DRAFT
ENVIRONMENTAL ASSESSMENT

WALLOPS FLIGHT FACILITY
ALTERNATIVE ENERGY PROJECT

Prepared for

National Aeronautics and Space Administration
Goddard Space Flight Center
Wallops Flight Facility
Wallops Island, VA 23337

In cooperation with

U.S. Army Corps of Engineers

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Appendix A

Wallops Flight Facility Alternative Energy Demonstration Project
Wind Energy Avian Study Report

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Prepared for
National Aeronautic and Space Administration
Goddard Space Flight Center
Wallops Flight Facility
Wallops Island, Virginia

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TABLE OF CONTENTS

TABLE OF CONTENTS (Continued)

LIST OF TABLES

LIST OF FIGURES

EXECUTIVE SUMMARY

The National Aeronautics and Space Administration (NASA) is considering constructing up to two 2.0-megawatt (MW) wind turbines at the Goddard Space Flight Center's (GSFC) Wallops Flight Facility (WFF) in Wallops Island, Virginia. The turbines would be a primary component of a mandated renewable energy initiative for generating electricity to support operations at the WFF. NASA is currently preparing an Environmental Assessment (EA) for the project in accordance with the National Environmental Policy Act (NEPA) of 1969, as amended (42 U.S.C. 4321, *et seq.)* and NASA Procedural Requirement 8580.1. Should wind energy be established as the final preferred alternative energy option, NASA would procure and construct up to two turbines (pending funding availability) in the next two to three years.

As part of its planning process for the wind turbine portion of the proposed alternative energy project, NASA conducted field studies to assess the project's potential impacts to birds and bats. These studies were scoped in consultation with several agency and non-governmental organizations in 2008. All parties received a copy of a draft Avian and Bat Study Plan for review and comment on June 5, 2008. Written comments were provided by the U.S. Fish and Wildlife Service (USFWS) and the Virginia Department of Game and Inland Fisheries (VDGIF). NASA reviewed the comments and incorporated pertinent input into a revised final study plan, while also considering what its project team deems adequate for determining significance of impact given the scope of the proposal while acknowledging the available staff and budget to conduct these studies. A final Avian and Bat Study Pan was submitted to the stakeholder group on October 17, 2008.

This report summarizes the avian use (abundance and behavior) data and bird and bat fatality data from searches of onsite towers collected during the period October 1, 2008 through October 1, 2009. Based on the study methods detailed in the Avian and Bat Study Plan, this effort included diurnal avian surveys during spring and fall migration periods, and fatality searches near existing towers in the vicinity of the proposed wind turbines. Searcher efficiency and carcass removal tests were also incorporated into the fatality surveys.

Avian observations documented throughout the 12-month study period at the two survey sites just east of the two proposed wind turbine sites were generally unremarkable in terms of species encountered and numbers of birds. Bird species totaling over 100 within a survey period included common species such as tree swallow, flicker, brant and yellow-rumped warbler. By far the largest numbers of birds observed were snow geese numbering in the hundreds, and even several thousand on one day in November 2008. Over 81 percent of the recorded flight heights were between 0 and 50 feet above ground level, although larger flocks of birds were generally seen at heights over 100 feet above ground or resting in marshes. Less than 2 percent of the observed birds were within the proposed wind turbine's rotor swept zone and they were generally hunting or feeding and observed in the August/September time period.

With the exception of ten bald eagles, one gull-billed tern and four peregrine falcons, no sensitive avian species were recorded during the point count surveys. No federally endangered piping plovers were observed in any of the surveys, despite their documented existence approximately three miles away on the northeast shoreline on Wallops Island and also three miles away on Assawoman Island. The lack of even one observation of the piping plover during the 12-month survey combined with the absence of suitable habitat in the proposed wind turbine area indicates risk to this species should be nil.

Remains of 25 birds and one bat were found at the towers. Of the bird remains, only 20 were deemed to be from fatalities. Bird fatalities occurred at the taller south Meteorological Tower (13 carcasses, body parts, or feathers) and the guyed Northern Boresight Tower (7 carcasses). Twelve species were identified of the twenty likely fatalities, including three European Starlings and seven night migrants. No rare, threatened, or endangered species were found. Searcher efficiency rates for the first half of the study period were approximately 50%, but improved to 68% in the second half. Overall, annual fatalities were estimated to be about 28 for study period for the Northern Boresight Tower and 52 fatalities for the Meteorological Tower, based on the numbers of carcasses (or feather clumps) multiplied times standard searcher efficiency and carcass removal rates.

Based on the findings from this study, there will be some insignificant risk to birds in the vicinity of the proposed wind turbines once erected. However, projects of this size (i.e., one or two turbines) have never been found to result in significant numbers of bird fatalities. Based on our field observations and on empirical studies conducted at wind plants around the U.S. and in Europe, biologically significant impacts are unlikely to occur. The potential risk to state or federally endangered avian species is insignificant, based on the lack of federally listed species and suitable habitat for piping plover, and the small numbers of state-listed species discovered during the 12-month survey period.

NASA has been closely monitoring the post-construction wildlife studies that have been conducted by the New Jersey Audubon Society (NJAS) at the existing Jersey Atlantic Wind, LLC/Atlantic City Utilities Authority five-turbine project on the Atlantic coastline in Atlantic City, New Jersey. It is a very similar setting to the Wallops Island environment and has allowed for a meaningful assessment of the type of impacts that might occur at the proposed project site. The results regarding relatively low avian and bat fatality at this five-turbine project over a 17-month period lend strong support to the potential for the Wallops Island two-turbine demonstration project to cause low risk to a similar coastal avian community. NASA will continue to review the findings of this on-going effort as it develops a post-construction monitoring study for its demonstration project.

1.0 INTRODUCTION

The National Aeronautics and Space Administration (NASA) is considering constructing up to two 2.0-megawatt (MW) wind turbines at the Goddard Space Flight Center's (GSFC) Wallops Flight Facility (WFF) in Wallops Island, Virginia. The turbines would be a primary component of a mandated renewable energy initiative for generating electricity to support operations at the WFF. WFF is an aerospace technology test site supporting scientific research through carrier systems (e.g., airplanes, balloons, rockets, and uninhabited aerial vehicles). NASA is currently preparing an Environmental Assessment (EA) for the project in accordance with the National Environmental Policy Act (NEPA) of 1969, as amended (42 U.S.C. 4321, *et seq.)* and NASA Procedural Requirement 8580.1. Should wind energy be established as the final preferred alternative energy option, NASA would procure and construct up to two turbines (pending funding availability) in the next two to three years.

As part of its planning process for the wind turbine portion of the proposed alternative energy project, NASA conducted field studies to assess the project's potential impacts to birds and bats. These studies were scoped in consultation with several agency and non-governmental organizations in 2008. This effort included holding a meeting on April 30, 2008 at the Herb Bateman Center at the Chincoteague National Wildlife Refuge (CNWR) to explain the proposed project, review the development schedule, invite feedback regarding both existing local knowledge of Wallops Island avian and bat resources, and solicit ideas about investigations that NASA might undertake to predict risk to birds and bats related to the operation of the wind turbines. Staff from Tetra Tech, Inc., Curry & Kerlinger, LLC and URS, Inc. joined NASA representatives at the meeting. These companies have been contracted to assist NASA in the planning and implementation of the proposed project, which includes the avian and bat risk assessment. Also in attendance at the meeting was staff from CNWR, Virginia Department of Game & Inland Fisheries (VDGIF), U.S. Navy, and College of William & Mary's Center for Conservation Biology. U.S. Fish and Wildlife Service (USFWS; Gloucester, VA Field Office), The Nature Conservancy, and Cape Henry Chapter of the National Audubon Society were also invited but were unable to attend. A conference call with staff from The Nature Conservancy took place on May 13, 2008 to discuss NASA's project plans and proposed avian and bat studies.

All parties received a copy of a draft Avian and Bat Study Plan for review and comment on June 5, 2008. Written comments were provided by the USFWS and the VDGIF. NASA reviewed the comments and incorporated pertinent input into a revised final study plan, while also considering what its project team deems adequate for determining significance of impact given the scope of the proposal while acknowledging the available staff and budget to conduct these studies. A final Avian and Bat Study Pan was submitted to the stakeholder group on October 17, 2008. No additional comments were subsequently received from the stakeholder group.

This report summarizes the avian use (abundance and behavior) data and bird and bat fatality data from searches of onsite towers collected during the period October 1, 2008 through October 1, 2009. Based on the study methods detailed in the Avian and Bat Study Plan, this effort included diurnal avian surveys during spring and fall migration periods, and fatality searches near existing towers in the vicinity of the proposed wind turbines. Searcher efficiency and carcass removal tests were also incorporated into the fatality surveys. A separate report prepared by Stantec Consulting summarizing the results of the summer-fall 2008 acoustical monitoring bat survey was submitted to NASA in December 2008.

2.0 PROJECT SITE AND FACILITY DESCRIPTION

The proposed alternative energy project considers the possible installation of wind turbines on Wallops Island. If selected as NASA's final preferred alternative, the wind energy demonstration project would consist of constructing and operating two 2.0-MW wind turbines with associated underground electrical power collection lines, new access roads, and an interconnection with the existing NASA WFF electrical power distribution system. The nominal planned wind turbine rotor diameter for a 2.0-MW wind turbine is 77 meters (m) (252.6 feet [ft]). Assuming the use of an 80 m (262.5 ft) tower, the assumed height from the ground to the top elevation of a rotating blade would be approximately 118.5 m (388.8 ft). This would result in a turbine blade tip clearance of 41.5 m (136.2 ft) from the ground to the lowest elevation of a rotating blade. The electricity generated by the wind turbines would only be used to power facilities at the WFF. Table 1 provides representative information for a 2.0-MW wind turbine model for evaluation of environmental impacts. NASA may consider other wind turbine models in the future, but they would be similar to the model specifications in Table 1.

Table 1: Basic Data for 2.0-MW Wind Turbine

2.0-MW Wind Turbine	
Rated power	2.0-MW
Cut-in wind speed	3.5 meters/second
Cut-out wind speed	25 meters/second – 10 minutes
Rated wind speed	14 meters/second
Wind class	IIa
Blade length	42.5 meters (139.5 feet)
Total height (to tip of blade)	120.5 meters (395.3 feet)
Installed Cost, 2 Turbines	$10,050,000
Annual kWh Production at WFF, 2 Turbines	10 GWh/year

Figure 1 shows the proposed project site on Wallops Island and Figure 2 provides a more detailed site plan showing specific project features within the immediate development area.

3.0 AVIAN FIELD STUDY OBJECTIVES

As stated in the final avian and bat study plan, NASA is undertaking an avian study plan with the following primary objectives:

1. Perform a pre-construction inventory of resident avian species and habitat in the vicinity of the proposed turbine sites;

2. Identify pre-construction migratory, nesting, and winter avian use (abundance and behavior) of the project site, including use of migration stopover, resting, or feeding areas in the vicinity of the development site;

3. Assess potential risk from wind turbine operation to avian species, primarily through monitoring of avian fatality at existing tall structures on Wallops Island; and

4. If wind turbines are selected as the final preferred alternative energy option, establish an adaptive post-construction management and impact monitoring plan based on results of the pre-construction studies and subsequent monitoring results following turbine installation.

4.0 AVIAN FIELD STUDY METHODS

4.1. Avian Field Observations

The proposed pre-construction avian field study was performed within the 12-month period commencing October 1, 2008 and ending October 1, 2009. Field investigations were conducted by qualified biologists working at Wallops Island for NASA (Joel Mitchell), the U. S. Navy (Marilyn Ailes, Adrianna Ortiz), and the U. S. Department of Agriculture Animal and Plant Health Inspection Service (APHIS) Program (Brian Scharle). These individuals were chosen to conduct the field work because they possess the following characteristics:

- Extensive prior experience conducting biological studies at Wallops Island;

- Ability to adjust work schedules to ensure their presence during key observation periods throughout the year-long field study; and

- Ability to offer historic knowledge of avian activity and habitat on Wallops Island that will strengthen the interpretation of field findings.

Figure 1: Proposed Wind Turbine Sites on Wallops Island

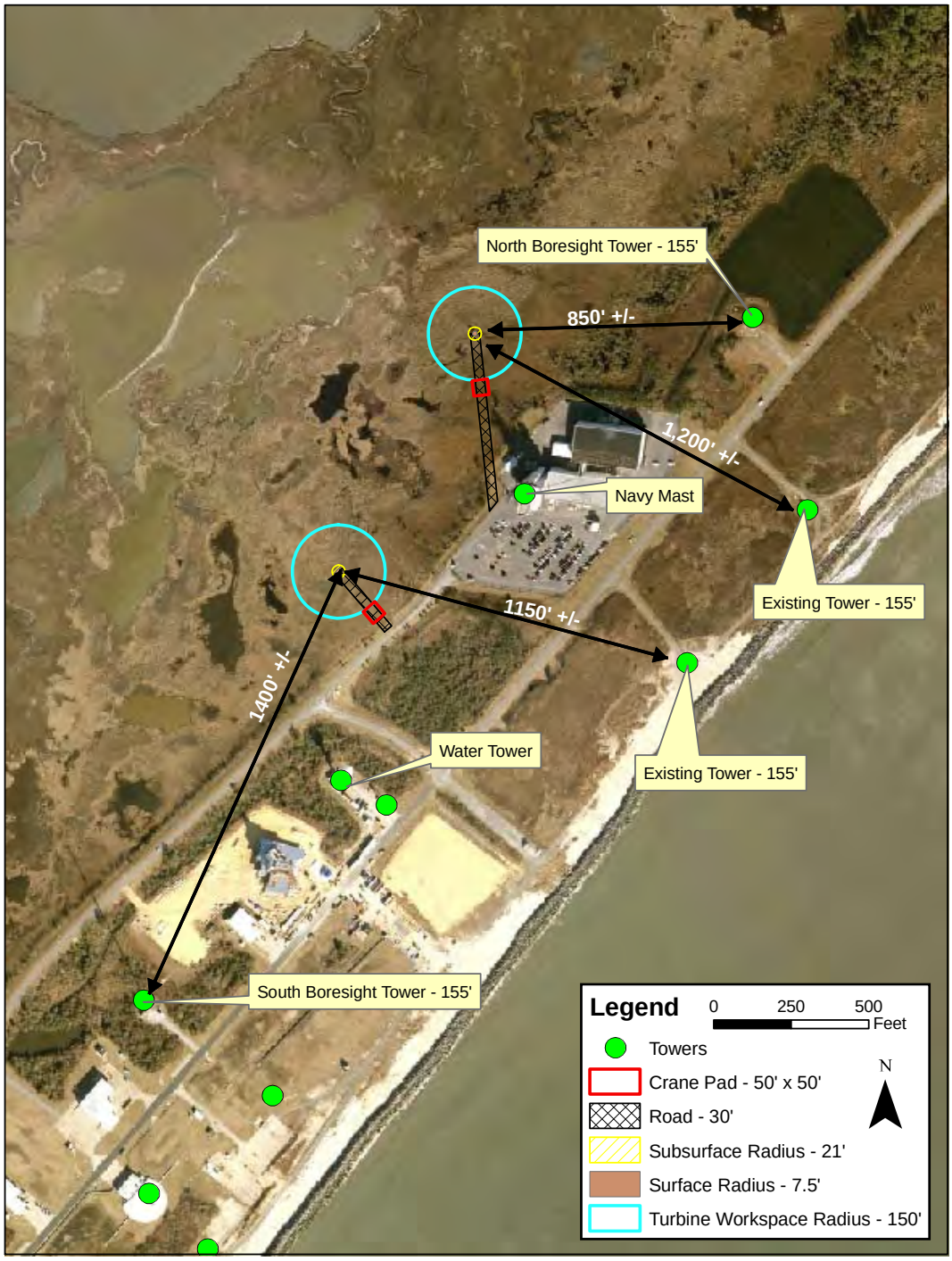

Figure 2: Proposed Wind Turbine Sites and Surrounding Facilities

The specific field investigations include the following:

1. Avian observations were conducted once per week at two point count locations with an unobstructed view of the proposed wind turbine development area. These locations are immediately east of and adjacent to the proposed project development site (see Figure 3). Site 1 is the northernmost survey site and Site 2 is the southernmost survey site shown in Figure 3. Throughout the 52-week period, biologists visited both observation sites at least once per week for a minimum of 15 minutes per day at each location to record avian activity. These field surveys were conducted in the morning between 7:00 am and 9:00 am.

   Data were recorded for birds observed within a 1 kilometer (0.62 mile) radius of the point count locations, including the two proposed wind turbine development locations. Data for each avian observation included: species identity, number of individuals, and behavior of individuals (to include altitude, flight direction, feeding vs. flying/migrating, resting, etc.).

2. During migration seasons (September 1 - October 31 and April 15 - June 15), the biologists conducted 15-minute avian observations at each location at least twice per week at the same two observation points referenced above. These surveys were conducted between 7:00 and 9:00 am and took the place of the weekly surveys discussed above. Additionally, during peak migration days, biologists supplemented these data by conducting observations at the U.S. Navy building mast tower (see Figures 2 and 3), which offers unobstructed, panoramic views of the Wallops Island air space (which includes the rotor swept areas of the proposed turbines). The on-site biologist team targeted fall and spring days when weather front movement was conducive to migratory activity and conducted their spot observations during daytime hours (between 9:00 am and 4:00 pm).

   Data collected during migration season surveys included the date and times of observations, species observed, numbers of individuals, and behavior. Behavioral information included the path where birds were flying in relation to the proposed turbine area(s), height of flight (below, within, or above the rotor height zone), perching behavior, and hunting behavior. Local weather data, including temperature, sky conditions, wind direction, and wind speed were also recorded.

4.2. Avian and Bat Fatality Searches at Existing Towers

Because the proposed wind turbine sites are located near several tall structures on Wallops Island, NASA has used these structures as surrogates for wind turbines to study avian and bat fatalities. By studying fatalities at these tall structures, some of which are far riskier to birds and bats than wind turbines, an indication of potential risk to nocturnal and diurnal birds that use the airspace above Wallops Island was

Figure 3: Avian and Bat Field Study Observation Locations

acquired. The rationale for conducting such studies is that wind turbines and unguyed towers in the same height range are responsible for similar numbers of bird fatalities and that guyed towers of the same height kill far more birds than do wind turbines (Gehring et al. 2009). Details regarding the surrogate towers are provided in Table 2 and their locations are shown on Figure 3.

To determine the number, type, and other characteristics of avian and bat fatalities at these structures, the above referenced biologists conducted fatality searches near both the guyed and unguyed towers. Guidance for the design for such studies is suggested in Anderson et al. (1999) and similar more thorough field and analytical designs for both wind turbines and communication towers can be found in Gehring et al. (2009) and Jain et al. (2007).

Table 2: Existing Structures on Wallops Island Employed for Fatality Searches

Type of Tower/Structure	Height, meters (feet)	Guyed vs. Unguyed, Lighting System	Location relative to proposed wind turbines
North Boresight Tower	47 (155)	Guyed Flashing Red strobe: Night only	259 m (850 ft) east of northernmost turbine
South Boresight Tower	47 (155)	Unguyed Flashing Red strobe: Night only (lights not yet installed)	427 m (1,400 ft) south of southernmost turbine
South Meteorological Tower	102 (335)	Unguyed. Flashing white strobe: Day and Night	1,295 m (4,250 ft) south of southernmost turbine

Fatality searches were conducted during the October 1, 2008 – September 30, 2009 time period. Searches took place at the North Boresight Tower and the South Boresight Tower (as listed in Table 2) because of their relatively close proximity to the proposed project site and to provide data on both guyed and unguyed towers of the same height. The taller meteorological tower farther south was also searched to provide data from a structure similar in height to the proposed wind turbines. Construction activities occurring in the vicinity of this tower limited access to the search area during portions of the latter one-half of the study period.

The intensity of searches was greater during the peak spring (April-early June) and fall (August-October) bird and bat migration seasons. Searches took place three times per week during the migration seasons and one time per week during the remainder of the year. Statistical analyses have demonstrated that these frequencies are adequate for determining the levels of avian and bat fatalities at wind turbines with a high degree of certainty and minimal margins of error (Jain et al. 2007).

Carcass searches were conducted as soon after sunrise as possible to discourage diurnal scavengers from foraging at the towers. At the northern boresight tower the search area extended outward to the full

extent of guy wires (approximately 18 m [60 ft]). At the south boresight tower and south meteorological tower, which have no guy wires, the search areas extended from the tower base outward to 80% of the tower height (approximately 38.1 m [125 ft] and 81.7 m [268 ft] radii, respectively). The area searched is a rectangle, with transects separated by 7 m (23 ft) (see Figure 4 for layout of transects). The order in which the towers were searched varied such that they were performed in rotation (for example, the tower searched first on one day was searched last during the next day). This search methodology has been peer reviewed and demonstrated to provide a robust estimate of fatality rates at communication towers and wind turbines (Gehring et al. 2009, Jain et al. 2007).

Information recorded for each carcass included: tower identification, date, time, species identification, number of individuals (if more than one), distance from the base of a tower, distance from the axis of a guy wire or set of guy wires (at guyed towers), the azimuth of a carcass from the tower, and the condition of the carcass. This protocol is similar to that employed during post-construction studies conducted at communication towers (Gehring et al. 2009).

Information on the conditions of a carcass included whether it was intact or a partial carcass, a feather grouping or feather tract, whether the carcass had been scavenged and the degree to which it had been scavenged, and the freshness of the carcass, as described below. In addition, the weather on the day of the carcass find and the night prior to the carcass find was recorded. The latter information specifically included data on visibility on the night prior to the carcass discovery.

With respect to birds, any feathers or clumps of feathers with flesh attached were recorded as a fatality. Loose feathers were not considered fatalities unless there were several primary or tail feathers indicating more than could be lost during normal molt. When unattached single loose feathers were found their location was recorded and the feathers removed and retained but were not recorded as a fatality. An exception to documenting single feathers was implemented at the North Boresight Tower, where single feathers were ubiquitous due to the large number of waterfowl and shorebirds that frequented the area.

The field observer estimated how long carcasses have been on the ground (time since death or injury) using the following categories: less than 1 day, less than 3 days, greater than 7 days, or greater than 1 month. These estimates were made from observations of carcasses. Carcasses rated as being fresh (no maggots, sign of fresh blood, little to no evidence of scavenging, and an eye that is still clear, round, and fluid filled) were estimated to be about 1 day old (less than or slightly greater than about 24 hours). Carcasses were presumed to be 2-4 days (48-96 hours) old if there was evidence of decomposition (slight), moderate-extensive scavenging (flesh removed and, or disarticulated), and the eye was sunken into the skull and shriveled. Carcasses more than 4 days to a week old will show fly larvae (maggots),

Figure 4: Pre-Construction Fatality Searches at Existing Towers on Wallops Island

potentially extensive scavenging, flesh that is either desiccated or decomposing (middle to later stages), and the eye may cease to be visible. If a carcass is shriveled and dried up with little or no flesh, it is likely to be months old. Later stages of decomposition and mummification cannot be aged with precision.

Carcasses were placed in airtight, plastic bags with an identification number linking that carcass to the main database. Carcasses were kept in a freezer on site and may be examined at any time by either the USFWS or the VDGIF.

In the study plan, it was stated that in the event that a state or federal endangered or threatened species was found, the USFWS and VDGIF would be notified within 24 hours via email and/or telephone. Such notification was not necessary as none were found.

4.2.1. Searcher Efficiency and Carcass Removal Trials

The preconstruction fatality study also included searcher efficiency and carcass removal trials to estimate the actual number of fatalities incurred at these structures. These trials adjust for numbers of carcasses that are not found by observers as well as carcasses that are removed by scavengers. These methods and the statistical background for these methods have been described in detail by Arnett et al. (2005) and Jain et al. (2007), and in many of the publications and reports provided in the Additional Resources section of the Avian and Bat Study Plan. Although the field methods, calculations and statistical tests used varies slightly from study to study, most researchers use similar methods and report similar results of those methods.

4.2.1.1. Searcher Efficiency Trials

For searcher efficiency tests, approximately 25 small birds, 25 tailless mice (bat surrogates), and 25 mid-large sized birds were placed under the towers on a randomized basis. The specific locations and numbers of carcasses to be set out in each trial were determined so that carcasses were placed at random distances and directions from the towers and were placed out on random survey dates. After an initial pilot testing period, these tests were performed in all seasons of the year. Carcasses were placed out about one hour prior to sunrise and then checked after fatality searches were completed on that day. GPS coordinates were taken for each carcass so they could be relocated after the tests. Checking after the searches ensured that carcasses remaining on the ground were not seen by observers as opposed to being removed prior to the search by scavengers. The searcher was not told when the carcasses would be placed out under the towers. In addition, the carcasses were marked so that they were recognizable. Initially, the marking consisted of a small piece of dental floss through the nares and around each tarsus. However, this method was discontinued due to difficulty in threading the floss though the cavities. Instead, feet were severed from both legs of the test carcasses just above the toes. This practice proved efficacious. Primary feathers of the wings and rectrices of the birds and bats to be used were clipped so

that they could be distinguished from tower induced fatalities. For the mice used as bat surrogates, the tails were removed. An efficiency rate for each observer was calculated as follows: total number of birds found was divided by total number placed out under towers, which was expressed as a percentage or proportion.

4.2.1.2. Carcass Removal Trials

Carcass removal tests determine the rate at which carcasses were removed from the site by scavengers. These rates were determined by placing 21 small birds, 26 tailless mice (bat surrogates), and 27 mid-large sized birds out at random under the three towers from March 1, 2009 through October 2, 2009. A pilot study using blackbird carcasses was initially established at each tower between October 3, 2008 and February 22, 2009. GPS coordinates were recorded for each carcass so that each could be relocated. No more than 3 bats and 3 birds were placed out on a given morning. This number was selected as the optimal number of carcasses to be used for this test as a greater number of carcasses would encourage vertebrate scavengers that are capable of learning that more food is available. If scavengers learn that they can find meals under the towers, they could easily bias the study results by removing carcasses on a regular basis. All tailless mice were placed during April through September 2009. Birds were placed out throughout the entire year. Each test carcass was marked via dental floss or by clipping wings or toes. Marking ensures that the test carcasses will not be confused with fatalities caused by the towers or some other source. Carcasses were placed randomly. The distance and direction from the tower, as well as the actual tower used, was recorded.

Once placed out, test carcasses were checked at one day periods. For example, if a carcass was placed out at dawn on day 0, it was checked on day 1, 2, 3, 4, 5, 7, and then at weekly intervals for three weeks after being placed out. This method for carcass removal trials has been employed by Johnson et al. (2002) as well as Jain et al. (2007, 2008).

4.2.2. Final Fatality Rate Calculation

The estimated fatality rate for small birds, bats, and mid-large sized birds, as well as all birds, can be calculated by incorporating the following variables: carcasses found, searcher efficiency rate (mean), and the carcass removal rate (mean). There are several accepted methods for these calculations (Johnson et al. 2002, Jain et al. 2007). For the purposes of this study, we used a multiplier of four to estimate the total number of likely fatalities at the towers. This number comes from the only carcass removal and searcher efficiency studies conducted at a large sample size of towers over multiple years (Gehring et al. 2009).

The estimated fatality rate will be greater than the number of carcasses found during the regular searches and provides a means of assessing the potential fatality rates that are likely to occur at the proposed wind turbine(s).

5.0 AVIAN SURVEY STUDY RESULTS

The following is a summary of avian survey data collected by NASA, U.S. Navy and APHIS Program biologists through the 12-month study period. As described in the Avian and Bat Study Plan the study period began on October 1, 2008 and ran through October 1, 2009. However, data collected prior to this date is also included in this section, particularly diurnal point count observations which began on September 12, 2008 and one migration survey on September 22nd. Fatality searches began on October 3, 2008 and ended on October 2, 2009.

5.1 Point Count Avian Observations

Point count observations were conducted at avian observation Sites 1 (northernmost site) and 2 (southernmost site) on 79 days between September 12, 2008 and October 1, 2009. These observation sites are shown on Figure 3. A total of 32,226 birds were observed during the survey period. Of this total, approximately 72.4 percent were snow geese, with an estimated 20,000 observed resting on the far western side of the adjacent marsh on November 20, 2008. Even without considering this one observation day, snow geese were recorded over twice as much as any other species. Tree swallows were the second most common species observed, followed by European Starling. Approximately 8.9 percent of the birds observed were passerines. A species abundance summary is provided in Table 3 and a summary of avian observations by species class is included in Table 4.

The distribution of survey days throughout the 12-month study period and corresponding numbers of birds observed each month are provided in Table 5. Species observed during the survey were predominantly waterbirds with a much smaller number blackbirds and songbirds. Only 60 raptors were observed through the study period, including 10 bald eagles and 2 peregrine falcons. Flight heights of birds were predominantly between 0 and 50 feet above ground level (81.3 percent). Approximately 12.3 percent of the observed birds were recorded flying between 51 and 150 feet above ground level and 6.4 percent were seen over 150 feet.

The number of birds recorded within the wind turbine rotor-swept zone (136 feet to 389 feet above ground level) was 598 or 1.9 percent of all observed birds. Of these birds, 188 were tree swallows (31.4 percent), 130 were great egrets (21.7 percent), 57 were starlings (9.5 percent) and 50 were snowy egrets (8.4 percent). Flight direction was predominantly to the west (65 percent), followed by south (25 percent),

Table 3: Species Abundance Summary

Species	Number Observed	Percent of Total
Snow Goose	23,321	72.4
Tree Swallow	1,569	4.8
European Starling	708	2.2
Canada Goose	501	1.6
Red-winged Blackbird	500	1.6
Great Egret	495	1.5
All other species	5,132	15.9
Total Birds Observed	32,226	100

Table 4: Avian Observations by Class of Species

Class of Species	Number Observed	Percent of Total
Waterfowl[1]	24,759	76.8
Shorebirds	588	1.8
Waders[2]	986	3.1
Gulls and Terns	951	3.0
Raptors	60	<0.1
Blackbirds[3]	1,554	4.8
Passerines[4]	2,864	8.9
Other[5]	464	1.4

[1] Waterfowl - includes geese, ducks, cormorants, and mergansers.
[2] Waders - includes herons, egrets, and ibis.
[3] Blackbirds - include crows, grackles, blackbirds, starlings, and cowbirds.
[4] Passerines - include all songbirds.
[5] Other - includes all other species, including but not limited to, owls, woodpeckers, doves, and pelicans.

Table 5: Number of Bird Observations by Month and Survey Effort

Month	Number of Surveys	Number of Birds Observed	Average Birds Observed Per Day
September 2008	5	741	148
October 2008	6	2,745	458
November 2008	4	20,665	5,166[1]
December 2008	3	1,833	611
January 2009	5	419	84
February 2009	4	191	48
March 2009	5	543	108
April 2009	12	752	63
May 2009	11	1,070	97
June 2009	7	627	90
July 2009	4	531	133
August 2009	4	682	171
September 2009	8	1,283	160
October 2009	1	154	154

[1] Includes a single daily observation of 20,000 snow geese on November 20, 2008.

east (5 percent) and north (5 percent). The majority of these birds were hunting or feeding (46 percent) or resting (43 percent). These birds were all observed in the August and September fall migration months.

In late September 2008 the largest separate flocks observed were 100-200 tree swallows and northern flicker flying at heights of approximately 30 feet. Over 100 tree swallows were again encountered on two occasions in early October. In mid-October groups of 90-120 yellow-rumped warblers were observed flying at heights below 100 feet on two different days. By far the largest flocks of birds observed were snow geese. Between October 21st and December 2nd separate flocks of snow geese were observed in large numbers generally flying west of the wind turbine sites at heights of 200 to 300 feet. This included snow geese numbering 1,000 on October 21st, 610 on October 29th, 120 on November 7th, 1,300 on December 2nd and 300 on December 8th. In addition, on November 20th approximately 20,000 snow geese were estimated to be resting in a field at the far side of the marsh west of the wind turbine sites.

The overall number of birds observed decreased from mid-December through the winter months in January and February. One bald eagle was observed hunting toward the south on February 19th. A great horned owl was heard calling on February 6th. Average daily avian observations more than doubled in March and sustained similar levels through June before increasing again approximately 50 percent in July and maintaining similar levels through October 1st (see Table 5 for monthly breakdown). Groups of birds over 100 in size were not observed in 2009 until May 14th when 120 brant were observed resting in the vicinity of Site 2. The only other observation of over 100 birds was a sighting of approximately 250 tree swallows on September 22nd flying at a height of 100 feet. Other groups of over 50 birds observed at once occurred 12 times in 2009, including separate sightings of tree swallows, red-winged blackbirds, mixed gulls, ducks, willets and great egrets.

Although no federally listed endangered or threatened species were observed during the field surveys, three species listed as threatened by the state of Virginia were observed. Bald eagle (10), gull-billed tern (1) and peregrine falcon (2) were observed in small numbers during the morning point count surveys. Two additional peregrine falcons were observed flying approximately 100 feet above ground during the diurnal migration surveys (one in spring and one in fall). Of these species, only peregrine falcons might nest on the marshes near the proposed turbine sites. Peregrines have been introduced as nesters to the marshes of the Atlantic coast, although they are not native to those marshes. Also, peregrines observed during the migration season could easily be from the Arctic population, many of which migrate along the Atlantic coast during fall and spring. Bald eagles and gull-billed terns will not likely nest in the vicinity of the turbines because there is little or no suitable habitat for them there. These birds will forage in the general vicinity, but not likely in large numbers. With respect to the Virginia population of bald eagles, the growth rate in recent years has been rapid and it is now nesting in areas where it has not nested in many

decades. It is likely that this species, because of its population growth, geographic expansion within Virginia, and its total numbers there now, should be considered for delisting as a state threatened species.

5.2 Avian Migration Season

During the fall and spring migration seasons birds were observed at least two days per week in the morning hours instead of once per week as was the case during non-migration months. Additional "spot" surveys were conducted during migration periods on days when weather conditions were deemed optimal for migration. These surveys were conducted during mid-morning to mid-afternoon hours from the mast tower location. Results of these observations are shown in Table 6. During Fall 2008, observations took place on four days (September 22, October 2, October 3 and October 7). Several individual raptors were recorded at flight heights under 100 feet. One peregrine falcon was spotted on October 7th at a height of approximately 100 feet. Flocks of birds spotted included Forster's tern and oystercatcher and a group of resting black ducks. Low flying flickers and tree swallows were recorded in groups of over 50 per hour. No large concentrations of raptors or waterbirds were recorded migrating during the survey period. Spring 2009 migration observations occurred on two days (May 7 and May 22). One peregrine falcon was seen flying at a height of 100 feet on May 7th and activity was generally low, with brant, black gulls and peeps the only other species recorded. Fall 2009 migration observations occurred on two days (September 15 and September 24), resulting in observations of two small flocks of four tree swallows flying 80 feet high and individual occurrences of red-winged blackbird, flicker and killdeer. In addition, the morning bird counts conducted during migration seasons resulted in a 50 percent higher incidence of birds in fall versus spring migration months.

5.3 Avian and Bat Carcasses Searches

On each survey day, all three tower locations shown in Figure 4 were surveyed. As stipulated in the study plan, discovery of individual feathers was not included as a fatality incident. Results of these searches appear in Table 7, along with which days fatality searches were conducted. Carcass searches were conducted on 83 days between October 3, 2008 and October 2, 2009 resulting in 25 records of bird carcasses, parts, or feathers and one bat carcass. Of these parts, five sets of remains could easily be from birds that were alive and simply preening or molting. For example, the tail feather of the Red-tailed Hawk was not likely to have been a fatality. Perhaps one or two may have been from birds that collided with the tower but were not killed. Bird remains were not found at the South Boresight (unguyed 155') Tower, whereas seven sets of remains were found at the North Boresight (guyed 155') Tower and 18 records of feathers, parts, or feathers were found at the Meteorological (guyed 355') Tower. At the North Boresight Tower, the records indicate a minimum of seven bird fatalities. At the Meteorological Tower, the information gathered indicates that a minimum of 13 (72% of 18 records) fatalities, based on the presence of remains that could only have come from a bird that expired.

Table 6: Diurnal Avian Migration Observations (from Mast Tower)
Page 1 of 2

Species	Time 1st seen	Time last seen	Total time (min)	Where seen	Height	Notes	Date	Temperature	Cloud cover
great blue heron	1345	1405	20	5	10		9/22/2008	72	partly cloudy
red tail hawk	1343	1344	1	4	200		9/22/2008	72	partly cloudy
Cooper's hawk	920		2	4	40		10/2/2008	58	Scattered
osprey	927		2	3	80	headed N	10/2/2008	58	Scattered
Cooper's hawk	929		0.3	4	20		10/2/2008	58	Scattered
Cooper's hawk	932		0.1	4	20		10/2/2008	58	Scattered
Cooper's hawk	935		0.3	4	20		10/2/2008	58	Scattered
marsh hawk	938		0.3	5	30		10/2/2008	58	Scattered
marsh hawk	940		0.1	4	30		10/2/2008	58	Scattered
marsh hawk	942		0.1	4	30	headed N	10/2/2008	58	Scattered
Cooper's hawk	942		0.1	4	20		10/2/2008	58	Scattered
Cooper's hawk	946		0.5	4	20		10/2/2008	58	Scattered
Monarch butterfly	948		0.2	3	80		10/2/2008	58	Scattered
Cooper's hawk	950		0.1	4	20		10/2/2008	58	Scattered
Cooper's hawk	952		0.3	4	20		10/2/2008	58	Scattered
marsh hawk	1431	1435	4	5	5	Hunting	10/2/2008	70	partly cloudy
osprey	922		5	6	150		10/3/2008	54	Clear
flicker	922			3	20	64 birds in hour	10/3/2008	54	Clear
black-throated blue warbler	927		0.5	3	50		10/3/2008	54	Clear
tree swallow	953			3 to 6	60	54 birds in hour	10/3/2008	54	Clear
Cooper's hawk	954		0.5	6	?		10/3/2008	54	Clear
Cooper's hawk	955		0.5	6	?		10/3/2008	54	Clear
double-crested cormorant	957		0.5	3	?		10/3/2008	54	Clear
osprey	1010		3	6	100	Hunting	10/3/2008	57	Clear
osprey	1014		1	6	150		10/3/2008	57	Clear
unknown warbler	1017		0.3	3	60	3 birds	10/3/2008	57	Clear
osprey	1020		6	6	100	Hunting	10/3/2008	57	Clear
osprey	1411	1413	2	2	200		10/7/2008	63	thin clouds
flicker	1416	1416	0.1	4	40		10/7/2008	63	thin clouds

Table 6: Diurnal Avian Migration Observations (from Mast Tower)
Page 2 of 2

Species	Time 1st seen	Time last seen	Total time (min)	Where seen	Height	Notes	Date	Temperature	Cloud cover
yellowlegs	1417			5	0	Resting	10/7/2008	63	thin clouds
marsh hawk (female)	1424		1	5	50	Hunting	10/7/2008	63	thin clouds
Forster's tern	1434		0.1	2	100	flock of 15	10/7/2008	63	thin clouds
Peregrine falcon	1435		0.1	2	100		10/7/2008	63	thin clouds
osprey	1442	1448	6	6	150	headed N	10/7/2008	63	thin clouds
flicker	1444		1	6	200		10/7/2008	63	thin clouds
oyster catcher	1450		1	5	10	flock of 17	10/7/2008	63	thin clouds
double-crested cormorant	1502		1	4	60	headed N	10/7/2008	63	thin clouds
black duck	1417			5	0	flock of 30 resting	10/7/2008	63	thin clouds
double-crested cormorant	1507		1	6	60	headed S	10/7/2008	63	thin clouds
Forster's tern	1512		2	1	30	headed S	10/7/2008	63	thin clouds
brant	1344			5	0	resting	5/7/2009	73	partly cloudy
Peregrine falcon	1414	1415	1	6	100	by mainland	5/7/2009	73	partly cloudy
black back gull	1427			5	0	resting	5/7/2009	73	partly cloudy
peeps	833		5	6	200	by mainland	5/22/2009	69	clear
peeps	850		5	5	50		5/22/2009	69	clear
tree swallow	910	912	2	5	80	Flock of 4	9/15/2009	78	partly cloudy
red-wing blackbird	916	917	1	5	60		9/15/2009	78	partly cloudy
flicker	920		30	4	30		9/15/2009	78	partly cloudy
tree swallow	925		45	6	80	Flock of 4	9/15/2009	78	partly cloudy
killdeer	838		30	3	80	Flying east	9/24/2009	72	overcast

Table 7: Fatality Search Findings (October 3, 2008 – October 2, 2009)
Page 1 of 2

Tower Location	Date	Qty	Species	Distance from Tower	Distance from Guy	Azimuth	Carcass condition
North Boresight (guyed) 155'							
	10/20/2008	1	Salt marsh sharp tailed sparrow	85	35	185	Eyes sunken but still fluid filled. No maggots; No disarticulation
	11/14/2008	1	double crested cormorant	50	30	45	One eye gone, some maggots, Round hole in dorsal rump area
	11/19/2008	1	Yellow rumped warbler	30	10	180	Good condition
	12/9/2008	1	Common grackle	45	20	165	Good condition, eyes sunken but still there, no maggots, no disarticulation, obvious broken neck. Left in place for searcher to find next a.m. However was gone next morning.
	3/11/2009	1	Unidentified sparrow spp.	1	Found at base	180	Carcass too old to identify
	5/20/2009	1	Red winged blackbird	15	10	65	Black feathers-Primaries and down
	6/19/2009	1	Starling	12.5	8	145	Skeletal body w/flesh and some feathers attached
South Boresight (unguyed) 155'							
No carcasses found							
Meteorological Tower (unguyed) 355'							
	10/9/2008	1	Clapper rail	200	NA	175	Partial wing & feathers
	10/14/2008	1	Northern Flicker	10	NA	175	Head only; 2 primaries
	10/17/2008		unknown	170	NA	72	Single primary feather
	11/14/2008		Red tailed hawk	190	NA	90	Single primary feather
	12/2/2008	1	Tree swallow	0	NA	20	Good
	12/10/2008	1	Clapper rail	75	NA	5	Medium sized foot

Table 7: Fatality Search Findings (October 3, 2008 – October 2, 2009)
Page 2 of 2

Tower Location	Date	Qty	Species	Distance from Tower	Distance from Guy	Azimuth	Carcass condition
Meteorological Tower (unguyed) 355' (continued)							
	12/16/2008	1	Marsh wren	0	NA	220	Eyes sunken, no maggots; no disarticulation.
	12/31/2008		Starling	300	NA	58	wings only
	1/9/2009	1	Largish bird Gull spp. Or harrier	0	NA	NA	5 feathers
	1/30/2009	1	Gull spp.	115	NA	120	1 primary; 1 down feather
	4/9/2009	1	Snow goose	135	NA	154	Clump of feathers-breast
	4/13/2009	1	American Robin	285	NA	40	Severed wing
	4/17/2009	2	1. Unknown bat 2. Red winged blackbird	250	NA	130	1. Unidentified bat species desiccated beyond recognition. 2. Female with eyes missing, but otherwise in good condition.
	5/18/2009	1	Largish species; gull??	50-100	NA	136-200	Clump of feather and numerous feathers, all apparently from same bird. Scattered by wind.
	6/19/2009	1	Starling	175	NA	180	Skeletal wing with some feathers
	7/1/2009	1	Unknown	270	NA	50	Feather clump
	7/24/2009	1	Starling	60	NA	208	Desiccated carcass; almost skeletal
	9/30/2009	1	Common grackle	50	NA	115	Scattered feathers (primaries or secondaries) gray in color
Fatality Survey Dates (2008):	October 3,7,9,10,14,15,17,20,22,24,28,30,31 November 7,14,19,25 December 2,10,16,22,31						
Fatality Survey Dates (2009):	January 9,13,21,30 February 2,12,21,24 March 5,11,25 April 2,3,8,9,10,13,16,17,21,23,24,27,28,30 May 4,6,8,12,14,15,18,20,22,27,28 June 4,10,11,24 July 1,14,24,31 August 5,14,21,28 September 3,9,10,11,16,17,18,23,24,25,30 October 1,2						
Fatality searches completed at all three tower locations on each survey day. Per plan solitary feathers are recorded but not counted towards totals							

A total of 18 (90%) of the 20 likely fatality finds were identified to species, representing 12 different species. Field crews did not identify 2 of 20 (10.0%) fatality records of carcasses, feathers, or body parts. Of the 18 birds for which identifications were made to species, seven (39%) are nocturnal migrants (Salt Marsh Sharp-tailed Sparrow, Yellow-rumped Warbler, Clapper Rail, Northern Flicker, Marsh Wren, Snow Goose, and American Robin). It is also possible that the unidentified sparrow that was found dead was a night migrant. The remaining species were either non-migratory (European Starlings) or daytime migrants (blackbird, grackle, swallow, and cormorant). Note that three of the 20 recorded fatalities were European Starlings, which are aliens to North America and not protected by the Migratory Bird Treaty Act. We have included these birds and those not likely to have been killed by the towers in Table 7 for completeness.

It is important to note that although many waterfowl, shorebirds, and raptors were noted during the visual observation study (see above); none of these birds were found dead at the towers. The only waterbirds found dead were a Double-crested Cormorant, found at the North Boresight tower, and two Clapper Rails found at the Meteorological tower. No rare, threatened or endangered species were among the fatalities.

Because no fatalities were observed at the unguyed South Boresight, while fatalities were found at the guyed North Boresight Tower, we suggest that guy wires are responsible for all or nearly all fatalities that were found at the North Boresight Tower.

The bat carcass was not identified to species. It is highly unlikely that the bat fatality was an endangered or threatened species because no endangered or threatened bats are known to occur (at least on a regular basis) within about 100 or more miles of the coastal zone of Virginia.

5.4 Searcher Efficiency and Carcass Removal Trials

Pilot Searcher Efficiency and Carcass Removal Study

Between October 3, 2008 and February 22, 2009 the fatality study manager conducted a pilot searcher efficiency study and put out six bird carcasses, all starlings, to test searcher efficiency during the fatality search surveys. This included using the same birds for searcher efficiency and scavenging. When the searcher found a bird, he left it in place. The site was then checked daily the first week and once a week thereafter until the bird was gone.

At the 335-foot south Meteorological Tower, one bird was placed in the evening prior to the morning search. It was not found by the searcher and when the study manager went out to the site the same day of the search it was gone. It was assumed that it was scavenged in 12 hours between the initial placement and the first search. Another starling at the same Meteorological tower was found by the

searcher and left in place and checked daily and then weekly. It was placed on December 16th and disappeared sometime during the week between December 24th and January 1st.

Two starlings were placed at the North Boresight Tower. One was found by the searcher and removed from the site due to a misunderstanding. The second starling was not actually placed, but was found the evening before a search with a broken neck and left in place. It was not found by the searcher, but a subsequent visit to the site the same day found it gone. Again, it was assumed that it was scavenged overnight.

Two starlings were placed at the South Boresight Tower. One was found and one was not. Both were left in place. One was scavenged after 12 days, while the other which was placed on December 16th and was scavenged in the week between December 24, 2008 and January 1, 2009.

In summary, the searchers found three of the six placed birds during this initial portion of the study, for a 50% efficiency rate. Two birds were scavenged completely within 24 hours. Three remained on the ground for over a week.

Full Searcher Efficiency and Carcass Removal Study

From March 1, 2009 through October 2, 2009 an assortment of medium to large birds, small birds and tailless mice (surrogates for bats) were placed at each of the three tower sites. The results of these searcher efficiency tests at the combined three sites were generally positive. Searcher efficiency for medium to large birds was 78% (21 of 27 birds found), efficiency for small birds was 73% (16 of 22 birds found), and efficiency for bat surrogates was 50% (13 of 26 tailless mice found). Only one of the seven (14%) bat surrogate carcasses placed at the North Boresite Tower was found, while the efficiency rate at the remaining two towers was 63% (12 of 19 carcasses found). As for total efficiency rates by tower, 62% (16 of 26 carcasses) were found by searchers at the North Boresite Tower and 71% (17 of 24 carcasses) were found at both, the South Boresite Tower and the South Meteorological Tower.

To determine the overall numbers of birds and bats that were likely killed at the towers, we multiplied the numbers of carcasses found by a factor of four. We used this factor because searcher efficiency rates were found to be roughly 50% or one in two birds were found. This rate is similar to that found at other studies of communication towers (Gehring et al. 2009). We used a similar carcass removal rate. Together these reveal a combined multiplier of four for calculating overall fatality rate. Studies of bird carcasses at communication towers reveal that a factor of four is likely to reflect searcher efficiency and carcass removal at a wide variety of habitats beneath communication towers. Gehring et al. (2009) found a factor of about four after completing over 90 individual searcher efficiency and carcass removal trials

(report coauthored by a U.S. Fish and Wildlife Service biologist and a biologist with the Michigan Natural Features Inventory).

Assuming a combined carcass removal and searcher efficiency multiplier of four, we estimate that a total of 28 birds annually were likely killed at the North Boresite Tower during the study period. For the Meteorological Tower, we estimate 52 fatalities annually based on 13 carcasses found. The study period covered a good portion of a year, but it is likely that the fatality rates for these towers is somewhat greater, based on the fact that the searcher efficiency pilot study conducted between October 3, 2008 and February 22, 2009 included a relatively small number of placed carcasses, when compared to the March 1, 2009 through October 2, 2009 period.

6.0 DISCUSSION AND CONCLUSIONS

6.1 Discussion

Field biologists conducted early morning surveys in accordance with the avian and bat study plan for avian point counts (once per week at the two separate survey locations, and then at least twice per week during spring and fall migration periods) and fatality searches (three times per week at all three towers during the migration seasons and one time per week during the remainder). Periodic diurnal avian migration observation days were to be conducted on fall and spring days when weather front movement was conducive to migratory activity. A total of four migration observation days were conducted in Fall 2008, and two days were surveyed in both the Spring 2009 and the Fall 2009 migration seasons.

This level of effort provided NASA a consistent characterization of avian and bat activity throughout the 12-month study period and efficiently allowed staff biologists, who have been working in the Wallops Island vicinity for several years and very familiar with the habitat there, to conduct the work. Although recommended by USFWS staff, radar surveillance of migrating birds and bats was considered and determined to be of much less value in determining avian and bat risk than steadily performing fatality searches at the three tall towers near the proposed wind turbine site. The presence of these towers so close to the proposed wind turbine sites created an excellent opportunity to study fatality at both guyed and unguyed structures, as well as a 355-foot-tall tower that is very similar in height to the 2.0-MW wind turbine. Pre-construction radar surveys are also rarely conducted for small wind energy facilities of two or less wind turbines, because of the expensive cost of such studies in relation to the overall project development costs, as well as their limited value in determining potential risk in such a small total wind turbine rotor-swept area.

Avian observations documented throughout the 12-month study period at the two survey sites just east of the two proposed wind turbine sites were generally unremarkable in terms of species encountered and numbers of birds. Bird species totaling over 100 within a survey period included common species such

as tree swallow, flicker, brant and yellow-rumped warbler. By far the largest numbers of birds observed were snow geese numbering in the hundreds, and even several thousand on one day in November 2008. Over 81 percent of the recorded flight heights were between 0 and 50 feet above ground level, although larger flocks of birds were generally seen at heights over 100 feet above ground or resting in marshes. Less than 2 percent of the observed birds were within the height range of the proposed wind turbine's rotor swept zone and they were generally hunting or feeding and observed in the August/September time period.

With the exception of ten bald eagles, one gull-billed tern and four peregrine falcons, no sensitive avian species were recorded during the point count surveys. Seven of the bald eagles were seen in the spring and three in the fall. Eight were flying or circling at heights ranging from 20 to 50 feet and two were resting. All were located west or northwest of the wind turbine sites. The gull-billed tern was seen on August 3, 2009 flying south of the project site in an easterly direction. The two peregrine falcons spotted during the point count surveys were located flying at 0 to 10 feet above ground level, one in April 2009 to the east of the proposed wind turbine area and one in September 2009 to the west of the project area. Two additional peregrine falcons were observed during migration surveys flying at heights of 100 feet, one on the far marsh in May 2009 and one along the sand dunes in October 2008.

It is important to note that no federally endangered piping plovers were observed in any of the surveys, despite their documented existence approximately three miles away on the northeast shoreline on Wallops Island, as well as three miles away on Assawoman Island. This is not unexpected because they are typically beach nesters and forage along beaches, and not in the marsh habitat that predominates the vicinity of the proposed wind turbine locations. The lack of even one observation of the piping plover during the 12-month survey combined with the lack of viable habitat in the proposed wind turbine area indicates the risk to this species should be very low.

Documented bird and bat fatalities were greatest at the taller South Meteorological Tower (13) than the shorter Northern Boresight Tower (7). Meanwhile, the lack of any observed fatalities at the unguyed Southern Boresight Tower reinforces the concept that guy wires cause greater fatalities than unguyed towers. Searcher efficiency rates for the first half of the study period were approximately 50%, but improved to 68% in the second half. The study plan states that approximately 25 small birds, 25 bats, and 25 mid-large sized birds would be distributed randomly under the three towers. The total number of carcasses planted for efficiency evaluation throughout the study period was 75, with all but six being planted after March 1st. Overall annual fatalities were estimated to be about 28 for the study period for the Northern Boresight Tower and 52 for the Meteorological Tower, based on the numbers of carcasses (or feather clumps) multiplied times standard searcher efficiency and carcass removal rates.

6.2 Conclusions

Flocks of over 50 birds were limited in number and with the exception of the 20,000 snow geese observed on November 20, 2008, most flocks were under 100 birds. The existence of the three tall towers in relatively close proximity to the proposed wind turbine sites presented a unique opportunity to evaluate potential fatality for the proposed project site. In 83 fatality survey days, 25 carcasses, parts, or feathers were found, along with one bat carcass were recovered. These fatalities did not include waterfowl, shorebirds, or raptors, nor did it include endangered or threatened species. In addition, the incomplete remains of birds did not appear to be similar to those of endangered or threatened species.

Because the proposed wind turbine sites are located near several tall structures on Wallops Island, NASA has used these structures as surrogates for wind turbines to study avian and bat fatalities. By studying fatalities at these tall structures, many of which are far riskier to birds bats than wind turbines, an indication of potential risk to nocturnal and diurnal birds that use the airspace above Wallops Island was acquired. The rationale for conducting such studies is that wind turbines and unguyed towers in the same height range are responsible for similar numbers of bird fatalities and that guyed towers of the same height kill far more birds than do wind turbines (Gehring et al. 2009). Our estimates of 28 fatalities annually during the study period at the Boresight Tower and 52 fatalities at the Meteorological Tower are similar to those published in the literature. Gehring et al. (2009) estimated that there were about four fatalities for every carcass found and if their numbers are used to calculate yearly fatality rates, they yield about 70 birds per 475 foot, guyed tower per year. These fatality numbers indicate that the estimates of fatalities from towers on Wallops Island are similar to those found at other communication towers. Because wind turbine fatalities are similar in number to fatalities found at unguyed communication towers, we expect similar numbers of fatalities of birds at the proposed Wallops Island turbines as those found at the unguyed tower we studied at Wallops Island. In addition, the numbers of bird fatalities at the two guyed towers are also not greater than what has been found at 470 foot tall, guyed communication towers studied intensively in Michigan. Thus, despite being a coastal site where large numbers of migrants are present, the numbers of birds killed by the two guyed towers are not in excess of communication towers found inland, lending support to our contention that the two wind turbines proposed for Wallops Island are not likely to experience extraordinary or biologically significant numbers of fatalities.

NASA has been closely monitoring the post-construction wildlife studies that have been conducted by the New Jersey Audubon Society (NJAS) at the existing Jersey Atlantic Wind, LLC/Atlantic City Utilities Authority five-turbine project on the Atlantic coastline in Atlantic City, New Jersey. It is a very similar setting to the Wallops Island environment and has allowed for a meaningful assessment of the type of impacts that might occur at the proposed project site. Results of site-specific bird and bat fatality studies taking place between August 2007 and December 2008 have been published and during this period carcasses of 30 birds (17 species) and 53 bats (2 species – red and hoary) were discovered near the

operating wind turbines. Of these carcasses the only sensitive species was a single peregrine falcon, while gulls (9) and common passerines were the most common finds. Carcass searches have taken place three days per week at each wind turbine during the study period. In addition, weekly ten-minute avian point counts and searcher efficiency studies have been part of this post-construction monitoring effort. The results regarding relatively low avian and bat fatality at this five-turbine project over a 17-month period lend strong support to the potential for the Wallops Island two-turbine demonstration project to cause low risk to a similar coastal avian community. NASA will continue to review the findings of this on-going effort as it develops a post-construction monitoring study for its demonstration project.

As a demonstration project, the installation of the two wind turbines will allow for continued avian and bat field studies, including the possible integration of different operational parameters when researching fatality or avian flight behavior in the vicinity of the wind turbines at different times of the year. Based on the post-construction monitoring results, NASA is willing to periodically adapt its operational regime to better investigate fatality during times of year when avian or bat risk is potentially higher (i.e., migration seasons or nesting periods for specific species).

A proposed monitoring study approach focused solely on documenting wind turbine fatalities is described in Section 7. NASA may also consider conducting post-construction field studies at some time that allow for a comparison of avian and bat fatality at the wind turbine sites with fatalities at the existing tower structures surveyed last year. This would allow NASA to determine differences in fatality at these different structure types, while also observing avian and bat behavior with the addition of wind turbines to Wallops Island.

7.0 PROPOSED POST-CONSTRUCTION AVIAN AND BAT FATALITY SURVEYS

NASA proposes to conduct two non-consecutive years of post-construction fatality surveys within the first three years of project operation. Surveys will include carcass searches, searcher efficiency trials, scavenger removal trials, and estimation of searchable area. These trials will be used to estimate overall avian and bat collision fatalities. Surveys will be conducted from March 1 through November 1. Before commencing this effort, NASA will consult with staff from the U.S. Fish and Wildlife Service (USFWS) and the Virginia Department of Game and Inland Fisheries (VDGIF) to discuss the purpose of the study as well as appropriate search intervals and other logistical matters related to the scavenger removal and searcher efficiency trials. The first year of surveys will take place after the wind energy facility is fully operational. A report of findings will be prepared and reviewed with USFWS and VDGIF staff. Adjustments to the study protocol will be made as deemed necessary and a second year of surveys will follow, likely during the third year of operation. NASA may consider adding a third year of study if warranted.

Fatality Searches

Bird and bat carcass searches will be conducted at each wind turbine within a 120 meter by 120 meter rectangular area. Search plots will be centered at the base of the turbine tower and the area will be searched along transects no more than 5 to 6 meters apart. Searches will be made every three days throughout the study period.

Field surveyors will likely be NASA and U.S. Navy biologists trained in the search protocol. Transects at each of the turbines will be walked slowly to visually locate bird and bat carcasses, including portions of carcasses. Search intervals will vary (i.e., approximately one to two hours per turbine location) depending upon specific ground conditions.

A standardized data sheet will be used for each search. The data sheet will include detailed weather observations, time, date, and observer name and carcass species identification. The data collected will also include:

I. Digital photographs of each carcass, including:

1) the posture and habitat in which it was found;
2) the dorsal and ventral sides;
3) photos that indicate the gender and reproductive condition of bats (if possible); and
4) any identifying characteristics such as bill, foot, wing or tail shape, and plumage coloration for birds.

II. Additionally, data collection will include:

1) turbine number;
2) location of carcass;
3) estimated distance and direction from turbine;
4) distance and bearing from transect from which it was first spotted;
5) condition of carcass (whole or partial, extent of injury and some measure of decomposition to estimate time of death);
6) preliminary estimate of days since death;
7) position of carcass (face-up/down, sprawled, balled up, etc);
8) species, age and sex, if determinable; and
9) substrate conditions when found (marsh/water, short/long grass, dense fragmite cover).

Searches will be initiated during optimal weather conditions, when possible, and to maximize the probability of locating carcasses they will commence as close to sunrise as possible. Carcasses found during the survey effort will be cataloged and stored in a freezer. If observers cannot determine species type because partial bird or bat carcasses were found, USFWS, VDGIF, or expert biologists will be asked to assist in species identification efforts. Where individual feathers, as opposed to carcasses or clumps of feathers (including feather tracts) are found, observers will note these but they will not be considered wind turbine fatalities. Any large fatality events or rare, threatened or endangered species found will be reported to USFWS and VDGIF staff within 48 hours of the discovery.

Weather conditions from the night (for night migrants during the migration season) and day (for other birds) prior to the surveys will be collected from local and national weather databases, or from personal observation at or near the site. If carcasses are found, descriptions of visibility conditions the night prior to the fatality surveys will be investigated and reported, particularly information concerning percent cloud cover and the presence of fog or low cloud ceilings.

Carcass Removal Trials

Carcass removal by scavengers will be monitored using no less than 30 specimens per year and will be performed periodically throughout the survey season. Planted carcasses will include an equal assortment of small birds, large birds and bats (or tailless mice, as bat surrogates). Carcasses will be fresh, inconspicuously marked, and will be placed in various ground cover types and at different turbine locations, should two be built. Carcasses will be monitored daily (during the first week) for removal and thereafter weekly until the carcass disappears. During carcass checks, the location and condition of the carcass will be recorded on standardized data sheets to document the degree of scavenging (e.g., wing missing, tail missing, head missing, breast eaten, etc.) over time. Incidental signs such as tracks or scat adjacent to the carcasses will also be identified and documented.

Searcher Efficiency Trials

To produce the best estimates of fatality, a number of individual searcher efficiency trials will be conducted periodically during the survey period to test searcher efficiency. Marked carcasses of various sizes, taxa and species will be left unbeknownst to the searcher at various locations and in various ground cover types. A record of how many days it took for a carcass to be found will be noted and the searcher efficiency findings, in combination with carcass removal results, will be factored into the fatality search results to calculate an estimated bird and bat fatality rate for the project site.

Searchable Area

As a result of brushy vegetation, water, or other conditions, the area beneath turbines may not be entirely searchable. To adjust for carcasses that may not be found because of this potential bias, those areas

that cannot be searched will be measured via GPS. Using the area that could not be searched, in concert with estimates of the "fall" zone (probability density distribution) of carcasses (bats and birds separately); a calculation of how many birds or bats may have actually been present within the unsearchable areas will be performed. Once this estimate has been made, it can be incorporated into the calculation of overall fatalities at the turbines.

Calculation of Adjusted Fatality Estimates

Using searcher efficiency, carcass removal, and searchable area estimates determined empirically, the overall numbers of bird and bat fatalities will be calculated. The resulting estimates will be larger than the numbers of carcasses found for both birds and bats, as well as for different groups of birds. The methodology to be used will be one of those that have been accepted by the USFWS and various state agencies and, therefore, have been peer-reviewed. The methodology is now being used by Bat Conservation International and the Bat Wind Energy Collaborative, although it has been modified slightly several times. The method do be used for this project will be a variant being developed by biologists with Curry & Kerlinger, LLC (methodology will be available before the end of 2010).

Survey Report

After the completion of each annual fatality survey a report of findings will be prepared. A summary of the results of the fatality searches will include recorded data for each carcass found, including the variables described above. Results of the carcass removal and searcher efficiency studies will also be presented. An estimated fatality rate will be calculated and presented which factors in the combined fatality search, carcass removal and searcher efficiency results. A discussion of the species of carcasses discovered during the fatality search will also be presented. Recommendations for any modifications to subsequent post-construction avian and bat fatality studies at the project site will also be presented.

8.0 LITERATURE CITED

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Attachment 1

Avian Point Counts (Sites 1 and 2) September 12, 2008 – October 1, 2009

Attachment 1: Avian Point Counts (Sites 1 and 2) September 12, 2008 - October 1, 2009

Date	Site	Species	No.	Time	Direction	Behavior	Sector	Height	Path	Notes
9/12/2008	1	Starling	8	0845	S	landing	W	15	1	foraging in myrtles
9/12/2008	1	red-bellied woodpecker	1	0852	N	landing	W	20	1	landed on dead tree
9/12/2008	1	common grackle	2	0854	W	flying	W	30	2	landed on marsh
9/12/2008	1	field sparrow	1	0854		calling	NW	5	1	
9/12/2008	1	bald eagle	1	0854	W	circling	NNW	200	3	
9/12/2008	1	herring gull	1	0854	W	circling	NNW	200	3	harrassing eagle
9/12/2008	1	Starling	2	0857	E	fly to mast	N	80	1	
9/12/2008	1	willet	1	0858		calling	W	10	2	
9/12/2008	1	chickadee	1	0859	N	flying	NW	20	1	
9/12/2008	1	pigeon	2	0859	E	flying	NW	30	1	
9/12/2008	1	willet	1	0900	N	flying	W	20	2	near turbine site.
9/12/2008	1	Starling	3	0901	N	flying	NE	80	1	
9/12/2008	1	Starling	2	0902	N	flying	W	20	1	
9/12/2008	2	yellowthroat	1	0908		scolding	W	5	1	
9/12/2008	2	catbird	1	0914		calling	NW	5	1	
9/12/2008	2	Starling	2	0914	S	flying	W	20	1	
9/12/2008	2	pigeon	2	0915	N	flying	W	40	1	
9/12/2008	2	laughing gull	1	0917	N	flying	NW	20	2	
9/12/2008	2	Starling	4	0918	S	flying	W	20	1	
9/16/2008	1	Starling	2	0819		sitting	S	20	1	
9/16/2008	1	Starling	1	0819	S	flying	E	80	1	
9/16/2008	1	Starling	1	0819	S	flying	W	20	1	
9/16/2008	1	herring gull	1	0820	S	flying	W	40	3	
9/16/2008	1	Canada goose	2	0821	N	flying	W	40	2	
9/16/2008	1	Starling	1	0822	N	flying	W	40	2	
9/16/2008	1	Starling	1	0822	N	flying	E	80	1	
9/16/2008	1	Starling	10	0823	S	flying	E	100	3	
9/16/2008	1	great egret	11	0825	S	flying	E	200	3	
9/16/2008	1	Starling	6	0826	N	flying	E	20	1	
9/16/2008	1	herring gull	1	0829	S	flying	S	100	1	
9/16/2008	2	Chipping sparrow	1	0832	N	scolding	E	1	1	
9/16/2008	2	pigeon	2	0834	N	flying	E	20	1	

Date	Site	Species	No.	Time	Direction	Behavior	Sector	Height	Path	Notes
9/16/2008	2	Carolina wren	1	0836		calling	S	20	1	
9/16/2008	2	Chipping sparrow	1	0838	N	flying	N	10	1	
9/16/2008	2	herring gull	2	0839	N	flying	E	100	3	
9/16/2008	2	Black duck	3	0841	N	flying	N	200	1	
9/16/2008	2	osprey	1	0842	N	hunting	E	100	2	
9/16/2008	2	Black duck	1	0842	S	flying	E	40	3	
9/16/2008	2	Black duck	5	0843	N	flying	E	100	2	
9/24/2008	1	Starling	2	0808		calling	W	80	1	on mast
9/24/2008	1	laughing gull	7	0812	N	flying	W	80	1	
9/24/2008	1	Black duck	3	0814	N	flying	W	10	2	
9/24/2008	1	Starling	3	0814	W	flying	S	30	2	landed 0817 in myrtles
9/24/2008	1	herring gull	1	0815	N	flying	W	20	2	
9/24/2008	1	Starling	1	0817	N	flying	W	10	2	landed in myrtles
9/24/2008	1	herring gull	2	0818	N	flying	W	30	3	
9/24/2008	1	Starling	6	0819	W	flying	W	40	1	landed in dead tree
9/24/2008	2	flicker	1	0822	E	flying	W	30	1	
9/24/2008	2	Starling	2	0823	E	flying	E	20	1	
9/24/2008	2	snowy egret	2	0823	N	flying	W	10	3	
9/24/2008	2	snowy egret	1	0824		standing	W		3	
9/24/2008	2	chickadee	1	0827	N	scolding	W	15	1	in myrtles
9/24/2008	2	tree swallow	12	0827	N	flying	W	50	2	
9/24/2008	2	Starling	1	0827	N	flying	W	30	2	
9/24/2008	2	tree swallow	1	0828	N	flying	W	40	2	
9/24/2008	2	chickadee	2	0829		scolding	E	15	1	in myrtles
9/24/2008	2	flicker	1	0830		calling	S	10	1	
9/24/2008	2	tree swallow	220	0831	N	flying	N	30	1	
9/24/2008	2	snowy egret	1	0832	N	flying	N	20	1	
9/24/2008	2	Canada goose	9	0834	N	flying	N	40	1	
9/24/2008	2	pintail	17	0835	NE	flying	E	40	1	
9/24/2008	2	mallard	3	0835	S	flying	E	30	3	
9/26/2008	1	Starling	10	0813		sitting	S	20	1	on dead tree periodic loud banging noises on marsh
9/26/2008	1	Starling	4	0813	N	flying	E	80	1	land on mast

Date	Site	Species	No.	Time	Direction	Behavior	Sector	Height	Path	Notes
9/26/2008	1	Starling	15	0817	N	flying	E	80	1	land on mast
9/26/2008	1	Black duck	1	0820	N	flying	W	40	2	
9/26/2008	1	Black duck	2	0820	S	flying	W	40	2	
9/26/2008	1	killdeer	1	0822	N	flying	N	70	1	
9/26/2008	1	Carolina wren	1	0824		singing	W	15	1	
9/26/2008	1	Black duck	4	0824	S	flying	W	50	2	
9/26/2008	1	herring gull	1	0826	S	flying	E	100	1	
9/26/2008	1	pigeon	3	0826	S	flying	W	150	2	
9/26/2008	1	herring gull	3	0827	N	flying	W	80	2	
9/26/2008	1	Black duck	1	0828	N	flying	W	110	2	
9/26/2008	2	snowy egret	1	0830		feeding	W	0	2	near turbine site.
9/26/2008	2	tri-colored heron	1	0832	S	flying	W	40	2	
9/26/2008	2	snowy egret	2	0833	S	flying	W	40	2	
9/26/2008	2	Black duck	2	0833	S	flying	W	20	2	
9/26/2008	2	Carolina wren	1	0834		calling	S	15	1	
9/26/2008	2	snowy egret	4	0835	S	flying	W	20	2	
9/26/2008	2	snowy egret	1	0836		feeding	W	0	2	under tower
9/26/2008	2	Black duck	1	0837	N	flying	N	40	3	
9/26/2008	2	laughing gull	2	0837	N	flying	N	40	2	
9/26/2008	2	yellowlegs	2	0838		feeding	W	0	2	
9/26/2008	2	snowy egret	1	0839	S	flying	W	30	2	
9/26/2008	2	Carolina wren	1	0840		calling	W	10	1	
9/26/2008	2	Starling	1	0842	N	flying	W	20	2	
9/26/2008	2	Black duck	2	0843	W	flying	W	15	3	
9/26/2008	2	tri-colored heron	1	0844	S	flying	W	30	3	
9/26/2008	2	boat-tailed grackle	40	0844	N	flying	W	20	3	
9/26/2008	2	yellowlegs	3	0844	N	flying	W	50	3	
9/26/2008	2	laughing gull	1	0845	S	flying	W	10	1	
9/26/2008	2	laughing gull	2	0845	N	flying	W	30	3	
9/30/2008	1	Starling	6	0815		calling	E	80	1	
9/30/2008	1	yellowthroat	1	0818		calling	S	15	1	
9/30/2008	1	flicker	70	0819	S	flying	W	50	2	
9/30/2008	1	red-bellied woodpecker	1	0819	S	perched	S	30	2	
9/30/2008	1	boat-tailed grackle	4	0820	S	flying	W	40	2	

Date	Site	Species	No.	Time	Direction	Behavior	Sector	Height	Path	Notes
9/30/2008	1	black-throated blue warbler	2	0823	S	flying	W	20	2	
9/30/2008	1	catbird	1	0824		perched	W	10	2	
9/30/2008	1	Carolina wren	1	0825		perched	W	15	2	
9/30/2008	1	Starling	1	0826		perched	W	30	2	
9/30/2008	1	goldfinch	1	0829	S	flying	W	20	2	
9/30/2008	1	mourning dove	3	0830	S	flying	W	30	1	
9/30/2008	1	yellow bellied sapsucker	2	0830	S	flying	W	15	2	
9/30/2008	2	song sparrow	5	0834		hunting	W	5	1	
9/30/2008	2	flicker	115	0834	S	flying	E	20	1	
9/30/2008	2	great egret	1	0837		feeding	E	0	3	
9/30/2008	2	boat-tailed grackle	1	0840		perched	E	15	2	
9/30/2008	2	song sparrow	2	0840		calling	E	15	2	
9/30/2008	2	catbird	1	0842		calling	S	15	1	
9/30/2008	2	red-winged blackbird	12	0845	W	flying	W	15	2	
9/30/2008	2	mockingbird	1	0847	S	flying	W	15	1	
9/30/2008	2	boat-tailed grackle	4	0847	S	flying	E	20	2	
9/30/2008	2	red-bellied woodpecker	1	0848	S	flying	E	40	2	
10/2/2008	1	Starling	10	0815		calling	E	80	1	on mast
10/2/2008	1	house finch	5	0818		feeding	S	15	1	
10/2/2008	1	mourning dove	1	0819	N	flying	W	15	1	
10/2/2008	1	flicker	4	0820	S	flying	W	20	1	
10/2/2008	1	pigeon	1	0822		calling	W	80	1	
10/2/2008	1	Cooper's Hawk	2	0823	S	flying	W	50	1	
10/2/2008	1	tree swallow	8	0825	S	flying	W	200	1	
10/2/2008	1	Cooper's Hawk	1	0827	S	flying	W	70	2	
10/2/2008	1	tree swallow	4	0828	S	flying	W	200	1	
10/2/2008	1	Canada goose	6	0829		calling	W	20	3	
10/2/2008	1	ring-billed gull	1	0830	E	flying	W	50	1	
10/2/2008	1	tree swallow	130	0830	S	flying	E	200	3	
10/2/2008	2	herring gull	2	0832	W	flying	W	150	3	
10/2/2008	2	tree swallow	120	0834	S	flying	E	100	3	
10/2/2008	2	Canada goose	11	0835	E	flying	W	20	3	
10/2/2008	2	great egret	1	0836	S	flying	W	10	3	
10/2/2008	2	cormorant	1	0838	N	flying	W	30	3	

Date	Site	Species	No.	Time	Direction	Behavior	Sector	Height	Path	Notes
10/2/2008	2	herring gull	2	0838	W	flying	W	100	3	
10/2/2008	2	great egret	2	0839	S	flying	W	20	3	circlling
10/2/2008	2	yellowlegs	3	0840		feeding	W		2	
10/2/2008	2	ring-billed gull	4	0841	N	flying	W	30	3	
10/2/2008	2	osprey	2	0842	S	flying	W	100	1	
10/2/2008	2	ring-billed gull	1	0842	E	flying	W	100	1	
10/2/2008	2	great egret	1	0843		feeding	W		2	
10/2/2008	2	boat-tailed grackle	13	0844	N	flying	E	40	2	
10/2/2008	2	boat-tailed grackle	20	0845	E	flying	W	20	1	land in myrtles
10/2/2008	2	Cooper's Hawk	1	0846	S	flying	E	100	2	
10/6/2008	1	Starling	2	0822		calling	E	80	1	on mast
10/6/2008	1	song sparrow	1	0825		perched	S	15	1	
10/6/2008	1	white-throated sparrow	2	0825		perched	W	5	1	
10/6/2008	1	boat-tailed grackle	2	0826	N	flying	E	40	1	
10/6/2008	1	pintail	1	0825	N	flying	E	150	2	
10/6/2008	1	house finch	5	0828	N	flying	W	80	2	
10/6/2008	1	Black duck	8	0830	N	flying	W	100	1	
10/6/2008	1	double-crested cormorant	3	0832	S	flying	W	200	3	
10/6/2008	1	house finch	2	0834	N	flying	W	40	2	
10/6/2008	1	flicker	1	0834	S	flying	W	40	2	
10/6/2008	1	red-winged blackbird	2	0835	N	flying	W	40	2	
10/6/2008	1	house finch	2	0835	S	flying	W	40	2	
10/6/2008	1	Carolina wren	1	0837		calling	S	15	1	
10/6/2008	2	yellow-rumped warbler	3	0840		perched	W	15	1	
10/6/2008	2	red-winged blackbird	10	0842	N	flying	W	60	1	
10/6/2008	2	great egret	1	0843		hunting	W		2	
10/6/2008	2	catbird	1	0844		calling	E	20	2	
10/6/2008	2	common grackle	1	0846	N	flying	W	60	3	
10/6/2008	2	great blue heron	3	0846	SE	flying	W	80	3	
10/6/2008	2	red-winged blackbird	1	0847	N	flying	W	60	3	
10/6/2008	2	common grackle	11	0848	N	flying	W	60	1	
10/6/2008	2	flicker	6	0849	N	flying	W	40	1	
10/6/2008	2	yellow-rumped warbler	1	0849	W	flying	W	50	1	
10/6/2008	2	flicker	12	0850	S	flying	W	40	1	

Date	Site	Species	No.	Time	Direction	Behavior	Sector	Height	Path	Notes
10/6/2008	2	common grackle	2	0854	W	flying	W	50	2	
10/6/2008	2	great egret	1	0854		hunting	W	10	3	
10/6/2008	2	Starling	6	0855	N	flying	S	30	1	
10/6/2008	2	herring gull	1	0855	W	flying	S	100	2	
10/8/2008	1	Starling	10	0812		calling	E	80	1	on mast
10/8/2008	1	cormorant	1	0814	N	flying	W	100	1	
10/8/2008	1	yellow-rumped warbler	6	0815	N	perched	W	10	1	working through bushes
10/8/2008	1	herring gull	2	0816	SW	flying	W	200	3	
10/8/2008	1	cowbird	4	0820	N	flying	W	30	2	
10/8/2008	1	flicker	3	0822	S	flying	W	20	1	
10/8/2008	1	song sparrow	1	0822	S	calling	S	15	1	
10/8/2008	1	flicker	1	0823	S	flying	W	15	1	
10/8/2008	1	ring-billed gull	2	0823	S	flying	W	60	2	
10/8/2008	1	herring gull	1	0824	SW	flying	S	60	2	
10/8/2008	1	common grackle	12	0827	N	flying	W	30	2	
10/8/2008	1	pigeon	2	0827		flying	E	80	1	circling mast
10/8/2008	2	great egret	1	0832	S	flying	W	10	3	
10/8/2008	2	cardinal	1	0832		calling	E	15	2	
10/8/2008	2	flicker	1	0833	W	flying	W	20	2	
10/8/2008	2	shorebirds	50	0833		resting	W	0	3	too far to identify
10/8/2008	2	pigeon	1	0834		flying	N	80	1	circling mast
10/8/2008	2	pigeon	8	0835	N	flying	W	50	3	
10/8/2008	2	royal tern	1	0835		hunting	W	30	3	
10/8/2008	2	marsh wren	1	0842		perched	W	20	1	
10/8/2008	2	catbird	1	0842		calling	E	15	1	
10/8/2008	2	herring gull	2	0843	S	flying	E	100	3	
10/8/2008	2	laughing gull	1	0845	W	flying	E	100	1	
10/8/2008	2	flicker	3	0846	S	flying	N	20	1	
10/8/2008	2	pigeon	3	0847		flying	N	80	1	circling mast
10/14/2008	1	cardinal	1	0824		calling	W	15	1	
10/14/2008	1	cormorant	1	0834	N	flying	W	100	2	
10/14/2008	1	brown creeper	1	0834		feeding	W	20	1	
10/14/2008	1	Starling	6	0835		circling	E	80	1	on mast
10/14/2008	1	flicker	1	0835	S	flying	W	100	2	

Date	Site	Species	No.	Time	Direction	Behavior	Sector	Height	Path	Notes
10/14/2008	1	Starling	2	0836	N	flying	W	150	1	
10/14/2008	1	yellow-rumped warbler	12	0837	N	feeding	W	20	1	
10/14/2008	1	yellow-rumped warbler	1	0839	N	flying	W	20	1	
10/14/2008	1	yellow-rumped warbler	2	0840	S	flying	W	20	1	
10/14/2008	1	Starling	3	0840	S	flying	W	60	2	
10/14/2008	1	yellow-rumped warbler	3	0843		feeding	S	20	1	
10/14/2008	2	yellow-rumped warbler	20	0845		feeding	W	15	1	
10/14/2008	2	great egret	2	0846	S	flying	W	20	2	
10/14/2008	2	great egret	2	0847		feeding	W	0	3	
10/14/2008	2	red-winged blackbird	2	0848	N	flying	W	40	1	
10/14/2008	2	Black duck	2	0850		resting	W	0	3	
10/14/2008	2	snowy egret	10	0850		feeding	W	0	3	
10/14/2008	2	marsh hawk	1	0852	N	feeding	W	10	3	
10/14/2008	2	herring gull	1	0853	S	flying	W	140	3	
10/14/2008	2	yellow-rumped warbler	60	0856	N	flying	W	20	1	
10/14/2008	2	yellow-rumped warbler	30	0858	N	flying	E	20	1	
10/14/2008	2	great egret	1	0859	N	flying	W	20	3	
10/14/2008	2	herring gull	1	0859	SW	flying	W	100	3	
10/14/2008	2	cormorant	4	0860		circling	W	40	3	
10/14/2008	2	white-throated sparrow	1	0860		calling	E	15	2	
10/21/2008	1	Starling	10	0815		perched	E	80	1	on mast
10/21/2008	1	pigeon	6	0816		calling	E	80	1	on mast
10/21/2008	1	yellow-rumped warbler	20	0817		feeding	W	20	1	in myrtles
10/21/2008	1	cardinal	1	0819		feeding	W	20	1	in myrtles
10/21/2008	1	red-winged blackbird	1	0820	S	flying	W	100	3	
10/21/2008	1	tree swallow	3	0821	S	flying	W	80	2	
10/21/2008	1	flicker	4	0821	S	flying	W	80	1	
10/21/2008	1	yellow-rumped warbler	1	0821	S	flying	W	80	1	
10/21/2008	1	cardinal	4	0823		feeding	W	10	1	
10/21/2008	1	white-throated sparrow	1	0823		feeding	W	10	1	
10/21/2008	1	robin	2	0824	S	flying	W	10	1	
10/21/2008	1	tree swallow	2	0826	S	flying	W	200	3	
10/21/2008	1	yellow-rumped warbler	30	0827	S	flying	W	100	2	
10/21/2008	1	Starling	6	0827	S	flying	W	40	2	

Date	Site	Species	No.	Time	Direction	Behavior	Sector	Height	Path	Notes
10/21/2008	1	tree swallow	3	0828	S	flying	W	150	1	
10/21/2008	1	pigeon	5	0828	N	flying	W	100	1	
10/21/2008	1	tree swallow	1	0829	S	flying	W	100	2	
10/21/2008	1	pintail	1	0830	E	flying	E	200	2	
10/21/2008	1	snow goose	1000	0830	NE	flying	W	300	3	
10/21/2008	1	yellow-rumped warbler	1	0830	S	flying	W	200	2	
10/21/2008	2	yellow-rumped warbler	40	0834		feeding	W	10	1	
10/21/2008	2	Black duck	2	0835	N	flying	W	100	3	
10/21/2008	2	tree swallow	1	0835	S	flying	E	100	1	
10/21/2008	2	Black duck	2	0837	S	flying	W	20	2	
10/21/2008	2	cormorant	7	0838	S	flying	W	20	3	
10/21/2008	2	Carolina wren	1	0839		calling	W	10	2	
10/21/2008	2	tree swallow	20	0840	N	circling	E	100	2	
10/21/2008	2	white-throated sparrow	1	0841		feeding	W	5	1	
10/21/2008	2	ring-billed gull	1	0841	S	flying	W	100	2	
10/21/2008	2	herring gull	2	0842	W	flying	W	150	2	
10/21/2008	2	tree swallow	20	0843	S	flying	W	200	1	
10/21/2008	2	Black duck	1	0843	N	flying	W	200	3	
10/21/2008	2	catbird	1	0844		calling	W	15	2	
10/29/2008	1	white-throated sparrow	1	0823	N	feeding	W	5	1	
10/29/2008	1	snow goose	140	0825	SW	flying	NE	200	2	
10/29/2008	1	pigeon	10	0825		calling	E	80	1	on mast
10/29/2008	1	snow goose	350	0826	SW	flying	NE	200	2	
10/29/2008	1	yellow-rumped warbler	1	0827	N	feeding	W	2	1	
10/29/2008	1	snow goose	80	0827	SW	flying	NE	200	2	
10/29/2008	1	herring gull	3	0828	S	flying	N	200	2	
10/29/2008	1	pintail	1	0829	S	flying	E	250	3	
10/29/2008	1	Starling	20	0829	S	flying	W	60	2	
10/29/2008	1	snow goose	40	30	SW	flying	NE	300	2	
10/29/2008	1	cowbird	1	0832	N	flying	W	30	2	
10/29/2008	1	yellow-rumped warbler	4	0835	N	flying	W	40	2	
10/29/2008	1	Starling	40	0837	S	flying	W	200	1	
10/29/2008	1	yellow-rumped warbler	4	0837	N	flying	W	100	2	
10/29/2008	1	yellow-rumped warbler	10	0838		feeding	W	10	1	

Date	Site	Species	No.	Time	Direction	Behavior	Sector	Height	Path	Notes
10/29/2008	1	cardinal	1	0838		feeding	W	10	1	
10/29/2008	2	herring gull	7	0840	S	flying	W	100	2	
10/29/2008	2	herring gull	3	0840	S	flying	E	100	3	
10/29/2008	2	Starling	1	0841	S	flying	E	100	3	
10/29/2008	2	yellow-rumped warbler	10	0843		feeding	S	30	1	
10/29/2008	2	Black duck	2	0844	S	flying	N	150	3	
10/29/2008	2	yellow-rumped warbler	5	0845	S	flying	W	50	2	
10/29/2008	2	Starling	20	0845	S	flying	W	50	2	
10/29/2008	2	Black duck	5	0846		feeding	W	0	2	
10/29/2008	2	great blue heron	1	0846		feeding	W	0	2	
10/29/2008	2	Black duck	1	0846	N	flying	W	200	3	
10/29/2008	2	yellow-rumped warbler	2	0848	W	flying	S	50	1	
10/29/2008	2	marsh hawk	1	0850	N	flying	NW	20	3	
10/29/2008	2	herring gull	1	0852	E	flying	N	200	1	
10/29/2008	2	yellow-rumped warbler	1	0853	N	flying	N	100	1	
10/29/2008	2	Starling	30	0854	S	flying	E	50	1	
10/29/2008	2	Starling	10	0855	W	flying	N	100	1	
11/7/2008	1	Starling	10	0818		calling	E	80	1	on mast
11/7/2008	1	cardinal	1	0818		calling	W	10	1	
11/7/2008	1	yellow-rumped warbler	10	0818		feeding	W	10	1	
11/7/2008	1	Cooper's Hawk	1	0822	S	hunting	W	10	1	
11/7/2008	1	Black duck	2	0822	N	flying	W	25	2	
11/7/2008	1	yellowlegs (Greater)	1	0822		calling	M	10	3	
11/7/2008	1	herring gull	2	0824	W	flying	N	100	1	
11/7/2008	1	white-throated sparrow	1	0824		calling	NE	20	2	
11/7/2008	1	cormorant	3	0826	W	flying	N	100	3	
11/7/2008	1	Starling	6	0829	N	flying	W	40	1	
11/7/2008	1	herring gull	1	0829	W	flying	W	100	3	
11/7/2008	1	herring gull	1	0830	E	flying	S	150	1	
11/7/2008	1	pigeon	4	0831		calling	E	80	1	on mast
11/7/2008	1	Black duck	1	0832	N	flying	E	150	3	
11/7/2008	1	herring gull	1	0833		circling	N	100	2	
11/7/2008	2	herring gull	1	0835	N	flying	N	20	3	
11/7/2008	2	red-breasted merganser	1	0835	E	flying	N	120	1	

Date	Site	Species	No.	Time	Direction	Behavior	Sector	Height	Path	Notes
11/7/2008	2	yellow-rumped warbler	15	0835		calling	E	20	2	
11/7/2008	2	catbird	1	0835		calling	E	10	2	
11/7/2008	2	Starling	2	0838	S	flying	W	150	3	
11/7/2008	2	herring gull	4	0838	E	flying	W	150	3	
11/7/2008	2	cormorant	21	0838	E	flying	SW	150	3	
11/7/2008	2	Canada goose	20	0839	N	flying	SW	100	3	
11/7/2008	2	yellow-rumped warbler	2	0844	N	flying	E	80	2	
11/7/2008	2	mourning dove	2	0844	W	flying	E	120	2	
11/7/2008	2	cormorant	1	0844	S	flying	N	100	1	
11/7/2008	2	yellow-rumped warbler	40	0847	N	flying	E	120	2	
11/7/2008	2	yellowlegs (Greater)	1	0847		calling	E	10	3	
11/7/2008	2	snow goose	80	0848	NE	flying	W	200	3	
11/7/2008	2	yellow-rumped warbler	1	0850	S	flying	E	100	2	
11/13/2008	1	pigeon	3	0807	E	flying	N	60	1	
11/13/2008	1	catbird	1	0807		calling	W	10	1	
11/13/2008	1	Black duck	2	0812	N	flying	W	150	3	
11/13/2008	1	yellow-rumped warbler	10	0812		chipping	W	10	1	
11/13/2008	1	pigeon	1	0815	E	flying	W	90	1	
11/13/2008	1	yellow-rumped warbler	1	0815	N	flying	W	150	1	
11/13/2008	1	Canada goose	3	0816		calling	W	0	2	
11/13/2008	1	sharp-shinned hawk	1	0817	S	hunting	W	60	2	
11/13/2008	1	yellow-rumped warbler	1	0817	S	flying	W	100	2	
11/13/2008	1	pigeon	2	0818	N	flying	W	120	2	
11/13/2008	2	yellow-rumped warbler	15	0822		chipping	E&W	10	1	
11/13/2008	2	white-throated sparrow	1	0824		calling	N	10	1	
11/13/2008	2	cardinal	1	0825		calling	W	10	1	
11/13/2008	2	Starling	3	0825	N	flying	W	160	2	
11/13/2008	2	Canada goose	8	0826		swimming	W	0	2	
11/13/2008	2	tree swallow	21	0827	N	flying	W	100	2	
11/13/2008	2	red-winged blackbird	1	0828	N	flying	W	150	1	
11/13/2008	2	Black duck	2	0829	w	flying	w	200	2	
11/13/2008	2	red-winged blackbird	1	0829	N	flying	W	250	2	
11/20/2008	1	herring gull	2	0812	S	flying	W	250	3	
11/20/2008	1	yellow-rumped warbler	5	0812		chipping	W	10	1	

Date	Site	Species	No.	Time	Direction	Behavior	Sector	Height	Path	Notes
11/20/2008	1	herring gull	1	0814	E	flying	E	200	3	
11/20/2008	1	tree swallow	2	0815	N	flying	E	200	2	
11/20/2008	1	junco	5	15		chipping	W	10	1	
11/20/2008	1	Canada goose	15	0816		calling	S	20	2	
11/20/2008	1	junco	1	0817		feeding	W	0	1	
11/20/2008	1	Black duck	2	0818		calling	W	0	2	
11/20/2008	1	Starling	1	0820	S	flying	W	150	3	
11/20/2008	1	yellow-rumped warbler	1	0820	S	flying	W	60	1	
11/20/2008	1	catbird	1	0822		calling	W	10	1	
11/20/2008	1	shorebirds	20	0825	N	flying	W	15	3	too far to identify
11/20/2008	1	American crow	8	0827	N	flying	W	80	2	
11/20/2008	1	yellow-rumped warbler	10	0827	E	flying	W	100	3	
11/20/2008	2	robin	12	0830		calling	E	10	1	
11/20/2008	2	yellow-rumped warbler	30	0830		feeding	E+W	15	1	
11/20/2008	2	white-throated sparrow	3	0831		calling	E	15	1	
11/20/2008	2	catbird	1	0831		calling	E	20	1	
11/20/2008	2	marsh hawk	1	0833	N	hunting	N	20	3	
11/20/2008	2	snow goose	20,000	0833		resting	W	0	3	on a field on the far side of the marsh
11/20/2008	2	yellow-rumped warbler	50	0835	S	flying	W	100	1	
11/20/2008	2	cormorant	1	0835	SE	flying	W	100	3	
11/20/2008	2	mallard	12	0836		feeding	W	0	3	
11/20/2008	2	white-throated sparrow	1	0836		feeding	W	5	1	
11/20/2008	2	yellow-rumped warbler	15	0837	S	flying	W	30	1	
11/20/2008	2	herring gull	1	0840	W	flying	W	60	1	
11/20/2008	2	Black duck	1	0842	W	flying	W	20	3	
11/20/2008	2	great blue heron	1	0842		feeding	W	0	3	
11/20/2008	2	yellow-rumped warbler	15	0844	S	flying	W	20	1	
11/25/2008	1	junco	10	0815		chipping	W	0	1	
11/25/2008	1	Cooper's Hawk	1	0816		hunting	W	10	1	
11/25/2008	1	marsh hawk	1	0816	S	hunting	W	20	2	
11/25/2008	1	mallard	6	0817		calling	W	0	2	
11/25/2008	1	yellow-rumped warbler	2	0822	N	flying	W	60	2	
11/25/2008	1	yellow-rumped warbler	10	0823	S	flying	W	60	1	

Date	Site	Species	No.	Time	Direction	Behavior	Sector	Height	Path	Notes
11/25/2008	1	ring-billed gull	1	0824	E	flying	W	160	2	
11/25/2008	1	Starling	2	0824	S	flying	W	200	2	
11/25/2008	1	yellow-rumped warbler	12	0826		feeding	W	20	1	
11/25/2008	1	chickadee	1	0827		calling	W	20	1	
11/25/2008	1	ring-billed gull	1	0829	S	flying	W	60	1	
11/25/2008	2	robin	2	0832	S	flying	W	15	1	
11/25/2008	2	robin	2	0832	S	flying	W	100	3	
11/25/2008	2	Black duck	2	0835		calling	W	0	2	
11/25/2008	2	robin	50	0834	S	flying	W	60	2	
11/25/2008	2	Black duck	1	0834	S	flying	W	160	3	
11/25/2008	2	white-throated sparrow	15	0835		scolding	W	5	1	
11/25/2008	2	snow goose	10	0840	NE	flying	W	300	3	
11/25/2008	2	tree swallow	1	0842	N	flying	E	100	3	
11/25/2008	2	tree swallow	2	0842	S	flying	E	120	3	
12/2/2008	1	Starling	12	0810		calling	E	80	1	on mast
12/2/2008	1	Starling	2	0814	S	flying	W	50	1	
12/2/2008	1	yellow-rumped warbler	5	0815		chipping	W	10	1	
12/2/2008	1	Starling	10	0817	S	flying	W	50	1	
12/2/2008	1	yellow-rumped warbler	13	0818		circling	W	50	2	
12/2/2008	1	great blue heron	1	0819	S	flying	W	20	1	
12/2/2008	1	yellow-rumped warbler	12	0820		feeding	W	10	1	
12/2/2008	1	Black duck	7	0822	S	flying	W	40	3	
12/2/2008	1	Starling	2	0824	S	flying	N	80	1	
12/2/2008	1	mourning dove	2	0825	S	flying	W	70	2	
12/2/2008	1	yellow-rumped warbler	7	0825	S	flying	W	90	2	
12/2/2008	1	cardinal	1	0825		feeding	W	3	1	
12/2/2008	2	Black duck	2	0828	S	circling	W	60	3	
12/2/2008	2	catbird	1	0829		calling	E	20	1	
12/2/2008	2	herring gull	1	0829	N	flying	W	70	3	
12/2/2008	2	Black duck	2	0831		feeding	W	0	2	
12/2/2008	2	great blue heron	1	0831	N	flying	S	20	1	
12/2/2008	2	snow goose	500	0831	S	flying	W	100	3	on a field on the far side of the marsh
12/2/2008	2	pintail	6	0833		circling	W	60	2	

Date	Site	Species	No.	Time	Direction	Behavior	Sector	Height	Path	Notes
12/2/2008	2	yellow-rumped warbler	1	0835	W	flying	E	40	1	
12/2/2008	2	mallard	1	0840	S	flying	W	100	3	
12/2/2008	2	great blue heron	1	0840	S	flying	W	50	3	
12/2/2008	2	marsh hawk	1	0841		hunting	W	30	3	
12/2/2008	2	snow goose	800	0841	S	flying	W	120	3	on a field on the far side of the marsh
12/2/2008	2	great blue heron	1	0842	W	flying	SE	30	1	
12/2/2008	2	white-throated sparrow	5	0843		scolding	W	5	1	
12/2/2008	2	Cooper's Hawk	1	0843	W	hunting	E	15	1	
12/8/2008	1	yellow-rumped warbler	5	0815		chipping	W	5	1	
12/8/2008	1	herring gull	2	0816		resting	W	0	3	
12/8/2008	1	herring gull	1	0827	S	flying	E	30	1	
12/8/2008	2	yellow-rumped warbler	20	0832		feeding	W	10	1	
12/8/2008	2	song sparrow	2	0833		feeding	W	10	1	
12/8/2008	2	herring gull	12	0834		hunting	W	20	3	
12/8/2008	2	tree swallow	30	0834	S	flying	W	40	3	
12/8/2008	2	tree swallow	2	0838	NE	flying	W	20	1	
12/8/2008	2	tree swallow	11	0841	S	flying	W	40	3	
12/8/2008	2	snow goose	300	0844	N	flying	W	100	3	on a field on the far side of the marsh
12/8/2008	2	red-winged blackbird	1	0844	N	flying	W	120	2	
12/8/2008	2	yellow-rumped warbler	12	0846	S	flying	W	20	1	
12/24/2008	1	starling	10+	0737		vocalizing	E	80	1	on mast
12/24/2008	1	herring gull	1	0740	W	flying	E	100	1	
12/24/2008	1	yellow rumped warbler	1	0742	E	flying	S	30	1	
12/24/2008	1	rock dove	5	0743	SW	flying	W	50	2	
12/24/2008	1	Black duck	1	0746	NE	flying	W	30	2	
12/24/2008	1	herring gull	1	0750	W	flying	E	200	2	
12/24/2008	1	yellow rumped warbler	2	0752	E	flying	W	20	1	
12/24/2008	2	yellow rumped warbler	1	0758	S	flying	W	10	1	
12/24/2008	2	yellow rumped warbler	4	0800		perching	W	10	1	
12/24/2008	2	sparrow spp.	1	0802	ground feeding		W	0	1	
12/24/2008	2	yellow rumped warbler	3	0805	S	flying	W	10	1	
12/24/2008	2	unknown species	1	0807	E	flying	SW	100	2	

Date	Site	Species	No.	Time	Direction	Behavior	Sector	Height	Path	Notes
12/24/2008	2	yellow rumped warbler	6	0808	W	flying	SE	10	1	
1/2/2009	1	Black duck	1	0721	NE	flying	W	50	2	
1/2/2009	1	herring gull	1	0724	w	flying	W	160	2	
1/2/2009	1	herring gull	16	0726	SW	flying	E	160	2	
1/2/2009	1	yellow rumped warbler	1	0727	SW	flying	W	30	2	
1/2/2009	1	Black duck	5	0729	NE	flying	W	50	2	
1/2/2009	2	herring gull	1	0732	E	flying	W	80	2	
1/2/2009	2	Black duck	2	0732	NE	flying	W	50	2	
1/2/2009	2	yellow rumped warbler	1	0738	SW	flying	W	30	2	
1/2/2009	2	herring gull	1	0741	W	flying	N	100	2	
1/2/2009	2	herring gull	1	0742	E	flying	W	80	2	
1/2/2009	2	Black duck	2	0744	NE	flying	N	50	2	
1/2/2009	2	Black duck	12	0745	NE	flying	W	50	2	
1/12/2009	1	Canada goose	12	0835		calling	SE	0	3	
1/12/2009	1	herring gull	1	0845	W	flying	W	100	3	
1/12/2009	1	yellow-rumped warbler	1	0847		scolding	SW	20	1	
1/12/2009	1	yellow-rumped warbler	2	0848	S	flying	S	15	1	
1/12/2009	1	great blue heron	1	0848	N	flying	S	25	1	
1/12/2009	1	Black duck	6	0848	N	flying	W	20	2	
1/12/2009	1	Black duck	3	0849		circling	W	80	2	
1/12/2009	2	Black duck	5	0852		preening	W	0	2	
1/12/2009	2	Canada goose	6	0852		resting	W	0	2	
1/12/2009	2	shoveler	2	0852		feeding	W	0	2	
1/12/2009	2	Black duck	6	0852		feeding	W	0	2	
1/12/2009	2	widgeon	2	0852		feeding	W	0	2	
1/12/2009	2	marsh hawk	1	0855	M	hunting	W	5	2	
1/12/2009	2	herring gull	1	0857	N	flying	W	100	3	
1/12/2009	2	yellow-rumped warbler	1	0858	W	flying	N	15	1	
1/12/2009	2	Black duck	2	0860	N	flying	W	60	2	
1/12/2009	2	yellow-rumped warbler	1	0862	N	flying	W	15	1	
1/12/2009	2	yellow-rumped warbler	1	0864		feeding	W	10	1	
1/12/2009	2	ring-billed gull	1	0865	W	flying	E	60	2	
1/15/2009	1	starling	1	0817		calling	E	80	1	
1/15/2009	1	yellow-rumped warbler	1	0820		feeding	W	20	1	

Date	Site	Species	No.	Time	Direction	Behavior	Sector	Height	Path	Notes
1/15/2009	1	ring-billed gull	1	0821	N	flying	W	160	2	
1/15/2009	1	starling	12	0822	S	flying	W	40	1	
1/15/2009	1	Cooper's Hawk	1	0824	W	hunting	N	40	1	
1/15/2009	1	common grackle	3	0830	S	flying	N	150	1	
1/15/2009	2	Canada goose	6	0831		resting	W	0	2	
1/15/2009	2	Black duck	4	0831		resting	W	0	2	
1/15/2009	2	shoveler	2	0831		resting	W	0	2	
1/15/2009	2	unknown species - peeps	25	0835	N	flying	W	10	3	
1/15/2009	2	ring-billed gull	1	0835	S	flying	W	10	3	
1/15/2009	2	Black duck	6	0836		circling	W	10	3	
1/15/2009	2	herring gull	2	0838	S	flying	W	60	3	
1/15/2009	2	Black duck	2	0838	S	flying	W	60	3	
1/15/2009	2	herring gull	8	0841	S	flying	W	60	3	
1/15/2009	2	kingfisher	1	0843	S	flying	W	30	2	
1/15/2009	2	herring gull	2	0844	S	flying	E	60	2	
1/23/2009	1	starling	12	0812		calling	NE	100	1	on mast
1/23/2009	1	cardinal	1	0813		calling	W	10	1	
1/23/2009	1	cardinal	1	0816		sunning	W	10	1	
1/23/2009	1	Canada goose	5	0818	S	flying	W	20	2	
1/23/2009	1	yellow-rumped warbler	1	0821		feeding	W	20	1	
1/23/2009	1	yellow-rumped warbler	1	0823	S	flying	W	30	1	
1/23/2009	1	yellow-rumped warbler	1	0825	S	flying	W	30	1	
1/23/2009	1	herring gull	1	0826	S	flying	W	200	2	
1/23/2009	2	seaside sparrow	1	0828		sunning	W	5	2	
1/23/2009	2	Cooper's Hawk	1	0832		sunning	W	5	1	
1/23/2009	2	gulls - unidentifiable	50	0834		resting	W	0	3	
1/23/2009	2	gulls - unidentifiable	30	0834		flying	W	30	3	over water beyond marsh
1/23/2009	2	unknown species - peeps	40	0834		resting	W	0	3	
1/23/2009	2	Black duck	1	0841	N	flying	W	100	2	
1/30/2009	1	starling	12	0808		calling	E	80	1	on mast
1/30/2009	1	herring gull	1	0810	W	flying	N	200	1	
1/30/2009	1	mallard	2	0820		calling	W	0	3	
1/30/2009	2	shoveler	2	0821		resting	W	0	2	
1/30/2009	2	widgeon	4	0821		resting	W	0	2	

Date	Site	Species	No.	Time	Direction	Behavior	Sector	Height	Path	Notes
1/30/2009	2	assorted gulls	50	0822		resting	W	0	3	
1/30/2009	2	hooded merganser	2	0822	S	flying	W	10	3	
1/30/2009	2	red-winged blackbird	2	0824		calling	E	15	2	
1/30/2009	2	mockingbird	1	0827		sunning	W	15	1	
1/30/2009	2	Canada goose	20	0828	S	flying	W	20	2	
2/6/2009	1	Canada goose	6	0815		calling	S	0	2	
2/6/2009	1	herring gull	1	0816	S	flying	W	20	3	
2/6/2009	1	great horned owl	2	0817		calling	N	20	2	
2/6/2009	1	herring gull	2	0817	W	flying	N	150	1	
2/6/2009	1	herring gull	1	0818	W	flying	N	150	1	
2/6/2009	1	yellow-rumped warbler	1	0818	S	flying	W	60	2	
2/6/2009	1	rock dove	3	17	S	flying	W	50	1	
2/6/2009	1	herring gull	1	0820	W	flying	N	100	1	
2/6/2009	1	starling	7	0820	E	flying	N	60	1	
2/6/2009	1	yellow-rumped warbler	1	0820	E	flying	N	50	1	
2/6/2009	1	herring gull	1	0822	W	flying	N	100	1	
2/6/2009	1	Black duck	3	0826	S	flying	N	100	1	
2/6/2009	1	pintail	6	0827	E	calling	N	50	1	
2/6/2009	2	white-throated sparrow	12	0830		feeding	W	0	1	
2/6/2009	2	cardinal	5	0830		feeding	W	0	1	
2/6/2009	2	Black duck	4	0834	E	flying	W	80	3	
2/6/2009	2	yellow-rumped warbler	6	0835		feeding	S	0	1	
2/6/2009	2	Black duck	1	0835		resting	W	0	3	
2/6/2009	2	ring-billed gull	5	0836		resting	W	0	3	
2/6/2009	2	herring gull	1	0837	W	flying	N	100	1	
2/13/2009	1	starling	6	0811		calling	N	80	1	on mast
2/13/2009	1	cardinal	5	0813		feeding	S	0	1	
2/13/2009	1	white-throated sparrow	8	0814		feeding	S	0	1	
2/13/2009	1	rock dove	4	0814		sunning	N	80	1	on mast
2/13/2009	1	yellow-rumped warbler	2	0819		feeding	S	0	1	
2/13/2009	1	killdeer	1	0822		calling	E	100	2	
2/13/2009	1	yellow-rumped warbler	2	0823		sunning	W	15	1	
2/13/2009	2	widgeon	4	0827		feeding	W	0	2	
2/13/2009	2	great blue heron	1	0828	N	flying	W	20	3	

Date	Site	Species	No.	Time	Direction	Behavior	Sector	Height	Path	Notes
2/13/2009	2	Black duck	2	0829	S	flying	W	20	2	
2/13/2009	2	yellow-rumped warbler	1	0830	N	flying	W	30	1	
2/13/2009	2	hooded merganser	1	0832		swimming	W	0	2	
2/13/2009	2	great blue heron	1	0837		feeding	W	0	2	
2/13/2009	2	red-winged blackbird	1	0838	N	flying	W	20	2	
2/13/2009	2	Black duck	2	0838		swimming	W	0	2	
2/19/2009	1	cardinal	2	0813		calling	W	10	1	
2/19/2009	1	starling	3	0813		calling	E	80	1	on mast
2/19/2009	1	Canada goose	5	0815		calling	W	0	3	
2/19/2009	1	herring gull	2	0821	N	flying	W	30	3	
2/19/2009	1	herring gull	2	0826	E	flying	W	60	1	
2/19/2009	2	Black duck	4	0827		preening	W	0	2	
2/19/2009	2	hooded merganser	1	0827		preening	W	0	2	
2/19/2009	2	shoveler	1	0827		swimming	W	0	2	
2/19/2009	2	shoveler	20	0830	N	flying	W	30	3	
2/19/2009	2	black back gull	4	0830		hunting	W	40	3	
2/19/2009	2	marsh hawk	1	0837	S	hunting	W	30	3	
2/19/2009	2	red-winged blackbird	1	0842	N	flying	W	60	1	
2/19/2009	2	herring gull	4	0843	W	flying	E	100	2	NOTE: 0850 immature bald eagle hunting in southern direction, W 80 3. Harassed by bb gulls.
2/27/2009		rock dove	2	0813		circling	N	80	1	on mast
2/27/2009	1	killdeer	2	0814		calling	E	0	2	
2/27/2009	1	Canada goose	6	0817		calling	W	0	2	
2/27/2009	1	rock dove	1	0821		circling	N	80	2	
2/27/2009	1	Black duck	1	0822	E	flying	S	30	1	
2/27/2009	1	boat-tailed grackle	1	0823		sunning	S	50	2	
2/27/2009	1	catbird	1	0825		calling	S	20	1	
2/27/2009	2	Canada goose	2	0830		resting	W	0	2	
2/27/2009	2	Black duck	4	0830		resting	W	0	2	
2/27/2009	2	red-winged blackbird	1	0830		calling	W	0	2	
2/27/2009	2	Black duck	2	0834		swimming	W	0	2	

Date	Site	Species	No.	Time	Direction	Behavior	Sector	Height	Path	Notes
2/27/2009	2	widgeon	2	0835		swimming	W	0	2	
2/27/2009	2	Black duck	1	0837	N	flying	W	830	3	
2/27/2009	2	kingfisher	1	0837	N	flying	W	40	3	
2/27/2009	2	yellow-rumped warbler	1	0840	N	flying	E	60	1	
2/27/2009	2	red-winged blackbird	3	0842	S	flying	W	60	2	
3/6/2009	1	Starling	6	0818		calling	N	80	1	on mast
3/6/2009	1	starling	2	0819	N	flying	W	80	1	
3/6/2009	1	rock dove	2	0819		circling	N	80	1	
3/6/2009	1	robin	2	0821		feeding	S	0	1	
3/6/2009	1	cardinal	2	0825		feeding	W	5	1	
3/6/2009	1	house finch	1	0826		calling	S	10	1	
3/6/2009	1	killdeer	2	0827		calling	E	10	2	
3/6/2009	1	herring gull	3	0828	W	flying	N	80	1	
3/6/2009	1	herring gull	2	0830	S	flying	W	30	3	
3/6/2009	2	mallard	8	0834	S	flying	W	20	2	
3/6/2009	2	marsh hawk	1	0837	S	hunting	W	20	2	
3/6/2009	2	Black duck	12	0837	S	flying	W	20	2	
3/6/2009	2	pintail	12	0838	N	flying	W	60	3	
3/6/2009	2	ring-billed gull	50	0839		resting	W	0	3	
3/6/2009	2	herring gull	1	0840	S	flying	W	40	3	
3/6/2009	2	mallard	8	0841	N	flying	W	60	3	
3/6/2009	2	Black duck	2	0841	S	flying	W	40	3	
3/6/2009	2	black back gull	1	0844	S	flying	W	100	3	
3/6/2009	2	robin	4	0846		feeding	E	0	1	
3/6/2009	2	black back gull	3	0847	S	flying	W	60	3	
3/6/2009	2	starling	2	0847	S	flying	W	20	1	
3/13/2009	1	robin	1	0812		feeding	W	0	1	
3/13/2009	1	mockingbird	1	0812		feeding	W	0	1	
3/13/2009	1	cardinal	2	0813		calling	W	0	1	
3/13/2009	1	starling	3	0814		calling	W	0	2	
3/13/2009	2	shoveler	2	0825		feeding	W	0	2	
3/13/2009	2	mallard	14	0826		feeding	W	0	2	
3/13/2009	2	shoveler	8	0827		feeding	W	0	2	
3/13/2009	2	Canada goose	6	0832		calling	W	0	3	

Date	Site	Species	No.	Time	Direction	Behavior	Sector	Height	Path	Notes
3/13/2009	2	yellowlegs (Greater)	1	0834		calling	W	0	2	
3/13/2009	2	white-throated sparrow	4	0835		calling	W	5	2	
3/19/2009	1	starling	1	0820		perching	S	30	1	
3/19/2009	1	herring gull	1	0821	w	flying	S	100	1	
3/19/2009	1	starling	4	0821		calling	S	80	1	
3/19/2009	1	cardinal	1	0822		feeding	S	10	1	
3/19/2009	1	Canada goose	10	0822		calling	S	20	1	
3/19/2009	1	red-winged blackbird	4	0822		calling	W	5	2	
3/19/2009	1	Carolina wren	1	0823		calling	S	10	1	
3/19/2009	1	tree swallow	1	0826		circling	S	100	1	
3/19/2009	1	starling	2	0827	W	flying	E	100	1	
3/19/2009	1	rock dove	1	0827	E	flying	N	80	1	
3/19/2009	1	seaside sparrow	1	0828		feeding	N	0	1	
3/19/2009	1	common grackle	1	0828		perching	S	30	1	
3/19/2009	1	cardinal	1	0829		feeding	S	0	1	
3/19/2009	1	herring gull	3	0833	W	flying	E	100	3	
3/19/2009	2	Canada goose	3	0835		swimming	E	0	2	
3/19/2009	2	mallard	5	0836		swimming	E	0	2	
3/19/2009	2	red-winged blackbird	4	0836		calling	E	5	2	
3/19/2009	2	yellow-rumped warbler	4	0836		feeding	S	10	1	
3/19/2009	2	shoveler	2	0837		feeding	W	0	2	
3/19/2009	2	bald eagle adult	1	-837		resting	W	5	3	
3/19/2009	2	herring gull	30	0838		resting	W	0	3	
3/19/2009	2	meadowlark	1	0839		calling	W	5	2	
3/19/2009	2	ring-billed gull	10	0839	N	flying	W	20	3	
3/19/2009	2	song sparrow	1	0842		feeding	W	5	2	
3/19/2009	2	mockingbird	1	0845		feeding	E	0	1	
3/19/2009	2	red-winged blackbird	2	0846		displaying	S	20	1	
3/26/2009	1	great egret	65	0804	N	flying	S	90	1	
3/26/2009	1	mourning dove	2	0804	N	flying	W	40	2	
3/26/2009	1	red-winged blackbird	2	0805		calling	W	30	1	
3/26/2009	1	starling	5	0805		calling	E	80	1	
3/26/2009	1	white-throated sparrow	7	0810		feeding	S	0	1	
3/26/2009	1	cardinal	1	0810		feeding	S	0	1	

Date	Site	Species	No.	Time	Direction	Behavior	Sector	Height	Path	Notes
3/26/2009	1	Canada goose	12	0815		calling	S	10	2	
3/26/2009	2	widgeon	2	0820		feeding	W	0	2	
3/26/2009	2	mallard	10	0820		feeding	W	0	2	
3/26/2009	2	red-winged blackbird	1	0821		displaying	W	3	3	
3/26/2009	2	common grackle	2	0822		perching	W	5	3	
3/26/2009	2	shoveler	1	0822	N	flying	W	10	3	
3/26/2009	2	yellowlegs (Greater)	1	0824		calling	W	0	3	
3/26/2009	2	great egret	2	0825	N	flying	W	40	2	
3/26/2009	2	great egret	2	0826	N	flying	W	40	2	
3/26/2009	2	red-winged blackbird	2	0827	N	flying	S	20	2	
3/26/2009	2	common grackle	2	0828		calling	N	20	2	
3/26/2009	2	mockingbird	1	0828		calling	N	15	2	
3/30/2009	1	tree swallow	1	0805		perching	W	10	1	
3/30/2009	1	house finch	2	0806		feeding	S	0	1	
3/30/2009	1	cardinal	2	0806		feeding	S	0	1	
3/30/2009	1	white-throated sparrow	4	0806		feeding	S	0	1	
3/30/2009	1	willet	3	0807		calling	W	5	3	
3/30/2009	1	starling	2	0808		calling	E	80	1	on mast
3/30/2009	1	Canada goose	6	0808		calling	W	10	3	
3/30/2009	1	tree swallow	2	0811		circling	W	15	1	
3/30/2009	1	house finch	3	0812		circling	S	10	1	
3/30/2009	1	Starling	1	0813		perching	S	30	1	
3/30/2009	1	Starling	6	0814		calling	E	80	1	on mast
3/30/2009	1	cardinal	1	0816		perching	E	20	2	
3/30/2009	1	common grackle	30	0816		perching	E	20	2	
3/30/2009	1	house finch	3	0818		perching	S	20	1	
3/30/2009	1	rock dove	1	20		calling	E	80	1	on mast
3/30/2009	2	mallard	7	0835		resting	W	0	2	
3/30/2009	2	widgeon	4	0835		resting	W	0	2	
3/30/2009	2	great egret	2	0836		chasing	W	5	3	
3/30/2009	2	chickadee	2	0836		calling	W	10	1	
3/30/2009	2	Black duck	3	0837		resting	W	0	2	
3/30/2009	2	great egret	10	0838	S	flying	W	150	3	
3/30/2009	2	mixed gulls	50	0839		resting	W	0	3	

Date	Site	Species	No.	Time	Direction	Behavior	Sector	Height	Path	Notes
3/30/2009	2	common grackle	1	0839	S	flying	W	100	3	
3/30/2009	2	red-winged blackbird	1	0839		calling	W	3	2	
3/30/2009	2	tree swallow	1	0844	E	flying	W	200	2	
3/30/2009	2	song sparrow	1	0845		perching	W	2	1	
3/30/2009	2	common grackle	4	0845	S	flying	W	150	2	
3/30/2009	2	red-winged blackbird	3	0848		displaying	W	5	2	
3/30/2009	2	house finch	1	0849	S	flying	E	50	3	
3/30/2009	2	Black duck	2	0850	N	flying	W	50	3	
4/6/2009	1	starling	2	0827	na	flitting	E	80	1	day cloudy and slightly foggy, wind out of SE
4/6/2009	1	White throated sparrow (hear	1	0835	NA	singing	N	unkn.	1	
4/6/2009	1	redwinged blackbird (heard)	1	0836	na	calling	E	unkn.	2	
4/6/2009	1	starling	4	0839	S	flying	N	80	1	
4/6/2009	2	flicker	1	0845	E	flying	W	8	1	
4/6/2009	2	G. Egrets	2	0847	S	flying	W	10	2	
4/6/2009	2	Herring Gull	1	0848	S	flying	W	40	3	
4/6/2009	2	Herring Gull	3	0850	na	hunting	W	40-50	3	
4/6/2009	2	Canada Goose	1	0850	na	standing	W	0	2	
4/6/2009	2	Duck spp. Unknown	2	0857	N	landing	W		3	
4/6/2009	2	Redwinged blackbird	1	0858	na	perched	E	10	1	
4/9/2009	1	Starling	4	0815	SE	flying	E	80	1	
4/9/2009	1	Tree swallow	2	0815	SE	flying	E	20	1	
4/9/2009	1	Tree swallow	2	0817	SE	flying	E	60	1	
4/9/2009	1	peregrine falcon	1	0817	N	flying	E	100	1	
4/9/2009	1	Tree swallow	1	0825	SE	flying	E	8	1	
4/9/2009	1	Tree swallow	2	0825	E	flying	N	150	1	
4/9/2009	1	starling	5	0827	SE	flying	E	30	1	
4/9/2009	1	common grackle	2	0828	E	flying	W	80	2	
4/9/2009	1	common grackle	1	0828	W	flying	W	80	1	
4/9/2009	1	cardinal female?	1	0830	N--S	flitting	W	3	2	
4/10/2009	1	starling	1	0802	NA	perched	E	80	1	
4/10/2009	1	tree swallow	2	0803	NA	perched	S	8	1	
4/10/2009	1	tree swallow	1	0805	S	flying	N	120	1	
4/10/2009	1	tree swallow	1	0806	N-S	flying	W	100	2	

Date	Site	Species	No.	Time	Direction	Behavior	Sector	Height	Path	Notes
4/10/2009	1	black duck	2	0808	W	flying	S	80	2	
4/10/2009	1	tree swallow	3	0810	n-S	flying	E	40	2	
4/10/2009	1	tree swallow	2	0812	S	flying	W	80	2	
4/10/2009	1	tree swallow	1	0815	N-S	circling	E	40	1	
4/10/2009	1	starling	1	0816	S	flying	E	80	2	
4/10/2009	2	american crow	1	0820	S	flying	E	30	2	
4/10/2009	2	red-winged blackbird	1	0820	NA	perched	E	15	1	
4/10/2009	2	red-winged blackbird	1	0821	NA	perched	W	15	2	
4/10/2009	2	red-winged blackbird	1	0823	NA	perched	W	5	2	
4/10/2009	2	red-winged blackbird	1	0823	NA	perched	W	20	2	
4/10/2009	2	red-winged blackbird	1	0824	NA	perched	N	8	1	
4/10/2009	2	Canada goose	2	0826	N	fllying	E	100	3	
4/10/2009	2	tree swallow	1	0827	NE	flying	E	30	2	
4/10/2009	2	red-winged blackbird	1	0829	S	flying	W	20	2	
4/10/2009	2	black duck	1	0830	N	landing	W	30	2	
4/10/2009	2	unknown small bird	1	0831	W	flying	W	150	3	
4/10/2009	2	common grackle	5	0832	SE	flying	W	60	2	
4/10/2009	2	unknown small bird	1	0834	SW	flying	E	120	2	
4/10/2009	2	great egret	1	0835	NE	flying	W	150	2	
4/13/2009	1	starling	10+	0804	NA	rched on m	E	50	1	
4/13/2009	1	Unk. Passerine	1	0805	NW	flying	E	60	1	
4/13/2009	1	tree swallow	1	0806	E	flying	E	100	1	
4/13/2009	1	tree swallow	1	0807	E	flying	E	20	1	
4/13/2009	1	starling	1	0808	NA	perched	E	20	1	
4/13/2009	1	unk. Gull (juvenile)	1	0809	E	flying	N	150	2	
4/13/2009	1	herring gull	1	0811	W	flying	N	200	2	
4/13/2009	1	tree swallow	2	0813	N	flying	E	150	1	
4/13/2009	1	house finch	1	0814	NA	perched	W	20	2	
4/13/2009	1	starling	3	0825	NA	perched	E	20	1	
4/13/2009	1	tree swallow	1	0819	N	flying	E	80	1	
4/13/2009	2	red-winged blackbird	1	0826	NA	perched	W	20	2	
4/13/2009	2	red-winged blackbird	1	0826	NA	perched	W	6	2	
4/13/2009	2	red-winged blackbird	1	0828	NA	perched	E	15	1	
4/13/2009	2	unk. Ducks	2	0830	N	landing	W	0	3	

Date	Site	Species	No.	Time	Direction	Behavior	Sector	Height	Path	Notes
4/13/2009	2	unk.tern.	2	0830	N-S	circling	W	20	3	
4/13/2009	2	great egret	1	0834	S	flying	W	40	2	periodic loud banging noises on marsh
4/13/2009	2	grackle	1	0834	S	flying	E	50	2	
4/13/2009	2	grackle	1	0836	SW	flying	S	75	1	
4/13/2009	2	red-winged blackbird	2	0838	S	flying	W	40	2	
4/16/2009	1	red-winged blackbird	3	0825		calling	W	5	2	not in sight
4/16/2009	1	herring gull	2	0827	N	flying	N	200	2	
4/16/2009	1	Unk. Passerine	1	0828	W	flying	W	150	1	(small, black, fast paserine, flew from mast to the marsh)
4/16/2009	1	cardinal	1	0829		perched	W	ground	2	
4/16/2009	1	Carolina wren	3	0829		perched	W	ground	2	
4/16/2009	1	starling	2	0830	N	flying	W	90	1	
4/16/2009	1	Carolina wren	5	0832		perched	W	ground	2	
4/16/2009	1	Cardinal, female	1	0832		perched	W	ground	3	
4/16/2009	1	ducks	8	0835	N	flying	N	15	1	
4/16/2009	1	gull-immature	1	0835	SW	flying	W	50	2	
4/16/2009	1	herring gull	1	0836	NW	flying	W	200	2	
4/16/2009	1	starling	2	0837	N	flying	W	100	1	mast
4/16/2009	2	herring gull	3	0840	N	flying	W	20	2	
4/16/2009	2	herring gull	5	0841	W	flying	W	50	3	circling towards the ground
4/16/2009	2	Canada goose	3	0841		resting	W	0	3	in wtaer
4/16/2009	2	herring gull	3	0842		resting	W	0	3	
4/16/2009	2	gull-immature	1	0843	W	flying	W	30	1	
4/16/2009	2	bald eagle- immature	1	0845	N	flying	W	10	3	
4/16/2009	2	herring gull	2	0847	N	flying	W	10	3	circling towards the ground
4/16/2009	2	unidentified paserine	1	0849	N	flying	E	70	2	black-color (towards sun), weak flight, hovers then dives- maybe Kestel?
4/16/2009	2	herring gull	7	0850	N	flying	W	30	2	
4/16/2009	2	herring gull	1	0851	E	flying	E	30	1	
4/16/2009	2	herring gull	2	0851	N	flying	W	30	2	
4/16/2009	2	herring gull	1	0853	W	flying	W	50	1	

Date	Site	Species	No.	Time	Direction	Behavior	Sector	Height	Path	Notes
4/16/2009	2	black duck	2	0853	S	flying	W	30	1	
4/16/2009	2	herring gull	1	0854	N	flying	S	100	2	4/16/09 very windy conditions following ~2 days of rain
4/17/2009	1	starling	5	0840		perched	E	100	1	4/17/09- outside fenceline; lots of calling, little movement
4/17/2009	1	red-winged blackbird	2	0842		calling	W	10	2	
4/17/2009	1	herring gull	2	0845	N	flying	W	100	2	
4/17/2009	1	cormorant	1	0846	NE	flying	W	150	1	
4/17/2009	1	ducks	3	0847	N	flying	W	80	2	
4/17/2009	1	ducks	2	0847	S	flying	W	40	2	
4/17/2009	1	starling	2	0848	N	flying	S	100	1	
4/17/2009	1	tree swallow	1	0850	N	flying	W	40	2	
4/17/2009	1	tree swallow	2	0852	SE	flying	W	60	1	
4/17/2009	1	osprey	1	0854	E	flying	W	40	1	
4/17/2009	2	red-winged blackbird	2	0857		perched	W	20	1	
4/17/2009	2	great egret	3	0858		standing	W	ground	2	
4/17/2009	2	grackle (boat tail?)	1	0859	SW	flying	W	15	1	
4/17/2009	2	ducks	7	0900	N	flying	W	5	3	
4/17/2009	2	bald eagle	1	0901	N	flying	W	5	2	
4/17/2009	2	gull	1	0903		hunting	W	10	2	diving to hunt
4/17/2009	2	herring gull	1	0906	N	flying	W	20	3	
4/17/2009	2	herring gull	1	0906	S	flying	W	20	3	
4/17/2009	2	ducks	2	0907	S	flying	W	2	3	
4/17/2009	2	tree swallow	1	0908	E	flying	W	20	1	
4/17/2009	2	gulls	2	0909		hunting	W	40	3	diving to hunt
4/17/2009	2	red-winged blackbird	1	0909		perched	W	6	2	
4/17/2009	2	unidentified paserine	1	0909	S	flying	E	70	1	
4/17/2009	2	Canada goose	23	0911	N	flying	E	200	3	
4/17/2009	2	Canada goose	19	0912	N	flying	E	200	3	
4/20/2009	2	red-winged blackbird	1	0845	NA	perched	E	15	2	
4/20/2009	2	tree swallow	1	0844	S	flying	E	70	2	
4/20/2009	2	red-winged blackbird	1	847	NA	perched	W	20	2	
4/20/2009	2	red-winged blackbird	1	850	N	flying	W	10	2	

Date	Site	Species	No.	Time	Direction	Behavior	Sector	Height	Path	Notes
4/20/2009	2	unk. Ducks	5	0853	N	flying	W	50	2	
4/20/2009	2	unk. Ducks	50	0855	N	landing	W	100-0	3	
4/20/2009	2	tree swallow	2	0857	E	flying	W	50	1	
4/20/2009	2	unk.ducks	5	0859	N	flying	W	20	3	
4/20/2009	1	starling	2	0902	NA	perching	E	80	1	
4/20/2009	1	starling	1	0903	E	flying	E	80	1	CLOUDY, SLIGHTLY FOGGY
4/20/2009	1	laughing gull	2	0904	NW	flying	W	90	2	
4/20/2009	1	red-winged blackbird	1	0905	NA	perched	S	10	2	
4/20/2009	1	tree swallow	1	0906	NE	flying	W	30	2	
4/20/2009	1	herring gull	1	0907	SW	flying	E	70	2	
4/20/2009	1	starling	2	0907	E	flying	E	80	1	to mast
4/20/2009	1	tree swallow	2	0909	N-S	circling	W	100	2	
4/20/2009	1	starling	1	0911	N	flying	W	40	1	
4/20/2009	1	starling	1	0914	E	flying	E	80	1	to mast
4/20/2009	1	tree swallow	2	0915	N	flying	E	100	2	
4/21/2009	1	starling	5	0845		perched	E	100	1	4/21- overcast, and wet (rain previous day and night)
4/21/2009	1	tree swallow	3	0846	N	flying	W	40	1	
4/21/2009	1	ducks	2	0846	S	flying	W	40	2	
4/21/2009	1	Canada goose	2	0851		calling	W	ground	3	
4/21/2009	1	Grackle (boat tail?)	1	0851	N	flying	W	20	1	
4/21/2009	1	tree swallow	4	0853	E	flying	E	35	1	
4/21/2009	1	tree swallow	6	0854	N	flying	E	60	1	
4/21/2009	2	red-winged blackbird	2	0900		calling	E		1	many calls at once making them unidentifiable
4/21/2009	2	tree swallow	1	0900	S	flying	S	40	1	
4/21/2009	2	red-winged blackbird	1	0902		perched	W	5	2	
4/21/2009	2	sparrow (chipping?)	1	0906		hopping	W	ground	1	
4/21/2009	2	Canada goose	2	0904		standing	W	ground	2	
4/21/2009	2	sparrow (chipping?)	1	0906		hopping	W	ground	1	
4/21/2009	2	ducks	2	0906	S	flying	W	50	2	
4/21/2009	2	egrets	2	0908		standing	W	ground	3	
4/21/2009	2	red-winged blackbird	1	0909		perched	N	10	1	

Date	Site	Species	No.	Time	Direction	Behavior	Sector	Height	Path	Notes
4/21/2009	2	unknown	4	0910	SE	flying	S	80	1	
4/21/2009	2	ducks/cormorants?	70	0913	N	flying	W	80	3	
4/21/2009	2	red-winged blackbird	1	0913		perched	W	4	2	
4/21/2009	2	Canada goose	3	0914		calling	W	ground	3	
4/21/2009	2	herring gull	1	0915	N	flying	W	30	2	
4/24/2009	2	red-winged blackbird	2	0832	NA	perched	W	20	2	
4/24/2009	2	black duck	2	0833	N	landing	W	200	2	hear numerous killdeer in marsh
4/24/2009	2	herring gull	1	0833	S	flying	W	50	2	
4/24/2009	2	red-winged blackbird	1	0834	E	flying	W	5	2	
4/24/2009	2	fish crow	1	0837	N	flying	E	20	2	
4/24/2009	2	turkey vultures	2	0838	N	flying	W	80	2	
4/24/2009	2	tree swallow	1	0839	S	flying	W	30	2	
4/24/2009	2	starling	1	0840	S	flying	W	30	1	
4/24/2009	2	red-winged blackbird	1	0840	NA	perched	W	5	2	
4/24/2009	2	red-winged blackbird	1	0844	NA	perched	W	5	2	
4/24/2009	2	herring gull	1	0845	E	flying	W	80	2	
4/24/2009	2	american crow	1	0847	NA	perched	W	20	2	
4/24/2009	1	starling	1	0849	E	flying	E	80	1	to mast
4/24/2009	1	red-winged blackbird	4	0850	W	feeding	W	0	1	
4/24/2009	1	tree swallow	2	0852	E	flying	W	20	1	5+ STARLINGS ON MAST
4/24/2009	1	red-winged blackbird	1	0852	E	feeding	W	0	1	
4/24/2009	1	tree swallow	2	0853	W	flying	W	20	1	
4/24/2009	1	tree swallow	1	0853	W	'ched on fe	W	8	1	
4/24/2009	1	tree swallow	1	0854	W	flying	W	8	1	
4/24/2009	1	tree swallow	2	0855	N	flying	E	30	2	
4/24/2009	1	great egret	1	0856	N	flying	W	50	2	
4/24/2009	1	Canada goose	2	0857	S	flying	W	50	2	
4/24/2009	1	Boat tailed grackle	2	0858	S	flying	W	20	1	
4/24/2009	1	starling	2	0859	W	flying	W	80	1	
4/24/2009	1	tree swallow	4	0900	E	flying	W	40	1	
4/24/2009	1	tree swallow	1	0901	S	flying	W	10	1	
4/24/2009	1	starling	1	0902	S	perched	W	20	1	

Date	Site	Species	No.	Time	Direction	Behavior	Sector	Height	Path	Notes
4/24/2009	1	starling	1	0903	N	flying	E	20	1	
4/24/2009	1	red-winged blackbird	1	0904	W	flying	E	50	1	
4/27/2009	1	house finch	1	0755		feeding	S	0	1	
4/27/2009	1	common grackle	1	0755		calling	W	30	1	
4/27/2009	1	tree swallow	6	0755		calling	S	10	1	
4/27/2009	1	starling	3	0757		calling	E	80	1	
4/27/2009	1	Canada goose	6	0858		calling	W	0	2	
4/27/2009	1	willet	2	0858		calling	W	0	2	
4/27/2009	1	cardinal	1	0859	S	flying	W	5	1	
4/27/2009	1	Forster's tern	3	0859		feeding	W	20	3	
4/27/2009	1	red-winged blackbird	2	0800	S	flying	W	100	2	
4/27/2009	1	red-winged blackbird	1	0802		calling	S	30	1	
4/27/2009	1	great egret	2	0803	S	flying	W	60	2	
4/27/2009	1	tree swallow	10	0803		feeding	all	30	1	
4/27/2009	1	cormorant	22	0805	N	flying	E	50	3	
4/27/2009	1	rock dove	2	0807	E	flying	N	70	1	
4/27/2009	1	common grackle	2	0809	S	flying	W	40	1	
4/27/2009	1	house finch	1	0809	S	flying	W	30	1	
4/27/2009	2	willet	2	0813		standing	W	0	2	
4/27/2009	2	mallard	2	0813		standing	W	0	2	
4/27/2009	2	great egret	3	0813	S	flying	W	20	2	
4/27/2009	2	Canada goose	2	0813	N	flying	W	20	2	
4/27/2009	2	house finch	1	0814		calling	W	10	1	
4/27/2009	2	red-winged blackbird	2	0815		calling	W	5	2	
4/27/2009	2	yellow-throat	1	0817		calling	S	5	1	
4/27/2009	2	great egret	2	0818	S	flying	W	30	3	
4/27/2009	2	osprey	1	0818	W	flying	S	40	2	
4/27/2009	2	cardinal	1	0820		calling	S	5	1	
4/27/2009	2	seaside sparrow	3	0820		perched	W	5	2	
4/27/2009	2	meadowlark	1	0821		calling	W	5	3	
4/27/2009	2	common grackle	5	0822		feeding	S	0	1	
4/27/2009	2	barn swallow	2	0823		feeding	W	15	2	
4/27/2009	2	red-winged blackbird	2	0825	N	flying	E	20	2	
4/27/2009	2	black duck	11	0826	N	flying	W	50	2	

Date	Site	Species	No.	Time	Direction	Behavior	Sector	Height	Path	Notes
4/27/2009	2	bald eagle immature	1	0826	S	flying	W	70	2	
4/27/2009	2	cormorant	16	0828	N	flying	W	120	3	
4/29/2009	1	tree swallow	2	0815		hunting	W	10	1	
4/29/2009	1	starling	3	0815		calling	E	80	1	on mast
4/29/2009	1	willet	1	0816		calling	E	0	3	
4/29/2009	1	house finch	1	0817		calling	N	5	1	
4/29/2009	1	pintail duck	2	0820	W	flying	E	200	1	
4/29/2009	1	turkey vultures	2	0821		circling	E	100	2	mowers nearby
4/29/2009	1	Boat tailed grackle	2	0822	E	flying	W	80	2	
4/29/2009	1	killdeer	1	0824	W	flying	E	100	2	
4/29/2009	1	black-backed gull	1	0825	N	flying	E	30	3	
4/29/2009	1	tree swallow	3	0825		hunting	E	40	2	
4/29/2009	1	black duck	2	0828	W	flying	S	50	2	
4/29/2009	2	red-winged blackbird	4	0832		calling	W	5	2	
4/29/2009	2	willet	2	0832		displaying	W	50	2	
4/29/2009	2	Canada goose	2	0833		resting	W	0	2	
4/29/2009	2	willet	4	0833		displaying	W	5	3	mowers left
4/29/2009	2	red-winged blackbird	2	0836	W	flying	E	30	2	
4/29/2009	2	laughing gull	1	0838	N	flying	W	50	2	
4/29/2009	2	herring gull	2	0839	N	flying	S	30	1	
4/29/2009	2	meadowlark	1	0841		calling	E	20	2	
4/29/2009	2	black duck	2	0843	E	flying	W	40	2	
4/29/2009	2	tree swallow	2	0843	N	flying	W	60	2	
4/29/2009	2	herring gull	1	0845	S	flying	W	20	3	
4/29/2009	2	Canada goose	2	0847	N	flying	W	20	3	
4/29/2009	2	herring gull	50	0847	N	flying	W	30	3	
4/30/2009	1	starling	1	0830		perched	S	30	1	
4/30/2009	1	house finch	1	0830		calling	S	10	1	
4/30/2009	1	red-winged blackbird	1	0830		calling	W	5	2	
4/30/2009	1	tree swallow	2	0831		hunting	E	60	1	
4/30/2009	1	starling	3	0831		calling	E	80	1	on mast
4/30/2009	1	house finch	5	0835		feeding	S	0	1	
4/30/2009	1	Canada goose	2	0835		calling	W	0	3	
4/30/2009	1	willet	2	0836		calling	W	0	3	

Date	Site	Species	No.	Time	Direction	Behavior	Sector	Height	Path	Notes
4/30/2009	1	herring gull	1	0837		resting	W	0	3	
4/30/2009	1	common grackle	1	0838		feeding	S	0	1	
4/30/2009	1	rock dove	1	0839		calling	E	80	1	on mast
4/30/2009	2	red-winged blackbird	2	0846		calling	E	15	2	
4/30/2009	2	willet	3	0846		calling	W	0	3	
4/30/2009	2	red-winged blackbird	2	0846		calling	W	5	2	
4/30/2009	2	Canada goose	4	0847		calling	W	0	3	
4/30/2009	2	yellow-throat	1	0847		calling	W	0	2	
4/30/2009	2	seaside sparrow	2	0849		calling	W	3	2	
4/30/2009	2	meadowlark	2	0850		calling	W	3	2	
4/30/2009	2	turkey vultures	1	0852		circling	N	50	2	
4/30/2009	2	red-winged blackbird	3	0853	N	flying	W	40	2	
4/30/2009	2	house finch	1	0854		calling	N	10	2	
4/30/2009	2	willet	2	0856		calling	W	5	2	
4/30/2009	2	bald eagle adult	1	0858		resting	W	3	3	
4/30/2009	2	black duck	1	0859	N	flying	W	6	3	
5/5/2009	1	meadowlark	1	0810		calling	N	10	2	
5/5/2009	1	red-winged blackbird	4	0810		calling	W	5	2	
5/5/2009	1	tree swallow	5	0810		hunting	S	20	1	
5/5/2009	1	Canada goose	2	0812		calling	W	10	3	
5/5/2009	1	catbird	1	0815		feeding	W	0	1	
5/5/2009	1	willet	2	0815		calling	W	0	3	
5/5/2009	1	chat	1	0815		calling	S	20	1	
5/5/2009	1	black duck	2	0817		calling	W	0	3	
5/5/2009	1	tree swallow	4	0817		perched	S	8	1	
5/5/2009	1	starling	1	0818	E	flying	W	10	1	carrying food
5/5/2009	1	starling	1	0818		preening	W	30	1	
5/5/2009	1	barn swallow	1	0819		hunting	E	10	1	
5/5/2009	1	Boat tailed grackle	1	0819	N	flying	S	20	1	
5/5/2009	1	cormorant	25	0820	N	flying	W	100	3	
5/5/2009	1	yellow-throat	1	0821		calling	W	20	2	
5/5/2009	1	killdeer	1	0822		calling	E	30	2	
5/5/2009	2	red-winged blackbird	1	0830		feeding	N	0	1	
5/5/2009	2	black duck	2	0830	N	flying	W	30	3	

Date	Site	Species	No.	Time	Direction	Behavior	Sector	Height	Path	Notes
5/5/2009	2	Forster's tern	3	0830	S	flying	W	30	3	
5/5/2009	2	great egret	1	0830	N	flying	W	50	3	
5/5/2009	2	great blue heron	1	0830	S	flying	W	50	3	
5/5/2009	2	willet	2	0831		calling	W	0	3	
5/5/2009	2	snowy egret	1	0831		feeding	W	0	3	
5/5/2009	2	red-winged blackbird	4	0832		calling	W	5	2	
5/5/2009	2	willet	1	0832	W	flying	W	10	2	
5/5/2009	2	cormorant	15	0833	N	flying	W	50	3	
5/5/2009	2	meadowlark	1	0833		calling	W	10	2	
5/5/2009	2	yellow-throat	1	0836		calling	W	10	2	
5/5/2009	2	catbird	1	0837	E	flying	N	5	2	
5/5/2009	2	Boat tailed grackle	1	0838	S	flying	W	80	2	
5/5/2009	2	laughing gull	2	0838	W	flying	N	100	2	
5/5/2009	2	tree swallow	2	0839		hunting	W	30	2	
5/5/2009	2	red-winged blackbird	2	0839		feeding	N	0	1	
5/5/2009	2	catbird	1	0840	S	flying	W	10	1	
5/5/2009	2	common crow	3	0844	W	flying	W	40	3	
5/6/2009	1	house finch	2	0835		calling	S	5	2	
5/6/2009	1	red-winged blackbird	1	0835		calling	S	10	1	
5/6/2009	1	tree swallow	8	0835		hunting	S	30	1	
5/6/2009	1	chat	1	0836		calling	S	30	1	
5/6/2009	1	starling	4	0836		calling	E	80	1	on mast
5/6/2009	1	herring gull	1	0836	E	flying	W	90	1	
5/6/2009	1	barn swallow	2	0840		perched	W	10	1	
5/6/2009	1	willet	2	0844		calling	W	0	2	
5/6/2009	1	great egret	2	0842		feeding	W	0	2	
5/6/2009	1	ring-billed gull	1	0843	E	flying	W	30	2	
5/6/2009	1	green heron	1	0844	N	flying	W	30	2	
5/6/2009	1	mourning dove	1	0844		calling	N	10	1	
5/6/2009	1	willet	2	0846		calling	W	10	3	
5/6/2009	1	herring gull	2	0847	N	flying	S	120	2	
5/6/2009	2	willet	3	0852		calling	W	5	3	
5/6/2009	2	bald eagle, adult	1	0853	E	flying	W	20	3	
5/6/2009	2	Forster's tern	1	0853		hunting	W	20	3	

Date	Site	Species	No.	Time	Direction	Behavior	Sector	Height	Path	Notes
5/6/2009	2	snowy egret	3	0854		hunting	W	0	3	
5/6/2009	2	red-winged blackbird	2	0856		calling	W	20	1	
5/6/2009	2	yellow-throat	1	0858		calling	W	5	2	
5/6/2009	2	Forster's tern	1	0858	W	flying	E	30	2	
5/6/2009	2	Canada goose	2	0859		calling	W	0	2	
5/6/2009	2	great egret	3	0900		feeding	W	0	3	
5/6/2009	2	great egret	1	0901	N	flying	E	30	2	
5/6/2009	2	tree swallow	2	0901		hunting	N	30	1	
5/6/2009	2	great egret	1	0902	N	flying	W	120	2	
5/6/2009	2	catbird	1	0903		calling	N	10	1	
5/6/2009	2	cardinal	1	0903		calling	N	10	1	
5/6/2009	2	great black-backed gull	1	0905	E	flying	N	60	3	
5/6/2009	2	black duck	1	0905		resting	W	0	2	
5/6/2009	2	rock dove	1	0905	S	flying	W	50	2	
5/6/2009	2	indigo bunting	1	0906		calling	N	20	1	
5/6/2009	2	catbird	2	0907		feeding	S	2	1	
5/6/2009	2	meadowlark	1	0907		calling	W	5	2	
5/8/2009	1	starling	3	0755		calling	E	80	1	on mast
5/8/2009	1	willet	2	0755		calling	W	0	3	
5/8/2009	1	Canada goose	2	0756		calling	W	0	3	
5/8/2009	1	cardinal	1	0757		calling	S	0	1	
5/8/2009	1	rock dove	1	0759		circling	E	80	1	on mast
5/8/2009	1	tree swallow	6	0800		hunting	S	20	1	
5/8/2009	1	herring gull	1	0802	W	flying	E	100	1	
5/8/2009	1	killdeer	1	0802		calling	S	30	1	
5/8/2009	1	meadowlark	1	0803		calling	W	0	3	
5/8/2009	1	red-winged blackbird	5	0804		displaying	W	5	2	
5/8/2009	1	house wren	1	0806		calling	5	10	1	
5/8/2009	1	barn swallow	2	0807		circling	S	20	1	
5/8/2009	1	catbird	1	0807		feeding	S	0	1	
5/8/2009	1	chat	1	0808		calling	S	5	1	
5/8/2009	1	herring gull	1	0809	N	flying	S	120	1	
5/8/2009	1	herring gull	3	0810	N	flying	S	200	2	
5/8/2009	2	meadowlark	1	0812		calling	W	5	2	

Date	Site	Species	No.	Time	Direction	Behavior	Sector	Height	Path	Notes
5/8/2009	2	willet	65	0812		circling	W	20	3	
5/8/2009	2	great egret	2	0813	S	flying	W	10	3	
5/8/2009	2	red-winged blackbird	4	0814		calling	W	5	2	
5/8/2009	2	snowy egret	1	0815		hunting	W	0	3	
5/8/2009	2	meadowlark	1	0815		calling	E	10	1	
5/8/2009	2	house wren	1	0815	E	flying	N	5	1	
5/8/2009	2	yellowlegs (Greater)	20	0817		resting	W	0	2	
5/8/2009	2	green heron	1	0819	N	flying	W	20	2	
5/8/2009	2	Forster's tern	1	0821		hunting	W	30	3	
5/8/2009	2	tree swallow	1	0822		hunting	S	20	1	
5/8/2009	2	Canada goose	2	0824		resting	W	0	3	
5/8/2009	2	brant	20	0825		resting	W	0	3	
5/12/2009	1	meadowlark	1	0745		calling	W	0	2	
5/12/2009	1	tree swallow	2	0745		perched	S	7	1	on box
5/12/2009	1	catbird	1	0745		calling	S	10	1	
5/12/2009	1	willet	2	0746		calling	W	0	3	
5/12/2009	1	starling	5	0746		calling	E	80	1	on mast
5/12/2009	1	red-winged blackbird	1	0746		calling	W	5	2	
5/12/2009	1	barn swallow	1	0747	W	flying	N	20	2	
5/12/2009	1	tree swallow	2	0748		perched	S	7	1	
5/12/2009	1	tree swallow	4	0748		hunting	S	30	2	
5/12/2009	1	snowy egret	2	0749		hunting	W	0	3	
5/12/2009	1	great blue heron	1	0749	S	flying	W	20	3	
5/12/2009	1	house wren	1	0752		perched	W	7	1	
5/12/2009	1	Boat tailed grackle	1	0754		perched	S	20	1	
5/12/2009	1	rock dove	2	0755		calling	E	80	1	
5/12/2009	1	herring gull	1	0757	N	flying	E	100	3	
5/12/2009	1	great egret	1	0757	S	flying	E	40	3	
5/12/2009	1	tree swallow	2	0758		perched	N	7	1	on box
5/12/2009	1	tree swallow	4	0758	E	flying	N	15	1	
5/12/2009	2	red-winged blackbird	6	0802		calling	W	5	2	
5/12/2009	2	great egret	1	0802		resting	W	0	2	
5/12/2009	2	willet	4	0803		calling	W	0	2	
5/12/2009	2	peeps	25	0803	S	flying	W	20	3	

Date	Site	Species	No.	Time	Direction	Behavior	Sector	Height	Path	Notes
5/12/2009	2	great egret	6	0803	S	flying	W	40	3	
5/12/2009	2	snowy egret	2	0803	N	flying	W	20	3	
5/12/2009	2	laughing gull	6	0806	S	flying	S	40	2	
5/12/2009	2	great egret	2	0807	N	flying	W	80	2	
5/12/2009	2	catbird	1	0808		calling	E	10	2	
5/12/2009	2	Canada goose	2	0808		calling	W	0	3	
5/12/2009	2	yellow-throat	1	0809		calling	N	5	2	
5/12/2009	2	meadowlark	1	0810		calling	W	5	2	
5/12/2009	2	barn swallow	1	0810	S	flying	W	15	1	
5/12/2009	2	song sparrow	1	0812		flying	W	10	2	
5/12/2009	2	black duck	1	0812	S	flying	W	20	2	
5/12/2009	2	great egret	1	0813	N	flying	W	160	3	
5/12/2009	2	snowy egret	1	0813	N	flying	W	80	2	
5/12/2009	2	mourning dove	1	0814	N	flying	W	20	2	
5/12/2009	2	seaside sparrow	1	0814	W	flying	W	5	2	
5/12/2009	2	Canada goose	2	0816		feeding	W	0	2	with 6 young
5/14/2009	1	starling	6	0755		calling	E	80	1	on mast
5/14/2009	1	yellowthroat	1	0755		calling	S	5	1	
5/14/2009	1	barn swallow	1	0756		hunting	S	20	2	
5/14/2009	1	red-winged blackbird	1	0757		calling	W	5	1	
5/14/2009	1	tree swallow	6	0757		hunting	E	20	1	
5/14/2009	1	common tern	1	0758	S	flying	E	20	3	
5/14/2009	1	fish crow	2	0759	N	flying	S	20	1	
5/14/2009	1	willet	3	0800		calling	W	10	3	
5/14/2009	1	cardinal	1	0800		calling	S	15	1	
5/14/2009	1	Savannah sparrow	1	0801		calling	W	20	1	
5/14/2009	1	seaside sparrow	1	0801		calling	W	20	2	
5/14/2009	1	snowy egret	1	0801	N	flying	N	60	2	
5/14/2009	1	yellow-breasted chat	1	0804		perched	S	30	1	
5/14/2009	1	rock dove	1	0805	S	flying	N	80	1	
5/14/2009	1	Boat tailed grackle	1	0807	S	flying	N	20	1	
5/14/2009	1	ibis	1	0809	N	flying	S	100	2	
5/14/2009	1	meadowlark	1	0810		calling	W	5	2	
5/14/2009	2	cowbird	1	0812		feeding	S	0	1	

Date	Site	Species	No.	Time	Direction	Behavior	Sector	Height	Path	Notes
5/14/2009	2	cormorant	3	0813	N	flying	S	100	1	
5/14/2009	2	willet	4	0814		calling	W	10	2	
5/14/2009	2	red-winged blackbird	4	0814		calling	W	5	2	
5/14/2009	2	great egret	1	0815	S	flying	W	20	3	
5/14/2009	2	tree swallow	1	0815		hunting	W	15	3	
5/14/2009	2	meadowlark	1	0816		calling	W	5	2	
5/14/2009	2	brant	120	0818		resting	W	0	3	
5/14/2009	2	catbird	1	0819		calling	N	15	1	
5/14/2009	2	great egret	3	0820	S	flying	W	30	3	
5/14/2009	2	laughing gull	1	20	S	flying	W	60	3	
5/14/2009	2	peeps	6	0822	S	flying	W	5	3	
5/14/2009	2	Canada goose	2	0822		resting	W	0	3	
5/14/2009	2	mourning dove	1	0823	N	flying	W	20	2	
5/14/2009	2	red-winged blackbird	4	0824	S	flying	W	10	2	
5/14/2009	2	ibis	2	0827	S	flying	W	80	3	
5/14/2009	2	Boat tailed grackle	2	0827	S	flying	W	20	2	
5/18/2009	1	red-winged blackbird	3	0755		calling	S	10	1	
5/18/2009	1	starling	4	0755		calling	E	80	1	on mast
5/18/2009	1	yellowthroat	1	0756		calling	W	10	1	
5/18/2009	1	snowy egret	8	0756		feeding	W	0	2	
5/18/2009	1	tree swallow	2	0758		feeding	S	20	1	
5/18/2009	1	Forster's tern	4	0802		feeding	W	10	2	
5/18/2009	1	red-winged blackbird	2	0803		calling	W	5	2	
5/18/2009	1	house finch	1	0804	N	flying	W	10	1	
5/18/2009	1	barn swallow	1	0805		feeding	S	10	1	
5/18/2009	1	turkey vultures	1	0806	N	flying	S	20	1	
5/18/2009	1	tree swallow	12	0807		feeding	S	25	1	
5/18/2009	1	willet	2	0808		calling	W	0	3	
5/18/2009	2	Forster's tern	3	0812		hunting	W	5	3	
5/18/2009	2	herring gull	2	0812	E	flying	W	30	3	
5/18/2009	2	willet	2	0812		perched	W	3	2	
5/18/2009	2	Boat tailed grackle	1	0813	N	flying	E	15	2	
5/18/2009	2	yellowthroat	1	0815		calling	W	5	2	
5/18/2009	2	willet	6	0815		calling	W	10	3	

Date	Site	Species	No.	Time	Direction	Behavior	Sector	Height	Path	Notes
5/18/2009	2	red-winged blackbird	4	0816		calling	W	5	2	
5/18/2009	2	Canada goose	2	0816		calling	S	10	2	
5/18/2009	2	tree swallow	1	0816		hunting	W	20	2	
5/18/2009	2	least tern	4	0817		hunting	W	5	3	
5/18/2009	2	Canada goose	2	0817		guard young	W	0	2	
5/18/2009	2	Boat tailed grackle	2	0817	N	flying	W	10	2	
5/18/2009	2	seaside sparrow	2	0818		calling	W	5	2	
5/18/2009	2	meadowlark	1	0819		calling	W	5	2	
5/18/2009	2	common crow	1	0820	N	flying	W	40	2	
5/18/2009	2	ibis	1	0820	N	flying	W	50	2	
5/18/2009	2	laughing gull	2	0822	N	flying	W	30	1	
5/18/2009	2	Forster's tern	1	0823		hunting	W	10	3	
5/18/2009	2	great egret	1	0823		hunting	W	0	2	
5/18/2009	2	green heron	1	0824	S	flying	W	15	2	
5/20/2009	1	meadowlark	1	0815		calling	S	5	2	
5/20/2009	1	starling	6	0815		calling	E	80	1	on mast
5/20/2009	1	cardinal	1	0816	S	flying	N	5	1	
5/20/2009	1	rock dove	2	0817	S	flying	W	20	2	
5/20/2009	1	Canada goose	3	0817	N	flying	E	30	3	
5/20/2009	1	red-winged blackbird	4	0817		calling	W	5	2	
5/20/2009	1	tree swallow	2	0818		hunting	W	15	1	
5/20/2009	1	herring gull	1	0819	N	flying	W	30	3	
5/20/2009	1	great egret	1	0819		hunting	W	0	3	
5/20/2009	1	Forster's tern	2	0819	N	flying	W	5	3	
5/20/2009	1	barn swallow	2	0820		hunting	E	10	1	
5/20/2009	1	yellow-breasted chat	1	0822	N	flying	S	10	1	
5/20/2009	1	Forster's tern	3	0823		hunting	W	10	2	
5/20/2009	1	Canada goose	1	0823		resting	W	0	2	
5/20/2009	1	great egret	1	0824	W	flying	S	20	1	
5/20/2009	1	common grackle	2	0825	N	flying	W	20	1	
5/20/2009	2	Canada goose	2	0827		resting	W	0	2	with 6 young
5/20/2009	2	snowy egret	1	0827	N	flying	W	20	2	
5/20/2009	2	catbird	2	0827		calling	E	15	2	
5/20/2009	2	willet	6	0827		calling	W	10	3	

Date	Site	Species	No.	Time	Direction	Behavior	Sector	Height	Path	Notes
5/20/2009	2	red-winged blackbird	8	0828		calling	W	5	2	
5/20/2009	2	peeps	1	0829	S	flying	W	30	3	
5/20/2009	2	Forster's tern	2	0830	S	flying	W	15	3	
5/20/2009	2	least tern	2	0830	S	flying	W	15	3	
5/20/2009	2	great egret	1	0835	S	flying	W	50	3	
5/20/2009	2	tricolor heron	1	0835	S	flying	W	50	3	
5/20/2009	2	killdeer	1	0837		feeding	W	0	2	
5/20/2009	2	Canada goose	3	0838		landing	W	0	2	
5/20/2009	2	turkey vultures	2	0842	N	flying	W	100	3	
5/20/2009	2	killdeer	4	0843		feeding	S	0	1	
5/20/2009	2	black duck	2	0844	W	flying	W	10	2	
5/20/2009	2	mourning dove	1	0845	N	flying	E	20	2	
5/21/2009	1	tree swallow	6	0800		hunting	S	20	1	
5/21/2009	1	starling	4	0800		calling	E	80	1	on mast
5/21/2009	1	barn swallow	2	0801		hunting	W	20	1	
5/21/2009	1	fish crow	1	0801	N	flying	S	30	1	
5/21/2009	1	common grackle	1	0802	W	flying	S	30	1	
5/21/2009	1	house wren	1	0804		calling	S	15	2	
5/21/2009	1	meadowlark	1	0804		calling	W	5	2	
5/21/2009	1	Forster's tern	4	0805		hunting	W	10	3	
5/21/2009	1	great egret	1	0805		hunting	W	0	3	
5/21/2009	1	bald eagle, adult	1	0806	N	flying	W	15	3	
5/21/2009	1	red-winged blackbird	3	0807		calling	W	5	2	
5/21/2009	1	snowy egret	1	0807		perched	N	40	2	
5/21/2009	1	green heron	2	0808	S	flying	W	80	2	
5/21/2009	1	yellowlegs (Greater)	4	0809	S	flying	W	60	2	
5/21/2009	1	common grackle	1	0811	N	flying	W	30	2	
5/21/2009	1	tricolor heron	1	0812	S	flying	W	100	2	
5/21/2009	1	willet	2	0813		calling	W	10	2	
5/21/2009	1	laughing gull	1	0814	W	flying	E	50	2	
5/21/2009	2	Canada goose	3	0818		feeding	S	0	1	with 6 young
5/21/2009	2	red-winged blackbird	6	0818		calling	W	5	2	
5/21/2009	2	black-backed gull	2	0819	N	flying	W	80	2	
5/21/2009	2	great egret	18	0821		hunting	W	0	3	

Date	Site	Species	No.	Time	Direction	Behavior	Sector	Height	Path	Notes
5/21/2009	2	Forster's tern	10	0822		hunting	W	10	3	
5/21/2009	2	willet	1	0823		resting	W	5	2	
5/21/2009	2	meadowlark	1	0824		calling	E	10	2	
5/21/2009	2	tricolor heron	1	0826	N	flying	W	80	3	
5/21/2009	2	willet	6	0828		scolding	W	20	3	
5/21/2009	2	tree swallow	2	0828		hunting	W	30	3	
5/21/2009	2	barn swallow	1	0828		hunting	W	30	3	
5/21/2009	2	catbird	1	0830		calling	S	10	1	
5/21/2009	2	black duck	1	0832		calling	W	0	2	
5/21/2009	2	black duck	3	0833		circling	W	80	3	
5/27/2009	1	starling	6	0815		calling	E	80	1	on mast
5/27/2009	1	red-winged blackbird	2	0815		calling	N	10	2	
5/27/2009	1	house wren	1	0816		calling	S	10	2	
5/27/2009	1	tree swallow	3	0816		hunting	S	15	1	
5/27/2009	1	barn swallow	1	0817		hunting	N	15	1	
5/27/2009	1	great blue heron	1	0817	S	flying	W	20	2	
5/27/2009	1	cardinal	1	0818		calling	S	10	1	
5/27/2009	1	killdeer	1	0819	N	flying	W	10	1	
5/27/2009	1	house wren	1	0823		calling	N	5	2	
5/27/2009	2	willet	1	0832	S	flying	W	5	2	
5/27/2009	2	red-winged blackbird	4	0832		calling	W	5	2	
5/27/2009	2	cardinal	1	0833		calling	N	10	1	
5/27/2009	2	great egret	4	0834	N	flying	W	10	3	
5/27/2009	2	laughing gull	2	0834		flying	W	15	3	
5/27/2009	2	green heron	1	0835	N	flying	W	20	2	
5/27/2009	2	great egret	3	0835		feeding	W	0	3	
5/27/2009	2	tricolor heron	1	0836	S	flying	W	40	2	
5/27/2009	2	barn swallow	2	0836		feeding	N	10	1	
5/27/2009	2	mourning dove	1	0837		resting	S	10	1	
5/27/2009	2	killdeer	1	0838		calling	W	10	2	
5/27/2009	2	ibis	2	0838	S	flying	W	30	2	
5/27/2009	2	mallard	1	0843	W	flying	W	30	2	
5/27/2009	2	great egret	1	0843	N	flying	W	30	2	
5/27/2009	2	meadowlark	1	0844		calling	S	5	2	

Date	Site	Species	No.	Time	Direction	Behavior	Sector	Height	Path	Notes
5/27/2009	2	yellow warbler	1	0845		calling	E	10	2	
5/27/2009	2	mallard	2	0845	E	flying	E	20	2	
5/27/2009	2	Canada goose	2	0845	S	flying	W	30	2	
5/27/2009	2	great egret	1	0846	N	flying	W	20	2	
5/28/2009	1	cardinal	2	0810		feeding	W	0	1	
5/28/2009	1	starling	6	0810		calling	E	80	1	on mast
5/28/2009	1	house wren	2	0811		calling	N	10	1	
5/28/2009	1	common grackle	2	0811	S	flying	N	80	2	
5/28/2009	1	laughing gull	1	0812	W	flying	N	80	2	
5/28/2009	1	meadowlark	1	0813		calling	N	10	2	
5/28/2009	1	willet	3	0814		calling	W	10	2	
5/28/2009	1	tree swallow	4	0816		resting	S	7	1	
5/28/2009	1	red-winged blackbird	1	0821		calling	W	10	2	
5/28/2009	1	common grackle	1	0823	N	flying	S	20	2	
5/28/2009	1	house finch	2	0823		resting	S	30	1	
5/28/2009	1	black & white warbler	1	0825		feeding	W	15	1	
5/28/2009	2	meadowlark	1	0830		calling	W	5	2	
5/28/2009	2	willet	2	0830		calling	W	10	3	
5/28/2009	2	red-winged blackbird	4	0832		calling	W	5	2	
5/28/2009	2	black duck	2	0832		resting	W	0	2	
5/28/2009	2	snowy egret	5	0833		feeding	W	0	3	
5/28/2009	2	ibis	1	0833		feeding	W	0	2	
5/28/2009	2	great egret	6	0833		feeding	W	0	3	
5/28/2009	2	barn swallow	2	0834		hunting	W	10	2	
5/28/2009	2	black backed gull	1	0834	S	flying	W	100	3	
5/28/2009	2	barn swallow	1	0835		hunting	S	20	1	
5/28/2009	2	house wren	1	0835		calling	N	10	2	
5/28/2009	2	yellowthroat	1	0835		calling	E	15	2	
5/28/2009	2	red-winged blackbird	1	0836		feeding	N	0	1	
5/28/2009	2	herring gull	2	0836	S	flying	W	100	3	
5/28/2009	2	laughing gull	10	0838		resting	W	0	3	
5/28/2009	2	great egret	2	0838		resting	W	0	3	
5/28/2009	2	great egret	1	0839	S	flying	W	50	3	
5/28/2009	2	ibis	1	0840	S	flying	W	10	2	

Date	Site	Species	No.	Time	Direction	Behavior	Sector	Height	Path	Notes
5/28/2009	2	common grackle	3	0841	S	flying	W	20	2	
5/28/2009	2	mallard	2	0842	E	flying	S	60	1	
5/28/2009	2	tree swallow	1	0843		hunting	W	20	2	
5/28/2009	2	great egret	1	0844	N	flying	W	30	2	
5/28/2009	2	Canada goose	15	0845	N	flying	W	10	3	
5/29/2009	1	tree swallow	1	0810		resting	S	7	1	
5/29/2009	1	house wren	2	0810		calling	S	15	2	
5/29/2009	1	starling	5	0810		calling	E	80	1	on mast
5/29/2009	1	catbird	1	0811		calling	W	15	1	
5/29/2009	1	laughing gull	3	0813	S	flying	W	20	2	
5/29/2009	1	common grackle	1	0815	S	flying	E	10	1	
5/29/2009	1	killdeer	1	0810		calling	N	20	1	
5/29/2009	1	barn swallow	2	0816		hunting	N	20	2	
5/29/2009	1	tree swallow	2	0818		hunting	W	30	2	
5/29/2009	1	black-poll warbler	5	0818		hunting	W	20	1	
5/29/2009	1	red-winged blackbird	4	0819	W	flying	W	10	2	
5/29/2009	1	rock dove	3	0820		calling	E	80	1	on mast
5/29/2009	1	Boat tailed grackle	2	0823		perched	W	30	1	
5/29/2009	1	cardinal	2	0824	S	flying	W	15	1	
5/29/2009	1	meadowlark	1	0825		calling	W	5	2	
5/29/2009	2	great egret	1	0827		feeding	W	0	2	
5/29/2009	2	meadowlark	1	0827		calling	W	5	2	
5/29/2009	2	laughing gull	6	0828	S	flying	W	10	3	
5/29/2009	2	willet	8	0828		calling	W	0	3	
5/29/2009	2	tree swallow	4	0829		hunting	W	10	3	
5/29/2009	2	least tern	2	0829		hunting	W	10	3	
5/29/2009	2	great egret	5	0830		resting	W	0	3	
5/29/2009	2	snowy egret	4	0830		resting	W	0	3	
5/29/2009	2	common tern	2	0831		hunting	W	10	3	
5/29/2009	2	red-winged blackbird	5	0832		calling	W	5	2	
5/29/2009	2	mallard	2	0833	E	flying	W	15	2	
5/29/2009	2	house wren	2	0834		calling	S	5	1	
5/29/2009	2	cormorant	1	0836	S	flying	W	120	3	
5/29/2009	2	common crow	1	0836	E	flying	W	30	3	

Date	Site	Species	No.	Time	Direction	Behavior	Sector	Height	Path	Notes
5/29/2009	2	peeps	1	0837	S	flying	W	100	3	
5/29/2009	2	laughing gull	1	0837	S	flying	E	40	2	
5/29/2009	2	willet	2	0839	S	flying	W	100	2	
5/29/2009	2	Forster's tern	2	0841	S	flying	W	30	3	
5/29/2009	2	snowy egret	1	0842	N	flying	W	40	2	
6/1/2009	1	Boat tailed grackle	1	0810		feeding	S	0	1	
6/1/2009	1	house wren	2	0810		calling	S	5	1	
6/1/2009	1	starling	6	0810		calling	E	80	1	on mast
6/1/2009	1	great egret	2	0812	N	flying	W	20	3	
6/1/2009	1	house finch	1	0814	N	flying	S	5	1	
6/1/2009	1	rock dove	1	0815	N	flying	S	20	1	
6/1/2009	1	tree swallow	4	0816		feeding	S	15	1	
6/1/2009	1	cardinal	1	0810		feeding	W	2	1	
6/1/2009	1	barn swallow	2	0818		feeding	S	10	1	
6/1/2009	1	Forster's tern	1	0820	N	flying	W	10	3	
6/1/2009	1	common grackle	2	0821	N	flying	W	15	2	
6/1/2009	1	common grackle	2	0821	N	flying	S	20	1	
6/1/2009	1	laughing gull	2	0821	N	flying	S	30	2	
6/1/2009	1	red-winged blackbird	1	0823		calling	W	5	2	
6/1/2009	1	great egret	1	0824	N	flying	W	20	2	
6/1/2009	2	ibis	3	0827	N	flying	W	20	3	
6/1/2009	2	great egret	1	0827	N	flying	W	20	3	
6/1/2009	2	red-winged blackbird	4	0827		calling	W	5	2	
6/1/2009	2	snowy egret	1	0828	N	flying	W	15	2	
6/1/2009	2	meadowlark	1	0828		calling	W	5	2	
6/1/2009	2	indigo bunting	1	0828	N	flying	W	15	2	
6/1/2009	2	willet	2	0829		resting	W	5	2	
6/1/2009	2	Canada goose	3	0830	N	flying	W	10	3	
6/1/2009	2	laughing gull	3	0830	S	flying	W	15	3	
6/1/2009	2	Boat tailed grackle	1	0832	N	flying	E	15	2	
6/1/2009	2	tree swallow	2	0832		hunting	W	20	2	
6/1/2009	2	meadowlark	1	0833	N	flying	W	5	2	
6/1/2009	2	great egret	1	0838	N	flying	W	30	2	
6/1/2009	2	willet	6	0840	N	flying	W	30	2	

Date	Site	Species	No.	Time	Direction	Behavior	Sector	Height	Path	Notes
6/1/2009	2	rock dove	2	0841	N	flying	W	60	2	
6/1/2009	2	common tern	1	0841		hunting	W	20	2	
6/1/2009	2	starling	2	0842		resting	S	10	1	
6/3/2009	1	ibis	2	0805	N	flying	W	30	2	
6/3/2009	1	tree swallow	4	0805		hunting	S	20	1	
6/3/2009	1	laughing gull	3	0805	S	hunting	E	30	1	
6/3/2009	1	house wren	2	0807		calling	S	5	1	
6/3/2009	1	meadowlark	1	0807		calling	W	5	2	
6/3/2009	1	great egret	8	0811		feeding	W	0	2	
6/3/2009	1	black duck	1	0812	N	flying	W	10	2	
6/3/2009	1	starling	6	0812		calling	E	80	1	on mast
6/3/2009	1	green heron	1	0814	N	flying	E	50	2	
6/3/2009	1	willet	2	0817		calling	W	10	2	
6/3/2009	1	barn swallow	2	0819		hunting	S	30	1	
6/3/2009	2	yellow warbler	1	0822		calling	E	10	2	
6/3/2009	2	red-winged blackbird	8	0822		calling	W	5	2	
6/3/2009	2	willet	6	0822		calling	W	10	2	
6/3/2009	2	seaside sparrow	1	0823		calling	W	5	2	
6/3/2009	2	greater yellow-legs	3	0824	N	flying	W	10	2	
6/3/2009	2	laughing gull	15	0824	S	flying	W	40	2	not all at once
6/3/2009	2	catbird	1	0826		calling	S	10	1	
6/3/2009	2	meadowlark	1	0826		calling	W	10	2	
6/3/2009	2	great egret	1	0826		feeding	W	0	2	
6/3/2009	2	barn swallow	2	0827		hunting	W	10	2	
6/3/2009	2	least tern	1	0827		hunting	W	10	2	
6/3/2009	2	black duck	2	0828		resting	W	0	2	
6/3/2009	2	great egret	4	0828	S	flying	N	20	2	
6/3/2009	2	snowy egret	1	0834	S	flying	W	10	3	
6/3/2009	2	snowy egret	2	0835	S	flying	W	20	3	
6/3/2009	2	Forster's tern	1	0835		hunting	W	10	3	
6/3/2009	2	Canada goose	1	0835		resting	W	0	3	
6/3/2009	2	common crow	1	0837	N	flying	W	60	3	
6/8/2009	1	common grackle	1	0810	E	flying	S	3	1	
6/8/2009	1	house wren	2	0810		calling	S	10	2	

Date	Site	Species	No.	Time	Direction	Behavior	Sector	Height	Path	Notes
6/8/2009	1	house wren	1	0811		calling	N	10	1	
6/8/2009	1	starling	5	0811		calling	E	80	1	on mast
6/8/2009	1	red-winged blackbird	3	0811		calling	W	5	2	
6/8/2009	1	ibis	1	0811	N	flying	W	20	2	
6/8/2009	1	barn swallow	1	0812		hunting	W	20	1	
6/8/2009	1	laughing gull	4	0815	N	flying	W	30	3	
6/8/2009	1	willet	2	0816		calling	W	10	3	
6/8/2009	1	cardinal	1	0816		calling	S	5	1	
6/8/2009	1	common grackle	1	0820	N	flying	W	40	2	
6/8/2009	1	tree swallow	3	0821		hunting	S	20	1	
6/8/2009	1	Boat tailed grackle	1	0822		hunting	W	0	1	
6/8/2009	1	ibis	2	0823	N	flying	E	30	3	
6/8/2009	1	laughing gull	1	0824	S	flying	E	20	2	
6/8/2009	2	red-winged blackbird	4	0826		calling	W	5	2	
6/8/2009	2	mallard	2	0827	N	flying	W	30	3	
6/8/2009	2	great egret	2	0827	S	flying	W	40	3	
6/8/2009	2	willet	3	0828		calling	W	10	3	
6/8/2009	2	catbird	1	0828		calling	S	5	1	
6/8/2009	2	Boat tailed grackle	1	0829	N	flying	W	5	2	
6/8/2009	2	snowy egret	1	0829	S	flying	W	15	2	
6/8/2009	2	laughing gull	1	0829	E	flying	W	25	2	
6/8/2009	2	great egret	2	0831	N	flying	W	15	3	
6/8/2009	2	red-winged blackbird	6	0831		calling	W	5	2	
6/8/2009	2	tree swallow	1	0831		hunting	W	15	2	
6/8/2009	2	barn swallow	1	0831		hunting	W	15	2	
6/8/2009	2	laughing gull	1	0832	E	flying	S	20	2	
6/8/2009	2	great egret	1	0833	S	flying	W	10	3	
6/8/2009	2	laughing gull	6	0835	S	flying	W	20	3	
6/8/2009	2	willet	1	0835		resting	W	5	2	
6/8/2009	2	tree swallow	2	0836		hunting	W	10	2	
6/8/2009	2	barn swallow	2	0839		hunting	W	10	2	
6/8/2009	2	snowy egret	1	0840	S	flying	W	10	3	
6/8/2009	2	willet	1	0840	S	flying	W	10	3	
6/8/2009	2	meadowlark	1	0840	W	flying	W	30	2	

Date	Site	Species	No.	Time	Direction	Behavior	Sector	Height	Path	Notes
6/8/2009	2	house wren	1	0841		calling	N	10	1	
6/8/2009	2	cardinal	1	0841		calling	N	10	1	
6/9/2009	1	house wren	1	0810		calling	S	10	1	
6/9/2009	1	barn swallow	2	0810		hunting	S	20	1	
6/9/2009	1	cardinal	1	0810		calling	S	10	1	
6/9/2009	1	willet	1	0812		calling	W	10	3	
6/9/2009	1	laughing gull	20	0814		circling	W	30	3	
6/9/2009	1	cardinal	1	0815		calling	W	10	1	
6/9/2009	1	common grackle	1	0815	S	flying	W	20	2	
6/9/2009	1	starling	1	0816	E	flying	N	60	2	
6/9/2009	1	house finch	1	0816		resting	N	10	1	
6/9/2009	1	house wren	1	0816		resting	N	10	1	
6/9/2009	1	common tern	1	0817	E	flying	N	100	2	
6/9/2009	1	tree swallow	2	0818		hunting	S	20	1	
6/9/2009	1	laughing gull	1	0818	N	flying	W	40	2	
6/9/2009	1	common grackle	1	0821	S	flying	W	30	2	
6/9/2009	1	common grackle	1	0822	E	flying	N	15	1	carrying nesting material
6/9/2009	1	great egret	1	0822	E	flying	N	80	3	
6/9/2009	1	common grackle	1	0823	S	flying	N	60	2	
6/9/2009	1	laughing gull	2	0823	S	flying	W	40	1	
6/9/2009	1	red-winged blackbird	1	0825		calling	W	10	2	
6/9/2009	2	red-winged blackbird	2	0827		calling	W	15	1	
6/9/2009	2	great egret	1	0817		hunting	W	0	2	
6/9/2009	2	willet	1	0827		resting	W	5	2	
6/9/2009	2	red-winged blackbird	6	0828		calling	W	5	2	
6/9/2009	2	cormorant	8	0829	W	flying	S	120	2	
6/9/2009	2	snowy egret	4	0830		hunting	W	0	2	
6/9/2009	2	ibis	5	0830		hunting	W	0	2	
6/9/2009	2	laughing gull	4	0831	S	flying	W	40	3	
6/9/2009	2	Forster's tern	2	0832		hunting	W	5	3	
6/9/2009	2	mourning dove	1	0832		calling	N	10	1	
6/9/2009	2	yellow-billed cuckoo	1	0832		calling	S	15	1	
6/9/2009	2	common crow	1	0834	S	flying	S	20	1	
6/9/2009	2	yellow-throat	2	0835		calling	W	10	2	

Date	Site	Species	No.	Time	Direction	Behavior	Sector	Height	Path	Notes
6/9/2009	2	mourning dove	1	0837	N	flying	W	50	2	
6/9/2009	2	ibis	1	0837	S	flying	W	80	2	
6/9/2009	2	ibis	4	0837	N	flying	W	100	2	
6/9/2009	2	catbird	1	0838		calling	S	20	1	
6/9/2009	2	meadowlark	1	0838		calling	W	5	2	
6/9/2009	2	willet	10	0838		calling	W	5	3	
6/9/2009	2	laughing gull	4	0839	S	flying	W	100	2	
6/9/2009	2	snowy egret	1	0840	S	flying	W	20	2	
6/10/2009	1	barn swallow	2	0808		hunting	S	20	1	
6/10/2009	1	house wren	2	0808		calling	S	10	1	
6/10/2009	1	red-winged blackbird	4	0808		calling	W	10	2	
6/10/2009	1	starling	1	0809		perched	S	30	1	
6/10/2009	1	yellow-breasted chat	1	0809		perched	S	30	1	
6/10/2009	1	yellow-throat	1	0810		calling	W	5	2	
6/10/2009	1	yellow-billed cuckoo	1	0811	N	flying	S	5	1	
6/10/2009	1	common crow	2	0812	S	flying	W	60	2	
6/10/2009	1	great egret	1	0814	N	flying	W	10	2	
6/10/2009	1	laughing gull	4	0815	S	flying	W	20	3	
6/10/2009	1	killdeer	1	0816	W	flying	S	10	1	
6/10/2009	1	great egret	1	0817	N	flying	W	30	3	
6/10/2009	1	tree swallow	2	0817		hunting	W	20	2	
6/10/2009	1	common grackle	1	0821		hunting	S	0	1	
6/10/2009	1	great egret	1	0822	N	flying	W	30	3	
6/10/2009	1	common tern	1	0822		hunting	W	10	3	
6/10/2009	2	starling	3	0825		feeding	S	0	1	
6/10/2009	2	red-winged blackbird	8	0825		calling	W	5	2	
6/10/2009	2	catbird	1	0825		calling	W	15	1	
6/10/2009	2	great egret	1	0825	S	flying	W	30	3	
6/10/2009	2	willet	5	0827		calling	W	10	3	
6/10/2009	2	ibis	1	0829		feeding	W	0	3	
6/10/2009	2	osprey	1	0831	S	flying	W	10	3	
6/10/2009	2	willet	1	0832		feeding	W	0	2	
6/10/2009	2	tri-colored heron	1	0833	S	flying	N	20	3	
6/10/2009	2	mallard	2	0833	E	flying	W	25	2	

Date	Site	Species	No.	Time	Direction	Behavior	Sector	Height	Path	Notes
6/10/2009	2	great egret	2	0834		hunting	W	0	3	
6/10/2009	2	barn swallow	3	0834		hunting	W	20	3	
6/10/2009	2	least tern	1	0835		hunting	W	10	3	
6/10/2009	2	laughing gull	10	0835	S	flying	W	30	3	
6/19/2009	1	house wren	2	0800		calling	S	10	1	
6/19/2009	1	barn swallow	2	0800		hunting	S	20	1	
6/19/2009	1	willet	1	0801		calling	W	10	2	
6/19/2009	1	ibis	1	0801	N	flying	W	20	2	
6/19/2009	1	tri-colored heron	1	0803	S	flying	W	30	3	
6/19/2009	1	great egret	1	0803	S	flying	W	30	3	
6/19/2009	1	yellowthroat	1	0805		calling	W	10	2	
6/19/2009	1	ibis	1	0807	N	flying	W	30	2	
6/19/2009	1	great egret	1	0807	N	flying	W	30	3	
6/19/2009	1	starling	1	0808		resting	S	40	1	
6/19/2009	1	tree swallow	2	0809		hunting	S	20	1	
6/19/2009	1	great egret	2	0809	E	flying	W	30	2	
6/19/2009	1	willet	5	0809		calling	W	10	2	
6/19/2009	1	meadowlark	1	0809		calling	W	10	2	
6/19/2009	1	green heron	1	0810	S	flying	N	40	1	
6/19/2009	1	tree swallow	6	0810		hunting	N	20	1	
6/19/2009	1	ibis	1	0812	N	flying	W	20	2	
6/19/2009	1	laughing gull	1	0814	S	flying	W	30	2	
6/19/2009	2	red-winged blackbird	16	0817		calling	W	5	2	
6/19/2009	2	great egret	1	0817	S	flying	W	50	2	
6/19/2009	2	yellowthroat	2	0817		calling	W	5	2	
6/19/2009	2	snowy egret	5	0819		hunting	W	0	2	
6/19/2009	2	great egret	6	0819		hunting	W	0	2	
6/19/2009	2	willet	5	0820		calling	W	5	2	
6/19/2009	2	ibis	1	0821	N	flying	W	20	2	
6/19/2009	2	tri-colored heron	3	0822	S	flying	W	30	3	
6/19/2009	2	tree swallow	6	0822		hunting	W	20	2	
6/19/2009	2	Boat tailed grackle	1	0823		displaying	W	5	3	
6/19/2009	2	ibis	2	0823	S	flying	W	20	2	
6/19/2009	2	Forster's tern	1	0824	W	flying	N	30	2	

Date	Site	Species	No.	Time	Direction	Behavior	Sector	Height	Path	Notes
6/19/2009	2	black duck	2	0824		resting	W	0	2	
6/19/2009	2	mourning dove	2	0825	N	flying	W	10	2	
6/19/2009	2	meadowlark	1	0825		calling	W	5	2	
6/19/2009	2	Forster's tern	2	0827		hunting	W	10	3	
6/25/2009	1	yellow-breasted chat	1	0810		calling	S	30	1	
6/25/2009	1	house wren	1	0810		calling	S	10	1	
6/25/2009	1	ibis	1	0811	N	flying	W	40	2	
6/25/2009	1	willet	2	0812		calling	W	10	3	
6/25/2009	1	tree swallow	3	0812		preening	S	10	1	
6/25/2009	1	yellow-throat	1	0813		calling	W	10	2	
6/25/2009	1	black duck	1	0815	W	flying	W	30	2	
6/25/2009	1	barn swallow	4	0815		hunting	W	20	2	
6/25/2009	1	meadowlark	1	0816		calling	W	10	2	
6/25/2009	1	house finch	3	0816		feeding	W	10	1	
6/25/2009	1	great egret	1	0817	N	flying	W	30	2	
6/25/2009	1	starling	7	0818	S	flying	W	30	2	
6/25/2009	1	laughing gull	1	0819	N	flying	W	80	2	
6/25/2009	1	ibis	4	0820	N	flying	W	40	2	
6/25/2009	1	great egret	1	0822	N	flying	W	40	2	
6/25/2009	1	rock dove	2	0823		calling	N	80	1	on mast
6/25/2009	1	red-winged blackbird	1	0823		calling	W	5	2	
6/25/2009	1	mockingbird	1	0823		calling	S	40	1	
6/25/2009	1	cardinal	1	0824		calling	SE	40	2	
6/25/2009	1	green heron	1	0824	S	flying	N	30	1	
6/25/2009	1	barn swallow	2	0825		fighting	N	5	1	
6/25/2009	2	turkey vultures	2	0827		circling	NE	80	2	
6/25/2009	2	black duck	1	0827	s	flying	W	5	2	
6/25/2009	2	willet	8	0828		calling	W	5	2	
6/25/2009	2	red-winged blackbird	12	0828		calling	W	5	2	
6/25/2009	2	meadowlark	1	0829		calling	W	5	2	
6/25/2009	2	mallard	3	0829		resting	W	0	2	
6/25/2009	2	yellow-throat	1	0830		calling	S	5	1	
6/25/2009	2	laughing gull	4	0831	S	flying	W	10	3	
6/25/2009	2	ibis	1	0832	N	flying	W	20	2	

Date	Site	Species	No.	Time	Direction	Behavior	Sector	Height	Path	Notes
6/25/2009	2	great egret	5	0832		hunting	W	0	3	
6/25/2009	2	Forster's tern	2	0833		hunting	W	10	3	
6/25/2009	2	osprey	1	0834		resting	W	10	3	on nest
6/25/2009	2	snowy egret	3	0834		hunting	W	0	3	
6/25/2009	2	barn swallow	10	0835		hunting	W	20	3	
6/25/2009	2	ibis	1	0835		hunting	W	0	2	
6/25/2009	2	ibis	2	0835	S	flying	W	10	2	
6/25/2009	2	indigo bunting	1	0838		resting	S	20	1	
6/25/2009	2	Canada goose	36	0838		grazing	S	0	1	
6/25/2009	2	willet	10	0838		circling	W	10	3	
6/25/2009	2	ibis	1	0839	N	flying	S	10	1	
6/25/2009	2	black duck	2	0840		resting	W	0	2	
6/25/2009	2	mourning dove	1	0841	N	flying	W	10	2	
6/25/2009	2	ibis	2	0842	N	flying	W	10	2	
6/25/2009	2	black duck	1	0842		resting	W	0	2	
6/25/2009	2	tri-colored heron	1	0842	N	flying	W	30	3	
7/2/2009	1	house wren	1	0700		calling	W	15	1\	
7/2/2009	1	willet	4	0700		calling	W	10	3	
7/2/2009	1	snowy egret	1	0700	N	flying	W	30	2	
7/2/2009	1	barn swallow	1	0700		hunting	N	15	1	
7/2/2009	1	ibis	3	0701	N	flying	W	100	2	
7/2/2009	1	great egret	1	0701	S	flying	W	60	2	
7/2/2009	1	laughing gull	1	0702	W	flying	N	100	1	
7/2/2009	1	osprey	1	0703	W	flying	W	40	3	
7/2/2009	1	tri-colored heron	2	0703	S	flying	W	60	3	
7/2/2009	1	meadowlark	1	0704		calling	W	5	2	
7/2/2009	1	red-winged blackbird	2	0704		calling	W	5	2	
7/2/2009	1	laughing gull	3	0705	S	flying	W	60	3	
7/2/2009	1	great egret	2	0705	S	flying	W	100	2	
7/2/2009	1	barn swallow	3	0705		hunting	W	20	2	
7/2/2009	1	Forster's tern	1	0705		hunting	W	10	3	
7/2/2009	1	snowy egret	1	0706	N	flying	W	70	2	
7/2/2009	1	starling	1	0706	E	flying	W	20	1	
7/2/2009	1	mourning dove	3	0707		calling	S	10	1	

Date	Site	Species	No.	Time	Direction	Behavior	Sector	Height	Path	Notes
7/2/2009	1	starling	1	0707		perched	S	30	1	
7/2/2009	1	ibis	1	0708	W	flying	W	40	2	
7/2/2009	1	willet	2	0708	W	flying	W	40	2	
7/2/2009	1	Boat tailed grackle	1	0709	S	flying	W	10	3	
7/2/2009	1	ibis	1	0710	S	flying	W	60	3	
7/2/2009	1	tri-colored heron	1	0710	S	flying	W	80	3	
7/2/2009	1	snowy egret	1	0710	N	flying	W	30	2	
7/2/2009	1	great egret	1	0712		hunting	W	0	3	
7/2/2009	1	barn swallow	6	0713		hunting	N	30	1	
7/2/2009	1	great egret	1	0714	S	flying	W	60	2	
7/2/2009	1	laughing gull	1	0715	W	flying	S	40	1	
7/2/2009	2	yellow-throat	2	0717		calling	S	15	1	
7/2/2009	2	yellow-billed cuckoo	1	0717		calling	E	15	1	
7/2/2009	2	Canada goose	35	0717		resting	W	0	2	
7/2/2009	2	mourning dove	1	0717	S	flying	W	20	2	
7/2/2009	2	laughing gull	1	0717	W	flying	N	30	1	
7/2/2009	2	willet	7	0718		calling	W	10	3	
7/2/2009	2	barn swallow	4	0717		hunting	W	20	2	
7/2/2009	2	black duck	2	0718	N	flying	W	30	2	
7/2/2009	2	red-winged blackbird	12	0720		calling	W	5	2	
7/2/2009	2	ibis	3	0722	S	flying	W	30	2	
7/2/2009	2	great egret	2	0722	N	flying	W	40	3	
7/2/2009	2	snowy egret	1	0723	N	flying	W	40	2	
7/2/2009	2	laughing gull	2	0723	S	flying	W	40	2	
7/2/2009	2	great egret	1	0725	N	flying	W	30	2	
7/2/2009	2	house wren	1	0727		calling	S	15	1	
7/2/2009	2	mourning dove	1	0727		calling	S	15	1	
7/2/2009	2	great egret	1	0728		hunting	W	0	3	
7/2/2009	2	ibis	2	0729	S	flying	W	30	3	
7/2/2009	2	willet	10	0729		displaying	W	40	3	
7/7/2009	1	red-winged blackbird	2	0843		calling	W	10	2	
7/7/2009	1	house wren	2	0843		calling	N	10	1	
7/7/2009	1	starling	3	0844		calling	E	80	1	on mast
7/7/2009	1	barn swallow	4	0844		resting	W	7	1	

Date	Site	Species	No.	Time	Direction	Behavior	Sector	Height	Path	Notes
7/7/2009	1	ibis	2	0847	N	flying	W	60	2	
7/7/2009	1	ibis	1	0848	N	flying	W	60	1	
7/7/2009	1	ibis	2	0848	N	flying	W	60	3	
7/7/2009	1	ibis	2	0849	N	flying	W	60	2	
7/7/2009	1	herring gull	2	0850	W	flying	N	100	2	
7/7/2009	1	ibis	2	0851	N	flying	W	80	2	
7/7/2009	1	great egret	1	0852	S	flying	W	60	2	
7/7/2009	1	ibis	11	0853	S	flying	W	60	3	
7/7/2009	1	great egret	1	0854	S	flying	W	100	2	
7/7/2009	1	killdeer	2	0854		calling	S	10	1	
7/7/2009	1	laughing gull	1	0855		circling	W	30	2	
7/7/2009	1	tree swallow	4	0856		hunting	S	20	1	
7/7/2009	1	ibis	1	0856	N	flying	S	40	1	
7/7/2009	2	red-winged blackbird	8	0859		calling	W	5	2	
7/7/2009	2	willet	6	0859		calling	W	0	3	
7/7/2009	2	tree swallow	6	0859		hunting	W	10	2	
7/7/2009	2	laughing gull	1	0859	E	flying	W	30	2	
7/7/2009	2	yellow-throat	2	0859		calling	W	5	2	
7/7/2009	2	meadowlark	2	0900		calling	W	5	2	
7/7/2009	2	ibis	1	0902	S	flying	W	40	2	
7/7/2009	2	common tern	1	0902		hunting	W	10	3	
7/7/2009	2	laughing gull	6	0904	S	flying	W	80	3	
7/7/2009	2	osprey	2	0904		hunting	W	20	3	feeding young
7/7/2009	2	willet	6	0904		hunting	W	0	3	
7/7/2009	2	ibis	1	0904	S	flying	N	80	3	
7/7/2009	2	common tern	2	0906		hunting	W	20	3	
7/7/2009	2	little blue heron	1	0906	S	flying	W	100	3	
7/7/2009	2	ibis	1	0906	N	flying	W	80	2	
7/7/2009	2	green heron	1	0907	N	flying	W	30	2	
7/7/2009	2	red-winged blackbird	12	0907	W	flying	W	20	2	
7/7/2009	2	great egret	4	0908	S	flying	W	30	3	
7/7/2009	2	ibis	1	0909	N	flying	W	100	2	
7/7/2009	2	green heron	1	0910	N	flying	W	20	2	
7/7/2009	2	catbird	1	0912		calling	S	10	1	

Date	Site	Species	No.	Time	Direction	Behavior	Sector	Height	Path	Notes
7/7/2009	2	black duck	1	0914	S	flying	N	10	3	
7/7/2009	2	great egret	1	0914		hunting	N	0	3	
7/20/2009	1	barn swallow	3	0808		hunting	S	10	1	
7/20/2009	1	starling	4	0808		calling	E	80	1	on mast
7/20/2009	1	ibis	1	0813	S	flying	W	30	2	
7/20/2009	1	rock dove	12	0813	N	flying	W	30	1	
7/20/2009	1	house wren	1	0814		calling	N	20	1	
7/20/2009	1	ibis	3	0815	N	flying	W	30	2	
7/20/2009	1	snowy egret	1	0815		hunting	W	0	2	
7/20/2009	1	common grackle	1	0817		perched	S	30	2	
7/20/2009	1	red-winged blackbird	1	0817	N	flying	S	20	1	
7/20/2009	1	great egret	1	0818	N	flying	W	40	2	
7/20/2009	1	catbird	1	0820		hunting	W	15	1	
7/20/2009	1	ibis	1	0822	N	flying	W	30	3	
7/20/2009	1	great egret	1	0823	S	flying	W	50	3	
7/20/2009	2	great egret	1	0825	N	flying	W	50	3	
7/20/2009	2	ibis	7	0826	N	flying	W	30	2	
7/20/2009	2	ibis	4	0826	S	flying	W	50	3	
7/20/2009	2	Forster's tern	1	0826		hunting	W	5	3	
7/20/2009	2	red-winged blackbird	3	0827		c	W	5	2	
7/20/2009	2	meadowlark	1	0827		calling	W	5	2	
7/20/2009	2	Forster's tern	1	0828		hunting	W	5	3	
7/20/2009	2	great egret	1	0828	S	flying	W	80	3	
7/20/2009	2	great egret	1	0828		hunting	W	0	3	
7/20/2009	2	laughing gull	2	0829	S	flying	W	60	3	
7/20/2009	2	yellow-throat	1	0830		calling	W	5	2	
7/20/2009	2	starling	2	0831		preening	S	15	1	
7/20/2009	2	red-winged blackbird	2	0833	S	flying	W	40	2	
7/20/2009	2	great egret	2	0833	N	flying	W	80	3	
7/20/2009	2	green heron	1	0834	N	flying	W	30	2	
7/20/2009	2	ibis	17	0835	S	flying	W	60	3	
7/20/2009	2	snowy egret	1	0837	N	flying	W	40	2	
7/20/2009	2	black duck	1	0838	N	flying	W	10	3	
7/20/2009	2	red-winged blackbird	60	0838		circling	N	5	2	

Date	Site	Species	No.	Time	Direction	Behavior	Sector	Height	Path	Notes
7/20/2009	2	laughing gull	2	0839	N	flying	W	40	3	
7/20/2009	2	osprey	1	0839		resting	W	15	3	on nest
7/20/2009	2	great egret	1	0840	S	flying	W	10	3	
7/20/2009	2	herring gull	1	0840	E	flying	W	30	3	
7/24/2009	1	house wren	1	0820		calling	S	5	1	
7/24/2009	1	killdeer	1	0820		calling	S	10	1	
7/24/2009	1	yellow-throat	1	0821		calling	S	5	2	
7/24/2009	1	ibis	6	0822	N	flying	E	30	2	
7/24/2009	1	starling	14	0823		feeding	S	0	1	
7/24/2009	1	barn swallow	10	0823		hunting	S	15	1	
7/24/2009	1	great egret	2	0825		feeding	W	0	2	
7/24/2009	1	willet	1	0825		calling	W	60	2	
7/24/2009	1	great egret	2	0828	S	flying	W	100	3	
7/24/2009	1	tri-colored heron	1	0828	N	flying	W	100	3	
7/24/2009	1	cardinal	1	0829		calling	S	10	1	
7/24/2009	1	laughing gull	1	0830	W	flying	S	50	1	
7/24/2009	1	willet	4	0830		calling	W	10	3	
7/24/2009	1	laughing gull	3	0832	N	flying	W	40	3	
7/24/2009	1	Forster's tern	2	0832		hunting	W	20	3	
7/24/2009	1	black duck	2	0832	N	flying	W	50	3	
7/24/2009	1	black-backed gull	1	0832	S	flying	W	100	3	
7/24/2009	1	mockingbird	1	0833	S	flying	N	10	1	
7/24/2009	1	ibis	7	0833	S	flying	W	80	3	
7/24/2009	1	great egret	2	0834	N	flying	W	120	3	
7/24/2009	2	black duck	7	0836	N	flying	W	80	2	
7/24/2009	2	great egret	19	0837		feeding	W	0	3	
7/24/2009	2	snowy egret	8	0837		feeding	W	0	3	
7/24/2009	2	greater yellow-legs	1	0838		feeding	W	0	2	
7/24/2009	2	barn swallow	5	0838		hunting	W	10	2	
7/24/2009	2	yellow-throat	2	0838		calling	W	5	1	
7/24/2009	2	red-winged blackbird	3	0838		calling	W	5	2	
7/24/2009	2	laughing gull	2	0842	N	flying	W	20	3	
7/24/2009	2	meadowlark	1	0844		calling	W	10	2	
7/24/2009	2	common tern	1	0845		hunting	W	15	3	

Date	Site	Species	No.	Time	Direction	Behavior	Sector	Height	Path	Notes
7/24/2009	2	great egret	3	0846	N	flying	W	80	3	
7/24/2009	2	tri-colored heron	1	0846	N	flying	W	60	3	
7/24/2009	2	tri-colored heron	1	0846		hunting	W	0	3	
7/24/2009	2	laughing gull	3	0848	N	flying	W	60	3	
7/24/2009	2	willet	2	0848	N	flying	W	20	3	
7/24/2009	2	osprey	1	0848		resting	W	15	3	on nest
7/24/2009	2	great egret	1	0849	N	flying	W	60	2	
7/24/2009	2	tri-colored heron	1	0850	N	flying	W	40	2	
7/24/2009	2	starling	7	0850	N	flying	S	20	1	
7/24/2009	2	great egret	1	0851	N	flying	W	80	3	
7/24/2009	2	tri-colored heron	1	0851	N	flying	W	100	3	
7/24/2009	2	little blue heron	1	0851	N	flying	W	120	3	
7/24/2009	2	laughing gull	2	0851	W	flying	W	60	3	
8/3/2009	1	tree swallow	6	0817		hunting	S	30	1	
8/3/2009	1	starling	4	0817		calling	E	80	1	on mast
8/3/2009	1	house wren	2	0818		calling	S	15	1	
8/3/2009	1	killdeer	2	0820		feeding	S	0	1	
8/3/2009	1	yellow-billed cuckoo	1	0820		calling	S	10	1	
8/3/2009	1	tree swallow	30	0822		hunting	W	30	1	
8/3/2009	1	house finch	1	0823		resting	S	10	1	
8/3/2009	1	great egret	1	0824	S	flying	W	60	3	
8/3/2009	1	gull-billed tern	1	0826	E	flying	S	60	1	***listed species**
8/3/2009	1	red-winged blackbird	1	0826		calling	W	5	2	
8/3/2009	1	yellow-throat	1	0828		calling	W	5	2	
8/3/2009	1	mockingbird	1	0829		resting	W	10	1	
8/3/2009	1	barn swallow	12	0831		resting	E	60	1	with young on mast
8/3/2009	2	yellow-throat	2	0834		calling	S	10	1	
8/3/2009	2	tree swallow	10	0834		hunting	W	20	2	
8/3/2009	2	ibis	20	0834	N	flying	W	30	2	
8/3/2009	2	red-winged blackbird	12	0836		resting	W	10	2	
8/3/2009	2	black-crowned night heron	2	0837	E	flying	W	20	2	
8/3/2009	2	catbird	2	0838		resting	S	20	1	
8/3/2009	2	greater yellow-legs	1	0839		hunting	W	0	2	
8/3/2009	2	great egret	3	0840		hunting	W	0	3	

Date	Site	Species	No.	Time	Direction	Behavior	Sector	Height	Path	Notes
8/3/2009	2	meadowlark	1	0841		calling	W	5	2	
8/3/2009	2	great egret	1	0842	N	flying	W	100	3	
8/3/2009	2	house wren	1	0844		calling	S	15	1	
8/3/2009	2	osprey	1	0845	E	flying	N	100	2	
8/3/2009	2	laughing gull	1	0845	W	flying	N	120	2	
8/3/2009	2	great egret	1	0845	N	flying	W	100	2	
8/3/2009	2	great egret	1	0846	S	flying	W	60	3	
8/3/2009	2	great egret	1	0847	S	flying	W	100	3	
8/3/2009	2	snowy egret	1	0847	S	flying	W	100	3	
8/3/2009	2	green heron	1	0847	N	flying	W	80	2	
8/3/2009	2	cardinal	1	0848		calling	E	15	2	
8/13/2009	1	tree swallow	8	0809		hunting	S	40	1	
8/13/2009	1	laughing gull	1	0810	E	flying	S	60	1	
8/13/2009	1	starling	1	0810		resting	S	40	2	
8/13/2009	1	rock dove	3	0811	N	flying	W	30	2	
8/13/2009	1	cardinal	1	0812	N	flying	W	5	1	
8/13/2009	1	killdeer	1	0812		calling	N	0	1	
8/13/2009	1	red-winged blackbird	1	0813		perched	N	50	1	
8/13/2009	1	mockingbird	1	0814	N	flying	W	15	1	
8/13/2009	1	red-winged blackbird	2	0814	N	flying	W	15	2	
8/13/2009	1	red-winged blackbird	1	0815		preening	W	15	1	
8/13/2009	1	common grackle	1	0817	S	flying	W	30	2	
8/13/2009	1	tree swallow	10	0819		hunting	W	30	2	
8/13/2009	1	willet	1	0820		calling	W	5	2	
8/13/2009	1	killdeer	3	0821		feeding	S	0	1	
8/13/2009	1	tree swallow	40	0822		hunting	W	70	2	
8/13/2009	2	red-winged blackbird	1	0824		calling	W	5	2	
8/13/2009	2	common tern	1	0825	S	flying	W	15	3	
8/13/2009	2	ibis	1	0825	S	flying	W	100	3	
8/13/2009	2	great egret	2	0825	S	flying	W	120	3	
8/13/2009	2	herring gull	1	0827	S	flying	W	100	3	
8/13/2009	2	green heron	1	0827	W	flying	W	80	3	
8/13/2009	2	osprey	1	0828		resting	W	10	3	on nest
8/13/2009	2	great egret	6	0828		hunting	W	0	3	

Date	Site	Species	No.	Time	Direction	Behavior	Sector	Height	Path	Notes
8/13/2009	2	meadowlark	1	0829		calling	W	5	2	
8/13/2009	2	red-winged blackbird	1	0829		calling	W	5	2	
8/13/2009	2	tree swallow	30	0831		hunting	W	40	3	flock gradually working south
8/13/2009	2	laughing gull	3	0832	N	flying	W	30	3	
8/13/2009	2	Forster's tern	3	0833		hunting	W	10	3	
8/13/2009	2	tree swallow	80	0836		hunting	N	30	3	
8/13/2009	2	catbird	1	0838		calling	W	10	1	
8/13/2009	2	orchard oriole	2	0838		hunting	S	15	1	
8/13/2009	2	yellow-throat	1	0839		calling	W	10	2	
8/13/2009	2	ibis	25	0839	S	flying	W	100	3	
8/13/2009	2	great egret	1	0839	S	flying	W	120	3	
8/17/2009	1	red-winged blackbird	2	0820	S	flying	W	20	2	
8/17/2009	1	tree swallow	1	0821		hunting	S	25	1	
8/17/2009	1	willet	1	0822		calling	W	15	2	
8/17/2009	1	cardinal	1	0822		scolding	S	10	1	
8/17/2009	1	great egret	8	0824		hunting	W	0	2	
8/17/2009	1	snowy egret	4	0824		hunting	W	0	2	
8/17/2009	1	tree swallow	4	0825	S	flying	W	30	2	
8/17/2009	1	plover species	1	0828	N	flying	W	20	2	
8/17/2009	1	laughing gull	1	0830	W	flying	N	100	2	
8/17/2009	1	brown pelican	1	0832	E	flying	N	80	2	
8/17/2009	1	royal tern	2	0834	W	flying	S	120	2	
8/17/2009	1	house finch	1	0835		resting	S	10	1	
8/17/2009	2	starling	3	0837		resting	S	20	1	
8/17/2009	2	marsh hawk	1	0838		hunting	W	15	2	
8/17/2009	2	great egret	2	0838	S	flying	W	80	3	
8/17/2009	2	laughing gull	2	0838	W	flying	W	100	3	
8/17/2009	2	red-winged blackbird	6	0839		resting	W	5	3	
8/17/2009	2	tree swallow	30	0839		hunting	W	15	3	
8/17/2009	2	ibis	5	0842		hunting	W	0	3	
8/17/2009	2	great egret	45	0842		hunting	W	0	3	
8/17/2009	2	snowy egret	15	0842		hunting	W	0	3	
8/17/2009	2	laughing gull	3	0844	S	flying	W	15	3	
8/17/2009	2	osprey	1	0845		resting	W	15	3	on nest

Date	Site	Species	No.	Time	Direction	Behavior	Sector	Height	Path	Notes
8/17/2009	2	ibis	3	0846	S	flying	W	15	3	
8/17/2009	2	laughing gull	1	0847	N	flying	W	100	3	
8/17/2009	2	ibis	6	0849	N	flying	W	60	2	
8/27/2009	1	starling	6	0810		calling	E	80	1	on mast
8/27/2009	1	great egret	30	0811		hunting	W	0	3	
8/27/2009	1	snowy egret	20	0811		hunting	W	0	3	
8/27/2009	1	laughing gull	6	0811	N	flying	W	25	3	
8/27/2009	1	Forster's tern	1	0814	N	flying	W	15	3	
8/27/2009	1	pelican	2	0815		resting	W	0	3	
8/27/2009	1	red-winged blackbird	1	0817	N	flying	W	20	2	
8/27/2009	1	mockingbird	1	0818		hunting	N	15	1	
8/27/2009	1	starling	4	0818	S	flying	W	15	2	
8/27/2009	1	mourning dove	1	0818	S	flying	W	20	2	
8/27/2009	1	great egret	3	0819	N	flying	W	100	3	
8/27/2009	1	ibis	1	0821	N	flying	W	10	3	
8/27/2009	1	black duck	1	0821	S	flying	W	100	2	
8/27/2009	1	ibis	4	0822	S	flying	W	15	3	
8/27/2009	1	common grackle	1	0824		resting	S	15	1	
8/27/2009	2	killdeer	2	0826		resting	S	0	1	
8/27/2009	2	tree swallow	4	0827		hunting	W	5	3	
8/27/2009	2	yellow-billed cuckoo	1	0832		eating	W	5	1	eating Chinese praying mantis
8/27/2009	2	red-winged blackbird	1	0835	S	flying	W	10	2	
8/27/2009	2	Forster's tern	1	0836		hunting	W	10	3	
8/27/2009	2	common grackle	2	0836	S	flying	W	15	3	
8/27/2009	2	herring gull	1	0838	S	flying	W	40	3	
8/27/2009	2	ibis	1	0838	S	flying	W	20	3	
8/27/2009	2	great egret	1	0838	S	flying	W	60	3	
8/27/2009	2	snowy egret	4	0838	S	flying	W	30	3	
8/27/2009	2	rock dove	7	0839	N	flying	W	50	2	
8/27/2009	2	peeps	20	0840	E	flying	N	50	2	
8/27/2009	2	red-winged blackbird	2	0840	S	flying	W	30	2	
8/27/2009	2	tri-colored heron	40	0841	S	flying	W	5	3	
9/14/2009	1	starling	6	0805		resting	S	30	1	
9/14/2009	1	starling	4	0806		calling	E	80	1	on mast

Date	Site	Species	No.	Time	Direction	Behavior	Sector	Height	Path	Notes
9/14/2009	1	tree swallow	40	0806		hunting	N	100	2	
9/14/2009	1	flicker	2	0806	S	flying	W	10	1	
9/14/2009	1	flicker	1	0807	N	flying	W	20	1	
9/14/2009	1	great egret	2	0809	N	flying	W	30	3	
9/14/2009	1	common grackle	4	0810		resting	N	30	1	
9/14/2009	1	red-winged blackbird	2	0810		resting	N	20	1	
9/14/2009	1	flicker	4	0812	S	flying	W	20	2	
9/14/2009	1	Canada goose	5	0814		calling	W	5	3	
9/14/2009	1	yellow-breasted chat	1	0816		feeding	S	15	1	
9/14/2009	1	yellow-rumped warbler	3	0816		feeding	S	15	1	
9/14/2009	1	great egret	2	0817	S	flying	W	60	3	
9/14/2009	1	common grackle	1	0817		feeding	S	20	1	
9/14/2009	1	rose-breasted grosbeak	1	0818		feeding	S	20	1	
9/14/2009	1	red-winged blackbird	4	0818	S	flying	S	15	1	
9/14/2009	1	yellow-rumped warbler	1	0819	S	flying	W	20	1	
9/14/2009	2	osprey	1	0821	S	flying	W	60	2	
9/14/2009	2	mallard	1	0822	N	flying	W	30	3	
9/14/2009	2	snowy egret	1	0822	S	flying	W	30	1	
9/14/2009	2	cormorant	1	0823		resting	W	5	3	
9/14/2009	2	great egret	15	0824		feeding	W	0	3	
9/14/2009	2	snowy egret	5	0824		feeding	W	0	3	
9/14/2009	2	black duck	6	0825	N	flying	W	20	3	
9/14/2009	2	flicker	4	0825	S	flying	W	20	2	
9/14/2009	2	tri-colored heron	10	0825	S	flying	W	140	3	
9/14/2009	2	laughing gull	1	0827	W	flying	W	30	2	
9/14/2009	2	herring gull	5	0828	N	flying	W	30	3	
9/14/2009	2	common tern	1	0828	N	flying	W	10	3	
9/14/2009	2	herring gull	4	0829		resting	W	5	3	
9/14/2009	2	peeps	40	0832		resting	N	0	3	
9/14/2009	2	common tern	1	0832		hunting	W	5	3	
9/14/2009	2	catbird	1	0832		calling	N	10	1	
9/14/2009	2	red-winged blackbird	1	0833	S	flying	N	20	1	
9/14/2009	2	cormorant	1	0834	S	flying	W	80	2	
9/14/2009	2	pine warbler	1	0835	E	flying	W	10	1	

Date	Site	Species	No.	Time	Direction	Behavior	Sector	Height	Path	Notes
9/14/2009	2	black-throated blue warbler	1	0836	N	flying	W	20	1	
9/14/2009	2	Carolina wren	1	0836		calling	S	20	1	
9/15/2009	1	starling	1	0820	W	flying	N	30	2	
9/15/2009	1	starling	6	0820		calling	E	80	1	on mast
9/15/2009	1	Canada goose	15	0820		calling	W	10	2	
9/15/2009	1	Canada goose	10	0824	N	flying	W	10	2	
9/15/2009	1	redstart	1	0827		feeding	W	15	1	
9/15/2009	1	herring gull	2	0829	W	flying	N	80	2	
9/15/2009	1	great egret	1	0829	N	flying	W	120	3	
9/15/2009	1	herring gull	1	0830	W	flying	S	140	2	
9/15/2009	1	mourning dove	1	0831	S	flying	W	40	1	
9/15/2009	1	mallard	3	0832	N	flying	W	120	3	
9/15/2009	1	orchard oriole	1	0834	S	flying	W	20	2	
9/15/2009	1	flicker	3	0834	S	flying	W	30	2	
9/15/2009	1	snowy egret	1	0834	N	flying	W	40	2	
9/15/2009	1	tree swallow	3	0835		hunting	W	80	2	
9/15/2009	2	boat-tailed grackle	1	0837		resting	W	5	2	
9/15/2009	2	black duck	1	0837	S	flying	W	60	2	
9/15/2009	2	marsh hawk	1	0839		hunting	W	10	2	
9/15/2009	2	great egret	1	0840	N	flying	W	40	3	
9/15/2009	2	cormorant	1	0840	E	flying	S	100	2	
9/15/2009	2	great egret	1	0842	N	flying	W	80	3	
9/15/2009	2	cormorant	3	0843	S	flying	W	120	2	
9/15/2009	2	merlin	1	0844	S	flying	W	15	1	
9/15/2009	2	yellow-throat	1	0844		calling	W	10	1	
9/15/2009	2	laughing gull	8	0845	S	flying	W	180	3	
9/15/2009	2	Canada goose	20	0845	N	flying	W	10	3	
9/15/2009	2	Forster's tern	1	0846	S	flying	W	30	3	
9/15/2009	2	great egret	5	0847		feeding	W	0	3	
9/15/2009	2	flicker	10	0849	S	flying	E	20	2	
9/15/2009	2	Canada goose	5	0849	N	flying	W	40	2	
9/15/2009	2	boat-tailed grackle	2	0852		chasing	W	15	2	
9/16/2009	1	mockingbird	2	0816		feeding	S	0	1	
9/16/2009	1	starling	11	0816		feeding	S	0	1	

Date	Site	Species	No.	Time	Direction	Behavior	Sector	Height	Path	Notes
9/16/2009	1	black duck	1	0818	W	flying	S	120	1	
9/16/2009	1	herring gull	2	0819	W	flying	N	100	1	
9/16/2009	1	boat-tailed grackle	3	0821	E	flying	S	20	1	
9/16/2009	1	cardinal	1	0825		calling	S	5	1	
9/16/2009	1	herring gull	1	0829	W	flying	N	120	1	
9/16/2009	2	great egret	1	0833	N	flying	W	40	2	
9/16/2009	2	great egret	9	0833		feeding	W	0	3	
9/16/2009	2	snowy egret	3	0833		feeding	W	0	3	
9/16/2009	2	Canada goose	1	0834		feeding	W	0	3	
9/16/2009	2	Carolina wren	1	0834		calling	S	5	1	
9/16/2009	2	herring gull	2	0835	E	flying	S	80	1	
9/16/2009	2	yellow-throat	1	0837		calling	N	10	1	
9/16/2009	2	black duck	1	0839		feeding	N	0	3	
9/16/2009	2	great egret	2	0840	N	flying	N	5	2	
9/16/2009	2	snowy egret	1	0840	N	flying	N	5	2	
9/16/2009	2	starling	3	0840	W	flying	S	15	2	
9/16/2009	2	snowy egret	2	0841	N	flying	W	20	3	
9/16/2009	2	laughing gull	1	0841	S	flying	W	20	3	
9/16/2009	2	black duck	2	0843		circling	W	10	2	
9/16/2009	2	cormorant	1	0843	S	flying	W	80	2	
9/16/2009	2	laughing gull	3	0844	S	flying	W	140	3	
9/16/2009	2	red-winged blackbird	12	0844		circling	W	10	3	
9/16/2009	2	great egret	1	0846		feeding	W	0	2	
9/16/2009	2	herring gull	1	0847	W	flying	W	100	2	
9/16/2009	2	flicker	1	0848		resting	E	30	2	
9/18/2009	1	mockingbird	1	0802		resting	S	20	1	
9/18/2009	1	starling	6	0804		calling	E	80	1	on mast
9/18/2009	1	fish crow	1	0805		calling	E	80	1	on mast
9/18/2009	1	catbird	1	0806		feeding	W	20	1	
9/18/2009	1	scarlet tanager	1	0807		scolding	S	20	1	
9/18/2009	1	Canada goose	12	0809		calling	S	15	2	
9/18/2009	1	herring gull	1	0810	S	flying	W	100	3	
9/18/2009	1	yellow-rumped warbler	2	0810	W	flying	S	30	1	
9/18/2009	1	laughing gull	12	0812	S	flying	E	60	3	

Date	Site	Species	No.	Time	Direction	Behavior	Sector	Height	Path	Notes
9/18/2009	1	herring gull	1	0814	W	flying	N	50	2	
9/18/2009	1	fish crow	1	0815	S	flying	E	60	3	
9/18/2009	1	herring gull	1	0815	W	flying	N	160	2	
9/18/2009	1	starling	1	0816		resting	S	20	1	
9/18/2009	1	mockingbird	1	0817		resting	W	15	1	
9/18/2009	1	cardinal	1	0817		calling	N	10	1	
9/18/2009	2	Canada goose	19	0819	E	flying	S	60	1	
9/18/2009	2	great egret	8	0820		feeding	W	0	3	
9/18/2009	2	snowy egret	3	0820		feeding	W	0	3	
9/18/2009	2	Forster's tern	3	0820		feeding	W	5	3	
9/18/2009	2	herring gull	2	0821	S	flying	W	80	3	
9/18/2009	2	ibis	1	0822		feeding	W	0	3	
9/18/2009	2	black duck	4	0824		resting	W	0	2	
9/18/2009	2	great egret	1	0826	N	flying	W	30	3	
9/18/2009	2	killdeer	2	0827	W	flying	S	60	2	
9/18/2009	2	Canada goose	2	0829	E	flying	W	40	3	
9/18/2009	2	bald eagle adult	2	0829	S	flying	W	60	3	
9/18/2009	2	black duck	3	0829	E	flying	W	40	2	
9/18/2009	2	great egret	10	0829	S	flying	W	30	3	
9/18/2009	2	cormorant	2	0829	W	flying	W	60	3	
9/18/2009	2	laughing gull	18	0832	S	flying	W	200	3	
9/18/2009	2	great egret	2	0832		resting	W	0	2	
9/18/2009	2	peregrine falcon	1	0833	N	flying	W	15	2	
9/18/2009	2	cormorant	1	0834	S	flying	W	30	2	
9/21/2009	1	starling	6	0820		calling	E	80	1	on mast
9/21/2009	1	yellow-rumped warbler	5	0822	N	flying	S	40	1	
9/21/2009	1	great egret	2	0823	N	flying	W	60	3	
9/21/2009	1	red-winged blackbird	4	0823		chasing	N	40	1	
9/21/2009	1	rock dove	3	0826	N	flying	S	80	1	
9/21/2009	1	cardinal	1	0828		calling	N	20	1	
9/21/2009	1	catbird	4	0831		feeding	W	15	1	
9/21/2009	1	laughing gull	1	0832	W	flying	S	80	2	
9/21/2009	2	boat-tailed grackle	1	0834	E	flying	S	80	1	
9/21/2009	2	green heron	1	0836		scolding	W	0	2	

Date	Site	Species	No.	Time	Direction	Behavior	Sector	Height	Path	Notes
9/21/2009	2	great egret	1	0838		feeding	W	0	3	
9/21/2009	2	Canada goose	30	0838		resting	W	0	3	
9/21/2009	2	common grackle	1	0838		resting	W	0	3	
9/21/2009	2	common crow	3	0839		resting	S	60	1	
9/21/2009	2	red knot	15	0840	N	flying	W	15	2	
9/21/2009	2	great egret	1	0841	N	flying	W	30	2	
9/21/2009	2	great egret	1	0842	N	flying	W	30	3	
9/21/2009	2	great egret	1	0843	S	flying	W	20	3	
9/21/2009	2	black duck	2	0843	S	flying	W	10	2	
9/21/2009	2	great egret	4	0844	N	flying	W	100	3	
9/21/2009	2	black duck	3	0845	S	flying	W	10	2	
9/21/2009	2	laughing gull	3	0845	S	flying	W	160	3	
9/21/2009	2	tri-colored heron	1	0845	N	flying	W	100	3	
9/21/2009	2	great egret	1	0847	N	flying	W	100	3	
9/21/2009	2	black duck	2	0848	N	flying	W	80	3	
9/21/2009	2	herring gull	6	0849		resting	W	0	3	
9/21/2009	2	yellow-billed cuckoo	1	0849	E	flying	S	10	1	
9/22/2009	1	starling	6	0757		calling	E	80	1	on mast
9/22/2009	1	common grackle	2	0800	W	flying	N	100	2	
9/22/2009	1	herring gull	1	0801	S	flying	W	120	3	
9/22/2009	1	tree swallow	250	0801	S	flying	W	100	2	
9/22/2009	1	starling	8	0802		resting	N	40	1	
9/22/2009	1	herring gull	1	0806	W	flying	N	60	2	
9/22/2009	1	tree swallow	40	0808	S	flying	W	80	2	
9/22/2009	1	flicker	1	0810	S	flying	W	80	2	
9/22/2009	2	laughing gull	4	0813	E	flying	W	20	2	
9/22/2009	2	great egret	1	0814		resting	W	0	2	
9/22/2009	2	black duck	3	0814		resting	W	0	2	
9/22/2009	2	great egret	4	0816		resting	W	0	3	
9/22/2009	2	laughing gull	20	0816		resting	W	0	3	
9/22/2009	2	herring gull	2	0817	N	flying	W	80	3	
9/22/2009	2	herring gull	1	0818	S	flying	W	100	3	
9/22/2009	2	great egret	2	0818	N	flying	W	100	3	
9/22/2009	2	common grackle	1	0821	S	flying	W	20	2	

Date	Site	Species	No.	Time	Direction	Behavior	Sector	Height	Path	Notes
9/22/2009	2	yellow-throat	1	0822		calling	E	10	1	
9/22/2009	2	killdeer	1	0822	E	flying	N	40	2	
9/22/2009	2	catbird	1	0824		resting	E	30	1	
9/22/2009	2	cormorant	1	0826	S	flying	W	20	2	
9/22/2009	2	tree swallow	70	0826	S	flying	W	40	2	
9/22/2009	2	laughing gull	1	0827	N	flying	W	60	2	
9/22/2009	2	yellow-rumped warbler	1	0828	S	flying	W	15	2	
9/22/2009	2	laughing gull	3	0828	S	flying	W	200	3	
9/23/2009	1	starling	3	0810		resting	S	30	1	
9/23/2009	1	starling	5	0810		calling	E	80	1	on mast
9/23/2009	1	laughing gull	7	0812	S	flying	N	200	3	
9/23/2009	1	herring gull	2	0813		resting	W	0	3	
9/23/2009	1	laughing gull	1	0814	S	flying	W	100	3	
9/23/2009	1	starling	6	0816		resting	W	20	1	
9/23/2009	1	great egret	1	0817	N	flying	W	160	3	
9/23/2009	1	black duck	1	0817	S	flying	W	40	2	
9/23/2009	1	great egret	2	0818	N	flying	W	80	2	
9/23/2009	1	herring gull	1	0819	S	flying	W	80	3	
9/23/2009	2	black duck	1	0828	S	flying	W	40	3	
9/23/2009	2	killdeer	2	0829		calling	S	20	1	
9/23/2009	2	great egret	1	0830		hunting	W	0	3	
9/23/2009	2	snowy egret	1	0830		hunting	W	0	3	
9/23/2009	2	Forster's tern	5	0832		hunting	W	15	3	
9/23/2009	2	laughing gull	10	0833		resting	W	0	3	
9/23/2009	2	herring gull	5	0833		resting	W	0	3	
9/23/2009	2	black duck	2	0834	N	flying	W	40	3	
9/23/2009	2	cormorant	1	0835	S	flying	W	60	3	
9/23/2009	2	great egret	1	0835	E	flying	W	40	3	
9/23/2009	2	great egret	1	0835	N	flying	W	5	3	
9/23/2009	2	red-winged blackbird	1	0836	E	flying	N	15	1	
9/23/2009	2	great egret	1	0837	N	flying	W	30	3	
9/23/2009	2	kingfisher	1	0837	N	flying	W	20	2	
9/23/2009	2	great egret	1	0838		feeding	W	0	2	
9/23/2009	2	common crow	1	0839	N	flying	W	80	2	

Date	Site	Species	No.	Time	Direction	Behavior	Sector	Height	Path	Notes
9/23/2009	2	laughing gull	1	0839	S	flying	W	10	3	
9/23/2009	2	snowy egret	1	0840		resting	W	5	3	
9/23/2009	2	great egret	1	0842	E	flying	E	40	1	
9/23/2009	2	red-winged blackbird	50	0842	N	flying	E	60	2	
9/28/2009	1	starling	5	0805		calling	E	80	1	on mast, jackhammer in use nearby
9/28/2009	1	common grackle	30	0807	E	flying	N	30	2	
9/28/2009	1	black duck	2	0808		calling	W	0	2	
9/28/2009	1	red-winged blackbird	3	0812	S	flying	W	20	1	
9/28/2009	1	cowbird	15	0813	E	flying	N	30	1	
9/28/2009	1	herring gull	1	0816	N	flying	W	30	2	
9/28/2009	1	merlin	1	0820	S	flying	W	40	2	I minute in sight
9/28/2009	2	cowbird	30	0822		circling	N	40	1	
9/28/2009	2	herring gull	1	0823	S	flying	W	80	2	
9/28/2009	2	yellow-throat	1	0823		calling	N	5	2	
9/28/2009	2	ring-billed gull	1	0823	E	flying	S	30	1	
9/28/2009	2	flicker	2	0825	N	flying	S	20	1	
9/28/2009	2	common crow	1	0826	W	flying	S	5	1	
9/28/2009	2	great egret	1	0827		feeding	W	0	3	
9/28/2009	2	black duck	2	0829	N	flying	W	40	3	
9/28/2009	2	herring gull	2	0829		resting	W	0	3	
9/28/2009	2	ring-billed gull	6	0829		resting	W	0	3	
9/28/2009	2	peeps	30	0829		resting	W	0	3	
9/28/2009	2	house wren	1	0832	E	flying	N	2	1	
9/28/2009	2	herring gull	1	0832	S	flying	W	80	2	
9/28/2009	2	great egret	1	0833		hunting	W	0	2	
9/28/2009	2	catbird	1	0834		calling	N	10	1	
9/28/2009	2	flicker	2	0834		resting	S	20	1	
9/28/2009	2	black-backed gull	1	0835	S	flying	E	60	2	
9/28/2009	2	common grackle	1	0836		resting	W	30	2	
9/28/2009	2	common grackle	1	0836	S	flying	W	60	2	
10/1/2009	1	starling	10	0810		calling	E	80	1	on mast
10/1/2009	1	rock dove	5	0810		resting	E	80	1	on mast
10/1/2009	1	great egret	1	0812	S	flying	W	160	2	

Date	Site	Species	No.	Time	Direction	Behavior	Sector	Height	Path	Notes
10/1/2009	1	cowbird	10	0813	S	flying	E	40	2	
10/1/2009	1	herring gull	1	0816	W	flying	N	200	3	
10/1/2009	1	Canada goose	1	0819	N	flying	W	200	3	
10/1/2009	1	ring-billed gull	1	0822	E	flying	N	220	1	
10/1/2009	1	killdeer	2	0824	W	flying	S	60	1	
10/1/2009	1	tree swallow	50	0825	N	flying	E	100	3	
10/1/2009	2	catbird	1	0827		calling	N	5	1	
10/1/2009	2	great egret	4	0827		feeding	W	0	3	
10/1/2009	2	snowy egret	1	0829	N	flying	W	30	2	
10/1/2009	2	Canada goose	5	0830		calling	S	20	2	
10/1/2009	2	snow goose	21	0832	N	flying	S	100	1	
10/1/2009	2	snowy egret	2	0833	N	flying	W	20	3	
10/1/2009	2	black duck	8	0835	N	flying	W	120	3	
10/1/2009	2	black duck	1	0835	S	flying	W	120	3	
10/1/2009	2	black duck	5	0838	N	flying	W	40	3	
10/1/2009	2	boat-tailed grackle	2	0838	N	flying	W	60	3	
10/1/2009	2	snowy egret	1	0838	N	flying	W	100	3	
10/1/2009	2	killdeer	1	0839		calling	S	20	1	
10/1/2009	2	red-winged blackbird	1	0840	N	flying	W	100	2	
10/1/2009	2	tree swallow	20	0842	S	flying	N	120	2	

Appendix B

Summer – Fall 2008 Passive Acoustic Monitoring Bat Survey Report

Summer-Fall 2008 Passive Acoustic Monitoring Bat Survey Report

for the Goddard Space Flight Center Wallops Flight Facility in Wallops Island, Virginia

Prepared for

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FINAL December 2008

Executive Summary

The National Aeronautics and Space Administration (NASA) is evaluating the prospect of erecting up to two 1.5 megawatt (MW) wind generation turbines of approximately 119 meters (m; 388.8 feet), with associated underground electric power collection lines and new access roads, at the Goddard Space Flight Center Wallops Flight Facility in Wallops Island, Virginia (Project). The Project includes an interconnection with the existing NASA WFF electrical power distribution system, and the electricity generated by the wind turbines will only be used to power facilities at the WFF. The turbines are being considered by NASA as the primary component of a renewable energy initiative that will generate electricity to support operations at the WFF.

Stantec Consulting (Stantec) has acted as a consultant to Tetra Tech NUS Inc. (Tetra Tech) who is assisting NASA with environmental studies connected with the siting of the Project facilities. Stantec was contracted to conduct passive acoustic bat surveys in the Project area in order to document bat activity. The surveys were conducted in accordance with an avian and bat assessment study plan developed previously by NASA in June 2008, which was in part based on the Final Site-Wide Environmental Assessment completed in 2005.

Over the course of the fourteen week summer-fall survey period (July 15 through October 21, 2008), Anabat acoustic detectors collected 229 combined detector-nights of recordings. Four detectors were deployed throughout the Project area. Two detectors were placed in an existing 50 meter (164 feet) unguyed tower, which is located approximately 427 meter (1,400 feet) south of the southern-most wind turbine site, and two were situated on 10 meter (33 feet) poles in adjacent marshlands. Stantec deployed detectors at the beginning of the survey period, and NASA personnel were scheduled to download data on a bi-weekly basis. This data was then to be routinely submitted to Stantec for subsequent review, analysis, and interpretation. Stantec personnel then returned to the site at the end of the survey period to remove the detectors.

A total of 2,140 bat call sequences were recorded during the summer-fall sampling period. The mean detection rate of all detectors was 9.3 detections per detector-night. Habitat, landscape, location, and survey effort probably account for the observed differences in detection rates between detectors. Bat calls were identified to the lowest possible taxonomic level. These were then grouped into six guilds based on similarity in call characteristics between some species and the uncertainty in the ability of frequency division detectors to adequately provide information for this differentiation. The majority of calls (55.2%) were identified as “unknown” (all recorded sequences had too few pulses or pulses of poor quality to be distinguishable to guild). The guild with the most identifiable calls was that of the Red bat/Eastern pipistrelle, representing 27.9 percent of the recorded calls. There were few recorded calls identifiable as belonging to the hoary bat or Myotis guild.

When considering the level of activity documented at Wallops Island from July to October, it is important to acknowledge that numbers of recorded bat call sequences are not necessarily

correlated with number of bats in an area. Acoustic detectors do not allow for differentiation between a single bat making multiple passes and multiple bats each recorded a single time. Quantitative comparisons of detection rates among detectors, seasons, or habitats are not possible, nor are direct correlation with weather variables, or linking detection rates to bat abundance. General trends must be interpreted with caution due to the limitations of the sampling design used in this survey.

Table of Contents

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1.0 Introduction

Despite the recent increase in general bat studies resulting from the growing wind-energy industry, most of the questions regarding risk to bats from wind turbines remain unanswered (Kunz *et al*. 2007a, 2007b). Mortality of eight bat species has been documented at wind energy facilities in the eastern United States (Kunz *et al*. 2007a), with most fatalities occurring during what is generally considered the fall migration period (August to November; Cryan 2003, Cryan and Brown 2007, Johnson *et al*. 2005). Species documented in the vicinity of wind turbines in the eastern U.S. include little brown myotis, northern myotis, eastern pipistrelle, seminole, hoary, silver-haired, red, and big brown bats. With the exception of eastern pipistrelles, the species killed most frequently—hoary, red, and silver-haired bat—are long-distance migrants, traveling dramatically greater migration distances than other North American species (Cryan 2003, Cryan *et al.* 2004, Cryan and Brown 2007, others).

Very little is understood about the behavior of migrating bats and the reasons behind their apparent susceptibility to collision with wind turbines. Throughout the scientific community a variety of hypotheses exist to explain this ecological concern. Several of these hypotheses suggest attraction of bat to wind turbines through (1) creation of linear habitat and/or potential roosts, (2) habitats and/or conditions favorable for foraging and high insect abundance, and (3) attraction through auditory cues. Other hypotheses indicate the possibility that turbines create an electromagnetic disorientation, or postulate that bats are unable to accurately determine wind turbine blade speed through echolocation. Further, it is unknown whether or not bats echolocate while migrating, and whether failure to echolocate could cause collision mortality, as bats are clearly able to avoid objects and maneuver rapidly while foraging (Kunz *et al*. 2007a).

In response to the potential risks apparently posed to nocturnal migrants, including bats, state and federal agencies typically require developers to survey their site to document the pre-construction level of bat activity in the area. To that end, this report has been prepared to review the findings of passive bat acoustic surveys conducted during the summer-fall of 2008 at the Goddard Space Flight Center Wallops Flight Facility in Wallops Island, Virginia (Project). Following is a brief description of the project; a review of the methods used to conduct scientific surveys and the results of those surveys. A discussion of those results is also presented.

1.1 PROJECT CONTEXT

The National Aeronautics and Space Administration (NASA) is evaluating the prospect of erecting up to two 1.5 megawatt (MW) wind generation turbines of approximately 119 meters (388.8 feet), with associated underground electric power collection lines and new access roads at the WFF in Wallops Island, Virginia. The Project includes an interconnection with the existing NASA WFF electrical power distribution system, and the electricity generated by the wind turbines will only be used to power facilities at the WFF. The turbines are being considered by NASA as the primary

component of a mandated renewable energy initiative that will generate electricity to support operations at the WFF.

Tetra Tech NUS, Inc. (Tetra Tech) contracted Stantec Consulting (Stantec) to conduct passive acoustic surveys during the summer-fall 2008 season to document bat activity patterns and species composition in the Project area. The surveys will provide data to help assess the potential risk for the proposed Project to impact bats. The scope of bat surveys was based on a combination of standard methods that have evolved within the wind power industry for pre-construction surveys, guidelines outlined by the study plan developed previously by NASA in June 2008, which was in part based on the Final Site Wide Environmental Assessment completed in 2005 (URS and EG&G 2005).

1.2 PROJECT AREA DESCRIPTION

The WFF lies within the Tidewater region of the embayed section of the Atlantic Coastal Plain Physiographic Province. Wallops Island is separated from the Main Base and Wallops Mainland by numerous inlets, marshes, bays, creeks, and tidal estuaries and is considered a barrier island; as such Wallops Island is subject to constant change due to ocean currents, wind erosion, and severe weather conditions. Wallops Island contains coastal primary sand dunes that serve as protective barriers from the effects of flooding and erosion caused by coastal storms. Habitats within the WFF area include dune systems, maritime forests, salt marshes, swamps, thickets, upland grasslands, and upland forests. Specifically, dune systems, maritime forest, and salt marsh are found on Wallops Island, and salt marsh, swamps, thickets, upland grasslands, and upland forest are found on Wallops Mainland and the Main Base (URS and EG&G 2005).

WFF is located in the climatic region known as the humid continental warm summer climate zone. Large temperature variations during the course of a single year and lesser variations in average monthly temperatures typify the region. The climate is tempered by the proximity of the Atlantic Ocean to the east and the Chesapeake Bay to the west. Also affecting the climate is an air current, know as the Labrador Current, which originates in the polar latitudes and moves southward along the Delmarva coastline. The current creates a wedge between the warm Gulf Stream offshore and the Atlantic coast (URS and EG&G 2005).

Wallops Island is technically zoned industrial by the state of Virginia. However, the island has been widely used over its history for a variety of government purposes. With the exception of the WWF facilities, the landscape adjacent to Wallops Island is predominantly agricultural or undeveloped. Rural residential areas, small villages, and businesses are scattered throughout the surroundings. The Town of Chincoteague, located approximately eight kilometers (5 miles) east of the Main Base on Chincoteague Island, Virginia, is the largest of the surrounding communities. Existing land uses at WFF include: administrative areas, fabrication areas, housing and recreation areas, institutional areas, separate operational areas, operations aircraft area, operations range, operations/explosive storage, Mid-Atlantic Regional Spaceport, and the Visitors Center Complex Area (URS and EG&G 2005).

In 1975, the Wallops Island National Wildlife Refuge was created when 151 hectare (373 acres) of land were transferred to the U.S. Fish and Wildlife Service (USFWS) from NASA. The refuge, comprised mainly of salt marsh and woodlands, is located east of Wattsville in Accomack County, Virginia, and is located 9.6 kilometers (6 miles) to the northeast of WFF. It contains habitat for a variety of species, including upland- and wetland-dependent migratory birds. A rare habitat, a sea-level fen, can also be found on the refuge. Sea-level fens are nutrient-poor, maritime seepage wetlands, confined to a few sites with an unusual combination of environmental conditions for the mid-Atlantic. Neotropical songbirds take advantage of the shelter and food that the forest can provide. Edge habitats, where two different habitats meet, are utilized by white-tailed deer, raccoons, and fox (USFWS 2008).

2.0 Acoustic Bat Survey

Fifteen species of bat occur in Virginia, based upon their normal geographical range. There are six *Myotis* species in Virginia including the gray bat (*Myotis grisescens*), little brown bat (*M. lucifugus*), northern long-eared bat (*M. septentrionalis*), Indiana bat (*M. sodalis*), eastern small-footed bat (*M. leibii*), and southeastern *Myotis* (*M. austroriparius*). Other species include silver-haired bat (*Lasionycteris noctivagans*), eastern pipistrelle (*Perimyotis* [=*Pipistrellus*] *subflavus*), big brown bat (*Eptesicus fuscus*), evening bat (*Nycticeius humeralis*), eastern red bat (*Lasiurus borealis*), hoary bat (*L. cinereus*), seminole bat (*L. seminolus*), Rafinesque's big-eared bat (*Corynorhinus rafinesquii*) and the Virginia big-eared bat (*C. townsendii virginianus*) (BCI 2001). Of these the Indiana bat, gray bat, and Virginia big-eared bat are listed as federally endangered; Rafinesque's big-eared bat is listed as state endangered; and the eastern small-footed bat is a Species of Special Concern.

2.1 INTRODUCTION

Stantec conducted summer-fall 2008 field surveys to document activity patterns and species composition of bats in the Project area. The survey was designed to use passive acoustic monitoring Anabat detectors. Acoustic bat detectors allow for long-term monitoring of activity patterns of bats in a variety of habitats, including the air space approaching the rotor-swept zone of modern wind turbines. The acoustic bat survey at the proposed Wallops Island wind turbine site was designed to document bat activity patterns near the rotor zone of the proposed turbines and at a lower height in the open salt marsh habitat adjacent to the proposed wind turbine site. The acoustic survey was *not* intended to relate bat activity patterns to weather conditions in the Project area.

2.2 METHODS

2.2.1 Field Surveys

Anabat II detectors (Titley Electronics Pty Ltd.) were used for the duration of the summer-fall acoustic bat survey. Anabat detectors were selected based upon their widespread use for this

type of survey, their ability to be deployed for long periods of time, and their ability to detect a broad frequency range, which allows detection of all species of bats that could occur in the Project area. Each Anabat detector was coupled with CF Storage ZCAIM (Titley Electronics Pty Ltd.), which programmed the on/off times and stored data on removable 1 GB compact flash cards. Anabat detectors are frequency division detectors, dividing the frequency of ultrasonic calls made by bats by a factor of 16 so that they are audible to humans, then recording the bat calls for subsequent analysis. The audio sensitivity setting of each Anabat system was set at between six and seven (on a scale of one to ten) to maximize sensitivity while limiting ambient background noise and interference. The sensitivity of individual detectors was then tested using an ultrasonic Bat Chirp (Reno, NV) to ensure that the detectors would be able to detect bats up to a distance of at least 10 m (33 ft).

Detectors were powered by 12-volt batteries charged by solar panels. Each solar-powered Anabat system was deployed in a waterproof housing enabling the detector to record while unattended for the duration of the survey. The housing suspends the Anabat microphone downward to give maximum protection from precipitation. To compensate for the downward position, a reflector shield of smooth plastic is placed at a 45-degree angle directly below the microphone. The angled reflector allows the microphone to record the airspace horizontally surrounding the detector and is only slightly less sensitive than an unmodified Anabat unit. Maintenance visits were conducted by NASA personnel. Typical survey design anticipates detector checks approximately every two weeks to verify the condition of the detectors and download data to a computer for analysis. There was a slight deviation for this download schedule. Key to the download process is immediate processing of the data to ensure that active calls are being recorded and so that modifications to the equipment can occur.

Four detectors, deployed between July 15 and October 21, were programmed to record acoustic data between 19:00 and 07:00. On July 15, two detectors – North and South Marsh - were suspended 10 m (33 ft) above the ground on two poles located in the northern section of the Project area. The poles were positioned 250 m (820 ft) apart in an open salt marsh (Figure 1, Figure 2) in the locations of the proposed turbines. On July 30, two detectors were placed in an existing tower at a height of 50 m (164) at the southern end of the Project area (Figure 3).

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Client/Project
Tetra Tech NUS, Inc.
Wallops Flight Facility
Wallops Island, Virginia

Figure No.
1

Title
Bat Detector Location Map

10/28/2008

2.3 DATA ANALYSIS

Potential call files were extracted from data files using CFCread© software. The default settings for CFCread© were used during this file extraction process, as these settings are recommended for the calls that are characteristic of northeastern bats. This software screens all data recorded by the bat detector and extracts call files using a filter. Using the default settings for this initial screen also ensures comparability between data sets. Settings used by the filter include a max TBC (time between calls) of 5 seconds, a minimum line length of 5 milliseconds, and a smoothing factor of 50. The smoothing factor refers to whether or not adjacent pixels can be connected with a smooth line. The higher the smoothing factor, the less restrictive the filter is and the more noise files and poor quality call sequences are retained within the data set. A call is a single pulse of sound produced by a bat. A call sequence is a combination of two or more pulses recorded in a call file. Understanding the parameters of these settings is important in terms of determining when individual calls are classified as "unknown".

Following extraction of call files, each file was visually inspected to ensure that files created by static or some other form of interference that were still within the frequency range of eastern bats were not included in the data set. Bat calls typically include a series of pulses characteristic of normal flight or prey location ("search phase" calls) and capture periods (approach phase calls and feeding "buzzes") and on a sonogram look very different from static, which typically forms a diffuse band of dots at either a constant frequency or widely varying frequency, caused by wind, vibration, or other interference. Using these characteristics, bat call files are easily distinguished from non-bat files.

Bat call sequences were individually marked and categorized by species group, or "guild" based on visual comparison to reference calls. Qualitative visual comparison of recorded call sequences of sufficient length to reference libraries of bat calls allows for relatively accurate identification of bat species (O'Farrell *et al*. 1999, O'Farrell and Gannon 1999). A call sequence was considered of suitable quality and duration if the individual call pulses were "clean" (i.e., consisting of sharp, distinct lines) and at least five pulses were included within the sequence. Call sequences were classified to species whenever possible, based on criteria developed from review of reference calls collected by Chris Corben, the developer of the Anabat system, and other bat researchers. However, due to similarity of call signatures between several species, all classified calls have been categorized into six guilds[1] reflecting the bat community in the region of the Project area as follows:

- **Unknown (UNKN)** – All call sequences with too few pulses (less than five) or of poor quality (such as indistinct pulse characteristics or background static). These calls were further identified as either "high frequency unknown" (HFUN) for calls above 30-35 kHz or "low frequency unknown" (LFUN) for calls below 30-35 kHz;

[1] Gannon *et al.* 2003 categorized bats into guilds based upon similar minimum frequency and call shape. These guilds were: Unidentified, Myotis, LABO-PISU and EPFU-LANO-LACI. Stantec broke hoary bats out into a separate guild due to the importance of reporting activity patterns of migratory species in the context of wind energy development.

- **Myotid (MYSP)** – All bats of the genus *Myotis*. While there are some general characteristics believed to be distinctive for several of the species in this genus, these characteristics do not occur consistently enough for any one species to be relied upon at all times when using Anabat recordings;

- **Red bat/eastern pipistrelle (RBEP)** – Eastern red bats, eastern pipistrelles and evening bats. These three species can produce calls distinctive only to each species. However, significant overlap in the call pulse shape, frequency range, and slope can also occur.

- **Big brown/silver-haired bat (BBSH)** – Big brown and silver-haired bats. These species' call signatures commonly overlap and have therefore been included as one guild in this report.

- **Hoary bat (HB)** – Calls of hoary bats can usually be distinguished from those of big brown and silver-haired bats by minimum frequency extending to 20 kHz or below. Hoary bats are easily identified by calls varying in minimum frequency across a sequence.

- **BEB** – **Big-eared bat (BEB) –** Big-eared bats. Known as "whispering bats," these species emit low-intensity calls and listen for insect-generated sounds while foraging close to the ground; detecting calls of these bats is therefore difficult. Calls of big-eared bats are not easily confused with calls of any other species that may coexist in the Project area. The Project area lies within the distribution range of Rafinesque's big-eared bat (VDGIF c2008).

Since some species do sometimes produce calls unique only to that species, all calls were identified to the lowest possible taxonomic level before being grouped into the listed guilds. Tables and figures in the body of this report reflect those guilds. However, since species-specific identification did occur in some cases, each guild is also briefly discussed with respect to potential species composition of recorded call sequences.

Once all of the call files were identified and categorized in appropriate guilds, nightly tallies of detected calls were compiled. Mean detection rates (number of calls/detector-night) for the entire sampling period were calculated for each detector and for all detectors combined.

2.4 RESULTS

2.4.1 Detector Call Analysis

Detectors were deployed on July 15 (Marsh detectors) and July 30 (Tower detectors) and continued to record data through October 21, 2008, for a potential individual survey period of 99 nights for the Marsh detectors and 64 nights for the Tower detectors. The four detectors recorded data for a combined survey period of 229 detector-nights out of a potential combined period of 326 nights. The range of dates that each detector was deployed is summarized in Table 1. Some data gaps occurred due to power failures, CF card errors, and severe weather. Detectors were brought in from the field due to a hurricane between September 5 and 11.

Table 1. Summary of bat detector field survey effort and results

Location	Dates	# Nights	# Detector-Nights*	# Recorded sequences	Detection Rate **	Maximum # calls recorded ***
North Marsh	7/15-10/21	99	72	744	10.3	81
South Marsh	7/15-10/21	99	72	1143	15.9	170
Tower East	7/30-10/21	64	41	99	2.4	30
Tower West	7/30-10/21	64	44	154	3.5	34
Overall Results	**--**	***326***	***229***	***2140***	***9.3***	--

* Detector-night is a sampling unit during which a single detector is deployed overnight. On nights when two detectors are deployed, the sampling effort equals two detector-nights, etc.

** Number of bat passes recorded per detector-night.

*** Maximum number of bat passes recorded from any **single** detector for a 12-hour sampling period.

The four Wallops Island detectors recorded a total of 2,140 bat call sequences (Table 1). The mean detection rate for the four Wallops Island detectors was 9.3 sequences/detector-night (Table 1). Detection rates were highest at the South and North Marsh detectors (15.9 and 10.3 sequences/detector-night, respectively), followed by the Tower West (3.5 sequences/detector-night) and East (2.4 sequences/detector-night) detectors.

Nightly call volumes varied over the survey period (Figure 4). Call volumes peaked between August 13 and August 16, with the greatest number of sequences recorded on August 15 (n=223). Sequences within the RBEP, BBSH, UNKN and to a lesser extent HB guilds accounted for these peaks. On August 15, the majority of sequences identified to species belonged to eastern red bats (46.6 %, n=104). High frequency unknowns likely to be red bats or eastern pipistrelles accounted for 44.4% (n=99) of sequences recorded on August 15.

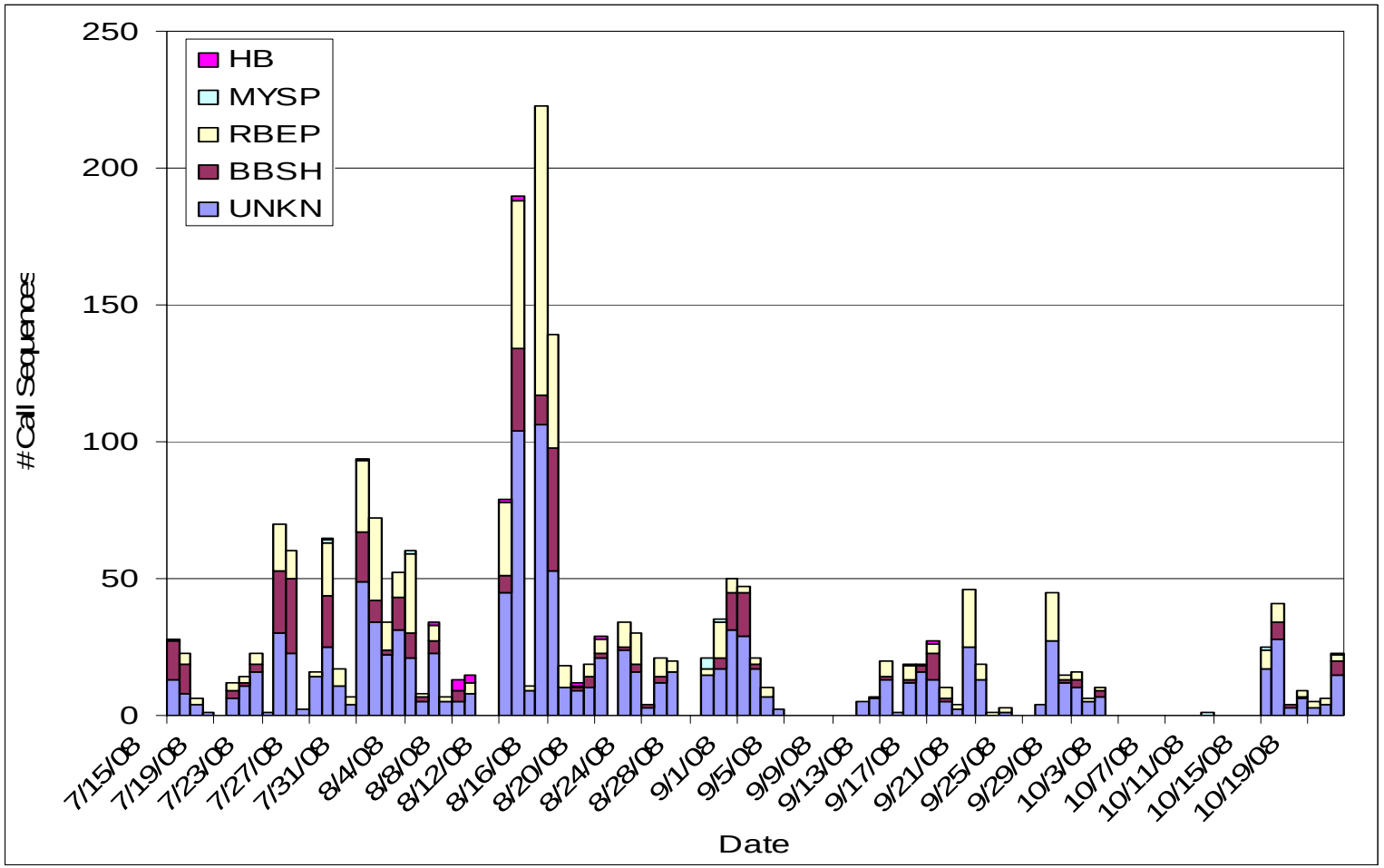

Figure 4. Total nightly bat call sequence detections by guild including hoary bat (HB), *Myotis spp.*(MYSP), eastern red bat/eastern pipistrelle/evening bat (RBEP), big brown/silver-haired bat (BBSH) and unknown (UNKN) guilds - Wallops Island Wind Project, summer-fall 2008.

When data from all four detectors were pooled, call volumes appeared to peak between 21:00 and 23:00. Call volumes tapered off toward dawn (Figure 5).

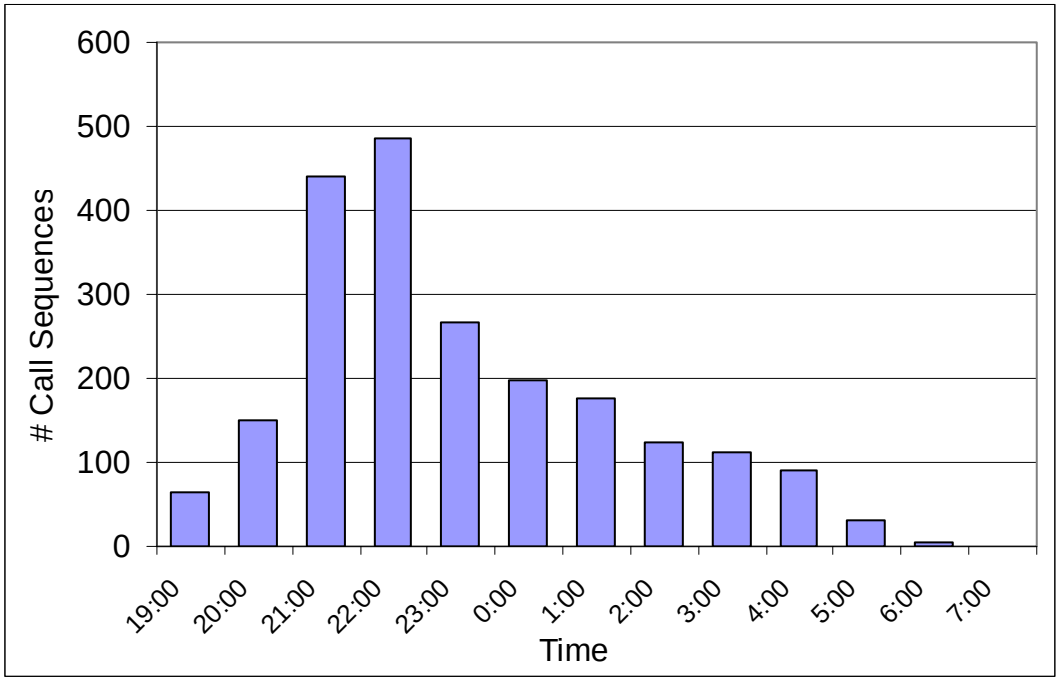

Figure 5. Hourly timing of call detections (n=2,140) at the Wallops Island Wind Project.

The majority of recorded call sequences (55.2%, n=1,181) were labeled as unknown (Table 2). Of these sequences, high frequency unknowns likely to be eastern red bats or eastern pipistrelles were most common (44.9%, n=960). Of the calls that were identified to species or guild, those of the RBEP guild were the most common (27.9%, n=596), followed by the species within the BBSH guild (15.7%, n=336), HB guild (0.8%, n=17) and MYSP guild (0.3%, n=10). Within the RBEP guild, eastern red bats accounted for 25.2% (n=540) of the 2,140 total sequences recorded at Wallops Island, followed by sequences just as likely belonging to red bats *or* eastern pipistrelles (2.5%, n=53) and eastern pipistrelles (0.1%, n=3). Within the BBSH guild, sequences just as likely belonging to big brown *or* silver-haired bats accounted for 10.8% (n=231) of the total sequences recorded, followed by those of big brown (4.4%, n=95) and silver-haired bats (0.5%, n=10).

Species composition differed only slightly between detector locations. Each of the Wallops Island detectors mainly recorded sequences of the RBEP and BBSH guilds, as well as high frequency unknowns likely belonging to species within the RBEP guild (Table 2). Unknown sequences likely to be eastern red bats and eastern red bats *or* eastern pipistrelles dominated at all detectors. Red bat/eastern pipistrelle guild sequences accounted for the majority of those identified to guild or species at all detectors except the North Marsh detector, where BBSH sequences were in slight majority over RBEP sequences. Overall, the majority of RBEP, and eastern red bat sequences in particular, were recorded at the Marsh detectors.

Table 2. Summary of the composition of recorded bat call sequences.

Detector	Guild					Total
	Hoary bat	Big brown/silver-haired bat	Red bat/ E. pipistrelle	Myotis	Unknown	
North Marsh	3	157	135	1	448	744
South Marsh	2	146	404	8	583	1,143
Tower East	4	14	17	0	64	99
Tower West	8	19	40	1	86	154
Total	***17***	***336***	***596***	***10***	***1,181***	***2,140***

Appendix A provides a series of tables with more specific information on the nightly timing, number, and species composition of recorded bat call sequences. Specifically, Appendix A Tables 1 through 4 provide information on the number of call sequences, by guild and suspected species, recorded at each detector and the weather conditions for that night. Results of acoustic surveys must be interpreted with caution. Considerable room for error exists in identification of bats based upon acoustic calls alone, especially if a site or regionally specific library of recorded reference calls is not available. Since a site specific or regional call libarary is not available, Stantec used its library of calls collected throughout the mid-Atlantic region as a baseline for comparison. Also, detection rates are not necessarily correlated with the actual numbers of bats in an area, because it is not possible to differentiate between individual bats (Hayes 2000). Stantec can provide NASA with a digital file of all acoustic calls, including all information about species identification and timing of calls from each detector on hourly and nightly basis, should that information be desired.

2.5 DISCUSSION

When data from all four Wallops Island detectors were pooled, bat activity appeared to peak in mid-August. Eastern red bats, high frequency unknown sequences mainly likely to be eastern red bats, and species within the BBSH guild primarily accounted for peaks in activity between August 13 and 16.

The majority of call sequences could not be identified to guild or species, however, due to short call sequences (less than five pulses) or poor call signature formation, often a result of bats flying at the edge of the detection zone of the detector or flying away from the microphone. The relatively small area sampled by bat detectors makes scenarios leading to un-identifiable call sequences common, but some information can still be gleaned from these recordings. The majority of unknown calls were high frequency unknowns likely to be eastern red bats or sequences just as likely belonging to eastern red bats as eastern pipistrelles. Low frequency unknowns were just as likely to be big brown as silver-haired bat sequences.

Bat activity appeared to vary by time of night, with peaks in activity occurring between 21:00 and 23:00. Patterns of bat activity within nights can vary, and anywhere from one to several peaks of activity have been documented. Several factors – such as sampling effort and detector location (e.g., Hayes 1997), and seasonal patterns in weather conditions, insect abundance and life history of bats (e.g., Anthony *et al.* 1981, Rautenbach 1996) may explain the overall nightly timing of bat activity. The unique factors associated with any acoustic bat survey with regard to effort, location, weather, prey abundance and other factors make it important to evaluate each dataset upon its own content.

The overall mean detection rate during the summer-fall 2008 survey period was 9.3 calls/detector-night. Summer-fall data in coastal marshland areas were not available for comparison with data from the Wallops Island survey. The fact that data recorded at the Wallops Island site were dominated by eastern red bat sequences and unknown sequences potentially belonging to eastern red bats is not surprising given seasonal distribution records for this species. When investigating the seasonal distribution of migratory tree-roosting bats in North America, Cryan (2003) suggested southward fall coastline migration (August-November) along the eastern seaboard may occur in eastern red bats[2]. However, it is important to keep in mind that although no call sequences recorded during this survey were definitively identified as those of evening bats, the possibility that this species may account for some of the sequences classified as eastern red bats does exist.

When considering the level of activity documented at the Wallops Island Project during the summer-fall 2008 acoustic survey, it is important to acknowledge that numbers of recorded bat call sequences are not necessarily correlated with number of bats in an area. Acoustic detectors do not allow for differentiation between a single bat making multiple passes and multiple bats each recorded a single time (Hayes 2000, Kunz *et al*. 2007). Similarly, acoustic interference can make detection of bats in certain areas difficult, lowering the estimate of acoustic activity. Furthermore, calls of some bats, such as Rafinesque's big-eared bat, are not as detectable as calls of other bats, limiting the inferences that can be made about the presence or absence of listed species. Rafinesque's big-eared bat (*Corynorhinus rafinesquii*) is the only listed species likely to occur in region of the Project area and surrounding counties (BCI 2001). Although no call sequences likely belonging to Rafinesque's big-eared bats were detected, the bat's distribution range overlaps the location of the Project area, which may provide suitable habitat (VDGIF c2008). However, roosting and foraging data for this species are lacking (BCI 2001). This survey can neither confirm nor exclude the presence of Rafinesque's big-eared bat in the Project area. Despite the limitations of acoustic surveys, patterns in timing and species composition of recorded call sequences can be used to make inferences about seasonal activity of bats.

[2] Cryan (2003) collected distribution data from museum specimens. Seasonal distribution maps of migratory tree-roosting species were interpreted according to the seasonal presence or absence of these species in different geographic areas.

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Appendix A

Bat survey results

Appendix A Table 1. Summary of acoustic bat data and weather during each survey night at the North Marsh detector - Summer-Fall 2008

		HB	BBSH			RBEP			MYSP	UNKN			
Night of	Operated Okay?	hoary bat	big brown bat	silver-haired bat	silver-haired/big brown	eastern pipistrelle	eastern red bat	pipistrelle/red bat	MYSP	high-frequency	low-frequency	unknown	Total
7/15/07	yes		1		5					5	4		**15**
7/16/07	yes		3		5		1			5	2		**16**
7/17/07	yes						2			2			**4**
7/18/07	yes												**0**
7/19/07	yes												**0**
7/20/07	yes				1		3			5	1		**10**
7/21/07	yes						2			4			**6**
7/22/07	yes						2			7	1		**10**
7/23/07	yes									1			**1**
7/24/07	yes		2	1	4		5			12	8		**32**
7/25/07	yes			1	10		2			2	9		**24**
7/26/07	yes									1			**1**
7/27/07	yes						1			4	1		**6**
7/28/07	yes		2		4		3			11	4		**24**
7/29/07	yes						1	1		2	1		**5**
7/30/07	yes									2			**2**
7/31/07	yes	1	2		5		5			21	5		**39**
8/1/07	yes				1		3			7	1		**12**
8/2/07	yes				1		4			9			**14**
8/3/07	yes		2		3		2	1		14	3		**25**
8/4/07	yes		1		2		3		1	6	2		**15**
8/5/07	no												**0**
8/6/07	no												**0**
8/7/07	no												**0**
8/8/07	no												**0**
8/9/07	no												**0**
8/10/07	no												**0**
8/11/07	no												**0**
8/12/07	yes		2		4		4			16	2		**28**
8/13/07	yes		5		8		6			23	4		**46**
8/14/07	yes						2			4			**6**
8/15/07	yes				3		16			32	2		**53**
8/16/07	yes		4		26		17	3		26	5		**81**
8/17/07	yes						3	1		4	1		**9**
8/18/07	yes												**0**
8/19/07	yes				2					3			**5**
8/20/07	yes	1			2		2			12	1		**18**
8/21/07	no												**0**
8/22/07	yes				1		2			11			**14**
8/23/07	yes				3		2			4			**9**
8/24/07	yes									2			**2**
8/25/07	yes									1			**1**
8/26/07	yes							1		7			**8**
8/27/07	yes												**0**
8/28/07	yes												**0**
8/29/07	yes									5			**5**
8/30/07	yes				1		5			6			**12**
8/31/07	yes		4		6		4			11	7		**32**
9/1/07	yes		9		4		1			10	3		**27**
9/2/07	yes						2			13			**15**
9/3/07	yes						1			3	1		**5**
9/4/07	yes												**0**
9/5/07	no												**0**
9/6/07	no												**0**
9/7/07	no												**0**
9/8/07	no												**0**
9/9/07	no												**0**
9/10/07	no												**0**
9/11/07	yes									1			**1**
9/12/07	yes									1			**1**
9/13/07	yes				1		4			6			**11**
9/14/07	yes												**0**
9/15/07	yes									1			**1**
9/16/07	yes		1				1			7	3		**12**
9/17/07	yes	1	1	1	2		3			5	2		**15**
9/18/07	yes		1				3			3			**7**
9/19/07	yes						1			1			**2**
9/20/07	yes									3			**3**
9/21/07	yes						1			2			**3**
9/22/07	yes												**0**
9/23/07	yes												**0**
9/24/07	yes												**0**
9/25/07	yes												**0**
9/26/07	yes									1			**1**
9/27/07	yes									1			**1**
9/28/07	yes				1		2			1			**4**
9/29/07	yes									2			**2**
9/30/07	yes						1			4			**5**
10/1/07	yes									1			**1**
10/2/07	no												**0**
10/3/07	no												**0**
10/4/07	no												**0**
10/5/07	no												**0**
10/6/07	no												**0**
10/7/07	no												**0**
10/8/07	no												**0**
10/9/07	no												**0**
10/10/07	no												**0**
10/11/07	no												**0**
10/12/07	no												**0**
10/13/07	no												**0**
10/14/07	no												**0**
10/15/07	yes									2			**2**
10/16/07	yes			2	3		4			9	2		**20**
10/17/07	yes				1					1			**2**
10/18/07	yes									1			**1**
10/19/07	yes						1			1			**2**
10/20/07	yes									2			**2**
10/21/07	yes			1	2		1			4			**8**
By Species		**3**	**40**	**6**	**111**	**0**	**128**	**7**	**1**	**373**	**75**	**0**	**744**
By Guild		**3**	**157**			**135**			**1**	**448**			
		HB	**BBSH**			**RBEP**			**MYSP**	**UNKN**			**Total**

Appendix A Table 2. Summary of acoustic bat data and weather during each survey night at the South Marsh detector - Summer-Fall 2008

		HB	BBSHHB			RBEP			MYSP	UNKN			
Night of	Operated Okay?	hoary bat	big brown bat	silver-haired bat	silver-haired/big brown	eastern pipistrelle	eastern red bat	pipistrelle/red bat	MYSP	high-frequency	low-frequency	unknown	Total
7/15/07	yes		2		6		1			2	2		**13**
7/16/07	yes		3				3				1		**7**
7/17/07	yes									1	1		**2**
7/18/07	yes									1			**1**
7/19/07	yes												**0**
7/20/07	yes		1		1								**2**
7/21/07	yes				1					6	1		**8**
7/22/07	yes		1		2		2			3	5		**13**
7/23/07	yes												**0**
7/24/07	yes		8		8		10	2		5	5		**38**
7/25/07	yes		6		10		6	2		7	5		**36**
7/26/07	yes									1			**1**
7/27/07	yes						1			8	1		**10**
7/28/07	yes	1	5		8	1	15		1	4	6		**41**
7/29/07	yes						3	1		6	2		**12**
7/30/07	yes						2			1			**3**
7/31/07	yes		2		6		13	3		10	4		**38**
8/1/07	yes				3		17	3		19	2		**44**
8/2/07	yes		1				5	1		13			**20**
8/3/07	yes		3		4		3	3		10	4		**27**
8/4/07	yes				6		23	3		12	1		**45**
8/5/07	no												**0**
8/6/07	no												**0**
8/7/07	no												**0**
8/8/07	no												**0**
8/9/07	no												**0**
8/10/07	no												**0**
8/11/07	no												**0**
8/12/07	yes						19			15	4		**38**
8/13/07	yes		1		6		45			54	8		**114**
8/14/07	yes									5			**5**
8/15/07	yes				8		88	2		67	5		**170**
8/16/07	yes		4		11		21			16	6		**58**
8/17/07	yes					1	2	1		4	1		**9**
8/18/07	yes	1			1			1		4	5		**12**
8/19/07	yes				2		5			2	5		**14**
8/20/07	yes						3			8			**11**
8/21/07	no												**0**
8/22/07	yes						5	1		12			**18**
8/23/07	yes						3	3		10	1		**17**
8/24/07	yes				1					1			**2**
8/25/07	yes				1		1			1			**3**
8/26/07	yes						3			9			**12**
8/27/07	yes												**0**
8/28/07	yes												**0**
8/29/07	yes						2		4	10			**16**
8/30/07	yes				3	1	6	1	1	9	2		**23**
8/31/07	yes		2		2		1			6	7		**18**
9/1/07	yes				3		1			7	9		**20**
9/2/07	yes		1		1					2	2		**6**
9/3/07	yes						1	1		3			**5**
9/4/07	yes									2			**2**
9/5/07	no												**0**
9/6/07	no												**0**
9/7/07	no												**0**
9/8/07	no												**0**
9/9/07	no												**0**
9/10/07	no												**0**
9/11/07	yes									2			**2**
9/12/07	yes									2		2	**4**
9/13/07	yes						1	1		1			**3**
9/14/07	yes												**0**
9/15/07	yes						3			4			**7**
9/16/07	yes				1					5		1	**7**
9/17/07	yes				6					2	3	1	**12**
9/18/07	yes						1			1		1	**3**
9/19/07	yes						1			1			**2**
9/20/07	yes						19	2		22			**43**
9/21/07	yes						5			11			**16**
9/22/07	yes						1						**1**
9/23/07	yes						1			1			**2**
9/24/07	yes												**0**
9/25/07	yes												**0**
9/26/07	yes									2			**2**
9/27/07	yes						5	13		26			**44**
9/28/07	yes									3	1	2	**6**
9/29/07	yes				2					1			**3**
9/30/07	yes									1			**1**
10/1/07	yes				2		1			4	1	1	**9**
10/2/07	no												**0**
10/3/07	no												**0**
10/4/07	no												**0**
10/5/07	no												**0**
10/6/07	no												**0**
10/7/07	no												**0**
10/8/07	no												**0**
10/9/07	no												**0**
10/10/07	no												**0**
10/11/07	no												**0**
10/12/07	no												**0**
10/13/07	no												**0**
10/14/07	no												**0**
10/15/07	yes						3		1	10			**14**
10/16/07	yes						3			6	3		**12**
10/17/07	yes										1		**1**
10/18/07	yes			1			2			3	2		**8**
10/19/07	yes									2			**2**
10/20/07	yes												**0**
10/21/07	yes						1		1	3			**5**
By Species		**2**	**40**	**1**	**105**	**3**	**357**	**44**	**8**	**469**	**106**	**8**	**1143**
By Guild		**2**	**146**			**404**			**8**	**583**			
		HB	**BBSH**			**RBEP**			**MYSP**	**UNKN**			**Total**

Appendix A Table 3. Summary of acoustic bat data and weather during each survey night at the Tower East detector – Summer-Fall 2008

		HB	BBSH			RBEP			MYSP	UNKN			
Night of	Operated Okay?	hoary bat	big brown bat	silver-haired bat	silver-haired/big brown	eastern pipistrelle	eastern red bat	pipistrelle/red bat	MYSP	high-frequency	low-frequency	unknown	Total
7/30/07	no												**0**
7/31/07	no												**0**
8/1/07	no												**0**
8/2/07	no												**0**
8/3/07	no												**0**
8/4/07	no												**0**
8/5/07	no												**0**
8/6/07	no												**0**
8/7/07	no												**0**
8/8/07	no												**0**
8/9/07	no												**0**
8/10/07	no												**0**
8/11/07	no												**0**
8/12/07	yes	1					4			6	2		**13**
8/13/07	yes	2	9		1		3			7	8		**30**
8/14/07	no												**0**
8/15/07	no												**0**
8/16/07	no												**0**
8/17/07	no												**0**
8/18/07	no												**0**
8/19/07	no												**0**
8/20/07	no												**0**
8/21/07	no												**0**
8/22/07	no												**0**
8/23/07	no												**0**
8/24/07	no												**0**
8/25/07	no												**0**
8/26/07	no												**0**
8/27/07	no												**0**
8/28/07	no												**0**
8/29/07	no												**0**
8/30/07	no												**0**
8/31/07	no												**0**
9/1/07	no												**0**
9/2/07	no												**0**
9/3/07	no												**0**
9/4/07	no												**0**
9/5/07	no												**0**
9/6/07	no												**0**
9/7/07	no												**0**
9/8/07	no												**0**
9/9/07	no												**0**
9/10/07	no												**0**
9/11/07	no									2			**2**
9/12/07	no						1			1			**2**
9/13/07	no									5	1		**6**
9/14/07	no									1			**1**
9/15/07	yes	1			1		1	1		6	1		**11**
9/16/07	no												**0**
9/17/07	no												**0**
9/18/07	no												**0**
9/19/07	no												**0**
9/20/07	no												**0**
9/21/07	no												**0**
9/22/07	no												**0**
9/23/07	no												**0**
9/24/07	no												**0**
9/25/07	no												**0**
9/26/07	no												**0**
9/27/07	no												**0**
9/28/07	no												**0**
9/29/07	no												**0**
9/30/07	no												**0**
10/1/07	no												**0**
10/2/07	no												**0**
10/3/07	no												**0**
10/4/07	no												**0**
10/5/07	no												**0**
10/6/07	no												**0**
10/7/07	no												**0**
10/8/07	no												**0**
10/9/07	no												**0**
10/10/07	no												**0**
10/11/07	no												**0**
10/12/07	no												**0**
10/13/07	no												**0**
10/14/07	no												**0**
10/15/07	yes						4			5			**9**
10/16/07	yes			1						7	1		**9**
10/17/07	yes										1		**1**
10/18/07	yes												**0**
10/19/07	yes						1						**1**
10/20/07	yes						2			2			**4**
10/21/07	yes			1	1					8			**0**
By Species		**4**	**9**	**2**	**3**	**0**	**16**	**1**	**0**	**50**	**14**	**0**	**99**
By Guild		**4**	**14**			**17**			**0**	**64**			**99**
		HB	**BBSH**			**RBEP**			**MYSP**	**UNKN**			**Total**

Appendix A Table 4. Summary of acoustic bat data and weather during each survey night at the Tower West detector – Summer-Fall 2008

		HB	BBSH			RBEP			MYSP	UNKN			
Night of	Operated Okay?	hoary bat	big brown bat	silver-haired bat	silver-haired/big brown	eastern pipistrelle	eastern red bat	pipistrelle/red bat	MYSP	high-frequency	low-frequency	unknown	Total
7/30/07	yes						1			1			**2**
7/31/07	yes		1		2		5			5	4		**17**
8/1/07	yes		1		3		7			4	1		**16**
8/2/07	yes												**0**
8/3/07	yes												**0**
8/4/07	yes												**0**
8/5/07	yes		1		1		1			4	1		**8**
8/6/07	yes	1	1		3		6			19	4		**34**
8/7/07	yes						2			3	2		**7**
8/8/07	yes	4	1		3					2	3		**13**
8/9/07	yes	3					4			5	3		**15**
8/10/07	yes												**0**
8/11/07	yes												**0**
8/12/07	yes												**0**
8/13/07	yes												**0**
8/14/07	yes												**0**
8/15/07	yes												**0**
8/16/07	yes												**0**
8/17/07	yes												**0**
8/18/07	yes												**0**
8/19/07	yes												**0**
8/20/07	yes												**0**
8/21/07	yes												**0**
8/22/07	yes						1			1			**2**
8/23/07	yes						3			1			**4**
8/24/07	yes												**0**
8/25/07	yes		1				6			10			**17**
8/26/07	n/o												**0**
8/27/07	no												**0**
8/28/07	no												**0**
8/29/07	no												**0**
8/30/07	no												**0**
8/31/07	no												**0**
9/1/07	no												**0**
9/2/07	no												**0**
9/3/07	no												**0**
9/4/07	no												**0**
9/5/07	no												**0**
9/6/07	no												**0**
9/7/07	no												**0**
9/8/07	no												**0**
9/9/07	no												**0**
9/10/07	no												**0**
9/11/07	no												**0**
9/12/07	no												**0**
9/13/07	no												**0**
9/14/07	no												**0**
9/15/07	no												**0**
9/16/07	no												**0**
9/17/07	no												**0**
9/18/07	no												**0**
9/19/07	no												**0**
9/20/07	no												**0**
9/21/07	no												**0**
9/22/07	yes												**0**
9/23/07	yes							1					**1**
9/24/07	yes												**0**
9/25/07	yes												**0**
9/26/07	yes									1			**1**
9/27/07	yes												**0**
9/28/07	yes									5			**5**
9/29/07	yes			1			3			7			**11**
9/30/07	yes												**0**
10/1/07	yes												**0**
10/2/07	no												**0**
10/3/07	no												**0**
10/4/07	no												**0**
10/5/07	no												**0**
10/6/07	no												**0**
10/7/07	no												**0**
10/8/07	no												**0**
10/9/07	yes												**0**
10/10/07	yes								1				**1**
10/11/07	yes												**0**
10/12/07	yes												**0**
10/13/07	yes												**0**
10/14/07	yes												**0**
10/15/07	no												**0**
10/16/07	no												**0**
10/17/07	no												**0**
10/18/07	no												**0**
10/19/07	no												**0**
10/20/07	no												**0**
10/21/07	no												**0**
By Species		**8**	**6**	**1**	**12**	**0**	**39**	**1**	**1**	**68**	**18**	**0**	**154**
By Guild		**8**	**19**			**40**			**1**	**86**			
		HB	**BBSH**			**RBEP**			**MYSP**	**UNKN**			**Total**

Appendix C
Federal Consistency Determination

FEDERAL CONSISTENCY DETERMINATION FOR THE ALTERNATIVE ENERGY PROJECT

**NATIONAL AERONAUTICS AND SPACE ADMINISTRATION
GODDARD SPACE FLIGHT CENTER
WALLOPS FLIGHT FACILITY
WALLOPS ISLAND, VA 23337**

Introduction

This document provides the Commonwealth of Virginia with the National Aeronautics and Space Administration's (NASA) Consistency Determination under Coastal Zone Management Act (CZMA) Section 307(c)(1) and Title 15 Code of Federal Regulations (CFR) Part 930, Subpart C, for implementation of the Alternative Energy Project at NASA's Goddard Space Flight Center Wallops Flight Facility (WFF), Wallops Island, Virginia.

NASA has prepared a Draft Environmental Assessment (EA) to evaluate the potential environmental impacts from the Alternative Energy Project in accordance with the National Environmental Policy Act of 1969 (NEPA), as amended (42 U.S. Code 4321-4347), the Council on Environmental Quality (CEQ) regulations for implementing NEPA (40 Code of Federal Regulations [CFR] 1500-1508), NASA's regulations for implementing NEPA (14 CFR Subpart 1216.3), and the *NASA Procedural Requirements (NPR) for Implementing NEPA* and *Executive Order (EO) 12114* (NPR 8580.1).

The U.S. Army Corps of Engineers (USACE) has served as a Cooperating Agency in the preparation of the Draft EA and all necessary consultation documents because they possess regulatory authority over the Proposed Action. USACE would undertake a "connected action" in its issuance of permits pursuant to Section 404 of the Clean Water Act and Section 10 of the Rivers and Harbors Act. Accordingly, the Draft EA and this Consistency Determination have been developed to also fulfill the USACE's obligations under NEPA and CZMA. NASA, as the WFF property owner and project proponent, is the Lead Agency and responsible for ensuring overall compliance with applicable environmental statutes.

The purpose of the proposed Alternative Energy Project is to generate clean, renewable energy at WFF from a technologically proven source in order to meet the requirements of the 2005 Federal Energy Policy Act and Executive Orders 13423 and 13514. The project would also support NASA's goal to set an example of leadership in environmental stewardship and accountability by a Federal agency. The EA encompasses a 25-year planning horizon, which is based on the expected life span of the proposed wind turbines.

Under the Proposed Action, NASA would construct two 2.0- megawatt "utility-scale" wind turbines on Wallops Island that would be capable of generating approximately 10 gigawatt-hours of electricity per year, and up to five 2.4-kilowatt "residential-scale" wind turbines at the Main Base and Mainland. The utility-scale wind turbines would be located on Wallops Island west of the U.S. Navy V-10/V-20 complex. One of the 2.4 kW wind turbines would be installed near the WFF Visitor Center, and a second one would be

installed near the security guard station at the Mainland. The locations of the remaining three residential-scale wind turbines are unknown at this time, but would be placed within the areas that NASA has identified as potential suitable locations at WFF.

Effects to Resources

NASA has determined that the Proposed Action would affect the land or water uses or natural resources of Virginia in the following manner:

Topography – The foundation for the utility-scale wind turbines and access roads would require filling of wetlands, resulting in permanently elevated areas of soil within the wetland, which would result in long-term adverse impacts on the topography in the areas immediately around the turbine footprints. Previously disturbed areas would be used for staging of equipment of materials and for construction vehicle parking. No changes in topography would occur with installation of the residential-scale wind turbines.

Geology and Soils – Spills or leaks of pollutants would have the potential to adversely affect soils. NASA would implement site-specific Best Management Practices (BMPs) for vehicle and equipment fueling and maintenance, and spill prevention and control measures. There would be minor long-term impacts on geology immediately around the driven piles.

Land Use – The area where the proposed utility-scale and residential-scale wind turbines would be located is zoned industrial by Accomack County and would be located in areas on WFF property that are currently unused and are not planned for future use. The construction and operation of the proposed wind turbines would not result in changes to land use, or impacts on NASA or the U.S. Navy's use of the area; therefore, no impacts would occur.

Surface Waters – There are potential adverse impacts during construction such as spills or leaks of pollutants, or from ground disturbance (i.e., grading, clearing, filling, and excavation) that would have the potential to cause soil erosion and the subsequent transport of sediment into waterways via stormwater. With implementation of mitigation measures for construction activities, no long-term or adverse impacts on surface waters would occur. NASA would minimize adverse impacts by developing site-specific Erosion and Sediment Control Plans, acquiring Virginia Stormwater Management Program permits as necessary, implementing BMPs, and following procedures outlined in WFF's Integrated Contingency Plan (ICP).

Wetlands – Up to 0.36 hectare (0.88 acre) of tidal wetlands would be filled for construction of the utility-scale wind turbine pads, underground cables, and access roads; 0.29 hectare (0.71 acre) of estuarine intertidal emergent wetlands, 0.06 hectare (0.14 acre) of palustrine emergent wetlands, and 0.01 hectare (0.03 acre) of palustrine scrub-shrub wetlands. Prior to construction, NASA would obtain necessary Federal, State, and local permits via the Joint Permit Application (JPA) process and would implement at least 0.362 hectare (0.895 acre) of compensatory mitigation at WFF's Mainland. No wetlands would be affected for construction of the residential-scale turbines.

Floodplains – The utility-scale wind turbines and the residential-scale wind turbine proposed at the Mainland guard station would be located within the 100-year and 500-

year floodplains. Because Wallops Island is entirely within the floodplain, no practicable alternatives exist. Minor, localized adverse impacts on the functionality of the floodplain on Wallops Island would be expected from the placement of fill material within the project site.

Air Quality – Short-term impacts from constructing the wind turbines would be negligible compared to the long-term beneficial impacts on air quality due to reduced greenhouse gas emissions and lowered use of fossil fuels during the production of electricity from the utility-scale wind turbines.

Noise – Operation of the wind turbines would result in localized, long-term, minor impacts on the surrounding environment from noise. Neither the public nor employees and visitors to WFF outside of Wallops Island would be able to hear the wind turbines; therefore, no impacts on either of these two groups would occur. No impacts on the occupational health of construction workers as a result of construction noise as all activities would be conducted in accordance with U.S. Occupational Safety and Health Administration standards.

Hazardous Materials and Hazardous Waste Management – Construction, maintenance, and decommissioning activities for the wind turbines would involve hazardous materials and produce hazardous waste. NASA would ensure implementation of WFF's ICP procedures, training, and mitigation measures, including spill prevention and response. Therefore, no impacts on human and environmental health due to hazardous materials and wastes are anticipated.

Vegetation and Terrestrial Wildlife – Short-term adverse impacts would be expected due to excavation and grading to construct all wind turbines, and the utility-scale turbine's access roads and underground cables. Long-term, adverse impacts to habitat would occur due to the permanent conversion of 0.36 hectare (0.88 acre) of wetlands to developed land for construction of the utility-scale wind turbines. NASA would implement wetland mitigation measures agreed upon through the JPA consultation process to offset the impacts. Impacts would be localized to the area within the wind turbine construction footprints.

Birds and Bats – There would be long-term adverse impacts due to the conversion of wetland habitat to developed land for construction of the utility-scale wind turbines and from operation of the all wind turbines. A post-construction monitoring study has been proposed as a means of better determining the utility-scale wind turbines' risk profile and to provide data for comparison of actual avian and bat mortality at the wind turbines with mortality estimated for the existing tower structures. The need for additional BMPs would be determined once the post-construction study is implemented.

Because the use of red or white flashing obstruction lights has been strongly correlated with a decrease in avian fatalities compared to non-flashing, steady burning lights at tower systems, NASA would utilize either red or white flashing light systems to satisfy Federal Aviation Administration requirements for lighting the utility-scale wind turbines. Numerous technologies and methodologies (e.g., blade color patterns, flight diverters, acoustic deterrents, etc.) are currently under development to lessen the potential risk that wind turbines pose to avifauna. NASA may consider implementing such technologies to both test their efficacy and to reduce potential impacts.

Threatened and Endangered Species – Although suitable habitat would not be affected by the project, avian mortality has been documented as an adverse effect of birds colliding with the rotating blades of wind turbines and cannot be discounted. NASA determined that the project "may affect, and is likely to adversely affect" the Piping Plover and Red Knot. The project would have "no effect" to federally listed mammals, sea turtles, insects, and plants. WFF has developed a protected species monitoring plan, which includes the Piping Plover and Red Knot, in cooperation with USFWS. NASA would continue to coordinate with Chincoteague National Wildlife Refuge and U.S. Department of Agriculture personnel in monitoring the Wallops Island beach for Piping Plover and Red Knot activity.

Essential Fish Habitat – Because EFH is located within the tidal wetlands that would be affected by the by construction of two proposed utility-scale wind turbines, NASA completed an EFH Checklist to determine what, if any impacts may occur on EFH. Based on the EFH Checklist, NASA has determined that the Proposed Action would result in adverse effects on EFH, but they would not be substantial. Effects on EFH would be offset by 0.362 hectare (0.895 acre) of compensatory mitigation at WFF's Mainland.

Socioeconomics – Construction activities would result in a benefit to the local economy due to employment opportunities for local construction workers and increased numbers of people in Accomack County during business hours resulting in a potential increase in the use of local stores and businesses for purchases. Disproportionately high or adverse impacts to low-income or minority populations are not anticipated.

Cultural Resources – All ground disturbances would be located outside of areas designated as having moderate or high potential for archeological resources. No adverse effects on archaeological resources are anticipated. Utility-scale turbines are not anticipated to adversely affect aboveground historic properties within or outside of WFF given the nature of the viewshed. Residential-scale turbines are not anticipated to adversely affect aboveground historic properties within WFF. Indirect visual effects to historic properties outside of the WFF property, should they be present, are possible and may be adverse, depending upon the nature of the property.

Transportation – Temporary impacts on traffic flow could occur during construction activities. As NASA or its contractor would closely coordinate with the Virginia Department of Transportation and the local community regarding the movement of oversized loads, no substantial impacts on transportation are anticipated.

Aesthetics – Due to the height of the residential-scale turbines compared to their surrounding environment (trees, towers, and buildings), they would not be seen from areas outside of WFF other than by motorists traveling along the highway adjacent to the WFF Visitor Center. Additionally, the viewshed looking towards the proposed utility-scale turbine site already contains radio towers, buildings, launch pad infrastructure, and from some viewing locations, the bridge that links Wallops Mainland with Wallops Island. Wind turbines would be white to blend in with sky. Therefore, the wind turbines would not result in a substantial change to the local viewshed and there would be no adverse impacts on the public viewshed. Potential adverse impacts on WFF employees and visitors within turbine shadow due to flickering effect of spinning blades on sunny days.

Cumulative Impacts – There would be adverse cumulative impacts on avifauna from construction and operation of the wind turbines. Cumulative impacts on wetlands would be mitigated. There would be beneficial impacts on air quality due to reduced greenhouse gas emissions and lowered use of fossil fuels during the production of electricity.

Consistency Determination

The Virginia Coastal Zone Management Program contains the following applicable enforceable policies:

- **Fisheries Management**. Administered by VMRC, this program stresses the conservation and enhancement of shellfish and finfish resources and the promotion of commercial and recreational fisheries.
- **Subaqueous Lands Management.** Administered by VMRC, this program establishes conditions for granting permits to use State-owned bottomlands.
- **Wetlands Management.** Administered by VMRC and VDEQ, the wetlands management program preserves and protects tidal wetlands.
- **Dunes Management.** Administered by VMRC, the purpose of this program is to prevent the destruction and/or alteration of primary dunes.
- **Non-point Source Pollution Control.** Administered by the Virginia Department of Conservation and Recreation, the Virginia Erosion and Sediment Control Law is intended to minimize non-point source pollution entering Virginia's waterways.
- **Point Source Pollution Control.** Administered by the State Water Control Board, the National Pollutant Discharge Elimination System permit program regulates point source discharges to Virginia's waterways.
- **Shoreline Sanitation.** Administered by the Department of Health, this program regulates the installation of septic tanks to protect public health and the environment.
- **Air Pollution Control.** Administered by the State Air Pollution Control Board, this program implements the Federal Clean Air Act through a legally enforceable State Implementation Plan.
- **Coastal Lands Management.** Administered by the Chesapeake Bay Local Assistance Department, the Chesapeake Bay Preservation Act guides land development in coastal areas to protect the Chesapeake Bay and its tributaries.

Based upon the following information, data, and analysis, NASA finds that the proposed Alternative Energy Project activities are consistent to the maximum extent practicable with the enforceable policies of the Virginia Coastal Zone Management Program. The table below summarizes NASA's analysis supporting this determination:

Virginia Policy	Consistent?	Analysis
Fisheries Management	Yes	There would be site-specific adverse effects on fish habitat within the fill placement area due to burial of existing intertidal wetland habitat and increased levels of turbidity during and immediately after construction. The adverse impacts are not anticipated to be substantial as NASA would provide compensatory wetland mitigation to offset habitat losses. Additionally, NASA would employ strict erosion and sediment controls during construction to mitigate impacts to water quality. The proposed action would not violate the provisions outlined in Code of Virginia § 28.2-200 through 28.2-713 and Code of Virginia § 29.1-100 through 29.1-570.
Subaqueous Lands Management	Yes	Project activities would not impact subaqueous areas.
Wetlands Management	Yes	Project activities would impact 0.36 hectare (0.88 acre) of tidal wetlands. NASA would obtain necessary permits via the JPA process and would implement 0.362 hectare (0.895 acre) of compensatory mitigation at WFF's Mainland.
Dunes Management	Yes	Project activities would not involve the alteration of existing dunes.
Non-point Source Pollution Control	Yes	Construction activities could temporarily increase non-point source runoff to nearby waterways. NASA would implement appropriate erosion and sediment control BMPs to minimize the impact. All land-disturbing activities would be conducted in accordance with the VSMP and NASA would obtain all necessary permits prior to project implementation.
Point Source Pollution Control	Yes	The project would not involve a new point source discharge to Virginia waters.
Shoreline Sanitation	Yes	The project would not involve the construction of septic tanks.
Air Pollution Control	Yes	Use of equipment for construction would result in minor emissions; however none would violate Federal or Virginia air quality standards.. With the implementation of low-emission alternative energy sources, the project would result in long-term beneficial impacts on air quality.
Coastal Lands Management	Yes	The proposed project would not include land development activities that would impact the Chesapeake Bay or its tributaries.

Pursuant to 15 CFR section 930.41, the Virginia Coastal Zone Management Program has 60 days from the receipt of this letter in which to concur with or object to this

Consistency Determination, or to request an extension under 15 CFR Section 930.41(b). Virginia's concurrence will be presumed if its response is not received by NASA on the 60th day from receipt of this determination. The State's response should be sent to:

Joshua A. Bundick
WFF NEPA Manager
Environmental Office
NASA Wallops Flight Facility
Wallops Island, VA 23337
(757) 824-2319

Appendix D
Biological Assessment

BIOLOGICAL ASSESSMENT FOR

NASA WALLOPS FLIGHT FACILITY

ALTERNATIVE ENERGY PROJECT

National Aeronautics and Space Administration

Goddard Space Flight Center

Wallops Flight Facility

Wallops Island, VA 23337

In cooperation with

U.S. Army Corps of Engineers, Norfolk District

March 2010

Table of Contents

Table of Figures

Table of Tables:

1. Introduction

1.1 Purpose of Document

Section 7(c) of the Endangered Species Act (ESA) of 1973 requires that a Biological Assessment (BA) be prepared for all federal actions that may affect federally listed or proposed endangered or threatened species. The federal action considered in this BA is the construction, operation, and maintenance of two wind turbines in order to comply with Executive Order s(EOs) 13423, *Strengthening Federal Environmental, Energy, and Transportation Management* (effective January 24, 2007) and 13514, *Federal Leadership in Environmental, Energy, and Economic Performance* (effective October 8, 2009) and the Federal Energy Policy Act (EPACT, effective August 8, 2005). This BA encompasses a 25-year planning horizon, which is based on the expected life span of the proposed action.

The U.S. Army Corps of Engineers (USACE), Norfolk District is assisting NASA in preparing this BA. The USACE has permitting authority for the project under Section 404 of the Clean Water Act. In cooperation with USACE, NASA has prepared this BA to consider the potential impacts to listed species (under the jurisdiction of the U.S. Fish and Wildlife Service [USFWS]) that may occur within the proposed action area (see Figure 1, Proposed Action Area). Table 1 provides a list of species that may occur in Accomack County, Virginia, where Wallops Island is located. The species list was generated from the USFWS Federally Endangered, Threatened, Proposed, and Candidate Species List for Accomack County, VA.

Table 1: Federally Endangered, Threatened, Proposed Candidate Species in Accomack County

Scientific Name	Common Name	Status
Calidris canutus	Red Knot	Candidate Species
Charadrius melodus	Piping Plover	Threatened
Cicindela dorsalis dorsalis	Northeastern Beach Tiger Beetle	Threatened
Sciurus niger cinereus	Delmarva fox squirrel	Endangered
Caretta caretta	Loggerhead Sea Turtle	Threatened
Amaranthus pumilus	Seabeach Amaranth	Threatened

USFWS. 2008

No habitat exists for the Northeastern Beach Tiger Beetle in the action area. The Delmarva fox squirrel does not occur on Wallops Island. The Loggerhead Sea Turtle does not nest in marshes, and no construction would take place in the open water areas in which a marine turtle might be found. Seabeach amaranth is a beach plant species found on accreting sand shorelines and not in marshes. Therefore, these species are not considered in this BA.

The federally listed threatened or candidate species that may actually occur on and/or near the proposed wind turbine sites are listed in Table 2.

Table 2: Table 2: Potential Protected Species in the Action Area

Scientific Name	Common Name	Federal Status
Charadrius melodus	piping plover	Threatened
Calidris canutus	red knot	Candidate Species

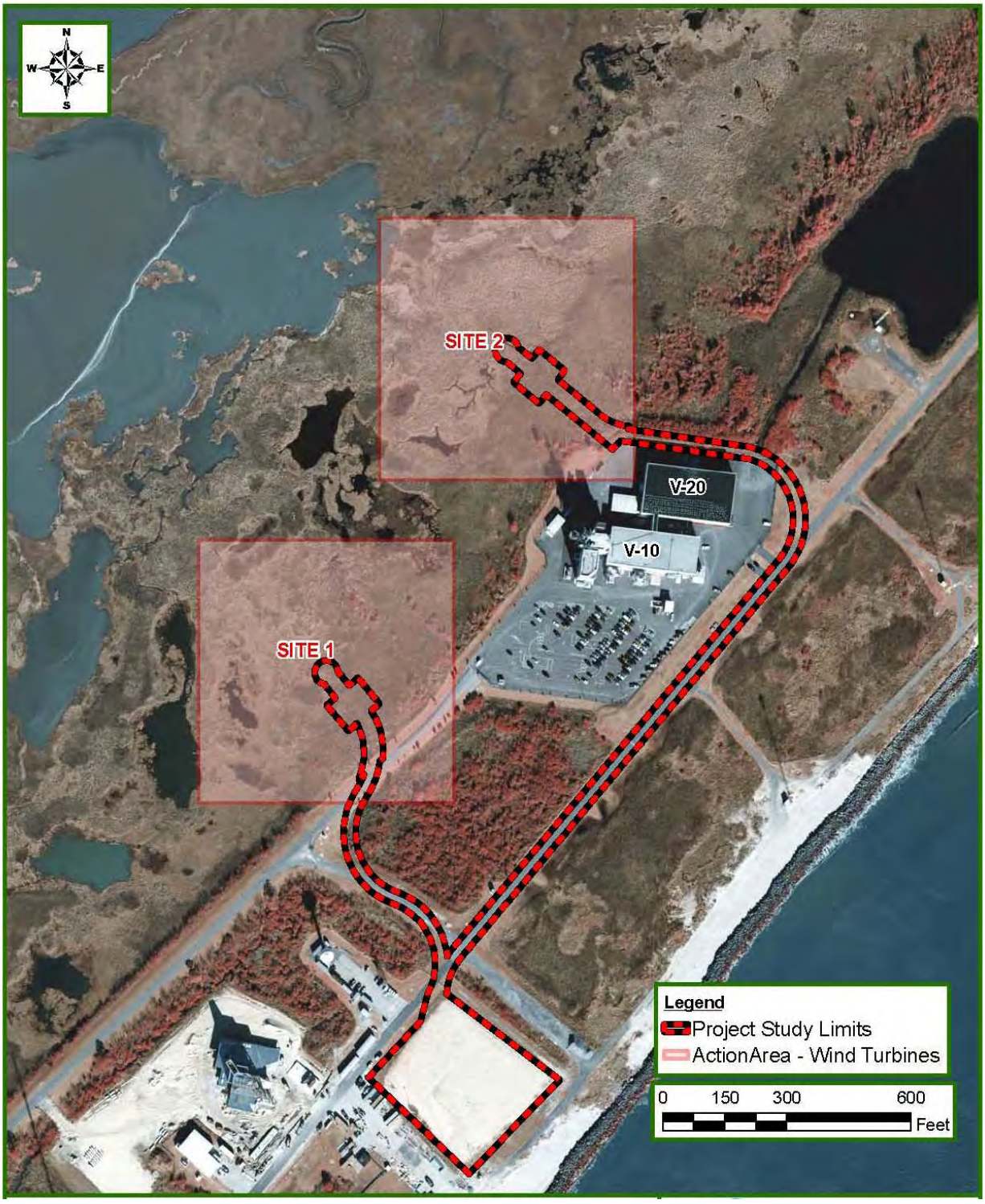

Figure 1: Proposed Action Area

2. Description of the Action

2.1 Proposed Action

NASA is proposing to construct two 2.0 megawatt (MW) wind turbines at the Wallops Flight Facility (WFF) located in Accomack County, Virginia that are capable of generating approximately 10 gigawatt hours per year (GWh/yr) of electricity. The wind turbines have an expected life span of 25 years. Because the proposed wind turbines have the potential to interfere with WFF's active airfields and tracking/telemetry systems, the area available for their construction is restricted to the proposed action area on Wallops Island, west of the U.S. Navy V-010/V-020 complex. The wind turbines would be constructed with a set-back distance of 153 meters (500 feet) from existing towers and buildings. The finished subsurface footprint of each wind turbine would be approximately 13 meters (42 feet) in diameter, with a 4.6 meter (15 foot) diameter surface foundation. A corridor 9.7 meters (32 feet) wide would be constructed for access roads to each wind turbine, including approximately 4.9 meters (16 feet) for a permanent gravel road surface and an additional 2.4 meters (8 feet) on each side for road shoulders. Power lines would be buried within or adjacent to the wind turbine access road corridors, as well as along existing roadways, before reaching an established point for interconnection with the existing Wallops Island 12.47 kilovolt electrical distribution system.

Previously disturbed areas, including the cleared area east of the U.S. Navy V-10/V-20 complex, would be used for staging of equipment and materials, and for construction vehicle parking. The construction period for two wind turbines would be approximately 6 months. A representative 2.0 MW wind turbine would have the following specifications:

- three composite (non-metal) rotor blades, each 42.5 meters (139.5 feet) in length;
- height of 120.5 meters (395.3 feet) at the top of the blade;
- a rotation speed of 9 to 19 revolutions per minute;
- a "swiveling" functionality so that rotor blades automatically rotate to face oncoming wind, and
- a generator and gearbox supported by elastomeric elements to minimize noise emission.

NASA would utilize data currently collected at various locations/towers on Wallops Island to monitor wind speed and direction, rather than build a new meteorological tower specifically for the proposed action. Operations and maintenance staff and equipment would be housed in existing NASA facilities, negating the need to construct any new buildings for operations and maintenance.

Routine service would be performed in accordance with the manufacturer's specifications in order to minimize wear and tear on the equipment, potential for excessive equipment breakdown and/or parts replacement and to maximize the energy production efficiency of the turbines. Unplanned maintenance would be carried out to any part of the wind turbines in response to a breakdown or failure.

2.2 Action Area

The Project would be located within the boundaries of WFF on Wallops Island in Accomack County, Virginia (see Figure 2, Vicinity Map). Wallops Island is a barrier island and is bordered by the Atlantic Ocean to the east. Wallops Island is located southwest of Chincoteague Island and east of Wallops Mainland, separated by Bogues Bay and numerous marshes, creeks, and tidal estuaries. The Project Area would be located in the Atlantic Ocean Coastal Watershed (HUC AO04). The site of the proposed wind turbine construction is located on Wallops Island within an intertidal, estuarine marsh approximately 304.8 meters (1,000 feet) southeast of tidal flats adjacent to Bogues Bay, and approximately 365.76 meters (1,200 feet) west of the Atlantic Ocean.

The area of effect for the construction of the turbines includes the footprint, access road infrastructure, work space for construction, and staging areas. The National Wetland Inventory (NWI) map identified multiple tidal and non-tidal wetlands throughout the site. There are four-distinct ecological communities including uplands, palustrine scrub-shrub wetlands, palustrine emergent wetlands, and estuarine intertidal emergent wetlands within the proposed construction footprint of the wind turbine facilities, access roads, and construction staging area. The construction of the proposed project would result in permanent impacts to 0.36 hectare (0.88 acre) of wetlands.

The operational area of effect of the wind turbines includes the overall height of the tower and top of the blades 120.5 meters (395 feet), the diameter of the blades 85 meters (279 feet), and the rotational area of the blades.

Figure 2: Proposed Wind Turbine Sites on Wallops Island

3. Species Potentially in the Action Area

3.1 Piping Plover

3.1.1. Description and Distribution

The Atlantic Coast piping plover population was listed as threatened on January 10, 1986.

Piping plovers are small, beige and white shorebirds with a black band across their breast and forehead. The plover breeds on coastal beaches from Newfoundland and southeastern Quebec to North Carolina to Florida, although some migrate to the Bahamas and West Indies. Plovers typically feed on invertebrates such as marine worms, fly larvae, beetles, crustaceans, and mollusks. Feeding areas include intertidal portions of ocean beaches, washover areas, mudflats, sandflats, wrack lines, and shorelines of coastal ponds, lagoons, or salt marshes (USFWS, 2006b).

3.1.2. Nesting

After they establish nesting territories and conduct courtship rituals which begin in late March or early April, piping plover pairs form shallow depressions (nests) in the sand to lay eggs. Nests are situated above the high tide line on coastal beaches, sandflats at the ends of sand spits and barrier islands, gently sloping foredunes, blowout areas behind primary dunes, and washover areas cut into or between dunes. Nest sites are shallow scraped depressions in substrates ranging from fine grained sand to mixtures of sand and pebbles, shells or cobble. They may also nest on areas where suitable dredge material has been deposited. Nests are usually found in areas with little or no vegetation although, on occasion, piping plovers will nest under strands of American beachgrass (*Ammophila breviligulata*) or other vegetation (USFWS, 2006b). Plovers typically lay four eggs that hatch in about 25 days (USFWS, 2007).

3.1.3. Status of Species in the Action Area

Since 1996, when monitoring was initiated at all Chincoteague National Wildlife Refuge (CNWR) units (including Assateague, Assawoman, and Metompkin) there had been an increasing trend in the number of nesting pairs (Table 3.1). However, since 2004, nesting has remained static and decreased at the Hook and Overwash areas, respectively, and has increased slightly at Assawoman and north Metompkin (Table 4).

Table 3: Table 3:. Record of Piping Plover Pairs and Number of Young Fledged at CNWR.

Year	# Pairs	# Young Fledged	Comments
1988[a]	32	27	0.84 young fledged/pair
1989[a]	32	36	1.13 young fledged/pair
1990[a]	42	24	0.57 young fledged/pair
1991[a]	38	30	0.79 young fledged/pair

Year	# Pairs	# Young Fledged	Comments
1992[a]	36	19	0.53 young fledged/pair
1993[b]	41	56	1.37 young fledged/pair
1994[b]	41	71	1.73 young fledged/pair
1995[b]	45	44	0.98 young fledged/pair
1996[c]	51	83	1.63 young fledged/pair
1997[c]	62	43	0.69 young fledged/pair
1998[c]	62	69	1.11 young fledged/pair
1999[c]	55	74	1.35 young fledged/pair
2000[c]	63	98	1.56 young fledged/pair
2001[c]	73	134	1.84 young fledged/pair
2002[c]	76	95	1.25 young fledged/pair
2003[c]	72	147	2.04 young fledged/pair
2004[c]	97	221	2.28 young fledged/pair
2005[c]	118	167	1.42 young fledged/pair
2006[c]	117	121	1.03 young fledged/pair
2007[c]	98	110	1.12 young fledged/pair
2008[c]	117	96	0.82 young fledged/pair

[a] Data from Assateague Island

[b] Data from Assateague, Assawoman, and Metompkin Islands

[c] Data from Assateague, Assawoman, Metompkin, and Cedar Islands

USFWS, 2008

Table 4: Table 4. Piping Plover Nesting Activities at Each CNWR Unit.

Area	Year	Nesting Pairs	Nests Attempts	No. Eggs	Eggs Hatched	Chicks Fledged	Fledglings/ Nesting Pair
Hook	2004	27	30	105	90	70	2.59
	2005	32	39	143	91	58	1.81
	2006	27	30	102	72	37	1.37

Area	Year	Nesting Pairs	Nests Attempts	No. Eggs	Eggs Hatched	Chicks Fledged	Fledglings/ Nesting Pair
	2007	22	30	94	18	24	1.09
	2008	30	36	108	71	21	0.70
Overwash	2004	11	11	43	33	26	2.36
	2005	8	12	48	27	16	2.00
	2006	8	10	29	16	4	0.50
	2007	6	8	22	6	6	1.00
	2008	6	6	20	13	5	0.84
Assawoman	2004	23	23	92	87	61	2.65
	2005	30	37	123	62	34	1.14
	2006	23	25	84	64	28	1.22
	2007	23	25	88	68	40	1.74
	2008	26	35	114	74	30	1.15
North Metompkin	2004	4	4	7	7	7	1.75
	2005	3	6	21	5	3	1.00
	2006	6	7	22	10	9	1.50
	2007	6	6	21	13	10	1.67
	2008	7	8	N/A	N/A	8	1.14

Piping plover nesting habitat has been delineated on Wallops Island dune and overwash areas at the northern and southern reaches of the property. As south Wallops Island has experienced substantial erosion (3.3 m [11ft]/year), suitable habitat is increasingly less abundant. According to Mitchell (2009, pers. comm.), no nesting plovers have been observed on south Wallops Island since at least 2000. However, as is often the case in a dynamic beach environment, at any time, storm events may create new overwash areas. North Wallops Island has been accreting, thus presenting additional potential habitat for plover nesting.

Annually between 1996 and 2008, piping plovers were observed feeding on Wallops Island, although exact numbers were not recorded. Additionally, nests were observed on Wallops Island in 1996 (3 pairs with 2 chicks total fledged); 1998 (1 pair unsuccessful); 2001 (1 pair unsuccessful); 2004 (1 pair-3 chicks fledged); 2005 (2 pairs, lost to predation); and 2006, (1 pair, lost to predation by a fox). Five nesting attempts were made on north Wallops Island during 2007 and 2008 but none were successful in producing fledglings. There were no nests observed in 1997, 1999, 2000, 2002, or 2003 (Table 5).

In 2009, four piping plover pairs have attempted nests on north Wallops Island. Of these, three have been successful at producing ten fledglings (Scharle, 2009).

Table 5. Record of Piping Plover Pairs and Number of Young Fledged at WFF 1986 - 2008.

Year	# Pairs	# Young Fledged	Comments
1986	2	0	All at south end of Island
1987	2	3	1.5 young fledged/pair; All at south end

Year	# Pairs	# Young Fledged	Comments
1988	0	0	No nesting
1989	5	Unknown	All at south end
1990	5	Unknown	All at south end
1991	3	Unknown	All at south end
1992	4	5	1.25 young fledged/pair; All at south end
1993	3	4	1.33 young fledged/pair; All at south end
1994	3	2	0.67 young fledged/pair; All at south end
1995	2	4	2.00 young fledged/pair; All at south end of Island
1996	3	2	0.67 young fledge/pair; 1 pair, 0 fledged at south end
1997	0	0	No nesting
1998	1	0	
1999	0	0	No nesting
2000	0	0	No nesting
2001	1	0	
2002	0	0	No nesting
2003	1	0	A pair of plovers scraped, but made no other attempts at nesting
2004	1	3	3.00 young fledged/pair
2005	2	0	One nest was predated (fox), the other nest hatched by the chicks were later lost
2006	1	0	Nest was set up with enclosure; a fox tried digging under enclosure to get nest but did not succeed. The nest however was abandoned due to this event.
2007	3	0	All nests were exclosed. One nest was predated by a fox, one nest lost to tide
2008	2	0	2 pairs of plovers scraped at north end, but made no other attempts at nesting

NASA, 2008

3.2 Red Knot

3.2.1. Description and Distribution

The red knot is currently a candidate species for protection under the Endangered Species Act.

The red knot was once the most numerous shorebird in North America, but during the 1800s and early 1900s it was put under severe hunting pressure on its migratory route.

The Red Knot is a medium sized, bulky sandpiper. It is a relatively short bird, with short legs. The head and breast are reddish in breeding plumage and grey the rest of the year. Outside of breeding season, it is found primarily in intertidal, marine habitats, especially near coastal inlets, estuaries, and bays. The Red Knot breeds in drier tundra areas, such as sparsely vegetated hillsides. The Red Knot typically feeds on invertebrates, especially bivalves, small snails, and crustaceans. During breeding season, the Red Knot also eats terrestrial invertebrates (Harrington, 2001). The Delaware Bay stopover is the final and most crucial spring stopover during the northern migration. This is because the birds feed on the eggs of spawning horseshoe crabs in preparation for their nonstop leg to the Arctic. The birds rest and feed in the Delaware Bay between late April and early June with the population peaking May 15th through 30th (Baker et al., 2004).

3.2.2. Nesting

The red knot nesting areas are located in the high arctic.Barrier islands merely provide a stopover point along their migratory route. No nesting activities are expected in or around the proposed action area.

3.2.3. Status of the Species in the Action Area

Recent research (Cohen, et. al., 2009) indicates that a significant portion of the red knot population utilizes the Virginia barrier islands as a stopover point on the migration north. Instead of horseshoe crab eggs, these birds feed on blue mussels, coquina clams, and various species of amphipods (Truitt and Brown, 2001). In the mid-1990s, 3 years of aerial surveys showed that numbers of red knots moving through the barrier islands of Virginia between mid-May and the second week of June reach 8,000 to 10,000 individuals (Watts and Truitt, 2000). During the 2009 migration season, flock sizes of 100 to 145 birds were observed in the Overwash and Hook areas of Assateague Island. In late May 2009, flocks of 5 to 30 individuals were observed on south Assawoman Island. On May 8, USFWS observed a flock size of almost 1,300 individuals on north Wallops Island (USFWS, 2009c). In late May 2009, flocks of approximately 20 to 200 red knots were observed on north Wallops Island (USFWS, 2009c).

4. Effects of the Proposed Action

Potential avian impacts associated with construction and operation of the proposed action could include loss of habitat; disturbances associated with the presence or activity of construction equipment; disturbances such as barriers to flight paths due to the presence of the turbines and the risk of collision with wind turbine blades.

4.1. Piping Plover

4.1.1. Direct and Indirect Effects

Both the northern and southern delineated piping plover nesting areas on Wallops Island are located a minimum of 4.8 km (3 miles) from the proposed action area. Additionally, the action area is located in wetlands on the western side of Wallops Island while the plover habitats are found on the beaches of the eastern side of Wallops Island.

Under the proposed action, no construction is planned for areas within known piping plover nesting habitat. Noise from construction activities would be of short duration and would likely present minor startle reactions. Temporary interruption of foraging and nesting activities for piping plover may occur as a result of human presence during staging and construction activities but the effect is unlikely.

The potential exists for piping plover to collide with the wind turbines, including the blades and tubular towers during breeding, staging, and migration periods. The results of available terrestrial mortality studies conducted primarily terrestrial environments for general avian species indicate that the majority of collisions with man-made structures take place at night during periods of inclement weather (Kerlinger, 2000). Birds that fly within the rotor zone of the proposed turbines during periods of low visibility would be at the greatest risk of collision. It may be that plovers wait out inclement weather conditions prior to flight. Peterson et al. (2006) observed a substantial decrease in the volume of migrating birds at an offshore facility in Europe during periods of low visibility and elevated collision risk.

Height of flight is an important factor to consider when assessing the risk of collision to piping plover. During the breeding season piping plover are mainly sedentary as they forage on invertebrates in the inter-tidal beach zone near nest sites. During this period, plovers mainly travel by walking or running between proximal foraging and breeding sites, however, some plovers may undertake short flights to foraging areas, flying low over the water (or adjacent land), typically less than 10 meters (33 feet), but sometimes at higher, unknown altitudes (Cape Wind Associates, 2007a). Their regular daily movements are not expected to result in crossings of the proposed action area. Unusual crossings of Wallops Island during the breeding season could include the crossings of failed breeders or unpaired birds seeking alternate habitat or a mate. However, a study conducted on Cape Cod in Massachusetts indicated that most breeding plovers did not change mates or move to new territories between nesting attempts (MacIvor, 1990). Due to the relatively sedentary behavior of piping plover during breeding season, the wind turbines are not anticipated to create a major barrier to the flight paths of piping plover during the breeding season. Therefore, given that historical nesting sites have been on the

opposite side of the island to the action area, effects from the proposed action would likely be insignificant to breeding plovers.

The majority of Atlantic Coast piping plover migratory movements are presumed to take place along the outer beaches of the coastline (USFWS, 1996), both during the day and night (O'Brien, et al., 2006). Most movements are presumed to occur along a narrow flight corridor, and offshore and inland observations are rare (USFWS, 1996). There is a great deal of uncertainty surrounding the migratory flight paths of piping plover. The hypothesized movement of piping plover along the shoreline during migration is based on observations of birds at stop-over locations along the Atlantic Coast, however the paths actually taken between these stop-overs are not documented. Some birds may occur inland or offshore while migrating if blown off course by weather events, although sightings away from the outer beaches, either inland or offshore, are rare (USFWS, 1996). The number of annual piping plover crossings of Wallops Island is unknown. However, since the best available information suggests that migration movements are believed to largely occur along the outer beaches, it is expected that the presence of the wind turbines would not present a major barrier to the flight path of migratory birds.

The risk of collision of piping plover during migration movements would be based on flight frequency through the proposed action area, height of flight, visibility conditions, and turbine avoidance behaviors (which are not known). Cape Wind Associates (2007b) used the Band model to estimate a 91 to 99 percent plover avoidance rate based on a range of known avoidance rates calculated for other species. These avoidance rates are consistent with rates calculated at a few existing wind farms in the U.S. where mainly geese and raptor species were estimated to have avoidance rates greater than 95 percent. Fernley et al. (2006) calculated the avoidance rates of geese at four land-based wind farms in the U.S. using the Band Collision Risk Model. The avoidance rates calculated at the four facilities ranged from 99.82 percent to 100 percent despite high use by geese at these wind farm sites.

4.1.2. Actions to Reduce Adverse Effects

Under the Proposed Action, the wind turbines and access roads would be constructed on the opposite side of the island from the piping plover preferred habitat and historical nesting sites. No construction is planned for areas within known piping plover nesting habitat. Noise from construction activities would be of short duration and would likely present minor startle reactions. Temporary interruption of foraging and nesting activities for piping plover may occur as a result of human presence during staging and construction activities, however any such effect is unlikely as these areas are approximately 4.8 km (3 miles) from the action area. Therefore no attempt would be made to reduce adverse effects to piping plovers from construction activities.

The Federal Aviation Administration (FAA) requires that any structure taller than 61 meters (200 feet) above ground level must have aircraft warning lights. Gehring, et. al. (2009) found that the use of red or white flashing obstruction lights strongly correlated with a decrease in avian fatalities compared to non-flashing, steady burning lights at tower systems. Gehring, et. al. further stated that "Removing non-flashing lights from towers is one of the most effective and economically feasible means of achieving a significant reduction in avian fatalities at existing communication towers." Because the proposed wind turbines would be taller than 61 meters (200 feet), NASA would utilize either red or white flashing light systems.

NASA would collaborate with CNWR in monitoring Wallops Island for piping plover activity. CNWR personnel routinely monitor Assateague, Wallops Island, Assawoman, and Metompkin Island beaches for piping plovers during nesting season. NASA field personnel would monitor Wallops Island for piping plover activity. The location of any nests discovered would be recorded with a Global Positioning System (GPS) unit, identified with signage, and closed to personnel or visitor access. This information would be used to determine when piping plovers are actually migrating to and from their nesting sites.

In addition to the plover nesting surveys, NASA would institute mortality surveys around the base of each turbine after the turbine construction is completed. Takes of piping plovers would be noted and reported to USFWS. Data from these surveys would be used to assess the impact of the proposed project to the plovers and serve as the basis for adaptive mitigation techniques.

Concurrently, educational signs would be posted at all beach access points to raise awareness of the species and to provide contact information. Basic species identification would be included in the natural resources training module of the WFF Environmental Management System (EMS), a requirement of all new employees at the facility. WFF would continue to distribute its annual piping plover nesting announcement; this annual message is sent to all WFF employees informing them of the potential for encountering the protected species.

4.1.3 Conclusion

The year-long avian and bat impact study showed no evidence that piping plovers frequent the action area (NASA, 2010.); the point count surveys conducted from 2008-2009 recorded no piping plovers at or in the proximity of the action area. Similarly, no carcasses of piping plovers were found in the surrogate tower mortality surveys (NASA, 2010). Observations suggest that impacts from the wind turbines on nesting piping plovers would be minimal. The action area is not in plover foraging or nesting habitat so habitat loss is not an effect. Construction noise and concomitant startle effects can be considered to be negligible as well. USFWS Guidelines for fireworks and piping plovers recommend a 1.2 km (0.75 mile) buffer between nesting plovers and pyrotechnic displays. Construction noise levels are approximately 40 decibels less than pyrotechnics and would be 4 times as far away. Operational effects to nesting plovers should be minimal as well. As discussed in Section 4.1.1, nesting plovers rarely fly above 10 meters (33 feet) However, given the scarcity of information concerning migrating plover flight paths, the possibility that the flight path of the piping plovers may take them over the action area at an altitude that would intersect the rotor-swept zone cannot be discounted. Because piping plover mortality may result as a consequence of collisions with the rotating blades, NASA concludes that the proposed action may affect, and is likely to adversely affect, the piping plover due to a small likelihood of collision with the turbine blades.

4.2 Red Knot

4.2.1. Direct and Indirect Effects

Red knots would be expected to be present in areas suitable for piping plover nesting during similar times of the year. Under the Proposed Action, the wind turbines and access roads would be constructed on the opposite side of the island from the preferred red knot foraging areas. As

the barrier islands are purely a stopover point on their migratory path to breeding grounds in the high Arctic, there would be no impact on red knot breeding activity.

Noise from construction activities would be of short duration and would likely present minor startle reactions. Temporary interruption of foraging activities for red knots may occur as a result of human presence during staging and construction activities.

Operations under the proposed action could result in red knot mortality as a result of collision with the wind turbine blades, however studies have suggested that such occurrences would be rare. Although no red knot avoidance data is available, rates calculated at a few existing wind farms in the U.S. where mainly geese and raptor species were estimated to have avoidance rates greater than 95 percent. Fernley et al. (2006) calculated the avoidance rates of geese at four land-based wind farms in the U.S. using the Band Collision Risk Model. The avoidance rates calculated at the four facilities ranged from 99.82 percent to 100 percent despite high use by geese at these wind farm sites.

4.2.2 Actions to Reduce Adverse Effects

Under the Proposed Action, the wind turbines and access roads would be constructed on the opposite side of the island from the preferred habitat and foraging sites. No construction is planned for areas within known habitat. Noise from construction activities would be of short duration and would likely present minor, if any, startle reactions. Therefore no attempt would be made to reduce adverse effects to red knots from construction activities.

NASA would collaborate with CNWR and U.S. Department of Agriculture (USDA) personnel in monitoring Wallops Island for red knot activity. This monitoring would be concurrent with piping plover monitoring. Any identification of the species within the area would be documented and reported to the appropriate federal and state agencies. This information would be used to determine when red knots are actually present on Wallops Island.

In addition to the monitoring surveys, NASA would institute mortality surveys around the base of each turbine after the turbine construction is completed. Takes of red knots would be noted and reported to USFWS. Data from these surveys would be used to assess the impact of the proposed project to the red knots and serve as the basis for adaptive mitigation techniques.

As stated in Section 4.1.2, NASA would utilize either red or white flashing obstruction light systems on the wind turbines to reduce the risk of avian (including red knot) fatalities.

Additionally, educational signs would be posted at all beach access points to raise awareness of the red knot and to provide contact information. Basic species identification would be included in the natural resources training module of the WFF Environmental Management System (EMS), a requirement of all new employees at the facility. WFF would continue to distribute its annual piping plover nesting announcement. This annual message is sent to all WFF employees informing them of the potential for encountering protected species, including red knots.

4.2.3. Conclusion

The year-long avian and bat impact study showed no evidence that red knots frequent the action area (NASA, 2010.); the point count surveys conducted from 2008-2009 recorded no red knots at

or in the proximity of the action area. Similarly, no carcasses of red knots were found in the surrogate tower mortality surveys (NASA, 2010). Moreover, observational data demonstrates that red knots on Wallops Island congregate on the opposite side of the island, approximately 4.3 km (3 miles) from the action area. It is reasonable to conclude that risk to red knots from the operation of the wind turbines is like to be small. However, it is not unknown for red knots to forage in marsh areas. Based on the proposed marsh location of this project and the possibility that it may provide suitable foraging habitat for red knots at some point, it is possible that the flight path of birds would be affected by the wind turbines, and mortality may result as a consequence of collisions with the rotating blades. Therefore, NASA determines that the proposed action may affect, and is likely to adversely affect, the red knot due to a small likelihood of collision with the turbine blades.

5. Cumulative Effects

The conclusions in this BA are based on the best scientific and commercial data available and are intended to assist in reaching a determination regarding the effects to each species in the context of the formal consultation process and as rendered in a formal biological opinion. NASA is unaware of any state, tribal, local, or private actions that are reasonably certain to occur within the action area considered in this BA. Federal agencies own and manage the property in the action area. Therefore, NASA is not aware of any cumulative effects in this area.

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Appendix E
Essential Fish Habitat Checklist

NOAA FISHERIES
NORTHEAST REGIONAL OFFICE
EFH ASSESSMENT WORKSHEET FOR
FEDERAL AGENCIES
(modified 08/04)

Introduction:

The Magnuson-Stevens Fishery Conservation and Management Act mandates that federal agencies conduct an EFH consultation with NOAA Fisheries regarding any of their actions authorized, funded, or undertaken that may adversely effect essential fish habitat (EFH). An adverse effect means any impact that reduces the quality and/or quantity of EFH. Adverse effects may include direct or indirect physical, chemical, or biological alterations of the waters or substrate and loss of, or injury to, benthic organisms, prey species and their habitat, and other ecosystem components. Adverse effects to EFH may result from actions occurring within EFH or outside of EFH and may include site-specific or habitat-wide impacts, including individual, cumulative, or synergistic consequences of actions.

This worksheet has been designed to assist Federal agencies in determining whether an EFH consultation is necessary, and developing the needed information should a consultation be required. This worksheet will lead you through a series of questions that will provide an initial screening to determine if an EFH consultation is necessary, and help you assemble the needed information for determining the extent of the consultation required. The information provided in this worksheet may also be used to develop the required EFH Assessment.

Consultation through NOAA Fisheries regarding other NOAA-trust resources may also be necessary if a proposed action results in adverse impacts. Part 6 of the worksheet is designed to help assess the effects of the action on other NOAA-trust resources. This helps maintain efficiency in our interagency coordination process. In addition, consultation with NOAA Fisheries may be required if a proposed action impacts marine mammals or threatened and endangered species for which we are responsible. Staff from our Northeast Regional Office, Protected Resources Division should be contacted regarding potential impacts to marine mammals or threatened and endangered species.

Instructions for Use:

An EFH Assessment must be submitted by a Federal agency to NOAA Fisheries as part of the EFH consultation. An EFH Assessment must include the following information:
1) A description of the proposed action.
2) An analysis of the potential adverse effects of the action on EFH, and the managed species.
3) The Federal agency=s conclusions regarding the effects of the action on EFH.
4) Proposed mitigation if applicable.

In some cases, this worksheet can be used as an EFH Assessment. If the Federal agency determines that the action will not cause substantial impacts to EFH, then this worksheet may suffice. If the action may cause substantial adverse effects on EFH, then a more thorough discussion of the action and its

impacts in a separate EFH Assessment will be necessary. The completed worksheet should be forwarded to NOAA Fisheries Northeast Regional Office, Habitat Conservation Division (HCD) for review.

The information contained on the HCD website (http://www.nero.noaa.gov/hcd/) will assist you in completing this worksheet. The HCD web site contains information regarding: the EFH consultation process; Guide to EFH Designations which provides a geographic species list; Guide to EFH Species Descriptions which provides the legal description of EFH as well as important ecological information for each species and life stage; and other EFH reference documents including examples of EFH Assessments and EFH Consultations.

EFH ASSESSMENT WORKSHEET FOR FEDERAL AGENCIES (modified 08/04)

PROJECT NAME: NASA Wallops Flight Facility Alternative Energy Project DATE: February 2010

PROJECT NO.:_____ LOCATION: Wallops Island, Accomack County, VA

PREPARERS: Joshua Bundick, Joel Mitchell, Shari Silbert

Step 1. Use the Habitat Conservation Division EFH webpage, Guide to Essential Fish Habitat Designations in the Northeastern United States to generate the list of designated EFH for federally-managed species for the geographic area of interest (http://www.nero.noaa.gov/hcd/index2a.htm). Use the species list as part of the initial screening process to determine if EFH for those species occurs in the vicinity of the proposed action. Attach that list to the worksheet because it will be used in later steps. Make a preliminary determination on the need to conduct an EFH Consultation.

1. INITIAL CONSIDERATIONS		
EFH Designations	**Yes**	**No**
Is the action located in or adjacent to EFH designated for eggs?	x	
Is the action located in or adjacent to EFH designated for larvae?	x	
Is the action located in or adjacent to EFH designated for juveniles?	x	
Is the action located in or adjacent to EFH designated for adults?	x	
Is the action located in or adjacent to EFH designated for spawning adults?	x	
If you answered no to all questions above, then EFH consultation is not required -go to Section 5. If you answered yes to any of the above questions proceed to Section 2 and complete remainder of the worksheet.		

Step 2. In order to assess impacts, it is critical to know the habitat characteristics of the site before the activity is undertaken. Use existing information, to the extent possible, in answering these questions. Please note that, there may be circumstances in which new information must be collected to appropriately characterize the site and assess impacts.

2. SITE CHARACTERISTICS	
Site Characteristics	**Description**
Is the site intertidal, sub-tidal, or water column?	**Intertidal**
What are the sediment characteristics?	**Proposed Project Site: Silt Loam, poorly drained, hydric soils** **Proposed Compensation Area: Loamy Sand, well drained soils**
Is Habitat Area of Particular Concern (HAPC) designated at or near the site? If so what type, size, characteristics?	**No**
Is there submerged aquatic vegetation (SAV) at or adjacent to project site? If so describe the spatial extent.	**No**
What is typical salinity and temperature regime/range?	**Salinity: 35 +/- 10 parts per thousand** **Temperature: 0-30ºC**
What is the normal frequency of site disturbance, both natural and man-made?	**Natural site disturbance may occur during storms and higher than normal tidal cycles, when the site may be inundated with wrack and other debris. The only man-made disturbance is related to noise from nearby activities, including traffic in and out of the U.S. Navy's Surface Combat Systems Center and rocket launches from the Wallops Flight Facility launch range.**
What is the area of proposed impact (work footprint & far afield)?	**Construction of a permanent access road, crane pad, and turbine foundations would result in a work footprint that would impact 0.71 acres of emergent tidal wetlands. Additionally, 0.14 acres of non-tidal emergent and 0.03 acres of non-tidal scrub-shrub wetlands would be impacted. NASA would provide compensatory mitigation for wetlands affected by the project. It is estimated that approximately 0.71 acres of current upland would be converted into tidal emergent wetlands. Compensatory mitigation for non-tidal wetlands would be accomplished through a combination of creation and restoration on Wallops Mainland.**

Step 3. This section is used to describe the anticipated impacts from the proposed action on the physical/chemical/biological environment at the project site and areas adjacent to the site that may be affected.

3. DESCRIPTION OF IMPACTS			
Impacts	**Y**	**N**	**Description**
Nature and duration of activity(s)			**NASA is proposing to construct two 2.0-megawatt wind turbine generators on the west side of Wallops Island. Construction would involve building permanent access roads to each turbine, driving foundation pilings, pouring concrete pile caps, and erecting the turbines in sections using a crane. It is expected that construction of both turbines would last approximately 6 months. Following turbine construction, NASA would also construct a wetlands compensation area approximately 2 miles west on Wallops Mainland to mitigate the wetlands lost during construction. A more complete discussion of the project is available in its Environmental Assessment.**
Will benthic community be disturbed?	**X**		**Within the footprint of the turbine sites, the benthic community would be covered with the materials described above. During establishment of the compensatory mitigation area, only minor benthic disturbances are anticipated; these impacts would be incidental to the lowering of the ground elevation to match that of an emergent tidal wetland. Incidental effects on the benthic community could occur when establishing the wetland compensation area; however these would be minor and localized.**
Will SAV be impacted?		**X**	
Will sediments be altered and/or sedimentation rates change?	**X**		**Within the roadway, crane pad, and turbine foundation, existing sediments would be permanently altered as they would be covered with coarser clean fill material topped with gravel. Within the compensation area, the coarser, sandy material would be removed to lower the elevation needed for establishing a wetland.**
Will turbidity increase?	**X**		**During construction of both the turbine sites and the compensatory mitigation area, turbidity could increase; however with strict adherence to Virginia standards for erosion and sediment control and timely replanting, effects would be localized and temporary.**
Will water depth change?	**X**		**Water depths within the project site would change as there would be approximately 6 feet of fill material covering an area that is presently at an approximate elevation of 3 feet above mean sea level. Water depth would increase at the compensation area. The current upland area would be lowered such that it would typically be inundated with water during high tide and dry at low tide.**

Will contaminants be released into sediments or water column?		**X**	**During construction, the potential exists for small leaks of hydraulic oil and diesel from equipment. However, the construction contractor would be required to regularly maintain and inspect vehicles to ensure that leaks or spills do not occur. Also, in the event that a release occurred, the WFF Integrated Contingency Plan would be implemented to mitigate impacts. During the operational phase, the turbines would have hydraulic oil in their gearboxes. Also, the electrical transformer would contain mineral oil. However, with regular maintenance and inspection, no releases of either material are anticipated.**
Will tidal flow, currents or wave patterns be altered?	**X**		**Tidal flow would be altered slightly due to the permanent fill. Rather than flowing over the proposed site, tidal waters would flow around the site. This impact would be highly localized. The compensation area would receive inundation from tidal waters when it typically would not have as upland.**
Will ambient salinity or temperature regime change?		**X**	**It is not expected that the project would affect salinity or temperature regime.**
Will water quality be altered?		**X**	**It is not expected that more than temporary adverse water quality impacts (increased turbidity) would occur. The project would adhere to Virginia Erosion and Sediment Control requirements and the contractor would re-vegetate disturbed areas once final grade is reached.**

Step 4. This section is used to evaluate the consequences of the proposed action on the functions and values of EFH as well as the vulnerability of the EFH species and their life stages. Identify which species from the EFH species list (generated in Step 1) will be adversely impacted from the action. Assessment of EFH impacts should be based upon the site characteristics identified in Step 2 and the nature of the impacts described within Step 3. The Guide to EFH Descriptions webpage (http://www.nero.noaa.gov/hcd/list.htm) should be used during this assessment to determine the ecological parameters/preferences associated with each species listed and the potential impact to those parameters.

4. EFH ASSESSMENT			
Functions and Values	**Y**	**N**	**Describe habitat type, species and life stages to be adversely impacted**
Will functions and values of EFH be impacted for:			
Spawning	**X**		**<u>Turbine and Mitigation Site Construction – Temporary</u> Temporary construction noise would likely drive potentially spawning adult red drum from the immediate area. <u>Turbine Site – Permanent</u> Permanent fill of the site would reduce the available area for spawning. <u>Mitigation Site - Permanent</u> Creation of in-kind emergent wetland habitat would provide permanent areas for spawning. As the proposed turbine site is currently dominated by *Phragmites*, the *Spartina* wetland that would be created would be of higher ecological value.**
Nursery	**X**		**<u>Turbine and Mitigation Site Construction – Temporary</u> Temporary construction noise would likely drive juvenile windowpane flounder, bluefish, summer flunder, scup, black sea bass, cobia, red drum, dusky shark, sandbar shark, and scalloped hammerhead shark from the immediate area, however species would be expected to return once construction activities cease. <u>Turbine Site – Permanent</u> Permanent fill of the site would reduce the available area for nursery for the above listed species. <u>Mitigation Site - Permanent</u> Creation of in-kind emergent wetland habitat would provide permanent areas for nursery of the above listed species. As the proposed turbine site is currently dominated by *Phragmites*, the *Spartina* wetland that would be created would be of higher ecological value.**
Forage	**X**		**<u>Turbine and Mitigation Site Construction – Temporary</u> Temporary construction noise would likely drive foraging**

			predators and their prey species from the immediate area until operations cease. Temporary, direct impacts to adult windowpane flounder, bluefish, summer flounder, scup, black sea bass, cobia, red drum, sand tiger shark, Atlantic sharpnose shark, dusky shark, sandbar shark, and scalloped hammerhead shark (juvenile only) would be expected, however both predator and prey species would return once construction is complete. **<u>Turbine Site – Permanent</u>** **Permanent impacts to the above species may result from displacement of habitat that may be frequented by prey fishes and crustaceans.** **<u>Mitigation Site - Permanent</u>** **Creation of in-kind wetland habitat would provide suitable habitat for prey species and permanent areas for foraging. As the proposed turbine site is currently dominated by *Phragmites*, the *Spartina* wetland that would be created would be of higher ecological value.**
Shelter	**X**		**<u>Turbine and Mitigation Site Construction – Temporary</u>** **Temporary construction noise would likely drive species from the immediate area until operations cease. Impacts to adult and juvenile windowpane flounder, bluefish, summer flounder, scup, black sea bass, cobia, red drum, sand tiger shark, Atlantic sharpnose shark, dusky shark, sandbar shark, and scalloped hammerhead shark (juvenile only) are possible. Impacts to juvenile scalloped hammerhead shark are possible.** **<u>Turbine Site – Permanent</u>** **Permanent impacts to the above species may result from displacement of habitat that may be utilized for shelter.** **<u>Mitigation Site - Permanent</u>** **Creation of in-kind wetland habitat would provide permanent areas for shelter. As the proposed turbine site is currently dominated by *Phragmites*, the *Spartina* wetland that would be created would be of higher ecological value.**
Will impacts be temporary or permanent?			**Temporary and Permanent**
Will compensatory mitigation be used?	**X**		**NASA would provide compensatory wetland mitigation to ensure no net loss of wetlands. It is estimated that 1:1 compensation would be required for intertidal emergent impacts.**

Step 5. This section provides the Federal agency's determination on the degree of impact to EFH from the proposed action. The EFH determination also dictates the type of EFH consultation that will be required with NOAA Fisheries.

5. DETERMINATION OF IMPACT		
	/	**Federal Agency=s EFH Determination**
Overall degree of adverse effects on EFH (not including compensatory mitigation) will be: **(check the appropriate statement)**		**There is no adverse effect on EFH** **EFH Consultation is not required**
	X	**The adverse effect on EFH is not substantial.** **This is a request for an abbreviated EFH consultation. This worksheet is being submitted to NMFS to satisfy the EFH Assessment requirement.**
		The adverse effect on EFH is substantial. **This is a request for an expanded EFH consultation. A detailed written EFH assessment will be submitted to NMFS expanding upon the impacts revealed in this worksheet.**

Step 6. Consultation with NOAA Fisheries may also be required if the proposed action results in adverse impacts to other NOAA-trust resources, such as anadromous fish, shellfish, crustaceans, or their habitats. Some examples of other NOAA-trust resources are listed below. Inquiries regarding potential impacts to marine mammals or threatened/endangered species should be directed to NOAA Fisheries' Protected Resources Division.

6. OTHER NOAA-TRUST RESOURCES IMPACT ASSESSMENT	
Species known to occur at site (list others that may apply)	**Describe habitat impact type (i.e., physical, chemical, or biological disruption of spawning and/or egg development habitat, juvenile nursery and/or adult feeding or migration habitat).**

Appendix F
Aesthetics Study Photo Log

NASA Alternative Energy Project
Aesthetics Analysis

PHOTOGRAPHIC LOG

Photo No. **1**	**Date:** 6-2009
Direction Photo Taken: View to the northeast from Harbor of Chincoteague Island Refuge	
Description: Viewshed Vantage Point 1 – Photo simulation of wind turbines from the southwest corner of Chincoteague Island located 4.8 miles northeast of Proposed Action site.	

Photo No. **2**	**Date:** 6-2009
Direction Photo Taken: View to the southwest from Queen Sound Boat Ramp	
Description: Viewshed Vantage Point 2 – Photo simulation of wind turbines from Queen Sound Boat Ramp located 6.2 miles to the northeast of the Proposed Action site.	

NASA Alternative Energy Project
Aesthetics Analysis

PHOTOGRAPHIC LOG

Photo No. 3	**Date:** 6-2009

Direction Photo Taken:
View to the south from Watts Bay Subdivision

Description:
Viewshed Vantage Point 3 – Photo simulation of wind turbines from Watts Bay Subdivision located 3.9 miles north of Proposed Action site.

Photo No. 4	**Date:** 6-2009

Direction Photo Taken:
View to the southeast from Wharton Subdivision

Description:
Viewshed Vantage Point 4 – Photo simulation of wind turbines from Mount Wharton Subdivision located 1.9 miles northwest of Proposed Action site.

NASA Alternative Energy Project
Aesthetics Analysis

PHOTOGRAPHIC LOG

Photo No. 5	**Date:** 6-2009

Direction Photo Taken:
View to the northeast from Arbuckle Neck Road

Description:
Viewshed Vantage Point 5 – Photo simulation of wind turbines taken from Arbuckle Neck Road located 2.3 miles southwest from Proposed Action site.

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Appendix G
Scoping and Coordination Letters

National Aeronautics and Space Administration
Goddard Space Flight Center
Wallops Flight Facility
Wallops Island, VA 23337-5099

April 23, 2008

Reply to Attn of: 250.W

Mr. Tylan Dean
U.S. Fish and Wildlife Service
6669 Short Lane
Gloucester, VA 23061

Dear Mr. Dean:

Per our telephone conversation on April 10, 2008, we are providing you additional information regarding the NASA Wallops Flight Facility's (WFF) proposed Alternative Energy Project:

Background

Executive Order (EO) 13423, *Strengthening Federal Environmental, Energy, and Transportation Management* (effective January 24, 2007), instructs Federal agencies to conduct their respective missions in an environmentally, economically, and fiscally sound; integrated; continuously improving; efficient; and sustainable manner. Section 2 of EO 13423 directs Federal agencies to implement sustainable practices for energy efficiency and reductions in greenhouse gas emissions, and for the use of renewable energy.

The Federal Energy Policy Act (EPACT) (effective August 8, 2005) requires Federal agencies to lower energy consumption and to utilize specified percentages of renewable electricity - 3 percent between fiscal years 2007 and 2009, 5 percent between 2010 and 2012, and 7.5 percent for 2013 and beyond.

WFF has identified several goals that meet its mission while promoting environmental stewardship and accountability. Those goals include:

- Reducing impacts on the natural environment by consuming energy from a source that provides zero greenhouse gas emissions;

- Reducing WFF's annual operating cost by consuming continual, low-cost power from a renewable and sustainable natural resource; and

- Setting an example for responsible stewardship of natural resources by a Federal agency.

WFF currently obtains all of its electricity from the local electric cooperative. The electricity is produced primarily by the combustion of fossil fuels; at the present time, no renewable sources are offered.

Purpose and Need

The purpose of the proposed Alternative Energy project is to generate clean, renewable energy from a technologically proven source that will be used by WFF in order to exceed the requirements of the 2005 EPACT and EO 13423, along with WFF's goal of setting an example of leadership in environmental stewardship and accountability by a Federal agency. Project implementation would not only buffer a portion of WFF's utility costs from future increases associated with rising electrical rates (e.g., market changes, tariff adjustments), but it would also contribute up to one percent toward federal renewable energy requirements for NASA as an agency.

A Department of Energy – funded study conducted by James Madison University in 2005 determined that Wallops Island has adequate wind resources for operation of wind turbines and recommended the installation of a single 1.5 megawatt (MW) rated capacity model.[1] The study also found that one 1.5 MW wind turbine would account for approximately 16 percent of the electricity required to operate WFF, which would supplement the electricity that is currently supplied to WFF via the local electric cooperative.

The current peak electricity usage on Wallops Island can accommodate up to approximately 3.0 megawatts (MW) of electrical generation without having to store or sell excess power,[2] and would equate to the rated maximum capacity of two of the 1.5 MW turbines recommended in the JMU study. WFF estimates that each wind turbine would generate approximately 4.5 gigawatt-hours (GWh) of electricity per year for the duration of its 25 year lifespan based on power output of wind turbines in similar settings.

In addition to wind energy, WFF is evaluating the large scale implementation of solar panels to meet its alternative energy needs. The solar arrays would be located on rooftops of existing buildings and in open upland areas. Exact placement would require careful coordination with the WFF airfield to minimize the potential for solar reflection impacting incoming aircraft.

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[1] Miles, Jonathan, Lotts, Mark, and Jeff Briggs. Wind Power Feasibility Study at NASA Wallops Space Flight Center-Final Report. June 2006.

[2]NASA. Wallops Flight Facility Fiscal Year 2007 Electrical Usage Analysis. January 2008.

Proposed Action and Alternatives

WFF has identified the desire for alternative energy sources that would be capable of generating up to 9.0 GWh per year (GWh/year) of power, the equivalent annual power generation of two 1.5 MW wind turbines. The Proposed Action consists of constructing up to two 1.5 MW wind turbines on Wallops Island to supplement the electricity that is currently supplied to WFF by the local electric cooperative.

Because the proposed wind turbines have the potential to interfere with WFF's active airfield and tracking/telemetry systems, the area available for their construction is extremely limited. The only available area at WFF for placement of wind turbines is restricted to the Proposed Action site (see enclosed maps); therefore WFF would not be able to operate more than two wind turbines. The Proposed Action would not lead to the installation of additional wind turbines in the future.

Under Alternative One, NASA would construct one 1.5 MW wind turbine on Wallops Island that would be capable of generating 4.5 GWh/year. In addition to the single wind turbine, NASA would install a system of solar panels that would be capable of generating up to 4.5 GWh/year (the equivalent of one 1.5 MW wind turbine). Approximately 14,000, 32 square feet (sq ft) solar panels, equaling an area of approximately 7 acres, would be needed to meet this power generating capability. Solar panels would be installed on building rooftops and in upland open spaces, with a total capacity for power generation of up to 1.5 MW.

Alternative Two consists of installing a system of solar panels that would be capable of generating 9.0 GWh/year of power, which is the estimated equivalent of two wind turbines. WFF would install approximately 28,000, 32 sq ft panels that would equal an area of approximately 14 acres. As with Alternative One, the panels would be installed on building rooftops and in upland open spaces, but with a total capacity for power generation of up to 3.0 MW.

Avian and Bat Impact Studies

In compliance with the National Environmental Policy Act of 1969 (NEPA), the Council on Environmental Quality (CEQ) regulations implementing NEPA (40 Code of Federal Regulations [CFR] Parts 1500 through 1508), and the NASA Policy Requirements (NPR) for implementing NEPA (NPR 8580.1), NASA is preparing an Environmental Assessment (EA) to analyze the potential impact of this proposed action and alternatives on the natural and human environment.

Of particular concern are potential impacts to avian and bat species from the operation of the wind turbines. To further define and quantify potential impacts, WFF will perform avian and bat studies and complete the EA prior to selecting an alternative energy option. As such, we are requesting your expertise and input to this study plan. The WFF Environmental Office invites you join us at a meeting of federal and state regulators and local interest groups to assist in the preparation of the Avian and Bat Impact Study Plans.

The meeting will be held on April 30, 2008 at 10:00 a.m. in the Chincoteague National Wildlife Refuge's Herb Bateman Center. A meeting agenda is enclosed. If you have any questions please contact either myself at 757-824-2319 or Ms. Shari Silbert at 757-824-2327.

Sincerely,

Joshua A. Bundick
NEPA Program Manager

2 Enclosures

National Aeronautics and Space Administration
Goddard Space Flight Center
Wallops Flight Facility
Wallops Island, VA 23337-5099

October 20, 2008

Reply to Attn of: 250.W

Ms. Karen Mayne
Supervisor
Virginia Field Office
U.S. Fish and Wildlife Service
6669 Short Lane
Gloucester, VA 23061

Dear Ms. Mayne:

Enclosed please find a copy of Wallops Flight Facility's (WFF) Alternative Energy Project Final Avian and Bat Study Plan. The proposed alternative energy project considers the installation of both wind turbines and photovoltaic systems at WFF. If selected as WFF's final preferred alternative, the wind energy development on Wallops Island would consist of constructing and operating no more than two 1.5 MW wind turbines with associated underground electrical power collection lines, new access roads, and an interconnection with the existing WFF electrical power distribution system.

WFF is currently preparing an Environmental Assessment for the project in accordance with the National Environmental Policy Act. The results of this avian and bat study will support the EA and will provide valuable insight into the level of impact that could result if wind energy were selected.

This study plan document was first submitted to you as a draft on June 5, 2008 following the project stakeholder group meeting held on April 30, 2008 at the Chincoteague National Wildlife Refuge. Written comments on the draft plan were provided by the Virginia Department of Game and Inland Fisheries (David Whitehurst, July 3, 2008) and the U.S. Fish and Wildlife Service (USFWS) (Karen Mayne, July 8, 2008). Based on stakeholder input received and subsequent internal review, NASA has revised and finalized its plan. As requested during the consultation process, the plan now provides:

- more detail regarding field survey observation and study transect locations, specific Anabat equipment installation locations and heights, and specific mortality search areas;
- additional discussion of field survey methods and associated data collection forms;
- specific information concerning the time of day, survey observation duration and time of year that field surveys will take place; and
- a detailed literature cited section

After careful review and consideration of the comments received on the draft study plan, WFF does not plan to conduct any radar-based pre-construction surveys. Although the 2003 USFWS guidance document does suggest the use of remote sensing techniques to assess avian and bat mortality risk at wind power facilities, this recommendation was based on a few preliminary radar studies that had been conducted at prospective or existing wind energy facilities. Since the 2003 guidance was issued, some 30 radar studies have now been conducted across the U.S. at prospective wind power facilities and, to date, none have proven to be a reliable and precise predictor of risk. As radar has yet to be validated as a risk assessment tool for such projects, WFF is undertaking a more readily quantifiable methodology based upon field observation by trained biologists and analysis of actual avian and bat mortality on Wallops Island.

As stated in the study plan, WFF intends to perform one year of pre-construction field observation and mortality searches in the project vicinity. The presence of two 47.2 meter (155 feet) tall boresight towers near the proposed wind turbine sites along with a 102.1 meter (335 feet) tall meteorological tower south of the project site present a unique opportunity to study avian and bat collisions at these surrogate structures. WFF plans to conduct mortality searches three times per week during the spring and fall migration seasons and one time per week during the remainder of the year. The results of these intensive field surveys will provide important site-specific data for assessing avian risk at the height of the proposed rotor swept area and will greatly contribute to assessing potential risk from the operation of the two proposed wind turbines.

WFF understands that if the preferred alternative energy choice includes installing either one or two wind turbines, this would present additional research opportunities for studying the potential environmental impacts of turbines within a coastal setting. NASA would promote partnering with other government agencies and/or non-governmental stakeholders for such research projects.

We appreciate your interest and input to date as we proceed with these studies. Please contact me at (757) 824-2319 or Ms. Shari Silbert at (757) 824-2327 if you have any questions or require additional information.

Sincerely,

Joshua A. Bundick
NEPA Program Manager

Enclosure

cc:
200/Ms. C. Massey
228/Mr. P. Smith
250/Ms. C. Turner
USFWS/Mr. T. Dean

Federal Aviation Administration
Air Traffic Airspace Branch, ASW-520
2601 Meacham Blvd.
Fort Worth, TX 76137-0520

Aeronautical Study No.
2008-WTE-2533-OE

Issued Date: 10/16/2008

Philip Smith
NASA Wallops Flight Facility
Wallops Flight Facility
BLDG N-161, Code 228
Wallops Island, VA 23337

**** DETERMINATION OF NO HAZARD TO AIR NAVIGATION ****

The Federal Aviation Administration has conducted an aeronautical study under the provisions of 49 U.S.C., Section 44718 and if applicable Title 14 of the Code of Federal Regulations, part 77, concerning:

Structure:	Wind Turbine (2) Wind Turbines at Wallops Flight Facility
Location:	Chincoteague, VA
Latitude:	37-51-21.79N NAD 83
Longitude:	75-28-07.60W
Heights:	380 feet above ground level (AGL) 391 feet above mean sea level (AMSL)

This aeronautical study revealed that the structure does not exceed obstruction standards and would not be a hazard to air navigation provided the following condition(s), if any, is(are) met:

As a condition to this Determination, the structure is marked and/or lighted in accordance with FAA Advisory circular 70/7460-1 K Change 2, Obstruction Marking and Lighting, white paint/synchronized red lights - Chapters 4,12&13(Turbines).

It is required that FAA Form 7460-2, Notice of Actual Construction or Alteration, be completed and returned to this office any time the project is abandoned or:

_____ At least 10 days prior to start of construction (7460-2, Part I)
__X__ Within 5 days after the construction reaches its greatest height (7460-2, Part II)

This determination expires on 04/16/2010 unless:

(a) extended, revised or terminated by the issuing office.
(b) the construction is subject to the licensing authority of the Federal Communications Commission (FCC) and an application for a construction permit has been filed, as required by the FCC, within 6 months of the date of this determination. In such case, the determination expires on the date prescribed by the FCC for completion of construction, or the date the FCC denies the application.

NOTE: REQUEST FOR EXTENSION OF THE EFFECTIVE PERIOD OF THIS DETERMINATION MUST BE POSTMARKED OR DELIVERED TO THIS OFFICE AT LEAST 15 DAYS PRIOR TO THE EXPIRATION DATE.

This determination is based, in part, on the foregoing description which includes specific coordinates, heights, frequency(ies) and power. Any changes in coordinates, heights, and frequencies or use of greater power will void this determination. Any future construction or alteration, including increase to heights, power, or the addition of other transmitters, requires separate notice to the FAA.

This determination does include temporary construction equipment such as cranes, derricks, etc., which may be used during actual construction of the structure. However, this equipment shall not exceed the overall heights as indicated above. Equipment which has a height greater than the studied structure requires separate notice to the FAA.

This determination concerns the effect of this structure on the safe and efficient use of navigable airspace by aircraft and does not relieve the sponsor of compliance responsibilities relating to any law, ordinance, or regulation of any Federal, State, or local government body.

A copy of this determination will be forwarded to the Federal Communications Commission if the structure is subject to their licensing authority.

If we can be of further assistance, please contact our office at (770) 909-4329. On any future correspondence concerning this matter, please refer to Aeronautical Study Number 2008-WTE-2533-OE.

Signature Control No: 592405-103447185 (DNE)
Michael Blaich
Specialist

DEPARTMENT OF THE ARMY
NORFOLK DISTRICT, CORPS OF ENGINEERS
FORT NORFOLK, 803 FRONT STREET
NORFOLK, VIRGINIA 23510-1096

REPLY TO
ATTENTION OF

December 23, 2009

WFF Alternative Energy Project
Eastern Virginia Regulatory Section

Goddard Space Flight Center
Ms. Caroline R. Massey
Assistant Director of Management Operations
Wallops Flight Facility
Wallop Island, VA 23337-5099

Dear Ms. Massey,

The Norfolk District Corps of Engineers agrees to be a cooperating agency in the preparation of documents for the WFF Alternative Energy Project, in accordance with the National Environmental Policy Act. Mr. Robert Cole will be the contact for the Norfolk District. Please forward to him any requests for participation, notices of meetings, requests for information, and written material to review. Mr. Cole may be contacted at 757-787-7567, by e-mail at "robert.h.cole@usace.army.mil", or by mail at Norfolk District Corps of Engineers, Eastern Shore Field Office, 22545 Center Parkway, Accomac, VA 23301-1330.

Sincerely,

Kimberly A. Prisco-Baggett

Kimberly A. Prisco-Baggett
Acting Chief, Eastern Virginia Regulatory Section

United States Department of the Interior

FISH AND WILDLIFE SERVICE
Ecological Services
6669 Short Lane
Gloucester, VA 23061

July 8, 2008

Mr. Joshua A. Bundick
National Aeronautics and Space Administration
Goddard Space Flight Center
Wallops Flight Facility
Wallops Island, VA 23337-5099

Re: NASA Wallops Flight Facility's Proposed Alternative Energy Project, Accomack County, Virginia

Dear Mr. Bundick:

The U.S. Fish and Wildlife Service (Service) has reviewed the project description provided in the National Aeronautics and Space Administration (NASA) April 23, 2008 letter and the Draft Wind Energy Avian and Bat Study Plan provided in your June 5, 2008 letter. The purpose of the project is to generate clean, renewable energy that will be used by the Wallops Flight Facility (WFF) in order to exceed the requirements of the 2005 Federal Energy Policy Act and Executive Order 13423, *Strengthening Federal Environmental, Energy, and Transportation Management*, along with WFF's goal of setting an example in environmental stewardship and accountability by a Federal agency. The proposed action consists of constructing up to two 1.5 megawatt (MW) wind turbines on Wallops Island. Alternatives also include installing a system of solar panels on building rooftops and upland open spaces. This letter provides comments on the draft avian and bat study plan and the alternatives and project scope described in NASA's April 23, 2008 letter. Additional comments on the project will be provided by the Service in further discussion and upon our receipt of the environmental assessment when a more detailed alternatives analysis is provided. This letter constitutes the preliminary report of the Service and the Department of the Interior on the proposed project and is submitted in accordance with provisions of the Fish and Wildlife Coordination Act (48 Stat. 401, as amended; 16 U.S.C. 661 et seq.), the Endangered Species Act (ESA) of 1973 (87 Stat. 884, as amended; 16 U.S.C. 1531 et seq.), the Migratory Bird Treaty Act (MBTA) of 1918 (40 Stat. 755, as amended; 16 U.S.C. 703-712), and the Bald and Golden Eagle Protection Act (BGEPA) of 1940 (54 Stat. 250, as amended; 16 U.S.C. 668-668d).

Based on our review of the referenced project, it appears that the proposed project may affect species under the jurisdiction of the Service, including migratory birds and endangered species. Wind energy facilities can adversely impact wildlife populations, particularly birds and bats, and

their habitats. Because of this potential harm to wildlife, in May 2003, the Service developed an *Interim Guidance on Avoiding and Minimizing Wildlife Impacts from Wind Turbines* (http://www.fws.gov/habitatconservation/wind.pdf). This guidance includes recommendations for the proper evaluation of potential wind energy sites, proper location and design of turbines and associated structures within sites selected for development, and pre- and post-construction research and monitoring to identify and/or assess impacts to wildlife. We encourage NASA to review these guidelines in the preparation of the Environmental Assessment (EA) and address any deviations from the interim guidelines, including why deviations are required.

The Service is concerned about the proposed wind turbine locations. A site development recommendation in the guidance states, "Avoid locating turbines in known local bird migration pathways or in areas where birds are highly concentrated . . . ." Examples noted in the guidance included wetlands and Federal refuges. The proposed wind turbines at Wallops Island are located in an extensive wetland system, within approximately 3 miles of the Assawoman Island Division of the Chincoteague National Wildlife Refuge (NWR) and within approximately 4 miles of the Chincoteague NWR, a nationally recognized bird migration pathway, a Western Hemisphere Shorebird Reserve, a World Biosphere Reserve, a National Natural Landmark, and an Important Bird Area (IBA).

The Chincoteague NWR was originally established in 1943 to provide habitat for migratory birds. Today, this refuge provides habitat for waterfowl, wading birds, shorebirds, and song birds, as well as other species of wildlife and plants. The refuge also supports several threatened and endangered species. According to results from the International Shorebird Surveys east of the Rocky Mountains, Chincoteague ranks second in species diversity during spring and fall shorebird migrations, and is among the top ten sites with greatest maximum counts. The Manomet Observatory organized the International Shorebird Surveys, which began in 1974 to collect information on shorebirds during migration. Chincoteague NWR is part of the barrier island system that constitutes the largest stretch of undeveloped barrier islands on the East Coast of North America, having been preserved through a combination of Federal, State, and privately owned (The Nature Conservancy) islands. These barrier islands extend from Assateague Island to Fisherman Island, and provide habitat for numerous species of birds throughout the year, as well as providing important aquatic habitat for numerous species of finfish and shellfish. These barrier islands in Maryland and Virginia have been designated a Western Hemisphere Shorebird Reserve due to the area's international importance as shorebird nesting, feeding, and resting habitat. Such designation is given where over 100,000 shorebirds use an area on an annual basis. The United Nations has designated these islands and lagoon systems as a World Biosphere Reserve due to their great ecological value. The U.S. Department of Interior has also designated these barrier islands as a National Natural Landmark due to their outstanding natural values. This project location is located within the Barrier Island/Lagoon System IBA. The Important Bird Area Program is administered by the National Audubon Society and identifies sites that provide essential habitat to nesting, migrating, or wintering birds. This IBA includes the seaward margin of the lower Delmarva Peninsula from the mouth of the Chesapeake Bay to the Maryland-Virginia border. This IBA is identified as the most important bird area in Virginia and supports the highest diversity and density of birds of

conservation concern in Virginia. For additional information on this IBA see: http://www.audubon.org/bird/iba/virginia/.

The Phase I Avian Risk Assessment prepared by Curry & Kerlinger, L.L.C. for this site, dated September 2004, concluded that, "Significant migration by hawks, songbirds, waterfowl, shorebirds, or other species occurs adjacent to and over the project site. This site is located at a major ecological magnet that attracts large numbers of migrants." The study also indicated that habitat on and adjacent to the site supports large concentrations of wintering waterfowl and is close to important wildlife habitat and protected lands that support large numbers of birds. The report indicated that the proposed turbine sites presented a "relatively high risk to various types of birds."

Endangered Species Act

The piping plover (*Charadrius melodus*), federally listed threatened, currently nests on Wallops Island and the neighboring Assateague Island, Assawoman Island, and Metompkin Island, and occurs in these areas during migration. Plovers also occur on several other barrier islands south of Metompkin Island.

The red knot (*Calidris canutus rufa*), a Federal candidate, occurs on the Virginia barrier islands during migration. Chincoteague NWR and other barrier islands in Virginia provide a stopover site and important feeding areas for the red knot. Candidate species are those being considered for possible listing pursuant to the ESA. While these species are not legally protected pursuant to the ESA, the Service provides this information for consideration in your environmental review process and to encourage efforts to avoid adverse impacts to these species. Please coordinate with us regarding impacts to candidate species to avoid potential project modifications or delays if a candidate species is federally listed before the project is completed.

Pre-construction studies should be designed to inform the analysis of the likely effects of the action on listed species or their habitat. If a Federal agency is involved with the permitting, funding, or carrying out of the project, as in this case, and listed species may be adversely affected, initiation of formal consultation between that agency and the Service pursuant to Section 7 of the ESA is required. Such consultation would result in a biological opinion addressing the anticipated effects of the project to the listed species, and may authorize a limited level of incidental take. The Service looks forward to early continued coordination with NASA to determine what studies/evaluations may be needed to allow our agencies to fulfill our mutual responsibilities under the ESA.

Migratory Bird Treaty Act

All native migratory birds (*e.g.*, waterfowl, shorebirds, passerines, hawks, owls, vultures, falcons) are afforded protection under the MBTA. The list of migratory birds can be found at 50 CFR 10.13. The MBTA provides that it is unlawful to pursue, hunt, take, capture or kill; attempt to take, capture or kill; possess, offer to or sell, barter, purchase, deliver or cause to be shipped,

exported, imported, transported, carried or received any migratory bird, part, nest, egg or product, manufactured or not. While the MBTA has no provision for allowing unauthorized take, we recognize that some birds may be killed at structures such as wind turbines even if all reasonable measures to avoid it are implemented.

The Service's Migratory Bird Program promotes bird conservation and has developed guidelines to assist individuals and organizations to comply with the MBTA. While it is not possible under the MBTA to absolve individuals, companies, or agencies from liability (even if they implement mortality avoidance or similar conservation measures), the Office of Law Enforcement has used enforcement and prosecutorial discretion in the past regarding individuals, companies, or agencies who have made good faith efforts to avoid the take of migratory birds.

In addition, Executive Order 13186 entitled, Responsibilities of Federal Agencies to Protect Migratory Birds (FR Vol. 66, No. 11, Jan. 17, 2001) states in part that federal agencies shall:

- o support the conservation intent of the migratory bird conventions by integrating bird conservation principles, measures, and practices into agency activities and by avoiding or minimizing, to the extent practicable, adverse impacts on migratory bird resources when conducting agency actions;
- o restore and enhance the habitat of migratory birds, as practicable.

Bald and Golden Eagle Protection Act

The bald eagle (*Haliaeetus leucocephalus*) and the golden eagle (*Aquila chrysaetos*) are likely to migrate through this area based on records from nearby hawk watch sites in Kiptopeke, Virginia, and Cape Helopen, Delaware. The bald eagle was removed from the Federal List of Endangered and Threatened Wildlife, effective August 8, 2007; however, both the bald eagle and golden eagle are protected by the MBTA and the BGEPA. The BGEPA prohibits the taking of bald and golden eagles or their nests and eggs. Under the BGEPA, taking is defined as "to pursue, shoot, shoot at, poison, wound, kill, capture, trap, collect, molest or disturb."

Specific Comments on Draft Avian & Bat Study Plan

- We recommend that the project sponsor provide a detailed description of all survey methods selected for this site to our office for review. We also recommend that all studies be completed and data analyzed prior to the release of a Draft Environmental Assessment.

- In order to determine the potential collision-hazard for a particular site, the spatial and temporal uses of the airspace by birds and bats needs to be defined during a multi-year period. This can best be accomplished by using remote sensing technology (radar, acoustic, and infrared monitoring) to collect data in various spatial and temporal scales (day and night, season to season, and year to year). For this project site, we recommend that a combination of acoustic monitoring and vertical and horizontal beam radar be used at night during both the spring and fall migration period to account for all birds and bats

moving through the site. Recommended monitoring time periods for avian species is from April-May and September- October. Bats should be monitored from June through October. Visual observation of eagles and raptors should occur from August through early December. Information collected from the radar study should include flight direction, altitude, and migration passage rates. This technology will give accurate data on whether individuals are moving through the rotor swept area of the proposed turbines.

- Bat detectors should be placed up as high as possible, for example, on one or more of the launch structures. If bats are migrating through the area they are likely to investigate such tall, tree-like structures.

- The guidance recommends three years of data as a standard for determining the presence and/or magnitude of bird and bat migration in areas of high seasonal concentrations. We believe risk at this site is sufficiently high to warrant three years of data collection.

- Survey results should be submitted to us for review and comment, along with proposed project-specific avoidance and minimization methods to reduce the risk of bat and bird mortality.

We commend NASA's efforts to develop renewable energy sources for the Wallops facility. We are concerned, however, about the potential impacts of turbines on protected species and trust resources. Such structures are known to have significant impacts on wildlife, including these protected species. The proposed location of the structures on a barrier island within an internationally important bird migration corridor potentially exacerbates potential impacts in this case. For these reasons, we recommend that NASA consider and further develop alternatives to the proposed two turbines. These alternatives should include your previous consideration of solar, but also consider other means of electrical generation and/or implementing or developing wind turbines that effectively reduce impacts to avian species and bats. The Service looks forward to working with NASA to develop a project that meets NASA's renewable energy goals while protecting the significant migratory bird resources of the Delmarva barrier system.

If you have any questions, please contact Kimberly Smith of this office at (804) 693-6694, extension 126.

Sincerely,

Karen L. Mayne

Karen L. Mayne
Supervisor
Virginia Field Office

cc: Chincoteague National Wildlife Refuge (Lou Hinds)

COMMONWEALTH of VIRGINIA

L. Preston Bryant, Jr.
Secretary of Natural Resources

Department of Game and Inland Fisheries

Robert W. Duncan
Executive Director

July 3, 2008

Joshua A. Bundick
NEPA Program Manager
Goddard Space Flight Center
Wallops Flight Facility
Wallops Island, VA 23337-5099

RE: WFF Alternative Energy Plan & Wind Energy Avian and Bat Study Plan.

Dear Mr. Bundick:

Thank you for the opportunity to comment on the NASA Wallops Flight Facility (WFF) Alternative Energy Plan and the Wind Energy Avian & Bat Study Plan. The Department of Game and Inland Fisheries (DGIF), as the Commonwealth's wildlife and freshwater fish management agency, exercises enforcement and regulatory jurisdiction over those resources, inclusive of state or federally endangered or threatened species, but excluding listed insects. We are a consulting agency under the Fish and Wildlife Coordination Act (48 Stat. 401, as amended; 16 U.S.C. 661 et seq.), and we provide environmental analysis of projects or permit applications coordinated through the Virginia Department of Environmental Quality (DEQ), the Virginia Marine Resources Commission, the Virginia Department of Transportation, the U. S. Army Corps of Engineers, the Federal Energy Regulatory Commission, and other state or federal agencies. Our role in these procedures is to determine likely impacts upon fish and wildlife resources and habitats, and to recommend appropriate measures to avoid, reduce, or compensate for those impacts.

As outlined in the April 23, 2008 letter to Ruth Boettcher (VDGIF Wildlife Diversity Biologist), NASA Wallops Flight Facility is reviewing two alternative energy options and proposes to conduct avian and bat studies to further define and quantify potential impacts before selecting an option. As follow-up, WFF has developed a Wind Energy Avian & Bat Study Plan. As part of this plan, WFF "is proactively seeking input from federal and state agency personnel and interested non-governmental stakeholders regarding pre-construction and post-construction assessments of potential impacts to birds and bats." We appreciate WFF involving "stake holders" early in the decision making process and look forward to working with all interested parties. In addition to the material provided,

we reference the U.S. Fish and Wildlife Service Interim Guidance on Avoiding and Minimizing Wildlife Impacts from Wind Turbines (2003) in providing comments for your consideration.

As part of the pre-construction assessment, WFF contracted a Phase I Avian Risk Assessment with Curry & Kerlinger, L.L.C. In reviewing this assessment and in light of the high bat fatalities occurring at wind facilities in the east, the VDGIF believes that Alternative One (wind turbines) will result in the take of birds, bats, and potentially state and/or federally listed species as well as the loss of wetland habitat. Alternative Two (solar panels), while requiring a larger area, will utilize existing rooftops thus reducing the impact to wildlife resources through loss of upland habitat. In addition, the use of solar panels will not likely involve the actual "take" of wildlife. Therefore, a more complete evaluation of Alternative Two (solar panels) should be performed.

As noted in the draft Phase I Avian Risk Assessment for the James Madison University-NASA Wind Power Project, Wallops Island, Accomack County, Virginia (Kerlinger 2004), "the two project sites will have significant bird use," that may "involve Section 7 ESA consultation." In the Executive Summary Kerlinger states "The birds that nest, migrate and make stopovers in the adjacent habitats, and wintering birds are very diverse and numerous, indicating that the general area is a very important area for birds. Extraordinarily large numbers of migrating raptors, waterfowl, shorebirds, other waterbirds, and songbirds migrate through the general, as well as winter in the area. Nearby there is a globally significant flightline for fall migrating Peregrine Falcons, Merlins, and some other species. The area is known for its waterfowl and shorebird migrations, which classify as world class. The migrations of these species are the reason so many national and state wildlife management areas, wildlife refuges, and even a national seashore are present nearby acting as ecological magnets for these species. Together these facts strongly suggest that the two project sites will have significant bird use." Kerlinger further recommends "Meet with the U.S. Fish and Wildlife Service…Such a meeting would involve potential Section 7 ESA consultation and a discussion of the expected scope of work."

While there is little information on bat use and movements through this area, anecdotal information suggest this may be a migration corridor. The presence of tree bats (hoary, red, and silver-haired) on the Bay Bridge Tunnel as well as flocks of bats landing on vessels off the Atlantic Coast suggests the coast may be used as a migration corridor. In addition, wind facilities in the east are recording the highest bat fatalities in the world. While these facilities are primarily located on mountain tops, high fatality rates have been documented from Tennessee, West Virginia, Pennsylvania, New York, and over to Quebec. The wind facilities in Quebec are located in flat agricultural fields away from mountains and apparent bat habitat.

The first three recommendations under the "Site Development Recommendations" in the USFWS guidance document recommend avoidance of sites similar to Wallops Island. Recommendation 1 states, "Avoid placing turbines in documented locations of any

species of wildlife, fish, or plant protected under the Federal Endangered Species Act." Recommendation 2 states, "Avoid locating turbines in known local bird migration pathways or in areas where birds are likely concentrated, unless mortality risk is low (e.g., birds present rarely enter the rotor-swept area). Recommendation 3 states, "Avoid placing turbines near known hibernation, breeding, and maternity nursery colonies, in migration corridors, or in flight paths between colonies and feeding areas. As documented in the Phase I Avian Assessment, the WFF site meets all three of these criteria.

While the issues above demonstrate that Alternative One is a high risk alternative and will result in take of birds, bats, and potentially state and/or federally listed species, the degree to which take will occur is not quantified. Because the WFF site will have significant bird use and likely bat use, any pre or post-construction studies should focus on determining the level of use by taxa and factors that influence use including, but not limited to temporal variation and meteorological data. These data will be helpful in selecting an alternative and developing mitigation strategies to avoid or minimize impacts to wildlife. To this end the VDGIF offers the following comments and recommendations concerning the Wind Energy Avian and Bat Study Plan.

General Comments:

The VDGIF recommends that WFF reference the USFWS Interim Guidance on Avoiding and Minimizing Wildlife Impacts from Wind Turbines in assessing the two alternative energy options. If WFF selects Alternative One as their energy option, the VDGIF recommends that WFF consult with both state and federal regulatory agencies that govern the take of wildlife early in the decision making process. Under both state and federal laws, the take of birds and/or bats is prohibited unless specifically permitted.

Overall we find the study plan lacks sufficient detail in order to provide appropriate comments. While the plan provides primary objectives and general approaches to objectives, it fails to provide the methodology that will be used to achieve these objectives. For example, the first objective of the avian study plan includes inventory of habitat, but no methods for inventorying habitat are provided. As part of the second objective, nesting activity is to be identified in the vicinity of the development site. Again, it is unclear as to the methods that will be used to address this objective? Under the "field investigations," point counts appear to be the method to achieve this objective with "Nests of rare, threatened or endangered species...located (approximately) and mapped with a Global Positioning System unit." The use of point counts as a method for finding nests is at best atypical, if not impractical to achieve this objective as point counts are typically "fixed points." In lieu of the methodology to be used to address objectives, we provide the following comments and look forward to seeing a more detailed proposal that includes the methods for achieving the stated objectives.

Specific Comments:

Page 1, paragraph 1: "NASA currently plans to build one wind turbine in early 2010, assess its performance and subsequently install a second similar wind turbine at a later date."

Comment: This statement appears to contradict the statement in the April 23, 2008 letter to Ruth Boettcher where it states "To further define and quantify potential impacts, WFF will perform avian and bat studies and complete the EA prior to selecting an alternative energy option." If the statement on page one is correct and a wind turbine will be built in 2010 followed by a second turbine, then it appears that an alternative energy option has already been chosen and avian and bat studies designed to help select an energy option is a moot point. If this is true, then avian and bat studies should be designed to gather data that will minimize and mitigate for take of birds and bats. These studies should be geared to quantify bird and bat use in the rotor swept area along with meteorological conditions associated with use.

Page 4, Existing Avian and Bat Baseline Information: NASA is "...closely monitoring the post-construction monitoring effort underway at the New Jersey Board of Public Utilities 5-turbine installation in Atlantic City, NJ. This wind energy facility uses wind turbines that are very similar to those that NASA is proposing and the project is also on a coastal site with may site characteristics that are similar to NASA's. The New Jersey Audubon Society recently prepared a draft report of the post-construction monitoring conducted from July-December 2007 and NASA and its contractors will analyze the results."

Comment: The review of avian studies in the US (Appendix IV) emphasized facilities with site characteristics that are not comparable (e.g., rangeland/farmland/agricultural, forested ridge/strip mine mountain, and desert) to the site characteristics of the WFF site. We would like a copy of the New Jersey Audubon Society's post-construction monitoring report for the installation in Atlantic City, NJ, for review.

Page 4, Avian Field Studies: "The proposed pre-construction avian field study will be performed in the 12-month period commencing July 1, 2008 and ending June 30, 2009."

Comment: While a single year of data will provide greater insight into bird and bat activity at the proposed site, the greatest threat for take will likely occur as birds and bats pass through the site. Because of temporal variation, the use of this air space will be difficult to quantify with one year of data. The USFWS Interim Guidance recommends "High seasonal concentrations of birds may cause problems in some areas. If, however, power generation is critical in these areas, an average of three years monitoring data (e.g., acoustic, radar, infrared, or observational) should be collected and used to determine peak use dates for specific sites."

Page 5, Item 4: "There is currently no plan to study nocturnal avian migration with radars, given the small number..."

Comment: While the lack of site specific monitoring for nocturnal migrants will make it difficult at best to determine potential risk to nocturnal species, recent radar studies on the Eastern Shore (Mabey et. al. 2007, Watts et. al. 2007) may provide some insight into potential risk.

Page 6, 5.0 Bat Field Studies: "The intended study plan is to record observations over an eight-week period between mid-July and mid-September 2008 when both resident and migrant bat activity can best be witnessed."

Comment: Acoustical bat data should be collected from April 1 through October 30 and preferably over multiple years. Because so little is known about bat use and migration along the coast a minimum of one full season of data collection is warranted. These data will help identify key activity periods where mitigation measures can be applied.
Ibid: "NASA also considered installing the recorders at the US Navy building "mast" tower, located just east of the northern-most turbine, at a height of approximately 170 feet above ground level."

Comment: If still feasible, recorders should be placed on the US Navy building "mast" tower as this will sample activity closest to the rotor swept area.

Ibid: "...and a second recorder will be located below vegetative canopy height in the same location."

Comment: Unless there is an objective to correlate below canopy activity with either rotor swept activity or fatality rates, the second recorder (below canopy level) is not necessary. The important data will be activity in the rotor swept area and not activity below the canopy. We recommend that in place of "below canopy recorders," additional recorders be placed to quantify activity in the rotor swept area.

Page 6; 6.0 Mitigation and Post-Construction Monitoring: "After the avian/bat pre-construction study is completed, NASA will collaborate with federal and state wildlife regulatory agencies and involved stakeholders to develop an avian/bat mitigation and post-construction monitoring plan."

Comment: This further implies that Alternative One has been chosen as the preferred energy plan and that any studies designed to assist in the selection of an option are moot. If Alternative One has already been selected, then because of the issues identified above including "... the general area is a very important area for birds. Extraordinarily large numbers ...migrate through...a globally significant flightline for fall migrating Peregrine Falcons, Merlins,...waterfowl and shorebird migrations, which classify as world class...the two project sites will have significant bird use" we recommend that initial discussions concerning the development of the mitigation and post-construction

monitoring plan not wait for the pre-construction study. Issues such as potential take of state and/or federally listed species, mitigation measures, etc. can be addressed without the pre-construction data.

Page 7; first paragraph: "The study protocol for these mortality surveys will be developed with input from the regulatory agencies and stakeholder groups to ensure that proper methods..."

Comment: We welcome the opportunity to work with all interested parties in developing post-construction monitoring and mitigation strategies.

We support the use of alternative energy sources, including wind energy. However, we feel the full impacts of such alternatives upon wildlife must be assessed. Once again, we encourage a more complete evaluation of solar panels and other potential alternative energy sources be performed. Potential adverse impacts should be avoided and minimized where possible. This should be through proper siting of power generating facilities and use of the best available technology. For those impacts that are unavoidable, appropriate mitigation should be implemented.

Thank you for the opportunity to comment on the alternative energy proposal and bird and bat study plan. Please contact Ernie Aschenbach (telephone (804) 367-2733) if we can be of further assistance.

Sincerely,

David K. Whitehurst, Director
Wildlife Diversity Division

cc: Kim Smith, USFWS
Rene Hypes, VDCR-DNH

Literature cited

Kerlinger, P. 2004. Draft phase I avian risk assessment for the James Madison University-NASA wind power project, Wallops Island, Accomack County, Virginia. Prepared for NASA Wallops Flight Facility. 52pp.

Mabey, S.E., B. Paxton, B. Watts, F. Smith, D. Dawson, and B. Truitt. 2007. Baseline assessment of neotropical migrant landbird stopover habitat in the lower Chesapeake Bay Region for conservation planning and protection. Draft report to the Virginia Department of Game and Inland Fisheries. 64pp.

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USFWS (U.S. Fish and Wildlife Service). 2003. Interim guidelines to avoid and minimize impacts from wind turbines. U.S. Department of the Interior, U.S. Fish and Wildlife Service, Washington D.C. 55pp.

COMMONWEALTH of VIRGINIA

L. Preston Bryant, Jr.
Secretary of Natural Resources

Department of Game and Inland Fisheries

Robert W. Duncan
Executive Director

April 29, 2009

Joshua A. Bundick
NEPA Program Manager
Goddard Space Flight Center
Wallops Flight Facility
Wallops Island, VA 23337-5099

RE: WFF Alternative Energy Project Final Avian and Bat Study Plan.

Dear Mr. Bundick:

Thank you for the copy of the "Wallops Flight Facility Alternative Energy Project: Final Wind Energy Avian & Bat Study Plan" (Final Plan). As stated in our comments dated July 3, 2008 (attached), we felt the original study plan "lacked sufficient detail in order to provide appropriate comments" and that we "look forward to seeing a more detailed proposal that includes the methods for achieving the stated objectives" for our review. While the Final Plan provides greater detail on fatality searches at existing towers, the overall plan continues to lack sufficient detail to understand sampling protocols and determine how risk assessment will be based on the proposed sampling effort. Some of the objectives do not appear to have associated sampling protocols while the Bat Field Studies lack objectives altogether. The following comments elaborate on our concerns and provide recommendations to strengthen sampling efforts in order to gather the appropriate data needed to assess risks.

General Study Design

We presume the means for assessing risk will be the data from the sampling efforts that represent presence, absence, and activity of species in the study area. In order to effectively determine these parameters, sampling efforts need to have a certain precision in their ability to detect a species. Typically, study designs are based on site specific pilot efforts or local studies that provide variance on the sample data. The variance in these data is the basis for determining sample sizes that can provide the precision to predict a certain event or occurrence; in this case the presence, absence, or probability of a species occurring within the study area. In both plans the degree of precision to which the

sampling efforts can or cannot predict bat and avian activity in order to assess risk is not clear. This will be important in assessing both general wildlife risk and risk to state and federally listed species such as peregrine falcons and piping plovers. In addition, the ability to assess risk should incorporate environmental co-variants (tides, seasons, time of day, annual variation, prey, etc.) that influence species occurrence. We are greatly concerned that the reduction in sampling effort for avian field observations, lack of sampling for environmental co-variants, short sample period for bats, and lack of pre-data will lead to a Type II Error (concluding no impact when in fact impact does exist, i.e., a false negative) (NWCC 1999). In addition, and in light of the Phase I Avian Risk Assessment (Kerlinger 2004), the recent report from the Jersey Atlantic Wind Power Facility (New Jersey Audubon Society 2008), and comments from VDGIF (July 3, 2008) and the U.S. Fish and Wildlife Service (July 8, 2008), we believe the Final Plan should include species specific studies to determine risk for state and federally listed species.

Recommendation: Coordinate with VDGIF, U.S. Fish and Wildlife Service, The Nature Conservancy, and The Center for Conservation Biology at The College of William and Mary to identify existing data and design pilot studies that will provide baseline data to develop appropriate studies to address risk assessment where data gaps exist. This should include specific efforts to address state and federally listed species. Consult with a biostatistician to help design studies that increase the precision of the sampling efforts.

Study Duration

Because site specific data derived from pre-construction surveys will be the basis for determining risk, we find the proposed duration of the study to be inadequate for both birds and bats. Due to the biological importance of this area and the current findings from the post-construction monitoring at the Jersey Atlantic Wind Power Facility (New Jersey Audubon Society 2008), and Casselman Wind-Energy Study (E.B. Arnett, Bat Conservation International, unpublished data), the duration of the proposed study plan, 1-year for birds and 8 weeks for bats, is insufficient to assess use and determine risk. In addition, the three major publications that provide guidance on assessing impacts of wind-energy development all recommend multi-year preconstruction surveys for areas with high biological significance.

Service Interim Guidance on Avoiding and Minimizing Wildlife Impacts from Wind Turbines (USFWS 2003).

Page 4:"Turbine Design and Operation Recommendations:

> 5. High seasonal concentrations of birds may cause problems in some areas. If however, power generation is critical in these areas, an average of three years monitoring data (e.g., acoustic, radar, infrared, or observational) should be collected and used to determine peak use dates for specific sites. Where feasible, turbines should be shut down during periods when birds are highly concentrated at those sites."

Assessing Impacts of Wind-Energy Development on Nocturnally Active Birds and Bats: A Guidance Document (Kunz et. al. 2007).

Page 2462: "best strategy for assessing potential interaction between bats and wind turbines is to implement a long-term acoustic monitoring program, best conducted throughout an entire annual cycle (April through November in temperate North America) to account for all potential variables and ideally covering >= 3 years to assess both within-year and inter-annual variability."

Environmental Impacts of Wind-Energy Projects (NRC 2007).

Chapter 3, Page 94: "Pre-Construction Studies: Conduct multi-year studies when appropriate to assess daily, seasonal and interannual variability of bird and bat populations."

Recommendation: Due to the biological significance of this area and the potential risk for take of both state and federally listed species, we recommend a minimum of three years of pre-construction studies.

Specific Comments

It is not clear which field studies are designed to address a particular objective. Therefore, we have based our comments and recommendations on the following assumptions:

Avian Objective 1: Perform a pre-construction inventory of resident avian species and habitat in the vicinity of the proposed wind energy development site:

The revised Final Plan shows a significant reduction in time and effort to assess avian activity in the area without supporting documentation for the change. In the first draft the avian sampling effort included the following: "During nesting and winter seasons, as well as peak migration periods in both Fall 2008 and Spring 2009, biologists will conduct diurnal surveys of avian migration activity in the project vicinity. Observations will be conducted at a set of point count locations (likely 3-4 points) within and adjacent to the project development site to be visited three to four times per week for no less than four hours per day by a biologist to record avian activity." In the revised Final Plan, the avian sampling effort is reduced to: "Throughout the 52-week period, biologists will visit both observation sites at least once per week for a minimum of 15 minutes per day at each location to record avian activity. These field surveys will be conducted in the morning between 7:00 am and 9:00 am." While this effort is increased to twice per week during the migration seasons, the overall effort to assess avian activity is significantly reduced without explanation or justification. In a simple comparison, the sampling effort has been reduced from 12-16 hours/point/week to 15-30 min./point/week, and a reduction from 3-4 points to two. We are concerned that the probability of the revised survey will not be sufficient to detect species occurrence, especially for rare species and considering that the sampling effort is not based on pre-existing data.

This objective also states that habitat will be inventoried in the vicinity of the project site, but no mention is made in the methods on how the habitat will be assessed and quantified, which habitat parameters will be measured, and how much area will be inventoried (e.g., will it include adjacent beaches, marshes, and tidal flats?). Based on the lack of protocols, it is our interpretation that habitat will not be inventoried. This appears to be inconsistent with the stated objective.

Recommendation: To address this objective, work with VDGIF, U.S. Fish and Wildlife Service, The Nature Conservancy, and the Center for Conservation Biology at the College of William and Mary to identify existing data, design pilot studies that will provide baseline data, and to develop appropriate inventory studies that incorporate environmental co-variants and probability of detection. Develop appropriate sampling protocols to identify habitat for resident and migratory species. Consult with a biostatistician to help design studies that increase the precision of the sampling efforts.

Avian Objective 2: Identify pre-construction migratory, nesting, and winter avian activity, including use of stopover, resting, or feeding areas in the vicinity of the development site;

Part of this objective is to document the use of stopover, resting, or feeding areas in the vicinity of the development site; however, we were unable to identify protocols to achieve this objective other than through limited observations made from the U.S. Navy building mast tower. Based on the location of the mast tower as shown in Figures 2 and 4, this observation platform will probably offer good views of the beach (it should be noted, however, that the portion of beach closest to the mast tower is not suitable for birds because of the rock revetment that has caused the berm seaward of the rocks to erode away) and will enable observers to detect avian movement between the beach and the marsh, but views of potential nesting, resting and forging areas in the marsh are likely to be obstructed by dense vegetation or obscured by distance. Even if key nesting, resting and feeding areas are successfully identified, the study plan includes no explanation on the level of data that will be collected at these sites to help characterize their relative importance throughout the annual cycle.

Recommendation: To address this objective, coordinate with VDGIF, U.S. Fish and Wildlife Service, The Nature Conservancy, and the Center for Conservation Biology at The College of William and Mary to identify existing data and develop appropriate surveys to sample these parameters.

Avian Objective 3: Assess potential risk from wind turbine operation to known avian species, primarily through pre-construction monitoring of avian mortality near existing tall structures on Wallops Island;

This objective appears to the primary focus for assessing avian risk. The rationale for this effort is based on two sites where similar numbers of bird fatalities were observed between towers and turbines. While this is a plausible hypothesis, we have great concern

that an untested sampling effort would be the major tool for assessing risk. It should be noted that while similarities were noted at the two sites, this was not a hypothesis that was tested at these sites. Caution should be used in assuming that this approach will be predictive of fatality rates at wind turbines until it is tested, especially considering that the technique is based on a sample size of two. However, we do see where this information can be useful for refining post-construction fatality surveys and identifying local conditions that are conducive to tower collision mortality.

The Final Plan has no contingency to use radar as a tool to assess risk because "no more than two wind turbines may ultimately be installed, there is no accepted radar methodology for assessing avian risk, and there is a lack of conclusive evidence demonstrating a correlation between radar data and avian risk." However, we do not believe these are legitimate reasons to exclude radar for the following reasons. It is not only the number of wind turbines that will determine the impact to wildlife. Wildlife impacts will be determined by a combination of variables including the number of turbines, ecological significance of the area, the species that will be impacted, and the probability of impact. Although the number of proposed turbines is small, the proposed site and species known from this area that can be impacted by these turbines is significant, including state and federally listed species. Though there is no accepted radar methodology for assessing risk, this can also be said for all sampling efforts used at wind facilities including point counts, visual observations, thermal infrared imaging, acoustic monitoring, as well as comparing fatality rates between towers and turbines. Because we lack standardized surveys, the guidance documents identified above all recommend the use of multiple strategies to best assess the species, activity, and potential risk at a site. Lastly, the reason there is a lack of conclusive evidence correlating radar data and avian risk is due to incomplete studies to test this hypothesis and not because the correlation does or does not exist. One of the objectives of the study at the Jersey Atlantic Wind Power Facility is to investigate correlations between mortality and flight dynamics using radar.

Recommendation: Employ a variety of survey methods that includes the use of radar. Long-range surveillance radar such as NEXRAD can provide information on stopover sites while marine radar can provide site specific information on passage rates and heights.

Bat Field Studies

Unlike the avian studies, there are no objectives defined for bat studies. In lieu of objectives, the Final Plan proposes installing acoustical detectors at three locations and sample for a period of eight weeks between July 28th and September 22nd with a lack of explanation and justification for the selected time period. As stated earlier, we believe this an insufficient time period to assess bat activity and potential risk. Because little to no work has been conducted on bat migration and movements on the coast, and because the Final Plan notes that "bats are typically present on Wallops Island from May to October," it is important to conduct surveys for an entire annual cycle (April through

October) in order to understand activity and assess risk. Under the current sampling effort, risk can only be assessed for the sampling period of July 28th through September 22nd. In addition, new data from the Casselman study (Arnett, pers. comm.) demonstrates significant annual variation in bat activity supporting the need for multi-year surveys.

The bat studies include a field review of bat habitat conditions within the proposed project development site, but no protocols or methodology are presented to describe how this will be accomplished.

Recommendations: For the reasons identified above, acoustical surveys should be conducted for an entire cycle (April through October) for three years. Protocols for conducting "bat habitat conditions" should be developed with input from VDGIF and the U.S. Fish and Wildlife Service.

We support the use of alternative energy sources, including wind energy. However, we feel the full impacts of such alternatives upon wildlife must be assessed. Once again, we encourage a more complete evaluation of solar panels and other potential alternative energy sources be performed. Potential adverse impacts should be avoided and minimized where possible. This should be through proper siting of power generating facilities and use of the best available technology. For those impacts that are unavoidable, appropriate mitigation should be implemented.

Thank you for the opportunity to comment on the alternative energy proposal and bird and bat study plan. Please contact Ernie Aschenbach (telephone (804) 367-2733) if we can be of further assistance.

Sincerely,

Raymond T. Fernald, Manager
Environmental Services Section

cc: Kim Smith, USFWS
Rene Hypes, VDCR-DNH

Attachment.

Literature Cited

Anderson, R.L., M. Morrison, K. Sinclair, and M.D. Strickland. 1999. Studying wind energy-bird interactions: a guidance document. Prepared for avian subcommittee and National Wind Coordinating Committee.

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COMMONWEALTH of VIRGINIA

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January 25, 2010

Mr. Randall M. Stanley
Facility Historic Preservation Officer
NASA / WFF FMB, Code 228
Building N-161, Room 127
Wallops Island, VA 23337

Re: Proposed Alternative Energy Program
NASA Wallops Flight Facility, Wallops Island, Accomack County
DHR File #: 2009-1883
Date Received: December 14, 2009

Dear Mr. Stanley:

We have received your request for our review and comment regarding the above referenced project. Unfortunately, at this time we are unable to make an informed decision concerning the effects of the proposed undertaking. We do not have the enough information needed to adequately evaluate the effects of the undertaking, specifically the lack of exact location and configuration of alternatives two and three.

If possible, in the future consultation please include additional photo simulations similar to Figure 5 but to scale to assist in our review of this undertaking.

Additionally, please seek comments of the National Park Service, specifically the Assateague Island National Seashore.

We will review the review the project again when an alternative is determined. If you have any questions about our comments, please contact me at: ron.grayson@dhr.virginia.gov or (804) 367-2323, Ext. 105.

Sincerely,

Ronald Grayson, RPA, Archaeologist
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From: Adam Duerr
To: Bundick, Joshua A. (GSFC-250.0)
Cc: Bryan Watts
Subject: Wallops Island Alternative Energy Project
Date: Friday, May 16, 2008 1:56:03 PM

Joshua –

I wanted to get back to you regarding assessment of potential for impacts to birds and bats at the proposed Wallops Island Alternative Energy Project. First, following the logic that Dr. Kerlinger established, the physical setting of coastal Virginia and the extensive wetland habitats surrounding Wallops Island certainly suggests that there may be great risk of bird strikes in this environment. Bird use of coastal Virginia varies greatly by season, with extensive use by a wide variety of taxonomic groups during spring and fall migration including shorebirds, secretive marsh birds, passerines, raptors, colonial waterbirds, and waterfowl. Additionally, different suites of species use this area during summer breeding and winter seasons. Because of the high biodiversity of species using the Virginia Barrier Island and Lagoon systems, this area has been designated an Important Bird Area for Virginia and has been accepted as an international IBA. Some of the sensitive and/or endangered species of birds that use or may use the specific project site include Roseate Terns, Piping Plovers, and Black Terns.

I believe that monitoring beyond the proposed 5 consecutive days of diurnal point counts is warranted so that species that use the area and therefore might be at risk can be identified. Because of the seasonal variability of use by birds, monitoring should be done throughout the year. As I suggested at the meeting, sampling to capture temporal variation in numbers and diversity of species cannot be completed in the time allotted before proposed construction of this facility in 2009. Therefore, I suggest sampling at areas beyond the immediate construction location to capture spatial variation. Such spatial variation may reflect temporal variation that can be expected at the proposed site.

In addition to expanded point counts, nighttime work should also be completed to quantify numbers of birds and bats that use or move through the proposed site and neighboring areas. Such night work should include use of radar to identify both the number of individuals moving through the area as well as characteristics of such movements. That is, radar studies can be implemented to determine the height above land that birds move through wetland and coastal habitats at the proposed and similar sites. Data on height of movements should further elucidate the potential risk that birds and bats face if this project is constructed.

The nighttime monitoring by radar should also be coupled with nocturnal surveys for birds and bats so that relative proportions and thus numbers of these species can be quantified. This will provide additional information to assess the overall risk to sensitive species that

may use the site. Such surveys should be completed while keeping in mind that all species cannot be detected at night. Therefore, the diurnals surveys described above must be integrated into this overall monitoring scheme to fully describe those species using or moving through the area. By combining radar with nocturnal and diurnal surveys, a comprehensive picture of bird and bat use of the site and the potential risk that the wind-power project poses to these species can be developed. Only after such surveys have been completed can the potential impacts of this project be fully assessed.

If you have any questions about my recommendations, please feel free to contact me.

Sincerely,

Adam Duerr

Adam E. Duerr, Ph.D.

The Center for Conservation Biology

College of William & Mary

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