Voisey's Bay Wind Energy Project Environmental Assessment Registration

Vale Newfoundland & Labrador Limited
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Happy Valley-Goose Bay, NL A0P 1E0

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Aivek Stantec Limited Partnership. (Project No. 121415527.700.200) December 2021

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1.0 INTRODUCTION

1.1 DESCRIPTION OF THE PROPONENT

Name of the Corporate Body:	Vale Newfoundland & Labrador Limited and Innu-Inuit Envest Limited Partnership
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President	John O'Shaugnessy Vale Newfoundland & Labrador Limited, General Manager, Labrador Operations Jason Moretto President, Innu-Inuit Envest GP Inc. (General Partner of Innu-Inuit Envest Limited Partnership)
Principal Contact for Environmental Assessment:	Andrew Kasza Vice-President – Engineering and Projects Envest Corp. 77 King Street West, Suite 3000 P.O. Box 95, TD Centre North Tower Toronto, ON, M5K 1G8 Tel: (905) 906-7657 e-mail: ak@envestcorp.com

This submission is for the development of a wind energy project at the Voisey's Bay mine site.

Innu-Inuit Envest Limited Partnership ("IIE") proposes to build, own, and operate the Voisey's Bay Wind Energy Project (the "Project"; including the wind turbines and related infrastructure described in further detail below, which comprise the Project).

IIE is a limited partnership, the limited partners of which are Innu Development Limited Partnership and NGC Nunatsiavut Inc., and Envest Corp (Envest). IIE was nominated to negotiate with VNL in respect of the Project pursuant to the process outlined in separate Impacts and Benefits Agreements with, respectively, the Innu Nation and the Nunatsiavut Government and VNL. Innu Development Limited Partnership is an economic development entity of the Innu Nation, and NGC Nunatsiavut Inc. is an economic development entity of the Nunatsiavut Government. Envest Corp. is an independent energy producer delivering private utility and recycling solutions to industry and government. Envest finances, builds, owns and operates turnkey clean energy systems tailored to customers' objectives in mission critical environments. Envest principals have experience with over 1,700 MW of on-shore wind generation assets in North America, covering experience in all phases of the wind generation project lifecycle including development, construction, commissioning, operation/maintenance, and asset management. In addition, Envest's Project Management Team has experience with over 1,500 MW of offshore wind generation assets throughout Europe. Envest was founded on principles based on commitments to Indigenous peoples. Its leadership team has pre-eminent experience in Canada in structuring energy and infrastructure transactions with Indigenous communities, including the Henvey Inlet Wind project, the largest First Nation wind partnership project in Canada (300 MW).

To facilitate the Project, VNL proposes to sublet a portion of its existing Surface Lease to IIE. The Project will be located on such sub-leased lands. VNL and IIE propose to enter into a Power Purchase Agreement for the supply by IIE of all energy and environmental attributes generated by the Project to VNL. VNL will be the sole customer of IIE. Pursuant to the Power Purchase Agreement, IIE will be responsible to design, engineer, procure, develop, construct, commission, operate and maintain the Project for the full term of the Power Purchase Agreement. IIE will be responsible to deliver the energy produced by the Project to VNL at the interconnection point between the Project and VNL's electrical facilities at the Voisey's Bay mine. Certain VNL equipment and facilities such as the dock, vehicles, and storage buildings may be used by IIE in respect of the construction, maintenance and operation of the Project in order to reduce the amount of equipment and facilities that must be brought to, or constructed at, the Voisey's Bay mine in order to build and operate the Project.

VNL is not the proponent of the Project as it will neither be the entity carrying out the Project or have charge, control or management of the Project. However, as set out in this document, VNL has significant involvement in aspects of the Project. This includes being the sole customer for the Project; being the lessor of the property involved; certain of VNL's assets and facilities being used during the construction and operations phases of the Project; the Project being required to comply with VNL's waste management, environmental responsibility and occupational health and safety requirements; and Vale having performed most environmental analysis and monitoring to date and being responsible for continuing monitoring for the Project. As a result, VNL is applying as co-proponent with IIE on this application in respect of the Project, on the basis that this will ensure all relevant parties and information are before the Department in the consideration of this application.

VNL and IIE will remain arm's length commercial parties and will not at any time be and are not representing by this submission that they will at any time be, affiliates, partners or joint venturers. There is no intention to create a joint corporate entity to carry out the Project.

1.2 NAME OF THE PROJECT

Voisey's Bay Wind Energy Project (the "Project").

1.3 PROJECT OVERVIEW

Since 2005, Vale Newfoundland & and Labrador Limited (VNL) has operated the Voisey's Bay mine, a remote open pit mine and processing site approximately 35 kilometers (km) south of Nain, in northern Labrador (Figure 1-1). The 8,100 tonnes-per-day facility produces nickel concentrate and copper concentrate. Nickel concentrate produced at Voisey's Bay is processed at VNL's hydrometallurgical processing facility in Long Harbour, on the island of Newfoundland. The Voisey's Bay mine is currently undergoing an expansion and transitioning from an open pit to an underground mine. Construction for the

Voisey's Bay Mine Expansion (VBME) project began in 2016, with underground mining production planned to begin in 2021. The underground mining development will occur at the Eastern Deeps and the Reid Brook deposits. The life of underground mining is currently estimated to end in 2036. In addition, an open pit mine is also being developed at Discovery Hill, which is expected to provide up to 5.3 Mt of potential ore grade material over its life of mine. The open pit mining at Discovery Hill will allow the mine to continue operating at full production in the time between the end of the open pit mining at the Ovoid pit, and the start-up and ramp-up for the underground mining operations.

The Project will provide supplemental electrical power to VNL's mining operations at Voisey's Bay. The Project will offset the forecasted diesel requirements of the VBME project, along with meeting Vale's global initiative to have a zero net carbon footprint in its operations by 2050. The Project will be comprised of five 4.2 megawatt (MW) wind turbines, having rotor diameters of 138 to 150 meters (m) and blade tip heights of 150 to 185 m, depending on the model of wind turbine chosen for the Project, together with associated electrical equipment required to collect and deliver electricity to VNL. This opportunity is intended to offset more than 13% of the forecasted diesel requirements at completion of the VBME Project. Such a target would result in an approximately 10 million litres / year reduction in the base case for diesel consumption. This will avoid approximately 25,000 tonnes of carbon dioxide equivalent (CO_2e) of greenhouse gas (GHG) emissions per year. Ongoing studies are reviewing these estimates and looking for ways to enhance offsetting of diesel use. Energy produced from the Project is intended solely for the use of the mine expansion and used as an off-grid system (no connection to external power grid).

The planned turbine site ("GPS Hill" site) is located within VNL's Surface Lease area and immediately east of existing Voisey's Bay mining operations (Figure 1-1). Selection of the GPS Hill site was made based on a consideration of wind resources (wind speeds), topography, geology, turbine size and logistics of construction and installation.

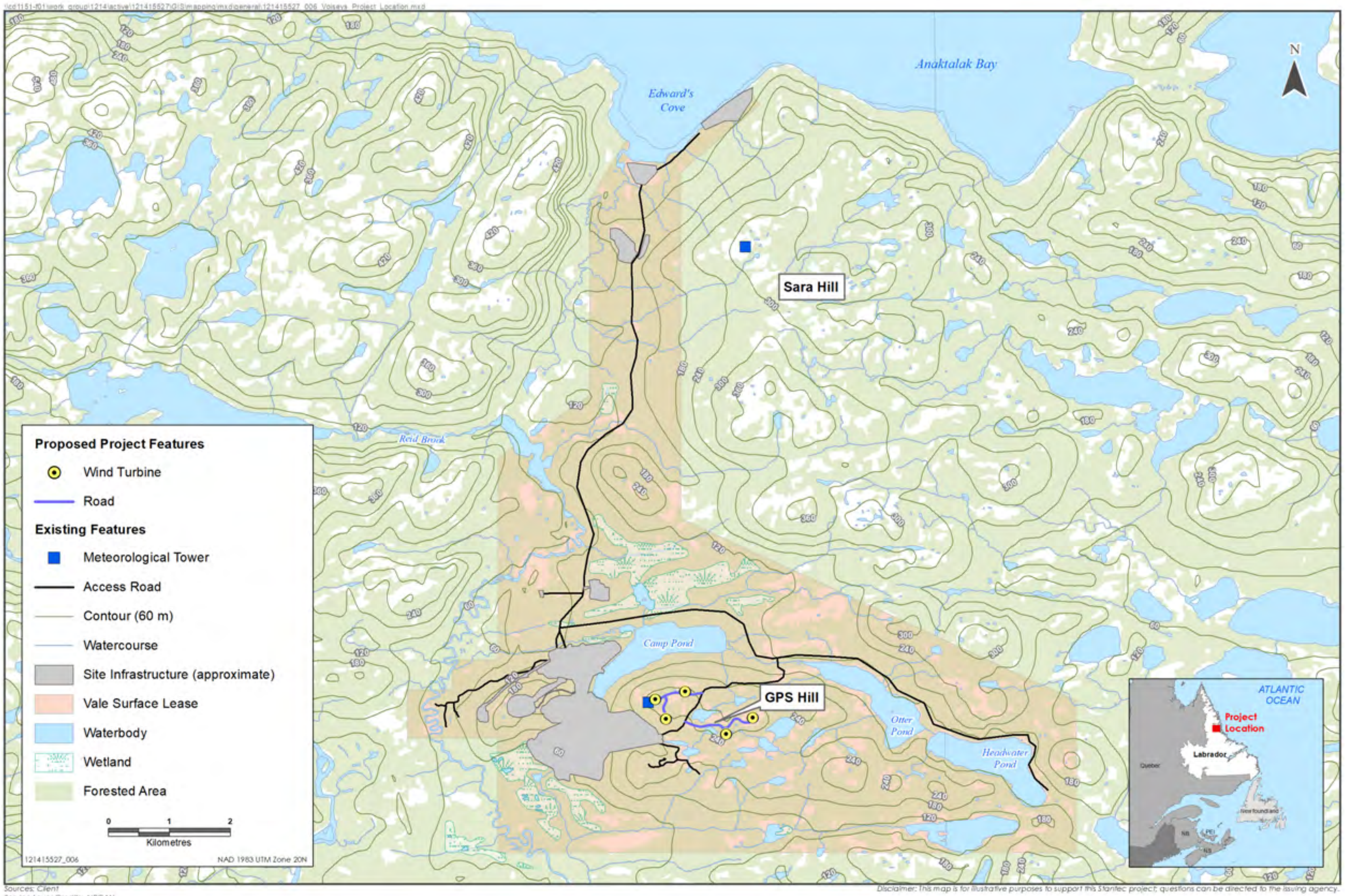

Figure 1-1 Project Location

1.4 NEED / PURPOSE / RATIONALE

The purpose of the Project is to offset the forecasted diesel requirements of the expanded Voisey's Bay mine site, along with meeting Vale's global initiative to have a zero net carbon footprint in its operations by 2050.

Remote mining projects that are not connected to central electrical grid networks like the Voisey's Bay mine typically operate on 100% fossil fuel (diesel) power supply. They generate carbon emissions and require fuel ships to travel in sensitive areas. Integrating renewable power to the mine power supply mix would allow a reduction in the expected Voisey's Bay mine power plant diesel consumption and carbon emissions by over 13%, representing cuts of 9.9 million liters of diesel and 25,219 tons of carbon equivalent each year (Table 1.1). Reducing diesel consumption will also help Vale mitigate its exposure to future oil price changes. Wind energy is inherently intermittent and variable. Consequently, an energy storage system will also be added to maintain grid stability even in high or changing wind conditions.

As the Voisey's Bay mine undergoes a transition from open pit mining to underground operations and important planning of underground infrastructure progresses a clear requirement for additional power supply has been identified. With increased energy demand the current approach to significantly higher electricity requirements for the underground mine operations includes the addition of 6 new diesel generators (Reid Brook – 3 generators; Eastern Deeps – 3 generators). In response to forecast changes in energy demand, including significantly higher operating costs resulting from increased diesel consumption, VNL are evaluating options to supplement these demands through alternative or renewable energy sources with a goal of integrating wind energy into the existing and expanded electrical system by 2023. Table 1.1 provides a comparison of diesel use, carbon emissions, heating requirements and cost savings for two scenarios: the base scenario if diesel is used to power the project; and the scenario in which the Project goes forward with five turbines.

Table 1.1 Comparison of Base Case Scenario (Diesel Only) with Five Wind Turbine Scenario

		Base Case Scenario (Diesel Only)	**Five Turbine + Battery Storage Scenario**
Power Station	Average Diesel Power Output	32.4 MW	25.9 MW
	Total Diesel Consumption	72.4 ML/yr	62.5 ML/yr
	Average Diesel Penetration	100.0%	79.8%
	Total Diesel Reduction (%)		**13.6%**
	Carbon Emissions	193,583 t/yr	168,364 t/yr
Heat	Additional Heating Required (MW)	0.0 MW	18.0 MW
	Additional Heaters CAPEX	0.0 M$	4.5 M$
	Additional Heaters OPEX	0.000 M$	0.090 M$

Table 1.1 Comparison of Base Case Scenario (Diesel Only) with Five Wind Turbine Scenario

		Base Case Scenario (Diesel Only)	Five Turbine + Battery Storage Scenario
Wind	Number of Turbines		5
	Rated Capacity		21.0 MW
	Net Average Wind Penetration		20.2%
	Annual Output (after curtailment)		57.2515 GWh
	Wind Power Curtailed		0.0%
Savings Versus Diesel Only Case	Net Fuel Savings (L)		9.9 ML/yr
	Net Fuel Savings ($/yr)		9.7 M$/yr
	Additional System Costs Due to Wind		2.506 M$/yr
	GHG Savings (CO2eq)		25,219 t/yr
	Total Savings (Fuel + O&M) ($/yr)		8.45 M$/yr

1.5 PROJECT SCHEDULE

A high-level preliminary Project schedule is presented in Table 1.2. Project construction will begin in 2022, with commissioning anticipated to be completed in December 2023. The Project is anticipated to provide power through the end of the mine life, currently forecast to be 2034 (11 years post-turbine construction), and into the decommissioning phase. However, this mine life may extend if additional deposits and expansions are realized. The turbines have a design life of 25-30 years, which accommodates the forecast, as well as an extended mine life should this occur.

Table 1.2 Proposed Project Schedule

Task	Start	Finish
Engineering Design	November 2021	March 2022
Permitting	December 2020	August 2022
Procurement	May 2022	July 2022
Geotechnical Survey	August 2022	October 2022
Construction	August 2022	October 2023
Commissioning	October 2023	November 2023
Operation / Maintenance	December 2023	2035 (currently planned)
Decommissioning	2035 (currently planned)	

1.6 APPROVAL OF THE UNDERTAKING

1.6.1 Internal Approval of the Project

The business model contemplates the infrastructure and assets required for the Project being built, owned and operated by IIE with VNL being the sole customer of IIE. As noted above, the Project will provide supplemental electrical power to VNL's mining operations at Voisey's Bay.

VNL and IIE will seek the necessary internal approvals to authorize the Project in accordance with their respective corporate governance structures.

1.6.2 Regulatory Permits and Authorizations

The permits and authorizations that may be required, or amendments to existing permits and authorizations for the Project are provided in Table 1.3. VNL and IIE will identify and seek the necessary provincial and federal permits, authorizations and other approvals that are required for the Project. The Project will also be subject to certain existing permits that VNL have obtained for current activities at their site, which are summarized in Table 1.4. The determination of which of VNL or IIE may apply for particular permits will be a function of the nature of the permit or authorization and possibly the timing of the finalization of the commercial arrangements between the parties. IIE and VNL will consult with regulators to determine which of the existing permits / approvals listed in Table 1.4 can be applied to the Project, and which will need to be obtained specifically by IIE.

Table 1.3 Permits and Authorizations Potentially Required by the Project

Permit or Authorization	Legislation / Regulation	Agency
Approval for a Wind Project / Industrial Generation		Department of Industry, Energy and Technology
Update / Amendment to Development Plan	*Mining Act*	Mines Branch, Mineral Development Division, Department of Industry, Energy, and Technology
Update / Amendment to Rehabilitation and Closure Plan	*Mining Act*	Mines Branch, Mineral Development Division, Department of Industry, Energy, and Technology
Environmental Assessment Approval	*Environmental Protection Act* and *Environmental Assessment Regulations*	Environmental Assessment Division, Department of Environment, Climate Change, and Municipalities
Electrical Permit	*Public Safety Act, Electrical Regulations*	Digital Government and Service NL
Certificate of Approval [A]	*Environmental Protection Act*	Pollution Prevention Division, Industrial Compliance Section, Department of Environment, Climate Change, and Municipalities

Table 1.3 Permits and Authorizations Potentially Required by the Project

Permit or Authorization	Legislation / Regulation	Agency
Permit to Alter a Body of Water [B]	*Water Resources Act*	Water Resources Management Division, Department of Environment, Climate Change, and Municipalities
Building Accessibility Registration Exemption Request and National Building Code of Canada Plans Review[C]	*Building Accessibility Act*	Digital Government and Service NL
Permit to Construct – Approval for Installation of a Sewage Holding Tank[C]	*Health and Community Services Act*	Digital Government and Service NL
Fuel Storage Tank Registration	*Storage and Handling of Gasoline and Associated Products Regulations, 2003, under the Environmental Protection Act*	Digital Government and Service NL
Certificate of Approval for Generator Operation[C]	*Environmental Protection Act* and *Air Pollution Control Regulations*	Pollution Prevention Division, Industrial Compliance Section, Department of Environment, Climate Change, and Municipalities
Land Use Approval	*Civil Air Navigation Services Commercialization Act*	Nav Canada [D]
Aeronautical Assessment for Obstruction Evaluation	*Aeronautics Act; Canadian Aviation Regulations*	Transport Canada

Notes:
[A] Operation of the wind farm may be rolled into VNL's existing Certificate of Approval for overall operations at Voisey's Bay
[B] Applicable only if Project infrastructure cross or impact a watercourse which is not planned at this time.
[C] Applications for these permits will be submitted if/when required.
[D] Nav Canada is a private, not for profit corporation that manages Canada's civil air navigation.

Table 1.4 Permits and Authorizations Held by VNL that may be Applicable to the Project

Permit or Authorization	Legislation / Regulation	Agency
Commercial Cutting Permit	*Forestry Act*	Department of Fisheries, Forestry, and Agriculture
Permit to Burn	*Forestry Act*	Department of Fisheries, Forestry, and Agriculture
Crown Land Lease (124621)	*Lands Act*	Lands Branch, Department of Fisheries, Forestry, and Agriculture
Wildlife Permit for the Deployment of Culvert-Type Traps for the Capture of Problem Bears at the Voisey's Bay Project Site in Labrador (Includes a Black Bear and Polar Bear Protection Permit)	*Wild Life Act*	Forestry Division, Department of Fisheries Forestry and Agriculture,

Table 1.4 Permits and Authorizations Held by VNL that may be Applicable to the Project

Permit or Authorization	Legislation / Regulation	Agency
Mine and Mill Operations Certificate of Approval – AA20-055659A	*Environmental Protection Act*	Pollution Prevention Division, Industrial Compliance Section, Department of Environment, Climate Change and Municipalities
Water Use Licences WUL-18-10054 - water withdrawal and use from Camp Pond for road dust control, process use, firefighting capabilities, underground operations, and domestic use	*Water Resources Act*	Water Resources Management Division, Department of Environment, Climate Change and Municipalities
Quarry Permits for HWP and km2.2	*Quarry Materials Act*	Mineral Lands Division, Department of Industry, Energy and Technology
Pressure Plant Registration (requires Amendment)	*Public Safety Act, Boiler, Pressure Vessel and Compressed Gas Regulations*	Digital Government and Service NL
Wind Farm Preliminary Land Use Approval	*Civil Air Navigation Services Commercialization Act*	Nav Canada
Business Firearms Licence (license number 11982947.0011)	*Firearms Act*	RCMP
TDG Equivalent Level of Safety	*Transportation of Dangerous Goods Act, 1992*	Transport Canada
GPS Hill MET Tower and Service Line Aeronautical Assessment for Obstruction Evaluation	*Aeronautics Act; Canadian Aviation Regulations*	Transport Canada
GPS Hill MET Tower Land Use Approval	*Civil Air Navigation Services Commercialization Act*	Nav Canada

1.7 ENVIRONMENTAL MANAGEMENT

All contractual arrangements between VNL and IIE will require IIE's construction and operation of the Project to comply with VNL's Voisey's Bay environmental management systems and policies.

VNL has directly and actively incorporated the principles of sustainability and environmental and social responsibility into the planning and implementation of the Voisey's Bay Mine / Mill Project, in order to avoid or reduce potential adverse environmental effects and to enhance benefits. These principles and practices will be carried over into the Project. Environmental management procedures related to the Project will include the implementation of VNL's existing Environment, Health and Safety Plans – including their updating and refinement as required – as well as continued adherence to applicable requirements and guidelines.

The following Health, Safety and Environmental plans already in place at the Voisey's Bay mine, will be applicable to the Project, with amendments as required:

- Environmental Protection Plan (EPP) for Operations
- EPP for Construction
- Emergency Response Plan
- Health and Safety Plan
- Water Management Plan
- Waste Management Plan

Vale's Environment Department will determine IIE compliance with federal and provincial regulatory requirements and all VNL's environmental / waste / health& safety plans and programs. With approval of the Environmental Assessment, ongoing compliance oversight, including compliance inspections/ audits, will be carried out by site Environmental Advisors to ensure that the project is designed, built, operated and decommissioned/reclaimed in compliance with established permit conditions, as well as those obtained for the project. In addition to VNL's on-site environmental staff, there are independent Environmental Monitors present on-site who are employed directly by, and report directly to, the Nunatsiavut Government and Innu Nation.

VNL has developed a Health, Safety and Environmental Management System (HSEMS) that is based on OHSA 18001/ISO 14001 Standards, which VNL strives to achieve by 2022 for the Voisey's Bay operations. This will remain in place and will be expanded to include the Project.

2.0 PROJECT DESCRIPTION

This section describes the infrastructure and construction, operation and maintenance, and decommissioning activities that comprise the Project. Project components and activities form the basis for the environmental assessment in Section 6.

2.1 LOCATION

The Project is located at GPS Hill, within VNL's Surface Lease area, and immediately east of current mining operations in Voisey's Bay, NL (Figure 1-1). The Voisey's Bay mine is located on the northeast coast of Labrador, on a peninsula bordered to the north by Anaktalak Bay and to the south by Voisey's Bay. The nearest communities are Nain, approximately 35 km northeast, and Natuashish, 80 km southeast.

2.2 COMPONENTS OF THE PROJECT

Key Project components, as shown in Figure 2-1 and described in the subsections below, include the following:

- Five 4.2 MW wind turbines
- New 13.8 kilovolt (kV) switching station, including:
  - Battery Energy Storage System (BESS)
  - E-House for containing electrical protection, controls, switching and communications equipment
  - System control and communications hardware and software
- 13.8 kV overhead / underground distribution system
- Access roads interconnecting mine site and turbine locations
- Cleared areas at each turbine location for laydown of turbine components
- Pads and foundations for equipment

Existing laydown areas throughout the Voisey's Bay site may also be used. New laydown areas specifically for the Project, other than those noted above, will not be created. The Project will interconnect with the existing Voisey's Bay mine electrical system at the Eastern Deeps powerhouse.

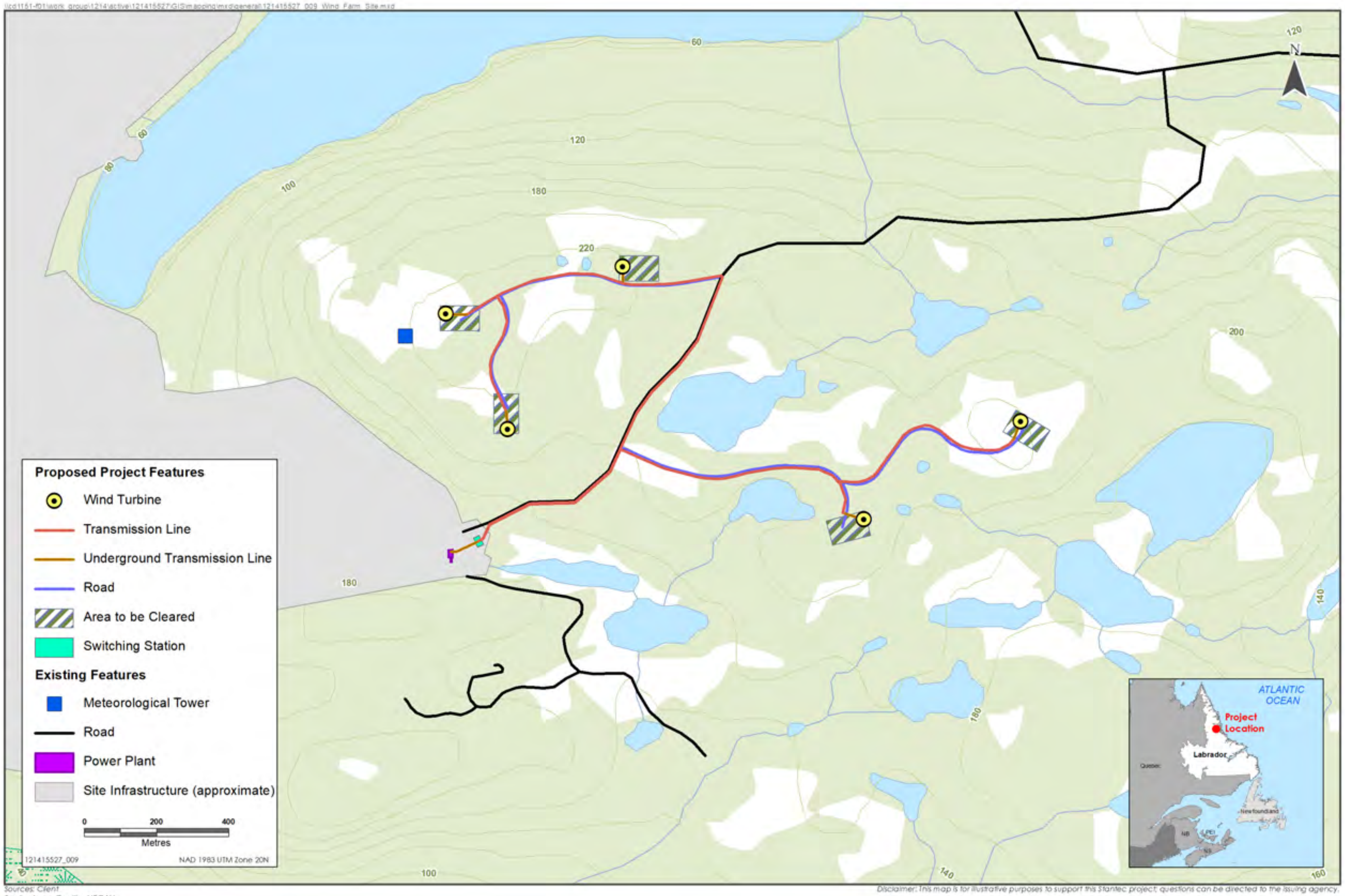

Figure 2-1 Proposed Project Infrastructure

2.2.1 Wind Turbines

The Project is currently planned to consist of five 4.2 MW turbines. The average cleared area required for the turbine, including laydown and assembly areas for the turbine components, will be approximately 70 m by 110 m. This excludes the access road, and distribution line.

Wind turbines and supporting infrastructure typically consist of the following components, as shown on Figure 2-2:

- Tower foundations
- Three or four steel or concrete tower sections with service access provided by stairs and/or service person lifts
- Stainless steel nacelle which houses the main shaft and generator
- Three fibreglass or carbon fibre rotor blades
- Cast iron hub
- Tower mounted transformer
- Electrical and grounding wires
- Buried grounding grid at perimeter of foundation

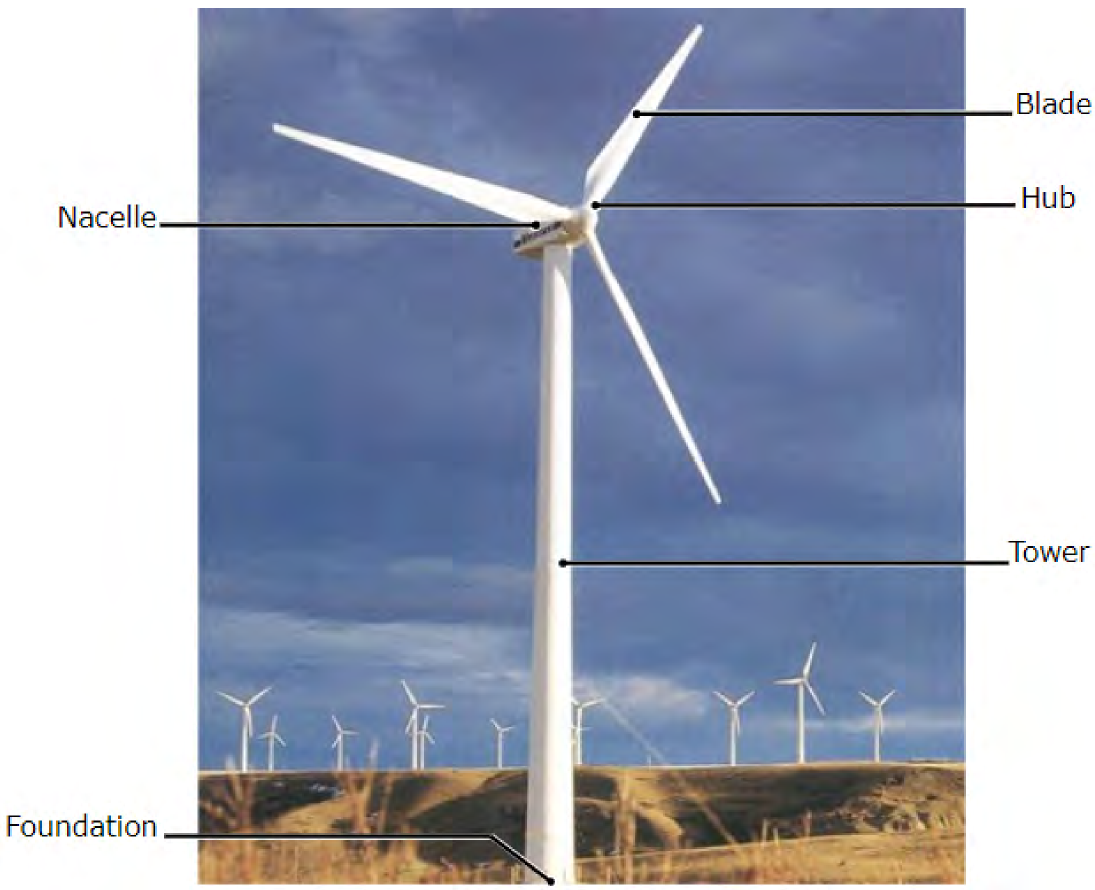

Figure 2-2 Typical Wind Turbine Components

There are two turbine models being considered for the Project, the Vestas V150-4.2 or Enercon E-138 EP3 E2 turbines. Specifications of each of these turbines is provided in Table 2.1 and manufacturer datasheets are provided in Appendix A.

Table 2.1 Wind Turbine Model Specifications

Wind Turbine Model	Enercon E-138 4.2 MW	Vestas V150 4.2 MW
Number of Turbines	5	5
Turbine Rated Power (MW)	4.2	4.2
Wind Farm Capacity (MW)	21.0	21.0
Hub Height (m)	81	105
Rotor diameter (m)	138.25	150
Total Maximum Turbine Height (m)	150	180
Cut-in Wind Speed (m/s)	2.0	3.0
Rated Wind Speed (m/s)	13.0	11.5
Cut-out Wind Speed (m/s)	28.0	24.5
Maximum sound pressure level at hub height (dBA)	106.0	108.0
Low Temperature Shutdown Level	-40ºC	-30ºC
Turbine Technology	Gearless, variable speed, single blade adjustment	Geared, full blade feathering with 3 pitch cylinders

As described in Table 2.1, the 4.2 MW turbines will range from 81 m to 105 m in height from ground level to the hub (i.e., the hub height), depending on the model selected. The swept diameter of each three bladed rotor will measure 138 m to 150 m. Therefore, the overall turbine components will reach a maximum height of 180 m.

The rotors are variable speed, with revolutions per minute dependent upon wind conditions. The nacelle is a stainless-steel enclosure, which includes a rotor hub, main shaft, generator, turbine control equipment, instrumentation, and cooling/heating equipment. These components are located at the top of the tower sections and are connected to the three bladed rotors via a main shaft and hub assembly. Both models under consideration are equipped with blade de-icing systems to allow them to run at lower temperatures while reducing potential for ice build-up.

A transformer and switch gear is located in the tower base of the turbine to transform the low voltage electricity created in the nacelle to medium voltage collection system level (13.8 kV). The distribution cables will be routed underground from the last riser pole to the turbine pad mounted transformer or directly into the turbine tower.

Turbine lighting will meet the design requirements and quality assurance for lights required under *Canadian Aviation Regulations* 2010-1 Part VI -General Operating and Flight Rules Standard 621.19 - Standards Obstruction Marking, Section. Transport Canada commonly recommends the use of medium intensity flashing red beacon lights.

Wind turbines will be delivered to the site by ship and unloaded at the existing port facility at Anaktalak Bay. It is anticipated that the delivery of turbines will result in a negligible increase in boat traffic over and above currently anticipated traffic to support on-going operations and expansion programs at the Voisey's Bay site.

2.2.2 Pads and Foundations

Reinforced concrete pads and foundations will be constructed for equipment including turbines, transformers, BESS, and E-house. Pads for cranes during construction will be constructed using compacted granular material at each of the turbine sites.

Based on the results of the preliminary geotechnical survey conducted in November 2020, a rock anchored concrete foundation has been selected for the wind turbines because there is competent bedrock present. This system uses rock anchors to tie the foundation down and provide necessary capacity to support the wind turbine.

Table 2.2 provides approximate material quantities for a single turbine foundation. Installation of the foundations will be supported by use of a mobile concrete batch plant. Operation of the batch plant and production of concrete will require water which will be brought to the plant by tanker truck. The Project will require approximately 2,000 cubic meters of concrete and 240 cubic meters of water specifically for the purpose of concrete. Water use and wash water management during batch plant operation will be conducted in accordance with the Voisey's Bay Environmental Protection Plan (EPP; Voisey's Bay EPP) and the Environmental Code of Practice for Concrete Batch Plant and Rock Washing Operations. Wash water will be directed to a closed system rinsing / settling basin which will be cleaned as required to maintain its retention capacity. Prior to release, wash water will be tested for parameters related to concrete and additives, pH, and total suspended solids, and for parameters specified in the provincial *Environmental Control Water and Sewage Regulations* and parameters related to fish habitat protection required in the federal *Fisheries Act*. If water does not meet discharge requirements, it will be further treated until the criteria are met.

Table 2.2 Turbine Foundations Material Quantities

Description	Quantity	Unit	Comment
Rock Anchored Foundation (One Unit)			
Unclassified Excavation	400	m^3	Excavation/Blasting required for site preparation
Engineered Fill	174	m^3	Required for backfill
Mud Slab – 15 MPa	3	m^3	
Concrete – 35 MPa	152	m^3	
Formwork	543	m^3	
Reinforcing Steel – 400 MPa	22,619	kg	Estimated at 100 kg/m^3
Rock Anchors – 65 mm dia Grade 1030 MPa	18	ea	Estimated at 100 kg/m^3

2.2.3 13.8kV Switching Station

The switching station will consist of outdoor enclosures containing transformers (grounding transformer and battery storage step-down transformer), the BESS, E-house, systems control and communications hardware. Incoming and outgoing 13.8 kV lines will connect the switching station to the existing mine service, and the wind turbine collection network. The overall footprint of the switching station is shown in Figure 2-3 and the overall footprint is approximately 100 m by 70 m.

2.2.3.1 Battery Energy Storage System

The BESS is a containerized solution enclosed in a standard 40-foot container; it includes:

- A customized insulated 40-foot container (40' L X 10' W X 9.5' H) as its core structure. The BESS enclosure will house the main components of the BESS system, including inverters, site controller, battery racks, inverter cooling system, fire suppression, insulation, and heating, ventilation, and air conditioning (HVAC) system. The HVAC system is installed in BESS enclosure for maintaining operating temperatures for the BESS equipment.
- Current design parameters include two 1,800 kilovolt-amperes (kVA) inverters with a combined power capability of 3,600 kVA, de-rated to 3,500 kVA, at 480 VAC.
- A site controller system based upon a PLC platform, which provides centralized control of the BESS. Its primary purpose is to provide a central interface between the application control requirements, battery bank, inverter, switchgear, cooling subsystems, and safety systems.
- Residue-free fire suppression agent (Novec 1230) system which includes a control panel, pull stations, integration with smoke and thermal detectors, and uninterrupted power supply (UPS). All fire suppression systems operate independently from the site controller system and are inclusive of a fire suppression system control panel and independent UPS.
- A battery management system which aggregates information from each battery rack system and communicates the battery system status to the site controller.
- Eight 3,500 kW / 2,800 kW/hr battery racks composed of 17 battery modules each that are connected in series. The battery racks are connected in parallel via a battery combiner.

2.2.3.2 E-House

The E-House consists of a 5.4 m by 12.6 m steel building, which will contain switchgear, protection and controls, metering, supervisory control, and data acquisition (SCADA), and communications equipment. The E-house will be located within the switching station enclosure and will provide for electrical connection of the 13.8 kV collector circuit as well as connection to the mine's 13.8 kV load circuits.

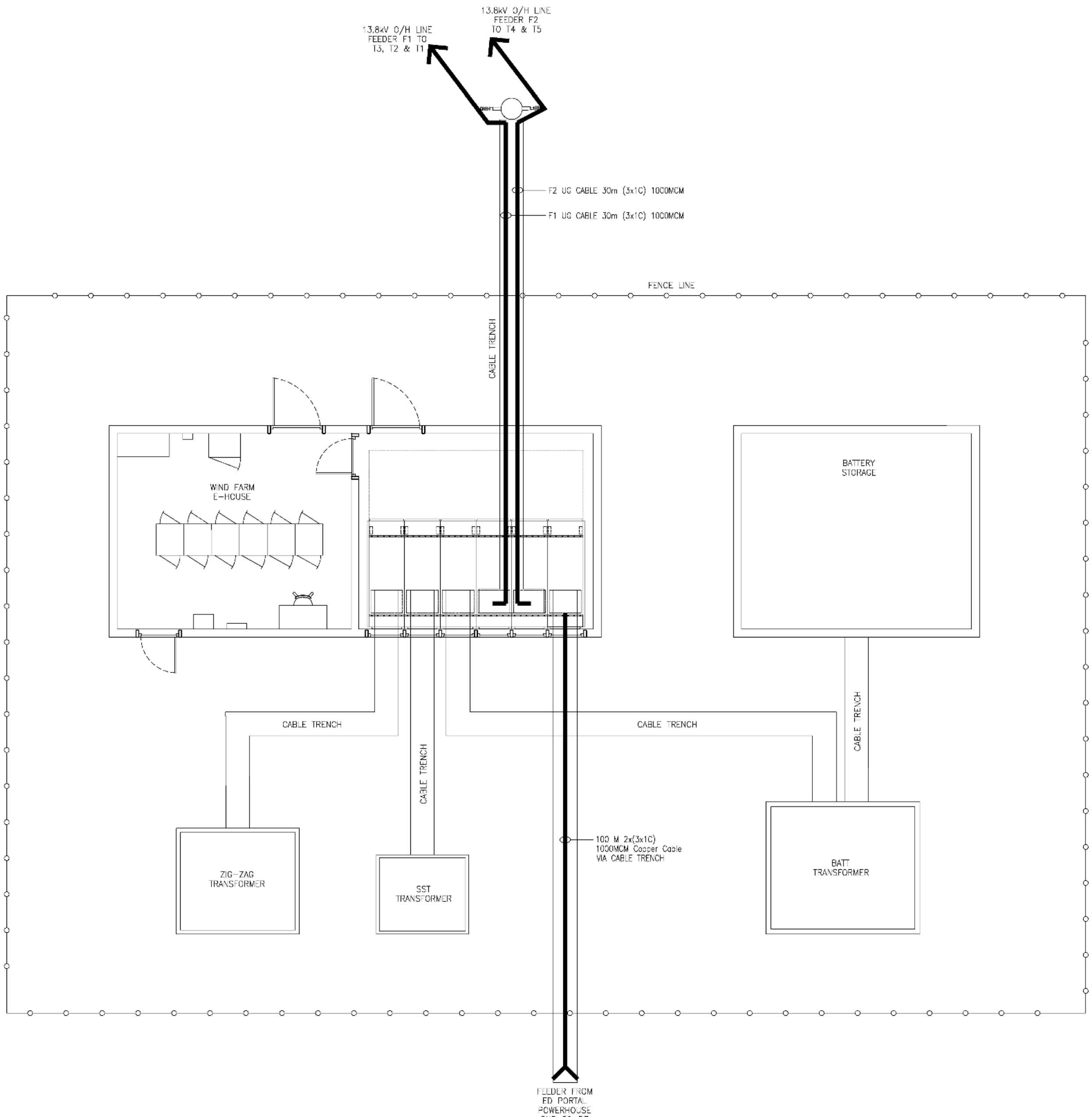

Figure 2-3 Switching Station Layout (Not to Scale)

2.2.3.3 System Control and Communications Hardware and Software

The system will include a site controller which will enable supervision, control and automation of the wind turbines, BESS, existing on-site generation, and controllable loads. The site controller will monitor and forecast loads, wind resource, and dispatch storage and generation in order to optimize the reduction in diesel use and the efficient operation of equipment. The Project will be remotely monitored and controlled 24 hours per day using typical wind farm control software including alarm call-outs, which will be supported by trained personnel at the Voisey's Bay mine site.

2.2.4 Linear Components

Linear components of the Project include the 13.8 kV overhead and underground distribution system and turbine access roads (Figure 2-1). Where possible, these two components will exist within the same right of way and it is assumed they will be within a 10 m corridor.

2.2.4.1 13.8 kV Overhead/Underground Distribution System

The 13.8 kV distribution system will connect the wind turbines and the main mine service connection point to the switching station. Collection and distribution lines will be either buried cables or overhead, wood-pole construction and will be primarily routed along the access roads. Trenching or directional drilling will be used to bury underground cabling.

2.2.4.2 Access Roads

Access roads will be constructed in order to reach each of the turbine sites and the switching station site for construction and ongoing operations and maintenance. These access roads will be connected to the main existing road that runs through the Project site. Existing roads / trails will be used and upgraded where possible. Road construction will be completed using clean, non-acid or metal generating compacted granular material sourced from existing supplies within the Voisey Bay's surface lease area.

The total amount of new and/or upgraded roads required is approximately 2.8 km.

2.3 SITE PREPARATION AND CONSTRUCTION ACTIVITIES

Site preparation and construction activities will include the following:

- General site preparation
  - Potential widening/extension of existing gravel road and new access road constructions to each of the five wind turbine locations
  - Crane pad area grading and preparation
  - Clearing/preparation of laydown areas
- Turbine platform development
  - Site clearing, grading and preparation
  - Construction of foundations
  - Turbine installation

- Overhead/Underground collection network construction
  - Tree cutting/clearing
  - Overhead/underground line installation
- E-house and BESS installation
  - Site clearing and preparation
  - Foundation construction
  - E-house and BESS installation

Site preparation and construction may require the use of a mobile lunchroom, office, or washcar trailer and on-site generator.

If a mobile lunchroom, office or washcar trailer is required, it will not be connected to site-wide water and sewage systems, may be moved between turbine sites as construction progresses, and would be removed entirely upon completion of construction. If this mobile unit is required, appropriate permit applications will be filed with regulators including a Building Accessibility Registration Exemption Request and National Building Code of Canada Plans Review and a Permit to Construct - Approval for Installation of Sewage Holding Tank.

If power required for construction cannot be sourced from the local Voisey's Bay system, generators will be used. If used, generators and their fuel will be managed and handled in accordance with the Voisey's Bay EPP, and an application for a Certificate of Approval for Generator Operation, and fuel storage tank registration, will be filed if required.

Mitigation and management measures will be implemented during site preparation and construction activities to reduce effects to the environment from Project-related activities. General environmental protection procedures for activities on site are provided in the Voisey's Bay EPP.

Clearing of vegetation (e.g., trees and shrubs) and grubbing of organics and soil materials may be required for site preparation. Measures will be implemented to reduce the potential effects of vegetation removal. Clearing and grubbing activities will be limited to those areas designated and will comply with the requirements of all applicable permits. Clearing, grubbing and disposal of related debris near watercourses shall adhere to relevant regulatory requirements.

During road and platform construction, measures will be implemented to reduce the effects on the local environment. Permanent erosion and sediment control measures will be implemented during and/or at the end of the construction phase to prevent the excessive runoff and erosion for the construction into the local drainage systems.

As detailed in the EEP, and as per industry best practices, localized depressions containing standing water will be drained through pumping and/or trenching operations during construction. Water quality will be addressed to determine if there are applicable disposal procedures required during the drainage process due to possible contamination. Erosion and sediment control measures will be implemented on site. During construction, silt fences will be placed at low points and at the contour of the site to keep the sediments on site. Riprap will be placed at locations where efforts to reduce surface runoff flow velocity are required to reduce erosion potential. Erosion control blankets will be placed in locations susceptible for erosion, such as ditches, slopes, and other sensitive locations.

Generally, surface runoff water will be handled through a series of open ditches and culverts, and where necessary, channeled to the environment in accordance with the EPP (VNL-VBME-RPT-00010) and the Certificate of Approval for Operations AA20-055659B (VNL-VBME-PMT-00018). Run-off water along the roadways will be drained by ditches where applicable. Ditches will be lined with a minimum 200 mm thick layer of granular subbase (Class "B") to serve as riprap over geotextile for a minimum distance of 3 m before and after culvert inlets and outlets. Thickness of the riprap layer will be based on anticipated ditch water flow velocity.

The existing drainage patterns for the Project will be maintained where practical. Existing streams and/or waterways will be maintained and/or reinstated during construction and new culverts and/or applicable infrastructure will be installed as required for each road crossings.

2.3.1 Site Preparation

Site preparation includes site clearing (vegetation removal and grubbing), excavation, grading and compaction installation of temporary drainage systems and implementation of erosion control measures prior to the commencement of construction activities within the areas of the wind turbine platform and access roads. The grubbings will be incorporated with the salvaged topsoil and stockpiled as per the EPP. In accordance with the IBA, timber harvested at Voisey's Bay is piled at the Exploration Laydown Area and made available for community consumption (i.e., firewood) via winter access across Anaktalak Bay. As per Fisheries and Oceans Canada (DFO) guidelines, the recommended minimum width of the buffer zone between areas involving land disturbance (including roads) and water bodies will be 20 m + 1.5 x slope (%); but a minimum buffer zone of 30 m and where possible a 100 m buffer zone will be maintained at all times, except where specified otherwise (Gosse et al., 1998).

A site assessment will determine the type, extent, depth, location, and quality of soils on the site. Salvage depth, timing and equipment must be determined based on the type of surface soil. Topsoil and/or existing roots will be removed to a depth where organics have been removed and rock or clean overburden is visible. Although in-situ or direct placement is preferred, where on-site progressive rehabilitation opportunities exist, salvaged soils may be windrowed adjacent the area of land disturbance or stockpiled at designated locations until the site has reached its useful life and disturbed areas re-contoured, at which point the topsoil is spread back over the site. Waste material will be stockpiled in designated areas with the appropriate erosion and sedimentation control measures in place, and with strict adherence to the Voisey's Bay Waste Management Plan (VNL-VBME-RPT-00003) and the Voisey's Bay EPP SWP-P05 (VNL-VBME-RPT-00010).

2.3.2 Earthworks

Earthworks includes the cut and fill for access roads and wind turbine platforms, and the construction of ditches, diversion channels and berms, and dikes. Generally, earthworks will be carried out in accordance with the following guidelines:

- Development and construction of the Project will involve clearing vegetation, stripping topsoil, grading and/or in-situ / direct placement or stockpiling. Sound soil conservation practices will be encouraged in accordance with site practice.
- Existing unsuitable soils (i.e., overburden) will be removed and replaced with suitable construction material.
- Fill materials will be placed and compacted over the proof-rolled subgrade in order to achieve adequate bearing capacities, as required for specific construction activities.
- Rocks/boulders and similar objects adjacent to areas undergoing excavation must be removed or secured if they potentially endanger workers/machinery.
- Dust control measures will be put in place.

2.3.3 Access Roads

New roads will be designed to incorporate safety, operation, and maintenance considerations, specifically the potential interactions between mining and other vehicle types, keeping road lengths and gradients to a minimum.

Standard design, turbine manufacturer design criteria and industry best practices will be applied to the road design. This includes, but is not limited to, connecting functional points by the shortest possible route, following the natural ground slope as much as possible, and establishing positive drainage. Road gradients will be selected based on the consideration to reduce fill requirements and right of way widths, maximize road use, and meet the design parameters as specified in the project civil design criteria.

Road layouts will endeavour to keep the total length of drainage ditches and number of culverts to a minimum. Ditching will be designed to reduce disturbance to the natural drainage pattern. Ditches will be cut and/or shaped in a normal manner and will be lined to reduce erosion in the areas where flow velocity is high.

2.3.4 Lay-Down, Storage, and Staging Areas

The lay-down, storage and staging area footprint will be sized to reduce disturbed areas and provide sufficient area for storage of material/equipment and movement of mobile cranes/vehicles. The subgrades will be prepared via cut/fill activities prior to final grading. The subgrade may consist of either rock fill or suitable common fill. In cases where the subgrade is directly overlain by Granular Base "Class A", 400 mm minus rock fill "Class C1" will be used for the upper layer. The voids of each layer (and/or suitable earth fill) will be filled with rock fragments prior to placement of the next layer.

At each of the five wind turbine locations, a 70x110 m lay-down area adjacent to the site access road will also be required to provide sufficient area to permit turbine equipment to be delivered, offloaded, and stored pending assembly and installation. A cleared, grubbed, compacted, and graded working area with a ground bearing capacity sufficient to support anticipated maximum axle loads and components will be provided.

2.4 OPERATION AND MAINTENANCE ACTIVITIES

The Project will be remotely monitored and controlled 24 hours per day using typical wind farm control software including alarm call-outs, which will be supported by trained personnel at the Voisey's Bay mine site. Regular maintenance activities will include:

- Maintenance of roads and access: Snow clearing, road maintenance and repair as required
- Servicing of wind turbines: inspection and maintenance in accordance with wind turbine supplier recommendations will be performed by approved technicians, including replacement of wear components, lubricants, and drone inspection of turbine blades
- Servicing of battery energy storage and electrical equipment: Inspection of components, transformer oil, periodic replacement of minor components and testing

The operation of wind turbines is typically reviewed for conflicts associated with noise, visual impact, and telecommunications interference, particularly with respect to human receptors.

Wind turbines produce mechanical noise at their nacelle (106 to 108 dB) and aerodynamic noise as the blades passes in front of the turbine tower. These noises usually impact receptors located within 500 m of the turbines in low-noise environments.

Although the Project turbines will produce noise, it is not anticipated to result in a conflict with human receptors. The nearest human receptor would be the workers at the Voisey's Bay mine. At the Voisey's Bay mine site, the camp facilities, where workers sleep, are located more than 2 km away from the closest turbine. There is considerable existing noise experienced by workers at the mine as mining operations occur 24 hours a day. In addition, the prevailing wind at site is from the west and the mine buildings are to the west of the wind farm, so it is very unlikely that the turbines will be heard at the mine.

VNL has an Industrial Hygienist on-site and has implemented a hearing conservation program for on-site workers and has strict policies on the mandatory use of hearing protection. Annual site-wide workplace personal and area noise monitoring is conducted for exposures to a variety of industrial activities on-site (e.g., working near diesel generators, use of heavy equipment). Such policies will apply in respect of the Project.

Visual impact is considered low given the distance to workers and lack of residences given the industrial nature of the activity at the Voisey's Bay mine site.

The operation of wind turbines can interfere with different communication signals including radio and microwave. The telecommunication facilities and corridors at the Voisey's Bay mine were considered in developing the wind turbine layout so that the turbines will not interfere with day-to-day or emergency communications.

2.5 DECOMMISSIONING AND REHABILITATION

As part of agreements between VNL and IIE, VNL will coordinate decommissioning of the Project, which will be carried out in a manner consistent with other decommissioning activities described in the Voisey's Bay Rehabilitation and Closure Plan (RCP). The RCP may require updating or an amendment to incorporate the components of the Project. All facilities would be dismantled, and the site would be fully rehabilitated. Generally, decommissioning and rehabilitation activities associated with the Project will include:

- Removal and appropriate disposal of all salvageable equipment, materials, and supplies
- Removal and appropriate disposal of all non-salvageable equipment, materials, and supplies
- Demolition and removal of all above-grade buildings, foundations, and other infrastructure
- Removal and appropriate disposal of all non-hazardous demolition debris
- Re-contouring
- Overburden and topsoil replacement
- Re-vegetation

If the wind turbine components are still in good enough condition for resale, the turbine will be dismantled with dedicated crane and specialized blade trailers in the same way they were installed.

The lithium-ion power batteries used in the energy storage system will be taken back by the battery manufacturer at end of life or at Project decommissioning. Battery manufacturers organize the disposal or recycling of the units.

2.6 WASTES, DISCHARGES, AND EMISSIONS

2.6.1 Emissions and Discharges

During the construction phase, emission sources will include mobile equipment and temporary power generation. As per the Voisey's Bay EPP, equipment will have exhaust systems regularly inspected and mufflers will be operating properly. Equipment will meet the requirements of the provincial *Air Pollution Control Regulations* under the *Environmental Protection Act.*

There will be no substantial discharges during the operational phase of the Project. As noted in Section 1.4, the Project will result in fewer GHG emissions than the diesel generation-only base case for expanded power requirements of the VBME.

2.6.2 Waste

Waste for construction and operation phases will be collected and disposed of in accordance with the Voisey's Bay Waste Management Plan. There are limited waste by-products created from the wind energy generation process. Some waste will be produced from ongoing maintenance for the turbine (e.g., lubricant, and hydraulic oils). Hazardous waste materials will not be generated in large quantities and will be disposed of through conventional waste-oil and hazardous waste disposal streams, as per existing site policies.

IIE will be required to comply with the Voisey's Bay Waste Management Plan in connection with the construction, operation and maintenance of the Project. IIE is committed to ensuring that collection, storage, transportation, and disposal of waste generated is conducted in a safe, efficient, and environmentally compliant manner. Storage, transportation, and disposal of waste (both hazardous and nonhazardous) will be in compliance with the *Transportation of Dangerous Goods Regulations, as* well as the NL *Environmental Protection Act*. In the event of a spill, protocols outlined in the Voisey's Bay EPP and VNL-LABR-0000-57-PGS_Petroleum Oil Lubricants Spill Response and Clean-up Standard Operating Procedures will be implemented. This includes the following considerations and actions:

- Determine the substance released or spilled
- Identify hazards from spilled materials
- Secure the spill scene and take all safety measures for the preservation and protection of human life
- Identify potential fire hazards and eliminate potential sources of ignition
- Assess the size and nature of the spill area and assess the requirement for additional personnel and resources
- Commence efforts to contain the spill under the direction of designated personnel and applicable procedures

2.6.3 Batteries

The energy storage system is based on lithium-ion power battery technology and generate no emissions. They will last 10 to 20 years depending on usage. Battery failure is not sudden but rather in the form of a gradual underperformance, so the timing of replacement can be adjusted. The batteries could therefore likely operate for the duration of the Project, up to current expected life of mine (2034). They could require one replacement if the life of the mine is extended. In that event, the battery manufacturer takes back the battery for recycling or disposal at replacement.

The battery energy storage system will be certified and tested according to UL9540 standards for battery design and safety.

2.7 EMPLOYMENT AND EXPENDITURES

2.7.1 Employment

It is anticipated that the work will be mainly completed by specialized contractors. Construction activities are expected to require approximately 62,500 person-hours, with the majority of site activities expected to occur over a period of 10-month period. This is equivalent to approximately 25 full-time equivalent employees. An estimation of anticipated workforce requirements, National Occupation Classification (NOC) code, during construction is provided in Appendix B.

Employment during operation will be limited. An estimation of anticipated workforce requirements, by NOC code, during operation is provided in Appendix B.

In constructing, operating and maintaining the Project, IIE will be required to comply with commitments in the Inuit IBA and the Innu IBA including commitments with respect to, amongst other things, employment and training. With respect to hiring, Innu Nation members / Nunatsiavut beneficiaries receive first preference for hiring followed by residents of Labrador, residents of Newfoundland and then out of province residents. VNL has an Aboriginal Affairs Department that, amongst other things, ensure that the terms of the Inuit IBA and the Innu IBA are implemented and adhered to.

Additionally, IIE will be required to comply with the Industrial and Employment Benefits Agreement, as amended, between VNL and the Government of Newfoundland and Labrador and the Voisey's Bay Benefits Plan between VNL and the Government of Newfoundland and Labrador.

2.7.2 Expenditures

Capital cost associated with the Project is provided in Table 2.3. The cost of the Project will be funded privately by IIE.

Table 2.3 Capital Costs

Component / Task	Capital Cost ($M CAD)
Wind Turbines	21.2
Installation of Wind Turbines and Construction of Foundations, Pads and New Access Roads	23.9
Existing Access Road Improvement	0.4
13.8kV overhead line construction	1.6
Interconnection Switching Station	3.5
Battery Energy Storage	4.7
Existing Plant Upgrades	4.8
Project Management & Indirect Costs	8.9
Contingency	8.6
TOTAL	**77.6**

3.0 ALTERNATIVES TO THE WIND ENERGY PROJECT

3.1 ALTERNATIVES TO THE WIND ENERGY PROJECT

With the expansion of the Voisey's Bay mining operation, increased energy demands will have to be met while reducing the venture's carbon footprint. In order to reduce the mine site diesel consumption and its operational energy costs, an alternative energy source is required. 100% diesel-based power is the base case for energy generation to support the VBME.

Grid connection could provide the site with electricity supply. However, the timing for construction, due to the remoteness of the site, as well as social and environmental implications to build such a long transmission line can be lengthy as it would likely need to stretch from central Labrador to the mine site. In addition, the cost to connect to the provincial grid could be prohibitively expensive.

Hydro and solar PV technologies are the only cost-competitive renewable alternatives to wind. The hydro resource is not available at the mine location and the solar resource is quite low at this site's latitude. Solar would also require a much larger ground footprint than wind for a similar energy output. From a sustainable energy perspective, wind energy was identified as the most viable option to provide renewable energy for the mine. As noted in Table 1.1, the Project would result in the avoidance of approximately 25,000 tonnes CO_2e in GHG emissions annually, which would otherwise result from the use of diesel fuel for on-site power generation.

Therefore, building a wind solution now can expedite the process of reducing emissions in Newfoundland and Labrador region. If, in the future, a grid connection also becomes feasible, the wind solution can be combined with the grid connection.

3.2 ALTERNATIVE MEANS OF CARRYING OUT THE WIND ENERGY PROJECT

3.2.1 Site Selection

Two sites were evaluated as potential locations for turbines: GPS Hill, located within the current surface lease area and immediately east of current mining operations, and Sara Hill, located on a ridge approximately 8 km north of the mine site and adjacent to the mine's access road for port operation (Figure 1-1). Various wind farm scenarios ranging from 1 to 80 wind turbines at both the GPS Hill and the Sarah Hill locations were modelled in support of this Project. A hybrid system model simulated the amount of wind energy that could be reliably integrated into the grid system and evaluated the diesel savings and the expected resulting cost of energy.

While the wind potential at Sara Hill is considered more reliable, the logistic challenges of building at this location are greater (Figure 3-1). Wind generation and transport at Sara Hill site would require construction of more access roads and transmission lines than at GPS Hill. In addition, Sara Hill would require more permitting, as it is outside the current surface lease area.

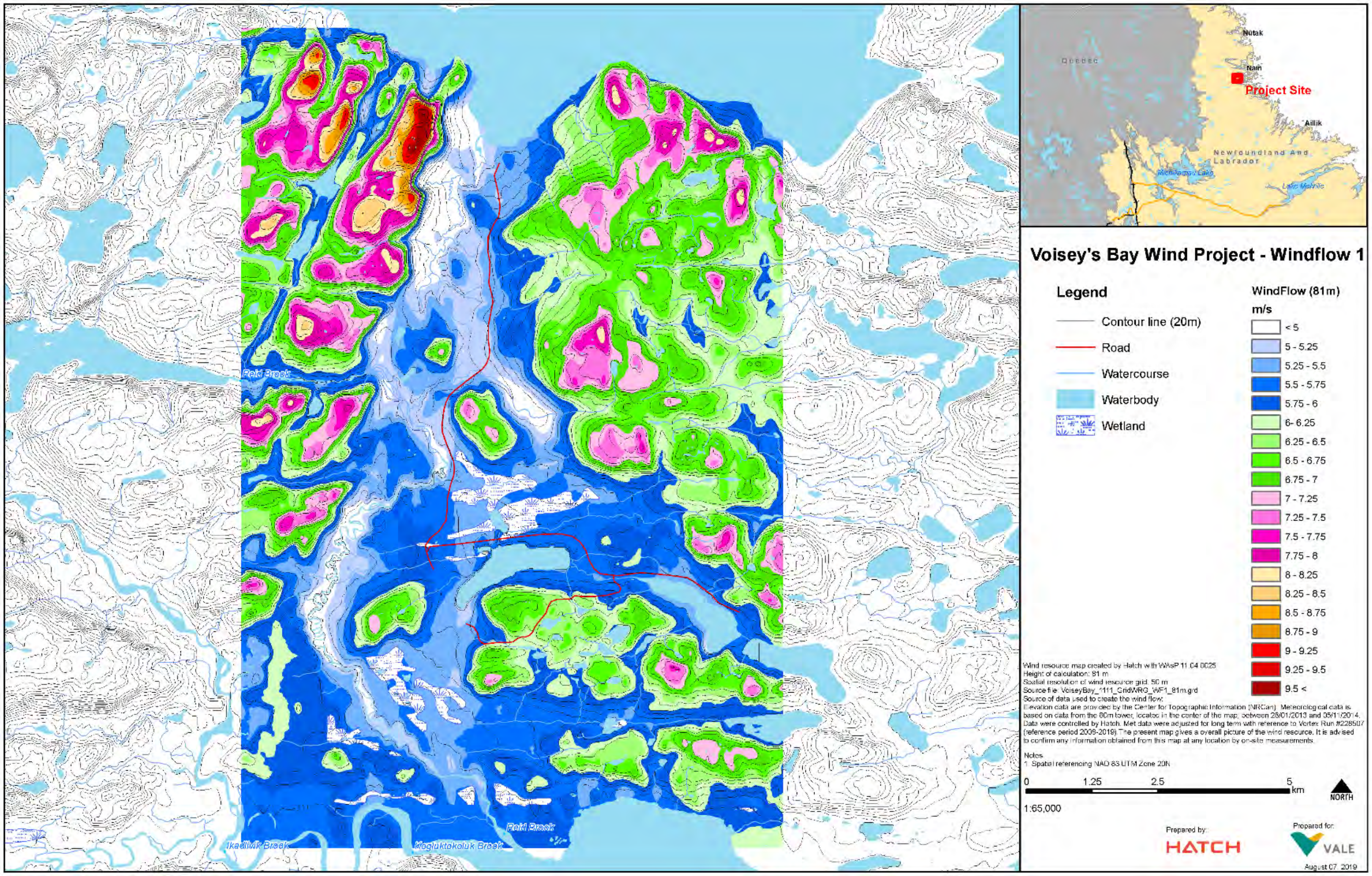

Figure 3-1 Windflow Map

3.2.2 Turbine Selection

Different turbine models have also been considered in the studies and a turbine selection exercise has been conducted.

Because of the remoteness of the site, the costs to repair it and the length of downtime associated with a failure are much higher than for typical wind farms. For this reason, only turbine manufacturers with proven reliability in small and remote projects and offering mature cold-climate technologies have been considered.

The wind resource at the selected site is considered to be sufficient for Project viability, but on the low end of the spectrum as far as wind power development. For this reason, only turbines tailored to take advantage of relative "low-wind" conditions have been considered; such turbine models are equipped with larger rotors to be able to harness more power at low speeds.

When considering the high costs of logistics, construction, and maintenance at this site, the levelized cost of energy over the wind farm life clearly favors solutions with fewer, larger models against smaller and more numerous turbines for a similar output. The environmental impact of installing less units for the same amount of power is also lesser.

Two turbine models, manufactured by Vestas and Enercon, were selected as frontrunners for advancing to the next stage of the feasibility assessment (Table 2.1). The advantages of the Vestas model are that it yields more energy with its large rotor, costs less to purchase, and has an extensive operational track record. The advantages of the Enercon model is that it yields a lower overall levelized cost of energy, has less costly logistics, has no gearbox in its design and includes a mature de-icing technology. Manufacturers have submitted bids for the Project and the evaluation and final selection process is still underway. Both models have been presented for consideration in this Registration.

3.2.3 Turbine Foundation Selection

Several types of turbine foundations have been considered, including rock-anchored, conventional gravity-based and above ground steel structures. The ground conditions encountered during geotechnical surveys and the cost are the main drivers for selecting the type of foundation. Given the presence of shallow bedrock and the high costs of civil work at site, Turbine towers will be anchored to the rock and limit the volume of concrete needed when compared to typical gravity-based wind turbine foundations. Section 2.2.2 provides additional information on the selected foundation type.

4.0 ENVIRONMENTAL SETTING AND POTENTIAL RESOURCE CONFLICTS

The Project is located at the Voisey's Bay mine site in northern Labrador. The nearest community to the Project is the community of Nain, located approximately 32 km from the Project Area. This section describes the environmental setting in the northern Labrador region, and where available, a description of specific environmental conditions of the Project Area is provided. This section also describes the potential resource conflicts from Project-related activities.

The existing environment is described based on the following spatial boundaries: the Project Area which is the immediate areas within which Project activities will occur, the Local Assessment Area (LAA), a 1 km buffer on the Project Area representing the area in which environmental effects may be reasonably expected to occur, and the Regional Assessment Area (RAA), a 20 km buffer of the Project Area and the area in which Project residual environmental effects may interact cumulatively with the residual environmental effects of other project or activities. These spatial boundaries are discussed in more detail in Section 5.2.3.

Where appropriate, site-specific baseline information was collected to augment existing information sources. Based on consultation with regulators, field programs were conducted for avifauna and bats. Avifauna field programs were conducted in 2019 and 2020, and included surveys for breeding birds, migratory birds, and common nighthawks. Additionally, acoustic monitoring was conducted for bats and migrating birds in 2020. Bird baseline reports for 2019 and 2020 summarize these field programs and their findings, are included Appendix C and D. The bat monitoring field program involved acoustic analysis at four locations. A baseline report for bats, which discusses these surveys, is included in Appendix E. Additionally, data collected as part of the Environmental Effects Monitoring (EEM) Program conducted in support of the Voisey's Bay mine was incorporated into the discussed of existing conditions where applicable.

4.1 REGIONAL GEOLOGY

The Precambrian bedrock of the Canadian Shield, dated from two billion years old to possibly four billion in some locations, is the primary physical landscape of Labrador (Voisey's Bay Nickel Company Limited [VBNC] 1997). This landscape has been, over geological time, lifted, folded, glaciated, submerged, and eroded which has contributed to the present landscape. The most recent glaciation has resulted in some of the more distinctive surface features. Most of Labrador was covered by a sheet of ice eighteen thousand year ago and the abrasive movements of these glaciers rounded mountain tops, cut deep fjords through river valleys, and gouged numerous depressions into the landscape (VBNC 1997). The land surface rebounded and was elevated as glaciers began to retreat, releasing from the tremendous weight of the continental ice sheets. The glacier retreat also resulted in a highly varied post-glacial landscape in Labrador. In coastal areas, water from melting glaciers deposited layers of sand and gravel that formed broad plateaus, eskers, deltas, and moraines that continue to be eroded by rivers flowing to the sea. In Northern Labrador, the landscape is characterized by the barren Kigalapait, Kaumajet, and Torngat mountains, rising to elevations over 1,700 m above sea level. The central coastal Labrador area is a complex of islands and striking headlands, deeply incised fjords and valleys which extend deep into the interior. The interior of central Labrador is dominated by an extensive, rolling plateau of lichen-dominated tundra that extends westward beyond the Quebec-Labrador border. The Mealy Mountains and a number of plateaus combine to form the more moderate, rolling landscape characteristic of southern Labrador.

In the immediate area of the site, the VNL claim block has sparse trees with barren highlands to the east and west. A central, north-south-trending valley runs throughout, which is more densely vegetated, has widely spaced string bogs and is covered by thick overburden. The mountainous region to the west is drained by Reid, Ikadlivik and Kogluktokoluk brooks, which empty through rocky, steep-sided valleys into Voisey's Bay. Elevations on the main block property extend from sea level to 175 m at Discovery Hill and to 225 m at the Eastern Deeps. Maximum elevations in the RAA are found at Anaktalak Bay, where peaks approach 500 m.

Site specific geologic conditions at GPS Hill were investigated in November 2020. Surface materials included sand, cobble, and gravel, with rootmat, organics, silt, and clay (Wood, 2020 unpublished).

Potential resource conflicts with surficial and bedrock geology from Project activities associated with the Wind Farm include localized disturbance of surficial soils and shallow bedrock. It is anticipated that these conflicts will be mitigated through the implementation of standard mitigation measures, as outlined in Voisey's Bay EPP. Standard mitigation includes reducing the footprint and surface disturbance of the Project. Existing quarries will be used for aggregate.

4.2 ATMOSPHERIC ENVIRONMENT

The atmospheric environment in northern Labrador is characterized by extremes in the warm and cold seasons, moderated in part by its proximity to the Labrador Sea (VBNC 1997). The climate in northern Labrador represents a transition zone between Arctic and sub-Arctic climates. The fall and winter seasons consist of intense, low-pressure weather systems with gale- to storm-force winds and heavy snow long the coast (VBNC 1997). Occurrences of fog, gales and precipitation generally decreases with distance inland from the coast, as well as topographic influences can cause local variations in the climate.

The nearest Environment and Climate Change Canada (ECCC) weather station to the Project Area is located in the community of Nain. The coldest months in the region are January and February, with an average daily temperature of -17.4 ºC to -17.6 ºC (Table 4.1). The warmest months are July and August, with an average daily temperature of +10.1 ºC to 11 ºC (Table 4.1). Extreme temperatures range between -39.4 ºC and +33.3 ºC (Government of Canada n.d.).

Table 4.1 1981 to 2010 Canadian Climate Normals Station Data for Nain, NL

	Average Daily Temperature		Extreme Daily Temperature		Average Daily Precipitation		Extreme Daily Precipitation	
	Mean (ºC)	Standard Deviation (ºC)	Min. (ºC)	Max. (ºC)	Rainfall (mm)	Snowfall (cm)	Rainfall (mm)	Snowfall (cm)
Jan	-17.6	3.5	-39.4	10.5	3.1	80.9	11	103.4
Feb	-17.4	4.3	-38.3	7.6	5.1	65.9	30.6	53.8
Mar	-12.5	3.4	-37	12.1	5.5	68.2	31.6	90.7
Apr	-4.6	2.5	-31.1	14.5	14.1	56.9	35.6	64.4
May	1.5	1.7	-17.5	25.6	30.2	26.7	45.7	28.6
Jun	6.4	1.4	-6.7	33.3	70.1	13.3	42.2	36.1
Jul	10.1	1.3	-2.8	33.3	98.6	0	54.1	0
Aug	11	1.2	-2.8	32.7	71.5	0	65.8	0
Sep	7.5	1.2	-6.7	29	79.9	2	63.8	25.9
Oct	2.1	1.4	-19	19.4	49.7	24.5	39.4	26.6
Nov	-4.4	2.1	-24.4	11.7	14.1	63.5	43.2	49.6
Dec								
Source: Government of Canada n.d.								

Although the average amount of precipitation is moderate, the prolonged winter season, with its sustained snow cover, results in a surface being saturated during much of the year and therefore, little wind-induced particulate matter is found in the air (VBNC 1997). Contaminants in the air in this region include those that have been carried on a continental scale by long-range transport mechanisms and those that are from local activities. The continental air mass trajectories are generally from southwest to northeast; air masses are moved from the central eastern areas of the continent up the Atlantic coast.

The region experiences strong seasonal variations in the strength and position of predominant winds, general air circulation, and seasonal storm systems (VBNC 1997). The climate normals during the fall and winter are a result of intense low-pressure systems which brings gale to storm-force winds and heavy precipitation (mostly snow) to the coast. Winter winds have a strong and persistent westerly flow, and summer winds are generally easterly. The climate in the winter is heavily influenced by the polar circulation which brings cold air masses into Labrador. Since the region is located on the coast of Labrador, it experiences strong seasonal effects and movements of air masses. Wind speed data for the Nain weather station is provided in Table 4.2.

Table 4.2 1981 to 2010 Wind Speed Station Data for Nain, NL

	Maximum Hourly Speed		Maximum Gust Speed	
	km/hour	Direction	km/hour	Direction
Jan	93	NW	117	NW
Feb	91	NW	120	W
Mar	104	NW	141	NW
Apr	93	N	111	N
May	80	W	93	NW
Jun	74	S	93	NW
Jul	72	NW	72	W
Aug	65	NW	81	NE
Sep	74	W	119	NW
Oct	85	W	128	W
Nov	83	W	130	W
Dec				
Source: Government of Canada n.d.				

Project activities will generate localized air contaminant emissions due to use of equipment and vehicles during construction and operation, as well as dust during construction activities. Equipment and vehicles will be maintained in good working order to reduce the amount of emissions generated. Dust will be controlled, if necessary, by the application of water, calcium chloride, or other approved dust control compound. With the implementation of standard construction and operation measures as outlined in the Voisey's Bay EPP, potential conflicts with the atmospheric environment are anticipated to be temporary and localized in nature.

4.3 AQUATIC ENVIRONMENT

VNL has implemented Freshwater and Marine EEM Programs associated with its mine and concentrator operation in Labrador. These programs, conducted annually since 2006, comprises four monitoring components: water quality (groundwater and surface water), sediment quality, fish population, and benthic invertebrate community. These programs involve a rolling cycle of study design, field sampling and reporting, providing information on the health of the marine and freshwater aquatic ecosystems at Voisey's Bay. Each component is monitored on a prescribed schedule and not all components are sampled each year. The most recent EEM Program was conducted in 2020 and included water quality monitoring (sampled annually), sediment quality, and fish population surveys (Aivek Stantec 2021). An overview of the general groundwater, surface water and fish and fish habitat environments are described below along with the results of the 2019 EEM Program. These sites are located within the RAA and with the nearest exposure sampling site approximately 580 m from the Project Area.

4.3.1 Groundwater Resources

Groundwater occurs as subsurface flow through soil and bedrock and in the Voisey's Bay area the subsurface flows are generally contained within the watersheds (VBNC 1997). Bedrock flows are assumed to be moving seaward, coinciding with the watershed drainage direction (VBNC 1997).

Results of the 2020 EEM Program were generally consistent with results from previous monitoring programs. Overall, the groundwater quality data collected throughout the 2019 EEM Program are indicative of groundwater that is soft to medium on a hardness scale (Aivek Stantec 2021).

Project activities are not anticipated to result in resource conflicts with groundwater.

4.3.2 Surface Water Resources

Within the region, there are a few large lakes, numerous small ponds and streams and rivers that flow to the Labrador Sea (VBNC 1997). Generally, baseline water quality conditions in the area have been affected since the 1940s by acid rain and increased human presence. Slightly acidic and weakly buffered lakes in these regions are particularly sensitive (Environment Canada 1996 in VBNC 1997) with the water quality of several streams and ponds in the area exhibiting sensitivity to acidification. Lower pH waters will tend to lead to elevated trace metal levels, and these may combine to reduce productivity of aquatic life.

Overall, the surface water quality data collected throughout the 2020 EEM program are typical of dilute freshwater environments, with some indication of possible anthropogenic influences at some sampling sites. Trace metal concentrations at Camp Pond are generally higher than other sampling locations (Aivek Stantec 2021).

The Canadian Council of Ministers of the Environment (CCME) has established freshwater quality guidelines for the protection of aquatic life in relation to aluminum, cadmium, chromium, copper, iron, lead, nickel, uranium, and zinc. Exceedances of the CCME Guidelines were observed for some parameters in 2019 (Aivek Stantec 2020), but no exceedances were observed in 2020 (Aivek Stantec 2021). However, there were exceedances of EEM-specific trigger levels recorded for cobalt, copper, and nickel in Camp Pond sediments (Aivek Stantec 2021).

In the LAA, there are a total of 32 waterbodies, covering approximately 1.5 km^2 (according to the Natural Resource Canada 1:50,000 mapping). The largest waterbody is the Camp Pond, located in the northern portion of the LAA. A variety of smaller ponds occur in the southern half of the LAA. The closest water body to Project infrastructure is associated with the southernmost turbine; this pond is approximately 35 m northwest of the turbine pad. Several watercourses and their tributaries and/or headwaters also occur in the vicinity of the Project, accounting for a total stream length of approximately 10.5 km within the LAA. The locations of the waterbodies and watercourses are shown in Figure 2-1. Based on the watercourse locations shown in the Natural Resource Canada 1:50,000 mapping, none of the new infrastructure associated with the Project, including access roads, will intersect watercourses. As a result, watercourse alteration is not anticipated to be required for the Project. Field verification of this assumption will be conducted prior to construction.

Buffer zones and erosion and sedimentation control measures presented in the Voisey's Bay EPP will be followed throughout the lifespan of the Project. With these mitigation measures in place, Project activities associated with the Wind Farm's operation and maintenance are not anticipated to result in resource conflicts with surface water.

4.3.3 Fish and Fish Habitat

Low lying valleys in the region contain deep glaciofluvial deposits of sands, gravel, and cobble, and support the most productive aquatic and terrestrial ecosystems region (VBNC 1997). These streams provide habitat for emerging insects whose aquatic life stages are an important element of stream and pond ecosystems. There are also larger streams and rivers with permanent flow and relatively high levels of productivity which occur along the valley bottoms, winding through the deep sands and gravel (VBNC 1997). In general, fish in the aquatic environments within the region have adapted to low productivity waters, which result in lower food availability than are expected from temperate aquatic ecosystems. Fish must also be able to withstand the extreme weather conditions of northern Labrador, which result in thick ice in many areas, streams that stop flowing due to freeze up, frazil ice, low water, possibly warm water conditions in late summer and ponds that may be ice-covered into June (VBNC 1997).

The fish species in the region, and which are common to northeastern coastal areas, include Arctic charr, brook trout, lake trout, round whitefish, threespine stickleback and ninespine stickleback (VBNC 1997) . Arctic charr and brook trout exist as both anadromous and landlocked (resident) forms and eat a variety of invertebrates and fish which are distributed throughout region. Anadromous forms use the freshwater environment for spawning, rearing, and overwintering, then return to the estuarine and marine environments (e.g., Voisey's Bay) to feed during the summer months (VBNC 1997). Anadromous Arctic charr and brook trout have similar life cycles (e.g., timing of migration and use of habitat). Landlocked forms carry out their entire life cycle in freshwater and, therefore, individual populations exist within individual ponds. Arctic charr and brook trout are also the principal exploited freshwater resources in the region (VBNC 1997). Round whitefish also inhabit streams and ponds. Lake trout primarily inhabit the freshwater pond environments and are not anadromous. Threespine and ninespine sticklebacks can inhabit both freshwater and marine/estuarine environments.

Based on the watercourse locations shown in the Natural Resource Canada 1:50,000 mapping, watercourse alteration is not anticipated to be required for the Project. Field verification of this assumption will be conducted prior to construction. Mitigation measures for working near waterbodies and watercourses are prescribed in the Voisey's Bay EPP and include the implementation of stream or riparian buffer zones. With the implementation of these mitigation measures, Project activities are not anticipated to result in resource conflicts with fish and fish habitat.

4.4 TERRESTRIAL ENVIRONMENT

Field surveys for the Project were conducted for Avifauna in 2019 and 2020, and for Bats in 2020. During these surveys, incidental data on habitat types and vegetation were also collected, although no formal vegetation surveys were conducted. These results are discussed in in Section 4.4.1 and 4.4.2 below. Detailed reports on these field programs are included in Appendices A to C.

VNL has implemented a Terrestrial EEM Program associated with its mine and concentrator operation in Labrador. The Terrestrial EEM Program, conducted bi-annually since 2006, comprises two monitoring components: Small Mammals and Red Berries. The most recent Terrestrial EEM Program was conducted in 2020 (SEM 2021a, b). These sites are located within the RAA and with the nearest exposure sampling site approximately 500 m from the Project Area (red berries are collected from the "exposure" site on GPS Hill).

The results of the 2020 Small Mammal program, with focus on red-backed vole sampling, suggested that mining and milling activities did not have substantial influence on metals of interest entering the terrestrial food web. Results of red berry sampling in 2020 showed differences in metal levels between sites and in trends between years, with berry samples at the Port Site having substantially higher numbers of copper nickel, and aluminum, which are assumed to be mine-related (SEM 2021b). Consistent with past years, the results of small mammal sampling in 2020 showed increased aluminum and nickel concentrations in red-backed vole tissue at Camp Pond and the Port Site (SEM 2021a).

4.4.1 Habitat

Habitat types within the LAA were mapped using the Earth Observation for Sustainable Developments of Forests (EOSD) land cover data (Wulder et al 2008), as well as Natural Resources Canada's wetland layer. The area of each habitat type is shown in Table 4.3. Since wetlands are included in a separate layer, the area shown for wetlands overlaps with some of the other habitat types, most notably with sparse conifer.

Table 4.3 Land Cover Types in the LAA

Land Cover Type	Area in LAA (ha)	Proportion of LAA
Tall Shrub	0.45	0.04
Low Shrub	259.77	24.57
Dense Conifer	46.28	4.38
Open Conifer	147.89	13.99
Sparse Conifer	250.40	23.68
Site Infrastructure	97.96	9.26
Water	142.30	13.46
Barren	945.05	10.63
Wetland*	3.56	0.34
Total	**1,057.47**	**100.00**

Note:
*Wetland area is located in a separate spatial dataset and overlaps with other habitat types. As such, wetland is not included in the calculated total area.

The most common habitat types in the LAA include barrens, low shrub, and sparse conifer. Barrens habitat is typically found on the tops of hills where thin soils and exposure to wind and blowing snow limit the growth of trees. In barrens habitats, ground cover is the dominant vegetation layer. Trees are typically restricted to sheltered microsites and are stunted, and wind pruned. Shrubs occurring in barrens habitat are typically low. The dominant species observed within barrens and low shrub habitat in the LAA include alpine bearberry (*Arctostaphylos rubra*), black crowberry (*Empetrum nigrum*), blueberry (*Vaccinium* spp.), *Cladina* and *Cladonia* lichens, and Arctic azalea (*Kalmia procumbens*).

Sparse conifer habitat is common throughout the LAA, most frequently encountered in valleys and on the lower slopes of the hills. This habitat type consists of coniferous woodlands underlain by a dense low shrub layer. The density of tree cover is generally low but varies between sites. Dominant tree species typically include tamarack (*Larix laricina*) and black spruce (*Picea mariana*). The shrub layer is dominated by Labrador tea (*Rhododendron groenlandicum*), dwarf birch (*Betula pumila*), with occasionally occurrences of willow (*Salix* spp.), green alder (*Alnus viridis*) or dwarf bilberry (*Vaccinium cespitosum*).

Wetland types in the LAA include open bogs, treed bogs, tall shrub swamps, and fens. Wetlands are found throughout the area but are more commonly encountered in low areas rather than on hill tops. Vegetation data from avifauna and bat field surveys conducted for the Project in 2019 and 2020 indicated that survey sites in wetlands had many of the same tree and shrub species as the surrounding landscape, including black spruce, tamarack, willow, and Labrador tea. Sphagnum mosses (Sphagnum spp.), sedges (*Carex* spp.), deergrass (*Trichophorum cespitosum*) and Pickering's reedgrass (*Calamagrostis pickeringii*) are common constituents of the ground vegetation layer.

4.4.2 Wildlife

4.4.2.1 Avifauna

Field surveys conducted in 2019 and 2020 identified a variety of bird species in the LAA during both the breeding season and fall migration. The full description and results of these surveys are included in the bird baseline surveys in Appendix C and D (Aivek Stantec 2019; 2020).The majority of birds observed were passerine landbirds, the most common of which included American robin (*Turdus migratorius)*, common redpoll (*Acanthis flammea*), Canada jay (*Perisoreus canadensis*), dark-eyed junco (*Junco hyemalis*), boreal chickadee (*Poecile hudsonicus*), yellow-rumped warbler (*Dendroica coronata*), fox sparrow (*Passerella iliaca*), ruby-crowned kinglet (*Regulus calendula*), and white-crowned sparrow (*Zonotrichia leucophrys)*. Waterfowl that have been observed in the area and may be associated with ponds in the GPS Hill area, include American black duck (*Anas rubripes*), green-winged teal (*Anas crecca*), Canada goose (*Branta canadensis*), and common goldeneye (*Bucephala clangula*). Raptors observed in the area include Golden eagle (*Aquila chrysaetos*), osprey (*Pandion haliaetus*), northern goshawk (*Accipiter gentilis*), sharp-shinned hawk (*Accipiter striatus*), and merlin (*Falco columbarius*).

During fall migration surveys, the majority of birds observed were flying below 60 m in altitude. Based on acoustic data, birds appeared to be most active between 6 am and noon. Activity levels were variable, but without obvious patterns, between mid-August and late September 2020 (Aivek Stantec 2019; 2020a). The majority of species observed during migratory surveys were land birds and were also observed during the breeding bird surveys. They included common redpoll, Canada jay, dark-eyed junco, boreal chickadee, American pipit (*Anthus rubescens*), white-winged crossbill (*Loxia leucoptera*) and white-crowned sparrow.

Specific migration surveys were conducted for waterfowl and raptors. These surveys resulted in very few observations of the targeted species. In 2019, no waterfowl or raptors were observed during these surveys, although incidental observations of both occurred during other survey types conducted during this timeframe. During the 2020 fall waterfowl passage migration surveys, two species were observed: Canada goose and American black duck. One raptor was observed during the 2020 fall raptor surveys; a golden eagle was observed at GPS Hill on August 15th. These results suggest that migrating waterfowl and raptors are uncommon in the LAA. Full results of these surveys are included in Appendix C and D. A spring migration survey is planned for 2022.

In addition, a fall acoustic survey was conducted from August 17 to September 28, 2020. Acoustic detectors recorded bird vocalizations 24 hours per day during this period. One of the goals of this survey was to investigate the presence and abundance of nocturnal migrants. Overall, the data did not indicate that large numbers of birds were moving through the area at night. Most bird vocalizations occurred during daytime hours. All species observed in the acoustic data were the same as those observed during the breeding bird and migratory passage surveys, and most are resident land bird species, the most common of which included common redpoll, American robin, Canada jay, and boreal chickadee. Common loon and Canada goose were also recorded. However, it is important to note that not all vocalizations could be identified to species due to the brevity or quality of recorded calls, and that all species potentially occurring in the area could not necessarily be detected by audio recorders. Full results of the acoustic surveys are discussed in Appendix D (Aivek Stantec 2020a). Overall, the acoustic data does not suggest that there are a large number of nocturnal migrants in this area.

Species richness and occurrence varied by habitat type. The breeding bird survey data indicated that the highest species richness was observed in the sparse conifer habitat (21 species observed), followed by wetland (15 species observed), and finally barrens (10 species observed). Barren habitats, where the majority of turbines are located, tend to have a relatively low species diversity and abundance. One species that prefers barren habitats is the American pipit.

One Species at Risk (SAR), the rusty blackbird (*Euphagus carolinus*), was observed during the 2020 field surveys. This species was observed west of the current site infrastructure and near a pond. Rusty blackbirds are listed as *Special Concern* under the *Species at Risk Act* (SARA), and as *Vulnerable* under the Newfoundland and Labrador *Endangered Species Act* (NL ESA). Two species of conservation concern (SOCC), defined as species that are ranked as S1 (critically imperiled) or S2 (imperiled) in Labrador by the Atlantic Canada Conservation Data Center (AC CDC), were identified within the vicinity of the Project. One golden eagle, was observed at GPS hill during the raptor migration surveys in 2020. Golden eagle has an AC CDC rank of S2B,SUM, which indicates that the breeding population is imperiled, and the migratory population is unrankable due to lack of information. Hoary redpoll (*Acanthis hornemanni*) was observed during the 2019 breeding bird surveys. Hoary redpolls have an AC CDC ranking of S1S2N,SUM, indicating that the non-breeding population ranging from imperiled to critically imperiled. The migratory population is not ranked.

An Important Bird Area is located along the Nain coast, approximately 40 km from the Project Area. The Nain Coastline Important Bird Area encompasses hundreds of islands, inlets, and shoals (Birdlife International n.d.). This is an important molting area for scoters (mostly surf scoters (*Melanitta* *perspicillata*), with a few white-winged scoters (*Melanitta deglandi*) and black scoters (*Melanitta americana*). Two SAR also occur in the IBA – harlequin ducks (*Histrionicus histrionicus*) and peregrine falcons (*Falco peregrinus*) (Birdllife International n.d.).

4.4.2.2 Bats

Acoustic surveys were conducted in 2020, during which four acoustic detectors were deployed between June 23 and October 11. During these surveys, a total of 3,300 echolocation sequences were recorded over a period of 343 detector nights. Of these, little brown myotis (*Myotis lucifugus*) accounted for 3,265 (99.8%). Little brown myotis are the most common bat species in NL and also the most common species of bat identified in the Project Area. The full description and results of the bat acoustic surveys are included in Bats Baseline Study (Aivek Stantec 2020b) in Appendix E.

Little brown myotis are a small, insectivorous species with an average mass between 5.5 g and 11 g, and a wingspan between 22 cm and 27 cm (Committee on the Status of Endangered Wildlife in Canada [COSEWIC] 2013). Their diet consists of a wide range of insects and spiders, and includes chironomids and other aquatic insects, as they often forage over water (COSEWIC 2013).

Little brown myotis have a wide distribution that extends from Alaska to Mexico. They are found in every province and territory except for Nunavut, and all United States (US) states, although they are absent from sizable portions of Texas and Florida, and do not occur north of the tree line. In Newfoundland and Labrador, little brown myotis is a resident species that is typically found in forested habitat in the spring, summer, and fall. During the breeding season, females form large maternity roosts in trees or human structures (such as attics or barns), where they give birth to and raise their pups. Little brown myotis spend their winters in hibernation at underground sites, such as caves and abandoned mines. No known hibernation sites occur in Labrador (Broders et al. 2013); however, little bat research has been done in this region. It is not known if these little brown myotis hibernate in the Voisey's Bay region or migrate to hibernation sites located further south. These records of little brown myotis represent the most northern known records of the species in Labrador.

Prior to this study, the northern-most record of a little brown myotis in Labrador was located in Makkovik (Broders et al. 2013), some 200 km southeast of Voisey's Bay. As such, this data represents a range expansion for the little brown myotis.

Little brown myotis are listed as *Endangered* under Schedule 1 of SARA. This species has seen drastic population declines in North America caused by a fungal pathogen called white-nose syndrome (WNS), which was first detected in New York state in 2006. WNS was confirmed on the Island of Newfoundland in the winter of 2016/2017 (US Fish and Wildlife Service 2019). In areas affected by WNS, mortality rates are typically high. Populations of little brown and northern myotis (*Myotis septentrionalis*) at known hibernacula in eastern Canada have declined by 94% since the arrival of WNS (COSEWIC 2013). It is not known if WNS has spread to Labrador, since there is little information known about hibernacula in this area (Environment and Climate Change Canada [ECCC] 2018a).

A recovery strategy for little brown myotis (in combination with the northern myotis and tri-colored bat (*Perimyotis subflavus*) was released in 2018 (ECCC 2018a). The short-term population objective for little brown and northern myotis in WNS affected areas is to stop the declining trend, and for the long term, to have a self-sustaining, resilient, redundant, and representative population (ECCC 2018a). Recovery planning strategies include species monitoring and research across Canada, public education, partnerships and stewardship, habitat and species conservation and management, and the development and implementation of management plans, laws, and policies (ECCC 2018a).

Little brown myotis are known to be vulnerable to wind turbine strikes/barotrauma, although they do not appear to be as susceptible as migratory, tree roosting bats. In one study of bat mortality at wind farms across Canada, it was determined that little brown myotis accounted for 13% of all bat mortalities from wind turbines (Zimmerling and Francis 2016).

Two migratory bat species were also identified during the 2020 acoustic monitoring program: hoary bats (*Lasiurus cinereus*) and silver-haired bats (*Lasionycteris noctivagans*). Acoustic data collected as part of these baseline studies represented the first confirmed records for both species in Labrador.

Hoary bats are the largest of the three species identified during studies performed at Voisey's Bay. They have distinct brown/grey fur, weigh between 20 g and 35 g and have an average wingspan of 43 cm (Anderson 2002). Hoary bats are insectivorous, and feed primarily on months, although their diet may also include flies, beetles, small wasps, and grasshoppers (Anderson 2002). Hoary bats are widespread in eastern Canada and are found in all US states. They are long-distance migrants, that move from northern breeding sites to overwintering sites, typically in the southern US or Mexico (Findley and Jones 1964, Cryan 2003, Baerwald 2015). As such, they would only occur in Labrador during the spring, summer, or fall. Hoary bats are typically solitary and roost in the foliage of mature deciduous or coniferous trees (Bat Conservation International 2017). Females typically give birth to two pups in the spring, although litter size can range from one to four (Anderson 2002).

During the 2020 acoustic surveys, seven echolocation sequences of hoary bats were recorded in the RAA between August 7 and 12 (Appendix E). One of these recordings occurred just west of the current infrastructure, three recordings occurred approximately 200 m west of the existing Port Road in the area of Little Reid Brook, and the remaining three recordings occurred at Sara Hill (mapping of the detector locations is provided in Appendix E). This timeframe corresponds with the migration period for hoary bats, suggesting that they are migrating through the area. No hoary bats were observed at GPS Hill. Of note, the detector located at GPS Hill malfunctioned in August, with the last recording occurring on August 15 (total of 49 detector-nights at GPS Hill). Attempts to repair the unit were unsuccessful. Unfortunately, this was the only detector located directly at GPS Hill, and as such data is missing for a portion of the fall migration period, however, the data obtained from the remaining detectors should suffice in providing a level of confidence in our overall findings. Additionally, the remaining three detectors provide data for a variety of habitat types in the vicinity of the Project Area (see Section 3.1 of Appendix E); it is assumed that these results can are transferable to similar habitat types on GPS Hill. Based on these results, it is assumed that hoary bats could occur in the Project Area during their fall migration.

Hoary bats are particularly vulnerable to turbine strikes, and account for approximately half of all bat fatalities at wind turbine facilities in North America (Arnett et al. 2008). The majority of fatalities occur during the migratory period.

Silver-haired bats are small bats with black fur with white tips, thus giving them a silver appearance. They weigh between 8 and 11 g and have an average wingspan of 29.5 cm (Bentley 2017). Silver-haired bats are insectivorous, and their diet is made up primarily of moths, flies, and beetles, although they consume other insects as well (Bentley 2017).

Silver-haired bats are widely distributed throughout the southern half of Canada and the US. They roost in mature coniferous and mixed-wood forest (Bat Conservation International 2021). In the spring, females form maternity colonies in cavities in trees or snags, where they give birth to two pups (Bentley 2017). During this time, males are typically solitary. In the fall, silver-haired bats migrate to more southern locations with milder temperatures, where they hibernate in roosts found in tree hollows, under loose bark, in wood piles or on cliff faces (Bat Conservation International 2021).

During the 2020 acoustic field surveys, a single silver-haired bat echolocation sequence was recorded on June 30. This recording occurred north of the LAA, approximately 200 m west of the existing Port Road and in the area of Little Reid Brook. Labrador is north of the known range for this species, and these data represent the first confirmed record of a silver-haired bat in Labrador. Based on these data it is not known if this individual was a vagrant, or if silver-haired bats regularly occur in Labrador. Although the migration patterns of the silver haired bat are not well known, they are thought to winter in the US Pacific Northwest, south-western states, and middle latitudes of the eastern US (Izor 1979, Cryan 2003, Baerwald 2015).

As a migratory, tree-roosting bat, silver-haired bats are vulnerable to turbine strikes, particularly during the migratory period.

4.4.2.3 Other Wildlife

Labrador supports a variety of wildlife species. Large mammals commonly occurring in the RAA include moose (*Alces alces*), caribou (*Rangifer tarandus*), black bear (*Ursus americanus*) and wolf (*Canis lupus*). The migratory George River Caribou Herd ranges across the Ungava Peninsula and was previously the largest herd in North America. The George River Caribou herd population peaked in 1993, with an estimated population of 776,000 individuals (Gunn et al. 2011). The population estimate recorded in the 2020 census was 8,100 individuals (Government of NL 2020), which represents a 99% decline. However, the 2020 census result showed an increase in population since 2018, the first such population increase in over 25 years (Government of NL 2020). This herd is listed as *Endangered* by COSEWIC. George River caribou are present seasonally, but only in low numbers, around Voisey's Bay. Caribou do not typically occur in close proximity to the active mine site. The Project will result in habitat loss and noise emissions which could affect caribou. However, the noise created by the Project represents only an incremental increase from the noise of the existing mine site. The habitat that will be lost does not represent important habitat for caribou. As such, caribou are not expected to interact with the Project. As required in the Voisey's Bay EPP, should encounters with caribou occur, compliance with the VNL Caribou Deterrence Protocol is required.

The terrestrial ecosystem also provides habitat for furbearers and small mammals, such as American marten (*Martes americana*), American mink (*Neovison vison*), snowshoe hare (*Lepus americanus*), arctic hare (*Lepus arcticus*), ermine (*Mustela erminea*), North American porcupine (*Erethizon dorsatum*), red fox (*Vulpes vulpes*), Canada lynx (*Lynx canadensis*), North American beaver (*Castor canadensis*), North American river otter (*Lontra canadensis*), northern bog lemming (*Synaptomys borealis*), red-backed vole (*Myodes gapperi*), rock vole (*Microtus chrotorrhinus*), and American red squirrel (*Tamiasciurus hudsonicus*). With the implementation of standard mitigation presented in the Voisey's Bay EPP and in Section 5.4, potential conflicts with wildlife are anticipated to be temporary and localized in nature. Control measures and environmental protection measures related to wildlife encounters are included in the Voisey's Bay EPP.

4.5 HERITAGE RESOURCES

The coast of Labrador has a long, and complex, cultural history that dates back about 7,500 years ago (VBNC 1997). Several generations of Innu and Inuit ancestry have lived in the Voisey's Bay area where they seasonally harvested the plant and animal resources of the land and sea. Pre-contact cultures in Labrador and Quebec Ungava are grouped under two broad categories: pre-Innu, which includes Quebec-Labrador Montagnais and Naskapi, or Innu, ancestors; and pre-Inuit, which include Nunavik (Inuit of Quebec) and Labrador Inuit predecessors (VBNC 1997).

A heritage resources assessment in support of the Voisey's Bay mine site environmental assessment (EA) was completed between 1995 and 1997 and included professional archaeologists surveying over 200 km^2 in the Voisey's Bay area, conducting visual inspections and test pitting. A total of 134 archaeological and contemporary sites were identified within the survey area (VBNC 1997). Of the 143 sites, 19 date to the pre-contact period, two to either the late pre-contact or early historic period and 102 to historic (pre-1960) or contemporary occupation (post-1960) (VBNC 1997).

Following the discovery of 134 archaeological, historic, and ethnographic sites inside the Voisey's Bay heritage resource survey area, there remains the possibility that undiscovered archaeological sites such as structures, tools, butchered animal bones and graves may be discovered or disturbed during construction and operation activities in the general area. As outlined in the existing Voisey's Bay EPP, (which IIE will be required to comply with in carrying out the Project) when required, an archaeologist will be engaged, under permit from the Nunatsiavut Government (Permitting Authority for Archaeological Activities on Labrador Inuit Lands) and the Innu Nation environmental monitors will examine the sites of proposed activity involving potential surface disturbance, prior to the commencement of these activities to determine whether the location of such activities is in an area of high archaeological potential, and to identify site-specific precautions which should be taken. If required, a Stage I archaeological assessment will be conducted.

Furthermore, IIE site personnel will be informed of the historic resources potential of the area, of their responsibility to report unusual findings, and to leave such findings undisturbed. Information will be provided through site educational programs offered as part of general orientation requirements, including Indigenous cultural awareness. If there was to be an accidental discovery of a historic resource during construction or operation, appropriate mitigation measures will be taken to reduce the impact to the historic resource wherever feasible. Procedures to be followed in the event of an accidental discovery are outlined in the Voisey's Bay EPP.

4.6 SOCIO-ECONOMIC ENVIRONMENT AND LAND USE

Communities in the immediate vicinity of Voisey's Bay include the Innu community of Natuashish and the Inuit community of Nain. VNL has well-established and effective communication and cooperation processes in place with relevant Indigenous governments and organizations, local communities, and other interested groups and individuals, which IIE will adhere to in carrying out the Project. These include consultation procedures in place with the Labrador Inuit and Innu pursuant to the Impact Benefit Agreements, as well as various other formal and informal mechanisms which provide and receive information to and from Indigenous and other communities in Labrador. Accordingly, VNL has a positive relationship with the Nunatsiavut Government and Innu Nation including the communities closest to Voisey's Bay.

The Labrador Innu primarily reside in two communities: Sheshatshiu in central Labrador and Natuashish on the North Coast of Labrador. Natuashish is located 73 km from the Project Area. The community of Natuashish was formed following the Innu's relocation from the community of Utshimassit (Davis Inlet). The March 2018 registered population of the Labrador Innu was 2,728. In 2016, the median age of the population of both First Nations (approximately 21.5 years) was less than half of that of the NL population in general (46 years) and the percentage of individuals below 15 years of age in Sheshatshiu (36.3%) and Natuashish (40.1%) was three times higher than that of the NL population (14.3%) (Statistics Canada 2017). The community is approximately 300 km north of Happy Valley-Goose Bay and is only accessible by plane or boat. Natuashish, a relatively small community, offers services and infrastructure to their members and residents. Main employers in Natuashish include the Innu Nation, Mushuau Innu First Nation Band Council, Mushuau Innu Health Commission, Mushuau Innu General Store, and the Natuashish Hotel.

The Nunatsiavut Government (NG) is the democratically elected body that administers government services in the five Inuit communities in Labrador: Nain, Hopedale, Postville, Makkovik and Rigolet. From 2006 to 2016, the population of Nunatsiavut increased by 6.0%, from 2,415 to 2,560 (Workforce Development Secretariat n.d.). Nain is the community located closest to the Project. It is located 35 km from the Project Area and is the most northern and largest community in Nunatsiavut (Tourism Nunatsiavut n.d.). Nain was founded in 1771 by Moravian Missionaries and is one of the oldest Inuit settlements in Canada (Canada C3 n.d.). The population of Nain 2016 was 1,125 with a median age of 31 years (Statistics Canada 2016). It is the administrative capital for the Nunatsiavut Government. According to the 2016 Census, the primary industries of employment include public administration, health care and social assistance, retail trade, construction, and education services (Statistics Canada 2016). Traditional land and resource use by the Innu and Inuit is described in the VBNC (1997) EA. Given the Project is located entirely within the existing Mine / Mill area, no different or additional interaction with, or effects on, Indigenous communities or their harvesting or other land use activities are likely to occur. The workforce for the construction and operation of the Project will adhere to current IBA commitments, and hiring will be conducted as per current IBA practices.

4.7 FUTURE ENVIRONMENT WITHOUT THE WIND ENERGY PROJECT

Without the Project, the environment of the GPS Hill site will remain as currently described in preceding sections and the mine will continue to rely solely on diesel fuel for on-site power generation. As discussed in Section 1.4, the Voisey's Bay mine is currently undergoing a major change to shift from open pit to underground operations with anticipated increases to its power generation requirements. With the expansion of the Voisey's Bay mining operation, increased energy demands will have to be met while reducing the venture's carbon footprint in line with Vale's corporate sustainability initiatives. In order to reduce the mine site diesel consumption and its operational energy costs, an alternative energy source is required.

The pursuit of wind energy at Voisey's Bay has the potential to result in the avoidance of approximately 25,000 tonnes CO_2e in GHG emissions annually, which would otherwise result from the use of diesel fuel for on-site power generation. The Project will also reduce anticipated diesel usage for power generation by approximately13%, or approximately 10 million liters per year. This will reduce the demand for diesel supply and reduce the requirements for shipping diesel to the remote site, avoiding emissions from transportation of fuel, as well as reducing the environmental risk associated with the transportation and handling of diesel fuel.

5.0 ENVIRONMENTAL EFFECTS METHODS AND ASSESSMENT

5.1 OVERVIEW OF METHODS

The environmental effects assessment is focused on environmental and socio-economic effects that have been identified as of concern by government agencies and community stakeholders. As discussed further in Section 5.2.1, two valued components (VCs), environmental or socio-economic attributes that may be affected by the Project, were selected for assessment: Avifauna and Bats. This assessment examines the environmental effects to Avifauna and Bats that could result from Project-related activities. The assessment of effects include the following steps:

- **Scope of the Assessment:** The scope of the assessment is defined by the components and activities required to construct and operate the Project. A description of Project activities and components is provided in Chapter 2. The scope of the assessment for the VCs is further defined by regulatory policies, spatial and temporal boundaries, and community and stakeholder engagement, as described in Section 5.2.
- **Existing Conditions:** The existing environment characterizes the conditions from historical and present activities in the Project Area, LAA and RAA. An overview of existing environmental conditions including regional geology, atmospheric environment, aquatic environment, terrestrial environment, heritage resources, and socio-economic environment and land use is provided in Chapter 4. Existing conditions for the VCs characterize the receiving environment, facilitate the selection of mitigation measures, and support the analysis of residual environmental effects and their associated significance.

- **Assessment Criteria and Methods:** This includes the residual effects characterization, significance definition, the environmental effects to be assessed for the VC, and the identification of the physical Project activities that may interact with the environmental effects identified for assessment. The Assessment criteria and methods for the avifauna and bat VCs are provided in Section 5.3.
- **Assessment of Environmental Effects:** Further assessment is conducted for potential interactions between Project activities and the identified VCs. Where an interaction occurs between a Project activity and the VC, there is an analysis of environmental effects pathways, identification of mitigation measures, and characterization of residual environmental effects. The environmental effects remaining after the application of the mitigation measures (i.e., the residual environmental effects) are characterized using standard descriptors (magnitude, geographic extent, duration, frequency, reversibility, and context) defined for each VC. The assessment of environmental effects for avifauna is provided in Section 5.5 and Section 5.6 for bats. A summary of residual effects is provided in Section 5.7.
- **Determination of Significance:** The significance of the effect to each VC is determined using the descriptors and based on a pre-determined definition of significance (defined in Section 5.3.2). The determination of significance for each VC is provided in Section 5.8.
- **Follow-up and Monitoring:** Where applicable, monitoring programs are identified for the VC to determine the effectiveness of mitigation measures and compliance with conditions of release. Follow-up and monitoring is described in Section 5.9.
- **Cumulative Effects:** Cumulative environmental effects of the Project are identified in consideration of other past, present, or reasonably foreseeable future projects or activities that have been or will be carried out (Chapter 6). The residual cumulative environmental effects of the Project in combination with other projects or activities that have been or will be carried out are evaluated, including the contribution of the Project to those cumulative environmental effects (as applicable).

5.2 SCOPE OF THE ASSESSMENT

5.2.1 Issues Scoping

The Project was developed in consultation with key stakeholders, is aligned with the policy priorities of Vale and as a first step involved consultation with government agencies, including the provincial Department of Environment, Climate Change and Municipalities Environmental Assessment Division, the provincial Department of Fisheries, Forestry and Agriculture Wildlife Division, and ECCC - Canadian Wildlife Services.

Through consultation, general regulatory guidance was provided with regards to EA Registration requirements such as inclusion of Project details for roads, transmission line, and other infrastructure. Also, it was raised through consultation that there is a potential concern for interactions with avifauna and bats. It was noted that the site is far north and outside of typical geographic range for NL resident bats; however, there have been some anecdotal reports of bats from residents in Nain, which may be the little brown bat found roosting in human structures because of the lack of forested habitat. Hoary bats could also be present, although at a low likelihood, as they migrate through NL in August / September. In addition to Avifauna and Bats, concerns regarding caribou and rare plants were raised. However, based on observations and experience, and the VBNC 1997 EA, there is low potential for caribou and rare plants as the Project Area is a barren land shrub that does not have high habitat potential.

Since the winter of 2019, VNL has provided updates to both IBA Implementation Committees: Tasiujatsoak Committee (Inuit) and Emish Committee (Innu). These updates were general in nature and feedback from both Committees has been positive. In accordance with agreements established with Intergovernmental and Indigenous Affairs, all environment permits are, and will continue to be, sent to both the Nunatsiavut Government and Innu Nation by the Government of Newfoundland and Labrador, as per their normal consultation process for environmental permits in Voisey's Bay. Also, IIE is a limited partnership, the limited partners of which include Innu Development Limited Partnership (an Innu economic development entity) and NGC Nunatsiavut Inc. (an Inuit economic development entity) along with Envest. Both economic development entities have been involved in this Project on many fronts since early in the planning for the Project.

In consideration of regulatory guidance, technical knowledge of the Project, existing conditions for the physical, biological, and socio-economic environments, and professional judgement of the Project Team on potential Project-interactions, two VCs have been selected for assessment, avifauna, and bats. The scope of the VCs includes Avifauna (i.e., bird species) and Bats, including SAR and SOCC. It also includes their habitats, defined as areas selected by species to meet their nutritional and shelter needs.

For the purpose of this assessment, SAR are species:

- Designated under Schedule 1 of the federal SARA
- Listed as *Extirpated, Endangered, Threatened*, or *Vulnerable* under the NL ESA
- Listed as *Extirpated, Endangered, Threatened, Vulnerable*, or *Special Concern* by COSEWIC

Species listed under SARA Schedule 1 or NL ESA have legal protection, whereas species listed under COSEWIC do not.

SOCC are those species identified as provincially rare in NL (ranked as S1 or S2 by the AC CDC).

5.2.2 Regulatory and Policy Setting

Applicable legislation to inform the scope of the assessment includes:

- The SARA provides a framework to facilitate recovery of species listed as *Threatened, Endangered* or *Extirpated* under the *Act* and to prevent species listed as *Special Concern* from becoming *Threatened* or *Endangered*. SARA protects SAR and their habitats for species listed under the *Act*, prohibiting: 1) the killing, harming, or harassing of *Endangered* or *Threatened* SAR (sections 32 and 36); and 2) the destruction of critical habitat of *Endangered* or *Threatened* SAR (sections 58, 60 and 61).
- The *Migratory Birds Convention Act, 1994* provides protection for migratory birds as well as their nests and eggs. This Act affords protection to most native bird species expected to occur in the RAA, except some non-migratory groups, such as raptors, kingfishers, and cormorants.

- The NL ESA provides protection for terrestrial vegetation and animal species considered to be *Endangered, Threatened* or *Vulnerable* in NL. The Wildlife Division, within the NL Department of Fisheries, Forestry and Agriculture coordinates the assessment and listing of SAR and develops recovery and management plans, monitoring programs and research projects to promote conservation of species listed under the *Act*.
- The NL *Wild Life Act* affords protection of wildlife (including avifauna species) and prohibits the hunting, taking, or killing of wildlife or classes of wildlife, whether in particular places or at particular times or by particular methods, except under license or permit. The *Act*, in combination with other provincial regulations and *Acts* including the *Wilderness and Ecological Reserves Act* and the NL ESA, protects the biodiversity and wildlife resources of NL from being compromised.

5.2.3 Boundaries

The scope of the assessment is defined by spatial boundaries (i.e., geographic extent of potential effects) and temporal boundaries (i.e., timing of potential effects). The spatial boundaries reflect the geographic range over which potential environmental or socio-economic effects may occur, whereas temporal boundaries identify when an environmental or socio-economic effect may occur throughout all phases of the Project.

5.2.3.1 Spatial Boundaries

The spatial boundaries are defined as follows:

- **Project Area**: The Project Area is the immediate area within which Project activities and features will occur, and within which direct physical disturbance associated with the Project will occur. The Project Area is illustrated on Figure 5-1. The Project Area consists of the area within which Project infrastructure will be located, including wind turbines as well as switching station, access / construction roads, and staging areas for turbine assembly.
- **Local Assessment Area (LAA)**: The LAA includes the Project Area and adjacent areas (e.g., 1-km radius buffer) where environmental effects may be reasonably expected to occur (Figure 5-1). The LAA was established to reflect the area within which specific Project effects are most likely to occur for birds and bats, including indirect habitat loss due to sensory disturbance (i.e., displacement or avoidance) (e.g., Barré et al. 2018; Zimmerling et al. 2013; Benitez-Lopez et al. 2010).
- **Regional Assessment Area (RAA):** The RAA is the area within which residual environmental effects may interact cumulatively with the residual environmental effects of other project or activities. The RAA includes the Project Area, LAA and a 20-km buffer around the Project Area (Figure 5-1).

5.2.3.2 Temporal Boundaries

Temporal boundaries for the assessment address the potential effects during the Project's construction, operation, and decommissioning phases over relevant timescales. The overall Project schedule is presented in Section 1.5.

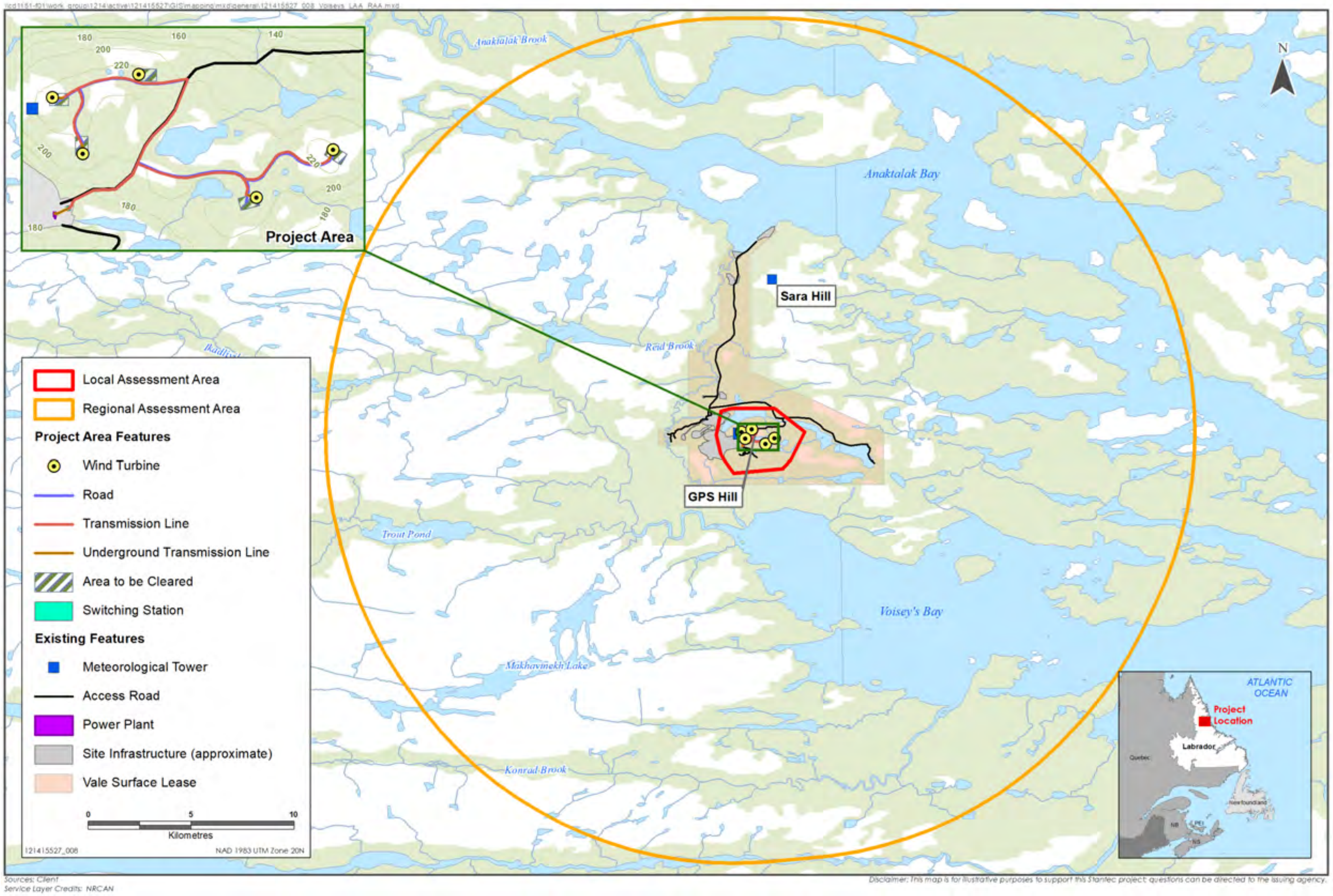

Figure 5-1 Spatial Boundaries

5.3 ASSESSMENT CRITERIA AND METHODS

5.3.1 Residual Environmental Effects Description Criteria

The descriptors used to characterize residual environmental effects on avifauna and bats are defined in Table 5.1.

Table 5.1 Characterization of Residual Environmental Effects

Characterization	Description	Quantitative Measure or Definition of Qualitative Categories
Direction	The long-term trend of the residual effect	**Neutral –** no net change in measurable parameters for avifauna and bats relative to existing conditions **Positive –** a residual effect that moves measurable parameters in a direction beneficial to avifauna and bats relative to existing conditions **Adverse –** a residual effect that moves measurable parameters in a direction detrimental to avifauna and bats relative to existing conditions
Magnitude	The amount of change in measurable parameters relative to existing conditions	***Change in Habitat*** **Negligible –** no measurable change in habitat for avifauna or bats, including SAR **Low –** change restricted to a specific group or habitat localized one generation or less, within natural variation **Moderate –** change restricted to a portion of a population or habitat, one or two generations, rapid and unpredictable change, temporarily outside range of natural variability **High -** change affecting a whole stock, population, or habitat outside the range of natural variation ***Change in Mortality Risk*** **Negligible –** no measurable change in avifauna or bats mortality is anticipated **Low –** a substantial change in the abundance of avifauna or bats in the LAA is not anticipated, although temporary local shifts in distribution in the LAA could occur **Moderate –** a substantial change in the abundance and/or distribution of avifauna or bats in the LAA might occur, although a measurable change in the abundance of avifauna or bats in the RAA is not anticipated **High –** a substantial change in the abundance and/or distribution of avifauna or bats in the RAA could occur
Geographic Extent	The geographic area in which an environmental, effect occurs	**Project Area –** residual effects are restricted to the Project Area **LAA –** residual effects extend into the LAA **RAA –** residual effects extend into the RAA
Frequency	Identifies how often the residual effect occurs during the Project	**Single event –** occurs once **Multiple irregular event –** occurs at no set schedule **Multiple regular event –** occurs at regular intervals **Continuous –** occurs continuously

Table 5.1 Characterization of Residual Environmental Effects

Characterization	Description	Quantitative Measure or Definition of Qualitative Categories
Duration	The period of time required until the measurable parameter for avifauna and bats returns to its existing condition, or the 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 phase **Long-term –** residual effect extends beyond the operation phase **Permanent –** recovery to baseline conditions unlikely
Reversibility	Pertains to whether a measurable parameter for avifauna and bats can return to its existing condition after the Project activity ceases	**Reversible –** the residual effect is likely to be reversed after activity completion and rehabilitation **Irreversible –** the residual effect is unlikely to be reversed
Ecological and Socio-economic Context	Existing condition and trends in the area where environmental 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

5.3.2 Significance Definition

A significant adverse residual effect on avifauna or bats is defined as one that threatens the long-term persistence, viability, or recovery of an avifauna and/or bat species population in the RAA, including effects that are contrary to or inconsistent with the goals, objectives or activities of recovery strategies, action plans and management plans.

5.3.3 Potential Effects, Pathways and Measurable Parameters

Project activities have the potential to interact with Avifauna and Bats. The assessment of Project-related environmental effects on avifauna and bats is focused on the following potential environmental effects:

- Change in habitat quality and use (including direct loss or indirect loss through sensory disturbance)
- Change in mortality risk

The measurable parameters used for the assessment of the environmental effects presented above, and the effect pathway, are provided in Table 5.2.

Table 5.2 Potential Environmental Effects, Effects Pathways and Measurable Parameters for Avifauna and Bats

Potential Environmental Effect	Effects Pathways	Measurable Parameters
Avifauna		
Change in habitat quality and use	• Direct and/or indirect loss or alteration of habitat due to vegetation clearing, sensory disturbance and/or edge effects	• Discussion of avifauna habitat directly or indirectly (qualitative) lost or altered for representative species, including SAR with the most potential to be affected by the Project
Change in mortality risk	• Direct and/or indirect risk due to site preparation and construction • Direct increase in mortality risk resulting from collisions with wind turbine blades or other infrastructure	• Discussion of avifauna mortality risk based on existing research and literature
Bats		
Change in habitat quality and use	• Direct and/or indirect loss or alteration of habitat due to vegetation clearing, sensory disturbance and/or edge effects	• Discussion of bat habitat directly or indirectly (qualitative) lost or altered for representative species, including SAR with the most potential to be affected by the Project
Change in mortality risk	• Direct and/or indirect risk due to site preparation and construction • Direct increase in mortality risk resulting from barotrauma or wind turbine strikes	• Discussion of bat mortality risk based on existing research and literature

5.3.4 Project Interactions with Avifauna and Bats

Project physical activities that might interact with avifauna and bats for each potential effect are identified in Table 5.3. These interactions are indicated by check marks and are discussed in detail in Sections 5.5 and 5.6 in the context of effects pathways, standard and Project-specific mitigation, and residual environmental effects. A justification is also provided for non-interactions (dash marks).

Table 5.3 Potential Project-Environment Interactions and Effects on Avifauna and Bats

Project Components and Physical Activities	Potential Environmental Effects to be Assessed			
	Avifauna		Bats	
	Change in Habitat Quality and Use	Change in Mortality Risk	Change in Habitat Quality and Use	Change in Mortality Risk
Construction				
Site Preparation and Construction	✓	✓	✓	✓
Operation & Maintenance				
Turbine operation	✓	✓	✓	✓
Inspection and Maintenance	✓	–	✓	–
Decommissioning				
Decommissioning and Reclamation	✓	–	✓	–

Notes:
✓ Potential interactions that might cause an effect.
– Interactions between the Project and the VC are not expected.

Activities that are classified by a dash mark (-) are not expected to interact with avifauna and bats. No interaction is expected to occur for a change in mortality risk (for either Avifauna or Bats) during inspection or maintenance or decommissioning and reclamation.

5.4 MITIGATION AND MANAGEMENT

Standard mitigation measures will be implemented throughout the lifespan of the Project. Many standard mitigation measures are included in the Voisey's Bay EPP, which IIE will comply with in carrying out the Project. Mitigation measures associated with the two Project VCs (Avifauna and Bats) are included in Table 5.4.

Table 5.4 Bird and Bat Mitigation Measures

VC		Mitigation	Project Phase		
Avifauna	Bats		C	O	D
✓	✓	Project footprint and disturbed areas will be limited to the extent practicable.	✓	✓	✓
✓	✓	Sensitive areas (e.g., wetlands) will be identified prior to construction and appropriate buffers will be flagged and maintained around these areas, where feasible.	✓	-	-
✓	✓	Vehicles and heavy equipment will be maintained in good working order and will be equipped with appropriate mufflers to reduce noise.	✓	✓	✓
✓	✓	Project vehicles will be required to comply with speed limits on all roads, including the access road.	✓	✓	✓
✓	✓	Site clearing and grubbing will be avoided during the breeding bird season, whenever possible. If this is not possible, pre-clearing surveys will be conducted for active migratory bird nests and buffer / set-back distances from active nests will be established.	✓	✓	-
✓	-	The discovery of nests by staff will be reported to the VNL Environmental Advisor at site and appropriate action or follow-up will be guided by Voisey's Bay Wildlife Management Plan.	✓	✓	✓
✓	✓	The contractor will adhere to EPP guidance regarding the use and storage of hazardous materials, waste disposal, vegetation clearing, etc.	✓	✓	✓
✓	✓	Project lighting will be limited to that which is necessary for safe and efficient Project activities.	✓	✓	✓
✓	✓	Turbine lighting will be the minimum allowed by Transport Canada for aeronautical safety, and white or red strobe lights may be used with the minimum intensity and flashes per minute allowable.	-	✓	-
✓	✓	A post-construction mortality monitoring program will be established, and carcass searches will be conducted at all turbines between April and October. Surveys will be designed to account for searcher efficiency and scavenger rates. The mortality monitoring program will be developed in consultation with the Government of NL Wildlife Division An adaptive management framework will be used to introduce new mitigation measures if high fatality rates are observed. Additional mitigation may include an increase in cut-in speeds, which would be expected to reduced fatality rates.	-	✓	-
		✓			
Notes: Project Phases: C = Site Preparation and Construction O = Operation and Maintenance D = Decommissioning and Reclamation					

5.5 ASSESSMENT OF ENVIRONMENTAL EFFECTS ON AVIFAUNA

5.5.1 Analytical Assessment Techniques

In this section, change in avifauna habitat and mortality risk is assessed based on existing information (Section 4.4) and information collected during field surveys (Appendix C and D). Based on the discussion of Project interactions with avifauna, only those interactions with a check mark in Table 5.4 are considered further in this assessment.

5.5.2 Assessment of Change in Habitat Quality and Use

5.5.2.1 Pathways

Site Preparation and Construction

Avifauna habitat will be directly lost during construction through vegetation removal during site preparation and conversion of land cover type. Vegetation will be cleared at each of the turbine pads, for access roads and other associated infrastructure. The turbine pads are a cleared area of approximately 110 m by 70 m (or 0.77 ha) which is used for laydown and assembly areas for the turbine components. The turbine pads will remain cleared throughout the lifespan of the Project and will be constructed with gravel/crushed stone fill. Table 5.5 indicates how much of each habitat type (as classified by EOSD land cover data (Wulder et al 200) will be lost in the LAA as a result of clearing for the turbine pads.

Table 5.5 Habitat Types to be Lost in LAA

Habitat Type	Turbine Pad Footprint (ha)	Total cover in LAA (ha)	Proportion of Habitat Type Lost in LAA (%)
Low Shrub	2.29	259.77	0.88
Coniferous Open	0.0009	147.89	0.0006
Barren	1.56	945.05	0.16

The majority of habitat that will be lost is low shrub, followed by barrens. Both habitat types are quite common in the LAA and surrounding area (Table 4.3). This loss accounts for less than 1% of low shrub and barren cover within the LAA, with 0.88% and 0.16% cover being lost, respectively. The 2019/20 breeding bird surveys sampled barrens, sparse conifer, and wetland habitat. Some low shrub habitat was also sampled, but based on field habitat observations, it was reclassified and grouped with the barrens habitat for analysis. The results of the breeding bird surveys indicated that barrens were the least productive habitat type, with 10 species recorded (in comparison with 15 species recorded in wetlands, and 21 species recorded in sparse conifer). None of the species observed in barrens were SOCC or SAR.

Indirect habitat loss will also occur through the creation of edge effects and sensory disturbance. In areas where vegetation is cleared for Project infrastructure, new edges may be created. Edge effects can include changes in microclimate, vegetation structure, changes to avifauna presence and/or abundance and behavioral responses of avifauna (Harper et al. 2005; Murcia 1995). The magnitude of edge effects varies depending on the distance to the edge and is typically greater closer to the edge (Fuentes-Montemayor et al. 2009). Different species are affected differently by the creation of new edges; some bird species prefer edge habitat (e.g., American robin, white-throated sparrow) and may increase in abundance along edges. Habitat interior specialists (e.g., Swainson's thrush (*Catharus ustulatus)*, northern waterthrush (*Seiurus noveboracensis*) will avoid edge habitats and may decrease in abundance in these habitats.

Noise, light, and dust emissions can result in sensory disturbance effects during the construction phase. For example, heavy equipment use and increased traffic result in an incremental increase in noise levels in the Project Area. Birds may adapt to sensory disturbance by avoidance, which can lead to abandoning habitat, and thus an indirect decrease in habitat availability. Sensory disturbance may also cause stress or other physiological effects. Chronic noise exposure can affect the ability of avifauna to perceive acoustic signals, causing changes in foraging and anti-predator behavior, reproductive success, density, and community structure (Barber et al. 2010). Lighting may be required for overnight construction but will be limited to the extent required for safety of workers. Light pollution can cause birds to modify their daily rhythms, including timing of singing (Dominoni 2015). This may be attributed to the fact that exposure to light at nighttime can suppress melatonin levels in the morning (Dominoni et al 2013a). Other studies suggest that light pollution may also result in changes to reproductive timing, including earlier development of gonads for first year reproductive birds (Dominoni 2013b). The physiological mechanism behind changes to reproductive timing is unknown. It is well known that artificial light can cause disorientation in nocturnally migrating birds, as they may become attracted to the light (Spoelstra and Visser 2013; Van Doren et al. 2017). This can result in birds becoming trapped in artificially lit areas, collisions with lit structures, or exhaustion. It is important to note that noise and light pollution are already occurring in this area in relation to the existing mine and increases related to the wind Project area anticipated to be incremental. Mitigation for noise and light pollution are included in the Voisey's Bay EPP.

The magnitude of indirect effects on habitat is directly associated with the level of nearby Project activity. These effects are generally considered greatest if disturbance occurs during critical periods (e.g., breeding season). These effects can be expected to occur in the LAA within 200 m of the Project Area but may extend farther (Ontario Ministry of Natural Resources 2000).

Operation and Maintenance

Direct habitat loss is expected to occur during the construction phase. However, indirect habitat loss through sensory disturbance will continue during the operations phase. Throughout operation, noise will remain higher than baseline as a result of increased traffic, maintenance and regular operation activities, and the noise of the rotating turbines. Lighting will be required in the Project Area to meet Transport Canada lighting requirements, and for the safety of site personnel. This noise and light pollution may result in the same sensory disturbance effects on birds as is described above for construction.

Decommissioning and Reclamation

During decommissioning, Project infrastructure will be removed, and the Project Area will be rehabilitated and revegetated. Sensory disturbance will occur during decommissioning activity but will cease when decommissioning is complete. It is anticipated that over time native vegetation will re-establish across most of the disturbed portions of the Project site. This will likely result in an increase in availability of habitat for a variety of plant and animal species. Small mammals and other wildlife will likely return as vegetation becomes established and as human activity ceases. It is important to note that it will take time for the full rehabilitation measures proposed for the Voisey's Bay site to create a stable site after closure of the mine and concentrator facilities. While the removal of surface buildings and structures will take place relatively quickly, revegetating the Project Area with healthy, sustainable vegetation that supports existing, native ecosystems will take a longer period of time.

5.5.2.2 Residual Environmental Effects

The mitigation measures described in Section 5.4 will reduce some of the effects on habitat availability for avifauna. However, some adverse residual effects are still expected to occur. Avifauna will experience direct habitat loss through clearing and land cover change in the construction and (to a lesser extent) operations phases. However, ample similar habitat exists in the LAA and RAA, and birds are expected to use vast areas of similar suitable habitats across the landscape.

Sensory disturbances will occur during all Project phases through noise, light, and dust pollution. These factors may result in behaviors such as avoidance, which reduce the amount of suitable habitat available for a variety of birds. However, sensory disturbance already exists in relation to mine site activities, and the Project is only expected to have incremental increases in noise. In addition, mitigation for noise, light and dust disturbance are included in the Voisey's Bay EPP. The magnitude of these changes are expected to be moderate for the construction phase, and low for the operations phase. Habitat changes resulting from Project construction and operations are anticipated to be long term, but reversible. Upon decommissioning of the wind farm, cleared areas will be rehabilitated and revegetated.

5.5.3 Assessment of Change in Mortality Risk

5.5.3.1 Pathways

Site Preparation and Construction

Construction activities will involve site clearing and grubbing, preparation of pads and laydown areas and the construction of access roads, powerlines and other associated infrastructure, requiring the mobilization and use of heavy machinery. Heavy machinery use has some potential for causing bird mortality through direct collisions but site preparation activities (vegetation clearing, grubbing and removal) will be the primary pathway to Project-related change in mortality risk. Birds are most at risk during the nesting season, when mating is occurring, a probable nest site in suitable nesting habitat and/or eggs or hatchlings are present that do not have the ability to move away from danger. Vegetation clearing can result in the destruction of nests, and the subsequent mortality of young birds or eggs. To mitigate these risks, nest searches will be conducted prior to the clearing of vegetation, as discussed in

Section 5.4. These searches would be conducted in accordance with CWS guidance and best practice. The nesting period for the Voisey's Bay region extends from early-May to mid-August (ECCC 2018b).

Operation and Maintenance

The primary pathway for bird mortality during operation is direct strikes with turbine blades, or with other windfarm infrastructure, including powerlines. A study that reviewed 43 wind farms across Canada found that on average, 8.2 ± 1.4 birds were killed per turbine per year. At the individual wind farms included in the study, these numbers ranged from 0 to 26.9 birds per turbine per year (Zimmerling et al. 2013). Nocturnal migrants have long been thought to be the most susceptible to turbine strikes, potentially because they are attracted to the lights on turbines (Longcore et al. 2008). However, newer studies do not support this idea, and suggest that nocturnal migrants are not killed at higher rates than diurnal migrants (Welcker et al. 2016). Raptors have been identified as being especially susceptible to turbine strikes due to their morphology and foraging behavior (de Lucas et al. 2008; Smallwood et al. 2009; Garvin et al. 2011).

Bird strikes at windfarms occur more frequently during inclement weather, including low cloud conditions or fog (Erickson et al. 2001). During these conditions, nocturnal migrants typically fly at lower altitudes, and are thus more susceptible to collisions. They may also be more attracted to artificial lights on nights with inclement weather, and research indicates that birds may be more attracted to pulsating red lights than they are to white strobe lights during these conditions (Erickson et al. 2001).

The ECCC/CWS guidance documents for environmental assessment were consulted in regard to site selection, assessment, and level of concern categories (Environment Canada 2007; ECCC 2018c). This site was determined to be a site with *Very High* site sensitivity as a result of having turbines greater than 150m in height, and as such is categorized as Level 4 concern.

Decommissioning and Reclamation

Bird mortality could occur during decommissioning through collisions with traffic, machinery, or infrastructure. If birds are nesting on Project infrastructure, eggs or fledglings could be destroyed when the infrastructure is dismantled and removed. However, mitigation measures are included in the Voisey's Bay EPP that require nest searches prior to any dismantling or removal of infrastructure. The EPP also contains mitigation for wildlife in relationship to heavy equipment and traffic.

5.5.3.2 Residual Environmental Effects

Mitigation measures implemented during the construction phase are expected to reduce the destruction of active nests, and therefore mortalities of young birds. The residual effects are expected to be low in magnitude and restricted to the Project Area. These effects would be short term in duration and occur irregularly.

A post-construction mortality monitoring program will be developed in consultation with regulators, and carcass searches will be conducted at the turbines between April and October. An adaptive management framework will be used to introduce new mitigation measures if high fatality rates are observed. Despite mitigation measures, bird strikes with turbines are likely occur during the life of the Project. However, these events are expected to be infrequent. The Project Area does not contain landform features that would concentrate birds, and it is not known to be an important migratory route. Existing information and field studies did not indicate the presence of breeding bird colonies or concentrations. In addition, very few raptors and waterfowl were observed during the migratory period. Subsequently, the magnitude of effects on bird mortality are anticipated to be moderate and medium term in duration. Mortalities are expected to occur irregularly, and are irreversible during the operation phase, but reversible upon decommissioning.

5.6 ASSESSMENT OF ENVIRONMENTAL EFFECTS ON BATS

5.6.1 Analytical Assessment Techniques

In this section, change in bat habitat and mortality risk is assessed on the basis of existing information (Section 4.4) and information collected during field surveys. Based on the discussion of Project interactions with bats, only those interactions with a check mark in Table 5.3 are considered further in this assessment.

5.6.2 Assessment of Change in Habitat Quality and Use

5.6.2.1 Pathways

Site Preparation and Construction

Most direct habitat loss for bats will occur during the construction phase as a result of land clearing and land cover conversion. Little brown myotis roost and form maternity colonies in trees and snags, as well as in human structures. On average, 1.23 ha of acres of habitat is lost per turbine at wind farms in Canada (Zimmerling et al. 2013). This would mean 6.15 ha lost for five turbines. If maternity colonies occur in the Project Area, they could be lost when tree clearing occurs.

As discussed in Section 5.5.2.1, the majority of the habitat that will be cleared for the turbine pads is low shrub and barrens (Table 5.5). Activity in these habitats is typically low for little brown myotis, as they prefer more forested areas, or open water for foraging. Similarly, it is unlikely that maternity roosts would occur in low shrub or barren habitats, since these roosts occur in trees, snags, or human structures, which are typically not present in low shrub or barrens habitat.

The recovery strategy identifies preliminary areas of critical habitat. At this preliminary stage, the only habitat feature considered as critical habitat are hibernacula, since suitable hibernacula may be limiting for little brown myotis (ECCC 2018a). There are no known hibernacula in the RAA. As such, this Project will not result in the loss of designated critical habitat for bats.

Construction can also result in indirect effects on habitat through sensory disturbance (e.g., noise, light pollution, dust, and vibrations). Sensory disturbance can result in a reduction of suitable habitat, since bats may avoid areas with loud noises, artificial lights, or excessive dust. If there are bat hibernacula in the area, vibrations and noise resulting from blasting activities could result in disturbance to hibernating bats and partial collapses of hibernation sites (West Virginia Department of Environmental Protection

2006; Sheffield et al. 1992). Bats are particularly vulnerable to disturbance during hibernation since increased frequency or length of awakenings can result in a loss of critical fat stores (Sheffield et al. 1992). Bats are also particularly vulnerable to disturbance during the breeding season; bats may abandon their young if disturbance levels are too high (Bat Conservation Trust n.d.; Sheffield et al. 1992). The magnitude of indirect effects on habitat are directly associated with the level of nearby Project activity.

Operation and Maintenance

Direct habitat loss is expected to be negligible or minor during operations, as the majority of land clearing activity will occur during the construction phase.

Wind turbine operations will result in sensory disturbance for bats, which can extend beyond the footprint of the turbines and have effects on bat behaviour. For example, research has shown that anthropogenic noise affects bat foraging effort and foraging success; bats have been found to spend less time foraging in noisy areas; (Schaub et al. 2008). Another study indicated that sensory disturbance for bats can extend for over 1 km from wind turbines. This study reported a decrease in bat activity near turbines that was observed for multiple species (Barré et al. 2018). Sensory disturbance primarily occurs at habitat edges and increases in magnitude with levels of Project activity.

Decommissioning and Reclamation

Decommissioning activities will include removing Project infrastructure and revegetation of the Project Area. This will likely increase the amount of habitat available for bats. However, if little brown myotis are using Project infrastructure for roosting, this habitat would be lost.

5.6.2.2 Residual Environmental Effects

The mitigation measures described in Section 5.4 will reduce some of the effects on habitat availability for bats. Direct habitat loss will occur during the construction phases, although it will be kept to the minimum footprint required.

Ample suitable bat roosting habitat occurs in the RAA, and little brown myotis bats are expected to relocate to other areas. In the case of migratory bats, ample suitable migration habitat also occurs. Residual effects on bat habitat quality and use are expected to be of moderate magnitude during the construction phase, and of low magnitude during operation and decommissioning. Effects are expected to be low to medium term in duration, and reversible.

5.6.3 Assessment of Change for Mortality

5.6.3.1 Pathways

Site Preparation and Construction

Bat mortality may occur during the construction phase through collisions with cars or machinery while bats are active at night. Young bats are particularly more susceptible than adults to collision with cars (Fensome and Mathews 2016). Bat mortality could also result from the destruction of bat roosts. Little brown myotis roost in trees, snags, or human structures. Maternity roosts are made up of 10s to 100s of females, who roost, give birth to, and raise their pups together. If a tree or snag containing a roost is destroyed during vegetation clearing, it could be fatal to roosting bats. Pups are particularly susceptible, as they are unable to fly and escape danger.

If hibernacula are located in or near the Project Area, disturbance could result in increased arousal during the hibernation period. Repeated arousals could result in increased fat consumption and premature energy depletion, starvation, and mortality (Environment Canada 2015). In addition, female reproductive success depends on spring fat reserves (Jonasson and Willis 2011), therefore a decrease in body condition during torpor could affect reproductive success.

Operation and Maintenance

The largest threat to bat mortality during the operations phase is turbine strikes or barotrauma. Barotrauma occurs when bats experience a rapid pressure drop as they enter the low-pressure area near turbine blades. This causes tissue damage to air-containing structures in their bodies and can includes pulmonary hemorrhaging (Baerwald et al. 2008). Barotrauma has been found to cause a high proportion of bat fatalities associated with turbines. One study at a windfarm in Alberta examined 188 dead bats found evidence of barotrauma in 90% of bat fatalities, while external injuries consistent with blade strikes were found in 50% (Baerwald et al. 2008).

Migratory bats that roost in trees (including hoary and silver-haired bats) are most susceptible to wind turbine related mortalities. In North America, migratory tree bats account for 75% of wind farm fatalities, and hoary bats accounted for half of all fatalities (Arnett et al. 2008). A high proportion of these fatalities occur during the fall migration season (Cryan and Barclay 2009). Hoary bats were identified during the fall 2020 migration period in the RAA. One silver-haired bat was also recorded in the RAA, which may represent a vagrant, as discussed in Section 4.4.2.2. Of the species recorded in the RAA, hoary and silver-haired bats are expected to be the most vulnerable to wind turbine related mortality. Although little brown myotis fatalities occur less frequently than hoary bats, little brown myotis fatalities do occur, and this species is still susceptible to barotrauma and blade strikes (Cryan and Barclay 2009). In one study of bat mortality at wind farms across Canada, it was determined that little brown myotis accounted for 13% of bat mortalities from wind turbines (Zimmerling and Francis 2016). Bats are long-lived and have low fecundity rates. As such, they are slow to recover from population declines.

Research has indicated that increasing cut-in speeds can reduce bat fatality rates, since bat activity is highest at low wind speeds (Arnett et al. 2006). Cut in-speeds are the minimum wind speed required for the blades to start moving. A study in Pennsylvania compared fatality rates at turbines that were fully operational with those that had cut in rates of 5 m/s and 6.5 m/s. Results indicted an average nightly bat fatality was reduced by 56 to 92% at the sites with reduced cut-in rates, with minimal annual power loss (Arnett et al. 2009).

Decommissioning and Reclamation

Bat mortality could occur during decommissioning activities, although it is predicted to be unlikely and uncommon. If bats roost in Project infrastructure, they could be killed during the removal of this infrastructure, particularly in young bats are present that cannot fly. Mortality from collisions with equipment or machinery is also possible.

5.6.3.2 Residual Environmental Effects

Bat fatalities can occur as a result of barotrauma and/or direct strikes with turbine blades. However, the number of migratory tree-roosting bats recorded in the LAA was low, and as such, risk of mortality is expected to be low. In addition, turbines are going to be located primarily in low shrub and barrens habitat, where bat activity is low. The magnitude of effects is anticipated to be moderate during the operation phase, and low during construction and decommissioning. Effects are predicted to be short to medium term in duration, occur irregularly, and be irreversible.

A post-construction mortality monitoring program will be developed in consultation with regulators, and carcass searches will be conducted at the turbines between April and October. An adaptive management framework will be used to introduce new mitigation measures if high fatality rates are observed. Additional mitigation may include an increase in cut-in speeds, which would be expected to reduced fatality rates.

No known hibernacula occur in RAA. Since the RAA is at the northern known range for little brown myotis, they may undertake short scale southern migrations to hibernate. As such, it is not anticipated that hibernating bats will be disturbed by Project activities.

5.7 SUMMARY OF RESIDUAL ENVIRONMENTAL EFFECTS

The residual environmental effects of the Project on avifauna and bats are summarized in Table 5.6.

The direction of most effects is adverse, although negligible effects are also anticipated. The magnitude of effects ranges from low to moderate, and geographic extent ranges from the Project Area to the LAA. Short term, medium-term and long-term effects are predicted, which may occur at irregular or continuous frequencies. Some effects are irreversible, and others are reversible. These effects occur in a disturbed ecological and economic context.

Table 5.6 Summary of Residual Environmental Effects on Avifauna and Bats

Residual Effect	Residual Environmental Effects Characterization							
	Project Phase	**Direction**	**Magnitude**	**Geographic Extent**	**Duration**	**Frequency**	**Reversibility**	**Ecological and Socio-economic Context**
Change in Avifauna Habitat Quality and Use	C	A	M	LAA	LT	C	R	D
	O	A	L	LAA	LT	C	R	D
	D	N	L	LAA	LT	C	R	D
Changes in Avifauna Mortality Risk	C	A	L	PA	ST	IR	R	D
	O	A	M	LAA	MT	IR	R	D
	D	N	L	LAA	ST	C	R	D
Changes in Bat Habitat Quality and Use	C	A	M	LAA	LT	C	R	D
	O	A	L	LAA	MT	C	R	D
	D	N	L	LAA	LT	C	R	D
Changes in Bat Mortality Risk	C	A	L	PA	ST	IR	R	D
	O	A	M	LAA	MT	IR	R	D
	D	N						

KEY

The descriptors used to characterize residual environmental effects on avifauna and bats are defined in Table 5.1.

N/A – not applicable

Project Phase
C: Construction
O: Operation
D: Decommissioning

Direction:
P: Positive
A: Adverse
N: Neutral

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

Geographic Extent:
PA: Project Area
LAA: Local assessment area
RAA: Regional assessment area

Duration:
ST: Short-term
MT: Medium-term
LT: Long-term
P: Permanent

NA: 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
R: Resilient
NR: Not resilient

5.8 DETERMINATION OF SIGNIFICANCE

The effects of the Project on avifauna habitat quality and use and mortality risk are predicted to be not significant. Avifauna habitat will be directly and indirectly lost as a result of the Project. Residual effects on bird habitat are predicted to be low to moderate in magnitude, long-term and reversible. Ample suitable habitat for birds occurs in the RAA, and breeding birds are expected to relocate to other areas. Bird mortalities will occur as a result of turbine strikes; however, these incidents are expected to occur infrequently. The Project Area is not known to be in an important migratory route, and no landscape features that concentrate migrating birds occur. Mortalities are not expected to threaten the long-term viability of bird populations in the RAA. The residual effects on avifauna mortality are predicted to be low to moderate in magnitude, short to medium term in duration, and reversible.

The effects of the Project on bat habitat quality and use and mortality risk are predicted to be not significant. Habitat will be indirectly and directly lost, but mitigation will decrease the levels of sensory disturbance. Bats in the Project Area are anticipated to relocate to nearby suitable habitat. Residual effects on bat habitat are predicted to be low to moderate in magnitude, medium to long-term in duration, and reversible. Bat mortalities will occur as a result of turbine strikes; however, these incidents are expected to occur infrequently. Very few migratory bats were recorded in the LAA during acoustic monitoring. Mortalities are not expected to threaten the long-term viability of bat populations in the RAA. They are also not expected in interfere with recovery strategy for the *Endangered* little brown myotis (Environment Canada 2015). The residual effects on bat mortality is predicted to be low to moderate in magnitude, short to medium term in duration, and reversible.

5.9 FOLLOW-UP AND MONITORING

To date, there have been no spring bird migration surveys for the Project, and little is known about spring bird migration in this region. To address this data gap, spring bird migration surveys will be conducted in 2021.

A bird and bat mortality monitoring program will be developed in consultation with regulators, after the wind farm becomes operational. This may include carcass searches under the turbines from April to October. The frequency of monitoring will be highest during the spring and fall migratory periods. The monitoring program will be designed to account for searcher efficiency and scavenger rates. An adaptive management framework will be used, and increased mitigation measures will be implemented as required, based on results. For example, cut-in speeds could be increased to reduce bat mortalities. The mortality monitoring program will be developed in consultation with the provincial Wildlife Division (bats) and CWS (avifauna).

6.0 CUMULATIVE ENVIRONMENTAL EFFECTS

6.1 CONTEXT FOR CUMULATIVE ENVIRONMENTAL EFFECTS

The assessment of cumulative environmental effects is carried out where residual environmental effects of the Project overlap with residual environmental effects from other projects or activities. Other projects and activities that may result in cumulative environmental effects with the Project include ongoing mining and expansion activities by VNL and other mineral exploration in the RAA (Table 6.1; Figure 6-1). The existing and expansion activities for the Voisey's Bay mine operation is the primary resource development activity in the RAA.

The potential for interactions between other Project and the VCs are shown in Table 6.1.

Table 6.1 Potential Interactions between Other Projects and the VCs

Project Name or Physical Activity	Description	VC Interaction	
		Avifauna	Bats
Ongoing and Expansion Activities by VNL	VNL is the owner and operator of the Voisey's Bay Mine / Mill in Northern Labrador which currently consists of an open pit mine, mill and concentrator, in addition to developing underground mines. Construction of the existing Mill and Concentrator began in 2002, and the production of nickel, copper and cobalt commenced in 2005 (VNL 2019). Construction for the VBME, part of what is referred to as the "Post Ovoid" phase of the Project, began in 2016, with underground mining production planned to begin in 2021. VNL is actively advancing studies to evaluate and develop the Discovery Hill open pit deposit, also part of the Post Ovoid phase (VNL 2019).	✓	✓
Other Mineral Exploration	As shown on Figure 6-1, there are several other mineral claims in the RAA which represent past, present and potential future exploration activities.	✓	✓

6.2 ASSESSMENT OF CUMULATIVE ENVIRONMENTAL EFFECTS

Cumulative effects result from the interaction of effects of multiple past, present and future projects and/or activities on a particular component of the environment. This section describes the pathways of the cumulative effects resulting from the Project and other projects identified in Table 6.1, mitigation that could be implemented to reduce cumulative effects, and the nature of the cumulative effects in the context of the residual effects of other projects. These projects potentially have similar pathways as effects arising from the Project, including a change in habitat quality and use, and a change in mortality risk.

The primary cumulative environmental effect pathway for change in habitat quality and use within the cumulative effects RAA is a direct change in habitat and indirect effects associated with sensory disturbance (e.g., noise and light emissions), resulting in avoidance behaviours by resident or migratory species. The proposed wind farm will be located within the existing surface lease and immediately to the east of current open pit mining operations at the Voisey's Bay mine site. The mine site represents a past, current and ongoing future source of noise and light emissions for surrounding habitats. The contribution of Project-related residual adverse effects to cumulative effects on change in habitat quality and use is anticipated to be limited in geographic area. The wind farm would result in incremental changes to sensory disturbances already occurring at the mine site. The footprint is relatively small compared to the existing operation and existing, approved mine expansion (i.e., VBME). Mitigation measures have been implemented at the existing mine site to reduce adverse effects to Avifauna and Bats. Similar mitigation measures will be implemented for the proposed Project.

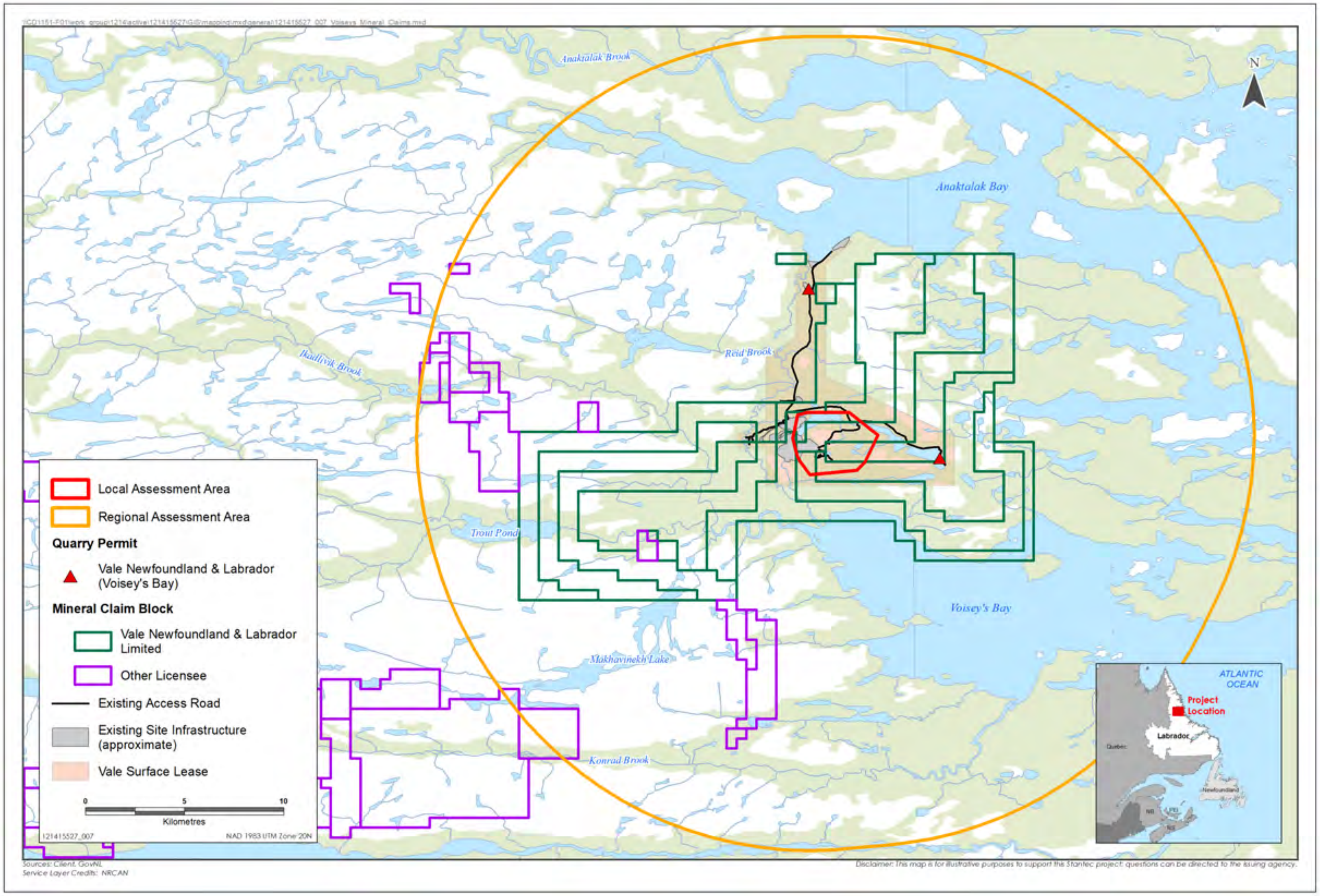

Figure 6-1 Other Physical Activities

The primary cumulative environmental effect pathway for change in mortality risk within the cumulative effects RAA is site preparation (vegetation clearing and grubbing) during construction and turbine operation. Increased mortality risk for Avifauna and Bats is potentially higher during Project construction, particularly for nesting birds and hibernating bats. Risk of mortality is also associated with turbine-related collisions during operation of the Project. Effects are not predicted to result in substantial change in the abundance of avifauna and bats in the cumulative effects RAA, however, potential temporary local shifts in distributions may occur. Mortality risk will eventually return to existing conditions post-decommissioning. The contribution of Project-related residual adverse effects to cumulative effects on change in mortality risk will also be low, as the residual adverse effect on Avifauna and Bats for the Project is predicted to be within the normal variability of existing conditions and is not expected to affect the long-term persistence or viability of avifauna and bats within the RAA.

With the implementation of proposed mitigation, it is unlikely that Project effects, in combination with effects from other projects and activities, would result in a cumulative reduction in the amount or composition of habitats within the RAA that would threaten the persistence or viability of Avifauna and Bats, including SAR and SOCC. This prediction assumes that other projects and activities in the RAA will be required to comply with various mitigation measures and regulations, including legal requirements to protect migratory birds such as clearing outside the bird breeding season, or where this is not possible, performance of bird nest sweeps and monitoring where there exists the potential to disturb nesting and breeding habitat.

For the reasons listed above, along with the limited spatial scale of the Project activities, the Project is not predicted to have significant adverse cumulative environmental effects on avifauna and bats.

7.0 FUNDING

No government funding has been provided to IIE in respect of the Project. The cost of the Project will be funded privately by IIE through equity contributions, debt arrangements and other sources.

8.0 PROJECT RELATED DOCUMENTS

Field studies for the Project were conducted in 2019 and 2020, which included surveys for Avifauna and Bats. The results of these surveys were summarized in three baseline reports, which include:

- Voisey's Bay Wind Project – 2019 Bird Monitoring Study (Aivek Stantec 2019)
- Voisey's Bay Wind Project – 2020 Bird Monitoring Study (Aivek Stantec 2020a)
- Voisey's Bay Wind Project – 2020 Bat Monitoring Study (Aivek Stantec 2020b)

These reports are included as Appendix C, D, and E.

In addition, the following engineering studies are currently ongoing or have been completed as part of the overall Project development and design:

- Wind resources assessment (2 meteorological towers and 1 teledetection LIDAR unit installed at site)
- Turbine layout design (including wind modelling, siting constraints, evaluation of losses)
- Geotechnical study (preliminary survey completed, final survey to come in 2021)
- Grid integration modelling (computer simulation of wind generation, diesel generation, energy storage, heating requirements and mine load profiles)
- Logistics study, includes maritime transport, cranes, offloading, delivery to site with specialized trailers and turbine assembly
- Civil design (preliminary design completed, detailed to be completed in 2021)
- Electrical design (preliminary design completed, detailed to be completed in 2021)
- Control and communications (preliminary design completed, detailed to be completed in 2021)
- Project feasibility assessment (evaluation of costs, revenues, and execution schedule)

9.0 CONCLUSION

IIE is proposing to build and operate a wind farm to support on-going underground mine expansion at VNL's Voisey's Bay mine site in Northern Labrador. The proposed Project is comprised of five 4.2 MW wind turbines and related electrical infrastructure, which would offset approximately 13% of the forecasted diesel requirements at completion of the VBME Project, with further optimization ongoing through Project design and planning. The Project also includes the construction of access roads, a switching station, and a 13.8 kV overhead / underground collection system. The proposed wind farm is located at GPS Hill, immediately to the east of current mining operations
(Figure 1-1).

Two VCs were selected for this assessment: Avifauna and Bats. Avifauna and Bats are anticipated to have interactions with the Project through changes to habitat quality and use, and changes to mortality risk. Mortality may occur through direct collisions with turbine blades or towers, or, in the case of bats, through barotrauma. One bat SAR, the little brown myotis, is known to occur in the vicinity of the Project. An environmental effects analysis was conducted for avifauna and bats, which determined that most effects will be low to moderate in magnitude, short to long-term in duration, and reversible.

VNL has several environmental management plans and monitoring programs in place at the Voisey's Bay Mine / Mill, including an EPP. IIE will be required, through its contractual arrangements with VNL, to meet the requirements of these environmental plans and programs. With the implementation of standard mitigation measures presented in the Voisey's Bay EPP, and in Section 5.4 of this report, together with industry best practice, residual effects of the Project on Avifauna and Bats are predicted to be not significant.

10.0 SIGNATURE

December 16, 2021
DATE

INNU-INUIT ENVEST LIMITED PARTNERSHIP, by its general partner, INNU-INUIT ENVEST GP INC.

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APPENDIX A

Manufacturer Datasheets for Turbine Models

Vestas®

4 MW PLATFORM

Wind. It means the world to us.™

Are you looking for the maximum return on **your investment** in wind energy?

Wind energy means the world to us. And we want it to mean the world to our customers, too, by maximising your profits and strengthening the certainty of your investment in wind power.

That's why, together with our partners, we always strive to deliver cost-effective wind technologies, high quality products and first class services throughout the entire value chain. And it's why we put so much emphasis on the reliability, consistency and predictability of our technology.

We have 40 years' experience in wind energy. During that time, we've delivered more than 132 GW of installed capacity in 83 countries. That is more than anyone else in the industry. We currently monitor over 43,000 wind turbines across the globe. All tangible proof that Vestas is the right partner to help you realise the full potential of your wind site.

What is the 4 MW Platform today?

The Vestas 4 MW platform was introduced in 2010 with the launch of the V112-3.0 MW®. Over 42 GW of the 4 MW platform has been installed all over the world onshore and offshore making it the obvious choice for customers looking for highly flexible and trustworthy turbines.

Since then the 4 MW platform was upgraded and new variants were introduced utilising untapped potential of the platform. All variants carry the same nacelle design and the hub design has been re-used to the largest extend possible. In addition, our engineers have increased the nominal power across the entire platform improving your energy production significantly.

With this expansion, the 4 MW platform covers all IEC wind classes with a variety of rotor sizes and a higher rated output power of up to 4.2 MW.

You can choose from the following turbines on the 4 MW platform:

- V105-3.45 MW™ – IEC IA
- V112-3.45 MW® – IEC IA
- V117-3.45 MW® – IEC IB/IEC IIA
- V117-4.2 MW™ – IEC IB -T/IEC IIA -T/IEC S -T
- V126-3.45 MW® – IEC IIB/IEC IIA
- V136-3.45 MW® – IEC IIB/IEC IIIA
- V136-4.2 MW™ – IEC IIB/IEC S
- V150-4.2 MW™ – IEC IIIB/IEC S
- V155-3.3 MW™ – IEC S

All variants of the 4 MW platform are based on the proven technology of the V112-3.0 MW® with a full-scale converter, providing you with superior grid performance.

Our 4 MW platform is designed for a broad range of wind and site conditions, enabling you to mix turbines across your site or portfolio of sites, delivering industry-leading reliability, serviceability and exceptional energy capture, optimising your business case.

All turbine variants are equipped with the same ergonomically designed and very spacious nacelle which makes it easier for maintenance crews to gain access, so they can reduce the time spent on service while maximizing the uptime without compromising safety. All turbines can be installed and maintained using standard installation and servicing tools and equipment further reducing the operation and maintenance costs by minimising your stock level of spare parts.

+77,000

The V112-3.45 MW® and the other 4 MW variants advance the already proven technology powering over 77,000 installed Vestas turbines worldwide - more than any other supplier.

How does our technology generate **more energy?**

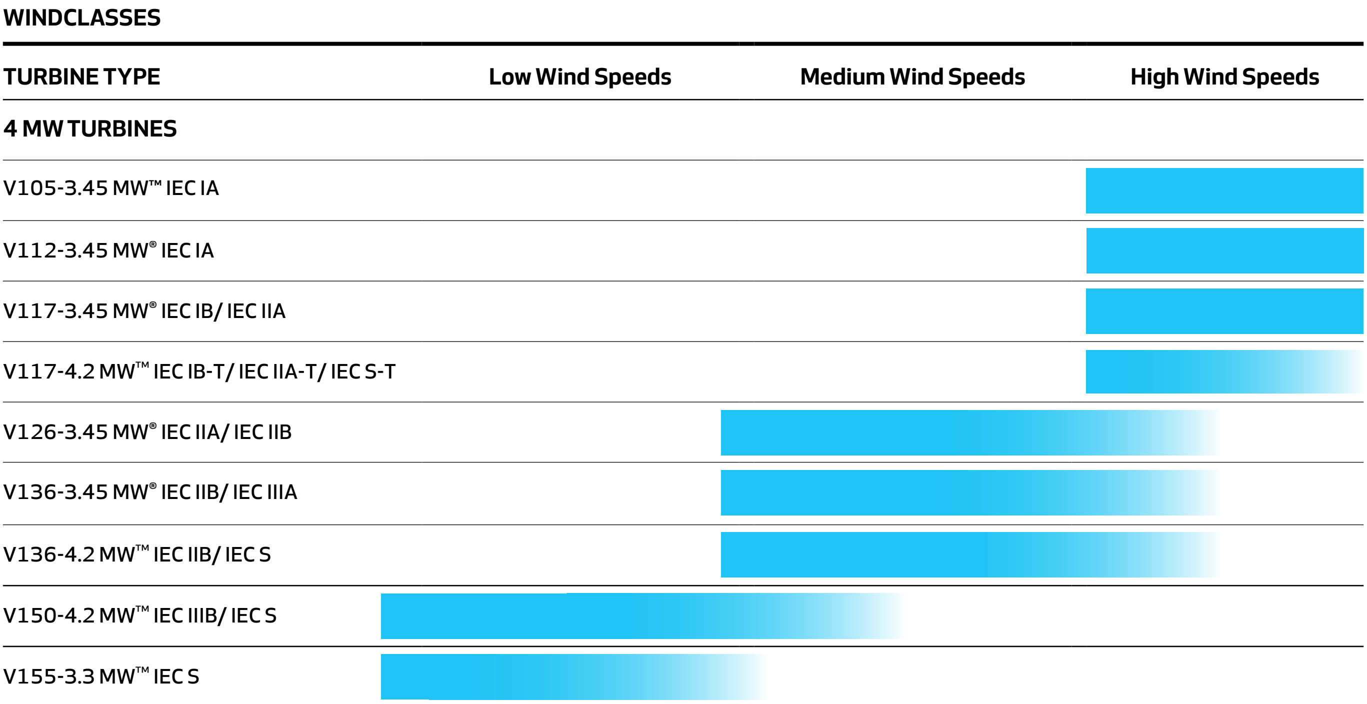
More power for every wind site
V112-3.45 MW®, V117-3.45 MW®, V117-4.2 MW™, V126-3.45 MW®, V136-3.45 MW®, V136-4.2 MW™ and V150-4.2 MW™ are available with several Sound Optimised Modes to meet sound level restrictions with an optimised production. The power system enables superior grid support and it is capable of maintaining production across severe drops in grid voltage, while simultaneously minimising tower and foundation loads. It also allows rapid down-rating of production to 10 per cent nominal power.

Proven technologies - from the company that invented them
The 4 MW platform is a low-risk choice. It is based on the proven technologies that underpin more than 77,000 Vestas turbines installed around the world. Using the best features from across the range, as well as some of the industry's most stringently tested components and systems, the platform's reliable design minimises downtime – helping to give you the best possible return on your investment.

With an operating range that covers all wind classes, our 4 MW platform delivers unrivalled energy production. The proven blade technology from the V112-3.0 MW® is used on the V105-3.45 MW™, the V112-3.45 MW®, V117-3.45 MW® and V117-4.2 MW™. The industry known structural shell blades are used on the V126-3.45 MW®, V136-3.45 MW®, V136-4.2 MW™, V150-4.2 MW™ and V155-3.3 MW™ - a technology which is also used on the 2 MW V110-2.0 MW®, V116-2.1 MW™ and V120-2.2 MW™ variants.

Reliable and robust
The Vestas Test Centre is unrivalled in the wind industry. We test most nacelle components using accelerated life testing under mixed and aggregated environmental conditions. For critical components, Highly Accelerated Life Testing (HALT) identifies potential failure modes and mechanisms. Specialised test rigs ensure strength and robustness for the gearbox, generator, yaw and pitch system, lubrication system and accumulators. Our quality-control system ensures that each component is manufactured to design specifications and performs at site. We systematically monitor measurement trends that are critical to quality, locating defects before they occur.

The 4 MW platform covers all wind segments enabling you to find the best turbine for your specific site.



Options available for the 4 MW platform

An option is an extra feature that can be added to the turbine to suit a project's specific needs. By adding options to the standard turbine, we can enhance the performance and adaptability of the wind power project and facilitate a shorter permitting cycle at restricted sites. The options can even be a decisive factor in realising your specific project, and the business case certainty of the investment.

Here is a list of the options available for the 4 MW platform:

- Power Optimised Modes
- Load Optimised Modes
- Condition Monitoring System
- Service Personnel Lift
- Vestas Ice Detection
- Vestas De-Icing
- Vestas Anti-Icing System™
- Low Temperature Operation to - 30°C
- Fire Suppression
- Shadow detection
- Vestas Bat Protection System
- Aviation Lights
- Aviation Markings on the Blades
- Vestas InteliLight™

Life testing

The Vestas Test Centre has the unique ability to test complete nacelles using technologies like Highly Accelerated Life Testing (HALT). This rigorous testing of new components ensures the reliability of the 4 MW platform.

V150-4.2 MW™ IEC IIIB/IEC S
Facts & figures

POWER REGULATION Pitch regulated with variable speed

OPERATING DATA

Rated power	4,000 kW/4,200 kW
Cut-in wind speed	3m/s
Cut-out wind speed	22.5m/s
Re cut-in wind speed	20m/s
Wind class	IEC IIIB/IEC S

Standard operating temperature range from -20°C* to +45°C with de-rating above 30°C (4,000 kW)

*subject to different temperature options

SOUND POWER

Maximum	104.9dB(A)**

**Sound Optimised modes dependent on site and country

ROTOR

Rotor diameter	150m
Swept area	17,671m²
Air brake	full blade feathering with 3 pitch cylinders

ELECTRICAL

Frequency	50/60Hz
Converter	full scale

GEARBOX

Type	two planetary stages and one helical stage

TOWER

Hub heights	Site and country specific

NACELLE DIMENSIONS

Height for transport	3.4m
Height installed (incl. CoolerTop®)	6.9m
Length	12.8m
Width	4.2m

HUB DIMENSIONS

Max. transport height	3.8m
Max. transport width	3.8m
Max. transport length	5.5m

BLADE DIMENSIONS

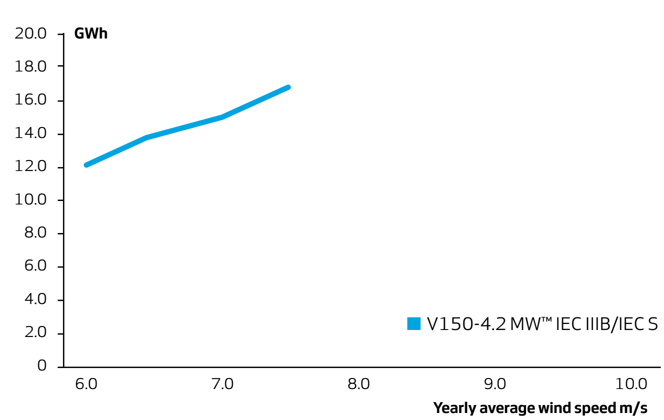
Length	73.7m
Max. chord	4.2m

Max. weight per unit for transportation	70 metric tonnes

TURBINE OPTIONS

- 4.2 MW and 4.5 MW Power Optimised Modes (site specific)
- Load Optimised Modes down to 3.6 MW
- Condition Monitoring System
- Service Personnel Lift
- Vestas Anti-Icing System™
- Vestas Ice Detection
- Low Temperature Operation to - 30°C
- Fire Suppression
- Shadow detection
- Vestas Bat Protection System
- Aviation Lights
- Aviation Markings on the Blades
- Vestas InteliLight®

ANNUAL ENERGY PRODUCTION



Assumptions
One wind turbine, 100% availability, 0% losses, k factor = 2,
Standard air density = 1.225, wind speed at hub height

Vestas Wind Systems A/S
Hedeager 42 . 8200 Aarhus N . Denmark
Tel: +45 9730 0000 . Fax: +45 9730 0001
vestas@vestas.com . **vestas.com**

02/2021-EN

E-138 EP3

3,500 kW / 4,200 kW

www.enercon.de

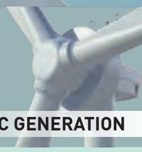
ENERCON
ENERGY FOR THE WORLD

TECHNICAL DATA

E-138 EP3

Last updated: 08/2019. Technical information subject to change.

The new EP3 range represents a radical cut in ENERCON's wind energy converter design. Compact and efficient with consistently optimised processes from production, transport and logistics to installation – these are the key characteristics of this WEC generation and ENERCON's response to new market requirements.



NEW WEC GENERATION

GENERAL

Nominal power	3,500 kW / 4,200 kW (E2)
Wind class (IEC)	IEC IIIA
Wind zone (DIBt)	WZ 2 GK II
Turbine concept	gearless, variable speed, full power converter
Design service life	25 years
Cut in wind speed	2.5 m/s
Cut out wind speed	28 m/s
Extreme wind speed at hub height (3-second gust)	52.5 m/s
Rotational speed	4.4 / 5 * - 10.5 rpm (3,500 kW) 4.4 / 5 * - 10.8 rpm (4,200 kW)
Ambient temperature for normal operation	-10 °C to +40 °C
Extreme temperature range	-20 °C to +50 °C
Grid feed / control system	ENERCON inverter
Grid frequency	50 Hz / 60 Hz
Sound power level	93.4 - 106.0 dB(A)* Yield and noise-optimised operation. Further modes on request.

ROTOR

Rotor diameter	138.25 m
Swept area	15,085 m²
Type	upwind rotor with active pitch control

TOWER

Hub height	**IEC IA**	**IEC IIA**	**IEC IIIA**
			80 m
			81 m
			110 m
			111 m
			130 m
			148 m
			160 m

* dependent on hub height

GENERATOR

Type	directly driven, separately excited annular generator
Cooling system	air cooling system

FEATURES

FEATURES	STANDARD	OPTIONAL
FACTS and transmission	X	
ENERCON SCADA	X	
ENERCON storm control	X	
Low radar reflectivity rotor blades	X	
Ice detection system Power curve method	X	
Additional ice detection system		X
Blade heating system		X
Hot-Climate		X
Shadow shutdown		X
ENERCON SCADA bat protection		X
STATCOM		X
Inertia Emulation		X
Sector management for wind farms		X
Beacon management for wind farms		X

ANNUAL ENERGY YIELD

Innovation
for a Better Life

LG Chem

CHANGE YOUR ENERGY
CHARGE YOUR LIFE

ADVANCED BATTERIES
FOR ENERGY STORAGE

Introducing LG Chem

LG Chem at a Glance

Energy Solutions

LG Chem

Foundation	1947
Headquarters	Seoul, Korea
Employees	26,000
Sales Revenue	USD 18B (2015)

Basic Materials & Chemicals

IT & Electronics Materials

Energy Solutions

With 22 years of experience in successfully delivering products and solutions to customers in the global energy sector, LG Chem is recognized as the industry leader in Lithium-ion battery manufacturing.

ESS Battery

Automotive Battery

IT & New Application Battery

Global Operation of Energy Solutions

LG Chem is successfully implementing rapid go-to-market strategies across its wide range of global networks. By locating manufacturing plants in the three strategic locations of Korea, China, and the U.S., LG Chem can supply batteries to meet the needs of local customers in the most efficient and timely manner.

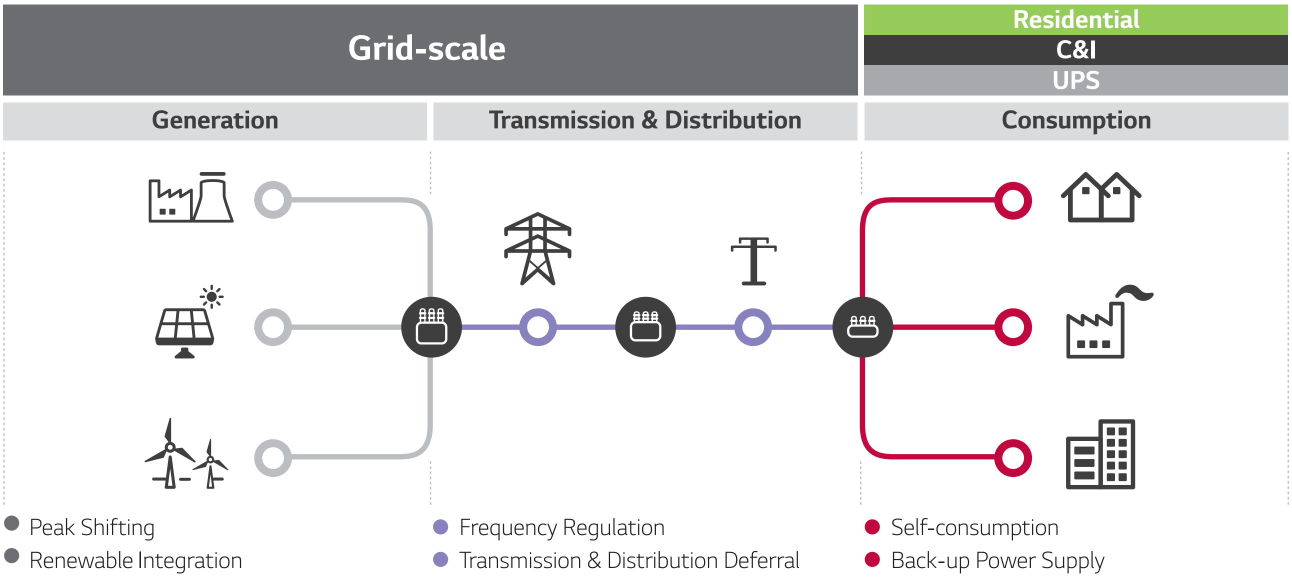
Business History of Energy Solutions

- '47 Founded LG Chem
- '95 Began Lithium-ion Battery R&D
- '99 Began Volume Production of Lithium-ion Battery
- '00 Began Volume Production of Polymer Battery
- '09 Began Volume Production of Automotive Battery
- '10 Began ESS Battery Business
- '12 Began Volume Production of Residential ESS
- '13 Installed the Largest Grid-scale Project in the U.S. (32MWh)
- '15 Began Volume Production of RESU6.4EX
- '16 Installed/Awarded Cumulative 1.6GWh of Grid-scale Projects (As of May, 2016)

Total Solutions for ESS (Energy Storage System)

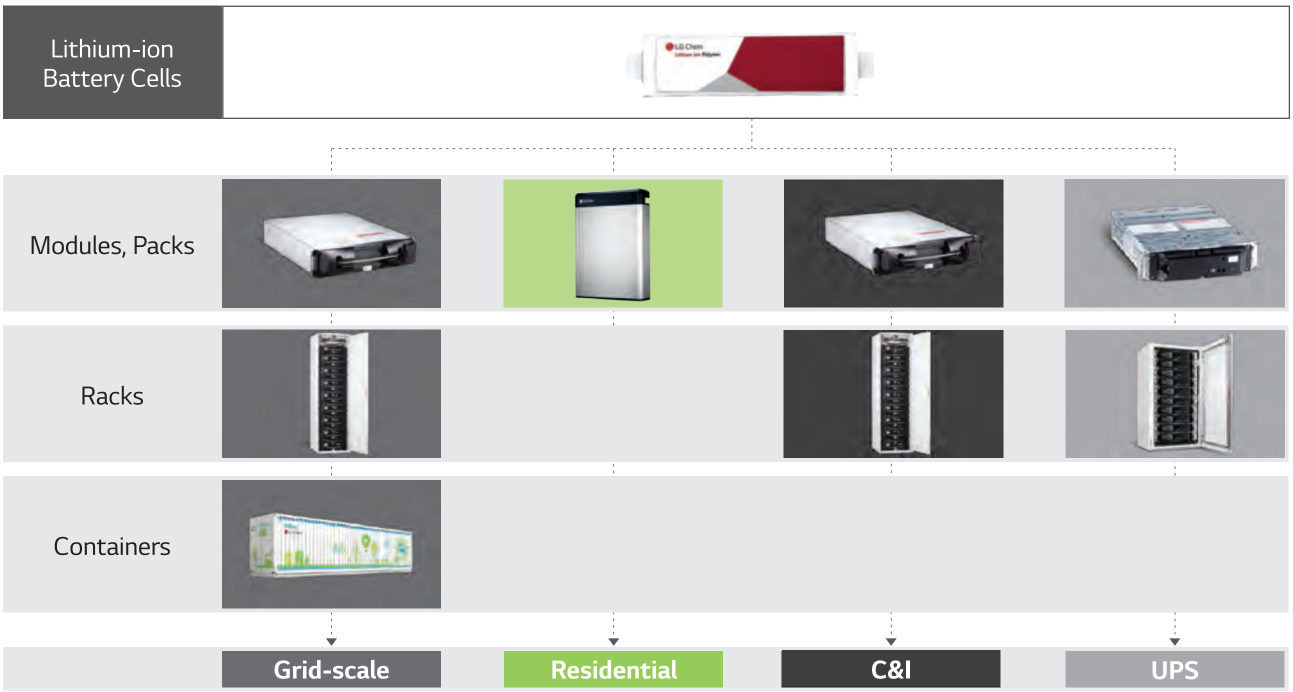
Applications of ESS

ESS (Energy Storage System) provides solutions for applications throughout power supply systems including Grid-scale, Residential, C&I (Commercial and Industrial), and UPS (Uninterruptible Power Supply).



Product Portfolio

LG Chem offers a wide variety of products, such as Battery Cells, Modules, Packs, Racks, and Containers that allow our customers to source total solutions.

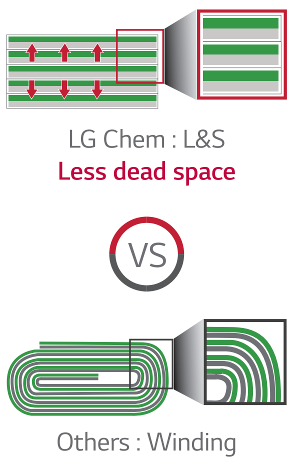


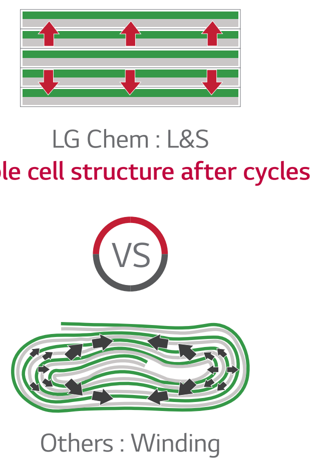
Technical Strengths

Lithium-ion Battery Cell

Compactness & Long Lifespan

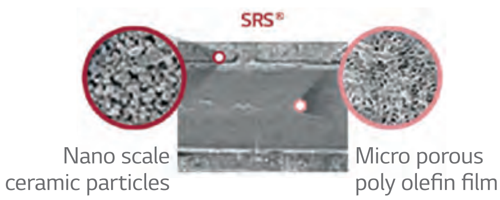
LG Chem's L&S (Lamination & Stacking) process minimizes dead space, enables higher energy density, and enhances the sustainability of cell structures.





Safety

LG Chem's SRS® (Safety Reinforced Separator) increases the mechanical and thermal stability of battery cells.

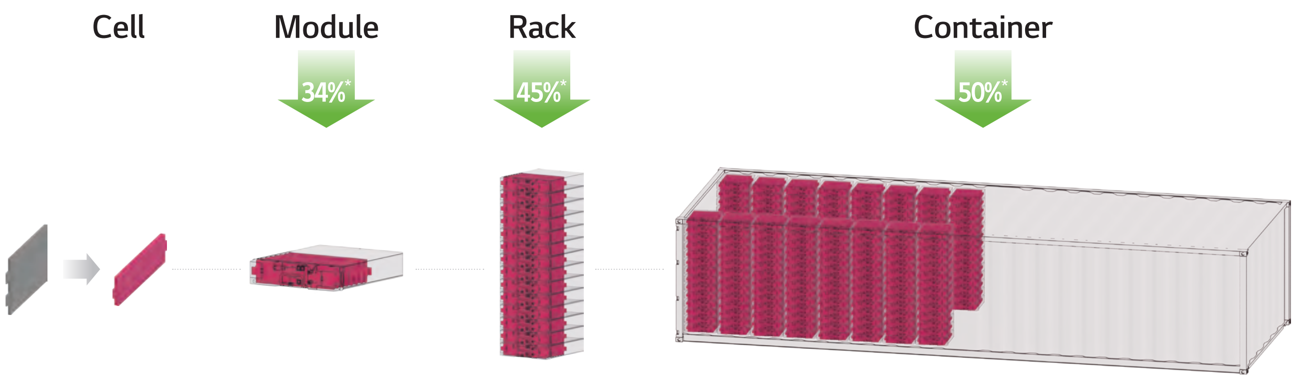


SRS® (Safety Reinforced Separator) | Separator technology with nano-coating of ceramic particles

Battery System

System Optimization

The high energy density and optimal dimensions of our new generation of Energy Cell (JH3) and Power Cell (JP3) have allowed us to radically improve the efficiency of pack design. In 2016, LG Chem is introducing this enhanced space efficiency in its Modules, Racks, and Containers.

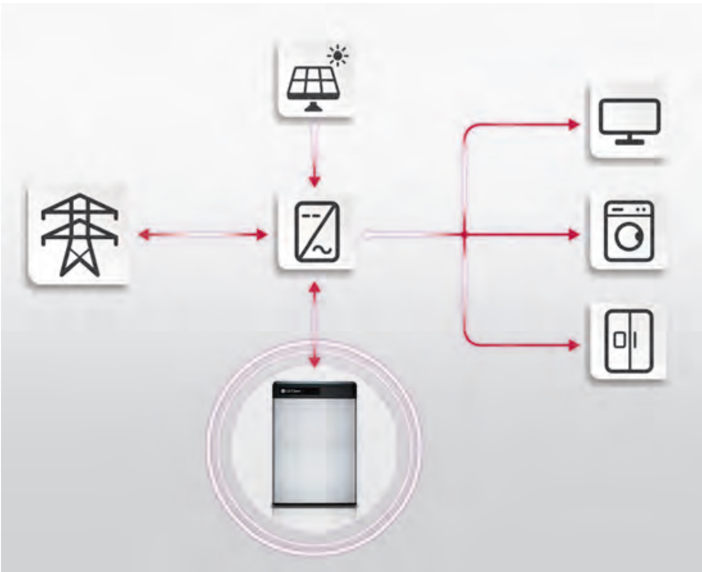


- High Energy Density 355Wh/ℓ → 410Wh/ℓ (15% ↑)
- Optimized Dimension for 19-inch Standard Racks

* % of Space Reduction
(Comparison with former models)

LG Chem ESS Solutions
Residential ESS

An ESS can store surplus energy generated from rooftop photovoltaic panels for use when needed. When the sun has set, energy demand is high, or there is a black-out, you can use the energy stored in your ESS to meet your energy needs at no extra cost. In addition, an ESS helps you pursue the goal of energy self-consumption and ultimately energy-independence.



Electricity Bill Saving

- Charge during off-peak times
- Discharge during peak times

Self-consumption

- Store solar energy generated from photovoltaic panels for the future use.

Emergency Power Back-up

- Discharge during a black-out, functioning as back-up power

Key Features of New RESU Series

Compact Size & Easy Installation

The compact and lightweight nature of the RESU is world-class. It is designed to allow easy wall-mounted or floor-standing installation for both indoor and outdoor applications. The inverter connections have also been simplified, reducing installation time and costs.

Powerful Performance

The new RESU series features industry-leading continuous power (4.2kW for RESU6.5) and DC round-trip efficiency (95%). LG Chem's L&S (Lamination & Stacking) technology provides durability ensuring 80% of capacity retention after 10 years.

Proven Safety

LG Chem places the highest priority on safety and utilizes the same technology for its ESS products that has a proven safety record in its automotive battery. All products are fully certified in relevant global standards.

Diversity in Product & Capacity Options

A total of five different models are available to meet customers varying needs with respect to voltage and capacity. With the RESU Plus, all 48V models can be "cross-connected" with one other 48V unit of any capacity. This allows the RESU range to offer energy storage capacities from 3.3kWh to 19.6 kWh.

48V

3.3kWh | 6.5kWh | 9.8kWh

400V

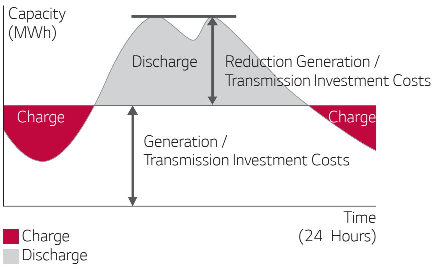
7.0kWh | 9.8kWh

RESU PLUS

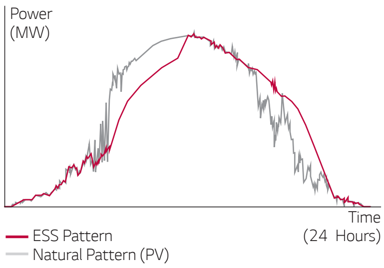
RESU Plus is an expansion kit specially designed for 48V models of new RESU series.
Number of expandable battery units: Up to 2EA

LG Chem ESS Solutions
Grid-scale ESS

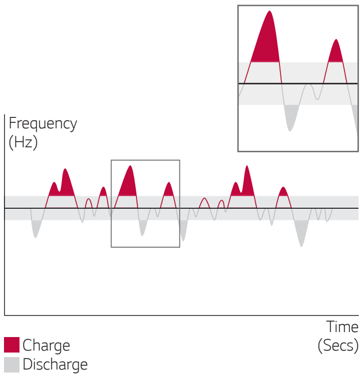
For stabilizing the grid, an ESS provides capabilities such as peak shifting, renewable integration, and frequency regulation. With our world-leading Lithium-ion battery technology, LG Chem can offer an entire battery system for grid-scale ESS applications.



Peak Shifting
- Charge during off-peak times
- Discharge during peak times



Renewable Integration
- Stabilize the intermittent renewable power by alternately charging and discharging



Frequency Regulation
- Charge when grid frequency increases
- Discharge when grid frequency decreases

Advanced Battery System of LG Chem

LG Chem focuses on supplying advanced battery systems, including Cells, Modules, Racks, and Containers.

Cells

High Energy Density

Modules

Space Efficiency

Racks

Container-optimized

- World's Biggest Loading Capacity (4.8MWh, 40ft HC ISO Container)
- Optimized System Configuration

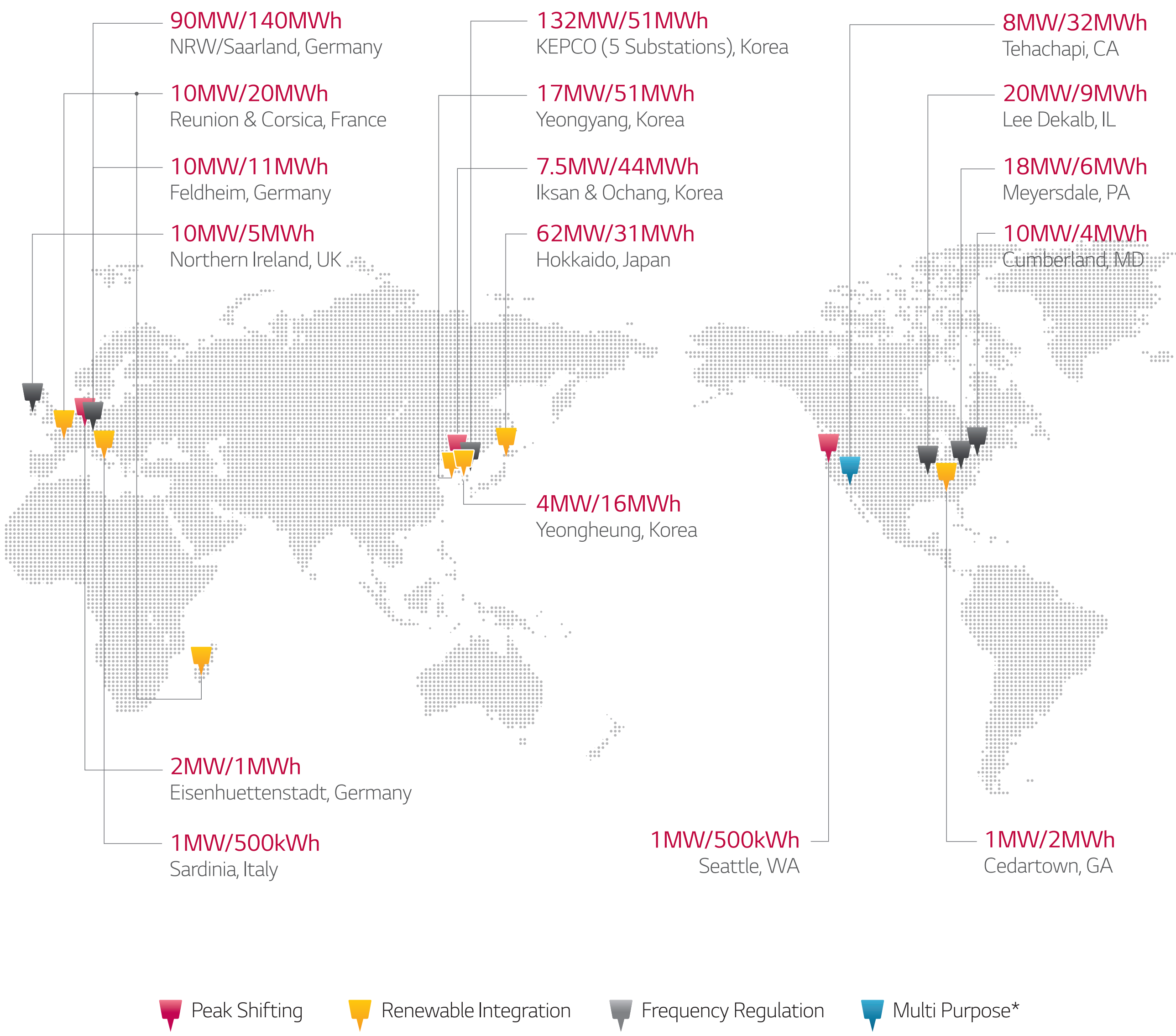
Global Reference

LG Chem has installed or been awarded approximately 1.6GWh of grid-scale projects since the launch of our ESS business.

1.6GWh (As of May, 2016)

World-leading Grid-scale ESS supplier with extensive experience and proven reference projects

* Cumulative amount of installed/awarded projects



* Consisting of two or more grid-scale applications

Specifications

Grid-scale ESS

Energy

Long-duration applications with continuous power supply (>1 hour)

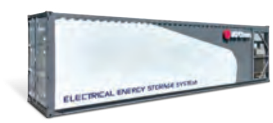
Energy Module

Models	M4863P3B	M48126P3B	M48189P3B
Energy [kWh]	3.3	6.5	9.8
Capacity [Ah]	63	126	189
Nominal Voltage [V]	51.8	51.8	51.8
Voltage Range [V]	42.0~58.8	42.0~58.8	42.0~58.8
Dimension [W x H x D, mm]	445 x 110 x 339	445 x 110 x 587	445 x 110 x 846
Weight [kg]	25	44	68

Energy Rack

Models	R800 (14 Modules)		
	M4863P3B	M48126P3B	M48189P3B
Energy [kWh]	45.7	91.3	137.0
Capacity [Ah]	63	126	189
Nominal Voltage [V]	725	725	725
Voltage Range [V]	588~823	588~823	588~823
Dimension [W x H x D, mm]	520 x 1,880 x 425	520 x 1,880 x 670	520 x 1,880 x 930
Weight [kg]	435	707	1,075
Models	R1000 (17 Modules)		
	M4863P3B	M48126P3B	M48189P3B
Energy [kWh]	55.5	110.9	166.4
Capacity [Ah]	63	126	189
Nominal Voltage [V]	881	881	881
Voltage Range [V]	714~1,000	714~1,000	714~1,000
Dimension [W x H x D, mm]	520 x 2,200 x 425	520 x 2,200 x 670	520 x 2,200 x 930
Weight [kg]	517	848	1,292

Energy Container



Models	40ft HC ISO Container
	M48126P3B
Energy [MWh]	4.8
System Voltage [V dc]	714~1,000
Dimension [W x H x D, m]	12.2 x 2.9 x 2.5
Weight [ton] (with battery)	50
Ambient Temperature [℃]	-20~50
Communication	CAN 2.0 B, Modbus TCP/IP

(System design can be changed according to customer requirements)

Power

Short-duration applications with fast response, high power supply (< 1 hour)

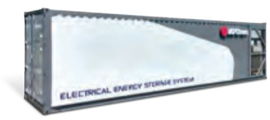
Power Module

Models	M4864P6B	M48128P6B
Energy [kWh]	3.3	6.6
Capacity [Ah]	64	128
Nominal Voltage [V]	51.5	51.5
Voltage Range [V]	42.0~58.8	42.0~58.8
Dimension [W x H x D, mm]	445 x 110 x 344	445 x 110 x 592
Weight [kg]	28	47

Power Rack

Models	R800 (14 Modules)	
	M4864P6B	M48128P6B
Energy [kWh]	46.2	92.3
Capacity [Ah]	64	128
Nominal Voltage [V]	721	721
Voltage Range [V]	588~823	588~823
Dimension [W x H x D, mm]	520 x 1,880 x 425	520 x 1,880 x 670
Weight [kg]	472	758
Models	R1000 (17 Modules)	
	M4864P6B	M48128P6B
Energy [kWh]	56.0	112.1
Capacity [Ah]	64	128
Nominal Voltage [V]	876	876
Voltage Range [V]	714~1,000	714~1,000
Dimension [W x H x D, mm]	520 x 2,200 x 425	520 x 2,200 x 670
Weight [kg]	562	909

Power Container



Models	40ft HC ISO Container
	M48128P6B
Energy [MWh]	4.0
System Voltage [V dc]	714~1,000
Dimension [W x H x D, m]	12.2 x 2.9 x 2.5
Weight [ton] (with battery)	50
Ambient Temperature [℃]	-20~50
Communication	CAN 2.0 B, Modbus TCP/IP

(System design can be changed according to customer requirements)

Residential ESS

RESU

48V

Models		RESU3.3	RESU6.5	RESU10
Total Energy [kWh]		3.3	6.5	9.8
Usable Energy [kWh]		2.9	5.9	8.8
Capacity [Ah]		63	126	189
Nominal Voltage [V]		51.8	51.8	51.8
Voltage Range [V]		42.0~58.8	42.0~58.8	42.0~58.8
Dimension [W x H x D, mm]		452 x 401 x 120	452 x 654 x 120	452 x 483 x 227
Weight [kg]		31	52	75
Enclosure Protection Rating		IP55		
Communication		CAN 2.0 B		
Certificates	Cell	UL1642		
	Product	CE / RCM / TUV (IEC 62619) / UL1973		

Compatible Inverter Brands : SMA, SolaX, Sungrow, Schneider, Ingeteam, GoodWe, Redback, Victron Energy
(As of 3Q. 2016, More brands to be added)

400V

Models		RESU7H	RESU10H	
Total Energy [kWh]		7.0	9.8	
Usable Energy [kWh]		6.6	9.3	
Capacity [Ah]		63	63	
Voltage Range [V]		350~450	350~450	385~550
Dimension [W x H x D, mm]		744 x 692 x 206	744 x 907 x 206	
Weight [kg]		76	97	99.8
Enclosure Protection Rating		IP55		
Communication		RS485	RS485	CAN 2.0 B
Certificates	Cell	UL 1642		
	Product	TUV (ICE 62619) / CE	TUV (IEC 62619) / UL1973 / CE	

Compatible Inverter Brands : SMA , SolarEdge (As of 3Q. 2016, More brands to be added)

C&I ESS

Models	R400	R600	R800 Bi Polar	R800		R1000	
Energy [kWh]	45.7	65.2	91.3	91.3	131.0	110.9	166.4
Capacity [Ah]	126	126	126	126	189	126	189
Nominal Voltage [V]	363	518	±363	725	725	880	880
Voltage Range [V]	294~412	420~588	294~412 -294~-412	588~823	588~823	714~1,000	714~1,000
Dimension [W x H x D, mm]	520 x 1,200 x 670	520 x 1,880 x 670	520 x 2,200 x 670	520 x 1,880 x 670	520 x 1,880 x 930	520 x 2,200 x 670	520 x 2,200 x 930
Weight [kg]	400	570	760	740	1,160	890	1,350
Certificates	UL 1973 (Listed), IEC 61000-6-2 / 61000-6-3, FCC Part15 Class A						

IDC UPS

Models	UPS Rack (10 Modules, 600V)	
	M4850P1B	M4860P2B
Energy [kWh]	27.4	32.1
Continous Power [kW]	123	96
Capacity [Ah]	54	63
Nominal Voltage [V]	511	518
Voltage Range [V]	420~588	420~588
Dimension [W x H x D, mm]	600 x 600 x 2,000	600 x 600 x 1,800
Weight [kg]	440	435

Telecom. UPS




Models	M4860P2S	M4863P3S	M48126P3S	M4830P2S1
Energy [kWh]	3.2	3.3	6.5	1.6
Capacity [Ah]	63	63	126	31.5
Nominal Voltage [V]	51.8	51.8	51.8	51.8
Voltage Range [V]	42.0~58.8	42.0~58.8	42.0~58.8	42.0~58.8
Dimension [W x H x D, mm]	445 x 122 x 600	455 x 110 x 339	455 x 110 x 587	182 x 212 x 278
Weight [kg]	35	26	44	14

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July 2016

APPENDIX B

Anticipated Workforce Requirements

Table B-1 Anticipated Workforce Requirements During Construction

Total Hours	NOC Code	General Description
1,921	0016	Senior managers - construction, transportation, production, and utilities
480	0111	Financial managers
720	0112	Human resources managers
960	0113	Purchasing managers
1,441	0114	Other administrative services managers
960	0121	Insurance, real estate, and financial brokerage managers
1,441	0211	Engineering managers
2,168	0711	Construction managers
185	0731	Managers in transportation
1,681	1111	Financial auditors and accountants
1,441	1112	Financial and investment analysts
3,362	1211	Supervisors, general office, and administrative support workers
1,681	1225	Purchasing agents and officers
1,201	1242	Legal administrative assistants
370	1315	Customs, ship, and other brokers
370	1521	Shippers and receivers
370	1526	Transportation route and crew schedulers
145	2122	Forestry professionals
2,139	2131	Civil engineers
662	2132	Mechanical engineers
3,516	2133	Electrical and electronics engineers
922	2144	Geological engineers
1,921	2154	Land surveyors
720	2234	Construction estimators
2,288	2261	Non-destructive testers and inspection technicians
2,168	2264	Construction inspectors
185	2274	Engineer officers, water transport
2,308	2281	Computer network technicians
1,282	2283	Information systems testing technicians
720	4112	Lawyers and Quebec notaries
5,600	7202	Contractors and supervisors, electrical trades, and telecommunications occupations
1,308	7205	Contractors and supervisors, other construction trades, installers, repairers, and servicers
662	7237	Welders and related machine operators
7,860	7242	Industrial electricians

Table B-1 Anticipated Workforce Requirements During Construction

Total Hours	NOC Code	General Description
1,282	7243	Power system electricians
2,328	7244	Electrical power line and cable workers
776	7245	Telecommunications line and cable workers
2,012	7282	Concrete finishers
1,742	7302	Contractors and supervisors, heavy equipment operator crews
726	7312	Heavy-duty equipment mechanics
1,810	7371	Crane operators
1,452	7372	Drillers and blasters - surface mining, quarrying and construction
1,110	7511	Transport truck drivers
5,808	7521	Heavy equipment operators (except crane)
1,110	7532	Water transport deck and engine room crew
290	8211	Supervisors, logging, and forestry
726	8221	Supervisors, mining, and quarrying
871	8241	Logging machinery operators
513	9241	Power engineers and power systems operators
3,018	9414	Concrete, clay, and stone forming operators
3,310	9526	Mechanical assemblers and inspectors

Table B-2 Anticipated Workforce Requirements During Operation

Hours per year	NOC Code	General Description
150	1225	Purchasing agents and officers
60	0016	Senior managers - construction, transportation, production, and utilities
250	1211	Supervisors, general office, and administrative support workers
80	0114	Other administrative services managers
60	2133	Electrical and electronics engineers
80	9241	Power engineers and power systems operators
40	7202	Contractors and supervisors, electrical trades, and telecommunications occupations
150	2281	Computer network technicians
450	2241	Electrical and electronics engineering technologists and technicians
250	2232	Mechanical engineering technologists and technicians

APPENDIX C

2019 Bird Baseline Report

Voisey's Bay Wind Project - 2019 Bird Monitoring Study Results

May 19, 2020

Prepared for:

Vale Newfoundland and Labrador Ltd
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1.0 INTRODUCTION

Aivek Stantec LP (Aivek Stantec) was retained by Vale Newfoundland and Labrador (VNL) to conduct an environmental assessment (EA) for the Voisey's Bay Wind-Energy Project (the Project), a proposed wind-energy development at the Voisey's Bay Mine Site, in northern Labrador approximately 30 km south of Nain.

At the time of this study (summer / early fall 2019), the Project includes four to seven turbines with a capacity of 5.6 MW each, to be located at one of two possible locations: Sara Hill or GPS Hill. The height of the turbines was not known at the time of the 2019 surveys. Additional Project components will include maintenance and control building(s), a substation, access / construction roads, and staging areas for turbine assembly.

This data report provides the results of avifauna surveys conducted in summer and fall 2019, including breeding bird surveys in June 2019, and fall migration surveys in September 2019, with these surveys completed at both the Sara Hill and GPS Hill sites.

2.0 METHODS

2.1 STUDY TEAM

Experienced professionals were responsible for the design, logistical planning, and data collection of this avifauna program. Species identification, data analysis, and interpretation was performed by qualified professionals (i.e., biologists / ornithologists). The members of the study team are provided in Table 3.1.

Table 2.1 Study Team – 2019 Avifauna Program

Role	Personnel
Project Manager	Barry Wicks, B.Sc.
Project Scientist	Michael Crowell, M.Sc.
Quality / Independent Review	Michael Crowell, M.Sc.
	Elizabeth Way, M.Sc.
Data Analysis and Report Preparation	Heather Button, B.Sc.
Information Management / GIS	Krystal Mathieson, M.Sc.

2.2 PRE-SURVEY PLANNING

Project planning and initial survey design included: defining the objectives and the purpose of the work; conducting a review of prior terrestrial and avifauna studies performed at the Voisey's Bay mine site, and developing a field sampling plan.

The objectives of the 2019 surveys were to:

- document the use of the sites by breeding birds, including species at risk (SAR) and species of conservation concern (SOCC)
- document fall migration at the two sites, and use of the sites by migrating birds
- document raptor presence and movement through the sites
- document waterfowl presence and movement through the sites

Aivek Stantec considered information and guidance provided in Environment Canada's guidelines for wind turbines and birds (Environment Canada 2007a) and survey protocols document (Environment Canada 2007b). Limitations, including the remoteness and access to the site were important factors in the selection of the initial study design.

For the purposes of data collection, a wind farm study area (WFSA) was defined within which observations of birds were made. The WFSA includes two distinct areas: GPS Hill and Sara Hill. The WSFA and survey stations are shown on Figure 2-1.

SAR species included those listed as *extirpated*, *endangered*, *threatened* or *special concern* by the federal *Species at Risk Act* (*SARA*), the Newfoundland and Labrador Endangered Species Act (NL ESA), or by the Committee on the Status of Endangered Wildlife in Canada (COSEWIC). SOCC include those species ranked as *S1* (critically imperiled) or *S2* (imperiled) in Labrador by the Atlantic Canada Conservation Data Centre (AC CDC). SOCC are not afforded protection under federal or provincial legislation, but are considered rare within Labrador, or the long-term sustainability of their populations in Labrador has been evaluated as tenuous. These species are often important indicators of ecosystem health and regional biodiversity. Rare species are often an indicator of unusual and/or sensitive habitat, and their protection as umbrella species can confer protection on co-existing species, and their associated unusual habitats.

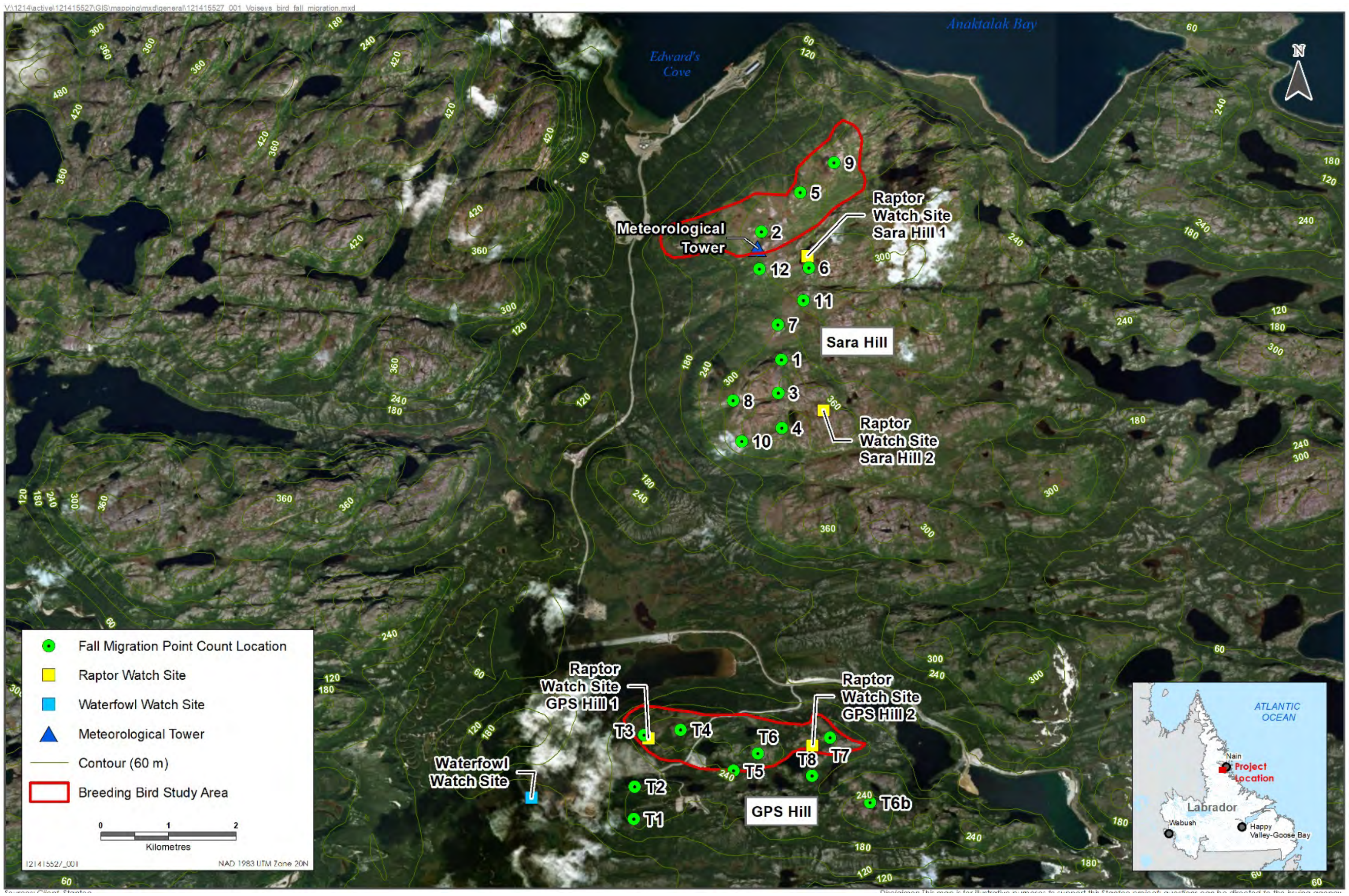

Figure 2-1 2019 Bird Survey Locations

2.3 BREEDING BIRD SURVEYS

Breeding bird surveys were conducted throughout the WFSA on June 5-7, 2019, following an atlassing-style protocol, similar to that used in widespread breeding bird atlas surveys in North America (MBBA 2020). Two qualified biologists traversed the habitat types within the WFSA on foot to detect and record the bird species within. Birds were detected primarily through auditory cues, but all birds detected auditorily, visually, or through sign were recorded. When possible, information on the sex and breeding status of each bird was recorded. The surveys were conducted under appropriate environmental conditions (i.e., light to no precipitation and light to moderate winds).

2.4 FALL MIGRATION SURVEYS

Guidance from CWS for migration monitoring (Environment Canada 2007b) specifies migration surveys be conducted every five days during the shoulder periods of migration, and every three days during peak periods of migration. However, due to the logistics associated with delivering a survey at a remote northern site, a single survey visit was conducted at each proposed turbine location in September. The WFSA and survey stations are shown in Figure 2-1.

2.4.1 Diurnal Landbird Migration Monitoring

Twenty-one survey stations were established at or near each of the proposed turbine locations and accessed via helicopter, as well as on foot. Surveys were conducted at each station once during the monitoring period which occurred over the course of three days from September 10-12, 2019.

Surveys began in the WFSA in the early morning after dawn to target migrating songbirds. Surveyors were flown in to within 100 m of each survey station and accessed each survey station from there on foot to reduce disturbance to local birds to the extent possible. Following arrival at each survey station, a 5-minute silent period was observed prior to the surveys to allow for bird activity to resume.

Surveys consisted of a 10-minute watch count, where birds detected via visual or auditory cues were noted. Point counts began shortly after sunrise and were concluded before noon on each survey day. Information collected at each station and for each observation included the date of survey, environmental conditions and behavioral data (activity, direction of flight, and relative height of flight).

2.4.2 Diurnal Raptor Passage Monitoring

Following the completion of migration monitoring surveys on each survey day, a two-hour watch count targeting migrating raptors was conducted at a point of relatively high elevation. Two survey stations were established within each of the GPS Hill and Sara Hill areas of the WFSA, and each were surveyed once during the fall migration survey period.

Surveys began between 11:30 and 13:30, and concluded between 14:30 and 16:30. Using binoculars, the surveyors scanned for birds in flight from all visible directions. Information collected during this survey included environmental data, observations of migrating birds, and behavioral data including relative flight height and direction of travel.

2.4.3 Diurnal Waterfowl Passage Monitoring

A survey station was established at GPS Hill, at a point of relative high elevation adjacent to a large open water wetland (Figure 2.1). Due to the lack of waterbodies at Sara Hill, waterfowl surveys were not necessary. A two-hour watch count targeting staging and migrating waterfowl was conducted on September 12, 2019. Information collected during this survey included environmental data, observations of migrating birds, and behavioral data including relative flight height and direction of travel.

3.0 RESULTS

3.1 HABITAT

The WFSA consists of two areas, Sara Hill and GPS Hill. Both areas occupy the tops of high hills. At Sara Hill almost all of the survey area is situated above the tree line. ELC mapping for the area (Jacques Whitford Environment Limited 1997) and observations made during the field surveys indicate that six land types are present within the Sara Hill survey area including heath barrens, gravel barrens, rocky barrens, dwarf birch thicket, alder thicket, and spruce-fir dwarf shrub forest. The ELC mapping indicates that most of the Sara Hill survey area is occupied by heath barrens and dwarf birch thickets.

The GPS Hill survey area is situated on a series of hills that are at lower elevation than those at the Sara Hill survey area. As such, the valleys between the hills at the GPS Hill survey area are typically occupied by forest and forested wetland. The GPS Hill survey area is occupied by eight land types which include heath barrens, rocky barrens, dwarf birch thicket, alder thicket, spruce-fir dwarf shrub forest, spruce/sphagnum forest, and bog-fen peat lands. The ELC mapping indicates that most of the GPS Hill survey area is occupied by heath barrens and spruce-fir dwarf shrub forest.

3.2 BREEDING BIRD SURVEYS

Overall, the bird species noted during the 2019 monitoring surveys were as expected for this environment and are typical of the habitat types found within the WFSA. A total of 19 species were identified within the WFSA, including one SOCC – hoary redpoll (*Acanthis hornemanni*). No SAR were observed. Seventeen species were recorded on GPS Hill, and 11 were recorded on Sara Hill. The higher bird species richness at the GPS Hill survey area is probably attributable to the greater habitat diversity in this area.

Species observed during the surveys and their highest breeding evidence (available as collected in the field) and Atlantic Canada Conservation Data Center (AC CDC) rank are presented in Table 3.1.

Table 3.1 Bird Species Observed during 2019 Breeding Bird Surveys

Bird Group	Common Name	Scientific Name	AC CDC General Status Rank	Species Highest Breeding Status	Location in WFSA
Waterfowl	white-winged scoter	*Melanitta deglandi*	S4N, SUM	Possible	GPS Hill
Waterfowl	common goldeneye	*Bucephala clangula*	S5B, S5M	Possible	Sara Hill
Shorebird	solitary sandpiper	*Tringa solitaria*	S4B, SUM	Possible	GPS Hill
Raptor	northern goshawk	*Accipiter gentilis*	S3	Observed	GPS Hill
Landbird	black-backed woodpecker	*Picoides arcticus*	S4	Possible	Sara Hill
Landbird	Canada jay	*Perisoreus canadensis*	S5	Confirmed	GPS Hill, Sara Hill
Landbird	ruby-crowned kinglet	*Regulus calendula*	S5B, S5M	Possible	GPS Hill
Landbird	gray-cheeked thrush	*Catharus minimus*	S4B, SUM	Possible	GPS Hill
Landbird	American robin	*Turdus migratorius*	S5B, S5M	Confirmed	GPS Hill, Sara Hill
Landbird	pine grosbeak	*Pinicola enucleator*	S5	Probable	GPS Hill, Sara Hill
Landbird	common redpoll	*Acanthis flammea*	S4	Confirmed	GPS Hill
Landbird	hoary redpoll	*Acanthis hornemanni*	S1S2N, SUM	Possible	GPS Hill
Landbird	white-winged crossbill	*Loxia leucoptera*	S5	Possible	GPS Hill, Sara Hill
Landbird	fox sparrow	*Passerella iliaca*	S5B, S5M	Possible	GPS Hill, Sara Hill
Landbird	dark-eyed junco	*Junco hyemalis*	S5B, S5M	Probable	GPS Hill, Sara Hill
Landbird	white-crowned sparrow	*Zonotrichia leucophrys*	S5B, S5\M	Confirmed	GPS Hill, Sara Hill
Landbird	northern waterthrush	*Parkesia noveboracensis*	S5B, S5M	Possible	GPS Hill
Landbird	blackpoll warbler	*Setophaga striata*	S5B, S5M	Possible	GPS Hill, Sara Hill
Landbird	yellow-rumped warbler	*Setophaga coronata*	S5B, S5M	Possible	GPS Hill, Sara Hill

Notes:

S1 = critically imperiled
S2 = imperiled
S3 = vulnerable
S4 = apparently secure
S5 = secure
SNA = not applicable (typically exotic species)
SU = Unrankable / Currently unrankable due to lack of information or due to substantially conflicting information about status or trends,

B = breeding population
N = nonbreeding population
M = migrant population
S#S# = a numeric range rank indicates any range of uncertainty about the status of the species. (AC CDC 2020)

Four species were confirmed as breeding within the WFSA, two species were recorded as probable breeders, 12 species were recorded as possible breeders and one species was only observed, with no evidence of breeding being noted.

3.3 FALL MIGRATION SURVEYS

3.3.1 Diurnal Landbird Migration Monitoring

Surveys were conducted over the course of three days in September 2019. Environmental conditions encountered on each survey day were cool with partial cloud cover, and moderate strong wind conditions. Visibility was generally unlimited.

3.3.1.1 Bird Species and Numbers Observed

Overall, the bird species noted during the 2019 monitoring surveys were expected for this environment and are typical of the habitat types found within the WFSA. A total of 63 individual birds representing 9 species were observed within the WFSA during the fall migration surveys. Table 3.2 provides a list of the species encountered during the surveys, including the relevant bird group and numbers of each species observed. This list includes incidental observations of birds recorded just prior or just after watch count survey timers were started or finished.

Table 3.2 Bird Species Observed During Fall Migration Monitoring Surveys in the WFSA

Bird Group	Common Name	Scientific Name	GPS Hill*	Sara Hill*	Total*
Gamebird	rock ptarmigan	*Lagopus muta*	2	0	2
Raptor	golden eagle	*Aquila chrysaetos*	0	1	1
Raptor	sharp-shinned hawk	*Accipiter striatus*	0	(1)	(1)
Landbird	Canada jay	*Perisoreus canadensis*	5	2	7
Landbird	common raven	*Corvus corax*	0	5	5
Landbird	American pipit	*Anthus rubescens*	10	4 (50)	14 (50)
Landbird	common redpoll	*Acanthis flammea*	1	0	1
Landbird	white-winged crossbill	*Loxia leucoptera*	7	25	32
Landbird	white-crowned sparrow	*Zonotrichia leucophrys*	2	1	3
*Individuals observed incidentally are presented in brackets					

The most frequently recorded birds in the WFSA were white-winged crossbill (*Loxia leucoptera*), (32 individuals), and American pipit (*Anthus rubescens*) (14 individuals, with an additional 50 observed incidentally).

3.3.1.2 Behavior Data

Different bird groups demonstrate differences in potential sensitivity to the presence of wind turbines (Kingsley and Whittam 2004). The data on migration have therefore been summarized according to seven bird groups: waterfowl (including ducks and geese), waterbirds (including herons, gulls, and cormorants), shorebirds (including plovers and sandpipers), raptors (including hawks, falcons, eagles), owls, and gamebirds (including grouse), as indicated above in Table 3.2

Table 3.3 summarizes the flying heights of the bird groups observed during the 10-minute watch counts conducted at each of the survey stations. Birds observed within 0 to 60 m of the ground were considered to be Tree to Above Tree" (TAT) height; those flying between 60-140 m above ground were considered to be "Well Above Tree" (WAT) height; those birds observed flying 140-200 m were characterized as "High" (H) and those above 200 m were classified as very high (VH).

Sixty-three birds representing nine species were observed during the diurnal landbird migration surveys. The majority of birds observed (84% of individuals) were within 60 m of the ground. The remaining 16% were observed flying at 60 to 140 m above ground.

Table 3.3 Relative Heights of Birds Observed during Fall Migration Surveys, 2019

Bird Group	Flight Height[A]				N[B]
	TAT (0 – 60 m)	WAT (60 – 140 m)	H (140 – 200 m)	VH (>200 m)	
Gamebirds	100% (100%)	-	-	-	1 (2)
Landbirds	80.% (85%)	20% (15%)	-	-	24 (60)
Raptors	-	100% (100%)	-	-	1 (1)
Total	77% (84%)	23% (16%)	-	-	26 (63)

Notes:
A Data presented are percentage of observations (percentage of individual birds) observed in each flight height category.
B Total number of observations (total number of individual birds).

Landbirds dominated the observations, with the majority of observations being at TAT height. Gamebird observations were limited to two rock ptarmigan (*Lagopus muta*) which were observed on the ground. A single raptor (golden eagle, *Aquila chrysaetos*) was observed at WAT height. No birds from other bird groups were observed during the fall migration surveys watch counts.

3.3.2 Diurnal Raptor Passage Monitoring

No raptor species were observed during the four two-hour raptor passage monitoring surveys, though a single raptor (golden eagle) was observed incidentally during transit between landbird migration survey stations. A number of landbirds were observed incidentally during these surveys, including Canada jay (*Perisoreus canadensis*), American robin (*Turdus migratorius*), white-winged crossbill (*Loxia leucoptera*), and white-crowned sparrow (*Zonotrichia leucophrys*).

3.3.3 Diurnal Waterfowl Passage Monitoring

Although waterfowl have been noted anecdotally in the surveyed areas during migration in the past by Vale staff, no waterfowl were observed in the WFSA during the waterfowl passage monitoring survey. Two waterfowl species were observed in the WFSA during breeding bird surveys, including common goldeneye (*Bucephala* clangula), and White-winged scoter (*Melanitta fusca*). Four landbird species were observed incidentally during this survey including Canada jay, common redpoll (*Acanthis flammea),* white-winged crossbill, and fox sparrow (*Passerella iliaca*).

3.4 SPECIES AT RISK AND SPECIES OF CONSERVATION CONCERN

Species at risk (SAR) include species listed as extirpated, endangered, threatened, or special concern by the federal *Species at Risk Act*, the Committee on the Status of Endangered Wildlife in Canada (COSEWIC), or the *Newfoundland and Labrador Endangered Species Act*.

Species of conservation concern (SOCC) are species not listed or protected by any legislation, but are considered rare in Labrador, or their populations may not be considered sustainable. SOCC are here defined to include species that are not SAR but are ranked S1 (critically imperiled) or S2 (imperiled), or S3 (vulnerable) in Labrador by the AC CDC.

No SAR were observed during the 2019 bird monitoring program. A single SOCC, (hoary redpoll) was observed on one occasion during the breeding bird surveys.

A notable species, golden eagle, was observed singly on a single occasion during the fall migration surveys. At the time of the sighting, the golden eagle was flying at WAT height while being mobbed (chased / attacked) by a common raven (*Corvus corax*).

4.0 SUMMARY

Monitoring of breeding bird species in the study area was conducted over three days from July 5 to July 7, 2019. These surveys identified a total of 19 species from four bird groups including landbirds, raptors, shorebirds, and waterfowl.

Migration monitoring, targeting passerine species was conducted over three days from September 10 to September 12, 2019. The 2019 fall survey identified a total of 9 species, predominantly landbirds. The majority (84%) of the individuals observed were foraging, resting or flying within 60 m of the ground. No observations of waterfowl were made.

Diurnal raptor passage and waterfowl passage surveys were also conducted during the fall migration monitoring in the fall of 2019. No concentrations of raptors or waterfowl were observed during the surveys, and all observations were of individual birds. No raptors or waterfowl were observed during the dedicated passage surveys, although one raptor was observed during a watch count targeting landbird species.

No SAR were observed during the 2019 bird monitoring program. One SOCC, hoary redpoll, and one species of note, golden eagle, were observed. Both observations were of a single individual.

5.0 REFERENCES

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APPENDIX A

Bird Survey Data

Table A.1 Breeding Bird Survey Data

Location	Date	Common Name	Scientific Name	Number Observed	AC CDC Rank	Breeding Evidence	Species Highest Breeding Status
GPS Hill	7/5/2019	white-crowned sparrow	*Zonotrichia leucophrys*	1	S5B,S5M	Habitat	Confirmed
GPS Hill	7/5/2019	American robin	*Turdus migratorius*	1	S5B,S5M	Pair in suitable nest	Confirmed
GPS Hill	7/5/2019	white-crowned sparrow	*Zonotrichia leucophrys*	1	S5B,S5M	Singing male present	Confirmed
GPS Hill	7/5/2019	dark-eyed junco	*Junco hyemalis*	1	S5B,S5M	Habitat	Probable
GPS Hill	7/5/2019	white-winged crossbill	*Loxia leucoptera*	1	S5	No indication Breeding	Possible
GPS Hill	7/5/2019	American robin	*Turdus migratorius*	1	S5B,S5M	No indication Breeding	Confirmed
GPS Hill	7/5/2019	northern waterthrush	*Seiurus noveboracensis*	1	S5B,S5M	Singing male present	Possible
GPS Hill	7/5/2019	white-crowned sparrow	*Zonotrichia leucophrys*	1	S5B,S5M	Agitated	Confirmed
GPS Hill	7/5/2019	blackpoll warbler	*Dendroica striata*	1	S5B,S5M	Singing male present	Possible
GPS Hill	7/5/2019	white-crowned sparrow	*Zonotrichia leucophrys*	1	S5B,S5M	Adult carrying food	Confirmed
GPS Hill	7/5/2019	white-crowned sparrow	*Zonotrichia leucophrys*	1	S5B,S5M	Singing male present	Confirmed
GPS Hill	7/5/2019	dark-eyed junco	*Junco hyemalis*	1	S5B,S5M	Habitat	Probable
GPS Hill	7/5/2019	American robin	*Turdus migratorius*	1	S5B,S5M	Habitat	Confirmed
GPS Hill	7/5/2019	American robin	*Turdus migratorius*	1	S5B,S5M	Habitat	Confirmed
GPS Hill	7/5/2019	white-crowned sparrow	*Zonotrichia leucophrys*	1	S5B,S5M	Singing male present	Confirmed
GPS Hill	7/5/2019	white-crowned sparrow	*Zonotrichia leucophrys*	1	S5B,S5M	Adult carrying food	Confirmed
GPS Hill	7/5/2019	white-crowned sparrow	*Zonotrichia leucophrys*	1	S5B,S5M	Habitat	Confirmed
GPS Hill	7/5/2019	American robin	*Turdus migratorius*	1	S5B,S5M	Habitat	Confirmed
GPS Hill	7/5/2019	dark-eyed junco	*Junco hyemalis*	1	S5B,S5M	Singing male present	Probable
GPS Hill	7/5/2019	white-crowned sparrow	*Zonotrichia leucophrys*	1	S5B,S5M	Singing male present	Confirmed
GPS Hill	7/5/2019	American robin	*Turdus migratorius*	1	S5B,S5M	Agitated	Confirmed
GPS Hill	7/5/2019	white-crowned sparrow	*Zonotrichia leucophrys*	1	S5B,S5M	Singing male present	Confirmed
GPS Hill	7/5/2019	dark-eyed junco	*Junco hyemalis*	1	S5B,S5M	Singing male present	Probable

Table A.1 Breeding Bird Survey Data

Location	Date	Common Name	Scientific Name	Number Observed	AC CDC Rank	Breeding Evidence	Species Highest Breeding Status
GPS Hill	7/5/2019	blackpoll warbler	*Dendroica striata*	1	S5B,S5M	Singing male present	Possible
GPS Hill	7/5/2019	ruby-crowned kinglet	*Regulus calendula*	1	S5B,S5M	Singing male present	Possible
GPS Hill	7/6/2019	white-winged crossbill	*Loxia leucoptera*	1	S5	Habitat	Possible
GPS Hill	7/6/2019	American robin	*Turdus migratorius*	1	S5B,S5M	Singing male present	Confirmed
GPS Hill	7/6/2019	white-winged scoter	*Melanitta fusca*	1	S4N,SUM	Habitat	Possible
GPS Hill	7/6/2019	white-crowned sparrow	*Zonotrichia leucophrys*	1	S5B,S5M	Singing male present	Confirmed
GPS Hill	7/6/2019	American robin	*Turdus migratorius*	1	S5B,S5M	Habitat	Confirmed
GPS Hill	7/6/2019	American robin	*Turdus migratorius*	1	S5B,S5M	Pair in suitable nest	Confirmed
GPS Hill	7/6/2019	dark-eyed junco	*Junco hyemalis*	1	S5B,S5M	Singing male present	Probable
GPS Hill	7/6/2019	American robin	*Turdus migratorius*	1	S5B,S5M	Fledged young	Confirmed
GPS Hill	7/6/2019	yellow-rumped warbler	*Dendroica coronata*	1	S5B,S5M	Singing male present	Possible
GPS Hill	7/6/2019	white-crowned sparrow	*Zonotrichia leucophrys*	1	S5B,S5M	Singing male present	Confirmed
GPS Hill	7/6/2019	American robin	*Turdus migratorius*	1	S5B,S5M	Singing male present	Confirmed
GPS Hill	7/6/2019	dark-eyed junco	*Junco hyemalis*	1	S5B,S5M	Habitat	Probable
GPS Hill	7/6/2019	fox sparrow	*Passerella iliaca*	1	S5B,S5M	Singing male present	Possible
GPS Hill	7/6/2019	ruby-crowned kinglet	*Regulus calendula*	1	S5B,S5M	Singing male present	Possible
GPS Hill	7/6/2019	white-crowned sparrow	*Zonotrichia leucophrys*	1	S5B,S5M	Singing male present	Confirmed
GPS Hill	7/6/2019	dark-eyed junco	*Junco hyemalis*	1	S5B,S5M	Habitat	Probable
GPS Hill	7/6/2019	fox sparrow	*Passerella iliaca*	1	S5B,S5M	Singing male present	Possible
GPS Hill	7/6/2019	northern waterthrush	*Seiurus noveboracensis*	1	S5B,S5M	Singing male present	Possible
GPS Hill	7/6/2019	white-crowned sparrow	*Zonotrichia leucophrys*	1	S5B,S5M	Singing male present	Confirmed
GPS Hill	7/6/2019	pine grosbeak	*Pinicola enucleator*	1	S5	Pair in suitable nest	Probable
GPS Hill	7/6/2019	white-winged scoter	*Melanitta fusca*	1	S4N,SUM	Habitat	Possible

Table A.1 Breeding Bird Survey Data

Location	Date	Common Name	Scientific Name	Number Observed	AC CDC Rank	Breeding Evidence	Species Highest Breeding Status
GPS Hill	7/6/2019	Canada jay	*Perisoreus canadensis*	1	S5	Fledged young	Confirmed
GPS Hill	7/6/2019	dark-eyed junco	*Junco hyemalis*	1	S5B,S5M	Singing male present	Probable
GPS Hill	7/6/2019	yellow-rumped warbler	*Dendroica coronata*	1	S5B,S5M	Singing male present	Possible
GPS Hill	7/6/2019	common redpoll	*Acanthis flammea*	1	S4	Habitat	Confirmed
GPS Hill	7/6/2019	white-winged crossbill	*Loxia leucoptera*	1	S5	Singing male present	Possible
GPS Hill	7/6/2019	American robin	*Turdus migratorius*	1	S5B,S5M	Singing male present	Confirmed
GPS Hill	7/6/2019	solitary sandpiper	*Tringa solitaria*	1	S4B,SUM	Habitat	Possible
GPS Hill	7/6/2019	American robin	*Turdus migratorius*	1	S5B,S5M	Singing male present	Confirmed
GPS Hill	7/6/2019	white-crowned sparrow	*Zonotrichia leucophrys*	1	S5B,S5M	Habitat	Confirmed
GPS Hill	7/6/2019	American robin	*Turdus migratorius*	1	S5B,S5M	Pair in suitable nest	Confirmed
GPS Hill	7/6/2019	fox sparrow	*Passerella iliaca*	1	S5B,S5M	Singing male present	Possible
GPS Hill	7/6/2019	white-crowned sparrow	*Zonotrichia leucophrys*	1	S5B,S5M	Habitat	Confirmed
GPS Hill	7/6/2019	white-winged crossbill	*Loxia leucoptera*	1	S5	Singing male present	Possible
GPS Hill	7/6/2019	white-crowned sparrow	*Zonotrichia leucophrys*	1	S5B,S5M	Singing male present	Confirmed
GPS Hill	7/6/2019	american robin	*Turdus migratorius*	1	S5B,S5M	Singing male present	Confirmed
GPS Hill	7/6/2019	hoary redpoll	*Acanthis hornemanni*	1	S1S2N,SUM	Habitat	Possible
GPS Hill	7/6/2019	common redpoll	*Acanthis flammea*	1	S4	Fledged young	Confirmed
GPS Hill	7/6/2019	dark-eyed junco	*Junco hyemalis*	1	S5B,S5M	Habitat	Probable
GPS Hill	7/6/2019	common redpoll	*Acanthis flammea*	1	S4	Habitat	Confirmed
GPS Hill	7/6/2019	fox sparrow	*Passerella iliaca*	1	S5B,S5M	Singing male present	Possible
GPS Hill	7/6/2019	white-crowned sparrow	*Zonotrichia leucophrys*	1	S5B,S5M	Habitat	Confirmed
GPS Hill	7/6/2019	blackpoll warbler	*Dendroica striata*	1	S5B,S5M	Singing male present	Possible
GPS Hill	7/6/2019	white-crowned sparrow	*Zonotrichia leucophrys*	1	S5B,S5M	Singing male present	Confirmed

Table A.1 Breeding Bird Survey Data

Location	Date	Common Name	Scientific Name	Number Observed	AC CDC Rank	Breeding Evidence	Species Highest Breeding Status
GPS Hill	7/6/2019	common redpoll	*Acanthis flammea*	1	S4	Singing male present	Confirmed
GPS Hill	7/6/2019	common redpoll	*Acanthis flammea*	1	S4	Habitat	Confirmed
GPS Hill	7/6/2019	American robin	*Turdus migratorius*	1	S5B,S5M	No indication Breeding	Confirmed
GPS Hill	7/6/2019	white-crowned sparrow	*Zonotrichia leucophrys*	1	S5B,S5M	Habitat	Confirmed
GPS Hill	7/6/2019	white-crowned sparrow	*Zonotrichia leucophrys*	1	S5B,S5M	Habitat	Confirmed
GPS Hill	7/6/2019	American robin	*Turdus migratorius*	1	S5B,S5M	Habitat	Confirmed
GPS Hill	7/6/2019	northern goshawk	*Accipiter gentilis*	1	S3	No indication Breeding	Observed
GPS Hill	7/6/2019	white-crowned sparrow	*Zonotrichia leucophrys*	1	S5B,S5M	Agitated	Confirmed
GPS Hill	7/6/2019	white-crowned sparrow	*Zonotrichia leucophrys*	1	S5B,S5M	Habitat	Confirmed
GPS Hill	7/6/2019	American robin	*Turdus migratorius*	1	S5B,S5M	Singing male present	Confirmed
GPS Hill	7/6/2019	American robin	*Turdus migratorius*	1	S5B,S5M	Agitated	Confirmed
GPS Hill	7/6/2019	white-crowned sparrow	*Zonotrichia leucophrys*	1	S5B,S5M	Habitat	Confirmed
GPS Hill	7/6/2019	white-crowned sparrow	*Zonotrichia leucophrys*	1	S5B,S5M	Habitat	Confirmed
GPS Hill	7/6/2019	American robin	*Turdus migratorius*	1	S5B,S5M	Habitat	Confirmed
GPS Hill	7/6/2019	American robin	*Turdus migratorius*	1	S5B,S5M	Singing male present	Confirmed
GPS Hill	7/6/2019	American robin	*Turdus migratorius*	1	S5B,S5M	Agitated	Confirmed
GPS Hill	7/6/2019	white-crowned sparrow	*Zonotrichia leucophrys*	1	S5B,S5M	Agitated	Confirmed
GPS Hill	7/6/2019	American robin	*Turdus migratorius*	1	S5B,S5M	Habitat	Confirmed
GPS Hill	7/6/2019	blackpoll warbler	*Dendroica striata*	1	S5B,S5M	Singing male present	Possible
GPS Hill	7/6/2019	American robin	*Turdus migratorius*	1	S5B,S5M	Singing male present	Confirmed
GPS Hill	7/6/2019	blackpoll warbler	*Dendroica striata*	1	S5B,S5M	Singing male present	Possible
GPS Hill	7/6/2019	American robin	*Turdus migratorius*	1	S5B,S5M	Singing male present	Confirmed
GPS Hill	7/6/2019	common redpoll	*Acanthis flammea*	1	S4	Habitat	Confirmed

Table A.1 Breeding Bird Survey Data

Location	Date	Common Name	Scientific Name	Number Observed	AC CDC Rank	Breeding Evidence	Species Highest Breeding Status
GPS Hill	7/6/2019	fox sparrow	*Passerella iliaca*	1	S5B,S5M	Singing male present	Possible
GPS Hill	7/6/2019	American robin	*Turdus migratorius*	1	S5B,S5M	Habitat	Confirmed
GPS Hill	7/6/2019	American robin	*Turdus migratorius*	1	S5B,S5M	Habitat	Confirmed
GPS Hill	7/6/2019	common redpoll	*Acanthis flammea*	1	S4	Singing male present	Confirmed
GPS Hill	7/6/2019	gray-cheeked thrush	*Catharus minimus*	1	S4B,SUM	Habitat	Possible
GPS Hill	7/6/2019	white-crowned sparrow	*Zonotrichia leucophrys*	1	S5B,S5M	Habitat	Confirmed
GPS Hill	7/6/2019	American robin	*Turdus migratorius*	1	S5B,S5M	Habitat	Confirmed
GPS Hill	7/6/2019	white-crowned sparrow	*Zonotrichia leucophrys*	1	S5B,S5M	Habitat	Confirmed
GPS Hill	7/6/2019	dark-eyed junco	*Junco hyemalis*	1	S5B,S5M	Agitated	Probable
Sara Hill	7/7/2019	blackpoll warbler	*Dendroica striata*	1	S5B,S5M	Singing male present	Possible
Sara Hill	7/7/2019	yellow-rumped warbler	*Dendroica coronata*	1	S5B,S5M	Habitat	Possible
Sara Hill	7/7/2019	white-crowned sparrow	*Zonotrichia leucophrys*	1	S5B,S5M	Habitat	Confirmed
Sara Hill	7/7/2019	common goldeneye	*Bucephala clangula*	1	S5B,S5M	Habitat	Possible
Sara Hill	7/7/2019	Canada jay	*Perisoreus canadensis*	1	S5	Habitat	Confirmed
Sara Hill	7/7/2019	dark-eyed junco	*Junco hyemalis*	1	S5B,S5M	Habitat	Probable
Sara Hill	7/7/2019	white-crowned sparrow	*Zonotrichia leucophrys*	1	S5B,S5M	Habitat	Confirmed
Sara Hill	7/7/2019	American robin	*Turdus migratorius*	1	S5B,S5M	Habitat	Confirmed
Sara Hill	7/7/2019	American robin	*Turdus migratorius*	1	S5B,S5M	Habitat	Confirmed
Sara Hill	7/7/2019	dark-eyed junco	*Junco hyemalis*	1	S5B,S5M	Habitat	Probable
Sara Hill	7/7/2019	white-winged crossbill	*Loxia leucoptera*	1	S5	Singing male present	Possible
Sara Hill	7/7/2019	fox sparrow	*Passerella iliaca*	1	S5B,S5M	Habitat	Possible
Sara Hill	7/7/2019	American robin	*Turdus migratorius*	1	S5B,S5M	Habitat	Confirmed
Sara Hill	7/7/2019	black-backed woodpecker	*Picoides arcticus*	1	S4	Habitat	Possible

Table A.1 Breeding Bird Survey Data

Location	Date	Common Name	Scientific Name	Number Observed	AC CDC Rank	Breeding Evidence	Species Highest Breeding Status
Sara Hill	7/7/2019	pine grosbeak	*Pinicola enucleator*	1	S5	Singing male present	Probable
Sara Hill	7/7/2019	pine grosbeak	*Pinicola enucleator*	1	S5	Habitat	Probable

Table A.2 Fall Migration Survey Data

Survey Area	Plot #	Common Name	Scientific name	Bird Group	AC CDC Rank	Number Observed	Flight Height (m)	Relative Flight Height	Direction of Travel	Behaviour	Distance from Observer
GPS Hill	T1	white-winged crossbill	*Loxia leucoptera*	Landbird	S5	4	<60	TAT	NE	flying	100
GPS Hill	T1	common redpoll	*Acanthis flammea*	Landbird	S4	1	60-140	WAT	E	flying	50
GPS Hill	T1	American pipit	*Anthus rubescens*	Landbird	S5B,S5M	4	60-140	WAT	SE	flying	50
GPS Hill	T2	No Birds Observed									
GPS Hill	T3	No Birds Observed									
GPS Hill	T4	American pipit	*Anthus rubescens*	Landbird	S5B,S5M	1	60-140	WAT	NE	flying	200
GPS Hill	T4	American pipit	*Anthus rubescens*	Landbird	S5B,S5M	2	<60	TAT	N/A	foraging	70
GPS Hill	T5	white-crowned sparrow	*Zonotrichia leucophrys*	Landbird	S5B,S5M	1	<60	TAT	N/A	foraging	50
GPS Hill	T6	white-winged crossbill	*Loxia leucoptera*	Landbird	S5	2	na	na	unknown	flying	200
GPS Hill	T6	Canada jay	*Perisoreus canadensis*	Landbird	S5	1	<60	TAT	N/A	foraging	100
GPS Hill	T6	white-crowned sparrow	*Zonotrichia leucophrys*	Landbird	S5B,S5M	1	<60	TAT	SW	flying	15
GPS Hill	T6b	rock ptarmigan	*Lagopus muta*	Raptor	S4	2	<60	TAT	W	flush	5
GPS Hill	T6b	American pipit	*Anthus rubescens*	Landbird	S5B,S5M	3	<60	TAT	W	flying	50
GPS Hill	T6b	Canada jay	*Perisoreus canadensis*	Landbird	S5	1	<60	TAT	N/A	foraging	200

Table A.2 Fall Migration Survey Data

Survey Area	Plot #	Common Name	Scientific name	Bird Group	AC CDC Rank	Number Observed	Flight Height (m)	Relative Flight Height	Direction of Travel	Behaviour	Distance from Observer
GPS Hill	T7	white-winged crossbill	*Loxia leucoptera*	Landbird	S5	1	<60	TAT	W	flying	100
GPS Hill	T7	Canada jay	*Perisoreus canadensis*	Landbird	S5	2	<60	TAT	E	flying	70
GPS Hill	T8	Canada jay	*Perisoreus canadensis*	Landbird	S5	1	<60	TAT	N/A	foraging	150
Sara Hill	T1	No Birds Observed									
Sara Hill	T3	white-crowned sparrow	*Zonotrichia leucophrys*	Landbird	S5B,S5M	1	<60	TAT	S	flying/foraging	50
Sara Hill	T3	unidentified passerine				1	<60	TAT	N	flying	200
Sara Hill	T4	No Birds Observed									
Sara Hill	T5	common raven	*Corvus corax*	Landbird	S5	2	60-140	WAT	SW	flying	300
Sara Hill	T5	American pipit	*Anthus rubescens*	Landbird	S5B,S5M	2	<60	TAT	NE	flying	20
Sara Hill	T6	Canada jay	*Perisoreus canadensis*	Landbird	S5	1	<60	TAT	SE	flying/foraging	20
Sara Hill	T7	No Birds Observed									
Sara Hill	T8	common raven	*Corvus corax*	Landbird	S5	1	60-140	WAT	NE	Mobbing	150
Sara Hill	T8	golden eagle	*Aquila chrysaetos*	Gamebird	S2B,SUM	1	60-140	WAT	NE	fleeing	150
Sara Hill	T8	American pipit	*Anthus rubescens*	Landbird	S5B,S5M	1	<60	TAT	SW	flying/foraging	50

Table A.2 Fall Migration Survey Data

Survey Area	Plot #	Common Name	Scientific name	Bird Group	AC CDC Rank	Number Observed	Flight Height (m)	Relative Flight Height	Direction of Travel	Behaviour	Distance from Observer
Sara Hill	T9	common raven	*Corvus corax*	Landbird	S5	2	<60	TAT	NE	flying	100
Sara Hill	T10	white-winged crossbill	*Loxia leucoptera*	Landbird	S5	24	<60	TAT	WNW	flying	100
Sara Hill	T12	American pipit	*Anthus rubescens*	Landbird	S5B,S5M	1	<60	TAT	E	flying	75
Sara Hill	T12	Canada jay	*Perisoreus canadensis*	Landbird	S5	1	<60	TAT	N/A	foraging	200
Sara Hill	T12	white-winged crossbill	*Loxia leucoptera*	Landbird	S5	1	<60	TAT	N/A	foraging	150

Table A.3 Fall Raptor Watch Data

Plot	Location	Date	Time	Visibility	Species	Scientific Name	AC CDC Rank	Number Observed	Flight Height (m)	Direction of Travel	Behaviour	Distance from Observer (m)
RW1	GPS Hill	9-Sep-19	13:30 - 16:30	Unlimited	Canada jay	*Perisoreus canadensis*	S5	1	<60	n/a	foraging	20
RW1	GPS Hill	9-Sep-19	13:30 - 16:30	Unlimited	white-winged crossbill	*Loxia leucoptera*	S5	1	n/a	n/a	flying	n/a
RW1	GPS Hill	9-Sep-19	13:30 - 16:30	Unlimited	white-crowned sparrow	*Zonotrichia leucophrys*	S5B,S5M	1	n/a	n/a	flying	n/a
RW1	GPS Hill	9-Sep-19	13:30 - 16:30	Unlimited	white-winged crossbill	*Loxia leucoptera*	S5	1	<60	south	flying	150
RW1	GPS Hill	9-Sep-19	13:30 - 16:30	Unlimited	Canada jay	*Perisoreus canadensis*	S5	1	<60	south	flying	20
RW1	GPS Hill	9-Sep-19	13:30 - 16:30	Unlimited	Canada jay	*Perisoreus canadensis*	S5	1	<60	na	foraging	20
RW1	GPS Hill	9-Sep-19	13:30 - 16:30	Unlimited	white-winged crossbill	*Loxia leucoptera*	S5	40	<60	south southwest	flying	200
RW2	GPS Hill	11-Sep-19	12:00 - 14:00	Unlimited	white-crowned sparrow	*Zonotrichia leucophrys*	S5B,S5M	1	<60	n/a	foraging	20
RW2	GPS Hill	11-Sep-19	12:00 - 14:00	Unlimited	Canada jay	*Perisoreus canadensis*	S5	2	<60	southwest	flying/foraging	150
RW2	GPS Hill	11-Sep-19	12:00 - 14:00	Unlimited	Canada jay	*Perisoreus canadensis*	S5	1	<60	n/a	foraging	10
RW2	GPS Hill	11-Sep-19	12:00 - 14:00	Unlimited	Canada jay	*Perisoreus canadensis*	S5	3	<60	n/a	flying/foraging	10
RW2	GPS Hill	11-Sep-19	12:00 - 14:00	Unlimited	Canada jay	*Perisoreus canadensis*	S5	1	<60	n/a	foraging	100

Table A.3 Fall Raptor Watch Data

Plot	Location	Date	Time	Visibility	Species	Scientific Name	AC CDC Rank	Number Observed	Flight Height (m)	Direction of Travel	Behaviour	Distance from Observer (m)
RW2	GPS Hill	11-Sep-19	12:00 - 14:00	Unlimited	unidentified passerine			1	<60	n/a	flying	150
RW1	Sara Hill	10-Sep-19	11:24-14:24	Unlimited	white-crowned sparrow	*Zonotrichia leucophrys*	S5B,S5M	1	<60	north	Foraging/flying	20
RW1	Sara Hill	10-Sep-19	11:24-14:24	Unlimited	Canada jay	*Perisoreus canadensis*	S5	1	<60	n/a	Foraging	200
RW1	Sara Hill	10-Sep-19	11:24-14:24	Unlimited	American robin	*Turdus migratorius*	S5B,S5M	1	<60	south	Flying	25
RW1	Sara Hill	10-Sep-19	11:24-14:24	Unlimited	white-crowned sparrow	*Zonotrichia leucophrys*	S5B,S5M	3	<60	n/a	Foraging	10
RW2	Sara Hill	12-Sep-19	12:00 - 13:00	Unlimited	No Birds observed.							

Table A.4 Fall Waterfowl Watch Data

Location	Date	Time	Visibility	Species	Scientific Name	AC CDC Rank	Number Observed	Flight Height (m)	Direction of Travel	Behaviour
WF Site 1	12-Sep-19	9:30 - 11:30	Unlimited	Canada Jay	*Perisoreus canadensis*	S5	3	<60	N/A	Foraging
WF Site 1	12-Sep-19	9:30 - 11:30	Unlimited	unidentified passerine			1	60-140	SSW	Flying
WF Site 1	12-Sep-19	9:30 - 11:30	Unlimited	common redpoll	*Acanthis flammea*	S4	3	<60	W	Flying
WF Site 1	12-Sep-19	9:30 - 11:30	Unlimited	white-winged crossbill	*Loxia leucoptera*	S5	2	60-140	W	Flying
WF Site 1	12-Sep-19	9:30 - 11:30	Unlimited	fox sparrow	*Passerella iliaca*	S5B,S5M	1	<60	N/A	Foraging
WF Site 1	12-Sep-19	9:30 - 11:30	Unlimited	unidentified passerine			1	<60	n/a	Foraging
WF Site 1	12-Sep-19	9:30 - 11:30	Unlimited	unidentified passerine			2	<60	W	Flying
WF Site 1	12-Sep-19	9:30 - 11:30	Unlimited	Canada Jay	*Perisoreus canadensis*	S5	1	<60	N/A	Foraging

APPENDIX D

2020 Bird Baseline Report

Aivek Stantec Limited Partnership

Voisey's Bay Wind Project – 2020 Bird Monitoring Study

March 16, 2021

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1.0 INTRODUCTION

Aivek Stantec LP (Aivek Stantec) was retained by Vale Newfoundland and Labrador (VNL) to conduct an environmental assessment for the proposed Voisey's Bay Wind-Energy Project (the Project), a proposed wind energy development at the Voisey's Bay Mine Site in Northern Labrador, approximately 30 km south of Nain.

Vale Newfoundland and Labrador (VNL) is considering the potential for four to five, 4.2 MW wind energy converters, having rotor diameters of 138 to 150 m and blade tip heights of 150 to 180 m. These turbines will be located at GPS Hill, which is within the current surface lease area and immediately east of current mining operations (Figure 1.1). Additional Project components will include maintenance and control building(s), a substation, wind turbine interconnects, access / construction roads, and staging areas for turbine assembly. For the purpose of this report, the proposed footprints of the turbines and associated infrastructure at GPS Hill, as well as the existing port road which was identified as a potential shared corridor for transmission line infrastructure (referred to herein as "port road"), are referred to as the Project Area.

Although the GPS Hill site has now been finalized, at the time of this study (summer / early fall 2020), a second site was also evaluated as potential locations for turbines: Sara Hill. Sara Hill is located on a ridge approximately 8 km north of the mine site and adjacent to the mine's access road for port operation (the port road). For this reason, Sara Hill was included in the survey design and is discussed throughout this report.

Field work in support of the Wind Energy Project commenced in 2019 with baseline surveys for birds, including breeding bird surveys and fall migration surveys (Stantec 2020). Breeding bird surveys were conducted throughout the Project Area using point counts. The fall migration surveys consisted of diurnal land bird migration surveys, diurnal raptor surveys, and diurnal waterfowl surveys. These surveys were limited in nature, as the proposed Project was in the early stages of planning. Since the 2019 surveys, the Project has become more clearly defined and potential locations of wind turbines have been identified.

The purpose of the 2020 field program was to augment the baseline data that was collected in 2019 through more robust field surveys including use of acoustic detectors to monitor migration over a longer period of time. This report presents the results of the 2020 field program only.

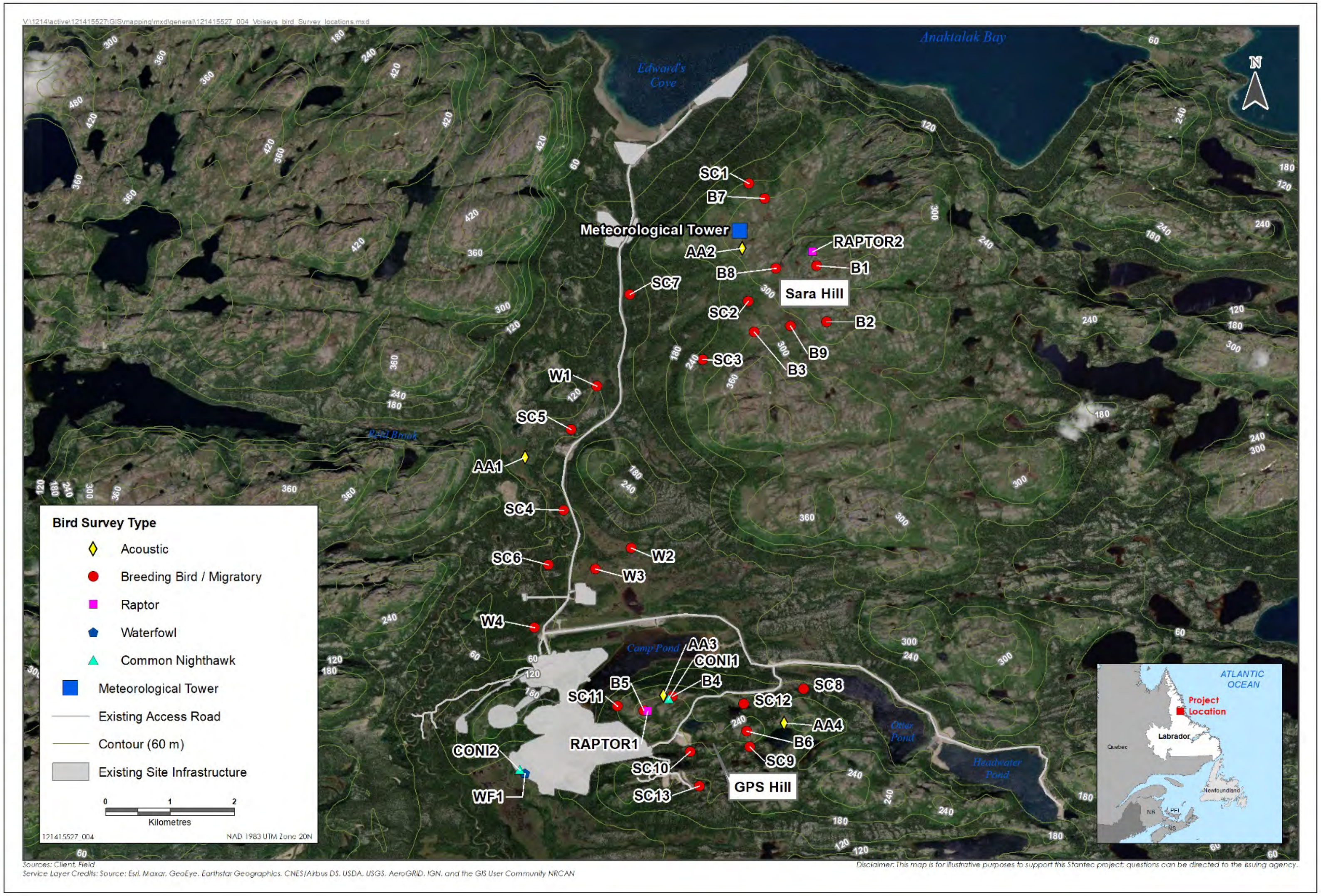

Figure 1-1 Bird Acoustic Detector Locations

2.0 METHODS

2.1 STUDY TEAM

Experienced professionals were responsible for the design, logistical planning, and data collection of this avifauna program. Species identification, data analysis, and interpretation was performed by qualified professionals (i.e., biologists / ornithologists). The members of the study team are provided in Table 2-1.

Table 2-1 Study Team – 2020 Avifauna Program

Role	Personnel
Project Manager	Barry Wicks, B.Sc.
Project Scientist	Colin Jones, B.Sc. (LGL Limited)
Quality / Independent Review	Michael Crowell, M.Sc.
	Bob Roy. B.Sc.
	Elizabeth Way, M.Sc.
Data Analysis and Report Preparation	Jennifer Randall, MES
	Joel Perkins
	Trevor Peterson, PhD
Information Management / GIS	Megan Blackwood, B.Sc., Dip. GIS

2.2 BREEDING BIRD SURVEYS

As per guidance for Environment Canada (2006, 2007a, 2007b), breeding bird surveys were conducted between June 26 and July 2, 2020. Surveys were conducted at 26 locations in the vicinity of the Project (Figure 1.1), each of which was surveyed at least twice (eight sites were surveyed three times). Survey points were generally grouped into three broad locations: Sara Hill, GPS Hill, and along the port road.

Breeding bird surveys consisted of 10-minute point counts, during which all birds observed or heard within a 100 m radius were recorded. This method is based on a modified fixed-radius point count sampling procedure (Bibby et al. 2000). All survey points were at least 250 m from another survey point. Surveys began near dawn, and continued until approximately 10:00 am, and were conducted in good weather with low winds and no precipitation. Observers collected data on each bird species observed, as well as information about environmental conditions at each survey point including wind conditions, cloud cover, temperature, and precipitation. In addition, the highest level of breeding evidence was recorded for all birds observed, using the categories established by the Maritime Breeding Bird Atlas (Appendix B). Survey locations were chosen to represent the three main habitat types present in the area surrounding the Project: barrens, sparse conifer, and wetlands as determined through review of the Earth Observation for Sustainable Development of Forests (EOSD) mapping (Wulder and Nelson 2003), and through field observations. This field program was developed in consultation with ECCC and the Newfoundland and Labrador Wildlife Division (e.g., Knaga, pers comm, 2020; Knaga et al. pers comm, 2020; Humber et al. pers comm, 2020).

2.3 COMMON NIGHTHAWK SURVEYS

The common nighthawk (*Chordeiles minor*) is a species-at-risk, and is listed as *Threatened* under the federal *Species at Risk Act* (SARA). To investigate the presence of this species in the Project Area, common nighthawk surveys were conducted in July and August. These surveys consisted of a 30-minute silent listening period, where the sky was scanned for signs of the species. Surveys were conducted at two locations on each of July 2 and August 6. One of these locations was again repeated on August 18.

Common nighthawk surveys were conducted at two locations at GPS Hill (Figure 1.1). Survey location CONI1 is located in barrens habitat, adjacent to survey location B4. CONI2 is located just west of the current site infrastructure, at the same location as the waterfowl survey.

2.4 FALL MIGRATION SURVEYS

2.4.1 Diurnal Landbird Migration Monitoring

Diurnal land bird migration surveys were conducted at the same 26 sites that were used for breeding bird surveys (Figure 1.1). Each site was surveyed four times during the migratory period. Surveys were conducted between August 4 and September 9, with each site being surveyed twice in August, and twice in September.

Surveys began in the early morning after dawn to target migrating songbirds. Survey sites were accessed either by foot or by helicopter. When the helicopter was used, surveyors were typically flown to within 100 m of the first survey station and accessed the subsequent survey station from there on foot to reduce disturbance to local birds to the extent possible. Following arrival at each survey station, a 5-minute silent period was observed prior to the surveys to allow for bird activity to resume.

Surveys consisted of a 10-minute watch count, where birds detected via visual or auditory cues were noted. Point counts began shortly after sunrise and were concluded before noon on each survey day. Information collected at each station and for each observation included the date of survey, environmental conditions and behavioral data (activity, direction of flight, and relative height of flight).

2.4.2 Diurnal Raptor Passage Monitoring

Following the completion of migration monitoring surveys on each survey day, a four-hour watch count targeting migrating raptors was conducted at a point of relatively high elevation. Two survey stations were established, one at GPS Hill and one at Sara Hill (Figure 1.1). Each survey station (Raptor 1 and Raptor 2) was surveyed four times between August 4 and September 9. These surveys were designed based on Environment Canada's guidance for Passage Migration Counts (Environment Canada 2006).

Surveys began between 11:00 and 13:45, and concluded between 15:00 and 17:45. Using binoculars, the surveyors scanned for birds in flight from all visible directions. Information collected during this survey included environmental data, observations of migrating birds, and behavioral data including relative flight height and direction of travel. Incidental observations of other (non-raptor) bird species were also collected.

2.4.3 Diurnal Waterfowl Passage Monitoring

A survey station for waterfowl passage monitoring (WF1) was established at GPS Hill, at a point of relative high elevation adjacent to a large fen containing large areas of open water (Figure 1.1). Due to the lack of waterbodies at Sara Hill, it was determined that waterfowl surveys were not necessary. Two-hour watch counts targeting staging and migrating waterfowl was conducted at this location five times between August 6 and Sept 9. These surveys were designed based on Environment Canada's guidance for Passage Migration Counts (Environment Canada 2006). During the first survey, a couple of other vantage points were visited, to view the open water from different angles. For the remaining surveys, the surveyors stayed at W1 for the entirety of the survey. Information collected during this survey included environmental data, observations of migrating birds, and behavioral data including relative flight height and direction of travel. Incidental observations of other (non-waterfowl) bird species were also collected.

2.4.4 Acoustic Monitoring

2.4.4.1 Rationale

Based on ECCC guidance for wind energy projects (2006, 2007a and 2007b), the site sensitivity of the proposed Voisey's Bay wind farm is classed as *very high* due to the potential use of wind turbines having a height greater than 150 m (this is a conservative assumption as the final turbine model has not been determined at the time of field surveys). The combination of a *very high* site sensitivity with a medium-sized facility (defined as >10 turbines; again a conservative assumption as only four to five turbines are being considered for this Project), the Voisey's Bay wind farm is category 4, the highest Level of Concern. For category 4 sites, the use of radar surveys to characterize nocturnal migrants are recommended by ECCC for baseline data collection. However, Voisey's Bay is a remote, northern site that provides unique logistical challenges, which would make radar surveys very difficult to execute. In addition, the consistent evidence from across eastern North America that most nighttime bird migration occurs 300-500 m above the ground, which is above the height of the proposed turbines. Based on the discussions with ECCC and the limitations of accessing this remote site during the current global COVID-19 pandemic, it was determined that acoustic surveys would be conducted as an alternative to radar surveys.

2.4.4.2 Field Methods

Four Wildlife Acoustic SM4 acoustic systems were deployed in the Project Area. Each detector is self-contained for sustained deployments and uses its internal battery function and large capacity data storage systems. Detectors were programed to record audible avian sounds 24 hours per day. Detectors were checked monthly during field survey visits to the site. During each check, the batteries were replaced, and a review of detector operations was made. The status of the storage card capacity was checked, and data cards were swapped out as needed. The acoustic detectors were deployed on August 17 and 18, and were active until between September 25 and 28.

2.4.4.3 Data Analysis

Recorded audio files were processed using a manufacturer recommended process. The dataset for this effort included one-hour recordings collected over the entire time the acoustic systems were deployed and programmed to operate. As such, each day of deployment included 24, 1-hour data files.

Due to the volume of data obtained, it was decided that data analysis would only occur for detectors AA3 and AA4. Since this field work was conducted, the Project location has been finalized for GPS Hill only. Since Sara Hill is no longer being considered, and no work is required along the port road, the data from detectors AA1 and AA2 were not analyzed.

Further, it was not necessary to analyze all data that was collected at detectors AA3 and AA4. The data were pared down in several ways to obtain a smaller dataset that is representative of the overall results. Each SM4 detector has two microphones that face in opposite directions. Since there is substantial overlap between the calls recorded on the two microphones, only the data from one microphone was analyzed from each detector. Following the initial clustering routine (discussed below), the raw data were pared down to equally spaced, 10-minute periods for each hour of recordings. One of these 10-minute periods was chosen at random for analysis and that 10-minute block of time was used for each hour of recording. This reduced the dataset to 1/6th of its original size. In this case, all call files between 16 minutes 40 seconds and 26 minutes and 40 seconds of each hour of data were retained and analyzed.

To locate and identify potential bird vocalizations, data were first processed with Kaleidoscope Pro software (version 4.3.2) to perform a basic "cluster analysis". A cluster analysis uses an algorithm to detect individual vocalizations in recordings and sorts them according to similarity to each other. Manufacturer default signal parameters were used to perform the cluster analysis, including a frequency range of 250 Hz – 10 kHz, length of 0.1 – 7.5 s, and maximum inter-syllable gap of 0.35 s. A Stantec biologist experienced in using audio recording to identify birds manually vetted potential vocalizations by both viewing the spectral features of the file as well as listening to the audio playback of that recording. For the initial pass, the biologist labeled each vocalization to species where possible and removed files that did not contain bird vocalizations. The majority of the "non-bird" recording that were removed were either noise, usually from high-wind events, red squirrels, or mechanical noise. Due to the overlap of acoustic characteristics between species, many vocalizations (such as simple call notes and not full songs of birds) were not diagnostic of a single species. In response the biologists resorted the data by date and time to help identify non-diagnostic vocalizations using the previously labelled call files as context. These remaining non-diagnostic calls where then identified to species when possible.

3.0 RESULTS

3.1 HABITAT

Habitat data was obtained from EOSD mapping for Labrador (Wulder and Nelson 2003). Based on this mapping, point count locations were chosen prior to field work to represent the major habitat types in the Voisey's Bay area. While in the field, vegetation data was collected at each point count to verify the EOSD classifications. After the conclusion of field work, the habitat at some point count locations were re-classified to match what was observed in the field.

Bird surveys were conducted at the three major habitat types found in the Project Area, including barrens, sparse conifer, and wetlands. Barrens habitats are most common at Sara Hill and are habitats where the ground cover is the dominant vegetation layer, with little tree cover. Shrubs occurring in barrens habitat are typically low. The dominant species observed within barrens habitat in the Project Area include alpine bearberry (*Arctostaphylos rubra*), black crowberry (*Empetrum nigrum*), blueberry (*Vaccinium* spp.), *Cladina* and *Cladonia* lichens, and Arctic azalea (*Kalmia procumbens*). Nine point count/migration count survey points were established in barens habitat.

Sparse conifer habitat is common throughout the region. These habitat types consist of coniferous woodlands underlain by a dense low shrub layer. The density of tree cover is generally low but varies between sites. At all bird survey sites located in this habitat type, the dominant tree species were tamarack (*Larix laricina*) and black spruce (*Picea mariana*). The shrub layer was dominated by Labrador tea (*Rhododendron groenlandicum*), dwarf birch (*Betula glandulosa*), with occasional occurrences of willow (*Salix* spp.), green alder (*Alnus viridis*) or dwarf bilberry (*Vaccinium cespitosum*). Thirteen point count survey points were established in sparse conifer habitat.

Wetland types in the vicinity of the Project include open bogs, treed bogs, tall shrub swamps, and fens. Vegetation data from the bird survey points located in wetlands indicated that these sites had many of the same tree and shrub species as the surrounding landscape, including black spruce, tamarack, willow, and Labrador tea. Sphagnum mosses (Sphagnum spp.), sedges (*Carex* spp.), deergrass (*Trichophorum cespitosum*) and Pickering's reedgrass (*Calamagrostis pickeringii*) are common constituents of the ground vegetation layer. Four point count survey points were established in wetlands.

Table 3-1 indicates which habitats were surveyed at each of the three project locations: GPS Hill, Sara Hill, and adjacent to the port road, which was identified as a potential shared corridor for transmission line infrastructure. Overall, nine surveys were conducted at GPS Hill, ten surveys were conducted at Sara Hill and seven surveys were conducted along the port road. All wetland surveys were conducted along the port road. Barrens were surveyed at both GPS Hill and Sara Hill, and sparse conifer was surveyed at all three sites.

Table 3-1 Number of Point Counts Conducted in Each Habitat Type

	GPS Hill	Sara Hill	Port Road	Total
Barren	3	6	0	9
Sparse Conifer	6	4	3	13
Wetland	0	0	4	4
Total	**9**	**10**	**7**	**26**

3.2 BREEDING BIRD SURVEYS

A total 25 species of birds were recorded during the breeding bird surveys. Survey data is provided in Appendix A, Table A.1. A species list, along with Atlantic Canada Conservation Data Centre (AC CDC) rankings and habitat occurrences, is presented in Table 3-2. Most species were passerines, although two species of waterfowl (American black duck (*Anas rubripes)* and green-winged teal (*Anas crecca*)) and one species of raptor (osprey (*Pandion haliaetus*) were also recorded. None of the species were confirmed as breeding; however, there was evidence to classify three species as probable breeders, including American robin (*Turdus migratorius*), ruby-crowned kinglet (*Regulus calendula*), and white-crowned sparrow (*Zonotrichia leucophrys*). Evidence to indicate possible breeding was recorded for sixteen species. No evidence of breeding activity was recorded for the remaining six species, as they showed no evidence of breeding and were categorized simply as observed. No species at risk (SAR) were observed during the breeding bird surveys.

Seven species were observed in the 2019 breeding bird surveys that were not observed in 2020. Of these, two were observed in other surveys in 2020 (including common goldeneye and gray-cheeked thrush). The remaining five species included black-backed woodpecker (*Picoides arcticus*), hoary redpoll (*Acanthis hornemanni*), northern goshawk (*Accipiter gentilis*), solitary sandpiper (*Tringa solitaria*), and white-winged scoter (*Melanitta deglandi*).

Table 3-2 Species Observed During Breeding Bird Surveys

Group	Species	Scientific Names	Highest Breeding Evidence	AC CDC S-Ranks for Labrador	Habitat Occurrence
Waterfowl	Green-winged Teal	*Anas crecca*	Observed	S5B,S5M	W
Waterfowl	American Black Duck	*Anas rubripes*	Observed	S5B,S5M	W
Raptor	Osprey	*Pandion haliaetus*	Observed	S4B,SUM	SC
Shorebird	Wilson's Snipe	*Gallinago delicata*	Possible	S5B,S5M	W
Landbird	American Three-toed Woodpecker	*Picoides dorsalis*	Observed	S5	SC
Landbird	Yellow-bellied Flycatcher	*Empidonax flaviventris*	Possible	S5B,S5M	SC
Landbird	Canada Jay	*Perisoreus canadensis*	Observed	S5	B, SC, W
Landbird	Boreal Chickadee	*Poecile hudsonicus*	Possible	S4	SC, W
Landbird	Ruby-crowned Kinglet	*Regulus calendula*	Probable	S5B,S5M	B, SC, W
Landbird	Swainson's Thrush	*Catharus ustulatus*	Possible	S5B,S5M	SC, W
Landbird	American Robin	*Turdus migratorius*	Probable	S5B,S5M	B, SC, W
Landbird	American Pipit	*Anthus rubescens*	Observed	S5B,S5M	B
Landbird	Yellow-rumped Warbler	*Setophaga coronata*	Possible	S5B,S5M	B, SC, W
Landbird	Blackpoll Warbler	*Setophaga striata*	Possible	S5B,S5M	B, SC, W
Landbird	Northern Waterthrush	*Parkesia noveboracensis*	Possible	S5B,S5M	SC
Landbird	Wilson's Warbler	*Cardellina pusilla*	Possible	S5B,S5M	SC
Landbird	American Tree Sparrow	*Spizella arborea*	Possible	S4B,SUM	SC
Landbird	Fox Sparrow	*Passerella iliaca*	Possible	S5B,S5M	SC, W
Landbird	Lincoln's Sparrow	*Melospiza lincolnii*	Possible	S5B,S5M	B, SC
Landbird	White-crowned Sparrow	*Zonotrichia leucophrys*	Probable	S5B,S5M	B, SC, W

Table 3-2 Species Observed During Breeding Bird Surveys

Group	Species	Scientific Names	Highest Breeding Evidence	AC CDC S-Ranks for Labrador	Habitat Occurrence
Landbird	Dark-eyed Junco	*Junco hyemalis*	Possible	S5B,S5M	SC, W
Landbird	Rusty Blackbird	*Euphagus carolinus*	Possible	S3B,SUM	W
Landbird	Pine Grosbeak	*Pinicola enucleator*	Possible	S5	B, SC
Landbird	White-winged Crossbill	*Loxia leucoptera*	Possible	S5	SC
Landbird	Common Redpoll	*Acanthis flammea*	Possible	S4	B, SC, W

Notes:

AC CDC Ranks:

S1 = critically imperiled
S2 = imperiled
S3 = vulnerable
S4 = apparently secure
S5 = secure
SNA = not applicable (typically exotic species)
SU = Unrankable / Currently unrankable due to lack of information or due to substantially conflicting information about status or trends,

B = breeding population
N = nonbreeding population
M = migrant population
S#S# = a numeric range rank indicates any range of uncertainty about the status of the species. (AC CDC 2020)

Habitat Codes:

B = barrens
SC = sparse conifer
W = wetland

Table 3-3 provides a breakdown of the number of point counts done per habitat type, and the number of species recorded in each. The greatest number of point counts were conducted in sparse conifer (13), followed by barrens (9) and wetland (4). The highest species richness was recorded in the sparse conifer habitat, with 21 species observed. The most abundant species observed included (in order of decreasing abundance) yellow-rumped warbler (*Setophaga coronata*), fox sparrow (*Passerella iliaca*), American robin, ruby-crowned kinglet, common redpoll (*Acanthis flammea*), dark-eyed junco (*Junco hyemalis*), and pine grosbeak (*Pinicola enucleator*). Although many species observed in the sparse conifer habitat were observed in other habitats, several species were only observed in sparse conifer habitat, including American three-toed woodpecker (*Picoides dorsalis*), American tree sparrow (*Spizelloides arborea*), northern waterthrush (*Parkesia noveboracensis*), osprey, white-winged crossbill (*Loxia leucoptera*), wilson's warbler (*Cardellina pusilla*) and yellow bellied flycatcher (*Empidonax flaviventris*). This suggests that these species may have specific habitat requirements that are met in the sparse conifer habitat.

The lowest species richness was observed in the barrens habitat, where 10 species were recorded. The most common species observed included (in order of decreasing abundance) American robin, American pipit (*Anthus rubescens*), common redpoll, and white-crowned sparrow. Only one species, the American pipit, was only recorded in barrens habitat. The American pipit prefers open habitats, including barrens, grasslands, and tundra (Sibley 2014).

Fifteen species were observed in wetland habitat, including a variety of species that also occured in other habitats, as well as several wetland-specific species. The most abundant species observed included (in order of decreasing abundance) American robin, Canada jay (*Perisoreus canadensis*), fox sparrow, and ruby-crowned kinglet. Species that only occurred in wetlands included American black duck, green-winged teal, rusty blackbird (*Euphagus carolinus*) and Wilson's snipe (*Gallinago delicata*). These species are known to be water or wetland associated.

Table 3-3 Point Counts and Species Richness by Habitat Type

Habitat Type	Number of Point Counts Completed	Species Richness (Number of Species)
Barrens	9	10
Sparse Conifer	13	21
Wetland	4	15

Species richness also varied by site. Table 3-4 indicated the species richness (number of species) by survey site. The highest species richness was observed along the port road between the port site and the main mine site, with 21 species observed. The port road was the only site in which wetland habitat was surveyed (see Table 3-1), which may account for the higher species richness. At both GPS Hill and Sara Hill, 15 species were observed.

Table 3-4 Point Counts and Species Richness by Site

Survey Location	Number of Point Counts Completed	Species Richness (Number of Species)
GPS Hill	9	15
Sara Hill	10	15
Port Road / Potential Transmission Line	7	21

3.3 COMMON NIGHTHAWK SURVEYS

No common nighthawks were observed during these surveys, or incidentally, in the Project Area.

3.4 FALL MIGRATION SURVEYS

3.4.1 Diurnal Landbird Migration Monitoring

3.4.1.1 Species Observations

A total of 30 species were observed during the migration monitoring surveys, including gamebirds, landbirds, shorebirds, and one waterbird (Table 3-5, Appendix A, Table A.2). This list includes species recorded as incidentals. The most common species (by number of individuals observed) were all landbirds, and included common redpoll, Canada jay, dark-eyed junco, boreal chickadee (*Poecile hudsonicus*), and white-crowned sparrow.

The number of species recorded at each of the three sites was very similar; 18 species were recorded along the port road, 19 species were recorded at GPS Hill, and 22 species were recorded at Sara Hill. The greatest number of individual birds were observed at Sara Hill, with 140 individuals. A total of 102 individuals were recorded at GPS Hill, and 138 individuals were recorded along the port road between the port site and the main mine site.

Table 3-5 Species Observed During the Diurnal Landbird Monitoring Surveys

Bird Group	Species	Scientific Name	Port Road	GPS Hill	Sara Hill	Total
Waterbird	Common Loon	*Gavia immer*		2	2	4
Gamebird	Spruce Grouse	*Falcipennis canadensis*		4		4
Gamebird	Willow Ptarmigan	*Lagopus lagopus*			12	12
Shorebird	Greater Yellowlegs	*Tringa melanoleuca*			1	1
Shorebird	Spotted Sandpiper	*Actitis macularius*		1	1	2
Shorebird	Wilson's Snipe	*Gallinago delicata*			1	1
Shorebird	Unidentified shorebird	-		1		1
Landbird	American Three-toed Woodpecker	*Picoides dorsalis*	1	3		4
Landbird	Yellow-bellied Flycatcher	*Empidonax flaviventris*	1			1

Table 3-5 Species Observed During the Diurnal Landbird Monitoring Surveys

Bird Group	Species	Scientific Name	Port Road	GPS Hill	Sara Hill	Total
Landbird	Horned Lark	*Eremophila alpestris*			6	6
Landbird	Canada Jay	*Perisoreus canadensis*	30	8	9	47
Landbird	Common Raven	*Corvus corax*	3	5		8
Landbird	Boreal Chickadee	*Poecile hudsonicus*	14	15	8	37
Landbird	Ruby-crowned Kinglet	*Regulus calendula*	2	1	1	4
Landbird	Gray-cheeked Thrush	*Catharus minimus*		1		1
Landbird	American Robin	*Turdus migratorius*	4	9	2	15
Landbird	American Pipit	*Anthus rubescens*			15	15
Landbird	Unidentified thrush	-		1		1
Landbird	Yellow-rumped Warbler	*Setophaga coronata*	2		1	3
Landbird	Blackpoll Warbler	*Setophaga striata*	3			3
Landbird	American Tree Sparrow	*Spizelloides arborea*		1	1	2
Landbird	Fox Sparrow	*Passerella iliaca*	1	2	1	4
Landbird	Lincoln's Sparrow	*Melospiza lincolnii*	1			1
Landbird	White-crowned Sparrow	*Zonotrichia leucophrys*	6	11	37	54
Landbird	Dark-eyed Junco	*Junco hyemalis*	14	17	11	42
Landbird	Lapland Longspur	*Calcarius lapponicus*			5	5
Landbird	Snow Bunting	*Plectrophenax nivalis*			2	2
Landbird	Unidentified sparrow	-			3	3
Landbird	Rusty Blackbird	*Euphagus carolinus*	1			1
Landbird	Pine Grosbeak	*Pinicola enucleator*	6	2	1	9
Landbird	White-winged Crossbill	*Loxia leucoptera*	4	1	2	7
Landbird	Common Redpoll	*Acanthis flammea*	20	17	18	55
Landbird	Pine Siskin	*Spinus pinus*	25			25
	Grand Total	-	**138**	**102**	**140**	**380**

3.4.1.2 Behavior Data

Different bird groups demonstrate differences in potential sensitivity to the presence of wind turbines (Kingsley and Whittam 2005). The data on migration have therefore been summarized according to bird groups. All species fell into one of two groups: landbirds and waterbirds.

Table 3-6 summarizes the flying heights of the bird groups observed during the 10-minute watch counts conducted at each of the survey stations. Birds observed within 0 to 60 m of the ground were considered to be "Tree to Above Tree" (TAT) height; those flying between 60 and 140 m above ground were considered to be "Well Above Tree" (WAT) height; those birds observed flying between 140 and 200 m were characterized as "High" (H) and those above 200 m were classified as very high (VH). Only birds that were flyover were included in the summary table below; birds that were perched, or were moving short distances throughout the survey site, were not included. For this reason, some bird groups presented in Table 3-5 are not included Table 3-6.

Table 3-6 Relative Heights of Birds Observed during Fall Migration Surveys, 2020

Bird Group	Flight Height				Total
	TAT (0 – 60 m)	WAT (60 – 140 m)	H (140 – 200 m)	VH (>200 m)	
Landbird	101	12	2	-	115
Waterbird	1	1	-	-	2
Total	102	13	2	-	**117**

Notes:
TAT = Tree to Above Tree; 0-60 m
WAT = Well Above Tree; 60-140 m
H = High; 140-200 m
VH = Very High; more than 200 m

Of the 117 individual birds observed, 102 (87%) were observed in the TAT height zone. Thirteen individuals (11%) were observed in the WAT zone, and 2 individuals (2%) were observed in the H zone. No birds were observed flying in the VH zone. Only two individual waterbirds (both common loons (*Gavia immer*)) were observed during the migration surveys. One individual was observed in the TAT zone, and one in the WAT zone.

3.4.2 Diurnal Raptor Passage Monitoring

One raptor was observed during the diurnal raptor passage monitoring. A golden eagle (*Aquila chrysaetos*) was observed on August 15 at the Raptor 1 survey point located at GPS Hill. One individual was observed at 2:25 pm flying at a height between 0 and 60m. Full survey results are included in Appendix A, Table A.3.

Four other species of raptors occurred as incidental observations during other surveys, which included osprey, merlin (*Falco columbarius*), sharp-shinned hawk (*Accipiter striatus*), and northern goshawk (*Accipiter gentilis*).

A variety of landbirds were also observed during the diurnal raptor surveys, including 18 horned larks (*Eremophila alpestris*), which were observed at Sara Hill. Waterfowl were also observed, including seven common goldeneye (*Bucephala clangula*), which were observed in a pond near Raptor 2 at Sara Hill.

3.4.3 Diurnal Waterfowl Passage Monitoring

Two species of waterfowl were observed at survey location WF1 during the waterfowl passage monitoring surveys: American black duck and Canada goose (*Branta canadensis*). Eight American black ducks were observed swimming in the pond adjacent to WF1 on the afternoon of August 6. On September 5 and 9, a total of 76 Canada geese were observed. On Aug 5, 31 individuals were observed swimming in the south sedimentation pond. On August 9, nineteen individuals were observed resting in the east sedimentation pond. On the same day, 25 individuals were also observed flying north at estimated heights between 350 and 500m. It is possible that some of the Canada geese observed on Aug 9 were the same individuals that were observed on Aug 5. Full survey results are presented in Appendix A, Table A.4.

Another species of interest that was observed during the waterfowl surveys was the spotted sandpiper (*Actitis macularius*). Two individuals were observed on August 18, one of which was a juvenile.

Other species of waterfowl/waterbirds noted in other survey types include green-winged teal, common goldeneye and common loon.

3.4.4 Acoustic Monitoring

3.4.4.1 Limitations

It is important to identify some of the limitations of the acoustic data to properly interpret the results. First, due to the ground-level placement of detectors, there is a recording bias of birds at or near ground level over higher-flying birds, particularly for those flying at high altitudes. As discussed in Section 2.4.4.3, not all recorded vocalizations can be identified to species due to the brevity or quality of recorded calls. Non-migrating birds that are recorded at ground level are more likely to be identified than migrating birds flying overhead. In addition, the type of calls made by birds in migration are more difficult to identify by species, and migrating birds tend to vocalize less than non-migrating birds at ground level. All of these factors lead to a bias in the data towards resident species and birds at ground level, rather than exclusively migratory flyovers.

There are limitations in the comparison of vocalizations to weather data as well. Weather events (e.g., wind, rain) can reduce the detection rate of birds. As such, it is not always possible tease out the influence of weather on bird vocalization frequency.

3.4.4.2 Acoustic Detector Locations

Four acoustic detectors were deployed in the vicinity of the Project; two were located at GPS Hill, one was located at Sara Hill, and one was located along the port road. The detector locations are shown on Figure 1.1 and are summarized in Table 3-7. As discussed in Section 2.4.4.3, results were only analyzed for detectors AA3 and AA4.

Table 3-7 Acoustic Detector Locations

Acoustic Detector ID	Site	Habitat Description
AA1	Port Road	• Adjacent to the shoreline of Little Reid Brook. • Within small conifer stand
AA2	Sara Hill	• Located south of the MET tower • Detector deployed in dwarf birch shrub thicket • Barren hilltop located to east • Bog/fen/open water wetland complex located to northeast
AA3	GPS Hill	• Located at margin of a small tamarack stand • Surrounded by exposed barrens habitat
AA4	GPS Hill	• Located near a sparsely forested patch located in barrens habitat • Pond located approximately 0.5 km away downslope

3.4.4.3 Species Results

Overall, data was analyzed for 8,054 vocalizations that were recorded at AA3 and AA4 between August 17 and September 27, 2020. Of these, 4,118 vocalizations were identified to species. The remaining vocalizations could not be identified to species due to the brevity or quality of recorded calls. Thirteen species were identified, all of which had been previously identified during other field surveys (Table 3-8). These included 11 landbird species, and two water-associated species (Common loon and Canada goose). The most frequently occurring species were common redpoll, Canada jay, American robin, and boreal chickadee. Of these four most frequently occurring species, three are resident species, and one (American robin) is migratory. In total, seven of the 11 identified species are residents in the RAA.

One vocalization was identified as an unknown alcid. Acids are a group of seabirds that include murres, guillemots, and puffins. This was the only observation of an alcid in the RAA.

Table 3-8 Species Identified in Acoustic Surveys

Species	Scientific Name	Seasonal Presence	AA3	AA4	Total
Common loon	*Gavia immer*	Migrant	27	103	130
Canada goose	*Branta canadensis*	Migrant	50	1	51
Canada jay	*Perisoreus canadensis*	Resident	150	875	1025
Common raven	*Corvus corax*	Resident	38	55	93
Boreal chickadee	*Poecile hudsonicus*	Resident	124	283	407
American robin	*Turdus migratorius*	Migrant	160	613	773
Northern waterthrush	*Parkesia noveboracensis*	Migrant	-	19	19
American tree sparrow	*Spizelloides arborea*	Migrant	-	3	3
White-crowned sparrow	*Zonotrichia leucophrys*	Resident	8	13	21
Dark-eyed junco	*Junco hyemalis*	Migrant	-	11	11
Pine grosbeak	*Pinicola enucleator*	Resident	130	36	166
White-winged crossbill	*Loxia leucoptera*	Resident	-	19	19
Common redpoll	*Acanthis flammea*	Resident	1,013	386	1,399
Unknown alcid	-	-	1	-	1
Unknown	-	-	2,031	1,905	3,936
Total	**-**	**-**	**3,732**	**4,322**	**8,054**

3.4.4.4 Temporal Trends: Time of Day

The acoustic data was analyzed by time of day, to investigate temporal trends. Total vocalizations of all species are graphed against time of day in Figure 3-1. Most vocalizations occur in the period between 1 hour before sunrise and 8 hours after sunrise. This would equate to approximately 5am to 2pm at the Project Area in the fall. This trend is seen at both detectors AA3 and AA4. Overall, vocalizations are lowest between 12 hours after sunrise (approximately 6pm) to 2 hours before sunrise (approximately 4am). This suggests that the majority of bird activity is occurring during morning hours and represents both resident species and migrants. Nocturnal vocalizations, which typically represents migratory behavior, appears to represent a low proportion of overall vocalizations at both sites. Again, these results could be influenced by the bias of the recorders to best detect species located closer to ground level.

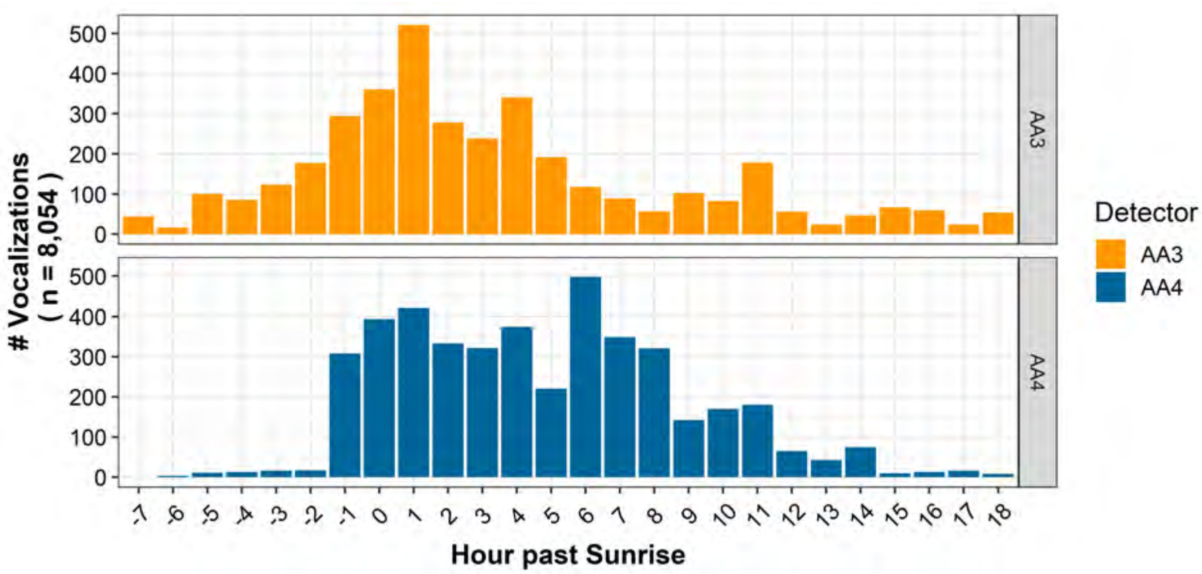

Figure 3-1 Total Number of Vocalizations by Time of Day

Timing of vocalizations was also mapped for individual species; these graphs are presented in Appendix C. Most species show trends similar to the overall data, with the majority of vocalizations occurring during morning hours. However, two species that indicate occurrences of nighttime activity include common redpoll and pine grosbeak. At detector AA3, common redpoll activity appears to begin five hours before sunrise (approximately 1 am), and an instance of activity occurred around midnight on at least one day. Common redpoll are resident species in the LAA. This activity could represent local movements or could represent migratory activity from individuals that nest in more northerly regions, and conduct small scale migrations to winter in warmer areas.

At detectors AA3, pine grosbeak showed spikes of activity at seven hours before sunrise (approximately 11 pm) and 16 hours after sunrise (approximately 10 pm). Pine grosbeak are residents in this region, and as such, this activity likely represents local movements or small-scale migration.

3.4.4.5 Temporal Trends: Seasonal

Total vocalizations were graphed by date, to look for seasonal trends (Figure 3-2). These results, which include all species, as well as unidentified vocalizations, do not show any discernable seasonal trends at either detector and within the time period monitored. Total vocalizations per day vary throughout the survey period. This entire period represents the migratory season, so it is not possible to comment on activity levels in the migratory versus non-migratory season.

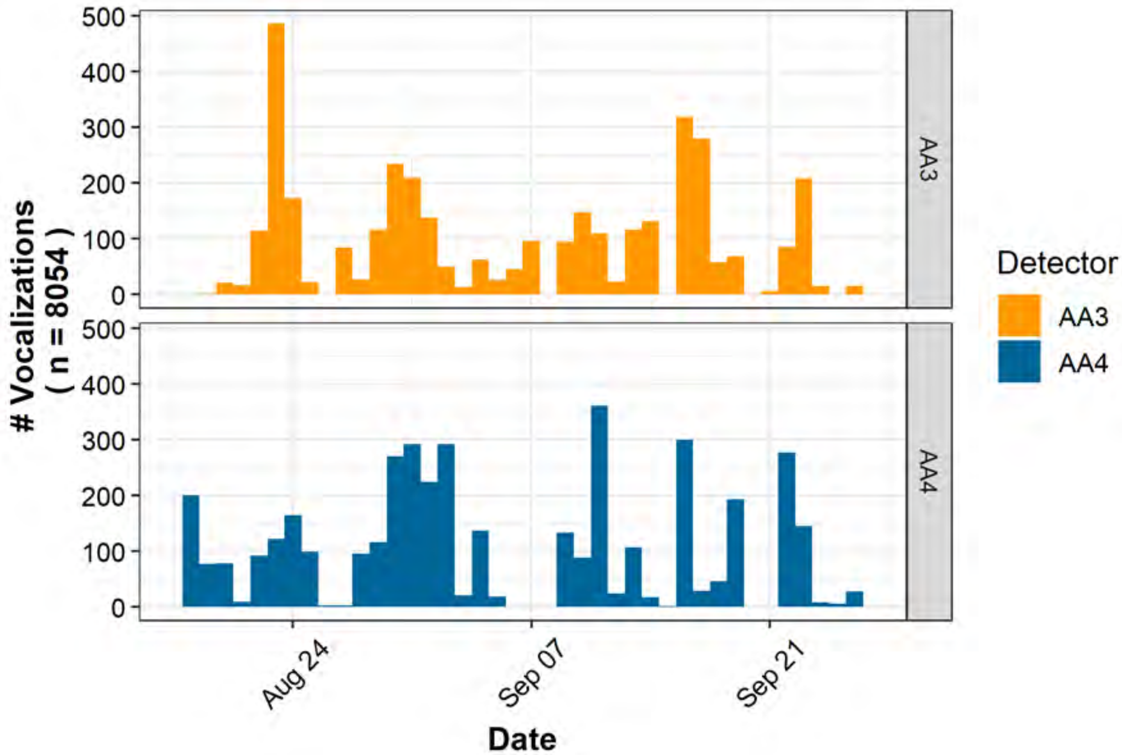

Figure 3-2 Total Number of Vocalizations by Date

Vocalization results by date are show for each species, and the identified group, in Appendix C. This data indicates how frequently each species occurred. Some species, including American tree sparrow, dark-eyed junco, white-winged crossbill, and the unidentified alcid, were only recorded on one or two days during the survey period. Other species, including American robin, Canada jay, boreal chickadee and common redpoll, were recorded on most days that the detectors were actively recording.

There are few noticeable instances of large numbers of vocalizations in Appendix C. For example, on August 23rd there were over 500 recordings of common redpoll at detector AA3, most of which were recorded overnight. This spike in activity could represent an arrival of migrating redpolls, or could represent local movements of a large resident group. Canada geese, a migratory species, were recorded in relatively large numbers (>20 recordings) on two separate days in September at detector AA3. Most of these recordings occurred around dawn. As such, these recordings may represent migratory fly-overs.

3.4.4.6 Effects of Weather

The acoustic data was compared to five weather variables. A weather station operated by VNL and located at a nearby airstrip was used for site-specific weather data. Total number of daily vocalizations were compared to mean wind speed, wind direction, relative humidity, mean temperature, and precipitation on the day when vocalizations were recorded (Figure 3-3). A negative relationship was observed with wind speed; as wind speed increased, vocalizations decreased. This may be because birds are less active in high winds, However, it could have also been attributable to poorer detection of bird vocalizations during windy conditions, and does not necessarily indicate a behavioral response. There was no apparent relationship between wind direction, relative humidity, mean temperature or precipitation with recorded vocalizations.

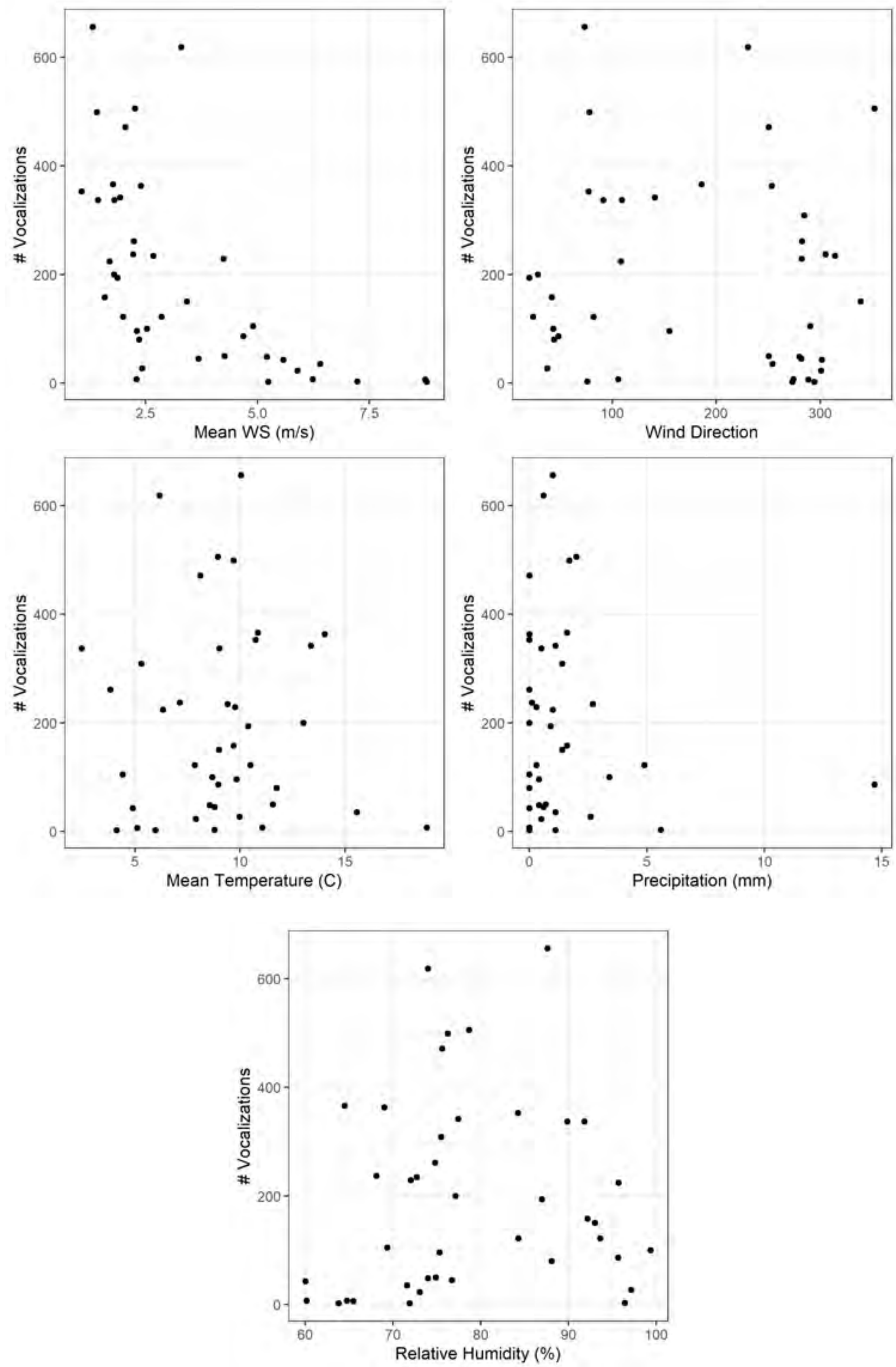

Figure 3-3 Daily Number of Vocalizations as Compared to Daily Weather Condition

3.5 SPECIES AT RISK AND SPECIES OF CONSERVATION CONCERN

Species at risk (SAR) include species listed as extirpated, endangered, threatened, or special concern by the federal SARA, the Committee on the Status of Endangered Wildlife in Canada (COSEWIC), or the *Newfoundland and Labrador Endangered Species Act*.

Species of conservation concern (SOCC) are species not listed or protected by any legislation, but are considered rare in Labrador, or their populations may not be considered sustainable. SOCC are here defined to include species that are not SAR but are ranked S1 (critically imperiled) or S2 (imperiled) in Labrador by the AC CDC.

One SAR, the rusty blackbird, was observed during the 2020 bird monitoring program. Rusty blackbirds are listed as *Special Concern* under SARA, and as *Vulnerable* under the Newfoundland and Labrador *Endangered Species Act* due to steep population declines that occurred through the twentieth century (COSEWIC 2017). This species is typically found in coniferous treed wetlands in the boreal forest (COSEWIC 2017). One rusty blackbird was observed during the breeding bird surveys at survey location W3, in a wetland along the southern portion of the port road. A rusty blackbird was observed at the same location (W3), during the diurnal landbird monitoring surveys. It is not known if this was the same individual that was observed during the breeding bird surveys. Rusty blackbirds were not observed during the 2019 bird surveys.

One SOCC, golden eagle, was observed during the raptor monitoring. This species has an AC CDC ranking of S2B, SUM in Labrador, which indicates that the breeding population is ranked as imperiled, and the migrant population is currently unrankable due to lack of information, or conflicting information. One individual golden eagle was observed in 2020, at GPS Hill. One golden eagle was also observed during the 2019 surveys at Sara Hill.

One other SOCC was observed in the 2019 field surveys: the hoary redpoll. This species was not observed during the 2020 surveys.

3.6 SUMMARY AND CONCLUSION

In all 2020 surveys combined, a total of 41 species were observed. During the breeding bird species, a total of 25 bird species were observed, including two species of waterfowl, one raptor, one shorebird, and 21 species of land birds. Most species were observed in sparse conifer habitat (21), followed by wetland (15). Only 10 species were observed in the barrens habitat.

During the diurnal landbird monitoring surveys, 30 species were observed. Again, the majority were landbirds, but gamebirds, shorebirds and one waterbird were also observed. The most common species included common redpoll, Canada jay, dark-eyed junco, boreal chickadee and white-crowned sparrow. During the landbird migration monitoring, 19 species were recorded at GPS Hill, 22 species were recorded at Sara Hill, and 18 species were recorded along the port road. Eighty-seven percent of individuals that were observed flying were located in the TAT (0-60 m) height class.

Only one species of raptor was recorded during the diurnal raptor surveys. One golden eagle individual was observed at GPS Hill. Two other species of raptors, including osprey and merlin, were observed incidentally during other survey types.

Two species of waterfowl, including American black duck and Canada goose, were observed at WF1 during the waterfowl migration surveys. Other species of waterfowl that were incidentally observed in the Project Area include green-winged teal and common goldeneye.

Acoustic monitoring occurred in the Project Area from August 17 to September 27, 2020. One of the goals of this survey was to investigate the presence and abundance of nocturnal migrants. Overall, the data did not indicate that large numbers of birds were moving through the area at night. Most bird vocalizations occurred between sunrise and noon. All species identified in the acoustic data were also observed during the breeding bird and migratory passage surveys, with the exception of one unidentified alcid. Many of the species recorded are resident land bird species, the most common of which included common redpoll, American robin, Canada jay, and boreal chickadee. Common loon and Canada goose were also recorded. However, it is important to note that not all vocalizations could be identified to species due to the brevity or quality of recorded calls, and that all species potentially occurring in the area could not necessarily be detected by audio recorders. No distinct seasonal patterns were observed; the number of bird passes recorded per night varied from night to night throughout the survey period.

One SAR, rusty blackbird, was observed during the 2020 field surveys. This species was observed at survey location W3 during both the breeding bird and landbird migration surveys. Rusty blackbirds are listed as *Special Concern* under SARA, and as *Vulnerable* under the Newfoundland and Labrador *Endangered Species Act.* One SOCC, golden eagle, was observed at GPS hill during the raptor migration surveys during the 2020 field surveys. A golden eagle was also recorded in the 2019 surveys near Sara Hill. A second SOCC, the hoary redpoll, was observed during the 2019 surveys but not during the 2020 surveys.

Nocturnal migrants (particular passerines, or small landbirds) have long been thought to be the most susceptible to wind turbine strikes because of their movements during low-no light conditions and, potentially because they may be attracted to the lights on turbines during certain weather conditions (Longcore et al. 2008). The Voisey's Bay area is north of the range of most North American migratory landbirds. The acoustic results did not show any obvious trends in vocalization activity during the fall migration seasons, or overnight, when nocturnal migrants would be expected. No landscape features occur in the area that would concentrate migrating birds beyond the possible effect of the Project being located generally within a coastal zone, as opposed to more mid-continental areas.

While the model of turbine to be used has not been finalized for this project, the tallest turbine being considered has a blade height of 180m. Although the migratory behaviour of many species is not fully understood, it is thought that most nocturnally migrating songbirds fly between 92 and 750m above ground level (Kerlinger 2003; Cooper 2004). Migrants tend to fly lower during inclement weather, including low cloud conditions or fog (Erickson et al. 2001). During the course of dozens of spring and fall nighttime migration radar surveys in the northeastern United States, Stantec (unpublished data) typically documents nighttime bird migration at heights of 300-500 m above the ground. Additionally, on those nights with inclement weather when night migrants may be flying lower than this, the overall magnitude of migration activity is typically lowest, likely offsetting potential risk of collisions due to fewer birds actively migrating.

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4.2 PERSONAL COMMUNICATION

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2020. Knaga, P. Canadian Wildlife Service, ECCC (Environment and Climate Change Canada). Meeting on April 20, 2020.

2020. Knaga, P., Mailihot, J, Breau, M. and Worthman, S. Canadian Wildlife Service, ECCC (Environment and Climate Change Canada). Meeting on June 17, 2020.

APPENDIX A

Bird Data

Appendix A BIRD DATA

Appendix A.1 Breeding Bird Survey Data

Date	Site ID	Species Name	Scientific Name	Count	ACCDC S-Rank	Breeding Evidance	Incidental	Habitat
6/26/2020	SC7	Blackpoll Warbler	*Setophaga striata*	1	S5B,S5M	Possible		Sparse Conifer
6/26/2020	SC7	Fox Sparrow	*Passerella iliaca*	1	S5B,S5M	Possible	X	Sparse Conifer
6/26/2020	SC7	Fox Sparrow	*Passerella iliaca*	1	S5B,S5M	Possible		Sparse Conifer
6/26/2020	SC7	Northern Waterthrush	*Parkesia noveboracensis*	1	S5B,S5M	Possible		Sparse Conifer
6/26/2020	SC7	Yellow-rumped Warbler	*Setophaga coronata*	1	S5B,S5M	Possible		Sparse Conifer
6/26/2020	W1	Canada Jay	*Perisoreus canadensis*	2	S5	-		Wetland
6/26/2020	W1	Canada Jay	*Perisoreus canadensis*	1	S5	-		Wetland
6/26/2020	W1	American Robin	*Turdus migratorius*	1	S5B,S5M	Possible	X	Wetland
6/26/2020	W1	Fox Sparrow	*Passerella iliaca*	1	S5B,S5M	Possible		Wetland
6/26/2020	SC5	Ruby-crowned Kinglet	*Regulus calendula*	2	S5B,S5M	Probable		Sparse Conifer
6/26/2020	SC5	American Robin	*Turdus migratorius*	1	S5B,S5M	Possible	X	Sparse Conifer
6/26/2020	SC5	Fox Sparrow	*Passerella iliaca*	1	S5B,S5M	Possible		Sparse Conifer
6/26/2020	SC5	Ruby-crowned Kinglet	*Regulus calendula*	1	S5B,S5M	Possible		Sparse Conifer
6/26/2020	SC5	Dark-eyed Junco	*Junco hyemalis*	1	S5B,S5M	Possible		Sparse Conifer
6/26/2020	SC5	Wilson's Warbler	*Cardellina pusilla*	1	S5B,S5M	Possible		Sparse Conifer
6/26/2020	SC4	Canada Jay	*Perisoreus canadensis*	1	S5	-		Sparse Conifer
6/26/2020	SC4	Blackpoll Warbler	*Setophaga striata*	1	S5B,S5M	Possible		Sparse Conifer
6/26/2020	SC4	Fox Sparrow	*Passerella iliaca*	1	S5B,S5M	Possible		Sparse Conifer
6/26/2020	SC4	Yellow-rumped Warbler	*Setophaga coronata*	1	S5B,S5M	Possible	X	Sparse Conifer
6/26/2020	SC6	White-crowned Sparrow	*Zonotrichia leucophrys*	1	S5B,S5M	Probable		Sparse Conifer
6/26/2020	SC6	Pine Grosbeak	*Pinicola enucleator*	1	S5	Possible		Sparse Conifer
6/26/2020	SC6	Ruby-crowned Kinglet	*Regulus calendula*	1	S5B,S5M	Possible		Sparse Conifer
6/26/2020	W3	Rusty Blackbird	*Euphagus carolinus*	1	S3B,SUM	Possible	X	Wetland
6/26/2020	W3	Swainson's Thrush	*Catharus ustulatus*	1	S5B,S5M	Possible	X	Wetland
6/26/2020	W3	American Black Duck	*Anas rubripes*	1	S5B,S5M	Observed	X	Wetland
6/26/2020	W3	American Robin	*Turdus migratorius*	1	S5B,S5M	Observed	X	Wetland
6/26/2020	W2	Canada Jay	*Perisoreus canadensis*	1	S5	-	X	Wetland
6/26/2020	W2	Yellow-rumped Warbler	*Setophaga coronata*	1	S5B,S5M	Possible	X	Wetland
6/26/2020	W2	Ruby-crowned Kinglet	*Regulus calendula*	1	S5B,S5M	Possible		Wetland
6/26/2020	W2	Rusty Blackbird	*Euphagus carolinus*	1	S3B,SUM	Possible	X	Wetland
6/26/2020	W2	Yellow-rumped Warbler	*Setophaga coronata*	1	S5B,S5M	Possible		Wetland
6/26/2020	W4	Dark-eyed Junco	*Junco hyemalis*	1	S5B,S5M	Possible		Wetland
6/26/2020	W4	Boreal Chickadee	*Poecile hudsonicus*	1	S4	Possible		Wetland
6/26/2020	W4	Ruby-crowned Kinglet	*Regulus calendula*	1	S5B,S5M	Possible	X	Wetland
6/26/2020	W4	Ruby-crowned Kinglet	*Regulus calendula*	1	S5B,S5M	Possible		Wetland
6/27/2020	SC11	Dark-eyed Junco	*Junco hyemalis*	1	S5B,S5M	Possible	X	Sparse Conifer
6/27/2020	B5	Pine Grosbeak	*Pinicola enucleator*	1	S5	-	X	Barren
6/27/2020	B5	Common Redpoll	*Acanthis flammea*	1	S4	Possible	X	Barren
6/27/2020	B4	Common Redpoll	*Acanthis flammea*	1	S4	-	X	Barren
6/27/2020	B4	Ruby-crowned Kinglet	*Regulus calendula*	1	S5B,S5M	-	X	Barren
6/27/2020	SC10	Fox Sparrow	*Passerella iliaca*	1	S5B,S5M	Possible	X	Sparse Conifer
6/27/2020	SC10	Lincoln's Sparrow	*Melospiza lincolnii*	1	S5B,S5M	Possible		Sparse Conifer
6/27/2020	SC10	Yellow-rumped Warbler	*Setophaga coronata*	1	S5B,S5M	Possible		Sparse Conifer
6/27/2020	SC10	Yellow-rumped Warbler	*Setophaga coronata*	1	S5B,S5M	Possible		Sparse Conifer
6/27/2020	SC13	American Three-toed Woodpe	*Picoides dorsalis*	1	S5	-	X	Sparse Conifer
6/27/2020	SC13	Canada Jay	*Perisoreus canadensis*	1	S5	-		Sparse Conifer
6/27/2020	SC13	Yellow-rumped Warbler	*Setophaga coronata*	1	S5B,S5M	Possible		Sparse Conifer
6/27/2020	SC8	Common Redpoll	*Acanthis flammea*	1	S4	Possible	X	Sparse Conifer
6/27/2020	SC12	American Robin	*Turdus migratorius*	1	S5B,S5M	Possible		Sparse Conifer
6/27/2020	SC12	Common Redpoll	*Acanthis flammea*	1	S4	Possible	X	Sparse Conifer
6/27/2020	SC12	Dark-eyed Junco	*Junco hyemalis*	1	S5B,S5M	Possible		Sparse Conifer
6/27/2020	SC12	Pine Grosbeak	*Pinicola enucleator*	1	S5	Possible		Sparse Conifer
6/27/2020	B6	Lincoln's Sparrow	*Melospiza lincolnii*		S5B,S5M	-		Barren
6/27/2020	SC9	Canada Jay	*Perisoreus canadensis*	1	S5	-		Sparse Conifer
6/27/2020	SC9	Fox Sparrow	*Passerella iliaca*	1	S5B,S5M	Possible		Sparse Conifer
6/27/2020	SC9	Pine Grosbeak	*Pinicola enucleator*	1	S5	Possible		Sparse Conifer
6/27/2020	SC9	White-crowned Sparrow	*Zonotrichia leucophrys*	1	S5B,S5M	Possible		Sparse Conifer
6/27/2020	SC9	Yellow-rumped Warbler	*Setophaga coronata*	1	S5B,S5M	Possible		Sparse Conifer
6/28/2020	SC7	American Robin	*Turdus migratorius*	1	S5B,S5M	-	X	Sparse Conifer
6/28/2020	SC7	Fox Sparrow	*Passerella iliaca*	1	S5B,S5M	-	X	Sparse Conifer
6/28/2020	SC7	Blackpoll Warbler	*Setophaga striata*	1	S5B,S5M	Possible		Sparse Conifer
6/28/2020	SC7	Northern Waterthrush	*Parkesia noveboracensis*	1	S5B,S5M	Possible		Sparse Conifer
6/28/2020	SC7	Pine Grosbeak	*Pinicola enucleator*	1	S5	Possible		Sparse Conifer
6/28/2020	SC7	Yellow-rumped Warbler	*Setophaga coronata*	1	S5B,S5M	Possible		Sparse Conifer
6/28/2020	W1	Canada Jay	*Perisoreus canadensis*		S5	-	X	Wetland
6/28/2020	W1	Canada Jay	*Perisoreus canadensis*	2	S5	-		Wetland
6/28/2020	W1	Wilson's Snipe	*Gallinago delicata*	1	S5B,S5M	Possible		Wetland
6/28/2020	W1	American Robin	*Turdus migratorius*	1	S5B,S5M	Possible		Wetland
6/28/2020	W1	Fox Sparrow	*Passerella iliaca*	1	S5B,S5M	Possible		Wetland
6/28/2020	SC5	Common Redpoll	*Acanthis flammea*	1	S4	Possible		Sparse Conifer
6/28/2020	SC5	Ruby-crowned Kinglet	*Regulus calendula*	1	S5B,S5M	Possible		Sparse Conifer
6/28/2020	SC5	Wilson's Warbler	*Cardellina pusilla*	1	S5B,S5M	Possible		Sparse Conifer
6/28/2020	SC5	Yellow-bellied Flycatcher	*Empidonax flaviventris*	1	S5B,S5M	Possible		Sparse Conifer
6/28/2020	SC5	Yellow-rumped Warbler	*Setophaga coronata*	1	S5B,S5M	Possible		Sparse Conifer
6/28/2020	SC4	Canada Jay	*Perisoreus canadensis*	2	S5	-		Sparse Conifer
6/28/2020	SC4	Blackpoll Warbler	*Setophaga striata*	1	S5B,S5M	Possible		Sparse Conifer
6/28/2020	SC4	Fox Sparrow	*Passerella iliaca*	1	S5B,S5M	Possible		Sparse Conifer
6/28/2020	SC4	Ruby-crowned Kinglet	*Regulus calendula*	1	S5B,S5M	Possible		Sparse Conifer
6/28/2020	SC4	Dark-eyed Junco	*Junco hyemalis*	1	S5B,S5M	Possible		Sparse Conifer
6/28/2020	SC6	Common Redpoll	*Acanthis flammea*	1	S4	Possible	X	Sparse Conifer
6/28/2020	SC6	Boreal Chickadee	*Poecile hudsonicus*	1	S4	Possible		Sparse Conifer
6/28/2020	SC6	Pine Grosbeak	*Pinicola enucleator*	1	S5	Possible		Sparse Conifer
6/28/2020	SC6	Ruby-crowned Kinglet	*Regulus calendula*	1	S5B,S5M	Possible		Sparse Conifer
6/28/2020	SC6	White-crowned Sparrow	*Zonotrichia leucophrys*	1	S5B,S5M	Possible		Sparse Conifer
6/28/2020	W3	Green-winged Teal	*Anas crecca*	1	S5B,S5M	-		Wetland
6/28/2020	W3	Rusty Blackbird	*Euphagus carolinus*	1	S3B,SUM	-	X	Wetland
6/28/2020	W3	Common Redpoll	*Acanthis flammea*	1	S4	Possible	X	Wetland
6/28/2020	W3	American Robin	*Turdus migratorius*	2	S5B,S5M	Probable		Wetland
6/28/2020	W3	Dark-eyed Junco	*Junco hyemalis*	1	S5B,S5M	Possible		Wetland
6/28/2020	W3	Wilson's Snipe	*Gallinago delicata*	1	S5B,S5M	Possible		Wetland
6/28/2020	W2	Canada Jay	*Perisoreus canadensis*	1	S5	-	X	Wetland
6/28/2020	W2	American Robin	*Turdus migratorius*	1	S5B,S5M	Possible	X	Wetland
6/28/2020	W2	Common Redpoll	*Acanthis flammea*	2	S4	Possible		Wetland
6/28/2020	W2	American Robin	*Turdus migratorius*	1	S5B,S5M	Possible		Wetland
6/28/2020	W2	Fox Sparrow	*Passerella iliaca*	1	S5B,S5M	Possible		Wetland
6/28/2020	W2	Yellow-rumped Warbler	*Setophaga coronata*	1	S5B,S5M	Possible		Wetland

Appendix A.1 Breeding Bird Survey Data

Date	Site ID	Species Name	Scientific Name	Count	ACCDC S-Rank	Breeding Evidance	Incidental	Habitat
6/28/2020	W2	Ruby-crowned Kinglet	*Regulus calendula*	1	S5B,S5M	Possible		Wetland
6/28/2020	W2	Wilson's Snipe	*Gallinago delicata*	1	S5B,S5M	Possible		Wetland
6/28/2020	W4	American Robin	*Turdus migratorius*	1	S5B,S5M	Possible		Wetland
6/28/2020	W4	Fox Sparrow	*Passerella iliaca*	1	S5B,S5M	Possible		Wetland
6/28/2020	W4	Ruby-crowned Kinglet	*Regulus calendula*	1	S5B,S5M	Possible		Wetland
6/28/2020	W4	Dark-eyed Junco	*Junco hyemalis*	1	S5B,S5M	Possible		Wetland
6/29/2020	SC12	Boreal Chickadee	*Poecile hudsonicus*	1	S4	-		Sparse Conifer
6/29/2020	SC12	unknown sparrow		1		-	X	Sparse Conifer
6/29/2020	SC12	American Robin	*Turdus migratorius*	1	S5B,S5M	Possible	X	Sparse Conifer
6/29/2020	SC12	Ruby-crowned Kinglet	*Regulus calendula*	1	S5B,S5M	Possible		Sparse Conifer
6/29/2020	SC12	White-crowned Sparrow	*Zonotrichia leucophrys*	1	S5B,S5M	Possible		Sparse Conifer
6/29/2020	SC12	Yellow-rumped Warbler	*Setophaga coronata*	1	S5B,S5M	Possible		Sparse Conifer
6/29/2020	B6	American Robin	*Turdus migratorius*	1	S5B,S5M	Possible	X	Barren
6/29/2020	B6	American Robin	*Turdus migratorius*	1	S5B,S5M	Possible	X	Barren
6/29/2020	B6	White-crowned Sparrow	*Zonotrichia leucophrys*	1	S5B,S5M	Possible		Barren
6/29/2020	B6	American Pipit	*Anthus rubescens*	1	S5B,S5M	Observed	X	Barren
6/29/2020	SC9	American Robin	*Turdus migratorius*	1	S5B,S5M	Possible	X	Sparse Conifer (Dense)
6/29/2020	SC9	White-winged Crossbill	*Loxia leucoptera*	1	S5	Possible		Sparse Conifer
6/29/2020	SC9	Ruby-crowned Kinglet	*Regulus calendula*	1	S5B,S5M	Possible		Sparse Conifer
6/29/2020	SC9	Dark-eyed Junco	*Junco hyemalis*	1	S5B,S5M	Possible		Sparse Conifer
6/29/2020	SC9	White-crowned Sparrow	*Zonotrichia leucophrys*	1	S5B,S5M	Possible		Sparse Conifer
6/29/2020	SC8	American Robin	*Turdus migratorius*	1	S5B,S5M	Possible	X	Sparse Conifer
6/29/2020	SC8	American Robin	*Turdus migratorius*	1	S5B,S5M	Possible	X	Sparse Conifer
6/29/2020	SC8	Yellow-rumped Warbler	*Setophaga coronata*	1	S5B,S5M	Possible		Sparse Conifer
6/29/2020	SC8	Ruby-crowned Kinglet	*Regulus calendula*	1	S5B,S5M	Possible		Sparse Conifer
6/29/2020	SC8	White-crowned Sparrow	*Zonotrichia leucophrys*	1	S5B,S5M	Possible		Sparse Conifer
6/29/2020	SC10	Common Redpoll	*Acanthis flammea*		S4	Possible	X	Sparse Conifer
6/29/2020	SC10	Fox Sparrow	*Passerella iliaca*	1	S5B,S5M	Possible	X	Sparse Conifer
6/29/2020	SC10	Lincoln's Sparrow	*Melospiza lincolnii*	1	S5B,S5M	Possible		Sparse Conifer
6/29/2020	SC10	Swainson's Thrush	*Catharus ustulatus*	1	S5B,S5M	Possible		Sparse Conifer
6/29/2020	SC13	Canada Jay	*Perisoreus canadensis*	1	S5	-		Sparse Conifer
6/29/2020	SC13	Dark-eyed Junco	*Junco hyemalis*	1	S5B,S5M	Possible		Sparse Conifer
6/29/2020	SC13	Yellow-rumped Warbler	*Setophaga coronata*	1	S5B,S5M	Possible		Sparse Conifer
6/29/2020	SC13	American Three-toed Woodpe	*Picoides dorsalis*	1	S5	Observed	X	Sparse Conifer
6/29/2020	B4	Canada Jay	*Perisoreus canadensis*	1	S5	-		Barren
6/29/2020	B4	American Robin	*Turdus migratorius*	1	S5B,S5M	Possible	X	Barren
6/29/2020	B4	Common Redpoll	*Acanthis flammea*	1	S4	Possible	X	Barren
6/29/2020	SC11	Yellow-rumped Warbler	*Setophaga coronata*	1	S5B,S5M	Possible		Sparse Conifer
6/29/2020	B5	American Robin	*Turdus migratorius*	1	S5B,S5M	Observed		Barren
6/29/2020	B5	American Robin	*Turdus migratorius*	1	S5B,S5M	Observed		Barren
6/29/2020	B5	Common Redpoll	*Acanthis flammea*	1	S4	Observed		Barren
6/30/2020	B2	American Robin	*Turdus migratorius*	1	S5B,S5M	Possible	X	Barren
6/30/2020	B2	White-crowned Sparrow	*Zonotrichia leucophrys*	1	S5B,S5M	Possible	X	Barren
6/30/2020	B9	American Robin	*Turdus migratorius*	1	S5B,S5M	Possible	X	Barren
6/30/2020	B9	Common Redpoll	*Acanthis flammea*	1	S4	Possible	X	Barren
6/30/2020	B9	American Robin	*Turdus migratorius*	1	S5B,S5M	Possible	X	Barren
6/30/2020	B9	White-crowned Sparrow	*Zonotrichia leucophrys*	1	S5B,S5M	Possible		Barren
6/30/2020	B3	American Robin	*Turdus migratorius*	1	S5B,S5M	Possible	X	Barren
6/30/2020	B3	Yellow-rumped Warbler	*Setophaga coronata*	1	S5B,S5M	Possible	X	Barren
6/30/2020	B3	American Robin	*Turdus migratorius*	1	S5B,S5M	Observed		Barren
6/30/2020	B3	Common Redpoll	*Acanthis flammea*	4	S4	Observed	X	Barren
6/30/2020	SC3	Blackpoll Warbler	*Setophaga striata*	1	S5B,S5M	Possible		Sparse Conifer
6/30/2020	SC3	Fox Sparrow	*Passerella iliaca*	1	S5B,S5M	Possible		Sparse Conifer
6/30/2020	SC3	Common Redpoll	*Acanthis flammea*	1	S4	Observed	X	Sparse Conifer
6/30/2020	SC2	American Robin	*Turdus migratorius*	1	S5B,S5M	Possible		Sparse Conifer
6/30/2020	SC2	American Tree Sparrow	*Spizella arborea*	1	S4B,SUM	Possible		Sparse Conifer
6/30/2020	SC2	Blackpoll Warbler	*Setophaga striata*	1	S5B,S5M	Possible		Sparse Conifer
6/30/2020	SC2	Fox Sparrow	*Passerella iliaca*	1	S5B,S5M	Possible		Sparse Conifer
6/30/2020	SC2	Fox Sparrow	*Passerella iliaca*	1	S5B,S5M	Possible	X	Sparse Conifer
6/30/2020	SC2	Dark-eyed Junco	*Junco hyemalis*	1	S5B,S5M	Possible		Sparse Conifer
6/30/2020	SC2	Common Redpoll	*Acanthis flammea*	2	S4	Observed	X	Sparse Conifer
6/30/2020	B7	American Robin	*Turdus migratorius*	1	S5B,S5M	Possible		Barren
6/30/2020	B7	White-crowned Sparrow	*Zonotrichia leucophrys*	1	S5B,S5M	Possible		Barren
6/30/2020	B7	Common Redpoll	*Acanthis flammea*	1	S4	Possible		Barren
6/30/2020	B7	Blackpoll Warbler	*Setophaga striata*	1	S5B,S5M	Possible		Barren
6/30/2020	SC1	American Robin	*Turdus migratorius*	1	S5B,S5M	Possible		Sparse Conifer
6/30/2020	SC1	Blackpoll Warbler	*Setophaga striata*	1	S5B,S5M	Possible		Sparse Conifer
6/30/2020	SC1	Pine Grosbeak	*Pinicola enucleator*	1	S5	Possible	X	Sparse Conifer
6/30/2020	SC1	Dark-eyed Junco	*Junco hyemalis*	1	S5B,S5M	Possible		Sparse Conifer
6/30/2020	SC1	White-crowned Sparrow	*Zonotrichia leucophrys*	1	S5B,S5M	Possible		Sparse Conifer
6/30/2020	SC1	Yellow-rumped Warbler	*Setophaga coronata*	1	S5B,S5M	Possible		Sparse Conifer
6/30/2020	SC1	Common Redpoll	*Acanthis flammea*	2	S4	Observed	X	Sparse Conifer
6/30/2020	B1	American Robin	*Turdus migratorius*	1	S5B,S5M	Possible	X	Barren
6/30/2020	B1	American Robin	*Turdus migratorius*	1	S5B,S5M	Possible	X	Barren
6/30/2020	B1	White-crowned Sparrow	*Zonotrichia leucophrys*	1	S5B,S5M	Possible	X	Barren
6/30/2020	B1	American Pipit	*Anthus rubescens*	12	S5B,S5M	Observed	X	Barren
6/30/2020	B8	White-crowned Sparrow	*Zonotrichia leucophrys*	2	S5B,S5M	Probable		Barren
6/30/2020	B8	American Robin	*Turdus migratorius*	1	S5B,S5M	Observed		Barren
6/30/2020	B8	Common Redpoll	*Acanthis flammea*	2	S4	Observed	X	Barren
7/1/2020	SC7	Northern Waterthrush	*Parkesia noveboracensis*	1	S5B,S5M	Possible		Sparse Conifer
7/1/2020	SC7	Pine Grosbeak	*Pinicola enucleator*	1	S5	Possible		Sparse Conifer
7/1/2020	SC7	Dark-eyed Junco	*Junco hyemalis*	1	S5B,S5M	Possible		Sparse Conifer
7/1/2020	SC7	Yellow-rumped Warbler	*Setophaga coronata*	1	S5B,S5M	Possible		Sparse Conifer
7/1/2020	W1	American Robin	*Turdus migratorius*	1	S5B,S5M	Possible	X	Wetland
7/1/2020	W1	Fox Sparrow	*Passerella iliaca*	1	S5B,S5M	Possible		Wetland
7/1/2020	W1	Ruby-crowned Kinglet	*Regulus calendula*	1	S5B,S5M	Possible		Wetland
7/1/2020	W1	Dark-eyed Junco	*Junco hyemalis*	1	S5B,S5M	Possible		Wetland
7/1/2020	W1	Yellow-rumped Warbler	*Setophaga coronata*	1	S5B,S5M	Possible		Wetland
7/1/2020	W1	White-crowned Sparrow	*Zonotrichia leucophrys*	1	S5B,S5M	Observed		Wetland
7/1/2020	SC5	Canada Jay	*Perisoreus canadensis*	1	S5	-	X	Sparse Conifer
7/1/2020	SC5	American Robin	*Turdus migratorius*	1	S5B,S5M	Possible		Sparse Conifer
7/1/2020	SC5	Fox Sparrow	*Passerella iliaca*	1	S5B,S5M	Possible		Sparse Conifer
7/1/2020	SC5	Ruby-crowned Kinglet	*Regulus calendula*	1	S5B,S5M	Possible		Sparse Conifer
7/1/2020	SC5	Wilson's Warbler	*Cardellina pusilla*	1	S5B,S5M	Possible	X	Sparse Conifer
7/1/2020	SC5	Yellow-rumped Warbler	*Setophaga coronata*	1	S5B,S5M	Possible		Sparse Conifer
7/1/2020	SC4	American Robin	*Turdus migratorius*	1	S5B,S5M	Possible	X	Sparse Conifer

Appendix A.1 Breeding Bird Survey Data

Date	Site ID	Species Name	Scientific Name	Count	ACCDC S-Rank	Breeding Evidance	Incidental	Habitat
7/1/2020	SC4	Fox Sparrow	*Passerella iliaca*	1	S5B,S5M	Possible	X	Sparse Conifer
7/1/2020	SC4	Lincoln's Sparrow	*Melospiza lincolnii*	1	S5B,S5M	Possible		Sparse Conifer
7/1/2020	SC4	Ruby-crowned Kinglet	*Regulus calendula*	1	S5B,S5M	Possible		Sparse Conifer
7/1/2020	SC4	Ruby-crowned Kinglet	*Regulus calendula*	1	S5B,S5M	Possible		Sparse Conifer
7/1/2020	SC4	Dark-eyed Junco	*Junco hyemalis*	1	S5B,S5M	Possible		Sparse Conifer
7/1/2020	SC4	Yellow-rumped Warbler	*Setophaga coronata*	1	S5B,S5M	Possible		Sparse Conifer
7/1/2020	SC6	Fox Sparrow	*Passerella iliaca*	1	S5B,S5M	-		Sparse Conifer
7/1/2020	SC6	American Tree Sparrow	*Spizella arborea*	1	S4B,SUM	Possible		Sparse Conifer
7/1/2020	SC6	Yellow-rumped Warbler	*Setophaga coronata*	1	S5B,S5M	Possible		Sparse Conifer
7/1/2020	SC6	Pine Grosbeak	*Pinicola enucleator*	1	S5	Possible		Sparse Conifer
7/1/2020	SC6	American Robin	*Turdus migratorius*	1	S5B,S5M	Observed		Sparse Conifer
7/1/2020	SC6	Common Redpoll	*Acanthis flammea*	2	S4	Observed	X	Sparse Conifer
7/1/2020	SC6	Common Redpoll	*Acanthis flammea*		S4	Observed	X	Sparse Conifer
7/1/2020	SC6	Osprey	*Pandion haliaetus*	1	S4B,SUM	Observed	X	Sparse Conifer
7/1/2020	W3	Rusty Blackbird	*Euphagus carolinus*	1	S3B,SUM	Possible		Wetland
7/1/2020	W3	Fox Sparrow	*Passerella iliaca*	1	S5B,S5M	Possible	X	Wetland
7/1/2020	W3	White-crowned Sparrow	*Zonotrichia leucophrys*	1	S5B,S5M	Possible		Wetland
7/1/2020	W3	American Robin	*Turdus migratorius*	1	S5B,S5M	Observed	X	Wetland
7/1/2020	W2	Canada Jay	*Perisoreus canadensis*	1	S5	-		Wetland
7/1/2020	W2	Blackpoll Warbler	*Setophaga striata*	1	S5B,S5M	Possible		Wetland
7/1/2020	W2	Fox Sparrow	*Passerella iliaca*	1	S5B,S5M	Possible		Wetland
7/1/2020	W2	Yellow-rumped Warbler	*Setophaga coronata*	1	S5B,S5M	Possible		Wetland
7/1/2020	W4	Common Redpoll	*Acanthis flammea*	1	S4	Possible		Wetland
7/1/2020	W4	Blackpoll Warbler	*Setophaga striata*	1	S5B,S5M	Possible		Wetland
7/1/2020	W4	Ruby-crowned Kinglet	*Regulus calendula*	1	S5B,S5M	Possible		Wetland
7/2/2020	SC1	American Robin	*Turdus migratorius*	1	S5B,S5M	Possible		Sparse Conifer
7/2/2020	SC1	Common Redpoll	*Acanthis flammea*	1	S4	Possible	X	Sparse Conifer
7/2/2020	SC1	American Robin	*Turdus migratorius*	1	S5B,S5M	Possible		Sparse Conifer
7/2/2020	SC1	American Robin	*Turdus migratorius*	1	S5B,S5M	Possible	X	Sparse Conifer
7/2/2020	SC1	Fox Sparrow	*Passerella iliaca*	1	S5B,S5M	Possible	X	Sparse Conifer
7/2/2020	SC1	Ruby-crowned Kinglet	*Regulus calendula*	1	S5B,S5M	Possible		Sparse Conifer
7/2/2020	SC1	Dark-eyed Junco	*Junco hyemalis*	1	S5B,S5M	Possible		Sparse Conifer
7/2/2020	SC1	Pine Grosbeak	*Pinicola enucleator*	3	S5	Observed		Sparse Conifer
7/2/2020	B7	Canada Jay	*Perisoreus canadensis*	3	S5	-		Barren
7/2/2020	B7	American Robin	*Turdus migratorius*	2	S5B,S5M	Observed	X	Barren
7/2/2020	B7	Common Redpoll	*Acanthis flammea*	1	S4	Observed	X	Barren
7/2/2020	B7	Pine Grosbeak	*Pinicola enucleator*	1	S5	Observed	X	Barren
7/2/2020	B7	White-crowned Sparrow	*Zonotrichia leucophrys*	1	S5B,S5M	Observed		Barren
7/2/2020	B2	Common Redpoll	*Acanthis flammea*	2	S4	Observed	X	Barren
7/2/2020	B9	American Robin	*Turdus migratorius*	2	S5B,S5M	Observed	X	Barren
7/2/2020	SC2	Pine Grosbeak	*Pinicola enucleator*	1	S5	Possible		Sparse Conifer
7/2/2020	SC2	American Robin	*Turdus migratorius*	1	S5B,S5M	Possible		Sparse Conifer
7/2/2020	SC2	American Tree Sparrow	*Spizella arborea*	1	S4B,SUM	Possible		Sparse Conifer
7/2/2020	SC2	Boreal Chickadee	*Poecile hudsonicus*	1	S4	Possible		Sparse Conifer
7/2/2020	SC2	Blackpoll Warbler	*Setophaga striata*	1	S5B,S5M	Possible		Sparse Conifer
7/2/2020	SC2	Dark-eyed Junco	*Junco hyemalis*	1	S5B,S5M	Possible		Sparse Conifer
7/2/2020	SC2	Wilson's Warbler	*Cardellina pusilla*	1	S5B,S5M	Possible		Sparse Conifer
7/2/2020	SC2	Yellow-rumped Warbler	*Setophaga coronata*	1	S5B,S5M	Possible		Sparse Conifer
7/2/2020	B3	American Robin	*Turdus migratorius*	1	S5B,S5M	Possible	X	Barren
7/2/2020	B3	American Robin	*Turdus migratorius*	1	S5B,S5M	Observed		Barren
7/2/2020	SC3	Pine Grosbeak	*Pinicola enucleator*	1	S5	Possible		Sparse Conifer
7/2/2020	SC3	Boreal Chickadee	*Poecile hudsonicus*	1	S4	Possible		Sparse Conifer
7/2/2020	SC3	Blackpoll Warbler	*Setophaga striata*	1	S5B,S5M	Possible		Sparse Conifer
7/2/2020	SC3	Dark-eyed Junco	*Junco hyemalis*	1	S5B,S5M	Possible		Sparse Conifer
7/2/2020	SC3	Wilson's Warbler	*Cardellina pusilla*	1	S5B,S5M	Possible		Sparse Conifer
7/2/2020	SC3	Common Redpoll	*Acanthis flammea*	1	S4	Observed	X	Sparse Conifer
7/2/2020	B1	White-crowned Sparrow	*Zonotrichia leucophrys*	1	S5B,S5M	Possible		Barren
7/2/2020	B1	American Pipit	*Anthus rubescens*	2	S5B,S5M	Observed		Barren
7/2/2020	B8	White-crowned Sparrow	*Zonotrichia leucophrys*	1	S5B,S5M	Possible		Barren

Appendix A.2 Migratory Landbird Survey Data

Date	Site ID	Species Name	Scientific Name	Number Observed	ACCDC S-Rank	Flight Height	Direction of travel	Incidental
8/4/2020	SC8	Common Redpoll	*Acanthis flammea*	3	S4	0-60	SW	
8/4/2020	SC12	American Robin	*Turdus migratorius*	1	S5B,S5M	0-60	SW	
8/4/2020	SC12	American Tree Sparrow	*Spizella arborea*	1	S4B,SUM	N/A	-	
8/4/2020	SC12	White-crowned Sparrow	*Zonotrichia leucophrys*	1	S5B,S5M	N/A	-	
8/4/2020	B6	American Robin	*Turdus migratorius*	1	S5B,S5M	N/A	-	
8/4/2020	B6	American Robin	*Turdus migratorius*	1	S5B,S5M	0-60	-	
8/4/2020	B6	White-crowned Sparrow	*Zonotrichia leucophrys*	1	S5B,S5M	N/A	-	
8/4/2020	B6	White-crowned Sparrow	*Zonotrichia leucophrys*	1	S5B,S5M	N/A	-	
8/4/2020	SC9	American Three-toed Woodpecker	*Picoides dorsalis*	1	S5	N/A	-	
8/4/2020	SC9	Gray-cheeked Thrush	*Catharus minimus*	1	S4B,SUM	N/A	-	
8/4/2020	SC10	Spruce Grouse	*Falcipennis canadensis*	4	S5	N/A	-	
8/4/2020	SC13	American Robin	*Turdus migratorius*	1	S5B,S5M	0-60	SE	
8/4/2020	SC13	Fox Sparrow	*Passerella iliaca*	1	S5B,S5M	0-60	S	
8/4/2020	SC13	Dark-eyed Junco	*Junco hyemalis*	5	S5B,S5M	0-60	E	
8/4/2020	B4	American Robin	*Turdus migratorius*	1	S5B,S5M	0-60	SW	
8/4/2020	B4	White-crowned Sparrow	*Zonotrichia leucophrys*	1	S5B,S5M	N/A	-	
8/4/2020	SC11	American Robin	*Turdus migratorius*	1	S5B,S5M	N/A	-	
8/4/2020	SC11	Dark-eyed Junco	*Junco hyemalis*	1	S5B,S5M	N/A	-	
8/4/2020	B5	Common Redpoll	*Acanthis flammea*	2	S4	0-60	-	
8/4/2020	B5	White-crowned Sparrow	*Zonotrichia leucophrys*	1	S5B,S5M	N/A	-	
8/5/2020	SC1	Dark-eyed Junco	*Junco hyemalis*	1	S5B,S5M	0-60	W	
8/5/2020	SC1	Dark-eyed Junco	*Junco hyemalis*	1	S5B,S5M	N/A	-	
8/5/2020	SC1	White-crowned Sparrow	*Zonotrichia leucophrys*	1	S5B,S5M	N/A	-	
8/5/2020	B7	White-crowned Sparrow	*Zonotrichia leucophrys*	1	S5B,S5M	N/A	-	
8/5/2020	B7	White-crowned Sparrow	*Zonotrichia leucophrys*	1	S5B,S5M	N/A	-	
8/5/2020	B2	White-crowned Sparrow	*Zonotrichia leucophrys*	1	S5B,S5M	N/A	-	
8/5/2020	B2	White-crowned Sparrow	*Zonotrichia leucophrys*	1	S5B,S5M	N/A	-	
8/5/2020	B9	Common Redpoll	*Acanthis flammea*	4	S4	60-140	NW	
8/5/2020	B9	White-crowned Sparrow	*Zonotrichia leucophrys*	1	S5B,S5M	0-60	Variable	
8/5/2020	SC2	Boreal Chickadee	*Poecile hudsonicus*	1	S4	N/A	Local movements	
8/5/2020	SC2	Dark-eyed Junco	*Junco hyemalis*	1	S5B,S5M	0-60	NW	
8/5/2020	SC2	Dark-eyed Junco	*Junco hyemalis*	1	S5B,S5M	N/A	-	
8/5/2020	SC2	White-winged Crossbill	*Loxia leucoptera*		S5	N/A	-	
8/5/2020	B8	White-crowned Sparrow	*Zonotrichia leucophrys*	1	S5B,S5M	0-60	W	
8/5/2020	B8	White-crowned Sparrow	*Zonotrichia leucophrys*	1	S5B,S5M	0-60	E	
8/5/2020	B1	White-crowned Sparrow	*Zonotrichia leucophrys*	1	S5B,S5M	N/A	-	
8/6/2020	SC7	American Robin	*Turdus migratorius*	1	S5B,S5M	N/A	-	
8/6/2020	SC7	Boreal Chickadee	*Poecile hudsonicus*	1	S4	N/A	-	
8/6/2020	SC7	Common Redpoll	*Acanthis flammea*	1	S4	0-60	S	
8/6/2020	SC7	Dark-eyed Junco	*Junco hyemalis*	1	S5B,S5M	N/A	-	
8/6/2020	W1	Canada Jay	Perisoreus canadensis	1	S5	N/A	-	
8/6/2020	W1	Common Redpoll	*Acanthis flammea*	2	S4	N/A	-	
8/6/2020	W1	Common Redpoll	*Acanthis flammea*	4	S4	0-60	E	
8/6/2020	W1	Dark-eyed Junco	*Junco hyemalis*	1	S5B,S5M	N/A	-	
8/6/2020	SC5	Blackpoll Warbler	*Setophaga striata*	2	S5B,S5M	0-60	SW	
8/6/2020	SC5	Canada Jay	Perisoreus canadensis	1	S5	N/A	-	
8/6/2020	SC5	Canada Jay	Perisoreus canadensis	1	S5	N/A	-	
8/6/2020	SC5	White-crowned Sparrow	*Zonotrichia leucophrys*	1	S5B,S5M	N/A	-	
8/6/2020	SC5	Common Redpoll	*Acanthis flammea*	2	S4	0-60	-	
8/6/2020	SC4	Canada Jay	Perisoreus canadensis	1	S5	0-60	SE	
8/6/2020	SC4	Ruby-crowned Kinglet	*Regulus calendula*	1	S5B,S5M	N/A	-	
8/6/2020	SC4	Dark-eyed Junco	*Junco hyemalis*	2	S5B,S5M	N/A	-	
8/6/2020	SC4	Yellow-rumped Warbler	*Setophaga coronata*	1	S5B,S5M	N/A	-	
8/6/2020	SC6	Blackpoll Warbler	*Setophaga striata*	1	S5B,S5M	N/A	-	
8/6/2020	SC6	Pine Siskin	*Spinus pinus*	25	S4B,SUM	0-60	-	
8/6/2020	SC6	Dark-eyed Junco	*Junco hyemalis*	1	S5B,S5M	N/A	-	
8/6/2020	W3	Boreal Chickadee	*Poecile hudsonicus*	2	S4	N/A	-	
8/6/2020	W3	Lincoln's Sparrow	*Melospiza lincolnii*	1	S5B,S5M	N/A	-	
8/6/2020	W3	Dark-eyed Junco	*Junco hyemalis*	1	S5B,S5M	N/A	-	
8/6/2020	W3	White-crowned Sparrow	*Zonotrichia leucophrys*	1	S5B,S5M	N/A	-	
8/6/2020	W2	Canada Jay	Perisoreus canadensis	1	S5	N/A	-	
8/6/2020	W2	Dark-eyed Junco	*Junco hyemalis*	1	S5B,S5M	N/A	-	
8/6/2020	W4	Boreal Chickadee	*Poecile hudsonicus*	1	S4	N/A	-	
8/6/2020	W4	Canada Jay	Perisoreus canadensis	1	S5	N/A	-	
8/6/2020	W4	Pine Grosbeak	*Pinicola enucleator*	1	S5	N/A	-	
8/6/2020	W4	Yellow-rumped Warbler	*Setophaga coronata*	1	S5B,S5M	N/A	-	
8/15/2020	SC8	Common Redpoll	*Acanthis flammea*	2	S4	60-140	SE	
8/15/2020	SC8	Common Redpoll	*Acanthis flammea*	1	S4	0-60	E	
8/15/2020	SC8	Dark-eyed Junco	*Junco hyemalis*	1	S5B,S5M	N/A	-	
8/15/2020	SC8	Unidentified shorebird		1		N/A	-	
8/15/2020	SC8	White-crowned Sparrow	*Zonotrichia leucophrys*	1	S5B,S5M	N/A	-	
8/15/2020	SC9	Canada Jay	Perisoreus canadensis	1	S5	N/A	-	
8/15/2020	SC9	Dark-eyed Junco	*Junco hyemalis*	1	S5B,S5M	N/A	-	
8/15/2020	SC9	Spotted Sandpiper	*Actitis macularius*	1	S4B,SUM	N/A	-	
8/15/2020	SC9	Unidentified thrush		1		0-60	S	
8/15/2020	SC10	Boreal Chickadee	*Poecile hudsonicus*	1	S4	N/A	-	
8/15/2020	SC10	Ruby-crowned Kinglet	*Regulus calendula*	1	S5B,S5M	N/A	-	
8/15/2020	SC10	Dark-eyed Junco	*Junco hyemalis*	1	S5B,S5M	N/A	E	
8/15/2020	SC10	White-crowned Sparrow	*Zonotrichia leucophrys*	1	S5B,S5M	N/A	-	
8/15/2020	SC13	Boreal Chickadee	*Poecile hudsonicus*	2	S4	N/A	-	
8/15/2020	SC13	Canada Jay	Perisoreus canadensis	1	S5	N/A	-	
8/15/2020	SC13	Pine Grosbeak	*Pinicola enucleator*	1	S5	N/A	-	
8/15/2020	SC13	Dark-eyed Junco	*Junco hyemalis*	4	S5B,S5M	N/A	Local movements	
8/15/2020	B4	American Robin	*Turdus migratorius*	1	S5B,S5M	N/A	-	
8/15/2020	B4	White-crowned Sparrow	*Zonotrichia leucophrys*	1	S5B,S5M	N/A	-	
8/15/2020	SC11	Common Redpoll	*Acanthis flammea*	1	S4	0-60	Unknown	
8/16/2020	B7	Common Redpoll	*Acanthis flammea*	2	S4	0-60	W	
8/16/2020	B7	Dark-eyed Junco	*Junco hyemalis*		S5B,S5M	N/A	Unknown	
8/16/2020	B7	White-crowned Sparrow	*Zonotrichia leucophrys*	1	S5B,S5M	N/A	-	
8/16/2020	SC1	Common Redpoll	*Acanthis flammea*	3	S4	0-60	W	
8/16/2020	SC1	White-winged Crossbill	*Loxia leucoptera*	2	S5	N/A	-	
8/16/2020	SC1	Yellow-rumped Warbler	*Setophaga coronata*	1	S5B,S5M	N/A	-	
8/16/2020	B2	American Pipit	*Anthus rubescens*	8	S5B,S5M	0-60	W	
8/16/2020	B2	Common Redpoll	*Acanthis flammea*	3	S4	0-60	SE	
8/16/2020	B2	White-crowned Sparrow	*Zonotrichia leucophrys*	1	S5B,S5M	N/A	-	
8/16/2020	B9	Canada Jay	Perisoreus canadensis	1	S5	N/A	-	
8/16/2020	B3	White-crowned Sparrow	*Zonotrichia leucophrys*	1	S5B,S5M	N/A	-	
8/16/2020	B8	Unidentified sparrow		1		N/A	-	
8/16/2020	B1	White-crowned Sparrow	*Zonotrichia leucophrys*	18	S5B,S5M	N/A	S	
8/17/2020	SC7	American Robin	*Turdus migratorius*	1	S5B,S5M	N/A	-	
8/17/2020	SC7	Boreal Chickadee	*Poecile hudsonicus*	1	S4	N/A	-	
8/17/2020	SC7	Canada Jay	Perisoreus canadensis	1	S5	N/A	-	
8/17/2020	SC7	Common Redpoll	*Acanthis flammea*	1	S4	0-60	Unknown	
8/17/2020	SC7	Fox Sparrow	*Passerella iliaca*	1	S5B,S5M	N/A	-	
8/17/2020	W1	Canada Jay	Perisoreus canadensis	1	S5	N/A	-	
8/17/2020	W1	Common Redpoll	*Acanthis flammea*	2	S4	0-60	Unknown	
8/17/2020	W1	Pine Grosbeak	*Pinicola enucleator*	1	S5	N/A	-	
8/17/2020	W1	Ruby-crowned Kinglet	*Regulus calendula*	1	S5B,S5M	N/A	-	
8/17/2020	SC4	American Robin	*Turdus migratorius*	1	S5B,S5M	N/A	Variable	
8/17/2020	SC4	Canada Jay	Perisoreus canadensis	1	S5	N/A	-	

Appendix A.2 Migratory Landbird Survey Data

Date	Site ID	Species Name	Scientific Name	Number Observed	ACCDC S-Rank	Flight Height	Direction of travel	Incidental
8/17/2020	SC4	Common Redpoll	*Acanthis flammea*	2	S4	0-60	E	
8/17/2020	SC6	Boreal Chickadee	*Poecile hudsonicus*	2	S4	N/A	-	
8/17/2020	SC6	Pine Grosbeak	*Pinicola enucleator*	1	S5	N/A	-	
8/17/2020	W3	Boreal Chickadee	*Poecile hudsonicus*		S4	N/A	-	
8/17/2020	W3	Canada Jay	Perisoreus canadensis	2	S5	N/A	-	
8/17/2020	W3	Common Raven	*Corvus corax*	1	S5	0-60	Variable	
8/17/2020	W3	Rusty Blackbird	*Euphagus carolinus*	1	S3B,SUM	N/A	NW	
8/17/2020	W4	Canada Jay	Perisoreus canadensis	1	S5	N/A	-	
8/17/2020	W4	Pine Grosbeak	*Pinicola enucleator*	1	S5	N/A	-	
8/18/2020	SC5	American Robin	*Turdus migratorius*	1	S5B,S5M	N/A	-	
8/18/2020	SC5	Canada Jay	Perisoreus canadensis	1	S5	N/A	-	
8/18/2020	SC5	Common Raven	*Corvus corax*	1	S5	N/A	-	
8/18/2020	SC5	Pine Grosbeak	*Pinicola enucleator*	2	S5	N/A	-	
8/18/2020	SC5	White-winged Crossbill	*Loxia leucoptera*	4	S5	N/A	-	
8/18/2020	W2	Boreal Chickadee	*Poecile hudsonicus*	3	S4	N/A	-	
8/18/2020	W2	Canada Jay	Perisoreus canadensis	1	S5	N/A	-	
8/18/2020	W2	Fox Sparrow	*Passerella iliaca*	1	S5B,S5M	N/A	-	
9/4/2020	SC8	American Robin	*Turdus migratorius*	1	S5B,S5M	N/A	-	
9/4/2020	SC8	Boreal Chickadee	*Poecile hudsonicus*		S4	N/A	-	
9/4/2020	SC8	Pine Grosbeak	*Pinicola enucleator*	1	S5	0-60	S	
9/4/2020	SC8	Dark-eyed Junco	*Junco hyemalis*	1	S5B,S5M	N/A	-	
9/4/2020	SC12	White-winged Crossbill	*Loxia leucoptera*	1	S5	N/A	-	
9/4/2020	B6	Common Raven	*Corvus corax*	1	S5	N/A	-	
9/4/2020	B6	Common Raven	*Corvus corax*	1	S5	N/A	Unknown	
9/4/2020	B6	Common Redpoll	*Acanthis flammea*		S4	0-60	Unknown	
9/4/2020	SC9	Canada Jay	Perisoreus canadensis	1	S5	N/A	-	
9/4/2020	SC9	Canada Jay	Perisoreus canadensis	1	S5	N/A	-	
9/4/2020	SC9	Dark-eyed Junco	*Junco hyemalis*	1	S5B,S5M	N/A	-	
9/4/2020	SC10	Boreal Chickadee	*Poecile hudsonicus*	3	S4	N/A	-	
9/4/2020	SC10	White-crowned Sparrow	*Zonotrichia leucophrys*	1	S5B,S5M	N/A	-	
9/4/2020	SC13	Boreal Chickadee	*Poecile hudsonicus*	4	S4	N/A	-	
9/4/2020	B4	Common Redpoll	*Acanthis flammea*	1	S4	140-200	Unknown	
9/4/2020	SC11	Common Redpoll	*Acanthis flammea*	4	S4	0-60	E	
9/5/2020	SC7	Canada Jay	Perisoreus canadensis	1	S5	N/A	-	
9/5/2020	SC7	Ruby-crowned Kinglet	*Regulus calendula*	1	S5B,S5M	N/A	-	
9/5/2020	W1	Canada Jay	Perisoreus canadensis	1	S5	N/A	-	
9/5/2020	W1	Canada Jay	Perisoreus canadensis	1	S5	N/A	-	
9/5/2020	W1	Dark-eyed Junco	*Junco hyemalis*	1	S5B,S5M	N/A	-	
9/5/2020	SC5	Boreal Chickadee	*Poecile hudsonicus*	1	S4	N/A	-	
9/5/2020	SC5	Canada Jay	Perisoreus canadensis	1	S5	N/A	-	
9/5/2020	SC4	American Robin	*Turdus migratorius*	1	S5B,S5M	N/A	-	
9/5/2020	SC4	Boreal Chickadee	*Poecile hudsonicus*	1	S4	N/A	-	
9/5/2020	SC4	Dark-eyed Junco	*Junco hyemalis*	1	S5B,S5M	N/A	-	
9/5/2020	W3	Boreal Chickadee	*Poecile hudsonicus*	3	S4	N/A	Local movements	
9/5/2020	W3	Common Redpoll	*Acanthis flammea*	1	S4	0-60	W	
9/5/2020	W2	Canada Jay	Perisoreus canadensis	2	S5	N/A	-	
9/5/2020	W2	Yellow-bellied Flycatcher	*Empidonax flaviventris*	1	S5B,S5M	N/A	-	
9/5/2020	W4	Canada Jay	Perisoreus canadensis	2	S5	N/A	-	
9/5/2020	W4	Dark-eyed Junco	*Junco hyemalis*	1	S5B,S5M	N/A	-	
9/5/2020	W4	White-crowned Sparrow	*Zonotrichia leucophrys*	1	S5B,S5M	N/A	-	
9/6/2020	SC8	Boreal Chickadee	*Poecile hudsonicus*	2	S4	N/A	-	
9/6/2020	SC8	Dark-eyed Junco	*Junco hyemalis*	1	S5B,S5M	N/A	-	
9/6/2020	SC12	Boreal Chickadee	*Poecile hudsonicus*	1	S4	N/A	-	
9/6/2020	SC9	Boreal Chickadee	*Poecile hudsonicus*	1	S4	N/A	-	
9/6/2020	SC9	Boreal Chickadee	*Poecile hudsonicus*	1	S4	N/A	-	
9/6/2020	SC9	Dark-eyed Junco	*Junco hyemalis*	1	S5B,S5M	N/A	-	
9/6/2020	SC10	Canada Jay	Perisoreus canadensis	1	S5	N/A	-	
9/6/2020	SC13	American Three-toed Woodpecker	*Picoides dorsalis*	1	S5	N/A	-	
9/6/2020	SC13	Fox Sparrow	*Passerella iliaca*	1	S5B,S5M	N/A	-	
9/6/2020	B5	White-crowned Sparrow	*Zonotrichia leucophrys*	2	S5B,S5M	N/A	-	
9/7/2020	SC1	Common Redpoll	*Acanthis flammea*	1	S4	0-60	N	
9/7/2020	SC1	Dark-eyed Junco	*Junco hyemalis*	1	S5B,S5M	N/A	-	
9/7/2020	SC1	Dark-eyed Junco	*Junco hyemalis*	1	S5B,S5M	0-60	Unknown	
9/7/2020	B7	Horned Lark	*Eremophila alpestris*	3	S4B,SUM	60-140	W	
9/7/2020	B2	American Pipit	*Anthus rubescens*	4	S5B,S5M	0-60	W	
9/7/2020	B2	Common Loon	*Gavia immer*	1	S5B,S5M	N/A	Unknown	
9/7/2020	B2	Horned Lark	*Eremophila alpestris*	2	S4B,SUM	0-60	SW	
9/7/2020	B9	Boreal Chickadee	*Poecile hudsonicus*	1	S4	N/A	Local movements	
9/7/2020	B9	Canada Jay	Perisoreus canadensis	1	S5	N/A	-	
9/7/2020	B9	Spotted Sandpiper	*Actitis macularius*	1	S4B,SUM	N/A	-	
9/7/2020	B3	Boreal Chickadee	*Poecile hudsonicus*	1	S4	N/A	-	
9/7/2020	B3	Horned Lark	*Eremophila alpestris*	1	S4B,SUM	0-60	SW	
9/7/2020	SC3	Pine Grosbeak	*Pinicola enucleator*	1	S5	N/A	-	
9/7/2020	B8	White-crowned Sparrow	*Zonotrichia leucophrys*	1	S5B,S5M	N/A	-	
9/7/2020	B8	White-crowned Sparrow	*Zonotrichia leucophrys*	1	S5B,S5M	N/A	-	
9/7/2020	B8	White-crowned Sparrow	*Zonotrichia leucophrys*	2	S5B,S5M	N/A	-	
9/7/2020	B1	Common Redpoll	*Acanthis flammea*	3	S4	0-60	E	
9/8/2020	B7	Lapland Longspur	*Calcarius lapponicus*	5	S3B, S4M	0-60	Variable	
9/8/2020	B7	Snow Bunting	*Plectrophenax nivalis*	2	S4B, S5M	0-60	Variable	
9/8/2020	B7	Unidentified sparrow		1		N/A	-	
9/8/2020	SC1	Canada Jay	Perisoreus canadensis	1	S5	N/A	-	
9/8/2020	B9	American Pipit	*Anthus rubescens*	1	S5B,S5M	60-140	S	
9/8/2020	B9	White-crowned Sparrow	*Zonotrichia leucophrys*	1	S5B,S5M	N/A	-	
9/8/2020	SC2	Boreal Chickadee	*Poecile hudsonicus*	1	S4	N/A	-	
9/8/2020	SC2	Canada Jay	Perisoreus canadensis	1	S5	N/A	-	
9/8/2020	SC2	Dark-eyed Junco	*Junco hyemalis*	1	S5B,S5M	N/A	-	
9/8/2020	SC3	Canada Jay	Perisoreus canadensis	1	S5	N/A	-	
9/8/2020	SC3	Dark-eyed Junco	*Junco hyemalis*	2	S5B,S5M	N/A	-	
9/8/2020	B8	White-crowned Sparrow	*Zonotrichia leucophrys*	1	S5B,S5M	N/A	-	
9/9/2020	SC7	Canada Jay	Perisoreus canadensis	1	S5	N/A	-	
9/9/2020	W1	Canada Jay	Perisoreus canadensis	1	S5	N/A	-	
9/9/2020	W1	Canada Jay	Perisoreus canadensis	1	S5	N/A	-	
9/9/2020	SC5	Canada Jay	Perisoreus canadensis	1	S5	N/A	Local movements	
9/9/2020	SC4	Canada Jay	Perisoreus canadensis	1	S5	N/A	-	
9/9/2020	SC4	Canada Jay	Perisoreus canadensis	2	S5	N/A	-	
9/9/2020	SC4	Dark-eyed Junco	*Junco hyemalis*	2	S5B,S5M	N/A	-	
9/9/2020	SC4	White-crowned Sparrow	*Zonotrichia leucophrys*	1	S5B,S5M	N/A	-	
9/9/2020	SC6	American Three-toed Woodpecker	*Picoides dorsalis*	1	S5	N/A	-	
9/9/2020	SC6	Common Redpoll	*Acanthis flammea*	1	S4	0-60	Unknown	
9/9/2020	SC6	Dark-eyed Junco	*Junco hyemalis*	1	S5B,S5M	N/A	-	
9/9/2020	W3	Boreal Chickadee	*Poecile hudsonicus*	1	S4	N/A	-	
9/9/2020	W3	Canada Jay	Perisoreus canadensis	1	S5	N/A	-	
9/9/2020	W3	Dark-eyed Junco	*Junco hyemalis*	1	S5B,S5M	N/A	-	
9/9/2020	W2	Canada Jay	Perisoreus canadensis	2	S5	N/A	Local movements	
9/9/2020	W2	Dark-eyed Junco	*Junco hyemalis*	1	S5B,S5M	N/A	-	
9/9/2020	W2	White-crowned Sparrow	*Zonotrichia leucophrys*	1	S5B,S5M	N/A	-	
8/4/2020		Common Loon	*Gavia immer*	1	S5B,S5M	0-60	E	X
8/5/2020		Greater Yellowlegs	*Tringa melanoleuca*	1	S4B,SUM	N/A	-	X
8/5/2020		Dark-eyed Junco	*Junco hyemalis*	1	S5B,S5M	0-60	-	X
8/5/2020		Canada Jay	Perisoreus canadensis	1	S5	N/A	-	X

Appendix A.2 **Migratory Landbird Survey Data**

Date	Site ID	Species Name	Scientific Name	Number Observed	ACCDC S-Rank	Flight Height	Direction of travel	Incidental
8/5/2020		Unidentified sparrow		1		N/A	-	X
8/15/2020		Canada Jay	Perisoreus canadensis	1	S5	N/A	-	X
8/16/2020		American Tree Sparrow	*Spizella arborea*	1	S4B,SUM	N/A	-	X
8/16/2020		American Pipit	*Anthus rubescens*	2	S5B,S5M	60-140	S	X
9/4/2020		Common Redpoll	*Acanthis flammea*	3	S4	0-60	E	X
9/4/2020		Canada Jay	Perisoreus canadensis	1	S5	0-60	-	X
9/4/2020		Common Loon	*Gavia immer*	1	S5B,S5M	60-140	E	X
9/4/2020		American Three-toed Woodpecker	*Picoides dorsalis*	1	S5	N/A	-	X
9/4/2020		American Robin	*Turdus migratorius*	1	S5B,S5M	N/A	-	X
9/5/2020		Common Redpoll	*Acanthis flammea*	2	S4	0-60	W	X
9/5/2020		White-crowned Sparrow	*Zonotrichia leucophrys*	1	S5B,S5M	N/A	-	X
9/5/2020		Canada Jay	Perisoreus canadensis	1	S5	N/A	-	X
9/6/2020		Canada Jay	Perisoreus canadensis	1	S5	N/A	-	X
9/6/2020		Common Raven	*Corvus corax*	2	S5	140-200	Variable	X
9/6/2020		Common Raven	*Corvus corax*	1	S5	N/A	-	X
9/7/2020		White-crowned Sparrow	*Zonotrichia leucophrys*	1	S5B,S5M	N/A	-	X
9/7/2020		Common Loon	*Gavia immer*	1	S5B,S5M	N/A	-	X
9/9/2020		Boreal Chickadee	*Poecile hudsonicus*	2	S4	N/A	-	X
9/9/2020		American Robin	*Turdus migratorius*	1	S5B,S5M	N/A	-	X
9/9/2020		Common Raven	*Corvus corax*	1	S5	N/A	Unknown	X
9/9/2020		Common Redpoll	*Acanthis flammea*	4	S4	N/A	Variable	X

Appendix A.3 Raptor Migration Survey Data

Date	Site ID	Species Name	Scientific Name	Count	Flight Height	Direction of travel	ACCDC S-Rank
4-Aug-20	Raptor 1	Common Redpoll	*Acanthis flammea*	1	0-60	S	S4
4-Aug-20	Raptor 1	Common Redpoll	*Acanthis flammea*	3	0-60	SE	S4
4-Aug-20	Raptor 1	Dark-eyed Junco	*Junco hyemalis*	2	0-60	SW	S5B,S5M
4-Aug-20	Raptor 1	Unidentified	-	1	-	-	-
5-Aug-20	Raptor 2	American Robin	Turdus migratorius	1	-	-	S5B,S5M
5-Aug-20	Raptor 2	White-crowned Sparrow	*Zonotrichia leucophrys*	5	-	-	S5B,S5M
15-Aug-20	Raptor 1	Canada Jay	Perisoreus canadensis	1	-	-	S5
15-Aug-20	Raptor 1	Canada Jay	Perisoreus canadensis	3	-	-	S5
15-Aug-20	Raptor 1	Common Raven	*Corvus corax*	2	60-140	Var. departed E	S5
15-Aug-20	Raptor 1	Common Raven	*Corvus corax*	2	>200	various - dpearted to E (lost sight after 14:29).	S5
15-Aug-20	Raptor 1	Common Raven	*Corvus corax*	2	60-140	various	S5
15-Aug-20	Raptor 1	Common Redpoll	*Acanthis flammea*	3	60-140	NE	S4
15-Aug-20	Raptor 1	Golden Eagle	Aquila chrysaetos	1	0-60	unk	S2B,SUM
15-Aug-20	Raptor 1	White-crowned Sparrow	*Zonotrichia leucophrys*	1	-	-	S5B,S5M
16-Aug-20	Raptor 2	Common Redpoll	*Acanthis flammea*	5	0-60	various	S4
16-Aug-20	Raptor 2	Common Redpoll	*Acanthis flammea*	1	0-60	unk. SW-NE (or vice versa)	S4
16-Aug-20	Raptor 2	Dark-eyed Junco	*Junco hyemalis*	1	0-60	N	S5B,S5M
16-Aug-20	Raptor 2	White-crowned Sparrow	*Zonotrichia leucophrys*	1	0-60	E. Pitched on tock when spotted. Carried on.	S5B,S5M
16-Aug-20	Raptor 2	White-crowned Sparrow	*Zonotrichia leucophrys*	1	-	-	S5B,S5M
4-Sep-20	Raptor 1	Canada Jay	Perisoreus canadensis	1	0-60	S	S5
4-Sep-20	Raptor 1	Canada Jay	Perisoreus canadensis	3	0-60	SE	S5
4-Sep-20	Raptor 1	Common Raven	*Corvus corax*	1	60-140	N	S5
4-Sep-20	Raptor 1	Common Raven	*Corvus corax*	1	60-140	NE	S5
4-Sep-20	Raptor 1	Common Redpoll	*Acanthis flammea*	2	0-60	NE	S4
4-Sep-20	Raptor 1	Common Redpoll	*Acanthis flammea*	5	60-140	SW	S4
4-Sep-20	Raptor 1	Horned Lark	*Eremophila alpestris*	4	60-140	N	S4B,SUM
4-Sep-20	Raptor 1	Horned Lark	*Eremophila alpestris*	14	0-60	W	S4B,SUM
4-Sep-20	Raptor 1	Dark-eyed Junco	*Junco hyemalis*	1	-	-	S5B,S5M
6-Sep-20	Raptor 2	Common Goldeneye	Bucephala clangula	4	0-60	-	S5B,S5M
6-Sep-20	Raptor 2	Common Raven	*Corvus corax*	1	60-140	N	S5
6-Sep-20	Raptor 2	Common Raven	*Corvus corax*	2	140-200	Variable. Generally SE	S5
6-Sep-20	Raptor 2	Common Raven	*Corvus corax*	1	140-200	SW	S5
7-Sep-20	Raptor 2	American Pipit	*Anthus rubescens*	6	0-60	SE	S5B,S5M
7-Sep-20	Raptor 2	Common Goldeneye	Bucephala clangula	3	-	-	S5B,S5M
7-Sep-20	Raptor 2	Common Loon	*Gavia immer*	1	-	-	S5B,S5M
7-Sep-20	Raptor 2	Unidentified	-	2	0-60	SW	-
8-Sep-20	Raptor 1	American Pipit	*Anthus rubescens*	1	-	-	S5B,S5M
8-Sep-20	Raptor 2	Horned Lark	*Eremophila alpestris*	2	-	-	S4B,SUM

Appendix A.4 Waterfowl Migration Survey Data

Date	Species Name	Scientific Name	Number Observed	Flight Height	Direction of travel	ACCDC S-Rank
6-Aug-20	American Black Duck	*Anas rubripes*	8	N/A	-	S5B,S5M
6-Aug-20	Common Redpoll	*Acanthis flammea*	3	0-60	S	S4
6-Aug-20	Merlin	*Falco columbarius*	1	0-60	Local Movements	S5B,S5M
6-Aug-20	Osprey	*Pandion haliaetus*	1	N/A	Unknown	S4B,SUM
6-Aug-20	Rusty Blackbird	*Euphagus carolinus*	2	N/A	Local Movements	S3B,SUM
18-Aug-20	Horned Lark	*Eremophila alpestris*	3	0-60	SW	S4B,SUM
18-Aug-20	Red-necked phalarope	*Phalaropus lobatus*	1	N/A	-	SNA
18-Aug-20	Spotted Sandpiper	*Actitis macularius*	1	N/A	-	S4B,SUM
18-Aug-20	Spotted Sandpiper	*Actitis macularius*	1	0-60	W	S4B,SUM
5-Sep-20	Canada Goose	*Branta canadensis*	31	N/A	-	S5B,SUN,S5M
5-Sep-20	Common Redpoll	*Acanthis flammea*	5	60-140	SW	S4
9-Sep-20	Canada Goose	*Branta canadensis*	19	N/A	-	S5B,SUN,S5M
9-Sep-20	Canada Goose	*Branta canadensis*	6	0-60	N	S5B,SUN,S5M
9-Sep-20	Canada Goose	*Branta canadensis*	19	0-60	N	S5B,SUN,S5M
9-Sep-20	Horned Lark	*Eremophila alpestris*	5	0-60	SW	S4B,SUM

APPENDIX B

Maritime Breeding Bird Atlas: Breeding Evidence Codes

Appendix B MARITIME BREEDING BIRD ATLAS: BREEDING EVIDENCE CODES

OBSERVED

X Species observed in its breeding season (no breeding evidence)

POSSIBLE

H Species observed in its breeding season in suitable nesting habitat

S Singing male(s) present, or breeding calls heard, in suitable nesting habitat in breeding season

PROBABLE

P Pair observed in suitable nesting habitat in nesting season

T Permanent territory presumed through registration of territorial song, or the occurrence of an adult bird, at the same place, in breeding habitat, on at least two days a week or more apart, during its breeding season. Use discretion when using this code. "T" is not to be used for colonial birds, or species that might forage or loaf a long distance from their nesting site e.g., Kingfisher, Turkey Vulture, and male waterfowl

D Courtship or display, including interaction between a male and a female or two males, including courtship feeding or copulation

V Visiting probable nest site

A Agitated behaviour or anxiety calls of an adult

B Brood Patch on adult female or cloacal protuberance on adult male

N Nest-building or excavation of nest hole by wrens and woodpeckers

CONFIRMED

NB Nest building or carrying nest materials, for all species except wrens and woodpeckers

DD Distraction display or injury feigning

NU Used nest or egg shells found (occupied or laid within the period of the survey)

FY Recently fledged young (nidicolous species) or downy young (nidifugous species), including incapable of sustained flight

AE Adult leaving or entering nest sites in circumstances indicating occupied nest

FS Adult carying fecal sac

CF Adult carying food for young

NE Nest containing eggs

NY Nest with young seen or heard

Source: https://www.mba-aom.ca/jsp/codes.jsp?lang=en&pg=breeding

APPENDIX C

Acoustic Results by Species: Vocalizations by Time of Day and Date

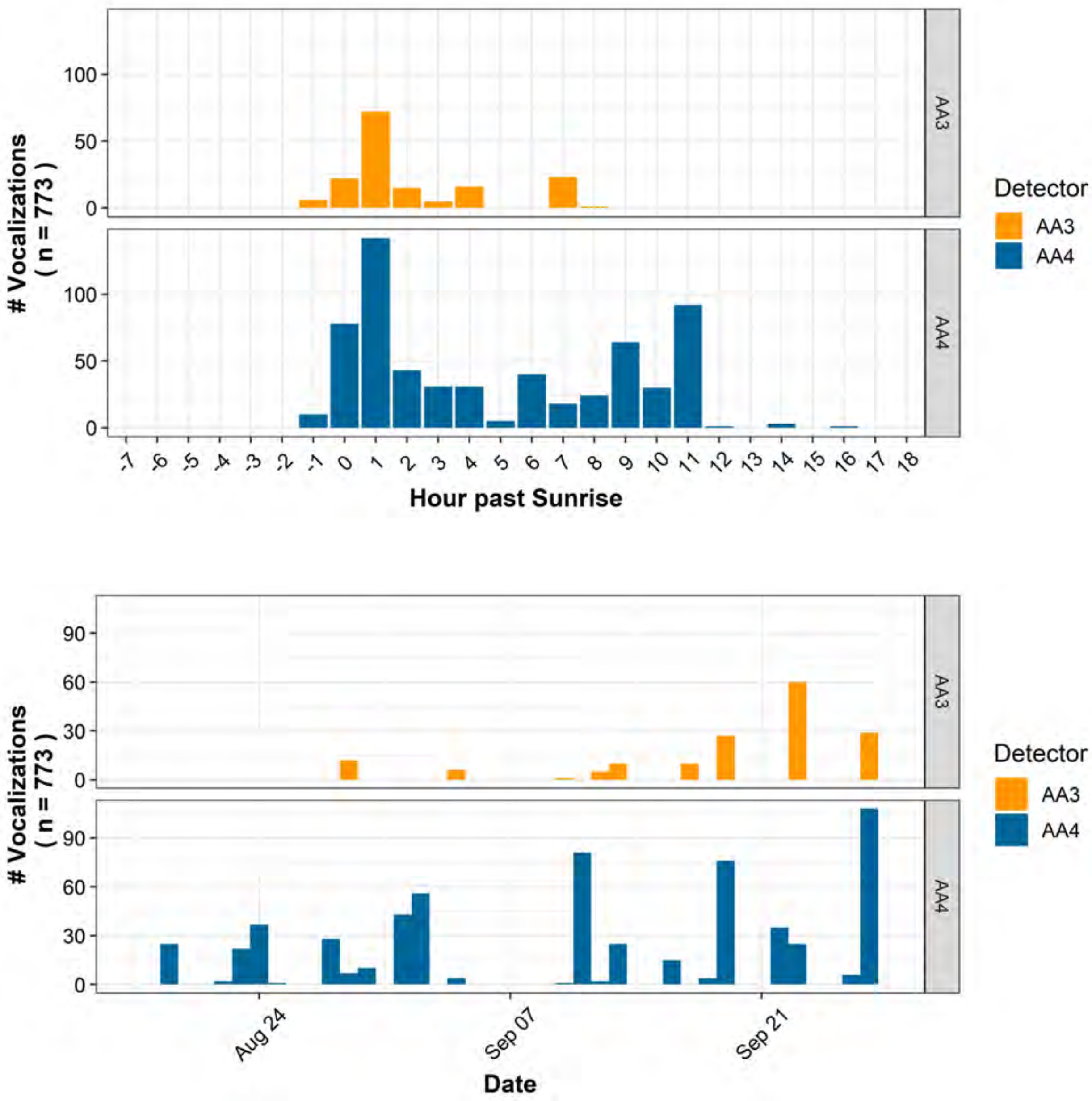


Figure C-1 American Robin – Acoustic Results by Time of Day and Date

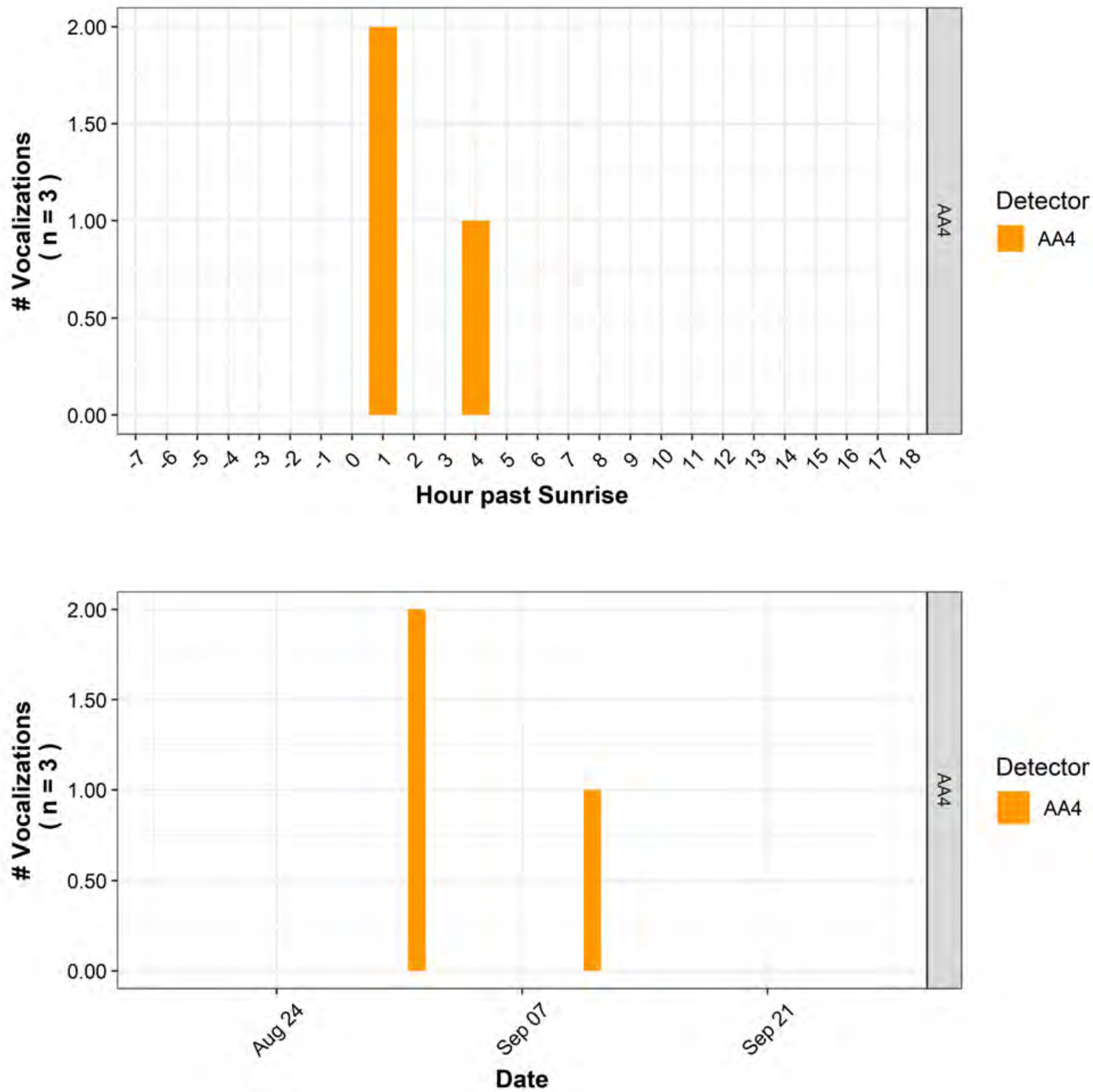


Figure C-2 American Tree Sparrow – Acoustic Results by Time of Day and Date

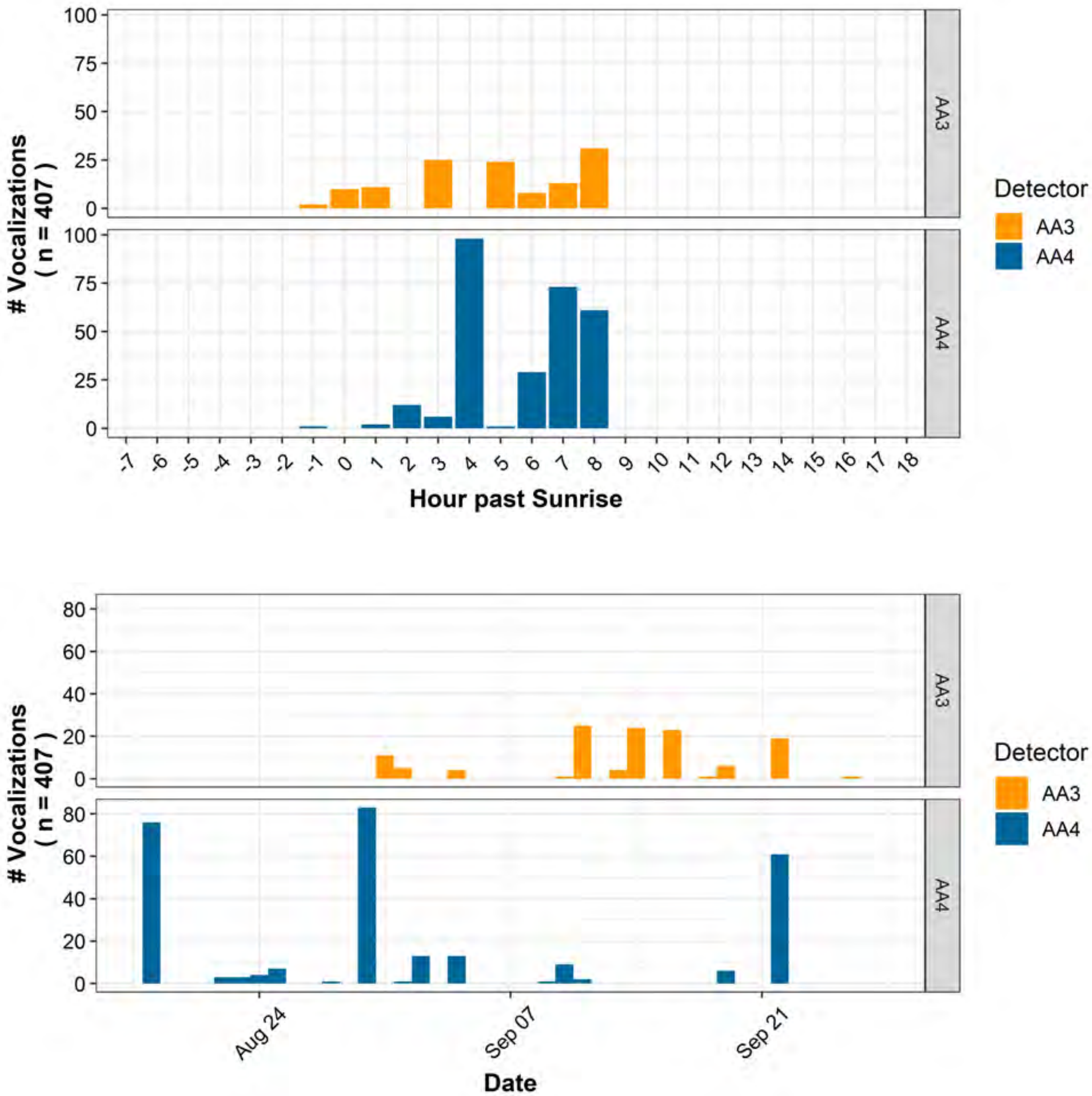


Figure C-3 Boreal Chickadee – Acoustic Results by Time of Day and Date

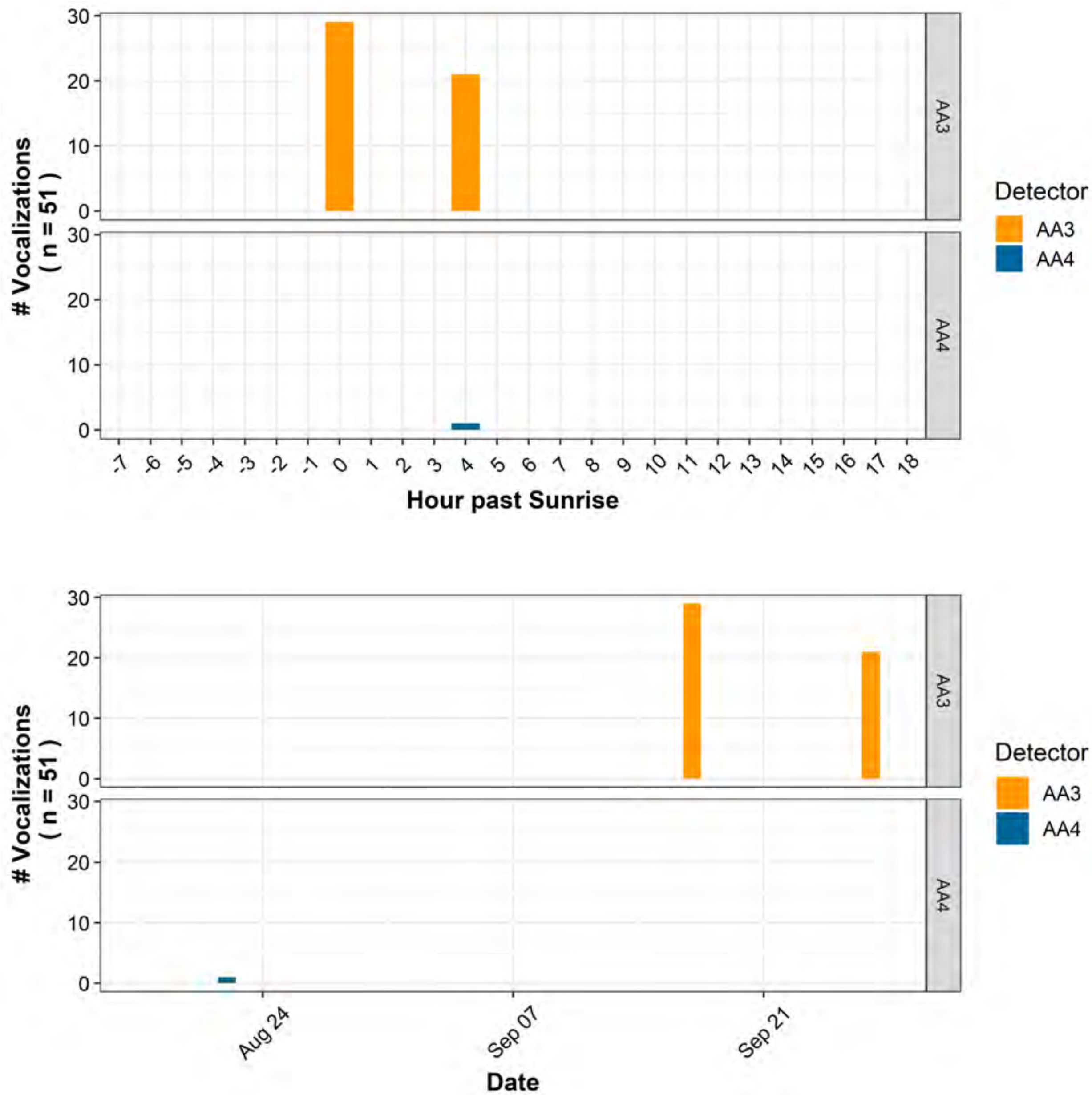
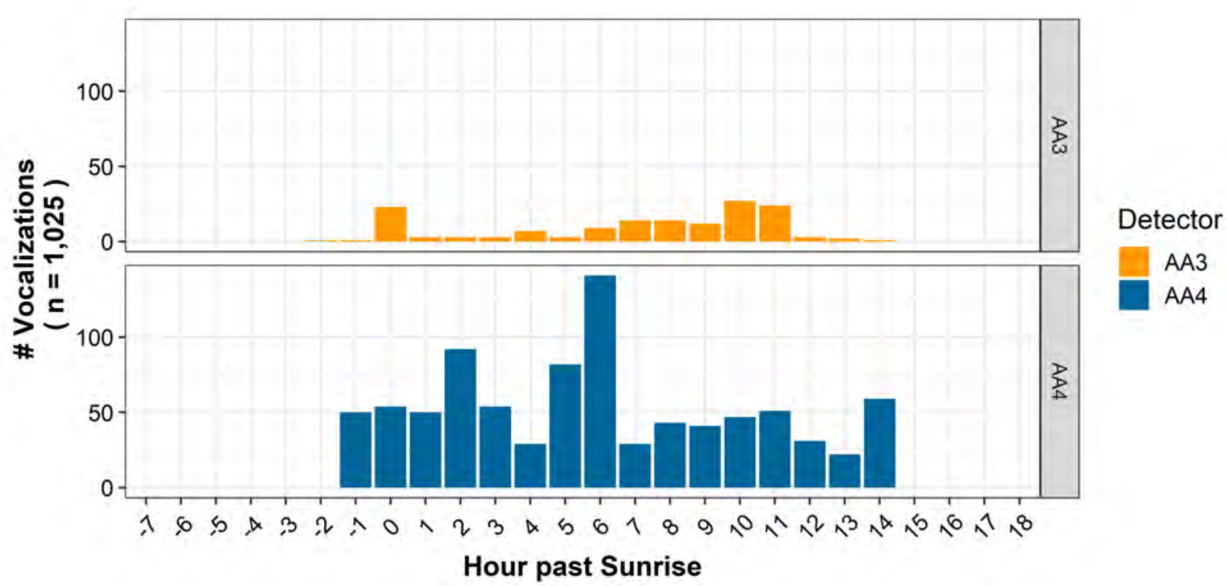


Figure C-4 Canada Goose – Acoustic Results by Time of Day and Date



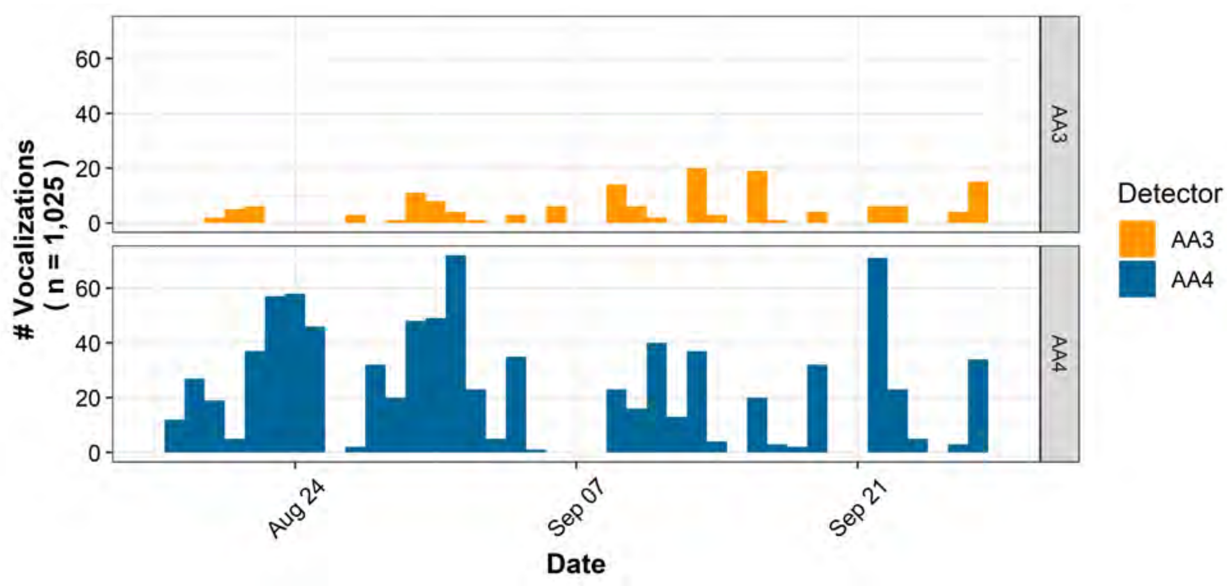


Figure C-5 Canada Jay – Acoustic Results by Time of Day and Date

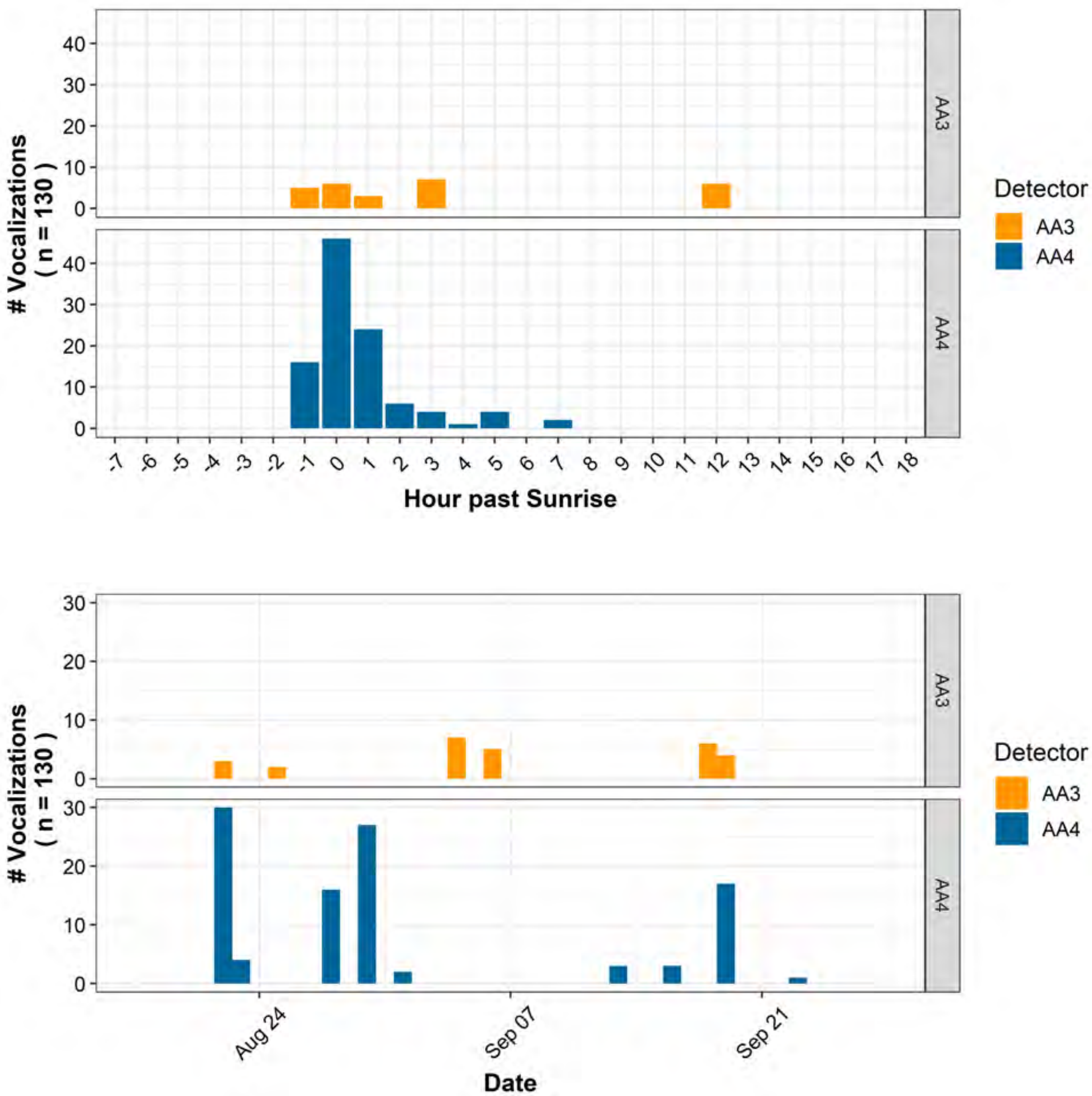


Figure C-6 Common Loon – Acoustic Results by Time of Day and Date

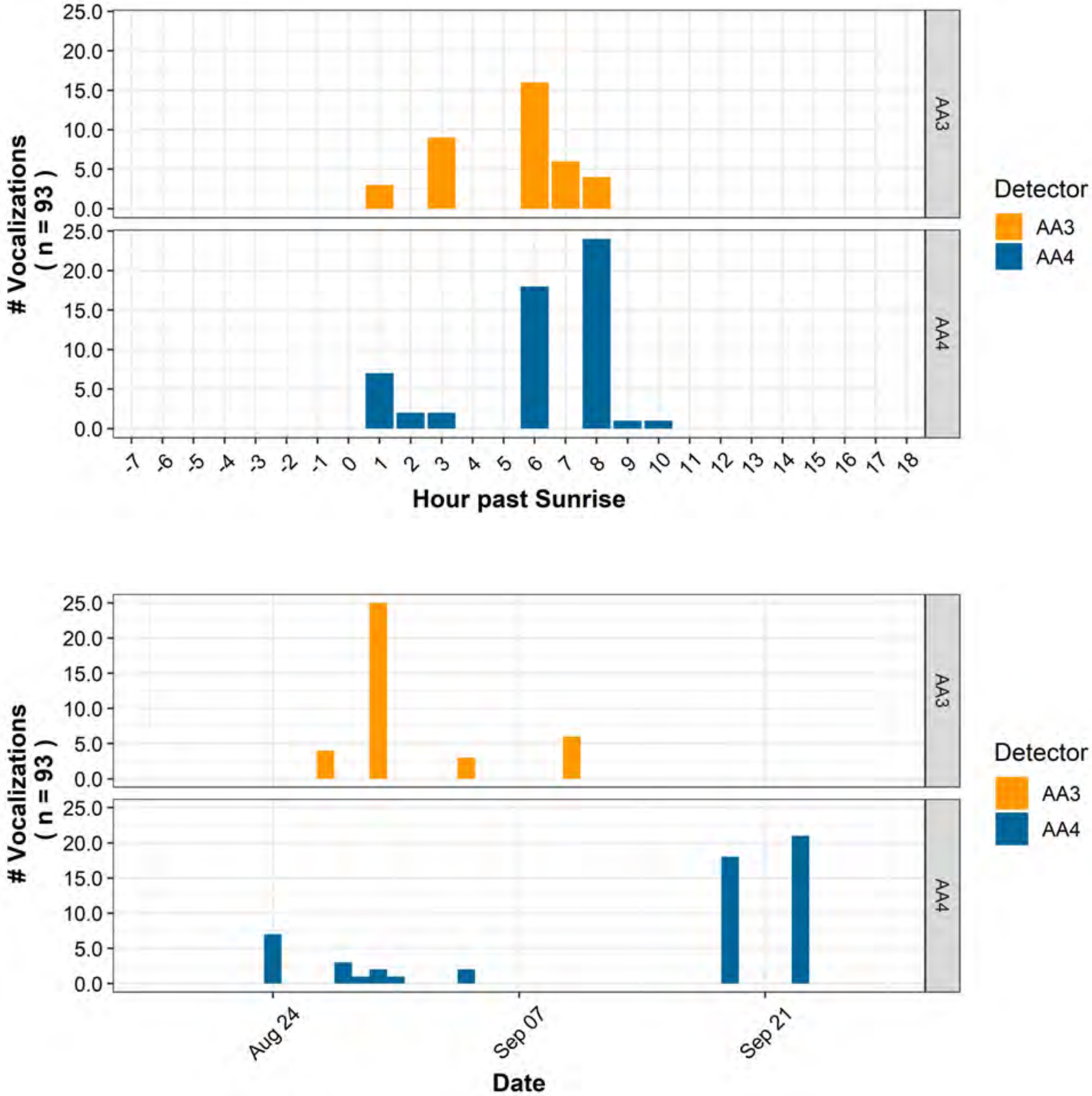


Figure C-7 Common Raven – Acoustic Results by Time of Day and Date

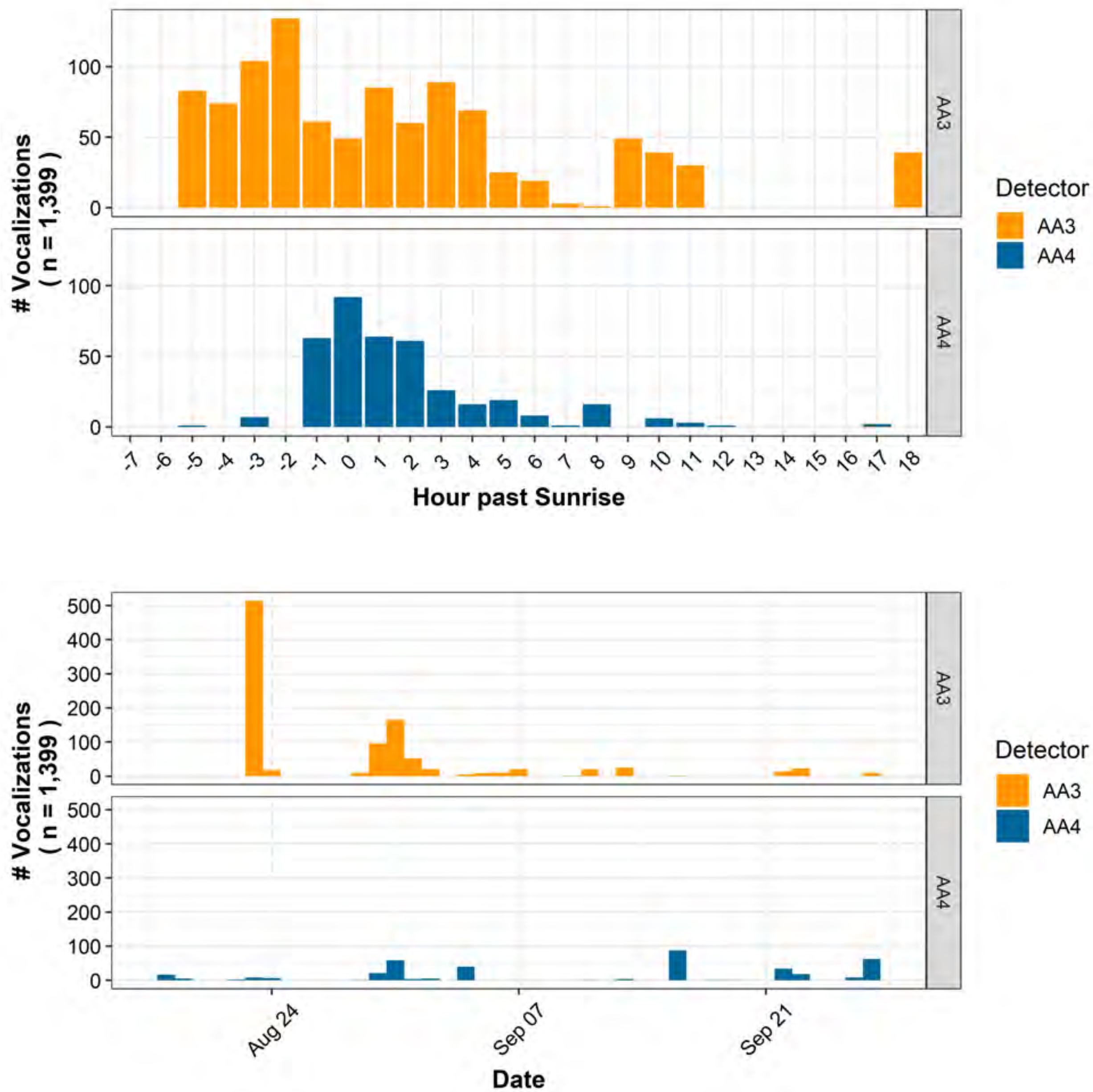


Figure C-8 Common Redpoll – Acoustic Results by Time of Day and Date

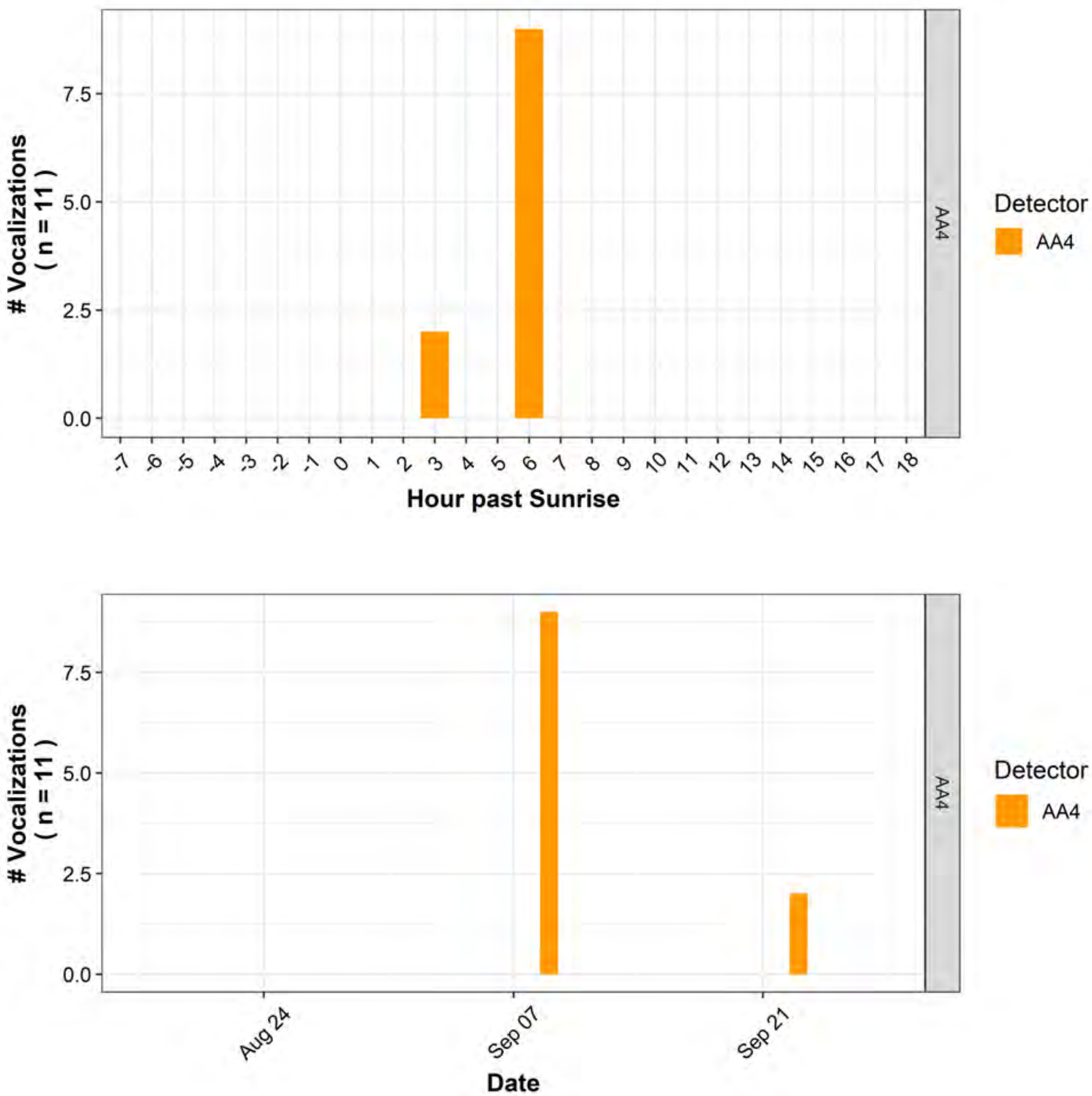


Figure C-9 Dark-Eyed Junco– Acoustic Results by Time of Day and Date

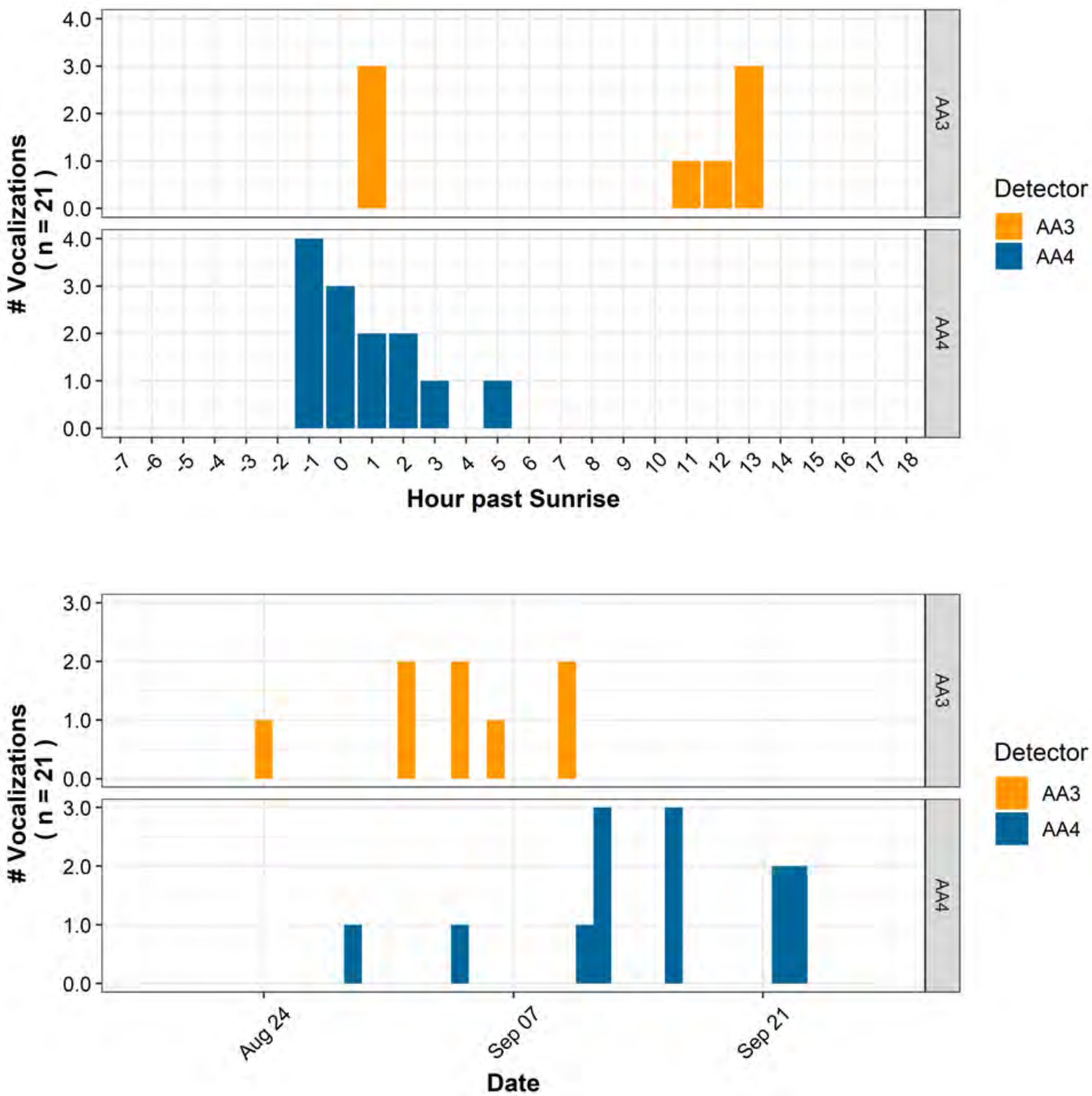


Figure C-10 White-Crowned Sparrow – Acoustic Results by Time of Day and Date

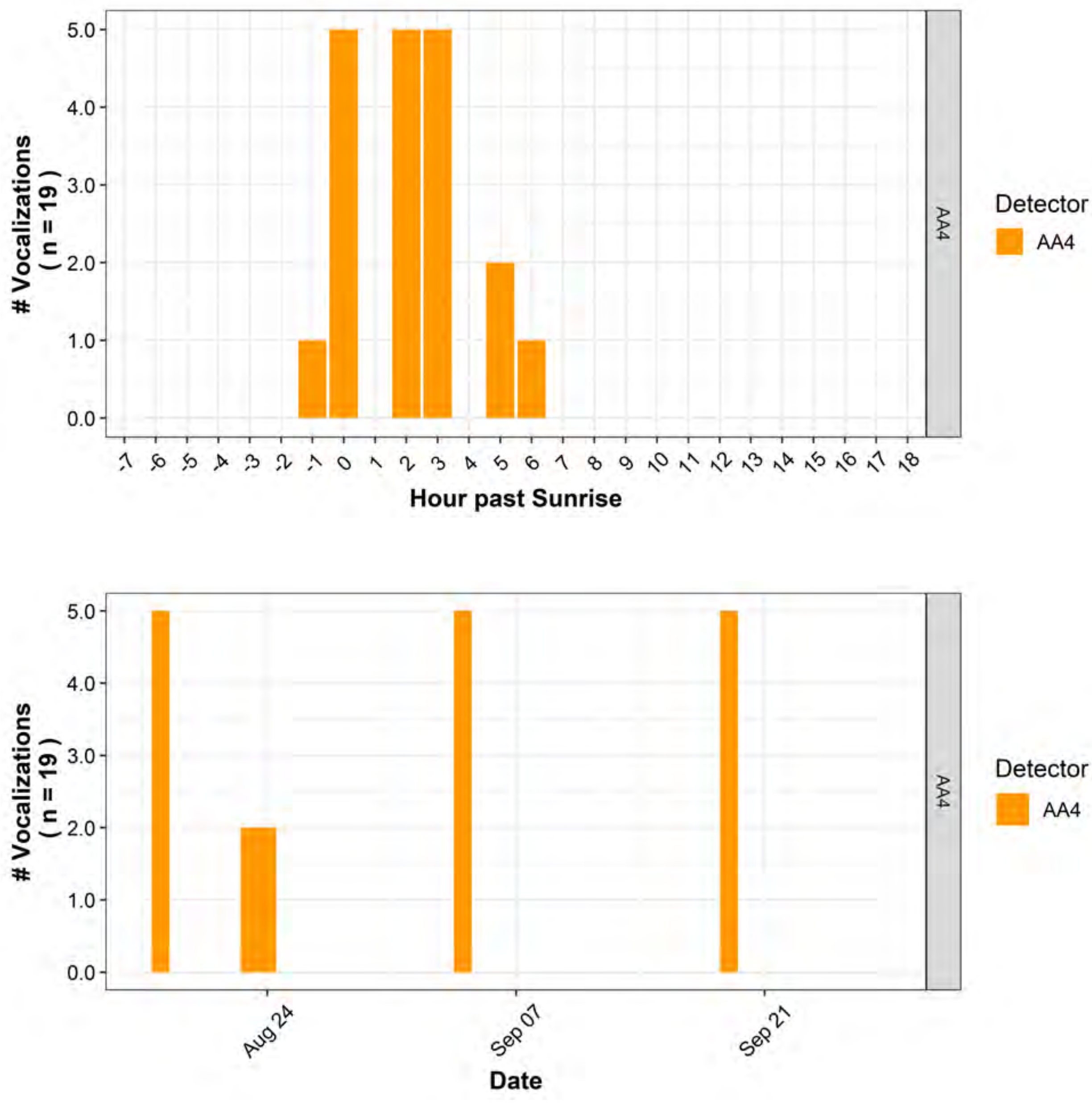
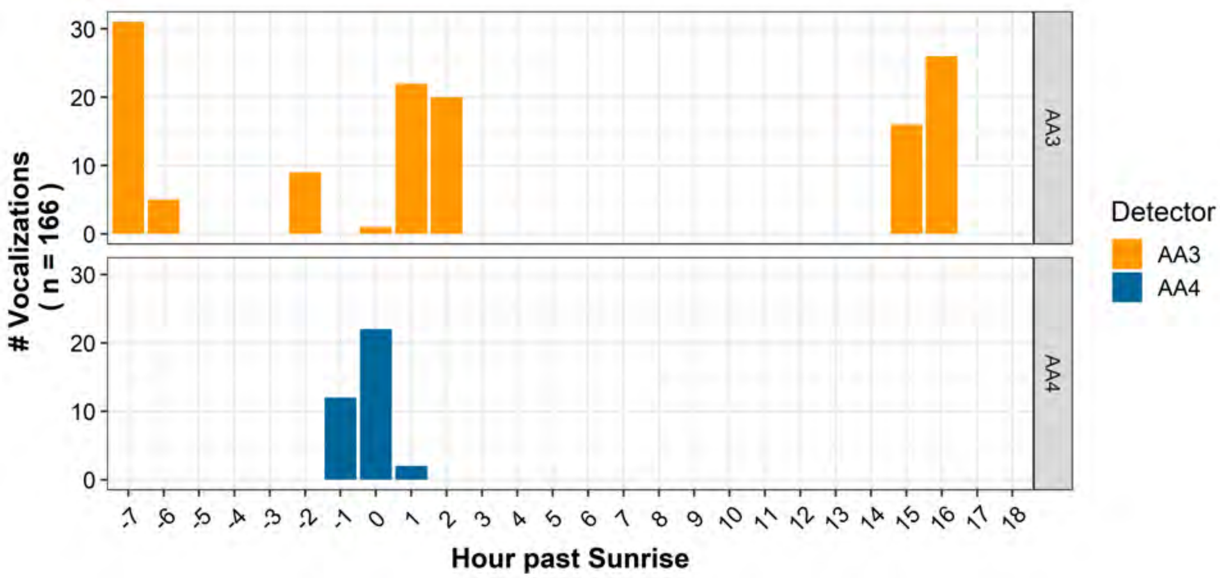


Figure C-11 Northern Waterthrush – Acoustic Results by Time of Day and Date



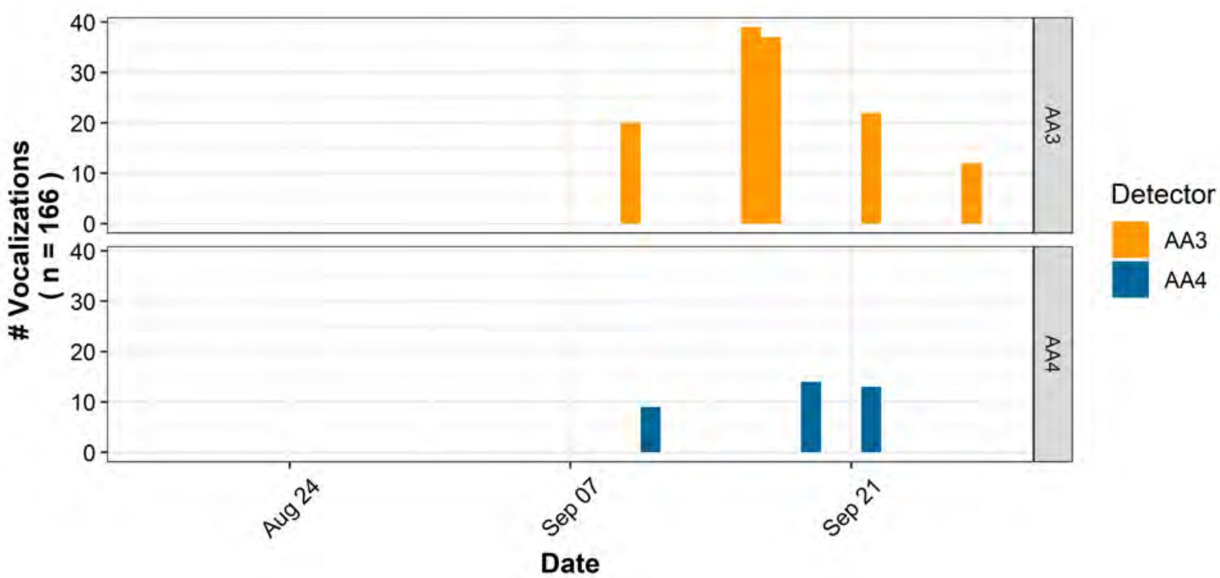


Figure C-12 Pine Grosbeak – Acoustic Results by Time of Day and Date

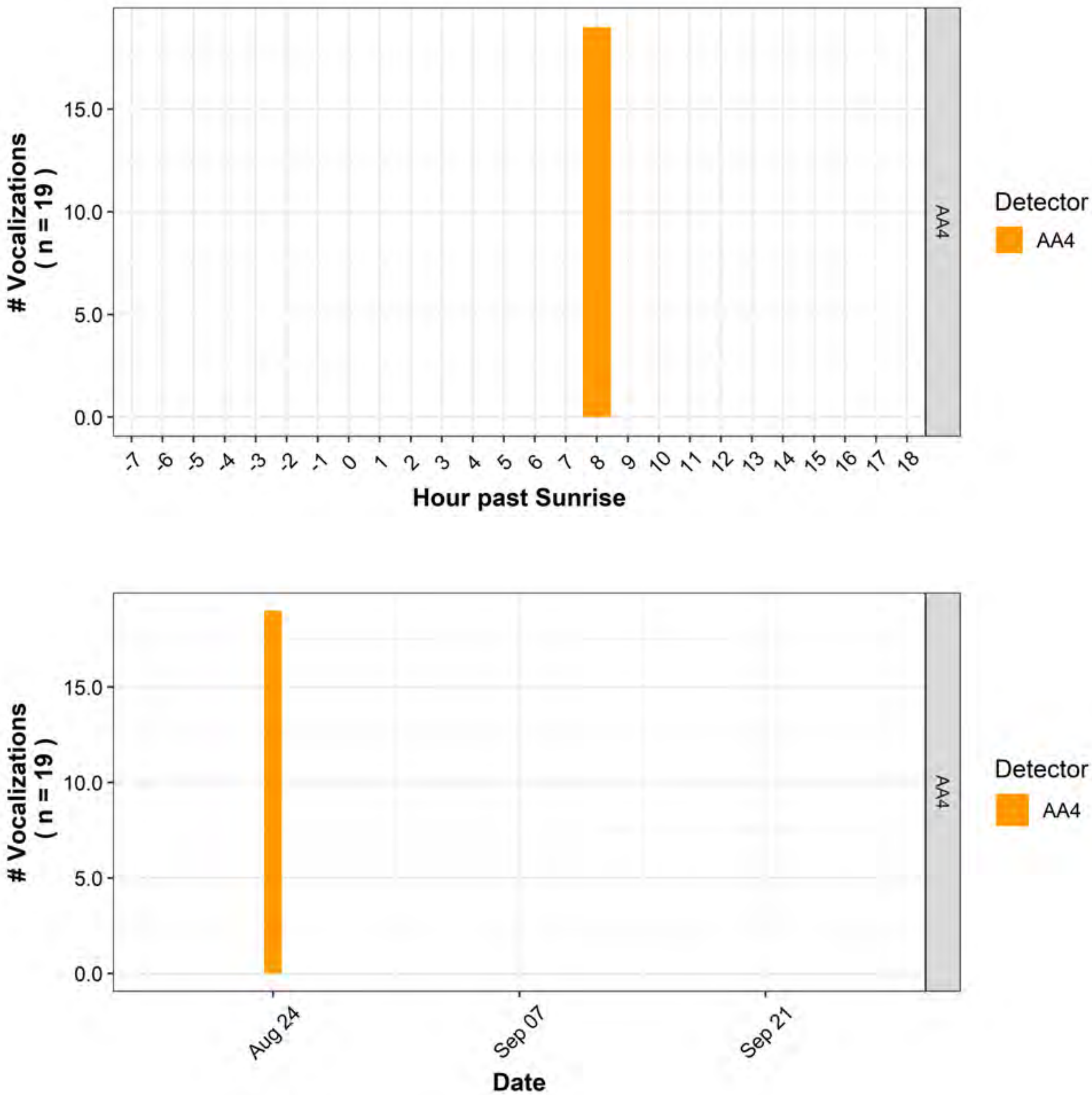


Figure C-13 White-Winged Crossbill – Acoustic Results by Time of Day and Date

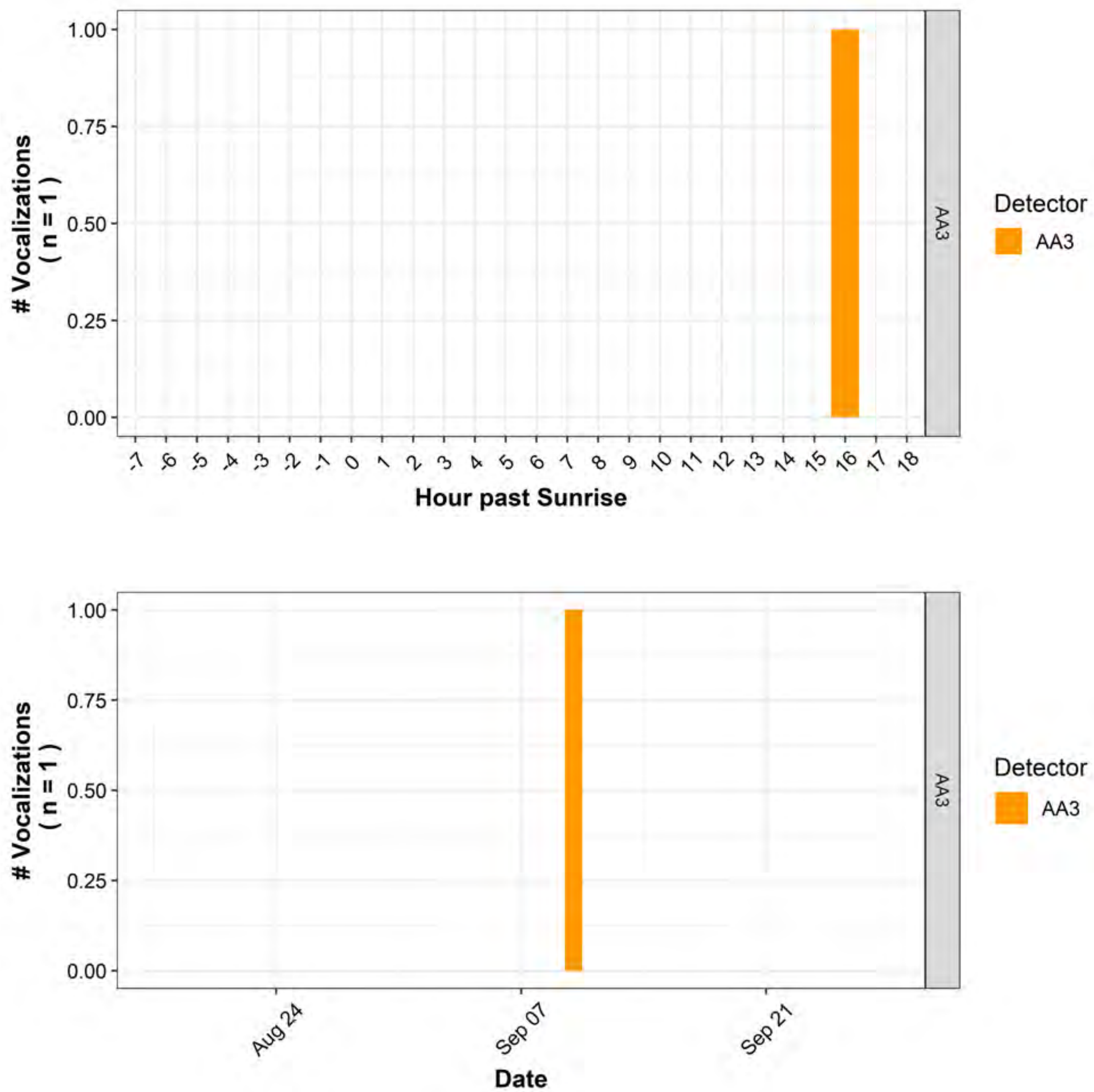


Figure C-14 Unidentified Alcid – Acoustic Results by Time of Day and Date

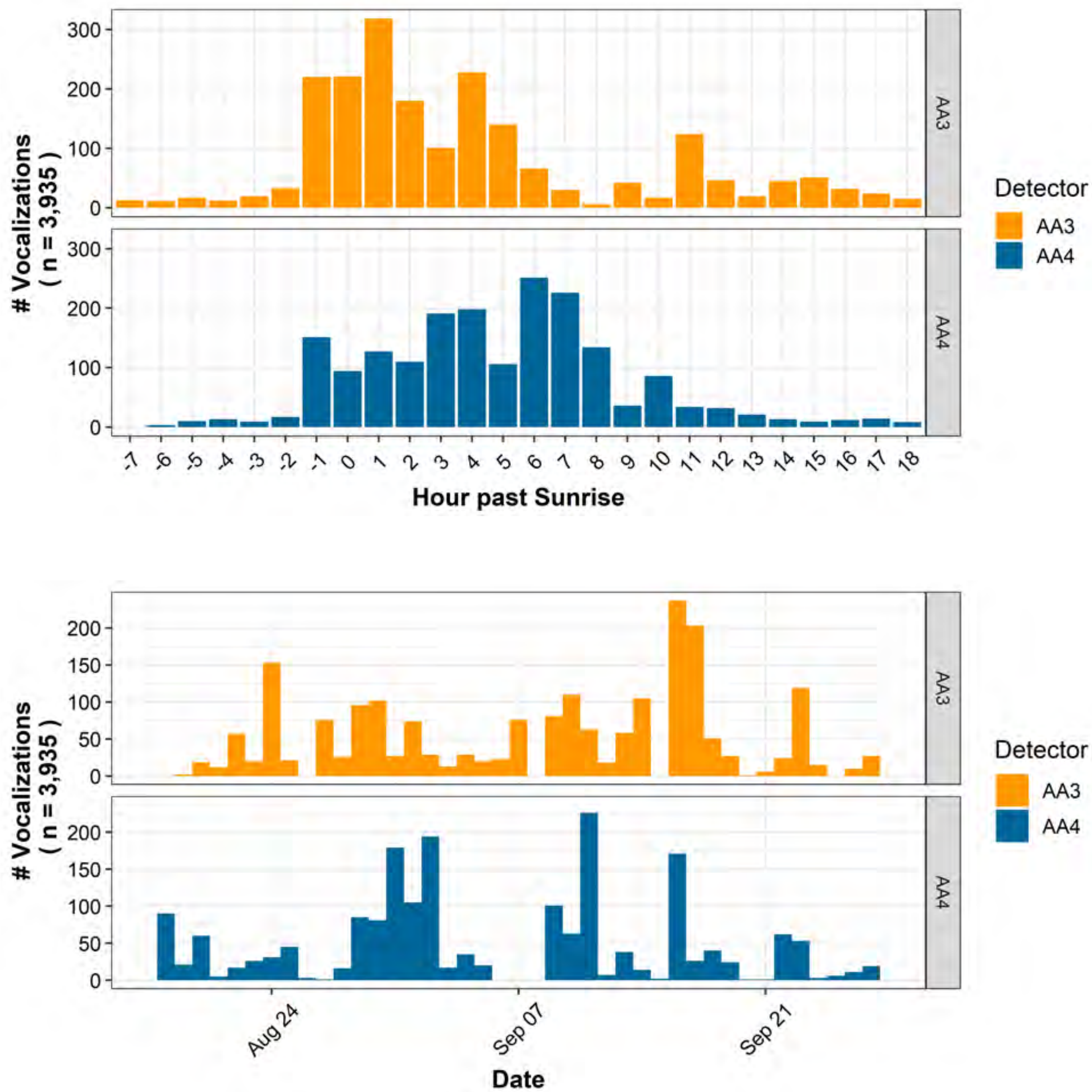


Figure C-15 Unidentified Calls – Acoustic Results by Time of Day and Date

APPENDIX E

Bat Baseline Report

Voisey's Bay Wind Project - 2020 Bat Monitoring Study Results

Final Report

February 12, 2021

Prepared for:

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Prepared by Randall, Jennifer Digitally signed by Randall, Jennifer Date: 2021.02.12 11:58:09 -04'00' ______________________________
(signature)

Jennifer Randall, B.Sc., MES

Reviewed by Digitally signed by Michael Crowell Date: 2021.02.12 12:09:30 -04'00' ______________________________
(signature)

Michael Crowell, M.Sc.

Reviewed by Roy, Bob Digitally signed by Roy, Bob Date: 2021.02.12 13:12:45 -05'00' ______________________________
(signature)

Robert Roy, CWB

Approved by Elizabeth Way Digitally signed by Elizabeth Way Date: 2021.02.12 15:56:51 -03'30' ______________________________
(signature)

Elizabeth Way, M.Sc.

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1.0 INTRODUCTION

Aivek Stantec LP (Aivek Stantec) was retained by Vale Newfoundland and Labrador (VNL) to conduct an environmental assessment for the proposed Voisey's Bay Wind-Energy Project (the Project), a proposed wind energy development at the Voisey's Bay Mine Site in Northern Labrador, approximately 30 km south of Nain.

Vale Newfoundland and Labrador (VNL) is considering the potential for four to five, 4.2 MW wind energy converters, having rotor diameters of 138 to 150 m and blade tip heights of 150 to 180 m. These turbines will be located at GPS Hill, which is within the current surface lease area and immediately east of current mining operations (Figure 1.1). Additional Project components will include maintenance and control building(s), a substation, wind turbine interconnects, access / construction roads, and staging areas for turbine assembly. For the purpose of this report, the proposed footprints of the turbines and associated infrastructure at GPS Hill, as well as the connecting access road, are referred to as the Project Area.

Although the GPS Hill site has now been finalized, at the time of this study (summer / early fall 2020), a second site was also evaluated as potential locations for turbines: Sara Hill. Sara Hill is located on a ridge approximately 8 km north of the mine site and adjacent to the mine's access road for port operation. For this reason, Sara Hill was included in the survey design and is discussed throughout this report.

Like all energy sources, wind energy can have adverse impacts on wildlife. Wind turbines are one of the leading causes of bat mortalities worldwide (O'Shea et al. 2016). Although both resident and migratory bat species can be killed by turbines, migratory bats account for the majority of documented fatalities (Lausen et al. 2010). Very little research has been done on bats in Labrador. As a result, it is not known if bats regularly occur in the Voisey's Bay area, or how bats use this habitat. Anecdotal evidence exists of bat occurrence in Nain (approximately 32.5 km northeast and more coastal), which suggests that they may also occur in Voisey's Bay. The most likely species to occur in this area is the little brown myotis (*Myotis lucifugus*), a resident species in Newfoundland, with recorded instances in southern Labrador. A second species, the northern long-eared myotis (*Myotis septentionalis*) has also been recorded in Labrador (Broders et al. 2013), but is not expected to occur as far north as Voisey's Bay. The little brown myotis and northern long-eared myotis are both listed as *Endangered* under the federal *Species at Risk Act* (SARA). One migratory species, the hoary bat (*Lasiurus cinereus*), also has the potential to occur, although it has not yet been documented in Labrador.

A bat monitoring field program was required to investigate the occurrence of bats in the Project Area, and to inform potential effects of the proposed wind farm on bats. This program was developed in consultation with Environment and Climate Change Canada (ECCC) and the Government of Newfoundland and Labrador Department of Fisheries and Land Resources Wildlife Division. The purpose of the bat monitoring field program was to determine if bats occur in the Voisey's Bay area and if so, to determine species occurrence in available habitats, and patterns of activity over the time period sampled. This data report provides the results of the bat monitoring program conducted in summer and fall 2020 at both GPS Hill and Sara Hill.

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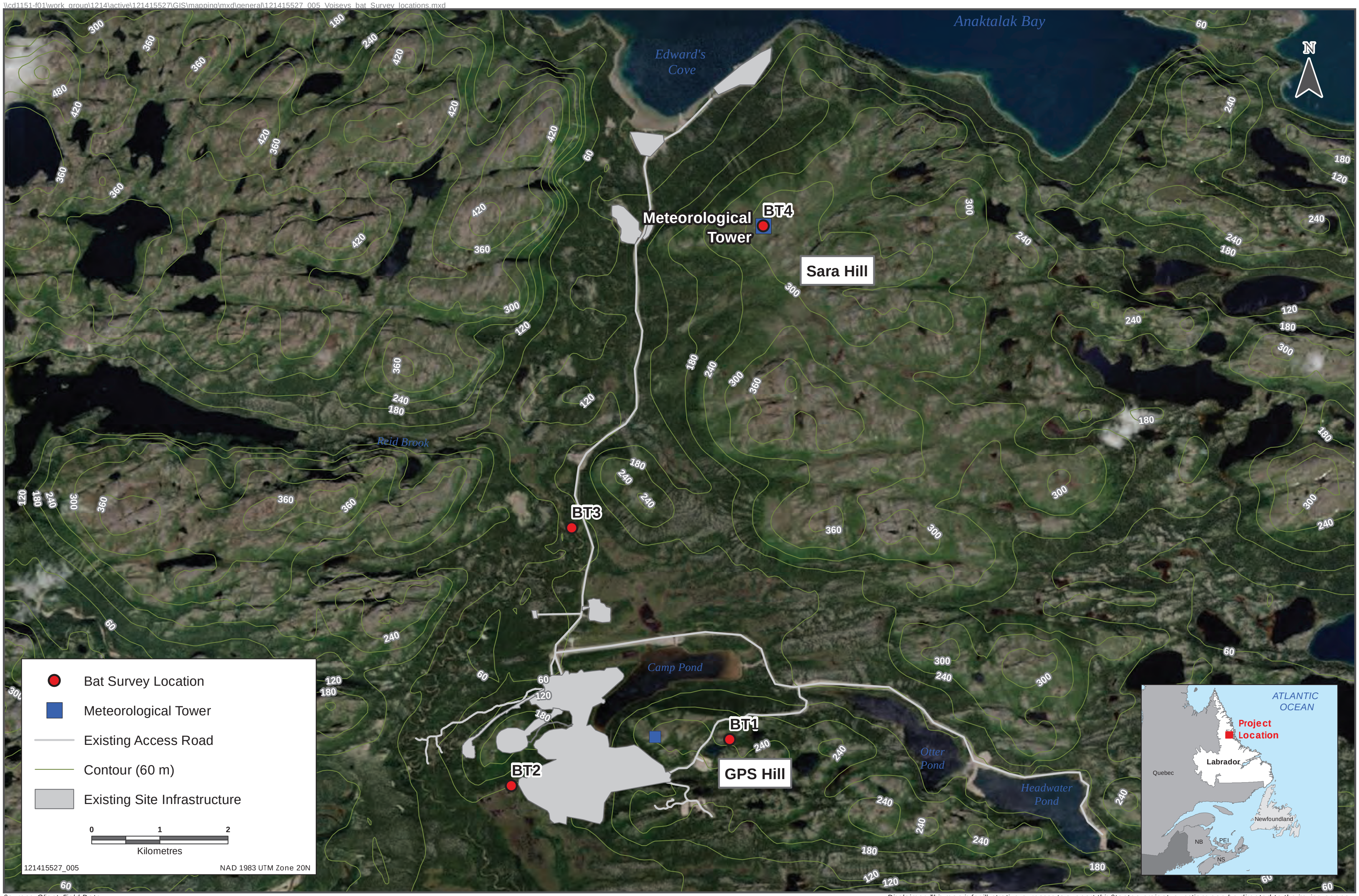

Sources: Client, Field Data
Service Layer Credits: Source: Esri, Maxar, GeoEye, Earthstar Geographics, CNES/Airbus DS, USDA, USGS, AeroGRID, IGN, and the GIS User Community NRCAN

Disclaimer: This map is for illustrative purposes to support this Stantec project; questions can be directed to the issuing agency.

Figure 1.1 Bat Acoustic Detector Locations

2.0 METHODS

2.1 STUDY TEAM

Experienced professionals were responsible for the design, logistical planning, and data collection of the 2020 bat monitoring program. Species identification, data analysis, and interpretation were performed by qualified professionals (i.e., biologists / environmental scientists). The members of the study team are provided in Table 2.1.

Table 2.1 Study Team – 2020 Bat Monitoring Program

Role	Personnel
Project Manager	Barry Wicks, B.Sc.
Project Scientist	Colin Jones, B.Sc. (LGL Limited)
Quality / Independent Review	Michael Crowell, M.Sc.
	Bob Roy, B.Sc., Certified Wildlife Biologist
	Elizabeth Way, M.Sc.
Data Analysis and Report Preparation	Jennifer Randall, MES
	Trevor Peterson, PhD
Information Management / GIS	Megan Blackwood, B.Sc., Dip. GIS

2.2 FIELD METHODS

Aivek Stantec conducted an acoustic monitoring program for bats from June 23 to October 11, 2020. June and July represent the breeding season for resident bat species. Based on literature review, anecdotal reports, and consultation with the Government of Newfoundland and Labrador Department of Fisheries, Forestry and Agriculture (formerly Department of Fisheries and Land Resources) Wildlife Division (J. Humber, 2020, pers. comm), little brown myotis was identified as the species most likely to be a resident in the area. During the spring and summer, little brown myotis would be expected to be found foraging in forested areas and over waterbodies, and travelling to and from maternity colonies located in trees or buildings. In August and September, little brown myotis take part in short-scale migrations to swarming and/or hibernation sites. The fall also represents the migratory period for long-distance migrants, such as the hoary bat, during which bats fly south to over-winter in warmer areas.

This study of bat occurrence / activity levels in the Study Area and suitable habitats in its vicinity was performed using non-invasive methods based on passive detection of the bats' echolocation calls. Four Wildlife Acoustics Song Meter Mini Bat detectors were deployed in the vicinity of the Project (Figure 1.1). These devices passively record the ultrasonic ecolocation calls of passing bats. Recorded bat acoustic data can be analyzed to identify bat species or groups of bat species. Acoustic monitoring stations were chosen to sample within representative bat habitat types in the vicinity of the Project. This approach and methods were developed in consultation with the Government of Newfoundland and Labrador Department of Fisheries, Forestry, and Agriculture Wildlife Division (J. Humber, 2020, pers. comm).

Acoustic monitoring has known limitations. It is not always possible to identify species based on bat recordings. The calls of some species are so similar that they cannot always be distinguished from each other at a site. In addition, the number of bats present cannot be determined from acoustic monitoring. It cannot be known if all recordings represent individual bats, or if one bat was recorded on multiple occasions. However, acoustic monitoring does allow for long-term, non-invasive sampling of bats, and was determined to be the best approach at Voisey's Bay. It is a commonly used approach for pre-construction surveys at wind farms (Vonhof 2002).

Research suggests that it is not yet clear if wind turbine related bat mortalities are best predicted by ground level or elevated acoustic detectors (Lausen et al. 2010). Therefore, monitoring occurred both at ground level, and at an elevated site (MET tower at Sara Hill area, at a height of approximately 18 m). The detector placed at a higher elevation may provide an indication of bat activity levels closer to the height of the turbine blades. The other three detectors were mounted in trees approximately 2 m above the ground.

Each detector was programed to be active from 30 minutes prior to sunset until 30 minutes after sunrise. The detector settings are shown in Table 2.2.

Table 2.2 Mini Bat Acoustic Detector Settings

Mini Bat Acoustic Detector Settings	
Recording format	Full-Spectrum
Sample rate	256 kHz
Minimum trigger frequency	12 Khz
Maximum length	15 seconds
Trigger window	3 seconds
Save noise?	No
Gain	12 dB

The detector settings were chosen based on the species with potential to occur in this area, and on standard settings that are typically used for bat detection in this region.

2.3 DATA ANALYSIS

Biologists processed audio files (.wav file format) recorded by bat detectors using Kaleidoscope Pro (KPro) software version 5.1.9g, running autoclassifier version 5.1.0, using a sensitivity setting of "0" and converting files to zero-crossing format. Although KPro software has a built-in species list for Labrador, this included only little brown myotis (*Myotis lucifugus*) and northern long-eared myotis (*Myotis septentrionalis*). Recognizing the limited amount of information on bat species occurrence in Labrador, we added other commonly occurring bat species in eastern Canada, including eastern red bat (*Lasiurus borealis*), hoary bat (*Lasiurus cinereus*), and silver-haired bat (*Lasionycteris noctivagans*) to the list of potential species when running KPro software. We used AnalookW software (version 4.2g) to disperse files into species groups as assigned by KPro, and an expert in acoustic bat identification then manually inspected the files assigned to each species to review accuracy of identifications, reclassifying files as necessary, and create final summary files. Visual QAQC was performed using AnalookW software, and samples of each species were also viewed and analyzed using SonoBat software (version 4.4.5) to corroborate identifications.

Date and time information were extracted from each identified bat pass and acoustic data were summarized by detector and night. Hourly temperature and wind speed data from the weather station operated by VNL and located at a nearby airstrip was used for weather related analysis. Bat activity patterns were summarized by hour past sunset, combining data among detectors, and analyzed relationships between temperature, wind speed, and bat activity on an hourly and nightly basis. Mean nightly temperature and wind speed were calculated based on hourly data recorded between sunset and sunrise and rounded timestamps of bat passes to the nearest hour for aligning bat activity and weather observations.

3.0 RESULTS

3.1 HABITAT

Four bat detectors were deployed in the vicinity of the Project (Figure 1.1). Two were located in the GPS Hill area; one at the location of the proposed turbines (BT1), and one west of the current infrastructure (BT2). BT1 was located adjacent to a pond, in an open conifer woodland dominated by tamarack (*Larix laricina*). BT2 was located at the toe of a slope in a grassy fen, and downslope of a mixedwood forest. BT3 was located adjacent to the port road, on a spit of land along Little Reid Brook. This detector was directly facing open water and was adjacent to a wetland. These three detectors were mounted in tamarack trees approximately 2 m above the ground. The final detector, BT4, was deployed on the MET tower at Sara Hill, which is located in barrens habitat on top of a large hill. The detector was mounted approximately 18 meters above the ground using a pully system. A photo of the setup is included in Appendix A.

A summary of the four detector locations and their surrounding habitat is presented in Table 3.1.

Table 3.1 Bat Detector Locations

Detector ID	Site	Location of Detector	Detector Height (meters above ground level)	Habitat Description
BT1	GPS Hill	In tamarack tree	2	• Adjacent to pond, next to a small water channel. • Located on a sloped bank in flood zone directly adjacent to water. • Open conifer woodland dominated by tamarack.

Table 3.1 Bat Detector Locations

Detector ID	Site	Location of Detector	Detector Height (meters above ground level)	Habitat Description
BT2	GPS Hill, west of current site infrastructure	In tamarack tree	2	• Grassy fen. • Approx. 100m from open water pools. • Located at toe of slope; upslope is a mixedwood forest. • West of terminus of south sedimentation pond.
BT3	Port Road	In tamarack tree	2	• On elevated vegetated 'spit' between braided forks of Little Reid Brook and adjacent to wetland. • Located directly adjacent to water, with microphone pointing in direction of open water. • Predominantly stunted tamarack along shoreline, with some black spruce.
BT4	Sara Hill	In MET tower	18	• Barrens habitat on hill top.

3.2 BAT ACTIVITY

3.2.1 Survey Effort and Recorded Bat Passes

The four bat detectors were deployed between June 23 and 30. They were recovered between September 4 and October 11. BT1 malfunctioned in August, with the last recording occurring on August 15. Although attempts were made to repair the unit, they were unsuccessful and BT1 was removed from site on September 4. The remaining three units remained deployed until October. BT1 is the only detector located directly at GPS Hill, and as such data is missing for some of the fall migration period at GPS Hill. However, the data obtained from the remaining detectors should suffice in providing a level of confidence in our overall findings. In addition, the remaining three detectors provide data for a variety of habitat types in the vicinity of the Project Area; it is assumed that these results are broadly transferable to similar habitat types at GPS Hill.

Dates of deployment, active detector-nights (DN), and recorded echolocation sequences are summarized in Table 3.2. Acoustic detectors operated for 343 out of a total of 387 attempted DN. With the exception of BT1, differences between nights deployed and nights active can be attributed to power loss resulting from dead batteries. BT2 and BT3 were active for the most nights, at 111 and 108 nights, respectively. Bats were detected during 170 of the active 343 DN.

In total, 3,300 echolocation sequences (also referred to as bat passes) were recorded by the four detectors (Table 3.2). The majority of recordings occurred at BT3, which accounted for 2,963 (90%) of the 3,300 recordings. This detector had a detection rate (# recorded call sequences per detector-night) of 27.44 call sequences per detector-night (calls/DN). The highest number echolocation sequences recorded during one night at BT3 was 432, which occurred on August 20 (during the fall migration period). The second highest detection rate was observed at BT1, at 3.12 sequences/DN. Although this detector was only active for 49 nights, a total of 153 echolocation sequences were recorded, with a maximum of 22 sequences recorded on the night of July 11. BT2 had a detection rate of 1.59 sequences/DN, with a total of 177 echolocation sequences recorded over 111 nights. The maximum number of echolocations sequences recorded in one night at this site was 35, on July 8. BT4, which was located on the MET tower at Sara Hill, had the lowest number of echolocation recordings, with a detection rate of 0.1 sequences/DN. Seven echolocation sequences were recorded at BT4, four of which occurred the night of August 9.

Table 3.2 Summary of Bat Detector Deployment Dates and Recorded Echolocation Sequences

Detector	Dates Deployed	Nights Detector was Deployed	Nights Detector was Active	Recorded Echolocation Sequences	Detection Rate (Recorded Sequences Per Detector-Night)	Maximum Sequences Recorded in One Night
BT1	June 27 - September 4	70	49	153	3.12	22
BT2	June 23 - October 11	111	111	177	1.59	35
BT3	June 26 - October 11	108	108	2,963	27.44	432
BT4	June 30 - October 5	98	75	7	0.093	4
Total		**387**	**343**	**3,300**	-	-

3.2.2 Species

Of the 3,300 echolocation sequences recorded, 3,273 (99%) were able to be identified to species (Appendix B, Table B.1). Three species of bats were identified from the acoustic results, including the little brown myotis, hoary bat, and the silver-haired bat. The number of bats identified to species by detector location is provided in Table 3.3. Appendix C includes screenshots of each detected bat species' sonogram, viewed in AnalookW and SonoBat software.

Table 3.3 Species Identified by Detector Location

Detector	Bat Activity (Number of Passes Recorded)				
	Little Brown myotis	Hoary Bat	Silver Haired Bat	Unknown	Total
BT1	152	0	0	1	153
BT2	175	1	0	1	177
BT3	2,934	3	1	25	2,963
BT4	4	3	0	0	7
Total	**3,265**	**7**	**1**	**27**	**3,300**

3.2.2.1 Little Brown Myotis

Little brown myotis accounted for 3,265 (99.8%) of the 3,273 passes identified to species (Table 3.3). It is important to note that echolocation sequences do not equate to the number of bats at a site; one individual bat may be recorded multiple times the same night if frequently flies by the detector. The little brown myotis, which is the most common species in Newfoundland and Labrador, was the only species identified at all four detector locations. Little brown myotis is a small, insectivorous species with an average mass between 5.5 and 11 g, and a wingspan between 22 and 27 cm (COSEWIC 2013) (Figure 3-1). Their diet consists of a wide range of insects and spiders, and includes chironomids and other aquatic insects, as they often forage over water (COSEWIC 2013).

Figure 3-1 Little brown myotis

Photograph by: James D. Kiser, Stantec Consulting Ltd.

The little brown myotis has a wide distribution in North America that extends from Alaska to Mexico. They are found in every province and territory except for Nunavut, and all US states, although they are absent from large portions of Texas and Florida, and do not occur north of the tree line (Havens 2006). In Newfoundland and Labrador, little brown myotis is a resident species that is typically found in forested habitat in the spring, summer and fall. During the breeding season, females form large maternity roosts in trees or human structures (such as attics or barns), where they give birth to and raise their pups. Little brown myotis spend their winters in hibernation at underground sites, such as caves and abandoned mines. No known hibernation sites occur in Labrador (Broders et al. 2013), however, very little bat research has been done in this region. It is not known if these little brown myotis hibernate in the Voisey's Bay region or migrate to hibernation sites located further south. These records of little brown myotis represent the most northern known records of the species in Labrador.

Little brown myotis are listed as *Endangered* under Schedule 1 of SARA. This species has seen drastic population declines in North America caused by a fungal pathogen called white-nose syndrome, which was first detected in New York state in 2006. White-nose syndrome was confirmed on the Island of Newfoundland in the winter of 2016/2017 (US Fish and Wildlife Service 2019). In areas affected by white-nose syndrome, mortality rates are typically high. Populations of little brown and northern long-eared bats at known hibernacula in eastern Canada have declined by 94% since the arrival of white-nose syndrome (COSEWIC 2013).

3.2.2.2 Hoary Bat

Seven echolocation sequences were identified as hoary bats. This species was recorded three times each at BT3 and BT4, and once at BT2. These are believed to be the first confirmed records of hoary bats in Labrador.

Hoary bats are the largest of the three species identified, on site and have distinct brown/grey fur (Figure 3-2). They weigh between 20 and 35 g and have an average wingspan of 43 cm (Anderson 2002). Hoary bats are insectivorous, and feed primarily on moths, although their diet also includes flies, beetles, small wasps and grasshoppers (Anderson 2002). Hoary bats are widespread in eastern Canada and are found in all US states. They are long-distance migrants, that move from northern breeding sites to overwintering sites, typically in the southern US or Mexico (Findley and Jones 1964, Cryan 2003, Baerwald 2015). As such, they would only occur in Labrador during the spring, summer or fall. Hoary bats are typically solitary and roost in the foliage of mature deciduous or coniferous trees (Bat Conservation International 2017). Females typically give birth to two pups in the spring, although littler size can range from one to four (Anderson 2002).

Hoary bats are particularly vulnerable to turbine strikes, and account for approximately half of all bat fatalities at wind turbine facilities in North America (Arnett et al. 2008). The majority of fatalities occur during the migratory period (Arnett et al. 2008).

Figure 3-2 Hoary bat

Photograph by: James D. Kiser, Stantec Consulting Ltd.

3.2.2.3 Silver-haired Bat

One echolocation sequence was identified as a silver-haired bat. This sequence was recorded at BT3 on June 30.

Silver-haired bats are a small bat with black fur that has white tips, giving them a silver appearance (Figure 3-3). They weight between 8 and 11 g and have an average wingspan of 29.5 cm (Bentley 2017). Silver-haired bats are insectivorous, and their diet is made up primarily of moths, flies and beetles, although they consume other insects as well (Bentley 2017).

Figure 3-3 Silver-haired bat

Photograph by: James D. Kiser, Stantec Consulting Ltd.

Silver-haired bats are widely distributed throughout the southern half of Canada and the United States. They roost in mature coniferous and mixed-wood forest (Bat Conservation International 2021). In the spring, females form maternity colonies in cavities in trees or snags, where they give birth to two pups (Bentley 2017). During this time, males are typically solitary. In the fall, silver-haired bats migrate to more southern locations with milder temperatures, where they hibernate in roosts found in tree hollows, under loose bark, in wood piles or on cliff faces (Bat Conservation International 2021).

Labrador is north of the known range for this species, and this represents the first confirmed record of a silver-haired bat in Labrador. Based on these data it is not known is this individual was a vagrant, or if silver-haired bats regularly occur in Labrador. Although the migration patterns of the silver haired bat are not well known, they are thought to winter in the United States Pacific Northwest, south-western states, and middle latitudes of the eastern United States (Izor 1979, Cryan 2003, Baerwald 2015).

As a migratory, tree-roosting bat, silver-haired bats are vulnerable to turbine strikes, particularly during the migratory period.

3.2.3 Temporal Activity Patterns

Bat activity varies seasonally. Results for each bat detector were plotted by date to determine the temporal variations in activity (Figures 3-4 to 3-7). Results for BT1 and BT2 were similar and show highest activity levels from late June to mid-July. At this point in the season, little brown myotis are likely foraging throughout the landscape, and bringing food back to their pups at maternity roosts. It is important to note that BT1 was not active in August, so the bat activity at this time is not known. At BT2, the number of little brown myotis passes is relatively low in August and September, suggesting that this site is not important for the short-scale migrations of this species.

At BT3, where most bat activity was recorded, activity levels occurring in June and July were similar to the activity levels at BT1 and BT2. However, the highest activity levels at this site occurred from early August to early September (Figure 3-6). By early August, the number of recorded passes increased considerably from that in July, and then peaked from mid-August to early September. This timing suggests that bats occur more frequently in this area after maternity colonies break up. It is possible that this area is used by little brown myotis as they move to swarming and/or overwintering sites.

BT4 has so few bat recordings, that it is not possible to determine temporal trends (Figure 3-7). The low level of activity may indicate that bats do not commonly occur in open, barrens habitat. All bat passes were recorded between Aug 7 and 11, however, there were only seven passes recorded which were made up of two species (little brown and hoary bats).

The latest that bats were recorded at any detector was September 21, when little brown myotis were recorded at both BT2 and BT3. This suggests that the majority of bats have moved out of the region, or into hibernation, by mid-to-late September.

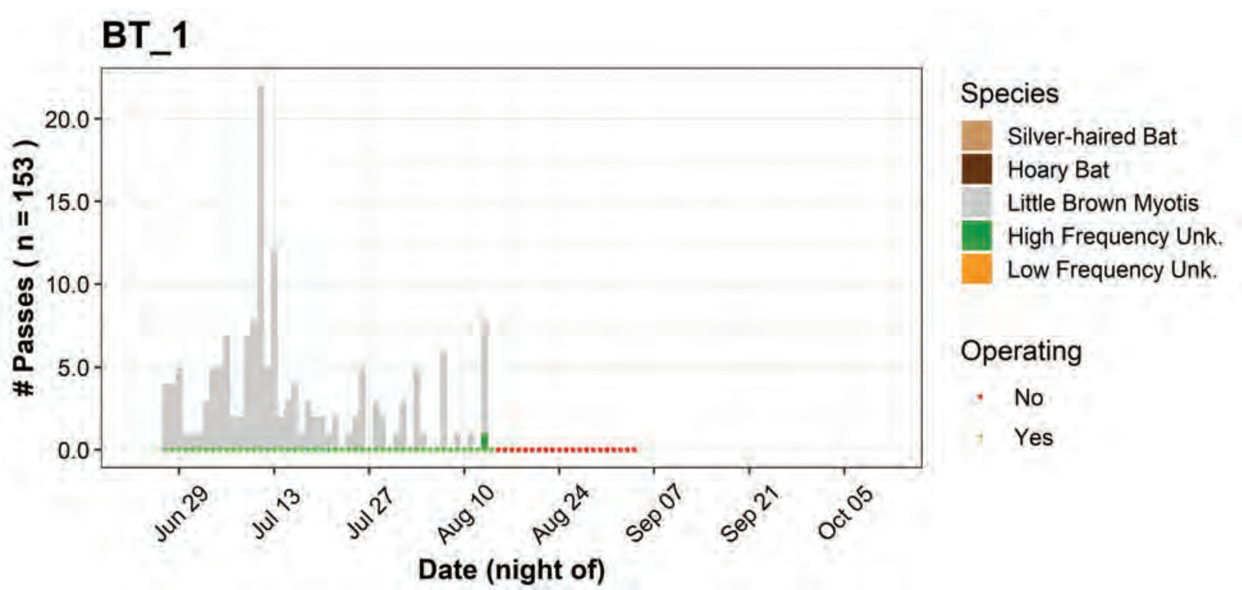

Figure 3-4 Species recordings by date at BT1

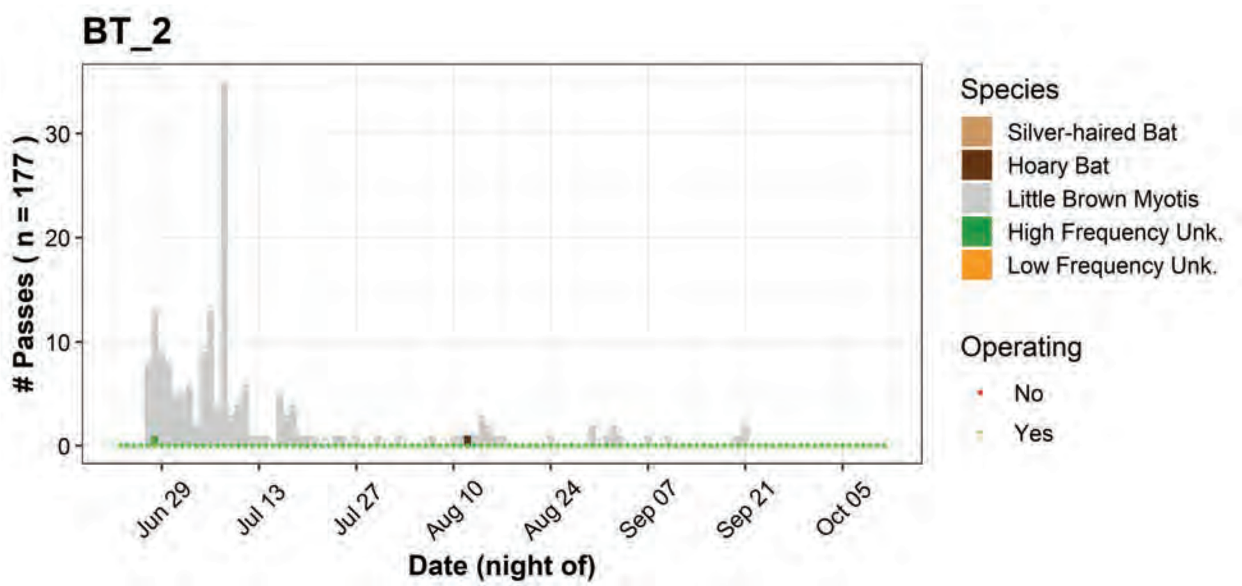

Figure 3-5 Species recordings by date at BT2

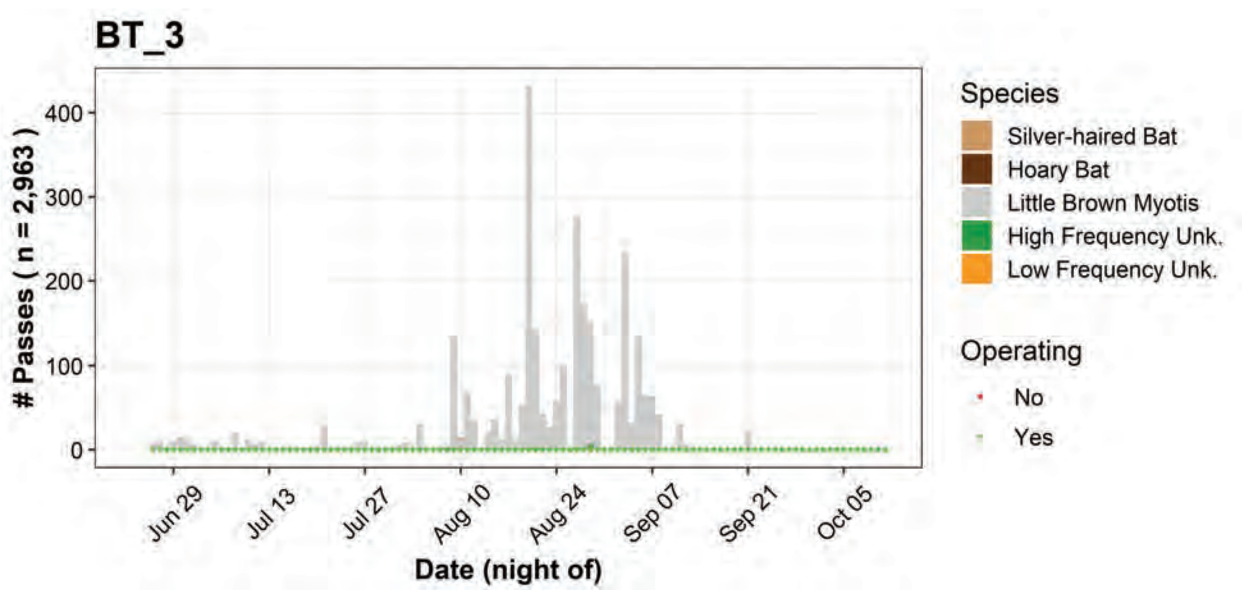

Figure 3-6 Species recordings by date at BT3

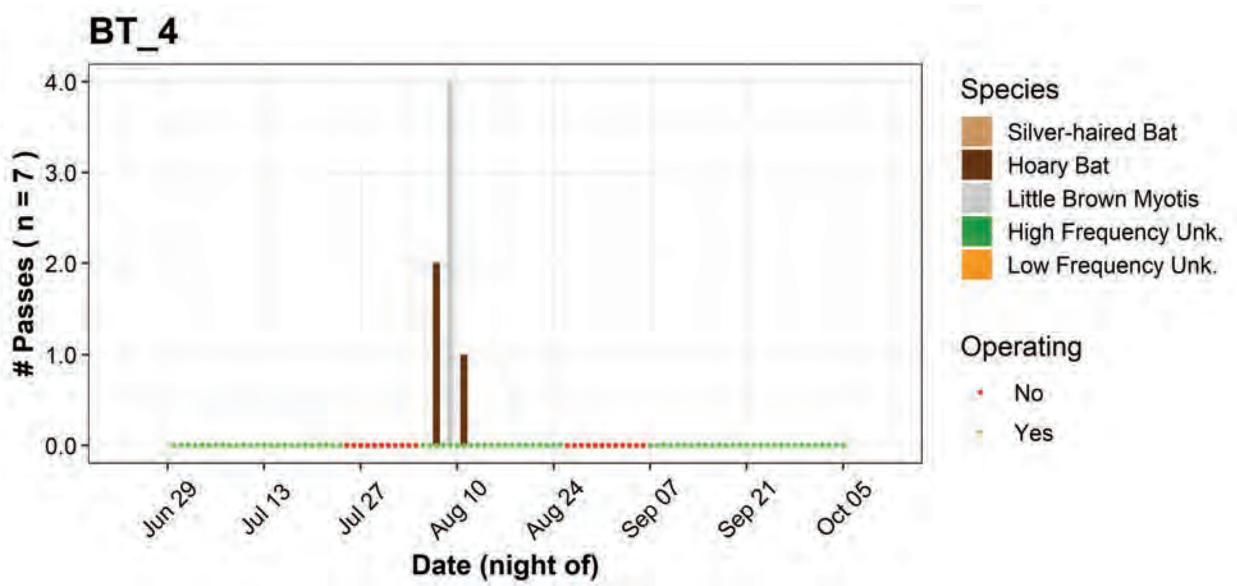

Figure 3-7 Species recordings by date at BT4

The seven hoary bat recordings occurred between August 7 and 12. This timeframe corresponds with the migration period for hoary bats, suggesting that they are migrating through the region. The one silver-haired bat detection occurred on June 30 at BT3. Activity of this species commonly peaks in late summer, corresponding with fall migration. However, detections of this species also occasionally increase during the spring migration season (Peterson, T., Stantec, pers. observation). The detection of this one bat in June could represent a spring migratory movement or an individual bat well off-course and out of the known typical range for the species.

Bat activity was also compared to hours past sunset (Figure 3-8). Most bat passes were recorded in the first hour past sunset, with the number of recorded passes decreasing steadily through to sunrise. No bat passes were detected before sunset or after sunrise.

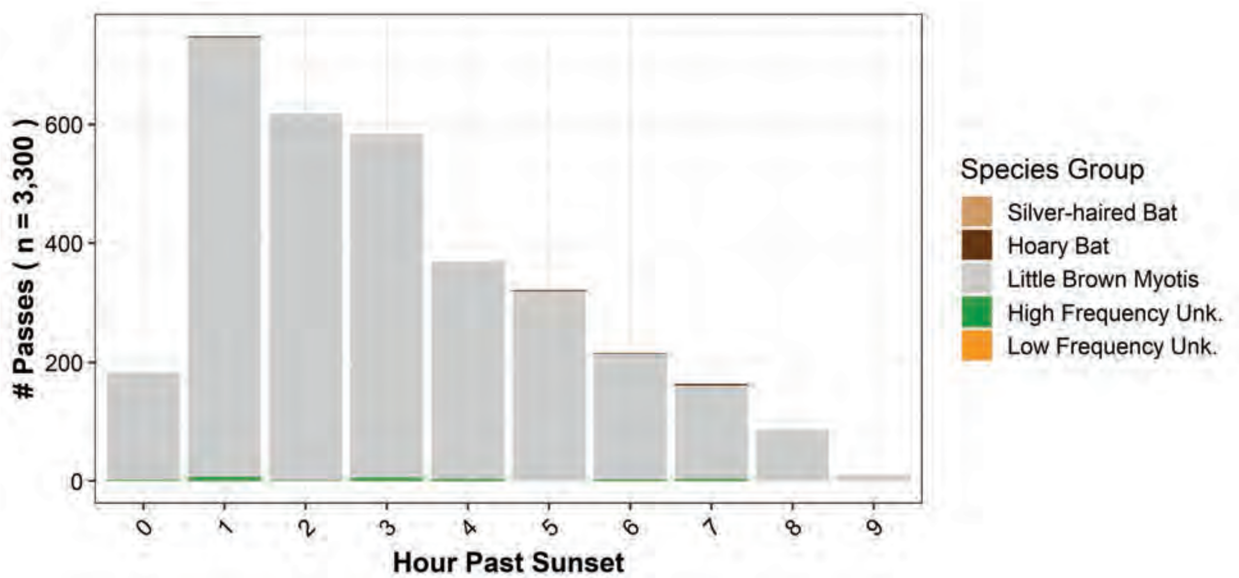

Figure 3-8 Number of bat passes recorded during each hour past sunset

3.2.4 Activity Patterns based on Weather

Hourly temperatures measured at night at the VNL weather station during the time when the bat detectors were deployed ranged from -9.9 to 23.3ºC. Bat activity occurred during hours with temperatures from 0.3 to 20.2ºC. Most bat passes occurred when hourly temperatures at the airstrip were between 7.5 and 12.5 ºC although temperatures were most often between 2.5 and 7.5 ºC (Figure 3-9). Hourly wind speeds measured at night at the VNL airstrip ranged from 0.1 and 13.7 m/s, with bat activity occurring when hourly wind speeds ranged from 0.3 and 8.2 m/s (Figure 3-10). Accordingly, bat activity occurred during relatively warm, calm conditions within the survey period.

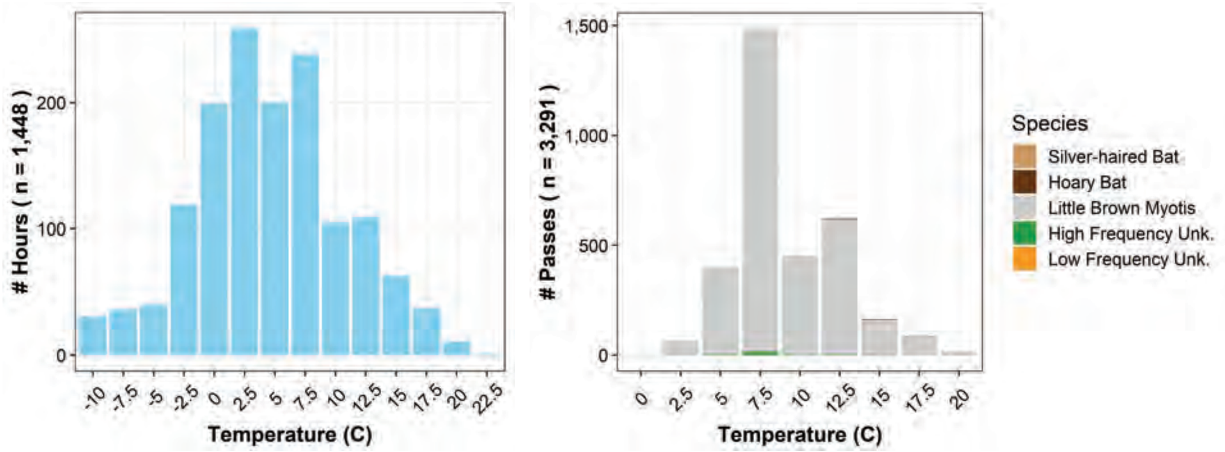

Figure 3-9 Distribution of hours at night (left) and bat activity (right) as a function of hourly temperature measured at the VNL airstrip

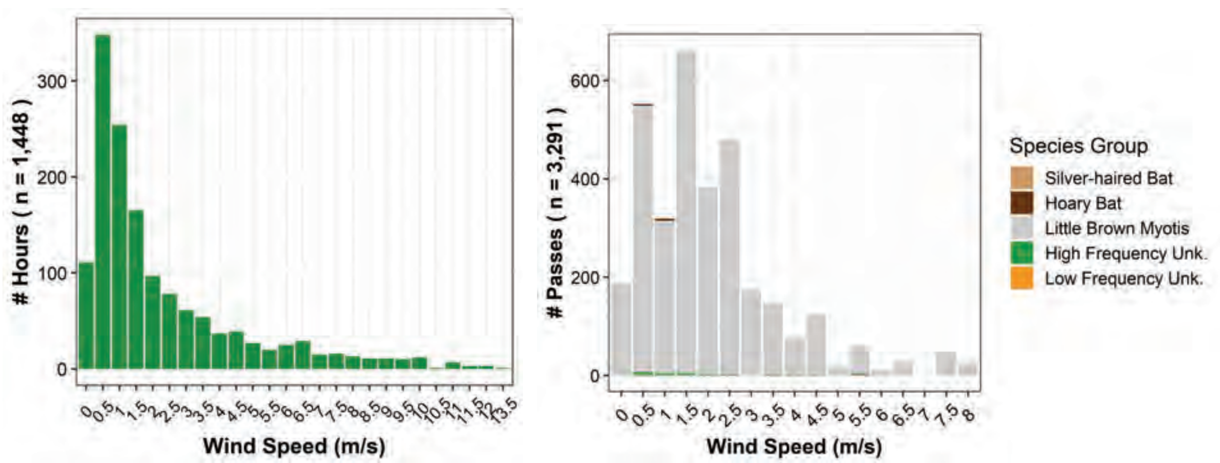

Figure 3-10 Distribution of hours at night (left) and bat activity (right) as a function of hourly wind speed measured at the VNL airstrip

4.0 SUMMARY AND CONCLUSION

Between June 23 and October 11, 2020, four acoustic detectors recorded 3,300 bat echolocation sequences. Of the sequences that could be identified to species, approximately 99% were identified as little brown myotis, which is a species-at-risk in Canada. An additional seven echolocation sequences were identified as hoary bats, and one was identified as a silver-haired bat.

Species identification based on acoustic data can be subjective, and provides less certainty than bats in hand. However, of the passes identified as hoary and silver-haired bats during our analysis, each had characteristics considered diagnostic for the species. For hoary bats, these characteristics include variable minimum frequencies extending below 20 kHz, hook-shaped pulses, and long pulse duration. In Eastern Canada, silver-haired bats would be the only species to produce calls with a quasi-constant minimum frequency of approximately 26 kHz and maximum frequency not exceeding approximately 55 kHz. Little brown myotis passes can be distinguished from northern long-eared myotis by their lower minimum and maximum frequencies, longer call duration, and less steep slope, and can be distinguished from eastern red bats by a more consistent profile, the minimum frequency, and the absence of a hook-shaped profile. Appendix C includes representative screenshots of bat passes recorded during the survey that were identified as little brown myotis, hoary bat, and silver-haired bat.

Migratory, tree roosting bats, including hoary bats and silver-haired bats, are most susceptible to wind turbine strikes, particularly during the migratory period. Hoary bats account for approximately half of all bat fatalities at wind turbine facilities in North America (Arnett et al. 2008). While hoary bats were recorded in the surveys, this species occurred in low numbers. Only one silver-haired bat was recorded, suggesting that this species is uncommon in the area.

Most bats were recorded at BT3, which was located approximately 200 m west of the existing port road on Little Reid Brook. The high level of bat activity at BT3 may be attributed to habitat preferences; bats may use the brook for commuting and/or foraging. Only seven bat passes were recorded at BT4, which was located on the MET tower at Sara Hill. This detector was located at 18 m in height above ground in an area above 300 m altitude, in comparison to the other three detectors which were deployed 2 m above the ground in areas below approximately 200 m altitude. These results may indicate one of two things; it could suggest that bats in this area more commonly occurred near the ground, rather than higher up and within the rotor-swept zone of future wind turbines; or, the low bat activity at BT4 could simply be a function of habitat preference, and indicate that bats are not common in open, wind-swept barrens habitat that occurs at higher altitudes in the area.

At BT1 and BT2, most bat activity was recorded between late June and mid-July, suggesting that these sites are used during the breeding season (though the detector at BT1 did not operate after August 14). At BT3, where most bat activity occurred, bat passes were highest from early August to early September. This suggests that bats occur more frequently in this area after maternity colonies break up, and bats may use this area while moving to swarming and/or overwintering sites.

The seven records of hoary bats occurred between August 7 and 12, which corresponds with the migratory period for this species in more southerly habitats, and the species was recorded at 3 of the 4 detector locations during that time period. This suggests that hoary bats may be migrating through the region in low numbers during the first half of August.

Most records of bats occurred when the average nightly temperature was between 5 and 7°C, and when average nightly wind speeds were <4 m/s.

This data represents the first confirmed record of hoary bats and silver-haired bats in Labrador. In addition, the records of little brown myotis are the most northerly records recorded in Labrador. Prior to this study, the northern-most record of a little brown myotis in Labrador was located in Makkovik (Broders 2013), which is over 200 km southeast of Voisey's Bay. As such, this data represents a range expansion for the little brown myotis.

Overall, the results of the bat acoustic surveys have provided important baseline information in a previously unstudied area. It is now known that little brown myotis commonly occur in this area, and two species of migratory bats also occur in lower numbers.

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2020. Humber, J. Ecosystem Management Ecologist (Endangered Species & Biodiversity), NL Wildlife Division. Phone Conversations on May 7 and June 10. 2020.

APPENDIX A

Photo of Bat Detector in MET Tower (BT4)

Appendix A PHOTO OF BAT DETECTOR IN MET TOWER (BT4)

Photo A.1 Bat detector set up in MET tower (BT4)

APPENDIX B

Raw Acoustic Detector Results

Appendix B RAW ACOUSTIC DETECTOR RESULTS

Table B.1 Raw Acoustic Detector Results and Weather Data

Detector	Date (night of)	Bat Activity (Number of Bat Passes)					Weather Data (Average Nightly Values)				
		Silver Haired Bat	Hoary Bat	Little Brown myotis	Unidentified Bat	Total	Mean Temperature (°C)	Mean Wind Speed (m/s)	Mean Humidity (%)	Mean Pressure (hpa)	Precipitation (mm)
BT_1	6/27/2020	0	0	4	0	4	4.06	1.60	99.42	1017.00	0
BT_1	6/28/2020	0	0	4	0	4	5.28	1.18	95.73	1021.83	0
BT_1	6/29/2020	0	0	5	0	5	12.54	1.11	85.57	1014.67	0
BT_1	6/30/2020	0	0	1	0	1	9.55	2.44	93.68	1013.17	0
BT_1	7/1/2020	0	0	1	0	1	4.89	0.82	99.88	1014.67	0
BT_1	7/2/2020	0	0	1	0	1	5.21	0.70	91.25	1013.83	0
BT_1	7/3/2020	0	0	3	0	3	5.84	0.81	81.13	1015.17	0
BT_1	7/4/2020	0	0	5	0	5	4.92	0.84	83.74	1016.43	0
BT_1	7/5/2020	0	0	5	0	5	14.52	0.95	62.49	1014.00	0
BT_1	7/6/2020	0	0	7	0	7	13.95	0.86	81.12	1015.57	0
BT_1	7/7/2020	0	0	2	0	2	18.64	1.37	56.16	1006.86	0
BT_1	7/8/2020	0	0	2	0	2	16.03	2.03	62.42	1004.29	0
BT_1	7/9/2020	0	0	7	0	7	6.60	1.43	94.37	1016.57	0
BT_1	7/10/2020	0	0	8	0	8	13.38	1.15	80.63	1008.29	0
BT_1	7/11/2020	0	0	22	0	22	8.93	0.93	100.00	1002.86	2.9
BT_1	7/12/2020	0	0	5	0	5	7.71	1.36	85.71	1006.71	0.1
BT_1	7/13/2020	0	0	12	0	12	6.22	0.74	93.64	1019.57	0
BT_1	7/14/2020	0	0	2	0	2	7.36	0.86	84.62	1024.00	0

Table B.1 Raw Acoustic Detector Results and Weather Data

Detector	Date (night of)	Bat Activity (Number of Bat Passes)					Weather Data (Average Nightly Values)				
		Silver Haired Bat	Hoary Bat	Little Brown myotis	Unidentified Bat	Total	Mean Temperature (°C)	Mean Wind Speed (m/s)	Mean Humidity (%)	Mean Pressure (hpa)	Precipitation (mm)
BT_1	7/15/2020	0	0	3	0	3	8.86	1.09	76.84	1024.57	0
BT_1	7/16/2020	0	0	4	0	4	18.02	1.67	60.90	1016.57	0
BT_1	7/17/2020	0	0	1	0	1	17.73	1.18	75.33	1009.33	0
BT_1	7/18/2020	0	0	3	0	3	17.17	1.56	82.32	1005.83	0
BT_1	7/19/2020	0	0	2	0	2	15.72	2.29	79.35	1003.71	0
BT_1	7/20/2020	0	0	2	0	2	14.41	1.33	98.56	989.43	0
BT_1	7/21/2020	0	0	1	0	1	15.51	4.21	75.35	998.57	0
BT_1	7/22/2020	0	0	2	0	2	14.51	3.67	73.53	1007.29	0
BT_1	7/23/2020	0	0	0	0	0	12.37	1.10	93.97	1008.29	1.2
BT_1	7/24/2020	0	0	1	0	1	13.03	0.83	95.60	1008.00	0.9
BT_1	7/25/2020	0	0	2	0	2	9.93	1.04	99.69	1008.63	0
BT_1	7/26/2020	0	0	5	0	5	9.95	1.61	81.96	1007.25	0
BT_1	7/27/2020	0	0	0	0	0	9.31	1.34	82.52	1013.25	0
BT_1	7/28/2020	0	0	3	0	3	5.47	0.93	97.23	1016.00	0
BT_1	7/29/2020	0	0	2	0	2	9.14	0.81	89.33	1013.50	0
BT_1	7/30/2020	0	0	0	0	0	8.86	1.20	91.79	1013.63	0
BT_1	7/31/2020	0	0	1	0	1	13.07	0.70	82.73	1010.00	0
BT_1	8/1/2020	0	0	3	0	3	15.43	0.56	78.75	1006.38	0
BT_1	8/2/2020	0	0	0	0	0	9.81	1.73	98.71	1011.88	8.1
BT_1	8/3/2020	0	0	5	0	5	7.61	0.91	94.98	1015.38	0
BT_1	8/4/2020	0	0	1	0	1	18.42	2.99	58.00	1015.50	0

Table B.1 Raw Acoustic Detector Results and Weather Data

Detector	Date (night of)	Bat Activity (Number of Bat Passes)					Weather Data (Average Nightly Values)				
		Silver Haired Bat	Hoary Bat	Little Brown myotis	Unidentified Bat	Total	Mean Temperature (°C)	Mean Wind Speed (m/s)	Mean Humidity (%)	Mean Pressure (hpa)	Precipitation (mm)
BT_1	8/5/2020	0	0	0	0	0	17.99	1.08	67.75	1003.63	0
BT_1	8/6/2020	0	0	0	0	0	12.09	1.16	86.01	1004.63	0
BT_1	8/7/2020	0	0	6	0	6	14.78	0.94	64.46	1009.88	0
BT_1	8/8/2020	0	0	0	0	0	17.25	1.10	96.25	1004.00	4.5
BT_1	8/9/2020	0	0	1	0	1	10.77	1.43	84.48	1012.00	0
BT_1	8/10/2020	0	0	0	0	0	19.80	1.13	64.35	1000.67	0
BT_1	8/11/2020	0	0	1	0	1	18.52	1.17	75.64	1000.33	0
BT_1	8/12/2020	0	0	0	0	0	12.18	2.15	85.18	1012.22	0
BT_1	8/13/2020	0	0	7	1	8	5.92	0.78	91.32	1023.00	0
BT_1	8/14/2020	0	0	0	0	0	14.76	1.75	57.55	1020.56	0
BT_2	6/23/2020	0	0	0	0	0	9.11	0.46	100.00	1007.50	0
BT_2	6/24/2020	0	0	0	0	0	2.92	0.84	93.62	1014.00	0
BT_2	6/25/2020	0	0	0	0	0	3.51	2.63	99.67	1016.17	3
BT_2	6/26/2020	0	0	0	0	0	4.12	1.79	100.00	1016.00	0
BT_2	6/27/2020	0	0	8	0	8	4.06	1.60	99.42	1017.00	0
BT_2	6/28/2020	0	0	12	1	13	5.28	1.18	95.73	1021.83	0
BT_2	6/29/2020	0	0	9	0	9	12.54	1.11	85.57	1014.67	0
BT_2	6/30/2020	0	0	8	0	8	9.55	2.44	93.68	1013.17	0
BT_2	7/1/2020	0	0	5	0	5	4.89	0.82	99.88	1014.67	0
BT_2	7/2/2020	0	0	5	0	5	5.21	0.70	91.25	1013.83	0
BT_2	7/3/2020	0	0	6	0	6	5.84	0.81	81.13	1015.17	0

Table B.1 Raw Acoustic Detector Results and Weather Data

Detector	Date (night of)	Bat Activity (Number of Bat Passes)					Weather Data (Average Nightly Values)				
		Silver Haired Bat	Hoary Bat	Little Brown myotis	Unidentified Bat	Total	Mean Temperature (°C)	Mean Wind Speed (m/s)	Mean Humidity (%)	Mean Pressure (hpa)	Precipitation (mm)
BT_2	7/4/2020	0	0	2	0	2	4.92	0.84	83.74	1016.43	0
BT_2	7/5/2020	0	0	9	0	9	14.52	0.95	62.49	1014.00	0
BT_2	7/6/2020	0	0	13	0	13	13.95	0.86	81.12	1015.57	0
BT_2	7/7/2020	0	0	4	0	4	18.64	1.37	56.16	1006.86	0
BT_2	7/8/2020	0	0	35	0	35	16.03	2.03	62.42	1004.29	0
BT_2	7/9/2020	0	0	3	0	3	6.60	1.43	94.37	1016.57	0
BT_2	7/10/2020	0	0	4	0	4	13.38	1.15	80.63	1008.29	0
BT_2	7/11/2020	0	0	6	0	6	8.93	0.93	100.00	1002.86	2.9
BT_2	7/12/2020	0	0	1	0	1	7.71	1.36	85.71	1006.71	0.1
BT_2	7/13/2020	0	0	1	0	1	6.22	0.74	93.64	1019.57	0
BT_2	7/14/2020	0	0	1	0	1	7.36	0.86	84.62	1024.00	0
BT_2	7/15/2020	0	0	0	0	0	8.86	1.09	76.84	1024.57	0
BT_2	7/16/2020	0	0	5	0	5	18.02	1.67	60.90	1016.57	0
BT_2	7/17/2020	0	0	3	0	3	17.73	1.18	75.33	1009.33	0
BT_2	7/18/2020	0	0	4	0	4	17.17	1.56	82.32	1005.83	0
BT_2	7/19/2020	0	0	1	0	1	15.72	2.29	79.35	1003.71	0
BT_2	7/20/2020	0	0	1	0	1	14.41	1.33	98.56	989.43	0
BT_2	7/21/2020	0	0	1	0	1	15.51	4.21	75.35	998.57	0
BT_2	7/22/2020	0	0	0	0	0	14.51	3.67	73.53	1007.29	0
BT_2	7/23/2020	0	0	0	0	0	12.37	1.10	93.97	1008.29	1.2
BT_2	7/24/2020	0	0	1	0	1	13.03	0.83	95.60	1008.00	0.9

Table B.1 Raw Acoustic Detector Results and Weather Data

Detector	Date (night of)	Bat Activity (Number of Bat Passes)					Weather Data (Average Nightly Values)				
		Silver Haired Bat	Hoary Bat	Little Brown myotis	Unidentified Bat	Total	Mean Temperature (°C)	Mean Wind Speed (m/s)	Mean Humidity (%)	Mean Pressure (hpa)	Precipitation (mm)
BT_2	7/25/2020	0	0	1	0	1	9.93	1.04	99.69	1008.63	0
BT_2	7/26/2020	0	0	0	0	0	9.95	1.61	81.96	1007.25	0
BT_2	7/27/2020	0	0	1	0	1	9.31	1.34	82.52	1013.25	0
BT_2	7/28/2020	0	0	0	0	0	5.47	0.93	97.23	1016.00	0
BT_2	7/29/2020	0	0	0	0	0	9.14	0.81	89.33	1013.50	0
BT_2	7/30/2020	0	0	1	0	1	8.86	1.20	91.79	1013.63	0
BT_2	7/31/2020	0	0	0	0	0	13.07	0.70	82.73	1010.00	0
BT_2	8/1/2020	0	0	0	0	0	15.43	0.56	78.75	1006.38	0
BT_2	8/2/2020	0	0	1	0	1	9.81	1.73	98.71	1011.88	8.1
BT_2	8/3/2020	0	0	0	0	0	7.61	0.91	94.98	1015.38	0
BT_2	8/4/2020	0	0	0	0	0	18.42	2.99	58.00	1015.50	0
BT_2	8/5/2020	0	0	0	0	0	17.99	1.08	67.75	1003.63	0
BT_2	8/6/2020	0	0	0	0	0	12.09	1.16	86.01	1004.63	0
BT_2	8/7/2020	0	0	1	0	1	14.78	0.94	64.46	1009.88	0
BT_2	8/8/2020	0	0	0	0	0	17.25	1.10	96.25	1004.00	4.5
BT_2	8/9/2020	0	0	0	0	0	10.77	1.43	84.48	1012.00	0
BT_2	8/10/2020	0	0	1	0	1	19.80	1.13	64.35	1000.67	0
BT_2	8/11/2020	0	0	1	0	1	18.52	1.17	75.64	1000.33	0
BT_2	8/12/2020	0	1	0	0	1	12.18	2.15	85.18	1012.22	0
BT_2	8/13/2020	0	0	1	0	1	5.92	0.78	91.32	1023.00	0
BT_2	8/14/2020	0	0	3	0	3	14.76	1.75	57.55	1020.56	0

Table B.1 Raw Acoustic Detector Results and Weather Data

Detector	Date (night of)	Bat Activity (Number of Bat Passes)					Weather Data (Average Nightly Values)				
		Silver Haired Bat	Hoary Bat	Little Brown myotis	Unidentified Bat	Total	Mean Temperature (°C)	Mean Wind Speed (m/s)	Mean Humidity (%)	Mean Pressure (hpa)	Precipitation (mm)
BT_2	8/15/2020	0	0	2	0	2	14.32	0.84	64.48	1014.56	0
BT_2	8/16/2020	0	0	1	0	1	15.23	0.83	70.29	1012.88	0
BT_2	8/17/2020	0	0	1	0	1	11.93	1.67	78.50	1011.11	0
BT_2	8/18/2020	0	0	0	0	0	8.97	1.17	97.16	1008.56	0
BT_2	8/19/2020	0	0	0	0	0	9.04	3.12	98.93	1005.33	0.6
BT_2	8/20/2020	0	0	0	0	0	8.47	1.94	99.18	1000.67	2
BT_2	8/21/2020	0	0	0	0	0	9.07	2.31	96.88	1008.11	0.7
BT_2	8/22/2020	0	0	0	0	0	8.64	1.04	98.66	1012.56	0.6
BT_2	8/23/2020	0	0	0	0	0	6.24	0.90	97.34	1011.67	0.3
BT_2	8/24/2020	0	0	1	0	1	6.52	1.48	98.99	1012.60	0.2
BT_2	8/25/2020	0	0	0	0	0	7.82	4.01	98.18	1001.90	1.1
BT_2	8/26/2020	0	0	0	0	0	8.87	8.47	94.90	994.40	6.4
BT_2	8/27/2020	0	0	0	0	0	8.48	1.74	98.18	993.00	2.9
BT_2	8/28/2020	0	0	0	0	0	9.18	2.04	77.98	996.70	1.2
BT_2	8/29/2020	0	0	0	0	0	8.56	3.78	71.33	1003.10	0.9
BT_2	8/30/2020	0	0	2	0	2	7.28	0.67	92.33	1009.60	0.7
BT_2	8/31/2020	0	0	0	0	0	3.67	0.90	89.22	1017.00	0.8
BT_2	9/1/2020	0	0	1	0	1	7.88	0.70	85.28	1013.40	0.5
BT_2	9/2/2020	0	0	2	0	2	14.74	3.43	87.96	992.30	0.4
BT_2	9/3/2020	0	0	1	0	1	12.25	2.51	81.14	1000.10	0.4
BT_2	9/4/2020	0	0	0	0	0	8.52	2.41	86.80	993.36	0.3

Table B.1 Raw Acoustic Detector Results and Weather Data

Detector	Date (night of)	Bat Activity (Number of Bat Passes)					Weather Data (Average Nightly Values)				
		Silver Haired Bat	Hoary Bat	Little Brown myotis	Unidentified Bat	Total	Mean Temperature (°C)	Mean Wind Speed (m/s)	Mean Humidity (%)	Mean Pressure (hpa)	Precipitation (mm)
BT_2	9/5/2020	0	0	0	0	0	10.46	5.12	76.21	999.45	0.3
BT_2	9/6/2020	0	0	0	0	0	4.18	0.83	98.58	1015.55	0.2
BT_2	9/7/2020	0	0	1	0	1	11.95	3.67	85.64	1005.09	0.2
BT_2	9/8/2020	0	0	0	0	0	9.87	6.93	74.99	1001.82	0.2
BT_2	9/9/2020	0	0	0	0	0	6.46	2.01	82.66	1023.00	0.1
BT_2	9/10/2020	0	0	1	0	1	3.06	0.64	97.15	1019.55	0
BT_2	9/11/2020	0	0	0	0	0	8.49	3.67	78.31	1009.18	0
BT_2	9/12/2020	0	0	0	0	0	5.37	2.96	87.67	1015.45	0.6
BT_2	9/13/2020	0	0	0	0	0	8.42	1.35	100.00	995.09	0.5
BT_2	9/14/2020	0	0	0	0	0	6.24	10.26	70.08	989.91	0.7
BT_2	9/15/2020	0	0	0	0	0	3.86	5.40	71.21	1009.64	0.1
BT_2	9/16/2020	0	0	0	0	0	6.08	2.11	96.50	998.55	0.9
BT_2	9/17/2020	0	0	0	0	0	3.79	8.42	63.20	998.64	0.1
BT_2	9/18/2020	0	0	0	0	0	0.27	1.45	95.60	1016.73	0
BT_2	9/19/2020	0	0	0	0	0	1.88	1.58	83.95	1020.91	0
BT_2	9/20/2020	0	0	1	0	1	6.51	5.59	74.00	1017.00	0
BT_2	9/21/2020	0	0	2	0	2	13.68	3.92	67.63	1013.45	0
BT_2	9/22/2020	0	0	0	0	0	8.20	0.77	93.42	1006.91	0
BT_2	9/23/2020	0	0	0	0	0	10.91	1.79	86.76	989.64	0
BT_2	9/24/2020	0	0	0	0	0	5.03	8.24	69.91	988.17	0.1
BT_2	9/25/2020	0	0	0	0	0	4.32	8.76	58.70	1001.08	0

Table B.1 Raw Acoustic Detector Results and Weather Data

Detector	Date (night of)	Bat Activity (Number of Bat Passes)					Weather Data (Average Nightly Values)				
		Silver Haired Bat	Hoary Bat	Little Brown myotis	Unidentified Bat	Total	Mean Temperature (°C)	Mean Wind Speed (m/s)	Mean Humidity (%)	Mean Pressure (hpa)	Precipitation (mm)
BT_2	9/26/2020	0	0	0	0	0	1.60	1.39	86.48	1010.38	0
BT_2	9/27/2020	0	0	0	0	0	2.44	1.84	95.33	1011.62	0.1
BT_2	9/28/2020	0	0	0	0	0	2.11	0.95	99.71	1014.23	0.1
BT_2	9/29/2020	0	0	0	0	0	3.96	1.91	99.63	1003.77	1
BT_2	9/30/2020	0	0	0	0	0	6.87	4.60	95.38	977.62	1.1
BT_2	10/1/2020	0	0	0	0	0	2.33	3.64	75.72	1005.15	0.5
BT_2	10/2/2020	0	0	0	0	0	2.13	1.20	79.81	1017.92	0.1
BT_2	10/3/2020	0	0	0	0	0	-0.55	1.44	96.58	1019.85	0.1
BT_2	10/4/2020	0	0	0	0	0	-1.28	0.94	85.69	1018.23	0
BT_2	10/5/2020	0	0	0	0	0	-0.69	1.26	77.06	1013.77	0
BT_2	10/6/2020	0	0	0	0	0	8.94	3.52	74.91	994.23	0
BT_2	10/7/2020	0	0	0	0	0	0.54	1.28	86.27	1001.08	0
BT_2	10/8/2020	0	0	0	0	0	1.14	3.55	96.72	986.08	0.9
BT_2	10/9/2020	0	0	0	0	0	1.66	11.06	69.93	982.23	0.6
BT_2	10/10/2020	0	0	0	0	0	1.98	6.52	59.61	996.77	0.1
BT_2	10/11/2020	0	0	0	0	0	4.24	6.94	65.67	1006.62	0
BT_3	6/26/2020	0	0	8	0	8	4.12	1.79	100.00	1016.00	0
BT_3	6/27/2020	0	0	12	0	12	4.06	1.60	99.42	1017.00	0
BT_3	6/28/2020	0	0	4	0	4	5.28	1.18	95.73	1021.83	0
BT_3	6/29/2020	0	0	10	0	10	12.54	1.11	85.57	1014.67	0
BT_3	6/30/2020	1	0	14	0	15	9.55	2.44	93.68	1013.17	0

Table B.1 Raw Acoustic Detector Results and Weather Data

Detector	Date (night of)	Bat Activity (Number of Bat Passes)					Weather Data (Average Nightly Values)				
		Silver Haired Bat	Hoary Bat	Little Brown myotis	Unidentified Bat	Total	Mean Temperature (°C)	Mean Wind Speed (m/s)	Mean Humidity (%)	Mean Pressure (hpa)	Precipitation (mm)
BT_3	7/1/2020	0	0	12	1	13	4.89	0.82	99.88	1014.67	0
BT_3	7/2/2020	0	0	6	0	6	5.21	0.70	91.25	1013.83	0
BT_3	7/3/2020	0	0	4	0	4	5.84	0.81	81.13	1015.17	0
BT_3	7/4/2020	0	0	1	0	1	4.92	0.84	83.74	1016.43	0
BT_3	7/5/2020	0	0	11	0	11	14.52	0.95	62.49	1014.00	0
BT_3	7/6/2020	0	0	3	0	3	13.95	0.86	81.12	1015.57	0
BT_3	7/7/2020	0	0	3	0	3	18.64	1.37	56.16	1006.86	0
BT_3	7/8/2020	0	0	19	1	20	16.03	2.03	62.42	1004.29	0
BT_3	7/9/2020	0	0	0	0	0	6.60	1.43	94.37	1016.57	0
BT_3	7/10/2020	0	0	12	1	13	13.38	1.15	80.63	1008.29	0
BT_3	7/11/2020	0	0	6	0	6	8.93	0.93	100.00	1002.86	2.9
BT_3	7/12/2020	0	0	10	0	10	7.71	1.36	85.71	1006.71	0.1
BT_3	7/13/2020	0	0	0	0	0	6.22	0.74	93.64	1019.57	0
BT_3	7/14/2020	0	0	0	0	0	7.36	0.86	84.62	1024.00	0
BT_3	7/15/2020	0	0	0	0	0	8.86	1.09	76.84	1024.57	0
BT_3	7/16/2020	0	0	4	0	4	18.02	1.67	60.90	1016.57	0
BT_3	7/17/2020	0	0	4	0	4	17.73	1.18	75.33	1009.33	0
BT_3	7/18/2020	0	0	2	0	2	17.17	1.56	82.32	1005.83	0
BT_3	7/19/2020	0	0	3	0	3	15.72	2.29	79.35	1003.71	0
BT_3	7/20/2020	0	0	4	0	4	14.41	1.33	98.56	989.43	0
BT_3	7/21/2020	0	0	29	0	29	15.51	4.21	75.35	998.57	0

Table B.1 Raw Acoustic Detector Results and Weather Data

Detector	Date (night of)	Bat Activity (Number of Bat Passes)					Weather Data (Average Nightly Values)				
		Silver Haired Bat	Hoary Bat	Little Brown myotis	Unidentified Bat	Total	Mean Temperature (°C)	Mean Wind Speed (m/s)	Mean Humidity (%)	Mean Pressure (hpa)	Precipitation (mm)
BT_3	7/22/2020	0	0	4	0	4	14.51	3.67	73.53	1007.29	0
BT_3	7/23/2020	0	0	1	0	1	12.37	1.10	93.97	1008.29	1.2
BT_3	7/24/2020	0	0	3	1	4	13.03	0.83	95.60	1008.00	0.9
BT_3	7/25/2020	0	0	4	0	4	9.93	1.04	99.69	1008.63	0
BT_3	7/26/2020	0	0	9	0	9	9.95	1.61	81.96	1007.25	0
BT_3	7/27/2020	0	0	11	0	11	9.31	1.34	82.52	1013.25	0
BT_3	7/28/2020	0	0	0	0	0	5.47	0.93	97.23	1016.00	0
BT_3	7/29/2020	0	0	3	0	3	9.14	0.81	89.33	1013.50	0
BT_3	7/30/2020	0	0	0	0	0	8.86	1.20	91.79	1013.63	0
BT_3	7/31/2020	0	0	3	0	3	13.07	0.70	82.73	1010.00	0
BT_3	8/1/2020	0	0	6	0	6	15.43	0.56	78.75	1006.38	0
BT_3	8/2/2020	0	0	9	0	9	9.81	1.73	98.71	1011.88	8.1
BT_3	8/3/2020	0	0	0	0	0	7.61	0.91	94.98	1015.38	0
BT_3	8/4/2020	0	0	31	0	31	18.42	2.99	58.00	1015.50	0
BT_3	8/5/2020	0	0	3	0	3	17.99	1.08	67.75	1003.63	0
BT_3	8/6/2020	0	0	1	0	1	12.09	1.16	86.01	1004.63	0
BT_3	8/7/2020	0	0	3	0	3	14.78	0.94	64.46	1009.88	0
BT_3	8/8/2020	0	2	1	0	3	17.25	1.10	96.25	1004.00	4.5
BT_3	8/9/2020	0	0	135	0	135	10.77	1.43	84.48	1012.00	0
BT_3	8/10/2020	0	1	12	0	13	19.80	1.13	64.35	1000.67	0
BT_3	8/11/2020	0	0	69	1	70	18.52	1.17	75.64	1000.33	0

Table B.1 Raw Acoustic Detector Results and Weather Data

Detector	Date (night of)	Bat Activity (Number of Bat Passes)					Weather Data (Average Nightly Values)				
		Silver Haired Bat	Hoary Bat	Little Brown myotis	Unidentified Bat	Total	Mean Temperature (°C)	Mean Wind Speed (m/s)	Mean Humidity (%)	Mean Pressure (hpa)	Precipitation (mm)
BT_3	8/12/2020	0	0	35	1	36	12.18	2.15	85.18	1012.22	0
BT_3	8/13/2020	0	0	0	0	0	5.92	0.78	91.32	1023.00	0
BT_3	8/14/2020	0	0	21	1	22	14.76	1.75	57.55	1020.56	0
BT_3	8/15/2020	0	0	37	0	37	14.32	0.84	64.48	1014.56	0
BT_3	8/16/2020	0	0	13	0	13	15.23	0.83	70.29	1012.88	0
BT_3	8/17/2020	0	0	90	0	90	11.93	1.67	78.50	1011.11	0
BT_3	8/18/2020	0	0	12	1	13	8.97	1.17	97.16	1008.56	0
BT_3	8/19/2020	0	0	54	0	54	9.04	3.12	98.93	1005.33	0.6
BT_3	8/20/2020	0	0	431	1	432	8.47	1.94	99.18	1000.67	2
BT_3	8/21/2020	0	0	141	3	144	9.07	2.31	96.88	1008.11	0.7
BT_3	8/22/2020	0	0	43	0	43	8.64	1.04	98.66	1012.56	0.6
BT_3	8/23/2020	0	0	27	0	27	6.24	0.90	97.34	1011.67	0.3
BT_3	8/24/2020	0	0	58	0	58	6.52	1.48	98.99	1012.60	0.2
BT_3	8/25/2020	0	0	99	1	100	7.82	4.01	98.18	1001.90	1.1
BT_3	8/26/2020	0	0	0	0	0	8.87	8.47	94.90	994.40	6.4
BT_3	8/27/2020	0	0	274	3	277	8.48	1.74	98.18	993.00	2.9
BT_3	8/28/2020	0	0	175	0	175	9.18	2.04	77.98	996.70	1.2
BT_3	8/29/2020	0	0	146	7	153	8.56	3.78	71.33	1003.10	0.9
BT_3	8/30/2020	0	0	77	0	77	7.28	0.67	92.33	1009.60	0.7
BT_3	8/31/2020	0	0	0	0	0	3.67	0.90	89.22	1017.00	0.8
BT_3	9/1/2020	0	0	4	0	4	7.88	0.70	85.28	1013.40	0.5

Table B.1 Raw Acoustic Detector Results and Weather Data

Detector	Date (night of)	Bat Activity (Number of Bat Passes)					Weather Data (Average Nightly Values)				
		Silver Haired Bat	Hoary Bat	Little Brown myotis	Unidentified Bat	Total	Mean Temperature (°C)	Mean Wind Speed (m/s)	Mean Humidity (%)	Mean Pressure (hpa)	Precipitation (mm)
BT_3	9/2/2020	0	0	56	1	57	14.74	3.43	87.96	992.30	0.4
BT_3	9/3/2020	0	0	234	0	234	12.25	2.51	81.14	1000.10	0.4
BT_3	9/4/2020	0	0	31	1	32	8.52	2.41	86.80	993.36	0.3
BT_3	9/5/2020	0	0	139	0	139	10.46	5.12	76.21	999.45	0.3
BT_3	9/6/2020	0	0	64	0	64	4.18	0.83	98.58	1015.55	0.2
BT_3	9/7/2020	0	0	63	0	63	11.95	3.67	85.64	1005.09	0.2
BT_3	9/8/2020	0	0	42	0	42	9.87	6.93	74.99	1001.82	0.2
BT_3	9/9/2020	0	0	3	0	3	6.46	2.01	82.66	1023.00	0.1
BT_3	9/10/2020	0	0	0	0	0	3.06	0.64	97.15	1019.55	0
BT_3	9/11/2020	0	0	31	0	31	8.49	3.67	78.31	1009.18	0
BT_3	9/12/2020	0	0	7	0	7	5.37	2.96	87.67	1015.45	0.6
BT_3	9/13/2020	0	0	2	0	2	8.42	1.35	100.00	995.09	0.5
BT_3	9/14/2020	0	0	0	0	0	6.24	10.26	70.08	989.91	0.7
BT_3	9/15/2020	0	0	1	0	1	3.86	5.40	71.21	1009.64	0.1
BT_3	9/16/2020	0	0	2	0	2	6.08	2.11	96.50	998.55	0.9
BT_3	9/17/2020	0	0	0	0	0	3.79	8.42	63.20	998.64	0.1
BT_3	9/18/2020	0	0	2	0	2	0.27	1.45	95.60	1016.73	0
BT_3	9/19/2020	0	0	1	0	1	1.88	1.58	83.95	1020.91	0
BT_3	9/20/2020	0	0	1	0	1	6.51	5.59	74.00	1017.00	0
BT_3	9/21/2020	0	0	22	0	22	13.68	3.92	67.63	1013.45	0
BT_3	9/22/2020	0	0	0	0	0	8.20	0.77	93.42	1006.91	0

Table B.1 Raw Acoustic Detector Results and Weather Data

Detector	Date (night of)	Bat Activity (Number of Bat Passes)					Weather Data (Average Nightly Values)				
		Silver Haired Bat	Hoary Bat	Little Brown myotis	Unidentified Bat	Total	Mean Temperature (°C)	Mean Wind Speed (m/s)	Mean Humidity (%)	Mean Pressure (hpa)	Precipitation (mm)
BT_3	9/23/2020	0	0	1	0	1	10.91	1.79	86.76	989.64	0
BT_3	9/24/2020	0	0	0	0	0	5.03	8.24	69.91	988.17	0.1
BT_3	9/25/2020	0	0	0	0	0	4.32	8.76	58.70	1001.08	0
BT_3	9/26/2020	0	0	0	0	0	1.60	1.39	86.48	1010.38	0
BT_3	9/27/2020	0	0	1	0	1	2.44	1.84	95.33	1011.62	0.1
BT_3	9/28/2020	0	0	0	0	0	2.11	0.95	99.71	1014.23	0.1
BT_3	9/29/2020	0	0	1	0	1	3.96	1.91	99.63	1003.77	1
BT_3	9/30/2020	0	0	0	0	0	6.87	4.60	95.38	977.62	1.1
BT_3	10/1/2020	0	0	0	0	0	2.33	3.64	75.72	1005.15	0.5
BT_3	10/2/2020	0	0	1	0	1	2.13	1.20	79.81	1017.92	0.1
BT_3	10/3/2020	0	0	1	0	1	-0.55	1.44	96.58	1019.85	0.1
BT_3	10/4/2020	0	0	0	0	0	-1.28	0.94	85.69	1018.23	0
BT_3	10/5/2020	0	0	0	0	0	-0.69	1.26	77.06	1013.77	0
BT_3	10/6/2020	0	0	2	0	2	8.94	3.52	74.91	994.23	0
BT_3	10/7/2020	0	0	0	0	0	0.54	1.28	86.27	1001.08	0
BT_3	10/8/2020	0	0	0	0	0	1.14	3.55	96.72	986.08	0.9
BT_3	10/9/2020	0	0	0	0	0	1.66	11.06	69.93	982.23	0.6
BT_3	10/10/2020	0	0	0	0	0	1.98	6.52	59.61	996.77	0.1
BT_3	10/11/2020	0	0	0	0	0	4.24	6.94	65.67	1006.62	0
BT_4	6/30/2020	0	0	0	0	0	9.55	2.44	93.68	1013.17	0
BT_4	7/1/2020	0	0	0	0	0	4.89	0.82	99.88	1014.67	0

Table B.1 Raw Acoustic Detector Results and Weather Data

Detector	Date (night of)	Bat Activity (Number of Bat Passes)					Weather Data (Average Nightly Values)				
		Silver Haired Bat	Hoary Bat	Little Brown myotis	Unidentified Bat	Total	Mean Temperature (°C)	Mean Wind Speed (m/s)	Mean Humidity (%)	Mean Pressure (hpa)	Precipitation (mm)
BT_4	7/2/2020	0	0	0	0	0	5.21	0.70	91.25	1013.83	0
BT_4	7/3/2020	0	0	0	0	0	5.84	0.81	81.13	1015.17	0
BT_4	7/4/2020	0	0	0	0	0	4.92	0.84	83.74	1016.43	0
BT_4	7/5/2020	0	0	0	0	0	14.52	0.95	62.49	1014.00	0
BT_4	7/6/2020	0	0	0	0	0	13.95	0.86	81.12	1015.57	0
BT_4	7/7/2020	0	0	0	0	0	18.64	1.37	56.16	1006.86	0
BT_4	7/8/2020	0	0	0	0	0	16.03	2.03	62.42	1004.29	0
BT_4	7/9/2020	0	0	0	0	0	6.60	1.43	94.37	1016.57	0
BT_4	7/10/2020	0	0	0	0	0	13.38	1.15	80.63	1008.29	0
BT_4	7/11/2020	0	0	0	0	0	8.93	0.93	100.00	1002.86	2.9
BT_4	7/12/2020	0	0	0	0	0	7.71	1.36	85.71	1006.71	0.1
BT_4	7/13/2020	0	0	0	0	0	6.22	0.74	93.64	1019.57	0
BT_4	7/14/2020	0	0	0	0	0	7.36	0.86	84.62	1024.00	0
BT_4	7/15/2020	0	0	0	0	0	8.86	1.09	76.84	1024.57	0
BT_4	7/16/2020	0	0	0	0	0	18.02	1.67	60.90	1016.57	0
BT_4	7/17/2020	0	0	0	0	0	17.73	1.18	75.33	1009.33	0
BT_4	7/18/2020	0	0	0	0	0	17.17	1.56	82.32	1005.83	0
BT_4	7/19/2020	0	0	0	0	0	15.72	2.29	79.35	1003.71	0
BT_4	7/20/2020	0	0	0	0	0	14.41	1.33	98.56	989.43	0
BT_4	7/21/2020	0	0	0	0	0	15.51	4.21	75.35	998.57	0
BT_4	7/22/2020	0	0	0	0	0	14.51	3.67	73.53	1007.29	0

Table B.1 Raw Acoustic Detector Results and Weather Data

Detector	Date (night of)	Bat Activity (Number of Bat Passes)					Weather Data (Average Nightly Values)				
		Silver Haired Bat	Hoary Bat	Little Brown myotis	Unidentified Bat	Total	Mean Temperature (°C)	Mean Wind Speed (m/s)	Mean Humidity (%)	Mean Pressure (hpa)	Precipitation (mm)
BT_4	7/23/2020	0	0	0	0	0	12.37	1.10	93.97	1008.29	1.2
BT_4	7/24/2020	0	0	0	0	0	13.03	0.83	95.60	1008.00	0.9
BT_4	8/5/2020	0	0	0	0	0	17.99	1.08	67.75	1003.63	0
BT_4	8/6/2020	0	0	0	0	0	12.09	1.16	86.01	1004.63	0
BT_4	8/7/2020	0	2	0	0	2	14.78	0.94	64.46	1009.88	0
BT_4	8/8/2020	0	0	0	0	0	17.25	1.10	96.25	1004.00	4.5
BT_4	8/9/2020	0	0	4	0	4	10.77	1.43	84.48	1012.00	0
BT_4	8/10/2020	0	0	0	0	0	19.80	1.13	64.35	1000.67	0
BT_4	8/11/2020	0	1	0	0	1	18.52	1.17	75.64	1000.33	0
BT_4	8/12/2020	0	0	0	0	0	12.18	2.15	85.18	1012.22	0
BT_4	8/13/2020	0	0	0	0	0	5.92	0.78	91.32	1023.00	0
BT_4	8/14/2020	0	0	0	0	0	14.76	1.75	57.55	1020.56	0
BT_4	8/15/2020	0	0	0	0	0	14.32	0.84	64.48	1014.56	0
BT_4	8/16/2020	0	0	0	0	0	15.23	0.83	70.29	1012.88	0
BT_4	8/17/2020	0	0	0	0	0	11.93	1.67	78.50	1011.11	0
BT_4	8/18/2020	0	0	0	0	0	8.97	1.17	97.16	1008.56	0
BT_4	8/19/2020	0	0	0	0	0	9.04	3.12	98.93	1005.33	0.6
BT_4	8/20/2020	0	0	0	0	0	8.47	1.94	99.18	1000.67	2
BT_4	8/21/2020	0	0	0	0	0	9.07	2.31	96.88	1008.11	0.7
BT_4	8/22/2020	0	0	0	0	0	8.64	1.04	98.66	1012.56	0.6
BT_4	8/23/2020	0	0	0	0	0	6.24	0.90	97.34	1011.67	0.3

Table B.1 Raw Acoustic Detector Results and Weather Data

Detector	Date (night of)	Bat Activity (Number of Bat Passes)					Weather Data (Average Nightly Values)				
		Silver Haired Bat	Hoary Bat	Little Brown myotis	Unidentified Bat	Total	Mean Temperature (°C)	Mean Wind Speed (m/s)	Mean Humidity (%)	Mean Pressure (hpa)	Precipitation (mm)
BT_4	8/24/2020	0	0	0	0	0	6.52	1.48	98.99	1012.60	0.2
BT_4	8/25/2020	0	0	0	0	0	7.82	4.01	98.18	1001.90	1.1
BT_4	9/7/2020	0	0	0	0	0	11.95	3.67	85.64	1005.09	0.2
BT_4	9/8/2020	0	0	0	0	0	9.87	6.93	74.99	1001.82	0.2
BT_4	9/9/2020	0	0	0	0	0	6.46	2.01	82.66	1023.00	0.1
BT_4	9/10/2020	0	0	0	0	0	3.06	0.64	97.15	1019.55	0
BT_4	9/11/2020	0	0	0	0	0	8.49	3.67	78.31	1009.18	0
BT_4	9/12/2020	0	0	0	0	0	5.37	2.96	87.67	1015.45	0.6
BT_4	9/13/2020	0	0	0	0	0	8.42	1.35	100.00	995.09	0.5
BT_4	9/14/2020	0	0	0	0	0	6.24	10.26	70.08	989.91	0.7
BT_4	9/15/2020	0	0	0	0	0	3.86	5.40	71.21	1009.64	0.1
BT_4	9/16/2020	0	0	0	0	0	6.08	2.11	96.50	998.55	0.9
BT_4	9/17/2020	0	0	0	0	0	3.79	8.42	63.20	998.64	0.1
BT_4	9/18/2020	0	0	0	0	0	0.27	1.45	95.60	1016.73	0
BT_4	9/19/2020	0	0	0	0	0	1.88	1.58	83.95	1020.91	0
BT_4	9/20/2020	0	0	0	0	0	6.51	5.59	74.00	1017.00	0
BT_4	9/21/2020	0	0	0	0	0	13.68	3.92	67.63	1013.45	0
BT_4	9/22/2020	0	0	0	0	0	8.20	0.77	93.42	1006.91	0
BT_4	9/23/2020	0	0	0	0	0	10.91	1.79	86.76	989.64	0
BT_4	9/24/2020	0	0	0	0	0	5.03	8.24	69.91	988.17	0.1
BT_4	9/25/2020	0	0	0	0	0	4.32	8.76	58.70	1001.08	0

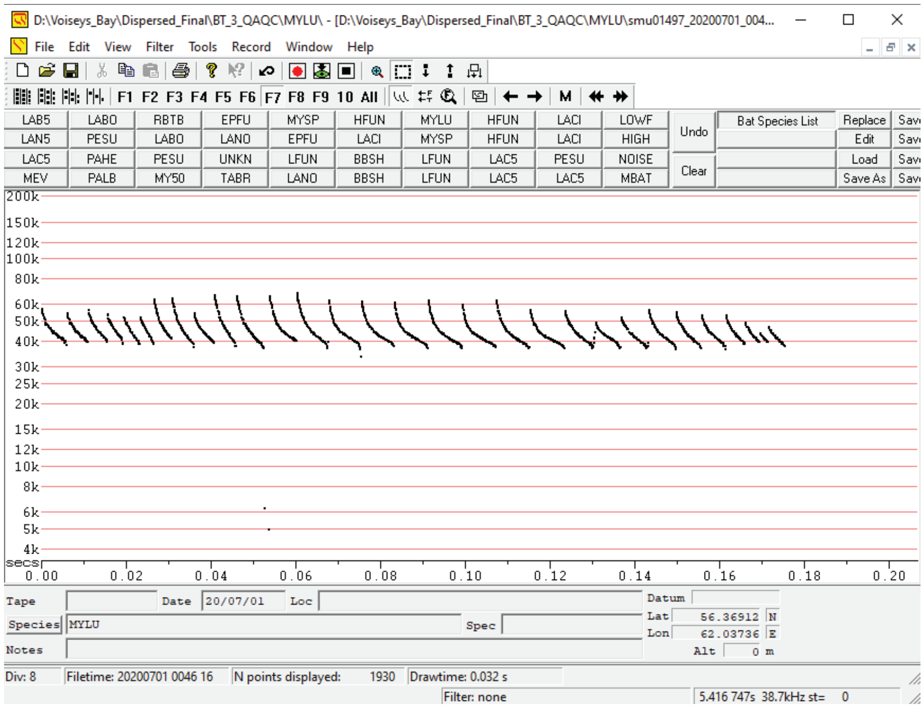
Table B.1 Raw Acoustic Detector Results and Weather Data

Detector	Date (night of)	Bat Activity (Number of Bat Passes)					Weather Data (Average Nightly Values)				
		Silver Haired Bat	Hoary Bat	Little Brown myotis	Unidentified Bat	Total	Mean Temperature (°C)	Mean Wind Speed (m/s)	Mean Humidity (%)	Mean Pressure (hpa)	Precipitation (mm)
BT_4	9/26/2020	0	0	0	0	0	1.60	1.39	86.48	1010.38	0
BT_4	9/27/2020	0	0	0	0	0	2.44	1.84	95.33	1011.62	0.1
BT_4	9/28/2020	0	0	0	0	0	2.11	0.95	99.71	1014.23	0.1
BT_4	9/29/2020	0	0	0	0	0	3.96	1.91	99.63	1003.77	1
BT_4	9/30/2020	0	0	0	0	0	6.87	4.60	95.38	977.62	1.1
BT_4	10/1/2020	0	0	0	0	0	2.33	3.64	75.72	1005.15	0.5
BT_4	10/2/2020	0	0	0	0	0	2.13	1.20	79.81	1017.92	0.1
BT_4	10/3/2020	0	0	0	0	0	-0.55	1.44	96.58	1019.85	0.1
BT_4	10/4/2020	0	0	0	0	0	-1.28	0.94	85.69	1018.23	0
BT_4	10/5/2020	0	0	0	0	0	-0.69	1.26	77.06	1013.77	0
TOTAL	**-**	**1**	**7**	**3265**	**27**	**3300**	-	-	-	-	-

APPENDIX C

Screenshots of Bat Passes

Appendix C SCREENSHOTS OF BAT PASSES



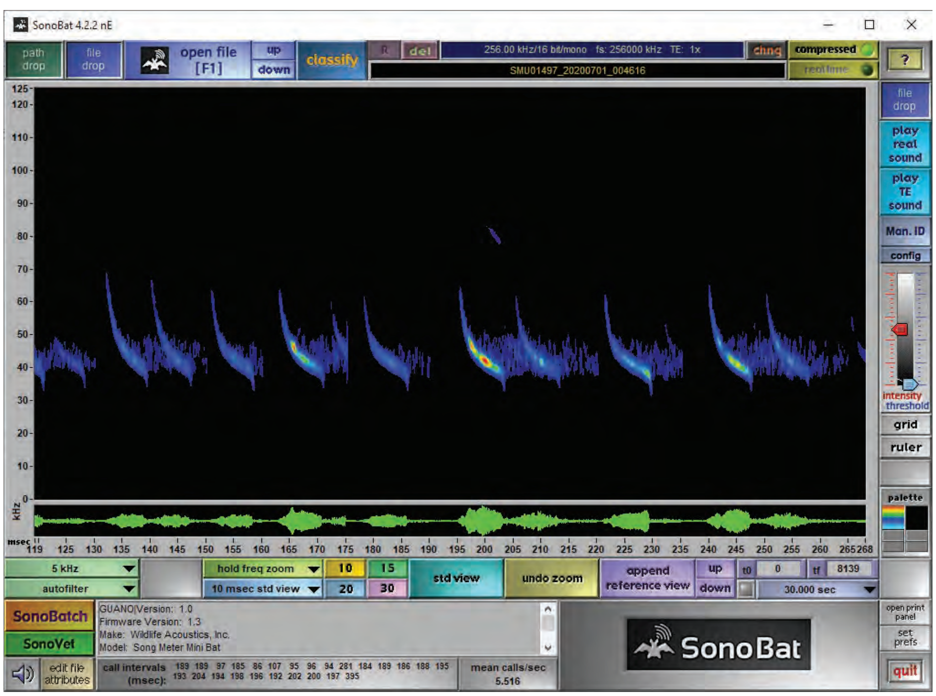


Figure C.1 Screenshots of a little brown myotis pass recorded at BT_3 on July 1 at 00:46:16 as viewed in AnalookW (above) and SonoBat (below)

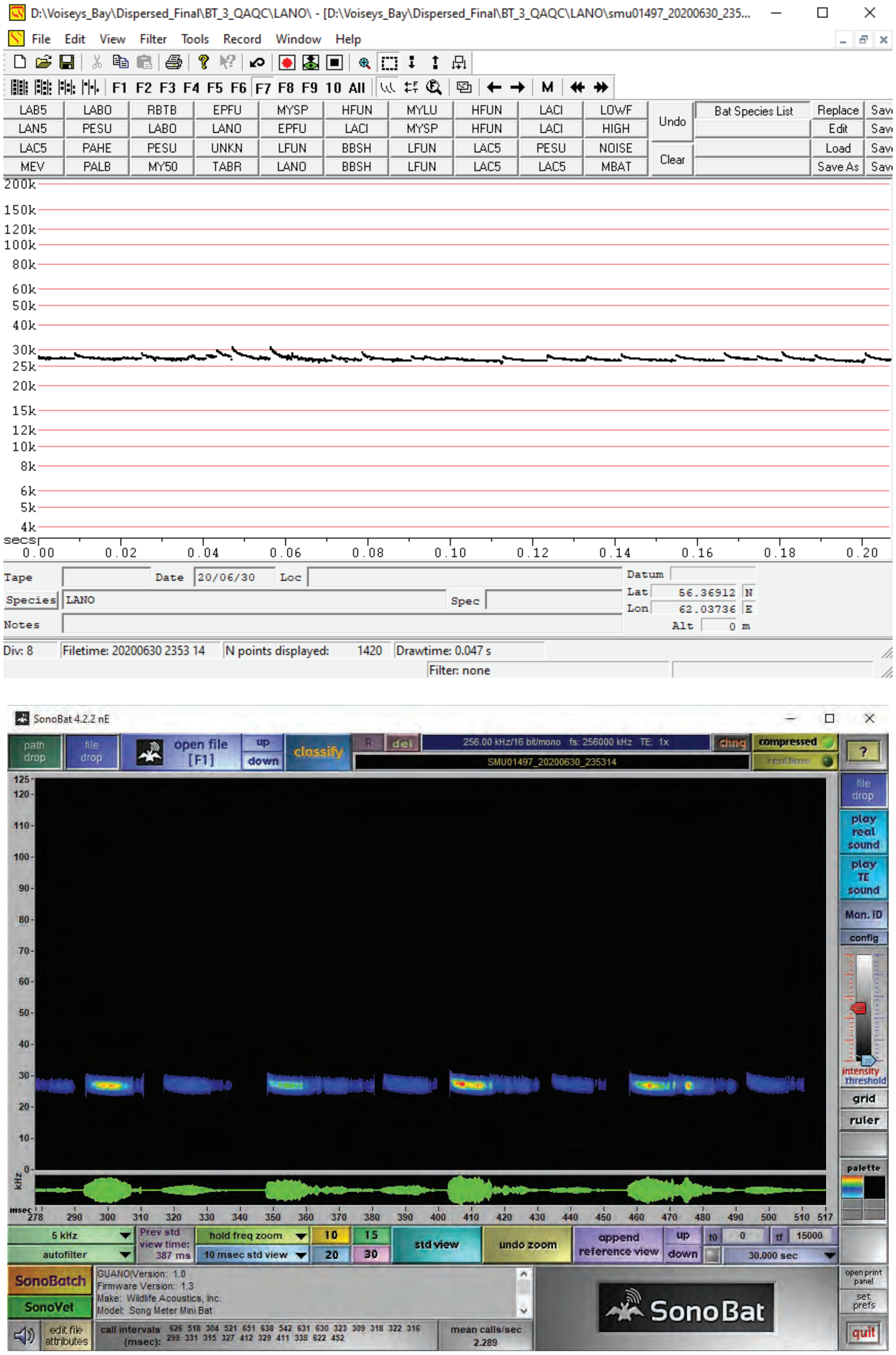
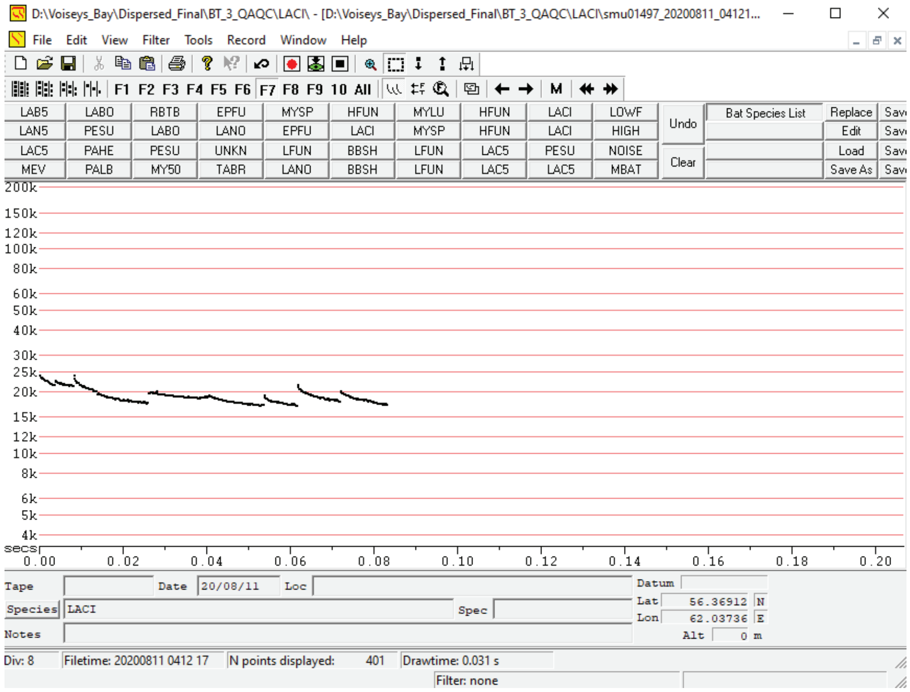


Figure C.2 Screenshot of a silver-haired bat pass recorded at BT_3 on June 30 at 23:53:14 as viewed in AnalookW (above) and SonoBat (below)



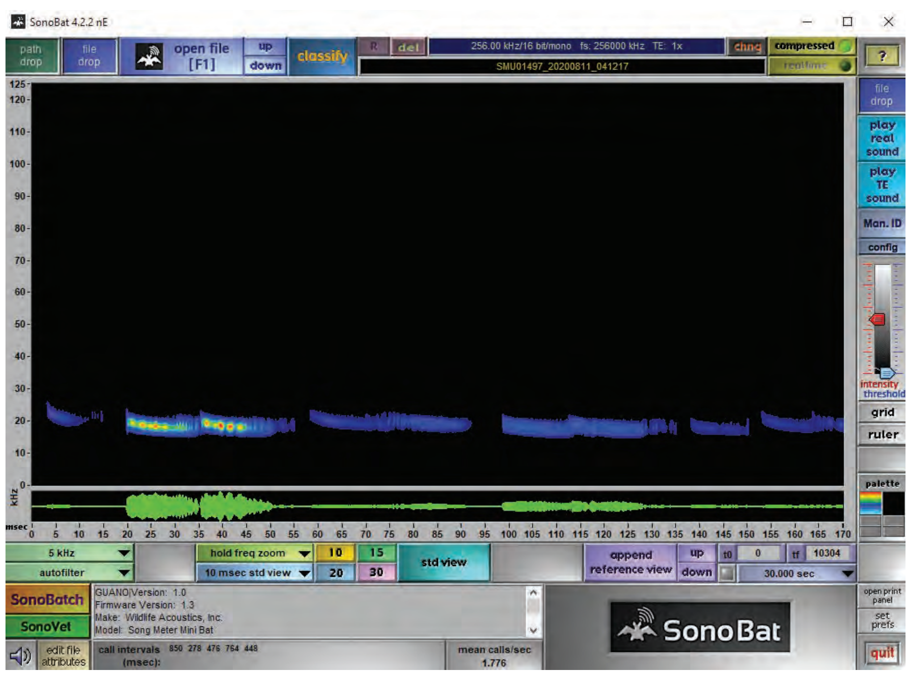


Figure C.3 Screenshot of a hoary bat pass recorded at BT_3 on August 11 at 04:12:17 as viewed in AnalookW (above) and SonoBat (below)