

January 14, 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 Barrachois Wind Farms**

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 Barrachois Wind Farm in Cape Breton County during the 2015 season. This letter provides a summary of the surveying activities.

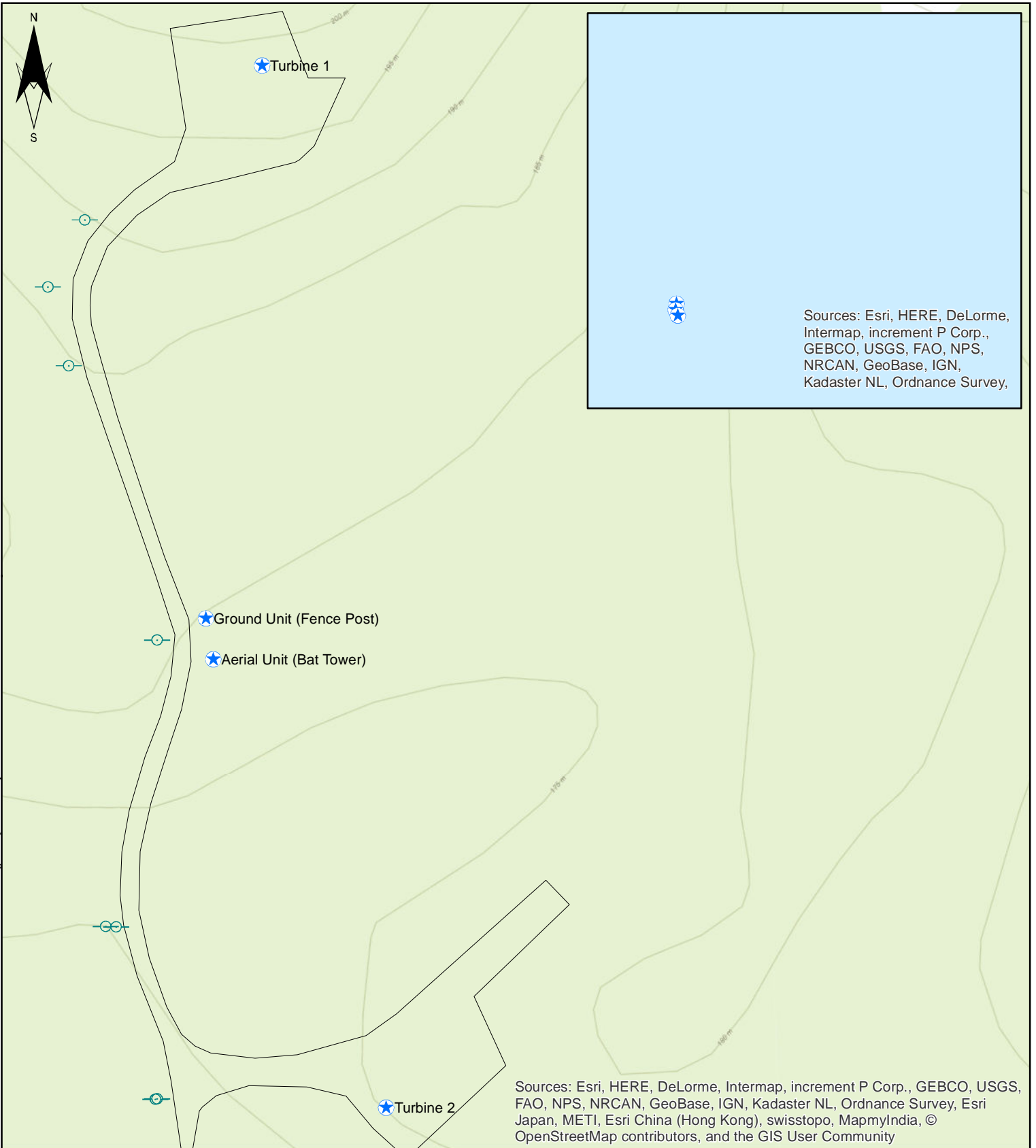
Each monitoring component is discussed in the following paragraphs.

## **Mortality Searches**

Bird and bat mortality surveys involve 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. This value represents a minimum estimate of bat and bird mortality adjusted for carcass removal rates, the percent area surveyed, and searcher efficiency. In addition to this mortality searches, periodic scavenger trials are performed so that a correction factor may be calculated to account for underestimates in the mortality search results due to carcasses being taken by scavengers. Similarly, searcher efficiency trials are conducted so that a correction factor may be calculated to account for underestimates due to carcasses not being detected by the searcher(s). This report discusses the methodology and results of the mortality searches, searcher efficiency trials and scavenger trials that were conducted at the Barrachois wind farm in 2015.

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.

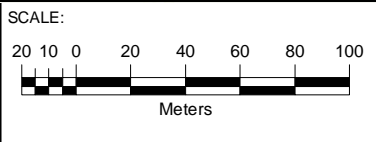


Sources: Esri, HERE, DeLorme, Intermap, increment P Corp., GEBCO, USGS, FAO, NPS, NRCAN, GeoBase, IGN, Kadaster NL, Ordnance Survey,

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Path: \\hfx1-fs1\project\$\5300 PROJECTS\2014\TV144008 Barrachois Post Construction Bat\Cad\Figure 1 [Barrachois].mxd User: derrick.schulz Date: 14/01/2016

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



PROJECT:  
**Barrachois Wind Farm**

DWN BY:  
 DS

CHK'D BY:  
 BC

**amec foster wheeler**

50 Troop Avenue, Unit 300  
 Dartmouth, N.S., B3B 1Z1  
 (P) 902-468-2848 (F) 902-468-1314  
 www.amec.com

DATUM: NAD83 CSRS

PROJECTION: UTM Zone 20 North

PROJECT NO: TV134008

TITLE:  
**General Site Location**

DATE:  
 January 2016

REV. NO:  
 .

FIGURE NO:  
 1

The bird and bat mortality surveys involved regular searches around the base of turbines for 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 Barrachois 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 Barrachois site resulted in the discovery of two bird carcasses since that date. The first, found on Sept 1 approximately 20 metres from the base of the lower turbine, is a suspected Black and White Warbler (*Mniotilta varia*), although this identification is tentative due to the weathered and partly decomposed state of the carcass when found (Photo 1).



Photo 1. Suspected Black and White Warbler (*Mniotilta varia*) found at lower Barrachois Turbine on Sept 1 2015.

The second find was a Magnolia Warbler (*Setophaga magnolia*), found on September 4 at the upper turbine (Photo 2).



Photo 2 Magnolia Warbler (*Setophaga magnolia*) found at upper Barrachois Turbine on Sept 4 2015.

Neither Black and White Warblers nor Magnolia Warblers are species of conservation concern. Both are migratory species which migrate south to overwinter.

No bat carcasses were found within either of the Barrachois turbine footprints during the 2015 carcass search period (August 20 to October 30).

## Scavenger Trials

Scavenger efficiency trials were conducted at Barrachois in late August, and late September. In the early morning, a total of 14 small animal carcasses (10 quail and 4 small brown 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. In one trial, a small brown sparrow carcass was used as a bat surrogate.

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:

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

Where:

$S_c$  is the proportion of carcasses not removed by scavengers over the search period

$n_{\text{visit0}}$  is the total number of carcasses placed

$n_{\text{visit1}} - n_{\text{visit3}}$  are the numbers of carcasses remaining on visits 1 through 3

Carcass persistence was very high during the scavenger efficiency trials, indicating relatively low scavenging rates at the site. In August, none of the carcasses were taken in the first week of the trial. The scavenger efficiency correction factor at the Barrachois site ranged from 0.76 to 0.79 (Table 1), and the mean for the site was 0.77.

Table 1. Scavenger efficiency at Barrachois in 2015

Month	Number of Carcasses Placed	S <sub>c</sub>
August/ September	14	0.76
September/ October	14	0.79

## Searcher Efficiency Trials

The searcher efficiency trial took place on 21 September 2015. A total of 14 small animal carcasses (10 quail and 4 bat surrogates) 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, 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<sub>e</sub>) for birds and bats for each searcher was calculated as follows:

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

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:

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

Where:

S<sub>eo</sub> is the overall searcher efficiency

S<sub>e1</sub> and <sub>2</sub> and <sub>3</sub>... are individual searcher efficiency ratings

n<sub>1</sub> and <sub>2</sub> and <sub>3</sub>... 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 considerably, 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 61%.

Table 2. Searcher efficiency for birds and bats at Barrachois

Searcher Name	Number of Searches	$S_e$ for Birds	$S_e$ for Bats	Total $S_e$	Overall $S_{eo}$
Beth Cameron	3	0.6	0	0.43	0.61
Jason Marsh	6	0.8	0.75	0.79	
John Krilow	2	0.6	0.25	0.50	
Maureen Cameron-MacMillan	6	0.6	0.5	0.57	

## Acoustic Monitoring

### Aerial System

On May 20, a dedicated 10 m bat survey tower was erected on the Barrachois site. Coordinates were 704181 5124726 (UTM NAD 83) (Photo 3). The microphone assembly pointed 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 weekly) to download data, check batteries, and verify that the system was intact and functioning properly.

This system remained in operation until October 27, 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.



*Photo 3: Pole erected on site for aerial Anabat system in 2015, showing detail of cleared area and forest edge.*

## **Ground System**

In 2015 an Anabat SD2 acoustic bat detector was deployed at the Barrachois site from 20 May to 27 October. Coordinates were 704187 5124737 (UTM NAD 83) and the location is depicted on Figure 1. 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 parallel to the tree line to allow sampling of the forest edge (Photo 2).





Photo 4: Ground-based Anabat system in 2015.

## 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 AnalookW 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 Barrachois 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 Figure 1 for both the aerial and ground Anabat units. These data are summarized in Table 3. The data indicate that low numbers of little brown bats

*(Myotis lucifugus)* continue to occur on the site. Of particular interest was the high level of bat activity during the night of September 11, as detected by both the ground and aerial bat detectors. This sudden increase could be due to a single bat remaining in the vicinity all night, or due to a number of *Myotis* bats passing through the area that night.

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

Myotis Activity Level Recorded by Ground and Aerial Detectors on Barrachois site in 2015

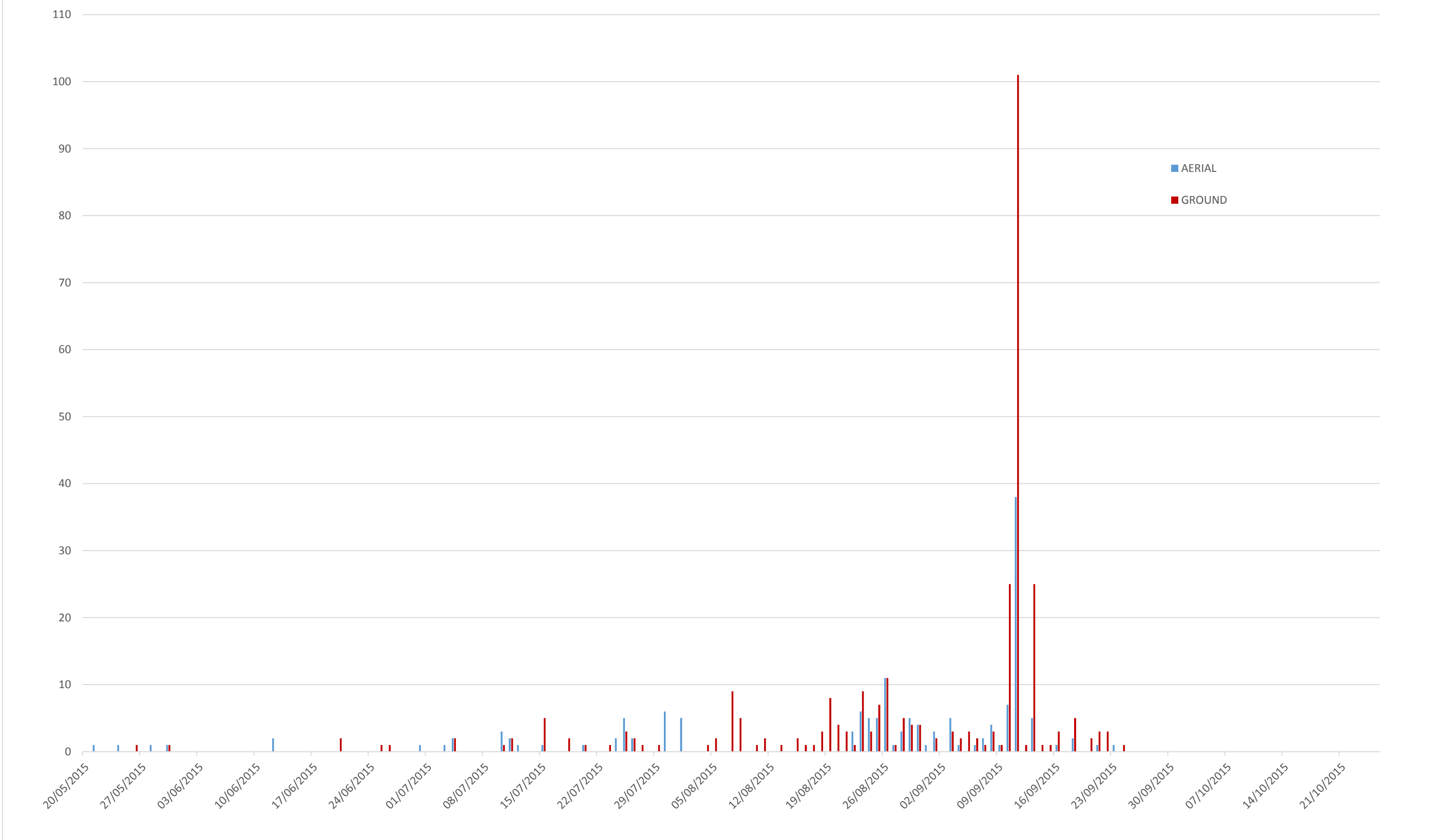


Table 3. Summary of Acoustic Monitoring Data from Aerial and Ground Anabat units at Barrachois Wind Farm, 2015.

Night	AERIAL		GROUND	
	MYOT	JUNK	MYOT	JUNK
20/05/2015	0	51	0	13
21/05/2015	1	1	0	0
22/05/2015	0	55	0	1
23/05/2015	0	1	0	0
24/05/2015	1	0	0	0
25/05/2015	0	69	0	0
26/05/2015	0	81	1	4
27/05/2015	0	3	0	0
28/05/2015	1	0	0	0
29/05/2015	0	0	0	0
30/05/2015	1	6	1	1
31/05/2015	0	0	0	2
01/06/2015	0	0	0	0
02/06/2015	0	6	0	2
03/06/2015	0	8	0	5
04/06/2015	0	3	0	2
05/06/2015	0	0	0	0
06/06/2015	0	0	0	1
07/06/2015	0	0	0	0
08/06/2015	0	0	0	0
09/06/2015	0	2	0	0
10/06/2015	0	0	0	0
11/06/2015	0	0	0	0
12/06/2015	2	5	0	0
13/06/2015	0	0	0	0
14/06/2015	0	0	0	0
15/06/2015	0	0	0	0
16/06/2015	0	3	0	5
17/06/2015	0	0	0	0
18/06/2015	0	0	0	0
19/06/2015	0	0	0	0
20/06/2015	0	0	2	2
21/06/2015	0	0	0	1
22/06/2015	0	0	0	0
23/06/2015	0	0	0	0
24/06/2015	0	0	0	5
25/06/2015	0	0	1	0
26/06/2015	0	0	1	1
27/06/2015	0	0	0	0

Night	AERIAL		GROUND	
	MYOT	JUNK	MYOT	JUNK
28/06/2015	0	0	0	0
29/06/2015	0	0	0	0
30/06/2015	1	0	0	0
01/07/2015	0	3	0	14
02/07/2015	0	14	0	0
03/07/2015	1	0	0	0
04/07/2015	2	0	2	0
05/07/2015	0	0	0	0
06/07/2015	0	0	0	0
07/07/2015	0	0	0	0
08/07/2015	0	0	0	0
09/07/2015	0	0	0	1
10/07/2015	3	0	1	0
11/07/2015	2	1	2	0
12/07/2015	1	6	0	7
13/07/2015	0	0	0	0
14/07/2015	0	0	0	0
15/07/2015	1	0	5	0
16/07/2015	0	0	0	1
17/07/2015	0	0	0	0
18/07/2015	0	0	2	0
19/07/2015	0	1	0	0
20/07/2015	1	0	1	0
21/07/2015	0	1	0	1409
22/07/2015	0	31	0	1508
23/07/2015	0	7	1	202
24/07/2015	2	0	0	51
25/07/2015	5	1	3	534
26/07/2015	2	2	2	318
27/07/2015	0	22	1	358
28/07/2015	0	41	0	0
29/07/2015	0	1536	1	986
30/07/2015	6	27	0	424
31/07/2015	0	0	0	924
01/08/2015	5	2788	0	345
02/08/2015	0	0	0	246
03/08/2015	0	0	0	288
04/08/2015	0	0	1	1065
05/08/2015	0	0	2	450

Night	AERIAL		GROUND	
	MYOT	JUNK	MYOT	JUNK
06/08/2015	0	0	0	1
07/08/2015	0	0	9	0
08/08/2015	0	0	5	1
09/08/2015	0	0	0	1312
10/08/2015	0	0	1	1
11/08/2015	0	0	2	0
12/08/2015	0	0	0	44
13/08/2015	0	0	1	0
14/08/2015	0	0	0	0
15/08/2015	0	0	2	0
16/08/2015	0	0	1	0
17/08/2015	0	0	1	0
18/08/2015	0	0	3	0
19/08/2015	0	0	8	0
20/08/2015	0	0	4	0
21/08/2015	0	0	3	0
22/08/2015	3	48	1	227
23/08/2015	6	220	9	1
24/08/2015	5	2	3	1
25/08/2015	5	9	7	0
26/08/2015	11	127	11	0
27/08/2015	1	504	1	447
28/08/2015	3	147	5	0
29/08/2015	5	0	4	0
30/08/2015	4	0	4	0
31/08/2015	1	28	0	68
01/09/2015	3	1	2	0
02/09/2015	0	1	0	0
03/09/2015	5	5	3	0
04/09/2015	1	0	2	1
05/09/2015	0	0	3	0
06/09/2015	1	0	2	0
07/09/2015	2	2	1	0
08/09/2015	4	3	3	0
09/09/2015	1	1	1	0
10/09/2015	7	18	25	121
11/09/2015	38	482	101	48
12/09/2015	0	85	1	1041
13/09/2015	5	0	25	0

Night	AERIAL		GROUND	
	MYOT	JUNK	MYOT	JUNK
14/09/2015	0	7	1	0
15/09/2015	0	0	1	0
16/09/2015	1	0	3	0
17/09/2015	0	0	0	1
18/09/2015	2	1	5	0
19/09/2015	0	0	0	0
20/09/2015	0	0	2	15
21/09/2015	1	0	3	0
22/09/2015	0	0	3	0
23/09/2015	1	0	0	0
24/09/2015	0	0	1	1
25/09/2015	0	0	0	2
26/09/2015	0	0	0	0
27/09/2015	0	9	0	65
28/09/2015	0	20	0	88
29/09/2015	0	15	0	24
30/09/2015	0	97	0	88
01/10/2015	0	1	0	1613
02/10/2015	0	13	0	1154
03/10/2015	0	17	0	50
04/10/2015	0	0	0	2
05/10/2015	0	0	0	3
06/10/2015	0	0	0	3
07/10/2015	0	0	0	0
08/10/2015	0	0	0	1
09/10/2015	0	12	0	1759
10/10/2015	0	0	0	5
11/10/2015	0	0	0	3
12/10/2015	0	0	0	8
13/10/2015	0	50	0	330
14/10/2015	0	5	0	31
15/10/2015	0	0	0	5
16/10/2015	0	22	0	472
17/10/2015	0	0	0	8
18/10/2015	0	3	0	0
19/10/2015	0	0	0	0
20/10/2015	0	5	0	0
21/10/2015	0	0	0	0
22/10/2015	0	18	0	0

Night	AERIAL		GROUND	
	MYOT	JUNK	MYOT	JUNK
23/10/2015	0	0	0	0
24/10/2015	0	0	0	0
25/10/2015	0	6	0	0

## Conclusions and Recommendations

Mortality searches are conducted to provide estimates of mortality for wind farms; however, corrected mortality estimates must be obtained in order to adjust for carcass removal (i.e. scavenging) rates, searcher efficiency, and the proportion of the survey area that is actually searched. The results of the mortality searches and associated scavenger and searcher trials conducted in 2015 indicate a low level of mortality and low scavenging rates. Searcher efficiency at the site is average, particularly considering the rough, rocky terrain at the site.

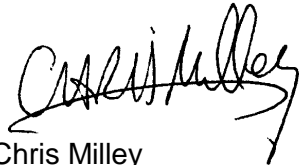
Analysis of the acoustic bat data for the Barrachois site indicates that *Myotis* bats occur on the site at low levels throughout the season, with a slight increase in late summer.

The bird and bat mortality monitoring plan for the site stated that a minimum of two years of acoustic bat monitoring and mortality searches at the site as well as scavenger and searcher efficiency trials; therefore, an additional year of post-construction monitoring at Barrachois is recommended, using similar methodology as 2015.

## 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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bc