Appendix L – Interim Avian Survey Report

INTERIM AVIAN SURVEY REPORT
APRIL 2013 – OCTOBER 2013

Virginia Offshore Wind Technology Advancement Project

(VOWTAP)

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ACRONYMS AND ABBREVIATIONS

Acronym	Definition
AIC	Akaike Information Criterion
amsl	above mean sea level
BCC	birds of conservation concern
BGEPA	Bald and Golden Eagle Protection Act
BOEM	Bureau of Ocean Energy Management
CFR	Code of Federal Regulations
DOE	U.S. Department of Energy
Dominion	Virginia Electric and Power Company, a wholly-owned subsidiary of Dominion Resources, Inc.
EBS	Ecological Baseline Survey
ESA	Endangered Species Act
GAP	General Activities Plan
GPS	Global Positioning System
IDW	inverse distance-weighted average
km	kilometer
km/hr	kilometer/hour
km^2	square kilometer
kV	kilovolt
m	meter
MBTA	Migratory Bird Treaty Act
mi	statute mile
mi^2	square mile
MW	megawatt
NEPA	National Environmental Policy Act
NHP	Natural Heritage Program
NJDEP	New Jersey Department of Environmental Protection
NREL	National Renewable Energy Laboratory
OCS	Outer Continental Shelf
Project	Virginia Offshore Wind Technology Advancement Project
RSZ	rotor swept zone
SGCN	species of greatest conservation need
U.S.C.	United States Code
USFWS	U.S. Fish and Wildlife Service
USGS	U.S. Geological Survey
VDGIF	Virginia Department of Game and Inland Fisheries
VOWTAP	Virginia Offshore Wind Technology Advancement Project
WEA	wind energy area
WTG	wind turbine generator

1 INTRODUCTION

Tetra Tech, Inc. (Tetra Tech) was contracted by Virginia Electric and Power Company, a wholly-owned subsidiary of Dominion Resources, Inc. (Dominion) to perform one year of avian surveys in support of the Virginia Offshore Wind Technology Advancement Project (VOWTAP or Project), a 12-megawatt (MW), two-turbine offshore wind demonstration project located approximately 24 nautical miles (nm) (27 statute miles [mi], 43 kilometers [km]) offshore of Virginia Beach, Virginia, adjacent to the Bureau of Ocean Energy Management (BOEM) designated commercial Wind Energy Area (WEA). The Project will also consist of submarine cable interconnecting the WTGs (Inter-Array Cable), a submarine transmission cable (Export Cable) that will convey the energy produced by the VOWTAP to shore. The onshore components of the VOWTAP are located entirely within the Camp Pendleton State Military Reserve (Camp Pendleton) in Virginia Beach, Virginia, and will comprise the following facilities:

- A Switch Cabinet that will serve as the transition point were the Export Cable will be spliced with the Onshore Interconnection Cable and separate Fiber Optic Cable;
- An underground Onshore Interconnection Cable;
- An underground Fiber Optic Cable; and
- An Interconnection Station.

Tetra Tech has completed avian surveys in support of the VOWTAP for the first 6-month period in 2013. The VOWTAP Wildlife Assessment Plan was developed to provide the VOWTAP team with the necessary data to address considerations under the Migratory Bird Treaty Act (MBTA), Endangered Species Act (ESA), Bald and Golden Eagle Protection Act (BGEPA), National Environmental Policy Act (NEPA), and state environmental regulations. The assessment approach and methods were also designed to meet BOEM's data requirements for site characterization studies to evaluate the potential impact of the VOWTAP, and included surveys within the proposed Research Lease Area and a 1 nm buffer around the proposed Research Lease Area (BOEM 2013).

Specific objectives of the avian studies were as follows:

1) Determine the species composition of the bird community in the Research Lease Area.
2) Gather information on behavior of birds in the Research Lease Area including data on foraging, sitting on the water, following vessels, and flight height.
3) Estimate the relative abundance of the birds in the Research Lease Area.
4) Identify the spatial and temporal distribution patterns of birds in the Research Lease Area.
5) Assess use of the Research Lease Area by rare, threatened, and endangered avian species.
6) Determine if any sensitive species occur at the preferred Export Cable landfall site and along the preferred Onshore Interconnection Cable and Fiber Optic Cable corridor.
7) Collect sufficient information to reduce bias and uncertainty associated with the baseline estimates of abundance.
8) Collect pre-construction information that may be useful to quantify any changes in the spatial distribution and abundance of birds post-construction monitoring.

The purpose of the survey and analysis was not to estimate population size, but to assess differential patterns of spatial-temporal occurrence, relative density, and flight behavior across the Offshore Survey Area. The avian survey methods were scaled to match the anticipated impacts of the proposed offshore wind project. The results of the pre-construction VOWTAP avian surveys provide adequate baseline data to characterize and assess the potential impacts of the proposed Project.

The VOWTAP avian surveys were further developed to meet the objectives identified in BOEM's avian survey guidelines (BOEM 2013). In 2013, BOEM issued guidelines for providing avian survey information (Guidelines) for renewable energy development projects on the Atlantic Outer Continental Shelf (OCS) (BOEM 2013). BOEM considers pre-construction avian surveys a component of site characterization (similar to the required geophysical surveys and others), with the purpose of evaluating the impact of the proposed development on biological resources (30 Code of Federal Regulations [CFR] Part 585 Subpart F). The Guidelines are intended to provide developers with a framework for baseline avian surveys at proposed federal offshore lease areas. The Guidelines are also intended to standardize data collection, analysis, and reporting for submittal with Research Activity Plans (RAPs) or Construction and Operations Plans.

The results of these interim pre-construction surveys are useful in developing a baseline of species composition, relative abundance, density, migration phenology, and distribution patterns. Existing wildlife data from the nearby WEA will be incorporated into reporting and risk analyses in the final comprehensive report in the spring of 2014.

Baseline pre-construction surveys conducted during the 2013 interim 6-month survey period included:

- Diurnal ship-based visual survey transects (once per month, 7 total).
- Onshore point-counts (once per month in April, August, September, and October 2013, 4 total). Two additional onshore point-counts will be conducted in March 2014 (6 total).

The avian survey implemented during the 2013 survey period was consistent with surveys at other proposed offshore wind projects in the United States and Europe (Kahlert et al. 2000; Innogy 2003; Camphuysen et al. 2004; CEFAS 2004; BOWind 2005; Chamberlain et al. 2006; Hüppop et al. 2006; Petersen et al. 2006; Winiarski et al. 2009; NJDEP 2010; Winiarski et al. 2011; Svedlow et al. 2012). Additionally, these surveys techniques are complimentary to the ongoing Mid-Atlantic Baseline Study and general purpose pelagic bird sampling efforts (Boyce et al. 2010; Williams 2013).

This interim report present the results of the first 6 months of data collection within the proposed Research Lease Area, adjacent research blocks, and a 1 nm buffer, as well as surveys along the preferred Onshore Interconnection Cable and Fiber Optic Cable route.

Prior to initiating surveys in the proposed Research Lease Area, Dominion consulted with state and federal natural resource and wildlife agencies to determine the appropriate methods and level of effort. The avian surveys methods, in the form of a Wildlife Assessment Plan, were reviewed by BOEM, U.S. Fish and Wildlife Service (USFWS), and the Virginia Department of Game and Inland Fisheries (VDGIF) in April 2013. The draft Wildlife Assessment Plan for the proposed Project was provided to BOEM, USFWS, and VDGIF for review on April 8, 2013. Comments were received from BOEM on April 11, 2013; from USFWS on April 12, 2013; and from VDGIF on April 12, 2013. A final draft of the Wildlife Assessment Plan was submitted to the agencies on April 23, 2013.

The first quarterly survey update was provided to BOEM, USFWS, and VDGIF on July 30, 2013. Updates were also provided separately to USFWS, BOEM, and VDGIF in late October and early November, prior to submitting this report. This interim report serves as the second quarterly report, and as an interim annual report. The third quarterly report will be provided to BOEM, USFWS, and VDGIF following the January 2014 ship-based survey. The final annual report will provide to the agencies following the conclusion of the field survey effort in April 2014.

The following terms are used to describe discrete areas included in the avian surveys in 2013:

- VOWTAP Offshore Survey Area – transects within 1 nm buffer around proposed Research Lease Area
- Transit to VOWTAP Offshore Survey Area – area between Rudee Inlet to VOWTAP Offshore Survey Area
- Transit Survey Area – area surveyed during transit between Rudee Inlet and VOWTAP Offshore Survey Area
- VOWTAP Onshore Avian Survey Area

1.1 Regulatory Framework

Impacts to birds are regulated under several federal laws including the MBTA, the ESA, BGEPA, and NEPA. Some species may also have additional protection under state law.

The MBTA of 1918 (16 United States Code [U.S.C.] 703−712; Ch. 128; July 13, 1918; 40 Stat. 755) was enacted as a prohibition on the killing of migratory birds. Migratory bird species listed under this act occur throughout the general Project vicinity, and indeed are ubiquitous worldwide. The MBTA does not have provisions for compliance measures to address potential incidental impacts to migratory birds. The USFWS has encouraged wind developers to evaluate existing avian resources within a proposed lease area and take reasonable measures to avoid avian mortality.

The ESA of 1973 (16 U.S.C. 1531–1544, 87 Stat. 884) prohibits the unauthorized take (take is defined as killing, injuring, or harming a listed species or its habitat), possession, sale, and transport of endangered species. Section 3 of the ESA defines “take” as “to harass, harm, pursue, hunt, shoot, wound, kill, trap, capture, or collect or to attempt to engage in any such conduct” (16 U.S.C. § 1532 (19)). Harm, in this case, means an act that actually kills or injures a federally listed wildlife species, and “may include significant habitat modification or degradation where it actually kills or injures wildlife by significantly impairing essential behavioral patterns, including breeding, feeding or sheltering” (50 CFR §17.3). To harass means to perform “an intentional or negligent act or omission which creates the likelihood of injury to wildlife by annoying it to such an extent as to significantly disrupt normal behavioral patterns which include but are not limited to, breeding, feeding or sheltering” (50 CFR §17.3).

The threatened and endangered avian species that are known to occur in the general vicinity of the proposed VOWTAP Research Lease Area include the federally endangered roseate tern (*Sterna dougallii*), federally threatened piping plover (*Charadrius melodus*), as well as red knot (*Calidris canutus*), a species proposed for federal listing as endangered (40 [176] Federal Register 53756, October 2, 2013). There is also some potential for the federally endangered Bermuda petrel (*Pterodroma cahow*) to occur in the area during the non-breeding season. Under the ESA, federal agencies authorizing or

permitting a development project with the potential to affect listed species must coordinate with the USFWS during the permitting process. It is expected that the proposed Project will not adversely affect roseate tern and, therefore, formal consultations may not be required (Burger et al. 2011). If USFWS deems that the Project has the potential to adversely affect roseate terns or other ESA listed species, formal consultation with the USFWS may be necessary. The VOWTAP avian surveys were designed to provide adequate data and analysis, and to support ESA review of the Project.

The BGEPA makes it unlawful to take, possess, sell, purchase, barter, offer to sell, purchase or barter, transport, export or import, at any time or any manner, any bald or golden eagle, alive or dead, or any part, nest, or egg thereof without a permit. BGEPA defines "take" as "to pursue, shoot, shoot at, poison, wound, kill, capture, trap, collect, destroy, molest, disturb individuals, their nests and eggs" (16 U.S.C. 668c). "Disturb" is defined by regulation at 50 CFR 22.3 in 2007 as "to agitate or bother a bald or golden eagle to a degree that causes…injury to an eagle, a decrease in productivity, or nest abandonment." The Project is not expected to have any effect on bald or golden eagles because the VOWTAP Wind Turbine Area is more than 20 miles from shore, and onshore Project components have been designed to avoid impacts to breeding sites.

The NEPA requires that federal agencies evaluate environmental consequences of major federal actions. Major federal actions include issuance of major federal permits that have the potential to affect the natural and human environments. Impacts to biological resources, including avian and bat species, must therefore be identified and evaluated as part of this environmental review process. The VOWTAP avian surveys were designed to provide adequate data and analysis to support the biological resources components of the NEPA review for BOEM and other federal and state agencies.

1.2 Agency Coordination

Prior to initiating surveys in the proposed Research Lease Area, Dominion consulted with state and federal natural resource and wildlife agencies to determine the appropriate methods and level of effort. The avian surveys methods, in the form of a Wildlife Assessment Plan, were reviewed by BOEM, USFWS, and the VDGIF in April 2013. The draft Wildlife Assessment Plan for the proposed VOWTAP was provided to BOEM, USFWS, and VDGIF for review on April 8, 2013. Comments were received from BOEM on April 11, 2013, from USFWS on April 12, 2013, and from VDGIF on April 12, 2013. A final draft of the Wildlife Assessment Plan was submitted to the agencies on April 23, 2013.

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1.3 Environmental Impact of Avian Assessment Surveys

Prior to conducting the ship-based avian surveys and supplemental onshore survey, Dominion evaluated the potential environmental effects from collecting baseline avian data aboard a vessel on the OCS. It was determined that potential effects from collecting baseline survey data in the proposed VOWTAP Research

Lease Area would be limited to impact producing factors associated with operations of the survey vessel. No wildlife were handled, captured, or restrained during wildlife assessment surveys for VOWTAP. BOEM evaluated the potential environmental effects of site assessment activities at proposed offshore wind projects on the OCS (BOEM 2012). USFWS concurred with the Environmental Assessment findings that site characterization surveys were unlikely to have a significant impact on birds or bats on the OCS.

1.4 Description of Wildlife Resources in the Proposed Research Lease Area

The proposed Research Lease Area consists of open ocean marine habitat with no islands or sand bars. The Research Lease Area has the potential to provide year-round habitat for seabirds and waterfowl, as well as for terrestrial birds during migration. Some Project components will be installed onshore and have the potential to affect migratory and non-migratory terrestrial species. However, the Onshore Interconnection Cable and Fiber Optic for the VOWTAP will be installed below ground from the landfall site to the proposed Interconnection Station and then to its final terminus with Dominion's existing infrastructure.

In general, avian abundance and species diversity decrease with distance from land (Petersen et al. 2006; NJDEP 2010). Offshore waters within the potential Research Lease Area likely provide habitat for sea ducks, gulls, terns, loons, grebes, storm-petrels, shearwaters, northern gannets, and alcids. The assemblage of birds in the offshore waters is dynamic, with seasonal changes in the composition of summer and winter populations. Migratory corridors may exist along the coast and over the open ocean.

The Research Lease Area is adjacent to the Atlantic coastal migratory flyway and within the Atlantic oceanic migratory flyway. The Atlantic oceanic migratory flyway is a loosely defined corridor generally encompassing most of the OCS waters of the eastern seaboard including the proposed Research Lease Area. Migrants using the Atlantic oceanic flyway may include songbirds, shorebirds, some terns, and other species moving between eastern North America (Arctic Canada, Atlantic Canada, and the northeastern U.S.) and the Caribbean, Central America, and South America. Species travelling the Atlantic oceanic flyway may occur within the proposed Research Lease Area.

The offshore waters and adjacent coastal areas of Virginia provide habitat for avian species with special state and federal conservation status. Some avian species, such as the peregrine falcon (*Falco peregrinus*), shorebirds, and passerines occur primarily in terrestrial habitat on the mainland and on barrier islands, but may also occur in the proposed Research Lease Area during migration. Federally listed and state listed avifauna may occur offshore during migration and non-breeding periods (Table 1-1). State and federally listed bird species may occur in the proposed Research Lease Area or near proposed onshore project components (Table 1-1). Two federally listed species, the roseate tern (*Sterna dougallii dougallii*) and piping plover (*Charadrius melodus*), are likely to occur in the Research Lease Area and along the adjacent Virginia coastline, although the frequency and distribution of their occurrence on the OCS is not well documented. A third federally listed species, Bermuda petrel (*Pterodroma cahow*), may occur in the Research Lease Area during the non-breeding period. Red knot (*Calidris canutus rufa*), a species proposed for ESA listing, may migrate through or near the proposed Research Lease Area (Harrington 2001; O'Connell et al. 2011).

Table 1-1. Federal and State Listed Avian Species That May Occur In or Near the Proposed Research Lease Area

Common Name	Scientific Name	Federal Status[1/]	State Status[1/]	Likelihood of Occurrence
Red knot	*Calidris canutus* ssp. *rufa*	PT	-	Low (May occur during the non-breeding period on the Virginia OCS, or on the Virginia coast)
Piping plover	*Charadrius melodus*	LT	LT	Moderate (May occur during the non-breeding period on the Virginia OCS, and is known to occur in Virginia beach)
Wilson's plover	*Charadrius wilsoni*	-	LE	Moderate
Bald eagle	*Haliaaetus leucocephalus*		LE	Present (Observed during May 2013 onshore point count surveys).
Peregrine falcon	*Falco peregrinus*	-	LT	Present
Caspian tern	*Sterna caspia*	-	SC	Present
Brown pelican	*Pelecanus occidentalis*	Delisted due to recovery	SC	Present
Bermuda petrel	*Pterodroma cahow*	LE	-	Low (May occur during non-breeding period on the Virginia OCS)
Roseate tern	*Sterna dougallii dougallii*	LE	LE	Low (May occur during migration on the Virginia OCS)
Least tern	*Sternula antillarum*	-	SC	Present
Gull-billed tern	*Sterna nilotica*	-	LT	Moderate
Sandwich Tern	*Sterna sandvicensis*	-	SC	Present

[1/] Species Status: LE – Listed as an endangered species; LT – Listed as a threatened species; FP – Federally Protected under the Bald and Golden Eagle Protection Act, PT – Proposed for listing as threatened species; PE – Proposed for listing as endangered; SC – Species of Concern.
The potential for occurrence in the Project Area was evaluated as follows:
Unlikely– no species range overlap with Project area or unsuitable habitat in Project vicinity;
Low– species range overlaps with Project area and marginally suitable habitat in Project vicinity;
Moderate– species range overlaps with Project area and suitable habitat present in Project area,
High–highly suitable habitat present in Project area, or known populations exist in Project vicinity,
Present - species observed during field survey.

Roseate terns are the only listed species (state and federal endangered status) that is likely to move through the proposed Research Lease Area with any regularity. Roseate terns have historically nested in coastal Virginia but currently do not breed south of Long Island, New York (VDGIF 2005; Burger et al. 2011; USFWS 2013). The piping plover is state and federally listed as threatened (USFWS 2012). The species is generally restricted to shorelines and is not known to make frequent flights over open water, except for possibly during migration (Burger et al 2011). Approximately 192 pairs of piping plover nested in Virginia in 2010 (Boettcher 2012; USFWS 2012).

Bald eagles (*Haliaeetus leucocephalus*), protected under the BGEPA, are known to nest in coastal Virginia. A total of 14 bald eagle nests occurred in the Virginia Beach area in 2011 (CCB 2013). Bald eagles, and other raptor species that rely on soaring flight, are unlikely to occur in the Research Lease Area. Other species of concern may occur along coastal portions of Virginia as well as within the offshore

Research Lease Area, including red-throated loon (*Gavia stellata*), which may be common within the Research Lease Area, and least tern (*Sterna antillarum*), a bird of conservation concern for USFWS, may also occur in the Research Lease Area (USFWS 2008).

There is a paucity of avian data for the Virginia OCS, although recent efforts by BOEM and the U.S. Department of Energy (DOE) have helped to increase knowledge about bird activity on the Mid-Atlantic OCS (O'Connell et al. 2009; O'Connell et al. 2011; Williams et al. 2013). Species lists for coastal Virginia and the OCS have been developed by the U.S. Navy and others; however, there is little information on the spatial-temporal distribution of birds in the proposed Research Lease Area. The Mid-Atlantic Ecological Baseline Studies and Modeling Program, funded in part by the DOE, is the first systematic effort to collect baseline information on bird occurrence and distribution on the mid-Atlantic OCS. The Program's goal is to develop baseline data on wildlife abundance, distribution, and diversity within the Mid-Atlantic WEAs. The preliminary results of this ongoing survey are particularly relevant to the evaluation of the VOWTAP because portions of the Mid-Atlantic Baseline Survey area transect both the Virginia WEA and the proposed Research Lease Area. The DOE-funded survey area included portions of the OCS from off the coast of Cape May, New Jersey south to the OCS east of the Virginia – North Carolina line (Williams 2013). Interim results of the 2012 Mid-Atlantic Baseline Study surveys, including ship-based and aerial surveys, have been incorporated into the avian risk analyses in the VOWTAP RAP document. Survey methods used for the ship-based survey component of the Mid-Atlantic Baseline Study were similar to those used in the VOWTAP site-specific surveys (Williams 2013). Conversations with the Mid-Atlantic Baseline Study's avian survey contractor (Biodiversity Research Institute) as well as with BOEM, DOE, USFWS, and VDGIF were held prior to initiating surveys for the VOWTAP, to assure that data collection methods for the two avian survey efforts were generally similar and would be comparable. Future results from the ongoing Mid-Atlantic Baseline Study will help put the VOWTAP avian survey results in a regional context, and will be discussed in the Project's 2014 comprehensive avian survey report.

1.4.1 Other Sources of Regional Data

Two reports from BOEM and the U.S. Geological Survey (USGS) are based on data from the USGS Avian Compendium. These reports evaluate bird occurrence information for shorebirds (O'Connell et al. 2011) and seabirds (O'Connell et al. 2009) in the continental shelf waters along the Atlantic Coast. Both compendium reports represent the most comprehensive modeling efforts for bird activity on the OCS.

The two Avian Compendium reports are based on existing datasets, many of them historical, of the distribution and abundance of birds on the western Atlantic OCS, from Maine to Florida, as well as some data from Atlantic Canada. The compendium reports include spatio-temporal modeling of species, as well as estimated population sizes (shorebirds only). Data from the avian compendiums will become available in GIS format in the future (O'Connell et al. 2009, 2011). The following trends pertinent to the Virginia OCS and greater Project Area region, were interpreted from a review of the two Avian Compendium reports:

- Common loon (*Gavia immer*) and red-throated loon (*Gavia stellata*) regularly occur off the coast of Virginia during the winter and early spring (O'Connell et al. 2009).

- Grebes are expected to occur off the southern coast of Virginia at relatively low densities during the winter (O'Connell et al. 2009).
- Double-crested cormorants may occur in the vicinity of the VOWTAP Wind Turbine Area during winter, spring and fall, at low densities, and great cormorant may occur at very low to low densities during the winter (O'Connell et al. 2009).
- Sea ducks and diving ducks (*Anatidae*) may be present off the coast of Virginia throughout the year, but are most abundant from November to April in coastal and shoal waters (O'Connell et al. 2009).
- During southward migration sea ducks begin to arrive on the Virginia coast and OCS in November and December, and depart during spring migration to more northerly breeding areas in March and April (O'Connell et al. 2009).
- In general, sea ducks are more abundant near the mouth of the Chesapeake Bay, and along the Delmarva Peninsula, as opposed to the southern coast of Virginia and North Carolina (O'Connell et al. 2009).
- Shearwaters and storm-petrels are most abundant in the western Atlantic during the summer months. Some species, such as Manx's shearwater (*Puffinus puffinus*), may occur year-round (O'Connell et al. 2009). Shearwaters generally occur off the coast of Virginia during the non-breeding austral-winter period, in May through September, although as mentioned, some species may be present year round (O'Connell et al. 2009). Storm-petrels (*Hydrobatidae*) occur in the VOWTAP Wind Turbine Area region primarily during the non-breeding austral-winter period, but some species may also be present year round (O'Connell et al. 2009).
- Two species of petrel, the black-capped petrel (*Pterodroma hasitata*) and the Bermuda petrel (*Pterodroma cahow*), may occur as vagrants on the Virginia OCS, typically within the Gulf Stream (O'Connell et al 2009). There are numerous historical records of black-capped petrel from the Virginia OCS, primarily within the Gulf Stream (O'Connell et al. 2009).
- Two species of storm-petrel, Wilson's storm-petrel (*Oceanites oceanicus*) and Leach's storm-petrel (*Oceanodroma leucorhoa*), are known to occur regularly on the Virginia OCS, primarily during the summer, but also during spring and fall (O'Connell et al. 2009). A third species, the Band-rumped storm-petrel (*Oceanites castro*), may occasionally occur on the Virginia OCS from spring – fall (O'Connell et al. 2009).
- Northern gannet (*Morus bassanus*) migrate from breeding areas in Atlantic Canada to lower latitudes of the Mid-Atlantic in late summer and early fall, individuals are known to over winter as far south as Georgia and Florida (O'Connell et al. 2009).
- During the winter, alcids may migrate as far south as the Virginia OCS from northern breeding areas to forage on bait fish and invertebrates. Six species of alcids (*Alcidae*) may occur off the coast of Virginia during winter; razorbill (*Alca torda*), common murre (*Uria aalge*), thick-billed murre (*Uria lomvia*), dovekie (*Alle alle*), black guillemot (*Cepphus grylle*), and Atlantic puffin (*Fratercula arctica*) (O'Connell et al. 2009). Alcids are not expected to be abundant in the Mid-Atlantic region (O'Connell et al. 2009).

In addition to the Avian Compendium, we reviewed other datasets to place the avifauna of the Research Lease Area in context with the Mid-Atlantic Region. The following results are pertinent to the VOWTAP.

The New Jersey Ecological Baseline Surveys (EBS) were performed north of the proposed Research Lease Area and Supplemental Survey Area off the coast of New Jersey. During the New Jersey Department of Environmental Protection (NJDEP) EBS ship-based bird surveys, a total of 153 avian species were documented. It is suspected that the offshore waters of Virginia would support a similar avian assemblage, because of similarities in distance from shore, water depth, and position along the western Atlantic coast. None of the species observed during the NJDEP EBS were federally listed endangered, threatened, or candidate species (NJDEP 2010). Species of conservation concern were observed during the NJDEP EBS.

The NJDEP EBS ship-based surveys demonstrated that the abundance of avifauna was highest near the shoreline during all seasons, and most abundant during the winter (NJDEP 2010). In offshore waters, black scoter (*Melanitta nigra*), northern gannet (*Morus bassanus*), and laughing gull (*Leuocophaeus atricillus*) were the most abundant species observed in the NJDEP EBS. These species are also likely to be abundant in the Project Area. Less than five percent of birds observed during ship-based surveys were observed flying within the rotor swept zones (RSZ) of potential offshore wind turbine generators (WTGs). Most of the birds observed in the RSZ were sea ducks, specifically scaup (*Aythya* spp.). The NJDEP EBS observed significant correlations between severe weather events and changes in sea duck and sea bird distributions. Cold weather and storms offshore appeared to increase the abundance of certain species in coastal waters (NJDEP 2010). Weather was found to have a significant effect on flight heights during both spring and fall migration, with decreased flight heights in inclement weather. It is probable that weather conditions will have similar effects on birds in the VOWTAP Area.

Avian radar was used to characterize the spatial and temporal parameters of bird movements in the NJDEP EBS area. Results from the radar surveys seem to indicate that there may be less nocturnal migration activity occurring offshore than has been previously suspected (NJDEP 2010). Other similar radar studies conducted nearshore and offshore generally confirm these observations (Mizrahi et al. 2010; Mizrahi 2011; Svedlow et al. 2012). Nocturnal migrant songbirds are considered to be at risk of collision with tall structures, especially during low visibility (Kerlinger et al. 2010).

Federal and state agencies also monitor species that are at risk of becoming rare, including the species of special concern listed in Table 1-2.

The USFWS monitors bird populations under a federal mandate and compiles a list of birds of conservation concern (BCC) (USFWS 2008). Species listed as BCC are not listed under the ESA, but are of greater conservation concern than other avifauna; BCC listing is a precautionary measure to assure that these species receive extra attention to avoid listing under the ESA (USFWS 2008). BCC listing does not incur any additional protection to the species' status, other than that already accorded under the MBTA or other relevant statutes (USFWS 2008). BCC species for the Mid-Atlantic Coast Bird Conservation Region 30 are listed in Table 1-2.

VDGIF maintains a list of species of greatest conservation need (SGCN) in the Commonwealth. These species are identified as part of the state's Wildlife Action Plan, and include species with declining populations (Table 1-2).

Table 1-2. Non-Listed Species of Special Concern and Species of Greatest Conservation Need Potentially Occurring in the VOWTAP Area

Common Name	Species Name	Status
Red-throated loon	*Gavia stellata*	BCC
Pied-billed grebe	*Podilymbus podiceps*	BCC
Horned grebe	*Podiceps auritus*	BCC
Great shearwater	*Puffunus gravis*	BCC
Audubon's shearwater	*Puffinus lherminieri*	BCC
American bittern	*Botaurus stellaris*	BCC
Least bittern	*Ixobrychus exilis*	BCC
Snowy Egret	*Egretta thula*	BCC
Bald eagle	*Haliaeetus leucocephalus*	BCC / BGEPA
Peregrine falcon	*Falco peregrinus*	SGCN / SE
Wilson's plover	*Charadrius wilsonia*	BCC / SE
Lesser yellowlegs	*Tringa flavipes*	BCC
Whimbrel	*Numernius phaeopus*	BCC
Hudsonian godwit	*Limosa haemastica*	BCC
Marbled godwit	*Limosa fedoa*	BCC
Red knot	*Calidris canutus rufa*	BCC / PESA/ SGCN
Semipalmated sandpiper	*Calidris pusilla*	BCC
Purple sandpiper	*Calidris martima*	BCC
Buff-breasted sandpiper	*Tryngites subruficollis*	BCC
Short-billed dowitcher	*Limnodromus griseus*	BCC
Gull-billed tern	*Sterna noltica*	BCC / SGCN
Least tern	*Sterna antillarum*	BCC / SGCN
Royal tern	*Sterna maxima*	SGCN
Black skimmer	*Rynchops niger*	BCC
Tricolored heron	*Egretta tricolor*	SGCN
Glossy ibis	*Plegadis falcinellus*	SGCN
Common tern	*Sterna hirundo*	SGCN
Purple sandpiper	*Calidris maritime*	SGCN
Short-billed dowitcher	*Limnodroumus griseus*	SGCN
Marbled godwit	*Limosa fedoa*	SGCN
Forster's tern	*Sterna forsteri*	SGCN

BCC – Bird of Conservation Concern (USFWS)
BGEPA- Bald and Golden Eagle Protection Act (USFWS)
PESA – Proposed for ESA listing (USFWS)
SOC – Species of Concern (NOAA Fisheries)
SGCN- Species of Greatest Conservation Need (VDGIF)
SE- State listed Endangered (VDGIF)
Source: VDGIF 2005, USFWS 2008; NOAA 2010; NOAA 2011

1.5 Description of Terrestrial Wildlife Habitats in the Onshore Survey Area

Terrestrial wildlife habitats on the coastal plain of Virginia are at least 24 nm (43 km) from the Offshore Survey Area. Virginia Beach, which encompasses the onshore portion of the Project Area, is part of a heavily developed with population densities over 1,000 people per square kilometer (km^2) (VDGIF 2005). Habitats in the region have been altered by human development, and are highly fragmented. The largest patches of natural habitat in the vicinity of the onshore Project Area occur on conservation lands and in protected areas, as well as on military reservations. No conservation lands occur within or immediately adjacent to the proposed alternative cable landfall sites or the alternative onshore cable routes.

The Onshore Survey Area is located in the Middle Atlantic Coastal Plain-Virginia Barrier Islands and Coastal Marshes ecoregion (EPA Level IV; Bailey et al. 1994). Beaches, dunes, and salt marshes are the

dominate topography in the ecoregion (Woods et al. 1999). Farther inland, the habitat transitions to the Middle Atlantic Coastal Plain - Chesapeake-Pamlico Lowlands and Tidal Marshes level IV ecoregion (Woods et al. 1999). Topography in the Chesapeake-Pamlico Lowlands consists of uniformly low elevation and nearly flat with tidal ponds, marshes and streams. Tidal marshes and some freshwater ponds occur in areas of poorly drained silty soils. Brackish and freshwater wetlands provide habitat for marine and estuarine fishes, shellfish, and waterfowl. An Oak-Hickory-Pine Forest extends from the Virginia Barrier Island and Coastal Marshes into the Chesapeake-Pamlico Lowlands ecoregion, and is the dominant community on well drained soils. Agriculture, urban development, and industrial development are common land uses, and have impacted drainage in the region. Areas of natural habitat have been isolated and fragmented by development.

Maritime Dune Grassland and Upper Beach communities occur at the Onshore Survey Area, near point-count station 4 (*see* Section 2.1.2) (Fleming and Patterson 2012). Maritime Dune Grassland habitat is ranked as S2 (imperiled community type), and Upper Beach is ranked as S3 (vulnerable community type) in Virginia (Fleming and Patterson 2012). The Maritime Dune Grassland community is restricted to a small dune strip and fore-dune area above the Upper Beach and the inter-tidal zone. The Maritime Dune Grassland community is heavily influenced by wind and the maritime environment, and the dominant vegetation consists of beachgrass (*Ammophila* spp.). These habitats may be used by shorebirds and seabirds, as well as terrestrial and marine invertebrates (Fleming and Patterson 2012).

There are remnants of a Maritime Upland Forest in the Onshore Survey Area near point count stations 2-3 (Section 2.1.2). Isolated hardwood stands include oak (*Quercu*s spp,), maple (*Acer* spp.), and sweet gum (*Liquidambar stryaciflua*); Loblolly pine (*Pinus taeda*) also occurs, and there is greenbrier (*Smilax* spp) in the understory. Other habitats in the Onshore Survey Area include early successional loblolly pine stands and mowed grass areas, near point count station 1 (*see* Section 2.1.2).

2 AVIAN ASSESSMENT METHODS

This section provides details on the methodologies employed during the May to October 2013 VOWTAP avian surveys. The level of effort for surveys to be completed during the second half of the VOWTAP avian surveys from November 2013 to April 2014 are also described.

The total area within transect boundaries during the 2013 ship-based avian surveys was 27.5 km^2 (10.6 square miles [mi^2]); the total size of the VOWTAP Offshore Survey Area sampled was 62.6 km^2 (24.2 mi^2).

2.1 Data Collection

2.1.1 Ship-based Surveys

The area of the proposed research lease for the VOWTAP is six OCS lease block aliquots (an aliquot is 1/16 of a lease block) totaling 1.7 mi^2 (4.32 km^2 or 432 hectares); however, the area required for the two-WTG Project will be only a fraction of the total proposed Research Lease Area. An additional three OCS aliquots within the adjacent Virginia WEA were included during site characterization activities, but are not part of the proposed Research Lease Area. A total of nine OCS lease block aliquots were evaluated.

Qualified and experienced biologists from the Center for Conservation Biology at the College of William and Mary collected the systematic ship-based visual observation survey data and provided the results to Tetra Tech's lead biologist for the VOWTAP. A continuous strip transect traversing the Offshore Survey Area was surveyed for birds monthly, from May to October 2013 (BOEM 2013). Incidental observations of marine mammals and sea turtles were also recorded. The avian survey transect was oriented so that the majority of the Research Lease Area, including the area where WTGs will be installed, was sampled. Separation between transect segments was greater than 300 meters (m), to avoid double counting (Figure 2-1).

Surveys began in May 2013 and continued monthly through October 2013. Surveys were intended to start in late-April 2013 but were delayed until early May due to poor weather, which caused sea conditions to be unsafe for a productive offshore avian survey. Therefore, two avian surveys were conducted in May 2013, one early in the month and one later in the month (Table 3-1, in Section 3). Data collection is ongoing through April 2014, with surveys occurring monthly.

During the interim survey period data were collected using standard distance sampling techniques, including distance and direction of the observed bird to the observer (Thomas et al. 2006). Surveys were conducted on days when seas were appropriate for a safe and productive ship-based survey (World Meteorological Organization Sea States of 1−4). Detailed weather observations were recorded at the start and end of each survey. Observers recorded bird data, as well as absolute wind speed, wind direction, air temperature, relative humidity, and sea state into standardized data dictionaries stored on a handheld Trimble Global Positioning System (GPS) unit. Surveys were conducted a minimum of 3 days apart, and were on average at least 3 weeks apart. Additional incidental data were collected during transit from the Virginia mainland to the Offshore Survey Area, along a pre-established survey route, through the Transit Survey Area (Figure 2-1).

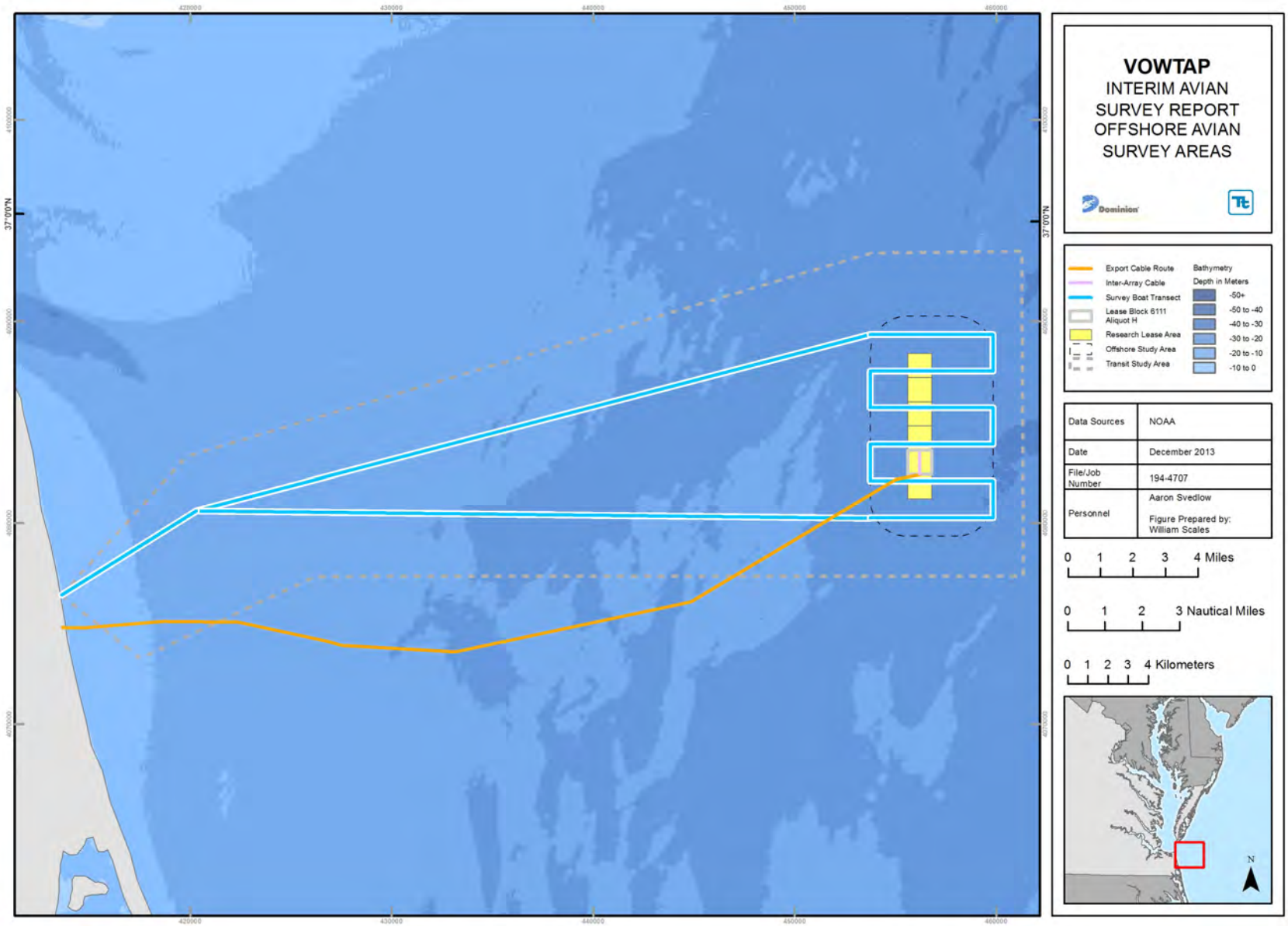

Figure 2-1. VOWTAP Ship-based Avian Survey Transects, Offshore Survey Area, Transit Survey Area, and Research Lease Area

The survey vessel traveled at a constant speed of 10 knots (18.5 kilometers/hour [km/hr]) while in the Offshore Survey Area. One primary observer recorded all birds sighted within a moving "box" that measured 300 m ahead and 300 m perpendicular to the ship. The primary observer was assisted by a data recorder- secondary observer. The secondary observer sighted birds on the opposite side of the vessel to the primary observer, within a 300 m strip transect. All observations were pooled and a 600 m transect width was used for analyses. Data were recorded on a handheld personal digital computer, and geo-referenced with GPS locations. All individual birds detected during the surveys were identified to species level when possible. Behavioral information on all birds encountered was recorded, including feeding, sitting on water, direct flight, and diving. The observers estimated a perpendicular distance from the ship to observed birds using the following categories: < 50 m, 50–100 m, 101–200 m, and 201–300 m. For birds observed in flight, the first instance the individual or flock was sighted was used to estimate perpendicular distance from the observers.

For birds observed in flight, the vertical flight height above the water was estimated and recorded within the following height bins: < 10 m, 10–25 m, 25–125 m, 126–200 m, and > 200 m. Instantaneous flight direction of sighted birds, at the time of first sighting, was also be recorded as follows: north (N), northeast (NE), northwest (NW), south (S), southeast (SE), southwest (SW), east (E), west (W), variable.

2.1.2 Onshore Point Counts

A series of four onshore point-count surveys were conducted in spring, summer, and fall 2013 along the preferred Onshore Interconnection Cable and Fiber Optic Cable route. The surveys consisted of one survey per month in April, August, September, and October 2013. An additional survey is planned for March 2014 to sample early spring shorebird migration.

Point counts were performed using a variation of the USGS North American Breeding Bird Survey methods (USGS 2001). Four point-count stations were sampled during each survey visit (Figure 2-2). Point count stations were labeled 1–4 starting inland at number 1 and ending at Camp Pendleton Rifle Range Road Beach at point count station 4 (Figure 2-2). Each point was surveyed for 30 minutes, and all birds observed were recorded on handheld tablet computers equipped with GPS. Flight heights, flight direction, behavior, and standard distance sampling metrics were recorded for each observation, as appropriate. Weather data were collected during each survey and habitat characteristics were recorded for each point count station, with a particular focus on possible nesting or foraging areas in the vicinity of the preferred Onshore Interconnection Cable and Fiber Optic Cable route.

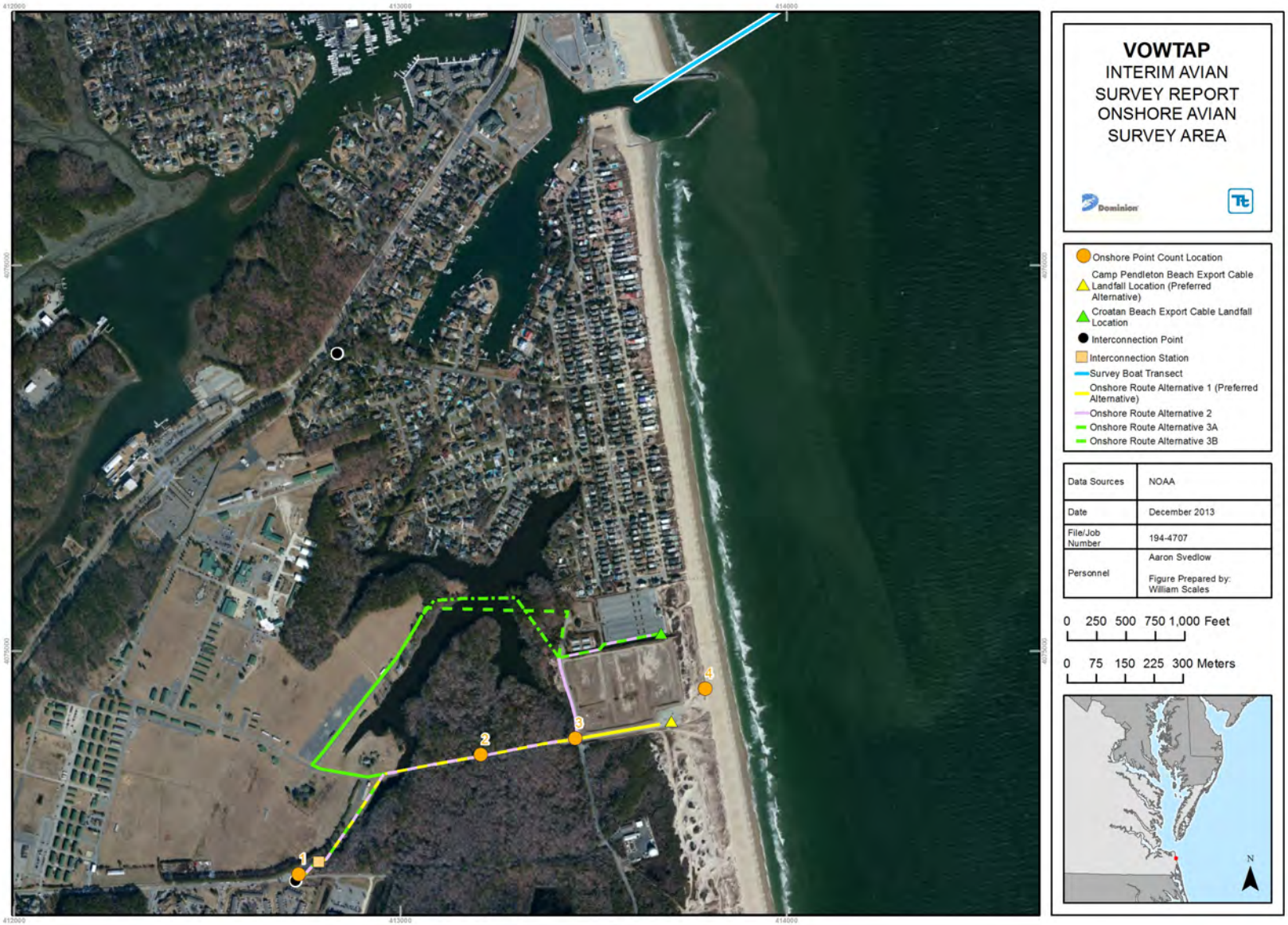

Figure 2-2. VOWTAP Onshore Avian Survey Area (in Proximity of Preferred Cable Landfall Location and Grid Interconnection Point South of Rudee Inlet and the Offshore Ship-based Transect)

2.2 Data Analyses

Data from the Offshore Survey Area were assessed separately from data collected in the Transit Survey Area and Onshore Survey Area. Data were archived and backed up by field biologists during transit, and at Tetra Tech's Portland, Maine office. Data are available upon request to Dominion.

Observational data were evaluated by species and were organized taxonomically into species groups consisting of species with similar ancestry and or similar life history traits. Consideration of encounter rate was also important in determining the species-groups, as in the case of storm-petrels, phalaropes, and northern gannet [*Maros bassanus*], which warranted separate groups because of higher relative encounter rates. Cormorants (*Phalacrocoracidae*) were lumped with seabirds because there were few observations of cormorants in the Survey Area and they exhibit behavioral patterns similar to some seabirds.

In order to assess relative diversity, the Shannon Diversity Index was calculated for the entire Offshore Survey Area and for the Onshore Survey Area. The Shannon Diversity Index (H) is useful for comparing diversity between locations or across temporal periods, and will be calculated for each season (to clarify any differences in diversity between seasons) once the final survey effort is completed in April 2014. The Shannon Diversity Index considers both species richness and species abundance (Shannon and Weaver 1949; Spellerberg and Fedor 2003; Margurran 2004 and usually ranges between 1.5 and 4.5. The larger the value the more "evenly" distributed is the species (i.e., similar abundances per species across all species observed), while the smaller Shannon Diversity Index value indicates less evenly distributed the abundance of the sample population across species (i.e. few species have high abundance, and many have low abundance). The following formula was used to calculate the Shannon Diversity Index:

$$H = \frac{N \ln N - \sum ni * \ln(ni)}{N}$$

Where N = the total number of individuals of all species encountered

n_i = the number of individuals of species *i*

A Simpson Diversity Index was also calculated for the Offshore Survey Area and for the Onshore Survey Area. The Simpson Diversity Index (D_s) is a measure of the probability that individuals selected from the sample population belong to the same species (Margurran 2004).

The following formula was used to calculate the Simpson Diversity Index:

$$Ds = \frac{N(N-1)}{\sum ni(ni-1)}$$

Where N = the total number of individuals of all species encountered

n_i = the number of individuals of species *i*

Data collected in the Offshore Survey Area were also analyzed using standard distance sampling methods to estimate density of all species pooled (Thomas et al. 2006). Differential probabilities of bird detection and adjusted density estimates derived from estimated probability of detection were calculated for all observations pooled. Data were analyzed using the program Distance (6.0), and estimator distribution was fitted using Akaike Information Criterion (AIC).

Density estimates were also calculated using interpolation analysis to account for spatial autocorrelation among observations. We employed an inverse distance-weighted average (IDW) geospatial analysis technique (ArcTool in ArcMap 9.3) to assess density estimates across the Study Area. The power multiplier was set to the default value of 2 for the IDW analysis. Spatial-temporal distributions (including distance from shore and water depth preferences) and flight heights for all observations were plotted in GIS for all species pooled.

3 RESULTS

3.1 VOWTAP Offshore Survey Area

Starting in May 2013, a total of seven boat surveys were conducted in the Offshore Survey Area. Surveys occurred once per month, with the exception of May, when two surveys were conducted (Table 3-1). The April 2013 survey could not be conducted due to weather conditions, and was delayed to early May. The final survey for this reporting period was conducted in October 2013; however, surveys are ongoing through April 2014. Surveys consisted of the vessel leaving port, transiting to the VOWTAP Offshore Study Area and traveling along the pre-determined transect at a constant speed of approximately 10 knots (Figure 2-1). Data on bird activity were collected during transit to the Offshore Study Area transect, but are presented separately.

3.1.1 Observation Totals and Species Richness

During the May to October 2013 surveys, 76 individual birds were encountered in the Offshore Survey Area (Figures 2-1 and 3-1). A total of twelve species were recorded in total, although species richness (*S*), or the number of different species, varied between surveys (Table 3-1). The highest species richness in the Offshore Survey Area was observed during the May and October surveys (*S* = 4 species), while the lowest species richness was during the June, July, August, and September surveys (*S* = 2 species). Average species richness across all surveys was 3 ± 1.2 species per survey effort (SE= 0.47) (Figures 3-1 through 3-4).

The number of birds encountered per survey effort in the Offshore Survey Area ranged from 6 birds on October 2, 2013, to 24 birds on August 13, 2013. The average number of birds encountered was 10.86 ± 4.2 birds per survey effort (SE = 0.48). The five most abundant species included purple martin (*Progne subis*) (n = 20, 26 percent), laughing gull (*Leucophaeus atrcilla*) (n = 17, 22 percent), red phalarope (*Phalaropus fulicarius*) (n = 14, 18 percent), common loon (*Gavia immer*) (n= 7, 9 percent), and Wilson's storm-petrel (*Oceanites oceanites*) (n = 5, 7 percent) (Table 3-1).

Data on abundance and species occurrence were collected in the Transit Survey Area during transit to the Offshore Survey Area on each of the 7 survey trips, from May to October 2013 (Table 3-2). In the Transit Survey Area a total of 368 birds were encountered, representing 21 identifiable species. The five most abundant species observed included royal tern (*Thalasseus maximus*) (n = 135, 37 percent), laughing gull (*Leucophaeus atrcilla*) (n = 100, 27 percent), purple martin (*Progne subis*) (n = 55, 15 percent), brown pelican (*Pelecanus occidentalis*) (n = 18, 5 percent), and double-crested cormorant (*Phalacrocorax auritus*) (n= 18, 5 percent).

Table 3-1. Results of the Interim VOWTAP Offshore Avian Surveys from the Offshore Survey Area – 2013

Common name	Scientific name	Number Observed by Date of Survey (2013)							Total
		14-May	22-May	17-Jun	8-Jul	13-Aug	10-Sep	2-Oct-	
Purple martin	*Progne subis*					20			20
Laughing gull	*Leucophaeus atricilla*		2	1	5	4	3	2	17
Red phalarope	*Phalaropus fulicarius*						14		14
Common loon	*Gavia immer*	5	2						7
Wilson's storm-petrel	*Oceanites oceanites*		3	2					5
Royal tern	*Thalasseus (Sterna) maximus*				3				3
Sanderling	*Calirdris alba*	3							3
Great black-backed gull	*Larus marinus*							2	2
Red-throated loon	*Gavia stellata*	1	1						2
Cory's shearwater	*Calonectris diomedea*							1	1
Ring-billed gull	*Larus delawarensis*							1	1
Sooty shearwater	*Puffinus griseus*	1							1
	Total	10	8	3	8	24	17	6	76
Species Richness (*S*) (number of different identifiable species)		4	4	2	2	2	2	4	12

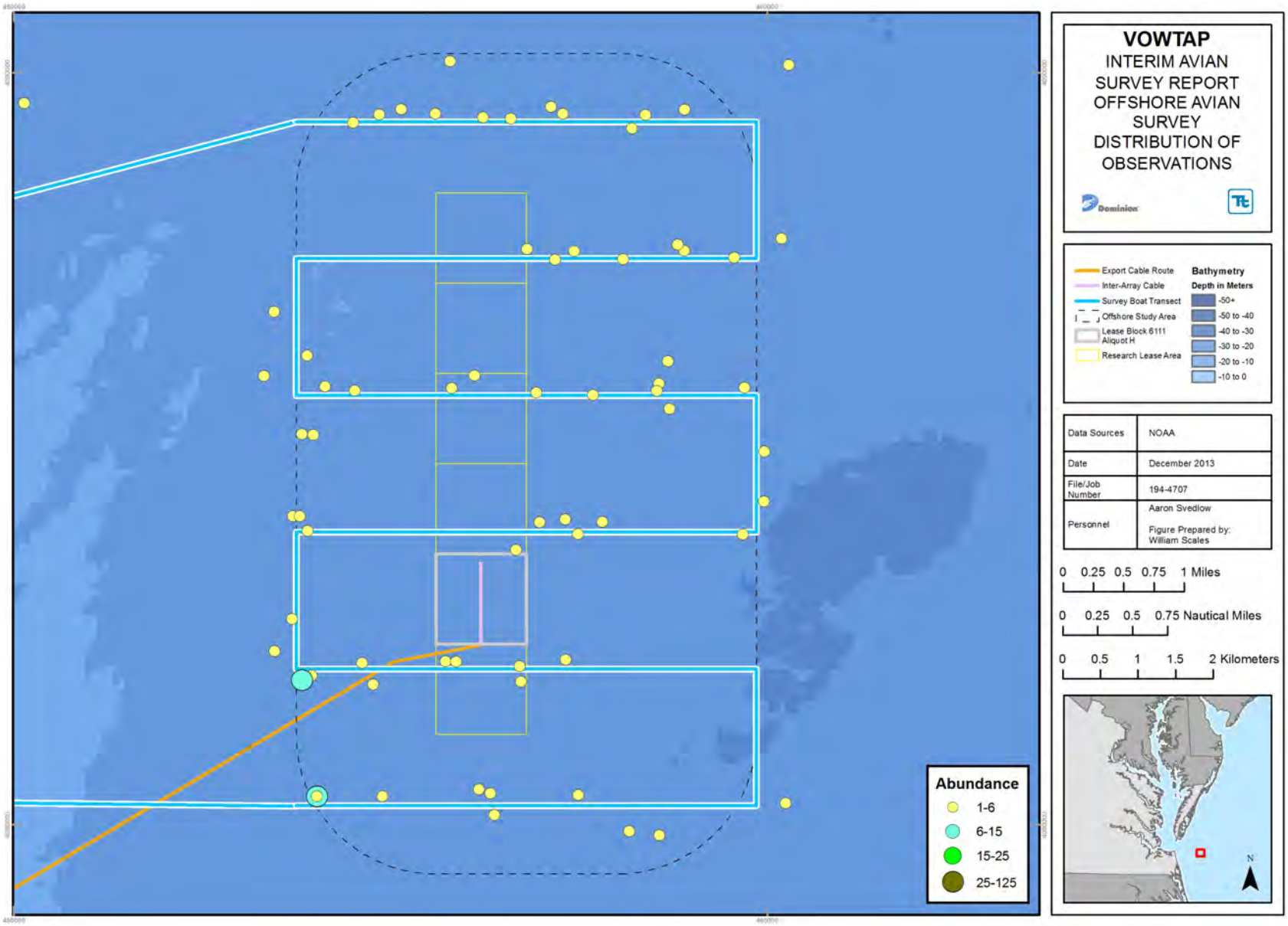

Figure 3-1. Distribution of Bird Observations during the Interim VOWTAP Avian Surveys in the Offshore Survey Area – 2013

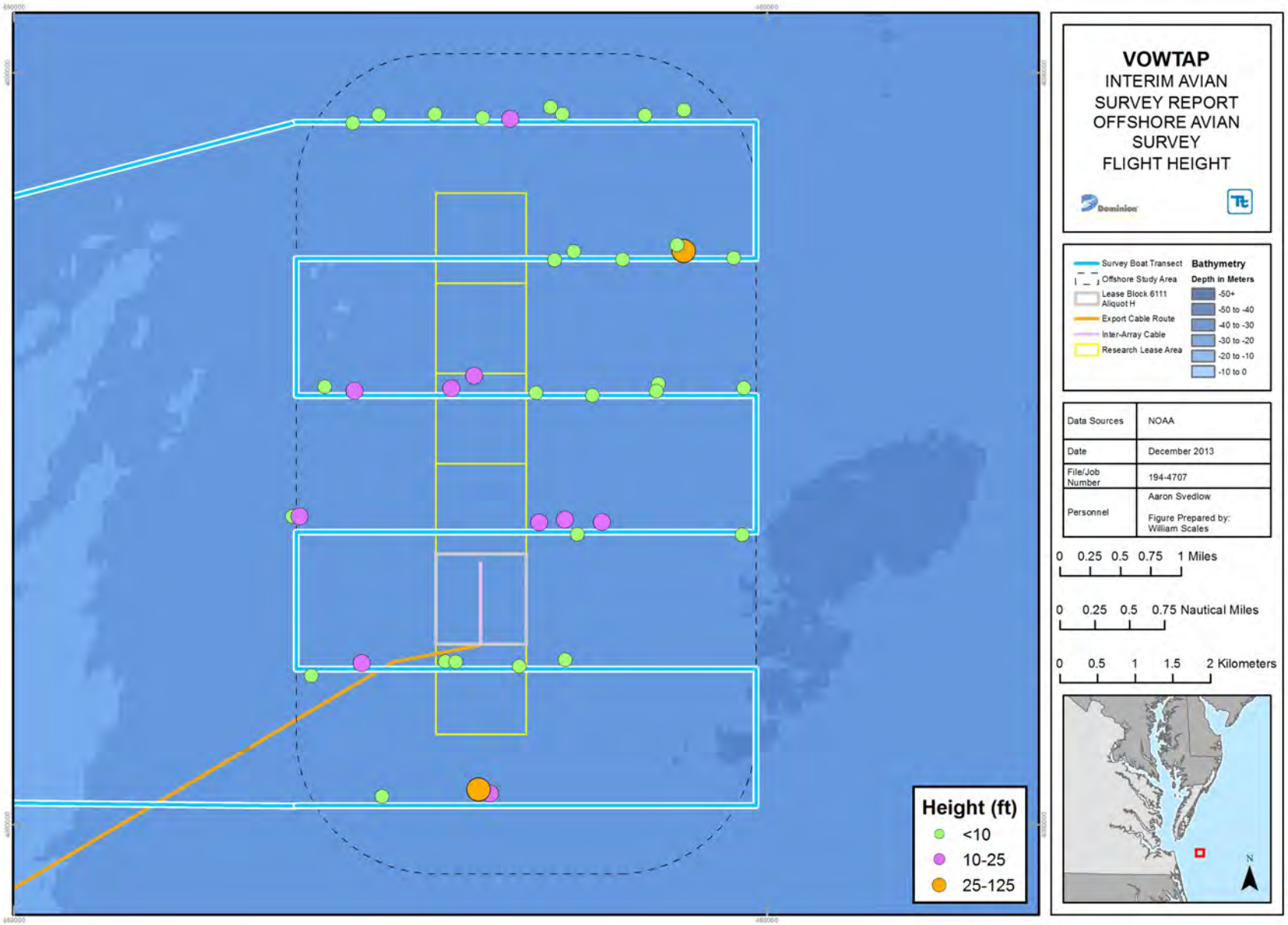

Figure 3-2. Flight Height of Bird Observations during the Interim VOWTAP Offshore Avian Surveys in the Offshore Survey Area – 2013

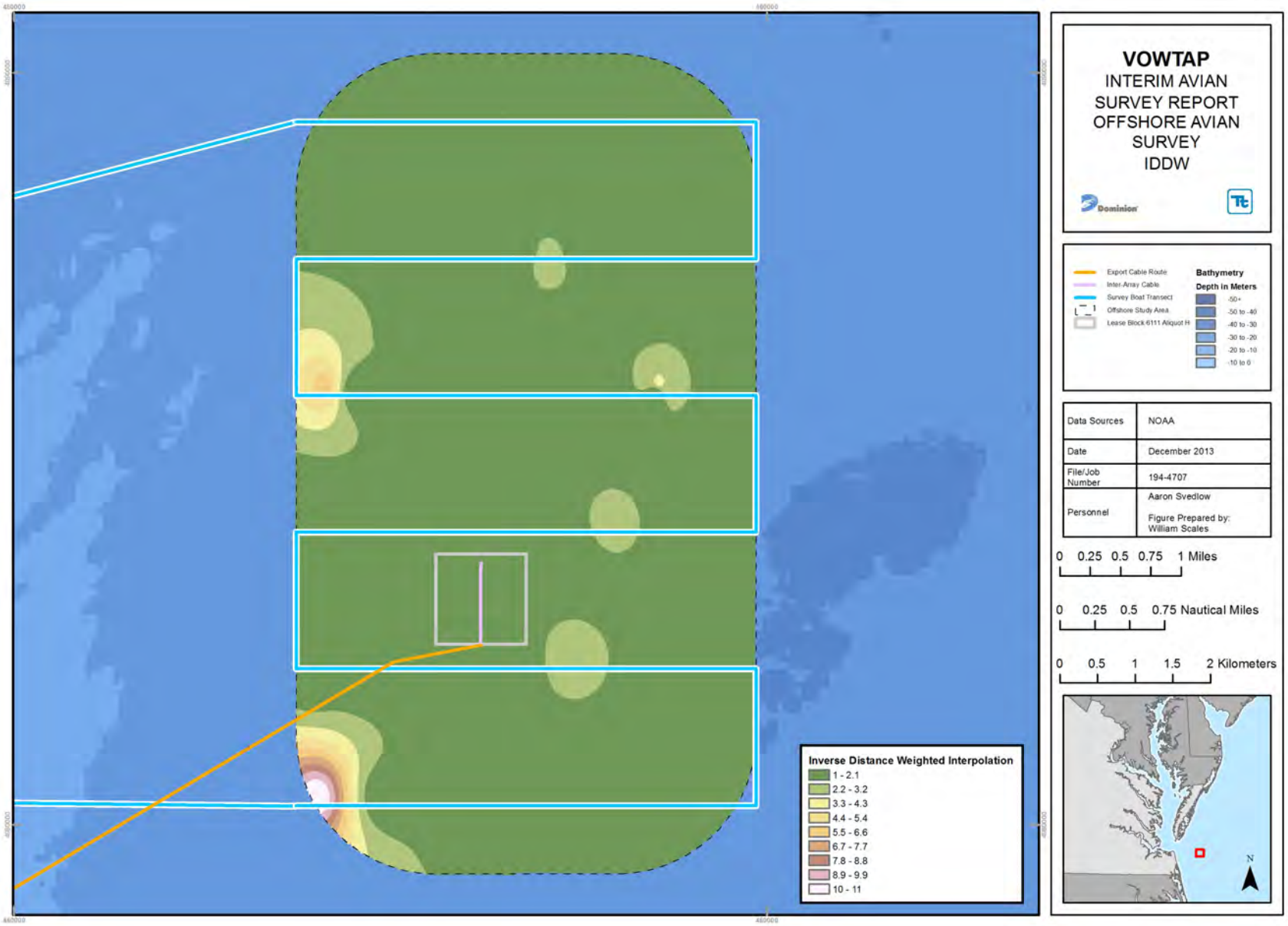

Figure 3-3. IDDW Interpolation of Bird Abundance during the Interim VOWTAP Avian Surveys in the Offshore Survey Area – 2013

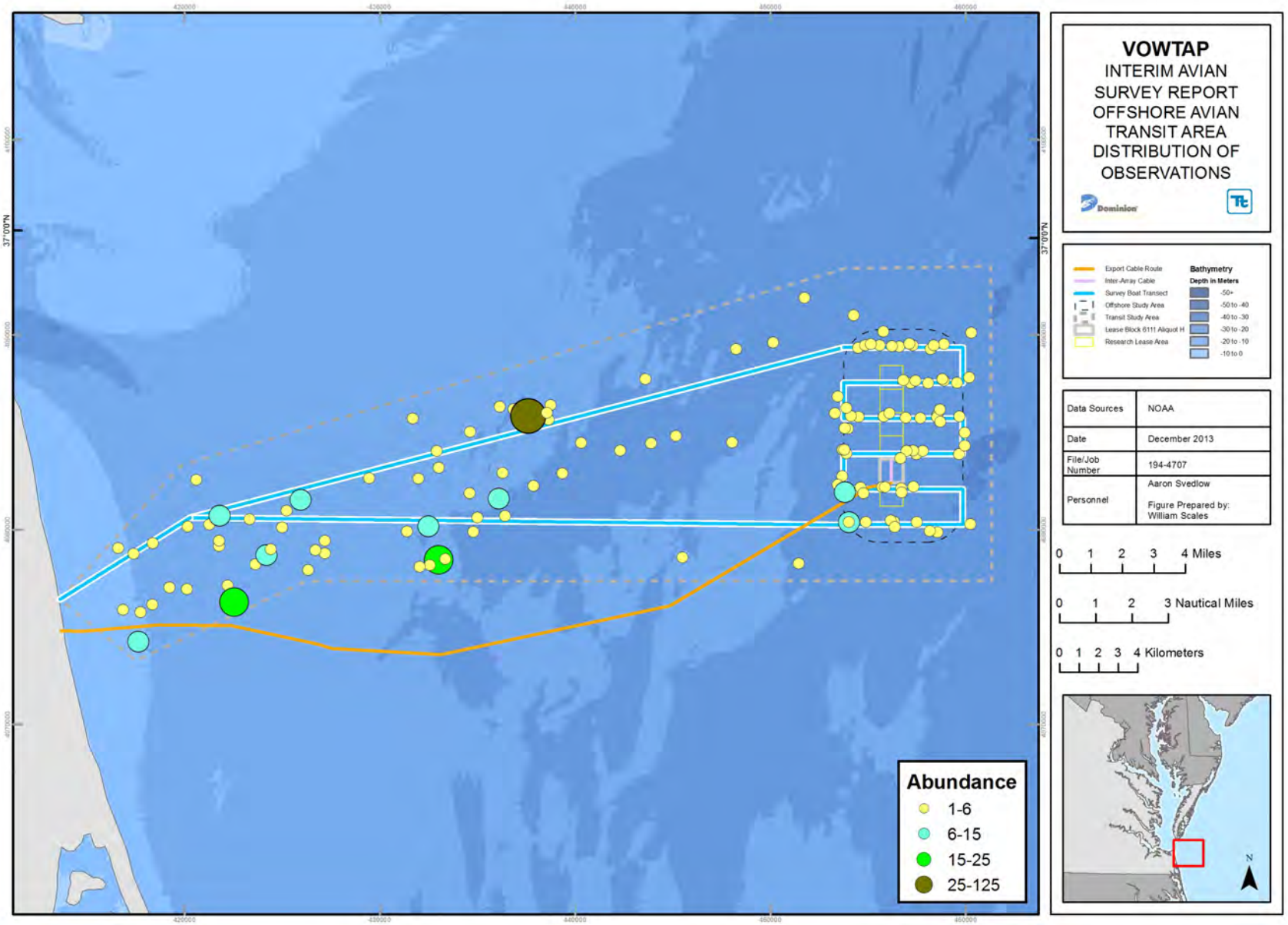

Figure 3-4. Distribution of Bird Observations during the Interim VOWTAP Avian Surveys in the Transit Survey Area – 2013

Table 3-2. Results of the Interim VOWTAP Offshore Avian Surveys from the Transit Survey Area – 2013

Common Name	Scientific Name	Number Observed
Royal tern	*Thalasseus maximus*	135
Laughing gull	*Leucophaeus atricilla*	100
Purple martin	*Progne subis*	55
Brown pelican	*Pelecanus occidentalis*	18
Double-crested cormorant	*Phalacrocorax auritus*	13
Common tern	*Sterna hirundo*	11
Northern flicker	*Colaptes auratus*	5
Sandwich tern	*Thalasseus* (*Sterna*) *sandvicensis*	5
Great black-backed gull	*Larus marinus*	4
Cory's shearwater	*Calonectris diomedea*	3
Herring gull	*Larus argentatus*	3
Audubon's shearwater	*Puffinus lherminieri*	2
Black tern	*Childonias niger*	2
Caspian tern	*Hydroprogne caspia*	2
Osprey	*Pandion haliaetus*	2
Surf scoter	*Melanitta perspcillata*	2
Belted kingfisher	*Megaceryle alcyon*	1
Gull species	*Larus* spp.	1
Lesser black-backed gull	*Larus fuscus*	1
Peregrine falcon	*Falco peregrinus*	1
Sanderling	*Caldris alba*	1
Whimbrel	*Numenius phaeopus*	1
	Total	368
	Species Richness (*S*) (number of identifiable different species)	21

3.1.2 Species Diversity

Species diversity in the VOWTAP Offshore Survey Area was measured with two indices, the Shannon Diversity Index and the Simpson Diversity Index. Each index accounts for the differences in abundance of observed species. The Shannon Diversity Index calculated for the interim survey period for the Offshore Survey Area was $H = 2.01$. This value indicates that a small number of species accounted for most of the abundance observed. This is consistent with the observational data, which indicate that a few species (purple martin, laughing gull, and red phalarope) comprised more than 67 percent of all birds observed in the Offshore Survey Area.

The Simpson Diversity Index during the interim survey period for the Offshore Survey Area was $D_s = 0.16$. D_s is a measure of the probability that two individuals randomly selected from the sample population will belong to the same species. A smaller Simpson's index number (D_S) indicates that the sample population is more diverse, and no single species is particularly abundant.

These diversity indices will be useful when comparing the results from the interim survey period with the full 1-year survey period. Once all data collection efforts have been completed we will complete an assessment of changes in diversity on a seasonal basis. Diversity indices were not calculated for the Transit Survey Area.

3.1.3 Rare, Threatened, and Endangered Species

No federally threatened or endangered species were observed during the interim VOWTAP Offshore Avian Surveys. A peregrine falcon (*Falco peregrinus*) was observed during an offshore survey, in the Transit Survey Area. Peregrine falcons are uncommon residents during the summer, and may occur in greater numbers during spring migration (March–April) and fall migration (September–October) in coastal Virginia (Rappole 2007). Peregrine falcons are state listed as endangered and are a species of greatest conservation need in Virginia (VDGIF 2005). Royal terns, a state SSGCN, were also observed during the offshore surveys in the Transit Survey Area.

3.1.4 Distribution and Estimated Density

Of the 76 birds encountered during the interim survey period in the Offshore Survey Area, 71 percent were in flight (n = 54). The remainder (29 percent) were observed sitting on the water (n = 22). Of the 54 birds observed in flight, most (68 percent, n =37) were observed flying less than 10 m (33 feet) above mean sea level (amsl). Approximately 28 percent (n = 15) of birds were observed flying between 10 to 25 m (33 to 82 feet) amsl. Overall, only 4 percent (n = 2) of birds observed in flight flew 25 to 125 m (82 to 410 feet) amsl, which generally corresponds to the RSZ of the proposed Project WTGs. Both birds that flew in the 2 to 125 m category were red-throated loons (*Gavia stellata*). The average flight height for all birds observed during the interim survey period in the Offshore Survey Area was 10.2 m (33.5 feet) (SE = 1.9 m [6.2 feet]). Observed flight heights varied by species group, although most species flew below 25 m (82 feet) amsl (Table 3-3).

Table 3-3. Flight Heights Observed during the Interim VOWTAP Offshore Avian Surveys from the Transit Survey Area – 2013

Species Group	<10m	10-25m	25-125m	Sitting on Water	Total (n)
Gulls	65%	30%	0%	5%	20
Loons	11.1%	0%	22.2%	66.7%	9
Purple Martin	65%	35.0%	0%	0%	20
Phalaropes	0.0%	0.0%	0%	100%	14
Shearwaters	50.0%	0.0%	0%	50%	2
Shorebirds	100%	0.0%	0%	0%	3
Storm-petrels	100%	0.0%	0%	0%	5
Terns	33.3%	66.7%	0%	0%	3
Total	48.7%	10.5%	2.6%	28.9%	76

Observations of birds were generally uniform throughout the Offshore Survey Area. There were more birds observed near the southwestern corner of the Area, but this is likely a function of where the purple martin flocks were sighted (Figure 3-1). Because these flocks were moving when observed, it is unlikely that the difference in numbers indicates greater use of the southwestern corner.

Density (birds per km^2) was estimated for the entire Offshore Survey Area, for all species pooled. Density estimates could not be calculated for individual species because encounter rates in the Offshore Survey Area were generally low, resulting in an insufficient number of observations on which to base species specific density estimates.

Interim data from the VOWTAP Offshore Survey Area were fitted to a half-normal key distribution, using program Distance 6.0, with a cosine adjustment of 2 orders (AIC = 503.6). The corrected estimated encounter rate was 31.6 birds per survey and detection probability was estimated at 54.1 percent. Average cluster size was estimated at 14.3 individuals per cluster. The estimated density was 1.07 birds per km^2 (95 percent confidence interval = 0.67 – 1.72 birds per km^2; SE = 0.25 birds per km^2). The estimated density of clusters (groups or flocks) of birds in the Offshore Survey Area was 0.72 birds per km^2 (95 percent confidence interval = 0.46 – 1.1 birds per km^2; SE = 0.16 birds per km^2). We anticipate that the additional data to be collected from November 2013 to April 2014 will refine the density estimates for the Offshore Survey Area. Density was not estimated for the Transit Survey Area because data were not collected using standardized distance sampling protocols during transit. The results of the IDW density estimates were similar to the distance sampling estimates (1.6 ± .78 birds per km^2) (SE = 0.11) (Figure 3-2).

3.2 VOWTAP Onshore Avian Survey Area

3.2.1 Observation Totals and Species Richness

Point count surveys were conducted in the Onshore Survey Area in April, August, September, and October, for a total of four surveys. During the interim Onshore Avian Survey period, 54 species were encountered (*S* = 54), and 2,615 individuals were observed (Table 3-4; Figures 3-5 and 3-6).

Table 3-4. Species Groups Observed during the Interim VOWTAP Onshore Avian Surveys from the Onshore Survey Area – 2013

Species Group	# of birds Encountered	Percentage of Total
Landbirds /Passerines	1,994	76.3%
Gulls	325	12.4%
Seabirds	115	4.4%
Terns	66	2.5%
Shorebirds	61	2.3%
Waterfowl	27	1.0%
Raptor	16	0.6%
Wading	11	0.4%
Total	2,615	--

The greatest species richness in the Onshore Avian Survey Area was observed during the October survey (*S* = 37), while the lowest species richness was during the April surveys (*S* = 5). Average species richness across all surveys was 23.5 ± 13.5 species per survey effort (SE = 7.8).

The number of birds encountered per survey effort in the Onshore Survey Area ranged from 8 birds in April to 2,186 birds in October. The average number of birds encountered was 653.7 birds per survey effort (SE = 592.7). When common grackle (*Quiscalus quiscula*) (n = 1,755) were removed from the analysis, the average encounter rate was reduced to 215 ± 176.3 birds (SE = 101.8) (Figure 3-6).

Figure 3-5. Distribution of Bird Observations during the Interim VOWTAP Avian Surveys in the Onshore Survey Area – 2013

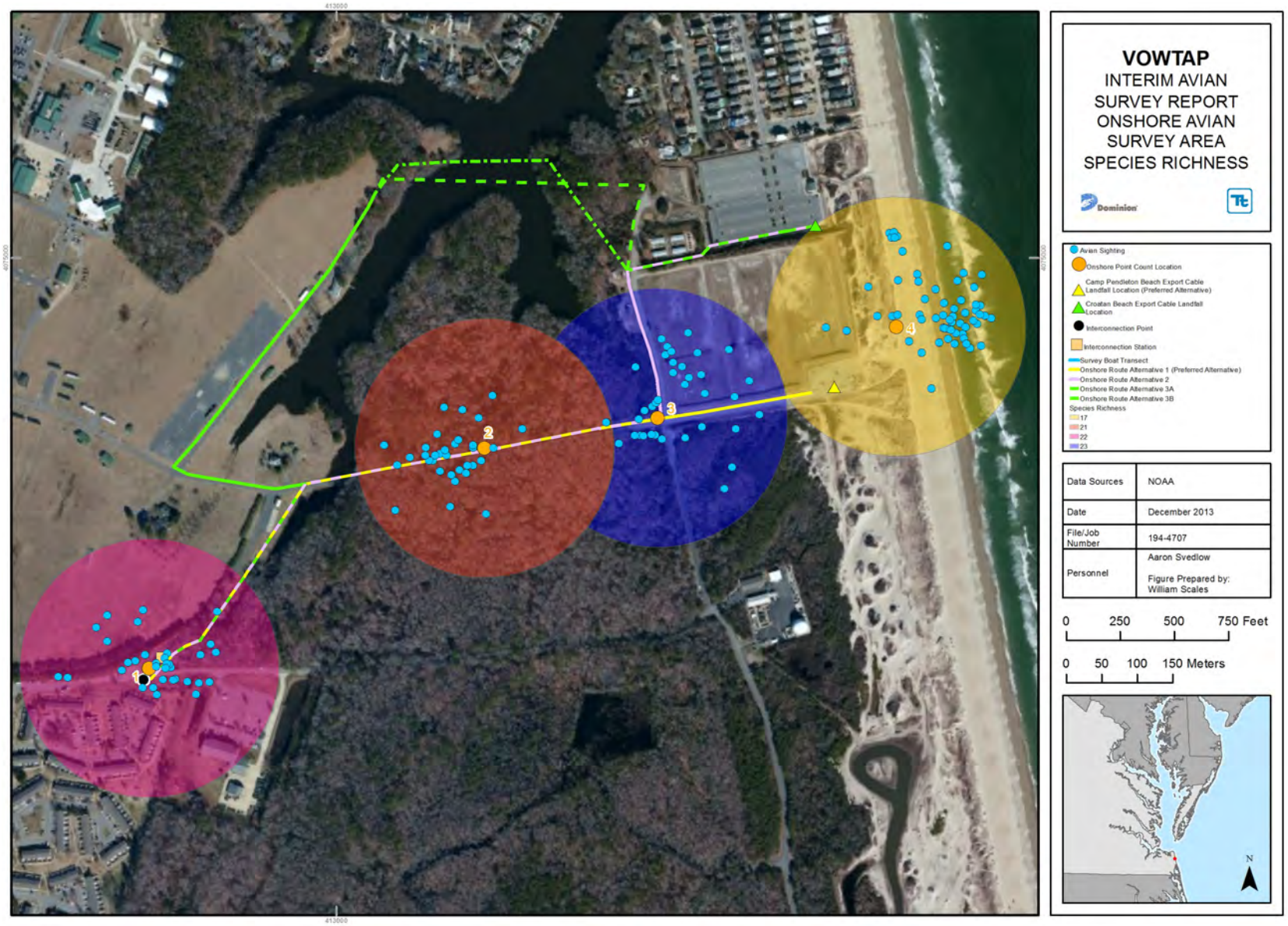

Figure 3-6. Species Richness by Location during the Interim VOWTAP Avian Surveys in the Onshore Survey Area – 2013

3.2.2 Species Diversity

There were 33 species of landbirds/passerines observed during the interim onshore avian survey period (Attachment A). In addition, we observed 5 gull species, 6 raptor species, 2 seabird species, 5 shorebird species, 2 species of tern, 2 species of wading bird, and 1 species of waterfowl (Attachment A).

The Shannon Diversity Index for all data from the Onshore Avian Survey Area pooled was H = 1.5. The Simpson Diversity Index for the Onshore Avian Survey Area was D_s = 2.14. Diversity among point count stations varied, with diversity highest at station 3 and lowest at station 4, as measured by the Shannon Index. The Simpson Diversity Index paints a different picture of species evenness and diversity across point count stations. According to the Simpson Diversity Index, the highest probability of randomly selecting two individuals from different species would be at point count station 3, and the lowest at point count station 1 [Table 3-5]).

Table 3-5. Summary of Onshore Diversity Metrics during the Interim VOWTAP Onshore Avian Surveys from the Onshore Survey Area – 2013

Point Count Station	Shannon Diversity Index (*H*)	Simpson Diversity Index (D_s)
1	0.45	1.16
2	0.22	1.25
3	0.20	5.5
4	0.66	3.2
Overall	1.5	2.14

3.2.3 Rare, Threatened, and Endangered Species

No federally listed birds were observed during the interim Onshore Surveys. Although two bald eagles were observed during the interim VOWTAP avian surveys in the Onshore Survey Area, no nests are known to occur along the proposed Onshore Interconnection Cable and Fiber Optic Cable route, or near the proposed cable Landfall Site. The closest known bald eagle nests are adjacent to Lake Redwing in the Dam Neck Fleet Training Center, approximately 1.2 mile (2 km) south of the Project Area. There are two nests northwest of Lake Redwing, both of which were occupied in 2013 (nests VB0601 and VB0702) (CCB 2013).

The following species of greatest conservation need were observed during the interim survey effort: chimney swift (*Chaetura pelagica*), whimbrel (*Numenius phaeopus*), northern parula (*Setophaga americana*), black-throated green warbler (*Setophaga virens*), black-bellied plover (*Pluvialis squatarola*), and brown thrasher (*Toxostoma rufum*) (Attachment A).

3.2.4 Distribution

The average number of birds encountered per point count station, for the interim 2013 survey period, was 654 ± 537.7 birds (SE = 310). The average species richness per point count station, for the interim 2013 survey period, was 21 ± 2.7 species (SE = 1.6). Abundance and species richness varied by point count station (Figure 3-2). The following is a summary of the results of the 2013 surveys:

- At point-count station 1, the most inland point-count station located near mowed fields, a total of 1,405 birds were observed, 97 percent of which were passerines. A total of 23 species were encountered at point 1.

- At point-count station 2, in the middle of the forested buffer between the maintained fields and Camp Pendleton Rifle Range Road Beach, 503 birds were observed, 99 percent of which were passerines, representing 20 species total.
- At point-count station 3, near the edge of the forested area but west of the Camp Pendleton Rifle Range Road Beach, we observed 130 birds, 97 percent of which were passerines. A total of 22 species were observed at point count station 3.
- At point-count station 4, on the Camp Pendleton Rifle Range Road Beach, 577 birds were observed, less than 1 percent of which were passerines. The most abundant species group at point-count station 4 was gulls (56 percent) (Table 3-6) (Figure 3-5).

Table 3-6. Summary of Observations by Point Count Station during the Interim VOWTAP Onshore Avian Surveys from the Onshore Survey Area – 2013

Species Group	Point 1	Point 2	Point 3	Point 4	Total
Landbirds/Passerine	1,367	500	126	1	1,994
Gulls	1		1	323	325
Seabirds				115	115
Terns				66	66
Shorebirds				61	61
Waterfowl	27				27
Raptor	7	3	3	3	16
Wading	3			8	11
Total	1,405	503	130	577	2,615

Avian abundance in the Onshore Survey Area peaked in October and was lowest in April. Species richness followed a similar trend (Table 3-7). The peak in landbird-passerine abundance was in October. Gull abundance also peaked in October. Seabirds were most abundant in September, and were not observed during surveys in August. Terns were most abundant in August and, along with waterfowl, were the only species group whose abundance peaked in August. Raptors were present during each survey month, but were most abundant in April and August. Wading birds were only observed in September and October (Table 3-7).

Table 3-7. Summary of Onshore Observations by Month during the Interim VOWTAP Onshore Avian Surveys from the Onshore Survey Area – 2013

Species Group	April	August	September	October	Total
Landbirds /Passerines		32	73	1,889	1,994
Gulls	1	52	17	255	325
Seabirds	1		90	24	115
Terns		39	24	3	66
Shorebirds		14	40	7	61
Waterfowl	1	25		1	27
Raptor	5	5	2	4	16
Wading			8	3	11
Total	8	167	254	2,186	2,615
Species Richness (*S*)	5	24	28	37	56

4 DISCUSSION

The proposed Research Lease Area is located approximately 24 nm (27 mi, 43 km) from the southern Virginia coast. This distance from shore, as well as other factors, is likely responsible for the low abundance and diversity observed during the interim VOWTAP avian surveys (Petersen et al. 2006; New Jersey Department of Environmental Protection 2010). In the Transit Survey Area and Offshore Survey Area, species richness decreased with distance from shore, as did abundance. The inverse was true in the Onshore Survey Area, where richness and abundance generally increased at point count locations further inland.

Most birds (71 percent) observed during the interim survey period were flying and a minority (29 percent) were sitting on the water. Flight heights in the Offshore Survey Area during the interim survey period averaged 10.2 m (33.5 feet) (SE = 1.9m [6.2 feet]), this is below the RSZ of the proposed WTGs (25 to 175 m amsl [82 to 574 feet amsl]). Only two birds, both red-throated loons, were observed flying in the 25 to 125 m flight height category (82 to 410 feet).

No federally listed species were observed during the interim survey period at the Offshore Survey Area, Transit Survey Area, or the Onshore Survey Area. In addition, we did not document any osprey, bald eagle, or colonial wading bird nests along the Onshore Interconnection Cable and Fiber Optic Cable route. A single state-listed species, peregrine falcon, was observed during survey in the Transit Survey Area. Although peregrine falcons are known to migrate offshore the species is not known to forage offshore. Peregrine falcons are unlikely to occur in high densities in the Research Lease Area because they only occur offshore during migration and do not nest or forage on the water. The species is not known to nest near any of the Project's onshore facilities.

The interim results of the ship-based surveys from the Offshore Survey Area and Transit Survey Area provide baseline information on which to evaluate the potential effects of the proposed VOWTAP. It is evident that avian activity in the Offshore Survey Area is generally low, as compared with other areas of the Mid-Atlantic region (O'Connell et al. 2009; O'Connell et al. 2011; Williams 2013). The species that were the most frequently observed in the survey area are generally common in the region.

The assemblage of birds on the OCS, including the Offshore Survey Area, is dynamic, with seasonal changes in species composition and abundance. The nature of the marine environment and the mobility of birds make the occurrence of a variety of species possible at nearly any location, year-round (Gaston 2004). Therefore, estimates of spatial and temporal distributions based on limited duration surveys may not fully describe the range of possible avian assemblages within a discrete area of the ocean. However, the results of the interim 2013 VOWTAP surveys provide sufficient information to assess the dominant trends in spatiotemporal distribution, abundance, and diversity within the Project Area.

The results of the full year of ship-based surveys will be summarized following the completion of the April 2014 ship-based survey. The comprehensive 2014 annual report will include an analysis of how avian species abundance and behavior may be correlated with co-variates (such as water depth, benthic habitat, and weather conditions). A full avian risk assessment is provided in the VOWTAP RAP in Section 4.

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Attachment A – Species Detected in the VOWTAP Offshore Survey Area - 2013

Common Name	Point 1	Point 2	Point 3	Point 4	Total
Common grackle	1,300	450	5		1,755
Laughing gull				301	301
Double-crested cormorant				85	85
Sanderling				57	57
American robin			45		45
Royal tern				42	42
House finch	10		26		36
Brown pelican				30	30
Canada goose	27				27
Common tern				24	24
Eastern bluebird			19		19
Herring gull				18	18
Carolina wren	7	6	2		15
American crow	1	9	4		14
Cedar waxwing	14				14
Mourning dove	12	1			13
Northern cardinal	1	8	2		11
American goldfinch	5		5		10
Carolina chickadee	2	4	3		9
Great blue heron				8	8
Osprey	1	1	3	2	7
Blue jay	3		3		6
Chimney swift	5		1		6
Ruby-crowned kinglet		5			5
Red-eyed vireo		5			5
Northern flicker	1	1	2		4
Ring-billed gull			1	3	4
Whimbrel	3			1	4
Cooper's hawk	2			1	3
Northern mockingbird	1		2		3
Northern parula	1	1	1		3
Pine warbler		3			3
American redstart	1		1		2
Bald eagle	2				2
Black-throated green warbler	2				2
Black-throated blue warbler	1		1		2
Turkey vulture	2				2
White-throated sparrow		2			2
Barn swallow				1	1
Black-bellied plover				1	1
Blue grosbeak			1		1
Blackpoll warbler		1			1
Brown thrasher			1		1
Eastern phoebe			1		1
Tufted titmouse		1			1
Great black-backed gull				1	1
Great crested flycatcher			1		1
Lesser yellowlegs				1	1
Pileated woodpecker		1			1
Red-tailed hawk		1			1
Sharp-shinned hawk		1			1
Stilt sandpiper				1	1
Tree swallow		1			1

Common Name	Point 1	Point 2	Point 3	Point 4	Total
Unknown larus gull	1				1
Yellow-bellied sapsucker		1			1
Total	1,405	503	130	577	2,615
Species Richness (*S*) (number of different species)	23	20	22	17	54