



United States Department of the Interior

FISH AND WILDLIFE SERVICE



Virginia Field Office
6669 Short Lane
Gloucester, VA 23061

September 12, 2014

Mr. William T. Walker
Chief, Regulatory Branch
Norfolk District, Corps of Engineers
803 Front Street
Norfolk, VA 23510-1096

Attn: Greg Culpepper, Regulatory Branch

Re: Savage Neck LLC and Kimberly
Jarvis, Northampton County, VA,
Permit NAO-2013-02299/13-V1843,
Project # 2014-F-0929

Dear Mr. Walker:

This document transmits the U.S. Fish and Wildlife Service's (Service) biological opinion based on our review of the referenced project and its effects on the federally listed threatened Northeastern beach tiger beetle (*Cicindela dorsalis dorsalis*) (NBTB) in accordance with section 7 of the Endangered Species Act (16 U.S.C. 1531-1544, 87 Stat. 884), as amended (ESA). Your April 1, 2014 request for formal consultation was received on April 30, 2014.

This biological opinion is based on information provided in the April 2, 2014 project proposal, telephone conversations, field investigations, and other sources of information. A complete administrative record of this consultation is on file in this office.

CONSULTATION HISTORY

- 04-02-14 The Service received an email from the U.S. Army Corps of Engineers (Corps) that included the project review package for the proposed project.
- 04-23-14 The Service conducted a site visit with the Corps.
- 04-30-14 The Service received the Corps' request to initiate formal consultation.
- 05-19-14 The Service sent a letter to the Corps acknowledging initiation of formal consultation.

08-08-14 The Service held an on-site meeting to discuss mitigation and monitoring requirements for the proposed project. Representatives from the Corps, Northampton County, and Mid Atlantic Environmental were in attendance.

BIOLOGICAL OPINION

DESCRIPTION OF PROPOSED ACTION

The project site is located on Tankards Beach which is part of the area known as Savage Neck, within Northampton County, VA (Latitude: 37 20 24, Longitude: -76 00 21) (Figure 1). The proposed action is the issuance of a Corps permit for the construction of five 33 foot (ft) wide by 180 ft long offshore breakwaters with beach augmentation (Figures 2-4). Maximum channelward encroachment of the breakwaters will be 203 ft from mean high water. Approximately 152,477 ft² of beach nourishment is proposed between mean high and mean low water landward of the breakwaters.

Construction and staging area access will be by land on tax parcel 66-A-6B (Figure 2). Access to the beach will be from a single point crossing the remaining dune system. The equipment will traverse the project area to construct an access path to the breakwaters, move rock for construction of the breakwaters, and place and grade additional sand for beach nourishment. No materials will be stockpiled on the beach, and work will be conducted when adult NBTBs are not present (no work from June 1 to September 15). No refueling of equipment or vehicles will occur on the beach. No use of pesticides will occur on the beach. The applicant will notify the Service before initiation of construction and upon completion of the project. Quality beach sand of appropriate grain size will be used for beach augmentation mean cumulative particle size distribution (D₅₀) of 0.4-0.7 millimeter with no high clay/silt content.

Approximately 89,256 ft² of subaqueous bottom will be covered by the structures and by sand (approximately 15,713 cubic yards of beach quality sand) placed for beach augmentation. When completed, the structures with beach augmentation, will protect 192,323 ft² of non-vegetated wetlands and dune (adult NBTB habitat), and 42,512 ft² of larval NBTB habitat. Buffer plantings disturbed during construction will be replaced with in-kind plantings.

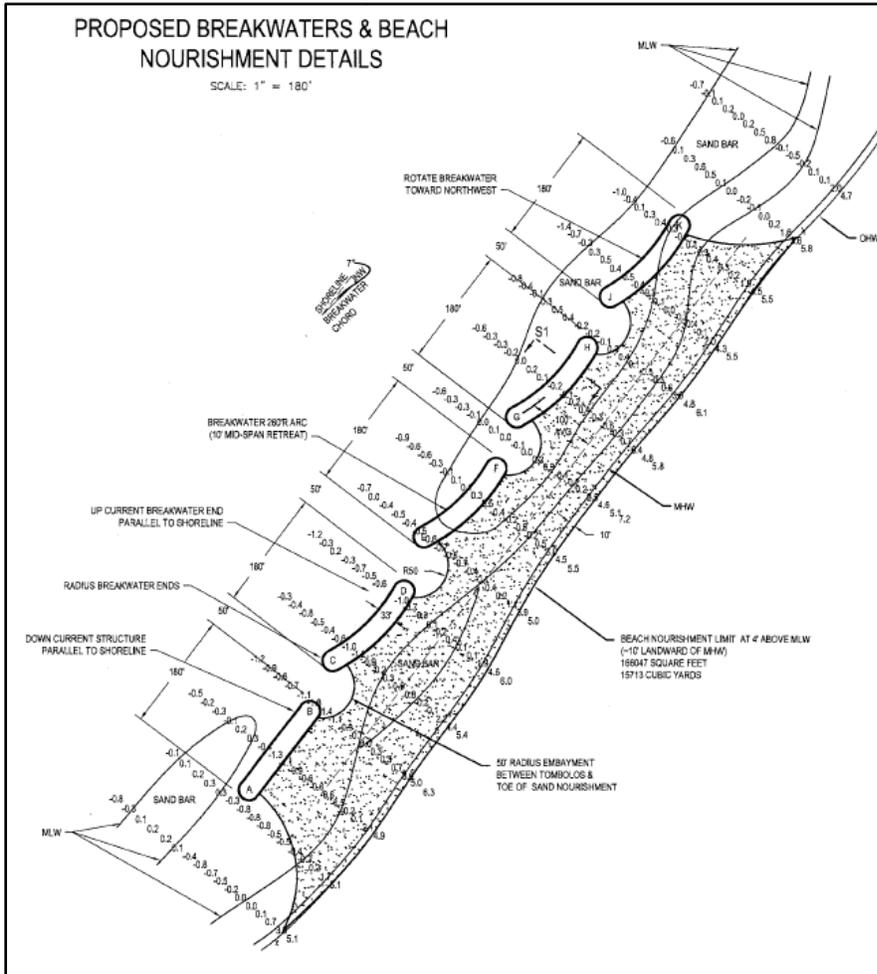


Figure 3. Breakwater design for Savage Neck LLC and Kimberly Jarvis breakwater project, Tankard Beach, Northampton County, VA.

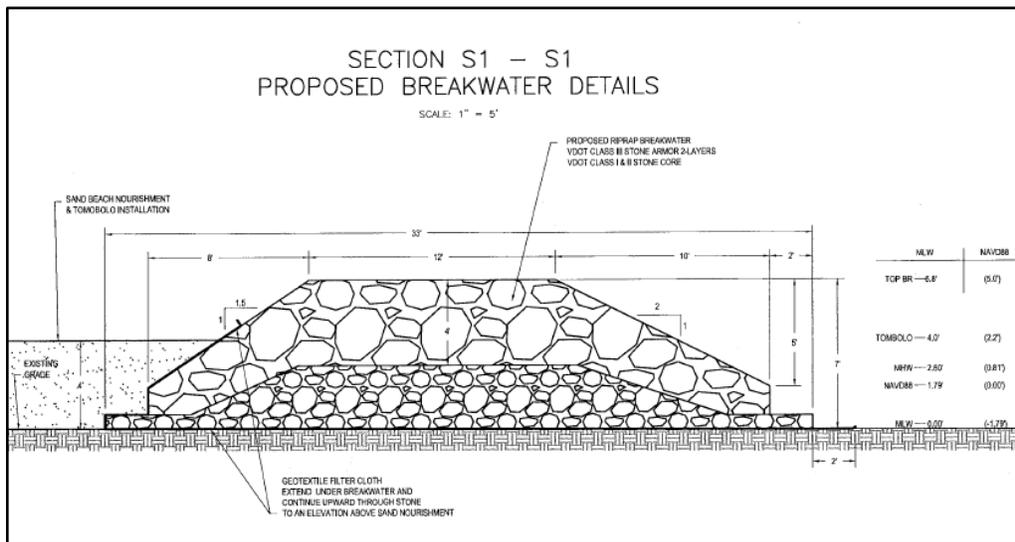


Figure 4. Breakwater cross-section for Savage Neck LLC and Kimberly Jarvis breakwater project, Tankard Beach, Northampton County, VA.

Action Area

The action area is defined as all areas to be affected directly or indirectly by the Federal action and not merely the immediate area involved in the action. The Service has determined that the action area for this project consists of:

1. Approximately 89,256 ft² of subaqueous bottom covered by the breakwater structures and sand placed for beach augmentation.
2. Approximately 60,744 ft² of subaqueous bottom impacted through siltation/turbidity as the structures and beach augmentation are put in place.
3. Approximately 89,232 ft² intertidal area covered by sand placed for beach augmentation.
4. Approximately 13,835 ft² uplands impacted by sand placement and grading.
5. Access route connecting uplands stockpile and staging area to beach (10,000 ft²).
6. The uplands staging area (1,000 ft²).

The total size of the action area is 264,067 ft² (Figure 5).

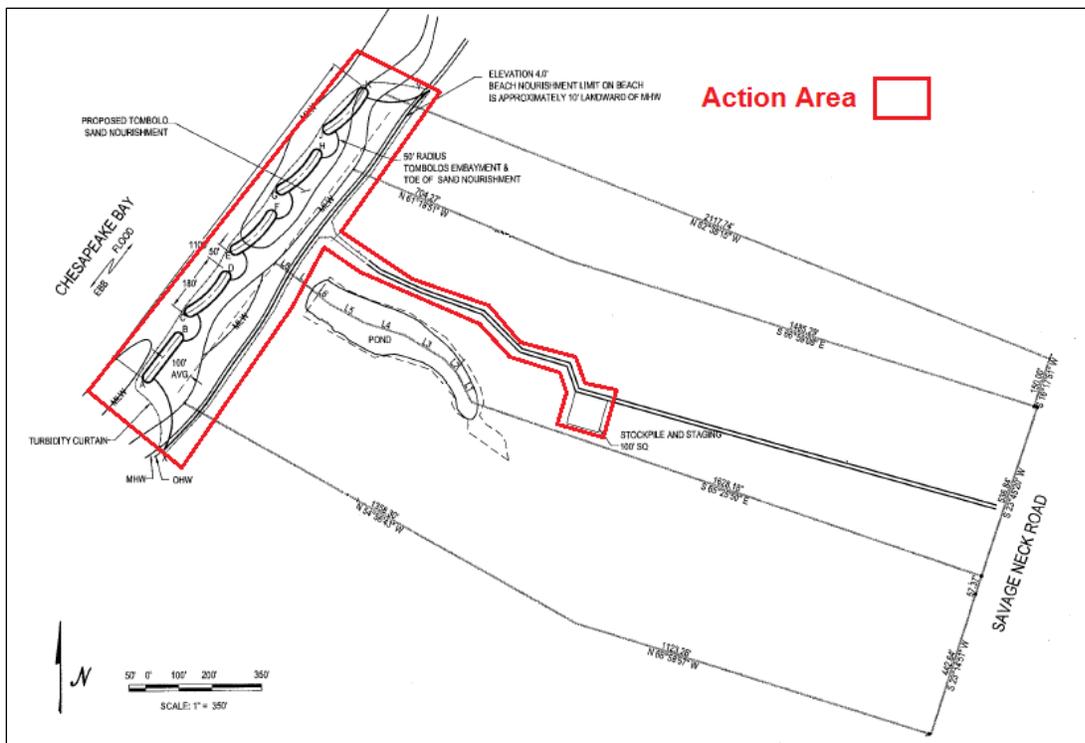


Figure 5. Action area (264,067 ft²) for proposed Savage Neck LLC and Kimberly Jarvis breakwater project, Tankard Beach, Northampton County, VA.

STATUS OF THE SPECIES AND CRITICAL HABITAT RANGEWIDE

The species description, life history, population dynamics, status, and distribution and critical habitat description, if applicable, are at: Stamatov 1972; Rosen 1980; Knisley 1987, 1991, 1997a, b, c, 2001, 2002, 2005a, b, c, d, 2009, 2012; Knisley et al. 1987, 2001; Knisley and Hill 1989, 1990, 1998, 1999; Vogler et al. 1993; Blair et al. 1994; Service 1994, 2005, 2007, 2008, 2009; Hill and Knisley 1994, 1995; Vogler and DeSalle 1994; Vogler and Goldstein 1997; U.S. Geological Survey 1998; Gowan and Knisley 2001; Nothnagle 2001; Drummond 2002; Fenster et al. 2006; Pearson et al. 2006; Davis 2007; National Park Service 2007; and Kapitulik 2011.

ENVIRONMENTAL BASELINE

Status of the Species/Critical Habitat Within the Action Area – The action area is within the section of shoreline referenced by the Service as the Tankards Beach NBTB site. This section of shoreline is part of the Savage Neck peninsula. The action area contains 103,835 ft² of adult NBTB habitat. The total number of adult NBTBs has been constant over the years: 1,791 adults in 1999 (Knisley and Hill 1999); 1,146 adults in 2002 (Knisley 2002); 1,248 adults in 2005 (Knisley 2005); and a peak count of 5,107 adults in 2009 (Knisley 2009). The most recent survey documented 993 adults (M. Drummond, Service, pers. obs. August 8, 2014).

The presence of larval NBTBs is assumed by the presence of adult NBTBs and by on-site observations (M. Drummond, Service, pers. obs. August 8, 2014) that the existing shoreline supports larval NBTB habitat. The action area supports 34,012 ft² of larval habitat.

Factors Affecting Species Environment Within the Action Area – The shoreline in the action area is comprised of parcels with individual homes under construction and an undeveloped lot to the south, resulting in limited use of the beach by the landowner's family and their guests. The types of activities common along this shoreline are limited to low impact human activities such as foot traffic, sun-bathing, fishing, and swimming access. These types of activities are known to pose a minimal threat to the NBTB.

The shoreline within the action area has been experiencing erosion, with noticeable loss of NBTB habitat resulting from Hurricane Sandy in 2012. Effects of Hurricane Sandy on adult and larval NBTBs at this site have not been quantified, but it was obvious during the August 8, 2014 site visit (M. Drummond, Service, pers. obs. August 8, 2014) that the storm caused significant impacts to the dune system along this section of shoreline, and resulted in the loss of both larval and adult NBTB habitat. Sections of shoreline to the south of the action area that had breakwaters in place prior to the hurricane were observed to have experienced less severe impacts.

Based on the Fifth Annual Report of the International Panel on Climate Change (IPCC, 2013), the most recent global estimates for mean sea level rise range from 0.8-2.7 ft by 2100, a range that reflects differing potential global carbon dioxide emissions over that time period. Further uncertainty exists regarding the rate and extent of melting ice sheets in the Arctic, and combined with carbon emissions that continue to increase globally (Oliver et al. 2013) and other

uncertainties; IPCC scientists agree that these are conservative estimates of likely outcomes. A National Climate Assessment completed in 2014 for the United States (Melillo et al. 2014) estimates that sea levels will rise another 1-4 ft by 2100; models evaluating a series of potential emission scenarios give broader ranges of 8 inches to 6.6 ft.

For Virginia, experts agree that these global and national-scale projections do not fully reflect conditions in the Mid-Atlantic region, where land subsidence and water withdrawals in the Coastal Plain significantly worsen sea level rise beyond that being experienced by any other region of the East Coast. Land subsidence alone causes more than half of the observed sea-level rise in the southern Chesapeake Bay. Land subsidence varies regionally in major part due to varying groundwater withdrawal rates, and has occurred around Norfolk, VA at an average rate of 0.12 inches/year since 1940. Global sea-level rise and land subsidence increase the risk of coastal flooding and contribute to shoreline retreat. The relative sea-level rise rates around the Chesapeake Bay range from 0.12 to 0.18 inches/year (Eggleston and Pope 2013). A study commissioned by the Virginia General Assembly and completed by the Virginia Institute of Marine Science (2013) determined that sea level rise may reach 7.5 ft by 2100 and “Given what is currently known, it seems reasonable to anticipate that sea level in Virginia will be 1.5 ft. higher than is presently sometime in the next 20 to 50 years.”

Coastal storms, and therefore storm surges, are more difficult to predict into the future, but Virginia Institute of Marine Science has projected a sea level rise of 1.5 ft and a storm surge of 4.5 ft (3 ft above lowest estimates of sea level rise) to be “a reasonable surge for a large but typical storm” for the Chesapeake Bay Region based on historic data. An assessment by Sallenger et al. (2013) of 6 decades of sea level rise measurements (1950-2009) for one Mid-Atlantic location (Cape Hatteras, NC) documented sea level rise rates 3-4 times global estimates published by the IPCC. Referencing the most recent IPCC report (IPCC 2013), this would extrapolate to sea level rise estimates of between 2.8 and 9.4 ft for Virginia by 2100. Notably, none of these projections reflect impacts from coastal storms or hurricanes, which are known to have devastating local and regional effects.

Increasing sea levels are changing the dynamics that maintain beach habitats, including increased shoreline erosion rates in some areas, and changes in sand deposition (U.S. Geological Survey 1998). Field observations from Service personnel indicate that increased sea level rise is impacting conditions at existing NBTB sites. A number of the sites are underwater or have eroded to the back marsh.

EFFECTS OF THE ACTION

Direct Effects – Because no project-related actions will occur on the beach during NBTB breeding and egg-laying, no direct effects to adult NBTBs are expected.

Larvae will be impacted from placement of materials, use of equipment, and construction-related foot traffic. There is 34,012 ft² of larval NBTB habitat, and all larvae within this area are likely to be crushed or entombed in their burrows as a result of equipment traversing the project site or from the placement of materials. Larvae not killed outright may be prevented from feeding due

to their sensitivity to vibrations, movements, and shadows, possibly resulting in injury or death.

Indirect Effects – Indirect effects are defined as those that are caused by the proposed action and are later in time, but still are reasonably certain to occur (50 CFR 402.02). Changes in sand movement and beach profile may occur following breakwater construction and beach nourishment as the beach equilibrates. Since the action area will be contoured during beach nourishment, the severity of change that may occur will be reduced and the effects are expected to be minor and temporary. Changes in sand movement and beach profile will affect the location, amount, and suitability of adult NBTB habitat. Because these changes are expected to be minor, short-term in duration, and of a temporary nature, the Service anticipates that any affects to adult NBTBs will be insignificant and discountable. There will be a shift in the areas available for use by larval NBTBs. Because these changes are expected to be minor, short-term in duration, and of a temporary nature, any affects to larval NBTBs will be insignificant and discountable.

Interrelated and Interdependent Actions – An interrelated activity is an activity that is part of the proposed action and depends on the proposed action for its justification. An interdependent activity is an activity that has no independent utility apart from the action under consultation. The Service is not aware of activities interrelated to or interdependent with the proposed action at this time.

Beneficial Actions – Construction of the breakwaters with beach nourishment will improve stability of the beach and increase the extent of suitable NBTB habitat. Currently within the action area there is 103,835 ft² of adult NBTB habitat. When the project is completed, the amount of adult NBTB habitat will increase by approximately 30,000 ft², resulting in a total of 133,835 ft² of adult NBTB habitat. Currently within the action area there is 34,012 ft² of larval habitat. When the project is completed, the amount of larval NBTB habitat will increase by approximately 8,500 ft², resulting in a total of 42,512 ft² of larval habitat.

CUMULATIVE EFFECTS

Cumulative effects include the effects of future State, tribal, local, or private actions that are reasonably certain to occur in the action area considered in this biological opinion. Future Federal actions that are unrelated to the proposed action are not considered in this section because they require separate consultation pursuant to section 7 of the ESA.

As provided in the *Factors Affecting Species Environment Within the Action Area* section, coastal storms, and therefore storm surges, are more difficult to predict into the future, but Virginia Institute of Marine Science has projected a sea level rise of 1.5 ft and a storm surge of 4.5 ft (3 ft above lowest estimates of sea level rise) to be “a reasonable surge for a large but typical storm” for the Chesapeake Bay Region based on historic data. An assessment by Sallenger et al. (2013) of 6 decades of sea level rise measurements (1950-2009) for one Mid-Atlantic location (Cape Hatteras, NC) documented sea level rise rates 3-4 times global estimates published by the IPCC. Referencing the most recent IPCC report (IPCC 2013), this would extrapolate to sea level rise estimates of between 2.8 and 9.4 ft for Virginia by 2100. Notably,

none of these projections reflect impacts from coastal storms or hurricanes, which are known to have devastating local and regional effects.

Many complex and dynamic forces will continue to determine sea level rise and coastal erosion rates. Increasing sea levels are changing the dynamics that maintain beach habitats, including increased shoreline erosion rates in some areas, and changes in sand deposition (U.S. Geological Survey 1998). Field observations from Service personnel indicate that increased sea level rise is impacting conditions at existing NBTB sites. A number of the sites are underwater or have eroded to the back marsh. This observed loss of habitat, coupled with projections of accelerated sea level rise and storm surge impacts, increases the need to conserve those NBTB beaches throughout the Chesapeake Bay that thus far have demonstrated greater climate change resiliency.

CONCLUSION

While some loss of larval NBTBs and their habitat will occur, the overall magnitude and severity of effects to NBTBs from the proposed action are anticipated to be minor since the majority of effects are short-term and temporary and the area affected by the project represents a small fraction of NBTB's entire range. The project will result in an increase in adult and larval NBTB habitat. The sand grain quality for the project is within the parameters of sand grain size required by NBTBs, so repopulation of the nourished area by adults is expected to occur the first year after construction. The beach north and south of the action area currently supports larval NBTB habitat and will serve as the source population for recolonization of the action area. The placement of breakwaters will provide resiliency to NBTB habitat in this section of shoreline.

After reviewing the current status of NBTB, the environmental baseline for the action area, the effects of the proposed action, and the cumulative effects, it is the Service's biological opinion that the issuance of a Corps' permit, as proposed, is not likely to jeopardize the continued existence of the NBTB. No critical habitat has been designated for this species; therefore, none will be affected.

INCIDENTAL TAKE STATEMENT

Sections 9 of the ESA and Federal regulation pursuant to section 4(d) of the ESA prohibit the take of endangered and threatened species, respectively, without a special exemption. Take is defined as to harass, harm, pursue, hunt, shoot, wound, kill, trap, capture or collect, or to attempt to engage in any such conduct. Harm is further defined by the Service to include significant habitat modification or degradation that results in death or injury to listed species by significantly impairing essential behavioral patterns including breeding, feeding, or sheltering. Harass is defined by the Service as intentional or negligent actions that create the likelihood of injury to listed species to such an extent as to significantly disrupt normal behavior patterns, which include, but are not limited to, breeding, feeding, or sheltering. Incidental take is defined as take that is incidental to, and not the purpose of, the carrying out of an otherwise lawful activity. Under the terms of section 7(b)(4) and section 7(o)(2), taking that is incidental to and not intended as part of the agency action is not considered to be prohibited taking under the ESA

provided that such taking is in compliance with the terms and conditions of this incidental take statement.

The measures described below are nondiscretionary, and must be undertaken by the Corps so that they become binding conditions of any grant or permit issued to Savage Neck LLC and Kimberly Jarvis, as appropriate, for the exemption in section 7(o)(2) to apply. The Corps has a continuing duty to regulate the activity covered by this incidental take statement. If the Corps (1) fails to assume and implement the terms and conditions or (2) fails to require Savage Neck LLC and Kimberly Jarvis to adhere to the terms and conditions of the incidental take statement through enforceable terms that are added to the permit or grant document, the protective coverage of section 7(o)(2) may lapse. To monitor the impact of incidental take, the Corps must report the progress of the action and its impact on the species to the Service as specified in the incidental take statement [50 CFR 402.14(i)(3)].

AMOUNT OR EXTENT OF TAKE ANTICIPATED

The Service anticipates incidental take of NBTB will be difficult to detect for the following reasons: coloring and small body size, tendency of larvae to remain in burrows beneath the surface of the sand, and finding a dead or impaired specimen is unlikely. However, the following level of take of this species can be anticipated by the areal extent of larval habitat affected.

The Service anticipates incidental take of all larval NBTBs within the 34,012 ft² of larval habitat present, as a result of placement of materials, use of equipment, and construction-related foot traffic. This take will be in the form of harm, harassment, or kill.

EFFECT OF THE TAKE

In the accompanying biological opinion, the Service determined that this level of anticipated take is not likely to result in jeopardy to the species or destruction or adverse modification of critical habitat.

REASONABLE AND PRUDENT MEASURES

The Service believes the following reasonable and prudent measures are necessary and appropriate to minimize take of NBTB:

- Ensure construction is conducted in a manner that minimizes disturbance to NBTB.

TERMS AND CONDITIONS

To be exempt from the prohibitions of section 9 of the ESA, the Corps must comply with the following terms and conditions, which implement the reasonable and prudent measures described above and outline required reporting/monitoring requirements. These terms and conditions are nondiscretionary.

1. No ground disturbance caused by construction-related foot traffic, equipment, or materials will occur on the beach outside of the project area (Figure 5).
2. Applicant will hire a certified engineer to conduct a standard sieve test on every 1,000 cubic yards of sand to ensure the materials mean cumulative particle size distribution (D_{50}) falls within the range of 0.3-0.7 millimeters grain size, with less than 1 percent silt/clay component.
3. Fuel, oil, and hydraulic fluids for equipment used will not be stored within 100 ft of any waterbody or wetland. Refueling of mobile equipment/vehicles will not occur within 100 ft of any waterbody or wetland (includes the beach area which is classified as non-vegetated wetlands). On-site personnel will select appropriate sites for these activities and subsequently use best management practices, secondary containment measures, or other standard spill prevention and countermeasures to manage the activity to prevent these fluids from entering the Chesapeake Bay.
4. Any small gasoline powered equipment, such as pumps and generators, and fuel tanks must be entirely enclosed or placed within a secondary containment structure that is large enough to completely contain all materials should a spill, leak, or overflow occur. Any spills of motor oil, hydraulic fluid, coolant, or similar fluids, not contained before entry into the action area, must be reported to this office at the contact number/email provided below and to the National Response Center (800-424-8802) immediately.
5. Pursuant to 50 CFR 402.14(i)(3), in order to monitor the impacts of incidental take, the Federal agency or any applicant must report the progress of the action and its impacts on the species to the Service. To meet this requirement, adult and larval NBTB surveys and a geomorphology assessment of beach characteristics must be conducted.

NBTB surveys must begin after project completion and be conducted each year for a period of 5 consecutive years as outlined below.

- The survey area will cover all NBTB habitat within the action area and the adjacent property to the south (between the existing Clarke Breakwater Project and the Savage Neck LLC and Kimberly Jarvis breakwater project).
- Adult and larval NBTB surveys shall be performed by a Service-approved surveyor. A list of pre-approved NBTB surveyors is enclosed. If a proposed surveyor not on the enclosed list is selected, the proposed surveyor's qualifications must be sent to the Service for review and approval at least 60 days prior to the survey.
- Data specific to each of the two sites must be provided.
- Adult NBTBs shall be inventoried on warm, sunny days between July 1 and July 25. The total number of adults observed at each site must be recorded.
- Larval inventories shall be conducted between October 10 and 30 during low tide on cool and/or cloudy days. The total number of larval burrows observed at each site must be recorded. An attempt to identify instar stage of larvae shall be made.
- A report will be provided to the Service documenting/including the following for

both adult and larval surveys: surveyor and dates, methods, results, photographic monitoring, and any habitat/population observations of significance within 30 days following completion of the larval survey each year.

- Capture and/or collection of NBTBs is not authorized under this requirement of the incidental take statement and must be permitted by appropriate Federal and State regulatory agencies.

A geomorphology assessment must begin after project completion and be conducted each year for a period of 5 consecutive years as outlined below.

- Aerial photography and analysis must be conducted by a Service approved individual. The proposed individual's qualifications must be sent to the Service for review and approval at least 60 days prior to initiation of aerial photography.
- Geo-referenced aerial photographs must be taken within the action area and the adjacent property to the south (between the existing Clarke Breakwater Project and the Savage Neck LLC and Kimberly Jarvis breakwater project). The photos will to be taken each year near the same time period and no later than October 30 of each year.
- Fixed point photographs will be taken from 10 different fixed points in the action area. These fixed points will be established near the water's edge, and will be used each year (coordinates for these sites will be documented). At these points, a photo will be taken both north and south. These photos need to be taken each year near the same time period and no later than October 30 of each year. The photos shall be in sufficient detail to assess value of the beach habitat to NBTBs and shall include detailed descriptions of the beach width and profile the entire length of shoreline.
- An assessment of performance of the structures must be conducted.
- A report will be provided to the Service by November 30 of each year documenting/including the following: coordinates of the 10 fixed point photographs, fixed point photographs, and geo-referenced aerials. Each annual report will build on the prior years, evaluating performance of the breakwaters and reaction of the shoreline to these structures.

Provide all required information in digital form to the Service contact/email address provided below.

6. Care must be taken in handling any dead specimens of proposed or listed species to preserve biological material in the best possible state. In conjunction with the preservation of any dead specimens, the finder has the responsibility to ensure that evidence intrinsic to determining the cause of death of the specimen is not unnecessarily disturbed. The finding of dead specimens does not imply enforcement proceedings pursuant to the ESA. The reporting of dead specimens is required to enable the Service to determine if take is reached or exceeded and to ensure that the terms and conditions are appropriate and effective. Upon locating a dead specimen, notify the Service's Virginia Law Enforcement Office at 804-771-2883 and the Service's Virginia Field Office at 804-693-6694.

The Service believes that no more than 34,012 ft² of larval NBTB habitat will be incidentally taken as a result of the proposed action. The reasonable and prudent measures, with their implementing terms and conditions, are designed to minimize the impact of incidental take that might otherwise result from the proposed action. If, during the course of the action, this level of incidental take is exceeded, such incidental take represents new information requiring reinitiation of consultation and review of the reasonable and prudent measures provided. The Federal agency must immediately provide an explanation of the causes of the taking and review with the Service the need for possible modification of the reasonable and prudent measures.

CONSERVATION RECOMMENDATIONS

Section 7(a)(1) of the ESA directs Federal agencies to utilize their authorities to further the purposes of the ESA by carrying out conservation programs for the benefit of endangered and threatened species. Conservation recommendations are discretionary agency activities to minimize or avoid adverse effects of a proposed action on listed species or critical habitat, to help implement recovery plans, or to develop information.

- We recommend that the Corps establish a process to mitigate for NBTB habitat loss from shoreline projects. This could include a means to establish conservation easements for the protection of the NBTB and its habitat, restoration of beach habitat in areas where habitat has been altered significantly, or other appropriate measures. This would contribute to recovery efforts for the NBTB by formally protecting sites through conservation easements or natural areas.

For the Service to be kept informed of actions minimizing or avoiding adverse effects or benefitting listed species or their habitats, the Service requests notification of the implementation of any conservation recommendations.

REINITIATION NOTICE

This concludes formal consultation on the action(s) outlined in the request. As provided in 50 CFR 402.16, reinitiation of formal consultation is required where discretionary Federal agency involvement or control over the action has been retained (or is authorized by law) and if: (1) the amount or extent of incidental take is exceeded; (2) new information reveals effects of the agency action that may affect listed species or critical habitat in a manner or to an extent not considered in this opinion; (3) the agency action is subsequently modified in a manner that causes an effect to the listed species or critical habitat not considered in this opinion; or (4) a new species is listed or critical habitat designated that may be affected by the action. In instances where the amount or extent of incidental take is exceeded, any operations causing such take must cease pending reinitiation.

Mr. Walker

Page 14

If you have any questions, please contact Mike Drummond of this office at (804) 824-2408, or via email at Mike_Drummond@fws.gov.

Sincerely,

Cindy Schulz
Field Supervisor
Virginia Ecological Services

Enclosure

cc: VDACS, Richmond, VA (Attn: Keith Tignor)
VDCR, DNH, Richmond, VA (Attn: René Hypes)

Literature Cited

- Blair, J.M., R.W. Parmelee, and R.L. Wyman. 1994. A comparison of the forest floor invertebrate communities of four forest types in northeastern United States. *Pedobiologia* 38(2):146-160.
- Boon, J.D. 2012. Evidence of sea level acceleration at U.S. and Canadian tide stations, Atlantic Coast, North America. *Journal of Coastal Research* 28(6):1437-1445.
- Davis, C. 2007. Monitoring and reintroduction of the northeastern beach tiger beetle, *Cicindela dorsalis dorsalis*, Monomoy National Wildlife Refuge, 2007. Report to the U.S. Fish and Wildlife Service, New England Field Office, Concord, NH.
- Drummond, M.R. 2002. The effects of geophysical factors on the distribution of the northeastern beach tiger beetle, *Cicindela dorsalis dorsalis* Say. M.S. Thesis, Christopher Newport University, VA.
- Eggleston J. and J. Pope (2013), U.S. Geological Survey Circular 1392, 30 p., <http://dx.doi.org/10.3133/cir1392>.
- Fenster, M.S., C.B. Knisley, and C.T. Reed. 2006. Habitat preference and the effects of beach nourishment on the federally threatened northeastern beach tiger beetle. *Cicindela dorsalis dorsalis*: Western Shore, Chesapeake Bay, Virginia. *Journal of Coastal Research* 22(5):1133-1144.
- Gowan, C. and C.B. Knisley. 2001. A population viability analysis for the northeastern beach tiger beetle in the Chesapeake Bay region. Report to U.S. Fish and Wildlife Service, Virginia Field Office, Gloucester, VA.
- Hill, J.M. and C.B. Knisley. 1994. A metapopulation study of the threatened northeastern beach tiger beetle, *Cicindela dorsalis dorsalis* in Northumberland County, Virginia. Report to Virginia Department of Conservation and Recreation, Richmond, VA.
- Hill, J.M. and C.B. Knisley. 1995. Distribution and abundance of a biological indicator species, *Cicindela dorsalis dorsalis* in relation to shoreline structures and modifications. Report to U.S. Fish and Wildlife Service, Virginia Field Office, Gloucester, VA.
- International Panel on Climate Change. 2013. *Climate Change 2013: The physical science basis contribution of Working Group I to the Fifth Assessment Report of the Intergovernmental Panel on Climate Change* [Stocker, T.F., D. Qin, G.-K. Plattner, M. Tignor, S.K. Allen, J. Boschung, A. Nauels, Y. Xia, V. Bex and P.M. Midgley (eds.)]. Cambridge University Press, Cambridge, United Kingdom and New York, NY, USA, 1535 pp.

- Kapitulik, N. 2011. Northeastern beach tiger beetle, *Cicindela dorsalis dorsalis*, monitoring of adults and larvae at Monomoy National Wildlife Refuge and South Beach 2011. Report to U.S. Fish and Wildlife Service, New England Field Office, Concord, NH.
- Knisley, C.B. 1987. Habitats, food resources, and natural enemies of a community of larval *Cicindela* in southeastern Arizona (Coleoptera: Cicindelidae). *Canadian Journal of Zoology* 65:1191-1200.
- Knisley, C.B. 1991. Management plan for a population of the threatened tiger beetle, *Cicindela dorsalis* at Accawmacke Plantation, Virginia. Report to Espey Houston and Company, Austin, TX.
- Knisley, C.B. 1997a. Distribution and abundance of the northeastern beach tiger beetle, *Cicindela dorsalis dorsalis*, in relation to shoreline modifications, in Virginia. Report to Virginia Department of Agriculture and Consumer Affairs, Office of Plant Protection, Richmond, VA.
- Knisley, C.B. 1997b. Microhabitat preferences of *Cicindela dorsalis dorsalis*, the northeastern beach tiger beetle. Report to Virginia Department of Agriculture and Consumer Services, Richmond, VA.
- Knisley, C.B. 1997c. Monitoring of the northeastern beach tiger beetle, *Cicindela d. dorsalis*, at Peaceful Beach Estates (O'Leary site) Northampton County, Virginia. Report to U.S. Fish and Wildlife Service, Virginia Field Office, Gloucester, VA.
- Knisley, C.B. 2001. A survey of the northeastern beach tiger beetle (*Cicindela dorsalis dorsalis*) along the western shoreline of the Chesapeake Bay, 2001. Report to U.S. Fish and Wildlife Service, Virginia Field Office, Gloucester, VA.
- Knisley, C.B. 2002. A survey of *Cicindela dorsalis dorsalis* along the eastern shoreline of the Chesapeake Bay, 2002. Report to U.S. Fish and Wildlife Service, Virginia Field Office, Gloucester, VA.
- Knisley, C.B. 2005a. A survey of the northeastern beach tiger beetle (*Cicindela dorsalis dorsalis*) at Eastern Shore of Virginia sites of the Chesapeake Bay, 2005. Report to U.S. Fish and Wildlife Service, Virginia Field Office, Gloucester, VA.
- Knisley, C.B. 2005b. Distribution and abundance of *Cicindela puritana* and *C. dorsalis dorsalis* in Maryland, 2005. Report to Heritage and Biodiversity Conservation Programs, Maryland Department of Natural Resources, Annapolis, MD.
- Knisley, C.B. 2005c. A survey of the northeastern beach tiger beetle (*Cicindela dorsalis dorsalis*) at all western and selected eastern shoreline sites of the Chesapeake Bay, 2004. Report to U.S. Fish and Wildlife Service, Virginia Field Office, Gloucester, VA.

- Knisley, C.B. 2005d. A five-year study of the northeastern beach tiger beetle in relation to beach use at Camp Silver Beach (YMCA), Northampton County, Virginia, 2000-2005. Report to U.S. Fish and Wildlife Service, Virginia Field Office, Gloucester, VA.
- Knisley, C.B. 2009. A survey of the northeastern beach tiger beetle (*Cicindela dorsalis dorsalis*) at Eastern Shore of Virginia sites, 2009. Report to U.S. Fish and Wildlife Service, Virginia Field Office, Gloucester, VA.
- Knisley, C.B. 2012. Survey for the northeastern beach tiger beetle, *Cicindela dorsalis dorsalis*, along the Virginia shoreline of the Chesapeake Bay, 2012. Report to U.S. Fish and Wildlife Service, Virginia Field Office, Gloucester, VA.
- Knisley, C.B. and J.M. Hill. 1989. Human impact on *Cicindela dorsalis dorsalis* at Flag Ponds, Maryland. Report to U.S. Fish and Wildlife Service, Chesapeake Bay Field Office, Annapolis, MD.
- Knisley, C.B. and J.M. Hill. 1990. Distribution and abundance of two tiger beetles, *Cicindela dorsalis media* and *C. lepida* at Assateague Island, Maryland, 1990. Report to Maryland Department of Natural Resources, Natural Heritage Program, Annapolis, MD.
- Knisley, C.B. and J.M. Hill. 1998. Distribution and abundance of *Cicindela dorsalis dorsalis*, the northeastern beach tiger beetle, along the western shoreline of the Chesapeake Bay in Virginia. Report to U.S. Fish and Wildlife Service, Virginia Field Office, Gloucester, VA.
- Knisley, C.B. and J.M. Hill. 1999. A survey of the eastern shore of Virginia for the northeastern beach tiger beetle, *Cicindela dorsalis dorsalis*, 1999. Report to U.S. Fish and Wildlife Service, Virginia Field Office, Gloucester, VA.
- Knisley, C.B., J.M. Hill, and A.M. Scherer. 2001. Translocation of threatened tiger beetle *Cicindela dorsalis dorsalis* (Coleoptera: Cicindelidae) to Sandy Hook, New Jersey. *Annals of the Entomological Society of America* 98(4):552-557.
- Knisley, C.B., J.L. Luebke, and D.R. Beatty. 1987. Natural history and population decline of the coastal tiger beetle *Cicindela dorsalis dorsalis* Say (Coleoptera: Cicindelidae). *Virginia Journal of Science* 38(4):293-303.
- Melillo, J.M., T.C. Richmond, and G.W. Yohe, Eds. 2014. *Climate Change Impacts in the United States: The Third National Climate Assessment*. U.S. Global Change Research Program, 841 pp. doi:10.7930/J0Z31WJ2.
- National Park Service. 2007. Threatened and endangered species activity report, 2007 season. Report to Gateway National Recreation Area, Sandy Hook, NJ.

- Nothnagle, P.J. 2001. Monitoring of the northeastern beach tiger beetle, (*Cicindela dorsalis dorsalis*) in Massachusetts in 2001. Report to U.S. Fish and Wildlife Service, New England Field Office, Concord, NH.
- Oliver J.G.J., G. Janssens-Maenhout, M. Muntean, and J.A.H.W. Peters. 2013. Trends in global CO2 emissions; 2013 Report, The Hague: PBL Netherlands Environmental Assessment Agency; Ispra: Joint Research Centre.
- Pearson, D.L., C.B. Knisley, and C.J. Kazilek. 2006. A field guide to the tiger beetles of the United States and Canada. Oxford University Press, Inc., New York, NY.
- Rosen, P.S. 1980. Erosion susceptibility of the Virginia Chesapeake Bay shoreline. *Marine Geology* 34:45-59.
- Sallenger Jr., A.H., K.S. Doran, and P.A. Howd. 2013. *Nature Climate Change* 2, 884–888 (2012) doi:10.1038/nclimate1597.
- Stamatov J. 1972. *Cicindela dorsalis* endangered on northern Atlantic coast. *Cicindela* 4:78.
- U.S. Fish and Wildlife Service. 1994. Northeastern Beach Tiger Beetle (*Cicindela dorsalis dorsalis*) Recovery Plan. Hadley, MA. 60 p.
- U.S. Fish and Wildlife Service. 2005. Partial survey of the western shoreline of Chesapeake Bay, Virginia, for the northeastern beach tiger beetle (*Cicindela dorsalis dorsalis*). Unpublished data. Virginia Field Office, Gloucester, VA.
- U.S. Fish and Wildlife Service. 2007. Survey of the Potomac River for the northeastern beach tiger beetle, (*Cicindela dorsalis dorsalis*). Unpublished data. Virginia Field Office, Gloucester, VA.
- U.S. Fish and Wildlife Service. 2008. Survey of the western shoreline of Chesapeake Bay, Virginia, for the northeastern beach tiger beetle (*Cicindela dorsalis dorsalis*). Unpublished data. Virginia Field Office, Gloucester, VA.
- U.S. Fish and Wildlife Service. 2009. Northeastern beach tiger beetle (*Cicindela dorsalis dorsalis*) 5-year review: summary and evaluation. Unpublished report. Virginia Field Office, Gloucester, VA.
- U.S. Geological Survey. 1998. The Chesapeake Bay: geologic product of rising sea level. Fact Sheet 102-98. Reston, VA.
- Virginia Institute of Marine Science. 2013. Recurrent flooding study for Tidewater Virginia: a report commissioned by the Virginia General Assembly, 141 pp.

- Vogler, A.P. and R. DeSalle. 1994. Diagnosing units of conservation management. *Conservation Biology* 8:354-363.
- Vogler, A.P. and P.Z. Goldstein. 1997. Adaptation, cladogenesis, and the evolution of habitat association in North American tiger beetles: a phylogenetic perspective. Pages 353-373 in T. Givnish and K. Systma, eds. *Molecular Evolution and Adaptive Radiation*. Cambridge University Press, Cambridge, MA.
- Vogler, A.P., R. DeSalle, T. Assmann, C.B. Knisley, and T.D. Schultz. 1993. Molecular population genetics of the endangered tiger beetle *Cicindela dorsalis dorsalis* (Coleoptera: Cicindelidae). *Entomological Society of America* 86:142-152.

**Approved Surveyors in Virginia for:
Northeastern beach tiger beetle (*Cicindela dorsalis dorsalis*)**

This list contains the names of individuals who are qualified to conduct habitat assessments/surveys for the referenced species in Virginia. If you select an individual not on this list to conduct habitat assessments/surveys for the referenced species, provide that individual's qualifications to this office for review and approval 60 days prior to the start of the survey. If a habitat assessment determines there is habitat for one or more of the referenced species, a species survey by an approved surveyor is needed. If the survey determines that any rare species are present, contact this office to allow us the opportunity to work with you to avoid or minimize adverse effects to rare species and their habitats during project design and implementation. Email correspondence and survey results to virginiafieldoffice@fws.gov. Inclusion of names on this list does not constitute endorsement by the U.S. Fish and Wildlife Service or any other U.S. Government agency.

Last Updated:	21 February 2013
---------------	------------------

ADULT Surveys:

Dawn Currier
City of Hampton
1255 Big Bethel Road
Hampton, Virginia 23666
(757) 825-4836
dcurrier@hampton.gov

Barry Knisley
Department of Biology
Randolph-Macon College
Ashland, VA 23005
(804) 752-7254
bknisley@rmc.edu

VA Division of Natural Heritage
217 Governor Street, 3rd Floor
Richmond, VA 23219

Anne Chazal
(804) 786-9014
anne.chazal@dcr.virginia.gov

Dot Field
(757) 787-5576
dot.field@dcr.virginia.gov

Kevin Heffernan
(804) 786-9112
kevin.heffernan@dcr.virginia.gov

Chris Hobson
(804) 371-6202
chris.hobson@dcr.virginia.gov

Darren Loomis
(757) 925-2318
darren.loomis@dcr.virginia.gov

Steve Roble
(804) 786-7951
steve.roble@dcr.virginia.gov

Rebecca Wilson
(804) 225-2303
rebecca.wilson@dcr.virginia.gov

LARVAL Surveys:

Barry Knisley
Department of Biology
Randolph-Macon College
Ashland, VA 23005
(804) 752-7254
bknisley@rmc.edu