WETLANDS & SUBAQUEOUS
LANDS SECTION

STATE OF DELAWARE
DEPARTMENT OF NATURAL RESOURCES &
ENVIRONMENTAL CONTROL
DIVISION OF WATER RESOURCES
89 KINGS HIGHWAY
DOVER, DELAWARE 19901

TELEPHONE (302) 739-9943
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January 3, 2008

G. Walter Swain
8241 Front Street
Lincoln, DE 19960

CERTIFIED MAIL
RETURN RECEIPT REQUESTED
7007 1490 0003 3233 8183

Dear Mr. Swain:

Your application for a Subaqueous Lands Lease (SL-159/05) Marina Permit (MP-161/05) and Water Quality Certification (WQ-160/05) to reconstruct and expand a previously existing marina with shoreline stabilization in Mispillion Harbor at the confluence of Cedar Creek and the Mispillion River on the east side of Lighthouse Road, Milford, Sussex County, Delaware, has been reviewed in accordance with the requirements of the Subaqueous Lands Act (7 Del. C., Chapter 72), the Regulations Governing the Use of Subaqueous Lands, the Environmental Control Act (7 Del. C., Chapter 60), the Delaware Marina Regulations, the Regulations Governing the Control of Water Pollution, and Section 401 of the Clean Water Act. After a detailed evaluation of the proposed project, your application is hereby denied for reasons stated in the attached memorandum to file.

If you should have any questions regarding this action, please feel free to contact this office.

Sincerely,

Laura M. Herr
Section Manager
Wetlands and Subaqueous
Lands Section

c: Dave Hardin, Restoration Ecological Services, Inc.
Frank Cianfrani, USACOE

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MEMORANDUM

TO: File

FROM: James T. Chaconas, Environmental Scientist

RE: SL-159/05, WQ-160/05, MP-161/05. Permit Review for an application from G. Walter Swain to reconstruct and expand a previously existing marina, including additional slips, a boat ramp and shoreline stabilization along Cedar Creek and the Mispillion River at the Mispillion Harbor on the east side of Lighthouse Road, Milford, Sussex County, Delaware

DATE: December 18, 2007

Background

The Wetlands and Subaqueous Lands Section (WSLS), Division of Water Resources, Department of Natural Resources and Environmental Control (Department) received an application for a subaqueous lands lease, marina permit and water quality certification from G. Walter Swain to construct the above-referenced facility along Cedar Creek and the Mispillion River on the east side of Lighthouse Road near Milford, Sussex County, Delaware. The application states that the project would add 24 new slips to a previously existing 26 slip marina, jointly consisting of a 6 foot by 460 foot dock, a 6 foot by 185 foot dock, two 8 foot by 96 foot piers, an 8 foot by 195 foot pier, twenty 3 foot by 12 foot finger piers, and seven 3 foot by 15 foot finger piers. Based on a review of the proposed plans, the Department has determined that all fifty boat slips proposed by this project would be built channelward of the mean low water line off of the applicant's property on public subaqueous lands. Additionally, a 22 foot by 100 foot boat ramp and 388 linear feet of stone rip-rap revetment with 7,735 square feet of vegetative (*Spartina alterniflora*) shoreline stabilization would be constructed. The previously existing marina authorized by Subaqueous Lands Lease SL-1203/90 and granted to Dorothy M. Bennett consisted of eleven 2 foot by 20 foot piers in Cedar Creek. That marina was destroyed by a storm in 1992. There have been no slips available at the site since 1992 and no new piers or docks have been constructed at the property since that time.

The commercial marina would provide 12 slips along the Mispillion River capable of berthing boats up to approximately 40 feet in length. The remaining 38 slips would be designed to accommodate boats up to approximately 24 feet in length. A proposed boat ramp would provide access to and from the water for users of the marina.

The shoreline at the proposed facility would be stabilized using a combination of stone rip-rap and vegetative plantings. Additional appurtenances at the proposed marina include a parking lot, office, house and restrooms.

The applicant's stated purpose of the proposed project is to reconstruct and expand an existing marina that was "largely destroyed by a storm in 1992."

DEPARTMENT REVIEW

The proposed project, most of which will be on public subaqueous lands is subject to the requirements of the Subaqueous Lands Act (7 Del C., Chapter 72), the Environmental Control Act (7 Del. C., Chapter 60), the Department's Regulations Governing the Use of Subaqueous Lands, Marina Regulations, and Regulations Governing the Control of Water Pollution, as well as Section 401 of the Clean Water Act. The Department completed a review of the permit application in accordance with these laws and regulations.

State Subaqueous Lands Act Requirements

Structures located in subaqueous lands are subject to the requirements of the Subaqueous Lands Act. 7 Del C. Section 7201 states:

> *Subaqueous lands in Delaware constitute an important resource of the State and require protection against uses or changes which may impair the public interest in the use of tidal and nontidal waters. The purposes of this chapter are to empower the Secretary to deal with or dispose of interest in public subaqueous lands and to place reasonable limits on the use and development of private subaqueous lands, in order to protect the public interest by employing orderly procedures for granting interests in public subaqueous lands and for issuing permits for uses of or changes in private subaqueous lands. To this end, this chapter empowers the Secretary to adopt rules and regulations to effectuate the purposes of the chapter, to apply to the courts for aid in enforcing this statute and the rules and regulations adopted pursuant hereto, and to convey interests in subaqueous lands belonging to the State.*

Regulations that have been adopted pursuant to the Subaqueous Lands Act include both the Delaware Marina Regulations and the Regulations Governing the Use of Subaqueous Lands (Subaqueous Regulations).

I. Delaware Marina Regulations

Section II.D.8 of the Marina Regulations states that the "construction of marinas shall not be permitted at sites that are recognized by the Department as critical habitats." Critical habitats, as defined by the Marina Regulations, are:

> "Areas classified by the Department and that serve an essential role in the maintenance of sensitive species. Critical habitat areas may include unique aquatic or terrestrial ecosystems that support rare, endangered, or threatened plants and animals. Rare, endangered, or threatened species are defined by both state and/or federal listings".

The proposed marina site is within an area upon which migratory and breeding shorebirds depend and is therefore recognized by the Department as critical habitat. It is and area of international significance to several species of migratory shorebirds using the Atlantic Flyway during their annual migrations including a species whose population has decreased to such critical levels that the U.S. Fish and Wildlife Service determined that it warrants protection under the Endangered Species Act. Additionally, there are several other State rare shorebird species that use this location for feeding and roosting during migration or for nesting.

Each spring tens of thousands of migratory shorebirds use the beaches in Mispillion Harbor for roosting and feeding (See Appendix 1 for a full list of Mispillion Harbor shorebirds). These beaches are located in very close proximity to the proposed marina, and include the beaches across Cedar Creek and the Mispillion River from the marina site, as well as on the marina property itself. Red Knots (*Calidris canutus)*, Ruddy Turnstones (*Arenaria interpres*), and Sanderlings (*Calidris alba*) are among the species observed in Mispillion Harbor during migration, and which are listed on the State of Delaware's Wildlife Action Plan as a Tier 1 Species of Greatest Conservation Need by DNREC's Natural Heritage and Endangered Species Program. Species are added to this list if they meet certain population or regulatory criteria at the national, regional, or state level. These species met several of the criteria, including their designation as State Species of Conservation Concern due to high migratory concentrations, making them vulnerable during migration. They are considered *highest priority* species in the New England/Mid-Atlantic Bird Conservation Region (BCR30) under the North American Bird Conservation Initiative. The U.S. Shorebird Conservation Plan considers Red Knots *highly imperiled,* while Ruddy Turnstones and Sanderlings are *species of high concern.* Of particular concern is the *rufa* subspecies of the Red Knot which is considered a *candidate* species for Endangered Species Act protection by the US Fish and Wildlife Service. This means their population has already been judged to warrant protection, but it has not yet been listed due to other high priority species. This subspecies has a Natureserve conservation rank of *highly imperiled.* Red Knots are also proposed to be added to the State of Delaware's endangered species list.

During their spring migration, Red Knots fly from Argentina to their arctic breeding grounds with their final and most important stopover in the Delaware Bay area (Kalasz, 2006). The stopover in mid-May through early June coincides with the annual spawning of horseshoe crabs. Horseshoe crab eggs are the primary food source for migrating shorebirds in Delaware Bay (Haramis et al. 2007). As the crabs lay their eggs along the sandy beaches, the birds eat the eggs to replenish their body weight, typically doubling it, and restoring energy for the remainder of their migration. During their short stay in the Delaware Bay area they must attain a sufficient amount of weight, not only to fly to the arctic breeding grounds, but also to pair, mate and lay eggs once they arrive. If the birds are unable to attain a minimum weight before continuing their flight, they are less likely to have the energy reserves to accomplish breeding. If birds are unable to breed, the population suffers because of the decreased chick production. It has also been found that birds that don't attain the weight needed by foraging in Delaware Bay have lower yearly survivorship further impacting the population (Baker et al. 2004). Red Knots have become particularly vulnerable in Delaware Bay because they require the most food for energy and lower horseshoe crab numbers since the late 1990's has reduced the food resources available to them and other migrating shorebirds. Mispillion Harbor has had the highest densities of crab eggs in recent years attracting a large proportion of the Red Knot stopover population. Mispillion Harbor is currently the only location in Delaware Bay that can support large numbers of shorebirds particularly when food resources are low elsewhere. Any further reductions to the remaining population of the *rufu* subspecies could lead to its extinction (Baker et al. 2004).

In addition to Mispillion Harbor's importance to migratory shorebirds, it is one of the few places on the Delaware Bay shore where American Oystercatchers have been recorded nesting. This species is also a Tier 1 Species of Greatest Conservation Need. It is a State Species of Greatest Conservation Need due to a small breeding population in Delaware. In addition, it has the highest conservation priority in the BCR30 and is listed as *highly imperiled* in the U.S. Shorebird Conservation Plan.

The Department's concerns with respect to the construction of the marina and its impact on shorebirds is that the addition of 50 boat slips and the corresponding increase in human activity would negatively impact the shorebird community, including the critically stressed Red Knots. Of primary concern is that the feeding and roosting behavior of the birds will be disturbed by the increased activity associated with the marina and they will, therefore, not gain the weight necessary to accomplish successful breeding or abandon the roosting and feeding area altogether. Disturbances caused by increased vigilance and escape flights to avoid perceived threatening situations have been shown to reduce daily weight gain by as much as 10% in shorebirds (Kalasz, 2006). Studies of the effects of vehicles or boats passing by flocks of birds at a constant, low rate of speed (such as the current boat traffic pattern in the Mispillion Harbor) causes less disturbance to the birds than if the birds are approached directly or by erratic movements (Bennett, 2007; Kalasz, 2006). Boats motoring in and out of the marina in close

proximity to the shorebirds (50 to 150 meters away) will tend to move erratically as they enter and exit the Harbor area, thus further disrupting the shorebirds. Additionally, the presence of the marina will tend to cause boat traffic in the Harbor to veer closer to the opposite shores from the marina causing the boats to move more erratically and pose a threat to shorebirds on those shores.

The increased human activity (movement and noise) at the marina will negatively impact the shorebirds. The likely presence of pet dogs and cats, which are predators of small animals such as shorebirds, will also increase disturbance to the birds thus decreasing the habitat value of the Mispillion Harbor for the species of concern. Pets are also known vectors for wildlife diseases that can be transmitted to susceptible wildlife populations. (Schaefer, J. 1991)

Additionally, the presence of up to 50 boats near the shorebird's roosting and feeding area makes the birds much more susceptible to being negatively affected by oil and fuel spills from the boats. The normal operation of many marine engines results in the discharge of hydrocarbon pollutants to the aquatic environment. Conventional boat engines release up to 30 percent of their fuel directly into the water and air as pollution (Schmidt et al. 2004). The discharged hydrocarbons can become adsorbed to sediments and suspended particles. Additionally, the thin layers formed by the hydrocarbons have been found to significantly affect the development and survival of marine fish eggs (Stolpe, N.E. 1992).

The proposed marina would also directly remove a small cobble beach along the property shoreline that is used by Ruddy Turnstones for feeding and roosting (Kalasz, 2006), thus, permanently removing this habitat for the shorebirds to use.

The materials used to construct the marina (CCA treated lumber) will also have a negative impact on the habitat value of Mispillion Harbor. Over 350 CCA treated pilings will be used to support the piers and docks comprising the berthing structure. The use of CCA lumber will introduce copper, chromium and arsenic into the water and sediments and consequently into the aquatic food chain of which the shorebirds are a part. Studies have shown that organisms living in close proximity to CCA treated dock pilings accumulate higher concentrations of CCA metals (Sanger & Holland, 2002). This impact in combination with increased boating activity, which continually resuspends sediments, thereby increasing the potential exposure of aquatic organisms to the sorbed pollutants, would pose a significant cumulative adverse impact.

The negative impacts of introducing CCA into the aquatic environment would also extend to the horseshoe crabs which the migrating shorebirds are dependent on to provide food to breed and complete their migration.

The site of the proposed marina is surrounded by land designated as Natural Area by the Department of Natural Resources and Environmental Control. This includes the

beaches considered critical shorebird habitat across from the proposed marina. Natural Areas involve areas of land or water, or of both land and water, whether in public or private ownership, which either retains or has reestablished its natural character (although it need not be undisturbed), or has unusual flora or fauna, or has biotic, geological, scenic or archaeological features of scientific or educational value. In addition, due to the international importance of this area as a critical stopover for migrating shorebirds, the Office of Nature Preserves considers The Mispillion River Natural Area worthy of designation as a Nature Preserve. The function of a Nature Preserve is to protect important features of Delaware's natural heritage and guarantee their existence for future generations. The proposed marina will undoubtedly have negative impacts on those lands in Mispillion Harbor designated as natural Areas.

The site is a critical habitat because in addition to the above named State very rare and rare shorebird species, it also provides important habitat to the State listed rare species, Sanderling *(Calidris alba)* and the Semipalmated Sandpiper *(Calidris pusilla)*. The State listed rare species, Black Skimmer *(Rynccops niger)*, Osprey *(Pandion haliaetus)* and the American Oystercatcher *(Haematopus palliates)* are also noted to breed or to have historically bred in the Mispillion Harbor.

In summary, the Department has concluded that the proximity of the proposed marina to this internationally significant migration stopover, breeding and nesting area poses an unacceptably high potential for significant adverse impacts to rare and threatened shorebird species in a Department recognized critical habitat.

II. Regulations Governing the Use of Subaqueous Lands (Subaqueous Regulations)

Section 3 of the Subaqueous Regulations requires that the application be evaluated based both on its impacts to environmental resources as well as its potential for public use impacts. This section also states that "an application may be denied if the activity could cause harm to the environment, either singly or in combination with other activities or existing conditions, which cannot be mitigated sufficiently." Additionally, Section 3.03 - Boat Docking Facilities states that "all new and existing marinas must comply with the requirements of the Department's Marina Regulations." Section 3.03 further states that "structures should be located away from critical habitats."

A. Environmental Considerations

The concerns addressed in Section I, above, are equally applicable to the Department's review of environmental considerations under the Subaqueous Regulations. The Department has concluded that the proximity of the proposed marina to this internationally significant migration stopover and nesting area poses an unacceptably high potential for significant adverse impacts to rare and threatened shorebird species in a Department recognized critical habitat area.

B. Public Use Considerations

A critical public use consideration is that the viable operation of the proposed marina is contingent upon the use of public subaqueous lands to provide the proposed boat slips and launching ramp. All 50 of the boat berthing areas or docks proposed for this marina will be located on public subaqueous lands. That is, the marina is not being constructed on lands owned by the applicant. In addition, the marina site is located in an area that is largely surrounded by public lands. Section 3.01 states that "the Department shall consider... the degree to which the proposed project fits in with the surrounding structures, facilities, and uses of the subaqueous lands and uplands...to determine whether to approve the application".

Recently, the State's DuPont Nature Center, the product of a collaborative effort between the State and the DuPont Company, opened within a very short distance of the proposed marina. The Dupont Nature Center is a state of the art interpretive science center to provide a close up view of the plants and animals that inhabit the Mispillion Harbor area. The site where the Center is located was purchased and constructed in recognition of the significant and unique natural resources that inhabit the area creating an opportunity for the Center to educate the public on the value of these resources. Allowing the use of public subaqueous lands for the construction of a new marina in close proximity to the Center would run counter to the public education mission of the Center and diminish the viability of the Center as a public resource.

The proposed marina is also located within an area that is recognized as an area with high conservation value by several conservation groups. The National Audubon Society designated the Delaware Coastal Zone as an Important Bird Area (IBA). IBAs are sites that provide essential habitat for one or more species of bird, including migrating birds and species of conservation concern such as the shorebirds at Mispillion Harbor (National Audubon Society, 2007a). The program is a global effort to identify and conserve areas that are vital to birds and to maintaining biodiversity (ibid.). Additionally, the Western Hemisphere Shorebird Reserve Network (WHSRN) designated Delaware Bay as a Site of Hemispheric Importance (Manomet, 2007a). WHSRN was formed in 1985 in response to documented serious population declines in shorebirds (Manomet, 2007b). According to WHSRN literature, the Network works to protect key shorebird habitats to sustain healthy populations of shorebirds (ibid.). WHSRN is a publicly funded group and is also supported by the U.S. Fish and Wildlife Service as an important tool for the conservation of shorebirds. Finally, Wetlands International designated the Delaware Bay Estuary as a as a site of global importance at the RAMSAR Convention on Wetlands (Wetlands International, 2007a). The Convention on Wetlands, signed in Ramsar, Iran, in 1971, is an intergovernmental treaty which provides the framework for national action and international cooperation for the conservation and wise use of wetlands and their resources (Wetlands International, 2007b). Each of these organizations has appropriately recognized the importance of Delaware Bay. However, the concentrations of shorebirds in Mispillion Harbor, alone, would qualify the site as a Globally Significant IBA

(National Audubon Society, 2007b), a Site of Hemispheric Importance by WHSRN (Manomet 2007b), and a Wetland of International Importance by The RAMSAR Convention on Wetlands (Wetlands International, 2007c).

Constructing a new marina in a publicly funded IBA or WHSRN site in the midst of prime shorebird habitat would run counter to the efforts of the Audubon Society and WHSRN to protect and conserve the shorebird habitat at Mispillion Harbor, greatly diminishing the public use of this unique area for studying shorebirds and the other flora and fauna unique to the area.

The area nearby the proposed marina site is an integral part of the regional recreational birding industry. The annual gross economic value of the recreational birding industry to the region has been estimated to be in the range of $6.8 – 15.9 million (U.S. Fish and Wildlife Service, 2003). Further impacts to the aquatic environment, such as those associated with the proposed marina, would reduce the recreational birding value of the area and consequently negatively impact the economic value to the public of this resource.

The Regulations require the Department to consider "The extent to which the public at large would benefit from the activity or project and the extent to which it would suffer detriment." The marina would benefit primarily the boaters who would use the 50 slips for berthing their vessels at the marina. The larger public would derive little or no benefit from this facility. Considering the critical importance of the Mispillion Harbor to threatened shorebird species, it is the Department's determination that the overall impact of the marina on the public use and enjoyment of the unique natural resources of this area would be a negative one.

The Department is also required to consider alternatives that would avoid adverse impacts. Boaters who would use the marina's proposed 50 slips could use the nearby public boat ramp as an alternative for launching their vessels. There is also a large drystack storage marina on Cedar Creek. Both the public boat ramp and the drystack marina are located upstream, away from critical shorebird habitat.

III. Water Quality Certification Requirements

Under Section 401 of the Federal Clean Water Act, projects requiring a federal permit for the placement of fill in Waters of the United States including wetlands, (as is proposed for the construction of the boat ramp and stabilization of the shoreline at the proposed marina), are required to obtain Water Quality Certification (WQC) from the State to certify that the project will not violate State water quality regulations.

Delaware has implemented Section 401 of the Clean Water Act by adopting Section 5 of the State's Regulations Governing the Control of Water Pollution. These Regulations state that "The Department shall provide water quality certification where the

applicant has provided reasonable assurance that the activity will be conducted in a manner which will not violate State water quality standards." Section 5.3 of the State of Delaware's Surface Water Quality Standards states that "Where high quality waters constitute an outstanding Natural resource, such as waters of National parks and wildlife refuges, existing quality shall be maintained and protected."

It is the Department's determination that the habitat at Mispillion Harbor constitutes an outstanding Natural resource and that the potential for adverse water quality impacts from the construction and operation of the marina, and the operation and maintenance of the vessels berthed there, will not maintain and protect existing water quality.

Additionally, the impact on existing uses, as well as the potential for secondary impacts and cumulative effects of the project must be considered under the WQC review. It is the Department's determination that the addition of 50 in-water boat slips at this location, with the attendant primary and secondary impacts from the operation and maintenance of those vessels, poses an unacceptable cumulative impact that may result in irreparable damage to the resource, and will adversely affect important existing uses such as recreational birding, eco-tourism, research and education within Mispillion Harbor.

Applicants for WQC are also required to follow a mitigation sequence in evaluating feasible alternatives to the project. In order of preference these include: determining if there are practicable alternatives to the project that avoid impacts to the resource; incorporating measures that can be taken to minimize project impacts; and thirdly, providing compensatory measures to provide replacement of the resources that can neither be avoided nor minimized.

A practicable alternative to avoid project impacts would be to use the existing public boat ramp or drystack marina upstream of the site at a safer distance from the area used by the shorebirds. The Department determined that the efforts by the applicant to minimize impacts were not adequate to offset negative impacts to shorebirds. Additonally, no mitigation measures for lost or diminished resources were included in the permit application.

IV. Conclusions

The proposed marina would be built in one of the most important migratory bird stopovers along the Atlantic Flyway with potential consequences of international significance. The proposed marina would introduce a variety of environmental stressors to the local fauna and flora including imperiled shorebird species that are dependent on the Mispillion Harbor for their migration and survival. Additionally, the construction and operation of a large marina at this location would be contrary to the public's interest in the use and conservation of this uniquely important habitat, including the efforts of

publicly funded organizations like the Audobon Society and the Western Hemisphere Shorebird Reserve Network to protect and conserve the resources of the area.

With respect to the Delaware Marina Regulations the proposed marina cannot be permitted because it is in a critical habitat. Moreover, construction and operation of a marina at this location would result in primary and secondary impacts to a critical habitat which supports imperiled shorebird species, resulting in an unacceptable cumulative environmental impact to the unique and important habitat within the Mispillion Harbor.

After thorough review of this application, the Wetlands and Subaqueous Lands Section recommends denial of the Subaqueous Lands Lease, Marina Permit and Water Quality Certification for this project, for all of the above stated reasons.

References:

Arvay, B. E-mail to J. Chaconas, October 25, 2007

Baker, A.J., P.M. Gonzalez, T. Piersma, L.J. Niles, I.L.S. Nascimento, P.W. Atkinson, N.A. Clark, C.D.T. Minton, M.K. Peck, and G. Aarts. 2004. Rapid population decline in red knots: Fitness consequences of decreased refueling rates and late arrival in Delaware Bay. Proc. R. Soc Lond. 271:875-882.

Bennett, K. Shorebird Technical Committee comments on the Marina proposed by Walter Swain in Mispillion Harbor. September 25, 2007.

Haramis, G. M., W. A. Link, P. C. Osenton, D. B. Carter, R. G Weber, N. A. Clark, M. A. Teece, and D. S Mizrahi, 2007. Stable isotope and pen feeding trial studies confirm the value of horseshoe crab *Limulus polyphemus* eggs to spring migrant shorebirds in Delaware Bay. J. Avian Biol. 38: 367-376

Kalasz, K. Memorandum concerning the Proposed Marina on the Swain Property in Mispillion Harbor to Bonnie Willis, Div. of Soil and Water, DNREC, September 19, 2006

Kalasz, K. E-mail to J. Chaconas, October 31, 2007

Manomet. 2007a. *List of Sites*. Retrieved December 4, 2007, from Manoment Center for Conservation Sciences website: http://www.whsrn.org/network/site-list.html.

Manomet. 2007b. *WHSRN: A Strategy for Saving Shorebirds*. Retrieved December 4, 2007, from Manoment Center for Conservation Sciences website: http://www.whsrn.org/about.html

National Audubon Society. 2007a. *What is an Important Bird Area?* Retrieved December 4, 2007, from National Audubon Society Website: http://www.audubon.org/bird/iba/iba_intro.html

National Audubon Society. 2007b. *Criteria Overview.* Retrieved December 4, 2007, from National Audubon Society Website: http://www.audubon.org/bird/iba/criteria.html.

Sanger, D.M. & Holland, A.F. 2002. *Evaluation of the Impacts of Dock Structures on South Carolina Estuarine Environments*, Technical Report Number 99, South Carolina Department of Natural Resources, Charleston, SC.

Torsten C. Schmidt, Stefan B. Haderlein, Rolf Pfister and Richard Forster. 2004. *Occurrence and fate modeling of MTBE and BTEX compounds in a Swiss Lake used as drinking water supply.* Water Research, Volume 38, Issue 6, Pages 1520-1529

Schaefer, Joe. 1991. *Impacts of Free-ranging Pets on Wildlife.* Document WEC-136, Department of Wildlife Ecology and Coservation, Florida Cooperative Extension Service, Institute of Food and Agricultural Sciences, University of Florida. December.

Stolpe, Nils E. 1992. *A Survey of Potential Impacts of Boating Activity on Estuarine Productivity*, presented at the Marine Engines and Vessels Public Workshop, Ann Arbor, Michagan, July 29, 1992.

U.S. Fish and Wildlife Service. 2003. Delaware Bay Shorebird-Horseshoe Crab Assessment Report and Peer Review. U.S. Fish and Wildlife Service Migratory Bird Publication R9-03/02. Arlington, VA. 99 p.

Wetlands International. 2007a. The RAMSAR List of Wetlands of International Importance. Retrieved December 4, 2007, from the RAMSAR website: http://www.ramsar.org/key_sitelist.htm.

Wetlands International. 2007b. The RAMSAR Convention on Wetlands. Retrieved December 4, 2007, from the RAMSAR website: http://www.ramsar.org.

Appendix 1. Shorebirds Commonly Observed in Mispillion Harbor

Common Name	**Scientific Name**
American Oystercatcher	*Haematopus palliatus*
Black-bellied Plover	*Pluvialis squatarola*
Black-necked Stilt	*Himantopus mexicanus*
Dunlin	*Calidris alpina*
Greater Yellowlegs	*Tringa melanoleuca*
Least Sandpiper	*Calidris minutilla*
Lesser Yellowlegs	*Tringa flavipes*
Red Knot	*Calidris canutus*
Ruddy Turnstone	*Arenaria interpres*
Sanderling	*Calidris alba*
Semipalmated Plover	*Charadrius semipalmatus*
Semipalmated Sandpiper	*Calidris pusilla*
Short-billed Dowitcher	*Limnodromus griseus*
Spotted Sandpiper	*Actitis macularia*
Western Sandpiper	*Calidris mauri*
White-rumped Sandpiper	*Calidris fuscicollis*