Appendix B

Avian and Bat Monitoring Plan

Cape Wind Avian and Bat Monitoring Plan – Draft Monitoring Protocols

NANTUCKET SOUND, MASSACHUSETTS

PREPARED FOR

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Project No. E159-504

July 27, 2010

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CAPE WIND AVIAN AND BAT MONITORING PLAN – DRAFT MONITORING PROTOCOLS
Nantucket Sound,
Massachusetts

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1.0 INTRODUCTION

The *Framework for the Avian and Bat Monitoring Plan for the Cape Wind Proposed Offshore Wind Facility* (ABMP) prepared by the Minerals Management Service (MMS)[1] and Cape Wind Associates (CWA) (September 19, 2008) outlines the general methods that will be used to gather data to assess potential impacts to bird and bat populations as a result of the proposed project. The monitoring will focus on bats and federally and state endangered birds, Roseate Tern and Piping Plover, which are known to occur in and near Nantucket Sound (Figure 1). The ABMP also includes specific study objectives and research questions that will be addressed through pre-construction, construction, and post-construction monitoring techniques. The ABMP will be further refined with input and assistance from regulatory agencies prior to implementation in the field. Thus, the purpose of this *Cape Wind Avian and Bat Monitoring Plan – Draft Monitoring Protocols*, prepared by ESS Group Inc. (ESS), is to present the detailed methodology that will be used to implement the monitoring program and address the study objectives presented in the ABMP.

The monitoring protocols are being developed in coordination with the Bureau of Ocean Management Regulation and Enforcement (BOEM) and the U.S. Fish and Wildlife Service (USFWS) and include several monitoring requirements as a result of previous regulatory review. As a requirement of the USFWS Biological Opinion and the MMS Record of Decision (MMS 4/28/10), the Monitoring Protocols will be peer-reviewed prior to implementation. This peer review will include at least one European scientist currently conducting similar monitoring efforts at off-shore wind projects. The peer review will allow data collection and analysis to be comparable with other ongoing off-shore monitoring efforts. To the greatest extent practicable, the Monitoring Protocols must incorporate methods to assess detectability and sufficiency of negative data. Components of the ABMP, such as radio telemetry, entail the take (i.e., capture, some risk of injury) of Roseate Terns and Piping Plovers and will be contingent on receiving recovery permits under section 10(a)(1)(A) of the United States Endangered Species Act.

[1] Secretarial Order 3302 issued June 18, 2010 renames the Minerals Management Service to the Bureau of Ocean Management Regulation and Enforcement (BOEM)

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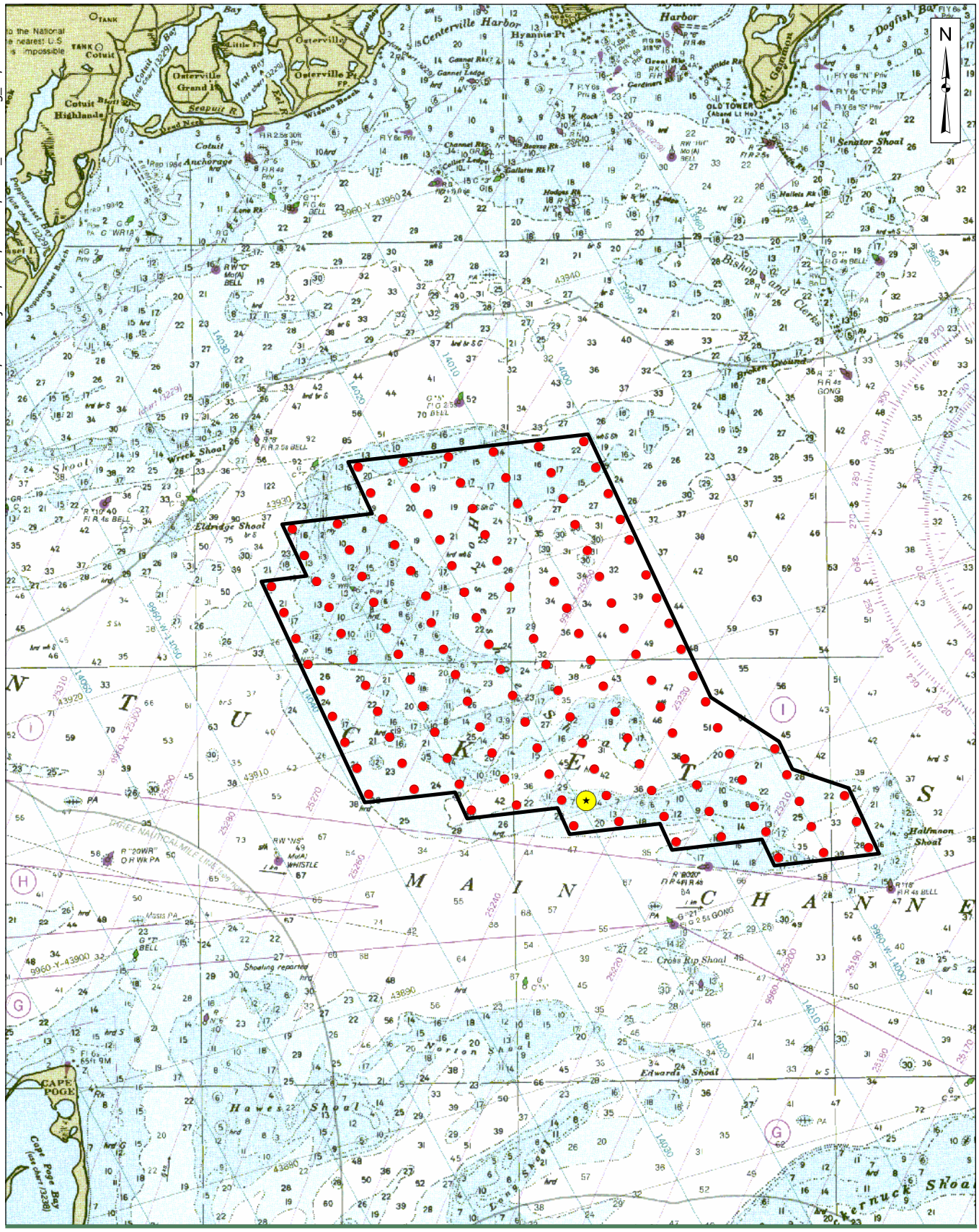

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Cape Wind Project
Nantucket Sound, Massachusetts

Scale: 1" = 10,000'

0 10,000 Feet

Source: 1) MassGIS, NOAA Chart csi1-13237

Legend

Wind Farm Boundary

Structures

Proposed Wind Turbines

MET Tower
(for monitoring equipment)

Locus Map

Figure 1

2.0 PRE-CONSTRUCTION MONITORING PROTOCOLS

The pre-construction monitoring program consists of four components: radio tracking of targeted species (Semipalmated Plover and Common Tern as surrogates for Piping Plover and Roseate Tern), acoustic monitoring to determine avian presence or absence, field-testing and monitoring of anti-perching techniques, and bat presence or absence surveys from the existing meteorological tower (MET tower).

2.1 Radio Tracking

The objective of the pre-construction radio tracking study is to test and refine the use of radio tags. Common Terns will be tracked as a surrogate for Roseate Terns, while Semipalmated Plovers will be used as a surrogate for Piping Plovers. The results of the radio tracking study will guide post-construction studies that will hopefully be successful at radio tracking Roseate Terns and Piping Plovers.

2.1.1 Methods and Schedule

Twelve Common Terns and 12 Semipalmated Plovers will be tagged with radio transmitters and tracked by airplane. Utilizing airplanes for tracking has been determined to be the most efficient and cost effective method to conduct similar tracking exercises. Due to the geographic separation between the likely nesting / capture locations on Bird or Ram Islands in Buzzard's Bay, and the potential to track individuals to Horseshoe Shoal or across Nantucket Sound, it is felt that boats would be too slow and ground tracking would be ineffectual. Common Terns will be tracked at least 12 times between July 1 and September 15. Semipalmated plovers will be tracked twice weekly during the month of August. The detailed methodology for bird capture, tagging, and aerial tracking is provided in the following sections.

Bird Capture

The North American Bander's Manual for Banding Shorebirds (Gratto-Trevor 2004) was the primary source consulted to determine a suitable method to trap plovers and terns. Birds will likely be captured using either nest traps or cannon nets.

Shorebirds are considered nongame migratory birds and so are subject to the Migratory Bird Act of the U.S. Therefore, CWA will first apply for a banding permit from the U.S. Bird Banding Laboratory (United States Geological Survey [USGS], PWRC, Bird Banding Laboratory, 12100 Beech Forest Road, STE-4037, Laurel, Maryland 20708-4037, USA) to band the target species. Additional permission from the banding office will be needed to use radios tags. CWA will apply for the following permits.

- Federal Bird Banding Permit, 50 CFR parts 13 and 21 from USGS – this permit covers bird capture and banding with leg band.
- Federal Migratory Bird Scientific Collection Permit, 50 CFR Parts 10, 13, 21.23 from USFWS– this permit covers the attachment of the radio transmitters to captured birds.

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- Massachusetts G.L. c. 131, Sec. 4(2) State Scientific Collection Permit (Commercial) from the Massachusetts Division of Fisheries and Wildlife – this permit will cover the capture and attachment of radio tag birds under state law. Additional approval may be necessary to collect Common Terns, a state-listed species of special concern.

- Massachusetts G.L. c. 131, Sec. 4(2) Massachusetts Bird Banding Permit from the Massachusetts Division of Fisheries and Wildlife – this permit covers bird capture and banding with leg band.

Additional permits or authorization may need to be obtained by USFWS for the use of cannon nets for the capture of Semipalmated Plovers as described in more detail below.

Common Tern Capture

Nests of Common Terns will be identified through consultation with the Massachusetts Natural Heritage and Endangered Species Program. Common Terns will presumably be captured from nesting areas on Bird Island or Ram Island in Buzzards Bay.

Terns will be captured in a nest trap, which will be made of wire mesh or flexible chicken wire. The chicken wire traps will be bent to accommodate the uneven terrain and rocks encountered at the nesting sites. The trap will be placed on the nest and the door to the trap will be adjusted to fit the size of the bird and held in place with pegs. After the trap is placed on the nest, banders will move away from the nest and remain quiet and motionless. Once a bird is observed in the trap, the bander will approach the trap rapidly towards the trap door, so the bird does not have a chance to flush from the trap. If the bird is able to escape out the door, the trap may need to be adjusted for size.

Semipalmated Plovers

Semipalmated Plovers do not nest in Massachusetts, but are found along intertidal flats and sandy beaches from late July to early September. Attempts will be made to capture Semipalmated Plovers using cannon nets or a comparable method based on consultation with the USFWS. Locating an appropriate location to trap Semipalmated Plovers will be done in consultation with Massachusetts Fish and Wildlife and USFWS. Cannon nets contain cannon explosives as well as projectiles attached to the leading edge of the net. Alternatively rocket nets contain the explosive inside the rockets, which are themselves attached to the leading edge of the net. Because both options involve the use of live charges, permission to use them takes a significant lead time. According to the USGS, the use of cannon nets/rocket nets is very tightly controlled. Only researchers within federal and state agencies or with a direct university link are normally allowed to purchase and use cannon/rocket net charges. Contractors (even contractors for agencies), pest control companies, and private individuals are not normally approved to purchase the cannon/rocket net charges. The capture of Semipalmated Plovers using cannon/rocket nets will likely be done in conjunction with USFWS or another regulatory agency.

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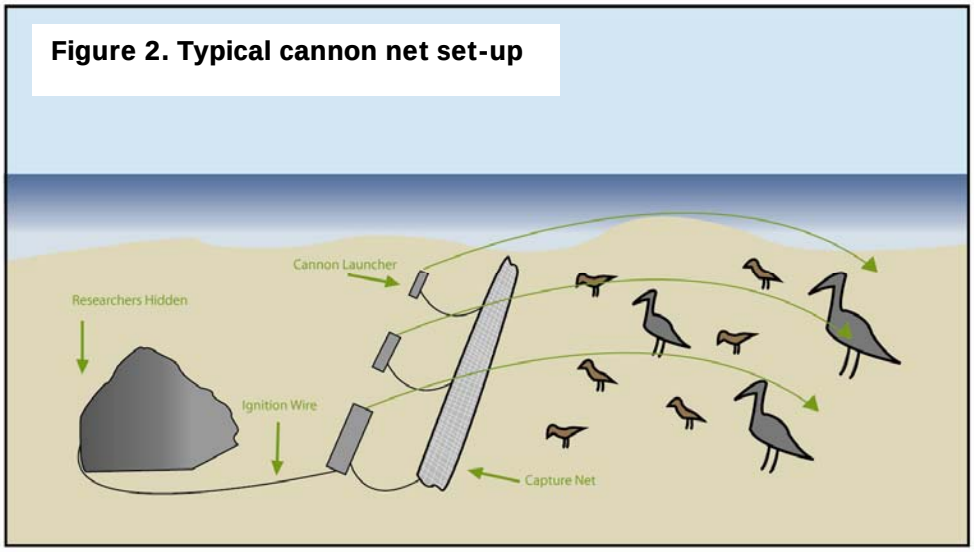
As cannon nets can be set at more exact angles and are considered safer, cannon nets will be the preferred option for capturing Semipalmated Plovers. The typical cannon net methodology as outlined by Gratto-Trevor (2004) is presented below.

Figure 2. Typical cannon net set-up



An appropriate site for cannon netting will be selected based on initial reconnaissance and agency consultation. The ideal site will have a large concentration of Semipalmated Plovers, adequate cover for the netting team to hide, and minimal public presence. The area will be cleared of large debris that could potentially snag the net or prevent it from landing flat on the ground.

The cannon net system typically consists of cannons that contain explosives and a net that has been fitted with projectiles attached to the leading edge of the net. The cannon net is initially tethered to the ground along its rear edge. The net will be furled along the tethered edge and the cannons are placed at an appropriate angle near the furled net. When the cannons are fired, the projectiles attached to the lead edge of the net shoot out to open the net (Figure 2). The cannons are attached to a battery-operated firing box, or they may be fired remotely with a radio system.

To minimize injury or death to birds, the net will not be fired if birds are on top of the furled net or in the air in front of the net before it is fired. Cannons will be set at appropriate angles to fire the net over the roosting birds (not through them), but not so high that the birds can escape before the net settles. The net will be initially test-fired to determine the full extent of the net. Nets, cannons and projectiles will be regularly checked for wear and maintained properly for safety. The cannon charges will be tested to ensure they are sufficient enough to open the net, but not so strong that they pull the tethered edge of the net from the ground.

After the net has been fired, a layer of burlap will be placed over the net to help keep birds calm until they are removed. Birds will be removed from under the leading edge of the net. Measures

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will be taken to ensure that the number of available personnel will be sufficient to remove and process birds in a timely manner.

Bird Tagging

Birds will be pulled from the trap or net by hand using the bander's grip (upright, with the bird's head between the bander's index and middle finger). One of two possible attachment methods will be selected; either the transmitter will be glued on to the back of the bird or it will be glued to a leg band attached to the bird. Based on consultation with other researchers, the leg band will likely be used.

Glue-on Back

Using the glue-on back method, feathers on the back will first be clipped or trimmed as necessary to create a suitable area for transmitter attachment. The radio transmitter will then be glued to the back of the bird using an epoxy designed for seabirds (one example is from Titan Corporation, Lynnwood, Washington, USA) (Figure 3). Attaching transmitters is a two-person job (Warnock and Warnock 1993). One person will hold the bird in the left hand with the head between the second and third fingers, and the wings between the first and second fingers and third and fourth fingers, leaving the right hand free for clipping. Scissors will be used to clip a 10 mm length of the posterior element of the dorsal feather tract, about 5 mm above the uropygial gland. The second person will mix the epoxy for 1.5 minutes and then apply the epoxy to the bird and radio tag. Epoxy is placed on the cleared area on the bird's back with a flat toothpick. Epoxy will also be applied to a radio tag after it has been scored with sandpaper. The tag will be held in place for approximately one minute until a firm bond is set.

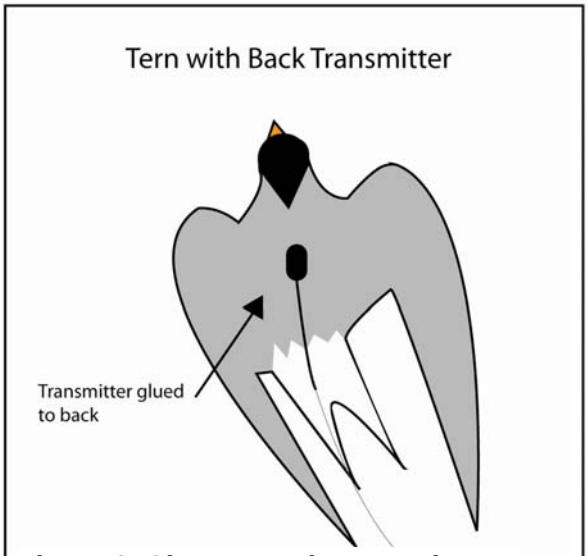
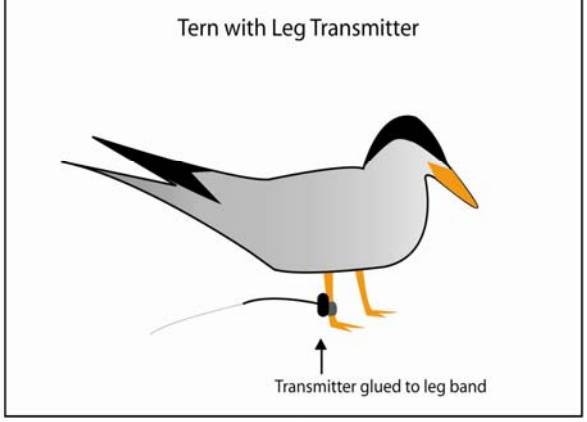


Figure 3. Glue-on Back Transmitter

Leg Band

If chosen, it is anticipated that bird bands will be obtained in coordination with USGS from the Patuxent Wildlife Research Center. The bands come in various sizes and are inscribed with a unique eight or nine digit number. Common Terns will be banded with size 2 bands, while Semipalmated plovers will be banded with size

Figure 4. Leg Band Transmitter



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1A or 1B bands. The butt-end band, a round band with two edges that butt evenly together when closed correctly, is the type of band that will be used. The band will be made of a hard metal, typically stainless steel, monel or incoloy, which will last longer in the salt-water environment than standard aluminum bands.

Bands will be attached using the following methods as outlined in the *North American Bird Banding Manual* (Gustafson et al. 1997). The band will be placed on the tarsus and, when closed, should be free enough to move up and down without abrasively rubbing either round or elliptical tarsi. Closed butt-end bands, lock-on, and any other closed bands will be opened before being placed on the bird's tarsus. When placed on the tarsus, the ends of the closed band should meet tightly and squarely. Special banding pliers will be used to close bands tightly. Care will be taken that the band numbers are not marred in the process of closing the band. Care will be taken to ensure that the ends of the band do not overlap. The right band size gives a proper fit when it is closed with butt-ends meeting tightly. Lock-on bands can be squeezed shut with the fingers and the flange folded over with a pair of pliers.

As wear on the band will likely occur along the bottom edge where the band number normally would rest, the band may be applied upside down on the bird's foot. This will place the band numbers farther from the wearing edge.

Using the leg band method, the radio transmitter will be fused directly to the leg band using epoxy prior to the leg band being attached to the bird's leg (Figure 4). The epoxy is mixed for 1.5 minutes and then applied to the leg band and radio tag after it has been scored with sandpaper. This method may be preferred over gluing transmitters to a bird's back based on correspondence and recommendations from other tern researchers (Rock, J.C., 2009 and Black A. 2009).

Radio Tags

Following research into radio tag manufacturers, availability and applicability to species, the following recommendations are made. Plovers will be tagged with the Advanced Telemetry Systems (ATS) A2430 tag and terns with the A2470 tag (or equivalent) based on weight and battery life given a pulse rate of 55 ppm (Table 1). Specifications on these ATS tags are provided in Table 1 below.

Table 1. Proposed Radio Tags for Radio Telemetry Study

Radio Tag	Producer	Target Species	Tag Weight	Attachment Method*	Battery Life	Pulse Rate
A2430	ATS	Plover	1.7 grams	Glue-On	40 days	55 ppm
A2470	ATS	Tern	3.1 grams	Glue-On	110 days	55 ppm

*Other attachment methods available include harnesses and leg bands.

Tagged birds will be located in the field using the R4500S receiver available from ATS, which functions as a datalogger and Global Positioning System (GPS) unit and toggles between tracking antennas. The R4500S receiver will record the time and signal strength of each transmitter

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located. The data is later downloaded and converted into an Excel spreadsheet for post-processing.

A 3-Element folding Yagi antennae will be used to track radio tag signals during the survey. This is the standard antenna used in other telemetry studies reviewed. Two antennas will be needed, one to attach to each wing strut on either side of the airplane. The antennas will be attached using standard kits available from ATS.

Aerial Survey Methods

Radio telemetry tracking will be conducted by air using a high-winged aircraft such as a Cessna 172, Cessna 182, Cessna Super Cub or a Cessna Skymaster. Tracking involves flying at low altitudes and low speeds which is not typical of normal aircraft flight.

An aircraft will be chartered and take off from the Barnstable Municipal Airport on Cape Cod, Massachusetts. The aircraft will fly along predetermined transects. Because Common Terns and Semipalmated Plovers are expected to be found in different shore areas, the flight plan will depend on the species being tracked. The route for Common Terns will cover Buzzards Bay as well as the project area over Horseshoe Shoal (Figure 5). Depending on where the Semipalmated Plovers are captured, the plan routes will likely focus on the southern side of Cape Cod and Nantucket Sound (Figure 6). The airplane will immediately begin searching for tagged birds upon reaching the initial survey starting points (Figures 5 and 6). The starting points will alternate between two locations. For terns, the end points are at Buttermillk Bay and near Horseshoe Shoal. The end points of the plover survey are within Nantucket Sound. The tracking method will depend on the success of locating tag birds and their location.

As described in Gilmer et al. (1981) and implemented by Ackerman et al. (2009) and Rock et al. (2007), basic aerial survey methods are the following.

1. Receiver operator will begin the search with the switchbox set to "both" right-wing and left-wing antenna to cover both sides of the aircraft.
2. At start, the RF gain (adjustment for receiver sensitivity) will be set to the maximum setting.
3. Aircraft altitude should be low, between 150 to 300 meters and follow set transects (Figures 5 and 6).
4. Operator will scan through various transmitter frequencies until a steady signal is received.
5. After receiving signal, the receiver operator will switch the switchbox between the left and right signal to determine which side the signal is coming from.
6. The aircraft will then be directed to fly in the direction of the signal (to the right or left) and the switchbox is set back to the "both" setting. Flying straight towards the signal will cause a signal null (see number 7 below).
7. As the aircraft gets closer to the transmitter, the signal strength will increase again and at this point the operator can begin to pinpoint the location of the bird.

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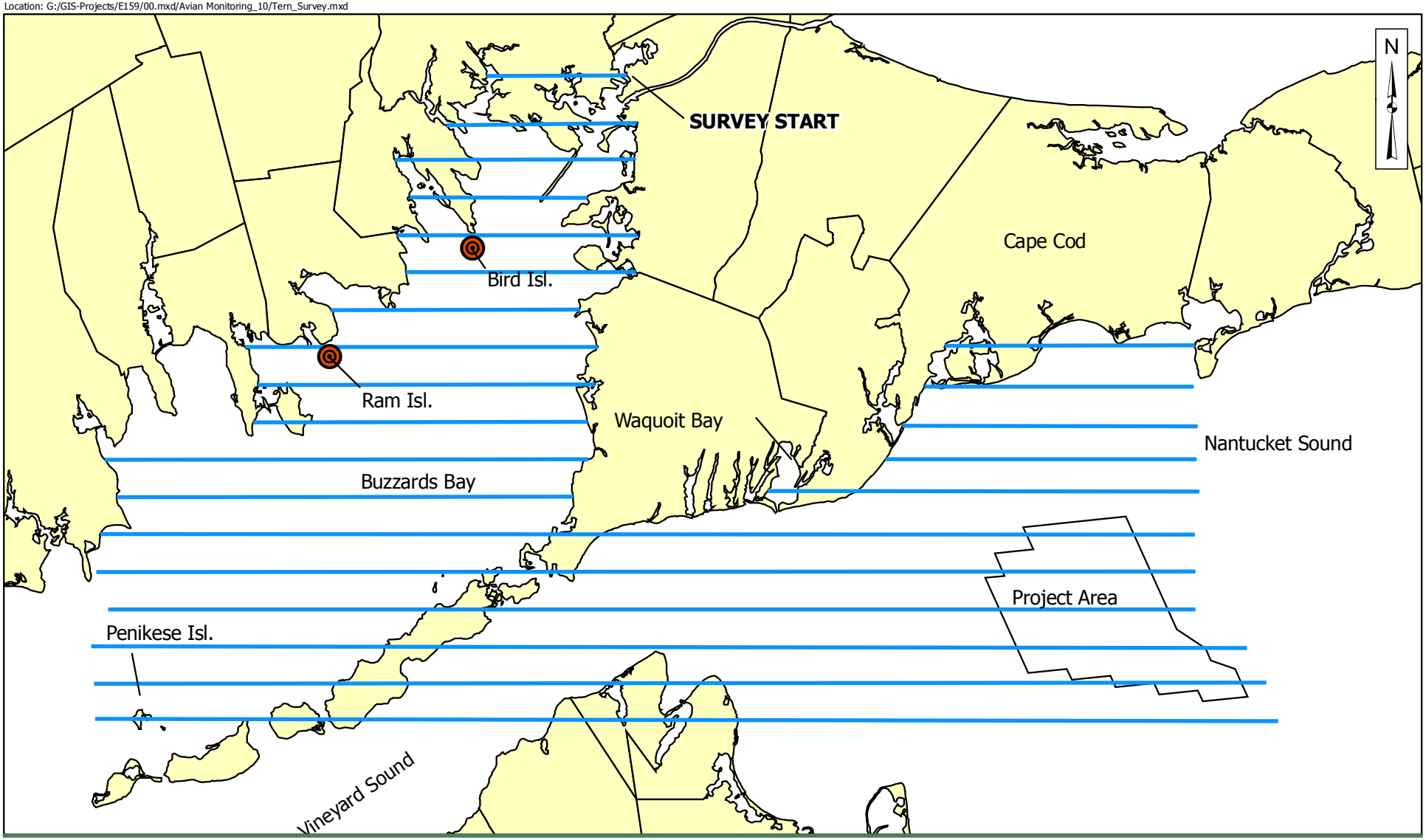

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Cape Wind Project
Nantucket Sound, Massachusetts

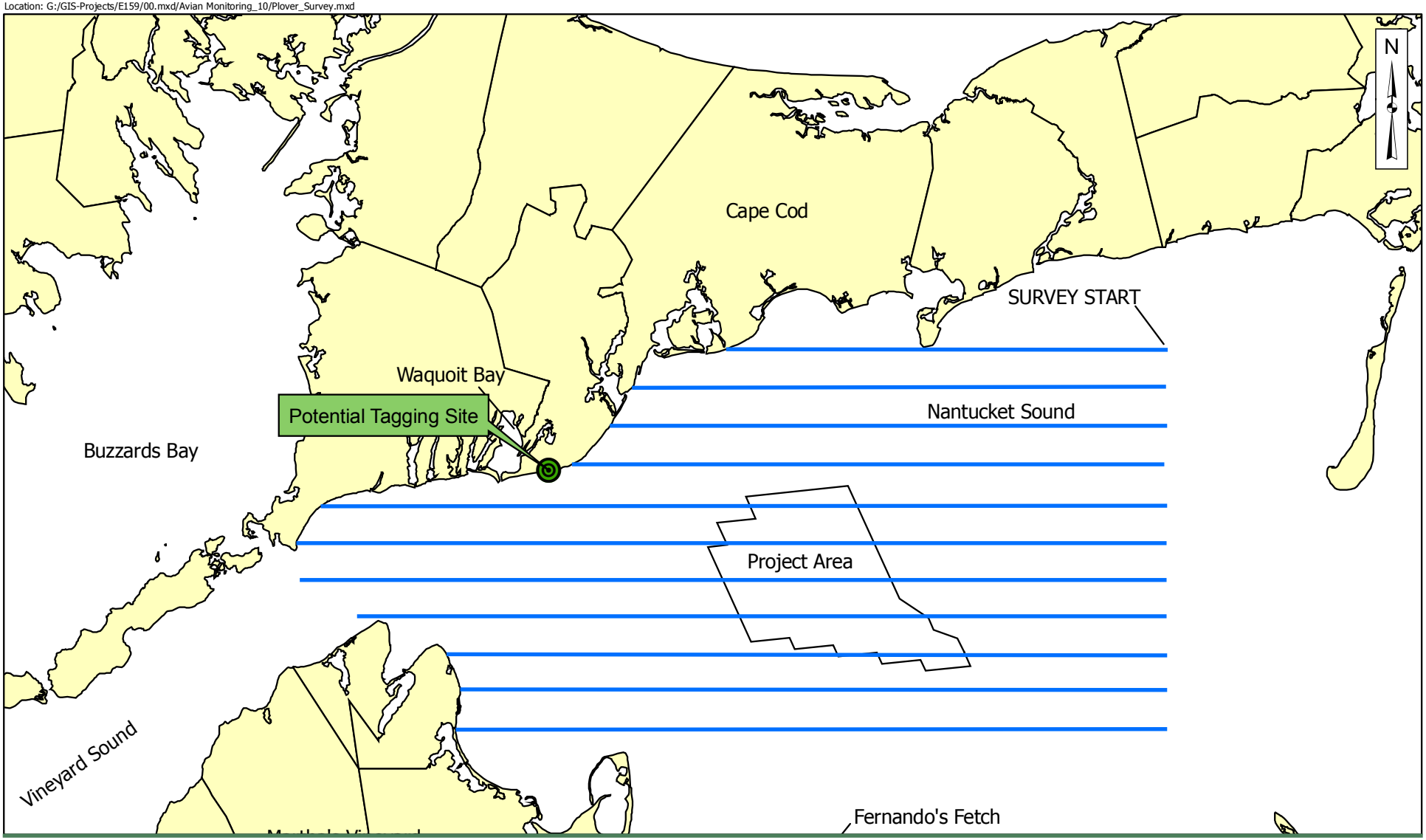
Scale: 1" = 24,000'
0 4 Kilometers

Transect Spacing: 1' latitude = 1.2 miles
Transect Total Length: 380 miles (not including turns)
Survey Area: 540 square miles
Ram Island to Project Area: >22 miles/35 km

Tern Radio Tracking Aerial Transects

Figure 5

Location: G:/GIS-Projects/E159/00.mxd/Avian Monitoring_10/Plover_Survey.mxd



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Nantucket Sound, Massachusetts

Scale: 1" = 24,000'
0 4 Kilometers

Transect Spacing: 1' latitude = 1.2 miles
Transect Total Length: 245 miles (not including turns)
Survey Area: 281 square miles
Waquoit Bay to Project Area: 6 miles/9.5 kilometers

Plover Radio Tracking Aerial Transects

Figure 6

8. The receiver operator will again toggle between right and left switches to determine on which side of the airplane the bird is located. The RF setting may need to be turned down at this point since the target is closer and louder.
9. Based on which side is stronger, the pilot will be directed to make a 360-degree turn. If the signal strength remains consistently strong on the same side, then the target bird is located within the radius of the airplane's 360-degree turn.
10. Circling and toggling between left and right switches will continue until the bird is located.
11. After the bird is located, the airplane will return to flying along the transects (Figures 5 and 6).

The flight plan may vary on the success of locating tagged birds and their location. If all tagged birds are located in one area, following transects away from the birds is not necessary. Tracking would then focus on the located birds.

Surveys will last for a maximum of four hours because of operator fatigue and available fuel. Depending on the number of birds tracked and the distance they are followed, it may not be possible to fly each transect during the survey. Flight plans may need adjustment based on tagged bird locations and movements.

Methods to Assess Sufficiency of Negative Data

Prior to initiating the study, CWA will conduct a trial survey to assess the range and detectability of the radio tags in an offshore environment. Tags will be placed in known locations and a field team will test the range of the radio tag signal by scanning for its frequency at varying distances from an airplane. The results of the study will help guide future radio tracking efforts.

2.1.2 Reporting

The data collected during the telemetry surveys will be downloaded from the receiver and imported into Excel for further processing using the basic software package ATSWinrec available from ATS. During the survey, the receiver will be set to the aerial mode. The following data is collected when in aerial mode.

- Year, month, hour, minute, second (in separate fields within the excel spreadsheet)
- Transmitter frequency
- Signal strength
- Number of pulses received during the recorded scan
- Pulse rate of detected transmitter
- Number of valid pulses during scan
- Calculated measurement from variable rate transmitters
- X and Y coordinates if GPS is used (this will be X & Y of airplane)

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- How long ago GPS position was taken in seconds

This raw data will then be uploaded into Ranges software (or other similar software) for further processing. The GPS coordinates of bird sightings will be loaded into the software so habitat maps, ranges and other analyses can be completed. The final product will include polygon overlays of tern and plover use of Nantucket Sound and the surrounding area based on the telemetry surveys. The geographic information systems extension tool, Animal Movement, may also be used to analyze results. Data will be presented to show concentric circles around 95% of observations, 75% of observations and 50% of observations (See Figure 2 in Rock et al. 2007). The 50% density circle will show the greatest concentration of tern foraging and plover locations.

The results will be summarized in a report that provides recommendations for subsequent studies. The report will be submitted to the BOEM and the USFWS at the end of the pre-construction study.

2.2 Avian Acoustic Monitoring

The objective of the avian acoustic monitoring program is to determine whether and how often the target bird species cross a given section of the project area. Bird calls can be recorded and analyzed to determine species occurrence. The limitations of acoustic monitoring include the relatively small portion of the overall project area that will be within the range of the microphones and the bias of the recording unit to collect calls from louder and lower-flying birds. As of May 2010, there has been very little offshore testing of Autonomous Recording Units (ARUs) and there is only one known published study that presents results of ARU use in an offshore environment (Farnsworth 2010).

2.2.1 Methods and Schedule

The acoustic monitoring system will be developed in consultation with Andrew Farnsworth, PhD, of the Cornell Lab of Ornithology or another avian acoustic expert. At the MET tower, the acoustic monitoring program will run from May through October and weather permitting, during at least three 24-hour intervals per month from November to April. An array (2) of Autonomous Recording Units (ARUs) will be set up on the MET tower prior to construction. Each ARU consists of a microphone, amplifier, frequency filter, programmable computer, software that schedules, records, and stores the data, and a disk drive to store the data. Each ARU microphone will be covered with a wind screen to reduce ambient background noise and the ARU will be placed in a flower pot on the deck of the MET tower. It may be possible to arrange the array of ARUs to estimate the elevation of the bird when the call is made. It is assumed that the ARUs will be able to be placed on the MET tower at a height above the ambient background noise of waves. The height of the MET tower deck is 10 meters above mean low low water (elevation 0.0 NAD 83). The range of the ARUs is uncertain, but with the microphones positioned at 10-20 meters above the water on the deck of the MET tower, the expected range is several hundred meters. The ARUs can run for up to 70 days off D-cells or 12-volt batteries. The ARUs will be retrieved at the end of the study period and the data will be downloaded.

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One ARU will be placed in a Roseate Tern breeding area and one ARU will be placed near a Piping Plover breeding area. The data will be used to verify the effectiveness of acoustic microphones for detection of these species and discrimination among tern and shorebird species.

Methods to Assess Sufficiency of Negative Data

Methods to assess the sufficiency of negative data were developed in consultation with Dr. Andrew Farnsworth. An initial noise survey using a calibrated noise meter will be conducted on the MET tower. The noise survey will be conducted under a variety of conditions and will be used to assess the ambient background noise level. The survey results will be analyzed to determine those frequencies that will be difficult to detect using the ARU, given the ambient background noise levels. Following the initial noise assessment, the ARU range and capabilities will be tested using bird call playback units. Bird calls will be played from varying distances from a playback unit mounted on boat and an ARU mounted on a boat or the MET tower. It should be possible to collect useful data on the ARU range and effectiveness with this initial upfront noise survey and bird call playback (Farnsworth 2010). The results of the trial tests will be used to develop and deploy an ARU system that rejects as much noise from the ocean surface as possible.

2.2.2 Reporting

Acoustic recordings will be analyzed using a software package (Raven) available from the Cornell Lab of Ornithology. The analysis will be used to identify species, relative frequency of occurrence and altitude if possible. The results will be summarized in a report that provides recommendations for subsequent studies. The report will be submitted to the BOEM and the USFWS at the end of the pre-construction study.

2.3 Anti-perching Monitoring

The objective of anti-perching monitoring is to evaluate the effectiveness of various bird perching deterrents that will be field-tested on the MET tower prior to the construction of the wind park. These deterrents include a fence to prevent access from the side, a stainless wire on top of the railing and a 0.65-meter-tall panel to restrict visibility of any avian species from the deck. Bird behavior around the deterrents will be analyzed to determine the most effective anti-perching technique and will guide selection of the anti-perching deterrents that will be used on the wind turbine monopoles following construction.

2.3.1 Methods and Schedule

The ABMP calls for monitoring of the anti-perching devices on the MET tower with remote video cameras for a length of time that provides sufficient data on anti-perching. We propose monitoring anti-perching devices from April to September when Roseate Terns are known to be present in Nantucket Sound. A camera produced by SeeMore Wildlife Systems that is suitable for use in an offshore environment will be set up on the MET tower. The video camera will be equipped with a trigger mechanism to limit the amount of data that will need to be reviewed and processed.

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If possible data collected from the camera will be relayed by antennae to a remote station that will be set up on the mainland. An appropriate remote station location will be selected in consultation with SeeMore Wildlife Systems. Finding a site at a relatively high elevation is the key element in identifying an inland location as the remote station needs a clear line of sight to the MET tower. From the remote station, the images/data will be uploaded to an FTP site or e-mailed.

Methods to Assess Sufficiency of Negative Data

Prior to initiating the study, several trial tests will be run with the camera to establish appropriate settings for the triggering software. This will minimize the number of false positives collected during the actual study. The camera will be field tested to ensure that it captures bird movements within a given direction and distance of the MET tower.

2.3.2 Reporting

The observations recorded by the camera will be analyzed to determine whether birds displayed avoidance behavior around the anti-perching deterrents. CWA anticipates that after data has been collected, avian experts will characterize whether a recorded observation shows a bird displaying attraction behavior. Any bird that lands on either the MET tower or one of the anti-perching devices will be considered to be displaying "attraction" behavior. The results will be summarized in a report that provides recommendations for subsequent studies or alterations to anti-perching devices. The report will be submitted to the BOEM and the USFWS at the end of the pre-construction study.

2.4 Bat Surveys

The purpose of the bat surveys is to assess the functionality of bat detection equipment in the marine environment and further characterize bat use of Nantucket Sound. There are no known bat migration corridors through the proposed wind park and bat movement across Nantucket Sound is expected to be sporadic (MMS 2009). Data gathered from the bat surveys will be used to further assess whether bats pass over Nantucket Sound.

2.4.1 Methods and Schedule

Pre-construction equipment testing and bat surveys will be conducted from April to October to determine whether bats are present in the project area. A passive bat monitoring station will be set up on the MET tower using an AnaBat SD2 Bat Detector available from Titley Electronics. The detector is hooked up to a microphone. The detector will be set up on the MET tower platform and connected to the microphone via electrical cable. The microphone will be placed within a waterproof casing ("bat-hat"). The power source for the detectors will likely be solar.

Equipment used for the bat monitoring will be obtained primarily from Titley Electronics and includes the following.

- AnaBat™ SD2 Bat detector

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- CF card/s: up to 4 GB cards may be used
- CF card reader
- Microphone: three choices available, Green (Hi), Black (Low) or White (Lo). See more on microphone choices below.
- USB to Serial adaptor
- Chirper: used to confirm that the Anabat Detector is logging calls.
- Power options: the detector will be run via a solar panel.
- GML1 remote download: enables the user to check the detector daily, verify and change settings, and download data through a secure server.
- Microphone would be installed in a bat hat (available from EME Systems) to protect from weather and provide waterproofing.

Microphones

The Hi (green) microphones available from Titley Electronics will be used on the MET tower. The Hi (green) microphone is designed to be used with extension cables. It is designed to drive the bat call data down a cable without loss of frequency response. The other potential microphone option is the Lo (white) microphone, which is designed for increased sensitivity to bats echolocating under 20kHz, while still having good sensitivity to bats calling in other frequency ranges. While the Lo Microphone is specially designed for its enhanced sensitivity to low frequency bats, it is also much more affected by background noise than the other microphones. Thus, the Lo microphone will most likely not be used on the MET tower in the offshore environment.

Data Analysis

The data stored on the SD2 AnaBat detector will be downloaded remotely each night if there is suitable general packet radio service cellular phone network coverage in the area around the MET tower. AT&T may provide coverage over the project area; further investigation is required to ensure coverage.

Assuming some form of remote download is possible, the data will be downloaded periodically to the GetMyLog website. The GetMyLog website is a dedicated site that will be used to connect directly to the detector, verify its status, change recording settings, and upload data. With the SD2 AnaBat detector, the system will be used to gauge battery power and change settings such as division ratio, sensitivity setting, and record start and end times.

CWA will use some of the assumptions of Gannon et al. (2003) and Hayes (2000) and Sherwin et al. (2000), as cited in Arnett et al. 2007, when analyzing bat calls. A bat pass will be considered a sequence of echolocation calls consisting of two or more individual calls (Gannon et al. 2003 and Thomas 1988, O'Farrell and Gannon 1999, as cited in Arnett et al. 2007). Bat passes will be treated as discrete, independent, events. We will assume that species consistently call at either

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high or low frequencies and that 35 kHz (average minimum call frequency) can be used as a threshold to accurately separate these species into two groups. Finally, we will assume that the number of bat passes is a valid reflection of bat activity in the area.

Methods to Assess Sufficiency of Negative Data

Prior to deployment, the AnaBat detector will be calibrated and field tested to ensure it is working properly. In addition, pre-recorded bat calls will be played from a boat at varying distances from the AnaBat detector on the MET tower to assess its range over the open ocean. The AnaBat chirper, available from Titley Electronics, will be used to confirm that the detector is logging calls properly.

2.4.2 Reporting

AnaLookW software will be used to manage, view and measure bat call data after it is downloaded from the AnaBat Detector. The data will be processed to identify species, bat presence/absence and bat abundance. The results will be summarized in a report that provides recommendations for subsequent studies. The report will be submitted to the BOEM and the USFWS at the end of the pre-construction study.

3.0 CONSTRUCTION MONITORING PROTOCOLS

Building upon information obtained during the pre-construction survey activities presented above in Section 2.0, monitoring will continue during the construction period. Passive monitoring will continue from equipment deployed on the MET tower while the balance of structures (wind turbines and ESP) that will be utilized in post-construction monitoring are constructed. Autonomous Recording Units (ARUs) will continue to gather data on avian acoustic signatures, the video camera will continue to monitor the effectiveness of the anti-perching devices deployed on the MET tower, and the AnaBat will continue to monitor for evidence of bat activity. The results of the passive monitoring during construction will be submitted to BOEM.

4.0 POST-CONSTRUCTION MONITORING PROTOCOLS

The post-construction monitoring protocols consist of five primary components: anti-perching monitoring, abundance and spatial distribution surveys, avian acoustic monitoring, radio telemetry, and the installation of Thermal Animal Detection Systems (TADS). These components may be modified or revised based on the results of the pre-construction monitoring program. The goal of the post-construction monitoring program is to document movements and locations of avian species in Nantucket Sound and determine how the wind park may be impacting the distribution of birds in the project area. Studies will again focus on the Roseate Tern and Piping Plover. Three years of data will be collected, analyzed and reported after the completion of construction activities.

4.1 Anti-perching Monitoring

The objective of the post-construction, anti-perching monitoring is to evaluate the effectiveness of additional anti-perching devices that will be installed on wind turbine platforms and the Electric Service Platform (ESP).

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4.1.1 Methods and Schedule

Following construction, two video cameras will be placed on the ESP and two turbine monopoles (suggested WTGs A4 and I0) to monitor the effectiveness of the anti-perching deterrents. The camera on the MET tower will remain. Assuming the camera system used during the pre-construction monitoring were sufficient, the same camera system available from SeeMore Wildlife Systems will be used. The ABMP Framework calls for six cameras on six monopoles. The purpose of the cameras is to measure the effectiveness of anti-perching devices. Since the ESP provides more potential perching areas than turbine monopoles, two cameras will be used on the ESP. Given the high per camera system cost, installation and attendant labor effort, we believe that monitoring the effectiveness of the anti-perching devices on two turbines is adequate to determine the effectiveness of the methodology.

Biologists will be deployed to the ESP and select turbines to monitor avoidance or attraction around perching deterrents. The biologists will be deployed during the breeding season from mid-May to late July and the staging season from mid-August to late September to observe tern behavior around the ESP and adjacent turbines. Observers will collect 32 hours of observations (staggered during day light hours) in field journals and photo document birds where possible.

4.1.2 Reporting

The results of the anti-perching monitoring will be summarized based on observations of bird behavior near the anti-perching devices. The results of monitoring on the ESP and turbines will initially be submitted to BOEM in bimonthly reports during the first year of project operation. The frequency of reporting will then change to annually unless BOEM determines that the data indicate a need for more frequent reporting.

4.2 Abundance and Spatial Distribution Surveys

The objective of the abundance and spatial distribution surveys is to document any changes in relative abundance and distribution of avian species within Nantucket Sound following construction.

4.2.1 Methods and Schedule

Surveys will be conducted by air using the same methods that were used to collect data on avian species during the preparation of the National Environmental Policy Act and the Massachusetts Environmental Policy Act review process. This will allow for statistical comparison with pre-construction avian surveys.

CWA will fly five (5) aerial surveys from May to late July (tern breeding period), four (4) surveys during the tern fall staging period from mid-August to late September, and ten (10) surveys during the winter (mid-October to mid-April) to monitor sea ducks and waterbirds for an annual (4 seasons) total of 19 aerial surveys.

The flight plan for winter sea ducks and waterbirds is illustrated in Figure 7. The flight plan during the tern breeding and staging period will shift to include a transect near Monomoy Island (Figure 8) as was done in the Mass Audubon surveys (Perkins et al. 2003, Perkins et al. 2004ab).

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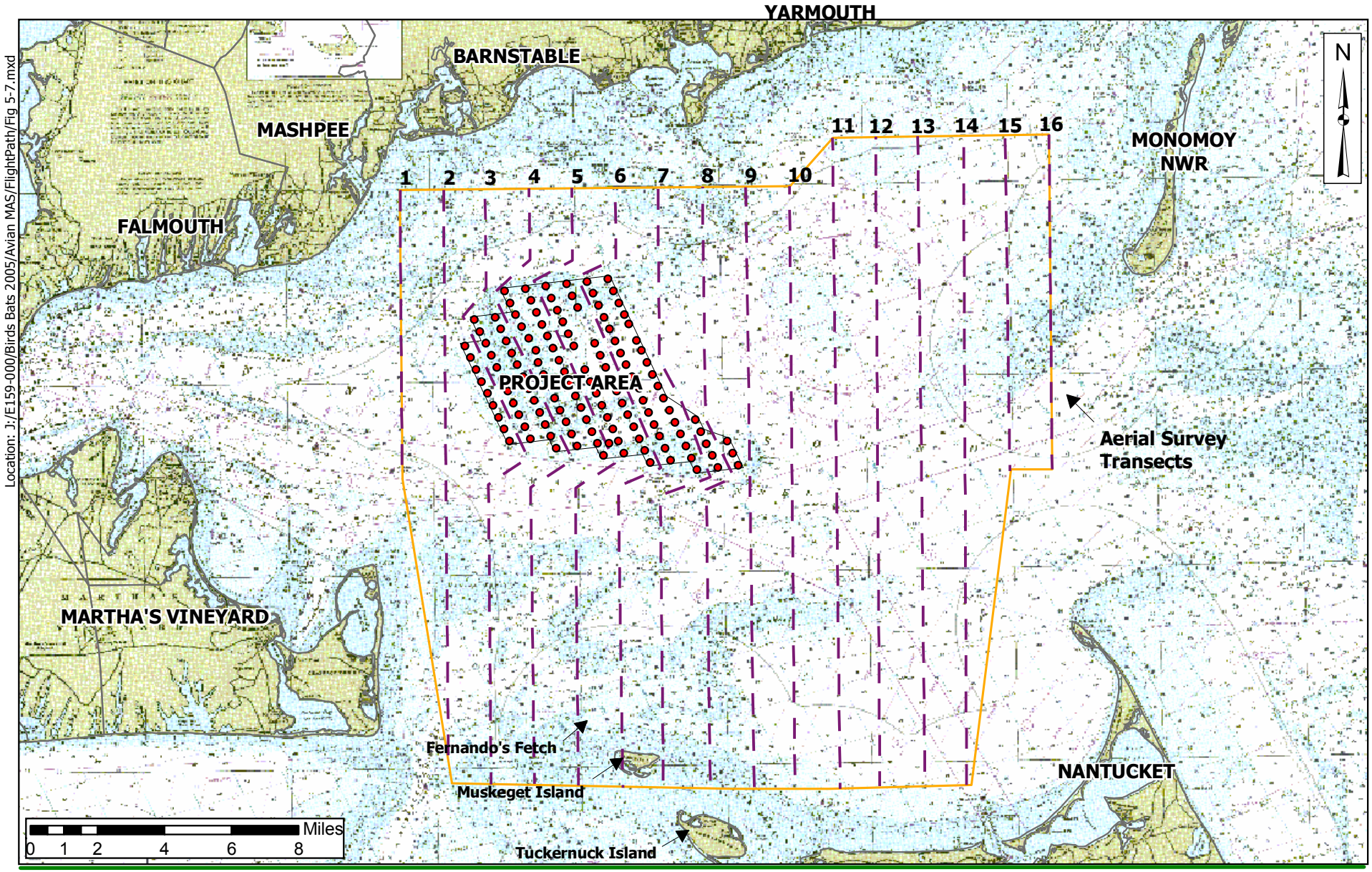

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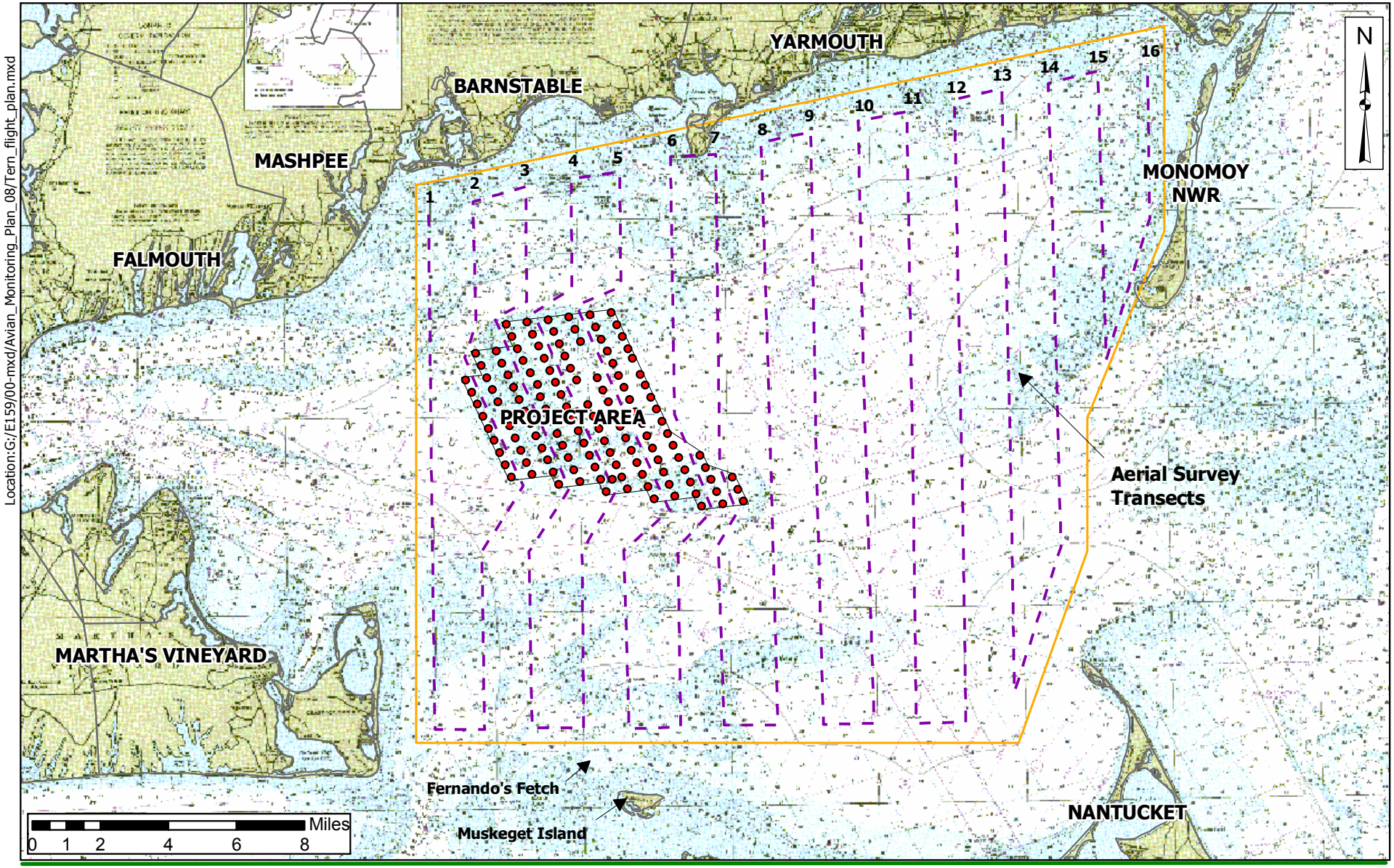
CAPE WIND AVIAN MONITORING PLAN
Nantucket Sound, Massachusetts

Scale: 1:260,000
Source: 1) NOAA Chart #13229 2) ESS, Approximate Site Boundary

Legend:
- Survey Transects
- Study Area Boundary
- Project Area

Flight Plan for Winter Sea Ducks and Waterbirds

Figure 7



Location:G:/E159/00-mxd/Avian_Monitoring_Plan_08/Tern_flight_plan.mxd

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CAPE WIND AVIAN MONITORING PLAN
Nantucket Sound, Massachusetts

Legend:
- Survey Transects
- Study Area Boundary
- Project Area

Flight Plan for Tern Breeding and Staging Period

Scale: 1:260,000
Source: 1) NOAA Chart #13229 2) ESS, Approximate Site Boundary

Figure 8

CWA will fly surveys at an altitude of 76 meters (250 feet), which was chosen as the lowest possible altitude in order to observe individuals clearly down to sea level with minimal disturbance to bird behavior. This flight height will be confirmed to be safe by a professional research flight pilot prior to the start of surveys. The surveys will be flown in a float plane (or equivalent) which will maintain an air speed of approximately 90 knots, or the slowest speed the aircraft can safely fly. The 76-meter altitude corresponds approximately to the rotor hub height (80.5 meters) of the proposed wind turbines. The flight lines will be slightly adjusted from pre-construction flight paths so that they are between turbine strings. Any proposed changes to the flight height or air speed resulting from safety concerns of a professional research pilot will be resolved between CWA, BOEM and USFWS prior to the start of surveys. Consultation with FAA will occur if deemed necessary.

Birds will be counted and identified along 16 transects spaced approximately 2,286 meters (7,500 feet) apart. Surveys will be flown at different times of the day, at different tides, and in somewhat varying weather conditions, but only when visibility is either good or excellent to ensure that birds can be seen. No observations will be made when sea states are greater than three (wave heights 0.5 to 1.5 meters) to ensure birds on the water can be seen. Flights will not take place during inclement weather when the safety of the pilot and survey crew would be compromised.

The survey team will consist of the pilot, a data recorder, and two observers. The pilot will maintain the airplane on transect, at the correct altitude and speed, and at the proper wing level altitude. Two observers will be seated on either side of the airplane. An aluminum rod will be attached perpendicular to the wing strut on each side of the airplane to delineate the transect boundaries. A clinometer will be used to measure the calculated angle for the placement of these aluminum rods. The distances between the airplane's float and the aluminum rods will be verified initially by flying over the airport at 76 meters (250 feet) using pre-measured 200-meter (656-foot) markers on the ground. The area visible between the float on the airplane and the aluminum rod will provide each observer with a 200-meter (656-foot) transect width within which all birds shall be counted. The observers will not be able to see the area directly below the airplane.

The data recorder and observers will maintain direct communication using aviation headsets. The observers will identify species, number of species, activity of bird (i.e., foraging or flying), and time of sighting. The data recorder will be responsible for entering the data identified by the observers and record a GPS point of the location at the beginning and end of each transect in addition to a GPS point every minute during each transect. Each observer's sightings shall be independently recorded on an audiotape linked directly to each headset.

4.2.2 Reporting

Results of the surveys will be transferred to a geographic information systems map to show abundance and spatial distribution of key bird species during specific times of year (tern breeding season, tern fall staging, winter sea ducks, and winter waterbirds). Sea duck species include Common Eider, Long-tailed Duck, Surf Scoter, Black Scoter, and White-winged Scoter. Winter

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waterbird species include loons, grebe, Northern Gannet, American Black Duck, American Goldeneye, mergansers, alcids, dovekie, and Razorbill. The results of the post-construction monitoring survey will be compared with pre-construction aerial surveys. The results of the aerial surveys will be submitted to BOEM in an annual report for each year of post-construction monitoring.

4.3 Avian Acoustic Monitoring

The objective of the post-construction avian acoustic monitoring is to record calls of the target species Roseate Tern and Piping Plover and determine whether there is any change in their distribution in the project area during the operation of the wind park. The post-construction monitoring program may require modifications based on the results of pre-construction monitoring based on recording effectiveness.

4.3.1 Methods and Schedule

Acoustic microphones will be placed on ten monopoles and ESP if pre-construction monitoring is effective. One microphone would be placed on each of the four corners of the project area (WTGs A4, I0, K16, A12), one in the approximate middle of the western and northern sides (WTGs A8, F0), and four placed at random in the interior of the project array (WTGs D5, H4, D10, H12). These would record flight calls of birds over the project 24 hours a day, seven days a week, from May through October and during three 24-hour intervals per month from November through April, weather permitting, to determine bird presence or absence in the airspace in and around the project site. The power source (batteries) would likely need replacement three times during this period or the recorders may run off of the turbines.

4.3.2 Reporting

Acoustic recordings will be analyzed using a software package available from the Cornell Lab of Ornithology. The analysis will be used to identify species, relative frequency of occurrence, and altitude if possible. The results of the acoustic monitoring will be submitted to BOEM annually for each year of post-construction monitoring.

4.4 Radio Tracking

Post-construction radio tracking will be used to document movements and locations of Roseate Terns and Piping Plovers over Nantucket Sound and the proposed project area.

4.4.1 Methods and Schedule

Assuming the pre-construction radio tracking of Common Terns and Semipalmated Plovers is effective and safe for the birds, radio transmitters will be attached to adult Roseate Terns and adult Piping Plovers using the similar methods as pre-construction radio tracking. The final number of birds to be sampled needs to be determined. The originally suggested numbers of 25 of each species may, upon further consideration, be a larger sampling than necessary and not warrant the additional risk to the species. It is suggested that a smaller sampling, possibly 8-12 of each species, is an appropriate and operationally more manageable survey size. Piping Plovers

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would be trapped on nests in consultation with USFWS and Massachusetts Natural Heritage and Endangered Species Program. It is assumed that Roseate Terns would be trapped on nests on Bird Island or Ram Island. The birds will again be tracked by airplane using the same methods as pre-construction monitoring.

Post-construction radio tracking will also include the use of a passive monitoring station. A receiver will be set up on the ESP and set to scan through the various radio tag frequencies over a longer period of time. The receiver will be connected to a power source available on the ESP. This set-up will use an omni-directional dipole antenna instead of a Yagi antenna. Because the receiver functions as a datalogger, data will be downloaded and analyzed after retrieval. The passive monitoring station will be used to collect presence/absence data rather than determining actual foraging locations.

4.4.2 Reporting

The results of the radio tracking survey will be analyzed using the same methods and software that was used during the pre-construction survey. The results will be summarized in a report that also provides recommendations for subsequent studies and/or study revisions. The report will be submitted to BOEM and USFWS on an annual basis for each year of post-construction monitoring.

4.5 Thermal Animal Detection Systems (TADS)

The objective of the TADS study is to collect data that can be used to quantify avian collision risk at the wind park. The TADS is a thermal imaging camera system that can be used to record bird or bat collisions with wind turbine blades. The cameras are capable of recording collisions at night and during foggy conditions which is not possible with conventional cameras.

4.5.1 Methods and Schedule

The ABMP calls for the installation of TADS on wind turbines post construction to record any collisions. The TADS will remain in place for a minimum of three years. TADS will be set up on two different turbines. A TADS will be placed on a turbine on the eastern perimeter (WTG I8) of the wind park, and the northern perimeter (WTG F0) of the wind park.

Cameras will be configured to cover as much of the rotor-swept-zone as practicable. The coverage will depend on the lens of the camera. A lens with a wider field of view has a shorter range than a lens with a narrower field of view.

Methods to Assess Sufficiency of Negative Data

The TADS monitoring program will be limited by several factors. The existing modeling has demonstrated that because collision risk of terns has been estimated to be so low, the probability of detecting a collision is very low. The cameras used in the TADS will not be able to cover the entire rotor-swept-zone. These factors will need to be taken into consideration when evaluating the results of the TADS study.

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Prior to initiating data collection, field tests will be conducted on the TADS to evaluate system performance under varying weather conditions. Similar to methods used at the Nysted Offshore Wind Farm in Denmark (Desholm 2005), the camera will be tested under various weather conditions to see how well the waterproof box, pan/tile head, windscreen wiper, sprinkler system, water valve and rubber vibration absorbers perform. If the images collected by the camera are not of reduced quality during poor weather conditions, then the TADS will be considered to be effective. In addition, the camera-triggering software will require testing and adjustments to reduce the number of false positives that it records.

4.5.2 Reporting

The results of the TADS study will be used to evaluate total annual tern and plover collision risk within the wind park. A report that summarizes the results of the study will be prepared and provided to BOEM and the USFWS for review. The report will be submitted at the end of the each year for three years following construction.

5.0 SUMMARY

These Monitoring Protocols provide the methodology that will be used to implement the ABMP and address the research questions that are outlined in the ABMP. The data gathered during the pre-construction and post-construction studies will be used to assess potential impacts to bird and bat populations as a result of the proposed project with a focus on endangered avian species. The studies include radio tracking, avian acoustic monitoring, anti-perching monitoring, bat detection surveys, abundance and spatial distribution surveys and installation of TADS. The Monitoring Protocols include proposed methods to assess the sufficiency of negative data to the maximum extent practicable as required in the USFWS Biological Opinion (11/11/08).

The Monitoring Protocols will be further refined based on comments from a scientific peer review, BOEM, and USFWS. Additional modifications to the Monitoring Protocols may be made as a result of pre-study field testing and results obtained during pre-construction monitoring. Any such modifications will be made in consultation with BOEM and USFWS.

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