Appendix C:

Bat Impact Assessment

AULD'S MOUNTAIN WIND TURBINE ACOUSTIC BAT MONITORING REPORT

Prepared for
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October 2013

Project No.: TV134002

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1.0 INTRODUCTION

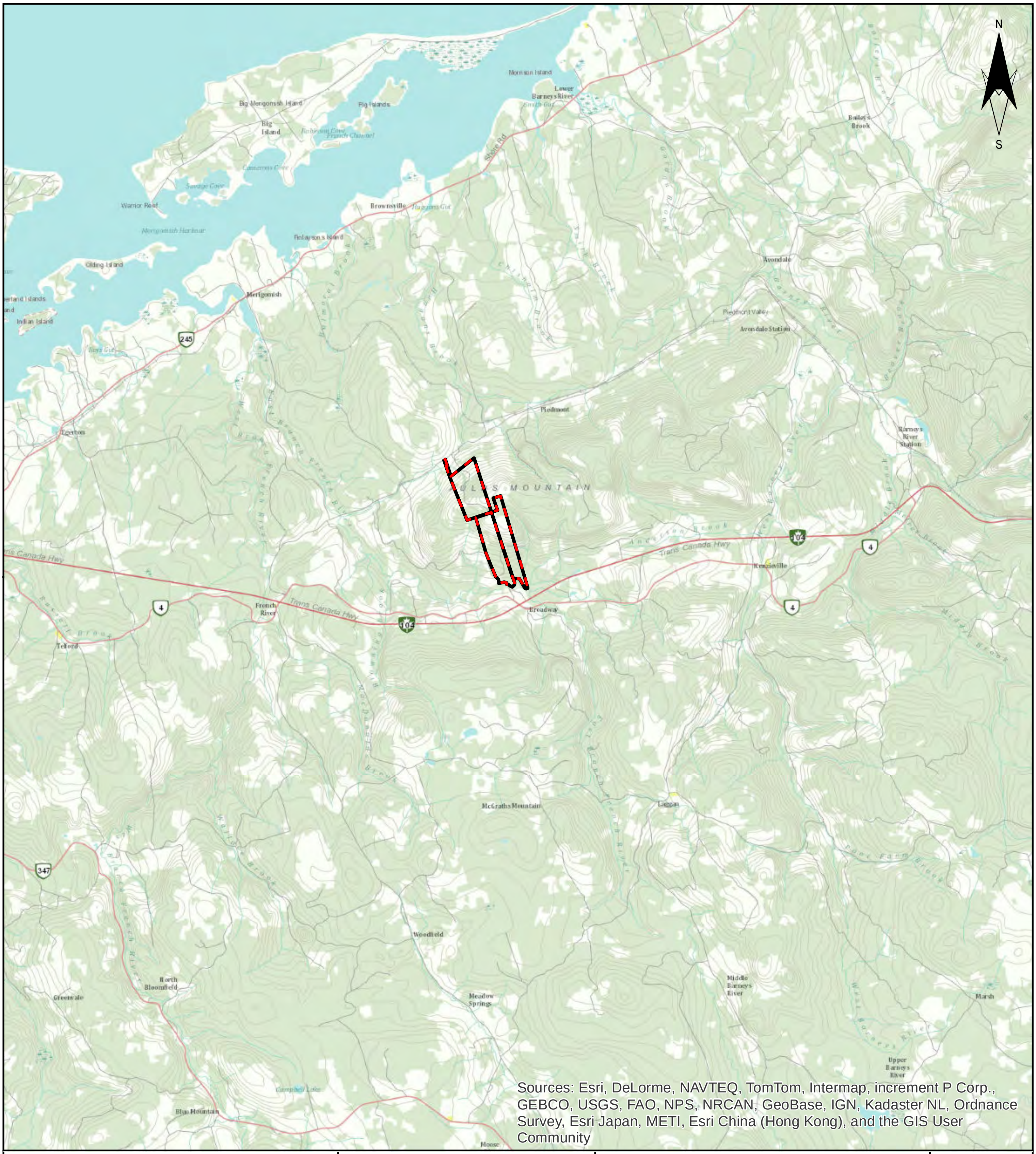
Natural Forces Wind Inc. is proposing to install a pair of wind turbines in Auld's Mountain, Nova Scotia, and has engaged the services of AMEC Environment & Infrastructure, a Division of AMEC Americas Limited (AMEC), to provide an assessment of the potential effects of the proposed project on local and migratory bat populations. In order to provide a complete assessment, AMEC has compiled relevant information on bats in the region, reviewed existing monitoring protocols, and employed a monitoring protocol previously developed to meet the specific needs of Natural Forces Wind Inc. Finally, AMEC has collected and analyzed data on the occurrence of bats in the project area in accordance with the protocol.

The location of the site is depicted in Figure 1.1

1.1 Legislation/Regulatory Environment

An environmental assessment (EA) is an assessment of the possible positive or negative impact that a proposed project may have on the environment, together consisting of the environmental, social and economic aspects. This is a planning tool that provides managers and decision makers with information on whether a proposed project may undermine sustainable development. There are two levels of environmental assessment legislation that govern the environmental assessment process. At the provincial level, the Nova Scotia Environment Act and the ensuing regulations provide the mandate to the NS Department of Environment to review and assess environmental assessment documents prior to the approval of projects that meets certain "trigger" conditions. Similarly, the Canadian Environmental Protection Act (CEPA) and the Canadian Environmental Assessment Act (CEAA) perform a similar function at the federal level, providing the mandates and authorities to various government departments including the Canadian Environmental Assessment Agency, Environment Canada, and the Department of Fisheries and Oceans Canada. Depending upon the location of the wind farm (private land, federal or provincial crown land), the source of funding (e.g., private investment vs. federal government) and the size of the wind farm, an environmental assessment will need to be completed for review and approval by either the NS Department of Environment, or the relevant federal department or agency.

One area of concern addressed in an EA is the potential effect that a project may have on local wildlife, and the habitats upon which these species depend. As a result, the federal Species at Risk Act (SARA) and the Nova Scotia Endangered Species Act (NSESA) must be considered in the EA process. Under the terms of the Acts, no project can have or potentially have a negative effect on a species listed by the Committee on the Status of Endangered Wildlife in Canada (COSEWIC) as endangered, threatened or of concern, under a list within the NS General Status of Wild Species as species of conservation concern.



CLIENT: Natural Forces Wind Inc. 1791 Barrington Street Suite 1030 Halifax, Nova Scotia Canada B3J 3L1	SCALE: 2 1 0 2 Kilometers	PROJECT: Aulds Mountain Wind Farm	DWN BY: DS CHK'D BY: BC
AMEC Environment and Infrastructure A Division of AMEC Americas Ltd. 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: TV134002	TITLE: General Site Location	DATE: October 2013 REV. NO: . FIGURE NO: 1.1

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Several federal and provincial government departments and agencies have legislative and regulatory responsibility of wildlife species and habitats in Nova Scotia, including bats. Bats are a matter of special interest in the EA process; since little is known about most species, there is a lack of understanding of the long term effects that past developments have had upon their wellbeing. In 2012, emergence of a devastating fungal infection affecting bat populations in eastern North America (see Section 2.0) led COSEWIC to designate three bat species, all known residents of Nova Scotia, as "Endangered" (COSEWIC 2012).

Federally, the Canadian Wildlife Service of Environment Canada is responsible for all migratory birds and for all wildlife on federally owned land. Within the Provincial government, the Wildlife Division of the Department of Natural Resources is responsible for all wildlife, other than that managed by federal government. Furthermore, several other government Departments and Agencies have an interest in wildlife resources, and while they do not have regulatory responsibility, they may provide useful and important information on bats suitable for inclusion in an EA. Examples include the Wildlife Division of the Nova Scotia Department of Natural Resources and the Heritage Division of Nova Scotia Tourism, Culture & Heritage. Local universities and non-profit organizations such as the Atlantic Canada Conservation Data Centre and local naturalist groups can also provide valuable information.

Since wind energy development activities have commenced in Nova Scotia, the Nova Scotia Department of Environment has regularly issued consistent approval conditions for environmental assessments of wind farm projects in the province, namely:

a) The Proponent must develop and implement a program to monitor for birds and bats to the standards as defined by the Nova Scotia Department of Natural Resources (NSDNR) and Canadian Wildlife Service (CWS). Based on the results of monitoring programs, the Proponent must make necessary modifications to mitigation plans and/or wind farm operations to prevent any unacceptable environmental effects to the satisfaction of NSE, based on consultation with NSDNR and CWS.
b) The Proponent must document accidental mortalities of bats and birds and submit an annual report to the Director of Wildlife, NSDNR, and CWS. The report shall be submitted in January of each operating year unless otherwise approved by NSE.

2.0 INTRODUCTION TO BATS

Bats are one of the most abundant groups of mammals on Earth, with over 1100 known species (Tudge 2000). Members of the Order Chiroptera, bat species are divided into two main families, the Microchiroptera (insectivorous bats) and the Megachiroptera (fruit bats). They are also among the most misunderstood mammals, with general dislike and irrational fear common worldwide. Worldwide, bats play vital roles in insect control and the life cycles of fruiting plants. Despite their important ecological roles and diversity, bats in general remain poorly understood and are often unfairly reviled by the public.

The only mammals which truly fly, all bats species have wings consisting of webbing stretched between their elongated fingers. The Microchiroptera (insectivorous bats) typically have small eyes, sharp pointed teeth, and distinctly-shaped ears. This group is also unique in that it utilizes ultrasonic noise, inaudible to humans, to navigate by echolocation. Echolocating bats produce high-pitched calls which bounce off objects in their path. The bat then uses its highly sensitive ears to detect the resulting echo, and interprets it to provide information on size, shape and direction of travel of objects in its path. These calls are usually fairly species-specific, and scientists can use the characteristics of these calls to identify bat species in an area. This ability to navigate by sound results in bats being able to fly and hunt in complete darkness, and in fact most bat species are primarily nocturnal. Megabats do not echolocate, and tend to be larger. They feed mostly on fruit and are found in tropical regions.

In temperate climes such as Nova Scotia, bat species deal with the inhospitable conditions of winter by either hibernating or migrating to warmer areas until spring. Larger, fast-flying species tend to migrate, while smaller species, which tend to be weaker fliers, usually hibernate. Some bat species may fly up to several hundred kilometers to a suitable hibernating site, known as a hibernaculum. Many species begin gathering at their chosen hibernaculum several weeks before hibernation actually begins, and many species mate at this time.

The colonial hibernation behavior of many species results in a high level of vulnerability during the winter months. While bats may arouse naturally and move around within their hibernaculum (Tuttle 1991), unintentional arousals during hibernation (such as being disturbed by humans entering their hibernaculum) can cause bats to rapidly deplete their stored fat reserves, eventually leading to starvation (Thomas, 1995). A small number of visits to a winter hibernaculum of colonial species can have serious effects on the bat population utilizing that hibernaculum. Another dramatic example of this winter vulnerability is the current white-nose syndrome (WNS) situation in the American Northeast. Named for a distinctive fungal growth around the muzzles and on the wings of affected bats, WNS causes bats to wake more frequently during hibernation and deplete their fuel and/or water stores (Reeder *et al*., 2012, Cryan *et al.*, 2010). First identified in a cave in New York, USA, in February 2006 (Blehert *et al.* 2008), WNS has since spread to five provinces (Ontario, Quebec, NS, NB, and PEI) and 21 states as of March 25, 2013.

The fungus responsible has been identified as a European species, *Geomyces destructans,* a cold-loving fungus that grows at temperatures below 20 °C (68 °F) and grows on the bats when they are hibernating in caves and mines during winter (Blehert *et al.* 2008). The fungus appears to disrupt the normal patterns of hibernation, causing bats to arouse too frequently from torpor and starve to death. The symptoms associated with WNS include loss of body fat, unusual winter behavior (including flying outside), and death. The mortality rate from white nose syndrome in some caves has exceeded 90% (Frick *et al.* 2010). WNS has contributed to the deaths of over 5.5 million bats in the northeastern US (US Fish & Wildlife Service, 2012). To date, seven hibernating bat species have been confirmed with infection of *Geomyces destructans* in the Northeast USA, and several of these species have suffered major mortality (Frick *et al*., 2010). Some of these species, like the Indiana bat (*Myotis sodalis*), were already considered endangered. The U.S Fish and Wildlife Service maintains a website documenting the current status of the WNS situation (http://www.fws.gov/whitenosesyndrome).

All of the species known to occur in NS have reported to exhibit white nose syndrome in other parts of their ranges. In the northeastern United States, the once common little brown bat (*Myotis lucifugus*), has suffered a major population collapse and may be at risk of rapid extirpation in the Northeast within 20 years, due to mortality associated with WNS (Frick *et al*. 2010). Dzal *et al.* (2001) reported a 78 per cent decline in the summer activity of the little brown bat in an area affected by WNS, as evidenced by echolocation surveys. WNS has already seriously decreased populations in NB (Canadian Broadcasting Company (CBC) News, 2012) and NS (CBC News, 2013). The long-term impact of the reduction in bat populations may be an increase in insect populations as they become subject to decreased bat predation, possibly leading to crop damage or increased pesticide requirements.

3.0 BAT SURVEY METHODOLOGY

3.1 Review of Available Data

The baseline bat monitoring survey began with a detailed desktop review of existing data. As the Nova Scotia Department of Environment (NSE) regards wind farm sites within 25 km of a known bat hibernaculum as having 'very high' site sensitivity (NSE 2009), it is imperative to determine whether the bat hibernacula are known to occur within this radius.

A review of geological mapping of the area was conducted to determine the likelihood of possible bat hibernacula, in the form of natural caves. NSDNR's Abandoned Mine Openings database was also consulted to determine if there are abandoned mines in the area which could also serve as hibernacula. As many parts of Nova Scotia have historically supported various types of mining activities, a review of the geology and mining history of the site can be beneficial in determining the likely presence of natural caves and/ or abandoned mines.

Bat species occurring in the general Sydney area were discussed with NSDNR's Regional Biologist for Cape Breton. Local naturalists were also consulted.

3.2 Acoustic Surveys

Electronic detection of bats has advanced considerably in recent years, enabling researchers to detect and monitor bats without capturing bats with mist nets. The Anabat SD2 detector, manufactured by Titley Scientific, is a well known monitoring system used throughout North America to identify and survey bats by detecting and analyzing their echolocation calls (Photo 3.1). The Anabat system is a passive detection system that monitors bat activity without human presence and intervention. It consists of a bat detector, a ZCAIM (Zero-Crossings Analysis Interface Module) and software. The Anabat detector unit contains an ultrasonic microphone, an electronic amplifier, and a digital signal divider. The bat detector will, if desired, produce an output audible to humans from the inaudible ultrasonic echolocation signals produced by the bats. The ZCAIM is an interface that is used to read the Anabat recorded data on a computer, and the software is used to present the data in a useable format. In the Anabat SD2 system used in the present study, the ZCAIM records data directly onto a compact flash card, which is then used to transfer data to a computer.

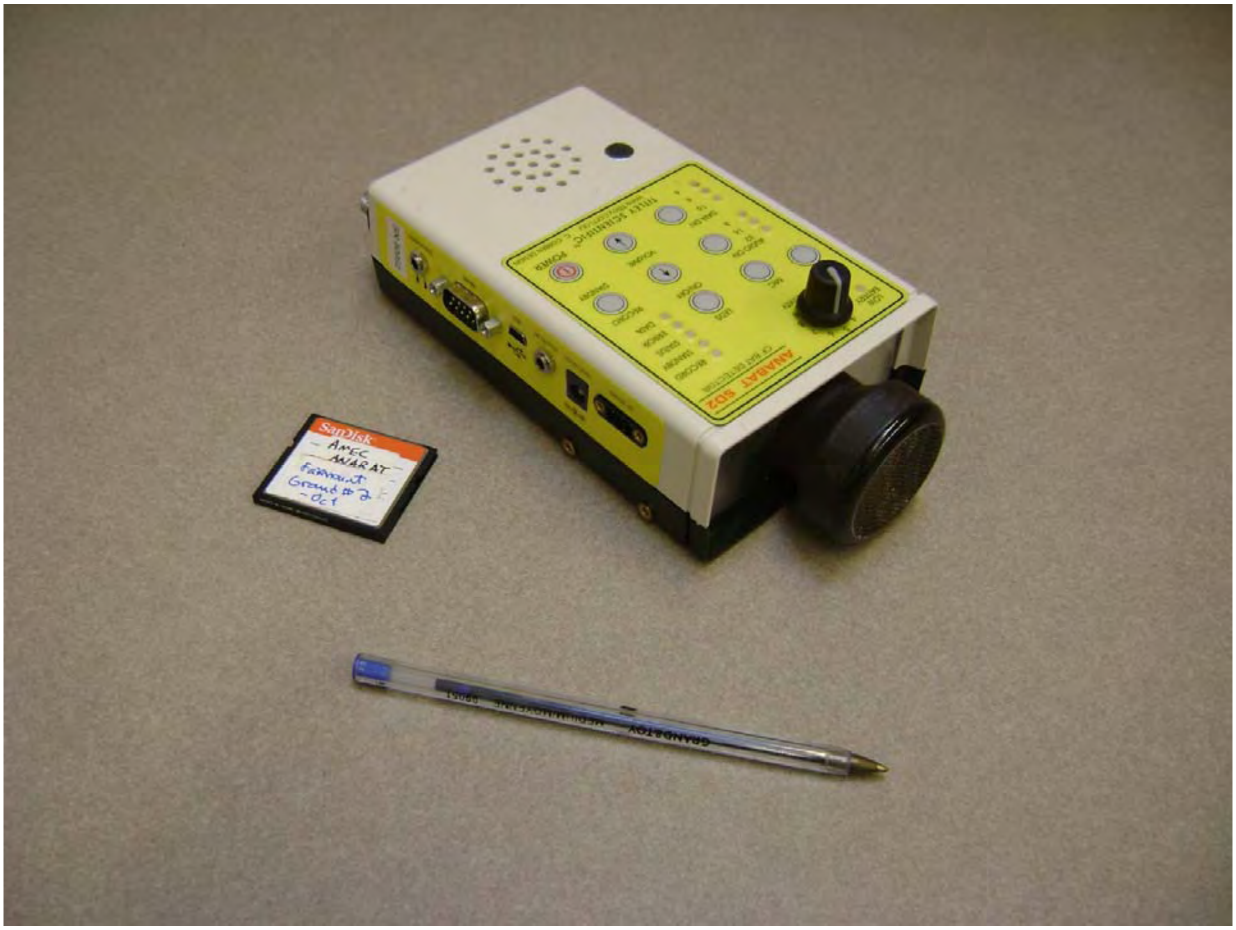

Photo 3.1 An Anabat SD2 acoustic bat detector and compact flash card.

Weller (2002) noted that there is a considerable variability in signals recorded by Anabat detectors depending upon their orientation. Based on Weller's research it was determined that multiple bat detectors should be deployed. While two detectors may record the same individuals, the redundancy will enable continued detection in the event one system fails due to battery depletion, weather events, or animal disturbance. Efforts must be made to ensure continuous detection for a complete picture of potential bat activity.

Based on previous acoustic bat surveys and literature reviews conducted by AMEC, it was decided that an aerial detector elevated 10 m above ground surface would be set to detect bats along the tree line at the edge of the cleared site, to permit detection of bats foraging near the tree canopy at the edge of the clearing and detect bats that may be migrating above the canopy. A second ground-based system was set to detect bats that forage on low flying insects in cleared areas. Use of the dual acoustic systems with a combination of ground and aerial orientation would provide effective cross coverage and ensure redundancy in the event one system failed due to battery failure or disturbance.

3.2.1 Aerial Systems

On August 24 2013, a 10 m portable aluminum weather tower was erected on the Auld's Mountain site to enable acoustic bat monitoring at that height. Coordinates were 20 T 548850E 5049041N (UTM NAD 83). The microphone assembly pointed to the southwest, and parallel to the tree line to allow sampling of the forest edge. A high-sensitivity Anabat microphone was attached to an extension cable and placed within a tubular waterproof plastic housing which was sealed around the cable at the base. This housing was secured to the uppermost section of the tower. The microphone faced downwards within the housing, and a Lexan plate angled at 45° from horizontal reflected incoming sounds into the waterproof housing. This allowed sampling of a horizontal section of the sky at treetop height. The tower was constructed with a cantilevered base, allowing it to be raised and lowered as needed. The microphone extension cable ran down the pole to the main body of the detector, which was placed in a locked, waterproof fiberglas housing at the base of the pole, along with the power supply.

This system remained in operation until Oct 3, 2013 and was frequently checked (approximately weekly) to download data, check batteries, and verify that the system was intact and functioning properly.

The detector was programmed to record all ultrasonic sounds between 7 pm and 7 am.

Photo 3.2 Pole erected on site for aerial Anabat system in 2013, showing detail of forest edge.

3.2.2 Ground Systems

2012 Deployment

Anabat SD2 acoustic bat detectors were deployed at the Auld's Mountain site in three different locations. Initially, two ground detectors were deployed on Aug 8 2013. Coordinates were 549046E,5048663N and 549112E 5048673N (UTM NAD 83) and the locations are depicted on Figure 3.1 (Anabat Survey Locations). The detectors were deployed, along with their power supply, on the ground in a waterproof housing fitted with a microphone tube, which 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 in each location, with the microphone tube pointing parallel to the tree line (northeast) to allow sampling of the forest edge (Photo 3.2). The waterproof housings were covered in brush to minimize visibility and potential vandalism.

TITLE:
Figure 3.1
Anabat Locations

PROJECT:
Aulds Mountain Wind Farm

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

LOCATION:
Aulds Mountain
Pictou County
Nova Scotia

DATE: **October 2013**

DATUM: **North_American_1983_CSRS**

PROJECTION: **Zone 20**

AMEC PROJECT NO: **TV134002**

LEGEND:
- Met Tower
- Unit 1 - Ground
- Unit 2 - Ground
- Unit 3 - Ground
- Unit 3 - Aerial
- Proposed Wind Turbines
- Contours
- 1045600062300_LF_LINE
- Aulds Mountain Lands

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Meters
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amec

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However, during a routine maintenance visit on Aug 24, it was discovered that Unit 1 had been damaged (Photo 3.3). The brush cover had been removed, the waterproof cover torn off and the housing torn open. The Anabat SD2 unit was lying upside down, fully exposed to the heavy rainfall which had fallen the previous night. Tooth marks, possibly coyote or black bear, were evident on the housing. This site was abandoned, and the ground survey focused on the second ground unit, Unit 2, which was then redeployed in a more sturdy waterproof housing.

Photo 3.3 Condition on Anabat Ground Unit 1 on Aug 24, showing evidence of damage by wildlife.

Photo 3.4. Condition on Anabat Ground Unit 2 on Sept 9, showing evidence of damage by wildlife.

This housing was also molested by wildlife, and was laying on its side with most of its waterproof wrapping removed at the next visit on Sept 9 (Photo 3.4). Tooth marks were again evident in the plastic housing. It was then redeployed in a new housing, which was heavily wrapped in heavy duty plastic wrap and wrapped in duct tape. It was then tucked under and attached with a hose clamp to a fallen tree a few metres from the original Unit 2 location. This had been disturbed by the next visit on Sept 16, found lying on its side with some plastic wrapping removed and the hose clamp apparently bitten through (Photo 3.5).

The Anabat SD2 was undamaged, and no data was lost, fortunately.

Photo 3.5. Initial placement of Anabat Ground Unit 2 on Sept 9 and conditions discovered on Sept 16

The continual flipping of the units by the wildlife led to the development and construction of a ground brace to pin the unit to the ground. This consisted of a steel plate attached to 4 removable 3 foot steel arms, which had holes in them to allow it to be staked to the ground with 30 cm steel stakes. The Anabat unit (Unit 3) was then deployed in a locked fibreglass housing screwed to the central plate on Sept 16 2013. This unit is depicted in Photo 3.6. This Anabat unit remained undisturbed until the end of the survey, on Oct 3, 2013.

A trail camera was also deployed at eth site from Sept 16 to Oct 3 covering the area where Unit 2 was deployed, to determine what was interfering with the equipment.

Photo 3.6 Ground Brace which was employed to minimize flipping of Anabat ground units by wildlife.

On Aug 16 a third ground unit was deployed near the future location of the aerial tower unit. This unit was deployed in a sturdy waterproof housing, which remain undisturbed until it was retrieved on Aug 24.

3.3 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.

4.0 SURVEY RESULTS

The remote trial camera did not capture any images of animals that could have been responsible for equipment damage. Numerous pictures of small herbivores and deer were captured.

4.1 Review of Available Data

Within 25 km of the Project site, there are 269 known abandoned mine openings, according to the Nova Scotia Abandoned Mine Openings (AMO) Database (NSDNR, 2013). None of these mine openings appear to correspond to caves known to support bats in Nova Scotia, as summarized by Moseley (2007a and 2007b). Total measured depths of most of the mine openings are not provided; however, one opening is reported to have a depth of approximately 10 m. The original depths of some of these openings were much greater, but according to the records, the majority have been filled or sealed for public safety (NSDNR, 2013). A single AMO occurs within 10 km of the site, McLaurin's iron mine shaft, which is located near Telford.

A previous report prepared by Strum Environmental for this project in 2012 stated that there is one known bat hibernaculum within 25 km of the project. This is MacLellan's Brook Cave, a dissolutional stream cave which is considered a minor hibernaculum (Mosely 2007), however the actual number of bats hibernating in this cave have not been confirmed.

4.2 ANABAT Data

4.2.1 Aerial System

The aerial system, which was deployed from Aug 24 to Oct 13 2013, recorded bat activity during 14 of the 40 deployment nights. The average was 1.72 calls per night (minimum 0, maximum 12). The majority of the bat calls were *Myotis* species, though one on Aug 24 appears to be an Eastern Red Bat (*Lasiurus borealis*). While it is difficult to confidently assign *Myotis* echolocation sequences to a particular species, the calls recorded show characteristics of both *M. lucifugus* and *M. septentrionalis*, and it is assumed that both species are present on the site.

Overall, the aerial unit recorded a rather small number of echolocation files. The majority of the aerial files appear to be "feeding buzzes", indicating that bats recorded by the aerial system were foraging. A compact flash card deployed from Aug 24 to Sept 8 appears to have been corrupted, resulting in a huge number of files being recorded, however the vast majority are unexplained noise. Very few (< 0.1%) of the sounds recorded during this period were attributed to bats. This period is not plotted on Figure 1.

Figure 4.1 and Table 4.2.1 depict the number of bat echolocation sequences recorded by the aerial Anabat unit at Auld's Mountain in 2013, as well as the temperature data from Tracadie and precipitation from Caribou Point, the nearest relevant weather stations. Weather data is from Environment Canada's website.

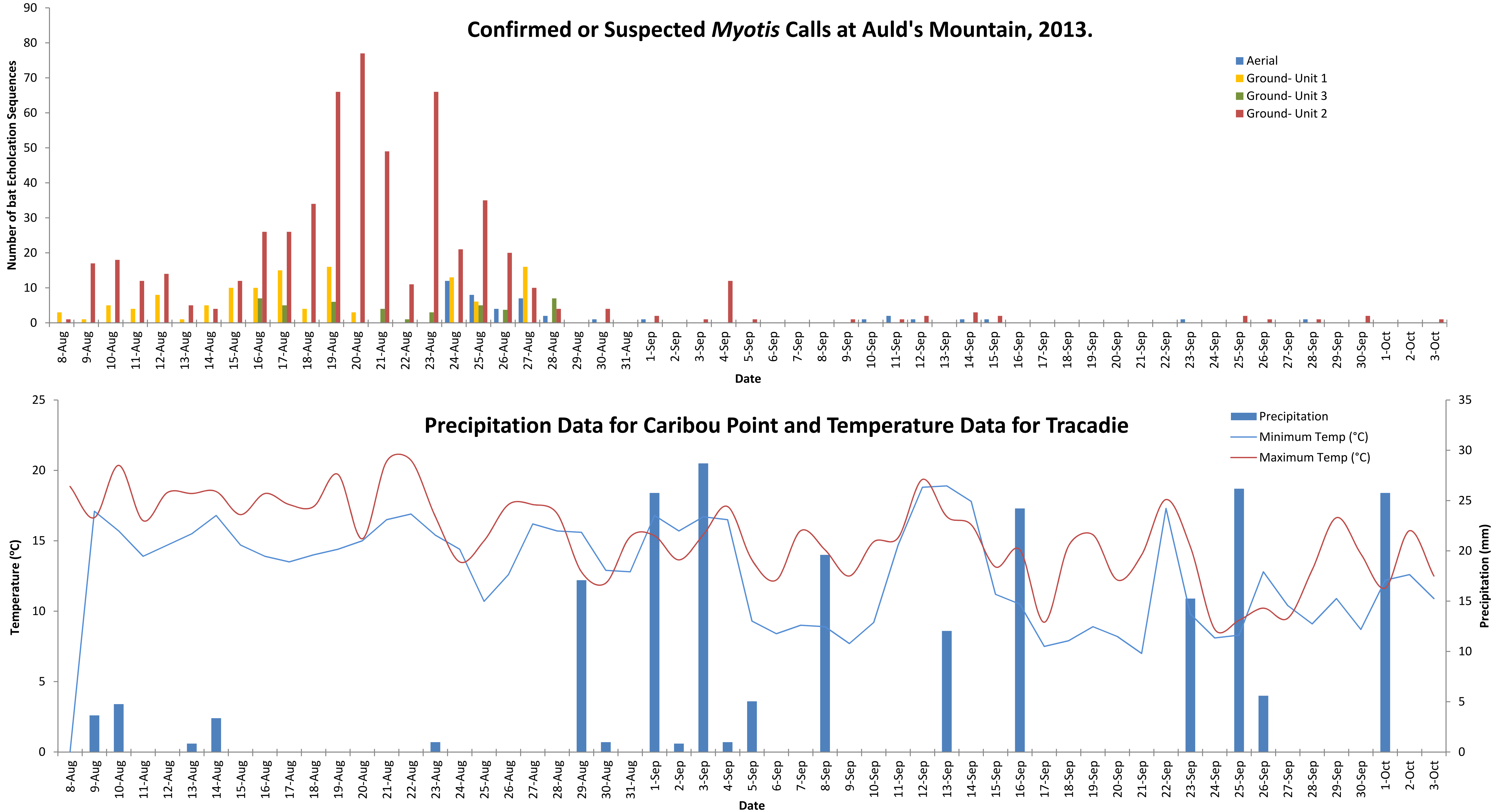

Figure 4.1 Myotis Calls at Auld's Mountain 2013, Precipitation (Caribou Pt) and Temperature (Tracadie) Data

Table 4.2.1: Number of bat echolocation sequences detected per night by aerial Anabat SD2 systems at proposed Natural Forces wind turbine site at Auld's Mountain, Pictou County, NS, in 2013.

Night	Total # of Ultrasonic Events Recorded	*Myotis* spp. Calls	Suspected *Myotis* Calls	Suspected other Bat Species Calls	Non-bat Sound Events ("Noise")
24-Aug	4477	12		1	4464
25-Aug	4908	8			4900
26-Aug	5390	4			5386
27-Aug	5254	7			5247
28-Aug	5295	2			5293
29-Aug	6825				6825
30-Aug	2169	1			2168
31-Aug	5696				5696
1-Sep	9199	1			9198
2-Sep	10289				10289
3-Sep	11908				11908
4-Sep	9463				9463
5-Sep	7703				7703
6-Sep	5985				5985
7-Sep	6499				6499
8-Sep	1101				1101
9-Sep	2				2
10-Sep	1	1			0
11-Sep	2	2			0
12-Sep	34	1			33
13-Sep	13				13
14-Sep	33	1			32
15-Sep	1	1			0
16-Sep	1				1
17-Sep	0				0
18-Sep	0				0
19-Sep	0				0
20-Sep	0				0
21-Sep	42				42
22-Sep	29				29
23-Sep	1	1			0
24-Sep	1				1
25-Sep	37				37
26-Sep	0				0
27-Sep	1				1
28-Sep	2	1			1
29-Sep	0				0
30-Sep	1				1
1-Oct	3				3
2-Oct	0				0
3-Oct	0				0

4.2.2 Ground System

A total of three ground systems were deployed at Auld's Mountain in 2013, covering different time periods and locations. The main ground system, Unit 2 was deployed from 8 Aug to 3 Oct 2013 and recorded bats on 36 of the 57 deployment nights (Figure 4.1). The average number of echolocation calls recorded per night was 12.8 (minimum 0, maximum 77). The data recorded by the ground system shows many feeding buzzes, indicating the bats are foraging in the area.

The second ground system, Unit 1, was deployed from 8 Aug and recorded until it was was damaged on 21 Aug 2013, recording bats on 13 of the 14 deployment nights (Figure 4.1). The average number of echolocation calls recorded per night was 6.07 (minimum 0, maximum 19). The data recorded by the ground system Unit 1 shows many feeding buzzes, indicating the bats are foraging in the area.

The third ground system, Unit 3, was deployed near the aerial survey location from 16 Aug to 23 Aug 2013 and recorded bats on 5 of the 7 deployment nights (Figure 4.1). The average number of echolocation calls recorded per night was 3.7 (minimum 0, maximum 7). Again, many of these calls were feeding buzzes.

Figure 4.1 and Table 4.2.2 depict the number of bat echolocation sequences recorded by the ground-based Anabat unit at Auld's Mountain in 2013, as well as the temperature data from Tracadie and precipitation from Caribou Point, the nearest relevant weather stations.

Table 4.2.2 Number of bat echolocation sequences detected per night by ground-based Anabat SD2 systems at proposed Natural Forces wind turbine site in Auld's Mountain, Pictou County, NS, in 2013.

Night	Total # of Ultrasonic Events Recorded	*Myotis* spp. Calls	Suspected *Myotis* Calls	Suspected other Bat Species Calls	Non-bat Sound Events ("Noise")
Unit 1- Ground					
8-Aug	18	3			15
9-Aug	1907	1			1906
10-Aug	6	5			1
11-Aug	5	4			1
12-Aug	8	8			0
13-Aug	10	1			9
14-Aug	44	5			39
15-Aug	16	10			6
16-Aug	18	10			8
17-Aug	16	15			1
18-Aug	24	4			20
19-Aug	39	16			23
20-Aug	13	3			10
21-Aug	12	0			12

Night	Total # of Ultrasonic Events Recorded	Myotis spp. Calls	Suspected Myotis Calls	Suspected other Bat Species Calls	Non-bat Sound Events ("Noise")
Unit 2- Ground					
8-Aug	6	1			
9-Aug	506	17			
10-Aug	390	18			
11-Aug	13	12			
12-Aug	15	14			
13-Aug	5	5			
14-Aug	8	4			
15-Aug	15	12		1 (LABO)	
16-Aug	27	26			
17-Aug	32	26			
18-Aug	41	34			
19-Aug	78	66			
20-Aug	89	77			
21-Aug	53	49			0
22-Aug	11	11			0
23-Aug	67	66			0
24-Aug	21	21			0
25-Aug	37	35			0
26-Aug	20	20			0
27-Aug	12	10			0
28-Aug	4	4			0
29-Aug	102				102
30-Aug	26	4			22
31-Aug	3				3
1-Sep	3	2			1
2-Sep	6				6
3-Sep	2	1			1
4-Sep	13	12			1
5-Sep	1	1			0
6-Sep	1	0			1
7-Sep	0	0			0
8-Sep	1	0			1
9-Sep	1	1			0
10-Sep	1	0			1
11-Sep	1	1			0
12-Sep	17	2			15
13-Sep	3	0			3
14-Sep	3	3			0
15-Sep	2	2			0

Night	Total # of Ultrasonic Events Recorded	Myotis spp. Calls	Suspected Myotis Calls	Suspected other Bat Species Calls	Non-bat Sound Events ("Noise")
16-Sep	64				64
17-Sep	0				0
18-Sep	2				2
19-Sep	3				3
20-Sep	1				1
21-Sep	28				28
22-Sep	211				211
23-Sep	0				0
24-Sep	64	0			64
25-Sep	385	2			383
26-Sep	2	1			1
27-Sep	0				0
28-Sep	2	1			1
29-Sep	0				0
30-Sep	2	2			0
1-Oct	131	0			131
2-Oct	1	0			1
3-Oct	1	1			0
Unit 3-Ground					
8/16/2013	1058	7			1051
8/17/2013	5	5			0
8/18/2013	2	0			2
8/19/2013	8	6			2
8/20/2013	0				0
8/21/2013	5	4			1
8/22/2013	4	1			3
8/23/2013	3	3			0

LABO= Eastern Red Bat, *Lasiurus borealis*

5.0 DISCUSSION AND CONCLUSIONS

While it is difficult to confidently assign *Myotis* echolocation sequences to a particular species, the calls recorded by both the aerial and ground units in 2103 show characteristics of both *M. lucifugus* and *M. septentrionalis*, and it is therefore assumed that both species are present on the Auld's Mountain site. Two calls, on Aug 15 and 20, appear to be from an Eastern Red Bat (*Lasiurus borealis*).

The decrease in bat echolocation sequences as the fall season progressed in 2013 is consistent with the seasonal behaviour of *Myotis* species in NS.

Overall, the review of the data from the 2013 monitoring program suggests a low level of bat activity on the Auld's Mountain site. Whether this is due to naturally low levels in this area or if the local population has been significantly impacted by White-Nose Syndrome is indeterminable without further research and analysis.

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Strum
ENVIRONMENTAL

BAT MONITORING REPORT
AULD'S MOUNTAIN, NS

December 7, 2012

Strum ENVIRONMENTAL

December 7, 2012

Mr. Andy MacCallum
Natural Forces Technologies Inc.
#1030 - 1791 Barrington Street
Halifax, NS   B3J 3L1

Dear Mr. MacCallum,

Re: Bat Monitoring Report
Auld's Mountain, NS

Attached is the Bat Monitoring Report prepared for Auld's Mountain, NS.

This report documents our observations, findings, and recommendations.

We trust this report to be satisfactory at this time. Once you have had an opportunity to review this correspondence, please contact us to address any questions you may have.

Thank you,

Garry Gregory, MSc.
Environmental Specialist
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APPENDICES

Appendix A: Drawings

1.0 INTRODUCTION

Strum Environmental completed a study of the bat community at a proposed wind energy development located at Auld's Mountain, Nova Scotia (the Project), on behalf of Natural Forces Technologies Inc. The objective of this study was to gather baseline data on the bat community at the Project site to facilitate pre- and post-construction comparisons and to inform the Project planning process.

This report summarizes the available information pertaining to the bat community in the general Project area and presents the survey results.

2.0 PROJECT SITE DESCRIPTION

Natural Forces Technologies Inc. has proposed the development of a two turbine wind farm at Auld's Mountain, located in Pictou County, Nova Scotia. The Project site is located in the small community of Piedmont, approximately 21 km east of New Glasgow (Drawing 1, Appendix A).

The Project site consists of the western extent of the Auld's Mountain between Highway 104 and the Piedmont Valley Road. The peak elevation of Auld's Mountain is 290 m, while the maximum elevation within the Project site boundaries is 240 m. Habitats at the Project site consist of clear-cut and forested areas (softwood, mixed wood, and unclassified), with minor hardwood species.

3.0 RELEVANT LEGISLATION

Bats are protected in Nova Scotia under the *Wildlife Act* (R.S., c. 504, c. 2). As such, it is unlawful to kill or harass any bat without a permit from Nova Scotia Department of Natural Resources (NSDNR).

Three bat species, present in Nova Scotia, have recently been listed as 'Endangered' by the Committee on the Status of Endangered Wildlife in Canada (COSEWIC). If the Government of Canada, upon review, accepts this recommended designation, these species could then qualify for protection and recovery under the *Species at Risk Act* (SARA). In addition, it is likely that these species will be added to the *Nova Scotia Endangered Species Act* (NSESA) (1998, c. 11, s. 1), which prohibits the killing or disturbance of a species at risk, the destruction or disturbance of its residence, and the destruction or disturbance of its core habitat. Currently none of the three species have a status under SARA or NSESA.

Details on these three species are included in the sections below.

Different levels of government are involved in the protection of bats through environmental assessment approval or through approval related monitoring program requirements. These include the following federal and provincial departments:

- Environment Canada – Canadian Wildlife Services (CWS);
- NSDNR – Wildlife Division; and
- Nova Scotia Environment (NSE).

4.0 STUDY METHODOLOGY

Study methodology included a desktop review of available information on the ecology of bat species in the province and the general Project area, as well as field surveys. Details of the methodologies and results are provided in the following sections.

4.1 Desktop Review

The desktop component consisted of a review of relevant literature as well as the following digital databases:

- Nova Scotia Abandoned Mine Openings Database (NSDNR 2011); and
- Nova Scotia Significant Species and Habitats Database (NSDNR 2012).

4.1.1 Ecology of Bat Species in Nova Scotia

Seven species of bat have been recorded in Nova Scotia (Broders *et al.* 2003):

- Big brown bat (*Eptesicus fuscus*);
- Hoary bat (*Lasiurus cinereus*);
- Little brown myotis (*Myotis lucifugus*);
- Northern long-eared myotis (*Myotis septentrionalis*);
- Red bat *(Lasiurus borealis*);
- Silver-haired bat (*Lasinycteris noctivagans*); and
- Tri-colored bat (*Perimyotis subflavus*).

Of these, only the Little brown myotis, Northern long-eared myotis, and the Tri-colored bat have known significant populations in Nova Scotia (Broders 2004).

Bat species in Nova Scotia are insectivorous (Randall 2011) and in general are most active shortly after sunset, although there is some variation in activity patterns among species (Broders *et al.* 2003). The most common resident species, the Little brown myotis and the Northern-long eared myotis, are typically active from May until August, at which time they return to caves and mine openings and commence swarming behaviours. These species congregate at these caves and mine openings, known as hibernacula, to over-winter. Cave hibernacula in Nova Scotia are most commonly found in areas with a bedrock geology consisting of limestone or gypsum, while anthropogenic openings (i.e., mines) are also exploited by bats. Tri-colored bat also overwinters in the province and typically uses the same type of habitat, but less is known about this species' hibernating ecology. Other bat species, including Hoary bat and Silver-haired bat, migrate from the province in the fall months and over-winter in the southern United States (Mosely 2007).

Although winter hibernacula provide a safe location to survive the winter months, the tendency of Little brown, Northern long-eared, and Tri-colored bats to gather at these locations increases their vulnerability to outbreaks of disease. One such example is White-Nose Syndrome (WNS); an infectious fungal disease caused by *Geomyces destructans* that has resulted in the deaths of over one million bats in eastern North America (Hallam and McCracken 2010). This disease has spread to Atlantic Canada within the last two years, and constitutes a serious threat to bat populations in the region (Hebda 2012). Affected hibernacula can suffer 95-99% mortality (McBurney 2012), and at least two significant colonies in New Brunswick have endured collapses since the arrival of the disease in Atlantic Canada (Hebda 2012; Vanderwolf et al. 2012).

Little Brown Myotis
Little brown myotis is the most common species in Nova Scotia, and is probably ubiquitous in the province (Broders *et al.* 2003). This species' range extends throughout most of North America. The species is an effective feeder on *Lepidopterans* (moths) (Thomas et al. 2012) and will prey heavily upon aquatic insects, particularly chironomids (Belwood and Fenton 1976), explaining the tendency to observe this species in close association with water. During the day, the Little brown myotis will roost in buildings, trees, under rocks, in wood piles, and in caves, congregating in tight spaces to roost at night (Fenton and Barclay 1980). Populations of Little brown myotis are thought to be limited by roost availability rather than food supply (Fenton and Barclay 1980).

As a non-migratory species, Little brown myotis hibernates from September to early or mid-May in abandoned mines or caves (Fenton and Barclay 1980; Mosely 2007). Disturbance of hibernating individuals is thought to be a contributing factor in the decline of Little brown myotis populations in some parts of its range (Fenton and Barclay 1980), as human intrusion into winter hibernacula causes a measurable increase in bat activity, leading to increased risks of mortality from premature depletion of fat reserves (Thomas 1995).

Little brown myotis was listed as 'Endangered' by COSEWIC in an emergency assessment in February 2012, based upon the predicted functional extirpation of the species within three generations as WNS spreads throughout the region (COSEWIC 2012a).

Northern Long-eared Myotis
Northern-long eared myotis, although once considered uncommon throughout Nova Scotia (Mosely 2007), is likely ubiquitous in the forested regions of the province (Broders *et al.* 2003). This species is widely distributed in the eastern United States and Canada, and is commonly encountered during swarming and hibernation (Caceres and Barclay 2000). As a forest dweller, this species feeds primarily on butterflies and moths, beetles, Neuroptids, aphids, and flies, and it is also known to employ a gleaning foraging strategy as opposed to relying strictly on aerial pursuit of prey (as cited in Caceres and Barclay 2000; Thomas et al. 2012). During the day, Northern long-eared myotis show a preference for roosting in trees; the characteristics of which have been shown to vary according to the reproductive status of bred females (Garroway and Broders 2008). Females appear to prefer shade tolerant deciduous trees over coniferous trees, whereas males roost solitarily in coniferous or mixed-

stands in mid-decay stages (Broders and Forbes 2004). Northern long-eared myotos are also non-migratory and are typically associated with Little brown myotis during hibernation, in caves or abandoned mines (Mosely 2007). Hibernation in this species is thought to begin as early as September and may last until May (as cited in Caceres and Barclay 2000).

Northern long-eared myotis was listed as 'Endangered' by COSEWIC in an emergency assessment in February 2012, based upon the predicted functional extirpation of the species within two to three generations as WNS spreads throughout the region (COSEWIC 2012b).

Tri-colored Bat
The Tri-colored bat, formerly known as the Eastern pipistrelle, is frequently observed in Nova Scotia but has a restricted distribution focused in the interior of the southwest region of the province (Farrow 2007; Farrow and Broders 2011). Research conducted at Kejimkujik National Park found Tri-colored bat to be locally abundant, and results indicate that this population may represent the only breeding population of the species in Canada (Broders *et al.* 2003). In the summer months, Tri-colored bat is concentrated in a geographic area bounded by Wolfville to the west, Halifax to the northeast, and Shelburne to the southeast (Quinn and Broders 2007). The species occurs throughout most of eastern North America, with Nova Scotia representing the northeastern extent of its range (Fujita and Kunz 1984).

Tri-colored bat requires clumps of *Usnea* lichen for roosting; a habitat feature typically associated with mature spruce and balsam fir trees (Farrow 2007; Farrow and Broders 2011). This association suggests that the species may be negatively impacted by intensive forestry practices that remove roosting habitat (Farrow 2007). The species typically forages over water bodies, but also feeds over tree canopies (reviewed by Quinn and Broders 2007) and it appears that, unlike Little brown myotis, the Tri-colored bat stays active throughout the night, possibly as a means to reduce intraspecific competition (Broders *et al.* 2003). This species is non-migratory, and generally hibernates alone, or in small numbers, in caves or abandoned mines where it appears to show a preference for small side passages, rather than main passages (Fujita and Kuna 1984; Mosely 2007). Individuals show strong fidelity to specific hibernacula, although in Nova Scotia only 10 hibernating individuals have ever been recorded (Quinn and Broders 2007).

Tri-colored bat was listed as 'Endangered' by COSEWIC in an emergency assessment in February 2012, based upon the predicted functional extirpation of the species within three generations as WNS spreads throughout the region. It is suspected that much of the Canadian Tri-colored bat population has already been affected by WNS and that the remainder will be affected within the next several years (COSEWIC 2012c).

Other Bat Species
Other bat species, including Big brown bat, Red bat, Hoary bat, and Silver-haired bat, have been recorded sporadically throughout Nova Scotia, and research suggests that there are no significant migratory movements of these species within the province (Broders *et al.* 2003). Records of these bat species in Nova Scotia are therefore considered as extralimital extensions into the province (Broders *et al.* 2003).

4.1.2 Bat Hibernacula
Multiple known bat hibernacula exist within a 100 km radius of the Project site (Table 1, below; Drawing 2, Appendix A).

Table 1: Known Bat Hibernacula within 100 km of the Project Site

Hibernacula	Distance from Project Site (km)	Direction
McLellan's Brook Cave	19.93	WSW
New Laing Adit	37.96	WSW
Hirschfield Galena Prospect	41.17	SE
Black Brook	93.15	SW
Lear Shaft	96.62	W
Gayes River Gold Mine	97.4	SW
Lake Charlotte Gold Mine	98.36	SW
Hayes Cave	100	WSW

Source: Mosely 2007

Mosely (2007) categorized known hibernacula based on the number of bats using the site or the potential of the site to provide suitable over-wintering habitat to bats.

The closest known hibernaculum, McLellan's Brook Cave, is a dissolutional stream cave in limestone and is considered a minor hibernaculum supporting less than 10 over-wintering bats, although this has been inferred from late summer activity around the cave opening (Mosely

The closest hibernaculum of significance is the Hirschfield Galena Prospect, located just over 40 km to the southeast. Approximately 200-300 bats, primarily Little brown myotis, gather at this abandoned mine adit (horizontal entrance) to over-winter. Lear Shaft is similarly considered a significant hibernaculum, predominantly due to the extensive network of underground mine workings (Mosely 2007). The suitability of this abandoned iron mine as a swarming site for Little brown myotis and Northern long-eared myotis has recently been verified (Randall 2011).

Hayes Cave, the largest hibernacula in Nova Scotia, is located over 95 km away from the Project site. Thousands of bats gather at this gypsum cave annually for both swarming (Randall 2011) and over-wintering (Mosely 2007), and it is thought that bats may undertake movements of tens to hundreds of kilometres to access this and other key swarming sites (Burns and Broders 2010). Species composition at this cave includes all three resident species (Mosely 2007), with Little brown myotis being the most prevalent (Poissant and Broders 2008).

The Nova Scotia Abandoned Mine Openings Database (NSDNR 2011) identifies 2,745 records within a 100 km radius of the Project site. These locations may provide over-wintering habitat for bats, although the majority of Nova Scotia's abandoned mine network has never been surveyed. The only abandoned mine occurring within 10 km of the Project site is McLaurin's iron mine shaft, located in the community of Telford.

The NS Significant Species and Habitats database (NSDNR 2012) identifies nine features pertaining to bats or bat habitat within a 100 km radius of the Project site. Seven of these records relate to known bat hibernacula already discussed. The two remaining records relate to observations of Little brown myotis 58 and 60 km to the southeast of the Project site, along the St. Mary's River near the community of Sherbrooke. An additional 26 features are classified as 'significant areas' within the database, although it is unknown if any of these relate to bats or bat habitat.

4.2 Field Surveys

Field surveys of bat migration and habitat use were carried out from September 25 to October 28, 2012 using an AnaBat SD2 Detector (Titley Electronics, Columbia, Missouri) deployed at the Project site. The AnaBat system records echolocation sounds made by the bats when flying near the detector. The distance at which bats can be detected is a function of the frequency of the call emitted by the particular species. Typically, migratory species emit calls at a low frequency which decreases the distance at which they can be detected (Weller and Baldwin 2012). The microphone was attached to a constructed tower and suspended approximately 3.5 m in the air to elevate the device above the vegetation in the immediate area (Rodhouse *et al.* 2011). This measure was taken both to reduce the effects of vegetation noise and to ensure that vegetation did not impede echolocation signals from reaching the microphone. The microphone was housed in a protective housing constructed with ABS-tubing to prevent damage resulting from adverse weather conditions, and a Plexiglas® plate angled at 45° was installed below this housing to deflect signals into the microphone.

The detector was deployed at the edge of a clearing associated with a meterological tower installed at the site (Drawing 3, Appendix A). Mixed, shrubby regrowth characterized the adjacent areas. The detector was positioned approximately 409 m to the southeast of Turbine 1, and 137 m to the northwest of Turbine 2.

The detector was set to record between 1900 and 0730 daily to coincide with sunrise/sunset times and to ensure that all periods of bat activity were encompassed in the monitoring period. The detector was visited eight days after deployment, at which time data was downloaded, the power source was replaced, and the system was tested to ensure proper functioning.

Data was downloaded into Analook software for analysis. This software uses known bat call characteristics, including frequency, shape, and duration, to identify bat calls from within the recorded audio files (O'Farrell *et al.* 1999). Where possible, calls were identified to species on the basis of their characteristics. Due to their similarity, calls of Nova Scotia's two resident *Myotis* species (Little brown myotis and Northern long-eared myotis) can be difficult to reliably distinguish from one another (O'Farrell *et al.* 1999; Broders 2011), so these calls were not identified to species.

4.2.1 Results

In total, 2,270 files were recorded, of which only four were determined to be bat generated ultrasound. All remaining files were extraneous noise likely caused by rustling vegetation, precipitation, or wind gusts. The four echolocation calls recorded during the monitoring period were associated with *Myotis* species bats (i.e. Little brown myotis and Northern long-eared myotis), common species in Nova Scotia. No calls were detected beyond October 15.

5.0 DISCUSSION OF RESULTS

The installation of wind turbines has the potential to impact bats both directly and indirectly (Arnett *et al.* 2007). Impacts include:

- mortality resulting from direct collision and/or barotrauma;
- habitat alteration; and
- sensory disturbance.

The significance of these impacts at the population level depends on a number of biotic and abiotic variables, including the number of individuals affected and the stability of the population, season, physiologic condition of the individuals affected, and weather factors.

Mortality

Necropsy of recovered carcasses found that the cause of death for bats killed at wind-energy facilities is an indiscernible combination of direct collision with the turbine blades and barotrauma (Grodsky *et al.* 2011), although more recent pathological research has found that traumatic injury is the major cause of bat mortality at wind farms and that post-mortem artifacts may manifest themselves as pulmonary barotrauma lesions (Rollins *et al.* 2012). Barotrauma is characterized by a drop in atmospheric pressure along the top of a rotating turbine blade, which causes thoracic, abdominal, and pulmonary injury to bats when passing through the low pressure area (Baerwald *et al.* 2008).

Much of the established literature has not attempted to elucidate the causes of bat mortality but has instead reported on the magnitude of mortalities. Regardless of the specific cause, large numbers of bat fatalities have been reported at wind energy facilities, particularly along forested ridgetops, in the eastern United States (Kunz *et al.* 2007a). In Canada, bat fatalities outnumber bird fatalities by 2.4:1 (EC *et al.* 2012). Since bats are long-lived and have low reproductive rates, such mortalities can potentially contribute to precipitous population decline, and can increase the risk of local extinctions (Arnett *et al.* 2007).

Research suggests that migratory tree-roosting species suffer the highest fatalities at wind farms (Kunz *et al.* 2007a; Kuvlevsky *et al.* 2007; Cryan and Barclay 2009), although deaths of Tri-colored bats constituted 25.4% of total bat fatalities at wind facilities in the eastern United States (as cited in Arnett *et al.* 2007). Migratory species, including Hoary bat, Eastern red bat, and Silver-haired bat, accounted for 71% of 2,270 bat fatalities recorded at wind energy facilities across Canada between 2006 and 2010 (EC *et al.* 2012). Most bat fatalities are reported in the late summer months (Johnson 2005) coinciding with the start of swarming and autumn migration (Arnett *et al.* 2007: EC *et al.* 2012). Periods of high mortality may therefore be linked with the timing of large-scale insect migrations when bats feed at altitudes consistent with wind turbine heights (Rydell *et al.* 2010). It has been found that bat fatalities increase exponentially with wind tower height, with turbine towers 65 m or taller having the highest fatality rates (Barclay *et al.* 2007). This hypothesis is also supported by the findings of Horn *et al.* (2008), who reported that bats were not being struck by turbine blades when flying in a straight line en route to another destination, but were struck while foraging in and around the rotor-swept zone of the turbine.

Temporal variation in bat activity and subsequent fatality rates can be influenced by weather variables, as well as the characteristics of the facility (Baerwald and Barclay 2011). Although bats exhibit species-specific responses to environmental variables (Baerwald and Barclay 2011), in general they appear to be more active when wind speeds are low, which increases the risk of collisions with rotating turbine blades (Arnett *et al.* 2007) and mortality resulting from barotrauma. Increasing the turbine cut-in speed, the minimum wind speed at which the turbine blades are permitted to begin rotating, has been shown to greatly reduce bat fatality because bats are less active at these wind speeds (Arnett *et al.* 2011).

Habitat Alteration

The construction and operation of wind-energy facilities create habitat alteration and disturbance through various means including vegetation clearing, soil disruption, and noise (NRC 2007), thereby indirectly impacting bats (Arnett *et al.* 2007). The removal of trees during the site clearing and preparation phases can be especially detrimental, particularly to those bat species which use trees as roosting habitat (Arnett *et al.* 2007).

Some studies, however, suggest that habitat changes related to wind power developments may in fact create benefits to bats by increasing cleared areas and creating access roads, both of which can be used by bats as foraging habitat (as cited in Arnett *et al.* 2007; Kunz *et al.* 2007a). In relation to this, small-scale disturbances, including creating small cutblocks or small scale access roads through forested habitat, have been shown to stimulate an increase in bat activity relative to previous years (Grindal and Brigham 1998). It is important to note, however, that increased edge habitat due to forest clearing may subsequently increase the risk of mortality by virtue of attracting bats to the area of the operating turbine (Kunz et al. 2007b).

Sensory Disturbance

Increased human presence may also disturb roosting bats (Arnett *et al.* 2007), but it is unknown if this disturbance is sufficient to disrupt normal behaviour or physiology. During hibernation, bats are sensitive to human presence, and human intrusion into hibernacula can lead to increased arousals leading to a premature depletion of fat reserves (Thomas 1995). Siting wind-energy facilities away from hibernacula is therefore recommended in the design phases of these projects.

It is unknown if noise associated with turbine operation has any measureable effect on bats, although it is thought that bats may become acoustically disoriented by the low-frequency noise emitted from rotating turbines (Kunz *et al.* 2007a). Bats have been shown, experimentally, to avoid foraging in areas with intense, broadband noise (Schaub *et al.* 2008), however this research was not conducted in the context of wind-energy development and other studies indicate that bats have been shown to forage in close proximity to operational turbines (Horn *et al.* 2008).

The Project site is not located in an area that is known to be heavily used by bats. Most of the prominent cave hibernacula are located in the central region of Nova Scotia where dissolutional bedrock of the Windsor Group is prominent. However, Little brown myotis and Northern long-eared myotis are largely considered ubiquitous throughout the province outside of winter, so it is likely that these species occur at or near the Project site during these times. Although not identified to species, the presence of *Myotis* sp. at the Project site in late September-early October was verified through the field surveys. That Tri-colored bat was not recorded was not entirely unexpected as it is believed that this species is locally abundant only in southwestern Nova Scotia (Farrow 2007).

Bat activity was quite low at the Project site, as determined through acoustic field surveys. It is difficult to ascertain if low levels of activity were a function of low abundance or were an artifact of the study design. Typically, bats at northern latitudes leave their summering areas to commence swarming behaviours in late summer (Burns and Broders 2010; Randall 2011) and hibernate from September to April (OMNR 2008). The monitored period in the current study did not begin until late September, meaning that it is possible that most of the area's resident bats had already begun moving towards their respective winter hibernacula prior to sampling.

Furthermore, the migratory species, including Hoary bat, Silver-haired bat, and Eastern red bat, usually start their southward movements in late summer/early autumn (Cryan 2003), so it is possible that these summer occupants had also left the area prior to sampling. Furthermore, migrating bats regularly fly at heights that exceed the detection range of the system employed in this study (Baerwald and Barclay 2009), so it is possible that these species were present in the area but went undetected. Regardless, it is thought that Nova Scotia occurs at or beyond the northern range of these species and that records are extralimital (not commonly found within the given geographical area) (Broders *et al.* 2003) or represent fall stragglers (Maunder 1988).

It is difficult to determine patterns of bat usage based upon a short monitoring period, and while the results of field surveys in conjunction with desktop information suggest that the Project site does not coincide with important bat habitat, it is possible that the Project may adversely affect bat populations either directly or indirectly. However, the results of the current study do not provide any evidence that the Project site is unsuitable for development due to impacts on the bat community.

6.0 CLOSURE AND RECOMMENDATIONS

It is recommended that post-construction bat monitoring, consisting of but not necessarily limited to carcass searches, be conducted at the Project site to verify the conclusions presented in this report.

This report has been completed for the sole benefit of Natural Forces Technologies Inc. Any other person or entity may not rely on this report without the expressed, written consent of Strum Environmental and Natural Forces Technologies Inc. The conclusions presented in this report represent the best judgement of the assessor based on the current environmental standards. The assessor is unable to certify against undiscovered environmental liabilities due to the nature of the investigation and the limited data available.

This report was prepared from desktop information collected in November/December 2012 and field data obtained in September/October 2012. The results in this report rely only on the conditions identified at this time.

Should additional information become available, Strum requests that this information be brought to our attention immediately so that we can re-assess the conclusions presented in this report. This report was prepared by Garry Gregory, Environmental Specialist. Senior review was completed by Carys Burgess, Senior Environmental Specialist.

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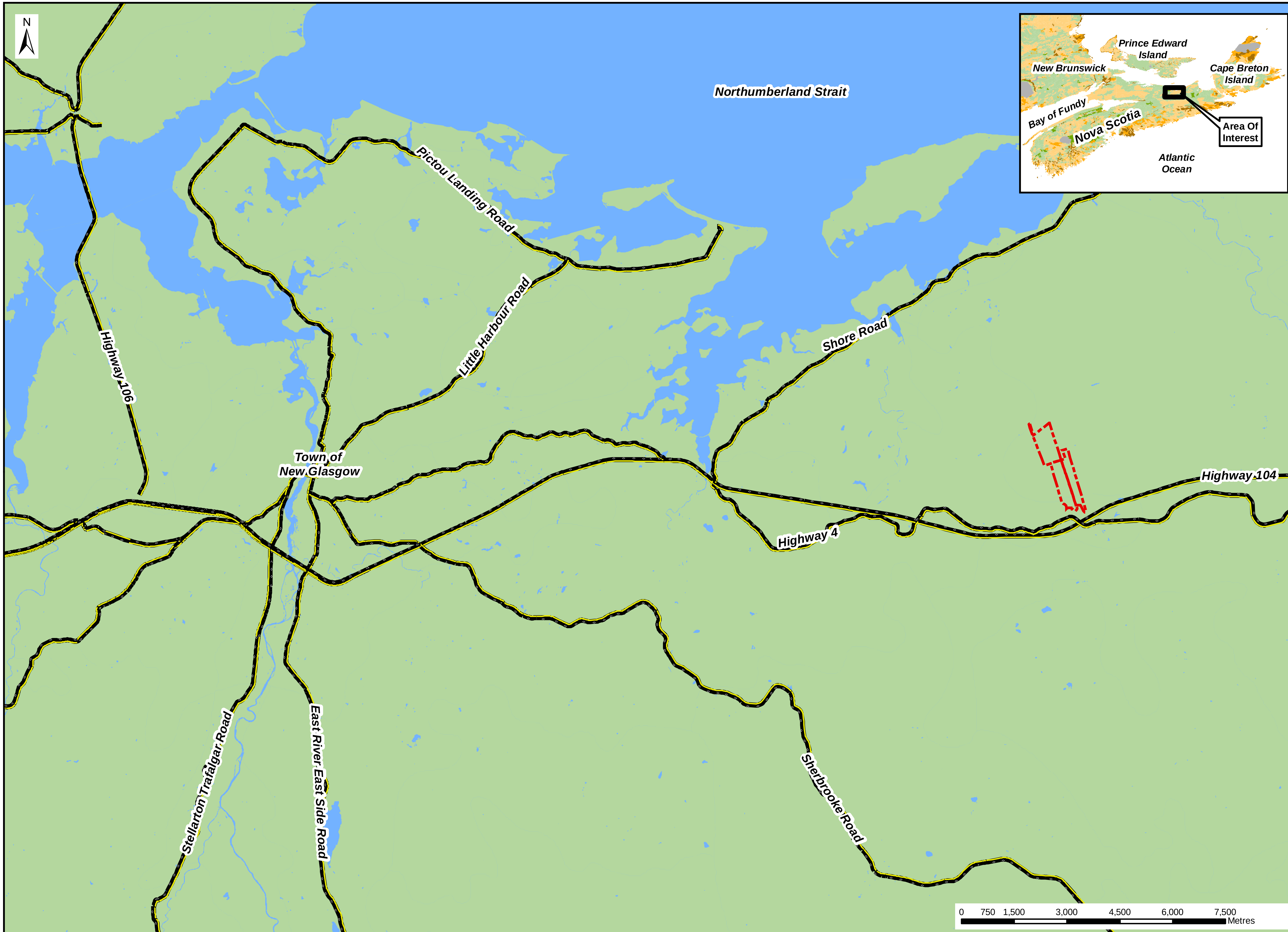
APPENDIX A
DRAWINGS



Notes:

1. Reference: Digital Topographic Mapping By Nova Scotia Geomatics Centre.
2. Projection: NAD83, UTM Zone 20 North.

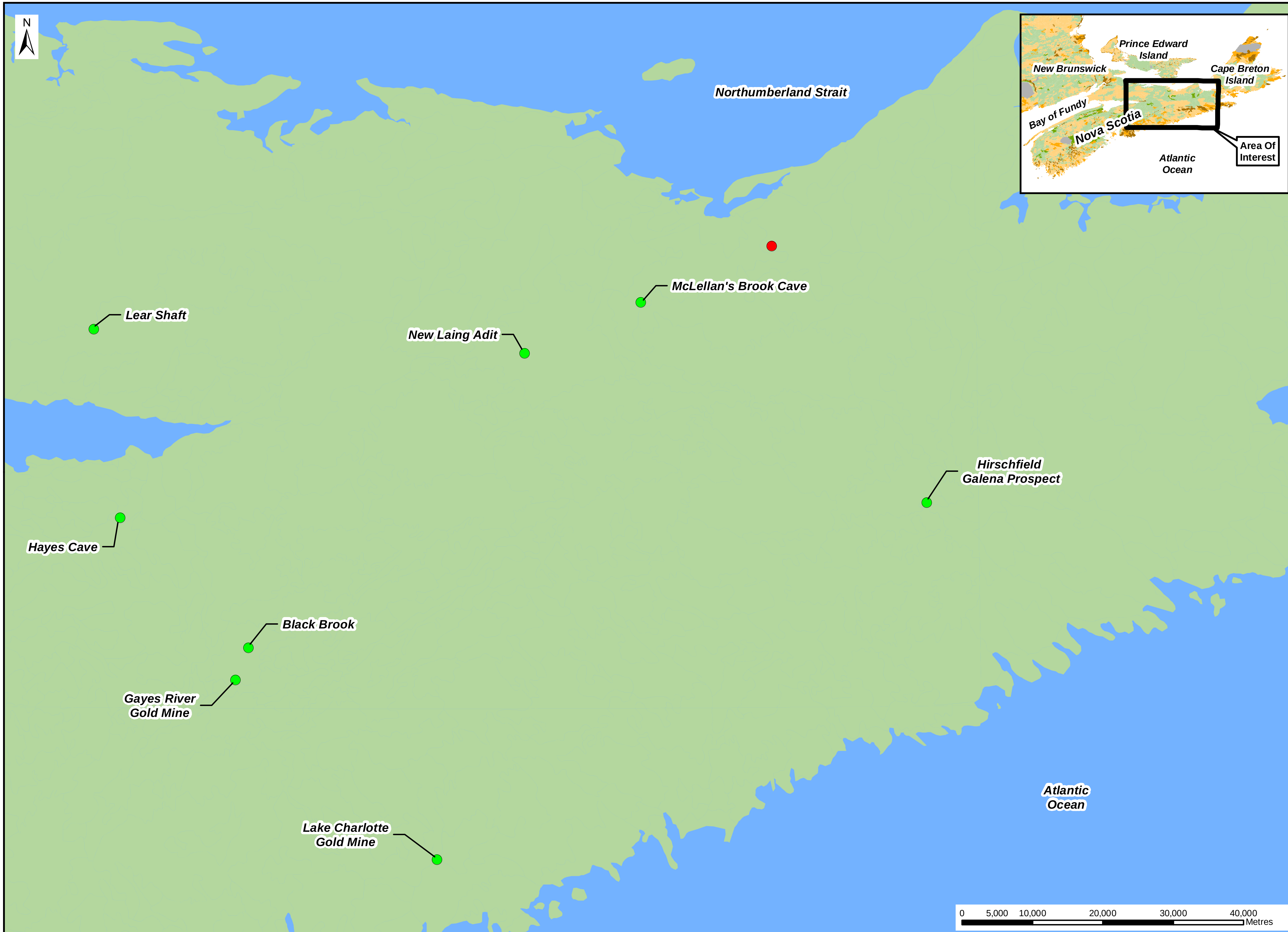
Legend:

- Project Site Boundary
- Water Body
- Highways

Project Site Location

Strum Environmental

Date:	Project #:
Dec. 2012	12-4509
Scale: 1:100,000	Drawing #: 1
Drawn By: G. Gregory	
Checked By: A. Walter	



Notes:

1. Reference: Digital Topographic Mapping By Nova Scotia Geomatics Centre.
2. Projection: NAD83, UTM Zone 20 North.

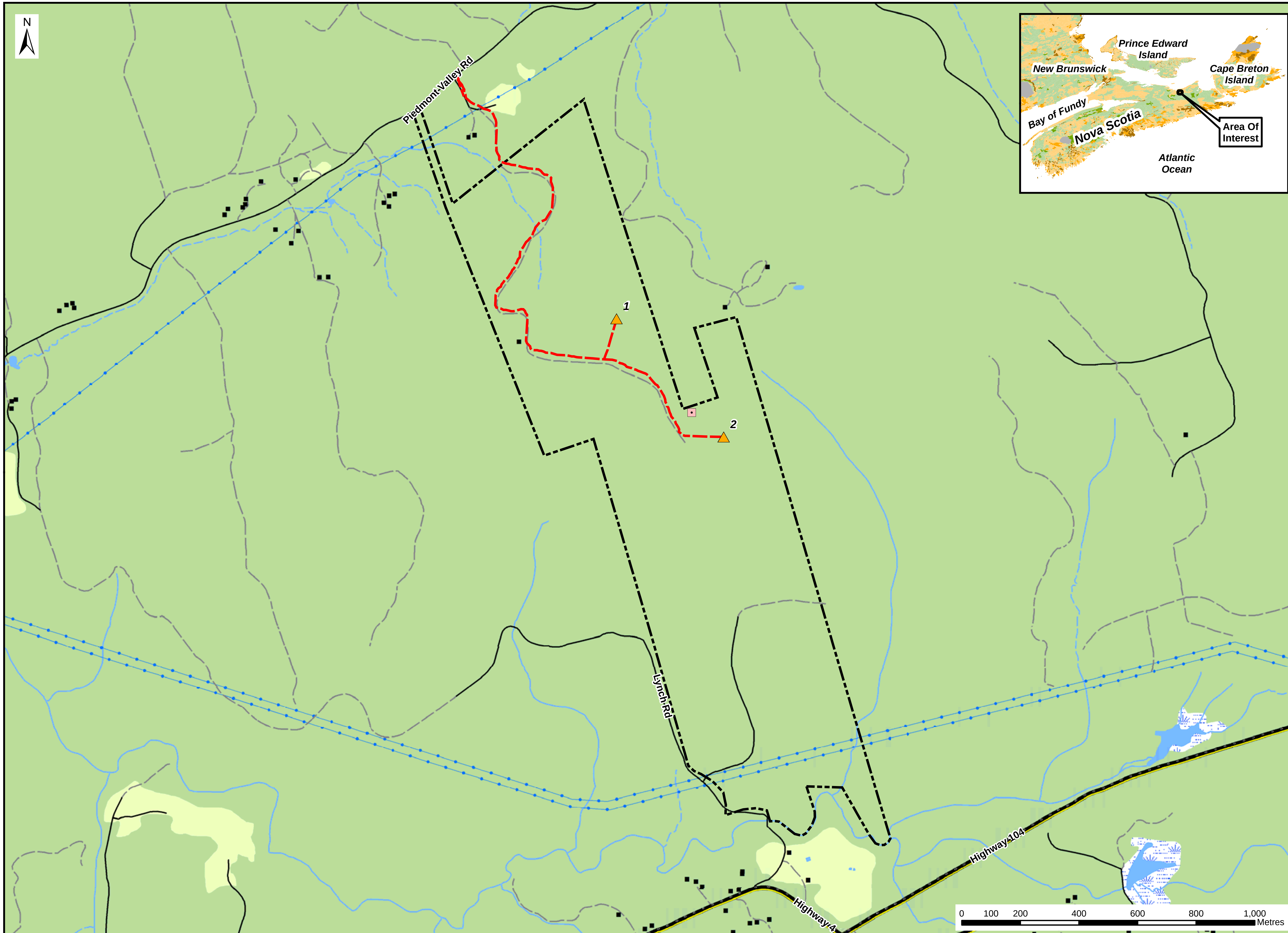
Legend:

- Project Site Location
- Known Bat Hibernacula

Known Bat Hibernacula within 100 km

Strum Environmental

Date: Dec. 2012	Project #: 12-4509
Scale: 1:100,000	Drawing #: 2
Drawn By: G. Gregory	
Checked By: A. Walter	



Notes:

1. Reference: Digital Topographic Mapping By Nova Scotia Geomatics Centre.
2. Projection: NAD83, UTM Zone 20 North.
3. GPS Points Taken Are Typically To +/-5m Accuracy.

Legend:

- Bad Detector
- Proposed turbine
- Proposed Access
- Project Site Boundary
- Buildings
- Major Roads and Highways
- Roads
- Access Roads / Trails
- Existing Transmission Lines
- Mapped Stream
- Indefinite Stream
- Water Bodies
- Mapped Wet Area
- Cleared Area

Bat Detector Location

Date: Dec. 2012	Project #: 12-4509
Scale: 1:12,000	Drawing #: 3
Drawn By: H. Serhan	
Checked By: G. Gregory	

Appendix D:

Archaeology Resource Impact Assessment

AULDS MOUNTAIN WIND FARM
Archaeological Resource Impact Assessment

Heritage Research Permit A2013NS032

May 2013

Davis MacIntyre & Associates Ltd.

Aulds Mountain Wind Farm
Archaeological Resource Impact Assessment

Heritage Research Permit A2013NS032

Category C

Davis MacIntyre & Associates
Project Number 13-019.1

Principal Investigator: Stephen A. Davis
Report Compiled by: Travis Crowell, April MacIntyre, and Laura de Boer

Submitted to:

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-and-

Coordinator, Special Places
Communities, Culture and Heritage
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Cover Image: View from Aulds Mountain looking north west towards the Northumberland Strait.

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- 3.2 Historical Background....................4
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Executive Summary

Davis MacIntyre & Associates conducted an archaeological resource impact assessment of the proposed Aulds Mountain Wind Farm Project in Pictou County. The assessment included a historical background study, consultation of the Maritime Archaeological Resource Inventory and a field reconnaissance of the study area in order to determine the potential for archaeological resources within the impact zone.

First Nations activity was likely focused in the low lands and surrounding navigable waterways rather than on Aulds Mountain. European settlement began as early as 1810 and several stone features were discovered, including a stone boundary wall and stone retaining wall. These physical features, in conjunction with background research, indicate that there was historic settlement in the area. Whether all of these features were purposed for agriculture or remnants of resource activity, such as mining and forestry, cannot be confirmed based on the information we currently have.

The assessment concluded that while there are historic features likely to be impacted by development their archaeological significance is low. Current plans of development for the access road and two turbine sites fall within an area of low archaeological potential and therefore no further archeological resource mitigation is recommended. If current construction plans change it is recommended that those areas not included in the current assessment be subjected to an archaeological resource impact assessment.

1.0 Introduction

In April 2013, Davis MacIntyre & Associates (DM&A) was contracted by Natural Forces to conduct a phase I archaeological resource impact assessment for two proposed wind turbines near Piedmont in Pictou County. The purpose of the assessment was to determine the potential for archaeological resources within the impact zone and to provide recommendations for further mitigation if deemed necessary. This assessment included consultation of the Maritime Archaeological Resource Inventory in the Department of Communities, Culture and Heritage as well as historic maps, manuscripts and published resources. A preliminary reconnaissance of the development area was also conducted.

This assessment was conducted under Category C Heritage Resource Permit A2013NS032. This report conforms to the standards required by the Department of Communities, Culture and Heritage under the Special Places program.

2.0 Study Area

Aulds Mountain Wind Farm proposes to construct two wind turbines with a 4.6 MW output close to the community of Piedmont, Pictou County.

The project will involve the construction of an access road and two towers erected on concrete pads. The study area was reached by a pre-existing logging road. The final section leading to the meteorological (Met) tower had been recently upgraded and possibly extended. The proposed sites of the two wind turbines, the Met tower pad, as well as the access road were investigated by archaeologists (Figure 2.0-1). Future expansion of the pre-existing logging road was taken into account during investigations.

The Aulds Mountain Wind Farm project lies within the French River Dissected Margin district plateau of the Avalon Uplands region in Nova Scotia (Figure 2.0-2).[1] This region boasts one of the harshest climates in Nova Scotia outside of the Cape Breton Highlands. Elevation is a significant factor in the climate's severity. Winters are long, the growing seasons are short, summers are cool, and average annual precipitation exceeds 1200 mm. Soils in the area are well-drained by the steep terrain, and more acidic at higher elevations. The soils are typically shallow, and of differing types of stony, sandy loams. The soil south of Piedmont in Barney's River is shale loam derived from Silurian shale. Mixed forest covers the area with hardwood stands growing on well-drained ridges. Trees most common to the area are Balsam Fir, Red Spruce, White Spruce, Red Maple, and Birch.[2]

[1] Davis and Browne, 1996: 22-23.
[2] Ibid., 38-39.

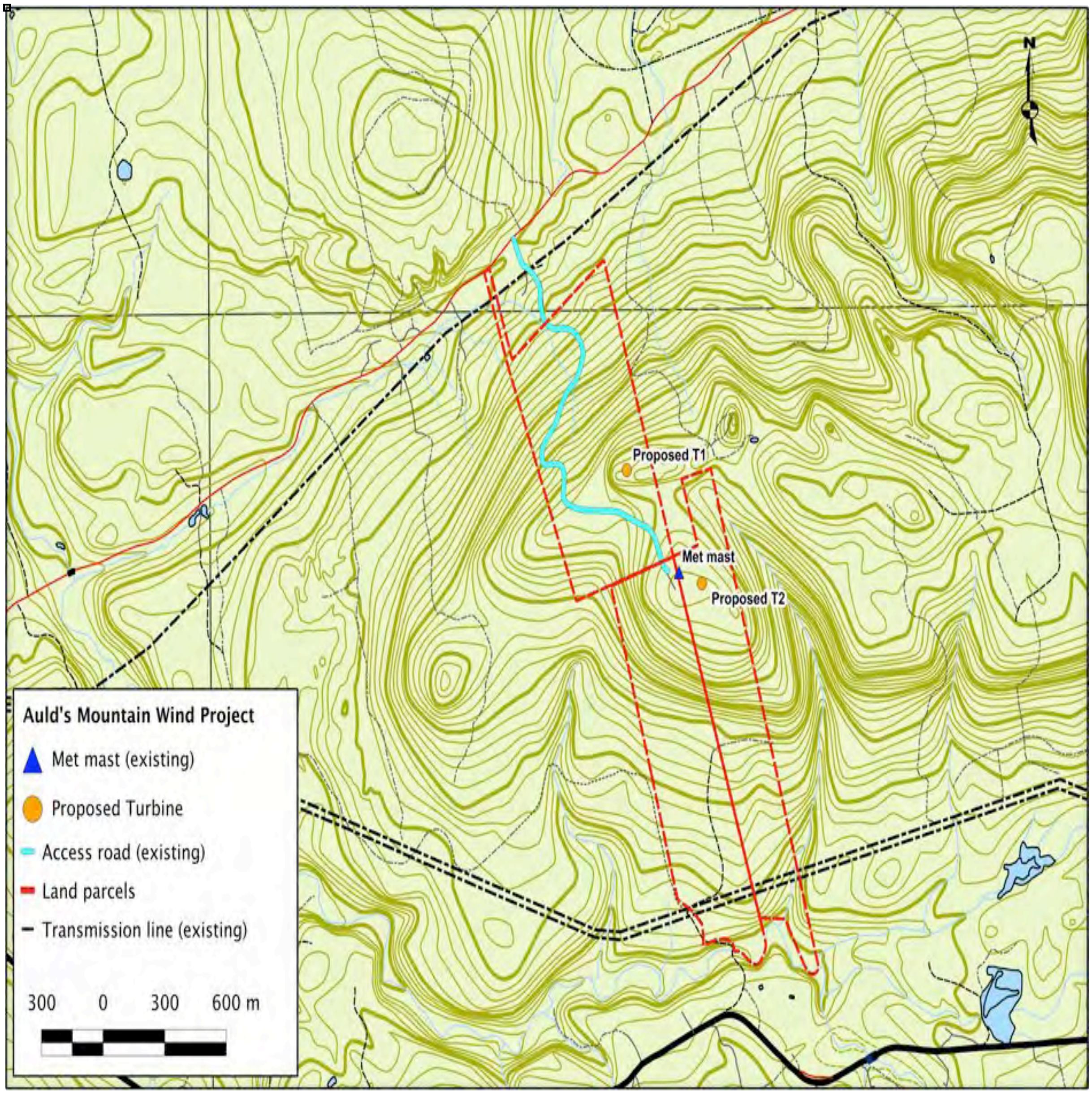

Figure 2.0-1: Map of study area showing the access road, Met mast, and proposed turbine sites.

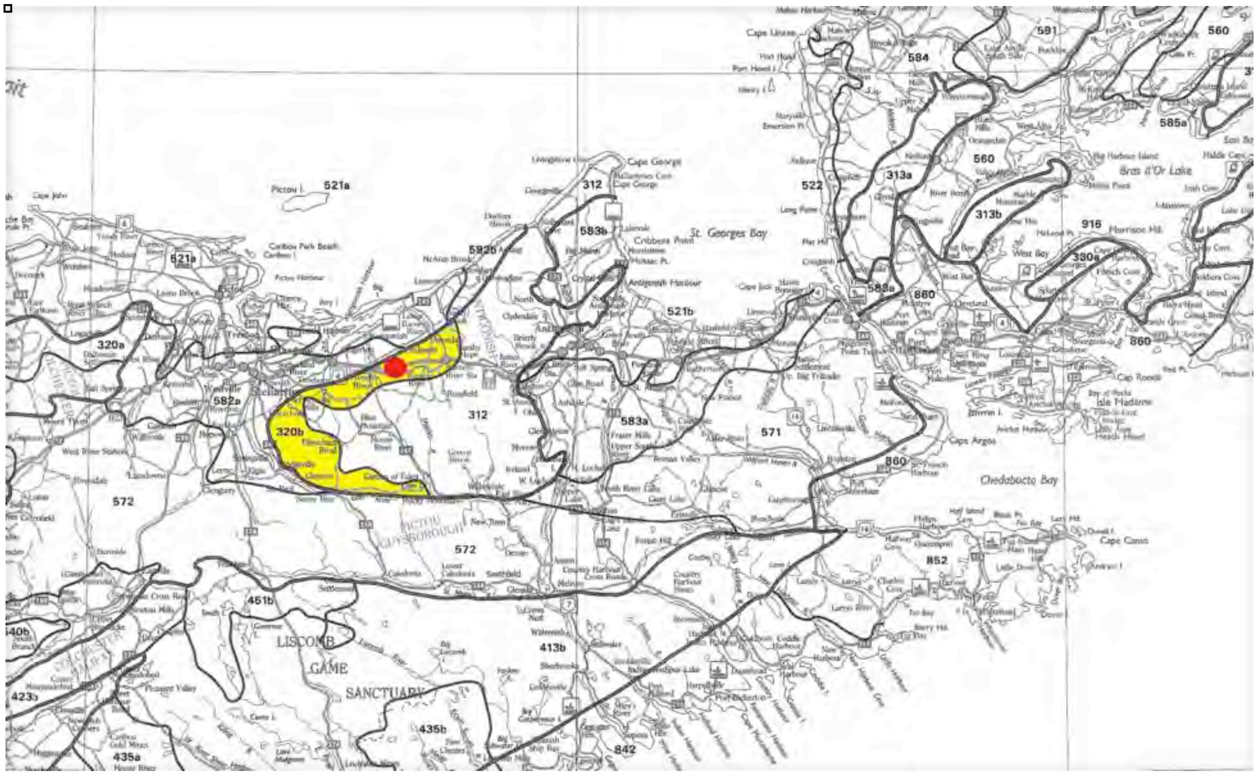

Figure 2.0-2: Map of the Natural Theme Regions of Nova Scotia showing Theme Region # 320b – French River Dissected Margin.[3]

3.0 Methodology

A historic background study was conducted by DM&A in May 2013. Historical maps, manuscripts, and published literature were consulted at Nova Scotia Archives and Records Management in Halifax. The Maritime Archaeological Resource Inventory, held at the Nova Scotia Museum's Heritage Division, was searched to understand prior archaeological research and known archaeological resources neighbouring the study area. A field reconnaissance was conducted on May 23rd, 2013 directed by Stephen Davis.

3.1 Maritime Archaeological Resource Inventory

The Maritime Archaeological Resource Inventory, a database of known archaeological sites in the Maritime Provinces, was consulted on 4 June 2013. There have been numerous archaeological sites or finds reported in the area of Merigomish Harbour, Barney's River and French River. In the early twentieth century, pioneering archaeologist Harlan Smith reported no fewer than 17 archaeological sites and two isolated finds associated with First Nations land use along the shores and on the islands in Merigomish Harbour, between 25 and 30 km north of the study area. A historic period

3 Davis and Browne, 1996.

Mi’kmaq burial site was also reported by Smith on the east side of Barney’s River Bridge near the “Ocean”, presumably Merigomish Harbour.

More recently, two historic Mi’kmaq camp sites have been reported in this vicinity and eleven nineteenth and twentieth century mills have been recorded on the French River (approximately 15 km west of the study area), along Barney’s River (18 to 21 km east and northeast), at Kenzieville (13 km southeast), and at Brownsville/Huggan’s Brook (18 km north). Two late nineteenth to twentieth century railway stations were also recorded on Barney’s River, 16 km and 21 km east of the study area.

The absence of recorded archaeological sites in close to the proximity to the study area is not necessarily an indication of absence of archaeological remains. Rather, it may be an indication that this area has not been subjected to a previous archaeological assessment.

3.2 Historical Background

3.2.1 The Precontact Period

The history of human occupation in Nova Scotia has been traced back approximately 11, 000 years ago, to the Palaeo-Indian period or *Saqiwe’k L’nu’k* (11,000 – 9,000 years BP). The only significant evidence of Palaeo-Indian settlement in the province exists at Debert/Belmont in Colchester County.

The *Saqiwe’k Lnu’k* was followed by the *Mu Awsami Kejihaw’k L’nu’k* (Archaic period) (9,000 – 2,500 years BP), which included several traditions of subsistence strategy. The Maritime Archaic people exploited mainly marine resources while the Shield Archaic concentrated on interior resources such as caribou and salmon. The Laurentian Archaic is generally considered to be a more diverse hunting and gathering population.

The Archaic period was succeeded by the Woodland/Ceramic period of *Kejihawek L’nu’k* (2,500 – 500 years BP). Much of the Archaic way of subsistence remained although it was during this period that the first exploitation of marine molluscs is seen in the archaeological record. It was also during this time that ceramic technology was first introduced.

The Woodland period ended with the arrival of Europeans and the beginning of recorded history. The initial phase of contact between First Nations people and Europeans, known as the Protohistoric period, was met with various alliances particularly between the Mi’kmaq and the French.

The Mi’kmaq inhabited the territory known as *Mi’kma’ki* or *Megumaage*, which included all of Nova Scotia including Cape Breton, Prince Edward Island, New Brunswick (north of the Saint John River), the Gaspé region of Quebec, part of the Maine and southwestern Newfoundland.
The area of Pictou County and Prince Edward Island was known as *Epekwitk aq Piktuk* meaning

“lying in the water” or “the explosive place”.[4] Merigomish was *Melegomichk* or “diversified by coves”, while French River was known as *Cakpesagakun* or “smelt-ground” to the Mi’kmaq.[5]

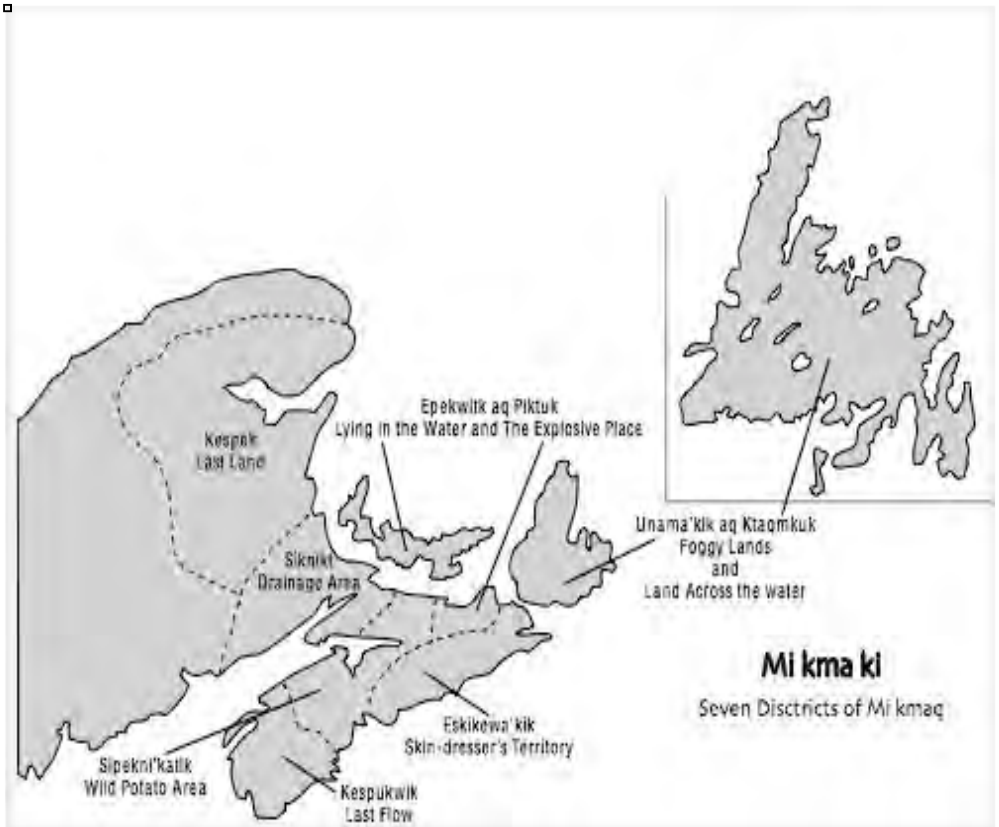

Figure: 3.2-1: Map of the Mi’kmaq Districts.[6]

3.2.2 European Settlement

Information on early European settlement of Piedmont is limited. The majority of the recorded history begins in the nineteenth century. This information is mostly contained in nineteenth and twentieth century maps. James Haggart, from the parish of Kenmore in Perthshire, is credited with settling the valley of Piedmont from 1810-1816 along with other Scots from Blair Athole. These Scottish settlers were a few of the many Scots who immigrated to Pictou County in the early nineteenth century. Rev. Donald McKeichan, the first minister of Barney’s River, gave the area the name Piedmont because of its location at the base of a range of hills. Piedmont, in Latin, means “foot of the mountain”. The Reverend may also have given the name because of a resemblance the land bore to the region of the same name in northern Italy.[7]

[4] Confederacy of Mainland Mi’kmaq. 2007:11
[5] Rand, 1875: 87-93
[6] Confederacy of Mainland Mi’kmaq. 2007:11
[7] PANS Scrapbook, MG9Vol.43. 1919:186

Earliest land grants date back to 1809, with a plot of 420 acres being granted just east of the study area to one John Smith (Figure 3.2-1). Smith was part of a group of 52 petitioners in August of 1809 to confirm grants of land from the Crown. Recipients of these land grants were required to take an Oath of Allegiance to His Majesty, as well as improve and cultivate the land. John Smith, with his wife and children, was granted a plot in the rear of the 82nd Grant. This grant, set aside for soldiers of the 82nd or Hamilton Regiment in the American Revolution, totalled 26, 030 acres.

By around 1820, three or four families were known to have lived in the area of Piedmont numbering over forty people. This approaches the recorded population of 56 in 1956.[8] There is little recorded of the life of the people there other than a noteworthy year in 1815 which came to be known as “The Year of the Mice” due to the population boom of a particularly large and fierce breed of mouse that allegedly could fight off a cat.[9] These mice created enough of a nuisance for the farmers of Piedmont to earn a page in history.

The Illustrated Historical Atlas of Pictou County by J.H. Meacham & Co. shows that the proposed area to erect the wind farm falls within two plots of land that were inhabited by at least 1879, but possibly earlier (Figure 3.2-2). The 80 acre southern plot was granted to Donald McGlashan, of whom there is little reference to in history. The Meacham map shows no home or structure on McGlashan’s land at that time, though that is not strict confirmation that nothing existed. The plot of land just south of McGlashan’s is shown to have a saw mill situated on the east branch of the French River.

The northern plot of 90 acres belonged to James Ross, a schoolteacher whose date of settlement in the area is recorded as 1849. The Meacham map depicts a structure south of the main road of the time. Ambrose F. Church’s map of Pictou County, published in 1867, shows a schoolhouse west of Ross’ property, outside of the study area, which may have been the one he taught at though that is not certain (Figure 3.2-3). The history of Piedmont notes there was a schoolhouse in the area prior to 1885, but it does not list a construction date.[10] A geological survey map from 1902 shows settlement in part of the study area (Figure 3.2-4). It is not clear whether either of these two structures are the same as the one shown on the Meacham map in 1879, but they are in a similar area. It seems there was sparse settlement in the Piedmont area from the early nineteenth century onward, though it was never a high density population.

The area east of the French River is also home to at least one report of buried treasure, reported by William G. MacDonald who was a former local of Avondale, Pictou County.[11] The story goes that a few miles east of the river a tall tree marked the location of buried treasure. This knowledge was passed to MacDonald by his father in about 1890, but the pock-marked ground from shovels around the base of the tree is evidence that this knowledge was not secret. MacDonald learned in 1902 that his cousin’s husband had tried to dig up the treasure with several other men. They were guided by an “eccentric old fellow” who had gleaned the treasure’s location from a dream. The dig ended when one of their lanterns was kicked over, spooking several of the men. The story ends on a mysterious note. An unknown four-masted schooner sailed into the harbour and disappeared down

[8] Fergusson, 1967: 525

[9] McLaren 1954: 210

[10] Fergusson, 1967: 525

[11] MacDonald, “Letter to the Editor”, Atlantic Advocate Vol.63 No.8, April 1973, 13-14.

a narrow channel. The next day the schooner was gone, leaving only a big hole under the tree with an imprint of a very heavy box and evidence of a hurried excavation. The provenance of the ship or the supposed treasure was never solved. While it is difficult to know the veracity of this story, it does demonstrate a maritime connection in the area as well as the development of local folklore by its new European inhabitants.

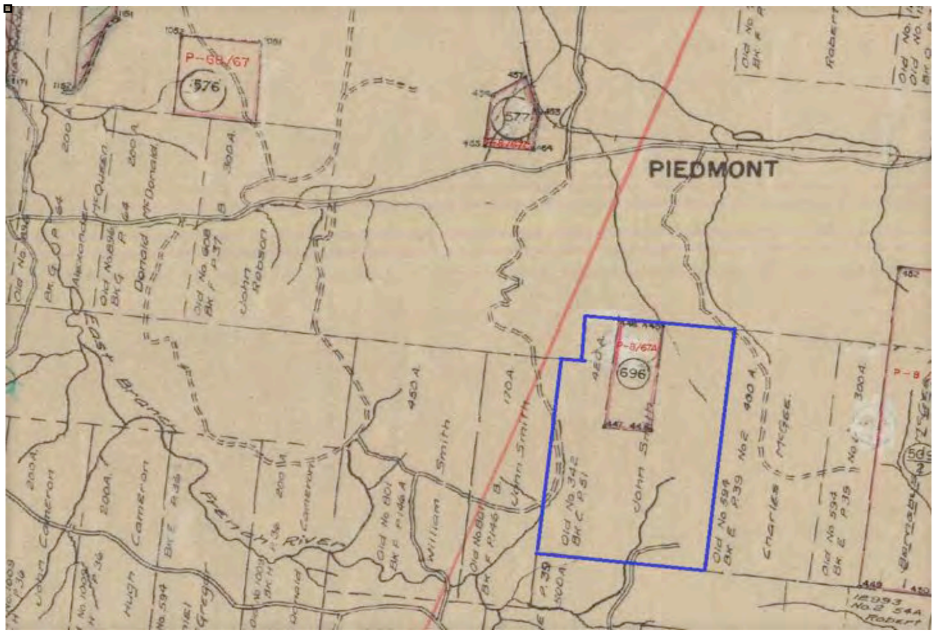

Figure 3.2-2: Part of the land grants index for Pictou County. The 420 acre plot granted to John Smith in 1809 is outlined in blue.[12]

[12] Nova Scotia Department of Lands and Forests, 2009.

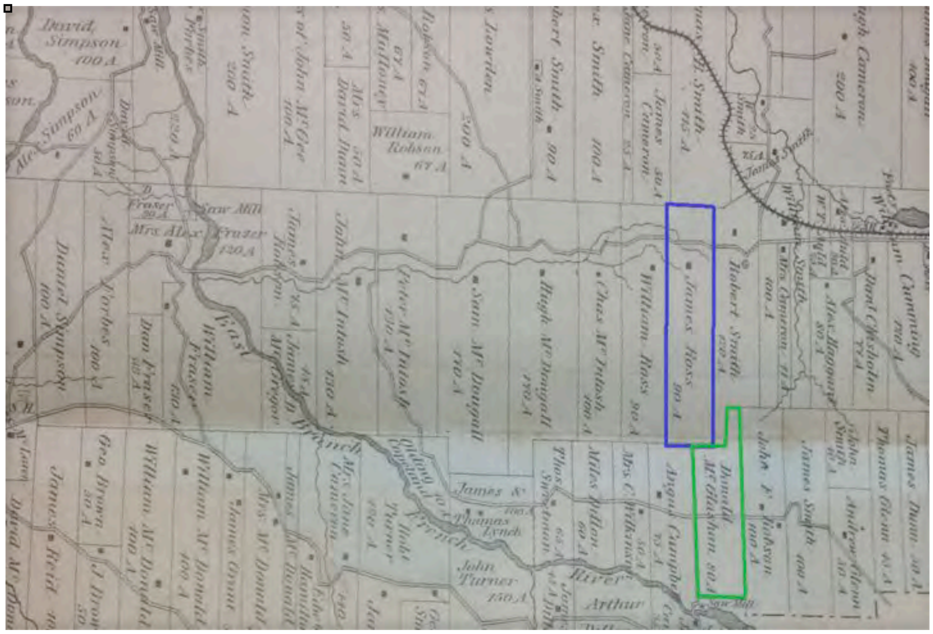

Figure 3.2-3: A part of the Illustrated Atlas of Pictou County by J.H. Meacham & Co. which highlights the two plots of land within the study area. The land granted to James Ross is highlighted in blue and indicates some form of settlement. The land granted to Donald McGlashan is highlighted in green.[13]

Figure 3.2-4: Approximate location of the study area in relation to historic settlement on Ambrose F. Church's (1867) map of Pictou County. The location of the school house is circled in blue.[14]

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[13] Meacham, 1879.
[14] Church, 1867.

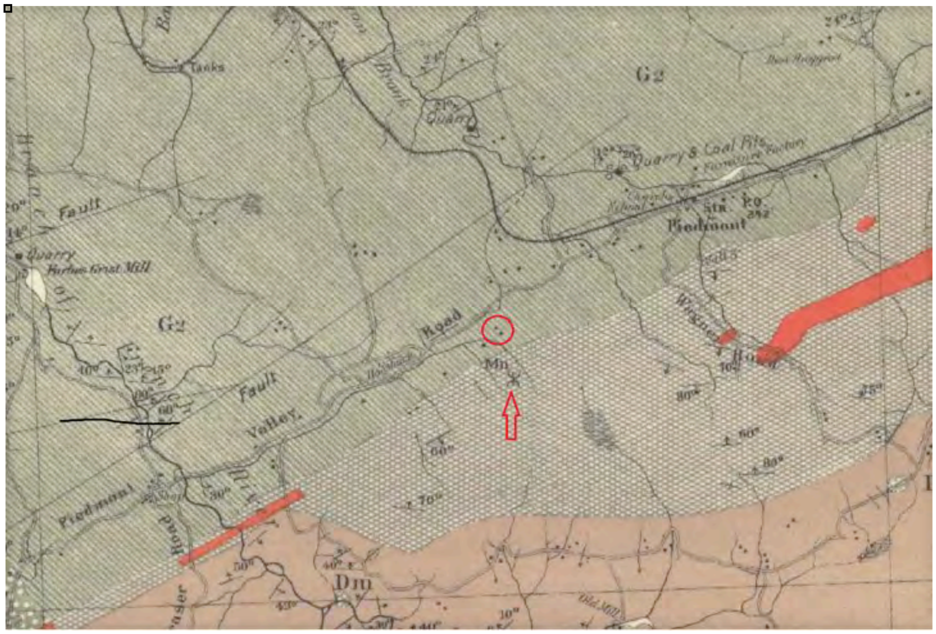

Figure 3.2-5: Part of a geological survey map of the Piedmont area from 1902 which shows a Manganese Mine operation as indicated by the arrow, as well as two settlements that are situated near the study area.[15]

3.3 Field Reconnaissance

An archaeological field reconnaissance was conducted on May 23rd, 2013 directed by Stephen Davis. The reconnaissance included the area around the access road, as well as the proposed development areas for the two wind turbines (Figure 3.2-6). The access road was a well-maintained gravel road that branched off a residential drive-way south of Piedmont Valley Road. Two apple trees marked the entrance of the road, and hinted to historic settlement. The upper portion of the road, closer to the second proposed turbine site, had been upgraded with new gravel and freshly dug ditches for water-runoff. This work was likely done when the Met tower was constructed. The forest was mixed, and consisted mainly of birch, spruce and balsam fir, with some pine trees growing at lower elevation. Trees were mature and generously spaced.

The survey began at the base of the access road and proceeded south to the proposed turbine sites. An area of up to 10 metres from both edges of the access road was investigated in anticipation of the road being widened when turbine construction begins. West of the access road, close to the entrance gate, was an extensive linear stone feature on the lip of an embankment, overlooking a brook (Plate 1). A similar feature could be seen on the opposing hill as well. Further south along the edge of the road another pile of stones was found, larger than the first (Plate 2). The size of this stone feature, the presence of conglomerate rocks, and informal configuration of the stone suggests it is a cultural feature, though not necessarily for agricultural purposes. Background research

[15] Fletcher, 1902

indicated there was mining activity in the area and these features may be mine tailings. This extensive linear stone feature runs north to south following the bank and watercourse.

East of the road, in the area opposite the second linear stone feature, an agricultural stone boundary wall was found stretching back into the forest, running east to west(Plate 3). This more formal wall was followed for 70m back into the forest and continued beyond that distance. The wall was double-skinned, meaning larger rocks were used for the outer walls with smaller fill in the middle, a style associated with the Scots of the Hebrides. A lot of time and effort would have gone into constructing this wall suggesting long-term occupation of the area. The stones were likely those found during tilling of the area for cultivation, and repurposed for building the wall that still exists today.

Forestry activity to the east of road is obvious, even at minor and moderate elevations. Skidder tracks, cut stumps, and large tracts of new growth next to mature stands were evident in the area. An old road east of the main road, abutting another small watercourse, is also evident (Plate 4). Whether this road is associated with historic mining, logging, or agriculture is not known. Following the older road south uphill our survey brought us into contact with a well-constructed stone retaining wall built along the bank of the watercourse (Plate 5). The time and effort into construction of the wall again suggests the expectancy of long-term settlement by its makers. Larger stones were used for the walls foundation with smaller stones stacked on top to a height of 1.5 to 2 meters. This retaining wall was located approximately 60m from the main access road and is not expected to be impacted by development.

The first proposed turbine site was accessed by hiking in north from the nearest point on the access road. The area was rocky, with cleaved bedrock exposed along the slope to the high ground. Tree growth was primarily mature deciduous with some evergreen growth (Plate 6). The understory was of ferns and grass with some berry brambles beginning to grow. No evidence of historical or pre-contact activity was found in this area.

The second proposed turbine site was accessed from the road, off the south-east edge of the Met tower pad (Plate 7). Geotechnical testing had already occurred allowing easy estimation of the impact area as well as exposing the soil. The exposed soil was examined for any archaeological evidence but none was found. The soil itself was sandstone and sandy silt overlaying orange sandy loam. Tree growth was all evergreen and of relatively equal age between 15-20 years. This, and cut stumps revealed in the surrounding area, indicate extensive clear-cutting in the area. The pervasive coniferous growth and little understory as well as thin soil horizon lend evidence that soil is not suitable to agriculture. Landscape was rollicking and showed no evidence of leveling from historic field clearing (Plate 8). Lack of running water at the top of the hill is a significant drawback to settlement. The combination of these factors results in a low probability for archaeological resources.

The area of disturbance around the Met tower was also walked to see if any archaeological material had been exposed by construction. Granular quartz cobbles and sandstone littered the ground but nothing of note was discovered.

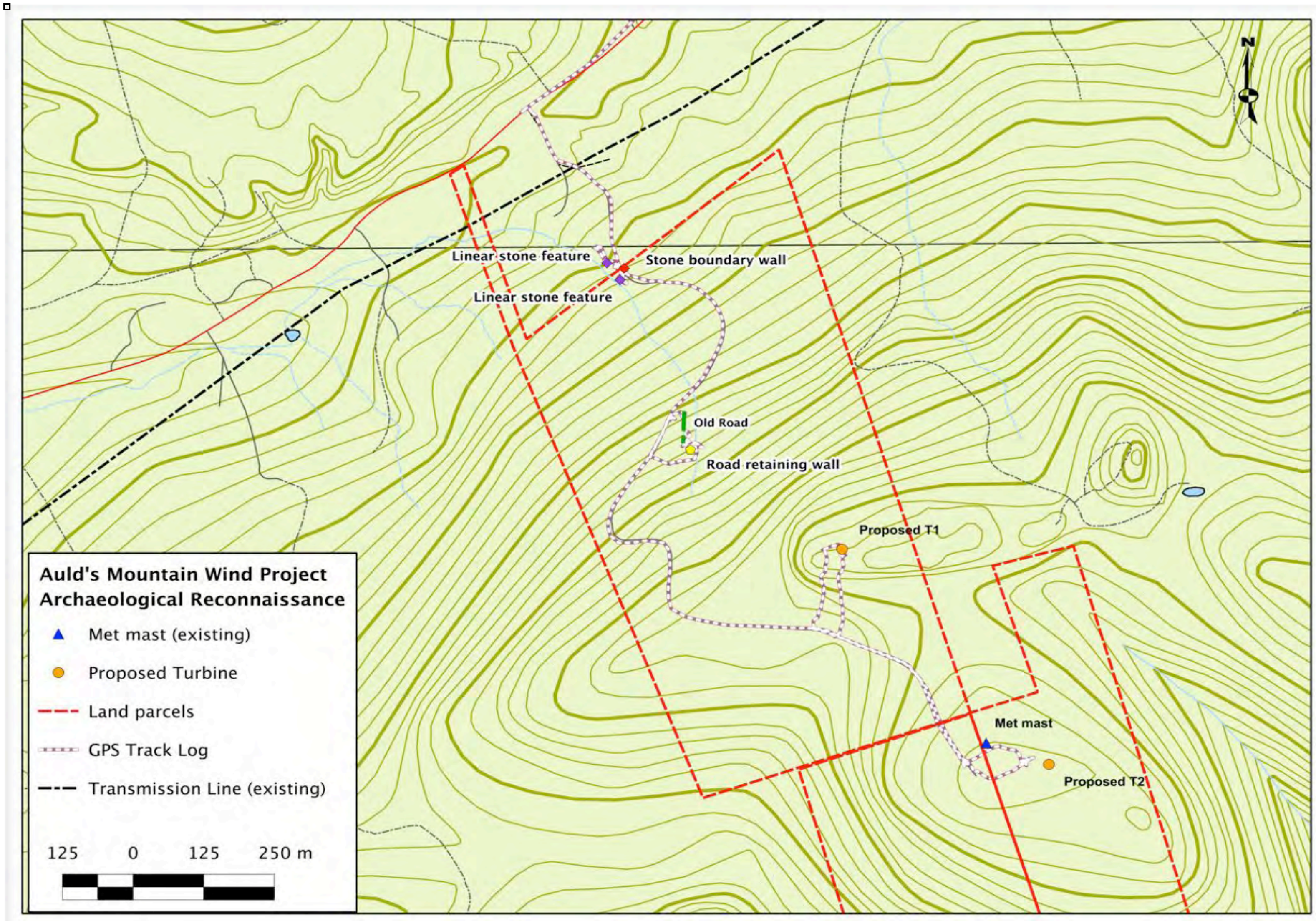

Figure 3.2-6: Map of development area with turbine sites and stone features marked.

4.0 Results & Discussions

The historical background study indicates Pictou County, Barney's River and French River were occupied and used by the Mi'kmaq and their ancestors prior to European contact. Aulds Mountain may have been visited for hunting and gathering, but the potential is low for finding any archaeological evidence of this activity. The study area appears to offer little in terms of long-term settlement and subsistence such as navigable waterways and fishing sites.

James Haggart and subsequent Scottish immigrants from areas like Blair Athole settled in the valley of Piedmont as early as 1810. Historical maps record land settlement in the study area as early as 1849 and Meacham's map indicates there was substantial enough settlement in the area to warrant a schoolhouse and mill on the southern portion of land granted at one point to Donald McGlashan.

Field reconnaissance revealed settlement in the area would have been "back" land, which is land granted to later waves of immigrants after much of the more productive "front" lands had been already granted. The existence of apple trees, relatively level woodlands, and two stone features appear to agree with the historic background research that there was settlement in the area. The linear stone features, if they are mine tailings, would suggest that in addition to agriculture the study area was also a site of extraction activities.

The proposed turbine sites were of higher elevation than the discovered features, which were discovered in the northern half of the roadway, and there were no signs of pre-contact or historic cultural activity, besides logging. The lack of navigable waterways and a landscape unsuitable to agriculture and settlement significantly diminish the likelihood of archaeological resources at these sites.

5.0 Recommendations & Conclusions

The two turbine sites, access road, and surrounding area have been determined to be of low potential for significant archaeological resources for both First Nations and Euro-Canadians.
A portion of the stone boundary wall and the linear stone feature are likely to be impacted should the access road be widened. However, these features are deemed of low historic significance and mitigation is not recommended. The diagnostic value of these sites is low and has primarily served to provide further evidence of cultural activity in the area. While it is possible there is a house or dwelling somewhere close-by, the field reconnaissance has found no evidence of one within the current development area. The stone retaining wall falls outside of the impact zone and is not expected to be disturbed by development. Should the route of the access road be altered significantly, specifically along the initial northern half of the access road, then archeologists should be contacted for further advice on mitigation strategies.

Avoidance is the preferred method of mitigation in all instances where archaeological resources are present. This investigation has indicated that nothing of archaeological significance will likely be impacted during construction activities. However, should any archaeological resources be encountered during ground disturbance activities, it is recommended that all activity cease and the Coordinator of Special Places (902-424-6475) be contacted immediately to determine a suitable method of mitigation.

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PLATES

Plate 1: Linear stone feature looking north-northwest.

Plate 2: Second linear stone feature looking southeast.

Plate 3: Stephen Davis standing on the rock boundary wall looking east. Note the position of the rocks relative to their size, with larger stones making up the outer walls and smaller stones in the interior.

Plate 4: Old road, east of the access road, looking north.

Plate 5: Road retaining wall along east section of old road looking southwest.

Plate 6: Archaeology crew at turbine site one, looking north.

Plate 7: Meteorological tower pad at the end of the access road, looking east-northeast.

Plate 8: Turbine site two, looking east. Note the survey tape and tree push-out from geological testing.

Appendix A:
Heritage Research Permit

NOVA SCOTIA

Heritage Research Permit (Archaeology)

Special Places Protection Act **1989**

(Original becomes Permit when approved by Communities, Culture and Heritage)

Office Use Only
Permit Number:
A2013NS032

Greyed out fields will be made publically available. Please choose your project name accordingly

Surname Davis	First Name Stephen
Project Name Auld's Mountain Wind Farm	
Name of Organization Davis MacIntyre & Associates Ltd	
Representing (if applicable) Natural Forces	
Permit Start Date 13 May 2013 (Rev. 22 May)	Permit End Date 31 July 2013

General Location: Auld's Mountain, Pictou County

Specific Location: *(cite Borden numbers and UTM designations where appropriate and as described separately in accordance with the attached Project Description. Please refer to the appropriate Archaeological Heritage Research Permit Guidelines for the appropriate Project Description format)*

20 T 548828 5049227   20 T 549194 5048824

Permit Category:
Please choose one

- [ ] Category A – Archaeological Reconnaissance
- [ ] Category B – Archaeological Research
- [x] Category C – Archaeological Resource Impact Assessment
- [x] I certify that I am familiar with the provisions of the *Special Places Protection Act* of Nova Scotia and that I have read, understand and will abide by the terms and conditions listed in the Heritage Research Permit Guidelines for the above noted category.

Signature of applicant Stephen Davis	Date 22 May 2013
Approved by Executive Director [signature]	Date June 7, 2013