



Managing Dredged Material Placement and Disposal Operations in Relation to Bird/Wildlife Aircraft Strike Hazards (BASH)

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PURPOSE: This technical note was developed by the U.S. Army Engineer Research and Development Center (ERDC), Environmental Laboratory (EL), to provide guidelines for reducing Bird/Wildlife Aircraft Strike Hazards (BASH) in approach and departure zones of nearby airports. The genesis of these U.S. Army Corps of Engineers (USACE) guidelines stems from several incidents, including (1) the creation of Brunswick Harbor Bird Island (BHBI) in proximity to airports on Saint Simons and Jekyll Islands, Georgia (Figure 1); (2) the recent commercial passenger aircraft that landed in the Hudson River (U.S. Airways Flight 1549) in January 2009 as a result of collision with several Canada Geese (Langer 2009, Marra et al. 2009); and (3) several other USACE ecosystem restoration and/or mitigation projects that have confronted potential BASH issues (see below).

The potential BASH associated with habitat creation have been a neglected aspect of the planning process for many federal and state agencies (including the USACE during dredged material deposition activities), yet bird-aircraft collisions continue to increase in frequency nationally and the damage to aircraft and the corresponding risks to passengers and crew cannot be ignored. By outlining the history and issues associated with USACE ecosystem



Figure 1. An aerial view of the Brunswick Harbor Bird Island in the Brunswick Harbor, GA. This photo, taken in August 2007, shows the island shortly before completion later in the year. (Photo provided by USACE Savannah District).

restoration conflicts with nearby airports, it is hoped that future similar conflicts can be avoided. This report (a) summarizes the issues associated with habitat creation or enhancement around airports as regulated by the U.S. Department of Transportation (USDOT) and Federal Aviation Administration (FAA) Advisory Circular 150/5200-33B (USDOT 2007); (b) details the history of and conflict during and after the BHBI construction in Brunswick Harbor, Georgia; (c) summarizes other restoration/mitigation and BASH conflicts within five USACE divisions; (d) provides guidance about how to minimize BASH during the future creation and management of dredged-material deposition areas designed as early-successional bird habitat; and (e) supports the objectives of a research work unit under the Dredging Operations and Environmental Research (DOER) program titled, “Reducing conflicts between coastal engineering projects and bird habitat needs.” (<http://el.erd.c.usace.army.mil/dots/coastalbirds.html>).

BACKGROUND: The U.S. Army Corps of Engineers is responsible for maintaining many of the navigable waterways and channels throughout the United States. Material obtained from various dredging techniques is often used beneficially in engineering and environmental restoration projects (e.g., maintenance dredging in waterways, beach nourishment, wetland and marsh mitigation) to create or enhance habitat for birds (Regional Sediment Management - Beneficial Use of Dredged Material, Section 204 of the 1992 Water Resources Development Act, as amended). In particular, numerous shorebird and wading bird species are frequently the targeted beneficiaries of wildlife habitat creation due to their well-documented population declines, sensitive or endangered status, and dependency on the early successional habitat made available through deposition of dredged material (Guilfoyle et al. 2006a, b).

However, habitats created or enhanced with dredged material that attract and concentrate shorebirds, wading birds, or other large groups of birds can create significant concerns depending on the specific location of the deposition site, particularly if there is an active airport nearby. Collisions between birds and aircraft pose a serious threat to the safety of passengers and flight crews on both civilian and military flights. Between 1988 and 2004, approximately 192 people were killed from bird-aircraft strikes (Dolbeer 2006). In the United States, collisions between aircraft and wildlife have cost the civil aviation industry over \$300 million since 1990 (Dolbeer et al. 2009), while global costs are estimated at \$1.2 billion since 1990 (Allen and Orosz 2001). Aircraft/wildlife collisions are estimated to cost the U.S. Air Force (USAF) \$35 million annually, while over the past 20 years, total costs of \$98 million have been estimated for aircraft collisions with Turkey Vultures (*Cathartes aura*) alone (Kelly and Wilkens 2006). The number of wildlife-aircraft strikes has increase from 1,700 in 1990 to over 7,500 in 2008; total reported collisions during this period exceed 89,000 (Dolbeer et al. 2009). The number of bird-aircraft collisions have increased recently due to a rise in air traffic and population increases of several large birds, particularly Canada Goose (*Branta canadensis*) (Dolbeer and Eschenfelder 2003, Dolbeer et al. 2009). Additionally, birds are less likely to detect the quieter turbofan-powered aircraft used today. Concerns about Bird/Wildlife BASH issues made international headlines recently with the well-publicized story of a commercial passenger aircraft (U.S. Airways Flight 1549) that was forced to land in the Hudson River in January 2009 after being damaged in a mid-flight collision with several Canada Geese (Langer 2009, Marra et al. 2009).

In the creation or restoration of wetland, marsh, or other wildlife habitat conditions, the U.S. Army, USAF, and USACE, operate under a Memorandum of Agreement (MOA) with the FAA

to document bird-aircraft strikes, to minimize BASH through proper airport management, and to accept responsibility for BASH risks inherent in the creation, conservation/mitigation of habitats, particularly those habitats that attract birds or other wildlife species to airports or adjacent areas. The signatory agencies of this MOA also agree that when a potential hazard is identified, that personnel with the FAA, USAF and U.S. Department of Agriculture – Wildlife Services (USDA-WS) have the expertise to assess aircraft-wildlife strike hazards for various land uses through the development of a Wildlife Hazard Assessment (WHA). If a conflict exists, then the signatory agencies agree to work with the airport-operating personnel to develop a Wildlife Hazard Management Plan (WHMP) to minimize or eliminate future BASH risks. The cooperating agencies should also minimize negative impacts to existing wildlife populations (particularly endangered, threatened or sensitive species), or wetland habitats. The MOA is posted online at: http://www.nap.usace.army.mil/cenap-op/regulatory/guidance/FAA_moa.pdf.

FEDERAL AVIATION ADMINISTRATION (FAA) ADVISORY CIRCULAR

The U.S. Department of Transportation, FAA, Advisory Circular 150/5200-33B (USDOT 2007) directs public airports to minimize land uses that may potentially attract wildlife, particularly birds. The presence of large, open tracts of land is inherent in the planning and development of operational airports. Open areas provide the necessary space for planes to take off and land, while also mitigating noise for the surrounding area. However, these open areas may contain poorly drained grasslands, wetlands or waste disposal sites, or other habitats and structures that provide opportunities for nesting, soaring (e.g., foraging hawks or vultures), and perching or roosting birds. This Advisory Circular addresses any land uses that may influence movement of wildlife into or across the flight path of arriving or departing aircraft. Specific separation criteria are established based on known operational flight patterns of piston- or turbine-powered aircraft and the distance and altitude at which most strikes occur (72% of strikes occur under 500 ft and 92% occur under 3,000 ft) (Dolbeer et al. 2009). These criteria have been established in prior FAA regulations and National Transportation Safety Board (NTSB) recommendations.

Specific separation criteria include:

- (1) Perimeter A: Airports serving piston-powered aircraft must locate wildlife attractants at least 5,000 ft from airport operations.
- (2) Perimeter B: Airports serving turbine-powered aircraft must locate wildlife attractants at least 10,000 ft from airport operations.
- (3) Perimeter C: For all airports, a distance of 5 statute miles is recommended between the farthest edge of an airport's operational area and a hazardous wildlife attractant area, especially if the attractant may cause the movement of wildlife through the approach and departure flight paths of aircraft.

Specific recommendations for land uses that may act as hazardous wildlife attractants around airports are discussed. Guidelines are detailed for municipal solid waste landfills (MSWLF), water management facilities, existing or restored wetlands, dredged soil contamination sites (including confined disposal facilities), agricultural land uses, and recreational land uses, including golf courses and landscape gardens. Because of the large numbers of birds attracted to solid waste landfills, a distance of 6 statute miles from an operating airport is recommended. All other land uses noted above are recommended at distances from active airports according to the

separation criteria for perimeters A through C. Wetland mitigation for impacts attributed to airport development or expansion should occur at distances according to the separation criteria. However, exceptions may be necessary when ecological conditions support threatened or endangered species, or if unique ecological functions (e.g., ground water recharge) cannot be moved to another location. Any storm water detention structures should be designed to drain within 48 hours; all efforts should be made to minimize or eliminate standing water. Agricultural land uses including crop production, livestock operations (free range or confined feedlots for dairy, cattle, hog, and chicken) should remain at distances according to the separation criteria, as should all aquaculture operations (e.g., trout and catfish production). Such agricultural land uses are known attractants for several potentially hazardous bird species including the European Starling (*Sturnus vulgaris*), Cattle Egret (*Bubulcus ibis*), and other fish-eating herons and egrets (e.g., Double-crested Cormorant (*Phalacrocorax auritus*) and Great Blue Heron (*Ardea herodias*); these species are recognized as common BASH for operational airports (Cleary and Dolbeer 2005, Dolbeer and Eschenfelder 2003). All landscaping features, including large grass areas, golf courses, or other aesthetic or recreational uses, should avoid plant species known to attract native wildlife. Airport personnel should consult with the local state university cooperative extension unit, USDA-WS office, or a trained, experienced wildlife damage biologist for assistance in developing a plant list that attracts as little hazardous wildlife species to the airport as possible. For any of these land uses outside the 5,000/10,000-foot separation criteria, yet within the 5 statute mile limit, the FAA recommends developing new or reviewing existing management plans to determine whether the land uses represent a potential hazard. Any proposed land use changes within the separation criteria around an airport requires FAA notification.

The Advisory Circular also provides an outline of procedures to develop a WHMP. The process generally begins when existing or proposed land use changes are recognized as potential hazardous wildlife attractants that may increase strike hazards for arriving and/or departing aircraft. Initially, the FAA will request the development of a WHA. Depending upon the results of the WHA and the aeronautical operations at the airport, the FAA may require the approval of a WHMP for inclusion in the airport certification. Personnel conducting the WHA must have the proper training and experience. Airport managers may use outside contractors or consultants, though the FAA recommends that only personnel qualified in wildlife management damage control be used. The FAA and USDA-WS have produced a manual to assist in the development, implementation and evaluation of a WHMP (Cleary and Dolbeer 2005) and this manual can be loaded for free at:

http://wildlife-mitigation.tc.faa.gov/wildlife/downloads/2005_FAA_Manual_complete.pdf.

This manual includes specific information about the history and nature of wildlife strikes, legal authority, regulations and specific wildlife management techniques to minimize wildlife strike hazards. The airport personnel must initiate the WHMP and its implementation. The WHMP must identify all areas within and around the airport that may attract hazardous wildlife. The goal of the plan is to promote aviation safety by minimizing damage to airport equipment or structures, and to protect all personnel and the general public from harm or injury. Coordination of the development and implementation of the WHMP is facilitated by the establishment of the Wildlife Hazards Working Group (WHWG). This group will assist in the communication, cooperation and coordination of the airport and local community during the implementation and

evaluation of the WHMP. Local participation of airport operators in local planning and zoning boards will assist in cooperation with airport operations, including the necessary tenets for implementation of the WHMP. Moreover, from the interaction between the airport operator and the local community, the airport can remain updated on any proposed or ongoing land use changes that may impact airport operations (e.g., development of parks, wetlands, waste facilities, etc.).

THE BRUNSWICK HARBOR BIRD ISLAND

Creation of the BHBI was first proposed as an opportunity for beneficial use of dredged material procured during the Brunswick Harbor Deepening Project, a joint project of the USACE, Savannah District, and the Georgia Department of Transportation (USACE 2007). In addition to providing important nesting habitat for various species of shorebirds and wading birds, the creation of the island was also estimated as the least cost option of dredged material deposition. The island was designed to be approximately 1,300 ft. long by 750 ft. wide, with 9 acres of high sandy nesting habitat, 6 acres of low loafing sandy habitat, and an additional 6 acres of marsh habitat; the total acreage was estimated to be around 21 acres.

In November 2000, the Savannah District issued a public notice on the BHBI construction plan to all interested parties, including the FAA and other federal, state and local agencies. The specific location of the island in the Brunswick Harbor was identified in collaboration with the Georgia Department of Natural Resources (GA DNR). The reviews of the island creation plan were largely positive, and no concerns about BASH issues were expressed at the time by the FAA or any other state or local agency.

In 2007, when island construction was nearly completed (Figures 1 and 2), the potential BASH situation created by the BHBI was identified by personnel with the McKinnon-Saint Simons Airport, Glynn County Airport Commission, Brunswick, Georgia. Concerns were expressed to the FAA, Atlanta Airports District Office; that office then informed personnel at the USACE, Savannah District, Savannah, Georgia, about the situation. In September 2007, a meeting was established with personnel from the Savannah District, GA DNR, ERDC, Glynn County Airport Commission (GCAC), FAA, and the USDA-WS. During this meeting, it was noted that in addition to being located within 5 miles of the McKinnon-Saint Simon's Airport, the BHBI was also within 5 miles of the Jekyll Island Airport. Although the Jekyll Island Airport supports significantly lower air traffic, the presence of BHBI within 5 miles of both airports constitutes a double violation of the FAA Circular 150/5200-33B.

After determining that the creation of BHBI created a potential BASH, it was noted that the USACE, under the terms of the existing MOU between the U.S. Army and the FAA, would be responsible for developing a Wildlife Hazard Assessment for BHBI, and to adopt management and/or monitoring approaches to minimize any BASH risks associated with the presence of the island. At that time, the island had not yet been completed, so the USACE instituted a design change that removed the creation of marsh habitat from the final completed island. The removal of marsh habitat on the island lowered the possibility of any BASH that could have potentially existed from nesting or roosting herons, egrets, and cormorants. The change reduced the original estimated size of the island from 21 acres to approximately 14 acres when completed. Further, it was agreed that the Savannah District would fund the research needed to develop a WHA. This

assessment was performed by the USDA-WS with oversight from ERDC (Stephens 2010). Under an existing MOA between the FAA and the USDA-WS, the FAA acknowledges the USDA-WS as the primary federal agency responsible for developing wildlife hazard assessments for airports certified for passenger service.



Figure 2. The Brunswick Harbor Bird Island under construction in September 2007: Note the aircraft flying approximately 1,000 ft over the island on its way to the McKinnon-Saint Simon's Airport, on Saint Simon's Island, GA. (Photo Credit: Michael P. Guilfoyle).

Methods Used During the Wildlife Hazard Assessment. The purpose of a WHA is to address one fundamental question: Does an existing situation/condition constitute a wildlife hazard for an operational airport? For most situations, the USDA-WS develops an assessment of the possibility of any BASH using the standardized approach developed for the Breeding Bird Survey (Robbins et al. 1986). That approach uses 3-minute roadside count surveys and was not applicable to BHBI; therefore, the protocol had to be modified during the assessment process.

The basic information needed to complete the assessment included statistics about the year-round daily use of BHBI by birds (based on abundance and species diversity data); how these birds

were utilizing BHBI (nesting, loafing, and/or roosting); and a determination of whether birds regularly flew in positions and/or altitudes that corresponded with the arriving and/or departing flight paths of aircraft associated with either airport.

The study design is detailed in Stephens (2010) and included conducting surveys at three points in and around the St. Simon's Sound (Figure 3). These three points represent controls in that they are located in areas where bird activity is likely unrelated to BHBI; these points are referred as (1) Jekyll Island, (2) St. Simon's Island, and (3) Gould's Inlet (Figure 3). Two additional points were located on either side of BHBI (Figure 4). These latter points represent treatments in that they are located in an area where bird activity is directly related to the presence of BHBI. All points were surveyed by boat, except Gould's Inlet, which was accessed by vehicle. The protocol involves first circling the island within 100 m and recording all loafing birds observed (using binoculars). Because of large numbers of birds, total counts of some birds were estimated in species groups (e.g., gulls and terns spp.); however, all species detected during surveys were recorded. Then, each point around BHBI is surveyed for 20 minutes, with each bird detected as observed, plus basic behavior (flying, loafing, feeding, etc.), direction of flight (heading towards, away from island), and estimation of bird altitudes. The three control points were surveyed using 10 minute counts. All points were surveyed at different daily time periods during the year (AM: 0500-0900; MIDA: 0900-1300; MIDB: 1300-1700; PM: 1700-2100). A complete survey of all points was completed for each time period every two weeks. In addition, data were also collected on weather, visibility, tide, and habitat conditions. Surveys were conducted 10-13 times per month; survey efforts began in October 2008 and ended in September 2009. During the monitoring period, a total of 138 surveys were conducted at the Bird Island, Jekyll Island, and St. Simon's Island points, while 134 surveys were conducted at the Gould's Inlet point (Stephens 2010).

The altitude of a bird was estimated using a range finder equipped with a clinometer. A flying bird was then placed into one of four altitude categories (0-250 ft, 500-750 ft, 750-1000 ft, and > 1000 ft). Since damage to aircraft can be much higher for collisions >500 ft (Dolbeer 2006), reliability of this approach is essential in determining whether flying birds associated with BHBI constitute a BASH. The approach was tested against objects of known height, including a helicopter, and shown to be a cost-effective method with an acceptable level of accuracy (Stephens 2010). For example, the altitude of smaller birds (e.g., terns) was difficult to estimate if the bird was greater than 500 ft from the observer. However, rangefinder readings from large soaring birds (e.g., hawks, pelicans) were easily acquired for altitudes as high as 750 – 900 ft. Rangefinder readings could be very difficult to determine during rough water conditions. In general, rangefinder readings were used to distinguish individual larger birds as reference points to categorize all other observed (e.g., smaller) birds into altitude categories during a point survey. In addition, the rangefinder was also used to verify altitude estimates when placement of an observation into an altitude category was in question. When possible, the rangefinder was also used to document the altitude of aircraft flying over the island.



Figure 3. Location of the Brunswick Harbor Bird Island in the Saint Simon's Sound, GA, along with the McKinnon-St. Simon's and Jekyll Island airports, and the three control survey points sampled during the wildlife hazard assessment (1=Jekyll Island; 2=St. Simon's Island; 3=Gould's Inlet).

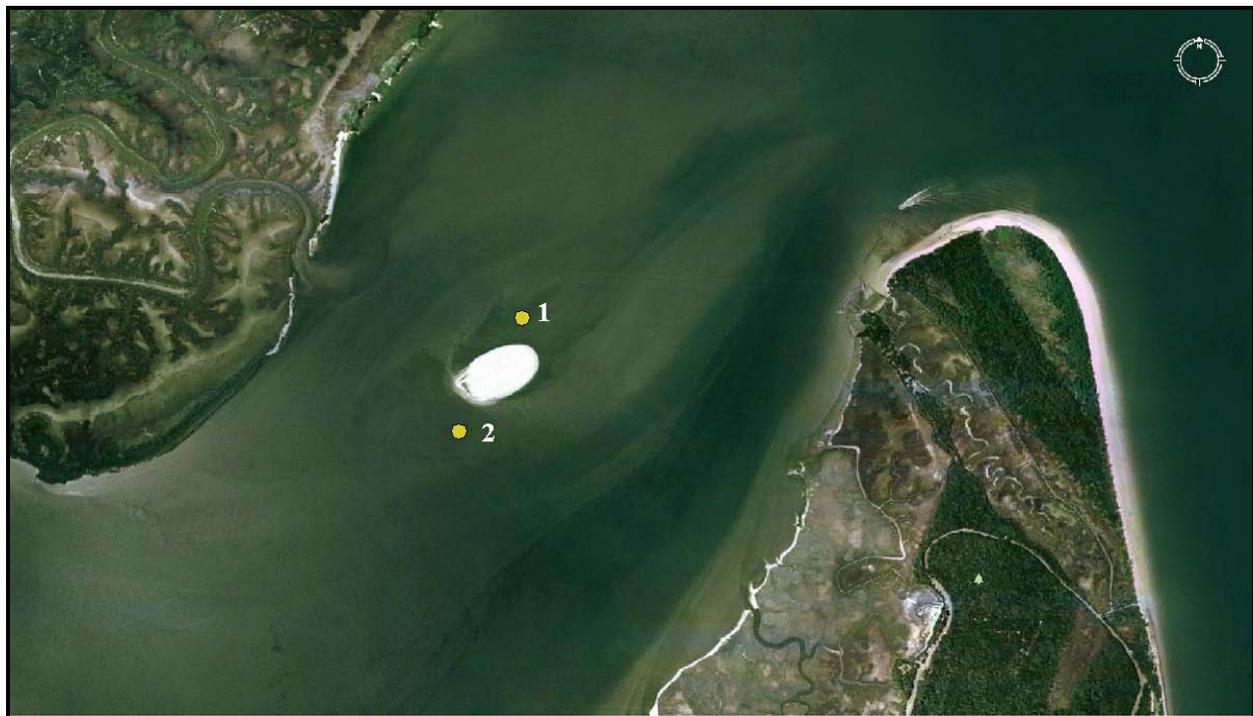


Figure 4. Location of the two survey points around the Brunswick Harbor Bird Island in the Saint Simon's Sound, GA, sampled during the wildlife hazard assessment.

Results from BHBI: An annual monthly average of approximately 1,800 or more birds were observed loafing, feeding and/or roosting on BHBI during the monitoring period; these values were much higher than the control sites (Stephens 2010). The highest counts of birds occurred during the months of May through August, corresponding to the breeding season. On BHBI, the monthly average of non-flying birds ranged from under 500 to almost 8,000 birds. Large numbers of breeding birds on the island contributed to this value, including approximately 6,000 pairs of the Royal Tern (*Sterna maxima*). The island also supports about 50 pairs of the state-listed Least Tern (*S. antillarum antillarum*) (Figure 5). For BHBI and the three control points, most birds (>90%) were observed flying under 250 ft. However, BHBI had the highest total average number of flying birds in August (approximately 1000 birds), while Gould's Inlet had the highest average of flying birds in April (also approximately 1000 birds). BHBI also had the highest number of birds observed flying between 500-750 ft in June.



Figure 5. The Brunswick Harbor Bird Island, completed in 2007, has become a popular nesting location for many terns and gulls species, including the Coastal Least Tern (*Sterna antillarum antillarum*). (Photo Credit; Odin Stephens, USDA-WS)

Sixty-three bird species categorized into 14 guilds were observed during the monitoring period. These guilds include Blackbirds, Corvids, Gulls, Grebes, Insectivores, Pelicans and Allies, Rails, Raptors, Shorebirds, Skimmers, Terns, Vultures, Wading Birds, and Waterfowl (Stephens 2010). Of these guilds, BHBI had the highest percentage of all sampling sites for Gulls, Pelicans and Allies, and Terns. These guilds, plus Skimmers, had the highest observations both non-flying and flying behaviors on BHBI from May/June – August than the other survey points. Wading Birds also had the highest observations flying around BHBI than the other surveys points from July through November. Observations on Gould's Inlet found the highest values for flying Shorebirds and Skimmers during the February/March – May period.

Altitude observations during the monitoring period showed that, of all the survey points, BHBI had the highest number of birds utilizing the medium altitude (250-500 ft) from November 2008 – May 2009. Observations of birds flying in the highest altitude category (VHigh >1,000 ft.) were uncommon at all surveys points, and over 98% of birds on BHBI flying this high were local in their movements. Measurements of aircraft approaching the McKinnon-St. Simon's Airport suggest that the majority of aircraft approaching the airport will fly at a lower altitude than departing aircraft. Therefore, the highest chance of bird-aircraft strikes associated with the presence of BHBI would occur during the approach. However, of 7 aircraft observed and measured with the rangefinder, most were near 1,000 ft (range 736-1,020 ft) (Stephens 2010), suggesting that the probability of bird-aircraft strikes is low. Moreover, pilots using Instrument Flight Rules (IFR) during approach were more likely to fly directly over the island, while pilots using Visual Flight Rules (VFR) were more likely to avoid flying over the island. Based on observations, most aircraft approaching Bird Island were using VFR and completely avoided the island (Stephens 2010).

Observations recorded during the survey period also note other potential BASH near the airports, including the movement of shrimping boats through the flight pathways of the airports (Figure 6), numerous roosting sites for Double-crested Cormorant (*Phalacrocorax auritus*), and the presence of a golf course adjacent to the McKinnon-St. Simon's airport (Stephens 2010). Originally, wildlife hazard assessments for each airport were to be conducted concurrently with the BHBI hazard assessment; however, the funding never materialized. Determination of BASH for each individual airport will have to occur at a future date.

The results from the assessment suggest that during June through August a minor bird hazard may exist over BHBI. This hazard was considered minor due to the infrequency of aircraft flying over BHBI during surveys. Further research with a "bird radar," specifically developed for detecting and tracking behavioral characteristics of birds and bats, was recommended for use around BHBI during that time period (Stephens 2010). A bird radar would provide detailed information on bird and aircraft movement and altitude over BHBI; however, the cost of the radar equipment, plus costs of personnel to use, monitor, collect and report these data are significant.

BASH RISKS AND USACE DISTRICT OPERATIONS

In October 2009, information was informally requested from USACE natural resources managers, via email survey, about conflicts between USACE operations (including ecological restoration and mitigation efforts) and potential BASH associated with operational airports. Seven replies were received concerning current and past conflicts in addition to the BHBI conflict in the Brunswick Harbor, detailed above. These situations likely represent a minimum of USACE operations/BASH conflicts nationally, and the likelihood of significant national increases in bird-aircraft collisions (Cleary et al. 2007, Dolbeer et al. 2009) suggest that future conflicts are likely. By providing a summary of these situations, and through increased awareness of BASH concerns, it is hoped that future habitat and wetland restoration and management efforts will be improved. These conflicts occurred in five USACE divisions and seven district offices and are summarized below.



Figure 6. A shrimping boat moving through the Brunswick Harbor near the Brunswick Harbor Bird Island; these boats attract many terns, gulls, and other birds and may pose a BASH risk for both the McKinnon-St. Simon's and Jekyll Island airports. (Photo Credit; Odin Stephens, USDA-WS).

Mississippi Valley Division

Saint Paul District, MN. The La Crosse Airport, Wisconsin, is located within the Upper Mississippi National Wildlife and Fish Refuge. The airport approach zone is directly over the refuge and USACE lands. Airport personnel are interested in expanding the airport facilities. This will entail destruction of wetland habitat. Preliminary planning for airport expansion and wetland mitigation is already incorporating BASH issues, and proposed wetland mitigation sites will occur outside of the 10,000 ft perimeter as detailed by Advisory Circular 150/5200-33B.

North Atlantic Division

New York District, NY. The USACE is currently supporting plans to restore wetlands in the Richard P. Kane Natural Area near the Meadowlands in northeast New Jersey, and close to the Teterboro Airport (Star-Ledger Editorial Board 2009). This airport has reported high numbers of bird-aircraft strike rates (5 bird strikes per 10,000 flights); this rate is higher than any other airport in the region, including Newark Liberty International and LaGuardia airports. Since 2000, this airport has reported more than 651 bird-aircraft collisions, also higher than any other airport in the

region, except John F. Kennedy Airport (Star-Ledger Editorial Board 2009). The FAA has expressed disfavor with the plan, particularly because the area is within 10,000 ft of the Teterboro Airport (Fallon 2009); however, the restoration efforts have proceeded. The restored wetland will encompass approximately 250 acres of tidal wetlands and the area will be open to the public for recreational activities such as hiking, bird watching and kayaking (O'Neill 2010). In the development of the project, operational planning efforts added infrastructure to allow the standing water areas to be drained on a daily basis to minimize use by ducks and geese (O'Neill 2010).

South Atlantic Division

Savannah District, GA. The Savannah District reported the potential conflict of a restored wetland complex within Phinizy Swamp, near the Augusta National Airport, at Bush Field. The USACE has been involved with parts of the Merry Brick Ponds in the northern part of Phinizy Swamp. These ponds are part of the Merry Land Wetland Mitigation Bank project. The FAA has been concerned that the restored wetlands may increase bird-aircraft strike hazards at the airport because the wetlands are just at the 5 mile distance requirement (Kennamer et al. 1999). Of particular concern are the estimated four million Red-winged Blackbirds (*Agelaius phoeniceus*) utilizing habitats within the constructed wetlands. The City of Augusta has proceeded to mow down vegetation with the use of airboats in the wetlands. Recent counts of the blackbirds have declined to several hundred birds.¹

South Pacific Division

Albuquerque District, NM. A wetland restoration project located in the Middle Rio Grande valley and relatively close to the Albuquerque International Airport was planned specifically to meet the requirements of the FAA Advisory Circular 150/5200-33B. All restoration features were constructed outside the 5 statute mile requirement and no specific conflict was reported.

Los Angeles District, CA. Approximately ten years ago, a wetland restoration project in the Goleta Slough was developed to reduce open water habitat and create better habitat for intertidal shorebirds. However, this project was very close to the Santa Barbara Municipal Airport. In fact, much of the historical extent of the Goleta Slough was filled to create the airport, leaving a relatively small, and remnant portion of the wetland on the western periphery. Concerns about the project were raised by the FAA and USDA-WS and the project was eventually halted.

Los Angeles District, CA. The Los Angeles District is involved with a series of ecosystem restoration projects along the Salt River in and near Phoenix, AZ (e.g., Tres Rios and Rio Salado Oeste), some of which are within a few miles of the Phoenix Sky Harbor Airport. The USACE has been working with the City of Phoenix to reduce hazardous wildlife attractants along the river reach near the airport by creating a low-flow channel to reduce or eliminate any standing water. There has also been some expressed interest in restoring wetlands within the Rio Salado

¹ Fischer, R. A. 2009. Personal communication with Dr. Gene W. Eidson, Clemson University. Clemson, South Carolina. Via email.

that are within 5 miles of the airport. Efforts are now underway to find restoration options that comply with the FAA Advisory Circular 150/5200-33B.

San Francisco District, CA. The San Francisco District was involved in an effort to restore nesting habitat for the Caspian Tern (*Hydroprogne caspia*). This species is an abundant nester around various coastal and riverine areas. Populations located around the Columbia River Estuary, Washington, have created considerable concern because of their significant predation on threatened and endangered salmonids. Efforts have been made to re-establish habitat for this species along the western coast in select areas to draw the population away from the Columbia River colony. The San Francisco area, particularly around the Don Edwards San Francisco Bay National Wildlife Refuge, currently supports Caspian Terns and therefore was perceived as a good candidate area for creation of more nesting areas. Unfortunately, multiple airports are in proximity to the proposed restoration sites. Of 21 selected potential sites, 4 sites were within 5,000 ft, and another 4 were within 10,000 ft of Moffett Airport. None of these sites were selected for nesting site restoration. Two additional sites were within 5 miles of both the Palo Alto and San Carlos Airports; however, neither site was within the approach or departure flight paths of either airport. Another three sites were within the 5 mile perimeter of the Hayward Airport, yet these sites were also located outside of the approach and departure flight paths. The FAA expressed concerns about all potential sites within 5 miles of any of the airports, and the project has been postponed indefinitely.

Southwest Division

Fort Worth District, TX. The Fort Worth District has been involved with the San Antonio Channel Improvement Project – Mission Reach (SACIP-MR). As part of this project, the USACE was planning to create a 7.3 acre emergent wetland. However, this wetland was directly adjacent to the Stinson Municipal Airport in San Antonio, TX. During consultation with the FAA, the USACE developed both a WHA and WHMP, the latter is currently under review. The WHA expressed several concerns about the large number of grackles (*Quiscalus* spp.) and blackbirds (*Agelaius* spp.) in the areas, and suggested that the restored wetland would only increase the number of these birds. Many of the areas around the SACIP-MR included open water habitats available to roosting waterfowl. While some of these areas may not pose a direct threat to airport operations, continued wildlife monitoring and awareness of these areas may be necessary to ensure the future safety of airport operations (Bazan 2006).

DISCUSSION AND RECOMMENDATIONS

The planning and construction of BHBI was conducted in good faith by the USACE Savannah District: all stages of the planning process were conducted in coordination with all pertinent federal, state, and local agencies and all pertinent regulations were strictly followed. Throughout the process that included public notices and reviews of the BHBI construction plans by the FAA and other agencies, no one apparently noticed or recognized the potential for BASH posed by the island until the island was nearly completed (Figure 7). Moreover, no one, not even FAA personnel, recognized the conflict with the 1997 FAA Advisory Circular 150/5200-33 (this circular has been updated at least twice, and the current Advisory Circular 150/5200-33B was issued in 2007). Thus, the goal of this technical note is to provide information about this situation to prevent further similar conflicts in the future. At this writing, the WHA for Bird Island is in

review, and recommendations are under consideration. Several key recommendations of the WHA include continued monitoring of bird use at BHBI; implementing ways to reduce or eliminate the possibility of other BASH situations around the airports from movements of fishing/shrimping boats and birds utilizing the adjacent golf course; and completing WHAs for both airports (Stephens 2010). One potentially contentious recommendation includes the purchase of a portable radar system to study the movements of birds in the Brunswick Harbor. Currently, the low overall BASH risk observed during the WHA study has called this recommendation into question by the USACE Savannah District, and further meetings are planned. Future decisions will need to determine if the situation may require the development of a WHMP. In addition, lower-cost monitoring techniques applied during peak activity periods by birds (e.g., June – August) have been suggested and may be an option. Furthermore, recent increases in large breeding birds on the island — such as Royal Terns, laughing Gulls (*Larus atricilla*), and Brown Pelicans (*Pelecanus occidentalis*) — have reduced its use by smaller nesting species, including the Coastal Least Tern and the Gull-billed Tern (*S. nilotica*). These smaller species represent a lower BASH potential for aircraft; therefore, efforts are currently being planned to remove, oil, or addle eggs of nesting large birds. It is hoped that this effort will reduce the nesting population of large birds in favor of increased nesting by the smaller tern species. This effort is expected to begin during the 2011 breeding season and it is hoped to result in decreased BASH risks for aircraft over the next several breeding seasons.



Figure 7. During the planning and construction of the Brunswick Harbor Bird Island (center of Brunswick Harbor above), no agency involved noticed the potential BASH risks nor the violation with FAA Advisory Circular 150/5200-33B. (Photo provided by T. Alan Garrett, USACE Savannah District).

Beneficial uses of dredged material, through the USACE Regional Sediment Management Program, continues to be a major focus of USACE operations during maintenance dredging activities, and the benefits of habitats created with dredged material for year-round populations of shorebirds and wading birds is well-documented (see Guilfoyle et al. 2006b, 2007 and articles therein). In addition to island creation and wetland/marsh restoration activities, the USACE is also often involved with extensive efforts to restore beaches through beach nourishment, which is also important for providing coastal bird habitat (Grippio et al. 2007). All these activities have the potential to attract large numbers of birds. The potential BASH risks associated with these activities have been overlooked throughout the planning process during dredged material deposition operations, yet bird-aircraft collisions continue to increase in frequency nationally and the potential damage to aircraft and the corresponding risk to lives of passengers and crew requires that the USACE become more aware of and implement the recommendations of FAA Advisory Circular 150/5200-33B.

The events associated with the BHBI in the Brunswick Harbor, and the results from the e-mail survey point to the conclusion that USACE districts that undertake consideration of FAA Advisory Circulars usually reduce conflicts and minimize or prevent costly research for WHA and WHMP development. USACE districts that have not implemented the recommendations of FAA Advisory Circulars occasionally have had to drop restoration or wetland mitigation projects. Some of these conflicts may be the result of USACE personnel not being aware of the circulars. Despite knowledge and efforts to conform, no other alternatives can be found and the restoration projects discontinued (e.g., San Francisco District above). Several recommendations are made below that will likely minimize conflicts for future USACE dredging deposition operations, including:

- Increase awareness and familiarity of all USACE personnel involved with planning and implementation of dredged material deposition with all FAA Advisory Circulars, particularly 150/5200-33B, which deals specifically with wildlife attractants near active airports.
- Implement a close review and inspection of all known planned and operational dredge material deposition activities; determine location and proximity of all operations to active airports, particularly airports certified for passenger service.
- Prepare and plan multiple sites for potential dredge material deposition so that wetland restoration, mitigation or habitat creation can continue even if one or more sites are lost due to conflicts.
- Minimize use of the mitigated/restored habitat by high flying/soaring birds like herons, egrets and cormorants by reducing or eliminating tall vegetation associated with marsh or wetland habitats; reduction of wetland areas by blackbirds or grackles may require frequent mowing or other habitat modifications.
- Recognize and acknowledge responsibility for development of wildlife hazard assessment when conflicts are identified (as detailed by the MOA between the U.S. Army and FAA); work with pertinent agencies to ensure BASH risks are minimized or eliminated.

ACKNOWLEDGEMENTS: Thanks to Odin Stephens (U.S. Department of Agriculture, Wildlife Services), Steve Calver and Alan Garrett (USACE Savannah District) for their external

review and helpful comments on this report. In-house Technical Reviews were provided by Drs. Doug Clarke and David Price of the Environmental Laboratory, ERDC.

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Guilfoyle, M. P. and R. A. Fischer. 2011. *Managing dredged material placement and disposal operations in relation to bird/ aircraft strike hazards (BASH)*, DOER Technical Notes Collection ERDC TN DOER-C36. Vicksburg, MS: U.S. Army Engineer Research and Development Center. <http://el.erdc.usace.army.mil/dots/door/door.html>.

REFERENCES

- Allan, J.R., and A.P. Orosz. 2001. The costs of bird strikes to commercial aviation In *Bird Strike 2001, Proceedings of the Bird Strike Committee USA/Canada meeting, Calgary, Alberta, Canada*: Ontario Canada :Transport Canada, Ottawa,.
- Bazan, L. R. 2006. *Wildlife hazard assessment for San Antonio Channel improvement – mission reach*, July 1, 2005 – July 1, 2006. San Antonio, TX: United States Department of Agriculture, Animal and Plant Inspection Service, Wildlife Services.. 172 pages.
- Clery, E. C., and R. A. Dolbeer. 2005. *Wildlife hazard management at airports, a manual for airport personnel* 2^d ed. Washington, DC: U.S. Department of Transportation, Federal Aviation Administration, Office of Airport Safety and Standards. USA. (http://wildlife-mitigation.tc.faa.gov/wildlife/downloads/2005_FAA_Manual_complete.pdf).
- Dolbeer, R. A. 2006. Height distribution of birds recorded by collisions with civil aircraft. *The Journal of Wildlife Management* 70:1345-1350.
- Dolbeer, R.A., and P. Escheenfelder. 2003. Population increases of large birds, airworthiness standards, and high-speed flight: a precarious combination. pp. In *Proceedings of the 55th International Air Safety Seminar*, 273-281. Dublin, Ireland.
- Dolbeer, R. A., S. E. Wright, J. Weller, and M. J. Begier. 2009. *Wildlife strikes to civil aircraft in the United States, 1990-2008*. Serial Report No. 15, Washington DC: U.S. Department of Transportation, Federal Aviation Administration, National Wildlife Strike Database, (<http://wildlife-mitigation.tc.faa.gov/wildlife/downloads/BASH90-08.pdf>).
- Fallon, S. 2009. Environmental work boosts fears of bird strikes and Teterboro Airport. NorthJersey.com, October 8, 2009. http://www.northjersey.com/news/Habitat_restoration_boosts_fears_of_bird_strikes.html.
- Grippio, M. A., S. Cooper, and A. G. Massey. 2007. Effect of beach replenishment projects on waterbird and shorebird communities. *Journal of Coastal Research* 23:1088-1096.
- Guilfoyle, M. P., R. A. Fischer, and M. C. Landin. 2006a. The history of avian habitat creation through dredged material deposition by the U.S. Army Corps of Engineers. In *Summary of First Regional Workshop on Dredging, Beach Nourishment, and Birds on the South Atlantic Coast*, ed. M. P. Guilfoyle, R. A. Fischer, D. N. Pashley, and C. A. Lott, 32-36. ERDC/EL DOER Technical Report. ERDC/EL DOER TR-06-10, Vicksburg, MS: U.S. Army Engineer Research and Development Center.
- Guilfoyle, M. P., R. A. Fischer, D. N. Pashley, and C. A. Lott, eds. 2006b. *Summary of First Regional Workshop on Dredging, Beach Nourishment, and Birds on the South Atlantic Coast*. ERDC/EL DOER Technical Report. ERDC TN DOER TR-06-10, Vicksburg, MS: U.S. Army Engineer Research and Development Center.
- Guilfoyle, M. P., R. A. Fischer, D. N. Pashley, and C. A. Lott, eds. 2007. *Summary of Second Regional Workshop on Dredging, Beach Nourishment, and Birds on the North Atlantic Coast*, ERDC/EL DOER Technical Report. DOER TR-07-26, Vicksburg, MS: U.S. Army Engineer Research and Development Center.

- Kelly, T. A., and T. Wilkens. 2006. Bird detection radar development: from Dare County to the Cape! *United States Air Force Flying Safety Magazine*, October 2006.
- Langer, G. 2009. Bird strikes: The feathers fly. ABC News Blogs. <http://blogs.abcnews.com/thenumbers/2009/04/bird-strikes-th.html>. July 18, 2009.
- Marra, P. P., C. J. Dove, R. Dolbeer, N F. Dahlan, M. Heacker, J. F. Whatton, N. E. Digs, C. France, and G. A. Henkes. 2009. Migratory Canada geese cause crash of US Airways Flight 1549. *Frontiers in Ecology and the Environment* 7:297-301.
- O'Neill, J. M. 2010. Work underway to restore massive tract in the Meadowlands. NorthJersey.com, May 25, 2010.
- Robbins, C. S., D. Bystrak, and P. H. Geissler. 1986. *The breeding bird survey: its first fifteen years, 1965-1979*. Research Publication 157. Washington, DC: U.S. Department of the Interior, Fish and Wildlife Service,.
- Star-Ledger Editorial Board. 2009. Beware of Birds Around Teterboro Airport. *The Star-Ledger*, October 13, 2009. http://blog.nj.com/njv_editorial_page/2009/10/beware_of_birds_around_teterbo.html.
- Stephens, O. L. 2010. *Wildlife hazard assessment for ACOE Bird Island, October 2008 – September 2009*. Brunswick, GA: United States Department of Agriculture, Animal and Plant Inspection Service, Wildlife Services.
- U.S. Army Corps of Engineers (USACE). 2007. Savannah District: Officials to celebrate completion of \$117 million Brunswick Harbor Deepening. Media Advisory 07-19. Savannah, GA: U.S. Army Corps of Engineers Savannah District Office.
- U.S. Department of Transportation (USDOT). 2007. Hazardous Wildlife Attractants on or Near Airports. Advisory Circular (AC NO: 150/5200-33B) Washington DC: Federal Aviation Administration. http://www.faa.gov/regulations_policies/advisory_circulars/index.cfm/go/document.information/documentID/22820.

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