2/10/2020

Burchill Wind Energy Project: 2019 Bat Study

PREPARED FOR NATURAL FORCES DEVELOPMENTS LIMITED PARTNERSHIP

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REPORT TO

Natural Forces Developments Limited Partnership
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ON

Burchill Wind Project,

Bat Study 2020

Saint John, NB

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February 10, 2020

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1 Introduction

Boreal Environmental Inc. (Boreal) was retained by Natural Forces Developments Limited Partnership (Natural Forces) to collect and summarize acoustic bat data for Burchill Wind Project (BWP). The Burchill Wind Project is located on Crown land approximately 15 km southwest of the City of Saint John, near Lorneville and the existing Coleson Cove Generating Station. This project will make use of the existing Burchill Road for access and will consist of 5 to 10 wind turbines with a total installed capacity ranging between 20 and 42 MW and will connect to the Saint John Energy electrical grid. The purpose of this report is to summarize the 2019 bat acoustic survey data for the proposed development. The bat surveys focussed on assessing activity levels for both migrant and resident bats across a variety of habitats throughout the proposed BWP development. The intent of this study is to summarize the findings of these surveys in order to predict potential effects on bats in support of the Environmental Impact Assessment (EIA), where this information will be used to develop appropriate mitigation and determine the significance of any residual effects on bats.

The data for this survey was collected by Boreal using six Anabat Swift™ passive bat detectors that were installed under a variety of habitat conditions near proposed turbine locations. Data was recorded continuously from June through early October of 2019. Boreal analyzed the calls to determine number of bat call event per night for each of six detector sites and identified temporal and spatial activity patterns. For the purposes of this study, Pre-Construction Bat Survey Guidelines for Wind Farm development in NB were followed as appropriate.

As no higher-altitude structures were available to mount bat detectors within the blade sweep zone (60m-200m), this study will be complimented by a radar survey being conducted by Acadia University. The results of the radar survey will be presented in a separate report.

2 Bat Populations in New Brunswick

Bat populations are poorly understood in New Brunswick. Historically, there is evidence of the occurrence of seven different species of bats which include the hoary bat (*Lasiurus cinereus*), red bat (L. borealis), silver-haired bat (*Lasionycteris noctivagans*), big brown bat (*Eptesicus fuscus*), little brown bat (*Myotis lucifugus*), northern myotis (*M. septentrionalis*), and tri-coloured bat (*Perimyotis subflavus*), although studies in Southern New Brunswick indicates that only two species were common prior to 2014: little brown bat and northern myotis (Broders, Findlay & Zheng, 2004). Of the seven species in the province, four are resident: little brown bat, northern myotis, tri-colored bat, and the little brown bat. The other three species migrate to warmer climates to the south for the colder months (van Zyll De Jong, 1985).

In 2014, three of the four New Brunswick resident bat species (little brown bat, northern myotis, and tri-coloured bat) were listed as Endangered under the federal Species at Risk Act (SARA) due to the decimation of local populations by an infectious disease known as White Nose Syndrome (WNS). The disease is caused by the introduced fungus *Pseudogymnoascus destructans*, which survives in damp, cold cave conditions and infects hibernating bats (Lorch et. Al. 2011). WNS causes these species to arouse during hibernation depleting them of resources leading to death in almost all cases (Environment Canada 2014). Migratory bats occurring in New Brunswick tend not to be affected by the disease as they do not overwinter in caves inoculated with the fungus. It is estimated that populations of little brown bat and northern myotis, once the most common species in the province, were reduced by as much as 99% due to this disease. The tri-colored bat which was known to occur in New Brunswick in lower numbers (Broders, Findlay & Zheng 2004,

Broders, McAlpine, and Forbes, 2001) was also given Endangered status. The population of tri-colored bats was potentially extirpated from New Brunswick as a result of WNS (CBC 2018).

While bat populations in Nova Scotia may be showing signs of a slow recovery (MTRI 2019) there is not yet any compelling evidence to that effect in New Brunswick (McAlpine pers. comm. 2019). Despite this, the big brown bat may be increasing in range and numbers by occupying niches formerly dominated by the Myotis species. The big brown bat is less susceptible to WNS as it tends to spend winters in larger buildings (McAlpine et al 2002) where *P. destructans* does not tend to flourish. Big brown bats are also known to hibernate in caves but there is some evidence that they have some resistance to *P. destructans* (Frank et. al. 2014). It is likely that this is now the most common species in southern New Brunswick (McAlpine pers. comm. 2019). While the range and population of big brown bats is largely unknown, they are known to occur in southern New Brunswick and have comprised the majority of calls recorded at recent pre-construction bat monitoring programs for wind energy developments in the province, including at the Wocawson Energy Project Phase 1 (Dillon 2018, Boreal 2019).

3 Bat mortality at wind energy developments

Across the continent, most bat fatalities occur in late summer and early fall and in many areas, the most affected tend to be long distance migratory species, such as the hoary bat. Nevertheless, bat mortality has also been documented in smaller numbers for resident bat species (Broders, 2011). Fall migration period in late August tends to see the majority of bat fatalities at wind developments although some fatalities have been reported during spring migration in Atlantic Canada (Broders, 2011). It is thought that spring migration behaviour is less structured and follows different routes compared to fall migration.

Based on data collected at 5 wind power projects for 7 project-years between 2008 and 2012 (pre-WNS), the estimated Atlantic Canada turbine mortality of bats was 0.26 ± 0.11 bats/turbine (Bird Studies Canada 2016). The total number of installed turbines in Atlantic Canada as of December 2015 was 521. There were an estimated 134 cumulative bat fatalities at all Wind Farms in Atlantic Canada as of the end of 2015 (Bird Studies Canada 2016). This number is not high relative to other Canadian jurisdictions such as Ontario and Alberta and losses tend to be biased toward resident overwintering species. Given that these results largely pre-date the large-scale die-off of resident bats as a result of WNS, which was first discovered in New Brunswick in 2014, it is likely that these collision rates would be much lower now. While WNS has decimated the populations of three of the four resident bat species, big brown bats may now have the highest potential for mortality due to interaction with turbines at this site.

4 Regulatory Framework

New Brunswick's Environmental Impact Assessment Regulation provides a framework for proactive environmental planning and opportunities for public involvement (NBDELG, 2019a). The BWP requires a provincial environmental impact assessment registration as a power generating facility with a production rating of three megawatts or more, as stipulated under Schedule A of the Environmental Impact Assessment Regulation.

The scope of the assessment was prescribed by the following documents:

- *Guide to Environmental Impact Assessment in New Brunswick* (Environment and Local Government, 2012);

- New Brunswick Sector Specific Guidelines: *Additional Requirements for Wind Turbines* (NBDELG 2019b); and
- *Pre-Construction Bat Survey Guidelines for Wind Farm Development in New Brunswick* (NBNRED 2009)

Field survey protocols and survey locations were developed in consultation with NBNRED's Forest Planning and Stewardship (FPS) Branch (Hubert Askanas and Colette Lemieux) and NBDELG (Shawn Hamilton) in May 2019. As part of this process, we reviewed records of bat species occurrence and known hibernacula in the vicinity of the proposed development.

Species listed in Schedule 1 of federal Species at Risk Act *(SARA)* are protected federally (Government of Canada 2002). In 2014, the three bat species that breed in New Brunswick (little brown bat, northern myotis, and tricolored bat) were classified as *Endangered* under SARA as a result of an emergency assessment in response to the ongoing decimation of resident overwintering bat populations caused by WNS. Provisions to protect and recover these species came into effect once they listed in Schedule 1 of *SARA*.

5 Spatial and Temporal Parameters

The bat studies in this report focus on multiple spatial scales:

1) **Primary Development Area (PDA)**: This is the maximum area of anticipated disturbance based on the current facility layout which includes turbine pads, access roads, power transmission, maintenance, and personnel facilities. The PDA is significantly larger than the likely project footprint but allows for some spatial adjustments of roads and other facilities to avoid constraints. The current turbine layout may also change but the general location and extent of the PDA will remain similar to that presented in Figure 1. This area was used to focus surveys for breeding and resident bats, which are more closely tied to species landscape and habitat features. It was also used to calculate potential for bat collisions with turbines. This is the are where potential direct effects on birds are most likely to occur.
2) **Study Area**: This is a larger area around the PDA that encompasses much of the undeveloped portion of the Lorneville peninsula. This area was used for migration surveys and as a reference for habitat availability in the immediate area around the PDA.
3) **Regional Assessment Area** (RAA): This is a radius of 5km surrounding the Study Area that is used to provide ecological context for the study area when considering migration movement of bats, any nearby hibernacula, and regional habitat availability.

This study considers all bats with potential to occur in the Study Area, including those that might breed there, and those potentially migrating through in spring and fall. We provide summaries of the findings of bat studies conducted between spring and fall of 2019.

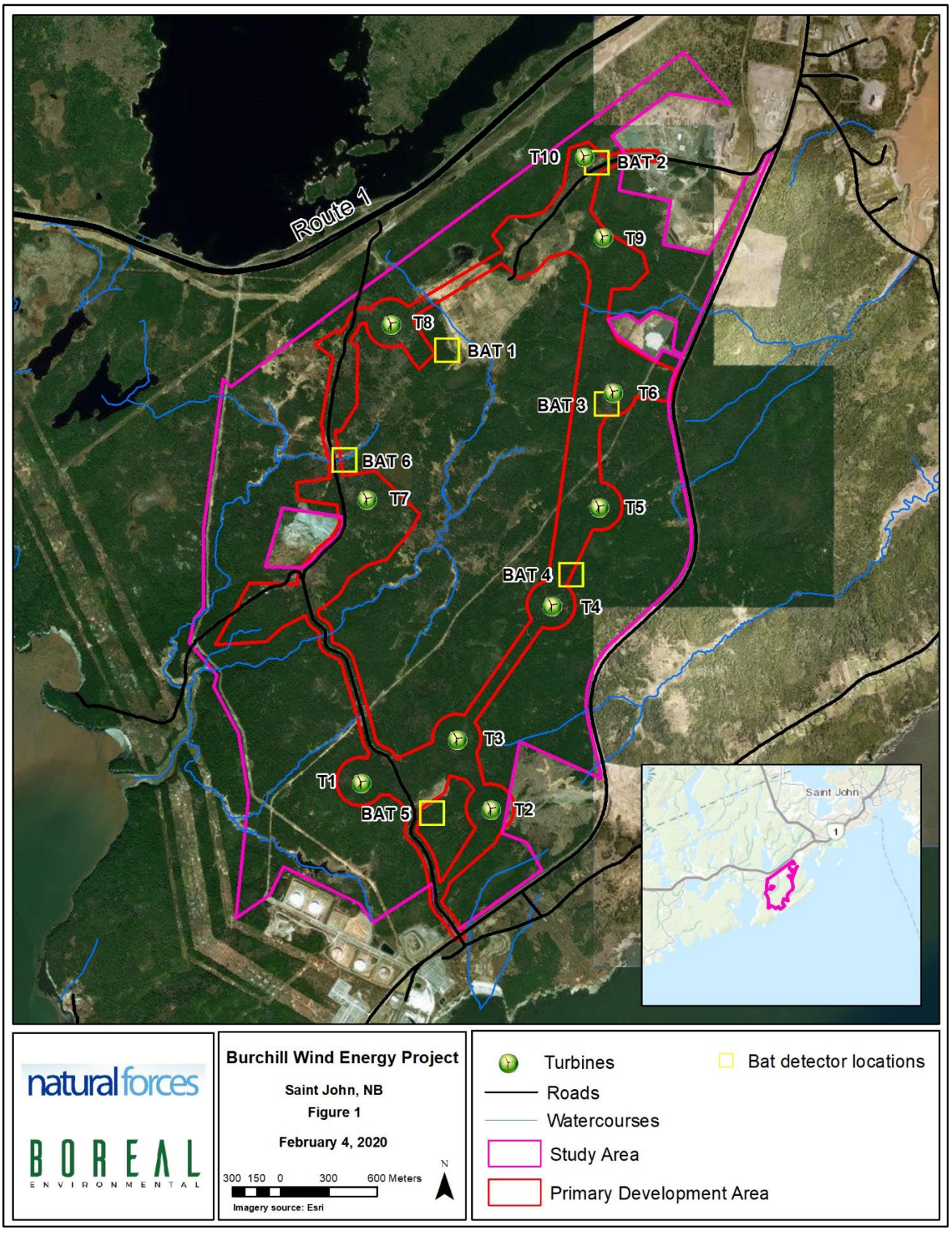

Figure 1. Overview of Study Area, Primary Development Area, and turbine layout.

6 Risk Level

New Brunswick Pre-construction Bat-Survey Guidelines for Wind Farm Development in New Brunswick (the guidelines) recommends that acoustic monitoring be conducted to gather bat data within the entire height range of the proposed wind turbine blade sweep area (e.g., 60m to 200m) where meteorological towers are available for deploying detectors within rotor sweep altitudes. The guidance recognizes logistical limitations where microphones often cannot be elevated to rotor sweep elevations in the absence of meteorological towers – especially with the widespread use of higher turbines in recent years. In such cases, the guidance suggests that some detectors should be deployed as high as possible using trees or made-for-purpose poles or towers. The guidance requires a minimum of one-year pre-construction survey including the summer and fall seasons.

Additional survey effort will be required if the following high-risk habitat features are present in the proposed wind farm development:

- Within 5km of a known hibernaculum, or potential cave or abandoned mine. These sites are particularly sensitive to disturbances and have the potential to experience high bat activity at particular times of the year.
- Within 500m from a coast line or other major water body (large lakes and rivers). These areas have potential to concentrate foraging and migratory movement.
- Located on or near forested ridge habitat. These areas are known to be migratory routes for bats and numbers may be concentrated here.

The proposed turbine locations and power facilities are over 1 km away from the coastline and no hibernacula are known to occur within 5 km of the site. The nearest hibernaculum is located at Greenhead, approximately 10 km to the northeast, with two more known hibernacula in Rockwood park, approximately 15 km to the northeast (Mosely 2007). The status and use of the hibernacula are not well understood since the WNS epidemic but it can be assumed that their occupancy is much lower.

The Study Area slopes generally from the northwest to the southeast and while not a smooth surface, there are no dramatic ridgelines that might funnel or concentrate migratory activity to a noteworthy extent.

None of the three triggers in the New Brunswick guidelines listed above that would warrant the requirement for additional surveys have been met. However, where no high-elevation sampling was possible for this study, Natural Forces has partnered with Acadia University to conduct a radar study of higher altitude migratory movements of both birds and bats in and around the Study Area.

7 Desktop Survey

When determining key issues for a proposed development, there are several publicly available data sources that can assist in identifying potential key interactions between the development and the surrounding environment. These data sources provide information of the general setting of the proposed devolvement, general habitat conditions in an around the development, important habitats and protected areas in and nearby the development, and know records for breeding areas and/or potentially sensitive or protected species in and around the development. These data sources include:

- Data request from the Atlantic Canada Conservation Data Centre (ACCDC) that includes known records for rare or protected species within a 5 km radius of the Study Area, and well as important and protected habitats nearby.
- New Brunswick Natural Resources and Energy Development (NBNRED) forest inventory data containing species composition and development stage.
- New Brunswick Department of Environment and Local Government (NBDELG) wetland and surface water feature data;
- Aerial imagery from a variety of publicly available sources; and
- Inventory of known hibernacula in southern New Brunswick.

In addition to the regulatory requirements described in Section 4, a review of available data and literature help to focus field efforts on key concerns and areas and species of highest risk.

As a part of this process, the information is used to understand the availability of habitat types (including hibernacula, and suitable maternity colony structure) within and around the Study area and allow us to characterize the potential effect of the development different habitat types as a result of the proposed development. The following sections 5.1 and 5.2 provide summaries of the known use of the site by bat species, sensitive habitats, and habitat composition, based on the current project layout (PDA).

7.1 Project Setting and Habitat Conditions

The proposed Burchill Wind Project is situated in southern New Brunswick on the Bay of Fundy at the western limits of Saint John on the Lorneville Peninsula between Lorneville Harbour and Musquash Harbour. (Figure 2). A deposit of Neoproterozoic limestone runs though the Study Area in a northeast/southwest configuration, extending through Saint John and along Route 2 toward French Village. This limestone, known as the Ashburn formation, is subject to the formation of solution caves, some of which have been known to support overwintering bats. The nearest of these caves is located ten kilometers away at Greenhead (with two others occurring in Rockwood park, more than 15 kilometers away).

The Study Area is situated in a largely contiguous forest habitat dominated by mature softwood with networks of shrub dominated riparian wetlands along watercourse flowing in a general northeast to southwest direction. The dominant tree species are red spruce *(Picea rubens)*, balsam fir *(Abies balsamea)* and eastern white cedar *(Thuja occidentalis)*. There are some small areas of ponded water visible in the study area but no large fresh waterbodies. There are several cleared corridors and areas including a former (i.e., decommissioned) municipal landfill site, a crude oil pipeline, roads and a former Quarry.

The Bay of Fundy shoreline is located 1.1 km south of the nearest proposed turbine location. Burchill Brook and Frenchman's Creek, both provincially mapped second order watercourses, are the largest watercourses located within the Study Area. These watercourses may potentially be important foraging areas for resident bats.

There are a number of mapped and unmapped wetlands within the Study Area which addressed in detail in the Watercourse and Wetland Assessments Report produced by Fundy Engineering for the Burchill Wind Project. The study area is located on a peninsula by nature of the estuarine bays to the east and west, although it does not project into the Bay of Fundy beyond the surrounding coastline at a larger scale.

7.2 Bat Habitat Types Within the Study Area

The Study Area is approximately 1048.8 ha in size and characterized by rough uneven terrain sloping away to the ocean in a general southward aspect. There are no significant open water features, except for a few small ponds and watercourses. There are two named watercourses: Burchill Brook and Frenchman's Creek that are fed by small networks of minor tributaries and drain to the southwest and west, respectively. The vast majority of the Study Area is forested representing 989.9 ha (94.4%) of the total area including wetlands that are, in general, forested swamps.

The habitat types identified in the Study Area were adapted from the New Brunswick Natural Resources and Energy Development (NBNRED) forest inventory based on species composition and development stage. Forest stand types were verified in field during the various bird survey and adjusted accordingly where the forest inventory differed from the field survey. The arrangement of the various habitat types within the Study Area is shown in Figure 2 and descriptions of each habitat type and the relative proportion of the study area that each habitat type comprise are provided in Table 1.

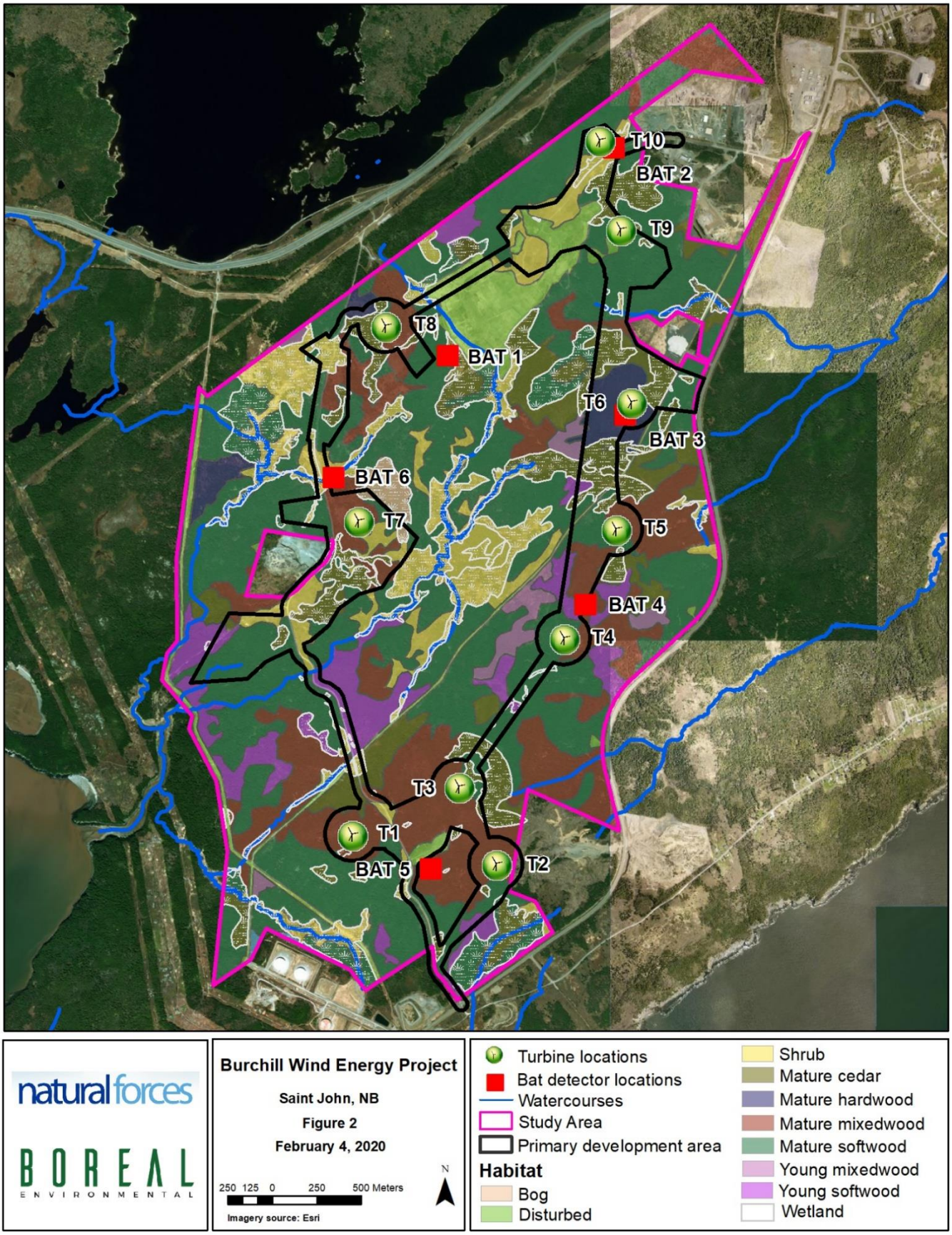

Figure 2. Habitat types within the Study Area, including areas of interior forest.

Table 1 provides a summary of the relative proportions and descriptions of the various habitat types within the Study Area, and potential for bat use for breeding and foraging.

Table 1. Summary of habitat type by area and percent cover.

Stand Type	Area (ha)	Percent (%)	Habitat Description
Disturbed	58.7	5.6	Disturbed habitat consists of a decommissioned landfill at Paddy's Hill located in the northern portion of the Study Area. This is dominated by various graminoid and forb species and regenerating patches speckled alder. A large section of the former landfill is regularly mowed and used as a runway for the Saint John Model Flying Club (SJMFC). The remaining disturbed portions of the Study Area are made up of a pipeline and road RoW's dominated by various graminoids, forbs and gravel/asphalt.
Bog	6.7	0.6	Ombrotrophic bog dominated by low ericaceous shrubs, stunted tree species, and herbaceous vegetation typical of this habitat type. Bog may offer foraging habitat due to a combination of open wetland and edge habitat.
Shrub	128.2	12.2	Shrub habitat is generally associated with tall shrub swamp, riparian areas and regenerating disturbed areas and is dominated by speckled alder. Riparian shrub swamp may provide habitat for foraging bats. The largest patch of Shrub habitat is located in the low-lying central portions of the Study Area and associated with Burchill Brook, Frenchmans Creek and their small tributaries. The remaining Shrub habitat is located mainly in the northern portion of the Study Area near Paddy's Hill and is upland.
Mature eastern white cedar (MEWC)	132.1	12.6	MEWC is dominated by mature eastern white cedar and tends to be wetland. Understory vegetation is sparse except under small canopy openings where patches of dense cedar regeneration occur. Cavity trees that may be suitable for bat maternity colonies can be found in these stands.
Mature hardwood (MHWD)	22.4	2.1	MHWD habitat tends to have a closed-canopy a mixture of shade tolerant and shade intolerant deciduous tree species. The shrub layer tends to be discontinuous and not well developed. In general, the herbaceous layer is well developed with various forb species. There are many cavity trees in these stands that would be suitable for maternity colonies for Myotis bats but the habitat type is not abundant.
Mature mixedwood (MMXD)	187.5	17.9	MMXD habitat is closed canopied and consists of mid to late successional coniferous and deciduous tree species. The shrub layer tends to be sparse and the herbaceous layer is well developed where deciduous tree species dominate.

Stand Type	Area (ha)	Percent (%)	Habitat Description
Mature softwood (MSWD)	433.0	41.3	MSWD is made up of shade tolerant coniferous tree species such as red spruce and balsam fir (not cedar). The shrub and herbaceous layer are not well developed.
Young mixedwood (YMXD)	17.0	1.6	YMXD habitat is closed-canopied and consists of early successional deciduous tree species. The shrub layer tends to be absent or very sparse, which is typical of early successional stands at this stage of development. The herbaceous is well developed with ferns and forb species.
Young softwood (YSWD)	63.2	6.0	YSWD is similar to YMXD; however, it is dominated by spruce and fir. Residual mature trees are scattered throughout. The shrub and herbaceous layer are patchy.
Total	**1048.8**	**100**	

7.3 Species of Conservation Concern Near the Study Area

Species of Conservation Concern (SOCC) include those whose populations are potentially vulnerable to disturbance or changes in environment to the extent that individual mortality has the potential to compromise the long-term sustainability of the populations in the area. For the purposes of this study it refers to species that are rare or uncommon as defined by the Atlantic Canadian Conservation Data Centre (ACCDC) and all species listed as Endangered, Threatened, or of Special Concern under federal or provincial Species at Risk assessments. All seven bat species that are known to occur in New Brunswick are considered SOCC. Three resident species (little brown bat, northern long-eared bat, and tricolored bat) are listed as Endangered under Schedule A of SARA. Silver-haired bats are listed as S1?, hoary and red bats are listed as S2?, while big brown bat is listed as S3. The question marks in the rankings refer to the uncertainty about how common they are and what their breeding status is in the province.

The ACCDC data for the Study Area includes known bat records within 5 km of the Study Area as well as known winter hibernacula near the Study Area (Appendix A). There are no previous records for bats or hibernacula in that within 5km of the Study Area.

While there are no known records, there is a possibility of any or all seven species occurring within the Study Area although numbers of breeding bats could be expected to be much lower than pre-WNS conditions. Cavity trees suitable for resident bat species and silver-haired bats, which also rear young colonially in cavities, are present within the mature hardwood, mixedwood, and even cedar stands found within the Study Area. Little brown, tricolored, and big brown bats often prefer buildings as maternity colonies, where they are available, but none are present within the Study Area. The entire Study Area represents suitable foraging habitat for all species with a mix of mature forest (both deciduous and coniferous) and a series of watercourses and associated shrub wetlands. Given the coastal proximity of the Study area, there is also likelihood that migratory bats may pass by the area during migration.

7 Scope of Fieldwork

With consideration for the ecological setting of the site, a study design was proposed to Shawn Hamilton of NBDELG and Hubert Askanas of NBDERD by email on March 29th, 2019 and further discussed in a follow-up meeting that was held in Fredericton on April 4th. Attending the meeting were Derrick Mitchell of Boreal

Environmental, Shawn Hamilton and Colette Lemieux of NBDELG, and Hubert Askanas of NBNRED. The study design was agreed on in those discussions and is described in detail below. The intent of this study is to provide baseline data on bat activity to assist in the prediction of potential environmental effects of the proposed wind facility on bat resources in the area, and to inform any potential mitigation that might be implemented based on this baseline information.

As no higher-altitude structures were available to mount bat detectors within and near the blade sweep zone (60m-200m), this study will be complimented by a radar survey being conducted by Acadia University. The results of the radar survey will be presented in a separate report.

8.1 Acoustic Data Collection

Acoustic surveys were designed to meet the requirements of the Pre-Construction Bat Survey Guidelines for Wind Farm development in NB. The detector count and locations were agreed on with Provincial Regulators prior to commencement of the survey. Acoustic data recorders were deployed, monitored, and data was collected and processed by Derrick Mitchell R.P.F. who has more than a decade of experience in acoustic surveys for bats.

Acoustic data was recorded using six Anabat Swift™ passive bat detectors. AnaBats detect ultrasonic bat calls through a transducer (microphone) and record them on a data storage card for later analysis. Anabat Swift detectors are weather-proof and hold enough battery power to sustain operation for several months under low-activity conditions such as found at this site. Regular visits were conducted to the site to collect data and batteries were monitored and changed as needed. All detectors ran continuously between June 1st to October 15th without any equipment failures. The Anabat Swift units were set to a sensitivity level of 16, as recommended by Titley. Each microphone was pointed downward above a 20 x 20 cm metal sheet mounted at a 45° angle to deflect sound upward into the microphone.

Anabat Insight^{tm}. 1.8.6. software (Titley Electronics, Ballina, NSW, Australia) was used to view and categorize frequency/time graphs from the bat calls recorded by the AnaBat detectors. For each call, the slope, maximum frequency (i.e., the highest frequency), minimum frequency (i.e., the lowest frequency), and duration were noted in order to determine species. Each variable was then compared with a library of reference calls collected from individual bats that had been identified to species. We defined a bat call (call) as a single, recognizable vocalization from one bat and a bat pass (pass) as one or more sequential calls, representing calls from a single bat, recorded in a one AnaBat digital file.

The detectors were programmed to record bat passes from a half hour before sunset to a half hour after sunrise to determine relative activity patterns by species or species groups over time. Bat pass monitoring was designed based on the protocols described in Bats and Wind Turbines: Pre-siting and Pre-construction Protocols (Lausen *et al*. 2010).

Bat species calls are usually distinguishable based on the characteristics of the geometry of the frequency/time graphs in Analook (Jones and Siemers, 2010). However, call recordings sometimes lack sufficient detail to allow species level identification due to factors such as; background noise, distance from the detector, weather and other environmental factors. Any partial or fragmented calls that could not be identified to species were classified as unidentified bats. These include records recognized as bat calls, for which species could not be determined.

The Pre-Construction Bat Survey Guidelines for Wind Farm development in NB requires that a minimum of suitable weather nights be sampled where there is no precipitation and wind speed is less than 20 kph. In order to determine the number of suitable sampling nights were met, weather data for the site was summarized for the sample evenings from a monitoring station operated by Environment Canada located at the Saint John Airport in east Saint John.

In settings where bat activity levels are sufficiently high, temporal correlations between bat activity, time of night, weather, and season can be investigated statistically. However, this site had insufficient activity levels to conduct meaningful statistic analyses of factors affecting bat activity levels.

8.2 Bat Activity Metrics: "Call Events'

Researchers typically measure bat activity by counting number of saved echolocation files containing sequences of bats calls. The duration of these recording files is adjustable but is set to ten seconds in most studies, including this one. While the ten-second file length is somewhat arbitrary, this method provides a reasonable metric of bat activity under most conditions. However, in cases where bat activity is very low and only few files are recorded each night, there can be activity occurrences that can greatly skew the data by generating outlying night of relatively high activity. These happen when a single bat forages near a detector for an extended time, causing the recording of multiple, consecutive ten-second files. Most detector nights at BWP during the 2019 survey had only two or less calls but occasionally there were events where there would be dozens of consecutive files, indicating that a single bat was likely foraging near the detector for extended periods. To mitigate these events from skewing the data by creating artificially high periods of activity, bat activity was measured using a count of "*bat call events*".

We defined bat call events as any file or sequence of files from the same species that occurred within one minute of each other on the same detector. As an example, if there were forty consecutive calls on a given night with no more than a 60 second gap between any two files recorded, they were considered one *bat call event*. In busier study areas where many hundreds of bat calls were recorded each night, this assumption may not be reasonable, but at BWP there were very few files recorded each night making it reasonable to assume that long strings of consecutive calls likely belonged to the same individual. There is a potential for error in such cases where a group of resident bats might be foraging together, but much less than the outliers created in the data if each file was considered a unique bat pass, and the outlier-nights created as a result of occasionally having dozens of calls within one hour at a single detector.

8.3 Acoustic Monitoring Sites

Six sites were chosen to set up the passive acoustic recorders throughout the Study area, and in proximity to areas of proposed turbines, according to the proposed Primary Development Area, shown on Figure 1. At these locations, detectors were deployed as elevation using trees in the areas, where pulleys were used to hoist the detectors as high as possible. Descriptions of the detector sites are provided in Table 2.

Table 2 Description of bat detetcor survey sites within the Study Area.

Monitoring Station	Location	Site/Setup Description	Photograph
BAT 1 (ID 546378)	2523678 E, 7354751 N (NB double stereographic NAD83)	Located along edge west of decommissioned landfill and adjacent to alder and graminoid dominated riparian swamp. Suspended from a branch on a mature red spruce tree by a rope approximately 8 m off ground. Anchored at two points to prevent movement during wind events. Detector microphone directed to the east – northeast.	

BAT 2 (ID 546485)	2524612 E, 7355920 N (NB double stereographic NAD83)	Located on the edge of alder and graminoid dominated swamp. Close to Paddy's Hill Road. Suspend from a branch on a young white birch tree approximately 5 m off ground. Anchored at two points to prevent movement during wind events. Detector microphone directed to the north – northeast.	
BAT 3 (ID 546394)	2524676 E, 7354417 N (NB double stereographic NAD83)	Located in mature hardwood stand dominated by yellow birch white birch and balsam fir. Suspend from a branch on a mature yellow birch tree approximately 10 m off ground. Anchored at two points to prevent movement during wind events. Detector microphone directed to the east-northeast perpendicular to a ridge line.	

BAT 4 (ID 546331)	2524454 E, 7353349 N (NB double stereographic NAD83)	Located in mature hardwood stand dominated by yellow birch white birch and balsam fir. Suspend from a branch on a mature yellow birch tree approximately 8 m off the ground at top of a ridgeline that is oriented north-south. Anchored at two points to prevent movement during wind events. Detector microphone directed to the north-northeast perpendicular to a ridge line.	
BAT 5 (ID 546331)	2523585 E, 7351863 N (NB double stereographic NAD83)	Located in mature hardwood stand dominated by yellow birch white birch and balsam fir. Suspend from a branch on an immature balsam fir tree approximately 8 m off ground at top of a ridgeline that is oriented northeast-southwest. Anchored at two points to prevent movement during wind events. Detector microphone directed to the northwest perpendicular to a ridge line.	

BAT 6 (ID 546394)	2523038 E, 7354065 N (NB double stereographic NAD83)	Located along the southern edge of Frenchman's Creek pond. The pond is less than 2 m deep on average and dominated by aquatic vegetation. Fringing wetland is dominated by blue-joint reedgrass and low shrubs. Recent beaver activity was evident; however, not currently active. Attached to mature balsam fir at approximately 1.5 m off the ground. Detector microphone directed to the northeast facing upstream.	

9 Acoustic Survey Results

9.1 Species Composition

Acoustic monitoring for bats was conducted at six locations in the Study Area between June 1st and October 15th of 2019 (137 nights). Call data was reviewed by Derrick Michell who has more than 15 years of experience analysing tens of thousands of bat call files from across Canada. A total of 328 bat call files were recorded over 152 nights of recorded. All of the identifiable calls came from only four different species with the majority being between Myotis bats (91) and big brown bats (84). Around half as many (42) bat call events were recorded for hoary bats and only two calls from red bats. No silver-haired or tricolored bats were detected. See Table 2 for a summary of bat call events by detector site. While it can be difficult to differentiate between northern long-eared bat and little brown bat calls under many conditions, it was likely that all of the Myotis calls were from little brown bats, based on the call intensity and slope. None of the Myotis calls were strongly suggestive of northern long-eared bats.

Table 3 Summary of total bat call events by species and category.

Species/Species Group	Migratory (Y/N)	Bat Detector						Total All Sites
		BAT 1	BAT 2	BAT 3	BAT 4	BAT 5	BAT 6	
Big brown bat - (EPFU)	N	13	20	0	8	7	36	84
Eastern red bat – (LABO)	Y	0	2	0	0	0	0	2
Hoary bat - (LACI)	Y	1	12	0	1	3	23	40
Little brown bat/Northern long-eared myotis – (Myotis)	Y	4	39	0	6	4	38	91
Unknown (Unk)			1	0	2	1	1	5
Total counts all species		**18**	**74**	0	**17**	**15**	**98**	**222**
Detector Nights		114 x 6	114 x 6	114 x 6	114 x 6	114 x 6	114 x 6	114 x 6
Average counts per detector night		0.03	0.11	0.00	0.02	0.02	0.14	0.32

23 windy/rain nights (137 - 23)

9.2 Calls per Detector Night

Of the 328 files recorded, there were 222 bat call events constituting an average of 0.32 bat call events per detector night when removing nights with rain or wind speed greater than 20 kph. Overall, this level of activity is very low relative to baseline activities levels prior to WNS, but is somewhat typical for New Brunswick in the years since 2014. The highest activity levels were found at BAT2 and BAT6, while no activity was recorded at BAT3, which was located in mature tolerant hardwood habitat that has an abundance of cavity trees along with low-clutter understory. If northern long-eared bats were present and breeding in the Study Area, this habitat would have high potential for use. Stations BAT2 and BAT6 were both located along the edges of wet areas with open water features which present ideal foraging areas for bats. The higher levels of activity at these sites was anticipated.

9.3 Seasonal Timing of Activity

There were very few calls recorded in June and July during spring migration and breeding periods. The majority of calls were recorded in the latter half of August as shown in Figure 4. While the majority of calls were for bats that are known to overwinter in the province (resident), most of the bat activity was recorded in late summer, during the migration period in Late August. Activity levels for true migratory bats (largely hairy bat) occurred well within the typical fall migration period for that species but the activity levels for Myotis and big brown bats continued a little longer into September and even October. The timing of this activity coincides with swarming activity near winter hibernacula prior to hibernation but it is highly unlikely that a winter hibernaculum is present within the Study area – especially given the low levels of activity. It is possible that the resident, overwintering bats are beginning to move towards winter hibernacula (possible in Saint John) during this period, or that resident bats are foraging later in the season in an effort to store additional energy to cope with the overwinter energy deficit caused by WNS. Another possibility is that these bats are taking advantage of seasonal migration of flying insects during this period (Rydell et al. 2010).

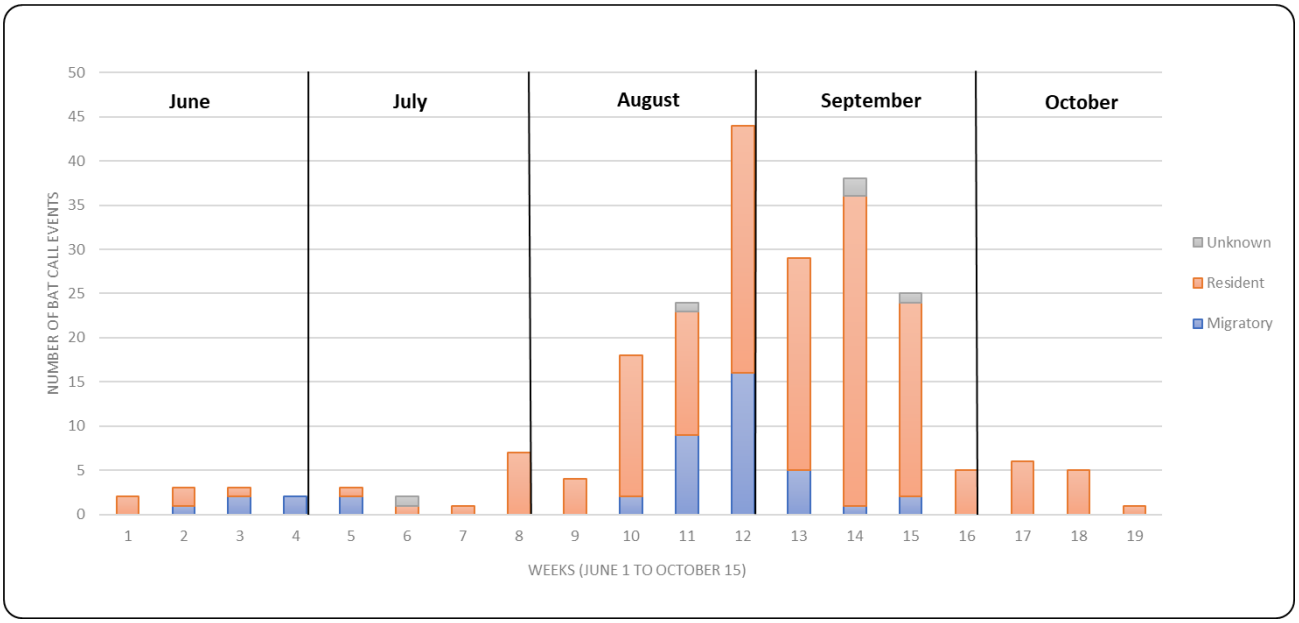

Figure 3 Weekly bat activity by species guild over the entire sampling period.

9.4 Spatial Patterns of Activity

Figure 4 shows the relative levels of activity at each of the six detector sites for resident and migratory guilds of bats. All sites showed low levels of activity with activity slightly skewed to northern detector sites. These two sites were located near surface water features and have edge habitat, both of which would have served to somewhat concentrate bat activity, as expected. Bat 1 was also near a small pond and watercourse but had lower activity levels, similar to = BAT4 and BAT5, which were located in mature mixedwood stands. Given the generally low level of bat activity across the site, there are no important spatial patterns of activity in the data that might warrant special mitigation due to localized elevated risks to bats.

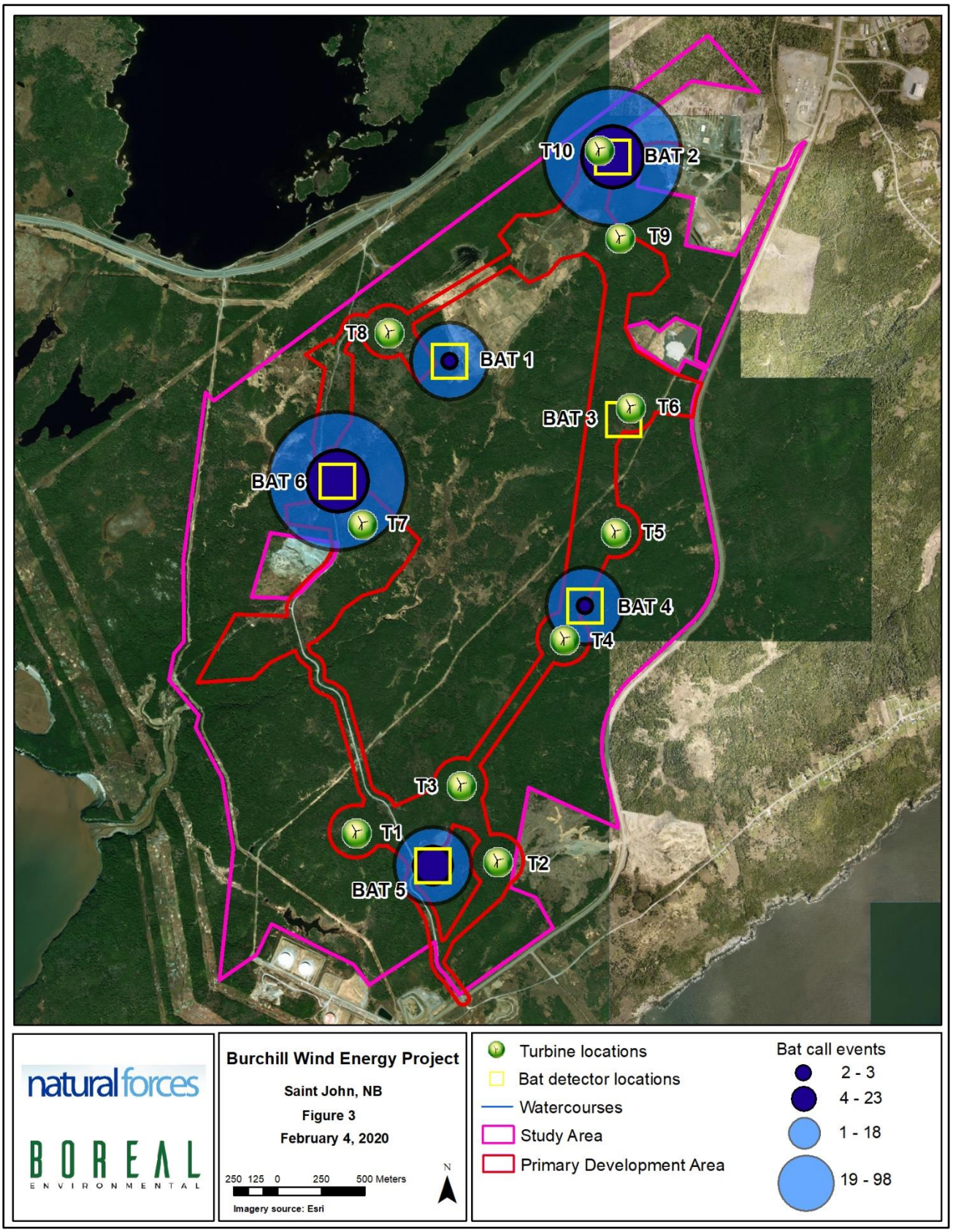

Figure 4. Magnitude of bat activity by detector location with the Study Area.

10 Discussion

10.1 Magnitude of Activity

A low number of *Myotis* sp. calls were recorded at all stations throughout the active season, with most occurring during the fall migration period, although these species are not considered migratory. The activity may have coincided with the bats' movement from summer maternity colonies back to winter hibernacula or with the exploitation of migrating aerial insects moving through the area in late summer. With a total bat activity recorded of only 0.32 bat call events per detector-night, the activity at the Study Area was comparable to other recent acoustic monitoring studies in New Brunswick.

At a study location for a proposed wind project development in Gloucester County, NB, WSP Consulting (2019) had recorded 7.3 call events per detector night for their study season in 2018 but only 0.25 for the study season in 2019.The report presents the data in total passes per night but this was converted by dividing by the number of detectors they used, for comparison.

Similarly low levels of activity were recorded at the Wisokolamson Energy Project in Albert County, NB, of 0.15 bat passes per night as recorded by WSP (WSP 2018); and at the Wocawson Energy Project near Sussex, NB, Boreal Environmental recorded 0.31 passes per detector night.

10.2 Habitat Loss

Habitat alteration may affect bats in the Project area. However, the acoustic survey results did not suggest the presence of active breeding colonies and no bat call events were recorded in the mature hardwood stand (BAT3) where the highest availability of cavity trees was readily available (as well as suitable roosting habitat for tree bats such as the red and hoary bats).

The Project will be sited on existing roads and disturbed areas where feasible, thereby minimizing the need to disturb new areas which may reduce potential displacement of some bat species. Given that most bat species tend to forage along edges, using roads and man-made corridors as foraging and navigation aids (Grindal and Brigham 1998) and that the interior forest detector sites saw little to no activity, it is not anticipated that the loss of mature forest habitat will have a population-level effect on the bat species recorded in the Study Area (Patriquin and Barclay 2003).

Bat activity was low overall for the Study area during the breeding season suggesting that use by resident bats for breeding is very low.

10.3 Turbine Collision Potential

The most apparent potential effect of the Project on bats is direct mortality resulting from collisions with turbine blades during Project operations. Mortality can either occur from direct contact with turbine blades or from barotrauma (Grodsky et al., 2011). Barotrauma is caused by rapid air-pressure reduction that causes tissue damage due to expansion of air in the lungs that is not accommodated by exhalations. It is probably the major cause of bat mortality from wind facilities (Rollins et al., 2012). Myotis sp., a species at risk were detected near the proposed turbine locations and therefore may be a potential for direct mortality.

According to other post-construction monitoring programs for wind facilities across Canada, bat fatalities typically outnumber bird fatalities (ECCC et al., 2012). Because bats have a long lifespan and a low reproductive rate, fatalities from wind facilities may be important if they are in areas with high numbers of bats which is not the case for the Study Area. Bird Studies Canada (2016) also conducted an analysis of post construction bat mortality at wind developments across Canada and found that bat mortality in Atlantic

Canada (0.26 deaths per turbine per year) is far lower than in other regions such as Ontario (18.52) and Alberta (7.99). This number is also several orders of magnitude lower than the numbers of bat mortalities reported at wind developments in Ontario and Alberta (BSC 2016).

Bird Studies Canada (2016) found that Myotis species were the most affected by collisions in Atlantic Canada. Given that this data largely proceeded the outbreak of WNS, it is likely that Myotis collisions are much lower now and based on activity levels recorded at wind developments more recently, big brown bats may now have similar mortality rates to Myotis species. In general, all bat collisions are low in Atlantic Canada (0.26 per turbine per year), even before WNS (Bird Studies Canada 2016). More data will need to be compiled from post-construction mortality surveys at New Brunswick wind project sites to determine how much lower that is figure is following the crash of resident bat populations.

At wind farms across Canada, most bat fatalities are reported in the late summer months coinciding with the start of swarming and autumn migration (Johnson, 2005; Arnett et al., 2007; ECCC et al., 2012, BSC 2016). Periods of high mortality may therefore be linked with the timing of large-scale insect migrations when bats feed at altitudes consistent with turbine heights (Rydell et al., 2010). The timing of bat mortalities in the literature coincides with the bat activity profile recorded over the season at BWP.

The highest mortality occurs on suspected migratory flyways (Arnett et al., 2008). The acoustic monitoring data conducted in the Study Area did not suggest that the area was a busy flyway., although a radar study is being conducted for the site by Acadia University that will help determine activity of birds and bats (combined) at higher elevations than was sampled in this study.

11 Conclusion

The total bat call events per detector-night recorded at BWP was only 0.32, attributed to only four species. Activity at the site was very low during the spring and early summer season suggesting that the area is not important for breeding bats. There was an increase in activity in the late summer by both migratory and resident bar species, although levels in general did not suggest that the area was an important migratory corridor. There were no important spatial patterns to the activity across the site. Of the activity recorded on site, it was somewhat concentrated at sites near small bodies of water, which was expected. The sampling program did not suggest that there was a likelihood that a wind development would constitute a higher risk than other wind developments in the region, and mortality rates from turbine collisions in the Atlantic Canada region are already relatively low compared to other provinces. While higher altitude sampling was not feasible during this study, a radar study of the area conducted by Acadia University, that will identify all nocturnal migration traffic of birds and bats (not distinguishable), will be presented in a separate report.

12 Report Disclaimers and Disclosures

The sole purpose of this report and the associated services performed by Boreal Environmental Inc. was to complete a bird study and report for Natural Forces Developments Limited Partnership for the Burchill Wind Project in Saint John, NB.

The observations made and facts presented in this report are based on data collection conducted from June 1st to October 15th, 2019. Site conditions at the time of visitation / sampling are reflected in this document and no independent confirmation of this information was made.

This report has been prepared on behalf of and for the exclusive use of Natural Forest Wind Energy. The report expresses the professional opinion of Boreal Environmental Inc., and is based on technical / scientific knowledge. Boreal Environmental Inc., accepts no liability or responsibility whatsoever for or in respect of any use of or reliance upon this report or data by any third party. Boreal Environmental Inc., makes no guarantee that the result of this analysis may not be different based on the services of another consultant. Boreal Environmental Inc., makes no guarantee that Natural Forces Developments Limited Partnership will be successful in the regulatory approval process.

13 Closing

This Report has considered factors relevant to the scope of the assessment and has completed the analyses in accordance with the methodologies described. The Report was prepared by Derrick Mitchell, if you have any questions or require clarification on particular elements of the report please contact the undersigned at derrick@borealenvironmental.com

Boreal Environmental Inc.,

Derrick Mitchell, B.Sc.F., R.P.F

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