

Appendix 5.7-G

**Fall 2002 – Winter 2003
Waterbirds Survey for the
Cape Wind Energy Project**

**APPENDIX 5.7-G
FALL 2002 AND WINTER 2003 WATERBIRDS SURVEY
FOR THE
CAPE WIND ENERGY PROJECT
NANTUCKET SOUND**

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TABLE OF CONTENTS

<u>SECTION</u>	<u>PAGE</u>
1.0 INTRODUCTION.....	1
2.0 METHODS.....	1
2.1 Location of Study Area and Alternative Sites	1
2.2 Aerial Surveys	2
2.2.1 Within the Study Area	2
2.2.2 Outside the Study Area	2
2.3 Boat Surveys.....	3
2.4 Comparison of Survey Methods.....	4
3.0 RESULTS	4
3.1 Aerial Surveys	4
3.1.1 Species and Abundances	5
3.1.2 Distribution of Waterbirds Within the Study Area	6
3.1.3 Outside the Study Area	7
3.2 Boat Surveys.....	8
3.2.1 Species and Abundances	8
3.3 Altitude of Flying Birds	8
4.0 DISCUSSION.....	9
4.1 Numbers, Distribution and Behavior of Species Present.....	9
4.2 Relative Numbers	11
4.3 Alternative Areas	13
4.4 Significance of the 2002-2003 Aerial and Boat Surveys	13
4.5 Conclusion	13
5.0 LITERATURE CITED.....	13

TABLES

Table 1	Aerial Survey Coverage and Percentage of each Alternative Site Flown
Table 2	Summary of Dates, Times, and Weather Conditions during the Winter Waterbird Boat Survey in Nantucket Sound, 2002
Table 3	Species Observed During the Aerial and Boat Surveys: Fall 2002 – Winter 2003
Table 4	Summary of Dates, Times, and Weather Conditions during the Eleven Fall/Winter Waterbird Aerial Surveys in Nantucket Sound, 2002 and 2003
Table 5	Numbers of Individuals Recorded in the Study Area During Eleven Aerial Surveys and Outside the Study Area on the Extended Flights (September 2002 – February 2003)
Table 6	Densities (individuals/km ²) of Waterbirds observed in the Study Area during Aerial Surveys
Table 7	Boat Survey Observations for October 22 and 24, 2002
Table 8	Altitude of Flying Waterbirds: Numbers Observed From the Boat
Table 9	Numbers of Waterbirds in Alternative 1 and in Regional Populations

FIGURES

Figure 1	Transects for the Fall 2002 – Winter 2003 Avian Surveys within Nantucket Sound
Figure 2	Flightlines for the Additional Routes Outside the Study Area during Fall 2002 – winter 2003 Aerial Surveys

Figure 3 Routes For Spring Summer Boat Surveys 2-7

ATTACHMENTS

- Attachment 1 Numbers of Individuals Observed on Each of the 11 Aerial Surveys In Nantucket Sound, MA, September 2002 - February 2003
- Attachment 2 Distribution of Waterbirds in the Study Area for Aerial Surveys 11-22 Combined.
- Attachment 3 Species Totals and Densities for Waterbirds in the Study Area in 3 Alternative Sites and the Area Outside of the Alternative Sites for Eleven Aerial Surveys Combined
- Attachment 4 Estimated Numbers of Waterbirds in the Study Area Fall 2002/Winter 2003 for Aerial Surveys 11-22.

EXECUTIVE SUMMARY

To evaluate the abundance and distribution of waterbirds during fall and winter in Nantucket Sound, eleven aerial surveys and two boat surveys were conducted between September 25, 2002 and February 21, 2003. The aerial surveys used the same standardized procedures as the previous winter surveys (March – April 2002) and focused on the same study area that included the three alternative sites proposed for installation of wind turbines and the surrounding waters. The surveys were conducted by day in fair weather along north/south transects in a study area of about 322 mi² (834 km²) that encompassed about 58% of Nantucket Sound. During one survey (February 14) substantial areas of the Sound were covered by ice. The study area excluded most of the immediate inshore waters, less than 1.2 miles (2 km) from land. The total distance flown within the study area for each of the aerial surveys was about 258 linear miles (415 km). The survey plane flew at an altitude of about 250 feet (75 m). Birds were counted and identified over a distance of 656 feet (200 m) on each side of the transect (a total transect width of about 1,312 feet (400 m)) resulting in an area of about 65 mi² (168 km²) examined per survey. The boat surveys visited Horseshoe Shoal to record the abundance and behavior of wintering waterbirds.

A total of twenty-seven (27) species of waterbirds were observed during the aerial and boat surveys. Seaducks, including three species of scoters (*Melanitta* spp), Common Eiders (*Somateria mollissima*), and Long-tailed Ducks (*Clangula hyemalis*), accounted for the majority (>90%) of 110,321 individuals observed within the study area and 30,597 observed elsewhere in Nantucket Sound. No listed species (those on the Federal or Massachusetts lists of endangered, threatened, or candidate species) were observed during the surveys, with the exception of seven Roseate Terns on the first aerial survey on September 25. Small numbers of Common Terns (*Sterna hirundo*), a Massachusetts's species of special concern and summer resident, were also observed during this first aerial survey. Common Loons (*Gavia immer*), another Massachusetts species of special concern, were observed on all 11 aerial surveys and were relatively evenly distributed throughout the study area. During the aerial surveys, more than 90% of all species, except gannets and gulls, were first observed sitting on the water (resting or foraging). For several species, numbers increased in November and remained relatively stable for the remaining counts.

The numbers of waterbirds within all of the alternative sites surveyed comprised less than about one percent of the Atlantic Flyway or eastern North American populations of these species, although the cumulative number using these areas was likely to have been greater due to turnover. The densities of seaducks (the most common species) varied greatly among the alternative sites. Eider and Long-tailed Duck densities were greatest outside the three alternative sites. Eider density outside of the alternative sites was nearly twenty times the density within Alternatives 2 and 3, and almost 3 times the density of Alternative 1. Long-tailed Duck densities outside of the alternative sites were 3.7, 2.1 and 1.7 times that of the three alternative sites. Scoter densities were highest in Alternative 2, greater than six times that of Alternative 1, the proposed Wind Park site. Gulls (*Larus sp.*), Razorbills (*Alca torda*), loons (*Gavia sp.*), and Northern Gannets (*Morus bassanus*) were more evenly distributed; there were no conspicuous differences in densities of these species between alternative sites and outside of those sites.

Although neither of the survey methods (plane nor boat) enabled exact measurements of the height at which individual birds were flying, very few (33) of 111,082 birds were observed in the height range of the proposed wind turbine rotors (75 – 417 feet (23 – 127 m)).

In summary, the density of waterbirds observed within the three alternative sites in Nantucket Sound considered for the proposed Wind Park were either smaller than or the same as those in the waters surrounding these areas, except for scoters which had their highest density in Alternative 2. The overall numbers of most species present within Nantucket Sound during late winter appear to be lower than in spring, when portions of the Sound become a staging area for several species (See Appendix 5.7-D).

1.0 INTRODUCTION

Paragraphs preceded by * contain only information that is repeated in each of the relevant Appendices, although wording may differ. These paragraphs refer principally to the background and the methods used. The material is repeated so that each report is a stand-alone document.

This report forms part of a series describing the waterbirds utilizing Nantucket Sound. A second year of study was conducted to corroborate the findings of the earlier studies in the winter/spring of 2002 (five flights: March 17 to April 5). The results of the earlier study are presented in Appendix 5.7-D.

This report provides information about the types and numbers of birds that occurred in Nantucket Sound and nearby areas during eleven (11) aerial and two boat (2) surveys from September 2002 – February 2003, focusing on the areas within and around the three alternative wind park sites identified by the Applicant (Alternatives 1, 2, and 3). The survey methods used are comparable to those used by the waterbird biologists who determine population and hunting harvest levels for the MADFW and the USFWS. The principal goal of this study was to extend the quantitative material reviewed by Kerlinger and Hatch (Appendix 5.7-A, 2001) in their preliminary risk assessment and the late winter/spring 2002 report (Appendix 5.7-D) by providing data from a second winter of research, to be used to assess the potential for Project impacts to waterbirds that use Nantucket Sound during the winter.

To provide a context for the surveys, additional observations on the distribution of species were made while in transit to/from the study area, principally in near-shore areas of the Sound. A survey of waterbirds outside Nantucket Sound, including Nantucket Shoals, was flown on April 14, 2003 when many wintering birds remained. This survey will be reported with subsequent surveys (March-October 2003) in the FEIS.

2.0 METHODS

2.1 Location of Study Area and Alternative Sites

*The same area examined in the late winter-early spring 2002 surveys was used for the fall 2002-winter 2003 surveys (Figure 1). This study area excludes almost all waters within 1.2 miles (2 km) of the shore because such areas commonly have a different avifaunal community from the principal areas of concern. A small portion of the study area, approximately 5 mi² (13 km²), is within the 1.2 miles (2 km) of land (near Muskeget Island at the southern edge). This area was included in the study area due to its proximity to Alternative 2 and because Muskeget Island extends into Nantucket Sound. The study area covers approximately 322 mi² (834 km²) (or about 58% of the area of Nantucket Sound). The area of each alternative site and that portion of the study area surrounding them are summarized in Table 1. The same area was examined in all surveys conducted for this study. The three alternative sites are:

- Alternative #1-Horseshoe Shoal, the Proposed Site for the Wind Park;
- Alternative #2-named Monomoy-Handkerchief Shoal, an area in the northeast part of the Sound; and
- Alternative #3-named Tuckernuck Shoal, an area south and west of the main shipping channels.
-

*The total distance flown for each of the aerial surveys was approximately 258 linear miles (415 km). The surveys were conducted at an altitude of about 250 feet (75 m). Birds were counted and identified over a distance of 656 feet (200 m) on each side of the transect (a total of 1,312 feet (~400 m)) resulting in a total area of approximately 65 mi² (168 km²) for each survey (Table 1).

**Table 1
Aerial Survey Coverage and Percentage of each Alternative Site Flown**

Alternative Site	Study Area (km²/mi²)	Kilometers²/Miles² Surveyed	% Area Surveyed
1	110 (42.5)	21.0 (8.1)	19
2	52 (20.1)	9.8 (3.8)	19
3	89 (34.4)	16.8 (6.5)	19
OUTSIDE	582 (224.7)	120.4 (46.5)	21
TOTAL	834 (322.0)	168.0 (64.9)	20

2.2 Aerial Surveys

2.2.1 Within the Study Area

Eleven aerial surveys of the study area were flown on September 25, October 8 and 21, November 20 and 25, December 13 and 27, 2002, January 6 and 12, and February 14 and 21, 2003. Extensive ice was present on one day, February 14, 2003. The goal of these surveys was to measure bird densities (numbers per unit area) by means of standardized protocols developed for use throughout the year.

*The survey plane was a Cessna-206 floatplane, flying at 250 feet (75 m) above sea level at an air speed of 90 knots (167 km/h). Plane altitude was a compromise between covering as large an area as possible, identifying and counting the birds seen, and putting as few birds as possible to flight before counting. For each survey, sixteen pre-determined systematic transects (Figure 1) were flown in north/south directions, with approximately 1.2 miles (2 km) between each transect. Surveys were flown at different times of day, at different tides and in varying weather (see Section 3.1, Table 3), but visibility was good during every survey. Flights were also varied in their starting point and direction of flight.

*Two observers were employed, one on each side of the plane. To identify outer transect boundaries, an aluminum rod was attached perpendicular to the wing strut on each side of the plane. The placement of these rods was determined with a clinometer to measure the calculated angle and the distances were verified by flying over the airport at 250 feet (75 m) using pre-measured 200-meter (656 feet) markers on the ground. The area visible between the float on the plane and the aluminum rod provided each observer with a 200-meter (656 foot) transect width within which all birds were counted. Additional sightings beyond the transect were recorded incidentally but were not used for density calculations.

*The survey team consisted of the pilot, a data recorder, and two observers (Jeremy Hatch and Jeffrey Burm) who sat on either side of the plane in the back seats. The pilot was responsible for keeping the plane on transect, at the correct altitude and speed, and for maintaining the wing level attitude. The data recorder and observers were in direct communication through aviation headsets. The observers identified species, number, activity and time of sighting. The data recorder was responsible for entering the data conveyed by the observers. Each observer's sightings were also recorded on independent audiotapes linked directly to each headset to provide a recording as backup for each observer.

Bird altitudes were estimated in relation to the height of the plane and the bird's apparent distance from the water. They were conveyed to the data recorder in 30-foot (10 meter) increments. Although this methodology was not precise, it was sufficient to show if birds were within or near the rotor swept zone (75-417 feet (23 to 127 m) above MLLW). In practice, few birds were observed at altitudes near the rotor swept zone so that the imprecision did not affect the conclusions.

*For compiling data from aerial surveys it is assumed that all individuals detected within a transect are recorded and that individuals are recorded only once. Based upon previous experience in Nantucket Sound, few birds were flushed by the plane and those individuals tended to circle round and settle near where they had been earlier. The number of individuals that flew far enough to be counted in adjacent transects was probably negligible, although we have no data to confirm this.

2.2.2 Outside the Study Area

In addition to the systematic surveys of the study area, observations were made in nearby areas to provide a wider context for interpreting the surveys. These additional observations included opportunistic extensions of the eleven systematic surveys, principally along selected shorelines of Nantucket Sound, Vineyard Sound and Buzzards Bay (Figure 2) while in transit to and from the study area. These additional areas were sometimes flown at higher altitudes and provide information on birds sighted, but these data were not used for calculating densities within the central study area. In addition to these opportunistic routes, one systematic survey of areas outside of Nantucket Sound, including Nantucket Shoals, was conducted on April 14, 2003, when most wintering

species were still present. This survey used the same observation methods as the systematic aerial surveys of the study area.

Data Compilation for Aerial Surveys

* During the aerial surveys, as observations were made, the data were relayed verbally to the recorder, who entered a GPS point, species type, number and activity into a database using a Trimble GeoExplorer 3C GPS unit. This GPS unit contains a data dictionary with preloaded attributes. Observer sightings were also recorded on an audiotape to provide independent recordings and backup for each observer.

*After each aerial survey, data (rover files) were transferred from the GPS unit to a PC using GPS Pathfinder Office 2.90. Observer entries were verified against the independent audiotapes. Rover files were differentially corrected using base files from the Rhode Island Trimble Reference Station. Corrected rover files were exported as ArcView shapefiles and projected into the Massachusetts State Plane North American Datum 1983. Shapefiles were then plotted on a digital NOAA Nautical Chart (#13237) using a Geographic Information System (GIS) with ESRI Software products. Each observation was assigned a specific location based on the time of the sighting and precise position of the plane (the resulting maps are presented in Attachment 2).

2.3 Boat Surveys

Two boat surveys were conducted on October 22 and 24, 2002 to complement the aerial surveys and to make observations of bird behavior (Figure 3). The survey vessel (the TG) from Patriot Party Boats was a 29-foot (8.8m) Hawk 29 bass boat, with a freeboard of 3 feet (0.9m). Observations were made from a height of about 7 feet (2.1 m) above the water. Surveys were conducted by traveling to areas (including Horseshoe Shoal) where birds were known to forage or roost, and observations were made on species, number, behavior and altitude of flight. No specific transect routes were followed (Figure 3).

*The survey team consisted of the captain and an observer (Jeffrey Burm). The captain was responsible for keeping the boat on course, while the observer recorded species, number of species, activity (i.e. foraging or flying), and altitude of bird into a Global Positioning System (GPS) each time a species was observed. Additional GPS points were recorded at the beginning and end of each transect.

*The altitude at which the waterbirds fly over Nantucket Sound is of particular interest because of concerns about possible collisions with turbine rotors (75-417 feet (23 to 127 m) MLLW). Estimating altitudes at sea is difficult because of the general lack of appropriate "yardsticks". The height above sea level for birds within 328 feet (100 m) of the boat was estimated using bird size, wave height and the boat as benchmarks and placing each estimate into a 20 ft (6 m) interval. In practice, few birds were observed at altitudes near the rotor-swept zone.

**Table 2
Summary of Dates, Times, and Weather Conditions during the Winter Waterbird Boat Survey in Nantucket Sound, 2002**

Survey	Date	Start	Finish	High Tide	Wind	Temp °F	Weather
1	22-Oct	06:00	14:00	13:24	NW 6 Knots	30s	Sunny
2	24-Oct	11:00	17:30	14:35	NW 9 Knots	40s	Sunny

Data Compilation for Boat Surveys

*As observations were made, the GPS point, species type, number of individuals, and activity were entered into a database using a Trimble GeoExplorer 3C GPS unit. This GPS unit contains a data dictionary with pre-loaded attributes. Observer sightings were also recorded on audiotapes to provide independent recordings and backup for the observer.

* After each boat survey, data (rover files) were transferred from the GPS unit to a PC using GPS Pathfinder Office 2.90. Rover files were differentially corrected using base files from the Rhode Island Trimble Reference Station. Corrected rover files were exported as ArcView shapefiles and projected into the Massachusetts State

Plane North American Datum 1983. Shapefiles were then plotted on a digital NOAA Nautical Chart (#13237) using a GIS with ESRI Software products.

2.4 Comparison of Survey Methods

*The aerial and boat surveys provided different information regarding avian use of Nantucket Sound. From the plane, the height chosen (250 ft (75 m)) enabled abundance and density estimates via counts of birds within the transect to be made before the presence of the airplane disturbed them. However, the ability to distinguish and count similar species, especially large numbers in mixed flocks, was reduced because of plane speed. From the boat, observers could more readily identify individual birds to species and count bird flocks since the vessel speed was slower than the airplane. However, birds were disturbed more readily by the presence of the vessel and the low vantage point from the vessel may have resulted in birds being missed because of wave height.

Data from the two boat surveys and the eleven aerial surveys were not combined for compiling quantitative spatial distributions.

3.0 RESULTS

A total of 27 species were observed during the eleven systematic aerial surveys, the aerial surveys conducted outside the study area, and the two boat surveys conducted between September 2002 and February 2003, (Table 3).

3.1 Aerial Surveys

The numerical results consist of counts or estimates of the numbers and identities of birds present in narrow strips on either side of the plane. The large numbers of birds sometimes present precluded any use of distance-sampling (Buckland et al, 1993) which is intended to address the changes of detection-probabilities with distance. Instead, it was assumed that all birds were detected within the narrow transect and we extrapolated directly from the observed densities to calculate numbers for the wider areas of interest. Extensive data are presented numerically and graphically in four Attachments. Maps to show the locations of sightings for each species of interest are presented in Attachment 2. On these maps all the individual sightings are plotted with symbols to indicate number: they do not show densities (individuals per unit area) and symbols overlap in many instances.

Table 3
Species Observed during the Aerial and Boat Surveys:
Fall 2002 - Winter 2003

Common Name	Scientific Name
Red-throated Loon	<i>Gavia stellata</i>
Common Loon	<i>G. immer</i>
Grebe	<i>Podiceps sp.</i>
Sooty Shearwater	<i>Puffinus griseus</i>
Northern Gannet	<i>Morus bassanus</i>
Great Cormorant	<i>Phalacrocorax carbo</i>
Double-crested Cormorant	<i>P. auritus</i>
Great Blue Heron	<i>Ardea herodias</i>
Canada Goose	<i>Branta canadensis</i>
Common Eider	<i>Somateria mollissima</i>
Long-tailed Duck	<i>Clangula hyemalis</i>
Black Scoter	<i>Melanitta nigra</i>
Surf Scoter	<i>M. perspicillata</i>
White-winged Scoter	<i>M. fusca</i>
Goldeneye	<i>Bucephala sp.</i>
Red-breasted Merganser	<i>Mergus serrator</i>
Dunlin	<i>Calidris alpina</i>
Laughing Gull	<i>Larus atricilla</i>
Bonaparte's Gull	<i>L. philadelphia</i>

Common Name	Scientific Name
Ring-billed Gull	<i>L. delawarensis</i>
Herring Gull	<i>L. argentatus</i>
Great Black-backed Gull	<i>L. marinus</i>
Black-legged Kittiwake	<i>Rissa tridactyla</i>
Roseate Tern	<i>Sterna dougallii</i>
Common Tern	<i>S. hirundo</i>
Dovekie	<i>Alle alle</i>
Razorbill	<i>Alca torda</i>

Eleven aerial surveys were conducted between September 25, 2002 and February 21, 2003. Details of the dates, times, tide, and weather conditions are provided in Table 4. Weather varied from survey to survey and included different wind conditions, tides, cloud cover, and precipitation regimes. There was precipitation on only one day consisting of light snow. Flights in heavy rain and wind were deemed too dangerous. On February 14, 2003 ice was widespread in the Sound and covered about one third of the study area.

Table 4
Summary of Dates, Times, Weather and Water Conditions during the Eleven Fall/Winter Waterbird Aerial Surveys in Nantucket Sound, 2002 and 2003

Survey	Date	Start	Finish	Start Point ¹	High Tide ²	Wind	Temp F	Weather
A12	25-Sep-02	14:40	19:00	1 North	15:08	NNE 8-18 Knots	mid 60s	Clear
A13	8-Oct-02	14:30	18:28	1 South	13:56	NNE 6-15 Knots	high50s	Clear
A14	21-Oct-02	14:25	18:40	1 North	12:50	NW 10 Knots	mid 50s	Clear
A15	20-Nov-02	13:15	17:50	16 North	15:22	0-5 Knots	low 50s	Hazy
A16	25-Nov_02	6:15	10:49	16 South	17:55	0-2 Knots	low 30s	Clear
A17	13-Dec-02	6:30	10:49	16 North	7:03	0 knots	high30s	Clear
A18	27-Dec-02	6:50	11:05	16 North	5:33	NNW 13-21 Knots	high20s	Clear
A19	6-Jan-03	9:27	13:27	16 North	14:20	NNE 4-8 Knots	high 20s	Overcast/Snow
A20	12-Jan-03	8:28	12:52	16 North	7:01	NNW 12-24 Knots	low 20s	Hazy
A21	14-Feb-03	9:28	13:17	16 North	9:44	NW 16-21 Knots	mid teens	Cloudy
A22	22-Feb-03	9:37	14:12	16 South	15:20	SW 10 Knots	Low 40s	Clear

¹ Start Point refers to Figure 1.

² High Tide data for Cape Poge, Chappaquiddick Island, Massachusetts (www.harbertides.com)

3.1.1 Species and Abundances

A total of 26 species of waterbirds were observed during the eleven aerial surveys and diverse aerial routes to/from the study area. (One species was seen only during the boat surveys: Sooty Shearwater). Table 5 summarizes the total numbers recorded within and outside the study area. Attachment 1 contains the numbers observed on each survey within and outside the study area. The numbers presented from outside the study area have been broken down to reflect the birds observed in Nantucket Sound, principally along the edges of the Sound, and the birds observed in Vineyard Sound and Buzzards Bay area.

For total counts of birds, six groups of related species were pooled, as follows: (1) scoter: Black, Surf, and White-winged; (2) eider: all eiders were treated as Common Eider, (3) gulls: the two species of large gulls, Great Black-backed and Herring, were pooled when individuals could not be identified readily to species, and small numbers of Ring-billed Gulls could have been present; (4) loons: Common Loons greatly outnumbered Red-throated Loons but species could not always be determined, (5) grebes: Horned and Red-necked, and (6) cormorants: Double-crested and Great.

Within the study area seaducks accounted for more than 90% of all 110,321 birds observed during the aerial surveys (Table 5): scoters (54,924), eiders (25,118) and Long-tailed Ducks (23,715). These proportions (50%: 23%: 21%) are similar to those found in the Winter 2002 surveys (53%: 26%: 14%) - see Appendix 5.7-D. Loons were the next most numerous group, totaling 1,863 sightings. Greater numbers of loons were observed in late November and early December. Cormorants were represented by a total of 1,247 sightings with the largest

numbers observed in September and October. Razorbill sightings totaled 1,080 with an influx in mid-December to mid-January. There were fewer than 1,800 sightings of gulls during the entire study period. The ice cover during the February 14, 2003 survey was associated with declines of grebes, eiders, gulls and razorbills, but not scoters.

Outside the study area, the seaducks similarly predominated, with relatively larger numbers of cormorants, gulls and inshore ducks (Table 5). The study area was sampled more frequently (11 repeated surveys) than the surrounding areas (7 differing routes), so the absolute numbers are not comparable.

3.1.2 Distribution of Waterbirds Within the Study Area

The 10 maps in Attachment 2 summarize the distribution of the major species groups (Loons, Grebes, Northern Gannet, Cormorants, Eider, Long-tailed Duck, Scoters, Merganser, Gulls, and Razorbill) within Nantucket Sound on diverse aerial routes to/from the study area as well as during the eleven aerial surveys; they do not include observations outside of Nantucket Sound.

These maps show that the distribution of some species within the study area was not uniform. There were locations within the study area that had much greater numbers of several species and other areas that had much lower numbers. For example, the largest numbers of eiders were found to the south and southwest of Alternative 3, near Muskeget Island and off Chappaquiddick Island. Another large cluster was found southwest of Monomoy. A smaller cluster was present in the western portion of Alternative 1. These observations are very similar to the distribution documented during the winter 2002 surveys (Appendix 5.7-D). Long-tailed Ducks were found in largest numbers west of Monomoy, and in the southern section of the study area in and around Tuckernuck Shoals.

**Table 5
Numbers of Individuals Recorded in the Study Area during Eleven Aerial Surveys and Outside the Study Area on the Extended Flights (September 2002-February 2003)**

Species	Total Within Study Area	# Surveys Observed	Total Outside Study Area		Total
			Nantucket Sound Area	Vineyard Sound/Buzzards Bay Area	
Loon (2): Common, Red-throated	1,863	11	402	31	2,296
Grebe	97	6	0	0	97
Northern Gannet	187	6	11	103	301
Cormorant (2): Great, Double-crested	1,247	6	5,265	9	6,521
Great Blue Heron	0	0	1	0	1
Canada Goose	25	1	0	0	25
Common Eider	25,118	11	16,350	41,503	82,971
Long-tailed Duck	23,715	10	1,379	0	25,094
Scoter (3): Black, White-winged, Surf	54,924	11	3,887	27,660	86,471
Goldeneye	0	0	25	4	29
Redbreasted Merganser	194	7	283	1	478
Dunlin	20	1	0	0	20
Laughing Gull	4	2	1	0	5
Bonaparte's Gull	531	7	2	10	543
Ring-billed Gull	1	1	0	0	1
Herring Gull	456	11	230	1	687
Great Black-backed Gull	359	11	1,627	1	1,987
Unknown Gull	366	8	1,129	1	1,496
Black-legged Kittiwake	70	4	0	0	70
Roseate Tern	7	1	0	0	7
Common Tern	27	1	2	0	29
Dovekie	30	3	0	0	30
Razorbill	1,080	8	3	11	1,094
Total	110,321		30,597	69,335	210,253

The scoter pattern was not as distinct, but numbers were greatest in the eastern and southern portions of the study area. Other species, like loons and razorbills, were spread more evenly over a much larger area without distinct clusters, also consistent with the winter 2002 surveys. Gannets were present in much smaller numbers compared to the 2002 late winter/spring study. Grebes and mergansers seemed to be more abundant in the southern part of the study area.

The three numerically dominant species groups (scoters, eiders, and Long-tailed Ducks) were not evenly distributed within the study area (Table 6, also see the maps in Attachment 2). Density (individuals per km²) was measured by adding individuals from the eleven aerial surveys and dividing by square kilometers flown within each of the alternatives and outside the alternatives (Attachment 3). The "outside area" is defined as the zone within the Study Area and outside the alternatives. For scoters, the density of birds in Alternative 2 was greater than within any of the other two sites and the "outside area". The density within Alternative 2 was more than 6 times that observed in Alternative 1 and twice that of the "outside area". Alternative 3 had the second highest density of the three areas. For eiders, the density outside of the three alternative sites was much greater than any of the alternatives. The "outside area" hosted about 195 birds per km² vs. 4 to 71 per km² in the three alternative sites. For Long-tailed Ducks, the density was greatest outside the three alternative sites (169/km²), as opposed to within the alternatives and ranged between 45 and 101 per km². Alternative 1 had the lowest density with about 45 per km².

Table 6
Densities (individuals/km²) of Waterbirds Observed within the Study Area during Aerial Surveys

Species	Alternative 1	Alternative 2	Alternative 3	Outside Area*	Total Area Density
Loons	11.19	10.61	14.35	10.66	11.09
Grebe	0.48	0.51	0.71	0.58	0.58
Gannet	0.48	0.00	1.01	1.33	1.11
Eider	70.86	10.20	4.05	194.87	149.51
Long-tailed Duck	44.67	78.88	101.55	168.59	141.16
Scoters	106.14	676.33	527.86	308.96	326.93
Gulls	4.33	3.98	20.60	10.89	10.64
Razorbill	3.67	10.00	5.77	6.71	6.43

*"Outside Area" refers to the area surrounding the three alternative sites within the study area.

The remaining species, including loons, grebes, gannet, gulls, razorbill, and the others were thinly spaced throughout the survey areas. The densities of these groups ranged from a high of 20 gulls per km² in Alternative 3 to a low of zero gannets per km² in Alternative 2. These species were also not distributed evenly. For species such as gulls, the densities in Alternative 3, for example, were five times the densities in Alternatives 1 and 2. Razorbill densities varied by a factor of more than two within the Alternative areas. Among the other species, including loons, grebes, and gannets, differences in densities were less evident.

Waterbird numbers outside and within each alternative of the study area on each survey were estimated by extrapolating observed densities to the entire areas (see Attachment 4). These graphs show the spatial distribution (with the largest numbers outside the alternative areas), and the temporal changes for the most common species or species group observed during each aerial survey.

3.1.3 Outside the Study Area

In addition to individuals observed within the Study Area, Table 5 summarizes the number of individuals observed outside the study area within and outside Nantucket Sound. These numbers are also summarized in Attachment 1 (Table B and C). Cormorants, gulls and eiders were more common outside the study area than within. Large numbers of gulls (2,436 of the 2,989 observed) and cormorants (5,013 of the 5,265 observed) were observed close to Monomoy Island. These species were also observed along the south shore of Cape Cod and the north shore of Nantucket Island, Eiders were observed in large numbers (41,503) outside of Nantucket Sound southwest of Martha's Vineyard and Cuttyhunk, with flocks of up to 5,000 individuals.

Other notable observations from outside the Sound include very large flocks (up to 5,000 individuals) of mixed scoters southwest of Martha's Vineyard, off Gay Head and Squibnocket.

3.2 Boat Surveys

3.2.1 Species and Abundances

A total of 10 species were observed during the boat surveys (Table 7), all of which were also observed during the aerial surveys, with the exception of the Sooty Shearwater. The majority of species observed during the two boat surveys were scoters (641), with White-winged Scoters making up about two-thirds of the total. The next most common species was the Common Eider (77). Sixty Common Eiders were observed in a single flock flying through the study area. Many of the flying seaducks commenced flying after being disturbed by the boat.

**Table 7
Boat Survey Observations for October 22 and 24, 2002**

Species	Flying	On water	Total Number
Red-throated Loon	0	2	2
Common Loon	7	9	16
Sooty Shearwater	1	0	1
Double-crested Cormorant	1	0	1
Common Eider	77	0	77
Long-tailed Duck	19	0	19
Black Scoter	9	6	15
Surf Scoter	2	45	47
White-winged Scoter	123	285	408
Unknown Scoter	169	2	171
Herring Gull	4	0	4
Total	412	349	761

3.3 Altitude of Flying Birds

During the aerial surveys the altitude of flying birds was estimated in relation to the surface of the water and the altitude of the plane. More than 110,000 individuals were observed, most of which were on the water surface or flying close to it. Of those observed flying, only 30 were flying within the range of the rotors (75-417 feet (23-127 m)). Twenty of these individuals were gulls flying at various heights and ten were Long-tailed Ducks observed flying at about 150 feet (46 m) asl. The majority of seaducks observed from the plane were on the water.

When possible, during the boat surveys, the altitude of birds in flight was estimated, usually when they were close to the boat or other reference object. Altitude estimates were made for 412 flying waterbirds (Table 8), of these 333 (81%) were observed flying less than 20 feet (6 m) above the water surface, and only 2 were observed flying above 80 ft (24 m). These included 1 gull and 1 loon flying at approximately 100 feet (31 m) and 110 feet (34 m) respectively, in the southern part of Horseshoe Shoal. Many of the low-flying individuals, especially seaducks, had been flushed by the boat.

**Table 8
Altitude of Flying Waterbirds: Numbers Observed From the Boat**

Species	Altitude (Feet)					Total
	<20	21-40	41-60	61-80	80+	
Loon	2	2	2	0	1	7
Shearwater	1	0	0	0	0	1
Cormorant	1	0	0	0	0	1
Eider	76	1	0	0	0	77
Long-tailed Duck	11	8	0	0	0	19
Scoter	242	61	0	0	0	303
Gull	0	1	1	1	1	4
Total	333	73	3	1	2	412

Although neither of the survey methods (plane or boat) resulted in precise measurements of the height at which individual birds were flying, the accuracy was sufficient to show that very few birds were observed in the height range of the prospective turbine rotors (75-417 feet (23-127 m)).

4.0 DISCUSSION

4.1 Numbers, Distribution and Behavior of Species Present

This section combines the results of the systematic aerial surveys and the boat observations conducted between September 2002 and February 2003 and provides a composite summary and interpretation of the numbers and distribution of each group of birds. The aerial surveys provide quantitative data for the study area, including the alternative sites, but the observations for the other parts of the Sound are not quantitatively comparable. The boat-based observations provide additional information on occurrences as well as behavior.

Loons – Loons were not observed in August 2002 (See Appendix 5.7-F), but were observed in small numbers in the study area during September and October of 2002 from both the boat and the plane. Most were Common Loons (83%), with smaller numbers of Red-throated Loons (14%) and the remainder were not identified to species. Numbers increased significantly in November and December, peaking in mid-December, and then declining in late December. In late February of 2003, their numbers increased again. These changes reflect the timing of migrations in the eastern U. S. and use of Nantucket Sound as a staging area during migration (which peaks in early April). This is consistent with the trend observed in 2002 (See Appendix 5.7-D). A total of 1,863 loons were observed within the study area during the aerial surveys. However, 1,283 of these were observed in the waters surrounding the three alternative sites (11/km²). Loons were evenly distributed in each of the alternative sites (11/km², 10/km², 14/km², respectively).

Loons were also common outside the study area. A total of 402 individuals were observed during the additional flightlines conducted outside the study area but within Nantucket Sound. A total of 18 individuals were observed during the boat surveys also outside the study area, but within Nantucket Sound. They occurred singly or in small parties on the water, rarely flying. The observed occurrences are consistent with historical reports (Veit and Petersen, 1993).

Grebes – These winter residents are seen regularly in coastal waters and were recorded on 6 consecutive surveys of Nantucket Sound beginning in December, 2002. Two species were present: Horned and Red-necked, but were not routinely distinguished. A total of 97 individuals were observed with the majority found in the southern part of the study area. Grebes were observed occurred singly or in small flocks on the water, rarely flying.

Northern Gannet – Northern Gannets were rarely observed in the Study Area except from mid-November to mid-December (181 of 187 observed). After mid-December, few were observed suggesting that most of these birds winter south of Nantucket Sound, which is corroborated by CBCs (National Audubon) and migration counts in New Jersey (Ward and Sutton 2001 and New Jersey Audubon Society/Cape May Bird Observatory unpublished data). CWA Aerial surveys indicated that this species was more abundant in the southern part of the Sound and south of Martha's Vineyard. The peak of northward migration for this species is in April (See Appendix 5.7-D). Some individuals were observed on the water and many were observed flying. Those observed flying during these flights were all close to the water's surface.

Cormorants – Double-crested Cormorants were numerous in September and October 2002 at daytime resting areas on Fernando's Fetch, Bishop & Clerks' Lighthouse, Monomoy Island, and on the sandbars north of Muskeget Island, but were rarely seen thereafter. A total of 1,247 individuals were recorded in the study area, but none of them were observed within the 3 alternative sites. A further 5,265 individuals were observed outside the study area within Nantucket Sound during the same timeframe, of which the majority were observed near Monomoy Island. The large numbers observed in September and October is consistent with the post-breeding dispersal and migration of this species (Ward and Sutton 2001, New Jersey Audubon Society/Cape May Bird Observatory unpublished data). Double-crested Cormorants winter primarily to the south of Nantucket Sound. One Great Cormorant was identified close to shore in February 2003, and others could have been overlooked amongst their smaller congener in the winter surveys.

Common Eider – This species is abundant in the winter. Eiders were observed on all 11 systematic aerial surveys, the boat surveys, and the additional flightline surveys (except for the first flight on September 25, 2002). Few individuals were seen on the first two systematic aerial surveys, but eiders were abundant from mid-October through February. The extensive ice-cover on February 14, 2003 was associated with smaller numbers in the study area. A total of 25,118 eiders were observed within the study area, mostly outside ($195/\text{km}^2$) the three alternative sites, occurring principally in the southwestern section between Muskeget Island and Cape Poge and west of Monomoy Island. Considerable numbers ($71/\text{km}^2$) were observed in the western part of Alternative 1, but few individuals were observed in Alternatives 2 and 3.

Outside of the study area, an additional 57,248 Eiders were observed (16,350 within Nantucket Sound and 41,503 in Vineyard Sound and Buzzards Bay). Eiders sometimes occurred singly or in small parties, but most characteristically were seen in large dense flocks. Recorded flock sizes ranged up to 5,000 individuals, but some flocks extended far beyond the transects and thus were not enumerated completely.

Long-tailed Duck – This species is abundant in the winter. It was observed on all aerial surveys (except the first survey in September) and on the two boat surveys. Few were observed during September and October, and numbers peaked on November 20, 2002 when 10,900 were observed within the study area, north of Muskeget. The greatest influx of migrants appears to be from mid-November into December. Their numbers were relatively stable on all subsequent surveys. A total of 23,715 individuals were observed within the study area during the aerial surveys, occurring in loose flocks numbering up to 300 individuals.

Long-tailed ducks were more common in the waters surrounding the three alternative sites, with the greatest concentrations in the southern and in the northeastern sections of the study area, west of Monomoy. The lowest densities recorded were in Alternative 1 ($45/\text{km}^2$). An additional 1,379 individuals were observed outside the study area within Nantucket Sound.

Long-tailed Ducks are understood to roost at night in Nantucket Sound and then fly in large flocks over Nantucket and Tuckernuck Islands to forage over the Nantucket Shoals during the day (Davis 1997). Several attempts were made during the aerial surveys to investigate this phenomenon but were unsuccessful, in part because the birds start moving before sunrise and continue after sunset.

Scoters – Scoters were the most abundant seabirds observed within Nantucket Sound; for a discussion of the uncertainties of enumerating the three species in the course of aerial surveys, see Appendix 5.7-D. During the present surveys a total 54,924 individuals were recorded within the study area and 3,887 individuals elsewhere within Nantucket Sound. An additional 27,660 individuals were observed outside of Nantucket Sound, the majority of which occurred southwest of Martha's Vineyard and Cuttyhunk. Scoters were observed in large numbers on every systematic flight except for that on September 25, 2002 which was very early in the migration period, when only 54 individuals were observed. Scoters were observed throughout the study area with the highest density recorded in Alternative 2 ($676/\text{km}^2$) and the lowest density recorded in Alternative 1 ($106/\text{km}^2$).

Mergansers – Only Red-breasted Mergansers were identified: a total of 194 individuals were recorded on seven of the aerial surveys (most of them (130) on December 13th). None were observed within the three alternative sites. All were near the shores of Muskeget and Tuckernuck Islands. Considerable numbers were also seen during the additional flights along the southern Cape Cod shoreline.

Gulls – The Bonaparte's gull was the most numerous gull observed in the study area during the aerial surveys. They were encountered mostly between November 2002 and January 2003, usually foraging close to the surface of the water or resting on the water. Great Black-backed and Herring gulls were the two other species that were commonly observed and recorded on every flight and Herring Gulls were observed on both boat surveys. Herring Gulls outnumbered the Great Black-backed Gulls by approximately 25%: a pattern that is the opposite of the summer. However, large flocks of Great Black-backed Gulls were observed on the beaches and sand flats near Monomoy, where they predominate as nesters. During the flights, gulls were more abundant in the southwestern part of the Sound (Alternative 3). The incidental observations from the plane suggest that many more gulls occurred close to the shore than over the open water. Black-legged Kittiwakes were observed on four aerial surveys as well as a few Laughing and Ring-billed Gulls. A small number of the flying gulls were seen near the altitude of the plane (250 feet (75 m)).

Terns – Terns are abundant in Nantucket Sound during the spring and summer (see Appendix 5.7-F) but are generally absent from the Nantucket Sound area between late October and April (Veit and Petersen 1993). Common and Roseate terns were observed in small numbers only during the first aerial survey on September 25, 2002. A total of 27 Common and 7 Roseate Terns were observed, but none occurred within the three alternative sites.

Auks/alcids -- Razorbills are fairly common during the winter in Nantucket Sound. They were observed on eight of the aerial surveys from November 2002 - February 2003. A total of 1,080 individuals were observed within the study area, with highest densities recorded in Alternative 2 (10.0/km²) and lowest densities recorded in Alternative 1 (3.67/km²). This species was relatively evenly distributed in small numbers throughout the rest of the study area. However, the majority of individuals were observed in the areas surrounding the three alternative sites. Dovekies were seen in small numbers (30), mostly with Razorbills.

Five additional species were observed during the studies, including the Sooty Shearwater, Great Blue Heron, Canada Goose, Goldeneye and Dunlin (Table 3). These species were observed in very small numbers indicating that they are not important members of the Nantucket Sound avifauna.

4.2 Relative Numbers

The importance of a site for wintering birds is best assessed in a biologically meaningful way in relation to its importance for regional and local populations. The number of wintering birds in the project area must be evaluated relative to larger units, such as the Atlantic or New England maritime populations to examine potential impacts of the proposed project. Although many waterbirds winter in Nantucket Sound or pass through the area during migration, the numbers observed in the proposed project area (Alternative #1) are generally modest in comparison to the regional (flyway) populations (Table 9). Estimates of these populations are unavoidably imprecise. Reasons for this include uncertainties of origin (where wintering birds breed), as well as difficulties in counting either breeding or wintering birds, and the uncertain numbers of non-breeders. (The principal exception to these generalizations is the Northern Gannet, one of the few wide-ranging species for which all breeders can be counted rather precisely). Furthermore, interpretation of incidental reports of numbers seen is very uncertain. Sources consulted for Table 9 include the recent authoritative accounts for each species in the Birds of North America series (Barr et al 2000, McIntyre and Barr 1997, Mowbray 2002, Robertson and Savard 2002, Bordage and Savard 1995, Brown and Fredrickson 1997, Goudie et al 2000, Savard et al 1998,). These accounts proved to be of limited value, reflecting the extent of knowledge of these species, and did not include totals for the relevant populations but did have indicative numbers. While the numbers of birds are not precisely known, numerical ranges are provided in Table 9 (from available sources) to demonstrate that the numbers of birds observed using the proposed Wind Park site, at any one time, (Alternative 1) were small compared to the regional populations.

Table 9 compares the numbers of the principal species observed in Alternative 1 during the aerial surveys with several measures of relevant populations: the numbers of these species in the waters of Massachusetts in the fall/winter, the North American Atlantic Flyway population, and the numbers killed each year by hunters. The statistic "Average Alternative 1" is an estimate of the average total numbers present and was calculated by adding the total number of individuals observed during the systematic aerial surveys, then dividing by the fraction of the area surveyed (19%), and dividing that total by the number of surveys flown (11 in 2002-2003, 5 in 2002).

Table 9
Numbers of Waterbirds in Alternative 1 and in Regional Populations

Species	Alt. #1 Estimated Numbers: Mean (SD) ⁴		Massachusetts Winter ¹	North American Atlantic Flyway ²	Annual Harvest ³
	2002 ⁵	2003 ⁶			
Loons (2 sp.)	391(391)	112 (106)	300	>75,000	N/A
Northern Gannet	22 (18.4)	5 (4.8)	~10,000	168,000	N/A
Eider	625 (269.7)	712 (610)	180,000-500,000	500,000+	17,000-24,000
Long-tailed Duck	1109 (426.9)	449 (439)	180,000-250,000	250,000+	10,000-13,000
Scoters (3 spp.)	2843 (1841.6)	1067 (902)	30,000	375,000+	18,000

Sources:

¹ The Massachusetts Winter numbers are derived from: Veit and Peterson 1993, Davis 1997, Krohn et al. 1992, Mass Division of Fisheries and Wildlife (Winter Waterfowl Survey).

² North American Atlantic Flyway is defined as extending from the offshore waters of the Atlantic Coast west to the Allegheny Mountains where, curving northwestward across northern West Virginia and northeastern Ohio, it continues in that direction across the prairie provinces of Canada and the Northwest Territories to the Arctic Coast of Alaska.

Numbers are derived from: Cape May Bird Observatory (Ward and Sutton 2001, D. Mizrahi personal comm.), Veit and Peterson 1993, National Audubon Society Christmas Bird Counts.

³ Annual Harvest numbers are for the entire US and are derived from: Martin and Padding 2002, Goudie et al. 2000, and Paul Padding, US Fish and Wildlife personal communication.

⁴ Extrapolated from transects covering 19% of area.

⁵ Five surveys, March – April 2002 (Appendix 5.7-D).

⁶ Eleven surveys, September 2002 – February 2003 (Appendix 5.7-G).

The numbers in Table 9 for Alternative 1 are based on the average numbers observed per km² in that area on each survey. These numbers make for conservative comparisons of wintering birds in the study areas with the biologically relevant populations if the larger counts include staging individuals.

The numbers of Eiders observed in Alternative 1 during both years suggest that the birds using this area represent less than one percent of the regional population (Table 9). For perspective, the annual (legal) hunting kill of eiders in the Atlantic Flyway, is more than twenty times the number of eiders present within Alternative 1 during an average survey.

Long-tailed Ducks and scoters show similar patterns to eiders, with only small numbers observed in Alternative 1 compared to the Atlantic populations and to the annual kills by hunters. For scoters and Long-tailed Ducks, the annual hunting harvest is more than six times and nine times the numbers observed during an average survey, respectively. For both Long-tailed Ducks and scoters the average number observed in Alternative 1 amounted to less than one percent of the Atlantic Flyway population.

For loons and gannets, species that are not hunted, the average numbers observed in Alternative 1 are also less than one percent of the estimated numbers in North American Atlantic Flyway populations (Table 9). For loons the regional numbers are based on those observed passing southern New Jersey (Ward and Sutton 2001, Cape May Bird Observatory data), while recognizing that some individuals of these species winter to the north of New Jersey, including the Cape Cod area (from Christmas Bird Counts, National Audubon Society – 2001 database), so it is likely that the entire population of these birds in the western Atlantic is greater than the number cited in Table 9. The average numbers estimated in Alternative 1 in 2002 (22), and in 2003 (5), are also very small when compared to estimated numbers in Massachusetts in winter (10,000) and the Atlantic Flyway (168,000) population. Most Gannets, both residents and migrants, generally occur further offshore (Veit and Petersen 1993).

Seaducks made up more than 90% of the birds observed during these surveys. Loons and Gannets comprised about 2 percent. With the exception of small numbers of terns (lingering summer birds) observed on the first flight none of the species observed is listed as endangered, threatened, or is a candidate species for listing in the US or Massachusetts. One species, the Common Loon, is a species of concern in Massachusetts. Common Loons that winter in Nantucket Sound and the adjacent waters may include some from the small Massachusetts population but most come from populations spread throughout northern New England and eastern Canada. The loons observed in this study were a mixture of Red-throated and Common Loons: the numbers here do not separate the two species.

4.3 Alternative Areas

The numbers of birds recorded in the three alternative areas during these surveys in Nantucket Sound for the Wind Park are summarized above (Table 6), and the densities in each alternative area are given in Attachment 3. These summaries indicate that Horseshoe Shoal (Alternative 1) was not preferred by wintering birds. For each of the 8 principal species groups, the bird densities were higher in other Alternatives or in Outside areas.

4.4 Significance of the 2002-2003 Aerial and Boat Surveys

Prior to the Cape Wind studies summarized in this report and in Appendix 5.7-D, very little quantitative information was available regarding waterbirds wintering more than one mile from shore in Nantucket Sound. Although numerous incidental observations have been recorded during ferry-crossings, the area is not a destination for regular seabird cruises and there have been no systematic surveys. The Cape Wind studies have provided an overview from two winters of the species that use the open waters of the Sound, as well as their relative abundance, density, distribution, behavior, and, to a lesser extent their seasonal patterns in the Sound.

The surveys conducted for Cape Wind during the late winter of 2002 (Appendix 5.7-D) and late fall 2002 – winter 2003 (this study) are likely to be representative of the species present in the Sound during most winters. This statement is based upon an analysis of data from the Christmas Bird Counts (National Audubon Society) and MADFW winter waterfowl surveys during the same years as the Cape Wind surveys. The data for the winters 2002 and 2003 collected by National Audubon and MADFW were not significantly different from the data collected during the previous decade (Appendix 5.7-B). Thus, the information gathered during the two winters by Cape Wind should be appropriate indicators of the birds present and their use patterns in most years. However, detailed understanding of seaduck distribution requires knowledge of their benthic prey (Guillemette et al. 1999, 2002). Additional information on bird numbers for the period from March 2003 through February 2004 will be included in the FEIS. As such, this information is very useful for assessing potential risk to birds in the areas where wind turbines have been proposed.

4.5 Conclusion

The surveys during the fall and winter of 2002/2003, like those in winter/spring 2002, demonstrated that the waterbirds using Nantucket Sound during this season, were principally seaducks with small numbers of other species. The species found were mostly common birds, involving no endangered, threatened, or candidate species. The sole exception comprised seven (7) Roseate Terns, lingering summer residents, observed in September, 2002.

The densities of birds in the three alternative sites were found to be lower, in general, than in surrounding areas. Moreover, Alternative 1 had lower densities than Alternatives 2 or 3 for seven of the eight principal species groups.

The numbers observed in Alternative 1 comprise only a small fraction of those wintering in Massachusetts or in the Atlantic Flyway. Furthermore, the numbers observed in Alternative 1 are very small compared to those killed by hunters every year.

5.0 LITERATURE CITED

- Barr, J. F., C. Eberl, and J. W. McIntyre 2000. Red-throated Loon (*Gavia stellata*). In *The Birds of North America*, No. 177 (A. Poole and F. Gill, eds.). The Birds of North America, Inc., Philadelphia, PA.
- Bordage, D., and J. L. Savard. 1995. Black Scoter (*Melanitta nigra*). In *The Birds of North America*, No. 651 (A. Poole and F. Gill, eds.). The Academy of Natural Sciences, Philadelphia, PA, and The American Ornithologists' Union, Washington, D.C.

- Brown, P. W., and L. H. Frederickson. 1997. White-winged Scoter (*Melanitta fusca*). In The Birds of North America, No. 274 (A. Poole and F. Gill, eds.). The Academy of Natural Sciences, Philadelphia, PA, and The American Ornithologists' Union, Washington, D.C.
- Buckland, S.T., Anderson, D.R., Burnham, K.P. and Laake, J.L. 1993. *Distance Sampling: Estimating Abundance of Biological Populations*. Chapman and Hall, London. 446pp.
- Davis, W.E. 1997. The Nantucket Oldsquaw flight: New England's greatest bird show? Bird Observer 25: 16-22
- ESS Group, Inc., J.J.Hatch, and P.Kerlinger. 2002. A late winter and early spring 2002 waterbird survey for the Cape Wind Energy Project Nantucket Sound. Prepared for Cape Wind Associates. Appendix 5.7-D of the DEIS-DEIR.
- ESS Group, Inc. and Kerlinger. 2003. A Comparison of the Audubon Christmas Bird Counts and MassWildlife Winter Waterfowl Populations. Prepared for Cape Wind Associates. Appendix 5.7-B of the DEIS-DEIR.
- Goudie, R.I., G.J. Robertson, and A. Reed. 2000. Common Eider (*Somateria mollissima*). In The Birds of North America, No. 546 (A. Poole and F. Gill, eds.). The Birds of North America, Inc., Philadelphia, PA.
- Guillemette, M., J.K.Larsen, and I Clausager. 1999. Assessing the impact of the Tuno Knob wind park on sea ducks: the influence of food resources. NERI Tech. Report No 263, Denmark.
- Guillemette, M., and J.K.Larsen 2002. Postdevelopment experiments to detect anthropogenic disturbances: the case of seaducks and wind parks. Ecol. Appl. 12: 868-877.
- Kerlinger, P., and J.J. Hatch. 2001. Preliminary avian risk assessment for the Cape Wind Energy Project. November 2001. Report prepared for Cape Wind Associates, LLC and Environmental Science Services, Inc.
- Krohn, W.B., P.O. Corr, and A.E. Hutchinson. 1992. Status of the American Eider with special reference to northern New England. U.S. Fish Wildl. Serv. Tech. Rep. Ser. 12, Washington, DC.
- Martin, E.M., and P. I. Padding. 2002. Preliminary estimates of waterfowl harvest and hunter activity in the United States during the 2001 hunting season. U. S. Fish and Wildlife Service, Division of Migratory Bird Management, Laurel, MD, July 2002.
- McIntyre, J. W., and J. F. Barr. 1997. Common Loon (*Gavia immer*). In The Birds of North America, No. 313 (A. Poole and F. Gill, eds.). The Academy of Natural Sciences, Philadelphia, PA, and The American Ornithologists' Union, Washington, D.C.
- Mowbray, T. B. 2002. Northern Gannet (*Morus bassanus*). In The Birds of North America, No. 693 (A. Poole and F. Gill, eds.). The Birds of North America, Inc., Philadelphia, PA.
- Robertson, G. J., and J.-P. L. Savard. 2002. Long-tailed Duck (*Clangula hyemalis*). In The Birds of North America, No. 651 (A. Poole and F. Gill, eds.). The Birds of North America, Inc., Philadelphia, PA.
- Savard, J. -P. L., D. Bordage, and A. Reed 1998. Surf Scoter (*Melanitta perspicillata*). In The Birds of North America, No. 363 (A. Poole and F. Gill, eds.). The Birds of North America, Inc., Philadelphia, PA.
- Veit, R.R., and W.R. Petersen. 1993. Birds of Massachusetts. Massachusetts Audubon Society, Lincoln, MA.
- Ward, D., and C.C. Sutton. 2001. The history of the Avalon Seawatch. In Hawkwatching in the Americas. Eds. K.L. Bildstein and D. Klem. Hawk Migration Association of North America, North Wales, PA.

Figures

Figure 1 - Transects for Fall 2002-Winter 2003 Avian Surveys within Nantucket Sound

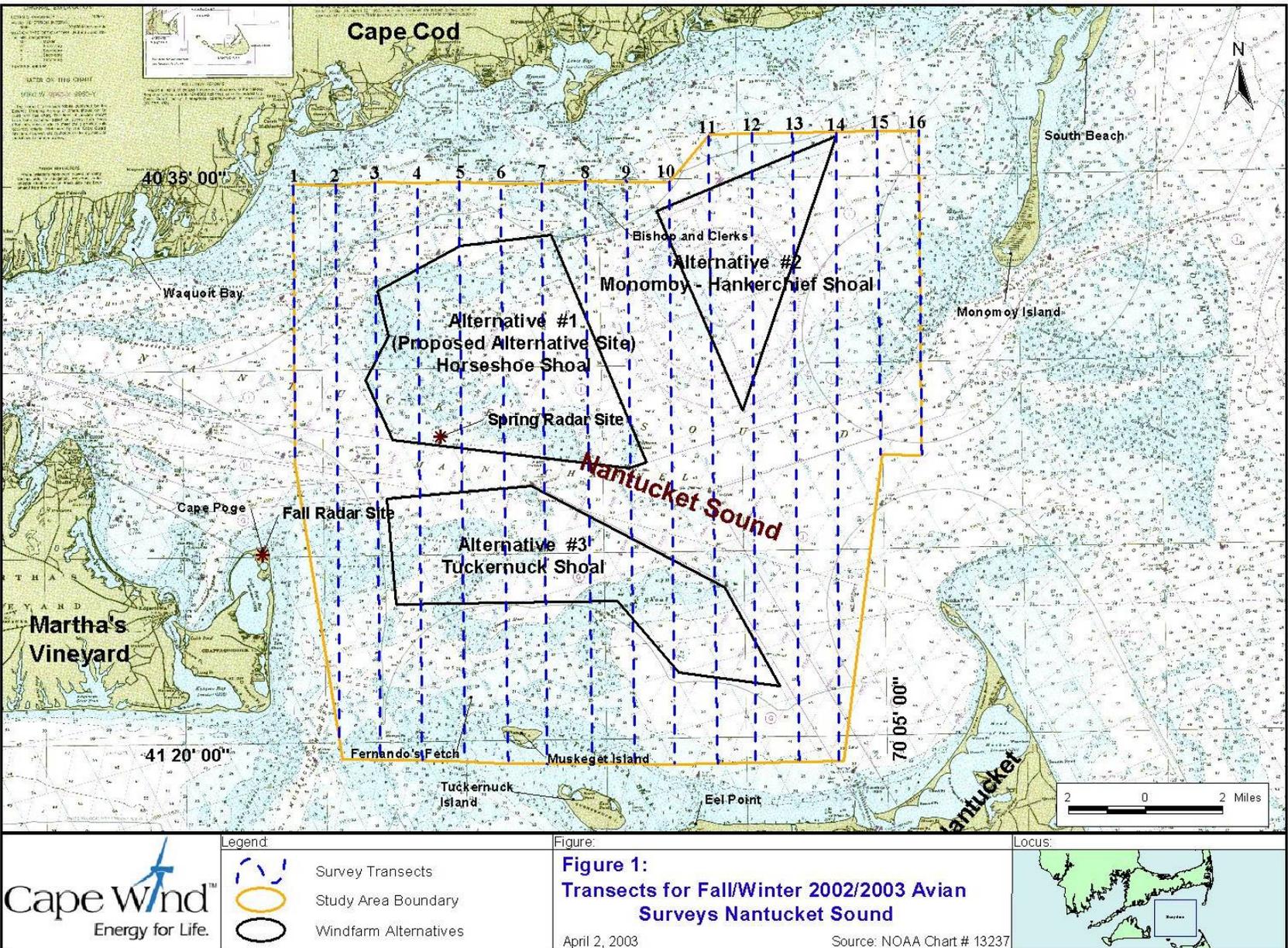


Figure 2 - Flightlines for the Additional Routes Outside the Study Area during Fall 2002-Winter 2003 Aerial Surveys

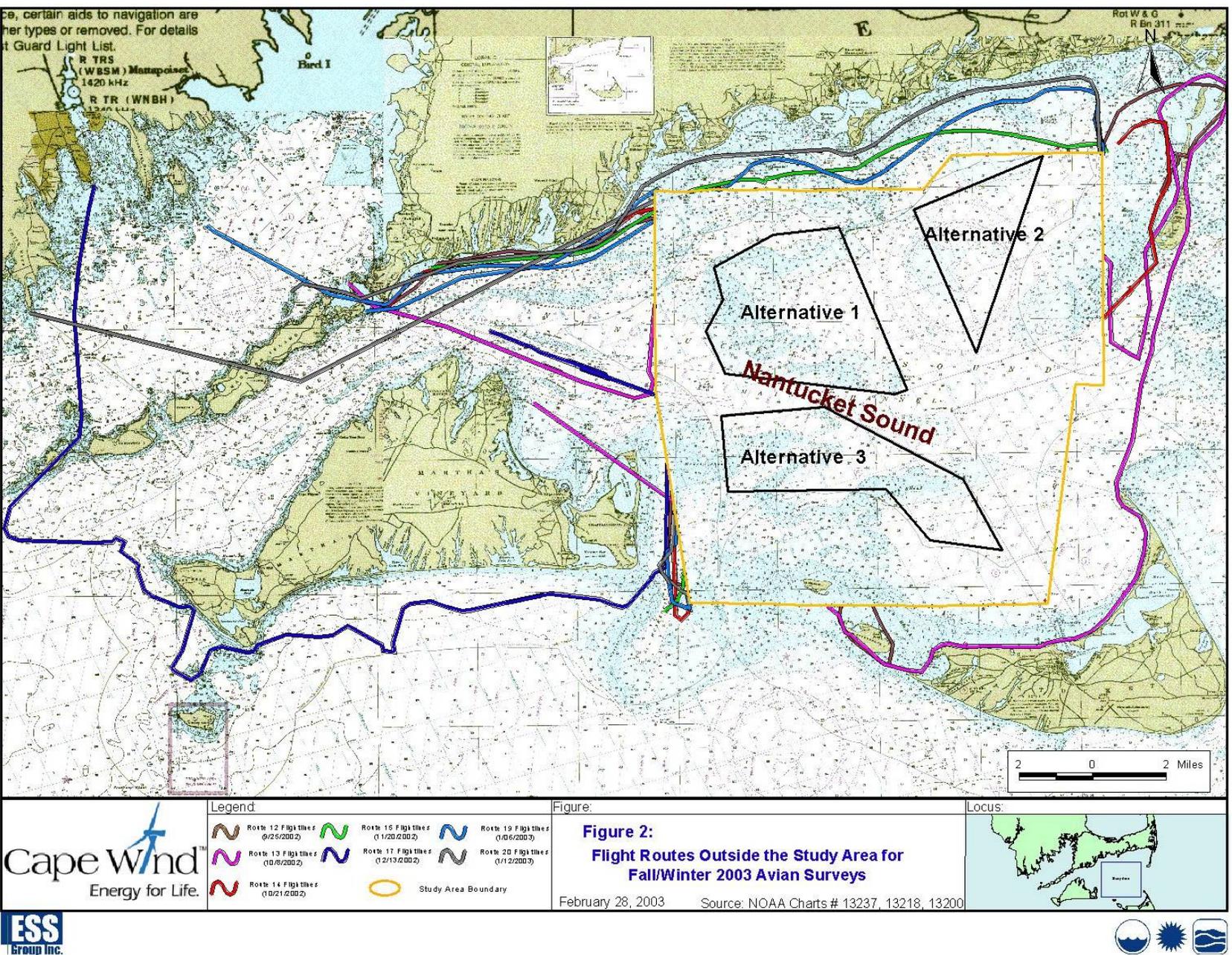
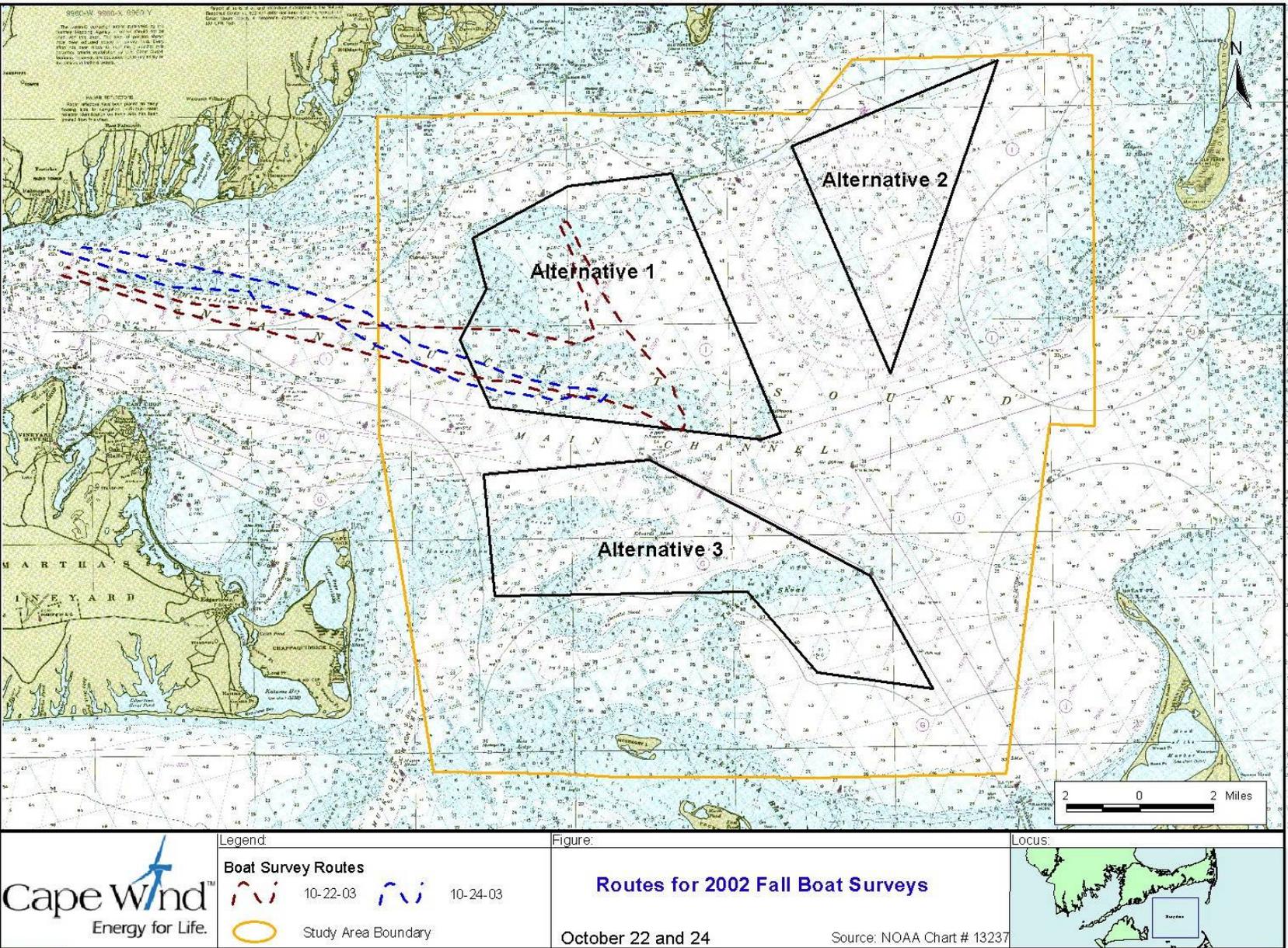


Figure 3. Routes for Fall Boat Surveys



ATTACHMENT 1

Numbers of Individuals Observed
On Each of the 11 Aerial Surveys
In Nantucket Sound, MA,
September 2002 - February 2003

Table A: Species Totals: Individuals Recorded Within the Study Area During Eleven Systematic Aerial Surveys

Species	Total	Sept 25, 2002	Oct 8, 2002	Oct 21, 2002	Nov 20, 2002	Nov 25, 2002	Dec 13, 2002	Dec 27, 2002	Jan 6, 2003	Jan 12, 2003	Feb 14, 2003	Feb 21, 2003
Loon: Common and Red-throated	1863	3	25	83	371	370	444	121	92	80	57	217
Grebe	97	0	0	0	0	0	20	22	20	25	4	6
Northern Gannet	187	0	0	0	54	94	33	1	1	4	0	0
Cormorant: Double-crested and Great	1247	201	607	355	64	12	8	0	0	0	0	0
Great Blue Heron	0	0	0	0	0	0	0	0	0	0	0	0
Canada Goose	25	0	0	0	0	0	25	0	0	0	0	0
Common Eider	25118	40	303	2295	2890	4095	3024	2418	3026	4003	801	2223
Long-tailed Duck	23715	0	136	60	10900	3086	3420	590	1183	1298	870	2172
Scoter: Black, White-winged, and Surf	54924	54	1261	4856	7145	4415	6322	4361	9153	5383	9813	2161
Goldeneye	0	0	0	0	0	0	0	0	0	0	0	0
Red-breasted Merganser	194	0	0	2	16	15	130	0	14	0	16	1
Dunlin	20	0	0	20	0	0	0	0	0	0	0	0
Laughing Gull	4	0	1	0	0	3	0	0	0	0	0	0
Bonaparte's Gull	531	0	0	0	204	103	25	42	56	100	1	0
Ring-billed Gull	1	1	0	0	0	0	0	0	0	0	0	0
Herring Gull	456	5	28	8	66	32	133	39	49	42	32	22
Great Black-backed Gull	359	18	90	1	13	35	99	42	21	11	26	3
Unknown Gull	366	0	7	0	7	16	31	180	92	31	2	0
Black-legged Kittiwake	70	0	0	0	0	0	23	0	12	34	0	1
Roseate Tern	7	7	0	0	0	0	0	0	0	0	0	0
Common Tern	27	27	0	0	0	0	0	0	0	0	0	0
Dovekie	30	0	0	0	0	0	0	0	19	3	0	8
Razorbill	1080	0	0	0	73	72	285	183	132	200	39	96
Totals	110321	356	2458	7680	21803	12348	14022	7999	13870	11214	11661	6910

Table B: Species Totals: Individuals Recorded Outside the Study Area Within Nantucket Sound During Eleven Aerial Surveys

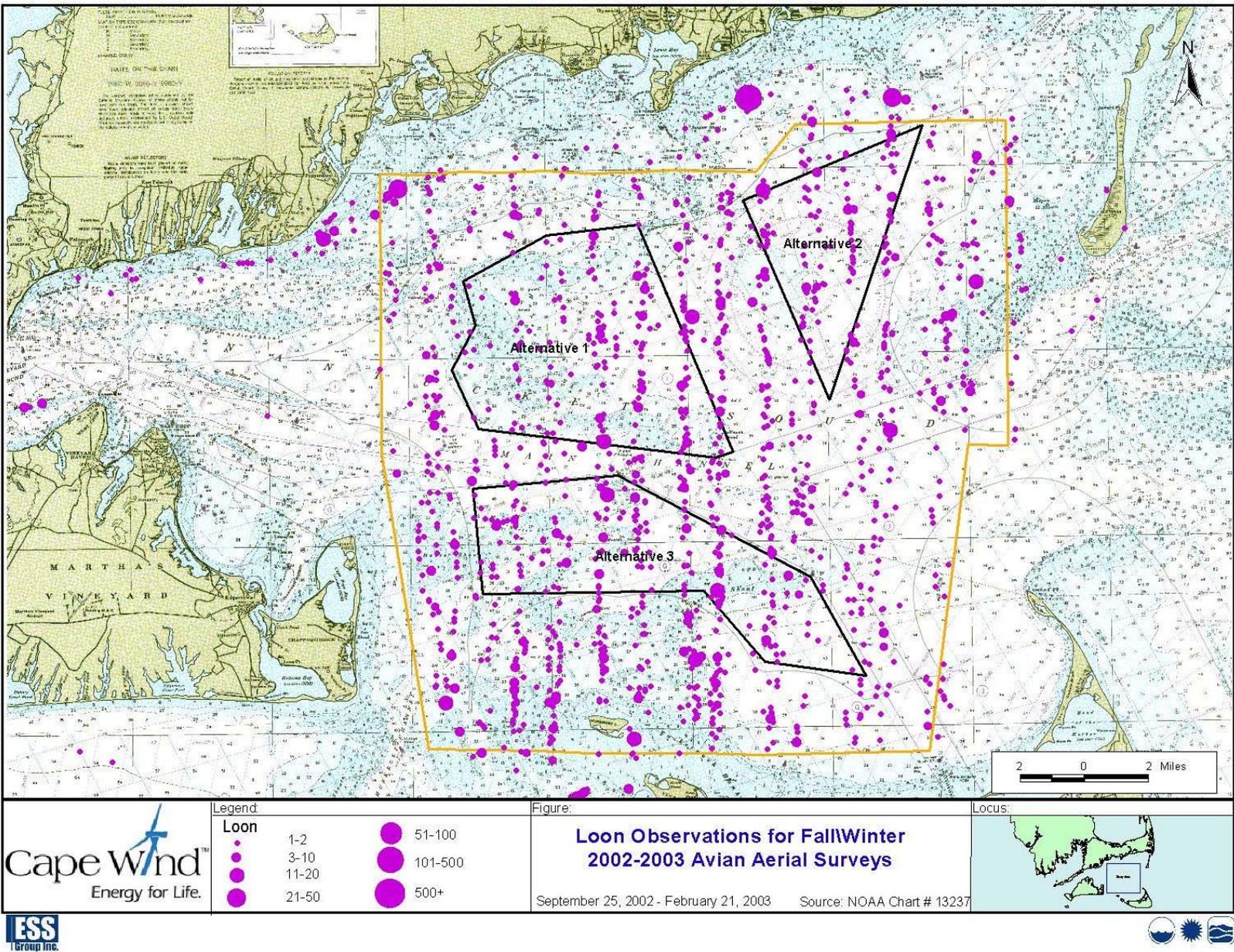
Species	Total	Sept 25, 2002	Oct 8, 2002	Oct 21, 2002	Nov 20, 2002	Nov 25, 2002	Dec 13, 2002	Dec 27, 2002	Jan 6, 2003	Jan 12, 2003	Feb 14, 2003	Feb 21, 2003
Loon: Common and Red-throated	402	0	7	38	330	0	2	0	21	2	0	2
Grebe	0	0	0	0	0	0	0	0	0	0	0	0
Northern Gannet	11	0	0	0	3	8	0	0	0	0	0	0
Cormorant: Double-crested and Great	5265	590	1331	3321	0	0	20	0	2	0	0	1
Great Blue Heron	1	0	1	0	0	0	0	0	0	0	0	0
Canadian Geese	0	0	0	0	0	0	0	0	0	0	0	0
Common Eider	16350	0	147	232	1150	106	1656	303	1456	3061	100	8139
Long-tailed Duck	1379	0	5	2	99	401	9	647	73	3	67	73
Scoter: Black, White-winged, and Surf	3887	48	49	94	595	0	59	79	700	25	76	2162
Goldeneye	25	0	0	0	0	0	1	0	0	0	6	18
Red-breasted Merganser	283	0	0	3	1	0	0	0	0	2	16	261
Dunlin	0	0	0	0	0	0	0	0	0	0	0	0
Laughing Gull	1	0	1	0	0	0	0	0	0	0	0	0
Bonaparte's Gull	2	0	0	0	0	0	0	0	2	0	0	0
Ring-billed Gull	0	0	0	0	0	0	0	0	0	0	0	0
Herring Gull	230	4	158	5	32	3	4	0	7	14	0	3
Great Black-backed Gull	1627	536	1052	2	5	1	3	0	10	12	0	6
Unknown Gull	1129	20	1023	0	0	5	3	0	0	3	0	75
Black-legged Kittiwake	0	0	0	0	0	0	0	0	0	0	0	0
Roseate Tern	0	0	0	0	0	0	0	0	0	0	0	0
Common Tern	2	2	0	0	0	0	0	0	0	0	0	0
Dovekie	0	0	0	0	0	0	0	0	0	0	0	0
Razorbill	3	0	0	0	3	0	0	0	0	0	0	0
Totals	30597	1200	3774	3697	2218	524	1757	1029	2271	3122	265	10740

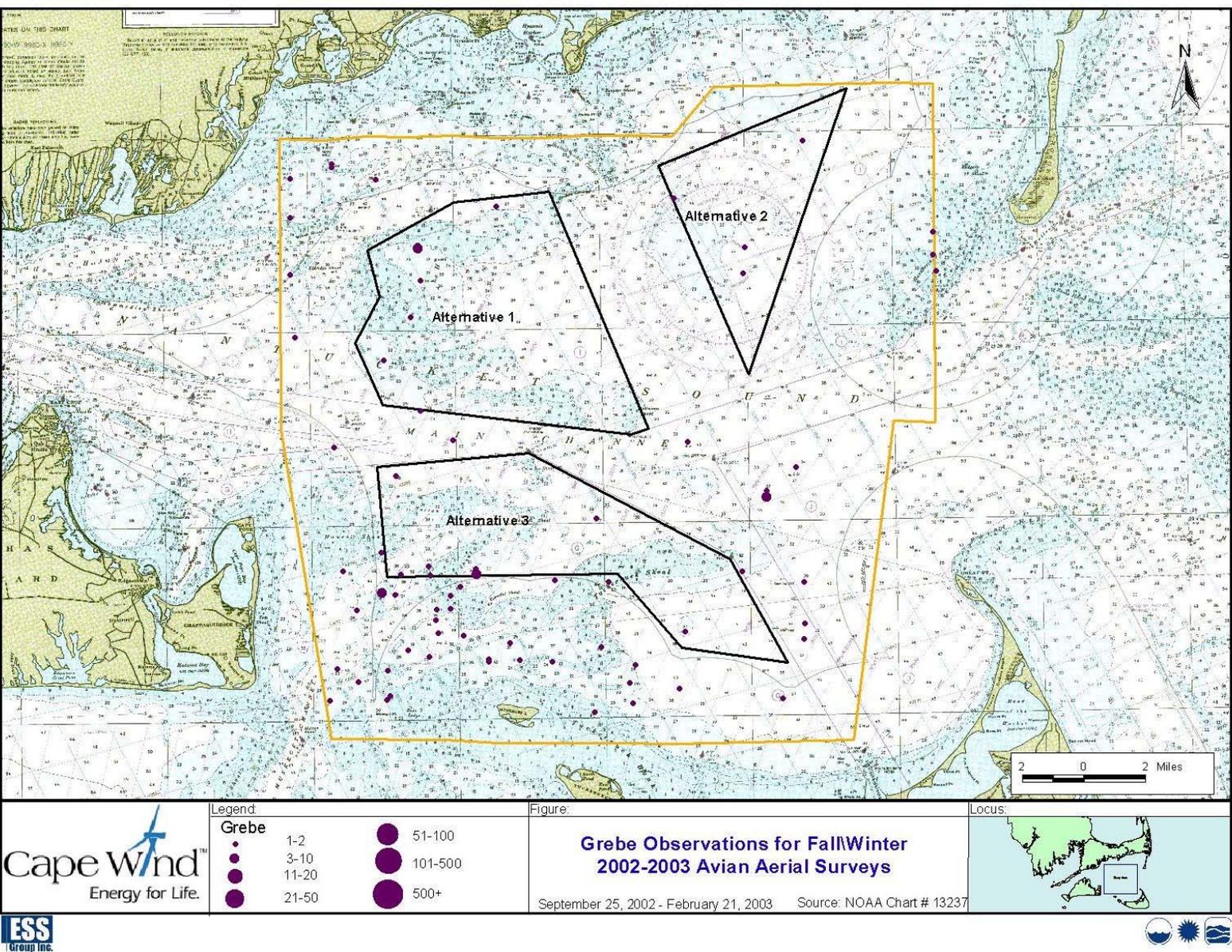
Table C: Species Totals: Individuals Recorded Outside the Study Area Within Vineyard Sound and Buzzards Bay During Eleven Aerial Surveys

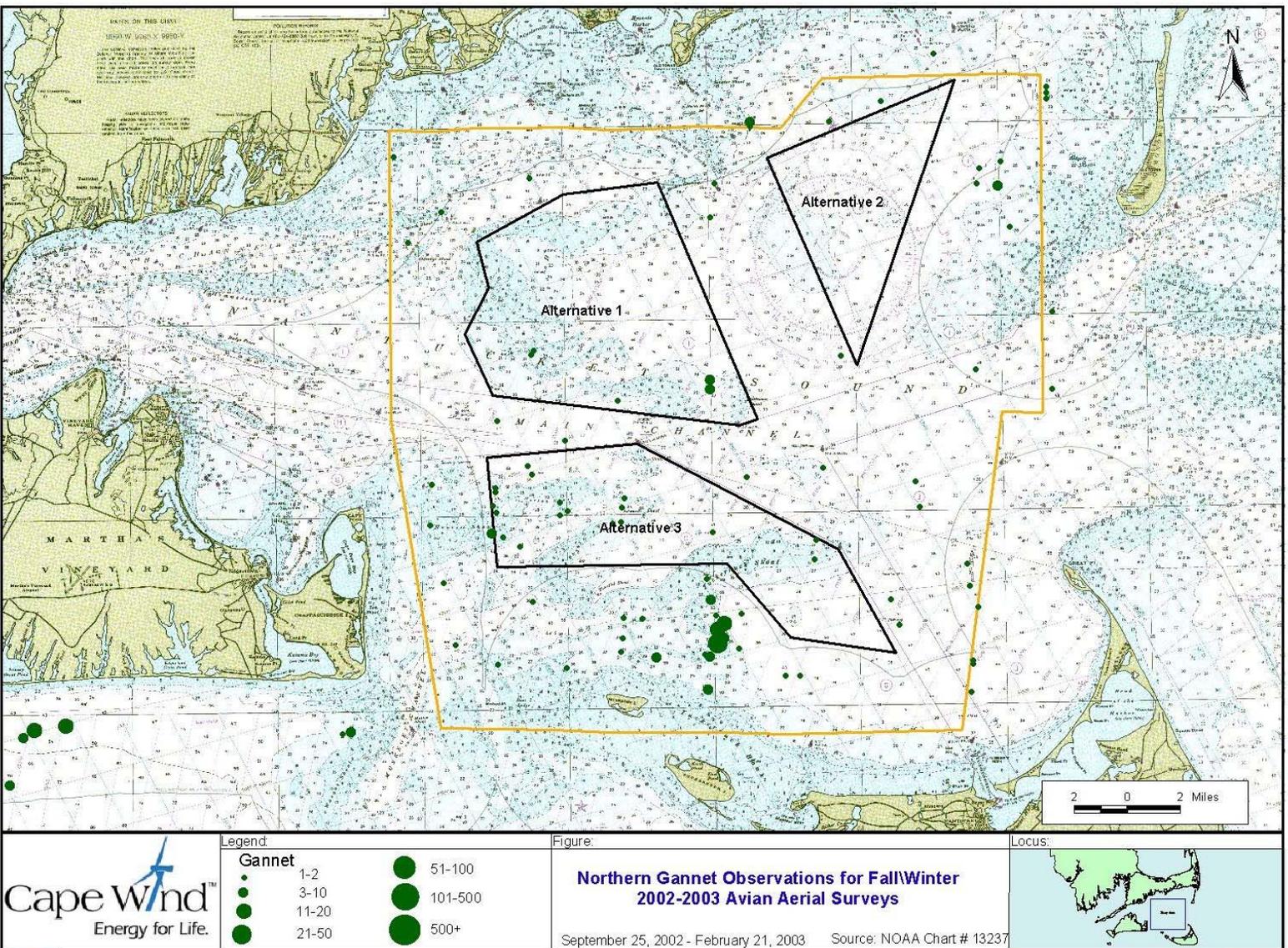
Species	Total	Sept 25, 2002	Oct 8, 2002	Oct 21, 2002	Nov 20, 2002	Nov 25, 2002	Dec 13, 2002	Dec 27, 2002	Jan 6, 2003	Jan 12, 2003	Feb 14, 2003	Feb 21, 2003
Loon: Common and Red-throated	31	0	0	0	0	27	4	0	0	0	0	0
Grebe	0	0	0	0	0	0	0	0	0	0	0	0
Northern Gannet	103	0	0	0	0	0	103	0	0	0	0	0
Cormorant: Double-crested and Great	9	1	1	0	0	1	1	0	2	0	2	1
Great Blue Heron	0	0	0	0	0	0	0	0	0	0	0	0
Canadian Geese	0	0	0	0	0	0	0	0	0	0	0	0
Common Eider	41503	0	0	0	0	5605	12483	13630	32	1000	0	8753
Long-tailed Duck	0	0	0	0	0	0	0	0	0	0	0	0
Scoter: Black, White-winged, and Surf	27660	0	0	0	0	1400	1727	1931	0	0	0	22602
Goldeneye	4	0	0	0	0	0	0	0	0	0	0	4
Red-breasted Merganser	1	0	0	0	0	0	0	0	0	0	0	1
Dunlin	0	0	0	0	0	0	0	0	0	0	0	0
Laughing Gull	0	0	0	0	0	0	0	0	0	0	0	0
Bonaparte's Gull	10	0	0	0	0	10	0	0	0	0	0	0
Ring-billed Gull	0	0	0	0	0	0	0	0	0	0	0	0
Herring Gull	1	1	0	0	0	0	0	0	0	0	0	0
Great Black-backed Gull	1	0	0	0	0	0	0	0	0	1	0	0
Unknown Gull	1	0	0	0	1	0	0	0	0	0	0	0
Black-legged Kittiwake	0	0	0	0	0	0	0	0	0	0	0	0
Roseate Tern	0	0	0	0	0	0	0	0	0	0	0	0
Common Tern	0	0	0	0	0	0	0	0	0	0	0	0
Dovekie	0	0	0	0	0	0	0	0	0	0	0	0
Razorbill	11	0	0	0	0	0	0	0	0	11	0	0
Totals	69335	2	1	0	1	7043	14318	15561	34	1012	2	31361

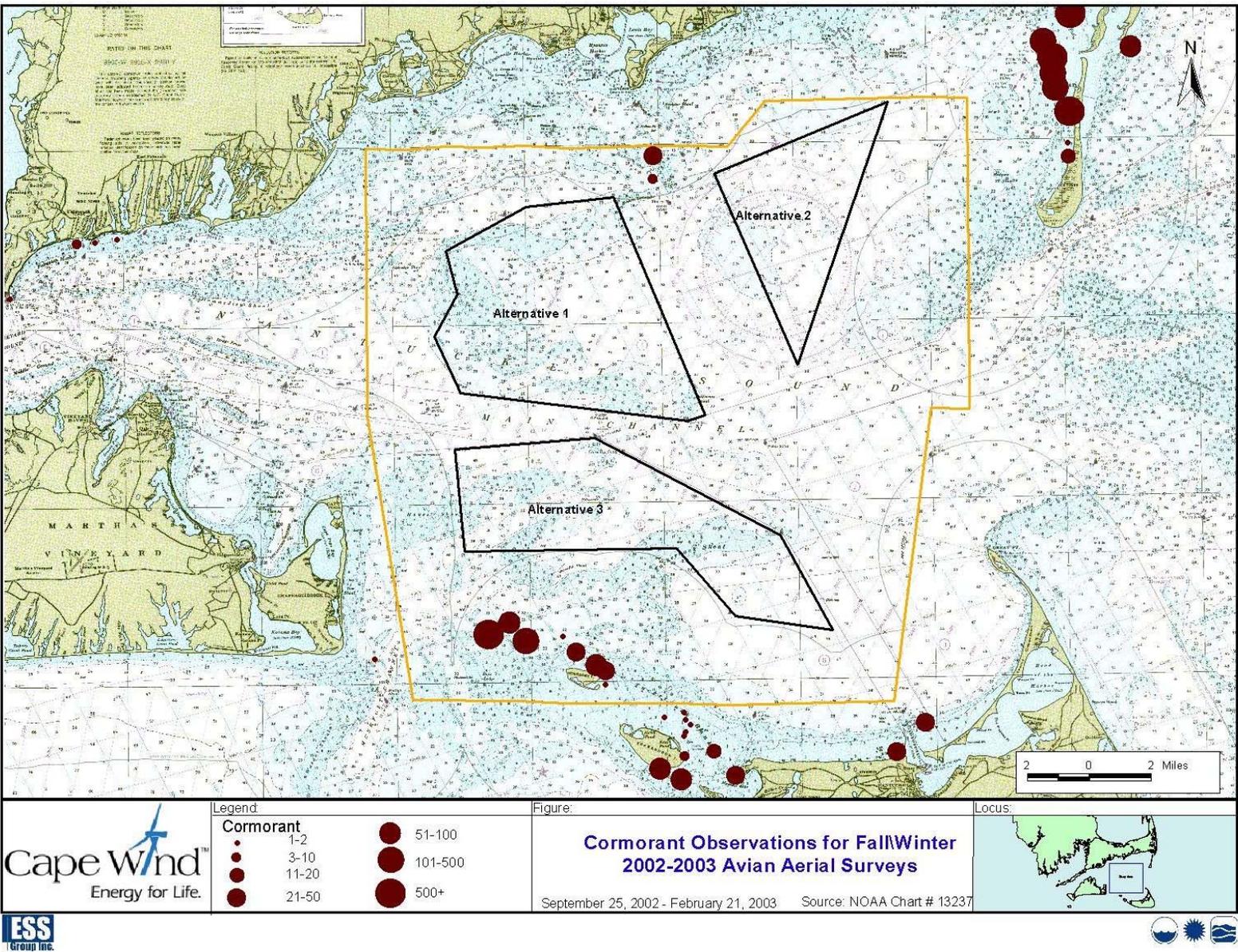
ATTACHMENT 2

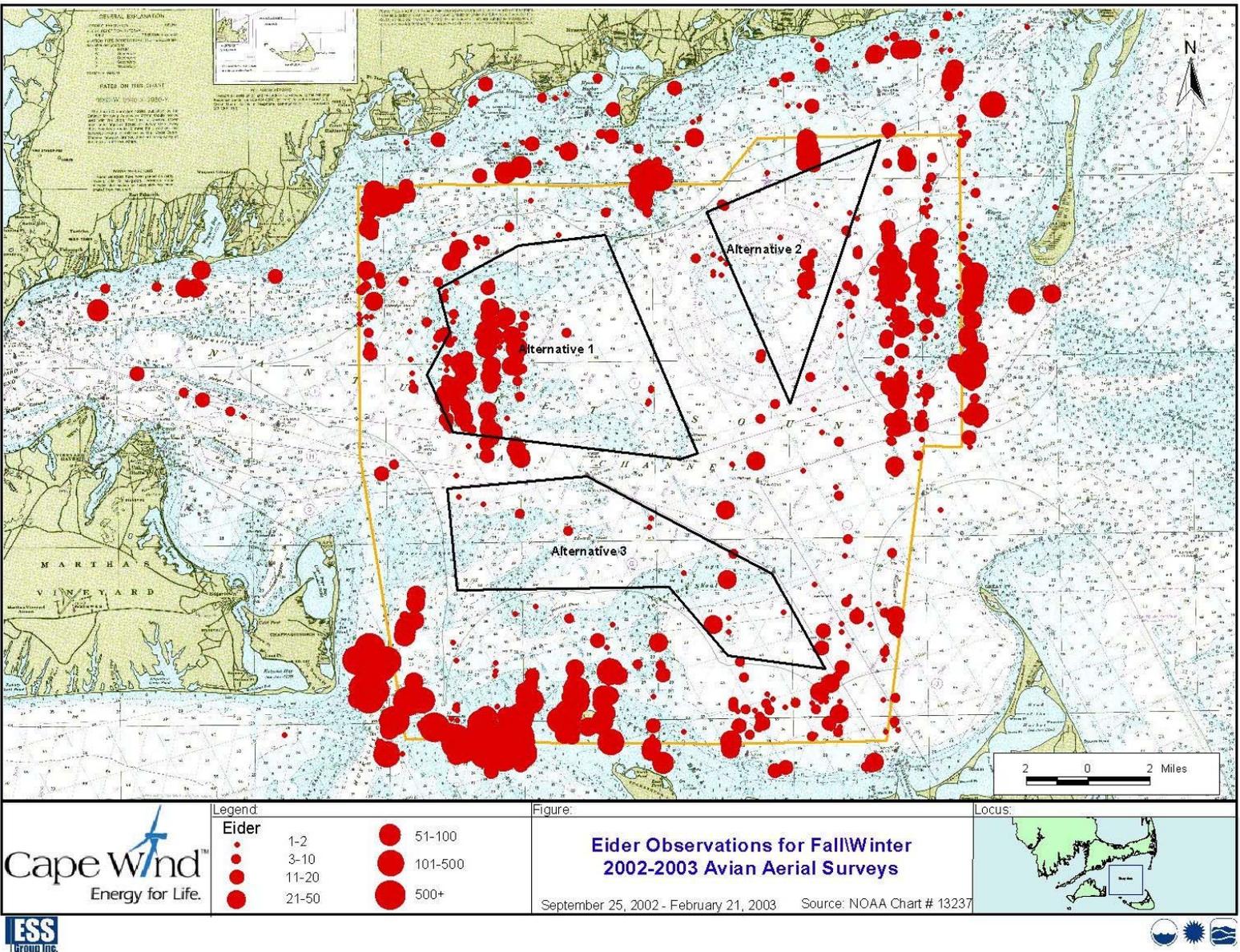
Distribution of Waterbirds in the
Study Area for Aerial Surveys
11-22 Combined

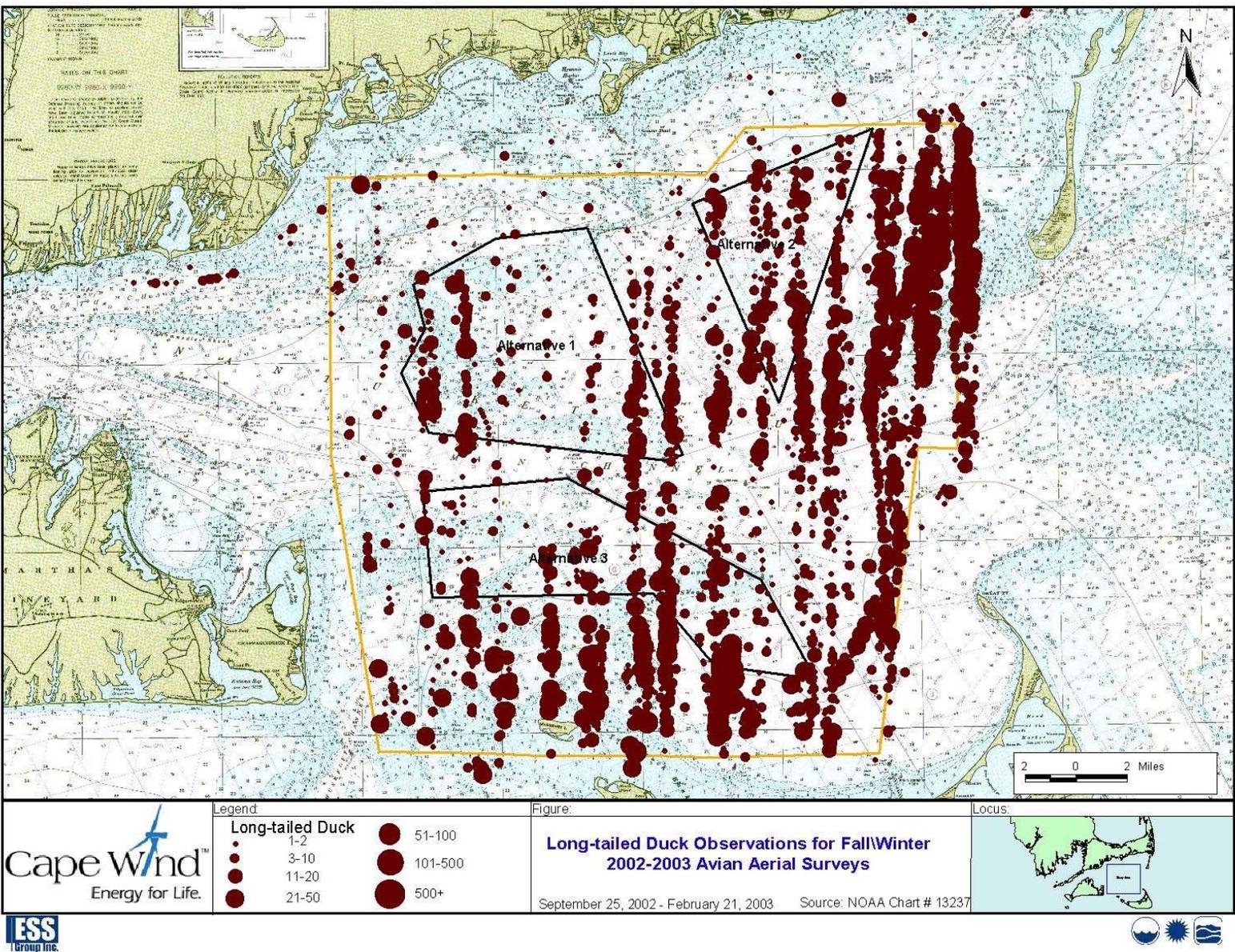


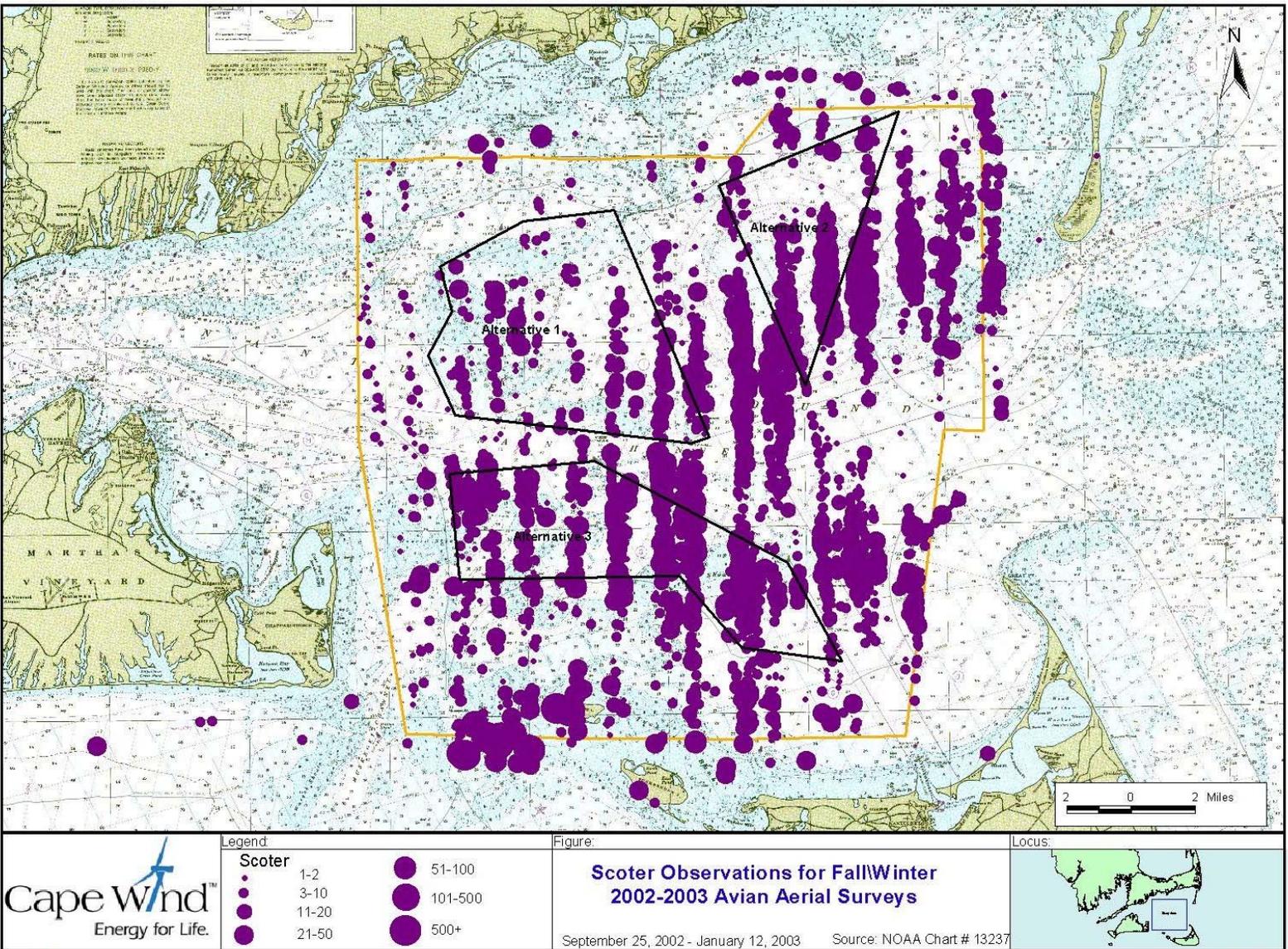








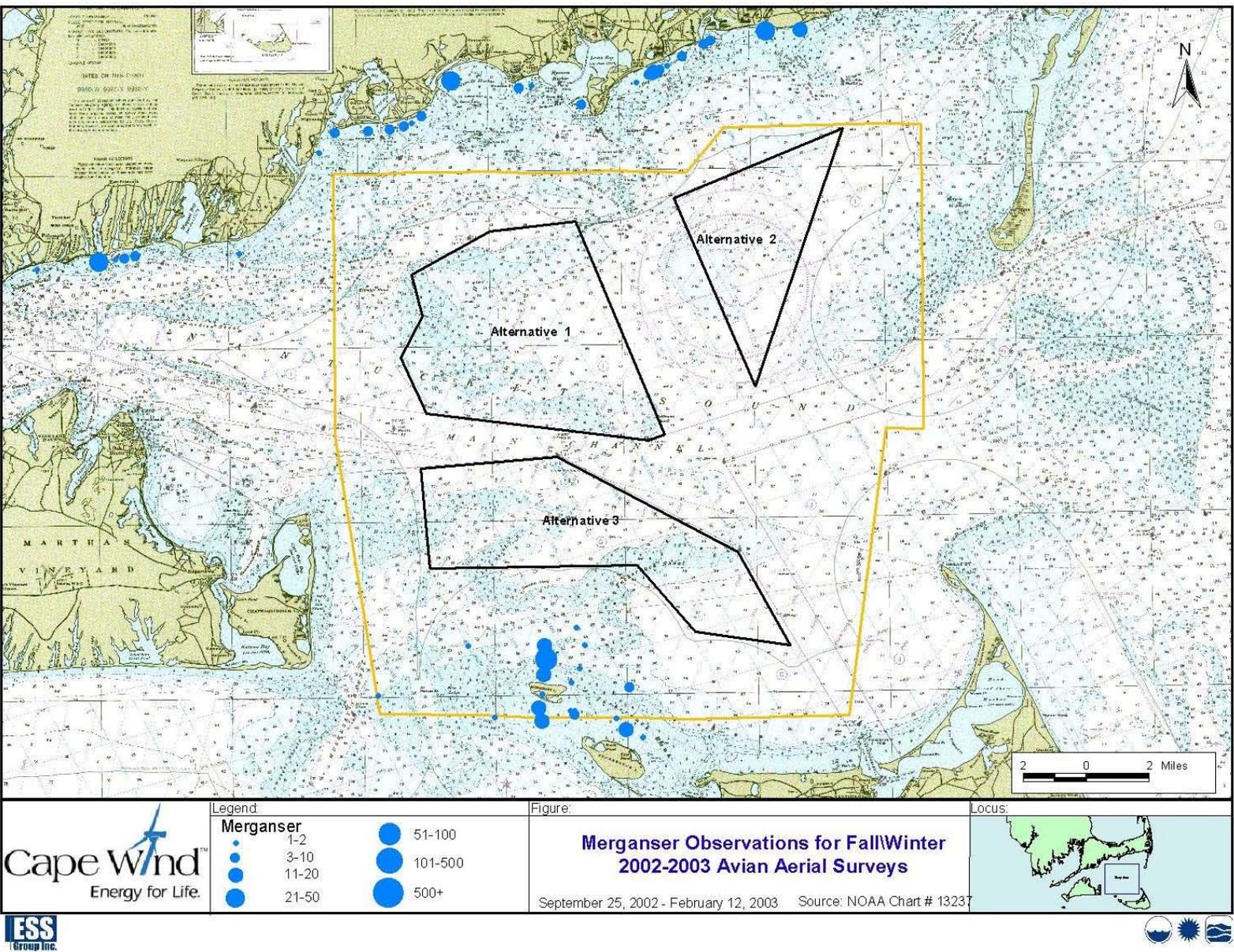


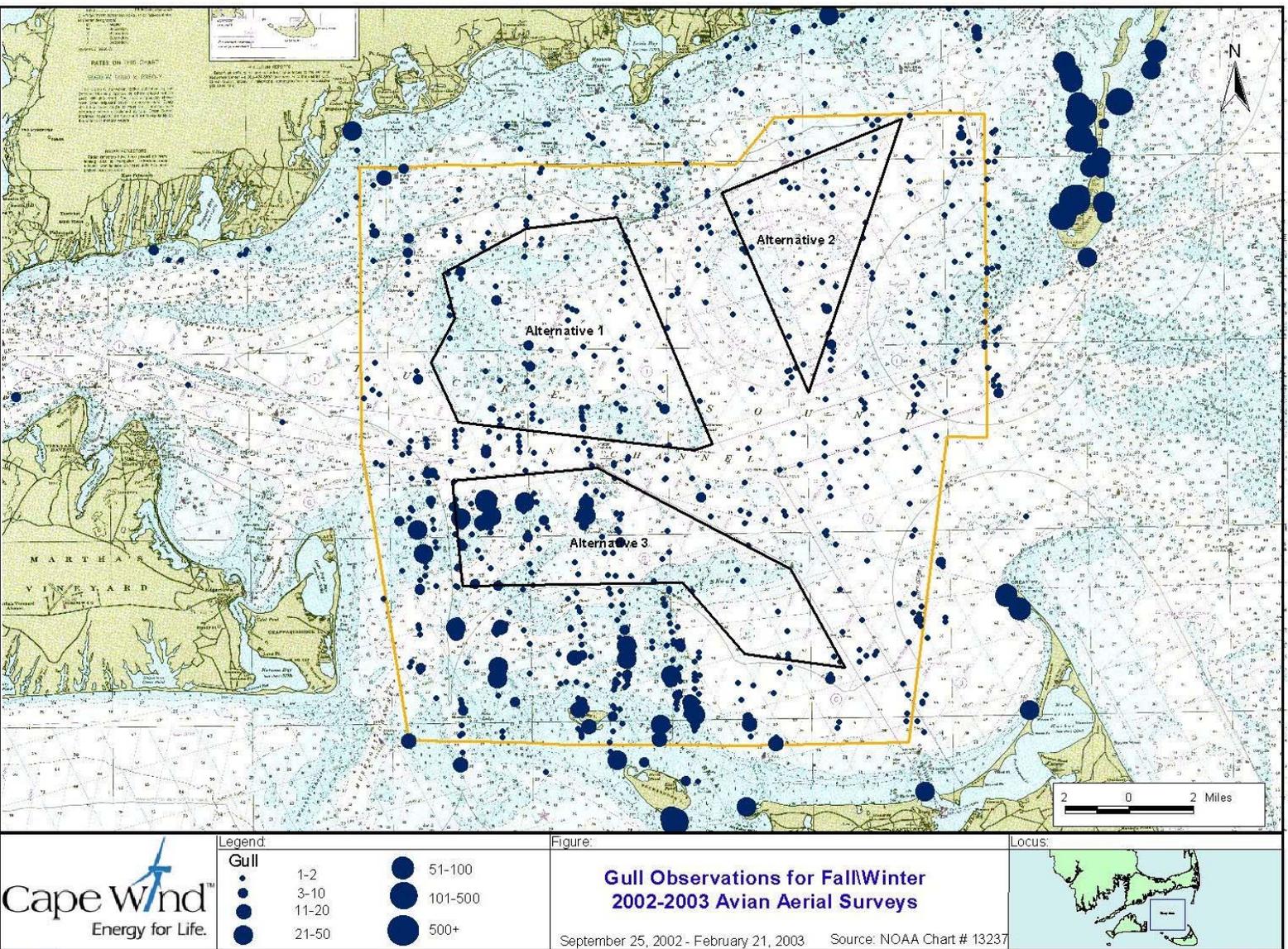


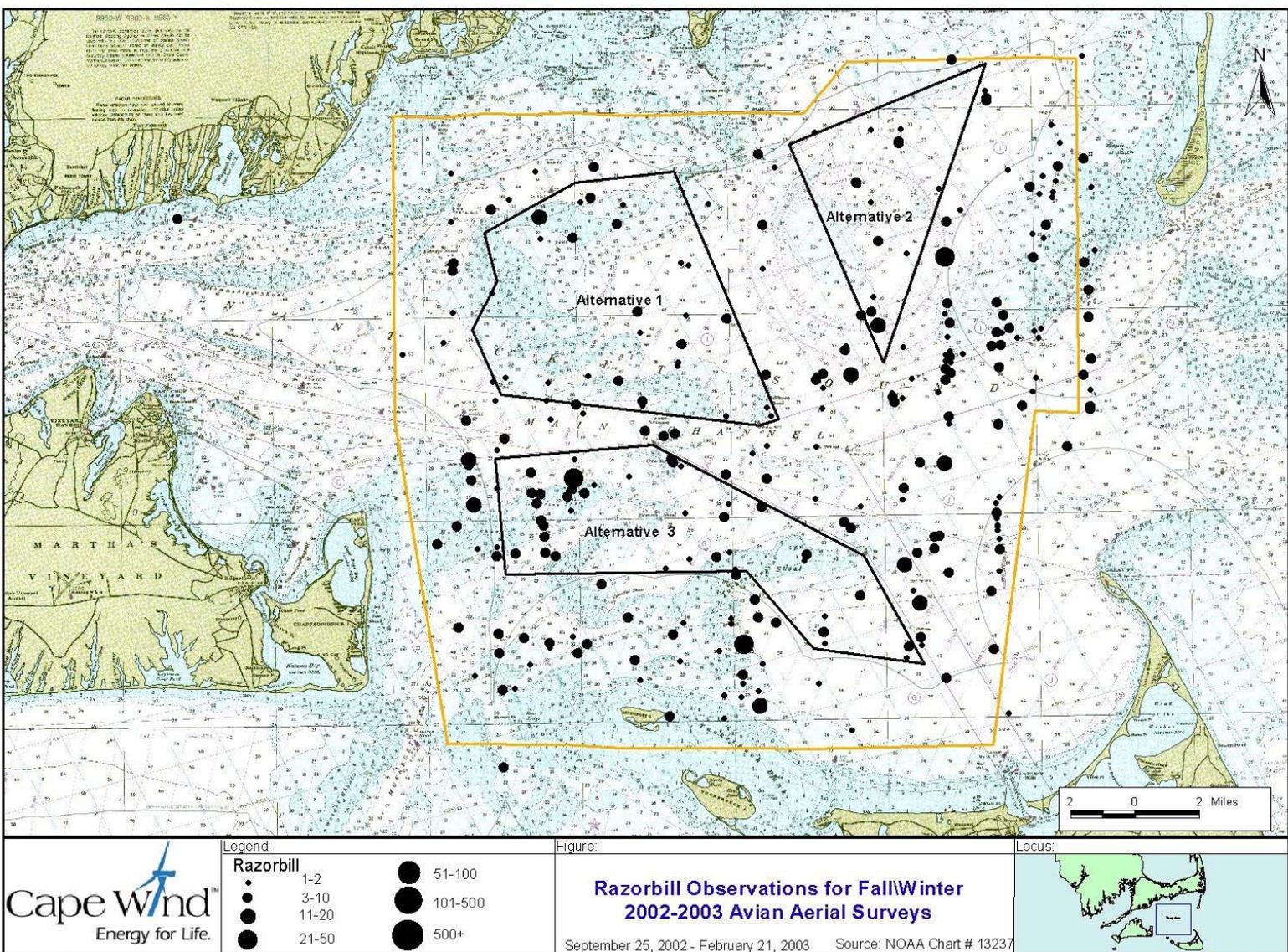
Legend	
●	Scoter 1-2
●	3-10
●	11-20
●	21-50
●	51-100
●	101-500
●	500+

Figure:
Scoter Observations for Fall/Winter 2002-2003 Avian Aerial Surveys
 September 25, 2002 - January 12, 2003 Source: NOAA Chart # 13237









	Legend Razorbill		Figure: Razorbill Observations for Fall/Winter 2002-2003 Avian Aerial Surveys September 25, 2002 - February 21, 2003 Source: NOAA Chart # 13237		Locus:
	● 1-2 ● 3-10 ● 11-20 ● 21-50	● 51-100 ● 101-500 ● 500+			



ATTACHMENT 3

Species Totals and Densities for
Alternative Sites and for the Area
Outside of the Alternative Sites
Within the Study Area for Eleven
Aerial Surveys Combined

Species Totals and Densities By Site Alternatives For All 11 Aerial Surveys Combined

Species	Location	Total Number Observed	Max/Min* Number	Density (indivs/km2)	Estimated** Number Present	Estimated Number Present per Survey
Loon	Alternative 1	235	58/0	11.19	1237	112
Loon	Alternative 2	104	32/0	10.61	547	50
Loon	Alternative 3	241	105/0	14.35	1268	115
Loon	Outside	1283	286/0	10.66	6110	555
Loon	Total	1863	444/3	11.09	9315	847
Grebe	Alternative 1	10	6/0	0.48	53	5
Grebe	Alternative 2	5	3/0	0.51	26	2
Grebe	Alternative 3	12	6/0	0.71	63	6
Grebe	Outside	70	22/0	0.58	333	30
Grebe	Total	97	25/0	0.58	485	44
Gannet	Alternative 1	10	6/0	0.48	53	5
Gannet	Alternative 2	0	0/0	0.00	0	0
Gannet	Alternative 3	17	8/0	1.01	89	8
Gannet	Outside	160	88/0	1.33	762	69
Gannet	Total	187	94/0	1.11	935	85
Cormorant	Alternative 1	0	0/0	0.00	0	0
Cormorant	Alternative 2	0	0/0	0.00	0	0
Cormorant	Alternative 3	0	0/0	0.00	0	0
Cormorant	Outside	1247	607/0	10.36	5938	540
Cormorant	Total	1247	607/0	7.42	6235	567
Eider	Alternative 1	1488	366/0	70.86	7832	712
Eider	Alternative 2	100	70/0	10.20	526	48
Eider	Alternative 3	68	34/0	4.05	358	33
Eider	Outside	23462	3893/40	194.87	111724	10157
Eider	Total	25118	4095/40	149.51	125590	11417
Long-Tailed Duck	Alternative 1	938	162/0	44.67	4937	449
Long-Tailed Duck	Alternative 2	773	138/0	78.88	4068	370
Long-Tailed Duck	Alternative 3	1706	1032/0	101.55	8979	816
Long-Tailed Duck	Outside	20298	9577/0	168.59	96657	8787
Long-Tailed Duck	Total	23715	10900/0	141.16	118575	10780
Scoter	Alternative 1	2229	592/0	106.14	11732	1067
Scoter	Alternative 2	6628	1873/0	676.33	34884	3171
Scoter	Alternative 3	8868	1568/0	527.86	46674	4243
Scoter	Outside	37199	6539/54	308.96	177138	16103
Scoter	Total	54924	9813/54	326.93	274620	24965
Merganser	Alternative 1	0	0/0	0.00	0	0
Merganser	Alternative 2	0	0/0	0.00	0	0
Merganser	Alternative 3	0	0/0	0.00	0	0
Merganser	Outside	194	130/0	1.61	924	84

Species	Location	Total Number Observed	Max/Min*	Density (indivs/km2)	Estimated** Number Present	Estimated Number Present per Survey
Merganser	Total	194	130/0	1.15	970	88
Gull	Alternative 1	91	40/0	4.33	479	44
Gull	Alternative 2	39	14/0	3.98	205	19
Gull	Alternative 3	346	136/0	20.60	1821	166
Gull	Outside	1311	273/5	10.89	6243	568
Gull	Total	1787	311/9	10.64	8935	812
Razorbill	Alternative 1	77	19/0	3.67	405	37
Razorbill	Alternative 2	98	54/0	10.00	516	47
Razorbill	Alternative 3	97	31/0	5.77	511	46
Razorbill	Outside	808	248/0	6.71	3848	350
Razorbill	Total	1080	285/0	6.43	5400	491

*The individual maxima do not sum to the Total given because maxima do not necessarily coincide.

**Estimated Number Present is calculated by dividing the total number observed by fraction of area surveyed flown.

ATTACHMENT 4

Estimated Numbers of Waterbirds
In the Study Area during
Fall 2002/Winter 2003 for
Aerial Surveys 11-22

