

**PRECONSTRUCTION AVIAN STUDIES**

**Bayshore Regional Sewerage Authority Wind Power Project**

**Borough of Union Beach**

**Monmouth County, New Jersey**

Report Prepared for:

**Bayshore Regional Sewerage Authority  
Union Beach, New Jersey**

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## REPORT ON PRECONSTRUCTION STUDIES

### Bayshore Regional Sewerage Authority Wind Power Project

#### Monmouth County, New Jersey

#### Abstract

The Bayshore Regional Sewerage Authority (BRSA) has received permits to construct a wind turbine at its wastewater-treatment facility near Conaskonk Point on Raritan Bay. The turbine will have a nameplate capacity of 1.5 MW, hub height of 80 meters (262 feet), and a rotor diameter of 77 meters (252 feet). Thus, the rotor-swept zone (RSZ) will extend from 42 m (137 feet) above ground level (agl) to 118 m (388 feet) agl. The turbine would be mounted on a steel tubular tower and be lit according to Federal Aviation Administration (FAA) guidelines: probably a red strobe-like flashing light or newer flashing red LED (FAA type L-864) on the nacelle at about 82 m (269 feet) agl. The electrical transmission line would be underground.

The New Jersey Department of Environmental Protection (NJDEP) required five pre-construction studies to document species diversity and abundance of birds utilizing the habitat and airspace where the BRSA turbine will be constructed. Conducted between 5 June and 18 December 2010, these studies confirmed the seasonal quantification of the avifauna found at the BRSA and reported earlier in the Phase I Avian Risk Assessment. These studies found the following:

**Breeding birds:** The breeding bird community near the turbine was composed of mostly common, widespread species. No federal or New Jersey listed threatened endangered or special-concern species were found as breeders on the project site. The adjacent salt marsh, however, contained the New Jersey special-concern Saltmarsh Sparrow (also *Red WatchList*) at relatively low abundance, as well as other salt marsh specialists.

**Fall songbird migrants:** Songbird migrants were observed mostly in disturbed shrubland and grassy lawns surrounding the BRSA facility, and to a lesser extent brush or marsh nearby. On 9 October, when the greatest diversity and abundance of songbirds were recorded, 50 minutes of sampling yielded only 24 species. On that date, the average number of birds in five 10-minute point counts was 29.8 individuals, of which Yellow-rumped Warbler (mean of 10.6 individuals) and Song Sparrow (mean of 4.2 individuals) made up about one-half of the individuals recorded. No federal or New Jersey listed threatened, endangered or special-concern species were observed.

**Fall raptor migrants:** The passage rate of raptors at Conaskonk Point was low relative to globally significant and well known hawk watches. Observations totaling 132 hours tallied 421 raptors, yielding a seasonal passage rate of 3.2 raptors/hour. No federally listed species were observed. Eight of the 13 species recorded were New Jersey special-status, including the New Jersey endangered Peregrine Falcon (seasonal passage of 0.18 individuals/hour; daily high of 0.92); New Jersey threatened Bald Eagle (0.11; 0.42), Cooper's Hawk (0.33; 2.00), and Red-shouldered Hawk (0.04; 0.12); and New Jersey special-concern Northern Harrier (0.38; 1.67),

Sharp-shinned Hawk (0.39; 2.33), Northern Goshawk (0.01; 0.12), and American Kestrel (0.05; 0.21). Migrants were spread over a wide area from inland of the facility to the edge of Raritan Bay.

**Shorebird migrants:** Shorebirds migrating at or stopping over in the marshes adjacent to the BRSA were not highly concentrated, nor were they present in great diversity or numbers. No federal or New Jersey listed threatened or endangered shorebird species were observed. Small numbers of Oystercatcher, a New Jersey species of special concern were observed in Plots 3, 4, and 5. Mean shorebird densities in six plots surveyed in late spring (June) and fall were minimal: 1.87 individuals/ha in spring and 2.71 individuals/ha in fall. Willet was the most abundant species in spring (nesting in local marshes), recorded at a mean of 1.55 individuals/ha, while Least Sandpiper was by far the most abundant species in fall, recorded at a mean of 1.38 individuals/ha. When the observed and expected frequencies of shorebirds recorded at different tides were examined, observed numbers in spring were not significantly different from expected values based on the proportion of tides sampled, but in fall the differences were significant. We believe this was because Willet, the most abundant spring species, was generally visible at all tides, while Least Sandpiper and other species “disappeared” into channels at low tide in fall. Few (17.4%) of shorebirds (N = 288) were found to fly within 100 m of the observation point near the turbine location, and nearly three-quarters of those birds flew below 30 m. The average shorebird flock size was 2.3 individuals, and the largest flock size recorded was 40 individuals. Compared with a mean density of 1,351 shorebirds/km recorded during spring migration along the shores of Delaware Bay, maximum values recorded at Conaskonk Point (12.5 shorebirds/km in spring, 22.0 shorebirds/km in fall) were minimal.

**Wintering birds:** Waterfowl were the most abundant wintering birds on Conaskonk Point, accounting for nearly 75% of all sightings (including raptors and landbirds) recorded in plots. Canada Goose (1.05 birds/ha) was the most abundant waterfowl in plots, followed by American Black Duck (0.99), Brant (0.79), Mallard (0.42), and Snow Goose (0.18). It should be noted that hunting occurs in the marshes immediately adjacent to the BRSA, so densities may have been impacted by this activity. Raptor and landbird abundances were low in comparison. Waterbird density peaked in December, while raptor and landbird densities decreased from November to December. During general observations totaling seven hours, waterbirds (N = 5,411) were much more abundant in flight than raptors (N = 18) or landbirds (N = 62), but most waterbirds (mostly scaup) were flying far from the turbine site (about 1 km distant) over Raritan Bay, where movement was generally north to west.

Overall, bird activity at the BRSA turbine site was not great and very few birds flew within the rotor swept height zone. No federally listed species were observed. The New Jersey endangered Least Tern (also *Red WatchList*) was found in the salt marshes and tidal creeks adjacent to the the project site only occasionally during the breeding/post-breeding season. All Least Terns were observed far from the turbine location and at altitudes below the rotor-swept zone. The same was true for the New Jersey endangered Black Skimmer (also *Yellow WatchList*).

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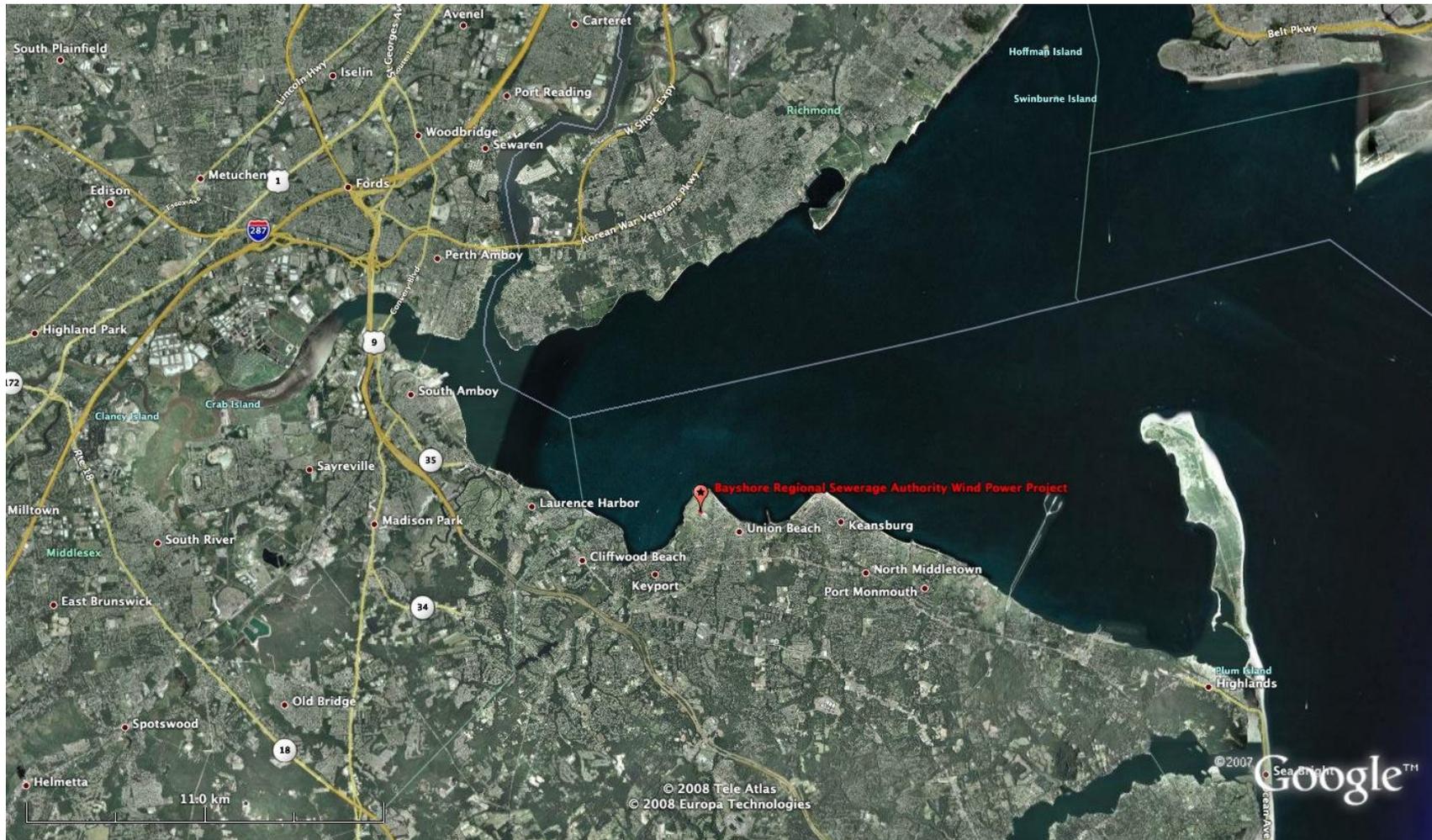
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## 1.0 Introduction

The Bayshore Regional Sewerage Authority (BRSA) has received permits to construct a wind turbine at its wastewater-treatment facility near Conaskonk Point on Raritan Bay (see Figure 1.0-1). The turbine would have a nameplate capacity of 1.50 MW, hub height of 80 meters (262 feet), and a rotor diameter of 77 meters (252 feet). Thus, the rotor-swept zone (RSZ) would inhabit airspace from 42 m (137 feet) above ground level (agl) to 118 m (388 feet) agl. The turbine would be mounted on a steel tubular tower and be lit according to Federal Aviation Administration (FAA) guidelines: probably a red strobe-like flashing light or newer flashing red LED (FAA type L-864) on the nacelle at about 82 m (269 feet) agl. The electrical transmission line would be underground.

The New Jersey Department of Environmental Protection (NJDEP) issued a technical manual (hereafter, “Tech Manual”) for evaluating wildlife impacts of wind turbines requiring coastal permits (NJDEP 2009). This manual calls for pre-construction studies to document species diversity and abundance of birds utilizing the habitat and airspace in the area where wind turbines will be constructed. Five studies were conducted according to the NJDEP guidelines:

- a. Breeding Bird Surveys
- b. Migrating Songbird Surveys
- c. Migrating Raptor Surveys
- d. Migrating Shorebird Surveys
- e. Wintering Bird Surveys

This document reports the results of studies conducted during the period 5 June- December 18, 2010. The study was conducted during this time period as a result of discussions between the New Jersey DEP and the BRSA. The discussions stipulated the dates of the survey and the methods used.

Special-status species have been given special attention in this report. Species listed as endangered (E) or threatened (T) by NJDEP or the U.S. Fish and Wildlife Service (USFWS)<sup>1</sup> receive special consideration, but we also highlight New Jersey species of special concern (SC)<sup>2</sup> and *WatchList* species (Butcher et al. 2007). Developed collaboratively by Audubon and the American Bird Conservancy (ABC), the *WatchList* highlights all the highest priority birds for conservation in the United States. It is based on the species assessment methodology that Partners in Flight (PIF; see Rich et al. 2004) has employed to rate the conservation status of landbirds. Audubon and ABC have taken PIF’s standards and applied them to the other bird groups.

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<sup>1</sup> From <http://www.state.nj.us/dep/fgw/tandespp.htm>, accessed 1 February 2011.

<sup>2</sup> from <http://www.state.nj.us/dep/fgw/spclspp.htm>, accessed 1 February 2011.

## 2.0 Breeding Bird Surveys (BBS)



**Figure 2.1-1.** Locations of BBS survey points relative to turbine

### 2.1 Methodology

Per the Tech Manual, five point count locations were selected to conduct breeding bird studies in the vicinity of the turbine location (see Figure 2.1-1). The location and geographical coordinates, as well as distance and bearing from the turbine are provided in Table 2.1-1. With one exception, the point count locations are separated by 150 m or more. The sole exception was the 115 m distance between points 1 and 3, because drainage ditches limited the area of salt marsh that could be accessed safely. In addition, the fact that there will only be a single turbine on a small site made it difficult to locate many point count locations or space those locations further apart. Nonetheless, point count centers were arranged so that effects along a distance gradient from the turbine could be examined.

Point 1 was located as close to the turbine base as possible, while points 2 and 5 were located adjacent to the BRSA facility. These three sampled the disturbed shrubland surrounding the BRSA facility, as well as nearby salt marsh and other habitats (e.g., a settling pond and the sewage treatment plant itself). Points 3 and 4 were located in salt marsh.

Each point was sampled on three different days (5, 19, and 26 June) in the early morning (between 05:29 and 07:03). To sample a point, the observer (in this case, Paul Kerlinger) recorded all birds seen or heard during a 5-minute period that began as soon as he arrived at the point. The observation period was divided into a 3-minute interval followed by a 2-minute interval. Birds not recorded in the 3-minute interval were added in the 2-minute interval.

When a bird was seen or heard, the following data were recorded: point count number, species, number of individuals, interval in which recorded (see above), distance from the observer (in three categories: <50m, 50-100m, and >100m), whether or not the bird was in flight, and an estimate of the altitude of flight. At the top of each data sheet, the following information was recorded: observer, date, start time, stop time, location, and weather (temperature, wind direction and speed, and percent cloud cover). Weather was favorable on all observation days.

**Table 2.1-1. BBS point count locations and surrounding habitats**

Point #	Coordinates	Distance/bearing from turbine	Habitat
1	40.451667°, -74.180361°	25 m, 230°	Disturbed shrubland bordering salt marsh and a sewage treatment plant
2	40.450056°, -74.180444°	200 m, 190°	Disturbed shrubland bordering a settling pond and a sewage treatment plant
3	40.451739°, -74.181699°	135 m, 265°	Salt marsh
4	40.452500°, -74.183083°	260 m, 285°	Salt marsh
5	40.450972°, -74.178472°	170 m, 125°	Disturbed shrubland bordering salt marsh and a sewage treatment plant

## 2.2 Results

As detailed in Table 2.2-1, 29 species of birds were recorded at point counts. The total number of species recorded at each point during the three sampling periods was similar, ranging from 13 to 16, but the mean number of birds was greater at points sampling disturbed shrubland bordering the BRSA facility (range of 19.7-27.7) than at those sampling salt marsh (range of 15.7-16.0). Point 1 at the turbine site had the lowest abundance of birds outside of salt marsh (mean of 19.7 individuals), while point 2 adjacent to the settling pond had the greatest abundance (mean of 27.7 individuals).

Common landbirds were found in the disturbed shrubland bordering the BRSA facility. Perhaps the most noteworthy species was Willow Flycatcher (*Yellow WatchList*), single males of which were heard at each of the points that sampled that habitat.

Among salt marsh specialists, the New Jersey special-concern Saltmarsh Sparrow (also *Red WatchList*) was the species of highest conservation priority encountered. Means of 1.0 and 0.7 individuals were recorded at points 3 and 4 respectively. Other salt marsh specialists in order of abundance were Marsh Wren (means of 3.3 and 3.3 at points 3 and 4 respectively), Willet (1.7 and 2.7), Seaside Sparrow (*Red WatchList*, 0.7 and 1.7), and Clapper Rail (*Yellow WatchList*, 0.3 and 2.0).

Two New Jersey special-concern American Oystercatchers were observed at low altitude (1-2 m) flying into the treated wastewater settling pond adjacent to point 2 on 5 June. It did not appear that these birds were nesting within any of the point count areas as the birds seen were simply passing through the site. Other birds attracted to the settling pond were Chimney Swift and swallows, which foraged for insects above it. One New Jersey threatened Osprey was recorded

far from point 3 as it flew over Raritan Bay to the north. No Osprey nests were visible from the point count locations.

**Table 2.2-1. Mean number of breeding birds in 5-minute point counts**

Species <sup>1</sup>	Point Count				
	1	2	3	4	5
Canada Goose	0.3				
American Black Duck				0.7	
Mallard	0.7			0.7	
<b>Osprey (NJ-T)</b>			0.3		
Clapper Rail ( <i>Yellow WatchList</i> )			0.3	2.0	
American Oystercatcher (NJ-SC)		0.7			
Willet	0.7	1.0	1.7	2.7	
Herring Gull				0.3	
Great Black-backed Gull				0.3	
Rock Pigeon					0.7
Mourning Dove	2.3	3.7	0.3		1.0
Chimney Swift		2.0			
Willow Flycatcher ( <i>Yellow WatchList</i> )	0.7	0.3			1.0
Tree Swallow		0.3			
Barn Swallow	1.0	5.3	1.7	0.3	1.0
Marsh Wren	1.3		3.3	3.3	
American Robin	2.7	1.7			3.3
Gray Catbird	1.3	0.3			1.3
Northern Mockingbird					0.3
European Starling	0.7	1.0		0.3	2.0
Yellow Warbler	1.0	2.3	0.7		2.3
Common Yellowthroat	1.3		0.3	0.7	0.7
Saltmarsh Sparrow (NJ-SC, <i>Red WatchList</i> )			1.0	0.7	
Seaside Sparrow ( <i>Red WatchList</i> )			0.7	1.7	
Song Sparrow	0.3	1.3	0.3		1.7
Northern Cardinal		0.3	0.3		
Red-winged Blackbird	5.0	6.7	5.0	2.0	6.0
Common Grackle	0.3	0.3			1.7
House Sparrow		0.3			
<b>Total mean birds</b>	<b>19.7</b>	<b>27.7</b>	<b>16.0</b>	<b>15.7</b>	<b>23.0</b>
<b>Total number of species</b>	<b>15</b>	<b>16</b>	<b>13</b>	<b>13</b>	<b>13</b>

<sup>1</sup> Species listed as endangered (E) or threatened (T) in New Jersey are indicated in boldface; special concern (SC) and *WatchList* species are noted; see Section 1.0. No federally listed species were observed.

### 2.3 Discussion

The above analyses characterize the pre-construction breeding bird community at the BRSA and surrounding properties. The breeding bird community in disturbed shrubland adjacent to the turbine site was dominated by common species. The adjacent salt marsh contained the New Jersey special-concern Saltmarsh Sparrow (also *Red WatchList*) as well as common species restricted to salt marshes. The treated wastewater settling pond, 200+ m to the west of the BRSA facility (and turbine site) was found to attract breeding and other birds to forage, most notably the New Jersey special-concern American Oystercatcher. It was 225 m distant from the turbine

location. The habitat where the turbine is located is in uplands dominated by herbaceous and brushy habitat that are adjacent to the salt marsh where special concern species were nesting.

### 3.0 Migrating Songbird Surveys



**Figure 3.1-1.** Locations of migrating songbird survey points relative to turbine

#### 3.1 Methodology

The purpose of this study was to quantify migrating songbird use of stopover habitats in the vicinity of the turbine. Per the Tech Manual, five point count locations were selected in disturbed shrubland adjacent to the BRSA facility (see Figure 3.1-1). The geographical coordinates of the points and their distance and bearing from the BRSA turbine are given in Table 3.1-1. In all cases, 150 m or more separated point count locations.

Point count centers were arranged so that effects along a distance gradient from the turbine may be examined. Point 1 was located as close to the turbine base as possible.

Each point was sampled on twelve different mornings (between 08:10 and 11:30) during fall migration (17 and 25 August, 4, 11, 18, and 26 September; 5, 9, 17, and 23 October; and 2 and 14 November), with 5-7 days separating samples. To sample a point, the observer (in this case, James Dowdell) used a playback of chickadee alarm calls to attract songbirds. He recorded all birds seen or heard during a 10-minute period that began as soon as he arrived at the point. The observation period was divided into a 3-minute interval followed by a 2-minute interval and a 5-minute interval.

When a bird was seen or heard, the following data were recorded on a Tech Manual data sheet: point count number, time of observation, species, number of individuals, interval in which recorded (see above), whether or not the bird was a flyover, and an estimate of the altitude of flight. At the top of each data sheet, the following information was recorded: observer, date, start time, stop time, location, and weather (temperature, wind direction and speed, and percent cloud cover). Weather was favorable on all observation days.

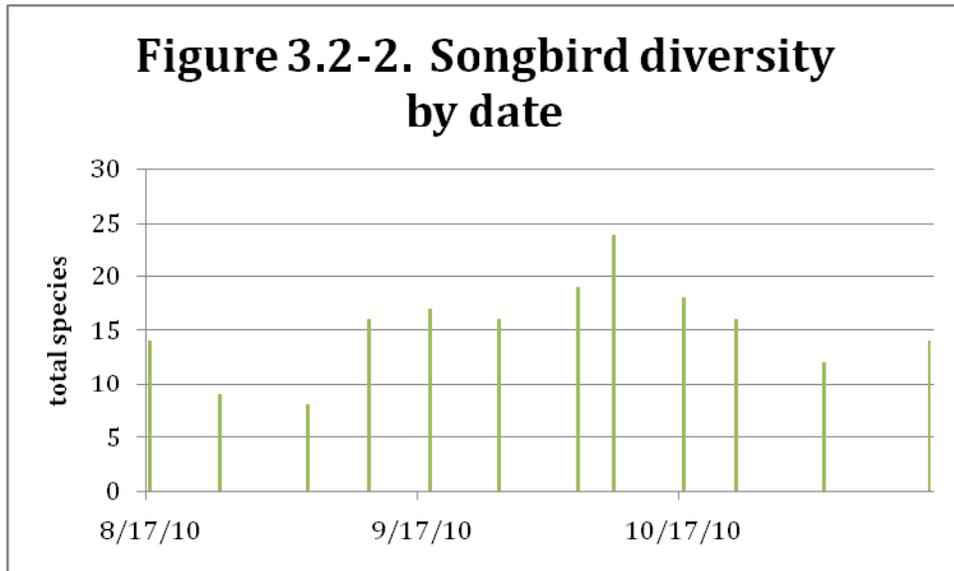
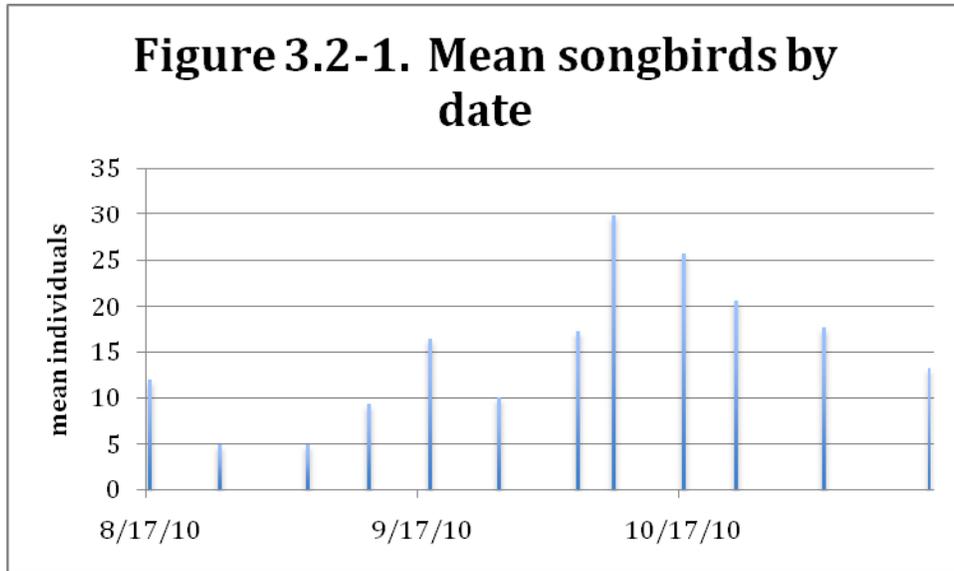
**Table 3.1-1. Migrating songbird point count locations and surrounding habitats**

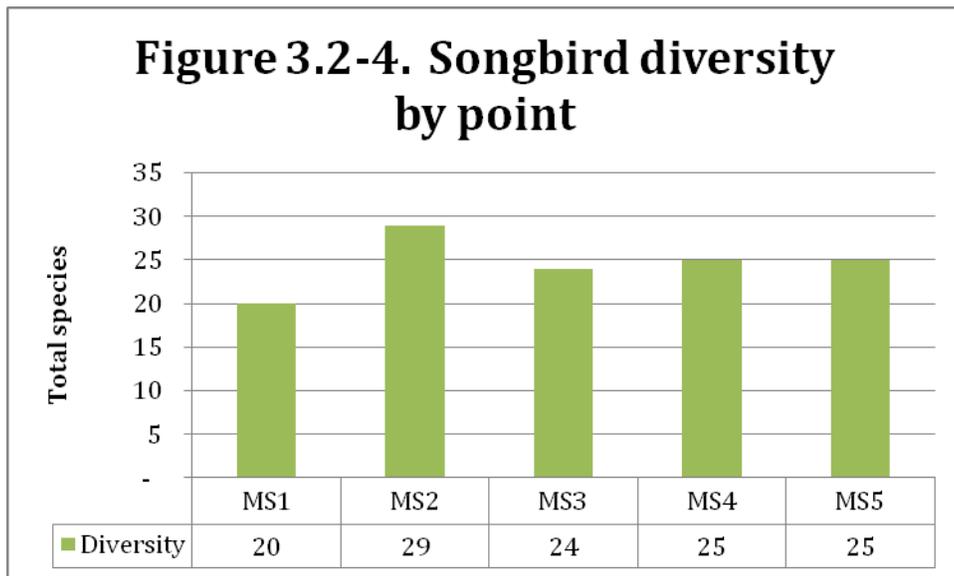
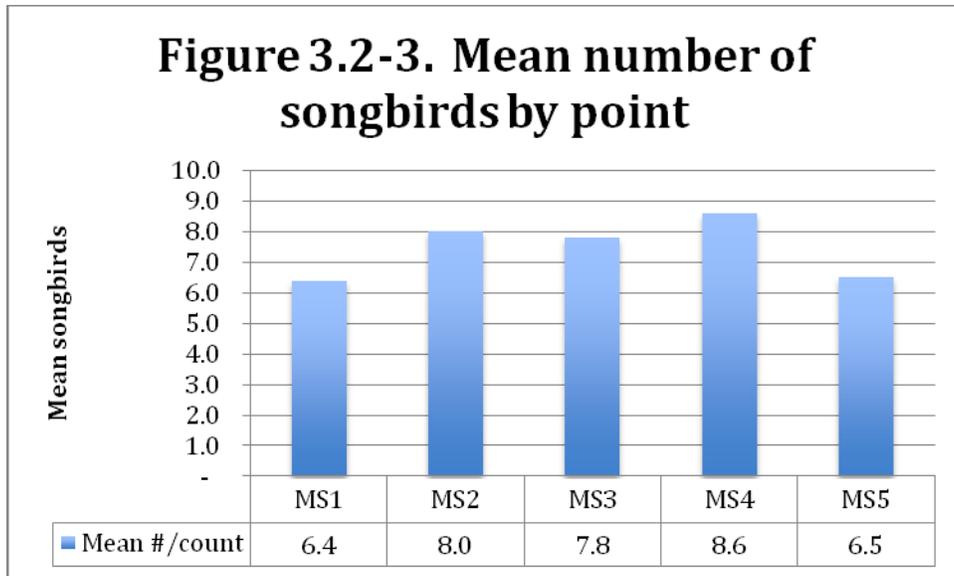
<b>Point #</b>	<b>Coordinates</b>	<b>Distance/bearing from turbine</b>	<b>Habitat</b>
1	40.451667°, -74.180361°	25 m, 230°	Disturbed shrubland bordering salt marsh and a sewage treatment plant
2	40.450056°, -74.180444°	200 m, 190°	Disturbed shrubland bordering a settling pond and a sewage treatment plant
3	40.449333°, -74.178917°	295 m, 160°	Disturbed shrubland bordering a sewage treatment plant and residential area
4	40.449917°, -74.177333°	315 m, 130°	Disturbed shrubland bordering a sewage treatment plant and residential area
5	40.450972°, -74.178472°	170 m, 125°	Disturbed shrubland bordering salt marsh and a sewage treatment plant

### 3.2 Results

As detailed in Table 3.2-1, 48 species of passerines were recorded in point counts, including three species of flycatchers, thirteen species of warblers, and eight species of sparrows. When the abundance of passerines in 10-minute point counts was examined by date (Figures 3.2-1), peak passage was found to occur in October. The maximum mean abundance recorded was 29.8 individuals on 9 October. The minimum was 5.0 individuals recorded in late August and early September. Songbird diversity appeared to be directly related to abundance (compare Figures 3.2-1 and 3.2-2, and see Table 3.2-1). Yellow-rumped Warbler was the most common migrant (total mean abundance of 36.6 individuals), followed by Song Sparrow (20.4), House Finch (16.2), and Gray Catbird (9.4).

The point count near the turbine base (MS1 in Figure 3.2-3) had the lowest mean abundance of all points (6.4 individuals per 10-minute count), as well as the lowest overall species diversity (20 species; see Figure 3.2-4).





### 3.3 Discussion

The above analyses provide pre-construction information with respect to numbers and type of migrating songbirds at the BRSA during fall migration. The mean number of songbirds recorded per point (range of 6.4-8.6 songbirds/point) is greater than that recorded in the New Jersey coastal zone by McCann et al. (1993), but those counts had 25-m fixed-diameter circles, while the counts in this study had circles that extended to 100 m from the observer location. Whereas large numbers of migrating songbirds are known to concentrate near Sandy Hook and the Atlantic Ocean during spring and fall migration, the BRSA site is more than 15 km from these locations.

**Table 3.2-1. Mean songbirds recorded in 10-minute point counts by date**

<b>Songbird species</b>	<b>8/17/10</b>	<b>8/25/10</b>	<b>9/4/10</b>	<b>9/11/10</b>	<b>9/18/10</b>	<b>9/26/10</b>	<b>10/5/10</b>	<b>10/9/10</b>	<b>10/17/10</b>	<b>10/23/10</b>	<b>11/2/10</b>	<b>11/14/10</b>	<b>Total</b>
Eastern Wood-Pewee				0.2									<b>0.2</b>
Willow Flycatcher ( <i>Yellow WatchList</i> )	0.2												<b>0.2</b>
Least Flycatcher				0.2									<b>0.2</b>
Eastern Phoebe						0.2	0.6	0.2	0.2				<b>1.2</b>
Blue-headed Vireo								0.2					<b>0.2</b>
Red-eyed Vireo					0.2								<b>0.2</b>
Blue Jay		0.4		0.8	0.2	0.2	0.2	1.0	0.2	0.4		0.8	<b>4.2</b>
American Crow									0.4	0.4			<b>0.8</b>
Fish Crow							0.4						<b>0.4</b>
Tree Swallow	4.0												<b>4.0</b>
Bank Swallow	1.2												<b>1.2</b>
Barn Swallow	1.6												<b>1.6</b>
Carolina Chickadee					0.2			0.2		0.2		0.2	<b>0.8</b>
Carolina Wren				0.2	0.4		0.2					0.4	<b>1.2</b>
House Wren	0.2	0.4	0.4	0.4	1.0								<b>2.4</b>
Marsh Wren	0.2				0.2		0.2						<b>0.6</b>
Golden-crowned Kinglet						1.2	1.8	2.6	1.6		0.4		<b>7.6</b>
Ruby-crowned Kinglet						0.2	1.0	2.2	2.0	0.4	0.6		<b>6.4</b>
Hermit Thrush										0.2			<b>0.2</b>
American Robin	0.2				0.4	0.4	0.2			0.4		1.2	<b>2.8</b>
Gray Catbird	1.6	2.4	1.2	0.8	2.0	0.6	0.4	0.4					<b>9.4</b>
Northern Mockingbird	0.2		1.2	1.2	1.6	0.2	0.8	1.0	1.0	0.4	0.4	0.4	<b>8.4</b>
Nashville Warbler								0.2					<b>0.2</b>
Northern Parula								0.2					<b>0.2</b>
Yellow Warbler	0.6	0.2		0.4	0.8	0.2							<b>2.2</b>
Magnolia Warbler						0.2		0.2					<b>0.4</b>
Black-throated Blue Warbler								0.2					<b>0.2</b>
Yellow-rumped Warbler				0.2			3.0	10.6	11.6	7.8	2.0	1.4	<b>36.6</b>
Pine Warbler							0.2						<b>0.2</b>
Palm Warbler				0.2	0.2							0.2	<b>0.6</b>
Blackpoll Warbler			0.6	0.2	0.6	1.0	0.4	1.0	0.4				<b>4.2</b>

<b>Songbird species</b>	<b>8/17/10</b>	<b>8/25/10</b>	<b>9/4/10</b>	<b>9/11/10</b>	<b>9/18/10</b>	<b>9/26/10</b>	<b>10/5/10</b>	<b>10/9/10</b>	<b>10/17/10</b>	<b>10/23/10</b>	<b>11/2/10</b>	<b>11/14/10</b>	<b>Total</b>
American Redstart			0.2										<b>0.2</b>
Northern Waterthrush		0.2			1.0								<b>1.2</b>
Common Yellowthroat	0.2	0.6	0.6	1.4	1.2	1.0	0.2	0.6					<b>5.8</b>
Wilson's Warbler				0.2									<b>0.2</b>
Field Sparrow									0.2				<b>0.2</b>
Savannah Sparrow						0.6		0.8	0.4	0.6	0.2		<b>2.6</b>
Song Sparrow	0.6	0.4	0.4	0.8		0.4	1.0	4.2	3.2	3.6	2.6	3.2	<b>20.4</b>
Lincoln's Sparrow								0.4					<b>0.4</b>
Swamp Sparrow							0.4	1.0	0.6	1.2	1.0	0.2	<b>4.4</b>
White-throated Sparrow						0.4	0.6	1.2	1.2	1.2	0.6	1.6	<b>6.8</b>
White-crowned Sparrow								0.2	0.6	0.2			<b>1.0</b>
Dark-eyed Junco								0.2	0.6		0.2	2.0	<b>3.0</b>
Northern Cardinal		0.2	0.4	1.4	1.2	0.6	0.6	0.6	0.8	1.0	0.6	0.6	<b>8.0</b>
Common Grackle								0.4					<b>0.4</b>
Brown-headed Cowbird											8.4		<b>8.4</b>
House Finch	0.4			0.8	4.4	2.6	5.2		0.4	1.6		0.8	<b>16.2</b>
American Goldfinch	0.8	0.2			0.8				0.4	1.0	0.8	0.2	<b>4.2</b>
<b>Total mean songbirds</b>	<b>12.0</b>	<b>5.0</b>	<b>5.0</b>	<b>9.4</b>	<b>16.4</b>	<b>10.0</b>	<b>17.4</b>	<b>29.8</b>	<b>25.8</b>	<b>20.6</b>	<b>17.8</b>	<b>13.2</b>	<b>182.4</b>
<b>Total diversity</b>	<b>14</b>	<b>9</b>	<b>8</b>	<b>16</b>	<b>17</b>	<b>16</b>	<b>19</b>	<b>24</b>	<b>18</b>	<b>16</b>	<b>12</b>	<b>14</b>	<b>48</b>

## 4.0 Migrating Raptor Surveys



**Figure 4.1-1.** Location of migrating raptor survey point relative to turbine

### 4.1 Methodology

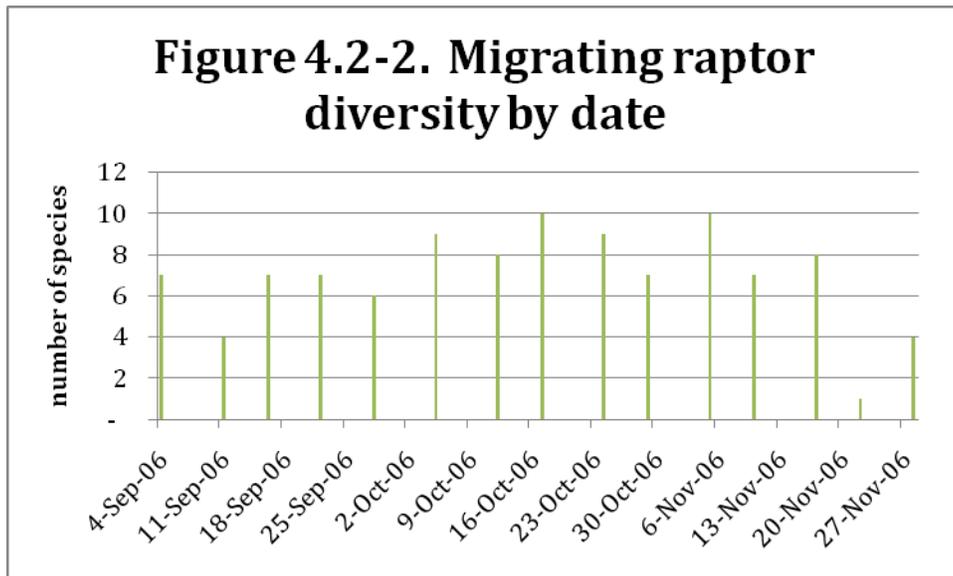
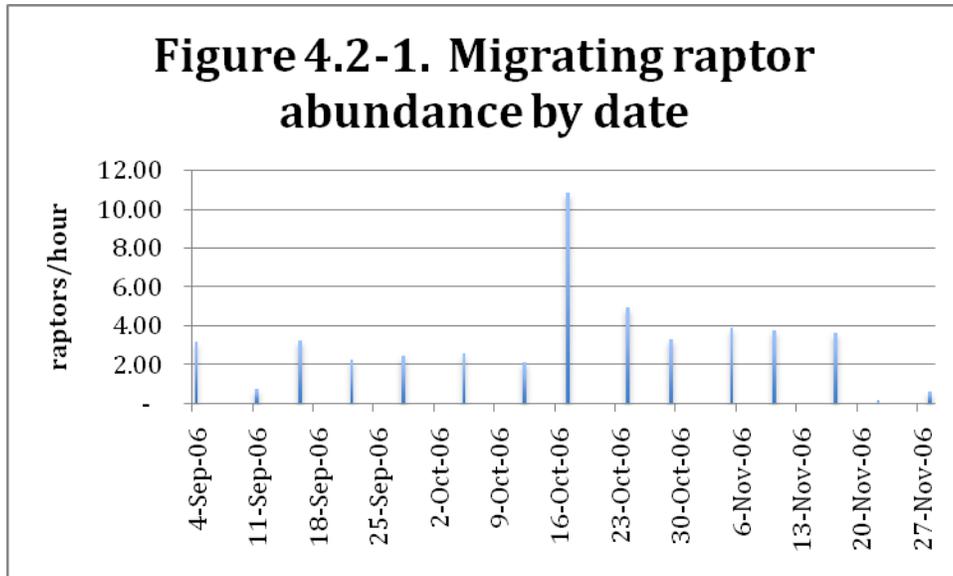
A raptor migration raptor survey was conducted during fall at the BRSRA site. The observation point (OP) was atop a concrete outbuilding 130 m southwest of the turbine site (coordinates 40.450964°, -74.181142°). That structure is about 2 m above the marsh, permitting panoramic views in all directions. Jim Dowdell, the observer, manned the OP on 15 days from September 1 to November 30, namely, 5, 12, 19, and 26 September; 3, 10, 17, 24, and 31 October; and 7, 14, 21, and 28 November 2010. Observations began early in the morning (between 06:30 and 07:30) and lasted until 16:00. The survey was conducted according to the guidelines of the Hawk Migration Association of North America (HMANA)<sup>3</sup>.

Observations were recorded on the standard HMANA data sheet. Data were recorded hourly and included wind speed, wind direction, temperature, cloud cover, visibility, precipitation, flight direction, height of flight, number of observers, duration of observation during each hour, species, and number of individuals per species. Weather was favorable on all observation days.

<sup>3</sup> See [http://rpi-project.org/docs/HMANA\\_Data\\_Collection\\_Protocol\\_20060611.pdf](http://rpi-project.org/docs/HMANA_Data_Collection_Protocol_20060611.pdf).

## 4.2 Results

Thirteen of the sixteen species normally observed at hawk watches in eastern North America were recorded in the 132 observation hours (15 days) conducted during this study (Table 4.2-1). Broad-winged Hawk, Rough-legged Hawk, and Golden Eagle were not recorded at the BRSA site. A total of 421 raptors were recorded (seasonal passage rate of 3.2 raptors/hour or 28.1 raptors/day).



Passage rates ranged from 0.13 raptors/hour on 23 November to 10.89 raptors/hour on 18 October (Table 4.2-1 and Figure 4.2-1). On most days, passage was less than 4 raptors/hour. Species diversity was fairly constant by comparison (Figure 4.2-2), with the 6-10 species recorded most days.

Red-tailed Hawk was the most abundant raptor recorded, with a seasonal passage rate of 0.86 individuals/hour (Table 4.2-1), followed by Osprey (0.53 individuals/hour), New Jersey special-concern Sharp-shinned Hawk (0.39), New Jersey special-concern Northern Harrier (0.38), and New Jersey threatened Cooper's Hawk (0.33). Of these birds, some Red-tailed Hawk and Osprey may have nested locally along the Raritan Bayshore and, therefore, the numbers observed may have included some individuals that were observed on multiple occasions.

No federally listed species were observed. With respect to New Jersey listed and special-concern raptors, nine species were recorded: the New Jersey endangered Peregrine Falcon; threatened Bald Eagle, Cooper's Hawk, Osprey, and Red-shouldered Hawk; and special-concern Northern Harrier, Sharp-shinned Hawk, Northern Goshawk, and American Kestrel. Their seasonal and greatest daily passage rates are displayed in Table 4.2-1.

Flight height and direction of raptor migration is summarized in Tables 4.2-3 and 4.2-4. Note that 80% of raptors flew in height class 2, which, based on HMANA criteria, extends from about 30 m above ground level (agl) to where birds were easily seen with the naked eye. The rotor-swept zone (RSZ) of the BRSA turbine would inhabit the lower altitudes of this height class (up to 120 m agl). About 10% of raptors recorded flew in height class 1, below the RSZ, while about 10% flew in height classes 3 and 4, well above the RSZ.

Flight direction was decidedly southerly, no doubt owing to the extensive water barrier to the north of Conaskonk Point (see Figure 1.0-1). No raptors, other than some Bald Eagles, were observed crossing Raritan Bay from the north (James Dowdell, pers. comm.). No clear relationship was evident between flight height and wind speed (Table 4.2-4).

### **4.3 Discussion**

This analysis characterizes pre-construction raptor migration during fall migration at the BRSA, near Conaskonk Point. The HMANA methodology was used to characterize hawk movements in the general area where the wind turbine will be located. Raptor passage during fall migration was spread from areas inshore of the BRSA to Conaskonk Point on Raritan Bay. The overall seasonal passage rate of 3.2 raptors/hour recorded at Conaskonk Point was low relative to globally significant hawk watches. Based on data presented by Zalles and Bildstein (2000), globally significant hawk watches often have seasonal passage rates in excess of 10 raptors/hour. For example, the passage rate at Cape May, New Jersey in fall has been consistently greater than 20-25 birds per hour, which is about six or seven times greater than observed at the BRSA site.

**Table 4.2-1. Abundance (birds/hour) and diversity of migrating raptors by date**

<b>Species<sup>1</sup></b>	<b>5-Sep-10</b>	<b>12-Sep-10</b>	<b>17-Sep-10</b>	<b>23-Sep-10</b>	<b>29-Sep-10</b>	<b>6-Oct-10</b>	<b>13-Oct-10</b>	<b>18-Oct-10</b>	<b>25-Oct-10</b>	<b>30-Oct-10</b>	<b>6-Nov-10</b>	<b>11-Nov-10</b>	<b>18-Nov-10</b>	<b>23-Nov-10</b>	<b>29-Nov-10</b>	<b>Mean</b>
Black Vulture	0.42															0.03
Turkey Vulture	0.95		0.21	0.54			0.11		0.24		0.12		0.50			0.18
Osprey	1.16	0.42	1.58	0.65	0.82	0.67	0.33	0.44	0.82	0.12	0.12	0.24	0.13	0.13		0.53
<b>Bald Eagle (NJ-T)</b>	0.11	0.11	0.42			0.11	0.22	0.11			0.12		0.25		0.13	0.11
Northern Harrier (NJ-SC)		0.11	0.21	0.32	0.21	0.44	0.56	1.67	0.71	0.71	0.12	0.24	0.13		0.25	0.38
Sharp-shinned Hawk (NJ-SC)	0.11			0.22		0.11	0.44	2.33	0.71	0.71	0.61	0.24	0.38			0.39
<b>Cooper's Hawk (NJ-T)</b>	0.21				0.21	0.44	0.22	2.00	0.59	0.35	0.12	0.48	0.13		0.13	0.33
Northern Goshawk (NJ-SC)										0.12						0.01
<b>Red-shouldered Hawk (NJ-T)</b>						0.11		0.11	0.12		0.12	0.12				0.04
Red-tailed Hawk	0.21					0.11		3.67	1.29	1.18	2.30	2.30	1.88		0.13	0.84
American Kestrel (NJ-SC)			0.21	0.11	0.21		0.11	0.11								0.05
Merlin		0.11	0.53	0.11	0.10	0.11		0.22	0.12	0.12	0.12	0.12	0.25			0.13
<b>Peregrine Falcon (NJ-E)</b>			0.11	0.32	0.92	0.44	0.11	0.22	0.35		0.12					0.18
<b>Abundance</b>	<b>3.16</b>	<b>0.74</b>	<b>3.26</b>	<b>2.27</b>	<b>2.46</b>	<b>2.56</b>	<b>2.11</b>	<b>10.89</b>	<b>4.94</b>	<b>3.29</b>	<b>3.88</b>	<b>3.76</b>	<b>3.63</b>	<b>0.13</b>	<b>0.63</b>	<b>3.19</b>
<b>Diversity</b>	<b>7</b>	<b>4</b>	<b>7</b>	<b>7</b>	<b>6</b>	<b>9</b>	<b>8</b>	<b>10</b>	<b>9</b>	<b>7</b>	<b>10</b>	<b>7</b>	<b>8</b>	<b>1</b>	<b>4</b>	<b>13</b>

<sup>1</sup> Species that are endangered (E) or threatened (T) in New Jersey are shown in boldface; special concern (SC) and *WatchList* species are indicated. See Section 1.0. No federally listed species were observed.

**Table 4.2-2. Special-status raptors recorded at the BRSA observation point**

Species	Total Individuals	Seasonal Passage <sup>1</sup>	Daily High	Date	Greatest Daily Passage <sup>1</sup>
Peregrine Falcon (NJ-E)	24	0.18	9	29-Sep-10	0.92
Bald Eagle (NJ-T)	14	0.11	4	17-Sep-10	0.42
Cooper's Hawk (NJ-T)	43	0.33	18	18-Oct-10	2.00
Red-shouldered Hawk (NJ-T)	5	0.04	1	various	0.12
Northern Harrier (NJ-SC)	50	0.38	15	18-Oct-10	1.67
Sharp-shinned Hawk (NJ-SC)	51	0.39	21	18-Oct-10	2.33
Northern Goshawk (NJ-SC)	1	0.01	1	30-Oct-10	0.12
American Kestrel (NJ-SC)	7	0.05	2	various	0.21

<sup>1</sup> Individuals/hour

**Table 4.2-3. Flight height and direction of migrating raptors (N = 421)**

Height <sup>1</sup>	Direction					Total
	W	SW	S	SE	E	
4	0.0%	0.0%	0.0%	2.4%	0.0%	<b>2.4%</b>
3	3.1%	1.2%	1.9%	2.6%	0.0%	<b>8.8%</b>
2	9.3%	23.3%	40.4%	7.1%	0.2%	<b>80.3%</b>
1	0.2%	1.7%	6.7%	0.0%	0.0%	<b>8.6%</b>
<b>Total</b>	<b>12.6%</b>	<b>26.1%</b>	<b>48.9%</b>	<b>12.1%</b>	<b>0.2%</b>	<b>100.0%</b>

<sup>1</sup> Height classes are from the HMANA data sheet: 1 = eye level to about 30 m, 2 = birds seen easily with unaided eye, 3 = at limit of unaided vision, 4 = beyond limit of unaided eye but visible with binoculars.

**Table 4.2-4. Flight height of migrating raptors in relation to wind speed (N = 421)**

Height <sup>1</sup>	Wind speed <sup>2</sup>					Total
	1	2	3	4	5	
4	0.0%	0.0%	0.0%	2.4%	0.0%	<b>2.4%</b>
3	0.0%	0.7%	5.0%	3.1%	0.0%	<b>8.8%</b>
2	0.0%	8.3%	31.8%	39.2%	1.0%	<b>80.3%</b>
1	0.5%	1.4%	5.9%	0.2%	0.5%	<b>8.6%</b>
<b>Total</b>	<b>0.5%</b>	<b>10.5%</b>	<b>42.8%</b>	<b>44.9%</b>	<b>1.4%</b>	<b>100.0%</b>

<sup>1</sup> Height classes are from the HMANA data sheet: 1 = eye level to about 30 m, 2 = birds seen easily with unaided eye, 3 = at limit of unaided vision, 4 = beyond limit of unaided eye but visible with binoculars.

<sup>2</sup> Wind speed classes are from the HMANA data sheet: 1 = 1-5 km/hr, 2 = 6-11 km/hr, 3 = 12-19 km/hr, 4 = 20-28 km/hr, and 5 = 29-38 km/hr.

## 5.0 Migrating Shorebird Surveys



**Figure 5.1-1.** Location of migrating shorebird plots and OPs relative to turbine

### 5.1 Methodology

Six 200 m by 200 m plots were established in the vicinity of the BRSA turbine to measure shorebird use of salt marsh, bayshore, and treated wastewater settling pond habitats (see Figure 5.1-1). In addition, an observation point (OP) was established near the turbine to count the number of shorebirds using habitat in the marshes and other areas at the project site and adjacent Conaskonk Point, as well as to quantify shorebird flight use of the area. Table 5.1-1 lists the coordinates of the OPs used to collect data.

**Table 5.1-1. Migratory shorebird and wintering bird survey locations and habitats**

Observation Point (OP)	Coordinates	Distance/bearing from turbine	Habitat
General observation	40.451563°, -74.180354°	35 m, 215°	~50 ha of diked salt marsh, including nearly 2 km of bayshore
Plot 1	40.451833°, -74.180639°	45 m, 270°	4 ha of diked salt marsh
Plot 2	40.450972°, -74.181167°	130 m, 225°	2 ha settling pond and surrounding embankment, 4 ha total area
Plot 3	40.452000°, -74.182222°	180 m, 275°	4 ha of diked salt marsh
Plot 4	40.452500°, -74.183083°	260 m, 285°	4 ha of diked salt marsh plus 200 m of bayshore
Plot 5	40.452500°, -74.183083°	260 m, 285°	4 ha of diked salt marsh plus 200 m of bayshore
Plot 6	40.451833°, -74.179556°	45 m, 90°	4 ha of diked salt marsh

Plot surveys and general observations were conducted on three days in spring (5, 19, and 26 June) and twelve days in fall (28 July; 3, 11, 17, and 25 August; 4, 11, 18, and 26 September; and 5, 9, and 17 October). Paul Kerlinger conducted spring surveys, and James Dowdell conducted them in fall. Each plot was surveyed for 20 minutes twice each day, and general observations were conducted for 30 minutes twice each day. Plot observations were done from a single points at corners or along sides of plots (see Figure 5.1-1) so as not to disturb birds using the habitats within the plots.

An effort was made to survey during different tides, namely, at high tide, falling tide, low tide, and rising tide. Surveys were considered to occur at high or low tide when they started or ended within 2 hours on either side of high or low tide. Surveys were classified as occurring during falling or rising tide if they both started and ended within the rising or falling tidal phase (i.e., outside of 2 hours on either side of high or low tide). In addition, tides were classified as spring tides on days when high tide exceeded 6 feet above mean low water or when low tide went below 0 feet mean low water. When tides did not meet these characteristics, they were classified as neap tides. Chi-square tests were used to examine if the observed number of shorebirds at different tides was significantly different than the expected number.

For plot surveys, all shorebirds observed or heard within the 200 m by 200 m plots were recorded. Before the 20-minute observation period was conducted, a total count was performed, for which the species, total count, and whether the count was an estimate or not were recorded. Then, during the 20-minute observation period, the number of feeding, roosting, and flying birds were recorded as well as the habitat in which they were found. Flight altitude in meters was recorded for birds in flight. At the top of each data sheet, the following data were recorded: observer, date, start and stop time, weather (temperature, wind direction and speed, and percent cloud cover), time of high tide, hours and minutes before or after high tide of the start and stop times, and map number.

For general surveys, all shorebirds observed during the 30-minute period were recorded. Data recorded included an estimate of flock size, direction of flight, estimate of flight altitude in meters, species identity, and flock composition (the percent of each species in the flock if they were mixed-species flocks). At the top of each data sheet, the following data were recorded: observer, data, start and stop time, weather (temperature, wind direction and speed, and percent cloud cover), time of high tide, and map number. Weather was favorable on all observation days.

## **5.2 Results**

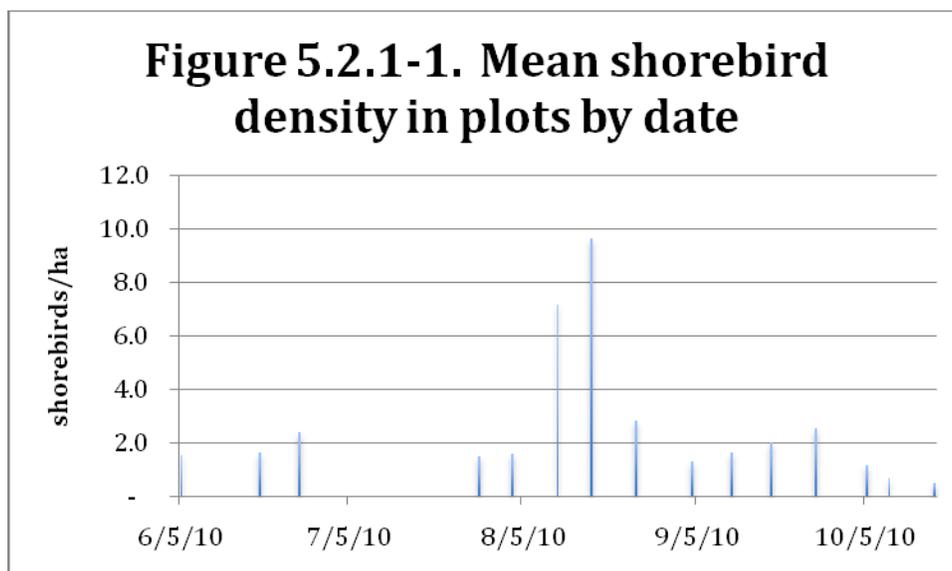
### **5.2.1 Plot Surveys**

Table 5.2.1-1 shows the shorebird density (in birds/ha) by date in the six 4-ha plots distributed in the vicinity of the BRSA turbine. Note that densities in plots rarely exceeded 10 birds/ha, and only during peak fall migration. The greatest density (25.5 birds/ha recorded on 17 August) was recorded in plot 2, which covered the treated wastewater settling pond.

Figure 5.2.1-1 charts mean density (all plots combined) by date. Note that mean densities never exceeded 3 birds/ha in June, and only twice exceeded that value in fall, in mid August.

**Table 5.2.1-1. Shorebird density (birds/ha) in plots**

Date	Plot 1	Plot 2	Plot 3	Plot 4	Plot 5	Plot 6	Mean
<i>Spring</i>							
6/5/10	1.0	-	2.0	1.3	4.8	0.3	<b>1.5</b>
6/19/10	1.5	1.5	3.0	1.5	2.3	-	<b>1.6</b>
6/26/10	3.3	0.5	2.0	4.0	4.5	-	<b>2.4</b>
<b>Mean</b>	<b>1.9</b>	<b>0.7</b>	<b>2.3</b>	<b>2.3</b>	<b>3.9</b>	<b>0.1</b>	<b>1.8</b>
<i>Fall</i>							
7/28/10	1.8	2.0	1.0	2.3	0.8	1.3	<b>1.5</b>
8/3/10	2.5	1.0	0.5	0.5	3.8	1.3	<b>1.6</b>
8/11/10	5.0	4.3	4.0	13.8	8.5	7.5	<b>7.2</b>
8/17/10	4.3	25.5	4.0	10.0	7.3	7.0	<b>9.7</b>
8/25/10	9.5	1.5	1.5	1.8	1.5	1.3	<b>2.8</b>
9/4/10	0.8	1.0	1.5	1.3	2.5	0.8	<b>1.3</b>
9/11/10	0.5	0.5	1.5	6.3	1.0	-	<b>1.6</b>
9/18/10	5.0	5.0	-	0.8	0.5	0.8	<b>2.0</b>
9/26/10	2.3	0.5	4.5	2.5	4.5	1.0	<b>2.5</b>
10/5/10	0.3	-	0.8	1.5	0.3	4.3	<b>1.2</b>
10/9/10	-	-	4.0	-	-	-	<b>0.7</b>
10/17/10	-	0.5	2.5	-	-	-	<b>0.5</b>
<b>Mean</b>	<b>2.6</b>	<b>3.5</b>	<b>2.1</b>	<b>3.4</b>	<b>2.5</b>	<b>2.1</b>	<b>2.7</b>



Tables 5.2.1-2 and 5.2.1-3 detail mean species densities by plot during spring and fall respectively. Note that species diversity in June (five species) was minimal compared with fall (21 species not including unidentified peeps and dowitchers).

**Table 5.2.1-2. Mean species density (birds/ha) at plots in spring**

<b>Species<sup>1</sup></b>	<b>Plot 1</b>	<b>Plot 2</b>	<b>Plot 3</b>	<b>Plot 4</b>	<b>Plot 5</b>	<b>Plot 6</b>	<b>Mean</b>
American Oystercatcher (NJ-SC)	-	-	0.40	0.10	0.40	-	<b>0.15</b>
Killdeer	-	0.30	-	-	-	-	<b>0.05</b>
Spotted Sandpiper	-	-	-	-	0.30	-	<b>0.05</b>
Willet	1.90	0.30	1.90	2.20	2.90	0.10	<b>1.55</b>
Yellowlegs sp.	-	0.10	-	-	0.10	-	<b>0.03</b>
Shorebird sp.	-	-	-	-	0.10	-	<b>0.02</b>
<b>Total mean density</b>	<b>1.90</b>	<b>0.70</b>	<b>2.30</b>	<b>2.30</b>	<b>3.80</b>	<b>0.10</b>	<b>1.85</b>

<sup>1</sup> Species listed as endangered (E) or threatened (T) in New Jersey are indicated in boldface; special concern (SC) and *WatchList* species are noted; see Section 1.0. No federally listed species were observed.

**Table 5.2.1-3. Mean species density (birds/ha) at plots in fall**

<b>Species</b>	<b>Plot 1</b>	<b>Plot 2</b>	<b>Plot 3</b>	<b>Plot 4</b>	<b>Plot 5</b>	<b>Plot 6</b>	<b>Mean</b>
Black-bellied Plover	-	0.02	0.06	0.27	0.04	0.15	<b>0.09</b>
American Golden-Plover ( <i>Yellow WatchList</i> )	-	-	0.02	0.08	-	0.06	<b>0.03</b>
Semipalmated Plover	0.21	0.29	0.58	0.23	0.56	0.23	<b>0.35</b>
Killdeer	-	0.10	0.31	-	-	-	<b>0.07</b>
American Oystercatcher (NJ-SC)	-	0.06	0.04	0.04	0.17	-	<b>0.05</b>
Spotted Sandpiper	-	0.10	-	0.04	0.04	0.02	<b>0.03</b>
Solitary Sandpiper	-	-	-	0.02	0.02	-	<b>0.01</b>
Greater Yellowlegs	0.04	-	0.10	-	0.06	0.21	<b>0.07</b>
Willet	0.02	-	0.04	0.17	0.02	-	<b>0.04</b>
Lesser Yellowlegs	0.23	-	0.08	0.06	0.08	0.08	<b>0.09</b>
Whimbrel (NJ-SC)	-	-	-	0.02	-	-	<b>0.00</b>
Hudsonian Godwit ( <i>Yellow WatchList</i> )	-	-	-	0.02	-	-	<b>0.00</b>
Ruddy Turnstone	-	-	-	0.02	0.04	-	<b>0.01</b>
<b>Red Knot (NJ-T, <i>Yellow WatchList</i>)</b>	-	-	-	-	0.04	-	<b>0.01</b>
Semipalmated Sandpiper ( <i>Yellow WatchList</i> )	0.35	0.33	0.13	0.50	0.15	0.02	<b>0.25</b>
Least Sandpiper	1.75	2.04	0.60	1.65	1.06	1.15	<b>1.38</b>
Pectoral Sandpiper	-	0.02	0.04	-	-	0.04	<b>0.02</b>
Stilt Sandpiper ( <i>Yellow WatchList</i> )	-	0.06	-	-	-	-	<b>0.01</b>
Buff-breasted Sandpiper ( <i>Red WatchList</i> )	-	-	-	0.02	-	-	<b>0.00</b>
Peep sp.	-	0.42	0.10	0.17	0.15	0.10	<b>0.16</b>
Short-billed Dowitcher	-	0.02	-	0.06	0.06	-	<b>0.02</b>
Long-billed Dowitcher	0.02	-	-	-	-	-	<b>0.00</b>
Dowitcher sp.	-	-	0.02	-	0.04	0.02	<b>0.01</b>
<b>Total mean density</b>	<b>2.63</b>	<b>3.48</b>	<b>2.15</b>	<b>3.38</b>	<b>2.54</b>	<b>2.08</b>	<b>2.71</b>
<b>Total species</b>	<b>7</b>	<b>11</b>	<b>13</b>	<b>16</b>	<b>15</b>	<b>11</b>	<b>23</b>

1 Species listed as endangered (E) or threatened (T) in New Jersey are indicated in boldface; special concern (SC) and *WatchList* species are noted; see Section 1.0. No federally listed species were observed.

In spring (Table 5.2.1-2), Willet was relatively common, making up 83% of all shorebirds recorded during plot surveys. Its densities were greatest in outer salt marsh plots, particularly plots 4 and 5. It was the only shorebird present in plot 1 adjacent to the turbine site, where it was recorded at a mean of 1.90 birds/ha. Willet seemed to be a nesting species on site, so information regarding this species does not appear to indicate migration stopover.

No federally listed species were observed. Two non-shorebird New Jersey special-status species were observed during spring surveys. A single New Jersey-endangered Black Skimmer (also *Yellow WatchList*) was observed to forage low over a creek at low tide in plot 5 on 19 June. There was an incidental record of two New Jersey-endangered Least Terns (also *Red WatchList*) outside of plots. They were seen traversing the shore of Raritan Bay far from plot 3 as that was being sampled on 19 June at low tide.

In fall (Table 5.2.1-3), Least Sandpiper was the only shorebird that occurred at mean abundances greater than 1 bird/ha in plots. Its greatest mean abundance was 2.04 birds/ha in plot 2, which covered the settling pond. Its overall mean abundance was 1.38 birds/ha. Semipalmated Plover (overall mean of 0.35 birds/ha) and Semipalmated Sandpiper (overall mean of 0.25 birds/ha) were moderately common by comparison. All other species were relatively scarce.

In fall migration, shorebirds listed as endangered or threatened in New Jersey were scarce in the plots. Two threatened Red Knots (also *Yellow WatchList*) were observed to fly low along the shore of Raritan Bay in plot 5 on 11 September. With respect to New Jersey endangered or threatened species that were not shorebirds, but were seen during shorebird surveys, the endangered Least Tern (also *Red WatchList*) was observed four times during plot surveys on 28 July: one bird at 30 m altitude in plot 1 during rising tide; one adult with a juvenile at 20 m altitude in plot 4 at high tide; a single individual at 20 m altitude in plot 4 at high tide; and three adults with two juveniles at 0-30 m altitude in plot 5 at high tide. One threatened Black Skimmer (also *Yellow WatchList*) was seen 400 m from plot 1 when it was sampled on 28 June during rising tide.

**Table 5.2.1-4. Chi-square test examining shorebird abundance by tide during spring**

	Tidal phase				Total	
	High	Falling	Low	Rising		
Plot surveys conducted	12.0	6.0	11.0	7.0	36.0	
Observed shorebirds	49.0	24.0	45.0	15.0	133.0	
Expected shorebirds	22.2	44.3	40.6	25.9	133.0	p = 0.13

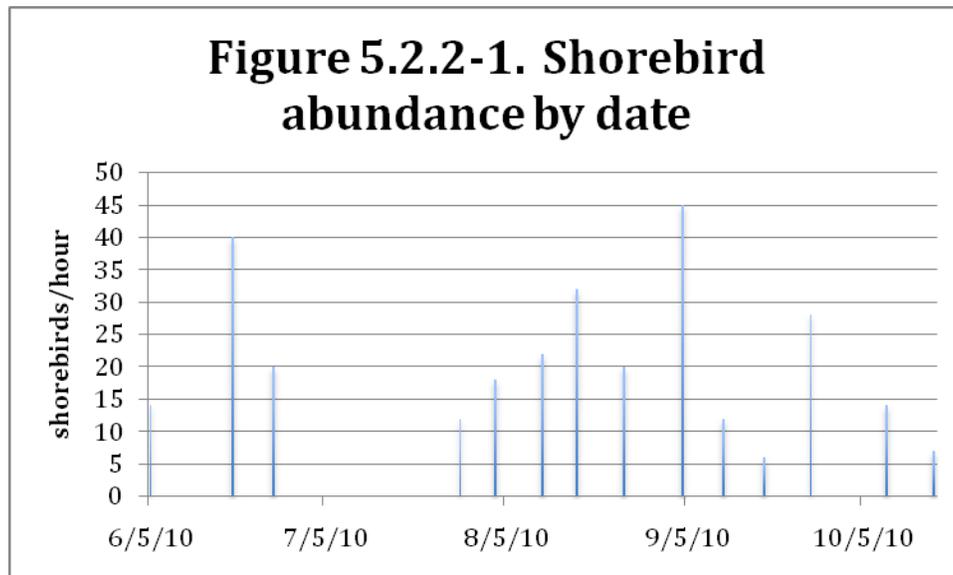
**Table 5.2.1-5. Chi-square test examining shorebird abundance by tide during fall**

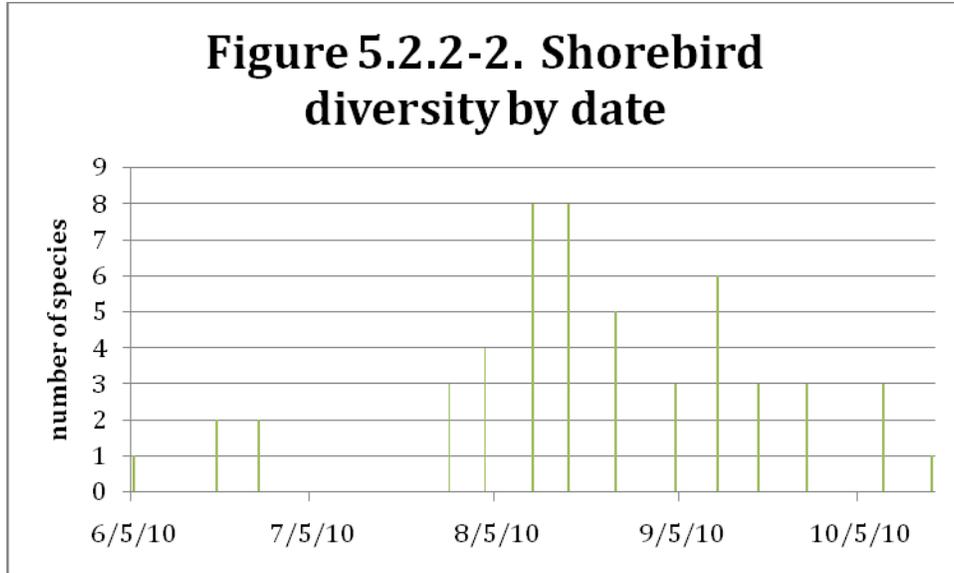
	Tidal phase				Total	
	High	Falling	Low	Rising		
Plot surveys conducted	50.0	29.0	42.0	23.0	144.0	
Observed shorebirds	360.0	153.0	47.0	221.0	781.0	
Expected shorebirds	271.2	157.3	227.8	124.7	781.0	p < 0.001

Tables 5.2.1-4 and 5.2.1-5 examine the observed and expected frequencies of shorebirds recorded at different tides. In spring, the observed numbers of shorebirds by tide was not significantly different from expected values based on the proportion of tides. In fall, however, observed values were significantly different from expected values. We believe these results are the consequence of the species recorded. Willet, the species primarily recorded in spring, breeds in raised salt marshes along the mid-Atlantic coast (Lowther et al. 2001), while Least Sandpiper, the species principally recorded in fall, tends to forage in channels more than other peeps (Nebel and Cooper 2008). Thus, while Willet was generally visible at all tides, Least Sandpiper and other species “disappeared” into channels at low tide.

### 5.2.2 General Surveys

Figure 5.2.2-1 shows shorebird abundance at Conaskonk Point by date. Note that the seasonal highs were approximately the same: 40 shorebirds/hour in spring and 45 shorebirds/hour in fall. Diversity (Figure 5.2.2-2), however, was greater in fall, with highs of eight species on two dates, while in spring highs did not exceed two species.





**Table 5.2.2-1. Shorebird abundance (birds/hour) by species and date in general surveys**

<b>Species<sup>1</sup></b>	<b>6/5/10</b>	<b>6/19/10</b>	<b>6/26/10</b>	<b>7/28/10</b>	<b>8/3/10</b>	<b>8/11/10</b>	<b>8/17/10</b>	<b>8/25/10</b>	<b>9/4/10</b>	<b>9/11/10</b>	<b>9/18/10</b>	<b>9/26/10</b>	<b>10/5/10</b>	<b>10/9/10</b>	<b>10/17/10</b>	<b>Mean spring</b>	<b>Mean fall</b>
Black-bellied Plover							4	2	2							-	0.67
American Golden-Plover ( <i>Yellow WatchList</i> )												1				-	0.08
Semipalmated Plover					2	2	3		3	2		8				-	1.67
Killdeer		2	1				1				1			7	7	1.00	1.33
American Oystercatcher (NJ-SC)							4	1			4					-	0.75
Spotted Sandpiper					2		1									-	0.25
Greater Yellowlegs				1						1				2		-	0.33
Willet	14	38	19	4												23.67	0.33
Lesser Yellowlegs						1										-	0.08
Whimbrel (NJ-SC)										2	1					-	0.25
Ruddy Turnstone						1										-	0.08
Sanderling (NJ-SC, <i>Yellow WatchList</i> )						1	3									-	0.33
Semipalmated Sandpiper ( <i>Yellow WatchList</i> )					9	1				1		19				-	2.50
Least Sandpiper				7	5	14	13	8		2				5		-	4.50
Peep sp.							3		40	4						-	3.92
Short-billed Dowitcher						1		7								-	0.67
Dowitcher sp.						1		2								-	0.25
<b>Total abundance</b>	<b>14</b>	<b>40</b>	<b>20</b>	<b>12</b>	<b>18</b>	<b>22</b>	<b>32</b>	<b>20</b>	<b>45</b>	<b>12</b>	<b>6</b>	<b>28</b>	<b>-</b>	<b>14</b>	<b>7</b>	<b>24.67</b>	<b>18.00</b>
<b>Total species</b>	<b>1</b>	<b>2</b>	<b>2</b>	<b>3</b>	<b>4</b>	<b>8</b>	<b>8</b>	<b>5</b>	<b>3</b>	<b>6</b>	<b>3</b>	<b>3</b>	<b>-</b>	<b>3</b>	<b>1</b>	<b>2</b>	<b>17</b>

<sup>1</sup> Species listed as endangered (E) or threatened (T) in New Jersey are indicated in boldface; special concern (SC) and *WatchList* species are noted; see Section 1.0. No federally listed species were observed.

Table 5.2.2-1 displays the abundance of shorebird species by date. The most abundant shorebird was Willet during the spring period, but peeps – particularly Semipalmated and Least sandpipers – were relatively abundant in fall.

Tables 5.2.2-2 and 5.2.2-3 examine shorebird abundance by tide. As in plot surveys, the same pattern occurred: observed spring abundance was not significantly different from expected abundance based on the proportion of tides. In fall, however, there was a very significant difference. Again, we believe this pattern resulted from Willet being generally visible at all tides, while Least Sandpiper and other species “disappeared” into channels at low tide.

**Table 5.2.2-2. Chi-square test examining shorebird abundance by tide during spring**

	Tidal phase				Total	
	High	Falling	Low	Rising		
Plot surveys conducted	3.0	-	10.0	5.0	18.0	
Observed shorebirds	32.0	-	32.0	10.0	74.0	
Expected shorebirds	37.0	-	24.7	12.3	74.0	p = 0.19

**Table 5.2.2-3. Chi-square test examining shorebird abundance by tide during fall**

	Tidal phase				Total	
	High	Falling	Low	Rising		
Plot surveys conducted	7.0	2.0	10.0	5.0	24.0	
Observed shorebirds	147.0	-	67.0	76.0	290.0	
Expected shorebirds	84.6	24.2	120.8	60.4	290.0	p < 0.001

Table 5.2.2-4 examines flight height and distance. Most shorebirds (96.9%) recorded in general surveys were found to fly at altitudes below 60 m, and nearly half (47.9%) did not exceed 30 m in altitude.

**Table 5.2.2-4. Shorebird flight height with distance (N = 288)**

Altitude	Distance				Total
	0-100m	101-200m	201-300m	>300m	
>120m	0.0%	0.0%	0.0%	0.0%	0.0%
61-120m	1.0%	0.7%	0.0%	1.4%	3.1%
30-60m	3.5%	21.5%	6.9%	17.0%	49.0%
<30m	12.8%	15.3%	9.4%	10.4%	47.9%
	17.4%	37.5%	16.3%	28.8%	100.0%

Only 17.4% of shorebirds were found to fly within 100 m of the observation point near the turbine location, and nearly three-quarters of those birds flew below 30 m. This appears to show that few shorebirds flew in the vicinity of the BRSA turbine site, and those that did flew low over the salt marsh, at altitudes below the rotor-swept zone (RSZ).

The largest shorebird flock observed had 40 peeps that were flying from north to west. The second largest flock had 14 Semipalmated Sandpipers that flew from southwest to northeast. No other flocks exceeded 10 individuals, and average flock size was 2.3 shorebirds/observation.

### **5.3 Discussion**

The above analysis characterizes pre-construction shorebird use of the BRSA site, as well as adjacent habitats of the Conaskonk Point area. Maximum abundances recorded in single, half-hour surveys of Conaskonk Point were 25 shorebirds in spring and 44 shorebirds in fall. This computes to 12.5 shorebirds/km and 22.0 shorebirds/km when the 2-km length of shoreline along Conaskonk Point is considered. These abundances are minimal when compared with the mean of 1,351 shorebirds/km that Clark et al. (1993) recorded during peak spring migration along 160 km of shoreline in Delaware Bay. Willet, which breeds locally, dominated spring shorebird observations, suggesting that the numbers of shorebirds that used the study area were actually less than indicated by the averages computed above. If shorebirds are using the Conaskonk Point area and adjacent areas of the Raritan Bayshore, they were well beyond detection distances from our observation sites.

Few shorebirds were found to fly in the vicinity of the BRSA turbine site, and those that did mostly flew at altitudes below the rotor-swept zone (RSZ).

## **6.0 Wintering Bird Surveys**

### **6.1 Methodology**

See Section 5.1. The methodology was the same as that employed for the Migrating Shorebird Surveys, using the same six 4-ha plots and observation points and the same general observation point. In addition to shorebirds, however, data were collected on waterfowl, other waterbirds, raptors, and landbirds. Observations were conducted on seven days (2, 14, 21, and 28 November and 5, 11, and 18 December) and at different tides. Weather was favorable on all observation days.

### **6.2 Results**

#### **6.2.1 Plot Surveys**

Table 6.2.1-1 presents the species recorded and their mean density in plots over the seven dates sampled. Note that waterfowl were the most abundant waterbirds, making up 93.5% of all waterbirds recorded. Canada Goose (1.05 birds/ha) was the most abundant waterfowl in plots, followed by American Black Duck (0.99), Brant (0.79), Mallard (0.42), and Snow Goose (0.18). All other waterfowl were scarce by comparison. Other waterbirds (e.g., shorebirds, herons, cormorants, etc.) were relatively scarce.

Waterbirds occurred at relatively low abundance and diversity in plot 1 adjacent to the turbine location. They were recorded at lower values only in plot 6. Plot 5, along the shore of Raritan Bay, had the greatest abundance and diversity of waterbirds. Thus, it appears that there is a gradient of abundance for waterbirds with fewer close to the brushy edge of the marsh where the turbine will be located and more individuals farther out on the marsh.

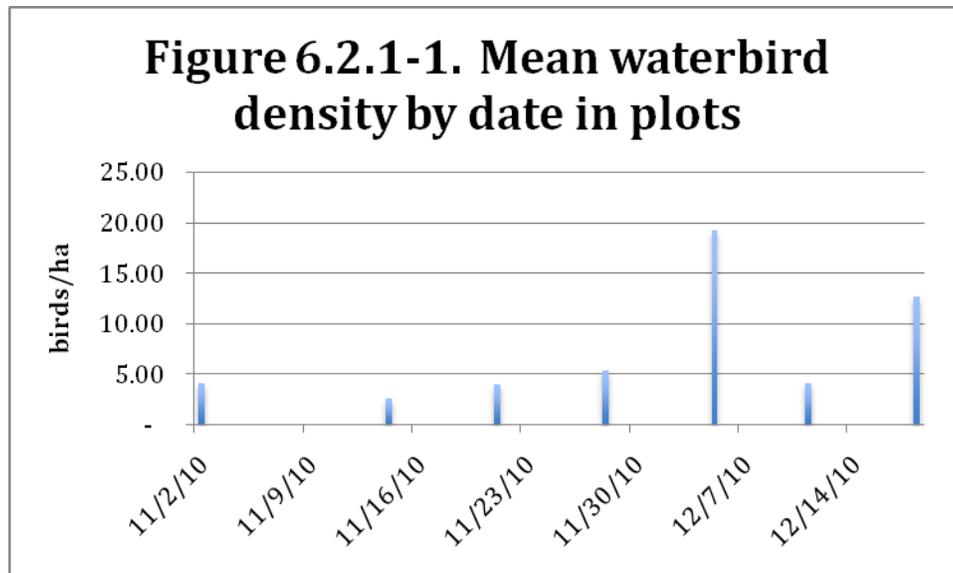
Raptor abundance was low in all plots. The New Jersey special-concern Northern Harrier was most abundant, recorded at an overall mean of 0.04 birds/ha. Landbird abundance was generally low. Only Song Sparrow (0.23 birds/ha) and Yellow-rumped Warbler (0.21) were relatively abundant.

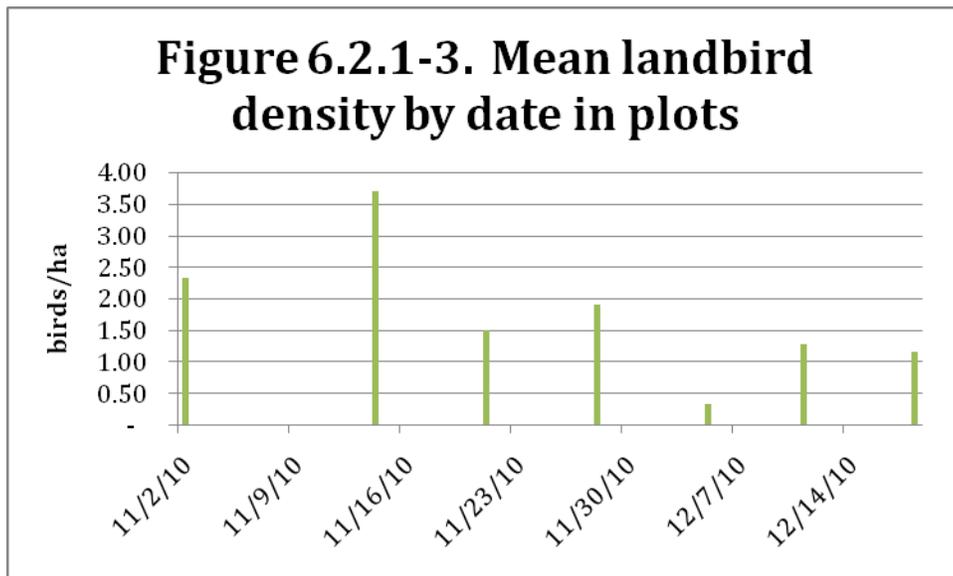
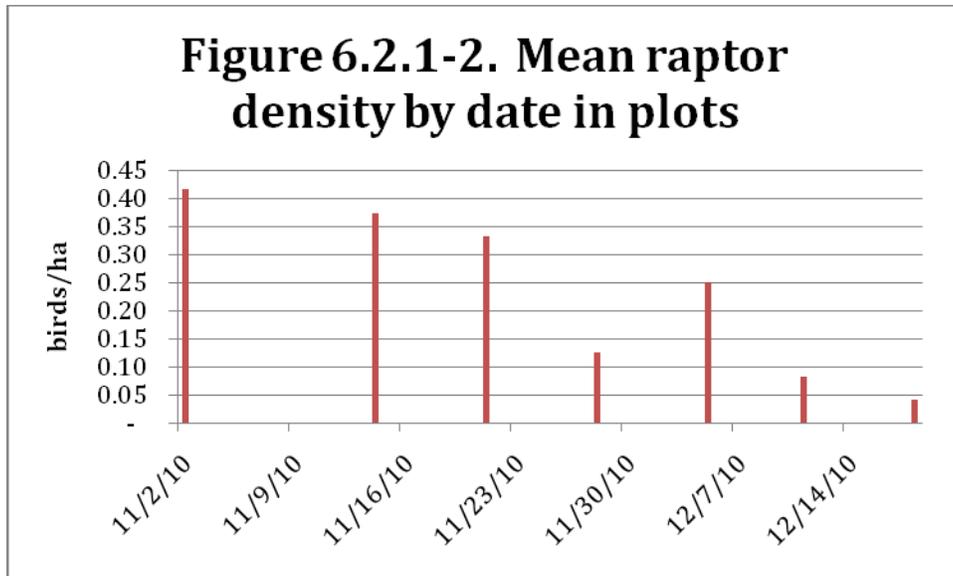
**Table 6.2.1-1. Mean species density (birds/ha) at plots in winter**

Species <sup>1</sup>	Plot 1	Plot 2	Plot 3	Plot 4	Plot 5	Plot 6	Mean
<b><i>Waterbirds</i></b>							
Snow Goose	-	-	1.11	-	-	-	<b>0.18</b>
Brant	-	-	-	1.16	3.61	-	<b>0.79</b>
Cackling Goose	-	-	-	-	0.02	-	<b>0.00</b>
Canada Goose	0.86	3.21	1.39	0.16	0.70	-	<b>1.05</b>
Wood Duck	-	-	0.05	-	-	-	<b>0.01</b>
Gadwall	0.05	-	-	-	-	-	<b>0.01</b>
American Black Duck	0.41	0.36	1.38	1.59	1.11	1.11	<b>0.99</b>
Mallard	0.64	0.48	0.64	0.30	0.20	0.27	<b>0.42</b>
Green-winged Teal	-	-	0.02	-	-	-	<b>0.00</b>
Hooded Merganser	-	-	-	0.05	-	-	<b>0.01</b>
Red-throated Loon	-	-	-	-	0.02	0.02	<b>0.01</b>
Double-crested Cormorant	-	0.11	-	0.11	0.16	-	<b>0.06</b>
Great Blue Heron	0.05	0.04	0.07	0.05	0.02	0.07	<b>0.05</b>
Great Egret	-	0.02	-	-	-	-	<b>0.00</b>
Black-bellied Plover	0.02	-	-	0.02	-	-	<b>0.01</b>
Killdeer	0.04	0.04	0.09	-	0.02	-	<b>0.03</b>
Greater Yellowlegs	-	-	-	-	0.02	0.02	<b>0.01</b>
Sanderling (NJ-SC, <i>Yellow WatchList</i> )	-	-	-	-	0.43	-	<b>0.07</b>
Dunlin	-	-	-	0.02	-	-	<b>0.00</b>
<b>Mean abundance</b>	<b>2.07</b>	<b>4.25</b>	<b>4.75</b>	<b>3.46</b>	<b>6.29</b>	<b>1.48</b>	<b>3.72</b>
<b>Species diversity</b>	<b>7</b>	<b>7</b>	<b>8</b>	<b>9</b>	<b>11</b>	<b>5</b>	<b>19</b>
<b><i>Raptors</i></b>							
Turkey Vulture	-	-	-	-	-	0.02	<b>0.00</b>
<b>Bald Eagle (NJ-T)</b>	-	-	0.04	-	-	-	<b>0.01</b>
Northern Harrier (NJ-SC)	0.07	0.07	0.02	0.04	0.05	0.02	<b>0.04</b>
Sharp-shinned Hawk (NJ-SC)	0.02	0.02	0.02	0.02	-	0.07	<b>0.02</b>
<b>Cooper's Hawk (NJ-T)</b>	-	0.02	0.02	-	0.02	0.05	<b>0.02</b>
<b>Red-shouldered Hawk (NJ-T)</b>	0.02	-	-	-	-	-	<b>0.00</b>
Red-tailed Hawk	0.02	-	-	-	0.02	0.02	<b>0.01</b>
<b>Peregrine Falcon (NJ-E)</b>	-	-	0.04	-	0.02	-	<b>0.01</b>
<b>Mean abundance</b>	<b>0.13</b>	<b>0.11</b>	<b>0.13</b>	<b>0.05</b>	<b>0.11</b>	<b>0.18</b>	<b>0.12</b>
<b>Species diversity</b>	<b>4</b>	<b>3</b>	<b>5</b>	<b>2</b>	<b>4</b>	<b>5</b>	<b>8</b>
<b><i>Landbirds</i></b>							
Mourning Dove	0.04	-	-	-	-	0.02	<b>0.01</b>
Downy Woodpecker	-	0.02	-	-	-	-	<b>0.00</b>
Northern Flicker	0.04	0.04	-	-	0.02	-	<b>0.01</b>
American Crow	-	-	0.05	0.02	-	-	<b>0.01</b>
Horned Lark (NJ-SC)	-	-	0.02	-	0.04	-	<b>0.01</b>
Carolina Chickadee	-	0.02	-	-	-	-	<b>0.00</b>
Marsh Wren	-	0.02	0.02	-	-	0.02	<b>0.01</b>
Golden-crowned Kinglet	0.02	-	-	-	0.02	0.04	<b>0.01</b>
Ruby-crowned Kinglet	-	0.02	-	-	-	0.04	<b>0.01</b>
Northern Mockingbird	-	-	-	-	-	0.02	<b>0.00</b>
American Pipit	-	-	-	0.02	0.02	-	<b>0.01</b>
Yellow-rumped Warbler	0.36	0.55	-	-	0.04	0.29	<b>0.21</b>

<b>Species<sup>1</sup></b>	<b>Plot 1</b>	<b>Plot 2</b>	<b>Plot 3</b>	<b>Plot 4</b>	<b>Plot 5</b>	<b>Plot 6</b>	<b>Mean</b>
Palm Warbler	0.02	-	-	-	-	-	<b>0.00</b>
Common Yellowthroat	-	0.04	-	-	-	-	<b>0.01</b>
American Tree Sparrow	0.02	0.02	-	-	-	0.02	<b>0.01</b>
Savannah Sparrow	-	-	0.11	0.02	0.07	-	<b>0.03</b>
Nelson's Sparrow ( <i>Yellow WatchList</i> )	-	-	-	0.07	0.02	-	<b>0.01</b>
Saltmarsh Sparrow ( <i>Red WatchList</i> )	-	-	-	-	0.02	-	<b>0.00</b>
Seaside Sparrow ( <i>Red WatchList</i> )	-	-	0.02	0.02	0.04	-	<b>0.01</b>
Song Sparrow	0.32	0.63	-	0.02	0.05	0.38	<b>0.23</b>
Swamp Sparrow	0.05	0.18	-	-	-	0.05	<b>0.05</b>
White-throated Sparrow	-	-	-	-	-	0.05	<b>0.01</b>
Dark-eyed Junco	-	-	-	-	-	0.02	<b>0.00</b>
Snow Bunting	0.02	-	-	-	0.04	-	<b>0.01</b>
Northern Cardinal	-	0.07	-	-	-	0.02	<b>0.01</b>
Red-winged Blackbird	0.02	0.05	-	-	-	-	<b>0.01</b>
Rusty Blackbird ( <i>Yellow WatchList</i> )	-	-	-	-	-	0.02	<b>0.00</b>
Boat-tailed Grackle	-	-	0.04	-	-	-	<b>0.01</b>
Brown-headed Cowbird	-	-	0.38	-	-	-	<b>0.06</b>
Purple Finch	-	-	-	-	-	0.02	<b>0.00</b>
House Finch	-	-	-	-	-	0.09	<b>0.01</b>
American Goldfinch	0.09	-	0.21	0.05	-	0.14	<b>0.08</b>
<b>Mean abundance</b>	<b>0.98</b>	<b>1.64</b>	<b>0.84</b>	<b>0.21</b>	<b>0.36</b>	<b>1.21</b>	<b>0.88</b>
<b>Species diversity</b>	<b>11</b>	<b>12</b>	<b>8</b>	<b>7</b>	<b>11</b>	<b>16</b>	<b>32</b>
<b>Total mean abundance</b>	<b>3.18</b>	<b>6.00</b>	<b>5.71</b>	<b>3.73</b>	<b>6.75</b>	<b>2.88</b>	<b>4.71</b>
<b>Total species diversity</b>	<b>22</b>	<b>22</b>	<b>21</b>	<b>18</b>	<b>26</b>	<b>26</b>	<b>59</b>

<sup>1</sup> Species listed as endangered (E) or threatened (T) in New Jersey are indicated in boldface; special concern (SC) and *WatchList* species are noted; see Section 1.0. No federally listed species were observed.





Figures 6.2.1-1, 6.2.1-2, and 6.2.1-3 chart mean density in plots by date for waterbirds, raptors, and landbirds respectively. Waterbird density peaked in December, while raptor and landbird densities appeared to decrease from November to December.

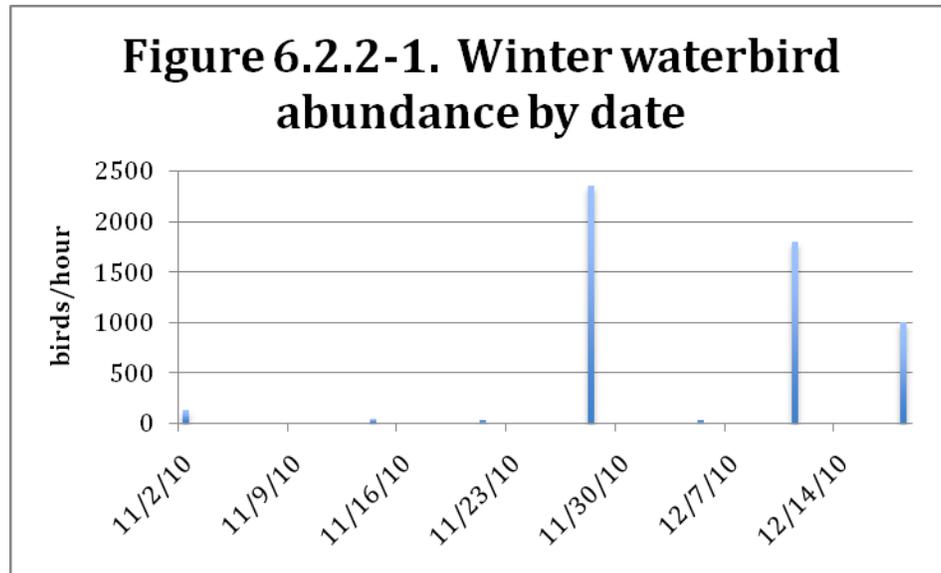
**Table 6.2.1-2. Chi-square test examining waterbird abundance by tide during winter**

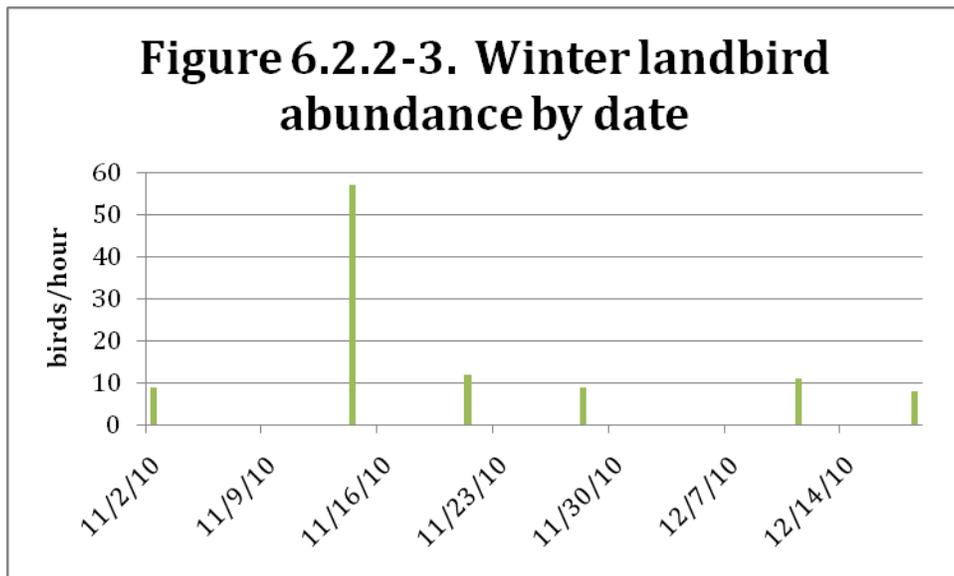
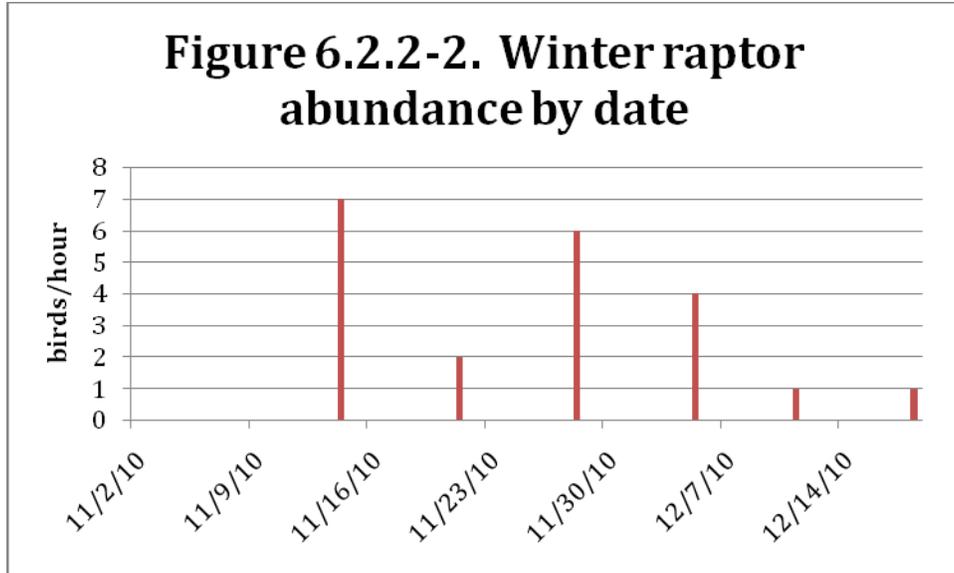
	Tidal phase				Total	
	High	Falling	Low	Rising		
Plot surveys conducted	28.0	14.0	33.0	9.0	84.0	
Observed waterbirds	304.0	423.0	416.0	106.0	1,249.0	
Expected waterbirds	416.3	208.2	490.7	133.8	1,249.0	p < 0.001

When waterbird abundance was examined by tide (Table 6.2.1-2), observed values were significantly different from expected values. The reason for this is uncertain.

### 6.2.2 General Surveys

The abundance pattern in the general surveys was similar to that in the plot surveys: waterbird abundance peaked in December, while raptor and landbird abundance decreased from November to December.





With respect to use of the airspace, waterbirds (Table 6.2.2-1) generally flew far from the turbine site. Indeed, over 4,500 scaup were recorded in flight over Raritan Bay at an estimated distance of 1 km or more from the observation point.

With respect to raptors (Table 6.2.2-2), few were recorded flying within 100 m of the turbine site, and those that did flew at low altitudes. With respect to landbirds (Table 6.2.2-3), most were recorded close to the turbine location, but this was a function of suitable habitat (i.e., the disturbed shrubland) being concentrated closer to the turbine location. The landbirds recorded flying in the 61-120 m altitude zone consisted of a flock of 18 Common Grackles and flocks of 8 and 16 American Robins.

**Table 6.2.2-1. Waterbird flight height with distance in winter (N = 5,411)**

Altitude	Distance				Total
	0-100m	101-200m	201-300m	>300m	
>120m	0.0%	0.0%	0.0%	0.0%	<b>0.1%</b>
61-120m	0.1%	0.0%	0.2%	2.2%	<b>2.5%</b>
30-60m	0.1%	0.6%	0.3%	84.9%	<b>85.8%</b>
<30m	0.4%	0.9%	0.6%	9.7%	<b>11.6%</b>
	0.6%	1.6%	1.1%	96.7%	<b>100.0%</b>

**Table 6.2.2-2. Raptor flight height with distance in winter (N = 18)**

Altitude	Distance				Total
	0-100m	101-200m	201-300m	>300m	
>120m	0.0%	0.0%	0.0%	5.6%	<b>5.6%</b>
61-120m	0.0%	22.2%	0.0%	0.0%	<b>22.2%</b>
30-60m	11.1%	5.6%	0.0%	11.1%	<b>27.8%</b>
<30m	11.1%	5.6%	16.7%	11.1%	<b>44.4%</b>
	22.2%	33.3%	16.7%	27.8%	<b>100.0%</b>

**Table 6.2.2-3. Landbird flight height with distance in winter (N = 62)**

Altitude	Distance				Total
	0-100m	101-200m	201-300m	>300m	
>120m	0.0%	0.0%	0.0%	0.0%	<b>0.0%</b>
61-120m	67.7%	0.0%	0.0%	0.0%	<b>67.7%</b>
30-60m	6.5%	0.0%	0.0%	0.0%	<b>6.5%</b>
<30m	21.0%	0.0%	0.0%	4.8%	<b>25.8%</b>
	95.2%	0.0%	0.0%	4.8%	<b>100.0%</b>

As already noted, the largest flocks of waterfowl were composed of scaup and were observed at 1 km from the observation point, over Raritan Bay. Flocks of 2,200 and 1,500 scaup were observed to fly from northeast to west, and a flock of 850 scaup was observed to fly from north to west. Flocks of 120 and 140 Brant were observed to fly from north to west at distances of about 0.5 km from the observation point. No other waterfowl was observed in flocks exceeding 15 individuals.

### **6.3 Discussion**

This analysis characterizes pre-construction abundances of wintering birds at the project site and adjacent Conaskonk Point marshes. Wintering bird abundance was low in salt marsh and shrubland habitats in the vicinity of the turbine location, with no bird species recorded at greater than 1 individual/ha in plot 1. Large numbers of birds, however, were observed about 1 km north of the turbine location on Raritan Bay, but they consisted of thousands of scaup, which are highly unlikely to fly in the vicinity of the turbine.

## 7.0 Conclusions

The five studies conducted between 5 June and 18 December 2010 characterize pre-construction conditions with respect to breeding birds, fall songbird migrants, fall raptor migrants, spring and fall shorebird migrants, and wintering birds in the vicinity of the site of the BRSA turbine. These studies confirm the seasonal characterization of the avifauna found in the Phase I Avian Risk Assessment (Kerlinger and Guarnaccia 2008) conducted for the BRSA project. In summary, these studies found the following:

**Breeding birds:** The breeding bird community that is located within disturbed shrubland near the turbine was composed of mostly common, widespread species. No federally listed species were observed. No New Jersey special-concern species were found as breeders. Adjacent salt marsh, however, contained the New Jersey special-concern Saltmarsh Sparrow (also Red WatchList) at relatively low abundance, as well as other salt marsh specialists. Cooper's Hawk (New Jersey threatened) may have nested somewhere close to the BRSA site or in nearby Union Beach.

**Fall songbird migrants:** Songbird migrants were not observed in particularly concentrated numbers and those that were present were mostly in disturbed shrubland and grassy lawns surrounding the BRSA facility, and to a lesser extent brush or marsh nearby. On 9 October, when the greatest diversity and abundance of songbirds were recorded, 50 minutes of sampling yielded only 24 species. On that date, the average number of birds in five 10-minute point counts was 29.8 individuals, of which Yellow-rumped Warbler (mean of 10.6 individuals) and Song Sparrow (mean of 4.2 individuals) made up about one-half of the individuals recorded.

**Fall raptor migrants:** The passage rate of raptors at Conaskonk Point was low relative to globally significant and well known hawk watches. Observations totaling 132 hours tallied 421 raptors, yielding a seasonal passage rate of 3.2 raptors/hour. While no federally listed species were observed eight of the 13 species recorded have New Jersey special-status, including the New Jersey endangered Peregrine Falcon (seasonal passage of 0.18 individuals/hour; daily high of 0.92); threatened Bald Eagle (0.11; 0.42), Cooper's Hawk (0.33; 2.00), and Red-shouldered Hawk (90.04; 0.12); and special-concern Northern Harrier (0.38; 1.67), Sharp-shinned Hawk (0.39; 2.33), Northern Goshawk (0.01; 0.12), and American Kestrel (0.05; 0.21). Migrants were spread over a wide area from inland of the facility to the edge of Raritan Bay.

**Shorebird migrants:** Shorebirds migrating at or stopping over in the marshes adjacent to Conaskonk Point at the BRSA were not highly concentrated, nor were they present in great diversity or numbers. The BRSA project site is not an important migratory stopover site for shorebirds, nor are the marshes adjacent to the site. Mean shorebird densities in six plots surveyed in spring and fall were relatively low and numbers present were minimal: 1.87 individuals/ha in spring and 2.71 individuals/ha in fall. Willet was the most abundant species in spring (nesting in local marshes), recorded at a mean of 1.55 individuals/ha, while Least Sandpiper was by far the most abundant species in fall, recorded at a mean of 1.38 individuals/ha. When the observed and expected frequencies of shorebirds recorded at different tides were examined, observed numbers in spring were not significantly different from expected values based on the proportion of tides sampled, but in fall the differences were very significant.

We believe this was because Willet, the most abundant spring species, was generally visible at all tides, while Least Sandpiper and other species “disappeared” into channels at low tide in fall. During general observations, few (17.4%) shorebirds (N = 288) were found to fly within 100 m of the observation point near the turbine location, and nearly three-quarters of those birds flew below 30 m, which is below the rotor swept height. The average shorebird flock size was 2.3 individuals, and the largest flock size recorded was 40 individuals. Compared with a mean density of 1,351 shorebirds/km recorded during spring migration along the shores of Delaware Bay, maximum values recorded at Conaskonk Point (12.5 shorebirds/km in spring, 22.0 shorebirds/km in fall) were minimal.

Wintering birds: Waterfowl were the most abundant wintering birds on Conaskonk Point, accounting for nearly 75% of all birds sightings (including raptors and landbirds) recorded in plots. Canada Goose (1.05 birds/ha) was the most abundant waterfowl in plots, followed by American Black Duck (0.99), Brant (0.79), Mallard (0.42), and Snow Goose (0.18). It should be noted that hunting occurs in the marshes immediately adjacent to the BRSA, so densities may have been impacted by this activity. Raptor and landbird abundances were low in comparison. Waterbird density peaked in December, while raptor and landbird densities appeared to decrease from November to December. During general observations totaling seven hours, waterbirds (N = 5,411) were much more abundant in flight than raptors (N = 18) or landbirds (N = 62), but most waterbirds (mostly scaup) were flying far from the turbine site (about 1 km distant) over Raritan Bay, where movement was generally north to west.

Overall, relatively few birds were observed at the BRSA turbine site and very few were observed flying within the rotor swept height zone. No federally listed species were observed. The New Jersey endangered Least Tern (also Red WatchList) was found to use the adjacent salt marshes and tidal creeks only occasionally during the breeding/post-breeding season. All Least Terns were observed far from the turbine location and at altitudes below the rotor-swept zone. The same was true for the New Jersey endangered Black Skimmer (also Yellow WatchList).

## 8.0 References

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