January 12, 2016

Mr. Chris Veinot, EIT
Development Engineer
Natural Forces
1801 Hollis Street Suite 1205
Halifax, NS B3J 3N4

Dear Chris Veinot,

Re: Summary of 2015 Monitoring at Boularderie-Hillside Wind Farm

At the request of Natural Forces, Amec Foster Wheeler staff conducted the required post construction mortality monitoring for birds and bats as well as acoustic surveying for bats at the Boularderie-Hillside Wind Farm in Cape Breton County during the 2015 season. This letter provides a summary of the surveying activities.

Each monitoring component is discussed in the following paragraphs.

Carcass/Mortality Searches

As agreed upon with Natural Forces, AMEC Foster Wheeler staff began conducting carcass searches at the Boularderie-Hillside Wind Farm site in 2015. The original mortality monitoring methodology and schedule was developed in accordance with Ontario Ministry of Natural Resources (OMNR) guidelines for post construction bat surveys (*Bats And Bat Habitats: Guidelines for Wind Power Projects;* OMNR 2010) and bird surveys (*Birds And Bird Habitats: Guidelines for Wind Power Projects;* OMNR 2011), as well as the Canadian Wildlife Service (CWS) guidance document for post construction bird surveys (*Recommended Protocols for Monitoring Impacts of Wind Turbines on Birds*; CWS 2007). It was modified somewhat upon

Amec Foster Wheeler conducted carcass surveys over the duration of the peak periods that bird and bat presence may be detected (May to October). The surveys were weighted to times to peak bird and bat migration periods, and spring breeding season for birds.

Weighting of field surveys was placed on the months of May, June, August, and September. Selection of survey dates was weather-dependent. Days with lower wind and favourable weather were chosen over those with high winds and rain.

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The Bird and bat mortality surveys involved regular searches around the base of turbines for any dead or injured birds or bats. Such surveys identify the number of bats or birds killed per turbine over a known period of time (expressed as bats or birds/turbine/time). This value represents a minimum estimate of bat/bird mortality adjusted for bat/bird carcass removal rates, and searcher efficiency. Larger wind farms may also incorporate the percent area searched, however, the Hillside-Boularderie wind farm is small enough that the entire study area should be searched.

Based on previous work by the Ontario Ministry of Natural Resources (OMNR), the following recommendations were followed:

- Surveys were initiated in the morning at first light, prior to sunrise, to minimize losses due to scavengers.
- All carcasses found were photographed and recorded/labeled with species, sex, date, time, location (UTM coordinates), carcass condition, searcher name, injuries, distance to nearest turbine, ground cover and distance to plot centre. A data sheet sample should be provided in the mortality report.
- The condition of each carcass collected was recorded in one of the following categories:
    - **intact** – a carcass that is not badly decomposed and shows no sign of having been fed upon by a predator or scavenger, although it may show signs of traumatic injury such as amputation from a turbine collision.
    - **scavenged** – an entire carcass that shows signs of having been fed upon by a predator or scavenger or a partial carcass that has been scavenged, with portions of it (for example, wings, skeletal remains, legs, pieces of skin) found in more than one location.

The twice weekly searches at the Boularderie-Hillside Wind Farm site did not result in the discovery of any bird or bat carcasses at either turbine during the 2015 carcass search period (May 5 to Oct 30).

Scavenger Trials

Scavenger efficiency trials are required to determine the effects that local scavengers (wildlife and domestic pets) may have on the results of the carcass searches. In areas of high scavenging activity, scavengers can remove a large proportion of any carcasses before they can be found during carcass searches, leading to an underestimate of the mortality rates caused by turbines.

Scavenger efficiency trials were conducted at Hillside-Boularderie at an approximately monthly frequency from May to September. In the early morning, 13 or 14 small animal carcasses (usually 10-11 quail and 2-3 small mammals) were randomly placed around the two turbines by Amec Foster Wheeler staff who were conducting the mortality searches, and the location of the carcasses was recorded. Following carcass placement, daily early-morning searches were conducted by another Amec Foster Wheeler employee until all of the carcasses were gone or two weeks had passed. The presence or absence of each of the placed carcasses was confirmed, and if present, the condition of the carcass (e.g., intact, partially scavenged) was recorded.

Japanese Quail (*Coturnix japonica*) carcasses were obtained from a commercial quail producer in Moncton, NB. Although OMNR (2010) recommends that bat carcasses should be used for scavenger trials, neither of the two most common bat species in Nova Scotia, the Little Brown Bat (*Myotis lucifugus*) and Northern Long-eared Bat (*M. septentrionalis*), could be used due to concerns about white-nose syndrome contamination risks, so mice or juvenile rats were used as a surrogate. Mouse and rat carcasses were obtained from a pet supply store. Mice, which are unavailable commercially in natural colours were artificially coloured to resemble *Myotis* spp.

A Scavenger Efficiency Correction Factor was calculated for each monthly trial, which allows for incorporation of losses due to scavenging into the carcass survey results. Proportions of carcasses remaining after each search interval are pooled to calculate the overall scavenger correction (S_c) factor (OMNR 2010), which is calculated as follows:

$$S_c = \frac{n_{visit1} + n_{visit2} + n_{visit3...}}{n_{visit0} + n_{visit1} + n_{visit2...}}$$

Where:
S_c is the proportion of carcasses not removed by scavengers over the search period
n_{visit0} is the total number of carcasses placed
$n_{visit1} – n_{visit3}$ are the numbers of carcasses remaining on visits 1 through 3

Table 1 Scavenger efficiency at Hillside Boularderie Wind Farm in 2015

Month	Number of Carcasses Placed	S_c
May/ June	13	0.62
June/ July	13	0.07
August/ September	14	0.74
September/ October	14	0.13

Carcass persistence was very high in August, with 8 of 14 carcasses still present after 14 days. Persistence was lowest in the July/August trial, with 12 carcasses gone after 3 days.

Searcher Efficiency Trials

Searcher efficiency trials are required to determine the effects of observer bias on the rate of carcass recovery. Different surveyors may have different rates of carcass recovery, depending on various individual factors. Searcher efficiency trials require a known number of discreetly marked carcasses to be placed around a wind turbine. Searchers examine the wind turbine area, and the number of carcasses that they find is compared to the number of carcasses placed. Searcher efficiency is another important factor in creating an estimate of total bat mortality.

Searcher efficiency trials were held Sept 21 for all searchers at the Hillside-Boularderie wind farm. A total of 13 small animal carcasses (10 quail/sparrow and 3 mouse) were randomly placed by an Amec Foster Wheeler personnel around the turbines in locations unknown to the Amec Foster Wheeler employee conducting the mortality searches.

In order to minimize the risk of scavenging, carcasses were placed in the early morning before 6 am, and searchers began surveying shortly after. When a carcass was found, the searcher recorded the species, turbine number and coordinates, and left the carcass in place for other searchers to find. Following the searcher efficiency trial, the person who placed the carcasses returned to the site to check whether the carcasses were still present and had not been scavenged during the searcher trial.

Searcher efficiency (S_e) for birds and bats for each searcher was calculated as follows:

$$S_e = \frac{\text{number of test carcasses found}}{\text{(Number of test carcasses placed - number of carcasses scavenged)}}$$

Since the number of turbines searched by each individual over the season will vary, it is necessary to calculate a weighted average that reflects the proportion of turbines each searcher searched. The weighted average or overall searcher efficiency is calculated as follows:

$$S_{eo} = S_{e1}(n_1/T) + S_{e2}(n_2/T) + S_{e3}(n_3/T)\ldots$$

Where:
S_{eo} is the overall searcher efficiency
S_{e1} and $_2$ and $_3$… are individual searcher efficiency ratings
n_1 and $_2$ and $_3$… are number of turbines searched by each searcher
T is the total number of turbines searched by all searchers

No test carcasses were scavenged during the trial, so searcher efficiency was simply the number of test carcasses found divided by the number placed. The percentage of birds (quail) found ranged from 60% to 80%, while for mice (surrogate for bats), the searcher efficiency varied considerable, reaching a high of 75% while one searcher did not succeed in finding any of the mouse carcasses (Table 2). Overall, the searcher efficiency ranged from 43% to 79%, and the overall weighted average searcher efficiency (S_{eo}) was 57%.

Table 2. Searcher Efficiency for Hillside-Boularderie Wind Farm, 2015

Searcher Name	Number of Searches	S_e for Birds	S_e for Bats	Total S_e	Overall S_e (S_{eo})
Beth Cameron	9	0.6	0	0.43	0.57
Jason Marsh	9	0.8	0.75	0.79	
John Krilow	10	0.6	0.25	0.50	
Maureen Cameron-MacMillan	13	0.6	0.5	0.57	

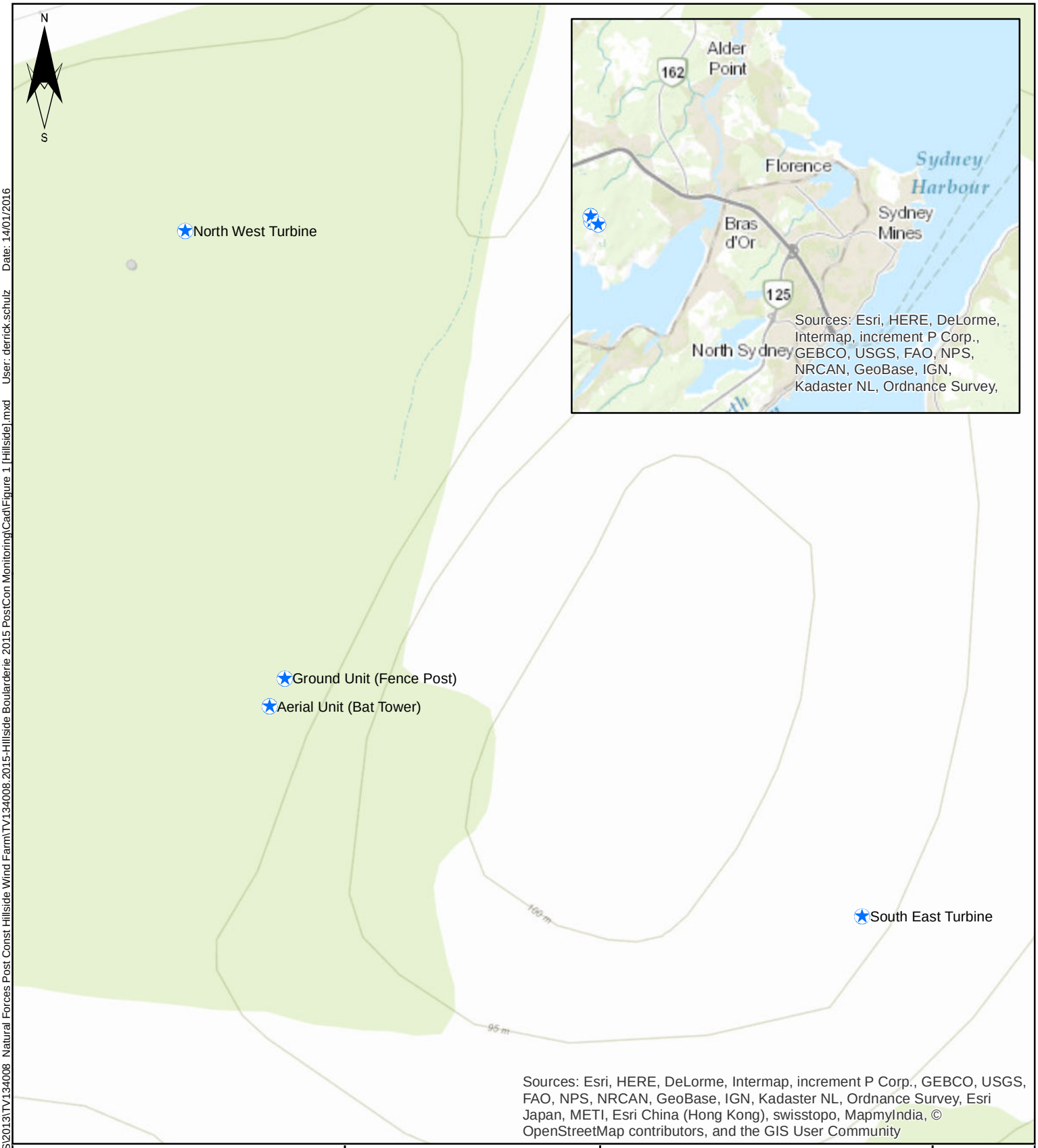
Acoustic Monitoring

Aerial System

On May 19 2015, a dedicated 10 m bat survey tower was erected on the Hillside-Boularderie site. Coordinates were 20 T 704181 5124726 (UTM NAD 83).The microphone assembly pointed north, parallel to the tree line to allow sampling of the forest edge. A high-sensitivity Anabat microphone was mounted on an extension cable and placed within a tubular waterproof plastic housing, which was then strapped to the top of the tower. The microphone faced downwards within the housing, and a plate angled at 45° from horizontal reflected incoming sounds upward into the waterproof housing. This allowed sampling of a horizontal section of the sky at approximate treetop height. The tower was constructed with a cantilevered base, allowing it to be raised and lowered as needed. A microphone extension cable ran down the pole to the main body of the Anabat SD2 bat detector unit, which was placed in a waterproof housing at the base of the pole, along with the power supply.

The Anabat SD2 was programmed to record all ultrasonic sounds between 7 pm and 7 am. This system was frequently checked (approximately biweekly or less) to download data, check batteries, and verify that the system was intact and functioning properly.

This system remained in operation until October 27 2015, after which the Anabat SD2 body and the power supply were removed. The tower was then lowered for the winter, to avoid damage due to frost heave, and left lying on site, well marked with flagging and stakes. It will be re-erected in spring 2016 for the next season of post-construction monitoring.



Path: \\hfx1-fs1\projects$\53300 PROJECTS\2013\TV134008 Natural Forces Post Const Hillside Wind Farm\TV134008.2015-HIllside Boularderie 2015 PostCon Monitoring\Cad\Figure 1 [Hillside].mxd User: derrick.schulz Date: 14/01/2016

CLIENT:
Natural Forces Wind Inc.
1791 Barrington Street Suite 1030
Halifax, Nova Scotia
Canada B3J 3L1

SCALE:
20 10 0 20 40 60
Meters

PROJECT:
HIllside Boularderie
Wind Farm

DWN BY: DS
CHK'D BY: BC
DATE: January 2016
REV. NO: .
FIGURE NO: 1

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DATUM: NAD83 CSRS
PROJECTION: UTM Zone 20 North
PROJECT NO: TV134008

TITLE:
General Site Location

Photo 1.Pole erected on site for aerial Anabat system in 2015, showing detail of cleared area and forest edge.

Ground System

In 2015 a ground-based Anabat SD2 acoustic bat detector was deployed at the Hillside-Boularderie site from 5 May 2015 to 27 s were 704187 20 T 5124737 (UTM NAD 83) and October 2015. Coordinate the location is depicted on Figure 1 (2015 Survey Location). The detector was mounted, along with its power supply, on a galvanized fence post installed for this purpose. The microphone was mounted in a waterproof housing identical to the 'bat hat' described for the aerial system, mounted on the fence post approximately 1 m above ground. This allowed sampling of a section of the sky approximately 45 degrees from horizontal. The detector was programmed to record all ultrasonic sounds between 7 pm and 7 am. This setup was placed within 5m of the tree line on the site, with the microphone tube pointing perpendicular to the tree line (east) to allow sampling of the forest edge (Figure 2).

Photo 2.Pole erected on site for ground Anabat system in 2015, showing detail of cleared area and forest edge.

ANABAT Data Format and Analysis

While deployed at the site, the ANABAT detectors recorded all ultrasonic frequencies detected onto a compact flash card. This data was then interpreted via Analook W software (version 3.8s) using zero-crossing analysis. All ultrasonic frequencies recorded were then displayed graphically as sonograms, and bat echolocation sequences were identified based on the minimum, maximum, and characteristic frequencies, in addition to the slope of the calls (O'Farrell *et al.* 1999). Sequences were identified to species using the Analook W software and published information on the calls of bat species native to eastern North America (Barclay 1989, Barclay *et al.* 1999, Betts 1998, Broders *et al.* 2001, Fenton and Bell 1981, Fenton *et al.* 1983, MacDonald *et al.* 1994). It should be noted that bats of the genus *Myotis* present within Nova Scotia (little brown bat and northern long-eared bat) generally cannot be distinguished reliably using these acoustic survey methods.

Analysis of the acoustic bat data for the Hillside-Boularderie site indicates that Myotis bats occur on the site at low levels throughout the season, with a slight increase in late summer. Levels of Myotis activity are plotted on Figure1 for both the aerial and ground Anabat units. This data is summarized in Table 3. A few occasion with missing data due to equipment failure are indicated as ND (no data). Overall, the data indicate that low numbers of little brown bats (*Myotis lucifugus*) continue to occur on the site, with a slight increase in frequency as the summer progresses.

No evidence of any other bat species was detected at the Hillside-Boularderie site during the 2015 season.

Table 3. Summary of Acoustic Bat Data recorded by Aerial and Ground-based Anabat SD2 bat detectors at Hillside-Boularderie Wind Farm in 2015.

	AERIAL		GROUND	
NIGHT	MYOT	JUNK	MYOT	JUNK
05/05/2015	0	8	0	8
06/05/2015	0	0	0	0
07/05/2015	0	0	0	0
08/05/2015	0	1	0	1
09/05/2015	0	0	0	0
10/05/2015	5	0	5	0
11/05/2015	0	2	0	2
12/05/2015	0	29	0	29
13/05/2015	0	0	0	0
14/05/2015	0	0	0	0
15/05/2015	1	1	2	1
16/05/2015	1	0	1	0
17/05/2015	1	0	1	0
18/05/2015	0	0	0	0
19/05/2015	0	0	0	0

	AERIAL		GROUND	
NIGHT	MYOT	JUNK	MYOT	JUNK
20/05/2015	4	5	0	9
21/05/2015	0	3	0	3
22/05/2015	0	36	0	36
23/05/2015	0	0	0	0
24/05/2015	0	0	0	0
25/05/2015	1	0	1	0
26/05/2015	0	0	0	0
27/05/2015	0	1	0	1
28/05/2015	0	0	0	0
29/05/2015	0	0	0	0
30/05/2015	0	0	0	0
31/05/2015	0	0	0	0
01/06/2015	0	0	0	0
02/06/2015	0	3	0	3
03/06/2015	0	2	0	2
04/06/2015	0	0	0	0
05/06/2015	0	0	0	0
06/06/2015	0	2	0	2
07/06/2015	1	0	1	0
08/06/2015	0	0	0	0
09/06/2015	0	0	0	0
10/06/2015	0	0	0	0
11/06/2015	0	0	0	0
12/06/2015	1	0	1	0
13/06/2015	0	1	0	1
14/06/2015	0	0	0	0
15/06/2015	0	0	0	0
16/06/2015	0	6	0	6
17/06/2015	0	0	0	0
18/06/2015	0	0	0	0
19/06/2015	0	0	0	0
20/06/2015	1	0	1	0
21/06/2015	0	2	0	2
22/06/2015	0	0	0	0
23/06/2015	0	1	0	1
24/06/2015	0	0	0	0
25/06/2015	0	0	0	0
26/06/2015	0	0	0	0

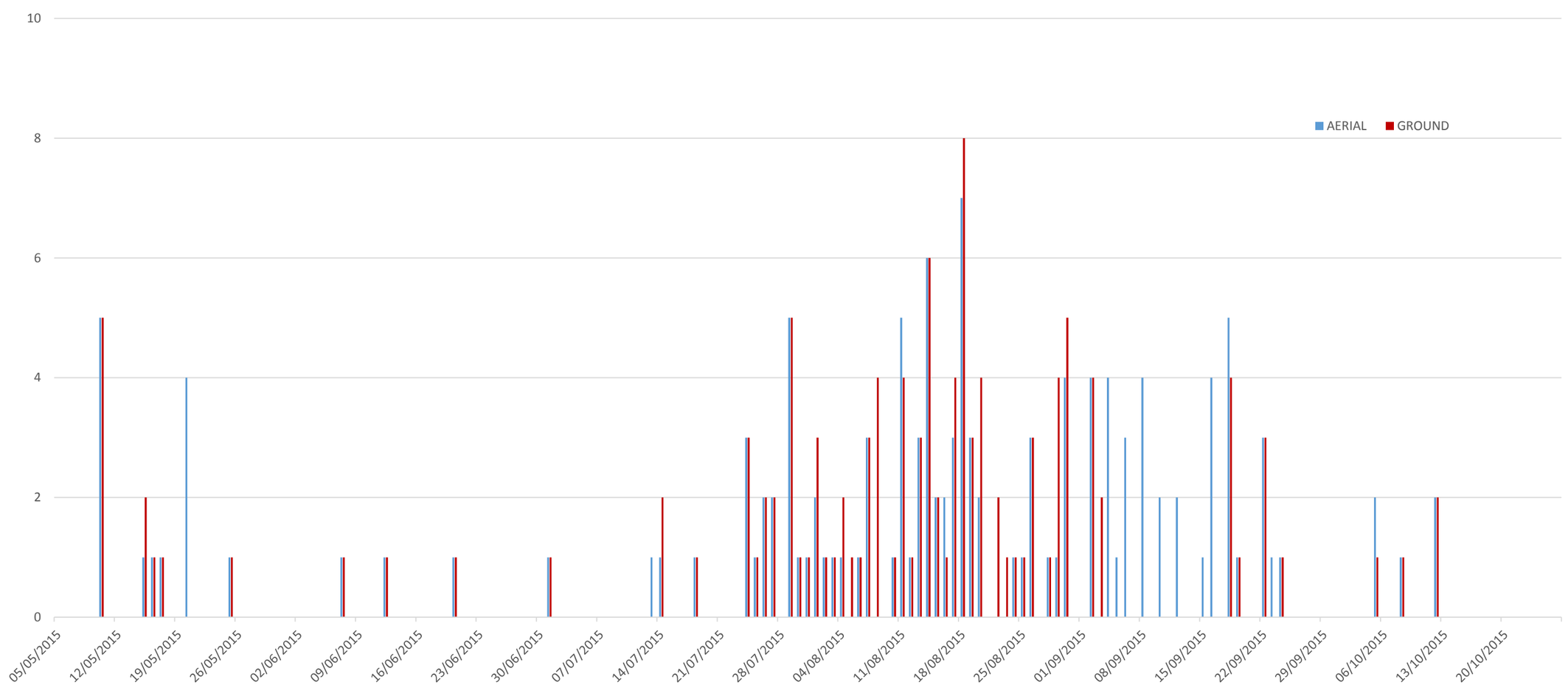
	AERIAL		GROUND	
NIGHT	MYOT	JUNK	MYOT	JUNK
27/06/2015	0	0	0	0
28/06/2015	0	0	0	0
29/06/2015	0	0	0	0
30/06/2015	0	0	0	0
01/07/2015	1	0	1	0
02/07/2015	0	0	0	0
03/07/2015	ND	ND	ND	ND
04/07/2015	ND	ND	ND	ND
05/07/2015	ND	ND	ND	ND
06/07/2015	ND	ND	ND	ND
07/07/2015	ND	ND	ND	ND
08/07/2015	ND	ND	ND	ND
09/07/2015	0	2	0	2
10/07/2015	0	0	0	0
11/07/2015	0	0	0	0
12/07/2015	0	54	0	54
13/07/2015	1	0	0	1
14/07/2015	1	1	2	0
15/07/2015	0	0	0	0
16/07/2015	0	0	0	0
17/07/2015	0	0	0	0
18/07/2015	1	0	1	0
19/07/2015	0	1	0	1
20/07/2015	0	0	0	0
21/07/2015	0	1	0	1
22/07/2015	0	39	0	180
23/07/2015	0	3	0	3
24/07/2015	3	0	3	0
25/07/2015	1	0	1	0
26/07/2015	2	10	2	6
27/07/2015	2	1	2	1
28/07/2015	0	338	0	338
29/07/2015	5	3	5	3
30/07/2015	1	1	1	1
31/07/2015	1	14	1	14
01/08/2015	2	2	3	1
02/08/2015	1	3	1	3
03/08/2015	1	1	1	1

	AERIAL		GROUND	
NIGHT	MYOT	JUNK	MYOT	JUNK
04/08/2015	1	4	2	3
05/08/2015	0	6	1	5
06/08/2015	1	14	1	14
07/08/2015	3	3	3	3
08/08/2015	0	0	4	4
09/08/2015	0	6285	0	5264
10/08/2015	1	1	1	1
11/08/2015	5	1	4	2
12/08/2015	1	8	1	8
13/08/2015	3	7	3	7
14/08/2015	6	4	6	4
15/08/2015	2	0	2	0
16/08/2015	2	6	1	7
17/08/2015	3	10	4	9
18/08/2015	7	2	8	1
19/08/2015	3	1	3	1
20/08/2015	2	5	4	3
21/08/2015	0	0	0	4462
22/08/2015	0	8022	2	7119
23/08/2015	0	869	1	868
24/08/2015	1	83	1	83
25/08/2015	1	5	1	5
26/08/2015	3	15	3	15
27/08/2015	0	677	0	677
28/08/2015	1	59	1	59
29/08/2015	1	196	4	193
30/08/2015	4	15	5	14
31/08/2015	0	985	0	985
01/09/2015	0	126	0	126
02/09/2015	4	49	4	49
03/09/2015	0	1	2	91
04/09/2015	4	3	0	0
05/09/2015	1	412	0	0
06/09/2015	3	45	0	0
07/09/2015	0	1051	0	0
08/09/2015	4	14	0	0
09/09/2015	0	338	0	0
10/09/2015	2	146	0	0

	AERIAL		GROUND	
NIGHT	**MYOT**	**JUNK**	**MYOT**	**JUNK**
11/09/2015	0	89	0	0
12/09/2015	2	1	0	0
13/09/2015	0	1	0	0
14/09/2015	0	44	0	0
15/09/2015	1	79	0	0
16/09/2015	4	7	0	0
17/09/2015	0	43	0	43
18/09/2015	5	0	4	1
19/09/2015	1	31	1	31
20/09/2015	0	13	0	13
21/09/2015	0	13	0	13
22/09/2015	3	0	3	0
23/09/2015	1	0	0	1
24/09/2015	1	173	1	173
25/09/2015	0	14	0	14
26/09/2015	0	72	0	72
27/09/2015	0	2612	0	2612
28/09/2015	0	694	0	694
29/09/2015	0	121	0	121
30/09/2015	0	148	0	148
01/10/2015	0	67	0	67
02/10/2015	**ND**	**ND**	**ND**	**ND**
03/10/2015	**ND**	**ND**	**ND**	**ND**
04/10/2015	0	0	0	1
05/10/2015	2	0	1	1
06/10/2015	0	1	0	1
07/10/2015	0	1	0	1
08/10/2015	1	1	1	1
09/10/2015	0	271	0	271
10/10/2015	0	58	0	58
11/10/2015	0	1620	0	1620
12/10/2015	2	1	2	1
13/10/2015	0	2	0	2
14/10/2015	0	1	0	1
15/10/2015	**ND**	**ND**	**ND**	**ND**
16/10/2015	0	240	0	240
17/10/2015	0	2	0	2
18/10/2015	**ND**	**ND**	**ND**	**ND**

NIGHT	AERIAL		GROUND	
	MYOT	JUNK	MYOT	JUNK
19/10/2015	**ND**	**ND**	**ND**	**ND**
20/10/2015	0	1309	0	1309
21/10/2015	0	21	0	42
22/10/2015	0	159	0	159
23/10/2015	0	1104	0	1104
24/10/2015	0	32	0	32
25/10/2015	0	8	0	8
26/10/2015	0	239	0	239

Figure 2. Myotis Activity Levels Levels at Hillside-Boularderie Wind Farm, 2015



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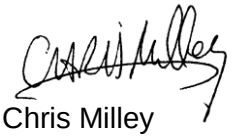
Conclusions and Recommendations- necessary?

CLOSING

We trust this report meets your requirements and look forward to the next season post-construction monitoring. Please contact the undersigned should have any questions or comments on any aspect of the monitoring and surveying programs for 2015 or 2016.

Amec Foster Wheeler Environment & Infrastructure,
a Division of Amec Foster Wheeler Americas Limited



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