each turbine searched, and a description of areas deemed to be unsearchable (e.g., vegetation height, type, slope, etc.) will be provided in the fatality report.

2.2.6 Calculation of Fatality Estimates

The corrected fatality estimates will be calculated using the Huso (2011) estimator and will include correction factors for scavenger removal, observer efficiency and the proportion of area searched. These correction factors are described below.

Scavenger Correction Factor
The following formula will be used to calculate the overall scavenger correction (S_c) factors based on the proportion of carcasses remaining after each search interval are pooled:

$S_c = n_{visit1} + n_{visit2} + n_{visit3}$
$n_{visit0} + n_{visit1} + n_{visit2}$
Where,

S_c	is the proportion of carcasses not removed by scavengers over the search period
n_{visit0}	is the total number of carcasses placed
n_{visit1} - n_{visit3}…	are the numbers of carcasses on visits 1 through 3

Observer Efficiency
Observer efficiency (S_e) will be calculated for each observer as follows:

S_e = number of test carcasses found
number of test carcasses placed – number of carcasses scavenged

The number of turbines that each individual searches will vary so it will be necessary to calculate a weighted average that reflects the proportion of turbines each observer searched. The weighted average or overall observer efficiency will be calculated as follows:

$S_{eo} = S_{e1}(n_1/T) + S_{e2}(n_2/T) + S_{e3}(n_3/T)\ldots$

Where,

S_{eo}	is the overall observer efficiency
S_{e1} and $_2$ and $_3$…	are individual observer efficiency ratings
N_1 and $_2$ and $_3$…	are number of turbines searched by each observer
T	is the total number of turbines searched by all observers

Proportion Area Searched
Proportion area searched (P_s) is calculated as follows:

P_s = actual area searched
πr^2
Where r = 85 m (or half the height of the blade tip, whichever is greater)

Corrected Fatality Estimates
The estimated bird and bat fatality (C) is calculated as follows:

$C = c / (S_{e0} \times S_c \times P_s)$

Where,

C is the corrected number of fatalities
c is the number of carcasses found
S_{e0} is the weighted proportion of carcasses expected to be found by observers (overall observer efficiency)
S_c is the proportion of carcasses not removed by scavengers over the search period
P_s is the proportion of the area searched

2.2.7 Other Considerations

- The above calculations will be presented in corrected number of birds/MW/year <u>and</u> bats/MW/year as well as birds/turbine/year <u>and</u> bats/turbine/year.
- Carcasses may be discovered incidental to formal searches. These carcasses will be processed (i.e., collected and recorded, etc.) and fatality data will be included with the calculation of fatality rates. If the incidentally discovered carcass is found outside a formal search plot, the data will be reported separately.

2.2.8 Worker Training and Monitoring

A site-specific worker environmental training plan will be developed and implemented throughout the Project's operating life. All employees and contractors working in the field will be required to attend the environmental training session prior to working on site. This training will include information regarding the sensitive biological resources, restrictions, protection measures (including minimizing light pollution), individual responsibilities associated with the Project, and the consequences of non-compliance. Written material will be provided to employees at orientation and participants will sign an attendance sheet documenting their participation.

Of particular importance is continued monitoring of the site during operation by workers, especially during years when fatality monitoring programs are not executed. Well-trained workers are an excellent source of information and "boots on the ground" to record any fatality events, particularly for species at risk. Personnel will be trained to identify and report fatality events. Additionally, road-killed animals or other carcasses (excluding species at risk, bats and migratory birds; see below) detected by personnel on or near roads within the Project area will be removed promptly. This measure reduces the attraction of raptors and other avian scavengers to the Project area.

In the event of a SFE occurring or listed species carcass being found by a Project employee, the SKMOE will be notified within 24 hours (or the next business day) of the observation and a CEA will be completed.

2.3 OPERATIONAL MITIGATION

Operational mitigation refers to adjustments made to the operation of wind turbines to help mitigate potential adverse environmental effects on bird and bats (i.e., significant fatality). The AMP for the Project identifies that implementation of operational mitigation may be required at any given time during the operational phase of the Project, should an SFE occur, or fatalities of listed species (see Figure 1) and discussion of the CEA with SKMOE result in the need to do so. Operational mitigation may be applied to one or more turbines or turbine clusters that are identified in the CEA.

In the absence of a SFE, operational mitigation may be considered during a review by SKMOE of the annual monitoring report with corrected fatality estimates, if those estimates exceed management triggers in tier 2 or tier 3 (see Figure 1). A tier 2 or 3 fatality rate would also require a CEA to assist in determining the options and need to implement operational mitigation.

Where operational mitigation is applied, an additional 2 years of effectiveness monitoring may be implemented. Monitoring the effectiveness of any adaptive mitigation techniques will help to evaluate the success of this mitigation. Note that if adaptive mitigation is applied prior to the second year of operation, the second year of the standard fatality monitoring program will also serve as the first year of mitigation effectiveness monitoring.

Specific adaptive mitigation options that will be considered to reduce bird and bat fatality rates of the Project which may include blade feathering, increased cut-in speeds, operational curtailment, fog cut-out, partial or complete turbine shutdown, and seasonal curtailment.
As additional mitigation options are developed and tested for WEPs, these options will also be considered. The specific adaptive mitigation measures prescribed to the Project will be identified through the CEA and discussions with SKMOE. Note that these mitigation options are considered for both listed and non-listed species of birds and bats.

3.0 Post-reclamation Monitoring

3.1 OBJECTIVE

The objective of the post-reclamation monitoring program is to quantify changes in the native plant community surrounding Project infrastructure and to identify and detect the presence of any prohibited, noxious and nuisance plant species, as identified in the *Weed Control Act* (2010). Post-reclamation monitoring will begin within the first few months after construction is completed to identify invasive species or problematic areas to reclaim.

3.2 NON-NATIVE INVASIVE PLANT MONITORING

passive monitoring of prohibited, noxious and nuisance plant species will occur for the life of the Project through training of maintenance personnel to examine areas adjacent to Project infrastructure for the presence of species listed in the *Weed Control Act* (2010). Similar to the reporting approach of bird and bat fatalities by workers, a documenting and reporting protocol will be developed for listed weed species.

3.3 POST-RECLAMATION MITIGATION

Approaches to weed control are described in Volume 1 of the EPP.

4.0 Reporting Requirements

Reporting requirements for the operation monitoring program varies according to the specific components described in this volume. A SFE or detection of a listed species carcass (see Figure 1 for species categories included) will be reported to SKMOE within 24 hours or the next business day. In the event of a SFE requiring a CEA, the CEA report will be prepared and submitted to SKMOE within 60 days of the reported event.

Data collected as a result of the post-construction monitoring programs will be submitted in accordance with SKMOE research permit requirements (e.g., loadforms).

Annual post-construction monitoring reports will be prepared and submitted by February 1 of the following year, and will include the following information as identified in the draft AM Guidelines:

4. Methodology and rationale for any ministry-approved deviations from this guidance document.
5. Description of any turbine habitat type classes and identification of representative monitoring turbines. Turbine habitat type classes can be considered equivalent to Treatment Groups as defined in the Wind Energy Bird and Bat Monitoring Database.
6. Results of carcass removal trials and observer efficiency trials.
7. Calculation of the carcass removal and observer efficiency using the Huso estimator.
8. Corrected, summarized fatality rate for:
    a. non-raptor birds per turbine and per MW, by season (April-May, June-July, August-October) and by year;
    b. raptors per turbine and per MW, by season and by year;
    c. bats per turbine and per MW, by season and by year; and
    d. corrected, summarized fatality rate excludes bird species listed in Section 4(1) of the Wildlife Regulations (Government of Saskatchewan 1981).
9. Results of any BACI studies or other population surveys that may have been required.
10. GIS shapefile indicating which turbines are being monitored and GPS locations of the individuals detected in the fatality monitoring.
11. Digital photograph of each carcass found in fatality monitoring in situ.
12. Digital copy of the monitoring data that was submitted to ENV.researchpermit@gov.sk.ca in accordance with the Research Permit submission requirements.
13. Fatality monitoring data per monitoring event per turbine including:
    a. turbine number and location;
    b. date and time the turbine is surveyed;
    c. weather conditions, including wind strength and direction;
    d. vegetation surrounding the turbine;
    e. observer identity (consistent name or number for each observer); and
    f. for each individual detected record:
        i. location (UTM coordinates);
        ii. species;
        iii. sex;
        iv. age class (if apparent);
        v. state of decomposition; and
        vi. apparent injuries and signs of scavenging.

5.0 References

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Blue Hill Wind Energy Project

Environmental Protection Plan

Volume 3 - Emergency Response Plan

December 2017

Table of Contents

1.0 INTRODUCTION

As part of the Environmental Impact Statement (EIS) for the Blue Hill Wind Energy Project (the Project), Algonquin Power Co. (Algonquin) has committed to the development of an Environmental Protection Plan (EPP) to summarize Algonquin's corporate commitments and regulatory requirements for the Project's environmental management. The EPP is divided into 3 Volumes and a map atlas (included in the Exhibits section) outlining site-specific information.

Volume 3 of the EPP presents of the Emergency Response Plan (ERP) for the Project and is intended to advise on-site personnel, contractors and landowners on the procedures they must follow in the event of an emergency situation during the construction and initial operations phase (pre-commissioning) of the Project.

1.1 EMERGENCY RESPONSE POLICY

The Blue Hill Energy Wind Project is committed to protecting people, property and the environment from impact resulting from emergency situations arising at the Project through the implementation of an emergency preparedness and response program. The Manager will develop, implement, and maintain this Plan for Project construction and initial operation in compliance with applicable laws and standards to ensure a timely and appropriate response to emergencies.

2.0 REGULATORY FRAMEWORK

The following regulations, licenses, standards and guidelines provide key elements of the framework for the Emergency Response Plan:

- *The Environmental Assessment Act*
- *The Environmental Management and Protection Act, 2010*
  - *Hazardous Substances and Waste Dangerous Goods Regulations* (E-10.2 Reg 3)
- *The Dangerous Goods Transportation Act*
  - *Dangerous Goods Transportation Regulations* (D-1.2 Reg 1)
- *The Saskatchewan Employment Act*
  - *Occupational Health and Safety Regulations, 1996* (O-1.1 Reg 1)
- *The Fire Safety Act, 2015*
  - *Saskatchewan Fire Code Regulations* (F-15.11 Reg 1)
- *The Canadian Environmental Protection Act, 1999* (1999, c. 33)
  - *Environmental Emergency Regulations* (SOR/2003-307)
- Canadian Standards Association Z731-03 Emergency Planning for Industry

3.0 POTENTIAL EMERGENCY SCENARIOS

On the basis of relevant experience and best professional judgment, the Manager believes that the emergencies that could occur at the Project may include: ice throw (from revolving rotor blades), fires, worker electrocutions, lightning strikes, lost blades, worker falls, planes crashing into towers or the transmission line, spills of hazardous materials and excavation cave-ins.

Industry-wide statistics on the frequency of occurrence of fires at wind farms are not available; however, the likelihood of fires occurring at the Project is low.

The hazardous materials used during construction will primarily consist of diesel and gasoline fuels for re-fuelling of equipment. During operations, only small amounts of hazardous materials are used. For this reason, the probability of a spill occurring is expected to be low.

The other types of potential emergencies include excavation cave-ins and equipment malfunctions. Any Project excavations will be for underground electrical, communication lines and turbine foundations. The buried electrical and communication lines will not be buried any more than 4 feet deep, so the possibility of a serious situation arising from an excavation cave-in is low. During construction of the foundations, all provincial safety regulations will be followed to prevent excavation cave-in.

The severity of the potential emergency scenarios on people, property and the environment was evaluated using rating criteria for determining severity of potential emergency situations (Table 3-1). The hazard analysis for the wind-energy site is shown in Table 3-2. Based on this analysis, the most important credible worst-case scenarios are those that have the potential to result in loss of life, which includes a major fire, electrocution, lightning strike, lost blade, and plane crashes.

3.1 CONSTRUCTION

The most probable emergencies that may occur during the construction phase of the Project are likely to involve spills of petroleum products used in construction equipment, excavation cave-ins and equipment malfunctions during construction. The worst-case credible scenario is a major spill of hazardous materials.

3.2 OPERATION

The most probable emergencies that could occur during the operational phase include ice throw, fire, electrocution, lightning strike, lost blade, falls, plane crash and equipment malfunctions during operations. The worst-case credible scenarios are fire, electrocution, lost blade, falls or plane crashes that result in loss of life.

4.0 EMERGENCY PROCEDURES

4.1 CONSTRUCTION - ROLES AND RESPONSIBILITIES

- The Contractor On-Site Construction Manager is designated as the "Emergency Response Coordinator" during an emergency situation and will be responsible for ensuring that all contractors, staff, on-site visitors and others adhere to the appropriate emergency response procedures as stated in this Plan and to the environmental protection measures stated in the Blue Hill Wind Energy Project EPP for the Project.
- Any visitor present at the site must report to the Contractor On-Site Construction Manager. In the event of an emergency, the Herbert Fire Department will arrange to provide fire-fighting and other resources as required. The resources of the Fire Department are shown in Table 4-1
- In the event of an emergency, contractors, landowners, and others who may be present at the site are responsible for **immediately calling 9-1-1** and then notifying the Contractor On-Site Construction Manager.

4.1.1 Emergency Procedures

The following emergency procedures shall be followed in the event of an emergency that occurs during construction of the Project:

- To prevent or minimize the occurrence of an emergency, the appropriate preventative measures outlined in the Project's EPP will be used at all times.
- Immediately upon being notified of an emergency situation, the Contractor On-Site Construction Manager will evaluate the situation by considering:
  - the nature of the emergency;
  - potential risks of injury to persons at or near the site;
  - potential risks to the environment;
  - potential risks to property; and
  - need for personnel and other resources to respond to the emergency.
- The Emergency Response Coordinator will notify on-site personnel, including any visitors, of the emergency via an alarm system such as by telephone, two-way radio or sirens, **then call 9-1-1**.
- The Herbert Fire Department will specify the location of the Incident Command Centre.
- The Emergency Response Coordinator will notify Algonquin Power's site manager and the Operator (contact info in Table 4-2) of the emergency according to the reporting form specified in Attachment A of this Plan.
- If required to prevent potential injury to human life, the Emergency Response Coordinator will evacuate the Project. The reception centre will be located at the Herbert Lions Club, Railway Avenue, Herbert, SK. The Emergency Response Coordinator will designate a person to conduct a "head-count" at the reception centre.
- The Emergency Response Coordinator will contact or designate a person to contact all other required resources (i.e., hazardous waste company).
- The Emergency Response Coordinator must report the emergency using the form stated in Attachment A of this plan.
- The Emergency Response Coordinator will identify any need for security measures at the Project during the emergency and designate one person to implement these measures.

4.2 INITIAL OPERATIONS

As construction of the Project proceeds, testing of Project operations will occur prior to final commissioning and commencement of the full Operation Phase of the Project. This is the 'initial operations' of the Project. The following emergency response procedures will apply during initial operations of the Project and are considered part of the Construction Phase of the Project.

4.2.1 Roles and Responsibilities

- The Contractor On-Site Construction Manager is designated as the Emergency Response Coordinator during any emergency situation that occurs during initial operation of the Project and will be responsible for ensuring that all contractors, staff, landowners on-site visitors and others adhere to appropriate emergency response procedures stated in this Plan and the environmental protection measures stated in the EPP. Additionally, the Operations Manager may be on-site at any time during initial operations. The Construction Manager will also report all emergency situations to the Operations Manager.
- Any visitors present on the site must report to the Contractor On-Site Construction Manager.
- In the event of an emergency situation, the Herbert Fire Department will arrange to provide fire-fighting and other resources as required. The resources of the Fire Department are shown in Table 4-1.
- In the event of an emergency situation, contractors, landowners and others who may be present at the Project are responsible for **immediately calling 9-1-1** and then notifying the Construction Manager.

4.2.2 General Emergency Procedures

The following emergency response procedures will be followed in the event of an emergency that occurs during the initial operation of the Project:

- To prevent or minimize the occurrence of an emergency the appropriate preventative measures outlined in the site Environmental Protection Plan will be used at all times.
- Immediately upon being notified of an emergency situation, the Contractor On-Site Construction Manager will evaluate the situation by considering:
  - the nature of the emergency
  - potential risks of injury to persons at or near the site
  - potential risks to property
  - potential risks to the environment
  - need for personnel and other resources to respond to the emergency
- The Emergency Response Coordinator will notify on-site personnel, including any visitors, of the nature of the emergency via an alarm system such as by telephone, two-way radio or sirens, then **call 9-1-1**.
- The Herbert Fire Department will specify the location of the Incident Command Centre.
- The Emergency Response Coordinator will notify Algonquin Power head office, the Operator and Algonquin Power of the emergency using the contact information provided in Table 4-2.
- If required to prevent potential injury to human life, the Emergency Response Coordinator will evacuate the Project. The reception centre will be located at the project construction office. If this is not possible, then the reception centre will be the Herbert Lions Club, Railway Avenue, Herbert, SK. The Emergency Response Coordinator will designate a person to conduct a "head-count" at the reception centre to ensure that all persons have been safely evacuated.
- The Emergency Response Coordinator will contact or designate a person to contact all other required resources (e.g., hazardous waste company).

- The Emergency Response Coordinator should report the emergency using the form stated in Attachment A.
- The Emergency Response Coordinator will identify any need for security measures at the Project during the emergency and designate one person to implement these measures.

4.3 CONTINGENCY EMERGENCY RESPONSE PROCEDURES

4.3.1 Contingency Procedures – Spills and Spill Prevention

- Take care to prevent the spill from entering into any waterways.
- Locate fuel storage and equipment servicing areas a minimum distance of 100m from any wetland/waterbody.
- Ensure that at all times during the construction phase, substance appropriate spill absorption materials for containing and recovering spills are readily available.
- In the event of a spill, and only if it is safe to do so, contain the spill either by constructing containment dikes, by using spill absorption materials or by other appropriate methods.
- Properly contain all absorbent materials used to absorb and clean-up spill as a hazardous waste.
- Arrange for proper disposal of all collected waste materials.
- Should a spill occur, contact the Saskatchewan Environment spill response center at 1-800-667-7525 and the Herbert Fire Department by calling 9-1-1.

4.3.2 Contingency Procedures – Safety

To prevent emergency situations, the following safety measures must be followed by all persons present at the Project at all times:

- Never lock a WTG tower access door from the inside, or otherwise inhibit a WTG emergency-response entry.
- Ensure that only one person at a time is allowed on any one ladder section (between platforms) when climbing a tower or in the WTG.
- Ensure that debris or obstacles are not placed in roadways, walkways, aisles, or otherwise obstruct travel routes.
- Ensure that only ANSI (CSA) approved fall arrest systems (safety harnesses, anchorage connectors, lanyards and safety cable devices) are used.
- Prevent all use of clothing made of acetate, polyester, rayon, or nylon by electrical workers.
- Ensure that no burning, welding, or other sources of ignition are applied to any enclosed tank or vessel, with or without openings, until it has been determined by the proper authority that no possibility of explosion exists.
- Follow all fire prevention measures, including a Hot Work Permit, when performing hot work such as cutting and welding. If out of doors, wet the surrounding area prior to the task. Use shields.
- Employ a fire watch if welding, burning, or grinding must be performed in an area where combustibles or flammables are present - the fire watch shall be equipped with proper fire extinguishing devices (fire extinguishers, water truck, etc.) - combustibles shall be moved or carefully protected from sparks.
- Ensure use of fire blankets when carrying out work with a risk of fire.
- Follow safe practices when refueling vehicles or equipment - do not leave vehicles unattended or tamper with fuel tank or gas pump.
- Prevent parking of vehicles where the exhaust system might ignite dry grass, weeds, or farm swathes.
- Control weeds and brush from growing up around site structures.

- Prohibit smoking inside the WTG. If permitted on the site, smoking should be restricted to designated areas and enforced. Extinguished smoking materials must be contained and disposed of properly.
- Prior to beginning any work, all workers will assess their work environment noting the possibility of a fire occurring, the proximity of firefighting equipment, and a safe escape route in the event of a fire.
- Conspicuously locate and label all firefighting equipment. Ensure it is easily accessible and that it will be inspected and maintained on a regularly scheduled basis. Replace fire extinguishers as necessary.
- Situate internal combustion engine powered equipment (e.g.: portable generators), such that the exhausts are clear of any combustible materials.
- Use only approved cleaning agents; do not use gasoline or other flammable liquids for cleaning.
- Store flammable substances in cabinets designed for flammables, and away from sources of ignition.
- Collect all oily rags in covered metal containers labelled as "Oily Rags - Do Not Discard" - oily rags shall not be discarded in regular rubbish bins, nor will oily rags be allowed to accumulate.
- To prevent fire or accident hazards, neatly collect and schedule for removal all scrap materials and/or rubbish - rags, packing materials, sawdust and other trash must be collected and placed in appropriately marked receptacles.
- Report all incidents, including near misses, to a supervisor or a safety representative so that reporting can commence and corrective measures can be taken to prevent recurrence.
- Ensure that all personnel attend the regularly scheduled site safety meetings with their employers.

4.3.3 Contingency Procedures – Fire

- On-site Project staff will be available 24 hours a day and must assist local fire departments with access to the WTGs in the unlikely event of fire or other disaster.
- The first person to observe a fire should:
  - Immediately sound the alarm to announce the emergency and then call 9-1-1.
  - Report the fire to the On-Site Construction Manager.
  - Evacuate and isolate the area (close doors), if possible.
  - Only if the person has been properly trained and feels it is safe to proceed - use available fire extinguishers to extinguish or contain the fire. If the fire is fueled by gas, the gas supply should be shut off prior to extinguishing the fire. Isolate area to contain the fire.
  - Immediately evacuate the area should initial firefighting attempts fail. (Failure to evacuate during a fire alarm may be justification for disciplinary action).
- The WTG main switch or switch gear must be tripped instantly. If this is not possible from the site, immediately request the local grid supervisor to break the connection.
- If the fire is inside a WTG, **call 9-1-1**, then attempt to extinguish it with a fire extinguisher if the person has been trained in fire-extinguishing and if it is safe to do so. If the fire is uncontrollable, **call 9-1-1**, evacuate the WTG immediately and set up a barrier to prevent others from entering.
- If the fire is outside a WTG, call **9-1-1** then, attempt to fight the fire if possible, but without taking personal risk - keep a clear escape path at all times.
- The Project may require instruction from local fire-protection personnel on proper methods and equipment for fighting site field fires.
- If fire-fighting attempts fail, no employee shall place his/her life in danger and should immediately evacuate the area.

4.4 REPORTING

4.4.1 Procedures

The following procedures must be followed for reporting all Project emergencies:

- Any person who identifies an emergency situation **must immediately call 9-1-1**, and then report it to the Emergency Response Coordinator or their designate. The Contractor On-Site Construction Manager will activate the ERP.
- The Emergency Response Coordinator will obtain immediate emergency response assistance, if required, by **calling 9-1-1**.
- The Emergency Response Coordinator or their designate are the only persons authorized to speak to outside agencies (police, fire department,) during an emergency situation.
- In the event of a spill of a hazardous material in excess of reportable limits, the spill must be reported to the Saskatchewan Environment Emergency Reporting Line at (800) 667-7525. Hazardous materials on site are likely to be flammable liquids (e.g. oil, gasoline, paints, and solvents) and thus, spills in excess of 100L must be reported.
- In the event of an emergency during construction, the Emergency Response Coordinator must immediately notify Algonquin Power using the emergency callout system and the telephone contact names and telephone numbers stated in Table 4-2.
- In the event of an emergency during initial operations, the Operations Manager will immediately notify Algonquin Power and the Operator using the telephone number stated in Table 4-2.
- The Emergency Response Coordinator will immediately notify any potentially affected landowners of the emergency using the telephone numbers stated in Table 4-3.
- After the emergency incident is under control, the Emergency Response Coordinator will complete the Emergency Reporting Form (Attachment A) and forward it to Algonquin Power and the General Contractor.
- In the event of media coverage of an emergency event, the Algonquin On-Site Manager will be the primary contact with the media, through consultation with Algonquin's Head Office (Director of Investor Relations). Any information shared with the media should be factual and succinct and should not speculate on the emergency situation.

4.4.2 Contact Telephone List

The contact telephone list for emergency reporting is attached in Table 4-2.

5.0 TRAINING

All contractors, employees and landowners who will be present on the Project must be aware of this Emergency Response Plan. The Contractor On-Site Construction Manager or the Operations Manager or their designate will conduct training sessions, informational events, or tailgate meetings to ensure that all persons are familiar with the ERP and are also aware of their duties and responsibilities as stated in the ERP. Training in Emergency First Aid, CPR and fire extinguisher use is suggested for on-site staff. All persons shall acknowledge understanding of and agree to comply with the Emergency Response Plan by signing the form attached as Table 5-1.

6.0 PLAN REVISION

This Plan will be reviewed on a regular basis, no less than annually, and also after any emergency event has occurred and will be revised and reissued as needed. The revisions and redistributions shall be recorded in Table 6-1.

Table & Forms

Table 3-1 Rating Criteria for Determining Severity of Potential Emergency Situations

	Catastrophic	Critical	Marginal	Neglible
People	Death or fatal injury	Permanent disability, severe injury or illness	Injury or illness not resulting in disability, major quality of life loss or perceived illness	Treatable first aid injury
Environment	A major hazardous spill that is uncontained	A minor hazardous chemical spill that is uncontained	A major hazardous materials spill which is contained	A minor hazardous chemical spill which is contained
Property	More than 50% of property located in the proximity of the impact is severely damaged	More than 25% of property located in the proximity of the mishap is severely damaged	More than 10% of property located in the proximity of the mishap is severely damaged	No more than 1% of property located in the proximity of the impact is severely damaged

Source: MIAC Industrial Emergency Response Planning Guide. 1996.

Table 3-2 Hazard Analysis

Type of Emergency	Probability of Occurrence within the next year	Area and Severity of Potential Effects			Comments
		People[(1)]	Property[(1)]	Environment[(1)]	
Ice throw from a single blade	Low	***Critical***	Marginal	Neglible	The WTGs will experience ice accumulation on blades during the blades; however, the WTGs are equipped with blade vibration sensors and all WTGs are located a minimum of 500 m from any residential homes. If the WTG deviates from normal operating conditions, the safety system is triggered, shutting down the WTG.
Major fire in the WTG (oil-filled) gearbox at the top of the tower (assuming workers are present)	Low	***Catastrophic***	***Catastrophic***	***Critical***	Two multi-purpose dry chemical fire extinguishers certified by ULC will be placed in each WTG – one in the nacelle and one at the base of the tower.
Minor fire in the WTG or O&M Facility (assuming workers are present)	Low	Marginal	Marginal	Marginal	Two multi-purpose dry chemical fire extinguishers certified by ULC will be placed in each WTG – one in the nacelle and one at the base of the tower.
Electrocution of a worker in a WTG tower	Low	***Catastrophic***	Neglible	Neglible	For safety reasons, each WTG maintenance crew consist of two qualified wind smiths that act as backup to each other
Lightning strikes	Low	***Catastrophic***	***Critical***	Neglible	WTGs will be equipped with lightning conductors, so if lightning strikes any Facility WTG, the damage will be minimized.
Lost blade from a single wind WTG	Low	***Catastrophic***	***Critical***	Neglible	WTGs have been located at least 1000m away from residential property.
Fall or falling object resulting in injury of a person	Low	***Catastrophic***	Neglible	Neglible	
Plane crash into a WTG or transmission line	Low	***Catastrophic***	***Catastrophic***	Neglible	
Spill of hazardous materials during construction or operation having the potential to be deposited into a waterbody	Low	Neglible	Neglible	***Critical***	Materials for containing and cleaning up hazardous materials will be kept at the Facility.
Trench cave-ins	Low	Marginal	Neglible	Neglible	
Equipment malfunctions during construction	Unknown	Marginal	Neglible	Neglible	
Facilities malfunctions during operations	Unknown	Neglible	***Critical***	Neglible	Each WTG is equipped with an electronic controller that measures and controls it's operations. If the key parameters measured deviate from normal operating conditions, the safety system is triggered, shutting down the WTG.

1. Severity stated is the likely possible worst-case scenario

Table 4-1 Herbert Fire Department Available Resources

Fire Department	Location	Fire Chief	Resources
Herbert Fire Department	**Herbert, SK**		[two fire trucks, including one water truck for grass fires; jaws-of-life, shared with the Town of Morse]

All Fire Departments can be contacted by Calling:
911

For Non-Emergency Fire Department Related Questions Please call:
The Town of Herbert Fire Department: 911

Table 4-2 Emergency Contact Telephone List

Emergency Contact List	
Organization	**Telephone #**
EXTERNAL	
ALL LOCAL EMERGENCY SERVICES - FIRE, POLICE, AMBULANCE	911
Saskatchewan Environment Spill Line	1-800-667-7525
INTERNAL ON-SITE	
On-Site Algonquin Construction Manager	TBD
Operations Manager	TBD
INTERNAL OFF-SITE	
Project Manager - Brandon Moore	905-829-6372

Table 4-3 Landowner Telephone Numbers

Wind Turbine Name	Landowner	Telephone #
		Home: Cell:
		Home: Cell:
		Home: Cell:

Table 5-1 Blue Hill Wind Energy Project Emergency Response Training

The following persons have attended Emergency Response Training:

Date	Name (Please Print)	Signature

Table 6-1 Emergency Response Plan Revision

Date	Area of Revision	Distribution

Attachment A
Blue Hill Wind Energy Project
Emergency Reporting Form

This form must be completed by the Construction or Operations Manager following an Emergency Event

Date: Time of Incident:

Briefly describe the emergency:

Describe the actions taken during the emergency:

Were there any injuries? Yes No, If yes describe:

Was there any damage to property? Yes No, If yes, describe:

If the emergency involved a spill of hazardous materials, please state the type and amount of material

Was the spill reported to the appropriate provincial authorities? Yes No

Describe the response to the spill:

Follow-up action required:

Other comments:

APPENDIX D
ENGAGEMENT

Appendix D ENGAGEMENT

D.1 OPEN HOUSE INVITATION AND POSTER

D.1.2

PUBLIC OPEN HOUSE

Proposed Wind Energy Project

Algonquin Power Co. is holding the first two open houses regarding Algonquin's 177 megawatt (MW) proposed Blue Hills Wind Power Facility between Herbert and Neidpath. These open houses will provide preliminary project information regarding project planning and development activities, as well as a chance for the public to meet the project team. Both meetings will provide the same information for your convenience.

Please join Algonquin to learn more about the progress of the wind facility development.

Information Session #1
Location: Hodgeville Community Centre
Main Street
Hodgeville, SK S0H 2B0
Date: January 23rd, 2017
Time: 4 to 8 p.m.

Information Session #2
Location: Herbert Lions Club
Railway Avenue
Herbert, SK S0H 2A0
Date: January 24th, 2017
Time: 4 to 8 p.m.

For more information, contact:

Olivia Neter, Algonquin Power Co.
Ph: 905.465.6717
Olivia.Neter@AlgonquinPower.com

Eileen Turano, Algonquin Power Co.
Ph: 905.829.6352
Eileen.Turano@algonquinpower.com

D.2 OPEN HOUSE ADVERTISEMENT

D.2.2

Seed Grain
1070

SERVICES AGRICULTURE

Public Notices
1135

Algonquin

PUBLIC OPEN HOUSE

Proposed Wind Energy Project

Algonquin Power Co. is holding the first two open houses regarding Algonquin's 177 megawatt (MW) proposed Blue Hills Wind Power Facility between Herbert and Neidpath. These open houses will provide preliminary project information regarding project planning and development activities, as well as a chance for the public to meet the project team. Both meetings will provide the same information for your convenience.

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For more information, contact:
Olivia Neter, Algonquin Power Co. Eileen Turano, Algonquin Power Co.
Ph: 905.465.6717 Ph: 905.829.6352
Olivia.Neter@AlgonquinPower.com
Eileen.Turano@algonquinpower.com

Obituaries
1160

D.3 OPEN HOUSE POSTER BOARDS

D.3.2

Algonquin

WELCOME

Blue Hills Wind Project

Open House

WELCOME

- SaskPower and Algonquin Power have agreed on a change of location for a 177 megawatt (MW) wind project to the location between Herbert and Neidpath in southwest Saskatchewan

- This first Open House provides:
  - background information on Algonquin Power
  - general project and wind power information
  - This is the first of multiple public open houses

- Public consultation and input is an important part of the Project design and the Environmental Assessment

WHO IS ALGONQUIN POWER CO.?

- 35 renewable and clean energy facilities with more than 1,300 MW of capacity
- 511 MW of contracted projects in development/construction

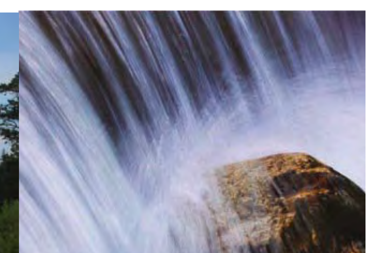
Algonquin

- A Subsidiary of Algonquin Power and Utilities Corp., Algonquin Power Company (APCo) is a non-regulated generation business that owns a widely diversified portfolio of operating interest in hydroelectric, wind energy and other energy projects across Canada and the United States

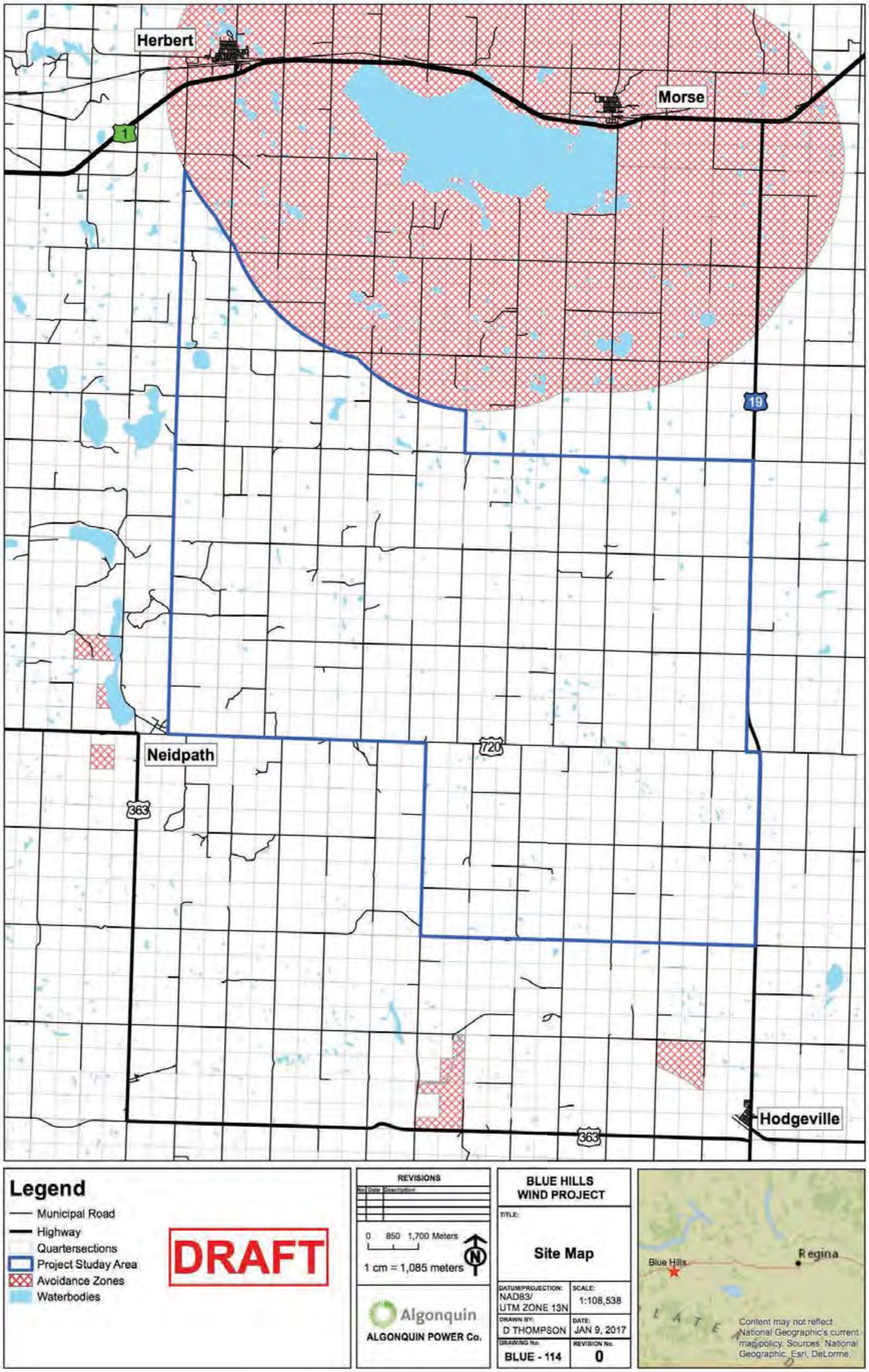
- APUC, has been traded on the Toronto Stock Exchange since 1997 and the New York Stock Exchange since 2016

- Algonquin's St. Leon I and II Wind Energy Project in Manitoba is one of the largest in Canada
  - 63 turbines completed in 2005 with an expansion of 10 additional turbines in 2012



BLUE HILLS WIND PROJECT LOCATION



THE BLUE HILLS WIND PROJECT

- An Environmental Impact Assessment will be undertaken

- The proposed project could involve construction of approximately 50 to 77 turbines *number could change

- Other project components will include:
  - Access Roads to the Turbines
  - Cabling to a Collector Station
  - [Interconnection to Transmission Line Substation]
  - Operations and Maintenance Building
  - Crane Pads
  - Project Substation
  - Meteorological Towers

- SaskPower will be conducting an Interconnection System Impact Study, to determine how the project will be connected to the transmission grid

Algonquin

ABOUT WIND POWER

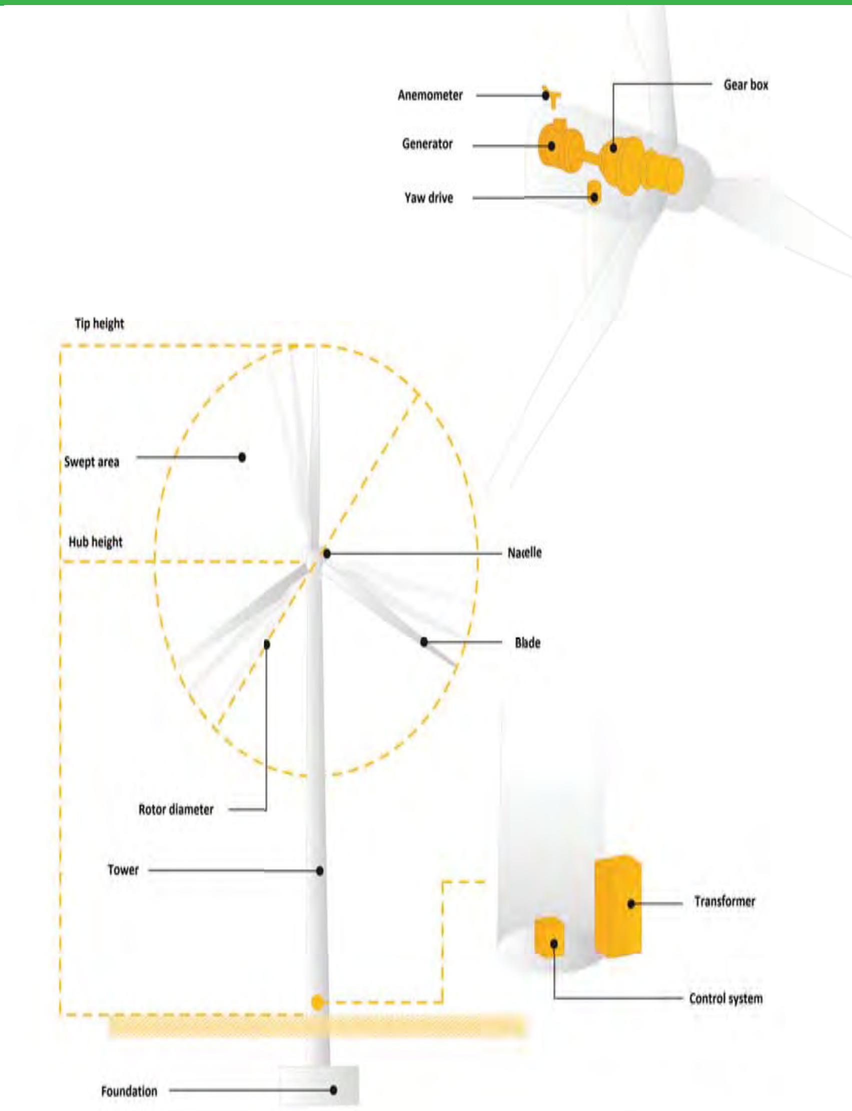
- Wind Power is renewable power
- Use of wind power reduces consumption of fossil fuels and offsets greenhouse gas emissions
- Wind Power uses fewer resouces than conventional energy sources

Algonquin

HOW DOES WIND POWER WORK?

TURNING WIND INTO ELECTRICITY

Wind power is the fastest-growing energy source in the world. Turbines powered by wind are mounted on towers 100 or more feet above the ground, where the wind is faster and less turbulent.



HOW IT WORKS

(1) When the blades start moving, they spin a shaft that leads to a generator.

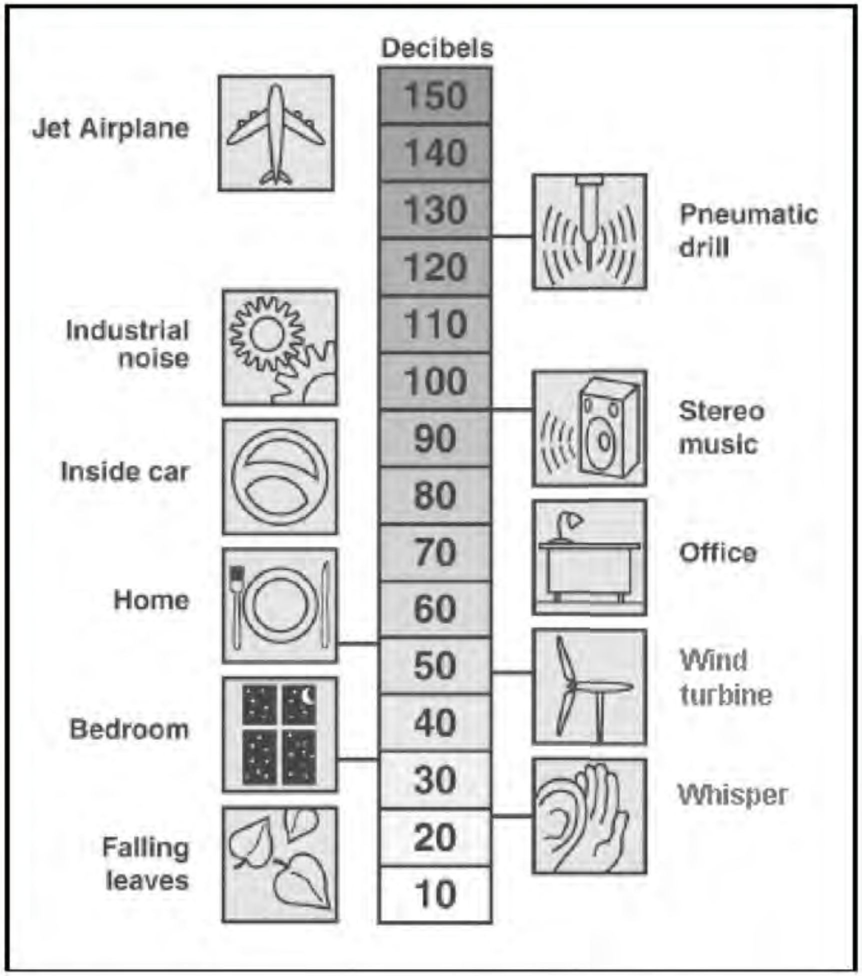
(2) The generator consists of conductor, such as a coiled wire, that is surrounded by magnets.

(3) The rotating shaft turns the magnets around the conductor and generates an electrical current.

(4) Sensors cause the top of the turbine to rotate to face into the wind and the blades change their angle to best catch the wind. The blades are flexible and stop spin-ning if wind is too strong.

Algonquin

WIND POWER TECHNOLOGY



- The efficiency of wind turbines has increased greatly and has made this power source more attractive to utilities
- Wind turbines typically utilized in Canada produce between 1 and 3.5 MW of power
- Continuous technological and siting design improvements reduce environmental impacts

Algonquin

THE TURBINE SITING PROCESS

- Characteristics of Local Wind
- Prefer cleared or open land and avoidance of tall buildings or forested areas
- Landowner consultation and considerations
- Avoid sensitive areas (wetlands, sensitive wildlife habitat, etc)
- Setback distances from roads, buildings, etc.
  - municipal bylaws
  - industry standards and practices
  - Provincial Wind Siting Guidelines
  - Sound levels, safety, etc.

Algonquin

APPROXIMATE CONSTRUCTION TIMELINE

Spring 2020

- Construction Starts - Access road entrance
- Turbine foundation excavation and concrete base pouring. Turbine deliveries begin.
- Electrical collector line installation and Substation construction

Fall 2020

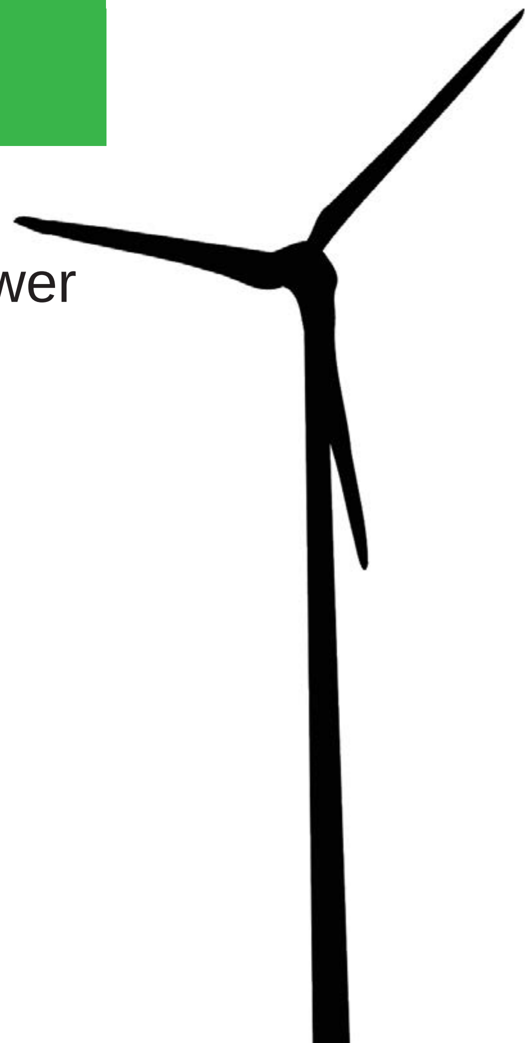
- Wind turbine erection begins
- Tower wiring begins
- Reclamation of sites where Turbines have been erected.
- Electrical testing of substation, collection and turbines.
- Reclamation of sites completed.

December 2020

- Commercial Operation

Algonquin

WIND TURBINE SITING FACTORS



- Wind Data from MET Tower
- Provincial Regulations
  - Turbine Siting Guidelines
- Local Regulations
  - Official Community Plan
  - Zoning By-laws
  - Other Restrictions
- Land Assembly
  - Participating Landowners
- Environmental Factors
  - Wildlife (plants and animals)
  - Wetlands
- Built Environment
  - Road Network
  - Buildings / Residences
- Topography
- Archeological Investigation

THE ENVIRONMENTAL ASSESSMENT

- The Project team will consult with the Saskatchewan Ministry of the Environment to ensure that all aspects of the proposed Environmental Assessment, at a minimum, meet established criteria.
- The Environmental Assessment process will involve consultations with RM's, government agencies and non-government agencies.
- Consultations are an important part of the process where valuable information can be exchanged and considered as the Project is developed.

Algonquin

PUBLIC, HEALTH AND SAFETY

- Traffic Management Plan for safe management of traffic and delivery of materials along public roads
- Limiting access to construction sites to minimize hazards to the public
- Implement:
  - Emergency Response Plan
  - Communications Plan
  - Spill Response Plans
  - Training for Construction Staff
- Train operations staff and implement operations and maintenance protocols to minimize risks to public health and safety
- Project turbines will be supplied by an established turbine manufacturer

Algonquin

BENEFITS TO THE COMMUNITY

- Tax Revenue
- Compatible with existing agricultural practices
- Provide local jobs
- Spin-off benefits to local businesses

Algonquin

PRELIMINARY FINDINGS - ENVIRONMENTAL EFFECTS

- Local studies are just beginning; experience elsewhere suggests no significant adverse effects from the project
  - minimal disturbance from sound levels
  - new turbines designed to lessen wildlife effects
  - aesthetics of the projects are subject to individuals preferences
- Project-specific investigations (wildlife surveys, heritage resource assessment) will be occurring soon
- Use of Wind power can offset the production of millions of kg of CO_2 (greenhouse gases)

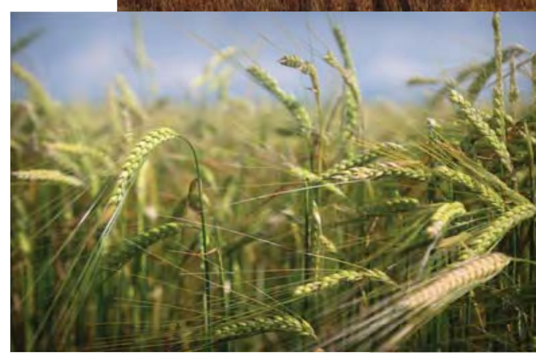
Algonquin

DECOMMISSIONING THE PROJECT

- Decommissioning activities would be similar to construction activities

- Sites could be returned to pre-project conditions including removal of infrastructure to below ground level and replacement of topsoil

- Most turbine components are recyclable



Algonquin

THANKS FOR ATTENDING

Please help yourself to the refreshments
as you complete the questionnaire.

Thank you for providing your views!

For further information contact:

Olivia Neter	Ph: 905.465.6717	Olivia.Neter@AlgonquinPower.com
Eileen Turano	Ph: 905.829.6352	Eileen.Turano@AlgonquinPower.com
Sean Fairfield	Ph: 905.465.4518	Sean.Fairfield@AlgonquinPower.com

Algonquin

D.4 OPEN HOUSE FACT SHEET

D.4.2

Fact Sheet

Project Developer
Algonquin Power Co.

Location
Rural Municipality of Lawtonia & Regional Municipality of Morse, SK, which is between Herbert and Neidpath

Capacity
177 megawatts (MW)

Power Purchase Agreement
25 years

Full Commercial Operation Date
Estimated Late 2020

Algonquin

Blue Hills Wind Project

The Blue Hills Wind Project is proposed as a 177 megawatt (MW) renewable energy generation facility. Once constructed, the facility will be able to produce enough renewable electricity to power approximately 70,000 homes.

About Algonquin Power Co.

A Subsidiary of Algonquin Power and Utilities Corp., Algonquin Power Company (APCo) is a non-regulated generation business that owns a widely diversified portfolio of operating interest in hydroelectric, wind energy and other energy projects across Canada and the United States.

Change of Location

SaskPower and Algonquin Power have agreed on a change of location for a 177 megawatt (MW) wind project to the location between Herbert and Neidpath in southwest Saskatchewan.

Project Benefits

- Employment opportunities during all phases of construction and operations
- Helping Saskatchewan meet its forecasted energy demand while reducing harmful greenhouse gases
- Provide a tax revenue stream for the local municipalities

D.5 OPEN HOUSE QUESTIONNAIRE

D.5.2

Blue Hills Wind-Energy Project
Public Open House Questionnaire

Algonquin

1. Was this Open House helpful in understanding the potential effects of the proposed Project?

   Yes ☐ Somewhat ☐ No ☐ Uncertain ☐

1.1. Please rate the information provided at this Open House – the quality was:

   Excellent ☐ Very Good ☐ Good ☐
   Adequate ☐ Poor ☐ Uncertain ☐

1.2. Was there enough information?

   Yes ☐ No ☐ Uncertain ☐

1.3. Is there a particular subject about whom you would like to see more information? If yes, what is that subject?

____
____
____
____
____

2. If you asked questions about the Projects to the staff present at the Open House, please rate the supplementary information they provided.

   Excellent ☐ Very Good ☐ Good ☐
   Adequate ☐ Poor ☐ Didn't Ask a Question ☐

3. After viewing the Open House information, how do you feel about the Projects?

   Support ☐ Oppose ☐ Neutral ☐ No Opinion ☐

Algonquin

3.1. Can you please provide additional details regarding your response to Question 3?

____
____
____
____

4. Do you have any other comments/questions you would like answered about the companies or the Projects? If so, please provide your contact information below.

Questions or Comments:

____
____
____
____
____
____

Contact Information:
Name: ____
Telephone # or Address: ____
Email: ____

Thank-you for joining us at this Open House & sharing your thoughts!

D.6 PROJECT WEBSITE

D.6.2

. Menu

- Project Summary
- Approvals
- Public Meetings
- Contact Us

Project Summary

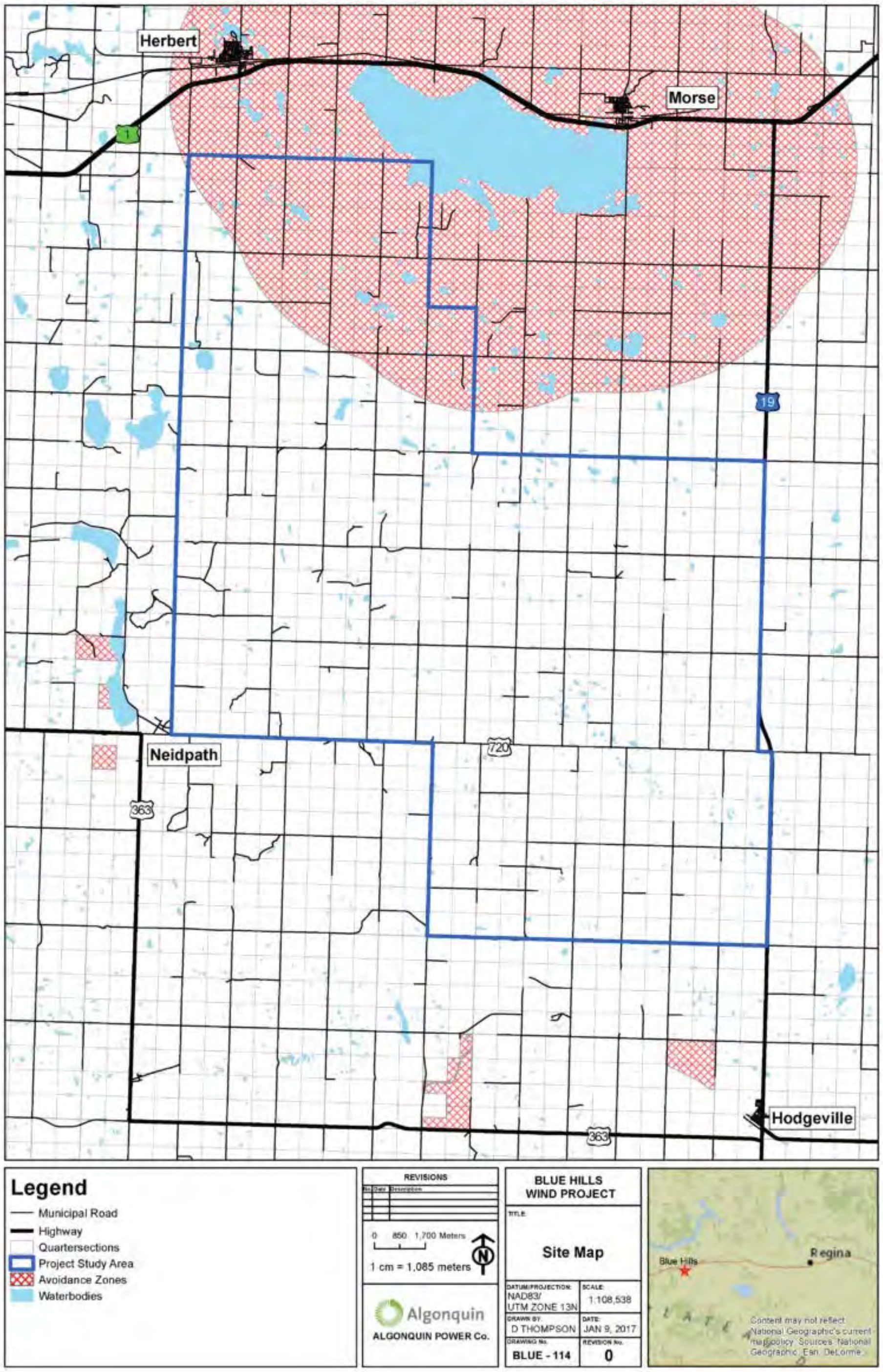
Public Open House

Public Open House Invitation Blue Hill Wind Project Sept. 27th and 28th

The Blue Hill Wind Project, is a 177 MW wind project, located between Herbert and Neidpath in southwest Saskatchewan.

The Project will be essential in achieving SaskPower's 2030 goal, of 30% renewable energy powering the grid.

The Project is currently in the regulatory review permitting process through the Ministry of Environment and is expected to be in service by late 2020.



Links

- Windfacts
- Wind Energy Institute of Canada
- Natural Resources Canada: Wind Energy
- David Suzuki Foundation
- Canadian Wind Energy Association
- Friends of Wind
- Health Effects & Wind Turbines

Search for: Search

APPENDIX E
ACOUSTIC ENVIRONMENT

Appendix E ACOUSTIC ENVIRONMENT

E.1 NOISE ASSESSMENT TECHNICAL REPORT

E.1.2

Blue Hill Wind Energy Project
Noise Impact Assessment

Prepared for:
Algonquin Power

Prepared by:
Stantec Consulting Ltd.

December 2017

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Abbreviations

dBA	A-Weighted Decibel
G	Ground Absorption Factor
ISO	International Organization for Standardization
L_{eq}	Energy Equivalent Sound Level
LAA	Local Assessment Area
km	kilometre
m	metre
MW	megawatt
MOECC	Ministry of Environment and Climate Change
ONAF	Oil Natural Air Forced
PDA	Project Development Area
PWL	Sound Power Level re 10^{-12} Watt
RM	Rural Municipality
SLL	Sound Level Limit
WTG	Wind Turbine Generator

Glossary

Ambient Sound Level or Ambient Noise	All-encompassing sound that is associated with a given environment, usually a composite of sounds from many sources near and far. Includes noise from all sources other than the sources of interest (i.e., sound other than that being measured), such as sound from other industrial sources, transportation sources, animals, and nature.
Attenuation	The reduction of sound intensity achieved by various means (e.g., air, humidity, and porous materials).
A-Weighting	The weighting network used to account for changes in level sensitivity as a function of frequency. The A-weighting network de-emphasizes the low (i.e., below 1 kHz) frequencies, and emphasizes the frequencies between 1 kHz and 6.3 kHz, in an effort to simulate the relative response of the human ear. See also frequency weighting.
Background Sound Level or Background Noise	Same as the ambient sound level.
Daytime	Defined as the hours (h) from 07:00h to 19:00h.
Decibel	A logarithmic measure of any measured physical quantity and commonly used in the measurement of sound. The decibel (dB) provides the possibility of representing a large span of signal levels in a simple manner. The difference between the sound pressure for silenced versus a loud sound is a factor of 1:1,000,000 or more and the same in Decibel is 0-130 dB, therefore it is less cumbersome to use a small range of equivalent values. A tenfold increase in sound power is equal to +10 dB; a tenfold increase in sound amplitude is equal to +20 dB.
Decibel, A-weighted	A-weighted decibels (dBA). Most common units for expressing sound levels since they approximate the response of the human ear.

Energy Equivalent Sound Level (L_{eq})	An energy-equivalent sound level (L_{eq}) over a specified period of time that would have the same sound energy as the actual (i.e., unsteady) time varying sound over the same period of time. It represents the average sound pressure encountered for the period. The period is often added as a suffix to the label (i.e., L_{eq}(24) for the 24-hour equivalent sound level). A L_{eq} value expressed in dBA is a good, single-value descriptor to use as a measure of annoyance due to noise.
Frequency	The number of times per second that the sine wave of sound repeats itself. It can be expressed in cycles per second, or Hertz (Hz).
Frequency Weighting	A method used to account for changes in sensitivity as a function of frequency. Three standard weighting networks, A, B, and C, are used to account for different responses to sound pressure levels. Note: The absence of frequency weighting is referred to as "flat" response or linear weighting. See also A-weighting.
Ground Absorption Coefficient	A parameter defined based on noise reflection characteristics of a surface. It varies between 0.0 (fully reflective) to 1.0 (fully absorptive).
Ground Effect	The change in sound level, either positive or negative, due to intervening ground between source and receiver. Ground effect is a relatively complex acoustic phenomenon, which is a function of ground characteristics, source-to-receiver geometry, and the spectral characteristics of the source. A commonly used rule-of-thumb for propagation over soft ground (e.g., grass) is that ground effects will account for about 1.5 dB per doubling of distance. This relationship is empirical and tends to break down for distances greater than about 30 to 61 metres (100 to 200 feet).
Hertz (Hz)	A unit of frequency, expressed as cycles per second.
International Organization for Standardization	An international body that provides scientific standards and guidelines related to various technical subjects and disciplines.

Line Source	Multiple point sources moving in one direction (e.g., a continuous stream of roadway traffic, radiating sound cylindrically). Sound levels from a line source decrease at an ideal rate of 3 dB per doubling of distance.
Mitigation	Measures taken to reduce, avoid, or control effects on the environment.
Night-time	Defined as the hours from 23:00h to 07:00h in Ontario noise guidelines.
Noise	Any unwanted sound. "Noise" and "sound" are used interchangeably in this document.
Noise level	Same as sound level.
Octave	The interval between two frequencies having a ratio of two to one. For acoustic measurements, the octave bands start at 1,000 Hz centre frequency and go up or down from that point, at a 2:1 ratio. From 1,000 Hz, the next centre frequency is 2,000 Hz; the next is 4,000 Hz, or 500 Hz, 250 Hz, etc.
Point of Reception	A representative point considered for the purpose of assessment within noise-sensitive receptor such as a residence (i.e., dwelling inhabited at least 6 months of the year).
Point Source	Source that radiates sound spherically (i.e., equally in all directions). Sound levels from a point source decrease at a theoretical rate of 6 dB per doubling of distance.
Predictable Worst Case Operation	A planned and predictable mode of operation for stationary source(s), during the hour when the noise emissions from the stationary source(s) have the greatest impact at a point of reception, relative to the applicable limit.
Sound	A wave motion in air, water, or other media. It is the rapid oscillatory compression changes in a medium that propagate to distant points. It is characterized by changes in density, pressure, motion, and temperature as well as other physical properties. Not all rapid changes in the medium are due to sound (e.g., wind distortion on a microphone diaphragm).

Sound Level	Generally, sound level refers to the weighted sound pressure level obtained by frequency weighting, usually A- or C-weighted, and expressed in decibels
Sound level meter	An instrument consisting of a microphone, amplifier, output meter and frequency-weighting networks that is used to measure noise and sound levels.
Sound Power Level	The total sound energy radiated by a source per unit time (i.e. rate of acoustical energy radiation). The unit of measurement is the Watt. The acoustic power radiated from a given sound source as related to a reference power level (i.e., typically 1E-12 watts, or 1 picowatt) and expressed as decibels. A sound power level of 1 watt = 120 decibels relative to a reference level of 1 picowatt.
Sound Pressure	The root-mean-square of the instantaneous sound pressures during a specified time interval in a stated frequency band.
Sound Pressure Level	Logarithmic ratio of the root mean square sound pressure to the sound pressure at the threshold of human hearing (i.e., 20 micropascals).
Spectrum (Frequency Spectrum)	The frequency dependent characteristic of sound often express as amplitude versus octave band frequency (see octave band).

1.0 INTRODUCTION

Algonquin Power (Algonquin) is proposing to construct the Blue Hill Wind Energy Project (the Project), a 177 megawatt (MW) facility located in southern Saskatchewan (SK) within the rural municipalities (RMs) of Morse and Lawtonia. The Project will consist of between 49 and 56 wind turbine generators (WTG) and associated infrastructure, including access roads, electrical collector lines and a substation. It is intended that seven of the 56 WTGs will be for contingency use; however, to be conservative, the maximum number of WTGs is considered for the Noise Impact Assessment (NIA). Each WTG will have a capacity between 3.2 MW and 3.7 MW; a capacity of 3.6 MW is used for assessment purposes. Three possible substation locations (one planned and two contingency) are proposed for the Project. Each substation development includes one 200 MVA transformer. All three locations are included in the assessment as a conservative approach.

The objective of the NIA is to assess the Project noise effect at identified points of reception. The associated methods and results are described in this technical data report. The prediction result was generated based on technical standards, manufacturer's information, and computer noise propagation modelling.

2.0 ASSESSMENT AREA

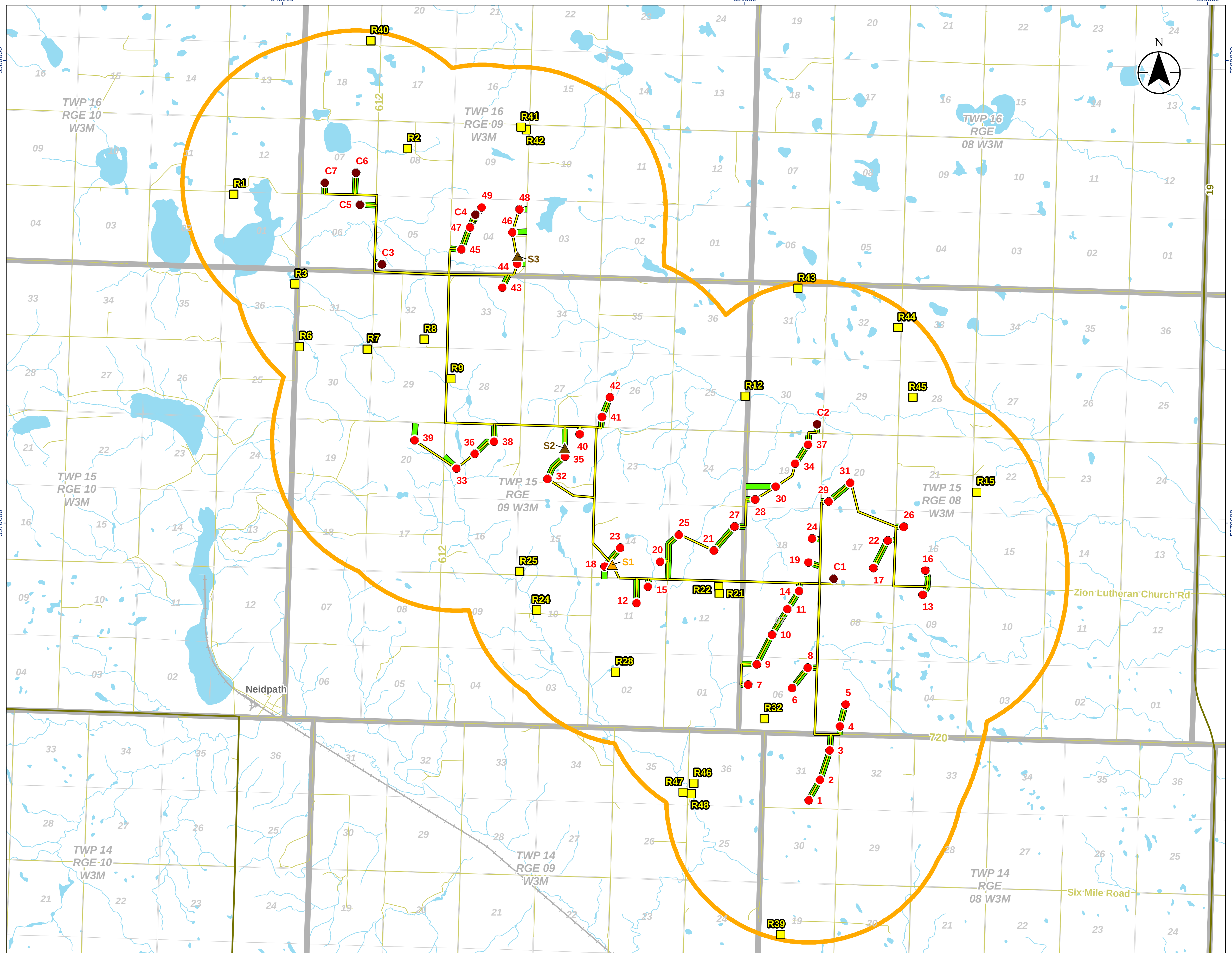
The Project is located approximately 10 km south of the town of Herbert, SK. The Project surrounding area is largely cultivated land. The Project Development Area (PDA) is represented by the physical Project footprint and consists of the area of physical disturbance associated with Project components, i.e., WTGs, access roads, collector lines, substation, and temporary workspaces. The Local Assessment Area (LAA) is defined as a 3 km buffer around the Project PDA as this area encompasses Project-related noise emissions. There is no Regional Assessment Area (RAA) defined for the acoustic environment as the Ontario Ministry of Environment and Climate Change's (MOECC) *Noise Guidelines for Wind Farms* (MOECC 2016) considers Project-only noise effects; therefore, there are no cumulative noise effects to consider and the LAA is sufficient for the assessment of potential effects on the acoustic environment. The PDA and LAA are shown in Figure E1-1.

There are 25 points of reception (i.e., receptors) identified inside the LAA. The receptor locations are presented in Table 1 and shown in Figure E1-1. All receptors are assumed to be residential dwelling locations and were assessed at an elevation of 4.5 m above ground level.

Table 1 Receptor Locations

Receptor Name[1]	Universal Transverse Mercator (UTM) Coordinates [2] (m)		Nearest Wind Turbine	Approximate Distance to Nearest Wind Turbine (m)
	Easting	Northing		
R22	349430	5568624	WTG_21	800
R32	350422	5565781	WTG_7	810
R21	349444	5568481	WTG_21	940
R9	343653	5573124	WTG_39	1550
R2	342713	5578097	WTG_C6	1250
R12	350006	5572745	WTG_C1	1670
R25	345134	5568958	WTG_18	1840
R8	343073	5573974	WTG_C4	1870
R24	345492	5568122	WTG_18	1760
R28	347205	5566787	WTG_12	1580
R42	345278	5578504	WTG_48	1740
R41	345165	5578557	WTG_48	1790
R15	355014	5570674	WTG_26	1760
R7	341841	5573759	WTG_C4	1860
R45	353635	5572719	WTG_C1	2150
R3	340281	5575166	WTG_C4	1920
R46	348896	5564382	WTG_1	2490
R48	348838	5564156	WTG_1	2560
R47	348666	5564186	WTG_1	2730
R6	340378	5573819	WTG_C4	2500
R1	338956	5577108	WTG_C7	2000
44	353312	5574224	WTG_C1	2720
R40	341917	5580425	WTG_C6	2890
R43	351152	5575074	WTG_C1	2950
R39	350774	5561113	WTG_1	2980

NOTE:
[1] Receptors R43 and R47 were identified by examining satellite imagery and were not field verified.
[2] UTM Zone 13 NAD 83



Noise Receptor

Noise Local Assessment Area

Proposed Project Layout

Wind Turbine Generator

Contingency Wind Turbine Generator

Substation

Contingency Substation

New Build Permanent Access Road

New Electrical Collector Line

Major Road

Minor Road

Railway

Watercourse

Waterbody

Township

Section

0 0.85 1.7 2.55 3.4 Kilometers

1:85,000 (At original document size of 11x17)

Notes

1. Coordinate System: NAD 1983 UTM Zone 13N
2. Base features produced under license with the Government of Saskatchewan and the Government of Canada
3. Layout: Algonquin, Sept 06, 2017, V3
4. Receptors: Field Validated by Stantec/Algonquin, 2017

Project Location
Near Herbert, SK

113254088-043 REVC
Prepared by acory on 2017-12-18
Technical Review by jchui on 2017-12-18

Client/Project
Algonquin Power Co.
Blue Hill Wind Energy Project

Figure No.
E1-1

Title
Noise Local Assessment Area and Receptor Locations

3.0 REGULATORY FRAMEWORK

There is no noise regulation in the Province of Saskatchewan. As such, in the absence of provincial guidance or regulations, assessment of the acoustic environment uses the Ontario Ministry of the Environment and Climate Change (MOECC) *Noise Guidelines for Wind Farms* (MOECC 2016) level of 40 dBA sound level limit (SLL) to determine a significant adverse effect threshold.

Other relevant assumptions appropriate for a prairie environment were also used during modeling of the potential acoustic effects and are stated in this report.

3.1 CLASSIFICATION OF RECEPTOR AREA

The MOECC noise guideline provides definitions of three possible classifications for receptor areas. Class 1, Class 2, and Class 3 areas are described as urban, mixed, and rural areas, respectively. The classification of an area is one of the determining factors for the SLL of receptors located within that area. The Project location and LAA is best described by the characteristics of a Class 3 area, which is defined in the noise guideline (MOECC 2008) as the following:

> **"Class 3 Area**
> Means a rural area with an acoustical environment that is dominated by natural sound having little or no road traffic, such as the following:
>
> - A small community
> - Agricultural area
> - A rural recreational area such as a cottage or a resort area; or
> - A wilderness area."

Typically, a receptor located within approximately 500 m of a provincial highway can be classified as a Class 2 area. As a conservative approach, the LAA is considered as a Class 3 area despite the location of some receptors being close to roadways and commercial operations. The regulatory requirements are most stringent for a Class 3 area.

3.2 SOUND LEVEL LIMIT

The SLL for wind turbine noise emissions at receptors provided in the MOECC noise guideline also vary according to wind speed at a 10 m reference height. The SLL is measured in A-weighted one hour equivalent sound level ($L_{eq,\,1hr}$). As wind speed at the reference height increases, the SLL also increases to address the corresponding increase in wind-induced background sound levels. Table 2 summarizes the SLLs prescribed in the MOECC noise guideline at each wind speed for a Class 3 area.

Table 2 Sound Level Limit for Wind Facilities for a Class 3 Area

Wind Speed (m/s) at 10 m height	≤ 6	7	8	9	≥10
Wind Turbine SLLs for a Class 3 Area. Expressed in A-weighted equivalent sound level ($L_{eq,\,1hr}$), applied at the Point of Receptions	40 dBA	43 dBA	45 dBA	49 dBA	51 dBA
NOTE: The SLL is based on a one hour equivalent sound level ($L_{eq,1HR}$)					

The SLL does not apply to participating receptors according to Section 6.5.6.1 of the noise guideline (MOECC 2013); however, to be conservative, this assessment includes all participating (i.e., lease agreement with Algonquin) and non-participating receptors within the LAA.

The SLL of 40 dBA at the wind speed of 6 m/s or less (at 10 m height) for a Class 3 area is the most stringent in the guideline. As a conservative approach, the SLL of 40 dBA was used at all receptors in this assessment.

4.0 METHODS

4.1 Environmental Noise Descriptors

Environmental noise typically varies over time. To account for this variation, a single number descriptor known as the energy equivalent sound level (L_{eq}) is used. It is defined as the steady, continuous sound level over that specified time that has the same acoustic energy as the actual varying sound levels over the same time. The unit for L_{eq} is in A-weighted decibel (dBA). dBA reflects the response of the human ear to different sound frequencies. The time period used for L_{eq} measurements and regulatory criteria is the 1 hour equivalent sound level ($L_{eq,1HR}$).

4.2 Acoustic Modelling

Noise prediction was conducted using Cadna/A acoustic modeling software (DataKustik 2017), based on the internationally accepted sound propagation algorithms (ISO 1993, 1996). These standards are commonly used by noise practitioners. All predictions were based on noise emission in full octave band frequencies; frequencies ranging from 31.5 Hz to 8,000 Hz were included.

A conservative approach is incorporated in the model such that meteorological conditions enhancing noise propagation (e.g., downwind and temperature inversion conditions) exist 100% of the time. The meteorological conditions used in the acoustics model do not occur all the time; therefore, model predictions are expected to be conservative.

The modelling parameters used in the assessment are summarized in Table 3. The wind speed is based on ISO 9613-2 standard, which assumes 1 to 5 m/s downwind condition from the source (i.e., at hub height) to the receptor in the sound propagation calculation. A ground absorption factor (G) of 0.7 is used in the model to represent the Project surrounding area is largely cultivated land. G is an index with value ranges from 0 to 1 where 0 represents reflective ground and 1 represent absorptive ground condition. Ground terrain is not incorporated in the noise model as the Project area is relatively flat; as well, it represents a conservative approach to the modeling.

Table 3 Acoustic Modelling Parameters

Item	Model Parameters	Model Setting
1	Temperature	10 °C
2	Relative humidity	70 %
3	Wind speed	Downwind condition, as per ISO 9613-2 standard downwind setting (wind speed of 1 to 5 m/s)
4	Noise propagation software	Cadna/A (DataKustik 2017)
5	Noise propagation calculation standard	ISO 9613
6	Ground conditions and attenuation factor	Ground absorption (G) of 0.7
7	Terrain Parameters (terrain resolution)	No terrain data incorporated

4.3 OPERATION SCENARIO

The wind farm will operate continuously throughout the year during the daytime (07:00 – 19:00) and nighttime (19:00 – 07:00) hours when favorable wind conditions exist within the cut-in (3 m/s) and cut-out wind speeds (22.5 m/s) at hub height. The NIA assumed that all sources of noise operate at 100% of the rated capacity which represents a conservative scenario for the predictable worst case hour of operation.

4.4 NOISE EMISSION SOURCES

The Project includes the operation of 49 WTGs and one substation. As a conservative approach, seven contingency WTGs and two contingency substations are included in this assessment. Therefore, a total of 56 WTGs and three substations are included in the assessment. All WTGs are assumed to be Vestas V136 3.6 MW model with serrated blade design and a hub height of 105 m. The WTGs will be operating in the standard P01 mode. Three possible substation locations (one planned and two contingency) are proposed for the Project. Each substation development includes one 200 MVA transformer. All three locations are included in the assessment as a conservative approach.

Table 4 summarizes the sound power levels for the WTG and substation. The WTG and substation locations are shown in Figure E1-1. The Universal Transverse Mercator (UTM) coordinates for the WTG and substation locations are presented in Appendix A of this report.

The sound power level for the WTGs was established using noise data information provided by Vestas. The sound power levels represent the WTG operation during a hub height wind speed of 10 m/s under standard operation mode “P-01 mode”. The hub height wind speed of 10 m/s is equivalent to the wind speed of 6 m/s at 10 m. In the MOECC noise guideline, the SLL increases with the wind speed at 10 m. The lowest SLL of 40 dBA corresponds to the wind speed of 6 m/s at

10 m. The overall sound power level for the WTG remains the same at operating windspeed higher than 10 m/s at hub height. Therefore, the NIA approach is conservative by using information that represent wind speed condition at the lowest noise threshold of 40 dBA.

The sound power level for the substation 200 MVA transformers under ONAF operation conditions were estimated by theoretical predication methods from acoustic literature (Crocker 2007).

Table 4 Wind Turbine Generator and Substation Sound Power Levels

Noise Source	Sound Power Level (dB) in Octave Band Center Frequency (Hz) per Unit									Overall dBA
	31.5	63	125	250	500	1000	2000	4000	8000	
Vestas V136 3.6 MW wind turbine generator [1]	117	114	109	106	102	100	98	90	73	105.5
Substation (200 MVA) [2]	101	107	109	104	104	98	93	88	81	104.7

NOTES:

[1] Based on manufacturer information.

[2] Based on theoretical prediction from acoustic literature (Crocker 2007).

5.0 RESULTS

Table 5 summarizes the predicted Project-only noise effect at the receptors. Figure E1-2 presents the Project-only noise contour results within the LAA. The model assumes that all 56 WTGs and three substation transformers are operating continuously during both the daytime and nighttime period; therefore, results are representative of the predictable worst case hour of operation.

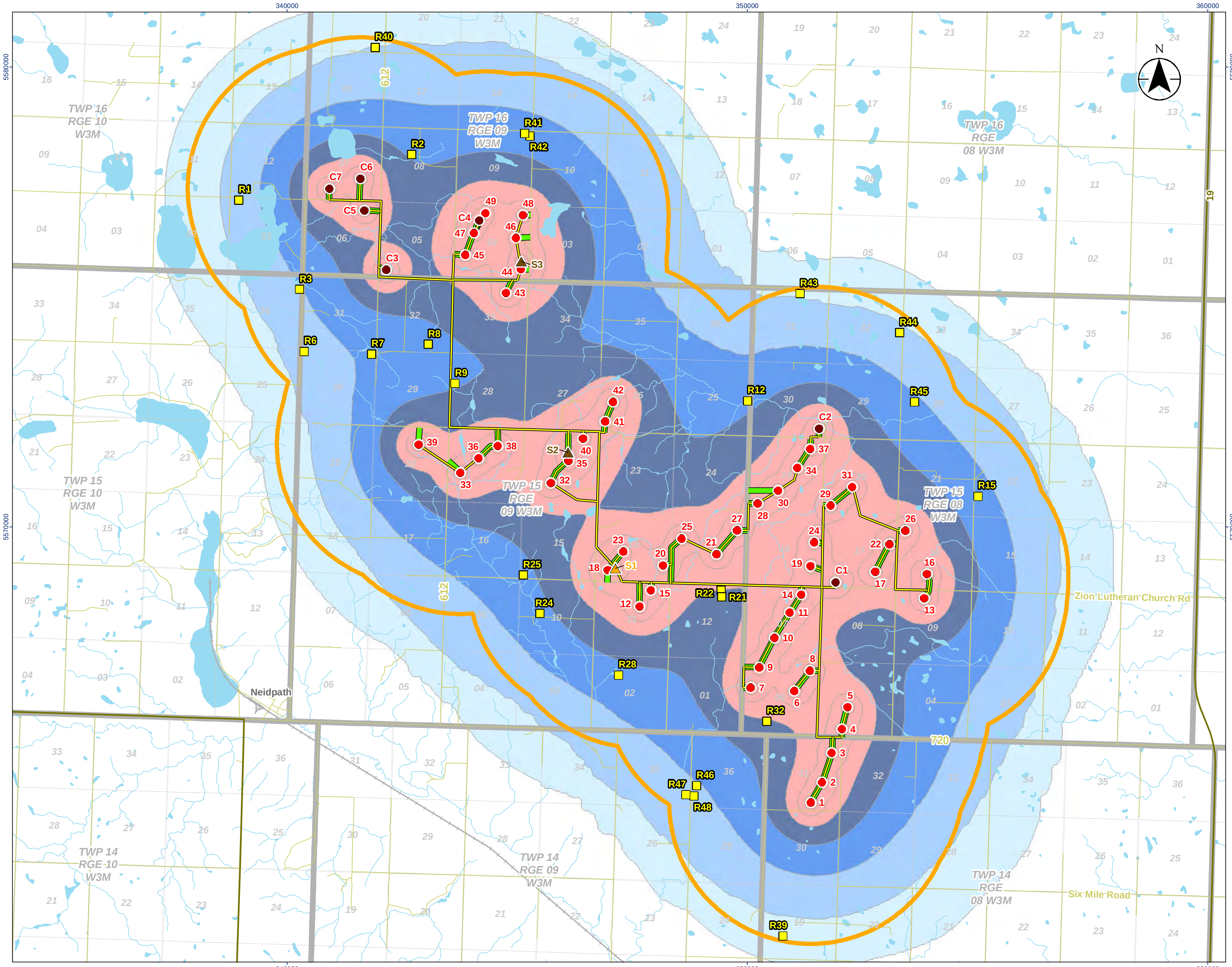
R22 is the receptor location with the highest predicted noise level of 40.0 dBA; it is located approximately 800 m from the closest WTG (ID# WTG 21). The results indicate that the Project noise effect meets the SLL of 40 dBA at all receptor locations.

Table 5 Project-Only Noise Effect

Receptor Name[1]	L_{eq} (dBA)
R22	40.0
R32	39.6
R21	39.4
R9	34.9
R2	34.7
R12	34.1
R25	34.3
R8	33.9
R24	33.9
R28	33.6
R42	32.5
R41	32.4
R15	31.7
R7	31.4
R45	30.6
R3	29.9
R46	29.6
R48	28.9
R47	28.3
R6	27.1
R1	27.0
R44	26.0
R40	25.1
R43	24.6
R39	22.6

NOTE:

[1] Receptors R43 and R47 were identified by examining satellite imagery and were not field verified.



Stantec Algonquin

- Noise Receptor
- Noise Local Assessment Area

Noise Contour

- 20 to 25 dBA
- 25 to 30 dBA
- 30 to 35 dBA
- 35 to 40 dBA
- Greater than 40 dBA

Proposed Project Layout

- Wind Turbine Generator
- Contingency Wind Turbine Generator
- Substation
- Contingency Substation
- New Build Permanent Access Road
- New Electrical Collector Line
- Major Road
- Minor Road
- Railway
- Watercourse
- Waterbody
- Township
- Section

0 0.85 1.7 2.55 3.4 Kilometers

1:85,000 (At original document size of 11x17)

Notes

1. Coordinate System: NAD 1983 UTM Zone 13N
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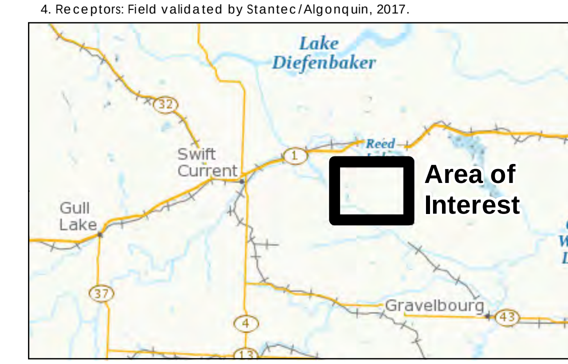
3. Layout: Algonquin, Sept 06, 2017, V3
4. Receptors: Field validated by Stantec/Algonquin, 2017.



Project Location 113254088-044 REVC
Near Herbert, SK
Prepared by acory on 2017-12-18
Technical Review by jchui on 2017-12-18

Client/Project
Algonquin Power Co.
Blue Hill Wind Energy Project

Figure No.
E1-2

Title
Predicted Leq Noise Contour Map - Project Only

6.0 SUMMARY AND CONCLUSIONS

Project noise effects have been predicted for all 25 receptors within the LAA. The predicted sound level the receptors are compared to the SLL of 40 dBA prescribed for Class 3 areas (i.e., rural areas) in the MOECC noise guideline. The predicted results at all receptors are at or below the SLL.

7.0 REFERENCES

Crocker, M.J. 2007. Handbook of Noise and Vibration Control. Malcolm J. Crocker. 2007 John Wiley & Sons, Inc.

DataKustik. 2017. Cadna/A Computer Aided Noise Abatement Model, Version 4.6.155. Munich, Germany.

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MOECC (Ontario Ministry of the Environment and Climate Change). 2008. Noise Guidelines for Wind Farms – Interpretation for Applying MOE NPC Publications to Wind Power Generation Facilities.

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MOECC. 2016. Noise Guidelines for Wind Farms. Ontario Regulation 359/09. Renewable Energy Approvals under Part V.0.1 of the Act.

Appendix A WIND TURBINE AND SUBSTATION LOCATIONS

A.1 WIND TURBINE GENERATOR AND SUBSTATION LOCATIONS

Table A-1 Wind Turbine Generator and Substation Locations

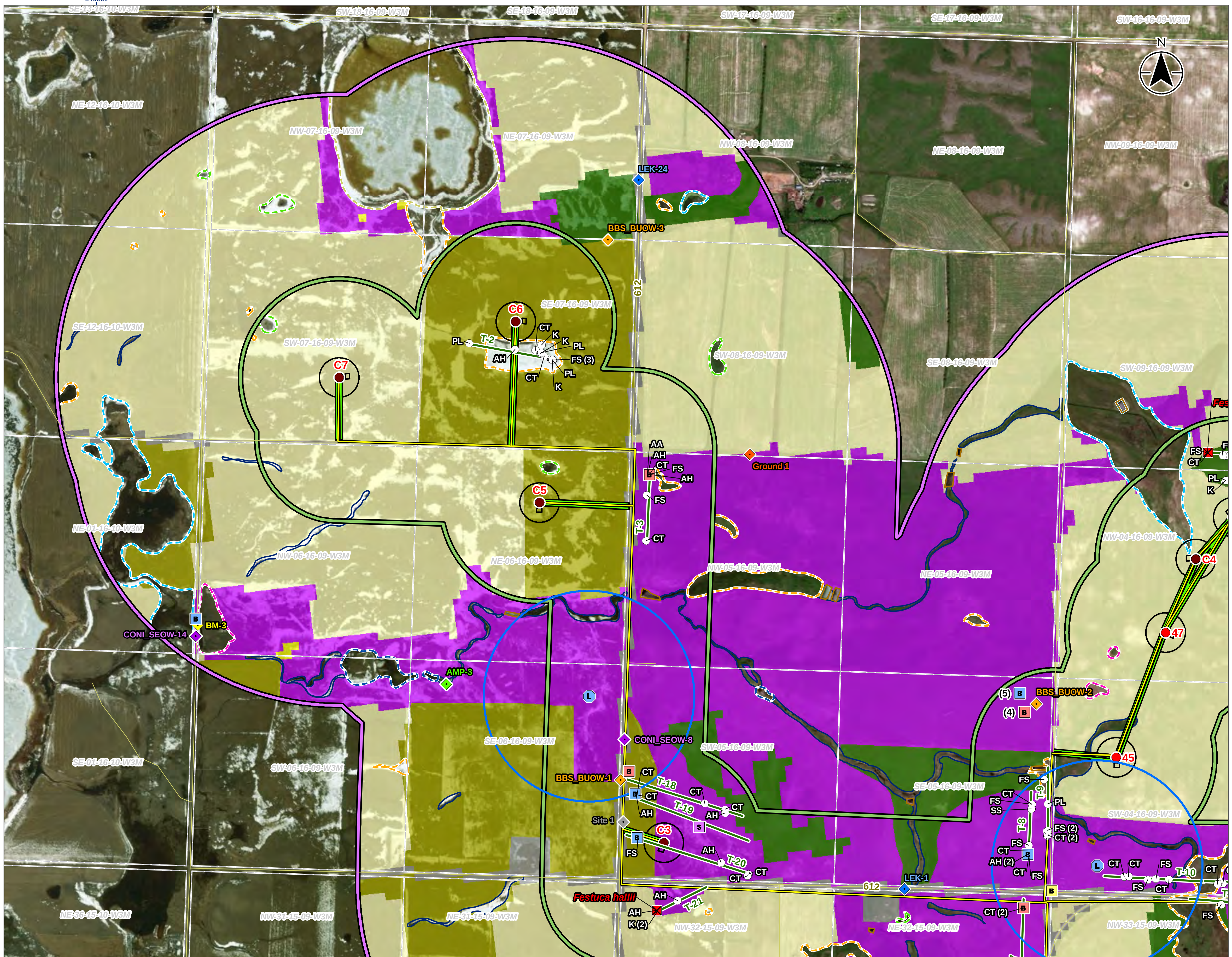
IDs	UTM Coordinates [1] (m)	
	Easting	Northing
WTG_1	351379	5564017
WTG_2	351625	5564457
WTG_3	351834	5565097
WTG_4	352054	5565611
WTG_5	352177	5566087
WTG_6	351022	5566442
WTG_7	350073	5566510
WTG_8	351357	5566881
WTG_9	350258	5566951
WTG_10	350587	5567594
WTG_11	350924	5568142
WTG_12	347660	5568278
WTG_13	353840	5568455
WTG_14	351169	5568533
WTG_15	347906	5568624
WTG_16	353899	5568980
WTG_17	352776	5569032
WTG_18	346972	5569067
WTG_19	351377	5569155
WTG_20	348173	5569168
WTG_21	349330	5569414
WTG_22	353087	5569631
WTG_23	347306	5569466
WTG_24	351452	5569669
WTG_25	348572	5569751
WTG_26	353433	5569924
WTG_27	349777	5569929
WTG_28	350220	5570510
WTG_29	351814	5570469

Table A-1 Wind Turbine Generator and Substation Locations

IDs	UTM Coordinates [1] (m)	
	Easting	Northing
WTG_30	350667	5570792
WTG_31	352284	5570874
WTG_32	345733	5570960
WTG_33	343768	5571185
WTG_34	351089	5571287
WTG_35	346110	5571440
WTG_36	344162	5571498
WTG_37	351366	5571703
WTG_38	344580	5571763
WTG_39	342858	5571791
WTG_40	346433	5571922
WTG_41	346915	5572296
WTG_42	347083	5572719
WTG_43	344763	5575093
WTG_44	345082	5575605
WTG_45	343873	5575915
WTG_46	344978	5576282
WTG_47	344061	5576389
WTG_48	345125	5576779
WTG_49	344318	5576827
WTG_C1 [2]	351561	5572142
WTG_C2 [2]	351922	5568801
WTG_C3 [2]	344176	5576668
WTG_C4 [2]	342155	5575591
WTG_C5 [2]	341683	5576882
WTG_C6 [2]	341593	5577569
WTG_C7 [2]	340922	5577357
S1	347136	5569104
S2 [2]	346110	5571621
S3 [2]	345095	5575772

NOTES:
[1] UTM Zone 13 NAD 83.
[2] Contingency locations.

APPENDIX F
BIOPHYSICAL MAP ATLAS



Stantec Algonquin

N

Proposed Project Layout

- Wind Turbine Generator
- Contingency Wind Turbine Generator
- Substation
- Contingency Substation
- New Build Permanent Access Road
- New Electrical Collector Line

Spatial Boundaries

- Project Development Area
- Vegetation Local Assessment Area
- Wildlife Local Assessment Area
- Major Road
- Minor Road
- Quarter Section

* See extended legend on the back of the page

Disclaimer: The Project layout will be subject to minor modifications as detailed engineering progresses to a finer scale. For example, further adjustments may occur such that access roads and collector lines overlap with existing truck-trails, existing cattle trails, property lines, etc., in order to further reduce potential effects.

0 0.15 0.3 0.45 0.6 Kilometers

1:15,000 (At original document size of 11x17)

Notes

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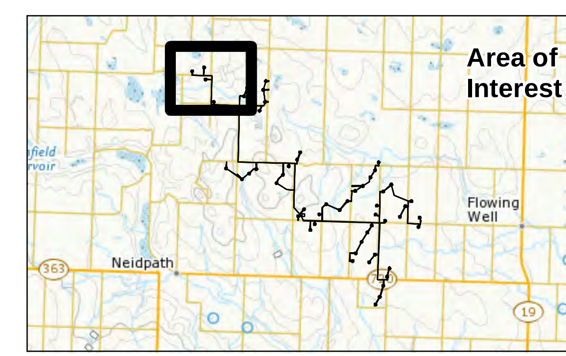

Project Location
Near Herbert, SK

113254088-025 REVF
Prepared by acoy on 2017-12-18
Technical Review by ceidem on 2017-12-18

Client/Project
Algonquin Power Co.
Blue Hill Wind Energy Project

Figure No.
Appendix F

Title
Biophysical Map Atlas

Species of Management Concern Observations

- Sharp-tailed Grouse Lek
- American Badger
- American Bittern
- Baird's Sparrow
- Barn Swallow
- Bobolink
- Chestnut-collared Longspur
- Ferruginous Hawk
- Loggerhead Shrike
- Northern Leopard Frog
- Short-eared Owl
- Sprague's Pipit
- Rare Plant*
- Rare Plant Area
- Noxious Weed

Species of Management Concern Setbacks

- Sharp-tailed Grouse Lek Setback (400 m, March 15 to May 15))
- Northern Leopard Frog Breeding Pond Setback (500 m, Year round)
- Rare Plant Setback (30 m)

Biophysical Surveys

- Amphibian Survey Site
- Breeding Bird/Burrowing Owl Survey Site
- Bat Acoustic Montoring Site
- Bird Movement Survey Site
- Common Nighthawk/Short-eared Owl Survey Site
- Sharp-tailed Grouse Lek Survey Site
- Nocturnal Radar Survey Site
- Yellow Rail Survey Site
- Vegetation Survey Transect

Historical Records (SKCDC)

- Wildlife

Land Cover

- Class 1 - Ephemeral Wetland
- Class 2 - Temporary Wetland
- Class 3 - Seasonal Wetland
- Class 4 - Semi-Permanent Wetland
- Class 5 - Permanent Wetland
- Class 6 - Alkaline Wetland
- Dugout
- Drainage
- Cultivated
- Developed
- Exposed Land/Barren
- Hayland
- Native Prairie
- Shrubland
- Tame Pasture

* Locations of *Festuca hallii* and *Paronychia sessiliflora* represent the start of the transect on which these species were recorded, not the specific location of a species occurrence. These species were not considered species of management concern at the time of the rare plant surveys; therefore, detailed location information was not collected.

Species Observation Label: B (4)
Where a number of observations of the sames species are made in close proximity to each other, a label with the count of observations is used for legibility. If there is no label, it is a single observation.

Weed Labels:

AA - Absinthe (*Artemisia absinthium*)
AH - Annual Hawksbeard (*Creptis tectorum*)
CT - Canadian Thistle (*Cirsium arvense*)
DR - Dame's Rocket (*Hesperis matronalis*)
FB - Field Bindweed (*Convolvulus arvensis*)
FS - Field Sow-thistle (*Sonchus arvensis* ssp. *arvensis*)
K - Kochia (*Bassia scoparia*)
NC - Night-flowering Catchfly (*Silene noctiflora*)
PL - Prickly Lettuce (*Lactuca serriola*)
RT - Russion-thistle (*Salsola kali*)
SS - Spiny-leaved Annual Sowthistle (*Sonchus asper* ssp. *asper*)
T - Tansy (*Tanacetum vulgare*)

Project Location
Near Herbert, SK

113254088-025 REVF
Prepared by acory on 2017-12-18
Technical Review by ceidem on 2017-12-18

Client/Project
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Blue Hill Wind Energy Project

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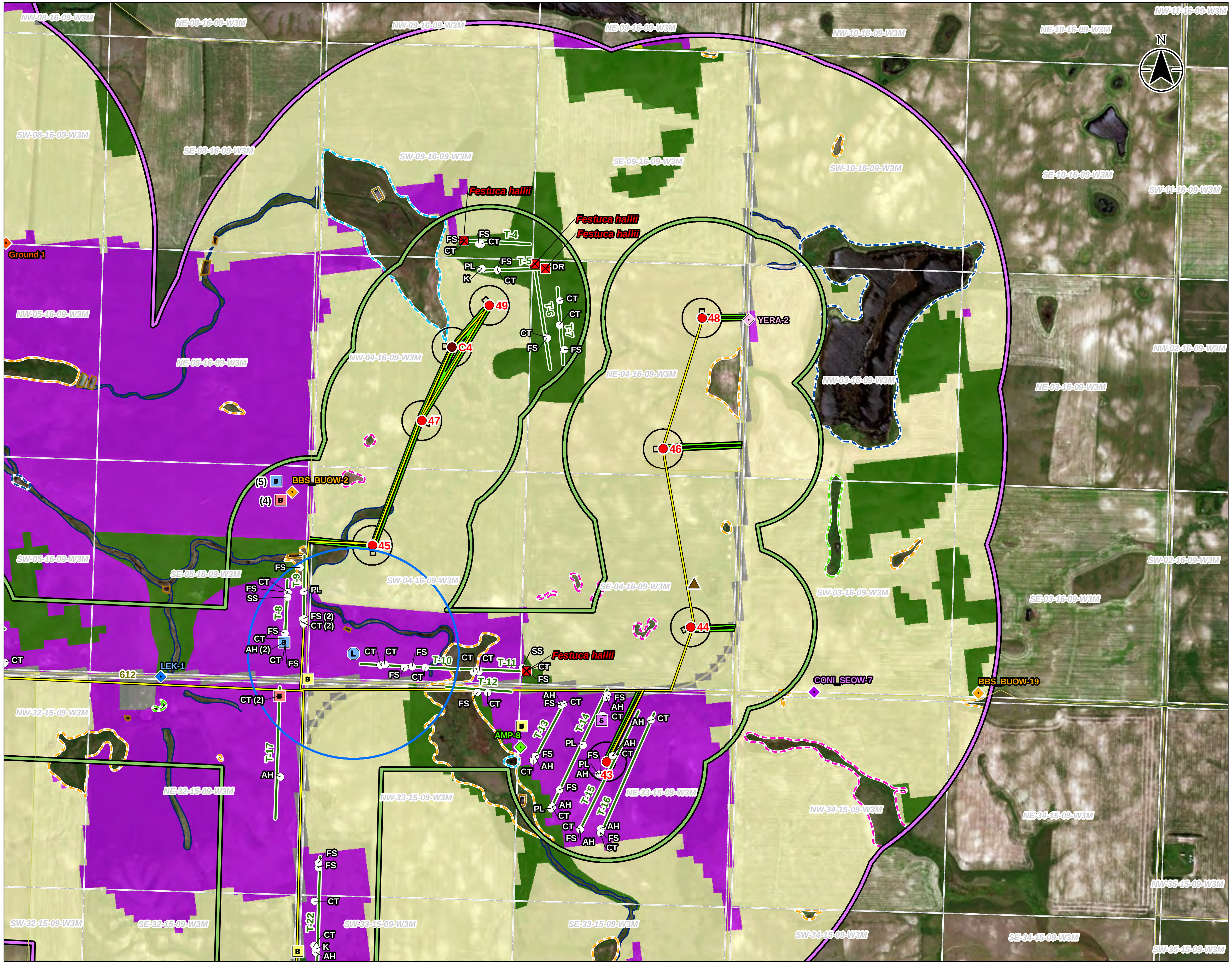

Stantec Algonquin

Proposed Project Layout

- Wind Turbine Generator
- Contingency Wind Turbine Generator
- Substation
- Contingency Substation
- New Build Permanent Access Road
- New Electrical Collector Line

Spatial Boundaries

- Project Development Area
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- Minor Road
- Quarter Section

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0 0.15 0.3 0.45 0.6 Kilometers
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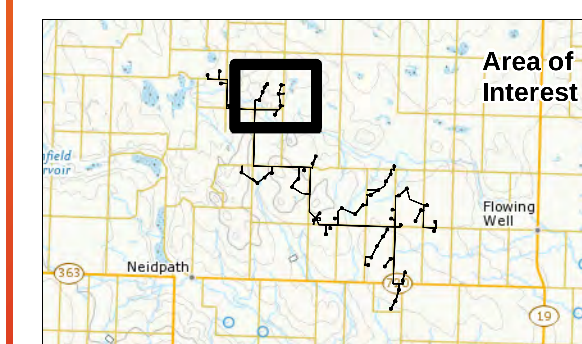

Project Location
Near Herbert, SK

113254088-025 REVF
Prepared by acoy on 2017-12-18
Technical Review by ceidem on 2017-12-18

Client/Project
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Blue Hill Wind Energy Project

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- Vegetation Survey Transect

Historical Records (SKCDC)

- Wildlife

Land Cover

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- Class 3 - Seasonal Wetland
- Class 4 - Semi-Permanent Wetland
- Class 5 - Permanent Wetland
- Class 6 - Alkaline Wetland
- Dugout
- Drainage
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- Developed
- Exposed Land/Barren
- Hayland
- Native Prairie
- Shrubland
- Tame Pasture

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- T - Tansy (*Tanacetum vulgare*)

Stantec Algonquin

Project Location
Near Herbert, SK

113254088-025 REVF
Prepared by acory on 2017-12-18
Technical Review by ceidem on 2017-12-18

Client/Project
Algonquin Power Co.
Blue Hill Wind Energy Project

Figure No.
Appendix F

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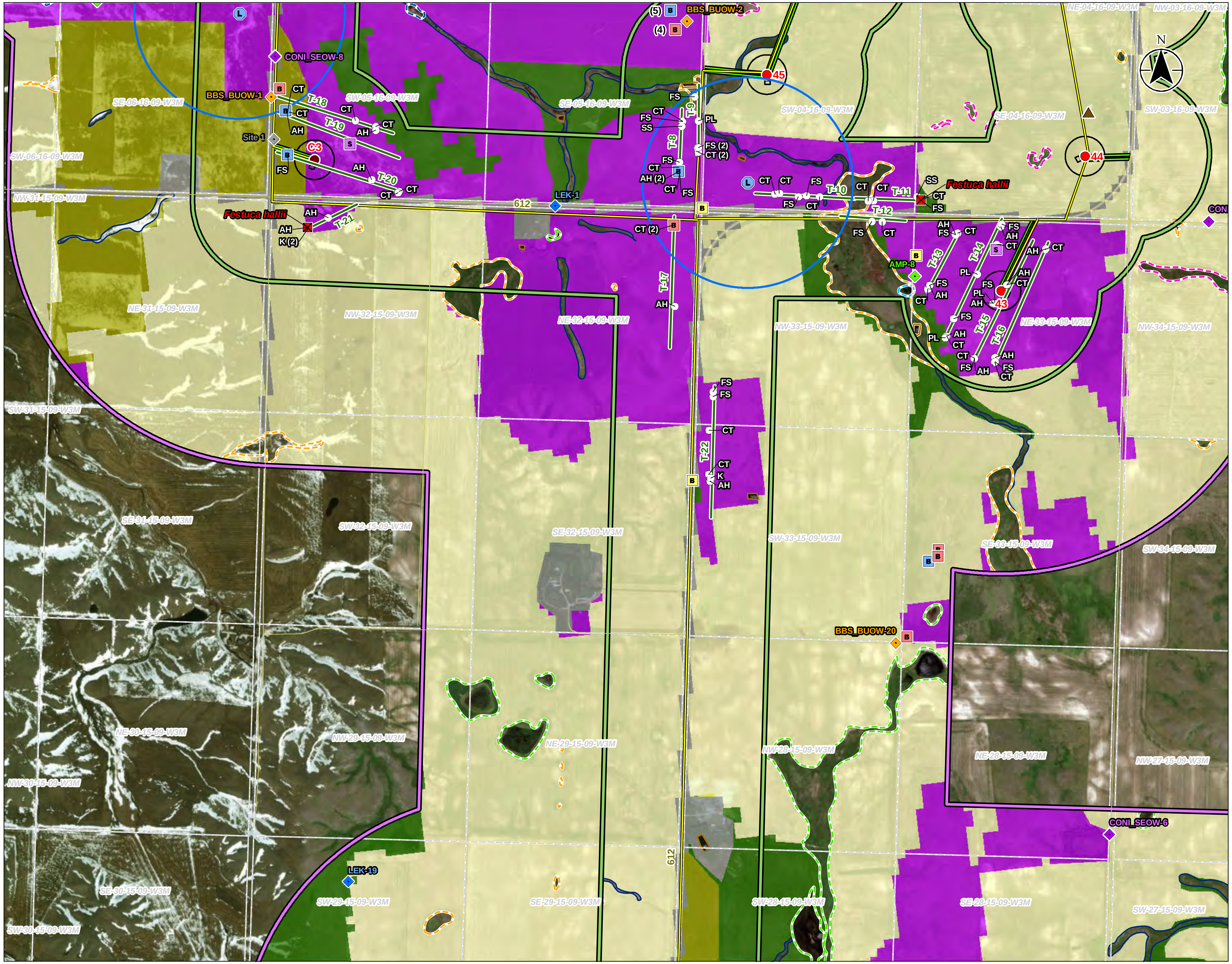

Stantec Algonquin

Proposed Project Layout

- Wind Turbine Generator
- Contingency Wind Turbine Generator
- Substation
- Contingency Substation
- New Build Permanent Access Road
- New Electrical Collector Line

Spatial Boundaries

- Project Development Area
- Vegetation Local Assessment Area
- Wildlife Local Assessment Area
- Major Road
- Minor Road
- Quarter Section

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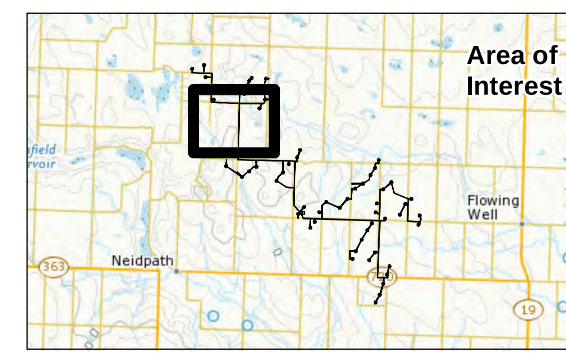

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113254088-025 REVF
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Client/Project
Algonquin Power Co.
Blue Hill Wind Energy Project

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Species of Management Concern Observations

- L Sharp-tailed Grouse Lek
- A American Badger
- A American Bittern
- B Baird's Sparrow
- B Barn Swallow
- B Bobolink
- C Chestnut-collared Longspur
- F Ferruginous Hawk
- L Loggerhead Shrike
- F Northern Leopard Frog
- S Short-eared Owl
- S Sprague's Pipit
- Rare Plant*
- Rare Plant Area
- Noxious Weed

Species of Management Concern Setbacks

- Sharp-tailed Grouse Lek Setback (400 m, March 15 to May 15))
- Northern Leopard Frog Breeding Pond Setback (500 m, Year round)
- Rare Plant Setback (30 m)

Biophysical Surveys

- Amphibian Survey Site
- Breeding Bird/Burrowing Owl Survey Site
- Bat Acoustic Montoring Site
- Bird Movement Survey Site
- Common Nighthawk/Short-eared Owl Survey Site
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- Yellow Rail Survey Site
- Vegetation Survey Transect

Historical Records (SKCDC)

- Wildlife

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Stantec Algonquin

Project Location
Near Herbert, SK

113254088-025 REVF
Prepared by acory on 2017-12-18
Technical Review by ceidem on 2017-12-18

Client/Project
Algonquin Power Co.
Blue Hill Wind Energy Project

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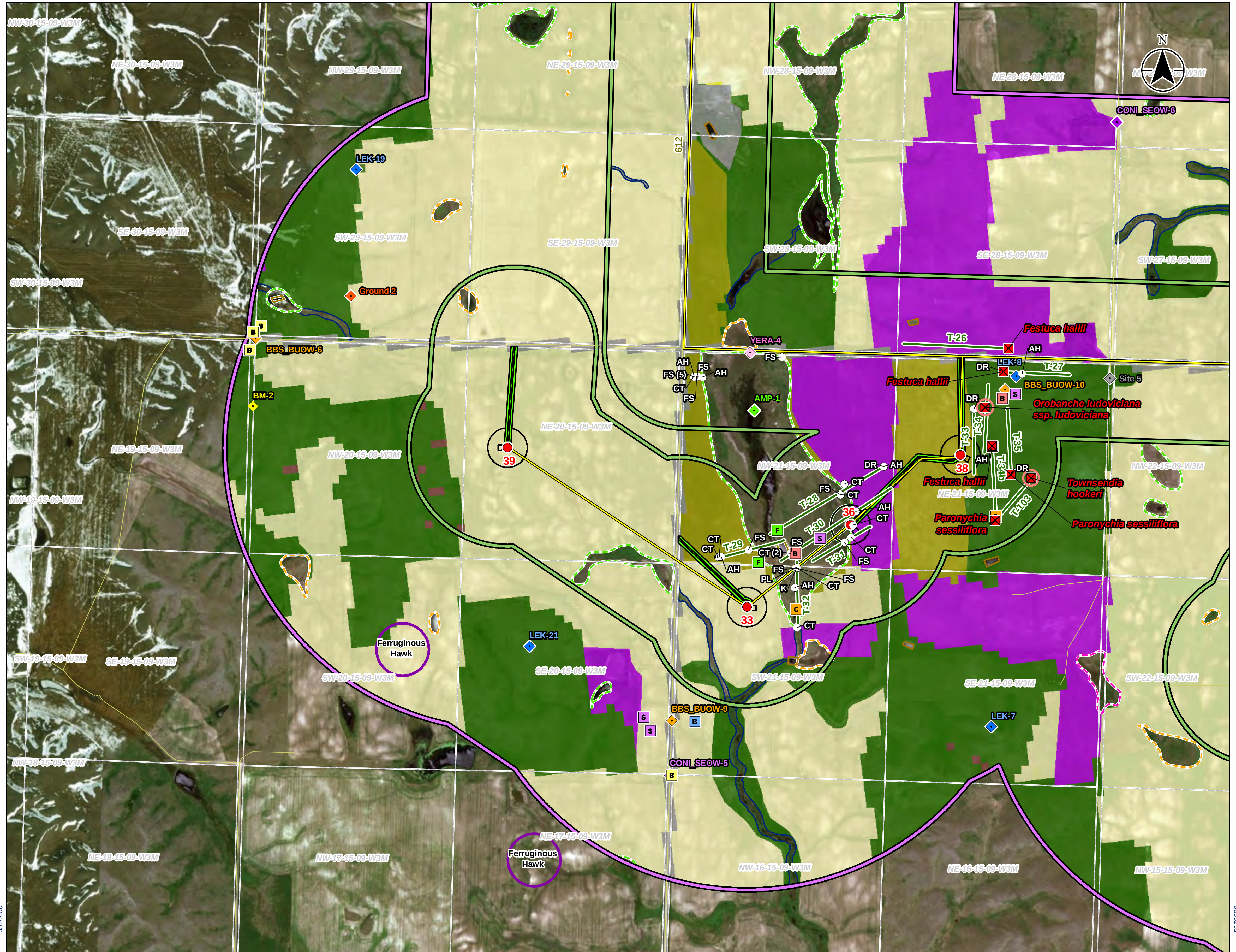

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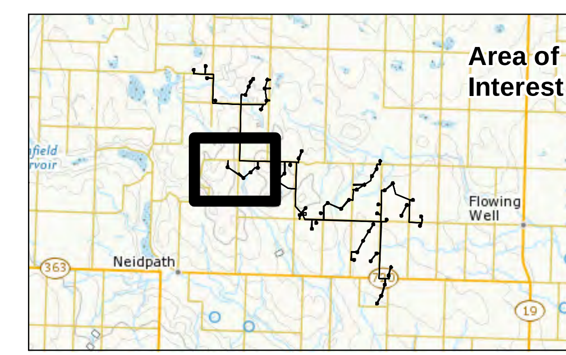

Project Location
Near Herbert, SK

113254088-025 REVF
Prepared by acoy on 2017-12-18
Technical Review by ceidem on 2017-12-18

Client/Project
Algonquin Power Co.
Blue Hill Wind Energy Project

Figure No.
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Biophysical Map Atlas

Species of Management Concern Observations

- Sharp-tailed Grouse Lek
- American Badger
- American Bittern
- Baird's Sparrow
- Barn Swallow
- Bobolink
- Chestnut-collared Longspur
- Ferruginous Hawk
- Loggerhead Shrike
- Northern Leopard Frog
- Short-eared Owl
- Sprague's Pipit
- Rare Plant*
- Rare Plant Area
- Noxious Weed

Species of Management Concern Setbacks

- Sharp-tailed Grouse Lek Setback (400 m, March 15 to May 15))
- Northern Leopard Frog Breeding Pond Setback (500 m, Year round)
- Rare Plant Setback (30 m)

Biophysical Surveys

- Amphibian Survey Site
- Breeding Bird/Burrowing Owl Survey Site
- Bat Acoustic Montoring Site
- Bird Movement Survey Site
- Common Nighthawk/Short-eared Owl Survey Site
- Sharp-tailed Grouse Lek Survey Site
- Nocturnal Radar Survey Site
- Yellow Rail Survey Site
- Vegetation Survey Transect

Historical Records (SKCDC)

- Wildlife

Land Cover

- Class 1 - Ephemeral Wetland
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Stantec Algonquin

Project Location
Near Herbert, SK

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Client/Project
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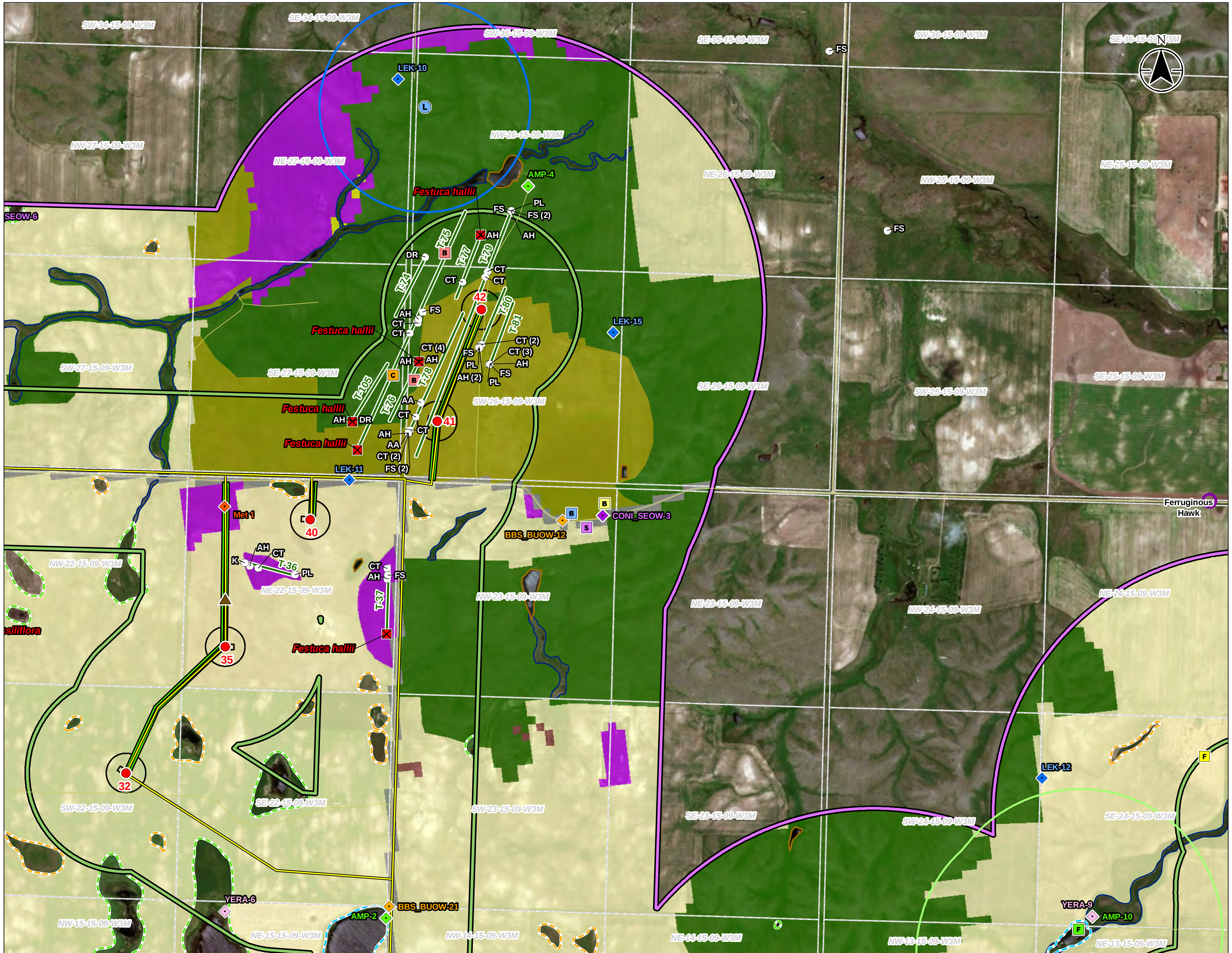

Stantec Algonquin

Proposed Project Layout

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Spatial Boundaries

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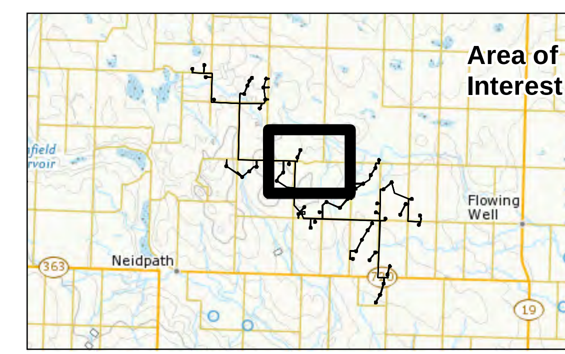

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Client/Project
Algonquin Power Co.
Blue Hill Wind Energy Project

Figure No.
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Biophysical Map Atlas

Species of Management Concern Observations

- Sharp-tailed Grouse Lek
- American Badger
- American Bittern
- Baird's Sparrow
- Barn Swallow
- Bobolink
- Chestnut-collared Longspur
- Ferruginous Hawk
- Loggerhead Shrike
- Northern Leopard Frog
- Short-eared Owl
- Sprague's Pipit
- Rare Plant*
- Rare Plant Area
- Noxious Weed

Species of Management Concern Setbacks

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Biophysical Surveys

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- Bird Movement Survey Site
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- Sharp-tailed Grouse Lek Survey Site
- Nocturnal Radar Survey Site
- Yellow Rail Survey Site
- Vegetation Survey Transect

Historical Records (SKCDC)

- Wildlife

Land Cover

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Stantec Algonquin

Project Location
Near Herbert, SK

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Client/Project
Algonquin Power Co.
Blue Hill Wind Energy Project

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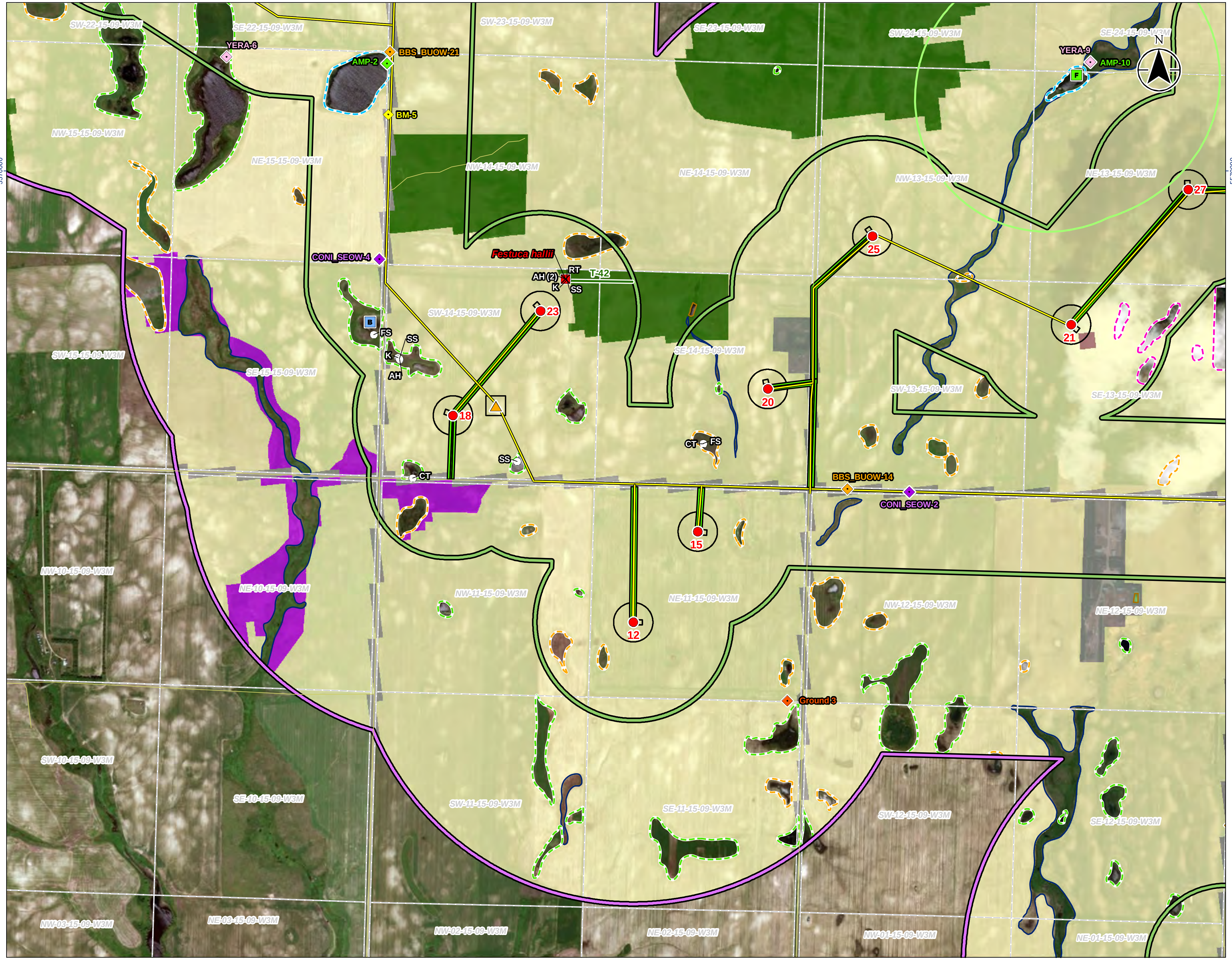

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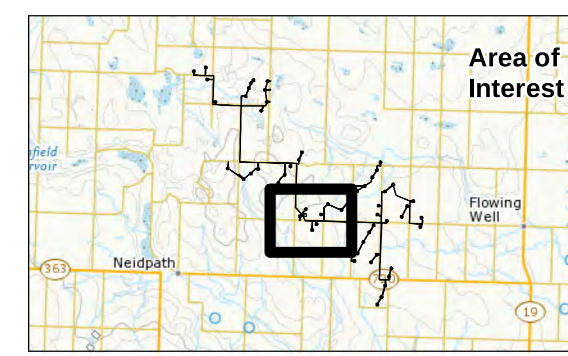

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Blue Hill Wind Energy Project

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Species of Management Concern Observations

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Stantec Algonquin

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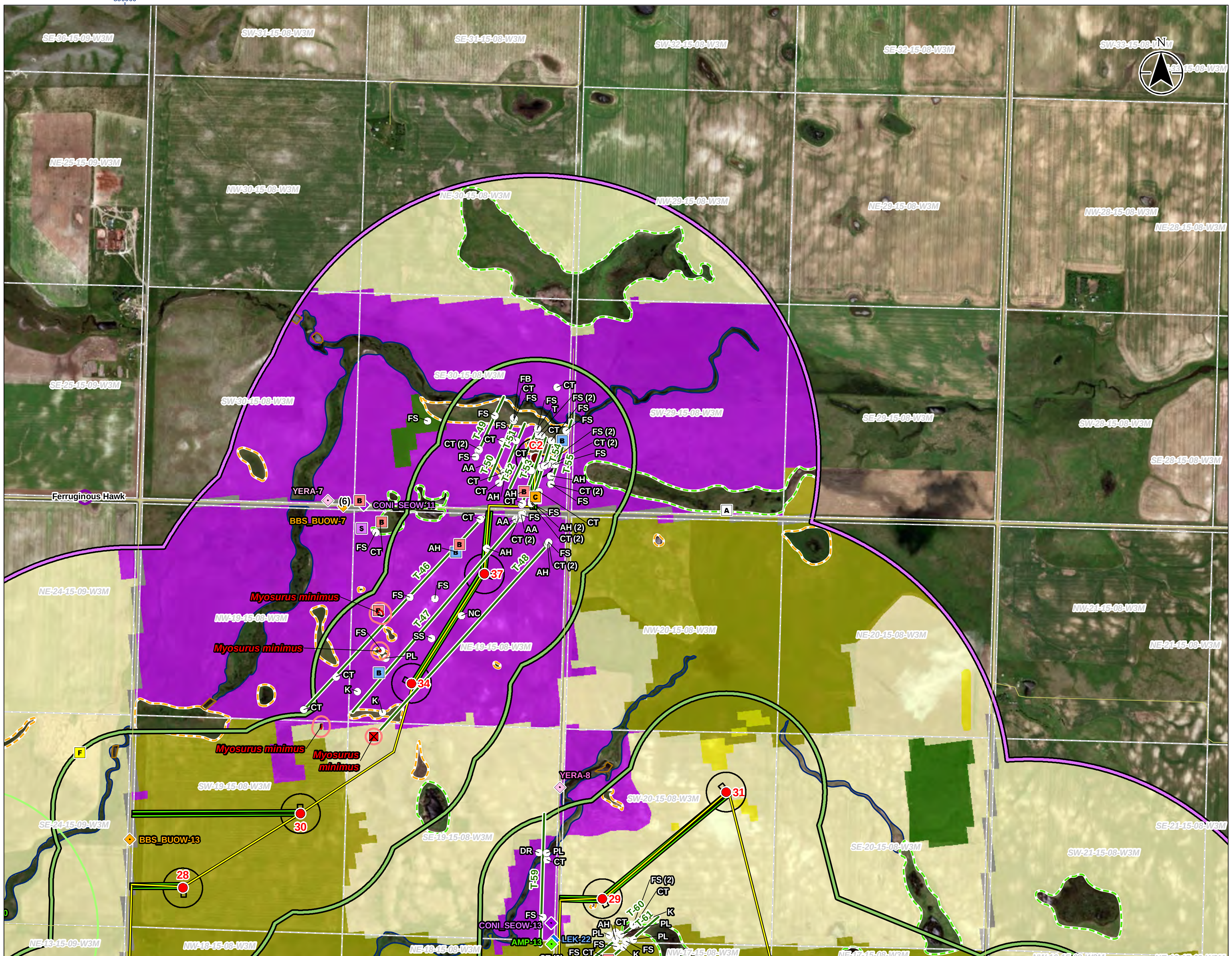

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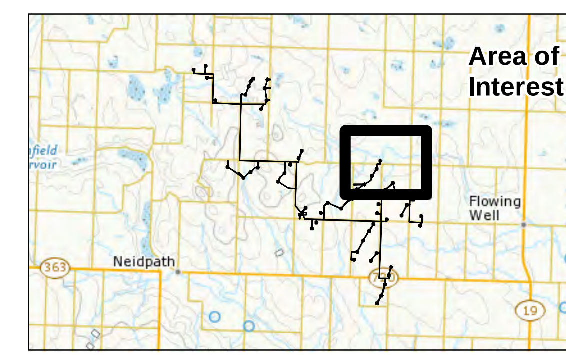

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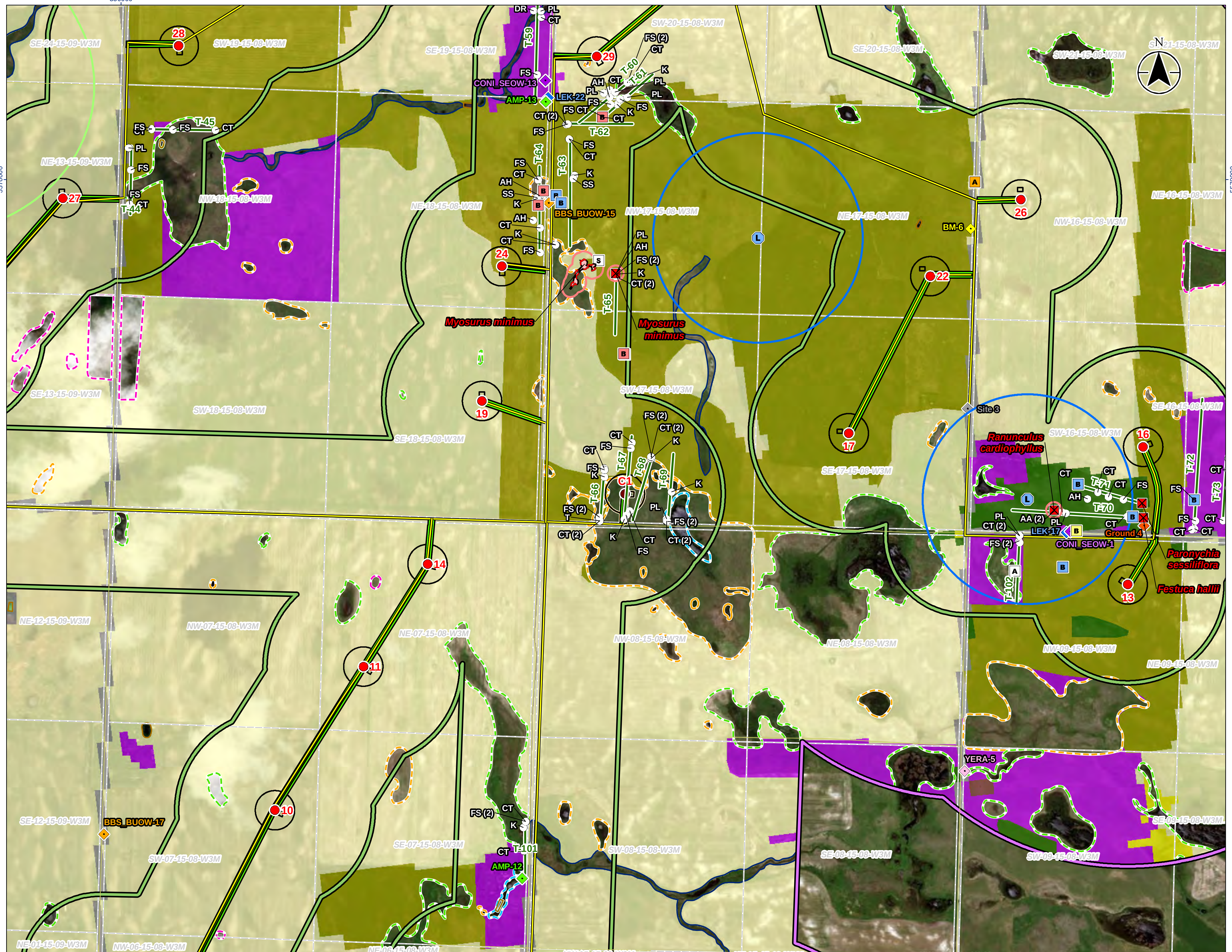

Stantec Algonquin

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0 0.15 0.3 0.45 0.6 Kilometers

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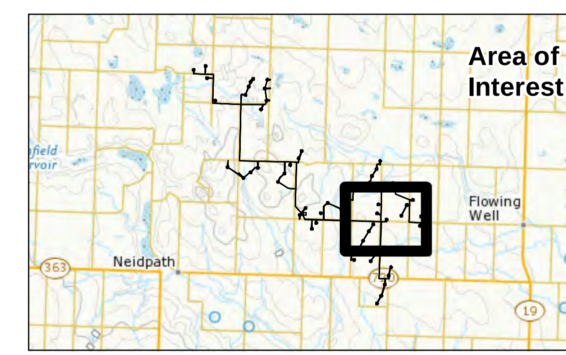

Project Location
Near Herbert, SK

113254088-025 REVF
Prepared by acoy on 2017-12-18
Technical Review by ceidem on 2017-12-18

Client/Project
Algonquin Power Co.
Blue Hill Wind Energy Project

Figure No.
Appendix F

Title
Biophysical Map Atlas

Species of Management Concern Observations

- Sharp-tailed Grouse Lek
- American Badger
- American Bittern
- Baird's Sparrow
- Barn Swallow
- Bobolink
- Chestnut-collared Longspur
- Ferruginous Hawk
- Loggerhead Shrike
- Northern Leopard Frog
- Short-eared Owl
- Sprague's Pipit
- Rare Plant*
- Rare Plant Area
- Noxious Weed

Species of Management Concern Setbacks

- Sharp-tailed Grouse Lek Setback (400 m, March 15 to May 15))
- Northern Leopard Frog Breeding Pond Setback (500 m, Year round)
- Rare Plant Setback (30 m)

Biophysical Surveys

- Amphibian Survey Site
- Breeding Bird/Burrowing Owl Survey Site
- Bat Acoustic Montoring Site
- Bird Movement Survey Site
- Common Nighthawk/Short-eared Owl Survey Site
- Sharp-tailed Grouse Lek Survey Site
- Nocturnal Radar Survey Site
- Yellow Rail Survey Site
- Vegetation Survey Transect

Historical Records (SKCDC)

- Wildlife

Land Cover

- Class 1 - Ephemeral Wetland
- Class 2 - Temporary Wetland
- Class 3 - Seasonal Wetland
- Class 4 - Semi-Permanent Wetland
- Class 5 - Permanent Wetland
- Class 6 - Alkaline Wetland
- Dugout
- Drainage
- Cultivated
- Developed
- Exposed Land/Barren
- Hayland
- Native Prairie
- Shrubland
- Tame Pasture

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Species Observation Label: B (4)
Where a number of observations of the sames species are made in close proximity to each other, a label with the count of observations is used for legibility. If there is no label, it is a single observation.

Weed Labels:

AA - Absinthe (*Artemisia absinthium*)
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CT - Canadian Thistle (*Cirsium arvense*)
DR - Dame's Rocket (*Hesperis matronalis*)
FB - Field Bindweed (*Convolvulus arvensis*)
FS - Field Sow-thistle (*Sonchus arvensis* ssp. *arvensis*)
K - Kochia (*Bassia scoparia*)
NC - Night-flowering Catchfly (*Silene noctiflora*)
PL - Prickly Lettuce (*Lactuca serriola*)
RT - Russion-thistle (*Salsola kali*)
SS - Spiny-leaved Annual Sowthistle (*Sonchus asper* ssp. *asper*)
T - Tansy (*Tanacetum vulgare*)

Stantec Algonquin

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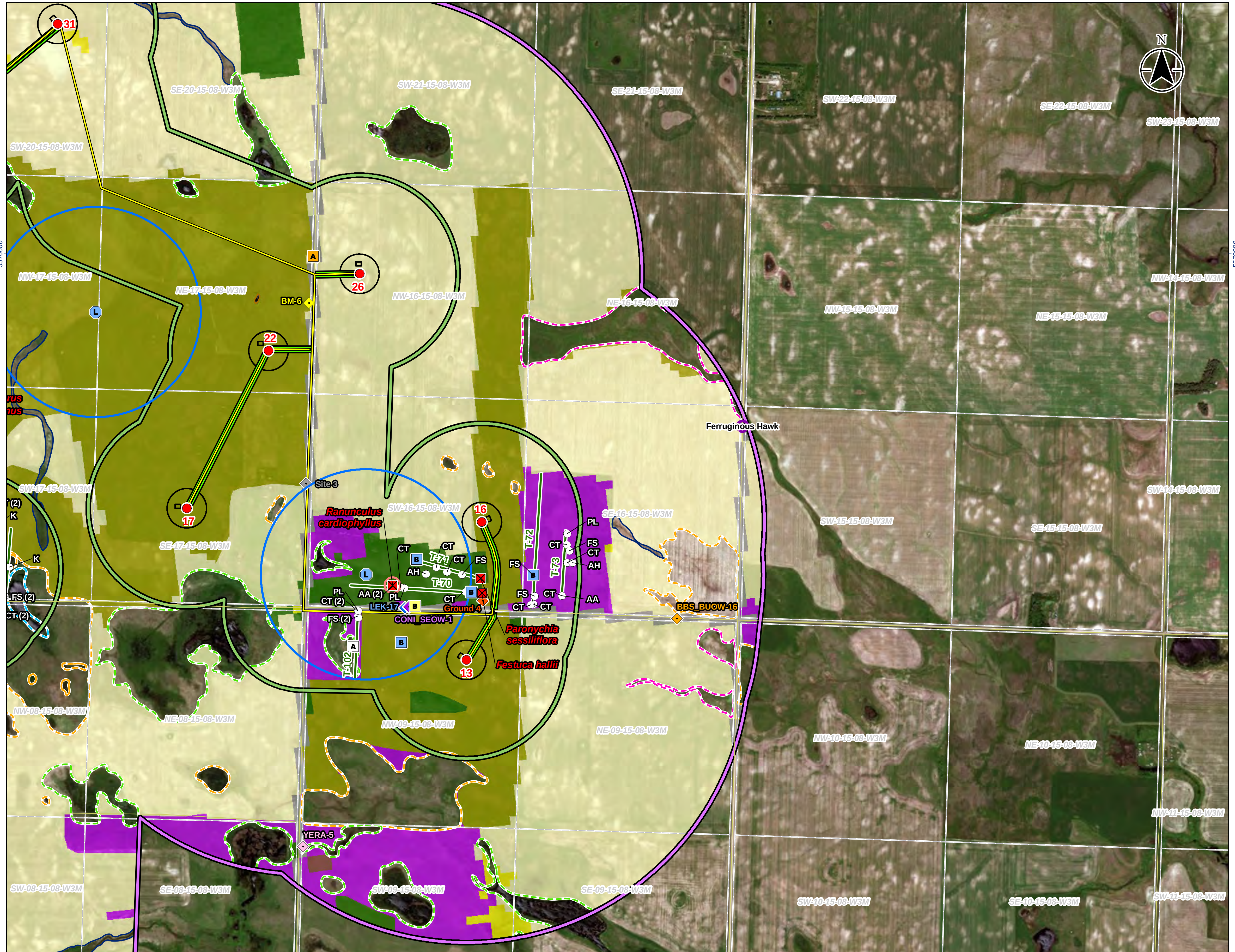

Proposed Project Layout

- Wind Turbine Generator
- Contingency Wind Turbine Generator
- Substation
- Contingency Substation
- New Build Permanent Access Road
- New Electrical Collector Line

Spatial Boundaries

- Project Development Area
- Vegetation Local Assessment Area
- Wildlife Local Assessment Area
- Major Road
- Minor Road
- Quarter Section

* See extended legend on the back of the page

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0 0.15 0.3 0.45 0.6 Kilometers

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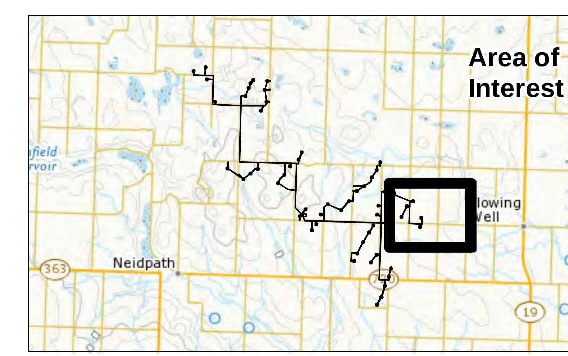

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Biophysical Surveys

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- Bat Acoustic Montoring Site
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- Sharp-tailed Grouse Lek Survey Site
- Nocturnal Radar Survey Site
- Yellow Rail Survey Site
- Vegetation Survey Transect

Historical Records (SKCDC)

- Wildlife

Land Cover

- Class 1 - Ephemeral Wetland
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Stantec Algonquin

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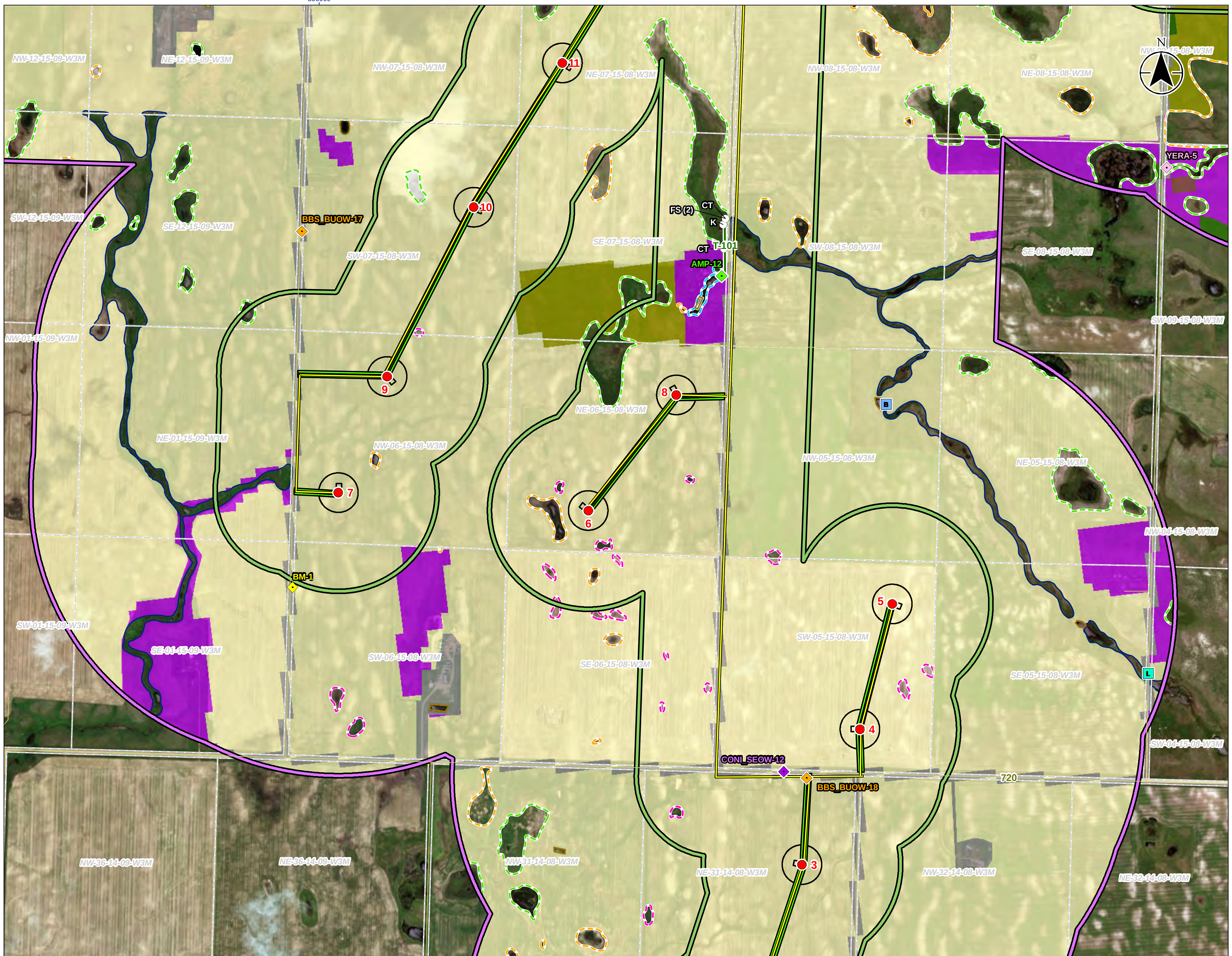

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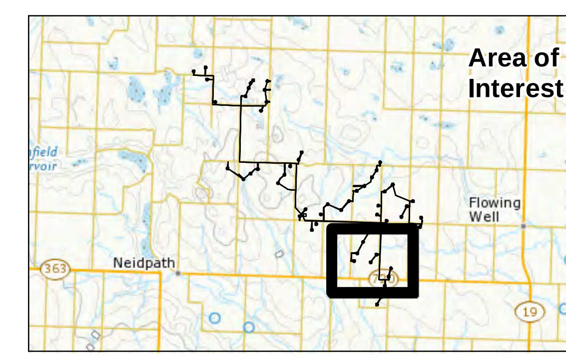

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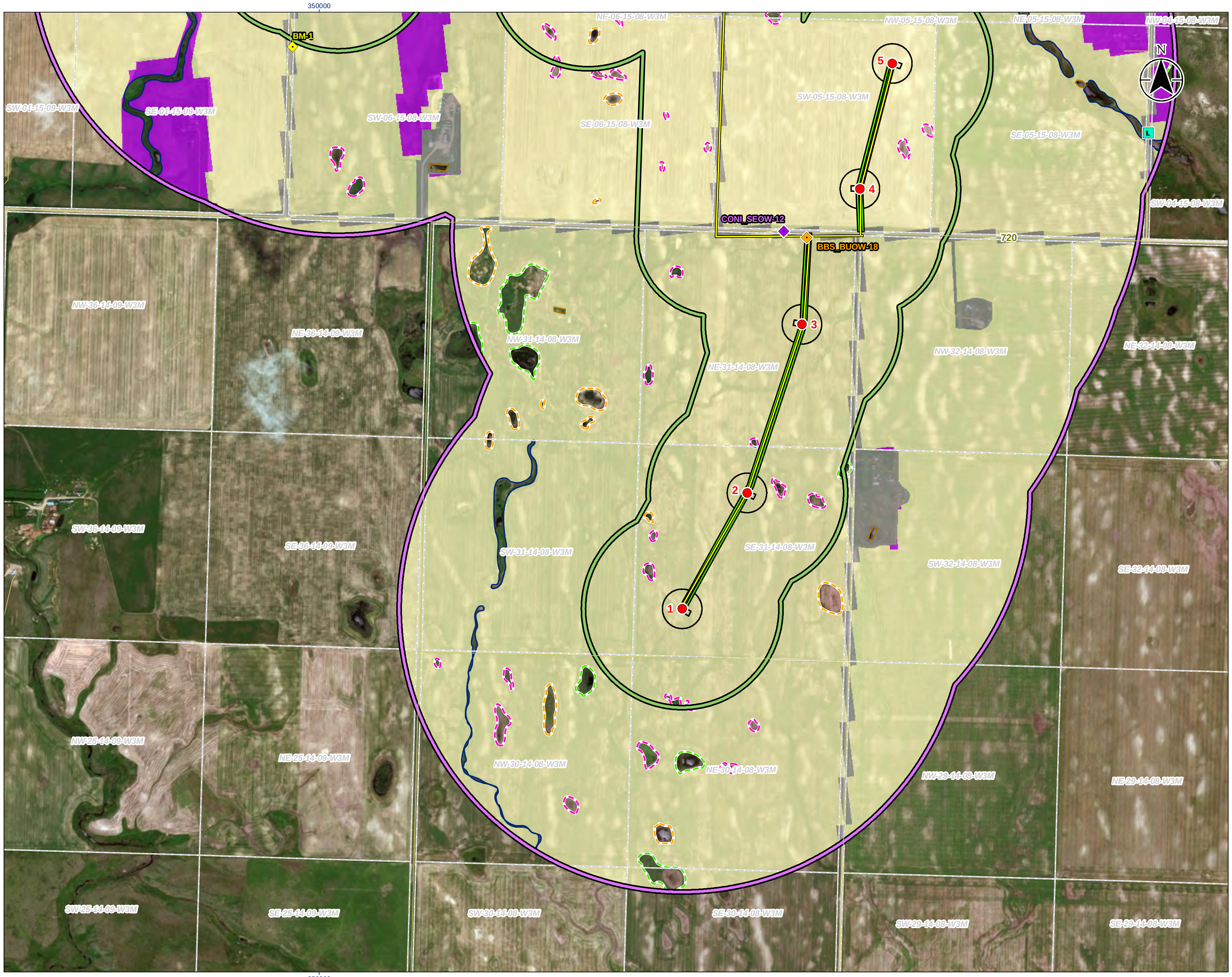

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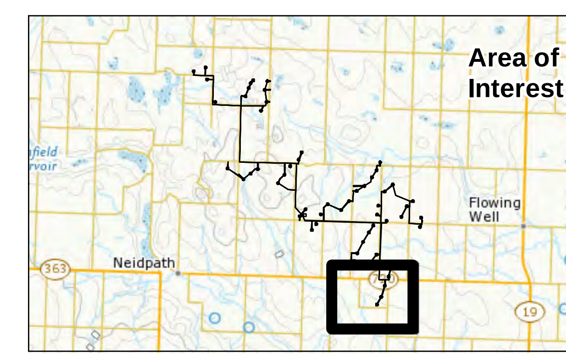

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Blue Hill Wind Energy Project

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Biophysical Map Atlas

APPENDIX G
VEGETATION AND WETLANDS

Appendix G VEGETATION AND WETLANDS

G.1 COMPREHENSIVE VASCULAR PLANT SPECIES LIST

Table G-1 Comprehensive Vascular Plant Species List

Provincial Scientific Name	Provincial Common Name	Provincial Rank
Acer negundo var. *interius*	Manitoba maple	S5
Achillea millefolium	common yarrow	S5
Agoseris glauca var. *glauca*	glaucous false dandelion	S4
Agropyron cristatum ssp. *pectinatum*	crested wheatgrass	SNA
Agrostis scabra var. *scabra*	hair grass	S4
Agrostis stolonifera var. *palustris*	spreading bent	SNA
Alisma triviale	broad-leaved water plantain	S4
Allium textile	prairie onion	S4
Alopecurus aequalis var. *aequalis*	short-awn meadow-foxtail	S4
Alopecurus arundinaceus	creeping meadow-foxtail	SNA
Alopecurus pratensis	meadow foxtail	SNA
Alyssum desertorum	alyssum	SNA
Amelanchier alnifolia var. *alnifolia*	Saskatoon	S5
Androsace septentrionalis	pygmyflower	S5
Anemone canadensis	Canada anemone	S4
Anemone cylindrica	long-fruited anemone	S4
Anemone multifida var. *multifida*	cut-leaved anemone	S4
Anemone patens var. *multifida*	prairie crocus	S5
Antennaria parvifolia	small-leaved everlasting	S4
Antennaria rosea ssp. *rosea*	pink pussytoes	S4
Anthoxanthum hirtum ssp. *arcticum*	sweet grass	S4
Apocynum cannabinum var. *hypericifolium*	Indian hemp	S4
Arabis pycnocarpa var. *pycnocarpa*	hairy rockcress	S4
Arnica fulgens	shining-leaved Arnica	S4
Artemisia absinthium	absinthe	SNA
Artemisia biennis var. *biennis*	sagewort	SNA
Artemisia campestris ssp. *caudata*	plains sagewort	S4
Artemisia campestris ssp. *pacifica*	western plains sagewort	S4

Table G-1 Comprehensive Vascular Plant Species List

Provincial Scientific Name	Provincial Common Name	Provincial Rank
Artemisia cana ssp. *cana*	hoary sagebrush	S5
Artemisia frigida	pasture sage	S5
Artemisia ludoviciana ssp. *ludoviciana*	prairie sage	S5
Astragalus agrestis	field milk-vetch	S4
Astragalus bisulcatus var. *bisulcatus*	two-grooved milk-vetch	S4
Astragalus cicer	cicer milk-vetch	SNA
Astragalus crassicarpus var. *crassicarpus*	ground-plum	S4
Astragalus flexuosus var. *flexuosus*	slender milk-vetch	S4
Astragalus gilviflorus var. *gilviflorus*	cushion milk-vetch	S5
Astragalus laxmannii var. *robustior*	Laxmann's milk-vetch	S4
Astragalus lotiflorus	low milk-vetch	S4
Astragalus pectinatus	narrow-leaved milk-vetch	S4
Atriplex gardneri var. *gardneri*	Nuttall's saltbush	S5
Atriplex prostrata	creeping saltbush	SNA
Atriplex rosea	red orache	SNA
Avena fatua	wild oat	SNA
Avenula hookeri	Hooker's oat grass	S5
Bassia scoparia	kochia	SNA
Beckmannia syzigachne	slough grass	S4
Bidens cernua	nodding beggar-ticks	S4
Boechera collinsii	Collins' rockcress	S4
Boechera grahamii	rockcress	S4
Boechera retrofracta	reflexed rockcress	S4
Bolboschoenus maritimus ssp. *paludosus*	prairie bulrush	S4
Bouteloua gracilis	blue grama	S5
Bromus carinatus var. *marginatus*	California brome	S4
Bromus ciliatus	fringed brome	S4
Bromus inermis	smooth brome	SNA
Bromus porteri	Porter's brome	S4
Calamagrostis stricta	northern geed grass	S5
Campanula rotundifolia	harebell	S5
Capsella bursa-pastoris	shepherd's-purse	SNA
Caragana arborescens	common caragana	SNA

Table G-1 Comprehensive Vascular Plant Species List

Provincial Scientific Name	Provincial Common Name	Provincial Rank
Carex atherodes	awned sedge	S4
Carex duriuscula	needle-leaved sedge	S5
Carex filifolia	thread-leaved sedge	S5
Carex inops ssp. *heliophila*	sun sedge	S5
Carex obtusata	blunt sedge	S4
Carex pellita	woolly sedge	S4
Carex praegracilis	graceful sedge	S4
Carex sartwellii var. *sartwellii*	Sartwell's sedge	S4
Cerastium arvense ssp. *strictum*	field mouse-ear chickweed	S5
Chamaerhodos erecta	little-rose	S4
Chenopodium album var. *album*	Lamb's-quarter's	SNA
Chenopodium glaucum var. *salinum*	Rocky Mountain goosefoot	S4
Chenopodium rubrum var. *rubrum*	red goosefoot	S4
Cicuta maculata var. *maculata*	spotted water-hemlock	S4
Cirsium arvense	Canada thistle	SNA
Cirsium flodmanii	Flodman's thistle	S4
Cirsium undulatum var. *undulatum*	wavy-leaved thistle	S4
Comandra umbellata ssp. *pallida*	bastard toadflax	S5
Comandra umbellata ssp. *umbellata*	bastard toadflax	S5
Convolvulus arvensis	field bindweed	SNA
Conyza canadensis	horseweed	S4
Crepis tectorum	annual hawksbeard	SNA
Cryptantha spiculifera	Macoun's cryptantha	S4
Cyclachaena xanthiifolia	false ragweed	S4
Dalea purpurea var. *purpurea*	purple prairie-clover	S4
Deschampsia cespitosa ssp. *cespitosa*	tufted hair grass	S4
Descurainia sophia	flixweed	SNA
Distichlis spicata	alkali grass	S5
Draba nemorosa	yellow whitlow-grass	S4
Drymocallis arguta	white cinquefoil	S4
Echinochloa crus-galli	barnyard grass	SNA
Eleocharis acicularis	needle spike-rush	S4
Eleocharis palustris	creeping spike-rush	S4

Table G-1 Comprehensive Vascular Plant Species List

Provincial Scientific Name	Provincial Common Name	Provincial Rank
Elymus albicans	Montana wheatgrass	S5
Elymus canadensis var. *canadensis*	Canadian wild rye	S4
Elymus lanceolatus ssp. *lanceolatus*	northern wheatgrass	S5
Elymus repens	creeping wild rye	SNA
Elymus trachycaulus ssp. *subsecundus*	slender wheatgrass	S5
Elymus trachycaulus ssp. trachycaulus	slender wheatgrass	S5
Epilobium ciliatum ssp. *ciliatum*	hairy willow-herb	S4
Epilobium palustre	marsh willow-herb	S4
Equisetum arvense	common horsetail	S5
Erigeron caespitosus	tufted fleabane	S4
Erigeron glabellus var. *glabellus*	streamside fleabane	S5
Erigeron lonchophyllus	low-meadow fleabane	S4
Erigeron pumilus var. *pumilus*	shaggy fleabane	S4
Eriogonum flavum var. *flavum*	yellow umbrella plant	S4
Erysimum asperum	western wallflower	S4
Erysimum cheiranthoides	wormseed mustard	SNA
Erysimum inconspicuum var. *inconspicuum*	shy wallflower	S4
Escobaria vivipara var. *vivipara*	pincushion cactus	S4
Fagopyrum tataricum	tartary buckwheat	SNA
Fallopia convolvulus	wild buckwheat	SNA
Festuca hallii	**plains rough fescue**	**S3**
Festuca saximontana var. *saximontana*	Rocky Mountain fescue	S5
Festuca trachyphylla	sheep fescue	SNA
Gaillardia aristata	great-flowered gaillardia	S4
Galium boreale	northern bedstraw	S5
Galium triflorum	sweet-scented bedstraw	S4
Gaura coccinea	scarlet gaura	S4
Gentiana affinis	oblong-leaved gentian	S4
Gentianella amarella ssp. acuta	autumn dwarf-gentian	S4
Geum aleppicum	yellow avens	S4
Geum triflorum var. *triflorum*	three-flowered avens	S5
Glycyrrhiza lepidota	wild licorice	S4
Gnaphalium palustre	western marsh cudweed	S5

Table G-1 Comprehensive Vascular Plant Species List

Provincial Scientific Name	Provincial Common Name	Provincial Rank
Grindelia hirsutula	curly-cup gumweed	S5
Grindelia squarrosa	gumweed	S5
Gutierrezia sarothrae	broomweed	S4
Helianthus annuus	common annual sunflower	S4
Helianthus nuttallii ssp. *nuttallii*	common tall sunflower	S4
Helianthus pauciflorus ssp. *subrhomboideus*	Rhombic-leaved sunflower	S4
Helianthus petiolaris ssp. *petiolaris*	prairie sunflower	S4
Hesperis matronalis	dame's rocket	SNA
Heterotheca villosa var. *villosa*	hairy false golden-aster	S5
Heuchera richardsonii	alumroot	S4
Hippuris vulgaris	common mare's-tail	S4
Hordeum jubatum ssp. *jubatum*	fox-tail barley	S5
Hymenoxys richardsonii var. *richardsonii*	Colorado rubber-plant	S4
Iva axillaris	poverty-weed	S4
Juncus balticus	Baltic rush	S4
Juncus bufonius	toad rush	S4
Juncus dudleyi	Dudley's rush	S4
Koeleria macrantha	June grass	S5
Krascheninnikovia lanata	winter-fat	S4
Lactuca serriola	prickly lettuce	SNA
Lappula squarrosa	blue-bur	SNA
Lemna turionifera	Turion duckweed	S4
Lepidium densiflorum var. *densiflorum*	Miner's pepperwort	SNA
Liatris punctata var. *punctata*	dotted blazing star	S5
Linum lewisii var. *lewisii*	flax	S4
Linum rigidum var. *rigidum*	large-flower yellow flax	S4
Lithospermum canescens	hoary puccoon	S4
Lithospermum incisum	narrow-leaved puccoon	S4
Lygodesmia juncea	skeleton-weed	S5
Lysimachia maritima	sea-milkwort	S4
Medicago lupulina	black medic	SNA
Medicago sativa ssp. *falcata*	yellow alfalfa	SNA
Medicago sativa ssp. *sativa*	alfalfa	SNA

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Provincial Scientific Name	Provincial Common Name	Provincial Rank
Melilotus albus	white sweet-clover	SNA
Melilotus officinalis	yellow sweet-clover	SNA
Muhlenbergia asperifolia	scratch grass	S4
Muhlenbergia cuspidata	prairie muhly	S4
Muhlenbergia richardsonis	mat muhly	S4
Mulgedium pulchellum	common blue lettuce	S4
Musineon divaricatum var. *divaricatum*	wild parsley	SNA
Myosurus minimus	**least mousetail**	**S3**
Nassella viridula	green needlegrass	S5
Oenothera biennis	yellow evening primrose	S4
Oenothera serrulata	shrubby evening primrose	S5
Orobanche fasciculata	clustered broom-rape	S4
Orobanche ludoviciana* ssp. *ludoviciana	**Louisiana broom-rape**	**S3**
Orthocarpus luteus	owl's-clover	S4
Oxytropis monticola	late yellow locoweed	S4
Packera cana	silvery groundsel	S4
Paronychia sessiliflora	**low whitlowwort**	**S3**
Pascopyrum smithii	western wheatgrass	S5
Pediomelum argophyllum	silvery scurf pea	S5
Pediomelum esculentum	Indian breadroot	S4
Penstemon albidus	white beardtongue	S4
Penstemon gracilis var. *gracilis*	lilac beardtongue	S4
Penstemon nitidus var. *nitidus*	smooth blue beardtongue	S4
Penstemon procerus var. *procerus*	pincushion beardtongue	S4
Peritoma serrulata	spiderflower	S4
Persicaria amphibia var. *emersa*	water smartweed	S4
Persicaria lapathifolia	pale persicaria	S4
Phalaris arundinacea	reed canary grass	S4
Phlox hoodii ssp. *hoodii*	moss phlox	S5
Physaria arenosa ssp. *arenosa*	Great Plains bladder-pod	S4
Plantago major	common plantain	SNA
Poa arida	plains blue grass	S4
Poa compressa	Canada blue grass	SNA

Table G-1 Comprehensive Vascular Plant Species List

Provincial Scientific Name	Provincial Common Name	Provincial Rank
Poa cusickii ssp. *pallida*	Cusick's blue grass	S4
Poa interior	inland blue grass	S4
Poa palustris	fowl blue grass	S4
Poa pratensis	Kentucky blue grass	SNA
Poa secunda ssp. *juncifolia*	big blue grass	S5
Poa secunda ssp. *secunda*	Canby blue grass	S5
Polygonum aviculare ssp. *aviculare*	doorweed	SNA
Polygonum aviculare ssp. *neglectum*	yard knotweed	SNA
Polygonum erectum	erect knotweed	SNA
Populus balsamifera ssp. *balsamifera*	balsam poplar	S5
Potentilla anserina ssp. *anserina*	silverweed	S4
Potentilla bipinnatifida	plains cinquefoil	S4
Potentilla concinna var. *divisa*	divided-leaved cinquefoil	S4
Potentilla gracilis var. *flabelliformis*	Idaho cinquefoil	S4
Potentilla hippiana	woolly cinquefoil	S5
Potentilla norvegica	rough cinquefoil	S4
Potentilla pensylvanica	prairie cinquefoil	S4
Prunus pensylvanica	fire cherry	S4
Prunus virginiana var. *virginiana*	chokecherry	S5
Puccinellia nuttalliana	Nuttall's salt-meadow grass	S4
Ranunculus cardiophyllus	**heart-leaved buttercup**	**S2**
Ranunculus cymbalaria	seaside buttercup	S4
Ranunculus macounii	Macoun's buttercup	S4
Ratibida columnifera	prairie cone-flower	S4
Rosa acicularis ssp. *sayi*	prickly rose	S5
Rosa arkansana	low prairie rose	S5
Rosa woodsii var. *woodsii*	Wood's rose	S5
Rumex acetosa	sour dock	SNA
Rumex crispus	curled dock	SNA
Rumex fueginus	golden dock	S5
Rumex occidentalis	western dock	S4
Rumex pseudonatronatus	field dock	SNA
Rumex triangulivalvis	triangular-valved dock	S5

Table G-1 Comprehensive Vascular Plant Species List

Provincial Scientific Name	Provincial Common Name	Provincial Rank
Sagittaria cuneata	arum-leaved arrowhead	S4
Salicornia rubra	red samphire	S4
Salsola kali	Russian-thistle	SNA
Schedonorus pratensis	meadow fescue	SNA
Schoenoplectus acutus var. *acutus*	hard-stemmed bulrush	S4
Schoenoplectus pungens	three-square rush	S4
Schoenoplectus tabernaemontani	soft-stem bulrush	S4
Selaginella densa var. *densa*	dense spike-moss	S4
Senecio integerrimus var. *integerrimus*	lamb-tongue ragwort	S4
Setaria viridis var. *viridis*	green foxtail	SNA
Shepherdia argentea	buffalo-berry	S4
Silene drummondii ssp. *drummondii*	Drummond's catchfly	S4
Silene noctiflora	night-flowering catchfly	SNA
Sisymbrium altissimum	tumbling mustard	SNA
Sisymbrium loeselii	tall hedge mustard	SNA
Sisyrinchium montanum var. *montanum*	common blue-eyed-grass	S4
Solanum triflorum	wild tomato	S4
Solidago altissima	tall goldenrod	S5
Solidago altissima ssp. *gilvocanescens*	canescent goldenrod	S5
Solidago gigantea	late goldenrod	S4
Solidago lepida var. *lepida*	western Canada goldenrod	S4
Solidago missouriensis var. *missouriensis*	Missouri goldenrod	S5
Solidago mollis var. *mollis*	velvet goldenrod	S4
Solidago multiradiata	northern goldenrod	S5
Solidago rigida ssp. *humilis*	stiff goldenrod	S4
Solidago simplex var. *simplex*	Mt. Albert goldenrod	S4
Sonchus arvensis ssp. *arvensis*	field sow-thistle	SNA
Sonchus asper ssp. *asper*	spiny-leaved annual sowthistle	SNA
Spartina gracilis	alkali cord grass	S4
Sphaeralcea coccinea ssp. *coccinea*	scarlet mallow	S5
Stellaria longifolia	long-leaf starwort	S4
Stellaria longipes ssp. *longipes*	long-stalked starwort	S5
Stenotus armerioides var. *armerioides*	thrifty goldenweed	S4

Table G-1 Comprehensive Vascular Plant Species List

Provincial Scientific Name	Provincial Common Name	Provincial Rank
Suaeda calceoliformis	sea-blite	S4
Symphoricarpos occidentalis	western snowberry	S5
Symphyotrichum ciliatum	Lindley's aster	S4
Symphyotrichum ericoides var. pansum	tufted white prairie aster	S5
Symphyotrichum falcatum var. *commutatum*	creeping white prairie aster	S4
Symphyotrichum falcatum var. *falcatum*	white prairie aster	S4
Symphyotrichum laeve var. *geyeri*	Geyer's aster	S5
Symphyotrichum lanceolatum var. lanceolatum	white panicled American-aster	S4
Tanacetum vulgare	tansy	SNA
Taraxacum officinale ssp. *officinale*	common dandelion	SNA
Thalictrum venulosum	veiny meadow-rue	S4
Thermopsis rhombifolia	golden-bean	S5
Thlaspi arvense	stinkweed	SNA
Townsendia hookeri	**Hooker's townsendia**	**S1**
Tragopogon dubius	yellow goat's-beard	SNA
Trifolium hybridum	alsike clover	SNA
Triglochin maritima	seaside arrow-grass	S4
Triglochin palustris	marsh arrow-grass	S4
Turritis glabra	tower mustard	S4
Typha latifolia	common cattail	S4
Ulmus pumila	Siberian elm	SNA
Urtica dioica ssp. *gracilis*	stinging nettle	S4
Utricularia vulgaris	common bladderwort	S4
Veronica peregrina ssp. *xalapensis*	hairy speedwell	S4
Veronica persica	bird's-eye	SNA
Vicia americana ssp. *americana*	American purple vetch	S5
Viola adunca var. *adunca*	sand violet	S5
Xanthisma grindelioides var. *grindelioides*	rayless tansy-aster	S4
Xanthisma spinulosum var. *spinulosum*	spiny goldenaster	S4
Xanthium spinosum	spiny cocklebur	SNA
Zigadenus venenosus var. *gramineus*	white camas	S4
Zizia aptera	heart-leaved Alexanders	S4

G.1.10

G.2 PHOTOGRAPHS

PHOTO 1 Native prairie on transect 59 at the SE 19-15-08 W3M, facing north.

PHOTO 2 Tame pasture on transect 17 at the NE 32-15-09 W3M, facing south.

PHOTO 3 Hayland in the SW 17-15-08 W3M, facing north.

PHOTO 4 Cultivated land in the NE 19-15-09 W3M, facing west.

PHOTO 5 Wetland Class II at wetland 36 in the SE 14-15-09 W3M, facing west

PHOTO 6 Wetland Class III at wetland 172 in the SW 14-15-09 W3M, facing south.

PHOTO 7 Wetland Class IV at wetland 1000 in the SW 17-15-08 W3M, facing south.

PHOTO 8 Alkaline Class III wetland at wetland 401 in the NW 21-15-09 W3M, facing west.

	
PHOTO 9 Drainage in the SE 19-15-09 W3M, facing south.	PHOTO 10 Dugout at T30 in the NW 21-15-09 W3M, facing north.

	
PHOTO 11 Macoun's cryptanth (*Cryptantha macounii*) – S2	PHOTO 12 Least Mousetail (*Myosurus minimus*) – S3

PHOTO 13 Louisiana broomrape (*Orobanche ludoviciana* ssp. *ludoviciana*) – S3

PHOTO 14 Heart-leaved buttercup (*Ranunculus cardiophyllus*) – S2

PHOTO 15 Hooker's Townsendia (*Townsendia hookeri*) – S1

Appendix G Vegetation and Wetlands
December 2017

G.2.6

APPENDIX H
WILDLIFE AND WILDLIFE HABITAT

Appendix H WILDLIFE AND WILDLIFE HABITAT

H.1 SPECIES RANKING DEFINITIONS

Table H-1 Species Ranking Definitions

Category	Definition
SKCDC[1]	
S1	Critically Imperiled/Extremely Rare – at very high risk of extinction or extirpation due to extreme rarity, very steep declines, high threat level, or other factors.
S2	Imperiled/Very Rare – at high risk of extinction or extirpation due to a very restricted range, very few populations, steep declines, threats or other factors.
S3	Vulnerable/Rare to Uncommon – at moderate risk of extinction or extirpation due to a restricted range, relatively few populations, recent and widespread declines, threats, or other factors.
S4	Apparently Secure – uncommon, but not rare; some cause for long-term concern due to declines or other factors.
S5	Secure/Common – demonstrably secure under present conditions; widespread and abundant; low threat level.
Modifiers for SKCDC Ranks	
A	Accidental or casual in the province, including species recorded infrequently that are far outside their range (birds or butterflies).
B	For migratory species, rank applies to the breeding population in the province.
N	For migratory species, rank applies to the non-breeding population in the province.
M	For migratory species, rank applies to the transient (migrant) population.
H	Historical occurrence but without recent verification (e.g., within 20 years).
U	Status uncertain and species unrankable due to lack of information.
X	A species that is believed to be extinct or extirpated.
NA	Conservation status is not applicable to this species (e.g., exotic species).
NR	Species is not yet ranked.
?	Can be added to any rank to denote an inexact numeric rank (e.g., S1? = believed to be 5 or fewer occurrences, but some doubt exists concerning status).
SK Wildlife Act[2]	
Extirpated	A species that no longer exists in the wild in Saskatchewan but exists in the wild outside the province.
Endangered	A species facing imminent extirpation or extinction.
Threatened	A species likely to become endangered if limiting factors are not reversed.
Vulnerable	A species of special concern because of low or declining numbers due to human activities or natural events but that is not endangered or threatened.

Table H-1 Species Ranking Definitions

Category	Definition
SARA[3]	
Extinct	A wildlife species that no longer exists.
Extirpated	A wildlife species that no longer exists in the wild in Canada, but exists elsewhere in the wild.
Endangered	A wildlife species that is facing imminent extirpation or extinction.
Threatened	A wildlife species that is likely to become an endangered species if nothing is done to reverse the factors leading to its extirpation or extinction.
Special Concern	A wildlife species that may become threatened or endangered because of a combination of biological characteristics and identified threats.
COSEWIC[4]	
Extinct	A wildlife species that no longer exists.
Extirpated	A wildlife species that no longer exists in the wild in Canada, but exists elsewhere in the wild.
Endangered	A wildlife species facing imminent extirpation or extinction.
Threatened	A wildlife species likely to become endangered if nothing is done to reverse the factors leading to its extirpation or extinction.
Special Concern	A wildlife species that may become threatened or endangered because of a combination of biological characteristics and identified threats.
Data Deficient	A wildlife species for which there is insufficient information to resolve a species' suitability for assessment or to permit an assessment of the species' risk of extinction.
Not At Risk	A wildlife species that has been evaluated and found to be not at risk of extinction given the current circumstances.

SOURCES:
[1] SKCDC 2017a.
[2] Government of Saskatchewan 1998.
[3] Government of Canada 2002.
[4] COSEWIC 2016.

H.2 WILDLIFE SAR AND SOMC WITH POTENTIAL TO OCCUR IN THE WILDLIFE RAA

Table H-2 SAR and SOMC with the Potential to Occur in the Wildlife RAA

Common Name	Scientific Name	SARA[1]	COSEWIC[1]	SKMOE[2]	SKCDC[3]	SAR	SOMC	SKMOE Activity Restriction Feature (Setback)[4]
INSECTS								
Dusky dune moth	*Copablepharon longipenne*	Endangered	Endangered		S1	Y		None
Pale yellow dune moth	*Copablepharon grandis*	Special Concern	Special Concern		S2	Y		None
Monarch	*Danaus plexippus*	Endangered	Special Concern		S2B	Y		None
Rhesus skipper	*Polites rhesus*				S2		Y	None
Verna's flower moth	*Schinia verna*	Threatened	Threatened		S1	Y		None
Gypsy cuckoo bumble bee	*Bombus bohemicus*	*No Status*	*Endangered*		SH		Y	None
Western bumble bee	*Bombus occidentalis occidentalis*	No Status	Threatened		S4		Y	None
Yellow-banded bumble bee	*Bombus terricola*	No Status	Special Concern		S5		Y	None
Nine-spotted lady beetle	*Coccinella novemnotata*	No Status	Endangered		S4		Y	None

Table H-2 SAR and SOMC with the Potential to Occur in the Wildlife RAA

Common Name	Scientific Name	SARA[1]	COSEWIC[1]	SKMOE[2]	SKCDC[3]	SAR	SOMC	SKMOE Activity Restriction Feature (Setback)[4]
AMPHIBIANS								
Canadian toad	*Anaxyrus hemiophrys*		Not At Risk		S4		Y	Breeding and overwintering habitat (90 m)
Great plains toad	*Anaxyrus cognatus*	Special Concern	Special Concern		S3	Y		Breeding and overwintering habitat (500 m)
Plains spadefoot	*Spea bombifrons*		Not At Risk		S3		Y	Breeding and overwintering habitat (90 m)
Northern leopard frog	*Lithobates pipiens*	Special Concern	Special Concern		S3	Y		Breeding and overwintering habitat (500 m)
Western tiger salamander	*Ambystoma mavortium*	No Status	Special Concern		S4		Y	None
Bullsnake	*Pituophis catenifer sayi*	No Status	Special Concern		S4		Y	None
Plains hog-nosed snake	*Heterodon nasicus*				S3		Y	Hibernacula (200 m)
UPLAND GAME BIRDS								
Sharp-tailed grouse	*Tympanuchus phasianellus*				S5		Y	Lek (400 m)

Table H-2 SAR and SOMC with the Potential to Occur in the Wildlife RAA

Common Name	Scientific Name	SARA[1]	COSEWIC[1]	SKMOE[2]	SKCDC[3]	SAR	SOMC	SKMOE Activity Restriction Feature (Setback)[4]
RAPTORS								
Osprey	*Pandion haliaetus*				S2B, S2M		Y	Nest site (1,000 m)
Bald eagle	*Haliaeetus leucocephalus*		Not At Risk		S5B, S5N, S4M		Y	Nest site (1,000 m)
Golden eagle	*Aquila chrysaetos*		Not At Risk		S3B, S3N, S4M		Y	Nest site (1,000 m)
Ferruginous hawk	*Buteo regalis*	Threatened	Threatened		S3	Y		Nest site (1,000 m)
Peregrine falcon	*Falco peregrinus anatum*	Special Concern	Special Concern		S1B, SNRM	Y		Nest site (1,000 m)
Burrowing owl	*Athene cunicularia*	Endangered	Endangered	Endangered	S2B, S2M	Y		Breeding bird (500 m)
Short-eared owl	*Asio flammeus*	Special Concern	Special Concern		S3B, S2N, S3M	Y		Breeding bird (500 m)
MIGRATORY BIRDS								
Horned grebe	*Podiceps auritus*	Special Concern	Special Concern		S5B, S5M	Y		None
Eared grebe	*Podiceps nigricollis*				S5B, S5M		Y	Breeding grebe colony (200 m)
Western grebe	*Aechmophorus occidentalis*	Special Concern	Special Concern		S3B, S3M	Y		Breeding grebe colony (200 m)
Double-crested cormorant	*Phalacrocorax auritus*		Not At Risk		S5B, S5M		Y	Nesting colony (1,000 m)
American white pelican	*Pelecanus erythrorhynchos*		Not At Risk		S5B, S5M		Y	Nesting colony (1,000 m)

Table H-2 SAR and SOMC with the Potential to Occur in the Wildlife RAA

Common Name	Scientific Name	SARA[1]	COSEWIC[1]	SKMOE[2]	SKCDC[3]	SAR	SOMC	SKMOE Activity Restriction Feature (Setback)[4]
American bittern	*Botaurus lentiginosus*				S5B		Y	Breeding bird (350 m)
Black-crowned night-heron	*Nycticorax nycticorax*				S4B		Y	Nesting colony (1,000 m)
Great blue heron	*Ardea herodias*				S5B		Y	Nesting colony (1,000 m)
Snowy egret	*Egretta thula*				SNA		Y	Nesting colony (1,000 m)
Cattle egret	*Bubulcus ibis*				SNA		Y	Nesting colony (1,000 m)
Great egret	*Ardea alba*				SNA		Y	Nesting colony (1,000 m)
Whooping crane	*Grus americana*	Endangered	Endangered	Endangered	SXB, S1M	Y		Staging area (1,000 m)
Yellow rail	*Coturnicops noveboracensis*	Special Concern	Special Concern		S3B, S3M	Y		Breeding bird (350 m)
Piping plover	*Charadrius melodus circumcinctus*	Endangered	Endangered	Endangered	S3B	Y		High-water mark (600 m)
Snowy plover	*Charadrius nivosus nivosus*				SHB		Y	High-water mark (600 m)
Long-billed curlew	*Numenius americanus*	Special Concern	Special Concern		S3B, S4M	Y		Breeding bird (200 m)
Red knot	*Calidris canutus rufa*	Endangered	Endangered		S2M	Y		Staging area (1,000 m)
Buff-breasted sandpiper	*Calidris subruficollis*	Special Concern	Special Concern		S4M	Y		None

Table H-2 SAR and SOMC with the Potential to Occur in the Wildlife RAA

Common Name	Scientific Name	SARA[1]	COSEWIC[1]	SKMOE[2]	SKCDC[3]	SAR	SOMC	SKMOE Activity Restriction Feature (Setback)[4]
Red-necked phalarope	*Phalaropus lobatus*	No Status	Special Concern		S4B, S3M		Y	None
Bonaparte's gull	*Chroicocephalus philadelphia*				S4B, S4M		Y	Nesting colony (400 m)
Franklin's gull	*Leucophaeus pipixcan*				S4B, S4M		Y	Nesting colony (400 m)
Herring gull	*Larus argentatus*				S5B, S5M		Y	Nesting colony (400 m)
Black tern	*Chlidonias niger*		Not At Risk		S5B, S5M		Y	Nesting colony (400 m)
Common tern	*Sterna hirundo*		Not At Risk		S5B, S5M		Y	Nesting colony (400 m)
Forster's tern	*Sterna forsteri*		Data Deficient		S4B, S4M		Y	Nesting colony (400 m)
Common nighthawk	*Chordeiles minor*	Threatened	Threatened		S4B, S4M	Y		Breeding bird (200 m)
Loggerhead shrike	*Lanius ludovicianus excubitorides*	Threatened	Threatened		S2B, S2M	Y		Breeding bird (400 m)
Bank swallow	*Riparia riparia*	Threatened	Threatened		S4B, S5M	Y		None
Barn swallow	*Hirundo rustica*	Threatened	Threatened		S5B, S5M	Y		None
Sprague's pipit	*Anthus spragueii*	Threatened	Threatened		S3B, S3M	Y		Breeding bird (250 m)
Chestnut-collared longspur	*Calcarius ornatus*	Threatened	Threatened		S3B	Y		Breeding bird (200 m)
McCown's longspur	*Rhynchophanes mccownii*	Special Concern	Threatened		S3B	Y		Breeding bird (200 m)

Table H-2 SAR and SOMC with the Potential to Occur in the Wildlife RAA

Common Name	Scientific Name	SARA[1]	COSEWIC[1]	SKMOE[2]	SKCDC[3]	SAR	SOMC	SKMOE Activity Restriction Feature (Setback)[4]
Baird's sparrow	*Ammodramus bairdii*	Special Concern	Special Concern		S4B	Y		None
Lark bunting	*Calamospiza melanocorys*	No Status	Threatened		S2B, S2M		Y	None
Bobolink	*Dolichonyx oryzivorus*	Threatened	Threatened		S4B, S4M	Y		none
Rusty blackbird	*Euphagus carolinus*	Special Concern	Special Concern		S3B, SUN, S3M	Y		Breeding bird (300 m)
MAMMALS								
American badger	*Taxidea taxus taxus*	No Status	Special Concern		S3		Y	None
Little brown myotis	*Myotis lucifugus*	Endangered	Endangered		S4	Y		Roost/foraging site (500 m)
Long-eared myotis	*Myotis evotis*				S2		Y	Roost/foraging site (500 m)
Western small-footed myotis	*Myotis ciliolabrum*				S2		Y	Roost/foraging site (500 m)
Northern myotis	*Myotis septentrionalis*	Endangered	Endangered		S3	Y		Roost/foraging site (500 m)
Big brown bat	*Eptesicus fuscus*				S5		Y	Roost/foraging site (500 m)
Silver-haired bat	*Lasionycteris noctivagans*				S5B		Y	Roost/foraging site (500 m)

Table H-2 SAR and SOMC with the Potential to Occur in the Wildlife RAA

Common Name	Scientific Name	SARA[1]	COSEWIC[1]	SKMOE[2]	SKCDC[3]	SAR	SOMC	SKMOE Activity Restriction Feature (Setback)[4]
Hoary bat	*Lasiurus cinereus*				S5B		Y	Roost/foraging site (500 m)
Eastern red bat	*Lasiurus borealis*				S4B		Y	Roost/foraging site (500 m)

SOURCES:

[1] Government of Canada 2017b

[2] SKMOE 1999

[3] SKCDC 2017d, 2017e

[4] SKMOE 2017b

H.2.8

H.3 WILDLIFE SAR AND SOMC HABITAT ASSOCIATIONS

Table H-3 Habitat Associations of Potential SAR and SOMC

Common Name	Scientific Name	SAR/ SOMC	Native Prairie	Tame Pasture	Hayland	Cultivated	Shrubland	Developed	Exposed/barren	Water	Wetland
INSECTS[1]											
Dusky dune moth	*Copablepharon longipenne*	SAR							✓		
Pale yellow dune moth	*Copablepharon grandis*	SAR							✓		
Monarch	*Danaus plexippus*	SAR	✓	✓							
Rhesus skipper	*Polites rhesus*	SOMC	✓								
Verna's flower moth	*Schinia verna*	SAR	✓								
Gypsy cuckoo bumble bee	*Bombus bohemicus*	SOMC	✓	✓	✓		✓	✓			
Western bumble bee	*Bombus occidentalis occidentalis*	SOMC	✓	✓	✓	✓	✓	✓			
Yellow-banded bumble bee	*Bombus terricola*	SOMC	✓	✓	✓	✓	✓	✓			
Nine-spotted lady beetle	*Coccinella novemnotata*	SOMC	✓	✓	✓	✓	✓	✓			
AMPHIBIANS[2]											
Canadian toad	*Anaxyrus hemiophrys*	SOMC	✓	✓	✓					✓	✓
Great plains toad	*Anaxyrus cognatus*	SAR	✓	✓	✓					✓	✓
Plains spadefoot	*Spea bombifrons*	SOMC	✓	✓	✓					✓	✓
Northern leopard frog	*Lithobates pipiens*	SAR	✓	✓	✓					✓	✓
Western tiger salamander	*Ambystoma mavortium*	SOMC	✓	✓	✓	✓	✓			✓	✓

Table H-3 Habitat Associations of Potential SAR and SOMC

Common Name	Scientific Name	SAR/ SOMC	Native Prairie	Tame Pasture	Hayland	Cultivated	Shrubland	Developed	Exposed/barren	Water	Wetland
Bullsnake	*Pituophis catenifer sayi*	SOMC	✓	✓	✓				✓		
Plains hog-nosed snake	*Heterodon nasicus*	SOMC	✓	✓	✓		✓				
UPLAND GAME BIRDS[3]											
Sharp-tailed grouse	*Tympanuchus phasianellus*	SOMC	✓	✓	✓		✓				
RAPTORS[3]											
Osprey	*Pandion haliaetus*	SOMC								✓	
Bald eagle	*Haliaeetus leucocephalus*	SOMC								✓	
Golden eagle	*Aquila chrysaetos*	SOMC	✓	✓	✓		✓		✓		
Ferruginous hawk	*Buteo regalis*	SAR	✓	✓	✓		✓		✓		
Peregrine falcon	*Falco peregrinus anatum*	SAR							✓		
Burrowing owl	*Athene cunicularia*	SAR	✓	✓							
Short-eared owl	*Asio flammeus*	SAR	✓	✓							✓
MIGRATORY BIRDS[3]											
Horned grebe	*Podiceps auritus*	SAR									✓
Eared grebe	*Podiceps nigricollis*	SOMC									✓
Western grebe	*Aechmophorus occidentalis*	SAR								✓	
Double-crested cormorant	*Phalacrocorax auritus*	SOMC								✓	
American white pelican	*Pelecanus erythrorhynchos*	SOMC								✓	✓
American bittern	*Botaurus lentiginosus*	SOMC									✓

Table H-3 Habitat Associations of Potential SAR and SOMC

Common Name	Scientific Name	SAR/ SOMC	Native Prairie	Tame Pasture	Hayland	Cultivated	Shrubland	Developed	Exposed/barren	Water	Wetland
Black-crowned night-heron	*Nycticorax nycticorax*	SOMC								✓	✓
Great blue heron	*Ardea herodias*	SOMC								✓	✓
Snowy egret	*Egretta thula*	SOMC								✓	✓
Cattle egret	*Bubulcus ibis*	SOMC								✓	✓
Great egret	*Ardea alba*	SOMC								✓	✓
Whooping crane	*Grus americana*	SAR				✓					✓
Yellow rail	*Coturnicops noveboracensis*	SAR									✓
Piping plover	*Charadrius melodus circumcinctus*	SAR								✓	✓
Snowy plover	*Charadrius nivosus nivosus*	SOMC								✓	✓
Long-billed curlew	*Numenius americanus*	SAR	✓	✓	✓	✓					
Red knot	*Calidris canutus rufa*	SAR								✓	✓
Buff-breasted sandpiper	*Calidris subruficollis*	SAR	✓	✓	✓	✓					
Red-necked phalarope	*Phalaropus lobatus*	SOMC								✓	✓
Bonaparte's gull	*Chroicocephalus philadelphia*	SOMC								✓	✓
Franklin's gull	*Leucophaeus pipixcan*	SOMC								✓	✓
Herring gull	*Larus argentatus*	SOMC						✓		✓	✓
Black tern	*Chlidonias niger*	SOMC								✓	✓

Table H-3 Habitat Associations of Potential SAR and SOMC

Common Name	Scientific Name	SAR/ SOMC	Native Prairie	Tame Pasture	Hayland	Cultivated	Shrubland	Developed	Exposed/barren	Water	Wetland
Common tern	*Sterna hirundo*	SOMC								✓	✓
Forster's tern	*Sterna forsteri*	SOMC								✓	✓
Common nighthawk	*Chordeiles minor*	SAR	✓	✓	✓		✓	✓	✓		
Loggerhead shrike	*Lanius ludovicianus excubitorides*	SAR	✓	✓	✓		✓				
Bank swallow	*Riparia riparia*	SAR							✓	✓	✓
Barn swallow	*Hirundo rustica*	SAR	✓	✓	✓	✓		✓		✓	✓
Sprague's pipit	*Anthus spragueii*	SAR	✓	✓							
Chestnut-collared longspur	*Calcarius ornatus*	SAR	✓	✓							
McCown's longspur	*Rhynchophanes mccownii*	SAR	✓	✓							
Baird's sparrow	*Ammodramus bairdii*	SAR	✓	✓	✓						
Lark bunting	*Calamospiza melanocorys*	SOMC	✓	✓	✓						
Bobolink	*Dolichonyx oryzivorus*	SAR	✓	✓	✓						
Rusty blackbird	*Euphagus carolinus*	SAR				✓	✓				✓
MAMMALS[4]											
American badger	*Taxidea taxus taxus*	SOMC	✓	✓	✓						
Little brown myotis	*Myotis lucifugus*	SAR						✓		✓	✓
Long-eared myotis	*Myotis evotis*	SOMC						✓			✓
Western small-footed myotis	*Myotis ciliolabrum*	SOMC	✓	✓				✓			✓

Table H-3 Habitat Associations of Potential SAR and SOMC

Common Name	Scientific Name	SAR/ SOMC	Native Prairie	Tame Pasture	Hayland	Cultivated	Shrubland	Developed	Exposed/barren	Water	Wetland
Northern myotis	*Myotis septentrionalis*	SAR						✓			✓
Big brown bat	*Eptesicus fuscus*	SOMC	✓	✓	✓	✓	✓	✓		✓	✓
Silver-haired bat	*Lasionycteris noctivagans*	SOMC						✓		✓	✓
Hoary bat	*Lasiurus cinereus*	SOMC						✓		✓	✓
Eastern red bat	*Lasiurus borealis*	SOMC						✓			✓
Total			**33**	**31**	**24**	**10**	**13**	**15**	**8**	**31**	**38**

NOTES:
✓ Habitat type where species may occur

SOURCES:
[1] Government of Canada 2002
[2] Stebbins 2003
[3] Cornell Lab of Ornithology and the American Ornithologist's Union 2017
[4] Reid 2006

H.3.6

H.4 ALL WILDLIFE SPECIES OBSERVED DURING 2017 FIELD STUDIES

Table H-4 All Wildlife Species Observed during 2017 Field Studies

Common Name	Scientific Name	SKCDC[1,2]	SARA[3]	COSEWIC[3]
Amphibians				
Boreal chorus frog	*Pseudacris maculata*	S5		Not at Risk
Northern leopard frog	*Lithobates pipiens*	S3	Special Concern	Special Concern
Birds				
Snow goose	*Anser caerulescens*	S5M		
Greater white-fronted goose	*Anser albifrons*	S5M		
Canada goose	*Branta canadensis*	S5B, S2N, S5M		
Tundra swan	*Cygnus columbianus*	S5M		
Blue-winged teal	*Spatula discors*	S5B, S5M		
Northern shoveler	*Spatula clypeata*	S5B, S5M		
Gadwall	*Mareca strepera*	S5B, S2N, S5M		
American wigeon	*Mareca americana*	S5B, S2N, S5M		
Mallard	*Anas platyrhynchos*	S5B, S5M		
Northern pintail	*Anas acuta*	S5B, S4N, S5M		
Green-winged teal	*Anas crecca*	S5B, S2N, S5M		
Canvasback	*Aythya valisineria*	S5B, S2N, S5M		
Redhead	*Aythya americana*	S5B, S2N, S5M		
Lesser scaup	*Aythya affinis*	S5B, S3N, S5M		
Bufflehead	*Bucephala albeola*	S5B, S1N, S3M		
Common goldeneye	*Bucephala clangula*	S5B, S3N, S3M		
Common merganser	*Mergus merganser*	S5B, S2N, S4M		
Ruddy duck	*Oxyura jamaicensis*	S5B		
Gray partridge	*Perdix perdix*	SNA		
Sharp-tailed grouse	*Tympanuchus phasianellus*	S5		
Horned grebe	*Podiceps auritus*	S5B, S5M	Special Concern	Special Concern
Eared grebe	*Podiceps nigricollis*	S5B, S5M		
Western grebe	*Aechmophorus occidentalis*	S3B, S3M	Special Concern	Special Concern
Rock pigeon	*Columba livia*	SNA		
Mourning dove	*Zenaida macroura*	S5B, S5M		

Table H-4 All Wildlife Species Observed during 2017 Field Studies

Common Name	Scientific Name	SKCDC[1,2]	SARA[3]	COSEWIC[3]
Common nighthawk	*Chordeiles minor*	S4B, S4M	Threatened	Threatened
Sora	*Porzana carolina*	S5B, S5M		
American coot	*Fulica americana*	S5B, S5M		Not at Risk
Sandhill crane	*Grus canadensis*	S5B, S5M		
American avocet	*Recurvirostra americana*	S4B, S4M		
Black-bellied plover	*Pluvialis squatarola*	S4M		
American golden-plover	*Pluvialis dominica*	S5M		
Semipalmated plover	*Charadrius semipalmatus*	SUB, S5M		
Killdeer	*Charadrius vociferus*	S5B, S5M		
Whimbrel	*Numenius phaeopus*	S4M		
Long-billed curlew	*Numenius americanus*	S3B, S4M	Special Concern	Special Concern
Marbled godwit	*Limosa fedoa*	S4B, S4M		
Red knot	*Calidris canutus rufa*	S2M	Endangered	Endangered
Semipalmated sandpiper	*Calidris pusilla*	S4M		
Short-billed dowitcher	*Limnodromus griseus*	SUB, S4M		
Long-billed dowitcher	*Limnodromus scolopaceus*	S5M		
Wilson's snipe	*Gallinago delicata*	S5B, S5M		
Spotted sandpiper	*Actitis macularius*	S4B, S4M		
Solitary sandpiper	*Tringa solitaria*	S5B, S4M		
Lesser yellowlegs	*Tringa flavipes*	S4B, S4M		
Willet	*Catoptrophorus semipalmatus*	S4B, S4M		
Greater yellowlegs	*Tringa melanoleuca*	S5B, S5M		
Wilson's phalarope	*Phalaropus tricolor*	S5B, S5M		
Red-necked phalarope	*Phalaropus lobatus*	S4B, S3M	No Status	Special Concern
Bonaparte's gull	*Chroicocephalus philadelphia*	S4B, S4M		
Franklin's gull	*Leucophaeus pipixcan*	S4B, S4M		
Ring-billed gull	*Larus delawarensis*	S5B, S5M		
Herring gull	*Larus argentatus*	S5B, S5M		
California gull	*Larus californicus*	S4B, S4M		
Caspian tern	*Hydroprogne caspia*	S2B, S2M		Not at Risk
Black tern	*Chlidonias niger*	S5B, S5M		Not at Risk
Common tern	*Sterna hirundo*	S5B, S5M		Not at Risk

Table H-4 All Wildlife Species Observed during 2017 Field Studies

Common Name	Scientific Name	SKCDC[1,2]	SARA[3]	COSEWIC[3]
Forster's tern	*Sterna forsteri*	S4B, S4M		Data Deficient
Double-crested cormorant	*Phalacrocorax auritus*	S5B, S5M		Not at Risk
American white pelican	*Pelecanus erythrorhynchos*	S5B, S5M		Not at Risk
American bittern	*Botaurus lentiginosus*	S5B		
Great blue heron	*Ardea herodias*	S5B		
Black-crowned night-heron	*Nycticorax nycticorax*	S4B		
White-faced ibis	*Plegadis chihi*	S2N, S2M		
Osprey	*Pandion haliaetus*	S2B, S2M		
Bald eagle	*Haliaeetus leucocephalus*	S5B, S5N, S4M		Not at Risk
Northern harrier	*Circus hudsonius*	S4B, S4M		Not at Risk
Swainson's hawk	*Buteo swainsoni*	S4B, S4M		
Red-tailed hawk	*Buteo jamaicensis*	S5B, S1N, S5M		Not at Risk
Rough-legged hawk	*Buteo lagopus*	S4N, S4M		Not at Risk
Ferruginous hawk	*Buteo regalis*	S3	Threatened	Threatened
Great horned owl	*Bubo virginianus*	S4		
Short-eared owl	*Asio flammeus*	S3B, S2N, S3M	Special Concern	Special Concern
American kestrel	*Falco sparverius*	S5B, S1N, S5M		
Merlin	*Falco columbarius*	S5B, S5N, S5M		Not at Risk
Peregrine falcon	*Falco peregrinus anatum*	S1B, SNRM	Special Concern	Special Concern
Prairie falcon	*Falco mexicanus*	S3B, S3N, S3M		Not at Risk
Western kingbird	*Tyrannus verticalis*	S5B, S5M		
Eastern kingbird	*Tyrannus tyrannus*	S5B, S5M		
Loggerhead shrike	*Lanius ludovicianus excubitorides*	S2B, S2M	Threatened	Threatened
Black-billed magpie	*Pica hudsonia*	S5		
American crow	*Corvus brachyrhynchos*	S5B, S4N, S5M		
Common raven	*Corvus corax*	S5		
Horned lark	*Eremophila alpestris*	S4B, S3N, SUM		
Tree swallow	*Tachycineta bicolor*	S5B, S5M		
Bank swallow	*Riparia riparia*	S4B, S5M	Threatened	Threatened
Barn swallow	*Hirundo rustica*	S5B, S5M	Threatened	Threatened
American robin	*Turdus migratorius*	S5B, SUN, S5M		

Table H-4 All Wildlife Species Observed during 2017 Field Studies

Common Name	Scientific Name	SKCDC[1,2]	SARA[3]	COSEWIC[3]
Brown thrasher	*Toxostoma rufum*	S5B, S5M		
European starling	*Sturnus vulgaris*	SNA		
House sparrow	*Passer domesticus*	SNA		
Sprague's pipit	*Anthus spragueii*	S3B, S3M	Threatened	Threatened
Lapland longspur	*Calcarius lapponicus*	S4N, S4M		
Chestnut-collared longspur	*Calcarius ornatus*	S3B	Threatened	Threatened
Snow bunting	*Plectrophenax nivalis*	S5N, S5M		
American tree sparrow	*Spizelloides arborea*	S4B, S5M		
Clay-colored sparrow	*Spizella pallida*	S5B, S5M		
Vesper sparrow	*Pooecetes gramineus*	S5B, S5M		
Lark sparrow	*Chondestes grammacus*	S5B, SNRM		
Savannah sparrow	*Passerculus sandwichensis*	S5B, S5M		
Grasshopper sparrow	*Ammodramus savannarum*	S4B		
Baird's sparrow	*Ammodramus bairdii*	S4B	Special Concern	Special Concern
Le Conte's sparrow	*Ammodramus leconteii*	S5B, S5M		
Lincoln's sparrow	*Melospiza lincolnii*	S5B, S5M		
Dark-eyed junco	*Junco hyemalis*	S5B, S4N, S5M		
Yellow-headed blackbird	*Xanthocephalus xanthocephalus*	S5B, S5M		
Bobolink	*Dolichonyx oryzivorus*	S4B, S4M	Threatened	Threatened
Western meadowlark	*Sturnella neglecta*	S4B, S4M		
Red-winged blackbird	*Agelaius phoeniceus*	S5B, SUN, S5M		
Brewer's blackbird	*Euphagus cyanocephalus*	S4B, SUN, S4M		
Brown-headed cowbird	*Molothrus ater*	S5B, SUN, S5M		
Common grackle	*Quiscalus quiscula*	S5B		
Yellow warbler	*Setophaga petechia*	S5B, S5M		
Mammal				
American badger	*Taxidea taxus taxus*	S3		
Pronghorn	*Antilocapra americana*	S3		
White-tailed deer	*Odocoileus virginianus*	S4		
Mule deer	*Odocoileus hemionus*	S4		
Coyote	*Canis latrans*	S5		

Table H-4 All Wildlife Species Observed during 2017 Field Studies

Common Name	Scientific Name	SKCDC[1,2]	SARA[3]	COSEWIC[3]
Big brown bat	*Eptesicus fuscus*	S5		
Silver-haired bat	*Lasionycteris noctivagans*	S5B		
Hoary bat	*Lasiurus cinereus*	S5B		
Eastern red bat	*Lasiurus borealis*	S4B		
Little brown myotis	*Myotis lucifugus*	S4	Endangered	Endangered
Long-eared myotis	*Myotis evotis*	S2		
Western small-footed myotis	*Myotis ciliolabrum*	S2		

NOTES:
[1] See Appendix H.1 for provincial and federal ranking definitions.

SOURCES:
[2] SKCDC 2017d, 2017e
[3] Government of Canada 2017b

H.4.6

H.5 BIRD MOVEMENT TECHNICAL REPORT

H.5.2

Blue Hill Wind Energy Project
Bird Movement Technical Report

Prepared for:
Algonquin Power Co.

Prepared by:
Stantec Consulting Ltd.

December 2017

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1.0 INTRODUCTION

One known environmental effect of wind energy facilities is the effect of bird mortality through collision strikes with turbines. This topic has been extensively studied over the past two decades and is relatively well understood.

Mortality rates at wind energy facilities varies from one facility to another across the landscape as a function of the bird species moving through a project area, local movement patterns, the abundance of birds, and other factors, including the proximity to landscape features that may concentrate birds.

Some bird species have been shown to have a higher risk of collision susceptibility (BSC et al. 2017), and understanding the species that inhabit a project area is helpful to better evaluate the potential for an increase in mortality risk from a project. The relative abundance of birds inhabiting or migrating through an area is expected to correlate to some degree with the relative collision risk a project may pose.

Some landscape features, such as watercourses and valleys, may funnel birds along local movement corridors. These local movement corridors differ from large-scale migration corridors, such as the four main flyways in North America. Other features, such as lakes and large wetlands, may concentrate birds of particular species groups at specific locations.

Therefore, understanding the species, their abundance, local movement patterns and the relative influence of concentration sites on the landscape is fundamental to an understanding of potential effects a project may have on increasing bird collision mortality risk. As such, to measure these parameters for the Project, Stantec undertook two field studies: a diurnal bird movement survey and a nocturnal movement survey using marine radar.

1.1 OBJECTIVES

The overall objectives of the bird movement survey program for the Project are:

- to understand the movement rates of birds within the Project and in relation to the landscape outside the Project area,
- to characterize the species composition of the birds inhabiting or migrating through the Project area in relation to the landscape,
- to understand the relative flight altitudes of birds across the Project area and in relation to the landscape,

- to characterize local movement patterns and identify areas of higher movement rates, and
- to compare bird movement within the Project area in relation to features on the landscape that may concentrate birds and bird activity.

The diurnal bird movement surveys are conducted by observers and have limitations on the ability to detect all birds passing through an area and at high altitudes (e.g., >300 m). However, they allow for many individuals to be identified to species or species group.

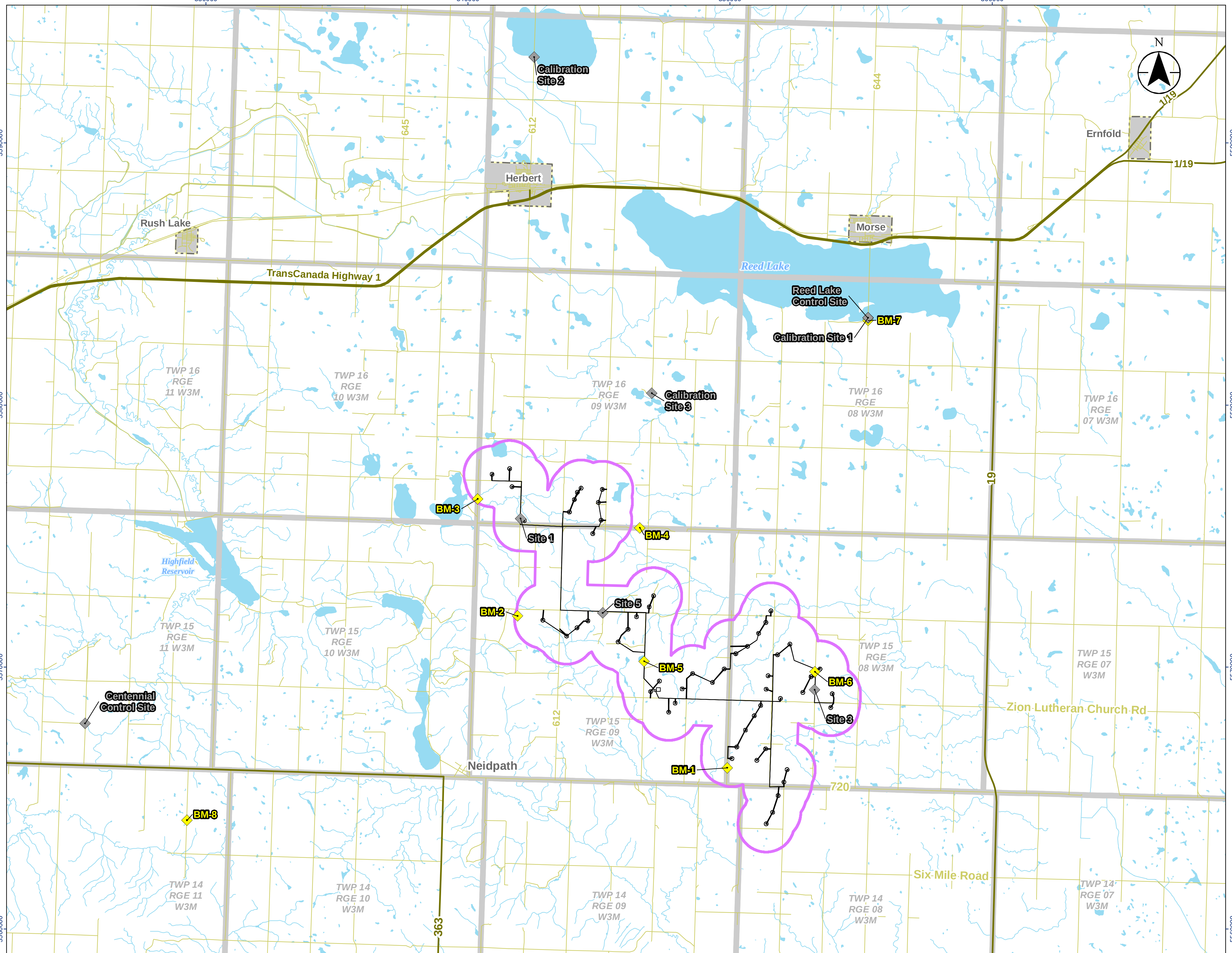
Nocturnal surveys, using marine radar equipment, provide a more precise measure of flight altitude up to 1,500 m, and within a larger surface area (1,500 m radius) but do not allow species to be differentiated.

The Project is located within a landscape that contains the Reed Lake Important Bird Area where large numbers of shorebirds, which are primarily nocturnal migrants, may concentrate. In addition to the standard bird movement survey, Algonquin undertook radar surveys to further investigate bird movement. The combination of these two survey methods provided a more thorough understanding of bird movement in this landscape than if only diurnal surveys had been applied.

1.2 STUDY AREA

The surveys were completed both within the area under consideration for siting of the Project (i.e., the Project area) and at two control sites, one located on the edge of Reed Lake, and the other located directly north of the Centennial Wind Project within an agricultural landscape (Figure H5-1). Once the proposed Project layout was finalized for the purposes of the environmental assessment, one survey site within the Project area was found to be outside the Local Assessment Area (LAA) of the Wildlife and Wildlife Habitat VC. However, as one of the objective of the bird movement surveys is to quantify bird movement within the Project area, all sites initially selected within the Project area were used in evaluating these metrics for the Project compared to the control sites. Therefore, for the purpose of this technical report, sites are discussed in the context of being within the Project area or being one of the two control sites.

The Reed Lake control site was selected as a positive control where activity rates were expected to be relatively high. The control site north of the Centennial Wind Project was located in a terrestrial landscape with no apparent features that would concentrate movements of birds and was considered a negative control where bird movement was assumed representative of the background terrestrial landscape of Saskatchewan. The comparison of each control site against survey sites in the Project area would provide a means of comparing relative movement rates. The negative control site was also located north of the Centennial Wind Project which helped to provide some context of potential fatality rates through a review of the Centennial Wind Project's mortality monitoring report for post-construction monitoring conducted in 2006 and 2007.



- Bird Movement Survey Site
- Nocturnal Radar Survey Site
- Project Development Area
- Wildlife Local Assessment Area
- Major Road
- Minor Road
- Railway
- Watercourse
- Waterbody
- Town/City
- Township

0 1.5 3 4.5 6 Kilometers

1:150,000 (At original document size of 11x17)

Notes

1. Coordinate System: NAD 1983 UTM Zone 13N
2. Base features produced under license with the Government of Saskatchewan and the Government of Canada
3. Project Development Area based on Algonquin layout Sept 06, 2017, V3

Project Location
Near Herbert, SK

113254088-039 REVD
Prepared by acory on 2017-12-18
Technical Review by ceidem on 2017-12-18

Client/Project
Algonquin Power Co.
Blue Hill Wind Energy Project

Figure No.
H5-1

Title
Diurnal Bird Movement and Nocturnal Radar Survey Locations

2.0 METHODS

Wildlife surveys followed SKMOE-approved survey protocols and were conducted under an SKMOE scientific research permit (permit #17FW070) and data reported to the SKMOE in accordance with permit conditions.

2.1 DIURNAL BIRD MOVEMENT SURVEYS

Diurnal bird movement surveys conducted by observers are a useful tool to document the rates of bird movement during the day at set survey locations on the landscape. These surveys allow for the comparison of relative rates of movement to identify patterns and specific locations where projects may result in a higher risk to birds or specific species groups of birds.

These surveys have limitations in the ability to detect birds traveling at all altitudes due to observer limitations, and as such are a more effective tool for measuring relative rates of movement on the landscape, rather than the proportions flying at specific altitudes.

2.1.1 Study Design

Bird movement surveys were conducted to document species, flight path (i.e., height and direction) and habitat use during peak migration in the spring and fall. Surveys were conducted at six sites (Sites 1 through 6) within the Project area (Figure H5-1). Sites 2 and 3 were located between a Migratory Bird Concentration Site to the southwest and Reed Lake to the northeast to document any potential bird movement between two migratory bird stopover sites. Sites 1, 4, 5 and 6 were located in areas representative of the overall landscape in the Project area, predominantly in cultivated fields, to document bird movement through the landscape. An additional two sites were located outside the Project area as control sites (Sites 7 and 8) to determine average bird movement beyond the Project area.

2.1.2 Survey Methods

Each visit targeted waterbirds (e.g., ducks, geese), songbirds (e.g., sparrows, blackbirds), and raptors (e.g., hawks, eagles) with distinct survey intervals (the period in the day when a specific species group was surveyed). Waterbirds were surveyed twice each visit (i.e., 1 hour total), once in the early morning from one half hour before sunrise to one hour after, and once in the evening from one hour before sunset to one half hour after. Songbirds were generally surveyed twice each visit in the morning between sunrise and 1100 (due to an overlap with the waterbird interval in the morning, one survey in the morning was a combined 30-minute waterbird/songbird survey). Raptors were generally surveyed twice each visit in the middle of the day between 1100 and 1800. Only for the first spring visit, songbird and raptor surveys were limited to a single combined 30-minute survey.

Movement surveys consisted of a two-minute waiting period upon arrival to allow disturbance associated with site access to subside followed by a 30-minute observation period. For all birds observed within a 1 km radius during the movement survey, the species, number of individuals, flight path and behavioural data (e.g., flapping, perched, soaring) were recorded. Observations made beyond the 1 km radius were recorded as incidentals. Surveys were conducted when visibility was at least 800 m with a ceiling of 500 m or greater (e.g., precipitation no greater than a light rain, no fog). Wind speed could impede bird activity and surveys were generally discontinued if the wind was consistently above 30 km/h, except if it was a tail wind increasing bird activity.

Three spring bird movement survey visits were conducted between mid-April and mid-May and four fall bird movement survey visits were conducted between early September and late October at each site. In the spring, survey visits were conducted between April 12 and 16, April 28 and May 1, and May 16 and 17, 2017. In the fall, survey visits were conducted between September 5 and 7, September 19 and 21, October 1 and 5, and October 17 and 18, 2017. During the third fall survey visit, Site 4 and Site 5 were not surveyed due to weather restrictions (e.g., three days of rain) and unsafe site access.

2.1.3 Data Analysis

To assess the risk of the Project to migrants that pass through the Project area, analysis of bird movement data focused on flight height and species guild. Data from control sites outside the LAA were analyzed separately and used to compare against movement rates within the Project area.

Diurnal bird movement rates were not analyzed in relation to the tower rotor-swept area (RSA) because of the limited altitude of birds detected using this survey method. A comparison of diurnal bird movement flight altitudes would be biased to birds flying at a maximum of approximately 200-300 m altitude and does not adequately measure movement rates at higher altitudes. The nocturnal radar surveys (see below) provide a more accurate estimate of proportional flight altitudes that can be used for this purpose.

The assessment of potential effects on wildlife (see the Wildlife and Wildlife Habitat section in the Environmental Impact Statement) focuses on representative wildlife species at risk (SAR) and species of management concern (SOMC).

Wildlife SAR are defined as species listed under Schedule 1, Schedule 2, or Schedule 3 of the federal SARA as *endangered, threatened* or *special concern* (Government of Canada 2002).

Wildlife SOMC are defined as provincially legislated SAR and other species identified in federal and provincial tracking lists and activity restriction guidelines, including species:

- Listed in *The Wildlife Act* of Saskatchewan as endangered, threatened or vulnerable (Government of Saskatchewan1998);
- Listed by the COSEWIC as *endangered, threatened* or *special concern* (Government of Canada 2017), but not yet listed under SARA;
- Assigned a ranking of S1 (critically imperiled/extremely rare) or S2 (Imperiled/Very Rare) (or a combination of these rankings) by the SKCDC (SKCDC 2017d, 2017e); and,
- Included in the Saskatchewan Activity Restriction Guidelines for Sensitive Species (SKMOE 2017).

2.2 NOCTURNAL RADAR SURVEYS

Radio detection and ranging (radar) is a useful tool for monitoring nocturnal bird movement patterns. Radar provides continuous and simultaneous sampling of bird movements over a large area day and night during clear or overcast conditions. This technology has been used to monitor migrant bird flight paths (e.g., Cooper et al. 1991, Cooper et al. 2001), assess bird movement relative to airports (e.g., Loots and Otter 2011), assess mortality risk for migratory birds (Desholm and Kahlert 2005, Mabee et al. 2006, Plissner et al. 2006) and examine movements of nocturnal birds around wind energy facilities (e.g., d'Entremont et al. 2017).

Marine (X-band) radar, originally designed for use on water, has several advantages over other radar technology, including portability (easily mounted to a truck or trailer) and its ability to detect small targets at low altitudes. This form of radar has been used extensively to describe nocturnal bird and bat flight paths and altitudinal distribution (Harmata et al. 1999, Mabee and Cooper 2004, Mabee et al. 2006). A combination of horizontal and vertical orientation of the antenna provides data on flight direction and flight height, respectively, though not simultaneously.

While radar can be effective for describing the height and direction of migrating birds, it has limited ability to differentiate objects moving at the same speed in close proximity, and therefore cannot be used for accurate counts of migratory birds travelling in flocks. Detection of small targets is also hampered by ground clutter (i.e., unwanted signals returned from land masses and vegetation). In addition, marine X-band radar cannot perform species-specific identification of birds, and even migratory bats can be indistinguishable from birds (Kunz et al. 2007). However, these shortcomings can be partially overcome by calibrating radar with diurnal visual observations (Plissner et al. 2006, Loots and Otter 2011).

2.2.1 Study Design

Nocturnal radar surveys were conducted between sunset and sunrise (~2100h to 0500h) from May 5-10, 2017 and May 26 -31, 2017 for spring migration and from August 12-17, 2017 and September 6-11, 2017 for fall migration. The timing of radar surveys differed somewhat from diurnal bird movement surveys to focus on shorebird and passerine migration periods, while also capturing some waterfowl movement, particularly in spring migration.

Three radar survey sites were sited within the Project area at locations with road access and minimal interference from ground clutter. There were three sites within the Project area compared to six for the diurnal bird movement surveys because radar has a larger detection area, and because of the much higher effort required to complete radar surveys compared to diurnal bird movement surveys. The combined radar coverage of these sites included 13 of 49 proposed wind turbine sites (Figure 1). Two additional control sites were established outside of the Project area, as described in Section 1.2.

To remove ground clutter, the radar sites were sited in small depressions or close to hedgerows that act to shield radar from ground clutter farther afield (Cooper et al. 1991, Larkin 2005).

To relate radar target data to migrants potentially flying over the Project area, target calibration (based on visual observation of bird species) was conducted in the evening at nearby wetlands immediately prior to nocturnal radar surveys. Target calibration involves the comparison of bird observations prior to sunset by one observer against what is observed by the radar. These comparisons allow for the validation of target size against number of birds in a group and species groups.

2.2.2 Survey Methods

2.2.2.1 Radar Equipment

Nocturnal migrant flight data were obtained using a Furuno X-band marine radar unit (model 2117BB/DC, 12 kW, 9,410 MHz, 1.98 m open array antenna with a beam width of 1.23° horizontal and 20° vertical - Furuno Electric Company Ltd. Miki Japan). The antenna was mounted on a hinged wooden frame attached to a pickup truck bed (Photo 1). This setup was based, in part, on that described by Harmata et al. (2003). The antenna was manually alternated between vertical and horizontal position every 30 minutes to obtain data on flight height and direction (i.e., bearing), respectively. In horizontal position, the radar was mounted approximately 2.5 m above ground, and in vertical position the radar was mounted approximately 3 m above ground. Radar range was set to 1.5 km on short pulse length in both the horizontal and vertical configurations to simultaneously optimize detection of small targets (i.e., individual birds) close to the radar, and the area sampled. The radar unit was oriented to true north in both horizontal and vertical configurations. Gain was set at 100% and sea clutter and rain clutter were set to 0% to maximize sensitivity for small bodied targets such as shorebirds. Because species identification and confirmation of size of biological targets observed with radar is generally not possible, the term target is used rather than individual or flock due to the lack of visual confirmation. To aid target identification and to minimize on-screen clutter, target trails were set to display for 30 to 60 seconds depending on the number of targets. Target data from insects and bats were reduced by excluding all small targets that appeared within 500 m of the radar as small, slow moving targets with weak reflectivity (after Kuntz et al. 2007).

Radar target (a single or group of birds in flight) data were collected with the radar in horizontal and vertical orientation. For horizontal target data, the radar operator managed the radar display and the data recorder plotted the flight path on a Trimble Navigation Ltd. Geo7X datalogger with a display that mirrored the radar display. For vertical target data, the radar operator measured the height based on altitude displayed on the monitor when a target was first observed entering the detection cone and where it disappeared. The resulting minimum and maximum flight heights were recorded using the datalogger. Target size (small, medium, or large or very large; see Appendix A for a description of target sizes) was also recorded for each target observed. Weather data were recorded every 30 minutes using a Kestrel™ 2000 Wind Meter.

Photo 1 Truck-mounted marine radar unit used for nocturnal radar surveys

2.2.2.2 Target Calibration

Diurnal target calibration was used to:

1. record visual observations of bird flight paths and flock size at local wetlands as a reference for nocturnal radar data targets (i.e., to correlate flock size and composition with target size, speed and trajectory).
2. ensure proper functioning of the radar unit (i.e., that targets observed at various distances and direction were observed on the radar screen), and
3. confirm differences in flight observed patterns on the radar screen of bird species from those of foraging bats and insects.

Calibration consisted of simultaneous radar and visual surveys, where the radar recorder and visual observer identified the same target. Both observers were positioned such that a 360-degree view of the wetland could be monitored. Target calibration was carried out at three locations: Reed Lake, Francis Lake (north of the town of Herbert) and an unnamed wetland near site 1 (Figure H5-1). Wetland locations are selected for target calibration for increased efficiency as they tend to have higher bird activity, but are also selected near the survey area to capture similar species and flock sizes. Additional targets identified to species during the nocturnal radar survey (i.e., a low light levels, using binoculars) were also used for target calibration. Calibration took place1-2 hours before sunset (i.e., immediately prior to nocturnal radar surveys) between May 6-9, 2017 and May 26-31, 2017 during spring migration and August 12 -16, 2017 and September 7-9, 2017 during fall migration. Data recorded for each target included: target size (small, medium, large, or very large), number of individuals per target, guild (see Table A-1 in Appendix A for a breakdown of guilds) and, where possible, species identification.

The calibration period also provided an opportunity to identify bird migrants arriving at Reed Lake and other nearby wetlands prior to nocturnal radar surveys. Calibration was not performed with the radar in vertical orientation as high altitude targets are extremely difficult to identify visually by the observers, particularly at Reed Lake where up to 100 targets were within radar range at a given time.

2.2.3 Data Analysis

To assess the risk of the Project to nocturnal migrants, analysis of radar targets focused on quantifying flight heights (vertical radar data) and flight path direction (horizontal radar data) relative to proposed infrastructure (turbines) within the Project area. Data from control sites outside the Project area were analyzed separately for comparison of Project migrant activity with activity at Reed Lake (suspected high activity site) and west of the Project (suspected low activity site).

The number of targets below, within and above the RSA was calculated for turbine hub heights ranging from a minimum of 80 m (with a 40 m blade and an RSA of 40-120 m) and a maximum of 105 m (with a 68 m blade and RSA of 37-173 m). The survey detection area is increasingly smaller at higher altitudes because of the dome shape of the radar beam in vertical orientation (up until the set detection limit of 1500 m); to account for the smaller detection area, and subsequent reduced probability of detection at higher altitudes, target counts were multiplied by an area-based correction factor. This correction factor accounts for the smaller area sampled by the radar as altitude increases. Therefore, hereafter results of vertical surveys are referred to as corrected vertical targets. Also, a limitation of radar data is that clutter and surface obstructions can sometimes cause targets flying at low altitudes to be missed; as such, it is likely that the proportion of movements below the RSA are also biased low, which would indicate that overall the proportion of movements within the RSA is conservatively high.

Flight height and flight path direction were assessed for seasonal (i.e., spring vs. fall migration) patterns and site-specific patterns (i.e. for each site). To help differentiate local flights from those of nocturnal migrants, flight altitude and directional data were separated into crepuscular activity (dawn and dusk) and nocturnal activity (night, defined as the period between nautical dusk and dawn). Flight path direction was also assessed in relation to fight path distance to help distinguish between local flights and migrants. Target flight path direction was summarized using circular histograms with direction split into 45 degree quadrants. Figures were generated in the statistical program R (R Development Core Team 2017).

3.0 RESULTS

3.1 DIURNAL BIRD MOVEMENT

3.1.1 Environmental Conditions

Surveys were conducted when visibility was at least 800 m with a ceiling of 500 m or greater (e.g., precipitation no greater than a light rain, no fog). Wind speed may impede bird activity and were generally discontinued if the wind was consistently above 30 km/h, except if it was a tail wind increasing bird activity. Surveys were suspended when weather conditions hindered the ability to accurately observe and identify species within the target radius and/or if weather was hindering bird movement.

Larger, heavier species (i.e., raptors, ducks, geese) are less affected by stronger winds and precipitation and may continue migration in conditions that smaller, lighter migrants (i.e., songbirds) may find unsuitable. Wind direction may be more important for predicting bird movement than overall speed as a strong tailwind may increase overall migration activities above those observed on a calm day as birds take advantage of the ability to cover more ground using less energy. Large weather systems can concentrate bird movement with increased migration activity before and after the system and minimal movement during as birds seek shelter.

3.1.2 Movement Rates by Season and Survey Visit

3.1.2.1 Spring Bird Movement Surveys

Within the Project area, a total of 2,096 individuals from 61 species of birds were recorded during spring bird movement surveys, including two SAR (ferruginous hawk [*Buteo regalis*] and Sprague's pipit [*Anthus spragueii*]), and one SOMC (red-necked phalarope [*Phalaropus lobatus*]) (Table 3-1). The five most abundant species observed in the Project area during spring movement surveys were horned lark (*Eremophila alpestris*; 251 individuals), red-winged blackbird (*Agelaius phoeniceus*; 186 individuals), mallard (*Anas platyrhynchos*; 171 individuals), Lapland longspur (*Calcarius lapponicus*; 82 individuals), and semipalmated plover (*Charadrius semipalmatus*; 75 individuals).

Within the Project area, Sites 1 and 3 had the most observations with 480 (22.9%) and 778 (37.1%) individuals, respectively; conversely, Sites 2 and 4 had the fewest observations with 129 (6.2%) and 158 (7.5%) observations, respectively. In the Project area, a total of 1,062 (50.7%) observations were recorded during the waterbird survey interval, 989 (47.2%) during the songbird interval, and 45 (2.1%) during the raptor interval (see Table 3-1). The average number of observations at the six sites in the Project area was 349 birds.

Table 3-1 Avian Species Observed during the 2017 Spring Bird Movement Surveys

Common Name[1,2]	Scientific Name	No. of Individuals Observed							
		Site 1	Site 2	Site 3	Site 4	Site 5	Site 6	Site 7[5]	Site 8[5]
WATERBIRD SURVEY INTERVAL[3]									
Waterfowl									
Snow goose	*Anser caerulescens*	0	0	60	0	0	0	0	0
Canada goose	*Branta canadensis*	0	8	26	9	4	6	24	2
Tundra swan	*Cygnus columbianus*	0	0	0	0	0	0	9	0
Blue-winged teal	*Spatula discors*	3	2	1	0	11	0	47	4
Northern shoveler	*Spatula clypeata*	2	0	4	0	1	0	78	6
Gadwall	*Mareca strepera*	3	3	29	0	19	7	11	2
American wigeon	*Mareca americana*	0	0	6	0	6	1	0	0
Mallard	*Anas platyrhynchos*	22	12	39	7	76	15	19	19
Northern pintail	*Anas acuta*	0	2	3	6	25	0	4	2
Green-winged teal	*Anas crecca*	0	0	0	0	0	0	9	2
Canvasback	*Aythya valisineria*	0	0	69	0	0	0	13	0
Redhead	*Aythya americana*	0	0	0	0	0	0	4	0
Lesser scaup	*Aythya affinis*	0	0	6	5	22	0	314	0
Common goldeneye	*Bucephala clangula*	0	0	0	0	0	0	11	0
Common merganser	*Mergus merganser*	0	0	0	0	0	0	1	0
Duck spp.	*n/a*	11	0	31	0	0	0	420	0
Waterfowl Total		**41**	**27**	**274**	**27**	**164**	**29**	**964**	**37**
Waterbird									
Eared grebe	*Podiceps nigricollis*	0	0	0	0	8	0	8	0
Western grebe	***Aechmophorus occidentalis***	**0**	**0**	**0**	**0**	**0**	**0**	**1**	**0**

Table 3-1 Avian Species Observed during the 2017 Spring Bird Movement Surveys

Common Name[1,2]	Scientific Name	No. of Individuals Observed							
		Site 1	Site 2	Site 3	Site 4	Site 5	Site 6	Site 7[5]	Site 8[5]
American white pelican	*Pelecanus erythrorhynchos*	0	0	0	0	0	0	11	0
Double-crested cormorant	*Phalacrocorax auritus*	0	0	3	0	0	8	58	0
American coot	*Fulica americana*	0	0	0	0	6	0	0	2
Sandhill crane	*Antigone canadensis*	0	0	40	0	0	0	14	0
Franklin's gull	*Leucophaeus pipixcan*	19	1	11	0	2	13	1,505	0
Ring-billed gull	*Larus delawarensis*	2	0	2	0	0	9	805	0
California gull	*Larus californicus*	0	0	0	0	0	0	80	0
Herring gull	*Larus argentatus*	0	0	0	0	0	1	1,182	0
Gull spp.	*n/a*	50	0	1	0	0	0	310	0
Forster's tern	*Sterna forsteri*	6	0	0	0	25	0	28	0
Common tern	*Sterna hirundo*	0	0	0	0	3	0	0	0
Waterbird Total		**77**	**1**	**57**	**0**	**44**	**31**	**4,002**	**2**
Shorebird									
American avocet	*Recurvirostra americana*	0	0	0	0	0	0	4	0
Semipalmated plover	*Charadrius semipalmatus*	0	0	75	0	0	0	0	0
Killdeer	*Charadrius vociferus*	0	0	0	0	1	0	4	1
Whimbrel	*Numenius phaeopus*	0	0	0	0	0	0	10	0
Long-billed curlew	***Numenius americanus***	**0**	**0**	**0**	**0**	**0**	**0**	**2**	**0**
Marbled godwit	*Limosa fedoa*	0	0	4	0	0	7	0	0
Red knot	***Calidris canutus rufa***	**0**	**0**	**0**	**0**	**0**	**0**	**4**	**0**
Short-billed dowitcher	*Limnodromus griseus*	0	0	0	0	0	0	8	0

Table 3-1 Avian Species Observed during the 2017 Spring Bird Movement Surveys

Common Name[1,2]	Scientific Name	No. of Individuals Observed							
		Site 1	Site 2	Site 3	Site 4	Site 5	Site 6	Site 7[5]	Site 8[5]
Long-billed dowitcher	*Limnodromus scolopaceus*	0	0	25	0	0	0	0	0
Wilson's snipe	*Gallinago delicata*	1	3	14	2	0	0	0	0
Spotted sandpiper	*Actitis macularius*	0	0	50	0	0	0	0	0
Solitary sandpiper	*Tringa solitaria*	0	15	39	0	0	0	0	0
Lesser yellowlegs	*Tringa flavipes*	0	0	0	0	0	0	13	0
Willet	*Tringa semipalmata*	0	1	1	0	0	0	6	4
Greater yellowlegs	*Tringa melanoleuca*	0	0	0	0	0	0	0	2
Wilson's phalarope	*Phalaropus tricolor*	0	0	1	0	0	1	6	0
Red-necked phalarope	***Phalaropus lobatus***	**0**	**0**	**0**	**0**	**1**	**0**	**22**	**0**
Sandpiper spp.	*n/a*	0	0	3	0	1	0	0	0
Shorebird spp.	*n/a*	24	0	0	21	0	0	354	0
Shorebird Total		**25**	**19**	**212**	**23**	**3**	**8**	**433**	**7**
RAPTOR SURVEY INTERVAL									
Osprey	*Pandion haliaetus*	0	0	0	0	1	0	0	0
Northern harrier	*Circus hudsonius*	4	1	1	1	1	4	1	4
Red-tailed hawk	*Buteo jamaicensis*	2	1	2	1	0	2	0	3
Swainson's hawk	*Buteo swainsoni*	1	6	5	2	2	0	1	0
Ferruginous hawk	***Buteo regalis***	**0**	**0**	**1**	**0**	**0**	**0**	**0**	**0**
Hawk spp.	*n/a*	0	0	0	1	0	0	0	4
American kestrel	*Falco sparverius*	1	0	1	0	0	0	0	0
Merlin	*Falco columbarius*	1	0	0	1	0	0	1	0
Raptor spp.	*n/a*	1	0	0	1	0	0	0	0

Table 3-1 Avian Species Observed during the 2017 Spring Bird Movement Surveys

Common Name[1,2]	Scientific Name	No. of Individuals Observed							
		Site 1	Site 2	Site 3	Site 4	Site 5	Site 6	Site 7[5]	Site 8[5]
Raptor Total		**10**	**8**	**10**	**7**	**4**	**6**	**3**	**11**
SONGBIRD SURVEY INTERVAL[4]									
Sharp-tailed grouse	*Tympanuchus phasianellus*	0	11	1	1	0	29	0	0
Gray partridge	*Perdix perdix*	0	0	0	2	0	0	0	0
Rock pigeon	*Columba livia*	5	0	3	0	0	0	0	0
Mourning dove	*Zenaida macroura*	2	0	3	1	0	0	0	0
Black-billed magpie	*Pica hudsonia*	0	0	1	1	0	0	0	0
Common raven	*Corvus corax*	0	0	0	1	0	0	1	0
American crow	*Corvus brachyrhynchos*	1	4	1	0	0	0	0	3
Horned lark	*Eremophila alpestris*	201	8	8	18	10	6	22	86
Barn swallow	***Hirundo rustica***	**0**	**0**	**0**	**0**	**0**	**0**	**7**	**0**
Tree swallow	*Tachycineta bicolor*	0	0	25	0	0	0	0	0
American robin	*Turdus migratorius*	0	0	4	0	0	0	4	2
European starling	*Sturnus vulgaris*	0	0	3	0	0	1	0	4
Sprague's pipit	***Anthus spragueii***	**0**	**4**	**0**	**0**	**0**	**0**	**2**	**0**
Lapland longspur	*Calcarius lapponicus*	45	0	0	37	0	0	0	65
Snow bunting	*Plectrophenax nivalis*	0	0	0	0	0	0	0	1
Grasshopper sparrow	*Ammodramus savannarum*	0	0	3	0	0	0	0	0
Clay-colored sparrow	*Spizella pallida*	2	1	0	5	1	1	0	2
Lincoln's sparrow	*Melospiza lincolnii*	0	3	1	0	0	0	0	0
Vesper sparrow	*Pooecetes gramineus*	0	0	1	1	0	1	2	0

Table 3-1 Avian Species Observed during the 2017 Spring Bird Movement Surveys

Common Name[1,2]	Scientific Name	No. of Individuals Observed							
		Site 1	Site 2	Site 3	Site 4	Site 5	Site 6	Site 7[5]	Site 8[5]
Savannah sparrow	*Passerculus sandwichensis*	0	3	2	0	7	3	0	1
Lark sparrow	*Chondestes grammacus*	0	0	8	0	0	0	0	0
Dark-eyed junco	*Junco hyemalis*	0	0	0	0	0	0	1	0
Western meadowlark	*Sturnella neglecta*	4	13	14	6	3	2	4	5
Yellow-headed blackbird	*Xanthocephalus xanthocephalus*	0	1	28	0	5	0	7	0
Red-winged blackbird	*Agelaius phoeniceus*	42	2	73	1	40	28	28	51
Brewer's blackbird	*Euphagus cyanocephalus*	0	15	25	4	0	6	129	11
Brown-headed cowbird	*Molothrus ater*	14	8	15	9	8	19	12	0
Common grackle	*Quiscalus quiscula*	3	1	6	14	0	12	21	0
Blackbird spp.	*n/a*	8	0	0	0	0	80	0	88
Songbird Total		**327**	**74**	**225**	**101**	**74**	**188**	**240**	**319**
Grand Total		**480**	**129**	**778**	**158**	**289**	**262**	**5,642**	**376**

NOTES:

1 Only targeted species observed during the appropriate timing interval are included (i.e., ducks are only counted if observed during the waterbird survey interval).

2 Bold names indicate a SAR or an SOMC.

3 Waterbird survey interval subdivided into waterfowl (i.e., ducks, geese and swans), waterbird (i.e., grebes, loons, gulls, terns, herons, and pelicans), and shorebird (i.e., wading species such as curlews, plovers, and sandpipers) species.

4 Songbird survey interval includes all landbirds such as passerines, corvids, and gamebirds.

5 Control sites which are outside of the Project area.

Stantec

The control site at Reed Lake (Site 7) had the most observations with 5,642 individuals recorded. This was more than seven times the number of birds observed at Site 3, which had the highest abundances recorded within the Project area, and more than all sites in the Project area combined. Five SAR (ferruginous hawk, long-billed curlew, red knot [*Calidris canutus*], western grebe [*Aechmophorus occidentalis*] and Sprague's pipit) and one SOMC (red-necked phalarope) were recorded at the Reed lake control site. The most abundant species observed at Site 7 were Franklin's gull (*Leucophaeus pipixcan,* 1,505 individuals), herring gull (*Larus argentatus,* 1,182 individuals), and ring-billed gull (*Larus delawarensis*, 805 individuals). Site 8, the control site north of the Centennial Wind Project, had 376 recorded observations, with species abundances being similar to sites within the Project Area with horned lark (86 individuals), Lapland longspur (65 individuals), and red-winged blackbird (51 individuals) as the most abundant (see Table 3-1).

3.1.2.2 Fall Bird Movement Surveys

A total of 85,867 individuals from 30 species of birds were observed in the Project area, with no SAR or SOMC recorded (Table 3-2). The five most abundant species observed in the Project area during fall movement surveys were snow goose (*Anser caerulescens*; 73,700 individuals), mallard (464 individuals), Canada goose (*Branta canadensis*; 451 individuals), horned lark (421 individuals), and greater white-fronted goose (*Anser albifrons*; 387 individuals).

Within the Project area, 97.5% of fall bird movement observations were waterfowl (i.e., ducks and geese). Snow goose accounted for most (84,160) observations during fall movement surveys with 73,700 individuals in the Project area (85.8% of total bird observations). Several of these observations were due to large flocks with over 2,000 individuals (see footnotes in Table 3-2 for specific observations). Both Sites 4 and 5 had flocks with more than 10,000 individual snow geese.

Overall, within the Project area, Sites 4 and 5 had the most observations with 39,387 (45.9%) and 24,268 (28.3%) observations, respectively; conversely, Sites 1 and 6 had the fewest observations with 734 (0.9%) and 3,845 (4.5%) observations, respectively (see Table 3-2). When the snow goose observations are removed, Sites 4 and 5 still had the highest number of observations (3,290 and 3,395 individuals, respectively), but were much closer to the numbers recorded at Sites 2 and 3 (1,807 and 2,659 individuals, respectively, excluding snow geese). Sites 1 and 6, both sites in the southeast portion of the Project area, continued to have the lowest number of observations, even after the snow geese were removed, with 659 and 357 individuals, respectively.

The control site near Reed Lake (Site 7) had 22,846 observations, similar to the number recorded at Site 5. The most abundant species observed at Site 7 were snow goose (10,460 individuals), American coot (*Fulica americana*, 2,075 individuals), and lesser scaup (*Aythya affinis*; 1,560 individuals). Additionally, three SAR (horned grebe, western grebe, and barn swallow) were recorded at the site (Table 3-2). Control Site 8 had 305 recorded observations with Canada goose (152 individuals), Lapland longspur (41 individuals), and horned lark (34 individuals) being the most abundant species (Table 3-2).

Table 3-2 Avian Species Observed during the 2017 Fall Bird Movement Surveys

Common Name[1,2]	Scientific Name	No. of Individuals Observed							
		Site 1	Site 2	Site 3	Site 4	Site 5	Site 6	Site 7[5]	Site 8[5]
WATERBIRD SURVEY INTERVAL[3]									
Waterfowl									
Snow goose	*Anser caerulescens*	75	6,582	6,585	36,097**	20,873**	3,488*	10,460*	0
Greater white-fronted goose	*Anser albifrons*	0	232	155	0	0	0	52	0
Canada goose	*Branta canadensis*	33	13	133	9	173	90	441	152
Goose spp.	*n/a*	340	1,350	1,003	3,100*	1,400	0	0	0
Tundra swan	*Cygnus columbianus*	0	0	3	0	0	0	96	0
Swan spp.	*n/a*	0	50	25	0	0	9	16	0
Blue-winged teal	*Spatula discors*	0	0	0	0	2	0	875	3
Northern shoveler	*Spatula clypeata*	0	0	0	0	0	0	492	0
Gadwall	*Mareca strepera*	0	0	0	0	0	0	300	0
American wigeon	*Mareca americana*	0	0	0	0	0	0	80	0
Mallard	*Anas platyrhynchos*	0	0	6	0	458	0	1,323	9
Northern pintail	*Anas acuta*	0	0	0	0	0	0	8	0
Canvasback	*Aythya valisineria*	0	0	0	0	0	0	992	0
Redhead	*Aythya americana*	0	0	0	0	40	0	183	0
Lesser scaup	*Aythya affinis*	0	0	0	0	0	0	1,560	0
Bufflehead	*Bucephala albeola*	0	0	0	0	0	0	2	0
Ruddy duck	*Oxyura jamaicensis*	0	0	0	0	0	0	36	0
Duck spp.	*n/a*	22	0	911	20	192	25	3,380	13
Waterfowl spp.	*n/a*	0	0	16	0	239	0	0	0
Waterfowl Total		**470**	**8,227**	**8,837**	**39,226**	**23,377**	**3,612**	**20,296**	**177**

Table 3-2 Avian Species Observed during the 2017 Fall Bird Movement Surveys

Common Name[1,2]	Scientific Name	No. of Individuals Observed							
		Site 1	Site 2	Site 3	Site 4	Site 5	Site 6	Site 7[5]	Site 8[5]
Waterfowl Total without Snow Goose		**395**	**1,645**	**2,252**	**3,129**	**2,504**	**124**	**9,836**	**177**
Waterbird									
Horned grebe	***Podiceps auritus***	**0**	**0**	**0**	**0**	**0**	**0**	**4**	**0**
Eared grebe	*Podiceps nigricollis*	0	0	0	0	0	0	30	0
Western grebe	***Aechmophorus occidentalis***	**0**	**0**	**0**	**0**	**0**	**0**	**9**	**0**
American white pelican	*Pelecanus erythrorhynchos*	0	0	0	0	0	0	8	0
Double-crested cormorant	*Phalacrocorax auritus*	0	0	0	0	0	0	33	0
American coot	*Fulica americana*	0	0	0	0	0	0	2,075	0
Sandhill crane	*Antigone canadensis*	0	0	1	0	0	0	24	0
Gull spp.	*n/a*	0	0	0	0	0	0	1	0
Waterbird Total		**0**	**0**	**1**	**0**	**0**	**0**	**2,184**	**0**
Shorebird									
Killdeer	*Charadrius vociferus*	0	0	0	0	0	1	7	0
Lesser yellowlegs	*Tringa flavipes*	0	0	0	0	0	0	4	0
Greater yellowlegs	*Tringa melanoleuca*	0	0	0	0	0	0	22	0
Wilson's phalarope	*Phalaropus tricolor*	0	0	0	0	0	0	82	0
Shorebird spp.	*n/a*	0	0	0	0	0	0	15	0
Shorebird Total		**0**	**0**	**0**	**0**	**0**	**1**	**130**	**0**
RAPTOR SURVEY INTERVAL									
Northern harrier	*Circus hudsonius*	0	1	1	0	0	1	1	2
Red-tailed hawk	*Buteo jamaicensis*	0	0	3	1	0	0	0	1
Swainson's hawk	*Buteo swainsoni*	0	0	1	0	0	0	1	0
Rough-legged hawk	*Buteo lagopus*	0	0	0	0	0	1	0	0

Table 3-2 Avian Species Observed during the 2017 Fall Bird Movement Surveys

Common Name[1,2]	Scientific Name	No. of Individuals Observed							
		Site 1	Site 2	Site 3	Site 4	Site 5	Site 6	Site 7[5]	Site 8[5]
Hawk spp.	*n/a*	0	0	2	3	0	0	2	0
American kestrel	*Falco sparverius*	1	0	0	0	1	0	0	1
Merlin	*Falco columbarius*	1	0	1	0	0	0	0	0
Great horned owl	*Bubo virginianus*	0	0	0	0	1	0	0	0
Raptor spp.	*n/a*	0	0	0	0	0	1	0	1
Raptor Total		**2**	**1**	**8**	**4**	**2**	**3**	**4**	**5**
SONGBIRD SURVEY INTERVAL[4]									
Sharp-tailed grouse	*Tympanuchus phasianellus*	0	1	0	0	0	32	0	0
Gray partridge	*Perdix perdix*	0	0	0	0	0	0	0	20
Rock pigeon	*Columba livia*	0	0	15	0	2	0	5	0
Mourning dove	*Zenaida macroura*	5	0	0	0	0	1	0	0
Black-billed magpie	*Pica hudsonia*	14	0	1	0	0	0	0	0
Common raven	*Corvus corax*	0	0	1	0	1	1	2	0
American crow	*Corvus brachyrhynchos*	0	0	0	0	0	0	1	0
Horned lark	*Eremophila alpestris*	96	68	14	111	71	61	47	34
Barn swallow	***Hirundo rustica***	**0**	**0**	**0**	**0**	**0**	**0**	**8**	**0**
American robin	*Turdus migratorius*	0	8	0	0	0	0	0	0
Brown thrasher	*Toxostoma rufum*	0	1	0	0	0	0	0	0
House sparrow	*Passer domesticus*	0	0	0	0	0	0	10	8
Lapland longspur	*Calcarius lapponicus*	15	39	5	0	0	34	103	41
American tree sparrow	*Spizelloides arborea*	0	0	4	0	0	0	0	0
Clay-colored sparrow	*Spizella pallida*	32	0	0	0	0	0	3	6
Vesper sparrow	*Pooecetes gramineus*	24	1	0	14	0	0	20	0

Table 3-2 Avian Species Observed during the 2017 Fall Bird Movement Surveys

Common Name[1,2]	Scientific Name	No. of Individuals Observed							
		Site 1	Site 2	Site 3	Site 4	Site 5	Site 6	Site 7[5]	Site 8[5]
Savannah sparrow	*Passerculus sandwichensis*	1	0	0	11	3	0	0	1
Western meadowlark	*Sturnella neglecta*	39	15	12	4	8	13	8	9
Red-winged blackbird	*Agelaius phoeniceus*	0	0	8	0	0	0	4	0
Brown-headed cowbird	*Molothrus ater*	2	0	0	0	0	0	0	1
Brewer's blackbird	*Euphagus cyanocephalus*	0	0	0	0	0	0	6	0
Blackbird spp.	*n/a*	0	0	168	0	0	32	0	0
Songbird spp.	*n/a*	34	28	170	17	804	55	15	3
Songbird Total		**262**	**161**	**398**	**157**	**889**	**229**	**232**	**123**
Grand Total		**734**	**8,389**	**9,244**	**39,387**	**24,268**	**3,845**	**22,846**	**305**
Grand Total without Snow Goose		**659**	**1,807**	**2,659**	**3,290**	**3,395**	**357**	**12,386**	**305**

NOTES:
1 Only targeted species observed during the appropriate timing interval are included (i.e., ducks are only counted if observed during the waterbird survey interval).
2 Bold names indicate a SAR or an SOMC.
3 Waterbird survey interval subdivided into waterfowl (i.e., ducks, geese and swans), waterbird (i.e., grebes, loons, gulls, terns, herons, and pelicans), and shorebird (i.e., wading species such as curlews, plovers, and sandpipers) species.
4 Songbird survey interval includes all landbirds such as passerines, corvids, and gamebirds.
5 Control sites which are outside of the Project area.
* Observation of at least 1 flock with 2,000 individuals or more.
** Observation of at least 1 flock with 10,000 individuals or more.

3.1.3 Species of Management Concern

During the spring bird movement surveys, five SAR (long-billed curlew, western grebe, ferruginous hawk, barn swallow, and Sprague's pipit) and one SOMC (red-necked phalarope) were recorded. Sprague's pipit and red-necked phalarope were both recorded in the Project area and at Site 7, and ferruginous hawk was only observed within the Project area. The remaining SAR and SOMC were only observed at the Reed Lake control site (Site 7).

During the fall bird movement surveys, three SAR (horned grebe, western grebe, and barn swallow) were recorded at Site 7, but no SAR or SOMC were observed within the Project area.

3.1.4 Movement Patterns on the Landscape

Within the Project area there were 2,096 observations in spring and 85,867 observations in fall. Waterfowl accounted for 97.5% (83,749 individuals) of the observations recorded during fall, of which 73,700 individuals were snow geese. Conversely, 47.2% (989 individuals) of the observations recorded during spring movement were landbirds, of which 251 were horned lark and 186 were red-winged blackbird. While absolute numbers observed do not indicate the actual number of birds using the region, these data suggest a greater number of individuals use the area in the fall for migration staging than in the spring.

As expected, Site 7 had the highest number of observations of all sites in the spring (5,638 individuals), and was an order of magnitude higher than the Project area sites; Site 8 had a similar number of observations (376) to the average (349) of the Project area sites.

Within the Project area, Site 3 had the most observations (778 individuals), likely due to the proximity of a large wetland west of the survey location.

Patterns differed in the fall where Site 4 had the most observations (39,387 individuals). However, when snow geese are removed as a few large flocks can greatly influence overall bird numbers, Site 7 again had the highest number of observations by an order of magnitude (Table 3-2). This is notable as most snow geese were not observed roosting on Reed Lake near Site 7, but tended to be at the east or west ends of the lake. Site 8 had the fewest observation in the fall with 305 individuals, which was similar to Site 6 in the Project area (357 individuals).

Overall, beyond Reed Lake having consistently higher numbers of birds, there were no clear patterns in bird movement rates when considering the spring and fall.

3.2 NOCTURNAL RADAR SURVEYS

3.2.1 Environmental Conditions

There were no precipitation events during the spring and fall surveys that prevented data collection; however, approximately 180 minutes of survey time was lost due to safety considerations (e.g., avoidance of lightning storms). During spring, five survey nights were clear with visible stars and five nights were partially cloudy or overcast (i.e., ≥ 50% cloud cover). During fall, six nights were clear and four nights were partially cloudy or overcast. The moon phase ranged from waxing crescent to full during spring surveys and from full to waning crescent during the fall surveys. Aurora Borealis occurred on May 27, 2017 during the spring and September 6 and 7, 2017 during fall surveys. Temperature ranged from 0°C to 29°C in spring and 4°C to 28°C in fall. Winds were generally calm to light during both seasons with the majority of winds ≤11 km/h; wind speed ranged from Beaufort 0 to 4 (0 to 28 km/h) during spring surveys and from Beaufort 0 to 5 (0 to 38 km/h) during fall surveys. Wind direction was highly variable and changed hourly some nights; in spring, winds were predominantly from the south and west, whereas in fall, winds were typically from the south and east. Cloud cover and wind direction were not linked to patterns in target height or flight path direction. Some evidence suggests targets were flying at lower altitude when wind speeds at ground level were ≥ 11 km/h (see Section 3.2.3.2).

3.2.2 Target Calibration

A summary of flock size and associated radar target size is provided for observed waterbird guilds in Table 3-5 and Table 3-6 (see species composition of each guild in Table A-1 in Appendix A). Data for small shorebirds indicate that small, medium, large, and very large targets comprised an average of 6, 15, 79, and 180 individuals (primarily unidentified shorebirds) during spring (Table 3-5). For medium-size waterfowl recorded during fall calibration, small, medium, and large targets represent and average of 4, 7, and 17 individuals (Table 3-6). Overall, 34 species were identified during calibration field work, including eight shorebird species. A breakdown of calibration for each species observed in spring and fall is provided in Table A-2 and Table A-3 in Appendix A.

Table 3-3 Summary of Target Calibration Data Collected during Spring 2017

Guild (size)	Target Size	Average Count	Minimum Count	Maximum Count	Total Count	Total Targets
Shorebird (small)	Small	6	1	40	65	13
	Medium	15	10	22	75	5
	Large	79	10	160	555	7
	Very large	180	180	180	180	1
	Total				**875**	**26**
Shorebird (medium)	Small	2	1	3	19	13
	Total				**19**	**13**
Wading bird (medium)	Small	3	3	3	3	1
	Medium	2	1	4	11	5
	Total				**14**	**6**
Wading bird (large)	Medium	1	1	1	1	1
	Total				**1**	**1**
Waterfowl (small)	Small	2	1	4	14	7
	Medium	2	1	3	19	10
	Large	11	6	15	21	2
	Total				**54**	**19**
Waterfowl (medium)	Small	2	1	8	96	61
	Medium	4	1	18	139	35
	Large	14	8	22	109	8
	Total				**344**	**104**
Waterfowl (large)	Small	2	1	4	19	13
	Medium	4	1	6	39	9
	Large	9	2	20	47	5
	Total				**105**	**27**
Waterbird (large)	Small	1	1	1	8	8
	Medium	2	1	6	13	6
	Large	4	4	4	4	1
	Total				**25**	**15**
Gull (medium)	Small	1	1	6	220	160
	Medium	4	1	16	125	36
	Large	16	9	28	64	4
	Total				**409**	**200**

Table 3-3 Summary of Target Calibration Data Collected during Spring 2017

Guild (size)	Target Size	Average Count	Minimum Count	Maximum Count	Total Count	Total Targets
Tern (medium)	Small	1	1	1	10	10
	Total				**10**	**10**
Passerine (small)	Small	3	1	16	27	9
	Medium	6	5	6	11	2
	Large	55	55	55	55	1
	Total				**93**	**12**
Passerine (medium)	Small	1	1	1	1	1
	Total				**1**	**1**
Grand Total					**1,950**	**434**

Table 3-4 Summary of Target Calibration Data Collected during Fall 2017

Guild (size)	Target Size	Average Count	Minimum Count	Maximum Count	Total Count	Total Targets
Shorebird (small)	Small	10	1	20	58	6
	Medium	17	15	19	34	2
	Total				**92**	**8**
Shorebird (medium)	Small	5	3	6	9	2
	Total				**9**	**2**
Waterfowl (small)	Small	2	2	2	2	1
	Total				**2**	**1**
Waterfowl (medium)	Small	4	1	21	127	36
	Medium	7	2	13	163	23
	Large	17	8	40	204	12
	Total				**494**	**71**
Waterfowl (large)	Medium	4	3	6	12	3
	Large	14	4	26	99	7
	Total				**111**	**10**
Waterbird (small)	Small	1	1	1	2	2
	Total				**2**	**2**
Waterbird (large)	Small	1	1	1	3	3
	Total				**3**	**3**

Table 3-4 Summary of Target Calibration Data Collected during Fall 2017

Guild (size)	Target Size	Average Count	Minimum Count	Maximum Count	Total Count	Total Targets
Raptor (large)	Small	1	1	1	1	1
	Total				**1**	**1**
Gull (medium)	Small	1	1	4	37	34
	Medium	7	4	10	29	11
	Total				**66**	**45**
Tern (medium)	Small	1	1	1	3	3
	Medium	15	15	15	15	1
	Total				**18**	**4**
Tern (large)	Small	1	1	1	1	1
	Total				**1**	**1**
Grand Total					**799**	**148**

3.2.3 Nocturnal Movements

3.2.3.1 All Targets Combined

3.2.3.1.1 Project Area Sites

Within the Project area, a total of 6,498 targets (i.e., horizontal and corrected vertical targets combined) were observed during both migratory seasons. Approximately 65% more targets were recorded during spring (4,042) compared to fall (2,454) and approximately 40% more vertical targets (3,804) were recorded compared to horizontal targets (2,694) (Table 3-5). The majority of targets were observed at night (vs. dusk and dawn) in fall (89%), while a lower proportion of targets were observed at night during spring (69%) (Table 3-7). The distribution of targets varied seasonally among the three sites, with the highest number of targets in the spring recorded at site 3 (1,880) and the highest number of targets in the fall recorded at site 5 (1,282). Site 1 had the highest number of targets combined for both seasons (2,328 total; spring – 1,469, fall – 859; Table 3-5).

Approximately 90% of targets recorded in the Project area were small (Table 3-6). Super large targets, observed for large flocks of waterfowl during target calibration (see Section 3.2.2, Table 3-1 and Table 3-2), were not observed during nocturnal radar surveys. The number of medium and large-sized targets was similar during spring (368) and fall (317) surveys (Table 3-6). The highest number of medium and large-sized targets was recorded at site 3 during spring and site 1 during fall (Table 3-6). During spring, large and medium-sized targets were recorded more often at dusk, while during fall, large and medium-sized target were recorded more often at night (Table 3-7). Large and medium-sized targets were recorded less often at dawn than during other time categories, particularly in fall (Table 3-7).

3.2.3.1.2 Control Sites

More targets were recorded at both control sites compared to sites within the Project area (Table 3-7). The highest number of targets was recorded at the control site near the Centennial WEP west of the Project area (3,893 total; spring – 1,821; fall – 2,072; Table 3-5); approximately 40% fewer targets were recorded at the Reed Lake site (2,836 total; spring – 1,609; fall – 1,227; Table 3-5). As with sites in the Project area, more targets were recorded at control sites during spring and more vertical targets were recorded compared to horizontal targets (Table 3-5). At both control sites, a higher proportion of targets were recorded at night (vs. dusk and dawn) during fall compared to spring (Table 3-7).

The number of medium and large-sized targets was greater at the Reed Lake site (483 medium, 47 large) compared to the Centennial site (137 medium, 9 large) in both spring and fall (Table 3-6). In addition, more medium and large-sized targets were recorded at Reed Lake compared to any one site within the Project area (Table 3-6). Large and medium-sized targets were recorded more often at night (vs. dusk and dawn) at both control sites (Table 3-7). Large and medium-sized targets were recorded less often at dawn than during other time categories, particularly in fall (Table 3-7).

Table 3-5 Number of Targets Recorded during 2017 Nocturnal Radar Survey

	Spring		Fall		Combined Seasons		
Site ID	**Horizontal**	**Vertical**	**Horizontal**	**Vertical**	**Horizontal**	**Vertical**	**Total**
Project Area							
Site 1	639	830	475	384	1,114	1,214	2,328
Site 3	644	1,236	186	128	830	1,364	2,194
Site 5	376	318	374	908	750	1,226	1,975
Total	**1,659**	**2,383**	**1,035**	**1,419**	**2,694**	**3,804**	**6,498**
Control Sites							
Centennial	617	1,204	576	1,496	1,193	2,700	3,893
Reed Lake	960	649	664	563	1,624	1,212	2,836
Total	**1,577**	**1,853**	**1,240**	**2,059**	**2,817**	**3,912**	**6,729**

Table 3-6 Size of Targets Recorded during 2017 Nocturnal Radar Survey

Target Size	Project Area							Control Sites				
	Site 1		Site 3		Site 5			Centennial		Reed Lake		
	Spring	Fall	Spring	Fall	Spring	Fall	Total	Spring	Fall	Spring	Fall	Total
Large	5	17	12	3	0	10	**47**	3	6	27	20	**56**
Medium	135	205	159	31	57	51	**638**	72	65	246	237	**620**
Small	1,329	637	1,709	280	637	1,221	**5,813**	1,746	2,001	1,336	970	**6,053**
Total	**1,469**	**859**	**1,880**	**314**	**694**	**1,282**	**6,498**	**1,821**	**2,072**	**1,609**	**1,227**	**6,729**

Table 3-7 Size of Targets Recorded at Dawn, Night and Dusk during 2017 Nocturnal Radar Survey

Target Size	Spring				Fall			Total
	Dawn	Night	Dusk	Total	Dawn	Night	Dusk	
Project Area								
Large	4	3	10	17	0	20	10	30
Medium	52	149	150	352	0	209	77	286
Small	246	2,674	754	3,674	37	1,950	152	2,138
Total	**302**	**2,826**	**914**	**4,042**	**37**	**2,179**	**239**	**2,454**
Centennial Control Site								
Large	0	1	2	3	0	5	1	6
Medium	3	53	17	72	3	54	8	65
Small	152	1,152	441	1,746	30	1,874	97	2,001
Total	**155**	**1,206**	**460**	**1,821**	**33**	**1,933**	**106**	**2,072**
Reed Lake Control Site								
Large	5	10	12	28	0	5	15	20
Medium	26	125	94	246	0	176	61	237
Small	159	764	413	1,336	82	760	128	970
Total	**191**	**899**	**519**	**1,609**	**82**	**941**	**203**	**1227**

3.2.3.2 Flight Altitudes (Vertical Targets)

Within the Project area, recorded flight altitudes averaged 275 m across both migratory seasons and were similar to those at the Centennial control site (293 m), and both lower than the Reed Lake control site (371 m) (Table 3-8). At sites within the Project area, the majority of vertical targets recorded during spring and fall surveys (corrected to account for the radar detection area) were above the RSAs for tower hub heights of 80 m (spring, 80%; fall, 83%) and 105 m (spring, 72%; fall, 76%) (Table 3-9).

Large-sized targets, though rarely encountered within the Project area, were relatively more common below and above the RSA compared to smaller sized targets (Table 3-9; Figure H5-2). The altitude of targets recorded in the Project area was similar during dusk and night in spring and fall, whereas altitudes at dawn tended to be lower, particularly during fall (Figure H5-3). At higher wind speeds (i.e., between 11-38 km/h) relatively more targets in the Project area were within the RSAs (17-27%, for 80 and 105 m hub heights, respectively) compared to lower wind speeds (13-21%).

The majority of flights recorded at the Centennial control site were above the RSAs for turbine hub heights of 80 m (spring, 77%; fall, 89%) and 105 m (spring, 67%; fall, 82%), as were those for the Reed Lake control site for 80 m (spring, 85%; fall, 68%) and 105 m (spring, 80%; fall, 64%) hub heights (Table 3-9). The percentage of targets in spring and fall within the RSA varied from 11 to 25% for the Project area compared to 9 to 31% for the Centennial control site and 10 to 26% for the Reed Lake control site. (Table 3-9). Large and medium-sized targets were recorded at higher elevations at the Reed Lake control site than records for the Project area (Table 3-9; Figure H5-4), whereas all large-sized targets recorded at the Centennial control site were within the RSA during both seasons (Figure H5-5). No distinct pattern was observed for flight altitudes and time of night at the control sites (Figures H5-6 and H5-7), nor between wind speed and target altitude.

Table 3-8 Mean Target Altitude Below, Within, and Above the Rotor Swept Area (RSA) for Turbines with 80 m and 105 m Hub Heights

Height Relative to the RSA	Mean Recorded Heights (m ± 1 S.D.)[1]	
	80 m Hub Height (RSA = 40-120 m)	**105 m Hub Height (RSA = 37-173 m)**
Project Area		
Below	9 ± 12	8 ± 10
Within	77 ± 25	109 ± 43
Above	345 ± 163	367 ± 157
Total	**275 ± 194**	**275 ± 194**
Centennial Control Site		
Below	12 ± 13	11 ± 12
Within	80 ± 23	109 ± 40
Above	341 ± 157	363 ± 150
Total	**293 ± 179**	**293 ± 179**
Reed Lake Control Site		
Below	26 ± 8	25 ± 7
Within	78 ± 24	94 ± 39
Above	472 ± 265	496 ± 258
Total	**371 ± 291**	**371 ± 291**

NOTE:
[1] Mean plus or minus one standard deviation.

Table 3-9 Count of Targets Observed Above, Within, and Below the Rotor Swept Area (RSA) for Turbines with 80 m and 105 m Hub Heights

Height Relative to the RSA	80 m hub height (RSA = 40-120 m)								105 m hub height (RSA = 37-173 m)							
	Spring				Fall				Spring				Fall			
	S[1]	M[2]	L[3]	Total (%)	S[1]	M[2]	L[3]	Total (%)	S[1]	M[2]	L[3]	Total (%)	S[1]	M[2]	L[3]	Total (%)
Project Area																
Above	1,807	100	3	**1,910 (80)**	1,137	41	4	**1,183 (83)**	1,623	91	3	**1,717 (72)**	1,045	31	2	**1,079 (76)**
Within	343	45	5	**393 (16)**	141	12	2	**155 (11)**	535	55	5	**595 (25)**	241	25	4	**270 (19)**
Below	69	8	3	**80 (4)**	63	14	4	**81 (6)**	61	7	3	**71 (3)**	55	11	4	**70 (5)**
Total	**2,219**	**153**	**11**	**2,383**	**1,341**	**67**	**11**	**1,419**	**2,219**	**153**	**11**	**2,383**	**1,341**	**67**	**11**	**1,419**
Centennial Control Site																
Above	892	29	0	**921 (77)**	1,302	36	0	**1,338 (89)**	782	28	0	**811 (67)**	1,193	32	0	**1,225 (82)**
Within	249	5	2	**256 (21)**	127	4	1	**132 (9)**	361	6	2	**369 (31)**	240	8	1	**249 (17)**
Below	27	0	0	**27 (2)**	25	1	0	**26 (2)**	24	0	0	**24 (2)**	21	1	0	**22 (1)**
Total	**1,168**	**34**	**2**	**1,204**	**1,454**	**41**	**1**	**1,496**	**1,168**	**34**	**2**	**1,204**	**1,454**	**41**	**1**	**1,496**
Reed Lake Control Site																
Above	488	57	7	**551 (85)**	327	55	3	**385 (68)**	457	55	7	**519 (80)**	306	51	3	**359 (64)**
Within	52	12	1	**65 (10)**	110	2	0	**112 (20)**	84	14	1	**99 (15)**	138	6	**0**	**144 (26)**
Below	30	2	1	**33 (5)**	63	3	0	**66 (12)**	28	2	1	**31 (5)**	56	3	**0**	**59 (10)**
Total	**569**	**71**	**9**	**649**	**500**	**60**	**3**	**563**	**570**	**71**	**9**	**649**	**500**	**60**	**3**	**563**

NOTES:
[1] Small target size
[2] Medium target size
[3] Large target size

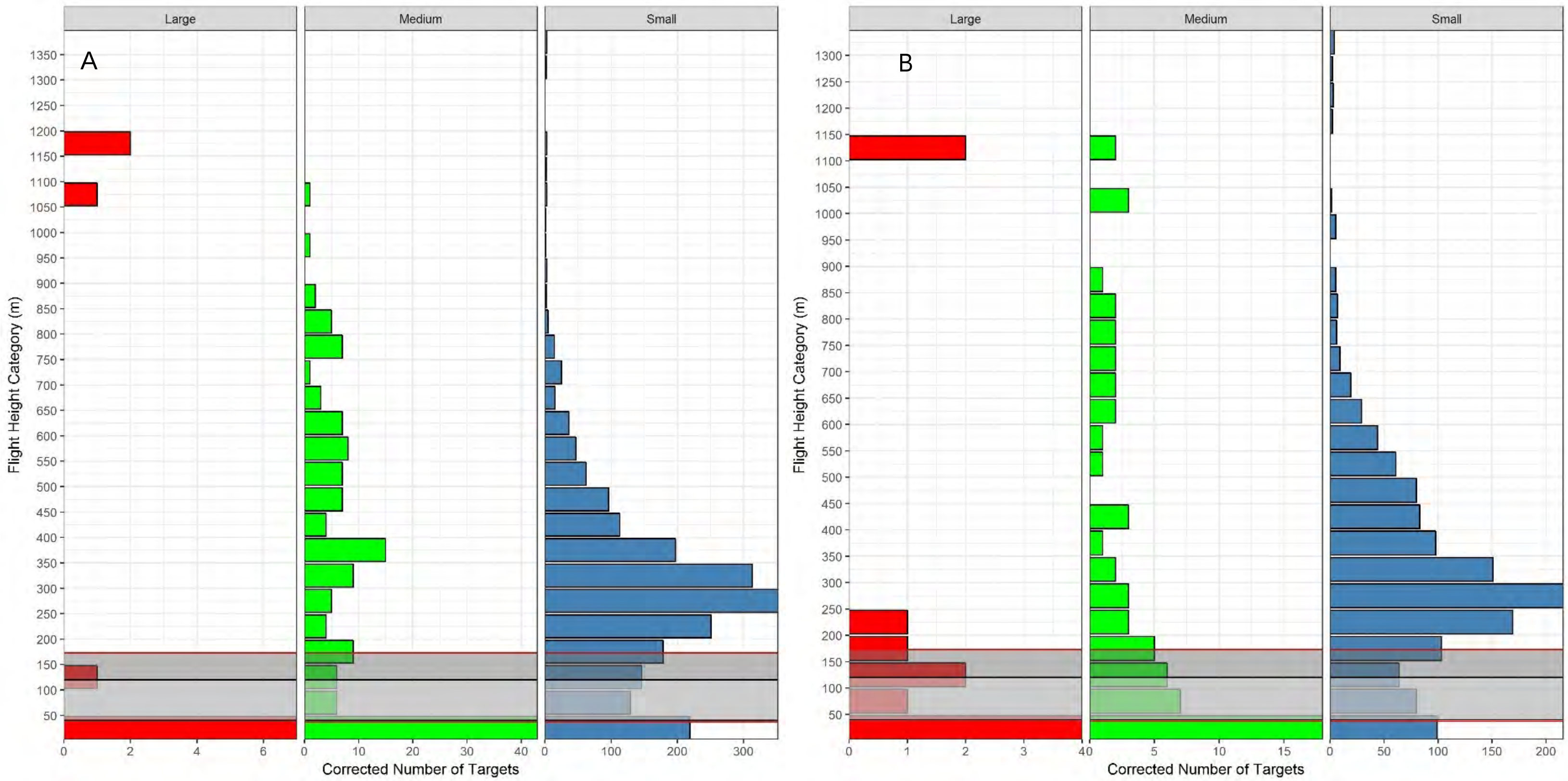


Figure H5-2 Flight Altitudes and Target Size Recorded at Radar Sites within the Project Area during Spring (A) and Fall (B) 2017. Light grey band represents 40-120 m RSA superimposed on 37-173 m RSA (dark grey).

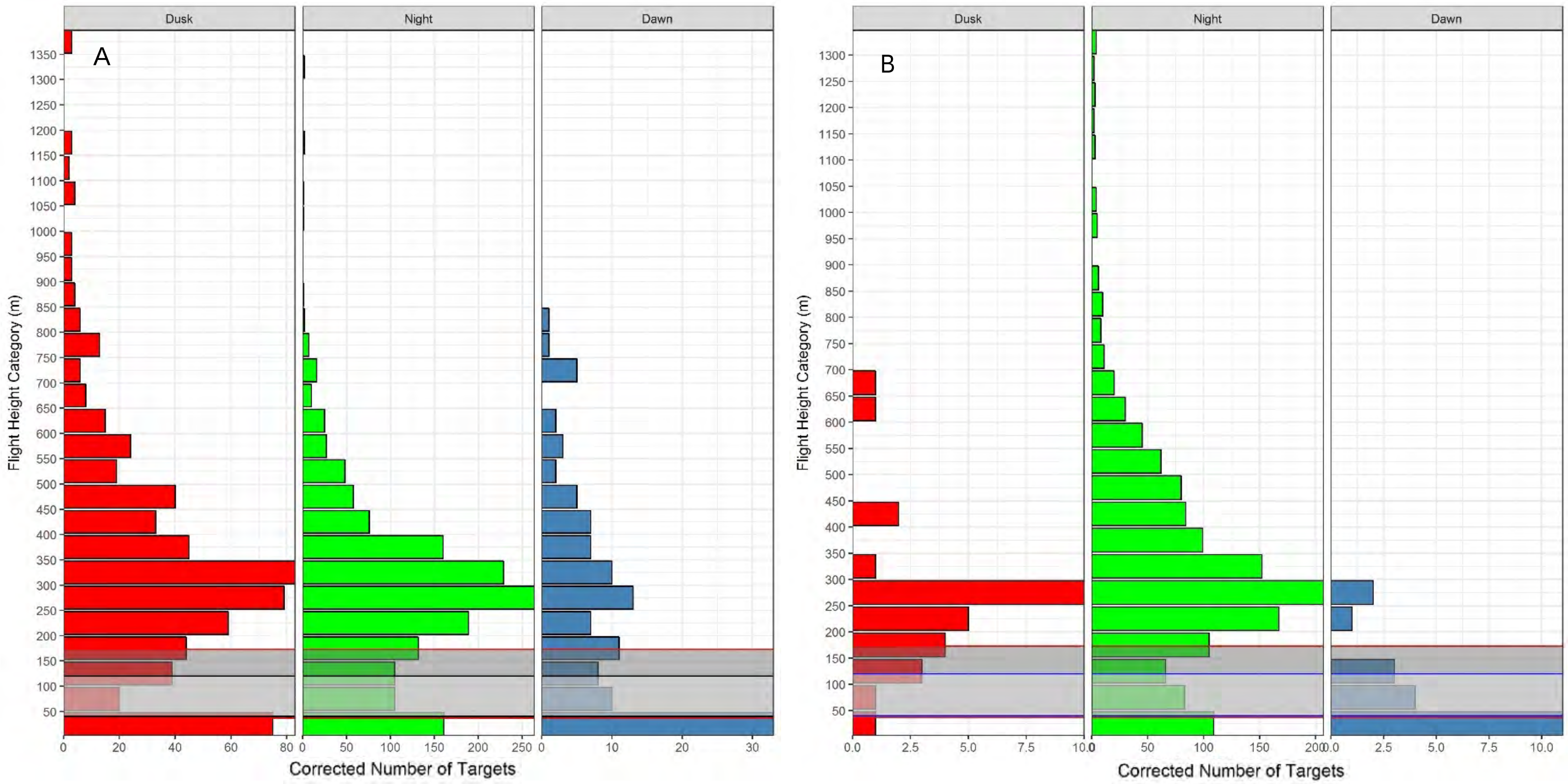


Figure H5-3 Flight Altitudes and Time of Night Recorded at Radar Sites within the Project Area during Spring (A) and Fall (B) 2017. Light grey band represents 40-120 m RSA superimposed on 37-173 m RSA (dark grey).

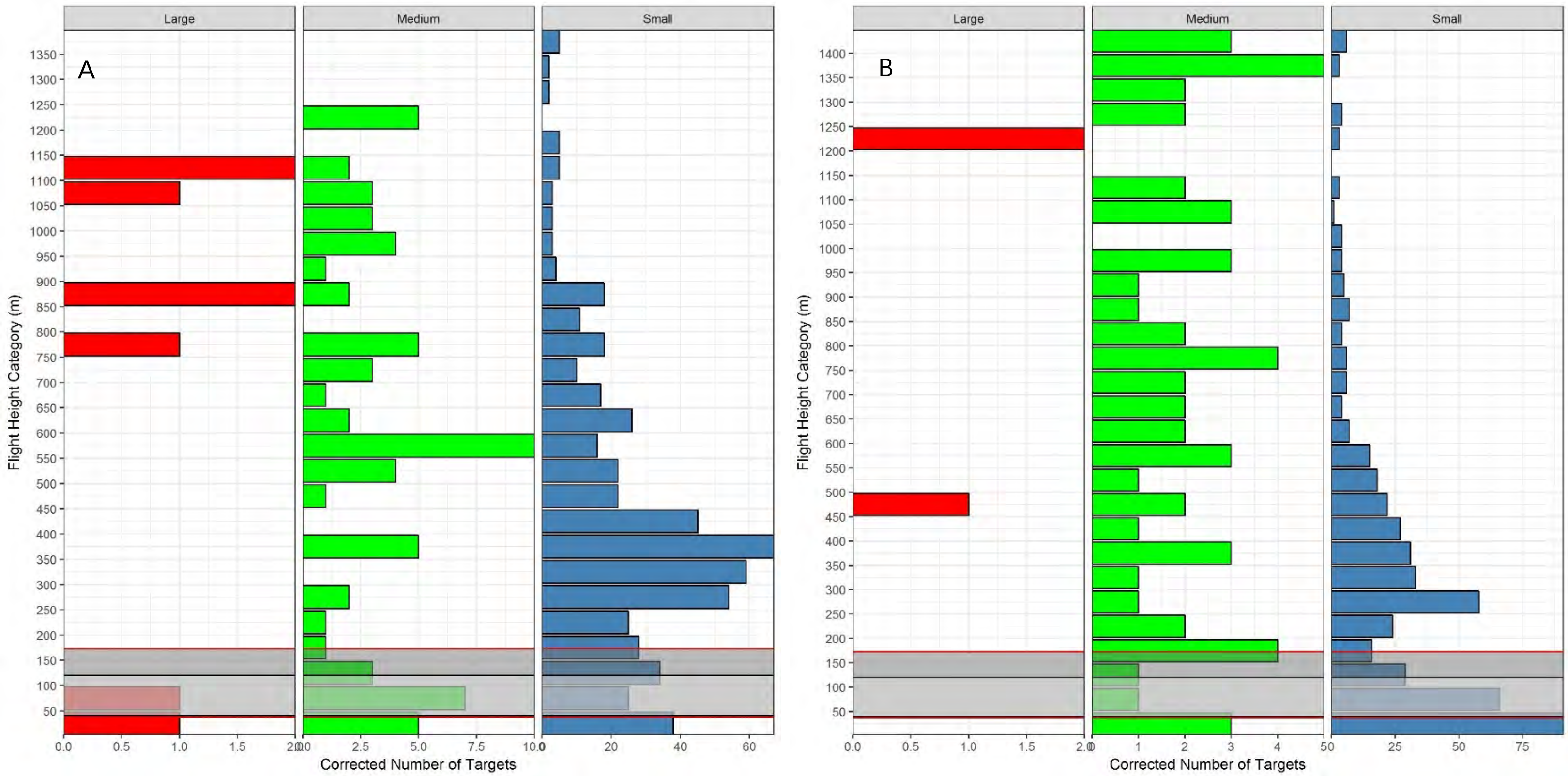


Figure H5-4 Flight Altitudes and Target Size Recorded at the Reed Lake Control Site during Spring (A) and Fall (B) 2017. Light grey band represents 40-120 m RSA superimposed on 37-173 m RSA (dark grey).

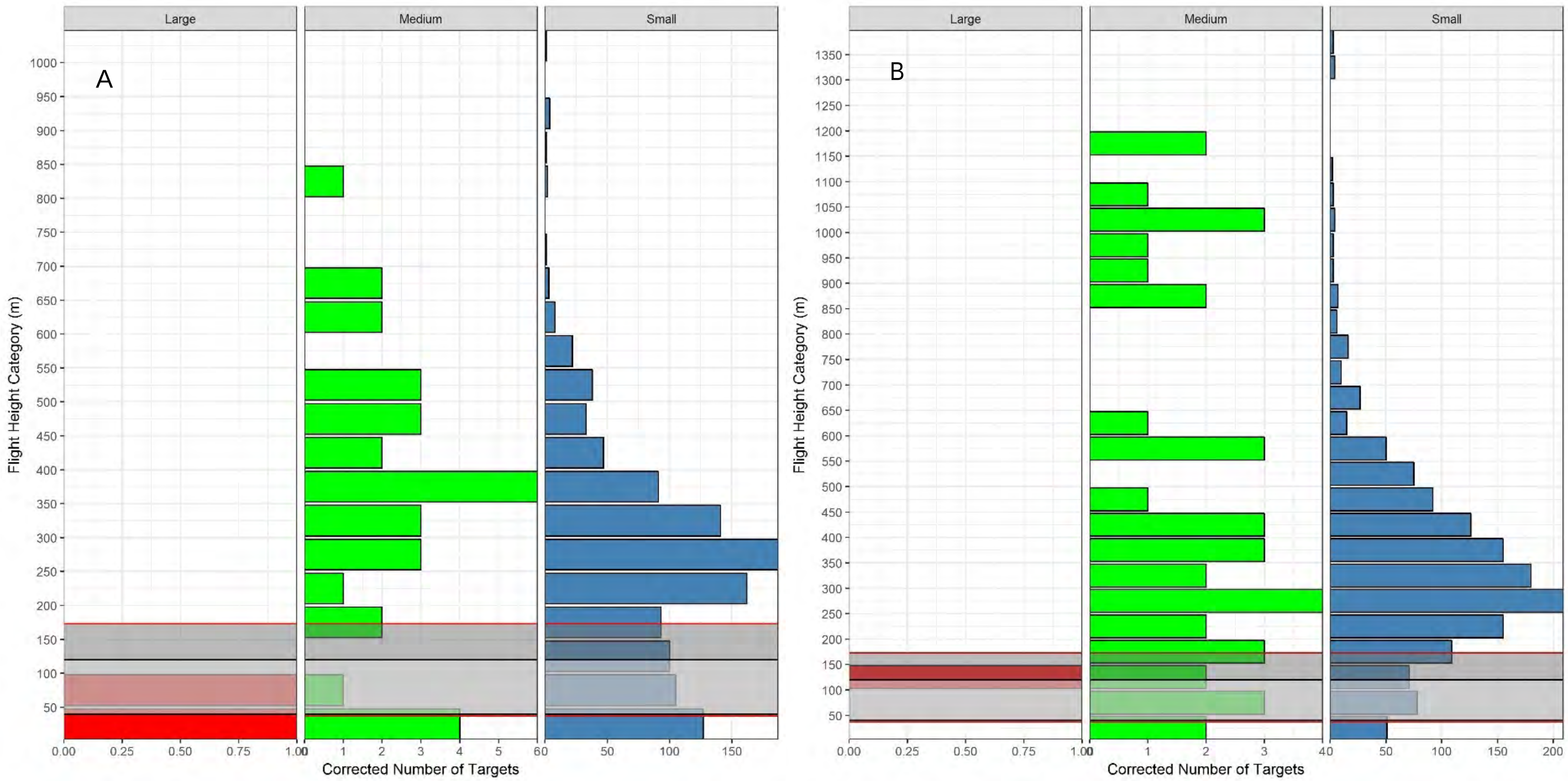


Figure H5-5 Flight Altitudes and Target Size Recorded at the Centennial Control Site during Spring (A) and Fall (B) 2017. Light grey band represents 40-120 m RSA superimposed on 37-173 m RSA (dark grey).

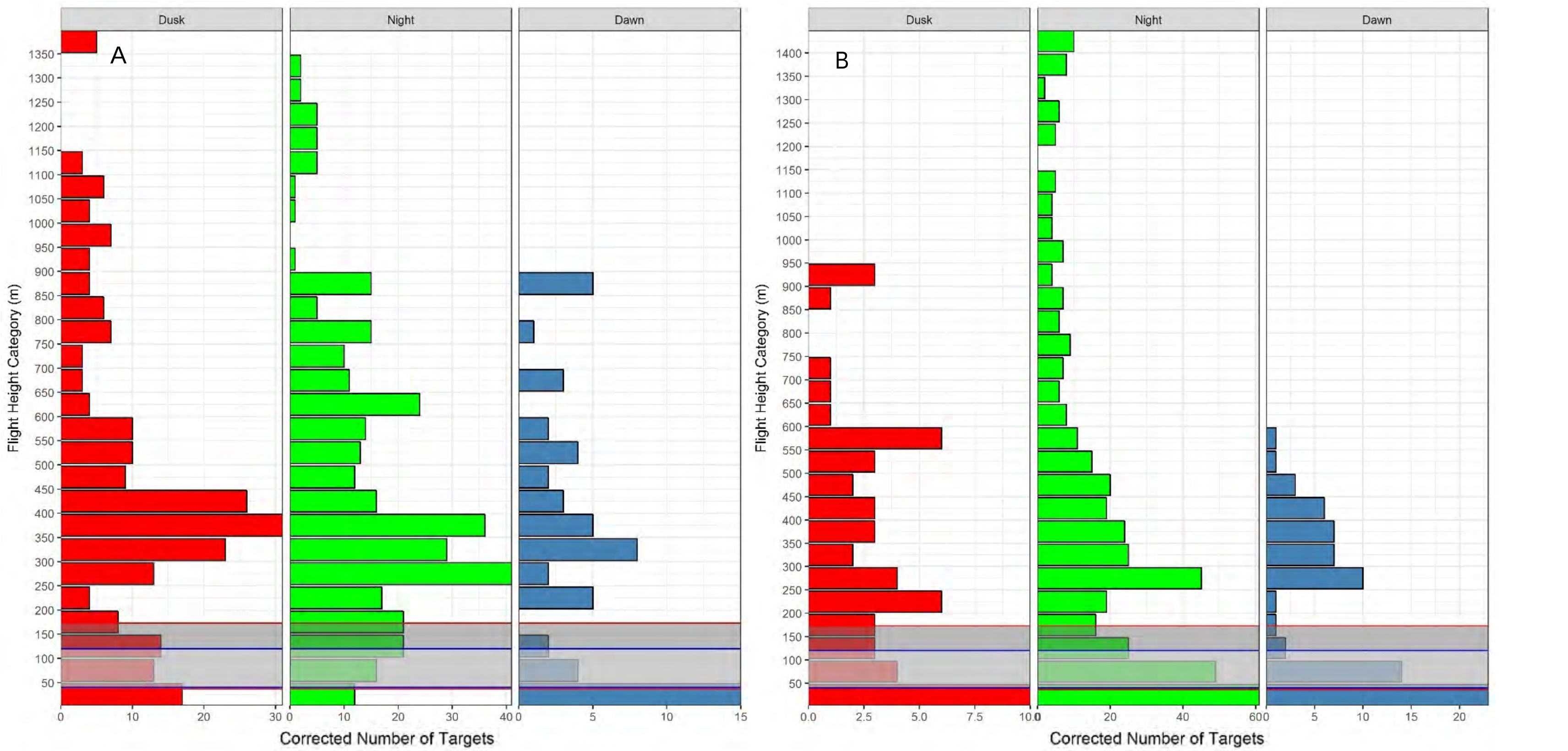


Figure H5-6 Flight Altitudes and Time of Night Recorded at the Reed Lake Control Site during Spring (A) and Fall (B) 2017. Light grey band represents 40-120 m RSA superimposed on 37-173 m RSA (dark grey).

Stantec

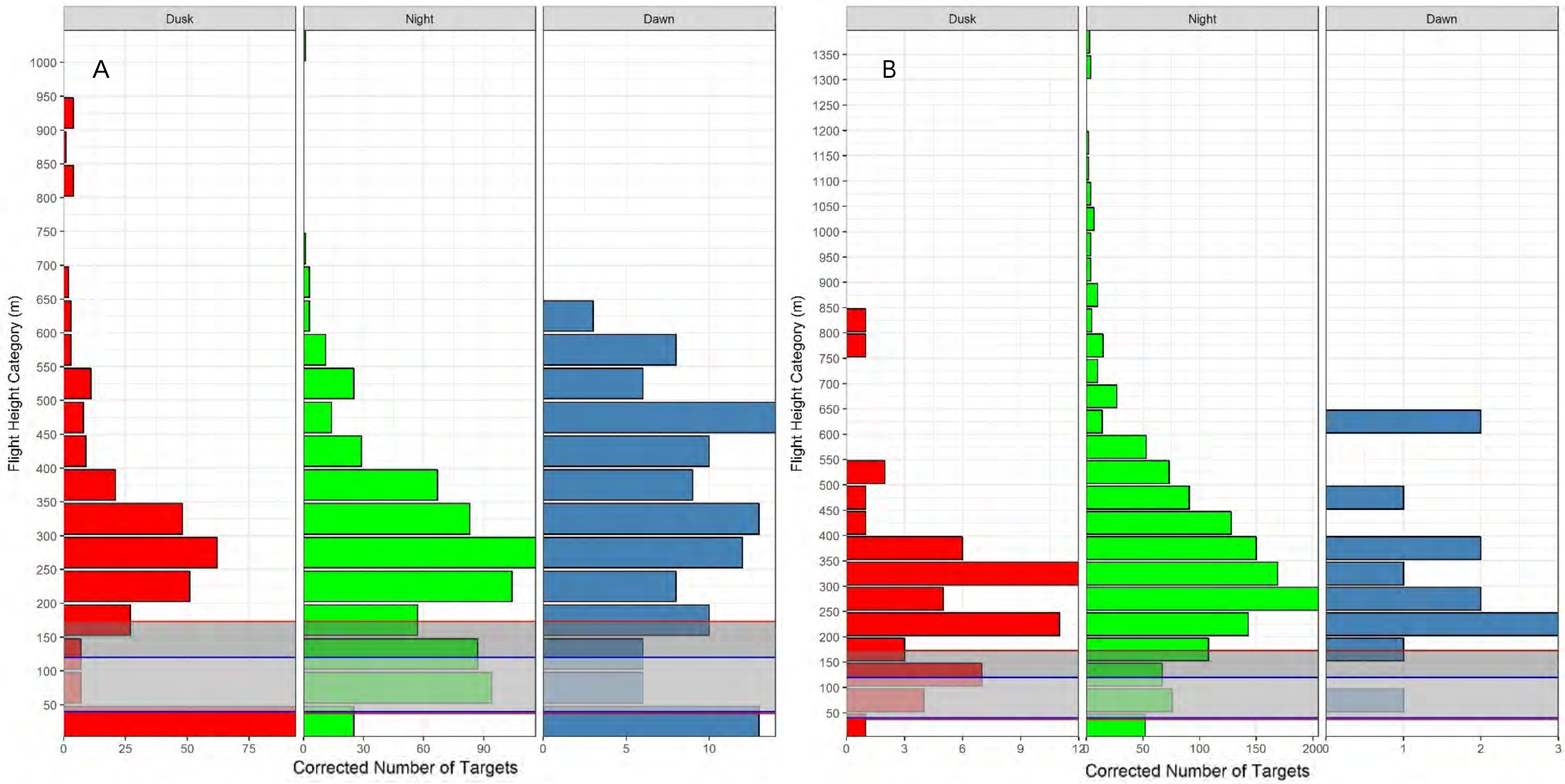


Figure H5-7 Flight Altitudes and Time of Night Recorded at the Centennial Control Site during Spring (A) and Fall (B) 2017. Light grey band represents 40-120 m RSA superimposed on 37-173 m RSA (dark grey).

3.2.3.3 Flight Direction (Horizontal Targets)

Direction of flight paths varied between seasons; within the Project area, the majority of spring flight paths for all target sizes were to the north and northwest, whereas flight paths recorded during the fall were multidirectional (Figure H5-8). Long distance flights (considered anything greater than 1.5 km radar range) were more common to the north and northwest in spring and to the west and southwest during fall (Figure H5-9).

At the Reed Lake control site, spring and fall flight paths were multidirectional for all target sizes; however, spring data had a stronger northward signal and fall data had a stronger signal to the south (Figure H5-10). Medium and large targets recorded at Reed Lake did not exhibit a strong directional pattern in either season. Long distance flights were more common during spring compared to fall (Figure H5-11). During spring, long distance flights were largely to the north and east, whereas during fall, long distance flights were multidirectional (Figure H5-11).

At the Centennial control site, spring flights were predominantly to the northwest and fall flights were predominantly to the southeast for all target sizes (Figure H5-12). Long distance flights were more common during spring compared to fall (Figure H5-13). During spring, long distance flights were largely to the north and northwest, whereas during fall, long distance flights were from the east, south or southeast (Figure H5-13).

3.2.4 Species of Management Concern

No SAR or SOMC were observed within the Project area during the nocturnal radar movement surveys. One SOMC (red-necked phalarope) was observed during target calibration outside the Project area (see Appendix A).

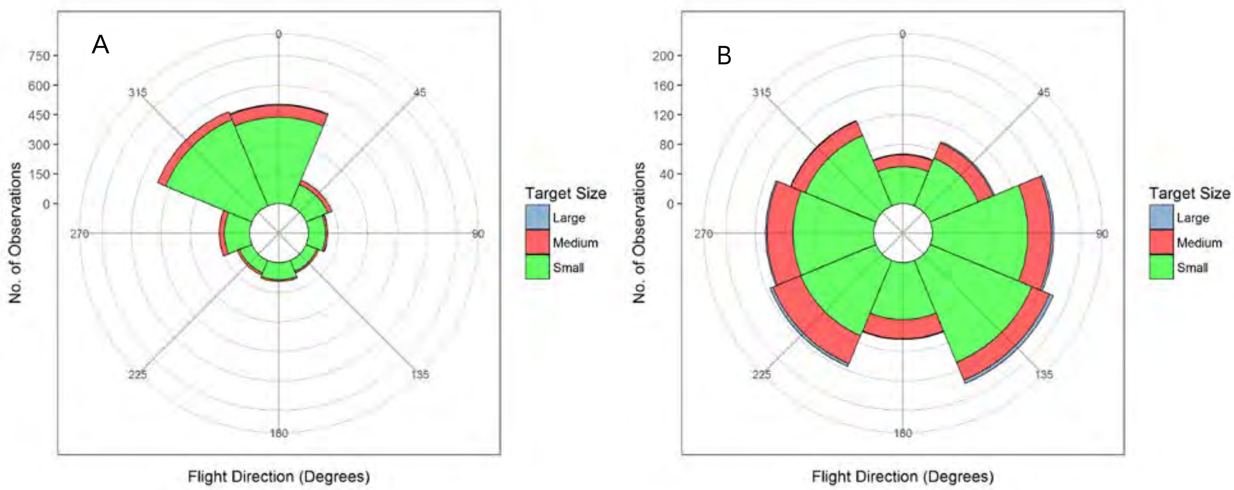


Figure H5-8 Flight Direction and Target Size Recorded within the Project Area during Spring (A) and Fall (B) 2017

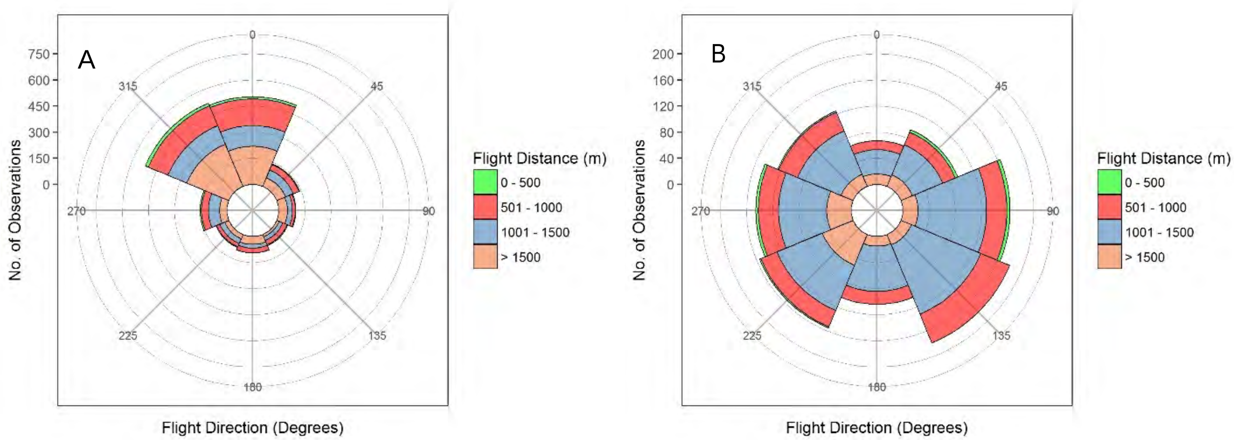


Figure H5-9 Flight Distance and Direction of Targets Recorded within the Project Area during Spring (A) and Fall (B) 2017

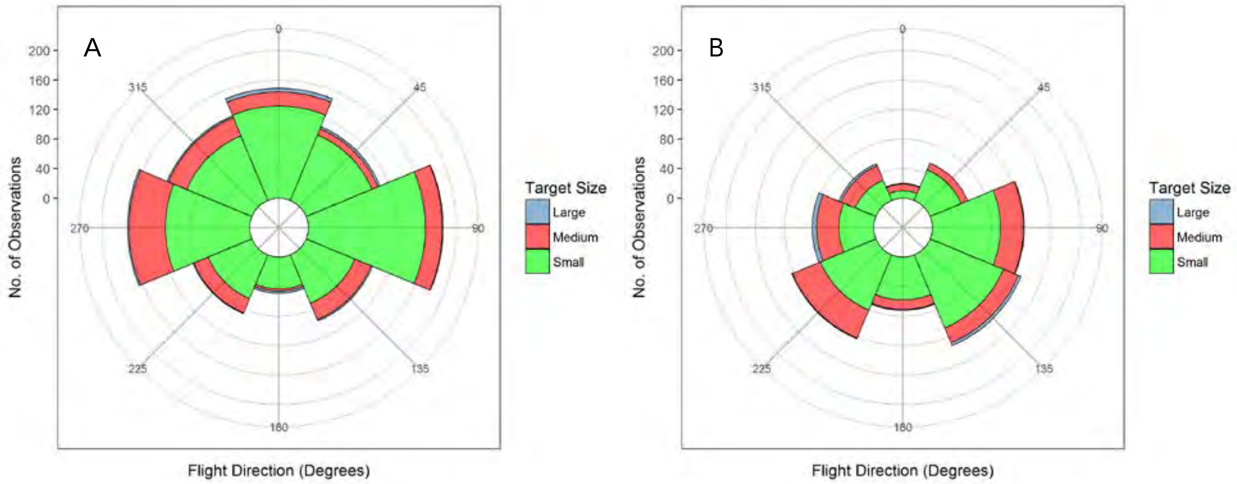


Figure H5-10 Flight Direction and Target Size Recorded at the Reed Lake Control Site during Spring (A) and Fall (B) 2017

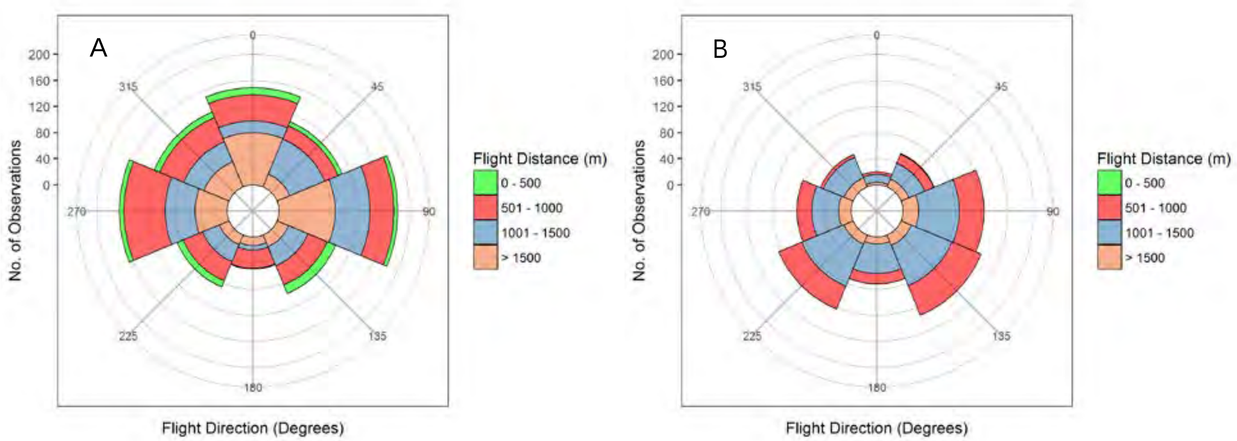


Figure H5-11 Flight Distance and Direction of Targets Recorded at the Reed Lake Control Site during Spring (A) and Fall (B) 2017

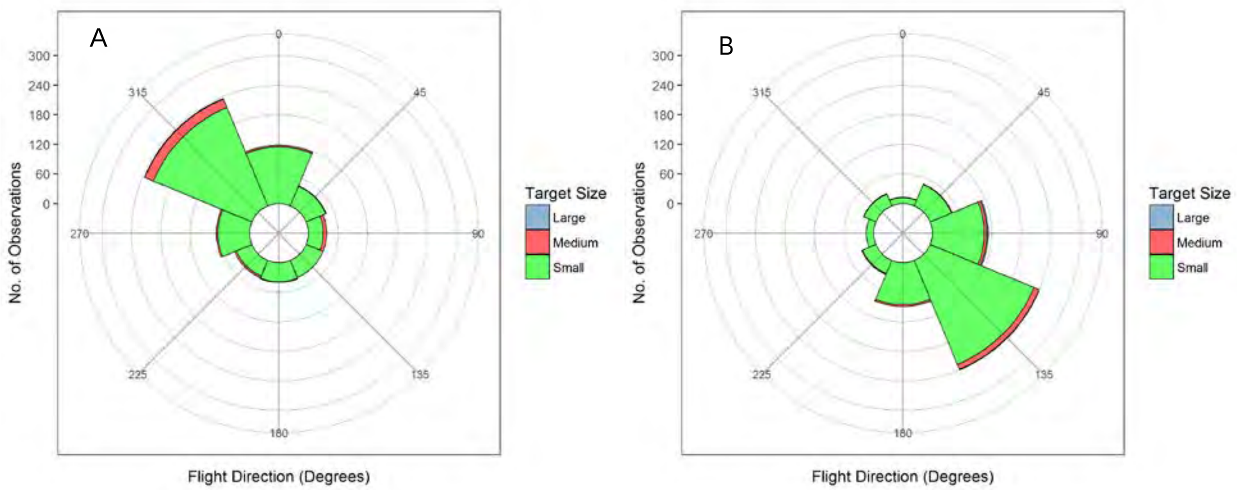


Figure H5-12 Flight Direction and Target Size Recorded at the Centennial Control Site during Spring (A) and Fall (B) 2017

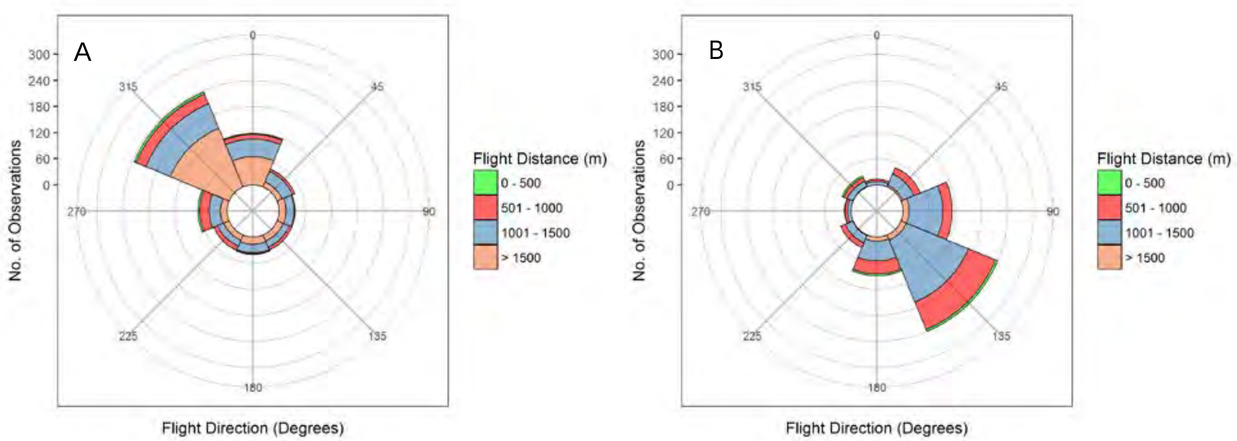


Figure H5-13 Flight Distance and Direction of Targets Recorded at the Centennial Control Site during Spring (A) and Fall (B) 2017

4.0 DISCUSSION

4.1 DIURNAL BIRD MOVEMENT SURVEYS

During the spring bird movement surveys, the number of birds passing through the sites within the Project area did not suggest there was a specific flight corridor across the landscape. Within the Project area, almost half (47.2%) of all birds observed were landbirds, while 26.8% were waterfowl, 13.8% shorebirds, 10.0% waterbirds, and 2.1% raptors. As expected, the control site near Reed Lake (Site 7) had a higher number of observations (5,642 individuals) than any site within the Project area, which averaged 349 individuals (ranged from 129 to 778 individuals). This was comparable to the control site near Centennial Wind Project (Site 8), which recorded 376 individuals.

During the fall bird movement surveys, there were several large flocks of snow geese (e.g., a single flock with more than 10,000 individuals) recorded. The large number of snow geese inflated the overall activity at certain sites (e.g., Sites 4 and 5) and created the appearance of major flight corridors in the Project area. When the snow goose observations are removed, sites within the Project area averaged 2,208 individuals compared to 14,311 individuals when snow goose observations were included. Even accounting for the fourth survey visit (i.e., an extra survey visit in the fall) and removing the snow goose observations, there appears to have been more activity in the Project area in the fall than during the spring (12,167 and 2,096 individuals, respectively). Sites 1 and 6 had the lowest number of observations in the fall (659 and 357 individuals, respectively) suggesting that the southeast portion of the Project area may be an area of low bird movement.

During the spring bird movement surveys, two SAR were recorded in the Project area (ferruginous hawk and Sprague's pipit), and one SOMC (red-necked phalarope). No SAR or SOMC were recorded within the Project area during the fall bird movement surveys.

4.2 NOCTURNAL RADAR MOVEMENT SURVEYS

Although data collected during the nocturnal radar survey represents a snapshot of total avian activity during a much broader migratory period, the large number of targets recorded (over 13,000) provides sufficient data from which baseline avian movement patterns can begin to be understood in and around the Project area. Calibration data along with target size, direction, distance, and height suggest that much of the nocturnal activity recorded is that of waterfowl, shorebirds and gulls; however, it is likely that some activity is associated with other avian species (e.g., passerines) and other nocturnal fliers (e.g., bats).

The spatial distribution of radar data suggests there isn't a portion of the Project area (east, center or middle) that has a notably higher activity level during spring and fall. Furthermore, the data suggest that nocturnal flight activity is greater in the control areas west and northeast of the Project area compared to within the Project area. The majority of flights recorded both in and outside of the Project Area were above the RSAs for proposed turbines during both seasons. It is likely that the number of birds flying above the RSA is underrepresented in the data as radar sensitivity, particularly for small targets, is skewed towards the radar unit (i.e., closer to ground level) (d'Entremont et al. 2017). It is also possible that waterbirds may be travelling above the 1.5 km detection altitude for the radar as observed elsewhere (e.g., Richardson 1979).

Within the Project area, more targets were recorded during spring compared to fall, and flight altitudes overlapped the RSA more often in the spring than during fall. This may be a reflection of seasonal differences, such as species composition and weather effects (Richardson 2000). Large targets were also uncommon at sites within the Project area, indicating that birds travelled above the Project area as individuals or in small groups.

Unexpectedly, the number of targets recorded at the Reed Lake site was lower than that recorded at the Centennial site west of the Project area, though it is unclear whether activity at the Centennial site is that of migrants or local birds. The overall pattern of long distance north-south flight paths suggests that many flights at the Centennial site were migratory, particularly during spring. The majority of these observations were small targets, which suggests these were individual birds rather than large, cohesive, flocks. A higher number of medium and large-sized targets recorded at Reed Lake indicates large cohesive flocks are more common at this site.

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Appendix A TARGET CALIBRATION OBSERVATIONS

Table A-1 Species Groupings for Avian Guilds Observed during 2017 Spring and Fall Radar Target Calibration

Guild (size)	Representative Species
Shorebird (small)	Semipalmated sandpiper (*Calidris pusilla*), red-neck phalarope (*Phalaropus lobatus*), Wilson's phalarope (*Phalaropus tricolor*), killdeer (*Charadrius vociferus*), unknown phalarope, unknown shorebird
Shorebird (medium)	American avocet (*Recurvirostra americana*), marbled godwit (*Limosa fedoa*), willet (*Tringa semipalmata*), greater yellowlegs (*Tringa melanoleuca*), unknown yellowlegs
Wading bird (medium))	White-faced ibis (*Plegadis chihi*), black-crowned night heron (*Nycticorax nycticorax*)
Wading bird (large)	Great blue heron (*Ardea herodias*)
Waterfowl (small)	Green-winged teal (*Anas crecca*), blue-winged teal (*Spatula discors*), bufflehead (*Bucephala albeola*)
Waterfowl (medium)	Gadwall (*Mareca strepera*), American wigeon (*Mareca americana*), northern pintail (*Anas acuta*), mallard (*Anas platyrhynchos*), northern shoveler (*Spatula clypeata*), lesser scaup (*Aythya affinis*), unknown duck
Waterfowl (large)	Canada goose (*Branta canadensis*)
Waterbird (small)	American coot (*Fulica americana*)
Waterbird (large)	Double-crested cormorant (*Phalacrocorax auritus*), American white pelican (*Pelecanus erythrorhynchos*)
Gull (medium)	Franklin's gull (*Leucophaeus pipixcan*), Bonaparte's gull (*Chroicocephalus philadelphia*), California gull (*Larus californicus*), unknown gull
Tern (medium)	Common tern (*Sterna hirundo*), black tern (*Chlidonias niger*), unknown medium tern
Tern (large)	Caspian tern (*Hydroprogne caspia*)
Raptor (large)	Northern harrier (*Circus hudsonius*)
Passerine (small)	Red-winged blackbird (*Agelaius phoeniceus*), unknown blackbird, unknown swallow
Passerine (medium)	Black-billed magpie (*Pica hudsonia*)

Table A-2 Species-Specific Target Calibration Data Spring 2017

Species[1]	Scientific Name	Target Size	Average Count	Minimum Count	Maximum Count	Total Count	Total Targets
Canada goose	*Branta canadensis*	Small	2	1	4	12	6
		Medium	4	1	6	39	9
		Large	9	2	20	47	5
						98	**20**
Blue-winged teal	*Spatula discors*	Small	2	1	4	12	6
		Medium	2	2	3	13	6
		Large	11	6	15	21	2
						46	**14**
Northern shoveler	*Spatula clypeata*	Small	1	1	2	8	7
		Medium	2	1	4	6	3
						14	**10**
Gadwall	*Mareca strepera*	Small	1	1	1	8	8
		Medium	4	1	15	51	14
						59	**22**
American wigeon	*Mareca americana*	Small	3	3	3	3	1
						3	**1**
Mallard	*Anas platyrhynchos*	Small	2	1	3	23	15
		Medium	2	1	7	17	8
						40	**23**
Northern pintail	*Anas acuta*	Small	1	1	2	7	6
						7	**6**

Table A-2 Species-Specific Target Calibration Data Spring 2017

Species[1]	Scientific Name	Target Size	Average Count	Minimum Count	Maximum Count	Total Count	Total Targets
Green-winged teal	*Anas crecca*	Medium	3	3	3	3	1
						3	**1**
Lesser scaup	*Aythya affinis*	Small	3	2	3	5	2
		Large	10	8	12	30	3
						35	**5**
Bufflehead	*Bucephala albeola*	Small	2	2	2	2	1
		Medium	1	1	1	3	3
						5	**4**
Unknown duck	n/a	Small	2	1	8	42	22
		Medium	7	1	18	65	10
		Large	16	9	22	79	5
						186	**37**
American avocet	*Recurvirostra americana*	Small	2	1	3	7	4
						7	**4**
Killdeer	*Charadrius vociferus*	Small	1	1	1	6	6
						6	**6**
Semipalmated sandpiper	*Calidris pusilla*	Medium	13	10	15	25	2
						25	**2**
Marbled godwit	*Limosa fedoa*	Small	1	1	2	8	6
						8	**6**
Willet	*Catoptrophorus semipalmatus*	Small	1	1	3	4	3
						4	**3**

Table A-2 Species-Specific Target Calibration Data Spring 2017

Species[1]	Scientific Name	Target Size	Average Count	Minimum Count	Maximum Count	Total Count	Total Targets
Wilson's phalarope	*Phalaropus tricolor*	Small	4	1	7	8	2
		Large	33	10	55	65	2
						73	**4**
Red-necked phalarope	***Phalaropus lobatus***	Large	60	60	60	60	1
						60	**1**
Unknown shorebird	n/a	Small	26	3	40	51	5
		Medium	17	13	22	50	3
		Large	108	80	160	430	4
		Very large	180	180	180	180	1
						711	**13**
Bonaparte's gull	*Chroicocephalus philadelphia*	Small	1	1	1	5	5
		Medium	1	1	1	8	8
						13	**13**
Franklin's gull	*Leucophaeus pipixcan*	Small	1	1	3	29	20
		Medium	5	4	6	23	5
		Large	28	28	28	28	1
						80	**26**
Ring-billed gull	*Larus delawarensis*	Small	1	1	3	112	107
		Medium	3	1	16	30	12
		Large	14	9	18	27	2
						169	**121**

Table A-2 Species-Specific Target Calibration Data Spring 2017

Species[1]	Scientific Name	Target Size	Average Count	Minimum Count	Maximum Count	Total Count	Total Targets
California gull	*Larus californicus*	Small	1	1	1	7	7
						7	**7**
Unknown gull	n/a	Small	3	1	6	74	28
		Medium	6	1	12	64	11
		Large	9	9	9	9	1
						147	**40**
Black tern	*Chlidonias niger*	Small	1	1	1	1	1
						1	**1**
Common tern	*Sterna hirundo*	Small	1	1	1	9	9
						9	**9**
Double-crested cormorant	*Phalacrocorax auritus*	Small	1	1	1	8	8
		Medium	2	1	6	13	6
						21	**14**
American white pelican	*Pelecanus erythrorhynchos*	Large	4	4	4	4	1
						4	**1**
Great blue heron	*Ardea herodias*	Medium	1	1	1	1	1
						1	**1**
Black-crowned night heron	*Nycticorax nycticorax*	Small	3	3	3	3	1
						3	**1**
White-faced ibis	***Plegadis chihi***	Medium	2	1	4	11	5
						11	**5**

Table A-2 Species-Specific Target Calibration Data Spring 2017

Species[1]	Scientific Name	Target Size	Average Count	Minimum Count	Maximum Count	Total Count	Total Targets
Black-billed magpie	*Pica hudsonia*	Small	1	1	1	1	1
						1	**1**
Unknown swallow	n/a	Small	1	1	2	**8**	**7**
						8	**7**
Red-winged blackbird	*Agelaius phoeniceus*	Small	12	16	16	16	1
						16	**1**
Unknown blackbird	n/a	Small	3	3	3	3	1
		Medium	6	5	6	11	2
		Large	55	55	55	55	1
						69	**4**
Total						**1,950**	**434**

NOTE:
[1] Bold indicates a SOMC

Table A-3 Species-Specific Target Calibration Data Fall 2017

Species[1]	Scientific Name	Target Size	Average Count	Minimum Count	Maximum Count	Total Count	Total Targets
Canada goose	*Branta canadensis*	Medium	4	3	6	12	3
		Large	14	4	26	99	7
						111	**10**
Blue-winged teal	*Spatula discors*	Small	2	2	2	2	1
						2	**1**
Northern shoveler	*Spatula clypeata*	Medium	10	10	10	10	1
						10	**1**
Gadwall	*Mareca strepera*	Small	4	2	5	7	2
						7	**2**
American wigeon	*Mareca americana*	Medium	5	5	5	5	1
						5	**1**
Mallard	*Anas platyrhynchos*	Small	2	1	3	5	3
		Medium	13	13	13	13	1
						18	**4**
Unknown duck	n/a	Small	4	1	21	115	31
		Medium	7	2	12	135	20
		Large	17	8	40	204	12
						454	**63**
American coot	*Fulica americana*	Small	1	1	1	2	2
						2	**2**
Greater yellowlegs	*Tringa melanoleuca*	Small	5	3	6	9	2
						9	**2**

Table A-3 Species-Specific Target Calibration Data Fall 2017

Species[1]	Scientific Name	Target Size	Average Count	Minimum Count	Maximum Count	Total Count	Total Targets
Unknown yellowlegs	n/a	Small	1	1	1	1	1
		Medium	15	15	15	15	1
						16	**2**
Unknown phalarope	n/a	Small	13	13	13	13	1
		Medium	19	19	19	19	1
						32	**2**
Unknown shorebird	n/a	Small	11	5	20	44	4
						44	**4**
Franklin's gull	*Leucophaeus pipixcan*	Small	1	1	4	34	31
		Medium	4	4	4	4	1
						38	**32**
Ring-billed gull	*Larus delawarensis*	Medium	8	6	10	25	10
						25	**10**
Unknown gull	n/a	Small	1	1	1	3	3
						3	**3**
Caspian tern	***Hydroprogne caspia***	Small	1	1	1	1	1
						1	**1**
Common tern	*Sterna hirundo*	Small	1	1	1	3	3
						3	**3**
Unknown tern	n/a	Medium	15	15	15	15	1
						15	**1**

Table A-3 Species-Specific Target Calibration Data Fall 2017

Species[1]	Scientific Name	Target Size	Average Count	Minimum Count	Maximum Count	Total Count	Total Targets
Double-crested cormorant	*Phalacrocorax auritus*	Small	1	1	1	3	3
						3	**3**
Northern harrier	*Circus hudsonius*	Small	1	1	1	1	1
						1	**1**
Total						**799**	**148**

NOTE:
[1] Bold indicates a SOMC

H.6 BAT ACTIVITY TECHNICAL REPORT

H.6.2

Blue Hill Wind Energy Project
2017 Pre-Construction
Bat Monitoring Report

Prepared for:
Algonquin Power Co.

Prepared by:
Stantec Consulting Ltd.

December 2017

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Abbreviations

ABAT	Alberta Bat Action Team
CF	Compact Flash
COSEWIC	Committee on the Status of Endangered Wildlife in Canada
ECCC	Environment and Climate Change Canada
ESRD	Alberta Environment and Sustainable Resource Development
GOA	Government of Alberta
LLD	Legal Land Description
km	Kilometres
km/h	Kilometres per hour
m	Metres
ms	Millisecond
m/s	Metres per second
MET	Meteorological
PVC	Polyvinyl chloride
SKMOE	Saskatchewan Ministry of Environment
SARA	*Species at Risk Act*
SK	Saskatchewan
Stantec	Stantec Consulting Ltd.
UTM	Universal Transverse Mercator

1.0 INTRODUCTION

Algonquin Power is proposing to develop the Blue Hill Wind Energy Project (the Project). The Project will consist of 49 to 56 WTGs, each with a capacity between 3.2 and 3.7 MW, for a total capacity of 177 MW. Each WTG consists of the following components: tower, nacelle, hub, rotor blades, controller and transformer. The height of each WTG tower will be between 80 to 105 m from the foundation to the hub depending on final equipment selection. Each WTG consists of three blades (each approximately 40 to 68 m long) with a rotor diameter of approximately 80 to 136 m. The Project is located approximately 10 km south of the town of Herbert, Saskatchewan (SK) (Figure H6-1). Reed Lake is located approximately 8 km northeast of the Project (Figure H6-1). The proposed Project footprint is 158.2 ha in total located on 62 quarter sections of private land consisting predominately of cultivated lands and agricultural lands (i.e., hayland and tame pasture), with some native prairie (Figure H6-1).

Bat fatalities at wind energy facilities have become an increasing concern, particularly for migratory bats (Arnett et al. 2008, Arnett and Baerwald 2013, ESRD 2013, Bird Studies Canada [BSC] et al. 2017, Zimmerling and Francis 2016, AWWI 2017). Though information is available on direct impacts to bats, population sizes for migratory bats are unknown and therefore there is uncertainty regarding whether current or future collision fatality levels represent a significant threat to overall migratory bat population levels (AWWI 2017).

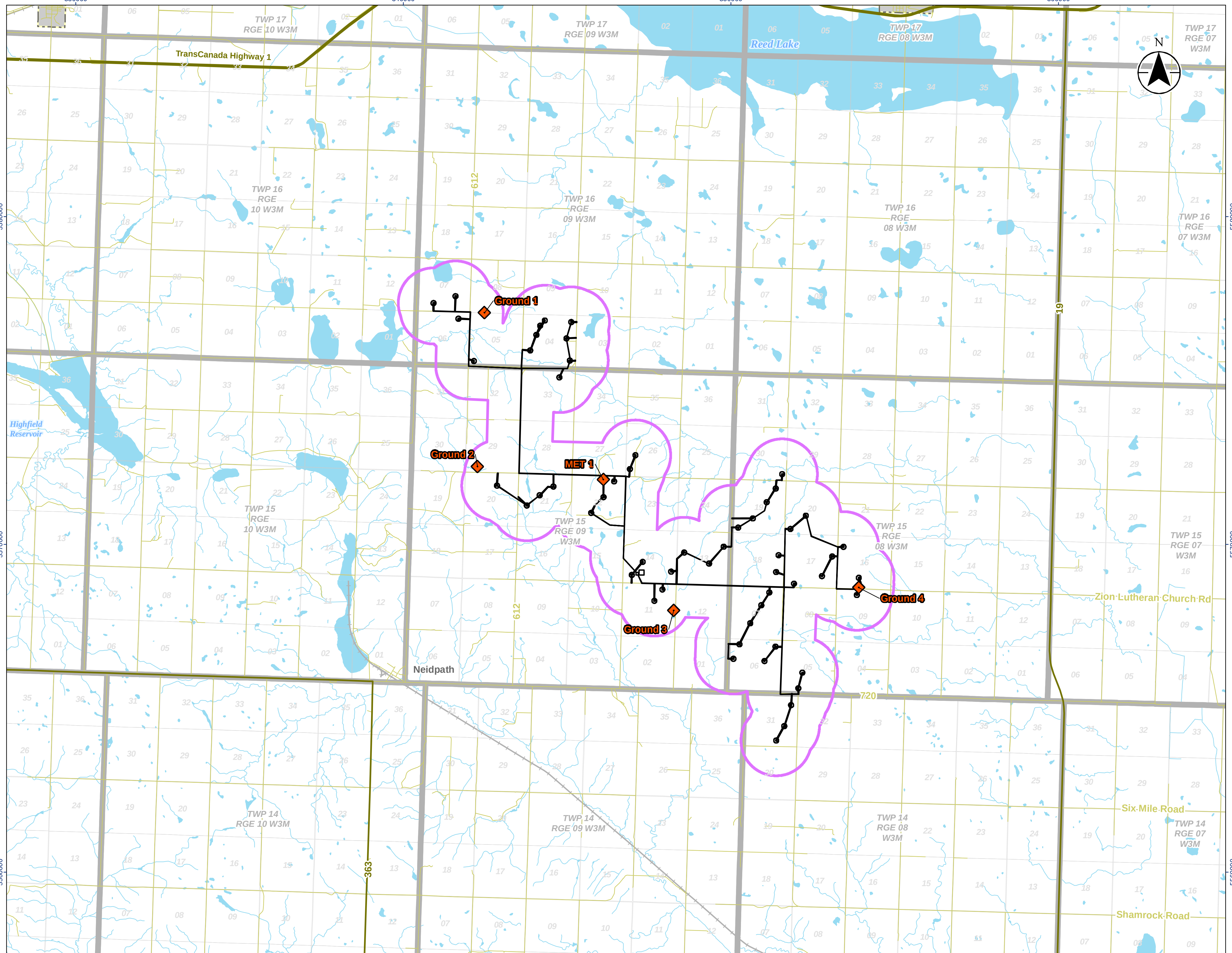
To identify the baseline level of migratory and total (migratory and non-migratory) bats in the Project area, Stantec Consulting Ltd. (Stantec) conducted acoustic bat activity surveys in 2017. This report summarizes the results of the spring and fall 2017 bat acoustic surveys, and will contribute to the assessment of potential mortality risk to bats in the Project area.

1.1 REGULATORY CONTEXT

Bats are protected under the *Wildlife Act* of Saskatchewan (SKMOE 1998), and under the federal *Species at Risk Act* for those bat species listed as *endangered* in Canada (Environment and Climate Change Canada [ECCC] 2017). As no Saskatchewan guidelines on thresholds for pre-construction bat activity rates pertaining to wind developments exist, Alberta guidelines were used as context for the potential magnitude of effects. The Saskatchewan Ministry of Environment (SKMOE) regularly directs proponents to Alberta Environment and Parks (AEP) guidance and survey protocols where none have been published in Saskatchewan, and previous experience with the SKMOE pertaining to assessment of effects to bats from wind developments in Saskatchewan confirms their reliance on the AEP guidance.

The *Wildlife Directive for Alberta Wind Energy Projects* (Government of Alberta [GOA] 2017) states that bat acoustic surveys must be conducted during the spring (May 1 to May 31) and fall (July 15 to October 15) bat migration periods (GOA 2017). Within the Directive, proponents are required to analyse their data and bat mortality esimates in comparison to The *Bat Mitigation Framework for Wind Power Development* (Alberta Environment and Sustainable Resource Development [ESRD] 2013; the "Framework"). The Framework establishes guidelines for interpreting pre-construction acoustic bat monitoring data for potential mitigation. This guidance document indicates potential fatality rates and acceptable activity levels based on bat passes per elevated (> 30 m height) detector night during the period identified in Lausen et al. (2010) for use in evaluating sites and applying mitigation. The thresholds of bat activity identified in ESRD (2013) are:

- Less than 1 migratory bat pass per detector night as potentially acceptable.
- 1 to 2 migratory bat passes per detector night as potentially requiring mitigation such as alternative siting locations and reduced turbine height or rotor length.
- Greater than 2 migratory bat passes per detector as likely requiring mitigation such as alternative turbine locations and changing cut-in speeds to reduce bat fatality.



- Bat Acoustic Monitoring Site
- Project Development Area
- Wildlife Local Assessment Area
- Major Road
- Minor Road
- Railway
- Town/City
- Township
- Section

0 1 2 3 4 Kilometers

1:120,000 (At original document size of 11x17)

Notes

1. Coordinate System: NAD 1983 UTM Zone 13N
2. Base features produced under license with the Government of Saskatchewan and the Government of Canada
3. Layout: Algonquin, Sept 06, 2017, V3

Project Location
Near Herbert, SK

113254088-042 REVD
Prepared by acory on 2017-12-18
Technical Review by kgibson on 2017-12-18

Client/Project
Algonquin Power Co.
Blue Hill Wind Energy Project

Figure No.
H6-1

Title
2017 Bat Acoustic Monitoring Site Locations for the Blue Hill Wind Energy Project

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2.0 METHODS

The bat activity studies for the Project followed methods provided in the *Wildlife Directive for Alberta Wind Energy Projects* (GOA 2017), the *Bat Mitigation Framework for Wind Energy Development* (ESRD 2013), and Lausen et al. (2010). The *Wildlife Directive for Alberta Wind Energy Projects* requires one year of spring and fall bat surveys. Therefore, acoustic surveys were conducted during the spring monitoring period (May) and fall monitoring period (July 15 to October 15) to determine whether activity rates vary by season, as higher levels of bat activity are expected in the fall than in the spring. Within the Directive (GOA 2017), proponents are required to report on data and bat mortality estimates in comparison to the Framework (ESRD 2013), which states a fall monitoring period of August 1 to September 10. For this report, data was analysed for both the full fall monitoring period and the period stated in the Framework.

This document provides methods for acoustic bat surveys for consistent sampling, including survey periods, survey timing, and detector placement based on project scale and landscape.

2.1 EQUIPMENT

A total of six AnaBat SD1 CF Bat Detectors (Titley Electronics) were installed at five sites within the Project area. All detectors were powered by two HAZE or PowerKing (12 Volt 18 Ah) sealed lead acid batteries connected in parallel. To prevent exposure to the elements, each detector was housed in an 8x8x4 cm PVC junction box enclosure, with an accompanying microphone pointing out of the junction box enclosure through a PVC elbow. To optimize data collection quantity, division ratios were set to 8. Sensitivity was adjusted to the highest level, which did not produce ambient static during set up (below the squelch zone). Data were recorded and stored on compact flash (CF) cards. The acoustic data is based on detectors operating one half hour after sunset to one half hour before sunrise (ESRD 2013). Therefore, the detectors were adjusted during each maintenance visit to account for the change in sunset and sunrise periods, and were programed to start data collection before and after the targeted time period in order that bat passes were recorded. Data collection started before and ended after the target monitoring periods (i.e., May 1 to May 31, and July 15 to October 15) such that activity rates throughout both periods were collected.

The bat call data were downloaded from the CF cards using CFC read storage ZCAIM interface (version 4.4.21u). The data collected were transcribed using the latest available software (AnalookW Version 4.2n).

2.2 MONITORING SITES

Two detectors were installed on the Project's meteorological (MET) tower ; one at a low elevation (2 m; MET 1 Low detector) and one at a high elevation (approximately 43 m; MET 1 High detector) as listed in Table 2-1 and shown on Figure H6-1. The elevated detector was installed with a pulley system developed by Stantec; heights were verified using a range finder. The power cable connecting elevated detectors to the battery source was secured to rope using zip ties and attached at the tower's base near the weather-proof battery container. The elevated detector was installed to provide information on bat activity within the turbine rotor-swept altitude, as ground (i.e., Low) detectors only reliably collect data on bats travelling from ground level up to approximately 30 m height (Titley Scientific 2015).

Ground level detectors (Ground 1, 2, 3 and 4) were installed at four additional ground sites (see Figure H6-1 and Table 2-1) to better understand the spatial distribution of bat activity in the Project area. To maintain consistency in data collection and allow data comparison, the four ground detectors were installed using the same parameters (i.e., height, orientation and detector settings) as the MET 1 Low detector. The ground sites were sited throughout the Project area to provide coverage of the Project area in locations similar to where turbines might be constructed (see Figure H6-1). All detectors were placed in the same locations during the spring and fall survey periods.

Based on data from the Swift Current airport, prevailing winds in the region originate from the northwest (Aviador 2017). In the spring, bats are expected to migrate from the south, and in the fall, from the north, but taking into account the prevailing wind direction, and for consistency, all detectors were oriented to the southeast in the spring and northeast in the fall. Orienting the microphones perpendicular to the prevailing wind direction provides a balance that increases potential bat detections while reducing interfering noise caused by prevailing winds.

Table 2-1 Site Information and Photos of the Blue Hill Bat Monitoring Sites

Monitoring Site	Location (LLD, UTM)	Site / Setup Description	Land Cover	Photo
Ground 1	NW-5-16-9-W3M; NAD 83, 13U, 342482, 5577064	Attached to a fence line with temporary PVC pipe at a height of approximately 2 m. Located ~400 m east of road	Cultivation to the north; tame pasture to the south. Treed shelterbelts ~150 m northwest and southeast	Photo orientation: facing north 

Table 2-1 Site Information and Photos of the Blue Hill Bat Monitoring Sites

Monitoring Site	Location (LLD, UTM)	Site / Setup Description	Land Cover	Photo
Ground 2	SW-29-15-09-W3M; NAD 83, 13U, 342262, 5572367	Attached to a fence line with temporary PVC pipe at a height of approximately 2 m. Located ~150 m north of road.	Cultivation to the east; tame pasture to the west Dugout and shrubby wetland ~200 m west.	Photo Orientation: facing west 
Ground 3	NE-11-15-09-W3M; NAD 83, 13U, 348249, 5567977	Attached to a fence line with temporary PVC pipe at a height of approximately 2 m. Located ~30 m west of road.	Surrounded by cultivation. Small wetland ~100 m south.	Photo Orientation: facing south 
Ground 4	SW-16-15-08-W3M; NAD 83, 13U, 353903, 5568679	Attached to a fence line with temporary PVC pipe at a height of approximately 2 m. Located 20 m west of road.	Tame pasture to the west; cultivation to the east and south. Old farmyard (treed) located ~600 m west.	Photo Orientation: facing west 

Table 2-1 Site Information and Photos of the Blue Hill Bat Monitoring Sites

Monitoring Site	Location (LLD, UTM)	Site / Setup Description	Land Cover	Photo
MET 1 (MET 1 High and MET 1 Low)	NE-22-15-09-W3M; NAD 83, 13U, 346107, 5571972	2 detectors were attached to the MET Tower: approximately 2 m and 43 m above ground. Located ~50 m south of road.	Located within tame pasture; surrounded by cultivation. Treed patch ~800 m west; small wetlands within 300 m east.	Photo Orientation: facing east 

2.2.1 Equipment Status Visits and Monitoring Issues

Spring 2017

All five sites (six detectors) began collecting data on April 28, 2017 at 19:00 hours. Equipment status checks were performed on May 12, 2017, during which the CF cards and HAZE batteries were exchanged for empty cards and charged batteries. Data were retrieved from the cards and stored for interpretation at a future date. All detectors were removed on June 1, 2017, at which time data were again retrieved and stored.

Detectors Ground 1, Ground 2, Ground 3, Ground 4 and MET 1 Low were in operation for the entire monitoring period and complete datasets were collected. The MET 1 High detector had a malfunction and did not collect data during the first round (April 28 through May 11, 2017), but was operational for the remainder of spring.

It is unknown why this detector malfunctioned, but is likely due to power failure. The malfunction at MET 1 High occurred during a portion of the peak spring activity period; however, the overall bat activity is calculated as bat passes per detector night, based on the number of operational nights during the monitoring period. Therefore, the average activity rate of the period when data were collected was assumed representative of the monitoring period. Though this resulted in reduced sample size, with five sites, ample data were collected for the Project area despite the malfunction.

Fall 2017

All five sites (six detectors) began collecting data on July 13, 2017 at 19:00 hours. Equipment status checks were performed on August 4, August 17, September 8, and September 30, 2017. During these visits the CF cards and HAZE batteries were exchanged for empty cards and charged batteries. Data were retrieved from the cards and stored for interpretation at a future date. All detectors were removed on October 17, 2017.

Detectors Ground 1, Ground 2, Ground 3 and Ground 4 were in operation for the entire monitoring period and complete datasets were collected. Two detectors had malfuncations during the fall 2017 monitoring period, accounting for 5% of the total dataset. MET 1 Low had an internal battery failture and did not collect data for 11 nights from July 24 through August 3, 2017. MET 1 High had a power failure and did not collect data for 19 nights between July 15 through August 3, 2017. Both detectors were replaced during the first maintenance visit and no other malfunctions occurred.

Though these two malfunctions resulted in reduced sample size at two locations, with six detectors, ample data were collected for the Project area despite the malfunctions.

2.3 ANALYSIS

2.3.1 Bat Echolocation Analysis

The unit of measure selected for analysis is a bat call sequence, which is expressed as a bat pass and can be used as a relative measure of bat activity. Bat passes per detector night is used as the relative measure of bat activity and is the primary measurement for reporting activity rates. A limitation to using bat passes as a metric is that it is unknown whether multiple passes represent one or several active bats in the area (i.e., one individual making multiple passes near the detector vs. multiple individuals passing by once each). Standard practice is to use ≥ 2 seconds between call sequences to define a bat pass (Loeb et al. 2015). Echolocation analysis to determine the number of bat passes and identify passes to species was conducted using AnalookW (version 4.2n). Data were compiled using Microsoft Excel and outputs modeled using R (version 3.2.2). Site-specific data for sunrise and sunset were generated using Anasun (version 1.0a). Bat calls and passes were visually distinguished using reference data from:

- Acoustics Workshop: Analysis of AnaBat files (Lausen 2008, pers. comm.)
- Acoustics Techniques Course: Reference Bat Calls (Lausen 2011, pers. comm.)
- Published literature
- Stantec bat call identification key

While automatic bat identification algorithms (e.g., Kaleidoscope Pro) exist and, in some cases, provide a more rapid and objective identification than manual identification, previous experience has indicated that these types of software do not completely analyze an entire dataset, and have a tendency to not recognize low quality calls and duplicate bat passes. Manual identification using AnalookW was therefore used to undertake a complete analysis of the dataset.

Where possible, bats were identified to species or grouping based on several parameters of their calls: frequency (minimum), duration, slope, and shape. Considerable regional variation can occur with the calls of a species based on habitat and other bat species in the area (Lausen, 2008, pers. comm.); therefore, parameters from western Canada records were relied upon more heavily.

Though detector setup methods such as microphone orientation and sensitivity reduce extraneous noise collected (see Section 2.1), large quantities of unwanted noise data can be collected by the detectors. Due to similarities between species echolocation parameters and/or degraded call quality from extraneous noise, some bats cannot be conclusively identified to species and were therefore grouped together. Due to the potential for call similarities, there is some uncertainty in differentiating calls of big brown bats (*Eptesicus fuscus*) and silver-haired bats (*Lasionycteris noctivagans*), eastern red bats (*Lasiurus borealis*) and little brown myotis (*Myotis lucifugus*), and bat species in the *Myotis* genus. In most cases, these groupings were not identified to species conclusively.

Considering the bat species in Saskatchewan (see Section 3.1) and the inability to identify all bat passes to species due to call quality and overlapping call parameters between species, the following five groupings were used for species classification in this study when individual species classification was not possible:

- **Low frequency bat**: includes big brown bat, silver-haired bat and hoary bat (*Lasiurus cinereus*)
- **High frequency bat**: includes eastern red bat, long-eared bat (*Myotis evotis*), little brown myotis and western small-footed bat (*Myotis ciliolabrum*)
- **Big brown bat or silver-haired bat**
- **Eastern red bat or little brown myotis**
- ***Myotis* species**: includes long-eared bat, little brown myotis, and western small-footed bat

Based on comparisons of echolocation results and fatality search results at a number of wind development projects in southern Alberta by Baerwald et al. (2008) and Baerwald and Barclay (2009), bat passes identified into the big brown/silver-haired grouping are likely to be mainly silver-haired bats. Likewise, the low frequency bat grouping is expected to be predominantly silver-haired and hoary bats.

The majority of bat fatalities at wind energy development sites in North America involve migratory species (ESRD 2013, Arnett and Baerwald 2013, Zimmerling and Francis 2016, AWWI 2017); therefore, migratory bats were considered as an additional grouping for this assessment. Three bat species known to occur within the Project area are considered migratory: hoary, eastern red, and silver-haired bats. As such, the migratory bat grouping includes the three migratory bat species and all individuals within the low frequency bat, big brown/silver-haired bat, and eastern red/little brown myotis groupings. Grouping migratory bats in this manner provides the most conservative estimate of the maximum potential migratory bat activity within the Project area.

3.0 RESULTS AND DISCUSSION

3.1 BAT SPECIES IN THE PROJECT AREA

Eight species of bat are known to occur in Saskatchewan, seven of which have the potential to occur within the Project area (Table 3-1). The distribution data for Saskatchewan's bats indicate that the northern myotis (*Myotis septentrionalis*), a non-migratory species of bat, is not expected to occur in the Project area (Caceres and Barclay 2000, Bat Conservation International 2012). The remaining seven bat species may potentially breed within the Project area, as suitable terrain and vegetation is present.

All seven bat species potentially occurring in the Project area were identified by call, and therefore confirmed as occurring in the Project area, which included: eastern red bat, hoary bat, silver-haired bat, big brown bat, little brown myotis, long-eared myotis, western small footed myotis.

Little brown myotis has been considered the most abundant and widespread bat species in North America (COSEWIC 2013), though this may change due to population changes as a result of white-nose syndrome. While little brown myotis are currently abundant in Saskatchewan, the species is listed as *endangered* under SARA (ECCC 2017) due to white-nose syndrome, which is currently decimating populations in eastern North America (USGS 2017).

Table 3-1 Bat Species With Potential to Occur in the Project Area

Common Name	Scientific Name	SRank[1]	Wildlife Act[2]	COSEWIC Status[3]	SARA Status[4]	Expected to Breed in the Project Area	Migratory Bat
Big brown bat	*Eptesicus fuscus*	**S5**	N/A	N/A	N/A	Yes (roosts in buildings, tree cavities, rock crevices)	No
Silver-haired bat	*Lasionycteris noctivagans*	**S5B**	N/A	N/A	N/A	Yes (roosts in foliage)	Yes
Eastern red bat	*Lasiurus borealis*	**S4B**	N/A	N/A	N/A	Yes (roosts in foliage)	Yes
Hoary bat	*Lasiurus cinereus*	**S5B**	N/A	N/A	N/A	Yes (roosts in tree cavities)	Yes
Western small-footed bat	*Myotis ciliolabrum*	**S2**	N/A	N/A	N/A	Yes (roosts in rock crevices; associated with badlands along river valleys)	No
Little brown myotis	*Myotis lucifugus*	**S4**	N/A	Endangered	Endangered (Schedule1)	Yes (roosts in buildings, tree cavities, rock crevices)	No
Long-eared bat	*Myotis evotis*	**S2**	N/A	N/A	N/A	Yes (roosts in buildings, tree cavities, rock crevices)	No

SOURCES:

[1] SKCDC (2017), [2] SKMOE (1998), [3] COSEWIC (2016), [4] ECCC (2017)

S Rank identifies subnational conservation rank (for Saskatchewan): S1: critically imperiled, S2: imperiled, S3: vulnerable, S4: Apparently Secure; S5: Secure; B refers to the Saskatchewan breeding population only.

3.2 BAT ACTIVITY LEVELS

This study uses Alberta's guidelines (ESRD 2013), which states that pre-construction migratory bat activity, based on elevated detectors (>30 m), can be correlated to post-construction mortality rate. While the correlation is based on elevated detectors, a limited number of MET towers requires that detectors be also placed near ground level throughout the Project area to increase spatial coverage. An average of 1 bat pass per detector night equates to 4 bat fatalities per turbine per year (Baerwald and Barcay 2009); therefore, this study provides bat activity levels in bat passes per detector night to allow for comparison to the Alberta risk asssessment guidelines (ESRD 2013).

3.2.1 Monitoring Summary

Spring 2017

During the 2017 spring monitoring period, migratory bat activity rates for all detectors during the full monitoring period (May 1 to May 31) ranged from 0 to 0.2 migratory bat passes per detector night, with an average of 0.1 migratory bat passes per detector night. During this same monitoring period, total bat activity rates for all bats in the Project area from all detectors combined ranged from 0 to 0.3 total bat passes per detector night, with an average of 0.1 total bat passes per detector night (Table 3-2).

Overall, Ground 1 recorded the highest levels of both total and migratory bat activity in the Project area, with 0.3 total and 0.2 migratory bat passes per detector night, respectively. This was likely due to the proximity of the detector to the treed shelterbelts. MET 1 High recorded no bat passes, and Ground 2 recorded only one bat pass during the spring monitoring period. Migratory bat activity was highest in mid-May (Figure H6-2), with the highest level of activity recorded on May 13, 2017, with an average of 0.67 migratory (and total) bat passes recorded among detectors (Figure H6-2).

Table 3-2 Summary of Bat Activity at Each Monitoring Site During the Spring 2017 Monitoring Period

	Ground 1	Ground 2	Ground 3	Ground 4	MET 1 High	MET 1 Low	Total
Number of Detectors	1	1	1	1	1	1	6
Detector Height Above Ground (m)	2	2	2	2	43	2	N/A
Number of Nights of Operation	31	31	31	31	20	31	175
Number of Detector Hours	372	372	372	372	240	372	2,100
Number of Raw Data Files	1,163	310	9,880	1,617	7,648	9,416	30,034
Number of Recorded Total Bat Passes from May 1 to May 31	10	1	4	4	0	2	21
Number of Recorded Migratory Bat Passes from May 1 to May 31	7	1	4	4	0	2	18
Total Bat Passes Per Detector Night	0.3	0	0.1	0.1	0	0.1	0.1*
Migratory Bat Passes Per Detector Night	0.2	0	0.1	0.1	0	0.1	0.1*

NOTES:
* Average bat pass per detector night for all detectors, based on total bat passes per night divided by number of functioning detectors.

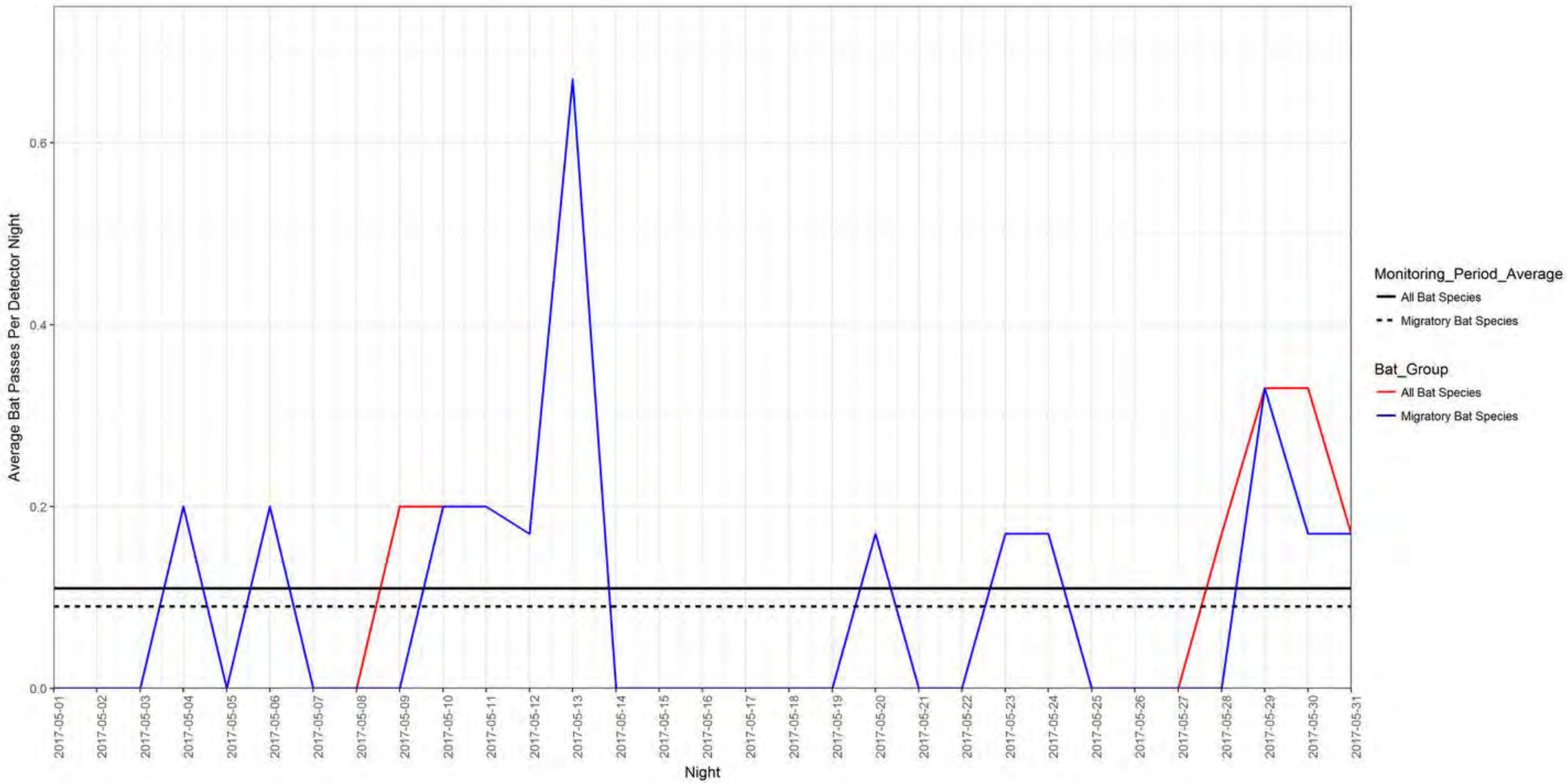

Figure H6-2 Bat Passes per Detector Night (Migratory and Total) During the 2017 Spring Monitoring Period

Fall 2017

During the 2017 fall monitoring period, migratory bat activity rates for all detectors during the full monitoring period (July 15 to October 15) ranged from 0.3 to 0.9 migratory bat passes per detector night, with an average of 0.5 migratory bat passes per detector night. Total bat activity rates for fall 2017 ranged from 0.4 to 1.4 total bat passes per detector night, with an average of 0.7 total bat passes per detector night (Table 3-3). Migratory bat activity peaked in early August with a range of 1.17 to 2.17 migratory bat passes recorded between August 5 and August 12, 2017, and again in late August, with a range of 2.5 to 4.0 migratory bat passes recorded between August 23 and August 26, 2017 (Figure H6-3).

During the monitoring period with the Framework (ESRD 2013; August 1 to September 10) the migratory bat activity rate ranged from 0.4 to 1.7 migratory bat passes per detector, with an average of 1.0 migratory bat passes per detector night. The migratory bat activity rate was recorded as 1.5 migratory bat passes per detector night at the elevated detector (Table 3-3). Total bat activity rates for this reduced period ranged from 0.6 to 2.5 total bat passes per detector night, with an average of 1.3 total bat passes per detector night. Peak activity was recorded in early and late-August (Figure H6-4).

The majority (98%; n=58) of bat passes at the MET 1 High detector were migratory (Table 3-3), consistent with observations that most bat fatalities at wind projects are migratory bats, as non-migratory bats are more active at a lower altitude (Arnett et al. 2008).

Table 3-3 Summary of Bat Activity at Each Monitoring Site During the Fall 2017 Monitoring Period

	Ground 1	Ground 2	Ground 3	Ground 4	MET 1 High	MET 1 Low	Total
Number of Detectors	1	1	1	1	1	1	6
Detector Height Above Ground (m)	2	2	2	2	43	2	N/A
Number of Nights of Operation	94	94	94	94	83	75	551
Number of Detector Hours	1,128	1,128	1,128	1,128	900	996	6,408
Number of Raw Data Files	3,479	122,221	55,720	5,572	13,528	9,975	210,495
Number of Recorded Total Bat Passes from July 15 to October 15	130	46	37	63	59	54	389
Number of Recorded Migratory Bat Passes from July 15 to October 15	86	31	24	47	58	47	293

Table 3-3 Summary of Bat Activity at Each Monitoring Site During the Fall 2017 Monitoring Period

	Ground 1	Ground 2	Ground 3	Ground 4	MET 1 High	MET 1 Low	Total
Total Bat Passes Per Detector Night from July 15 to October 15	1.4	0.5	0.4	0.7	0.8	0.7	0.7*
Migratory Bat Passes Per Detector Night from July 15 to October 15	0.9	0.3	0.3	0.5	0.8	0.6	0.5*
Nights of operaton during Alberta guideline period of August 1 to September 10	40	40	40	40	38	38	236
Number of Recorded Total Bat Passes from August 1 to September 10	98	27	25	51	59	50	310
Number of Recorded Migratory Bat Passes from August 1 to September 10	69	15	16	38	58	43	239
Total Bat Passes Per Detector Night from August 1 to September 10	2.5	0.7	0.6	1.3	1.6	1.3	1.3*
Migratory Bat Passes Per Detector Night from August 1 to September 10	1.7	0.4	0.4	1.0	1.5	1.1	1.0*

NOTES:

* Average bat pass per detector night for all detectors, based on total bat passes per night divided by number of functioning detectors.

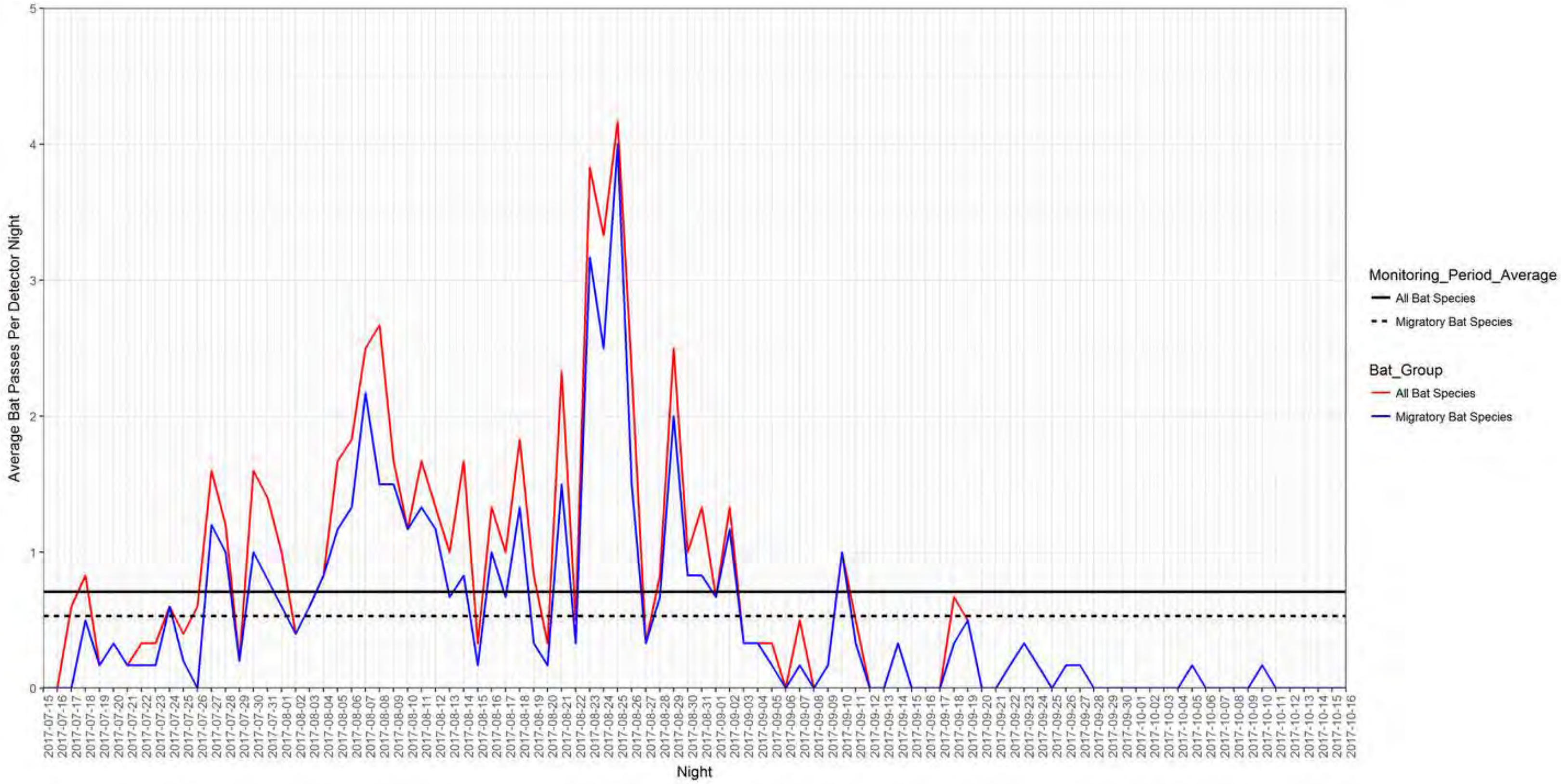

Figure H6-3 Bat Passes per Detector Night (Migratory and Total) During the 2017 Fall Monitoring Period (July 15 – October 15)

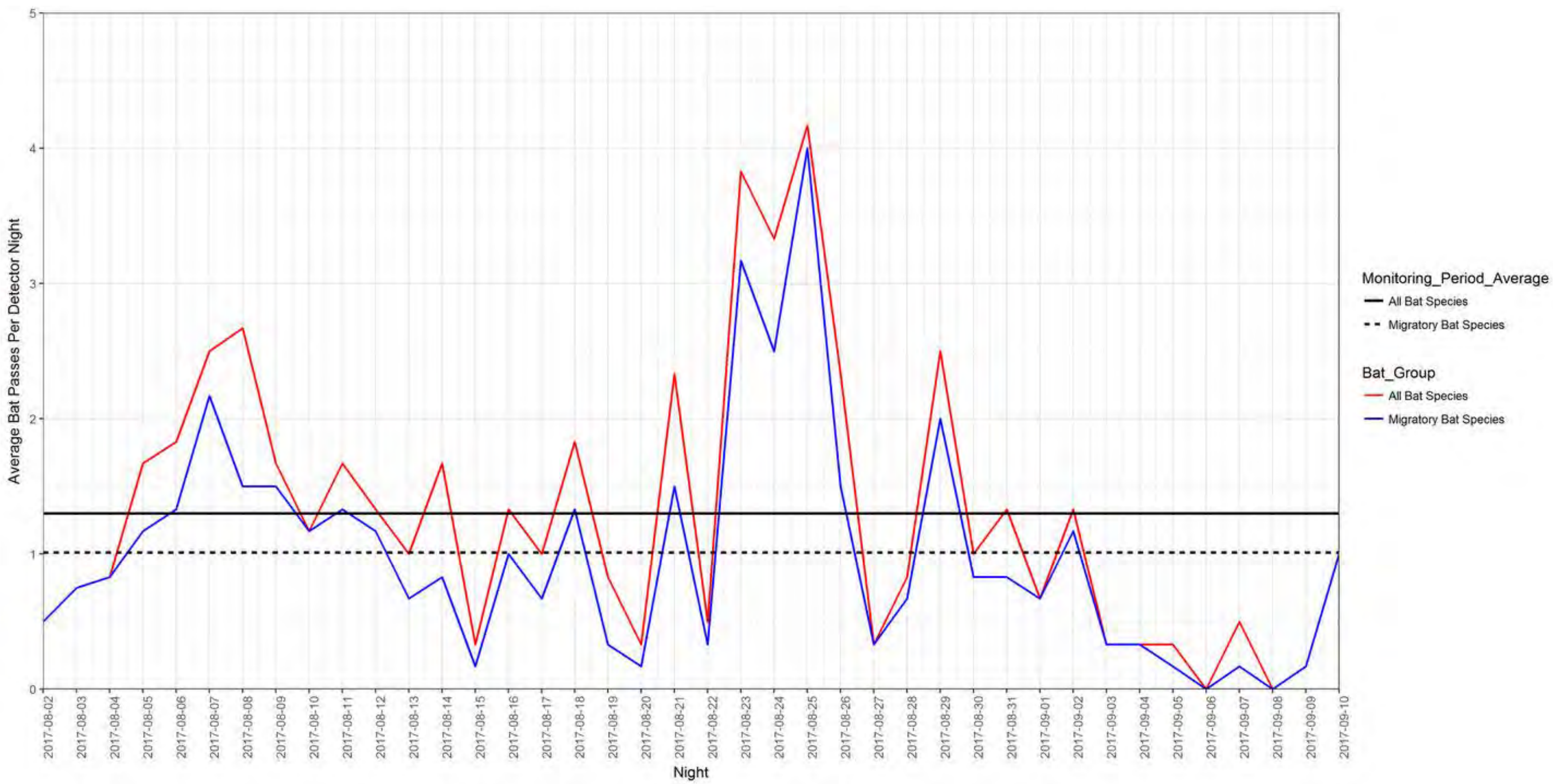

Figure H6-4 Bat Passes per Detector Night (Migratory and Total) During the 2017 Framework Recommended Fall Monitoring Period (August 1 – September 10)

3.2.2 Nightly Bat Activity Levels

Spring 2017

The highest levels of bat activity were recorded between 22:00 and 22:59 hours, with a total of 5 bat passes recorded. Bat activity was relatively even over the evenings between 21:00 and 04:59 hours (Figure H6-5). Non-migratory bats were only recorded between 23:00 – 02:00 hours (Figure H6-5).

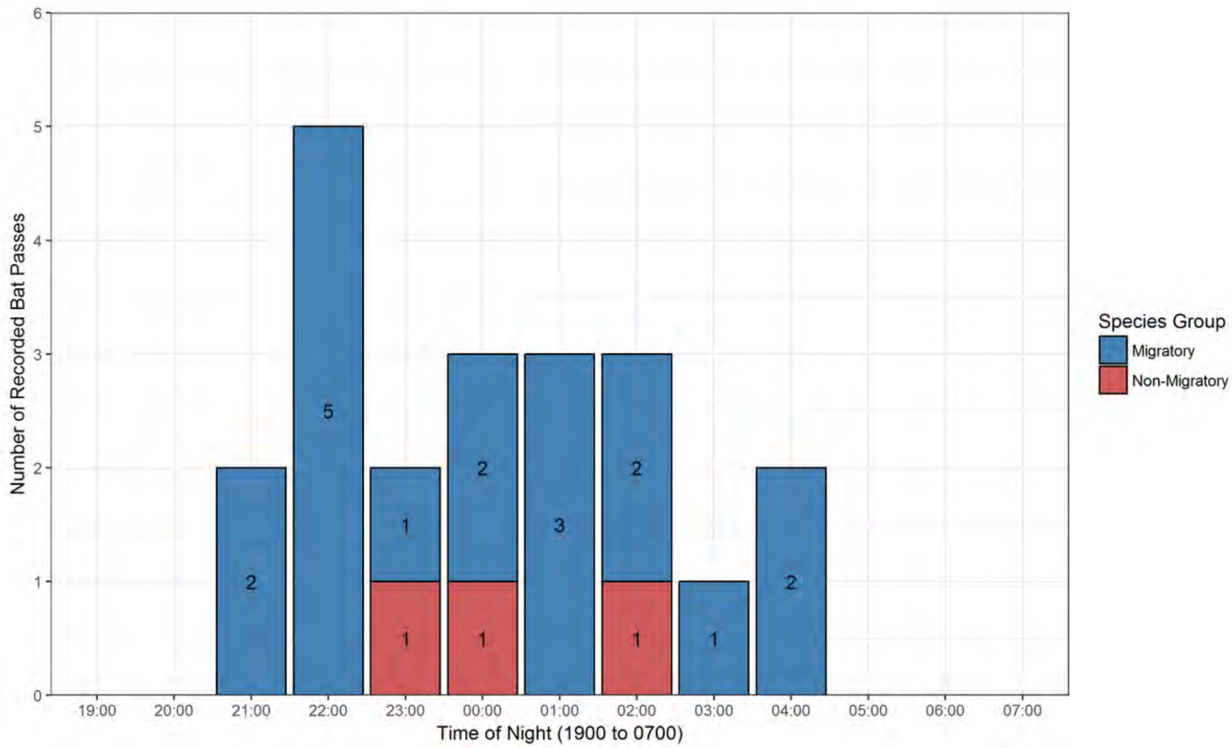

Figure H6-5 Distribution of Hourly Bat Activity for Migratory and Non-migratory Bats During the Spring 2017 Monitoring Period

Fall 2017

The highest levels of bat activity were recorded between 01:00 and 01:59 hours, with a total of 50 bat passes recorded. Most activity occurred between 22:00 and 03:59 hours (Figure H6-6).

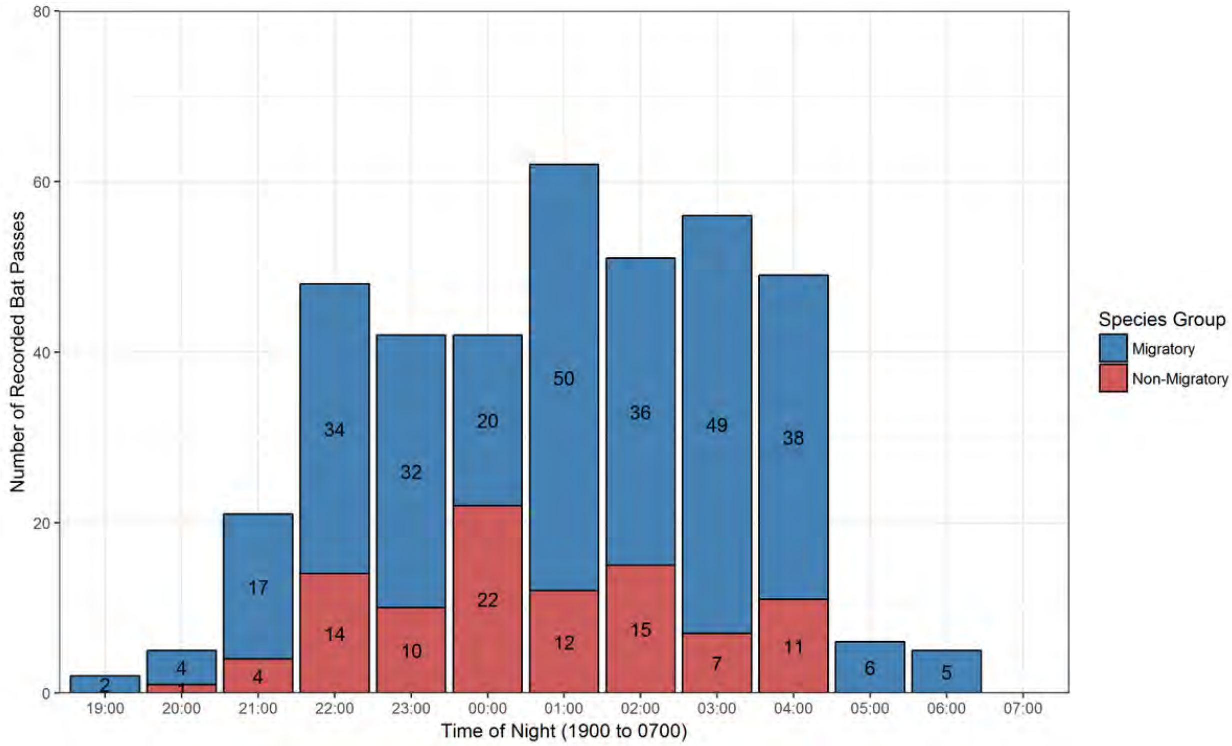

Figure H6-6 Distribution of Hourly Bat Activity for Migratory and Non-migratory Bats During the Fall 2017 Monitoring Period (July 15 to October 15)

3.3 BAT ACTIVITY BY SPECIES OR SPECIES GROUPING

The most common species or species grouping in the Project area during the spring and fall monitoring periods was the big brown/silver-haired grouping, followed by *Myotis* species (Figure H6-7 and H6-8). The big brown/silver-haired group was recorded consistently throughout both the spring and fall monitoring periods. In the spring, the *Myotis* species were recorded at the beginning and end of the monitoring period (i.e., in early and late-May), and in the fall they were observed mainly in the first portion (late July to early September) of the monitoring period.

The most common migratory species or species grouping was the big brown/silver-haired bat species grouping. During the spring monitoring period, bat observations were relatively sparse but consistent throughout May. During the fall monitoring period, the big brown/silver-haired group began increasing in mid-August, peaking in late August, and decreased to very little activity by mid-September.

Other migratory bat species and species groupings, including silver-haired bat, eastern red bat, hoary bat, and low frequency bats, displayed similar patterns of activity to the big brown/silver-haired bat species grouping during both the fall monitoring period, with most activity recorded in mid to late-August and decreasing to very little activity by September. Aside from the big brown/silver-haired grouping, very few observations of migratory bats were identified to species in the spring monitoring period.

The highest levels of bat activity during both the spring and fall monitoring periods were observed at Ground 1, which was located approximately 150 m south of treed shelterbelts, which could potentially provide roosting habitat, followed by Ground 4, which was located approximately 600 m east of an abandoned farmstead, which could also provide roosting habitat. Ground 1 also had the highest observations of *Myotis* species in the spring and fall monitoring period.

Terminal phase calls (i.e., a feeding buzz) within a bat call sequence is indicative of feeding activity and a high number of feeding buzzes could indicate a foraging area or nearby roost areas where higher levels of foraging take place. Foraging areas may have greater potential for fatalities from turbine operation. Very few terminal phase calls were recorded in the spring monitoring period. In the fall monitoring period, MET 1 High and MET 1 Low recorded the highest percentage of migratory bat passes with feeding buzzes. MET 1 High and Ground 2 recorded the highest percentage of non-migratory bat passes with feeding buzzes; however, Ground 2, Ground 3, Ground 4 and MET 1 Low had similar percentages of feeding buzzes. Migratory bats typically forage at high altitudes (above tree tops) which is consistent with greater feeding activity at the MET 1 High detector, which had small wetlands present within 300 m of the site. *Myotis* bats tend to forage close to the ground, therefore ground detectors are more likely to record feeding activity.

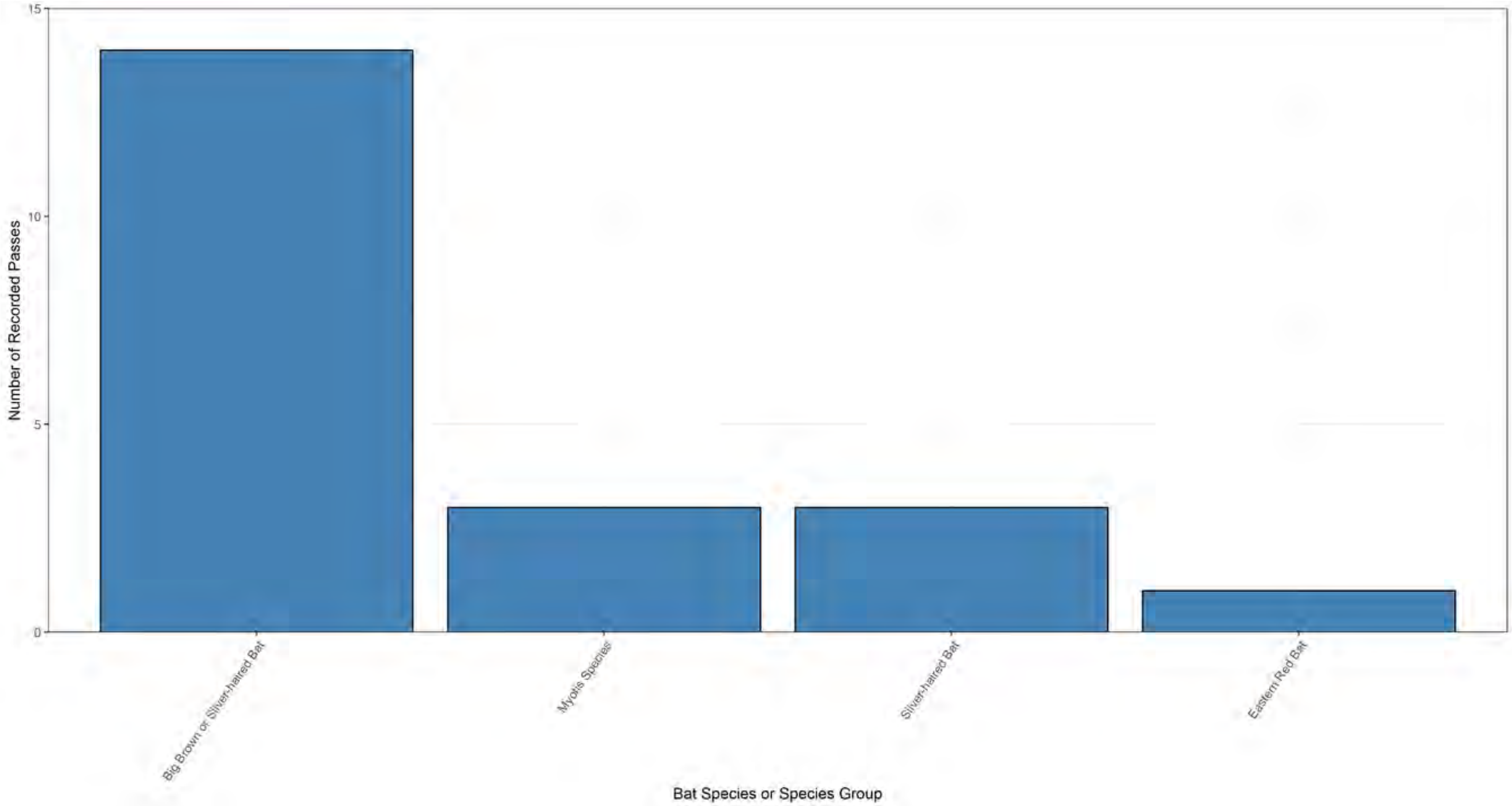

Figure H6-7 Total Bat Passes per Species or Species Grouping During the Spring 2017 Monitoring Period

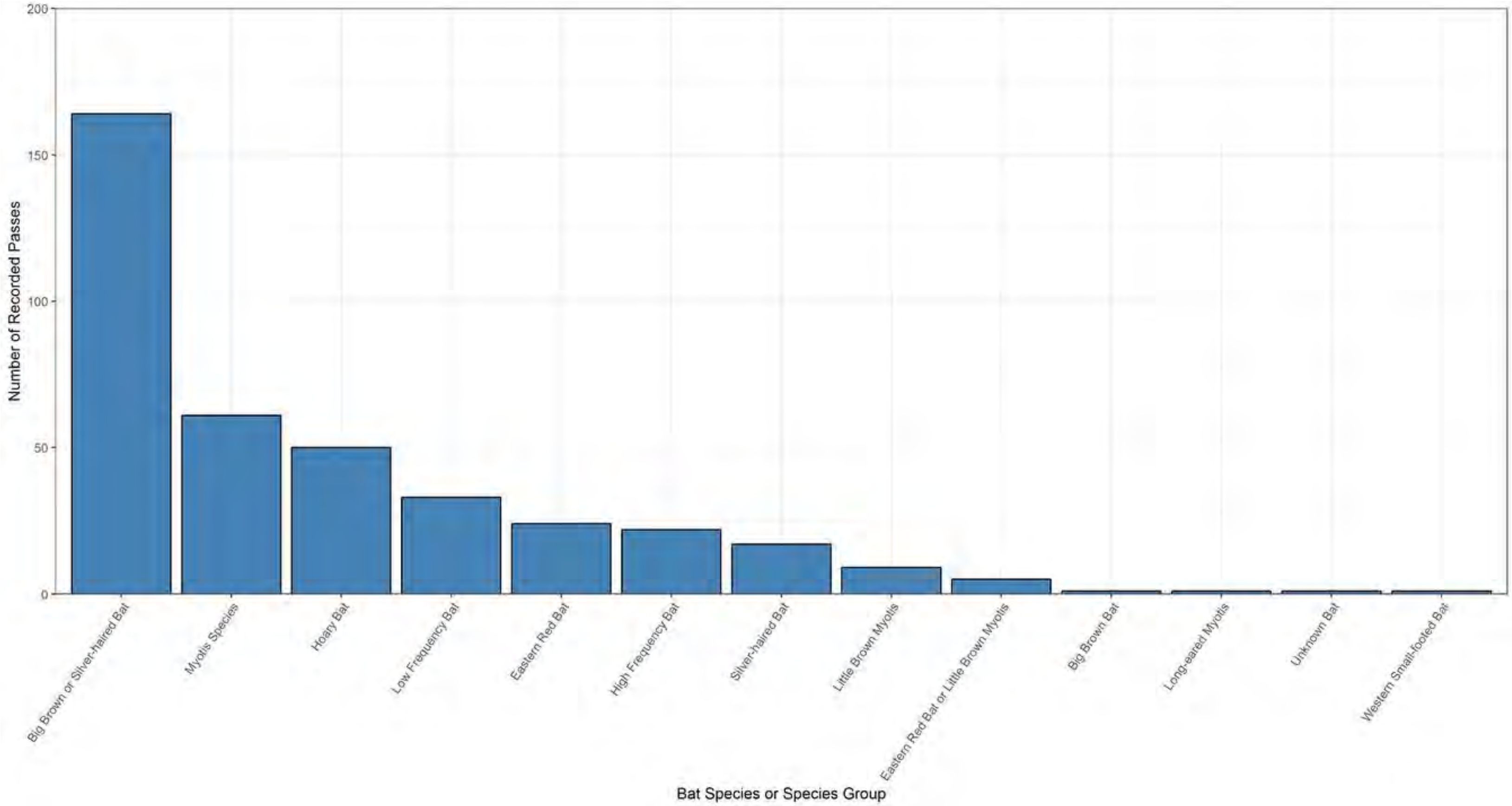

Figure H6-8 Total Bat Passes per Species or Species Grouping During the Fall 2017 Monitoring Period

4.0 SUMMARY

The average activity rate for bats during the spring monitoring period was 0.1 total bat passes per detector night for both migratory and non-migratory bats. There were no bat passes recorded at the elevated detector (MET 1 High) during the spring monitoring period, though this detector only recorded for half the monitoring period due to a malfunction. Nonetheless, no detections during the period monitored is not common and suggests low activity rates for the Project area.

The average activity rate for migratory bats during the full fall monitoring period (July 15 to October 15) was 0.5 migratory bat passes per detector night (0.8 migratory bat passes per detector night at the elevated detector). For the Framework fall monitoring period (August 1 to September 10), the average activity rate for migratory bats was 1.0 migratory bat passes per detector night (1.5 migratory bat passes per detector night at the elevated detector).

Bat activity rates were low in both the spring and fall monitoring periods; however, there were approximately 18 times as many total bat passes recorded during the fall monitoring periods as during the spring monitoring period, and 7 times as many migratory bat passes per detector night. This is consistent with results of previous studies where the highest rates of bat mortality at wind projects in North America were consistently found during August and September (Arnett et al. 2008).

The higher proportion of migratory bat activity at the elevated detector is consistent with observations that most bat fatalities at wind projects are migratory bats (94.9% in Alberta, 71.3 to 74% in Canada), as non-migratory bats are more active at lower altitude (BSC et al. 2017, Zimmerling and Francis 2016). The potential for fatality of non-migratory bats is expected to be low as *Myotis* species tend to travel and forage below the rotor swept area (Arnett et al. 2008).

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H.7 REVIEW OF MORTALITY RISK RELATED TO OPERATION OF WIND PROJECTS

H.7.1 Direct Mortality

During operation of wind turbine projects, direct mortality may occur to birds or bats colliding with rotor blades, towers, or nacelles, or generally to a much lesser extent, to a wide variety of wildlife that may be struck by project-related traffic.

H.7.1.1 Collisions with Wind Turbines

The primary mechanism for direct wildlife mortality is collision of birds and bats with towers, nacelles, and revolving blades of wind turbines. The effects of wind turbines on bird and bat mortality rates and risk have been increasingly studied over the past thirty years, and are now considered to be relatively well understood.

The Swedish Environmental Protection Agency reviewed reported bird mortality at 31 wind energy facilities in Europe, 23 in the United States, and 5 in Canada, finding an overall average of 2.3 bird deaths per turbine per year, and a median of 1.6 within North America (Rydell et al. 2012). The results are comparable to previous reviews from North America which identified mean annual mortalities per turbine per year of 2.2 birds (Erickson et al. 2001). Another recent review of 43 wind facilities in Canada that corrected for detection bias reported a higher mean of 8.2 ± 1.4 (95% CI; range 0 to 26.9) bird deaths per turbine per year (Zimmerling et al. 2013). This study included five facilities in Saskatchewan (mean of 10.1 mortalities per turbine per year) and 26 facilities in Alberta (mean of 4.5 mortalities per turbine per year). While relatively few studies have examined mortality rates over the entire annual cycle, most focus on the period from April to November, when 95% of collisions occur (Zimmerling et al. 2013).

Risk of mortality is often a function of landscape features and bird species present at a particular site (Kingsley and Whittam 2005). Certain landforms (e.g., ridges, steep slopes, valleys, shorelines) can funnel bird movements, especially during migration, such that turbines in these areas might pose a higher level of risk to birds. Topographic features are also one of the most important factors influencing raptor collisions with turbines (Kingsley and Whittam 2005). Wind-energy facilities located within prairie landscapes typically have a relatively lower bird and bat mortality rate than those in landscapes with features such as forested ridges and large rivers (Arnett et al. 2007, Arnett et al. 2008, Baerwald and Barclay 2009). However, factors may differ less predictably at a local scale or among land cover types. For example, there was generally little effect of land cover types or local features, such as coulees and trees, on fatality rates at the Centennial wind energy project (WEP) (Golder Associates 2008).

An analysis of mortality monitoring results from 116 studies at more than 70 wind-energy facilities in North America identified that small passerines accounted for 62.5% of all bird fatalities, upland game birds for 8.2%, diurnal raptors for 7.8%, unidentified birds for 5.2%, doves and pigeons for 3.9%, and the other 14 bird groups accounting for less than 3% each (Erickson et al. 2014). Data from Canadian WEPs show similar proportions of fatalities by bird species groups (BSC et al. 2017). Waterfowl generally represent a small proportion of birds struck by wind turbines across Canada (3.3%), though this number is substantially higher for Alberta WEPs (13.5% of fatalities; BSC et al. 2017). This difference may be a function of the high abundance of nesting waterfowl in Bird Conservation Region 11 – Prairie Pothole Region (EC 2013), and siting of a WEP in a landscape of high nesting waterfowl density may result in a higher risk for duck collisions with WEPs. At five wind facilities in the United Kingdom, collisions of medium to large goose species was a rare event, suggesting that they may avoid wind turbines, or wind farms altogether (Pendlebury 2006, Arnett et al. 2007). Behavioural avoidance of wind turbines by birds in general has been well documented; for example, Rydell et al. (2012) noted that 62% of individuals encountering wind turbines changed their flight direction or altitude. Moreover, after the installation of a wind energy facility, birds tend to fly, on average, at higher altitudes during nocturnal flights than before construction based on radar estimates (d'Entremont et al. 2017), suggesting that birds adapt flight patterns and behaviour in response to changes on the landscape.

Landbirds

Migratory songbirds account for the majority of bird fatalities at wind facilities throughout North America (62.5%, Erickson et al. 2014; 69.4%, BSC et al. 2017). This is largely due to the relative abundance of songbirds, but likely also a function of many species migrating nocturnally, sometimes at altitudes within the rotor swept area of wind turbines. Overall, most of the migratory passerines are neotropical migrants that breed in temperate and boreal regions, and overwinter in tropical areas. However, in Alberta, horned larks accounted for 28% of avian fatalities at WEPs, an order of magnitude more than any other species; this is likely due to their abundance in agricultural landscapes over the majority of their annual cycle, compared to other species only passing through over brief periods in spring and fall (BSC et al. 2017). These results are also consistent with the fatality results from the Morse WEP where horned larks were 10 of 28 fatalities (36%) (Golder Associates 2017). However, even for species such as horned lark that are most commonly struck, the estimated mortality from wind turbines throughout North America ranges from 0.03 to 0.04% of the population (Erickson et al. 2014). Zimmerling et al. (2013) found similar rates at wind farms in Canada and concluded they were not sufficient to cause population-level effects.

The implications of mortality can be greater for species at risk (SAR), which typically have smaller populations and can be more vulnerable to the loss of individuals. No studies have specifically examined mortality risk of loggerhead shrikes, Sprague's pipits, or chestnut-collared longspurs, but these species are all absent from the mortality reports for Canada reviewed by BSC et al. (2017), and only one chestnut-collared longspur mortality has been reported at the Centennial

WEP (Golder Associates Ltd. 2008). There is also evidence of some species at risk co-existing safely with WEPs. For example, at the Judith Gap WEP in 2006 and 2007, 41 Sprague's pipits were detected within the project lands during the post-construction breeding bird surveys, but there were none among the 406 fatalities recorded during the monitoring program (TRC 2008).

Waterbirds

Waterbirds broadly refer to waterfowl (e.g., swans, geese, and ducks), shorebirds (e.g., avocets, stilts, plovers, sandpipers, and phalaropes), and a wide variety of other species (e.g., rails, coots, cranes, herons, pelicans, cormorants, loons, grebes, gulls, and terns). Overall, the group accounts for a relatively small proportion of fatalities at wind energy facilities in North America (6%, Erickson et al. 2014).

Waterfowl account for a small proportion of fatalities at wind energy facilities in Canada (3.3%, BSC et al. 2017) and North America overall (2.7%, Erickson et al. 2014). However, higher rates were noted in Alberta, where mallards alone accounted for 11.7% of fatalities, driving waterfowl fatalities overall to 13.5% (BSC et al. 2017). This higher rate in Alberta may be a function of a specific project that was sited near a wetland heavily used by ducks; for comparison, the Centennial WEP, sited in a terrestrial landscape with few wetlands, reported that 3 of 90 (3.3%) bird fatalities were ducks (2 mallards and 1 northern pintail; no goose carcasses were detected) (Golder Associates Ltd. 2008). At the Morse WEP, out of 28 bird fatalities there were no ducks and only one unidentified goose species reported during the 2015 to 2017 monitoring programs (Golder Associates 2017). Although not specifically assessed, waterfowl collision rates in grassland regions of Saskatchewan are expected to be comparable to those for Canada, with the potential to have higher waterfowl collision rates where WEPs are sited near important staging wetlands. Mallard is the most abundant duck species in North America and frequently feeds in fields, which may in some case be near wind turbines. This species and other dabbling ducks undertake erratic spring courtship flights in which a female is pursued by two or more males, which can result in higher collision susceptibility. However, waterfowl are known to generally avoid wind turbines during flight (Whitfield 2010, Sugimoto and Matsuda 2011), accounting for their typically low collision rates. Geese in particular are known to have low mortality rates because of their turbine avoidance behaviour (Sugimoto and Matsuda 2011). This is consistent with the proportion of fatalities observed at the Centennial Wind Energy project near Swift Current, Saskatchewan, where out of 90 carcasses detected over a two-year period, waterfowl fatalities were limited to three ducks and no geese.

There are no waterfowl in Saskatchewan that are considered SAR or species of management concern (SOMC). While breeding waterfowl densities vary annually in the prairies in relation to environmental conditions and population fluctuations, North American waterfowl abundance in 2014 was the highest on record since standardized waterfowl breeding surveys began in 1955, with 47.3 million breeding pairs of ducks in the traditional survey area, 34% above the long-term mean (USFWS 2017). An extensive study on waterfowl mortality from wind developments in the prairie pothole region supported the expectation that wind turbines had no direct effect on breeding female survival in mallards and blue-winged teal (Gue et al. 2013).

Shorebirds account for an even smaller proportion of bird fatalities at wind energy facilities in North America (1%, Erickson et al. 2014). This is consistent with results from Alberta, where there were three shorebird mortalities (one each killdeer, marbled godwit, and upland sandpiper) out of a total of 355 birds reported (BSC et al. 2017). Project-specific information within Saskatchewan is also consistent with this observation. The Centennial WEP had two shorebird fatalities (a killdeer and an unknown species) out of 100 total (Golder Associated Ltd. 2008), while the Morse WEP reported one shorebird (an upland sandpiper) fatality out of 28 total bird fatalities detected, despite being located approximately 4.5 km southeast of Reed Lake. Notably, all the mortalities identified in Alberta and at the Centennial WEP and Morse WEP involved locally breeding species rather than arctic migrants, and none were SOMC.

In a review of migration height, most arctic-nesting shorebirds traveled at 1,726 m to 2,865 m above ground to make use of strong, cool and more laminar (i.e., less turbulent) wind currents for their long-distance migration movements (Green 2004). Only knots migrated at an average of about 400 m altitude (Green 2004), but even this is above the rotor swept area of wind turbines. Dokter et al. (2010) also reported results from a weather radar migration study that showed many birds ascend quickly to high altitude (above 2,000 m) for long-distance migration. These data are also supported by results about migration altitude of shorebirds in the Canadian Maritimes from Richardson (1979). The high migration altitude and steep rate of climb of shorebirds likely explains the very low proportion of shorebirds found in mortality monitoring studies (AB ESRD 2001).

Projects located in areas of high shorebird abundance would be expected to have relatively higher rates of fatalities. However, even in areas supporting large concentrations of shorebirds, evidence indicates that mortality rates remain low. For example, the Gulf Winds project is a 118 turbine (283 MW) facility within a wetland complex of the Laguna Madre, recognized as a Ramsar wetland of international importance, and the most critical part of the coast of the Gulf of Mexico for shorebirds, supporting 20% of the overwintering piping plover population (Withers 2002). Yet mortality monitoring identified only 53 shorebird mortalities per year (0.19 shorebirds/MW/year), accounting for 5.5% of the total mortality rate of 3.4 birds/MW/year for the project (Confidential Monitoring Report). Similarly, three years of mortality monitoring at the neighbouring Penascal wind facility yielded results below the North American average, with an even lower proportion of shorebirds (Jerry A. Roppe, pers.comm.; Wally Erickson, pers.comm.).

In the prairie pothole region, the 354-turbine Buffalo Ridge project on the border of Minnesota and South Dakota offers the best insights into shorebird collision rates. A four-year monitoring study revealed an overall mortality rate of 3.8 birds/MW/year, with no shorebird fatalities attributable to collisions, despite three shorebirds among the ten species observed as having greatest exposure to collision risk (Johnson et al. 2000a). During various behavioural surveys, 8 to

81% of shorebirds flew within the rotor swept area, suggesting that the absence of documented collisions reflects a high propensity for turbine avoidance (Johnson et al. 2000a).

Reed Lake is located approximately 7 km from the closest proposed Project turbine, and is part of the Chaplin-Old Wives-Reed Lakes (C-OW-RL) Western Hemisphere Shorebird Reserve Network Site, an internationally recognized staging area for migrating shorebirds. The majority of shorebirds staging at C-OW-RL use the aquatic or shoreline habitat for feeding to acquire nutrient stores for migration. Shorebirds in general are an order of magnitude lower at Reed Lake than they are at Chaplin or Old Wives (CWS 2007). The most common shorebirds at Reed Lake are stilt sandpipers, red-necked phalaropes and semipalmated sandpipers; the red knot, a species listed under SARA as *endangered*, is also known to stage at this lake. While some piping plovers also stage at the C-OW-RL complex, they tend to be scarcer at Reed Lake due to limited availability of mud flats (CWS 2007). The Montana Nature Conservancy (Martin et al. 2009) identified 1.6 km as an appropriate setback from piping plover nesting habitat in their ecological risk assessment of wind energy development. The Project is over four times this distance from Reed Lake.

Other waterbirds (e.g., rails, coots, cranes, herons, pelicans, cormorants, loons, grebes, gulls, and terns) collectively account for 3.7% of bird mortalities documented at Canadian wind energy facilities (BSC et al. 2017), and 2.2% for North America overall (Erickson et al. 2014). The percentage is somewhat higher in Alberta (7.6%), reflecting the abundance of species in prairie potholes such as grebes, coots, pelicans, and gulls (BSC et al. 2017). Inland wind energy facilities generally pose a low risk to waterbirds, unless located directly adjacent to waterbird colonies, or in areas of high wetland abundance where waterbirds may nest and move regularly between wetlands. The proximity of wind energy facilities to large roosting or breeding wetlands likely increases collision risk.

At the Buffalo Ridge wind facility, waterbirds accounted for 9% of fatalities, and included American coot, pied-billed grebe and herring gull, all common species found in the prairie pothole region. Similar fatality rates of waterbirds were observed at the Centennial WEP, involving primarily horned grebe, eared grebe, sora, American coot, and Franklin's gull. The Morse WEP had 5 waterbird fatalities out of the 28 bird carcasses detected, and included American coots, American white pelicans and a sora (Golder Associates 2017). Cranes sometimes flew within the rotor swept area at Buffalo Ridge, but no mortalities were detected; this is consistent with results from the Centennial Wind Energy Project (Golder Associates Ltd. 2008) and the lack of any crane mortality in the review by Erickson et al. (2014), and a single sandhill crane fatality in Canada (BSC et al. 2017).

Raptors

Diurnal raptors (e.g., hawks, falcons, eagles) have been identified as species of concern for a number of wind developments. In Canada, raptors account for 7.7% of bird fatalities at WEPs; the proportion was somewhat lower in Alberta at 5.1% (BSC et al. 2017), and similar for North America as a whole (7.8%, Erickson et al. 2014). Red-tailed hawk and turkey vulture are the two most commonly affected raptor species.

The vulnerability of raptors to wind turbine collisions achieved a high profile due to elevated collision rates at the Altamont Pass Wind Resource Area, where establishment of nearly 5,000 turbines began in 1982, when there was little understanding of mortality risk (Zimmerling et al. 2013). The rotor swept area of early turbines extended to as little as 9 m above ground, and sometimes with only 10 m separation from the rotor swept area of adjacent turbines. The limited options for avoidance contributed to high levels of mortality for golden eagles, burrowing owls, and other raptors (Erickson et al. 2001). Smallwood et al. (2009) showed that repowering the Altamont Pass Wind Resource Area to larger modern turbines would significantly reduce mortality risk.

With changes to turbine design, improved understanding of risk factors, and proactive mitigation, mortality risk for raptors has declined considerably at newer projects. For example, at the 105-turbine Seawest wind energy facility in Wyoming, Johnson et al. (2000b) reported no effect over four years on density or reproductive success of raptors at 134 nests among and within 16 km of the facility, compared to a reference area with 44 additional nests. There was a single raptor fatality (a red-tailed hawk) reported during monitoring at the Buffalo Ridge energy project, and this is at least in part attributed to the rotor swept area being above the mean flight height of raptors on site (Johnson et al. 2000a). Similarly, although at least two active great horned owl nests at Centennial WEP successfully hatched young, no owl collision fatalities were detected. No raptor fatalities were detected at the Morse WEP during monitoring conducted in 2015 to 2017 (Golder Associates 2017).

In general, nocturnal owls appear to be at low risk of collision, accounting for only 0.1% of mortalities recorded at wind energy facilities in Canada (BSC et al. 2017). While studies have not specifically addressed the vulnerability of owls to turbines, the low collision rates may be a function of most nocturnal species favouring forested habitat where turbines are uncommon, whereas owls that hunt in open country are mostly diurnal, and may reduce their risk by actively avoiding turbines. This is consistent with the general observation that raptors appear largely capable of avoiding turbines when they are adequately spaced to allow birds to hunt in between them. For example, Garvin et al. (2011) studied effects on raptors of the Forward Energy wind project in Wisconsin, and found that while there was some displacement of raptors from the area post-construction, others remained present, and only 6.4% of 1455 raptor observations were within 100 m of turbines, and active avoidance was documented. These results are consistent with results from Johnson et al. (2000a) who found small scale (<100 m from turbine) avoidance by northern harriers at the Buffalo Ridge Wind Resource Area in Minnesota.

There has been little study of the effects of wind energy developments specifically on ferruginous hawk, a SARA-listed *threatened* species in Canada. Kolar and Bechard (2016) found that in the Columbia Plateau Ecoregion of Oregon, red-tailed hawks, Swainson's hawks, and ferruginous hawks did not select nesting locations in relation to density of wind turbines on the landscape, but instead appeared to stagger their distribution in relation to nesting substrate and to reduce competition (Kolar 2013). At a finer scale, Kolar (2013) reported that there was a significant negative relationship between turbine density and daily nest survival of ferruginous hawks (b = -0.89, SE = 0.39, 85% CI = -1.47 to -0.30), with mortality of chicks arising from starvation or depredation. However, none of the 60 fledgling hawks in the study area were struck by turbines (Kolar and Bechard 2016). At the Centennial WEP, Golder Associates Ltd. (2008) reported that two ferruginous hawk nests were identified within the mortality monitoring area in 2006. One nest was approximately 350 m from a turbine while the second was approximately 470 m away. The first nest successfully hatched young, but the second was not confirmed. Neither nest was monitored to determine fledging success. In 2007, two ferruginous hawk nests were again detected at the same locations. One nest was destroyed when the hedgerow was cleared for agricultural activities and the pair re-nested nearby at approximately 450 m from a turbine. Both nests successfully fledged 4 young in 2007, well above the average of the species (e.g., 2.8 young per occupied nest, based on 629 nests in North Dakota, Gilmer and Stewart 1983). These two nests were within the Saskatchewan Ministry of Environment (SKMOE) activity restriction guidelines of 1,000 m (SKMOE 2017) and the high reproductive output of these two pairs indicates that the adults were not impeded from adequately foraging to feed young.

Bats

Mortality risk to bats has been studied extensively at wind facilities and forms part of many standard assessments and mortality monitoring programs. Baerwald (2008) suggested that barotrauma (i.e., decreased pressure causing hemorrhaging of internal tissues) was a major cause of mortality of bats, but more recent studies have indicated that the majority of bat fatalities are caused by direct strikes of turbines blades with bats (Grodsky et al. 2011, Capparella et al. 2012, Rollins et al. 2012).

The average bat mortality rate varies greatly within Canada. Zimmerling and Francis (2016) analyzed data from across Canada and reported an average annual fatality rate of 15.5 bats/turbine. BSC et al. (2017) reported that from 66 projects reporting mortality data in the period from 2007 to 2014, corrected annual mortality rates for bats ranged from 0.26 bats/turbine in Atlantic Canada to 18.52 bats/turbine in Ontario, with an intermediate level of 8.34 bats/turbine in Alberta. The differences reflect variability in land cover (e.g., prairie vs. forested landscapes), as well as in abundance of bats, most notably the dramatic decline in eastern bat populations due to white nose syndrome in the maritime provinces where the disease has been detected in nearly all counties (https://www.whitenosesyndrome.org/resources/map).

Across Canada, migratory bats (hoary bat, eastern red bat, silver-haired bat) accounted for 68.5% of mortalities in the review by BSC et al. (2017), while resident species (little brown myotis, big brown bat, northern long-eared myotis, eastern small-footed bat, and tri-colored bat) comprise the remainder (31.5%). In Alberta, resident bats accounted for a much smaller proportion of mortalities (5.6%), similar to the 7% rate over four years of mortality monitoring at the Buffalo Ridge wind energy facility in Minnesota (Johnson et al. 2000a). At the Judith Gap WEP in Montana, all fatalities recorded were either hoary bats or silver-haired bats (TRC 2008). Resident bat fatality rates are even lower within Saskatchewan. The Centennial WEP reported that resident bats accounted for only 2.3% of fatalities during 2006 and 2007 monitoring, both of which were big brown bats (Golder Associates 2008). Migratory bats accounted for 97.3 percent of fatalities; overall, the fatality rate at Centennial was 7.9 bats/turbine/year (4.4 bats/MW/year). The Morse WEP did not report any resident bats out of the 43 observed fatalities in 2015 to 2017, and corrected fatality rates were estimated at 13.3 bats/turbine/year (5.77 bats/MW/year) (Golder Associates 2017).

Patterns of elevated bat fatalities have been documented at wind facilities on nights with wind speed less than 6 metres per second (m/s) (Arnett et al. 2008), corresponding to when aerial insects are most active (Kunz et al. 2007). Horn et al. (2008) also indicated that blade rotational speed, which correlates to wind speed, was a significant predictor of collisions with turbines where higher wind speeds were correlated with lower bat fatality rates when turbines were active. This also suggests that bats may be more active on nights with lower wind speeds when turbines are typically not operating. Across Canada, most bat fatalities at WEPs occur between July and September, with a peak in mid-August to early-September (BSC et al. 2017). At the Centennial WEP 85% of bat fatalities occurred between August 1st and September 3rd (Golder Associates Ltd. 2008).

H.7.1.2 Vehicle Collisions

Slow-moving terrestrial animals such as reptiles and amphibians are particularly vulnerable to vehicle collisions, although all wildlife are potentially at risk if they cross roads at or near ground level. However, project-related vehicle traffic during operation is typically limited to occasional monitoring and maintenance visits. In almost all landscapes, this represents a very small increase over background traffic levels, and therefore only a minor incremental increase in mortality risk.

H.7.2 Indirect Mortality

The introduction of wind turbine infrastructure to a landscape may result in changes in behaviour for some wildlife species that have implications for mortality, including facilitation of predator abundance affecting prey species, and avoidance responses that may reduce fitness or abandonment of nests and young.

In grassland areas where natural perches are not common, the addition of infrastructure such as WTGs and collector line poles can facilitate hunting and sometimes even nesting by corvids and raptors that would otherwise be absent or in low densities (Slater and Smith 2010). An increase in the local populations or redistribution of these predatory species can in turn lead to declines in prey, including smaller birds as well as mammals, amphibians, and reptiles (Richardson et al. 2017). Conversely, in areas where the availability of existing perches is not a limiting factor for corvids or raptors (i.e., such perches are common), the introduction of additional infrastructure and associated sensory disturbance may result in displacement of some of these predators, and a concurrent reduction in predation pressure for their prey (Francis et al. 2009).

For most projects, indirect effects pose a lesser mortality risk than direct effects.

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APPENDIX I
HERITAGE RESOURCES

Appendix I HERITAGE RESOURCES

I.1 REFERRAL

I.1.2

Government
of
Saskatchewan

Ministry of Parks Culture and Sport

Heritage Conservation Branch
2nd Floor, 3211 Albert Street
Regina, Canada S4S 5W6

Phone: 306-787-5772
Carlos.germann@gov.sk.ca

September 14, 2017

Our file: 17-1558

Ms. Lauren Stead
Stantec Consulting Ltd.
Agent for: **Algonquin Power**
100 – 75 24th Street E
SASKATOON SK S7K 0K3
Email: lauren.stead@stantec.com

ORIGINAL E-MAILED
Sept. 15/17

Dear Ms. Stead:

RE: Algonquin Power – Blue Hill Wind Project:
See Table 1 for 48 Locations;
HERITAGE RESOURCE REVIEW

Thank you for referring this project for heritage resource review.

In determining the need for, and scope of, Heritage Resource Impact Assessment (HRIA) pursuant to s.63 of *The Heritage Property Act*, the following factors were considered: the presence of previously recorded heritage sites, the area's overall heritage resource potential, the extent of previous land disturbance, and the scope of new proposed land development.

The proposed project is located on both cultivated land and undisturbed hummocky native prairie near seasonal water sources. The latter is a terrain type considered to have moderate to high potential for containing archaeological sites. Although none are presently in direct conflict with the development, there are a number of sites recorded nearby. As heritage resources may be adversely affected by this wind farm development, an HRIA study is required for those areas specified in Table 1.

The HRIA, including systematic surface survey and sub-surface test exploration, is a proponent responsibility. The study will first establish the presence of heritage sites within the project area and where suitable site avoidance measures (including right-of-way relocation) may be implemented. If heritage sites are located in unavoidable conflict with development, the study must also establish the content, structure and significance of those sites, and, on that basis, recommend both the need for and scope of any further study (including archaeological salvage excavation or other conservation action).

The HRIA must be carried out by qualified personnel under an approved investigation permit issued through this office. Normally, two days are required to process a heritage contractor's permit application.

...2

If you have any questions regarding these heritage regulatory requirements, please contact Kim Cloutier at the above address or by calling 787-2848. Thank you again for referring this proposed development and for your cooperation in protecting the province's cultural heritage.

Sincerely,

Carlos Germann
Director

cc: Kim Cloutier, Archaeologist, Heritage Conservation Branch, Ministry of Parks, Culture and Sport

Table 1: HRIA Requirements for 48 Heritage Sensitive Quarter Sections

Quarter Section	Infrastructure	HCB Requirement(s)	HCB Comments
SW-14-15-09-W3M	3 WTG New Access Road Collector Lines	**HRIA Required for WTG 23 buffer zone** No further concerns for WTG 18, SS-Main, Collector Lines and Access Roads	250 m buffer zone for WTG 23 impacts hummocky native prairie in SW and SE 14. Remainder is cultivated.
SW-21-15-09-W3M	1 WTG New Access Road Collector Line	No further concerns	Impacts cultivation and low wet areas
NW-06-16-09-W3M	Infrastructure Buffer	No further concerns	Impacts cultivation
SE-24-15-09-W3M	Infrastructure Buffer	No further concerns	Impacts cultivation and sloping wet areas
NE-20-15-09-W3M	1 WTG New Access Road Collector Line	No further concerns	Impacts cultivation
SE-06-16-09-W3M	Infrastructure Buffer	No further concerns	Impacts cultivation
SW-26-15-09-W3M	2 WTG New Access Road Collector Line	**HRIA Required for WTG 41 and 42 buffer zones** No further concerns	250 m WTG buffer zones impacts hummocky native prairie in SW&NW 26 and SE 27. Remainder

		for Access Road and Collector Line	is cultivated
NE-13-15-09-W3M	1 WTG New Access Road Collector Line	No further concerns	Impacts cultivation
NE-01-15-09-W3M	Infrastructure Buffer	No further concerns	Impacts cultivation and low wet area
SW-04-16-09-W3M	1 WTG New Access Road Collector Line	No further concerns	Collector line buffer zone impacts portions of native prairie but ploughed lines create minimal disturbance. Remainder in cultivation.
NE-33-15-09-W3M	1 WTG New Access Road Collector Line	No further concerns	Impacts cultivation
SE-30-15-08-W3M	1 Contingency WTG New Access Road Collector Line	No further concerns	Impacts cultivation
NW-03-16-09-W3M	Infrastructure Buffer	No further concerns	Impacts cultivation
NE-05-15-08-W3M	Infrastructure Buffer	No further concerns	Impacts cultivation
NW-04-16-09-W3M	2 WTG 1 Contingency WTG New Access Road Collector Lines	**HRIA Required for WTG 49 buffer zone** No further concerns for WTG 47 and C4, Access Roads and Collector Lines	250 m WTG buffer zone impacts hummocky native prairie adjacent to a seasonal water sources in NW&NE 4 and SW 9. Remainder is cultivated.
NW-14-15-09-W3M	Collector Line	No further concerns	Impacts sloping edge of a large landform (native prairie)
SW-03-16-09-W3M	Infrastructure Buffer	No further concerns	Impacts cultivation
SE-32-15-09-W3M	Infrastructure Buffer	No further concerns	Impacts cultivation
SE-07-16-09-W3M	1 Contingency WTG New Access Road Collector Lines	No further concerns	Impacts cultivation
SE-09-16-09-W3M	Infrastructure	No further concerns	Impacts cultivation

	Buffer		
NW-13-15-09-W3M	1 WTG New Access Road Collector Line	No further concerns	Impacts cultivation
NW-26-15-09-W3M	Infrastructure Buffer	**HRIA Required for WTG 42 buffer zone**	250 m buffer zone impacts hummocky native prairie
SW-33-15-09-W3M	Infrastructure Buffer	No further concerns	Collector line buffer zone impacts portions of hummocky native prairie but ploughed lines create minimal disturbance. Remainder is cultivated.
SE-05-16-09-W3M	Collector Line	No further concerns	Impacts cultivation and low wet areas
NE-14-15-09-W3M	Infrastructure Buffer	No further concerns	Impacts cultivation
SW-05-16-09-W3M	1 Contingency WTG New Access Road Collector Line	No further concerns	Impacts cultivation and low wet area
SE-14-15-09-W3M	1 WTG New Access Road Collector Line	No further concerns	Impacts cultivation
SE-21-15-09-W3M	Infrastructure Buffer	No further concerns	Impacts cultivation
NW-20-15-09-W3M	Infrastructure Buffer	No further concerns	Impacts cultivation
NE-04-16-09-W3M	2 WTG New Access Road Collector Line	No further concerns	Impacts cultivation
NE-21-15-09-W3M	1 WTG New Access Road Collector Line	**HRIA Required for WTG 38 and Access Road buffer zones (native prairie portions only).** No further concern for Collector Line.	Infrastructure buffer zones impact hummocky native prairie. Remainder is cultivated.
SE-28-15-09-W3M	Infrastructure Buffer	No further concerns	Collector line buffer zone impacts portions of hummocky native prairie but ploughed lines create

			minimal disturbance
SW-27-15-09-W3M	Infrastructure Buffer	No further concerns	Impacts cultivation. EbNt-4 located in this quarter section but is avoided by development.
SW-29-15-08-W3M	Infrastructure Buffer	No further concerns	Impacts cultivation and low wet area
SE-27-15-09-W3M	Infrastructure Buffer	**HRIA Required for WTG 41 buffer zone** No further concerns for Collector Line	250 m WTG buffer zone impacts hummocky native prairie. Remainder is cultivated.
NW-05-15-08-W3M	Infrastructure Buffer	No further concerns	Impacts cultivation
NW-05-16-09-W3M	Collector Line	No further concerns	Impacts cultivation
SW-23-15-09-W3M	Collector Line	No further concerns	Impacts cultivation
SW-28-15-09-W3M	Infrastructure Buffer	No further concerns	Impacts cultivation and low wet area
NW-21-15-09-W3M	1 WTG New Access Road Collector Line	No further concerns	Impacts cultivation and low wet area
NE-22-15-09-W3M	2 WTG 1 Contingency Substation New Access Road Collector Lines	**HRIA Required for WTG 40, SS-C1, and Access Road buffer zones (native prairie portions only).** No further concern for Collector Line.	Buffer zones impact portions of hummocky native prairie. Remainder is cultivated.
NE-32-15-09-W3M	Collector Line	No further concerns	Impacts cultivation
SE-05-15-08-W3M	Infrastructure Buffer	No further concerns	Impacts cultivation
SW-09-16-09-W3M	Infrastructure Buffer	**HRIA Required for WTG 49 buffer zone**	250 m buffer zone impacts hummocky native prairie
NE-06-16-09-W3M	1 Contingency WTG New Access Road Collector Line	No further concerns	Impacts cultivation and low wet area
NW-23-15-09-W3M	Collector Line	No further concerns	Collector line buffer zone impacts portions of hummocky native prairie but ploughed lines create minimal disturbance.

			Remainder is cultivated.
NW-33-15-09-W3M	Collector Line	No further concerns	Collector line impacts portions of hummocky native prairie but ploughed lines create minimal disturbance. Remainder is cultivated.
SE-20-15-09-W3M	Infrastructure Buffer	No further concerns	Impacts cultivation

I.2 HERITAGE CLEARANCE LETTER

I.2.2

Government
of
Saskatchewan

Ministry of Parks Culture and Sport

Heritage Conservation Branch
2nd Floor, 3211 Albert Street
Regina, Canada S4S 5W6

Phone: 306-787-5772
Carlos.germann@gov.sk.ca

December 14, 2017

Our file: 17-1558

Ms. Lauren Stead
Stantec Consulting Ltd.
Agent for: **Algonquin Power**
100 – 75 24th Street E
SASKATOON SK S7K 0K3
Email: lauren.stead@stantec.com

ORIGINAL E-MAILED
12/14/17

Dear Ms. Stead:

RE: Algonquin Power – Blue Hill Wind Project (Your file: 113254088); Heritage Resource Impact Assessment Review (Permit #17-188)

Please be advised we received (December 7, 2017) the final report from Stantec Consulting Ltd. on the heritage resource impact assessment (HRIA) of this project completed under Investigation Permit #17-188.

Four new archaeological sites (EbNs-2, 3, and EbNt-5, 6) were discovered in the course of pedestrian survey and subsurface testing of the development area (Table 1 below). Two of these EbNs-2 and EbNt-6) are considered "sites of a special nature" (SSN) pursuant to s.64 of *The Heritage Property Act* and must be afforded special consideration.

Provided all four sites can be avoided in accordance with the buffer zones noted in Table 1, this office has no further concerns with the project proceeding as planned. Please note that the buffer zones must be established or marked in the field by a professional archaeologist prior to construction.

If EbNs-3 cannot be avoided as noted, mapping and detailed sub-surface testing is required prior to construction. Depending on these results, possible further investigation including salvage exaction and data recovery may also be required.

If either EbNs-2 and EbNt-6 cannot be avoided as noted, this must be contacted to determine appropriate next steps when "sites of a special nature" may be impacted.

... 2

On behalf of the Heritage Conservation Branch, please convey our appreciation to Algonquin Power for having commissioned this investigation, and for its continuing assistance and support in preserving Saskatchewan's archaeological heritage.

Sincerely,

Carlos Germann
Director

Cc Kim Cloutier, Archaeologist, Heritage Conservation Branch

Table 1: Requirements for Site Avoidance on Blue Hill Wind Project (File: 113254088)

Borden No.	Legal	Site Type	Buffer Zone Requirements
EbNs-2	NW and SW 26-15-9-W3M	Multiple stone circle features; petroglyph (SSN)	• 200 m buffer zone for permanent Project infrastructure • 100 m buffer zone for temporary construction activities
EbNs-3	SE 27-15-9-W3M	Recurrent stone circle features	• Staked 15 m buffer zone around the site
EbNt-5	NW 20-15-9-W3M	Single Feature	• Outside of project area; no further requirements
EbNt-6	NE and NW 4-16-9-W3M	Recurrent stone circle and cairn features (SSN)	• 200 m buffer zone for permanent Project infrastructure • 100 m buffer zone for temporary construction activities

APPENDIX J
EMPLOYMENT AND ECONOMY

Appendix J EMPLOYMENT AND ECONOMY

J.1 ECONOMIC BENEFIT ANALYSIS

J.1.2

Blue Hill Wind Energy Project
Economic Benefit Analysis

Prepared for:
Algonquin Power

Prepared by:
Stantec Consulting Ltd.

December 2017

Table of Contents

LIST OF TABLES

Abbreviations

ABEX	Decommissioning Expenditure
CAPEX	Capital Expenditure
IOIC	Input-Output Industry Codes
MW	Megawatt
NAICS	North America Industry Classification System
O & M	Operation and Maintenance
OPEX	Operations Expenditure
PY	Person Year
RM	Rural Municipality
SCIPIOM	Statistics Canada Inter-Provincial Input Output Model

Glossary

Person years	Person years (PYs) is a unit of measurement used to describe the amount of work done by one person, working on a full-time basis, in one year.
Direct Employment	Employment with the Proponent and its contractors created through construction, operation and decommissioning of the Project (e.g., construction labour, project management).
Gross domestic product	Gross domestic product (GDP) is the total value of the goods and services produced in a given area (e.g., country) over a given period of time (typically on an annual basis). GDP can be measured in three ways: production approach, income approach and expenditure approach.
Indirect Employment	Employment created through Project spending on goods and services (e.g., employment with suppliers/manufacturers of materials used during construction).
Induced Employment	Employment created through the spending on behalf of direct and indirect workers on consumer goods and services (e.g., restaurant servers, retail positions).
Input-output Industry Classification	Input-output Industry Classification (IOIC), a variant of the North American Industry Classification System (NAICS), is used by Statistics Canada System of National Accounts which includes input-out tables, national and provincial multipliers and Statistics Canada Interprovincial Input-Output Model, among others.
National and provincial multipliers	Statistics Canada national and provincial multipliers, derived from input-output tables, are used to assess the effects on the economy of an exogenous change in final demand for the output of a given industry. Multipliers provide a measure of the interdependence between an industry and the rest of the economy. Multipliers show the direct, indirect, and induced effects on gross output, the detailed components of GDP, jobs, and imports. The provincial multipliers show the direct, and indirect effects.

North American Industry Classification System	The North American Industry Classification System (NAICS), formally adopted in 1997 by Canada, Mexico and the United States (against the backdrop of the North American Free Trade Agreement [NAFTA]), provides a common statistical framework and definition of the industrial structure of these countries. The Canadian version of NAICS is managed by Statistics Canada and is composed of sectors, subsectors, industry groups, and industries.
Statistics Canada Interprovincial Input-Output Model	The Statistics Canada's Interprovincial Input-Output Model (SCIPIOM), based on input-out tables, is used to simulate the economic impact on the business sector of an expenditure ('shock') on a given set of goods and services or the output of one of several industries. The model simulates direct and indirect impacts, including the number of jobs created, indirect taxes and subsidies generated and gross domestic product (among others).

1.0 INTRODUCTION

Algonquin Power (Algonquin) is proposing to construct the Blue Hill Wind Energy Project (the Project), a 177 megawatt (MW) wind energy facility, located in southern Saskatchewan, within the Rural Municipalities (RM) of Morse and Lawtonia. The Project will benefit both Saskatchewan and Canada through economic development and diversification, job creation, and increased government revenue. It will also support the current provincial government's strategic interest in developing the province's wind energy portfolio to meet 2030 renewable energy targets (SaskPower 2015).

This technical report estimates the Project's economic benefits during construction, operation and maintenance, and decommissioning. This information supports the discussion of Project Benefits, provided in Section 2 of the Environmental Impact Statement (EIS), and assessment of potential effects on employment and economy, provided in Section 10. Project benefit information provided in this report include employment, government revenue (e.g., tax revenue), and economic contributions to the Saskatchewan and Canadian economy.

2.0 METHODS, ASSUMPTIONS, AND LIMITATIONS

2.1 METHODS

Economic impacts were estimated using the following steps:

- The benefits analysis was undertaken at the local, provincial (Saskatchewan), and national levels. As depicted in Figure J1-1, the Local Assessment Area (LAA) and Regional Assessment Area (RAA) are defined as:
  - LAA: Communities within the Swift Current Census Agglomeration (CA) 720, and the Moose Jaw Census Division (CD) No. 7
  - RAA: Includes the LAA and communities within Regina CMA No. 705.
- Expenditure information provided by Algonquin Power for the three Project phases (construction, operation and maintenance, and decommissioning), were broken down by expenditure type, and region within which the expenditure will likely occur. Expenditures occurring in Saskatchewan were broken down into LAA, RAA, and "Other Saskatchewan." Other expenditures in Canada were classified as "Other Canada." Expenditures occurring outside of Canada, such as the purchase of equipment manufactured overseas, are not counted in the analysis.
- Expenditures were then categorized into commodity classes, based on North American Industry Classification (NAICS) 2012 and Statistics Canada Input-Output Industry Codes (IOIC).
- Economic impacts at the provincial (Saskatchewan) and federal level were estimated using multipliers obtained from Statistics Canada's Interprovincial Input-Output Model (SCIPIOM), for each commodity class (available from Statistics Canada 2017a). Multipliers are either expressed as a quotient of expenditure (e.g., dollars of GDP generated per dollar of expenditure), or as a relationship (e.g., number of jobs per $1 million of expenditure). Multipliers were used to estimate direct, indirect, and induced effects.

- The SCIPIOM does not provide local area multipliers. The following steps were undertaken to derive LAA and RAA employment multipliers:
  - LAA and RAA employment multiplier adjustment quotients were estimated by first deriving area multipliers for the LAA and RAA using Moore's equation[1] (from Thulin 2014), and then dividing these multipliers by the area multiplier for the province of Saskatchewan.
  - Applying Moore's equation, local area multipliers for the LAA and RAA are estimated at 1.83 and 2.23, respectively, while the area multiplier for the province of Saskatchewan is estimated at 2.70. Based on these multipliers the LAA and RAA adjustment quotients are estimated at 0.68 and 0.83, respectively.
  - These adjustment quotients were then applied to provincial level employment multipliers for each commodity class to estimate indirect and induced employment within the LAA and RAA.
- Government revenue includes corporate income taxes (federal and provincial), personal income taxes (federal and provincial), sales taxes (federal and provincial), and municipal taxes (i.e., property taxes).
- Sale and other consumption taxes were estimated based on SCIPIOM multipliers, from Statistics Canada 2017a.
- Corporate income taxes associated with expenditures were estimated based on a function of gross operating surplus, estimated from expenditures based using SCIPIOM multipliers, and nominal federal and provincial corporate tax rates.
- Personal income taxes were estimated based on a function of employment income and federal and provincial individual tax rates.
- Property tax information was provided by Algonquin.

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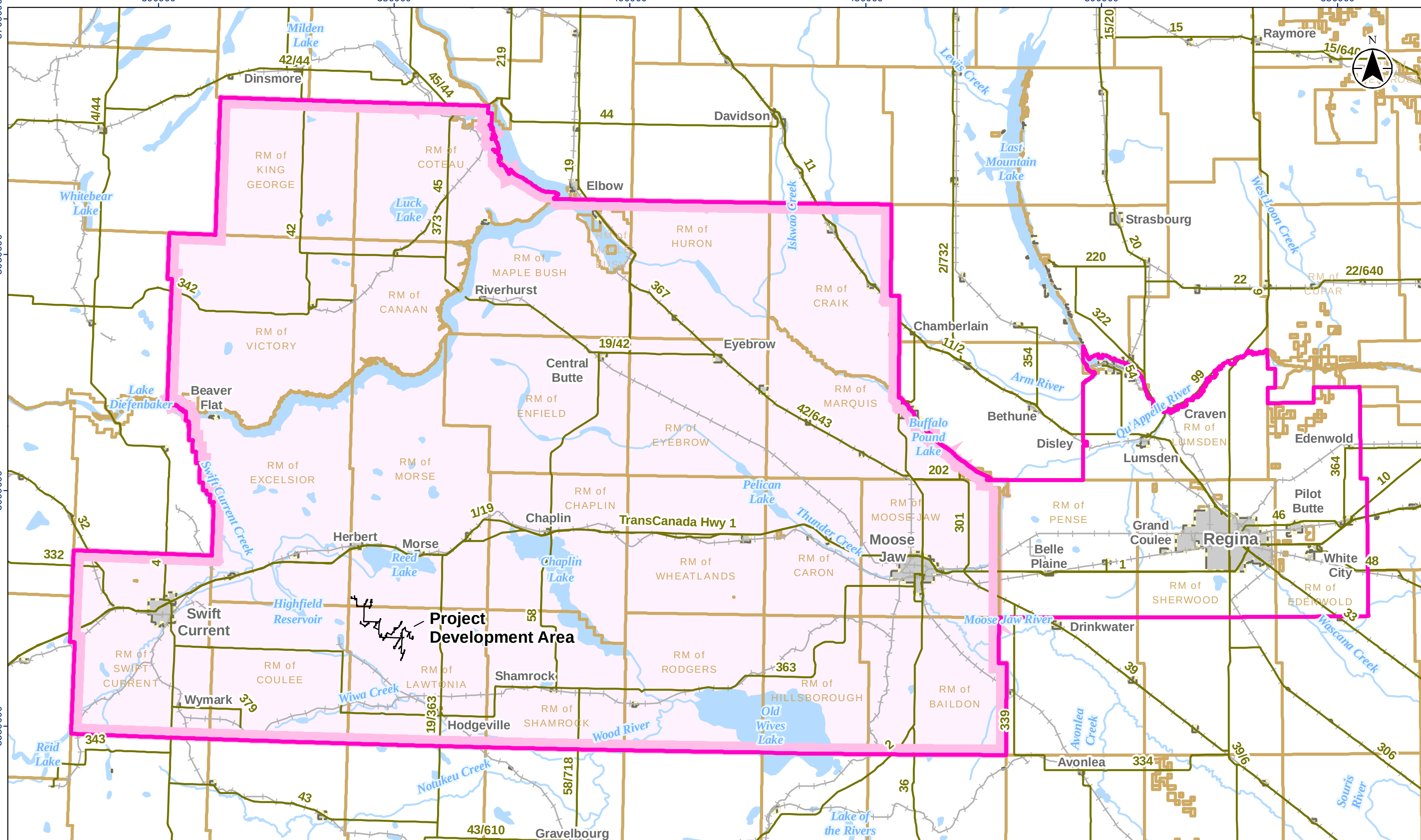
[1] From Thulin (2014), Moore's Equation is $M = 1/[1-(-0.20365 + 0.13783(\log P))]$, where M is the multiplier and P is the population. Moore's Equation is based on empirical research undertaken in the USA in the 1970s, which demonstrated that there is a direct relationship between population and the magnitude of economic multiplier. Areas with larger populations tend to have higher multipliers because the greater diversification of the economy supports larger potential for the recycling of dollars.



Employment and Economy Local Assessment Area

Employment and Economy Regional Assessment Area

Rural Municipality

Major Road

Railway

Town/City

Watercourse

Waterbody

0 10 20 30 Kilometers

1:1,250,000 (At original document size of 8.5x11)

Notes

1. Coordinate System: NAD 1983 UTM Zone 13N
2. Base features produced under license with the Government of Saskatchewan and the Government of Canada.
3. Assessment Areas are based on RM boundaries within Census Agglomeration, Census Divisions and Census Metropolitan Areas.

Stantec Algonquin

Project Location
Near Herbert, SK

113254088-049 REVA
Prepared by acory on 2017-12-18
Technical Review by ceidem on 2017-12-18

Client/Project
Algonquin Power Co.
Blue Hill Wind Energy Project

Figure No.
J1-1

Title
Employment and Economy Assessment Areas

2.2 ASSUMPTIONS AND LIMITATIONS

The following assumptions and limitations apply to the estimates provided in this report:

- Estimates are provided in 2017 nominal Canadian dollars
- The Project is at an early stage in planning, so expenditure estimates are subject to change
- Regional breakdown of expenditures reflects a pre-procurement estimate, and may be subject to change
- The results of the multiplier analysis using the SCIPIOM multipliers are considered accurate to within +/-25%
- Estimates of employment are rounded to the nearest 5 person-years (PYs). Dollar values rounded to the nearest $0.1 million.
- Corporate tax revenue that may be payable from revenues earned from power sales not included in the estimate of government revenue.

3.0 PROJECT COSTS

3.1 CAPITAL COSTS

Total Capital Expenditures (CAPEX), excluding costs associated with the procurement of wind turbine generators, blades, and towers, associated with construction of the Project is estimated at $93 million. Wind turbine generators, blades, and towers will be purchased from foreign suppliers, and therefore do not result in economic impacts within Canada. Of total CAPEX labour accounts for approximately $11 million and equipment, materials, goods, and services are $82 million. Of total domestic CAPEX, approximately 53% ($49 million) is expected to occur within Saskatchewan and 47% ($44 million) within other parts of Canada (see Table 3-1). Within Saskatchewan, 24% of provincial CAPEX ($12 million) is expected to occur within the local area and 76% ($37 million) within Regina CMA No. 705. A summary of CAPEX by location of accrual is provided in Table 3-1.

Table 3-1 Domestic CAPEX by Location

	$ millions				
	Saskatchewan				
Expenditure	LAA	Reginal CMA No. 705	RAA	Other Canada	Total Canada
Labour	1.6	2.8	4.4	6.9	**11.4**
Equipment, materials, goods, and services	10.4	34.6	45.0	36.7	**81.6**
Total	**12.0**	**37.4**	**49.4**	**43.6**	**93.0**
NOTE: 1) Totals may not sum due to rounding					
SOURCE: Algonquin 2017					

A description of estimated CAPEX, including a breakdown by major types of commodities and services that will be procured during construction, and the distribution of costs between Saskatchewan and other parts of Canada are listed in Table 3-2. Expenditures listed in Table 3-2 are additionally categorized by IOIC. In addition to expenditures identified in Table 3-2, Algonquin will be incurring site acquisition costs.

Table 3-2 Categorization of CAPEX, IOIC Industries and Location of Spend

Expenditure Category	Statistics Canada IOIC	$ millions				
		Saskatchewan			Other Canada	Total Canada
		LAA	Regina CMA No. 705	RAA		
Labour						
Pre-development						
Algonquin	BS221100 - Electric power generation, transmission, and distribution	0.0	0.0	0.0	2.0	**2.0**
Permitting external Services	BS541600 - Management, scientific and technical consulting services	0.0	0.5	0.5	0.0	**0.5**
General external services	BS541600 - Management, scientific and technical consulting services	0.0	0.4	0.4	0.1	**0.5**
Engineering and Development						
Algonquin	BS541300 - Architectural, engineering and related services	0.0	0.0	0.0	2.1	**2.1**
Construction						
Algonquin	BS221100 - Electric power generation, transmission, and distribution	0.1	0.4	0.5	0.5	**1.0**
Construction Services	BS23B000 - Non-residential building construction	0.2	0.2	0.4	1.1	**1.5**
Earthworks and Civil	BS23B000 - Non-residential building construction	0.6	0.6	1.1	0.0	**1.1**
Foundations	BS23B000 - Non-residential building construction	0.4	0.2	0.6	0.1	**0.7**
Wind turbine generator erection	BS23B000 - Non-residential building construction	0.1	0.3	0.3	0.6	**0.9**
Building (O&M)	BS23B000 - Non-residential building construction	0.0	0.0	0.1	0.0	**0.1**
Substation installation	BS23B000 - Non-residential building construction	0.1	0.1	0.1	0.0	**0.1**
General transport	BS484000 - Truck transportation	0.0	0.0	0.1	0.0	**0.1**
Collector system	BS23B000 - Non-residential building construction	0.0	0.1	0.1	0.1	**0.2**

Table 3-2 Categorization of CAPEX, IOIC Industries and Location of Spend

Expenditure Category	Statistics Canada IOIC	$ millions				
		Saskatchewan			Other Canada	Total Canada
		LAA	Regina CMA No. 705	RAA		
Energization and commissioning	BS221100 - Electric power generation, transmission, and distribution	0.0	0.1	0.1	0.4	**0.5**
Common services	BS561100 - Office administrative services	0.1	0.0	0.1	0.0	**0.1**
Subtotal (Labour)		**1.6**	**2.8**	**4.5**	**6.9**	**11.4**
Equipment, Materials, Goods and Services						
Pre-development						
Permits and approvals	BS541600 - Management, scientific and technical consulting services	0.0	2.0	2.0	0.0	**2.0**
Construction						
Wind Turbine Generators						
Turbines	BS333600 - Engine, turbine and power transmission equipment manufacturing	0.0	0.0	0.0	0.0	**0.0**
Blades	BS333600 - Engine, turbine and power transmission equipment manufacturing	0.0	0.0	0.0	0.0	**0.0**
Tower sections	BS333600 - Engine, turbine and power transmission equipment manufacturing	0.0	0.0	0.0	0.0	**0.0**
Foundations	BS23B000 - Non-residential building construction	0.0	15.0	15.0	5.0	**20.0**
Turbine erection	BS23B000 - Non-residential building construction	0.0	1.7	1.7	15.3	**17.0**
Lighting (NavCanada, etc.)	BS23B000 - Non-residential building construction	0.0	0.0	0.0	0.3	**0.3**
SCADA system and testing	BS541300 - Architectural, engineering and related services	0.0	0.1	0.1	0.1	**0.2**

Table 3-2 Categorization of CAPEX, IOIC Industries and Location of Spend

Expenditure Category	Statistics Canada IOIC	$ millions				
		Saskatchewan			Other Canada	Total Canada
		LAA	Regina CMA No. 705	RAA		
Substation						
Main power transformer	BS23B000 - Non-residential building construction	0.0	0.0	0.0	2.5	**2.5**
Control house	BS23B000 - Non-residential building construction	0.0	0.3	0.3	1.0	**1.3**
Substation, ‘other’ equipment	BS23B000 - Non-residential building construction	0.0	1.0	1.0	2.9	**3.8**
Civil/earthworks	BS23B000 - Non-residential building construction	0.5	0.5	1.0	0.0	**1.0**
Foundations	BS23B000 - Non-residential building construction	0.0	1.0	1.0	0.0	**1.0**
SCADA	BS541300 - Architectural, engineering and related services	0.0	0.1	0.1	0.4	**0.5**
SCADA system and testing	BS541300 - Architectural, engineering and related services	0.0	0.1	0.1	0.1	**0.2**
Commissioning	BS221100 - Electric power generation, transmission, and distribution	0.0	0.0	0.0	0.4	**0.4**
Other Construction Components						
Batch plant	BS23B000 - Non-residential building construction	0.0	0.1	0.1	0.1	**0.3**
Laydown area(s)	BS23B000 - Non-residential building construction	0.2	0.2	0.4	0.0	**0.4**
Road maintenance	BS23C100 - Transportation engineering construction	0.8	0.3	1.0	0.0	**1.0**
Erosion control	BS541600 - Management, scientific and technical consulting services	0.4	0.1	0.5	0.0	**0.5**
Restoration	BS541600 - Management, scientific and technical consulting services	0.4	0.1	0.5	0.0	**0.5**
Building permits	GS913000 - Other municipal government services	0.0	0.0	0.0	0.0	**0.0**
Utilities	BS221300 - Water, sewage, and other systems	0.2	0.1	0.2	0.0	**0.2**
Misc. (fencing, screws, etc.)	BS416000 - Building material and supplies wholesaler-distributors	0.1	0.0	0.1	0.0	**0.1**

Table 3-2 Categorization of CAPEX, IOIC Industries and Location of Spend

Expenditure Category	Statistics Canada IOIC	$ millions				
		Saskatchewan			Other Canada	Total Canada
		LAA	Regina CMA No. 705	RAA		
Civil/Earthworks						
Access roads and RM road upgrades	BS23C100 - Transportation engineering construction	5.0	5.0	10.0	0.0	**10.0**
Temporary roads, pads, crossings	BS23C100 - Transportation engineering construction	2.5	2.5	5.0	0.0	**5.0**
Collector System						
Cable and plowing	BS23B000 - Non-residential building construction	0.0	2.0	2.0	6.0	**8.0**
Other	BS23B000 - Non-residential building construction	0.0	0.8	0.8	2.3	**3.0**
Other Facilities/Equipment						
O&M building	BS23B000 - Non-residential building construction	0.5	1.5	2.0	0.0	**2.0**
MET tower	BS334A00 - Other electronic product manufacturing	0.0	0.1	0.1	0.4	**0.5**
Office Lease	BS531100 - Lessors of real estate	0.0	0.0	0.0	0.0	**0.0**
Subtotal (Equipment, Materials, Goods and Services)		**10.4**	**34.6**	**45.0**	**36.7**	**81.6**
Total (Labour, Equipment, Materials, Goods and Services)		**12.0**	**37.4**	**0.0**	**49.4**	**43.6**
NOTE: 1) Totals may not sum due to rounding						
SOURCE: Algonquin 2017						

3.2 OPERATING AND MAINTENANCE COSTS

Project operation expenditures (OPEX) is estimated at $800,000 annually. This includes $700,000 in labour and $100,000 in equipment, materials, goods, and services. A description of estimated OPEX, including a breakdown by major types of commodities and services that will be procured during operation and maintenance, and the distribution of costs between Saskatchewan and other parts of Canada are listed in Table 3-3. Expenditures listed in Table 3-3 are additionally categorized by IOIC.

Table 3-3 Categorization of OPEX Expenditures, IOIC Industries and Location of Spend

Expenditure Category	Statistics Canada IOIC	$ millions				
		Saskatchewan				
		LAA	Regina CMA No. 705	RAA	Other Canada	Total Canada
Labour						
Algonquin	BS23C300 - Electric power engineering construction	0.1	0.0	0.1	0.0	**0.1**
Turbine	BS811A00 - Repair and maintenance (except automotive)	0.6	0.0	0.6	0.0	**0.6**
Subtotal (Labour)		**0.7**	**0.0**	**0.7**	**0.0**	**0.7**
Equipment, Materials, Goods and Services						
Common Services	BS23C300 - Electric power engineering construction	0.1	0.0	0.1	0.0	**0.1**
Subtotal (Equipment, Materials, Goods and Services)		**0.1**	**0.0**	**0.1**	**0.0**	**0.1**
Total (Labour, Equipment, Materials, Goods and Services)		**0.8**	**0.0**	**0.8**	**0.0**	**0.8**
NOTE: 1) Totals may not sum due to rounding						
SOURCE: Algonquin 2017						

In addition to expenditures described in Table 3-3, it is currently estimated that annual land owner payments of 0.4 million to 0.6 million will occur. These payments will occur within the LAA. Land owner payments are not included in Table 3-3 as indirect and induced effects are not modelled (subsequent spending of payments on the part of landowners is unknown).

3.3 DECOMMISSIONING

Decommissioning is estimated to occur over a two-year period following the 25-year operational life of the Project (should capital investments in prolonging the operational life of the Project not occur). Decommissioning costs (ABEX) are conceptual and based on an 'order-of-magnitude' estimation of total costs associated with constructing the project. Conceptually, decommissioning costs are estimated at roughly $50 million, inclusive of labour, equipment, materials, goods, and service costs. Approximately 50% of expenditures are estimated to occur in the LAA and 50% in Regina CMA No. 705. A description of estimated ABEX, categorized by IOIC, is provided in Table 3-4.

Table 3-4 Categorization of Estimated ABEX Expenditures, IOIC Industries and Location of Spend

Expenditure Category	Statistics Canada IOIC	$ millions				
		Saskatchewan			Other Canada	Total Canada
		LAA	Regina CMA No. 705	RAA		
Labour						
Construction, earthworks, equipment operation, transport, etc.	• BS221100 - Electric power generation, transmission, and distribution • BS23B000 - Non-residential building construction • BS484000 - Truck transportation	2.8	2.8	5.6	0.0	5.6
Common Services	• BS561100 - Office administrative services	0.0	0.1	0.1	0.0	0.1
Subtotal (Labour)		**2.8**	**2.9**	**5.7**	**0.0**	**5.7**
Equipment, Materials, Goods and Services						
Turbine and general infrastructure dismantling and removal; site remediation, road maintenance etc.	• BS23B000 - Non-residential building construction • BS23C100 - Transportation engineering construction • BS541600 - Management, scientific and technical consulting services • BS221300 - Water, sewage, and other systems • BS23C100 - Transportation engineering construction	22.0	22.0	44.0	0.0	44.0
Subtotal (Equipment, Materials, Goods and Services)		**22.0**	**22.0**	**44.0**	**0.0**	**44.0**
Total (Labour, Equipment, Materials, Goods and Services)		**24.8**	**24.9**	**49.7**	**0.0**	**49.7**
NOTE: 1) Totals may not sum due to rounding						
SOURCE: Stantec 2017						

4.0 EMPLOYMENT

Project expenditures during construction, operation and maintenance, and decommissioning have the potential to result in direct, indirect, and induced employment. Employment is created through three primary pathways:

- Project expenditures on labour will result in direct employment during all Project phases
- Project purchases of equipment, materials, goods and services from local and regional businesses could create indirect employment
- The purchase of consumer goods and services by individuals who are employed directly or indirectly by the Project could create induced employment

The following sections present estimated employment in person-years (PYs) for construction, operation and maintenance, and decommissioning.

4.1 CONSTRUCTION

Total domestic employment (direct, indirect, and induced) associated with Project construction is estimated at 295 PYs (Table 4-1). Total direct employment is estimated at 85 PYs and indirect and induced (combined) employment at 210 PYs. Total Saskatchewan employment is estimated at 65 PYs (22% of total domestic employment).

Table 4-1 Construction Employment (PYs)

Direct, Indirect or Induced Effect	Person-years				
	Saskatchewan			Other Canada	Total Canada
	LAA	Regina CMA No. 705	RAA		
Direct	20	25	45	40	**85**
Indirect	10	10	20	190	**210**
Induced					
Total	**30**	**35**	**65**	**230**	**295**

NOTE:
1) Totals may not sum due to rounding

SOURCE: Algonquin 2017; economic multipliers taken from Statistics Canada 2017a

4.2 OPERATION AND MAINTENANCE

Annual employment (direct, indirect, and induced) associated with Project operation and maintenance is estimated at nine PYs (Table 4-2). Total direct employment is estimated at seven PYs and indirect and induced (combined) employment at two PYs. All domestic operation and maintenance employment occurs in Saskatchewan.

Table 4-2 Operation and Maintenance Employment (PYs)

<table>
<tr><th rowspan="3">Direct, Indirect or Induced Effect</th><th colspan="5">Person-years</th></tr>
<tr><th colspan="3">Saskatchewan</th><th rowspan="2">Other Canada</th><th rowspan="2">Total Canada</th></tr>
<tr><th>LAA</th><th>Regina CMA No. 705</th><th>RAA</th></tr>
<tr><td>Direct</td><td>7</td><td>0</td><td>7</td><td>0</td><td>7</td></tr>
<tr><td>Indirect</td><td rowspan="2">2</td><td rowspan="2">0</td><td rowspan="2">2</td><td rowspan="2">0</td><td rowspan="2">2</td></tr>
<tr><td>Induced</td></tr>
<tr><td>Total</td><td>9</td><td>0</td><td>9</td><td>0</td><td>9</td></tr>
<tr><td colspan="6">NOTE:
1) Totals may not sum due to rounding</td></tr>
<tr><td colspan="6">SOURCE: Algonquin 2017; economic multipliers taken from Statistics Canada 2017a</td></tr>
</table>

4.3 DECOMMISSIONING

Conceptually, total (direct, indirect, and induced) decommissioning employment is estimated at 180 PYs. Total direct employment is estimated at 60 PYs and indirect and induced (combined) employment at 115 PYs. Because decommissioning is estimated to occur 25-years into the future, a breakdown of employment by location is not provided.

5.0 LABOUR INCOME

Project expenditures during construction, operation and maintenance, and decommissioning have the potential to result in direct, indirect, and induced labour income. Labour income is created through three primary pathways:

- Project expenditures on direct labour
- Project purchases of equipment, materials, goods and services
- The purchase of consumer goods and services by individuals who are employed directly or indirectly by the Project

The following sections present estimated labour income for construction, operation and maintenance, and decommissioning.

5.1 CONSTRUCTION

Total domestic labour income associated with Project construction is estimated at $22.4 million. Direct employment accounts for approximately 51% ($11.4 million) of total labour income with indirect and induced employment accounting for the remaining 49% ($11.1 million). The average cost of direct labour is estimated at $133,780/full-time equivalent (FTE)[2] Canada-wide. The average cost of indirect and induced labour is estimated at $52,700/FTE. A summary of direct, indirect, and induced labour income associated with the Project is provided in Table 5-1.

Table 5-1 Domestic Construction Labour Income

Effect	$ millions				
	Saskatchewan			Other Canada	Total Canada
	LAA	Regina CMA No. 705	RAA		
Direct	1.6	2.8	4.4	6.9	**11.4**
Indirect	0.5	0.5	1.0	6.2	**11.1**
Induced				3.9	
Total[1]	**2.1**	**3.3**	**5.4**	**17.0**	**22.4**
NOTE: 1) Totals may not sum due to rounding					
SOURCE: Algonquin 2017; economic multipliers taken from Statistics Canada 2017a					

[2] One FTE is equivalent to one person working full-time for one year.

5.2 OPERATION AND MAINTENANCE

Annual labour income associated with Project operation and maintenance is estimated at $810,000. Direct employment accounts for approximately 89% ($720,000) of annual labour income with indirect and induced employment accounting for the remaining 11% ($90,000). The average cost of direct labour is estimated at $102,225/FTE Canada-wide. The average cost of indirect and induced labour is estimated at $53,312/FTE, respectively. A summary of direct, indirect, and induced labour income associated with the Project is provided in Table 5-2.

Table 5-2 Annual Operation and Maintenance Labour Income

Effect	$ millions				
	Saskatchewan				
	LAA	Regina CMA No. 705	RAA	Other Canada	Total Canada
Direct	0.7	0.0	0.7	0.0	**0.7**
Indirect	0.1	0.0	0.1	0.0	**0.1**
Induced					
Total[1]	**0.8**	0.0	0.8	0.0	**0.8**

NOTE:
1) Totals may not sum due to rounding

SOURCE: Algonquin 2017; economic multipliers taken from Statistics Canada 2017a

5.3 DECOMMISSIONING

Total labour income associated with decommissioning is estimated at $12 million (2017 dollars) based on conceptual ABEX estimates. Based on conceptual employment estimates) the cost of Canada-wide labour is estimated at $103,000/FTE for direct employment, $50,000/FTE for indirect and induced employment. Because decommissioning is estimated to occur 25-years into the future location-specific information on labour income is not presented.

6.0 GOVERNMENT REVENUE

The Project will contribute to government revenues through direct, indirect, and induced economic activity. Based on the location of the Project contributions to municipal, provincial, and federal governments are anticipated. Table 6-1 provides a summary of direct, indirect, and induced government revenue for Saskatchewan, and Canada for construction and operation and maintenance. Since decommissioning is estimated to occur 25-years into the future, at which time government tax rates will likely differ from those available at the time of writing, estimates of government revenue are not provided. Estimates of municipal revenue are limited to direct effects within Saskatchewan.

An estimated $16.6 million in federal government revenue will be generated during Project construction through the collection of corporate income tax, personal income tax and sales tax (Table 6-1). Provincial government revenue is estimated at $13.6 million.

Operation and maintenance activities are estimated to generate $0.4 million in federal government revenue and $0.3 million in provincial government revenue annually. As well, the Project will pay property tax, in an amount to be determined by the local taxing authority.

Table 6-1 Government Revenue (Direct, Indirect, and Induced)

Location	Type	$ millions	
		Construction (Total)	Operation and Maintenance (Annual)
Saskatchewan			
Federal	Corporate income tax	4.5	0.1
	Personal income tax	1.4	0.1
	Sales tax	0.0	0.0
	Subtotal	**5.9**	**0.2**
Provincial	Corporate income tax	3.6	0.1
	Personal income tax	0.7	0.1
	Sales tax	1.1	0.0
	Subtotal	**5.4**	**0.2**
Municipal	Other taxes	0.0	To be determined
	Subtotal	**0.0**	**To be determined**
	Subtotal	**11.2**	**0.4**

Table 6-1 Government Revenue (Direct, Indirect, and Induced)

Location	Type	$ millions	
		Construction (Total)	Operation and Maintenance (Annual)
'Other' Canada			
Federal	Corporate income tax	5.5	0.1
	Personal income tax	5.2	0.0
	Sales tax	0.1	0.0
	Subtotal	**10.8**	**0.1**
Provincial	Corporate income tax	4.8	0.1
	Personal income tax	2.9	0.0
	Sales tax	0.4	0.0
	Subtotal	**8.1**	**0.1**
	Subtotal	**19.1**	**0.2**
Total Canada			
Federal	Corporate income tax	9.9	0.3
	Personal income tax	6.6	0.1
	Sales tax	0.1	0.0
	Subtotal	**16.6**	**0.4**
Provincial	Corporate income tax	8.4	0.2
	Personal income tax	3.7	0.1
	Sales tax	1.5	0.0
	Subtotal	**13.6**	**0.3**
Municipal	Other taxes	0.0	To be determined
	Subtotal	**0.0**	**To be determined**
	Grand Total	**30.3**	**0.6**

NOTE:
1) Totals may not sum due to rounding

SOURCE: Algonquin 2017, Government of Canada 2017, Statistics Canada 2017a, 2017b, and 2017c

7.0 ECONOMIC CONTRIBUTION

7.1 CONSTRUCTION

Domestic CAPEX are predicted to generate $79.6 million in GDP, of which 45% ($35.7 million) will be generated in Saskatchewan and 55% ($43.9 million) within other parts of Canada. A summary of direct, indirect, and induced GDP generated through CAPEX associated with the Project is provided in Table 7-1. GDP effects are not calculated at the local/'other' regional level.

Table 7-1 Gross Domestic Product (million $), Construction

Effect	$ millions		
	Saskatchewan	'Other' Canada	Total Canada
Direct	22.5	20.9	**43.3**
Indirect	8.3	14.4	**22.7**
Induced	4.9	8.7	**13.6**
Total	**35.7**	**43.9**	**79.6**
NOTE: 1) Totals may not sum due to rounding			
SOURCE: Algonquin 2017; economic multipliers taken from Statistics Canada 2017a			

7.2 OPERATION AND MAINTENANCE

OPEX are expected to generate $0.7 million annually in GDP, all of which is estimated to be generated in Saskatchewan. A summary of direct, indirect, and induced annual GDP generated through OPEX associated with the Project is provided in Table 7-2. GDP effects are not calculated at the local level.

Table 7-2 Annual Gross Domestic Product, Operation and Maintenance

Effect	$ millions		
	Saskatchewan	'Other' Canada	Total Canada
Direct	0.5	0.0	**0.5**
Indirect	0.1	0.0	**0.1**
Induced	0.1	0.0	**0.1**
Total	**0.7**	**0.0**	**0.7**
NOTE: 1) Totals may not sum due to rounding			
SOURCE: Algonquin 2017; economic multipliers taken from Statistics Canada 2017a			

7.3 DECOMMISSIONING

It is estimated that ABEX could generate $35 million in GDP, all of which is estimated to occur in Saskatchewan. Direct effects are estimated to account for 63% ($22 million) of generated GDP, indirect effects 23% ($8 million), and indirect effects 14% ($5 million). GDP effects are not calculated at the local/'other' regional level.

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