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## INTRODUCTION

In September 2003, U.S. Department of the Navy (the Navy) decided to homebase its carrier-based squadrons of Super Hornet aircraft at Naval Air Station (NAS) Oceana, in Virginia, and Marine Corps Air Station (MCAS) Cherry Point, in North Carolina. Prior to that decision, the Navy had determined that these squadrons would need an additional practice landing field, known as an outlying landing field (OLF), to support the number of Field Carrier Landing Practice (FCLP) operations that are part of the pre-deployment training cycle. The FLCP operations are low-level, "touch-and-go" flight patterns to train pilots for landing on aircraft carriers.

The Navy had to consider both operational and environmental criteria to determine where to build an OLF. Suitable locations should minimize transit time between the homebase and the OLF, yet avoid highly populated areas, development, existing military and civilian air traffic, and designated federal and state protected lands. The Navy identified five potential sites in rural areas of northeastern North Carolina that were suitably located between NAS Oceana and MCAS Cherry Point. The Navy's preferred site, OLF Site C in Washington County, has a low population density, is 95% agricultural land, and is located 6 miles west of Pocosin Lakes National Wildlife Refuge (NWR).

Although this area of northeastern North Carolina is ideally located for the construction and operation of an OLF, this region also supports seasonably abundant populations of snow geese (*Chen caerulescens*) and tundra swans (*Cygnus columbianus*), which forage in the agricultural lands surrounding several NWRs. Although the waterfowl roost in open water within the refuge during the winter months, they leave their roosts during the day to forage on waste grain in harvested fields of corn and soybeans and on shoots of winter wheat in and around OLF Site C.

As part of the National Environmental Policy Act (NEPA) process, the Navy had to evaluate (1) whether the Bird Aircraft Strike Hazard (BASH) risk at OLF Site C (and the other potential site alternatives) was manageable given the migratory waterfowl populations that overwinter at Pocosin Lakes NWR and (2) what potential environmental impacts would be associated with implementation of a BASH management plan that could manage that risk.

## STUDY AREA

The proposed OLF site encompasses approximately 30,000 acres. Within the central 2,000-acres, the Navy would construct its core area, including an 8,000-foot runway, an air traffic control tower, and other supporting structures. Beyond the core area, the Navy proposed to control the land use, either through acquisition of the land or acquisition of restrictive easements, to ensure that the lands surrounding the core area would remain compatible with aircraft operations and flight safety.

OLF Site C is located at the western edge of an agricultural area west of the Pocosin Lakes NWR (Figure 1). The 30,000-acre site is primarily agricultural, with large canals providing drainage throughout the site. Beyond OLF Site C, the agricultural lands transition to forestland, forested wetlands, and pasture. The nearest population center is the City of Plymouth, approximately 10 miles southeast of the site.

The Pocosin Lakes NWR (Pungo Unit) is located approximately 6 miles from the center of OLF Site C. Pocosin Lakes NWR provides roosting and foraging habitat for a large population of overwintering waterfowl. Waterfowl roosting areas at the Pocosin Lakes NWR include the 2,800-acre Pungo Lake (approximately 7 miles from the center of OLF Site C); the 4,900-acre New Lake (approximately 19 miles from the center of OLF Site C); and a number of impoundments managed for waterfowl, including Marsh A, Smartweed, and Jones Pond. Pettigrew State Park is located approximately 15 miles northeast of the center of OLF Site C and includes the 16,600-acre Phelps Lake, which also functions as a roosting area for overwintering waterfowl.

## METHODS

The Navy; the U.S. Department of Agriculture, Animal and Plant Health Inspection Service, Wildlife Services Program (USDA WS); and Ecology and Environment, Inc. (E & E) conducted a series of desktop and field studies to determine the BASH conditions at OLF Site C and the other potential site alternatives. Although the data collection and assessment included OLF Site C and several other potential site alternatives, this paper focuses on the work conducted at OLF Site C. Studies conducted included a 20-week survey of waterfowl movements and distribution in the region of northeastern North Carolina that included OLF Site C and Pocosin Lakes NWR; a noise response experiment that documented the responses of waterfowl to aircraft; crop mapping and habitat availability assessment within the OLF site and within a 20-mile radius of Pocosin Lakes NWR; a review of historic state (e.g., North Carolina Wildlife Resources Commission [NCWRC]) and federal (U. S. Fish and Wildlife Service [USFWS]) survey counts from the past 50 years and of historic (2000-2003) tundra swan flock location data; and a radar survey at OLF Site C.

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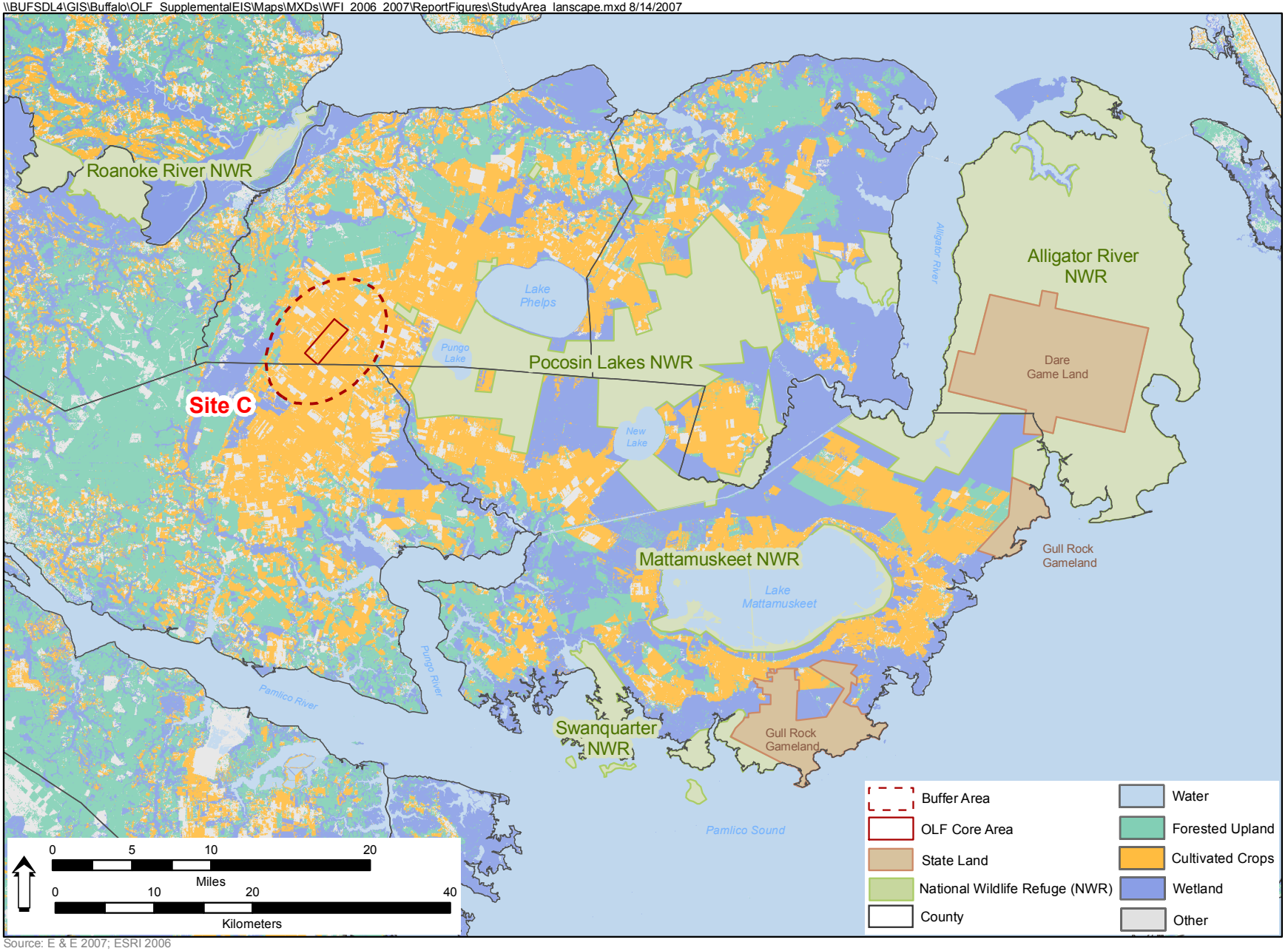



Source: E & E 2007; ESRI 2006
USFWS, 2006; USGS 1992 & 2001

**Figure 1 Regional Location.**

Additional studies used to evaluate the potential risk associated with these BASH conditions, and whether that risk was manageable, included a BASH Assessment by the USDA WS and a study of BASH management programs at existing military and civilian airfields near populations of migratory waterfowl.

**Overwintering Waterfowl Study.** Ground and aerial waterfowl surveys were conducted during the 2005-2006 overwintering season to determine the numbers of migratory waterfowl (tundra swans and snow geese), their regional distribution, and habitat use in the region of northeastern North Carolina that includes OLF Site C and Pocosin Lakes NWR. Flock sizes and locations and the types of agricultural fields and other habitats waterfowl were located in were documented during this 20-week study, which extended from November 2005 through March 2006. In addition, waterfowl movement information (e.g., departure and arrival times from and to roost sites) was recorded.

**Noise Response Evaluation.** The Navy conducted three flight trials to characterize the noise from Super Hornet flight operations and to evaluate the response of waterfowl to these operations. While Super Hornet aircraft flew simulated FCLP operations, the reactions of migratory waterfowl were recorded, as were measurements of noise. Flight trials were conducted at OLF Site C in December 2005, January 2006, and February 2006. Researchers compared waterfowl behavior documented during the pre-test flight, test flight, and post-test flight periods to determine whether waterfowl responded any differently during Super Hornet test flights.

**Crop Mapping and Habitat Assessment.** Crop types within OLF Site C and within a 20-mile radius of Pocosin Lakes NWR (the approximate maximum daily foraging travel distance by overwintering waterfowl from their primary roosting location [Bellrose 1980; Petrie et al. 2002]) were recorded in the fall of 2005, prior to the fall harvest. Information on the availability of winter wheat also was recorded during the 2005-2006 overwintering season. This information was used to evaluate how implementation of a BASH management plan at OLF Site C would impact the regional availability of foraging habitat for waterfowl overwintering at the Pocosin Lakes NWR.

**Review of Historical Waterfowl Population and Distribution Data.** Information on historic waterfowl population and distribution in northeastern North Carolina was collected and evaluated to determine the historical context of the data collected during the 2005-2006 overwintering season and to determine the regional population and distribution trends. Historic survey data included Mid-Winter Waterfowl Survey counts (1961-2005) conducted by the Atlantic Flyway Council and USFWS and counts by NCWRC for the Mid-Winter Waterfowl Survey units in northeastern North Carolina; the annual Goose, Swan, and Brant surveys (1994-2003) conducted by the NCWRC; and annual counts at NWRs (early to late 1990s-2006). A review of tundra swan flock locations from a project conducted jointly by Cornell University, NCWRC, USFWS, and the U.S. Geological Survey (USGS) that tracked collared swans during the 2000-2001, 2001-2002, and 2002-2003 overwintering seasons also was conducted.

**Radar Study.** During the 2003-2004 overwintering season, a Mobile Avian Radar System (MARS) was installed at OLF Site C to monitor bird activity. The radar unit was located at the center of the OLF Site C core area and collected data on bird movements within a 4- to 6-nautical mile-radius of the radar unit to altitudes of 8,500 feet above ground level (agl). The metrics generated from the radar data include passage rates (i.e., the number of targets), average altitudes, flight directions, and airspeeds of these targets. Field observations were completed jointly with the 2003-2004 radar study to determine avian arrival/departure dates, the relative abundance of birds, and to identify bird species that could pose a BASH risk.

**BASH Assessment**. Representatives from the USDA WS and the WS National Wildlife Research Center conducted site visits, evaluated OLF Site C for wildlife hazards, and provided recommendations for BASH management activities that could be employed at OLF Site C.

**Comparative Airfield Assessment.** Information on aircraft operations, waterfowl population and distribution, and waterfowl foraging habitat in and around five operating airfields and two military training ranges were collected. This information was reviewed to evaluate the efficacy of BASH management programs and the impact of aircraft operations on waterfowl populations at existing facilities. Airfields considered suitable for the comparative analysis were established military and civilian airfields (and ranges) with surrounding land use, natural habitats, and wildlife species (i.e., tundra swans, snow geese, and ducks) composition similar to those present near OLF Site C. In addition, the airfields/ranges had levels of operations similar to or greater than the number of operations proposed for OLF Site C and included low-altitude flight paths over waterfowl concentration areas. The facilities selected for evaluation included: Dover Air Force Base, Delaware; NAS Fallon, Nevada; NAS Whidbey Island, Washington; Kingsley Field Air National Guard Base/Klamath Falls Airport, Oregon; Vancouver International Airport, British Columbia; Restricted Area (R)-5314/Dare County Range, North Carolina; and R-5316A/ Bombing Target (BT)-9/BT-11, North Carolina.

## RESULTS

The desktop and field studies were conducted to support the *Supplemental Environmental Impact Statement for Introduction of F/A-18 E/F (Super Hornet) Aircraft to the East Coast of the United States*. Only the results that pertain to BASH conditions and BASH management are presented here. The complete technical reports can be found at www.olfseis.com.

**BASH Conditions.** Blackbirds (primarily the red-winged blackbird [*Agelaius phoeniceus*] and common grackle [*Quiscalus quiscula*]), tundra swans, and ring-billed gulls (*Larus delawarensis*) were the most numerous bird species observed in the vicinity of OLF Site C during the 2003-2004 radar surveys and joint field observations. One or more flocks of tundra swans were observed flying through the study area on 33 separate days. Tundra swan numbers during these surveys were highest in early December and again from mid-February to early March. Gulls and blackbirds were occasionally observed in large flocks within the study area. Flocks of gulls, blackbirds, European starlings (*Sturnus vulgaris*), and turkey vultures (*Cathartes aura*) also were observed at OLF Site C by USDA WS personnel during site visits, and a bald eagle (*Haliaeetus leucocephala*) was observed once flying in the vicinity of OLF Site C.

Data collected during the 2005-2006 overwintering waterfowl study were consistent with the findings of the 2003-2004 radar and joint field observations. The median number of tundra swans observed during the ground and aerial surveys within the 30,000-acre OLF site over the course of the 2005-2006 overwintering waterfowl study was 1,516, with a range of zero to 5,817 (Table 1). Although snow geese were observed at and around the NWR, they were never observed at OLF Site C during the 2005-2006 overwintering season.

**Table 1 Summary of Daily Counts of Tundra Swans at OLF Site C (2005-2006)**

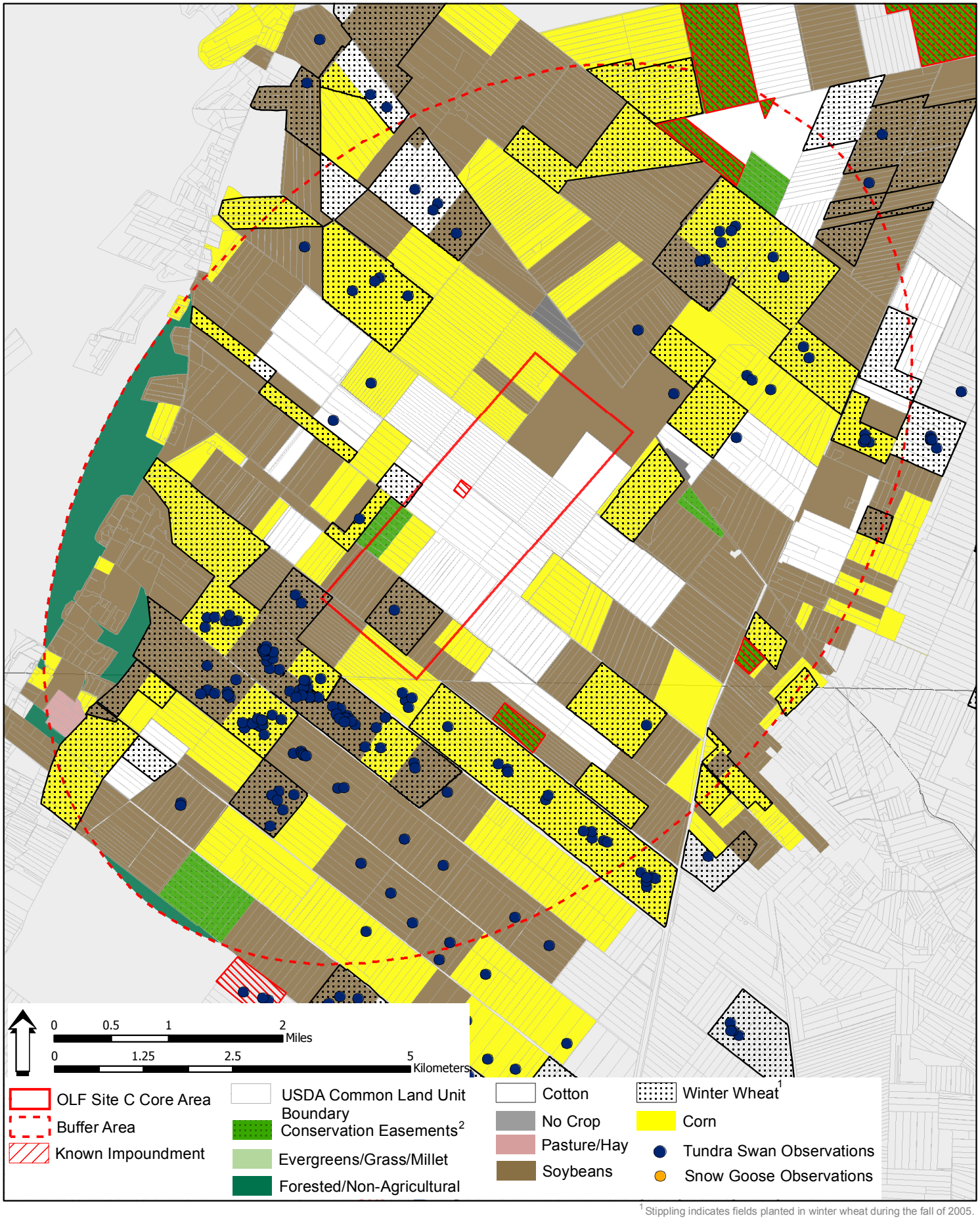
| | Number of Surveys Conducted | Daily Maximum | Daily Minimum (Non-zero value[1]) | Median of Daily counts[2] |
|---|---|---|---|---|
| **OLF Site C** | | | | |
| November | 9 | 4,212 | 0 (1,994) | 0 |
| December | 10 | 5,817 | 760 | 1,283 |
| January | 11 | 4,490 | 130 | 1,354 |
| February | 10 | 3,218 | 807 | 1,595 |
| March | 4 | 2,251 | 500 | 1,145 |

[1] For months where the minimum daily count was zero, a non-zero minimum count also is provided, if available.

[2] Medians were calculated using all counts for each month, including zero counts.

Roosting habitat is not known to occur on OLF Site C, so habitat use by these species was entirely for foraging and associated resting/loafing activities. Tundra swans were far more frequently observed in winter wheat fields (104 observations) than in soybean fields (28 observations), cornfields (13 observations), or cotton fields (two observations). Tundra swans were observed in over 60% of the available winter wheat fields on the site and foraged on approximately 13%, or 3,792 acres, of the site. The 2005-2006 overwintering waterfowl study data show a relatively large concentration area in the southern portion of the site (Figures 2 and 3). While tundra swans used a number of fields within OLF Site C during the overwintering season, they were normally concentrated in a few locations on a daily basis. The number of flocks counted in the OLF Site C buffer area during the daily surveys ranged from one to 12 and averaged four flocks per survey. No flocks of ducks, snow geese, or Canada geese were observed within the 30,000-acre OLF Site C during the 2003-2004 and 2005-2006 field surveys. In addition, the review of historic waterfowl data indicated that the population and distributional trends observed in 2003-2004 and 2005-2006 are typical for waterfowl in North Carolina.

**Potential BASH Risk.** The movement patterns of tundra swans near OLF Site C would result in flocks flying over the proposed airfield and across low-altitude flight tracks at certain times of the day from November to March. Field observations and radar data indicate that the BASH conditions from these movements would be severe during two distinct time periods each day: (1) between 7:00 A.M. and 10:00 A.M., when tundra swans fly from roost areas to agricultural fields surrounding the site; and (2) approximately 1 hour before sunset, when tundra swans fly back to roost sites (E & E 2006c), necessitating the implementation of BASH management measures. The altitude of daily tundra swan movements in relation to aircraft altitudes during these periods also could elevate the potential BASH risk. Tundra swans fly at altitudes between




[1] Stippling indicates fields planted in winter wheat during the fall of 2005.
[2] Easement areas may be seasonally flooded (Stanton 2005).

**Figure 2 Crop Types within the 30,000-acre OLF Site C 2005-2006 Overwintering Waterfowl Study**

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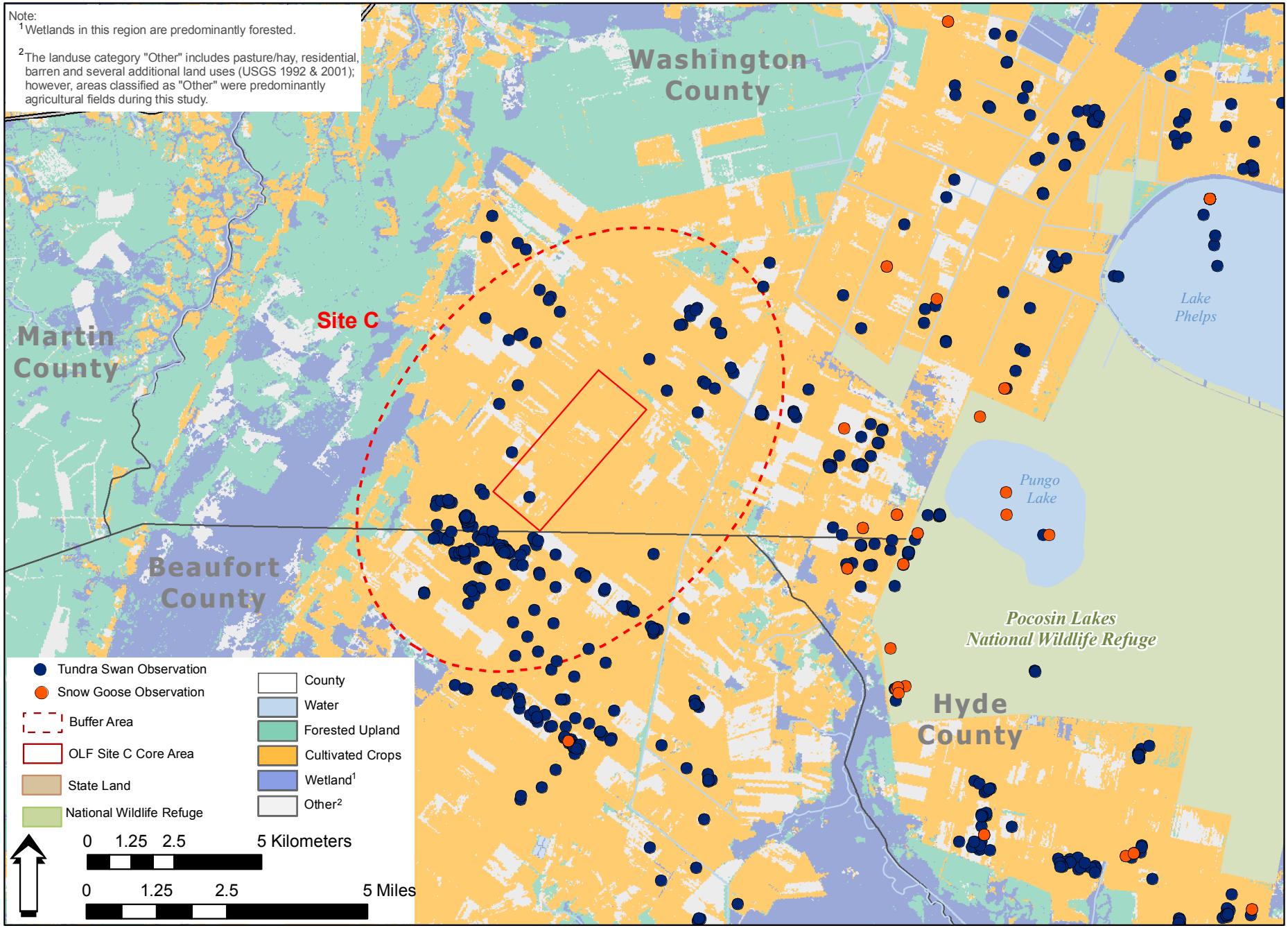


Source: USGS 2004

**Figure 3 OLF Site C Waterfowl Observations 2005-2006 Overwintering Study**

100 and 600 feet agl for local movements (Geo-Marine 2006), which would place flocks of tundra swans at the same altitude as aircraft conducting FCLP operations.

The BASH conditions would be moderate during other times of the day in November through March, based on three primary field observations: (1) tundra swans remained in agricultural fields throughout the day, with minimal movement between other fields and roosting areas (E & E 2006c); (2) tundra swans have been infrequently observed foraging at night (E & E 2006c; Geo-Marine 2006); and (3) tundra swans may be unlikely to flush or lift up beneath an aircraft during an overflight (E & E 2006d).

**Management of BASH Risk.** As a result of these and other studies, the BASH conditions at OLF Site C were determined to necessitate implementation of BASH management measures for the control of wildlife species near the site. The three types of BASH management measures needed to effectively reduce the BASH risk at OLF Site C would involve land use controls, active controls, and flight advisories. The BASH risk was determined to be manageable without significant impact on waterfowl or other wildlife species, based on the following BASH conditions and proposed BASH management measures:

1. Daily and annual waterfowl movements were largely predictable. Tundra swans tended to leave the roosting areas at Pocosin Lakes NWR between 7:00 A.M. and 10:00 A.M., remained in the fields through the midday, and returned to the roost areas approximately one hour before sunset. They tended to fly to fields north, west, and northwest of the Pocosin Lakes NWR. If land use is controlled at OLF Site C to reduce its attractiveness to waterfowl, the swans would tend not to forage there or fly over OLF Site C since minimal agricultural lands are located west of the site. Snow geese, Canada geese, and ducks tended to remain on or close to the refuge. The overwintering season generally extends from November through March. Following the overwintering season, waterfowl migrate to their northern breeding grounds, and the severity of the BASH conditions would be greatly reduced.

   The Navy would control approximately 30,000 acres, either through acquisition of the land or acquisition of restrictive easements. This would allow the Navy to manage agricultural fields at OLF Site C in a manner that would reduce or eliminate their attractiveness to migratory waterfowl. All agricultural land within the core area beyond the airfield structures would be converted to turf grass and managed to reduce its attractiveness to migratory waterfowl and other bird species. Land areas beyond the core area also would be managed to reduce their attractiveness to migratory waterfowl and other bird species by implementing two types of agricultural management techniques: agricultural land conversion and agricultural land control.

   Agricultural land conversion would be implemented to specifically minimize waterfowl movements and foraging behavior and other migratory bird movements (e.g., blackbirds) in the vicinity of low-level flights, the highest BASH-risk areas. Conversion of agricultural land would be accomplished by one or a combination of the following:

   - Replacement of corn and soybean propagation with a cotton rotation, where cotton would be planted for three consecutive years and then rotated with fallow fields.

- Conversion of agricultural land to low scrub-shrub vegetation consistent with flight safety.
- Conversion of agricultural land to a mixed-pine, pine-hardwood, and bottomland hardwood forest in areas that would not create obstructions to flight safety.
- Conversion of agricultural land to a maintained monoculture grassland habitat (e.g., turf grass).

Agricultural land control would be completed to maintain crop types while reducing or eliminating the attractiveness of agricultural fields to migratory waterfowl by one or a combination of the following:

- Harvesting corn and soybeans by complete removal (i.e., discing the land immediately after harvest to make the residual grain unavailable to waterfowl) or leaving corn as tall stalks.
- Eliminating winter wheat or other winter grain crops from the crop rotation.
- Using hedgerows to break cropland into smaller fields that would be less attractive to waterfowl that prefer large, open fields.
- Prohibiting the flooding of fields to create impoundments.

2. The majority of the aircraft operations would occur at night, when bird movements are minimal. During the 2003-2004 radar study and 2005-2006 overwintering waterfowl study, tundra swans were observed using OLF Site C during the day, exhibiting limited movements at night (Figure 4). The only significant nighttime waterfowl movements at the site occurred during fall and spring migrations (Geo-Marine 2006).

3. A mobile radar unit at OLF Site C would be installed to monitor migratory bird movements and to provide real-time advisories when setting Bird Watch Conditions (BWCs) or when notifying aircrews of potential hazards. Control of agricultural fields in the eastern portion of the buffer area combined with other land management practices on the site would likely be effective in minimizing tundra swan and snow goose movements across the OLF site. However, sporadic movements of waterfowl within the site would be expected based on the proximity of major waterfowl roosting areas. Issuance of elevated BWCs would likely be limited to transient events when flocks of waterfowl are transiting the immediate airspace of the facility during the day and intermittently at night. An elevated BWC could potentially affect flight operations for short periods during any given day during the overwintering season. Other bird species (e.g., gulls, blackbirds, raptors) could periodically contribute to the issuing of an elevated BWC, which also could affect flight operations for short periods during any given day throughout the year.

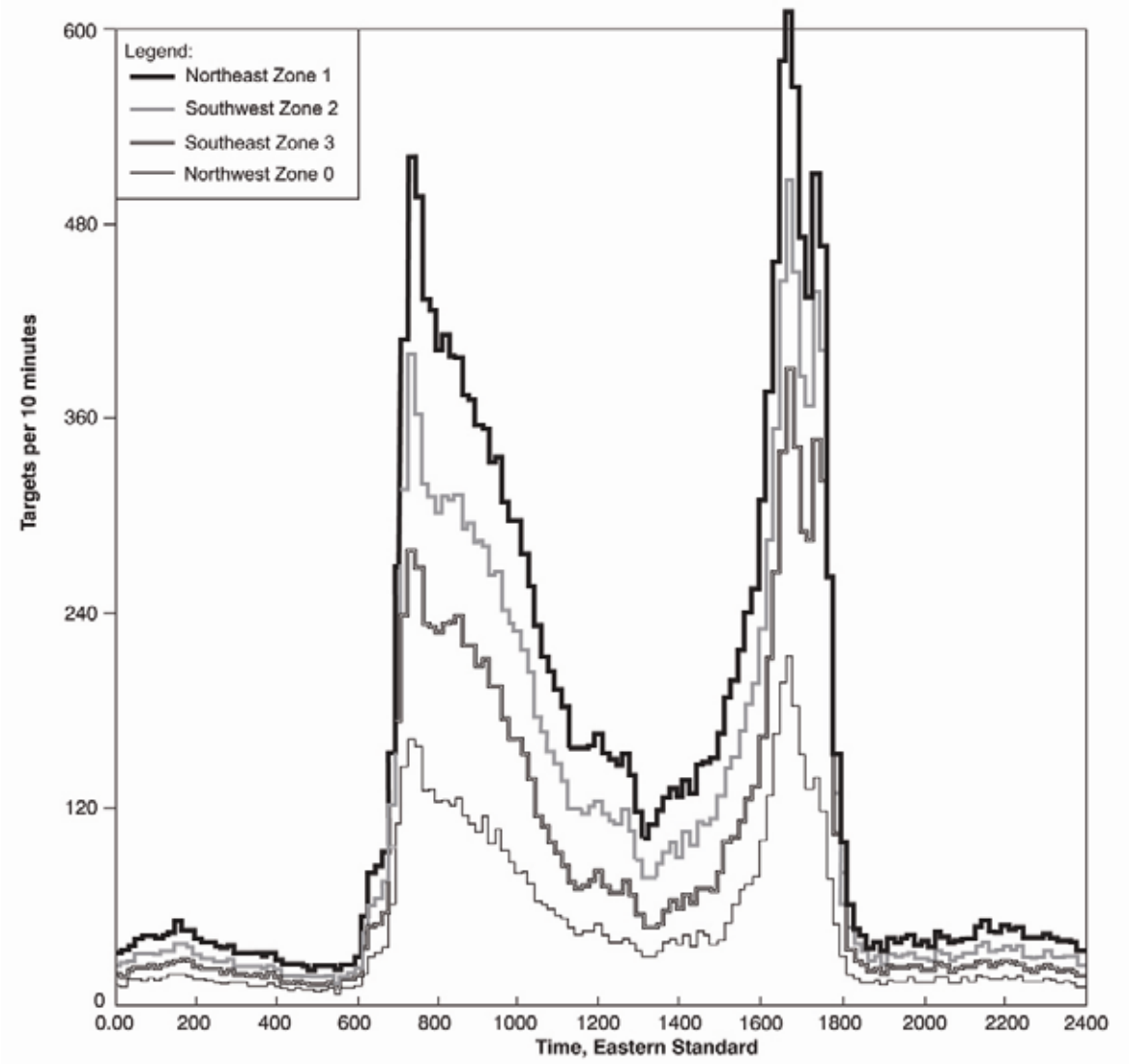


**Figure 4 Radar Results for December Showing Hourly Avian Movements at OLF Site C (Geomarine 2006)**

4. Wildlife strikes involving waterfowl have historically been low in number in North Carolina, and BASH management programs have been successfully implemented at airfields and training ranges near large concentrations of waterfowl. Approximately 1,200 bird and wildlife strikes have been recorded since 1990 throughout North Carolina (USDA 2006). The majority of these events involved civilian aircraft and birds that were not positively identified (i.e., 63%). Gulls, blackbirds, mourning doves (*Zenaida macroura*), various sparrows, and European starlings were the five most commonly identified species involved in strike events (i.e., 20%). One incident was reported that involved a snow goose. This incident occurred in 2001 near Elizabeth City, when a civilian aircraft struck a snow goose at night, causing damage to the wing of the aircraft. No incidents in North Carolina involving aircraft and tundra swans are definitively recorded in the National Wildlife Strike Database; however, a strike that occurred in October 2004 while a Cessna 172 was en route may have involved a tundra swan. It was reported in the database as a "duck or goose," exact species unknown (USDA 2006). The

majority of all of the recorded strikes occurred when waterfowl are not wintering in North Carolina, between the months of July and November (64%), with most strikes occurring between August and October (46%).

In the study of five active military and civilian airfields and two military training ranges where an equal or greater number of annual flight operations are occurring at low altitudes near high populations of migratory waterfowl, successful BASH management programs have been implemented, and the number of bird strikes has been relatively low (E & E 2006e). Despite the aircraft noise exposures, the numbers of migratory waterfowl that overwinter or stage on habitats close to the comparison airfields and training ranges have remained stable or increased during the past 10 to 30 years. Further, overwintering populations of tundra swans, snow geese, and ducks on federal, state, and private lands are able to coexist in proximity to major military and civilian air installations.

## CONCLUSIONS

Based on the studies conducted, the BASH risk was determined to be manageable without significant impact to waterfowl or other wildlife species. Land management of the 30,000-acre site to reduce its attractiveness to migratory waterfowl and other bird species would result in the loss of potential foraging habitat. Approximately 17,765 acres of potential waterfowl forage habitat (waste corn and soybeans) within the 30,000-acre OLF Site C, including the core area, would be made unavailable for foraging through the use of agricultural conversion or agricultural controls. Of that 17,765 acres**,** approximately 6,068 acres planted in winter wheat following the fall harvest also would be controlled, resulting in a loss in foraging habitat. The loss of potential foraging habitat would involve approximately 8% of the regional corn and soybeans and 5% of the regionally available winter wheat within a 20-mile radius of the Pocosin Lakes NWR (Table 2).

**Table 2 Summary of Agricultural Land Considered for Conversion or Control for Construction of OLF and Land Management at OLF Site C**

| | Acres of Cultivated Cropland/Potential Foraging Habitat[a,b] | | |
|---|---|---|---|
| | Total Agricultural Land (% of regional area) | Corn and Soybeans[c] (% of regional area) | Winter Wheat[d] (% of regional area) |
| Core Area | 1,960 (0.6) | 939 (0.4) | 159 (0.1) |
| Buffer Area | 20,393 (6) | 16,826 (8) | 5,899 (5) |
| **Total** | **22,353 (7)** | **17,765 (8)** | **6,058 (5)** |
| Regional Area[e] | 299,000 | 219,200 | 118,400 |

[a] The acreage of cultivated cropland is based on the ground and aerial surveys conducted during the fall and winter of 2005-2006. This provides an assessment of the potential foraging habitat removed for the construction of the airfield and implementation of the conceptual BASH management plan, as crop types are subject to change on an annual basis.

[b] Potential foraging habitat includes the acreage of cultivated cropland planted in corn, soybeans, and winter wheat.

[c] Fall 2005 growing season.

[d] Winter 2005-2006 growing season.

[e] Potential foraging habitat within a 20-mile radius of Pungo Lake (in Pocosin Lakes NWR).

Waterfowl would be expected to modify their foraging habits to use other forage areas. While waterfowl populations would be affected, these impacts were not considered significant, since the availability of the foraging habitat within a 20-mile radius of OLF Site C would be sufficient to support the redistribution of waterfowl.

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