APPENDIX S
Land Use Ecological Services
Fish and Wildlife Resource Impact Assessment

PWGC
Strategic Environmental Engineering Solutions

# APPENDIX R

## Land Use Ecological Services

## Fish and Wildlife Resource Impact Assessment

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# Suffolk County Firematics Site
# 676 Maple Street, Yaphank NY

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## 1. Description of Terrestrial and Aquatic Ecological Resources at the Suffolk County Firematics Site

The Suffolk County Firematics site, located at 676 Maple Street, was investigated by William P. Bowman PhD on June 26, 2018 and July 7, 2018 (Figures 1 and 2). The ecological communities located on and within 0.5 miles of the site were characterized according to the classifications described in *The Ecological Communities of New York State* (Edinger et al, 2014) (Figure 2). Edinger et al (2014) describes ecological communities that are created or maintained by human activities or highly modified by human influence as "cultural" communities. Due to the large number of cultural ecological communities observed within 0.5 miles of the site (e,g. mowed lawn, mowed lawn with trees, mowed roadside, cropland, flower garden/landscaping, paved road, sand mine, construction spoils) and the insignificance of these communities as wildlife habitat, boundaries between these community types were not delineated and are identified collectively as Cultural and Cultural-Agricultural cover types on Figure 2.

The Firematics site largely consists of lawns dominated by clipped grasses and maintained by routine mowing. Some planted trees are present, including honey locust (*Gleditsia triacanthos*) and scarlet oak (*Quercus coccinea*), in the eastern portion of the site surrounding the site's roads and parking areas. Scattered eastern red cedar (*Juniperus virginiana*) trees are located within the mowed lawn areas. Various commonplace weeds can be found within the mowed lawn areas and in areas where mowing is impeded by fences or other structures such as common and English plantain (*Plantago lanceolata* and *Plantago major*), white clover (*Trifolium repens*), common St Johnswort (*Hypericum perforatum*), field sorrel (*Rumex acetosella*), field strawberry (*Fragaria virginiana*), and rough-fruited cinquefoil (*Potentilla recta*). The perimeter of the Firematics site is less frequently mowed; accordingly, there is a greater diversity of native and invasive plant species present including Asiatic bittersweet (*Celastrus orbiculatus*), common mullein (*Verbascum thapsus*), goldenrods (*Solidago sp.*), dogbane (*Apocynum cannabinum*), grey birch (*Betula populifolia*), pitch pine (*Pinus rigida*), autumn olive (*Elaeagnus umbellata*) , brambles (*Rubus sp.*), sweetgale (*Comptonia peregrina*), fleabanes (*Erigeron sp.*), field hawkweed (*Hieracium pratense*), mugwort (*Artemesia vulgaris*), spotted knapweed (*Centaurea maculosa*), and birdfoot trefoil (*Lotus corniculatus*).

These mowed fields and shrubby margins provide limited habitat for wildlife, and the species that are present include commonplace species that are highly tolerant of or commensal with human activity or developed habitats. These species include songbirds such as American robin (*Turdus migratorius*), northern mockingbird (*Mimus polyglottos*), European starling (*Sternus vulgaris*), mourning dove (*Zenaida macroura*), song sparrow (*Melospiza melodia*), chipping sparrow (*Spizella passerina*), and field sparrow (*Spizella pusilla*); and small mammals such as woodchuck (*Marmota monax*), white-footed mouse (*Peromyscus leucopus*), house mouse (*Mus musculus*), meadow vole (*Microtus pennsylvanicus*), pine vole (*Pitmys pinetorum*), and eastern chipmunk (*Tamias striatus*). A complete list of the plant and wildlife species observed on June 26, 2018 is presented in Section 8.

The Suffolk County Firematics site is surrounded by natural pitch pine-oak forests. Some of these forests are relatively undisturbed, whereas the pine-oak forests to the east and south of the site are utilized for brush truck training and exhibit anticipated impacts including deeply rutted

truck tracks and fallen trees. These forests are generally dominated by white oak (*Quercus alba*) and black oak (*Quercus velutina*) with relatively low abundance of pitch pine (*Pinus rigida*), i.e. less than 20% pine cover. The forests to the northwest of the Firematics site have a greater proportion of pitch pine reaching nearly complete pine canopy cover. The understory composition of these oak-pine forests is variable with some areas featuring abundant tree oak seedings and other areas with a nearly continuous heath layer comprised of lowbush blueberry (*Vaccinium pallidum* and *Vaccinium angustifolium*), black huckleberry (*Gaylussacia baccata*), occasional scrub oak (*Quercus ilicifolia*), and other characteristic woody and herbaceous ground-layer species such as bracken fern (*Pteridium aquilinum*), Pennsylvania sedge (*Carex pensylvanica*), sweet fern (*Comptonia peregrina*), and whorled loosestrife (*Lysimachia quadrifolia*). Observed birds and wildlife within these forests include wild turkey (*Meleagris gallopavo*), white-tailed deer (*Odocoileus virginianus)*, and songbirds such as white-breasted nuthatch (*Sitta carolinensis*), common grackle (*Quiscalus quiscula*), and eastern towhee (*Pipilo erythrophthalmus*). The pine-oak forests surrounding the Suffolk County Firematics site provide high quality wildlife habitat. Other characteristic fauna of these forests include common yellowthroat (*Geothlypis trichas*), field sparrow (*Spizella pusilla*), prairie warbler (*Setophaga discolor*), pine warbler (*Setophaga pinus*), blue jay (*Cyanocitta cristata*), red fox (*Vulpes fulva*), white-footed mouse (*Peromyscus leucopus*), meadow vole (*Microtus pennsylvanicus*), pine vole (*Pitmys pinetorum*), short-tailed shrew (*Blarina brevicauda*), eastern chipmunk (*Tamias striatus*), southern flying squirrel (*Glaucomys volans*), raccoon (*Procyon lotor*), and opossum (*Didelphis marsupialis*).

The unlined recharge basin located in the southern portion of the Firematics site features a small area (approximately 0.04 acres) of wet meadow habitat dominated by spikerush (*Eleocharis sp.*), broom sedge (*Carex scoparia*), Canada rush (*Juncus canadensis*), Deptford pink (*Dianthus armeria*), curled dock (*Rumex crispus*), and willow shrubs (*Salix* sp.). The steep, sandy slopes of the recharge basin are vegetated by native species such as pitch pine, eastern red cedar, big-toothed aspen (*Populus grandidentata*), switch grass (*Panicum virgatum*), and black cherry (*Prunus serotina*) along with invasive species such as autumn olive, mugwort, spotted knapweed, sweet vernal grass (*Anthoxanthum odoratum*), cleavers (*Galium aparine*), daisy fleabane (*Erigeron annuus*), Asiatic bittersweet, and Japanese honeysuckle (*Lonicera japonica*). Scattered tree oaks are present along the upper slopes of the basin. The presence of shallow groundwater (or standing water during wet periods) indicates that this recharge basin serves as a focal point for wildlife on and adjacent to the Firematics site. A wild turkey hen with several poults was observed in the recharge basin during the field investigation. Waterfowl, such as mallard (*Anas platyrynchos*) and/or Canada geese (*Branta canadensis*), were observed in the wastewater treatment pond to the west of the Firematics site and may utilize the unlined recharge basin when standing water is present. Amphibians, such as spring peeper (*Pseudacris crucifer*), may utilize the recharge basin although none were observed during the field inspection. Several meadowhawk dragonflies (*Sympetrum sp.*) were observed during the field inspection.

The mowed lawns and pitch pine-oak forests present on the subject property appear to provide habitat for typical diversity and density of native and invasive vegetation and do not show any obvious visual indications of contamination such as stunted vegetation, abnormal plant growth, or diseased plant tissues. However, due to the extensive maintenance and disturbance of the site,

it is not certain that any visual indicators of long-term exposure of vegetation to contamination should be expected.

Due to the diversity and quality of the pitch pine-oak forest present, it is expected that the margins of the Firematics site provides foraging, cover, and breeding habitat for typical diversity and density of wildlife including invertebrates, birds, and mammals. There were no obvious visual indications of adverse impacts of contamination on wildlife (*i.e*. extensive or recent wildlife mortality). Young wild turkey and Canada geese were observed on or adjacent to the site.

## 2. Description of Terrestrial and Aquatic Ecological Resources with 0.5 miles of the Suffolk County Firematics Site

The land uses and ecological community types present within 0.5 miles of the Suffolk County Firematics site include municipal facilities (i.e. Suffolk County Police Department Headquarters and Suffolk County Correctional Facility), industrial uses on Grucci Lane and the Long Island Compost facility on Horseblock Road, and residential properties and neighborhoods with large areas of pitch pine oak forests interspersed within these developed properties. Two agricultural areas are present, one to the south of the Firematics site and the Schmidt Sod farm to its northeast. All natural areas within 0.5 miles of the Firematics site consist of pitch pine-oak forests (as defined by Edinger et al, 2014). The forest areas present throughout the 0.5 mile radius area are similar to the description provided above in Section 1. Pitch pine-oak forests can exhibit wide variability and "range from having widely spaced pine trees….to a nearly pure stand of pines with only a few widely spaced oak trees", according to Edinger et al. 2014. Similarly, the pitch pine-oak forests surrounding the Firematics site include stands dominated by young pitch pine (such as those immediately surrounding the western margin of the Firematics site and to the south of the site), mixed stands of pine and oak, and stands dominated by mature white and black oak trees with few pitch pine trees. In addition, there are forest gaps and/or areas of past disturbance where the forests have greater abundance of early successional trees such as big-toothed aspen, black cherry, and black locust (*Robinia pseudoacacia*). The terrestrial ecological communities present on adjacent properties and within 0.5 miles of the site provide high quality habitat for a wide variety of plants, invertebrates, and wildlife including those species described in Section 1.

Aquatic ecological resources, such as freshwater wetlands or surface waters, located on, immediately adjacent to, or within 0.5 miles of the Firematics site are very limited. As described previously, a small 0.04 acre wet meadow community is present within the unlined recharge basin and provides limited aquatic habitat and aquatic resources for wildlife, as standing water in this basin is seasonal and intermittent based on the plant species observed. The larger 0.11 acre lined recharge basin does not provide aquatic habitat due to the absence of natural soils or plant community. Four 0.05 acre basins utilized for wastewater treatment are located approximately 700 feet to the west of the site. These ponds are utilized by common waterfowl, i.e. mallard and Canada goose. These ponds are artificial features and do not contain permanent standing water based on review of aerial imagery. The water source for these ponds is discharge from the

wastewater treatment process, not groundwater. Accordingly, no permanent aquatic ecological resources are supported by these ponds.

There are no natural aquatic ecological resources within 0.5 miles of the Firematics site. The New York State Department of Environmental Conservation Environmental Resource Mapper (http://www.dec.ny.gov/gis/erm) and the United States Fish and Wildlife Service National Wetlands Inventory Mapper (https://www.fws.gov/wetlands/Data/Mapper.html) confirm that no freshwater wetlands or surface water features are located within 0.5 mile of the site. Depth to groundwater maps for Long Island prepared by the US Geological Service https://ny.water.usgs.gov/maps/li-dtw10/ indicate the groundwater is typically 10-15 feet below the ground surface on and within 0.5 miles of the Firematics site.

### 2.1 Significant Wildlife, Plant, or Ecological Resources within 0.5 miles of the Suffolk County Firematics Site

No endangered, threatened, or rare wildlife are expected to occur on the Firematics site due to the limited habitat available. On-line databases including the NYSDEC Environmental Resource Mapper (http://www.dec.ny.gov/gis/erm) and the NYS EAF Mapper (http://www.dec.ny.gov/eafmapper/) do not identify any known records of endangered, threatened, or rare wildlife, plants, or ecological communities on or immediately adjacent to the Firematics site. These databases indicate that the large tracts of forested habitat in and adjacent to Southaven County Park and Wertheim National Wildlife Refuge and perhaps within 0.5 miles of the site may provide habitat for a New York State-listed bat, the northern long-eared bat (*Myotis septentrionalis*). Northern long-eared bats are threatened in New York State. They are known to utilize a wide range of young and mature forest types, including pitch pine oak forest (NYNHP, 2017). Northern long-eared bats are typically found in forest interiors (Carroll et al, 2002) and tend to avoid woodlands with significant edge habitat (Yates and Muzika, 2006). During the day, northern long-eared bats roost in dead trees, in live trees under loose bark or in cavities, or in buildings. Roosts of female bats tend to be large diameter, tall trees, and, in at least some areas, located within a less dense canopy (Sasse and Pekins, 1996). Accordingly, the pitch pine-oak forests within 0.5 miles of the Suffolk County Firematic sites provide suitable summer habitat for this species. However, the more fragmented forests adjacent to the site are not expected to provide high-quality summer habitat for northern long-eared bat due to its preference for forest interiors.

### 2.2 Significant Wildlife, Plant, or Ecological Resources within 0.5 to 2.0 miles of the Suffolk County Firematics Site

Extensive, high-quality aquatic and terrestrial ecological resources associated with the Carmans River are located to the east of the Suffolk County Firematics site. Ecological resources associated with the Carmans River are largely located within two large public parks, Southaven County Park and Wertheim National Wildlife Refuge, shown on Figure 1. The Carmans River has extensive freshwater wetland communities in its headwaters, and brackish and tidal marshes where it empties into Bellport Bay. The nearest freshwater wetland communities associated with the Carmans River are located approximately 1.1 miles from the Suffolk County Firematics site.

The river is protected as a Wild, Scenic, and Recreational River by New York State and is characterized as a Significant Coastal Fish and Wildlife Habitat by New York State Department of State. The freshwater and tidal wetlands, NYSDEC Wild, Scenic, and Recreational River Corridor, and the NYS Department of State Significant Coastal Fish and Wildlife Habitat area are identified on Figure 1. Large areas of these significant ecological resources are located within 2.0 miles of the Suffolk County Firematics site.

The Carmans River is of regional ecological significance as one of four major riverine systems on Long Island, due to the presence of many unique, high-quality, and rare ecological resources; and its support of outdoor- and wildlife-related human uses (NYSDOS, 2008). For example, it is one of a few streams on Long Island that support populations of sea-run brown trout and wild brook trout and provides habitat for one of the largest pirate perch populations, a Species of Greatest Conservation Need, on Long Island. The New York Natural Heritage Program indicates that a significant ecological community, i.e. red maple-black gum swamp, is located within the freshwater reaches of the river's watershed and significant estuarine or marine communities, i.e. high salt marsh, brackish tidal marsh, and marine eelgrass meadow, are located at the mouth of the river at Bellport Bay. Areas of the Carmans River in Southaven County Park and Wertheim National Wildlife Refuge provide habitat for several New York State-listed wildlife and plant species, including northern long-eared bat, bald eagle (*Haliaeetus leucocaphalus*), northern harrier (*Circus cyaneus*), eastern mud turtle (*Kinosternon subrubrum*), Collins sedge (*Carex collinsii*), blunt-leaved grape fern (*Botrychium oneidense*), and pale duckweed (*Lemna valdiviana*), according to the NYS EAF mapper ((http://www.dec.ny.gov/eafmapper/). The river is also an important habitat for migratory and over-wintering waterfowl and utilized by large numbers of birds including black duck (*Anas rubripes*), mallard, Canada goose, canvasback (*Aythya valisineria*), hooded and red-breasted mergansers (*Lophodytes cucullatus* and *Mergus serrator*), greater and lesser scaup (*Aythya marila* and *Aythya affinis*), redhead (*Aythya americana*), northern shoveler (*Anas clypeata*), northern pintail (*Anas acuta*), gadwall (*Mareca strepera*), and American widgeon (*Mareca americana*) (NYSDOS, 2008).

## 3. Discussion of Terrestrial Ecological Pathways for Contaminants of Concern

Soil sampling pursuant to the Remedial Investigation/Feasibility Study Work Plan (prepared by PW Grosser Consulting, Inc., November 2018) was conducted at forty seven locations at the Firematics site. The sampling plan included, but was not limited to, quantifying PFOS (perfluorooctane sulfonate) and PFOA (perfluorooctanoic acid) concentrations in the upper soils (i.e. between 0-2 inches below ground surface and between 2-24 inches below ground surface) and corresponding to soil zones where biological activity occurs (i.e. from soil invertebrates, burrowing mammals, and plant roots). In sediment samples collected December 19, 2017, PFOS concentrations ranged between 0.00021 and 1.78 mg/Kg and PFOA concentrations ranged between 0.000087 and 0.49 mg/Kg. PFOS and PFOA concentrations in shallow soil samples within the site areas used for active training of foam use and suppression of open pit fires (including mowed lawn areas), and in the unlined basin for stormwater management, exceeded the site-specific screening criteria of 0.080 mg/Kg for PFOS and 0.110 mg/Kg for PFOA developed to protect groundwater. There are no NYSDEC standards for PFOS and PFOA

concentration in soils necessary to protect human health or ecological resources under NYCRR Part 375 Environmental Remediation Programs (NYSDEC, 2006). Accordingly, the potential for impacts to the site's terrestrial ecological resources from the observed PFOS and PFOA concentrations in the upper soils cannot be quantitatively evaluated.

Published studies on bioaccumulation of PFAS compounds (per- and polyfluoroaklyl substances, such as PFOS and PFOA) and the ecological effects in terrestrial ecosystems and food webs are scarce relative to studies in marine or freshwater ecosystems (D'Hollander et al, 2014). However, uptake and bio-accumulation of PFAS compounds has been documented in agricultural plants (Stahl et al, 2009); coniferous and broad-leaved trees (Zhang et al. 2015); woody shrubs (D'Hollander et al, 2014); soil invertebrates and earthworms (Rich et al, 2014; D'Hollander et al, 2014); small mammals (Hoff et al, 2014); large mammal herbivores, i.e. roe deer and cows (Falk et al. 2012; Vestergren et al, 2013); songbirds (Lopez-Antia et al, 2017); and a terrestrial raptor (Bustnes et al. 2014). Plant uptake of PFAS compounds is a passive process associated with evapotranspiration and uptake of contaminants from soils and soil water (Gobelius et al, 2017) and results in the accumulation of PFAS compounds in all plant tissues (i.e. leaves, shoots, and roots), including berries (D'Hollander et al, 2014), with the highest concentrations observed in leaves (Gobelius et al, 2017). In soil invertebrates, the accumulation of PFAS compounds in body tissues occurs through contact with and ingestion of soil and soil organic matter (Rich et al, 2014). Small burrowing mammals will be exposed to PFAS compounds through consumption of contaminated water, inhalation of air, ingestion of fine soil particles, and consumption of plants or invertebrates with accumulated levels of PFAS compounds (D'Hollander et al, 2014). Similarly, accumulation of PFAS compounds in songbirds would be expected to result from consumption of insects and invertebrates, seeds, and fruits with PFAS accumulation and incidental consumption of soil particles. In limited studies, PFAS compounds have potential to bioaccumulate or biomagnify in terrestrial food chains with potential increased exposure to organisms at higher trophic levels. Laboratory studies have indicated that PFOS is moderately acute to slightly chronically toxic to terrestrial birds, i.e. northern bobwhite quail (*Colinus virginianus*) (Newsted et al, 2005; Newsted et al, 2007), tree swallow (*Tachycineta bicolor*) (Custer et al. 2014), and chicken (*Gallus gallus*) (O'Brien et al. 2009). However, the potential acute and/or chronic effects of PFOS and other PFAS to terrestrial wildlife at concentrations experienced in the environment are not well documented.

PFOS and PFOA concentrations were generally lower in other portions of the site with less direct exposure to PFAS compounds, as indicated by the absence of site-specific screening criteria in these areas. This indicates that terrestrial wildlife that utilize the active fire training areas for foam use and open pit suppression, and the un-lined recharge basin, are subject to greater exposure to PFOS and PFOA. Wildlife observed or expected to utilize the mowed lawns in the active fire training areas include small mammals, such as woodchuck and white-footed mouse and commonplace songbirds including American robin, northern mockingbird, European starling, and mourning dove. Wild turkey has been observed both on mowed areas of the Firematics site and utilizing the unlined recharge basin as a foraging area and water source. The tall fence appears to limit the use of these high exposure areas of the site by white-tailed deer.

A quantitative assessment of the expected impacts (e.g. increased mortality, reduced reproductive success, etc.) of the observed PFOS and PFOA soil concentrations on the health of the site's wildlife cannot be developed due to the absence of 1) published New York State soil concentration screening criteria for PFOS and PFOA for the protection of ecological resources, 2) studies documenting the effects on wildlife of PFOS and PFOA exposure at concentrations similar to those experienced in the environment, and/or 3) PFOS and PFOA concentrations observed in wildlife tissues at the site. However, it is reasonable to conclude that the potential impacts to terrestrial wildlife health within 0.5 miles of the Firematics site are small and localized, due to the limited size and habitat quality of the area of contaminated soils, i.e. a maximum of ~15 acres of mowed lawn interspersed with asphalt surfaces and structures relative to the size of the home ranges and population densities of potentially affected wildlife. Accordingly, the potential effects of soil PFOS and PFOA contamination are likely to be limited to only a small number of organisms or a small portion of the home range of an effected organism. For example, seasonal home ranges for wild turkey have been reported at 0.8 to 1.6 square miles (Niedzielski B and J Bowman, 2016). Home ranges of woodchuck range between 4.2-6.4 acres for females and 32.9-43.0 acres for males (Lehrer EW and RL Schooley, 2010). Home territories of songbirds are variable in size depending on species and availability of food (Newton, 1998), nest sites (Brawn and Balda, 1988), and mates (Chuang-Dobbs et al., 2001), but are expected to range between 2.2 and 9.9 acres (Lambert and Hannon, 2000; Sillett et al., 2004; Hallworth et al., 2008). American robin breeding territories in New York State have been found to be somewhat smaller at 0.3 to 0.5 acres (Howell, 1942). Population densities of white-footed mouse (*Peromyscus leucopus*) and woodchuck (*Marmota monax*) range between 35-85 individuals per acre and 1.2-4.6 individuals per acre, respectively (Nupp and Swihart 1998; Maher, 2006). Predation of these small mammals and songbirds by birds of prey could result in transfer and concentration of contaminant loads in these top predators. However, nesting territories of red-tailed hawks, Cooper's hawk, and great-horned owls are 790 to 3,090 acres, 330 to 5,000 acres, and 560 to 2,190 acres in size, respectively (Minor et al., 1993; Rosenfield et al. 1991; Rohner, 1997). In light of the small size of the contamination, the potential adverse effects on only several dozen to a few hundred small mammals or songbirds are not considered to be ecologically significant due to the commonplace nature of these organisms. Similarly, the numbers of impacted songbirds, gamebirds (i.e. wild turkey), and raptors are likely to be very small and no significant impacts to the populations of these species are expected. Furthermore, no mammals or birds listed as endangered, threatened, or special concern are reported to occur at the site (NYNHP correspondence dated May 19, 2008).

Lastly, none of the potentially effected wildlife are subject to hunting and human consumption of meat as 1) hunting is not authorized on the subject County lands, 2) deer hunting could occur on adequately sized nearby private lands, but deer are not likely to be exposed to the on-site contamination due to the site's fencing, and 3) only limited turkey hunting is authorized on Long Island and not in any locations proximal to the Firematics site.

## 4. Discussion of Aquatic Ecological Pathways for Contaminants of Concern

Aquatic ecosystems are vulnerable to PFAS contamination as a result of the high water solubility of these compounds (Ahrens, 2011) allowing for long-distance transport through ground- and

surface waters, strong adsorption to soil and sediment organic matter allowing for subsequent uptake by aquatic benthic invertebrates (Martin et al, 2004), potential for the contaminants to bioconcentrate in fish tissues from waterborne exposure and consumption of food or prey with PFAS contamination (Giesy et al, 2010), and potential for the contaminants to bioaccumulate in top predators (Kannan et al, 2005). PFAS compounds have been documented throughout aquatic ecosystems and food webs including aquatic invertebrates and benthic and pelagic fish (Martin et al, 2004); aquatic herpetiles, i.e. snapping turtles (*Chelydra serpentina)* (de Solla et al, 2012); herbivorous and piscivorous waterfowl (Sinclair et al, 2006); insectivorous birds feeding upon aerial adult stages of benthic aquatic insects, i.e. tree swallow (*Tachycineta bicolor*) (Custer et al, 2014); piscivorous mammals, i.e. mink (*Mustela vison*) and river otter (*Lutra canadensis*) (Kannan et al, 2002); and piscivorous birds, particularly top predators, such as great blue heron (*Ardea herodias*) and bald eagle (*Haliaeetus leucocaphalus*) (Route et al, 2011; Custer et al, 2013). Biomonitoring studies of PFAS accumulation in aquatic ecosystems indicate that exposure to PFOS is greater for piscivorous vs non-piscivorous species (Sinclair et al, 2006), benthic vs pelagic species (Martin et al, 2004); and higher vs lower-trophic level species (Kannan et al, 2005). Laboratory studies have indicated that PFOS is moderately acute to slightly chronically toxic to aquatic organisms (Giesy et al, 2010) and birds (Newsted et al, 2007). However, the potential acute and/or chronic effects of PFOS and other PFAS on aquatic organisms and wildlife at concentrations experienced in the environment are not well documented.

PFAS movement through groundwater flow to monitoring wells located east and southeast of the Suffolk County Firematics site in excess of the US EPA Health Advisory Limit (Remedial Investigation/Feasibility Study Work Plan prepared by PW Grosser Consulting Inc., November 2017), and observation of PFOS and PFOA in limited surface water sampling in December 2017 in freshwater and tidal reaches of the Carmans River, indicates an existing pathway for PFOS and PFOA contamination to accumulate in the significant aquatic ecological resources of the Carmans River. The PFOS and PFOA concentrations observed in limited surface water sampling in December 2017 (3.8-13.4 ng/L and 1.95-14.7 ng/L in freshwater; 13.4-15.8 and 3.2-5.5 ng/L for marine waters) were below water quality criteria values for the protection of avian wildlife (47 ng/L for PFOS) and protection of aquatic organism (continuous concentration of 21,000 ng/L for PFOS and 2,5000,000 ng/L for PFOA) recommended by Giesy et al. 2010. However, there are no NYSDEC standards for PFOS and PFOA concentrations in surface waters necessary to protect ecological resources. Therefore, further evaluation of the potential accumulation of PFAS compounds in aquatic organisms and potential ecological effects of PFAS accumulation in the Carmans River is warranted in light of 1) the accumulation of PFAS compounds in most invertebrate, fish, and wildlife receptors in aquatic ecosystems, 2) the regional significance of the aquatic ecological resources of the Carmans River, 3) human consumption of freshwater and marine fish and waterfowl harvested from the Carmans River, and 4) documented groundwater contamination in the watershed upgradient of the Carmans River.

## 5. Human Uses of Lands and Resources within 2.0 miles of the Suffolk County Firematics Site

A wide range of land uses are present within 2.0 miles of the Suffolk County Firematics site including industrial uses (such as Caithness Long Island, the Town of Brookhaven Landfill, the DeCharro Brothers recycling facility on Grucci Avenue, and the Long Island Compost organic waste recycling facility on Horseblock Road); various municipal uses (such as Suffolk County Offices, Suffolk County Police Department Headquarters, and the Suffolk County Correctional Facility); commercial uses on Montauk Highway and Zorn Avenue; residential neighborhoods; and agricultural uses including the Suffolk County Farm and Education Center, Schmidt Sod Farm on Yaphank Avenue, and Glovers Farm on Victory Avenue. As described previously, there are large areas of pitch pine-oak forests within 0.5 miles of the Firematics site (Figure 2). However, there is little public use of these lands or their ecological resources due to the non-recreational nature of these municipal lands (i.e. the Suffolk County Fire Academy, Police Department, and Correctional Facility) and private land ownership.

In contrast, there is extensive human use of the public lands and terrestrial and aquatic resources within 0.5 to 2.0 miles of the Firematics site including opportunities for recreation involving human contact with and/or consumption of terrestrial and/or aquatic ecological resources. The diverse recreational, historical, and education sites/facilities within 2.0 miles of the Suffolk County Firematics site include Southaven County Park, Wertheim National Wildlife Refuge, two New York State-owned boat launches and surrounding State lands on Lower (Lily) Lake and the Carmans River, the Carmans River Nature Trail and Sanctuary, a private paddle craft launch operation at Carmans River Canoe and Paddle Rental, the Suffolk County Farm and Education Center, Robinson Duck Farm County Park, Schuyler County Park, and the Suffolk County Almshouse Cemetery. The most significant of these public lands in terms of ecological resource value and human use, Southaven County Park and Wertheim National Wildlife Refuge, are located downgradient of the expected groundwater flow from the Firematics site.

Southaven County Park is approximately 1,350 acres and located a minimum of 0.6 miles east of the Firematics site. Southaven County Park offers a diverse range of recreational opportunities including camping (both tent and trailer sites), picnicking, hiking, horseback riding, and trap/skeet shooting. In addition, the 10-acre Schuyler County Park is located adjacent to Southaven County Park at 154 Gerard Road. There are no trails or recreation activities or uses in this small County park. Many recreational amenities involving human contact and/or consumption of terrestrial and/or aquatic ecological resources are permitted within 2.0 miles of the Firematics site at Southaven County Park including paddling (but not swimming), freshwater fishing, and hunting for waterfowl. Southaven Park is stocked with approximately 2,000-3,000 brown and rainbow trout each year and supports a native brook trout population. Anglers in Southaven County Park target species including largemouth bass, bluegill, pumpkinseed, yellow perch, brown bullhead, brook trout, brown trout, and rainbow trout. Carmans River is utilized by large numbers of waterfowl in the fall and winter including black duck, mallard, Canada goose, canvasback, hooded and red-breasted mergansers, greater and lesser scaup, redhead, northern shoveler, northern pintail, gadwall, and American widgeon. Waterfowl hunting is offered in Southaven Park in the months of November-January.

Wertheim National Wildlife Refuge is approximately 2,550 acres and located a minimum of 1.3 miles southeast of the Suffolk County Firematics site. Wertheim National Wildlife Refuge offers passive recreational opportunities, such as hiking, cross-country skiing, birdwatching, photography, and environmental interpretation on its trail network. Limited hunting of white-tailed deer is offered to the public annually. Paddling is allowed within the tidal waters of Wertheim Refuge with launch points for paddlecraft located both within and adjacent to the Refuge. Fishing occurs throughout the Refuge including fishing from the shore and boats between Sunrise and Montauk Highways. Downstream of Montauk Highway, only fishing from boats is authorized. Common target fish species in Wertheim Refuge include striped bass, weakfish, brown trout, brook trout, rainbow trout, largemouth bass and white perch. No shellfishing is authorized by the NYSDEC in the tidal mouth of the Carmans River; however, waters of Bellport Bay are seasonally certified for shellfishing.

## 6. Conclusions

Site investigations have indicated PFOS and PFOA concentrations in shallow soil samples within the site areas used for active training of foam use and suppression of open pit fires (including mowed lawn areas), and the unlined basin for stormwater management, exceeded the site-specific screening criteria for PFOS and PFOA developed to protect groundwater. In addition, PFOS and PFOA movement through groundwater flow to monitoring wells located east and southeast of the Suffolk County Firematics site has been documented with concentrations in excess of the US EPA Health Advisory Limit. Limited surface water sampling in December 2017 in freshwater and tidal reaches of the Carmans River (including Hards Lake) indicate the presence of PFAS compounds.

PFOS and PFOA are known to bioaccumulate in both terrestrial and aquatic ecosystems. A quantitative assessment of the expected impacts (e.g. increased mortality, reduced reproductive success, etc.) of the observed PFOS and PFOA soil concentrations on the health of the Firematics site's terrestrial wildlife cannot be developed due to the absence of 1) published New York State soil concentration screening criteria for PFOS and PFOA for the protection of ecological resources, 2) studies documenting the effects on wildlife of PFOS and PFOA exposure at concentrations similar to those experienced in the environment, and/or 3) PFOS and PFOA concentrations observed in wildlife tissues at the site. However, in light of the small size of the contamination relative to the home ranges of the affected terrestrial wildlife, the potential adverse effects on only several dozen to a few hundred small mammals or songbirds are not considered to be ecologically significant due to the commonplace nature of these organisms.

Further evaluation of the potential accumulation of PFAS compounds in aquatic organisms and potential ecological effects of PFAS accumulation in the Carmans River is warranted in light of 1) the documented groundwater contamination in the watershed upgradient of the Carmans River, 2) the accumulation of PFAS compounds in most invertebrate, fish, and wildlife receptors in aquatic ecosystems, and 3) the regional significance of the aquatic ecological resources of the Carmans River and 4) human consumption of freshwater and marine fish and waterfowl harvested from the Carmans River.

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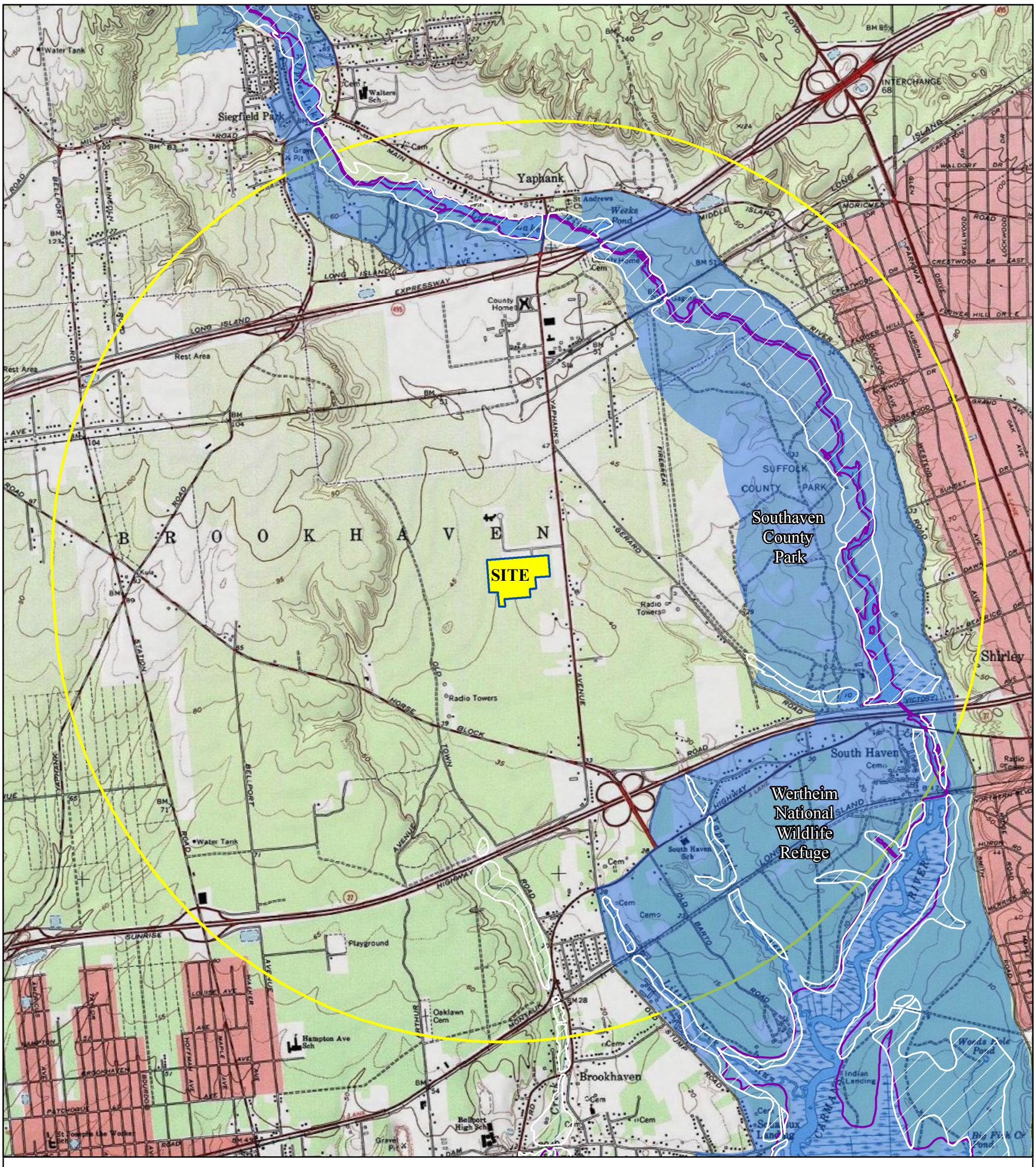
## 8. *Plant and Wildlife Species Observed During Field Inspections on June 26, 2018*

*Prepared by William P. Bowman PhD (Land Use Ecological Services)*

| **Common Name** | **Scientific Name** | | **Common Name** | **Scientific Name** |
|---|---|---|---|---|
| Yarrow | *Achillea millefolium* | | Rough-fruited Cinquefoil | *Potentilla recta* |
| Sweet Vernal Grass | *Anthoxanthum odoratum* | | Black Cherry | *Prunus serotina* |
| Dogbane | *Apocynum cannabinum* | | Bracken Fern | *Pteridium aquilinum* |
| Mugwort | *Artemesia vulgaris* | | Yellow Wood Sorrel | *Oxalis europaea* |
| Grey Birch | *Betula populifolia* | | Scrub Oak | *Quercus ilicifolia* |
| Japanese Barberry | *Berberis thunbergii* | | White Oak | *Quercus alba* |
| Pennsylvania Sedge | *Carex pennsylvanica* | | Black Oak | *Quercus velutina* |
| Broom Sedge | *Carex scoparia* | | Scarlet Oak | *Quercus coccinea* |
| Asiatic Bittersweet | *Celastrus orbiculatus* | | Multiflora Rose | *Rosa multiflora* |
| Spotted Knapweed | *Centaurea maculosa* | | Brambles | *Rubus sp.* |
| Sweet Fern | *Comptonia peregrine* | | Field Sorrel | *Rumex acetosella* |
| Hair Grass | *Deschampsia flexuosa* | | Curled Dock | *Rumex crispus* |
| Deptford Pink | *Dianthus armeria* | | Willow | *Salix sp.* |
| Deertongue | *Dichanthelium sp.* | | Goldenrod | *Solidago sp.* |
| Autumn Olive | *Elaeagnus umbellate* | | White Clover | *Trifolium repens* |
| Spikerush | *Eleocharis sp.* | | Lowbush Blueberry | *Vaccinium pallidum* |
| Daisy Fleabane | *Erigeron annuus* | | Lowbush Blueberry | *Vaccinium angustifolium* |
| Wild Strawberry | *Fragaria virginiana* | | Common Mullein | *Verbascum thapsus* |
| Cleavers | *Galium aparine* | | Wild Grape | *Vitis sp.* |
| Black Huckleberry | *Gaylussacia baccata* | | | |
| Honey Locust | *Gleditsia triacanthos* | | Mallard | *Anas platyrynchos* |
| Field Hawkweed | *Hieracium pretense* | | Canada Goose | *Branta canadensis* |
| Common St Johnswort | *Hypericum perforatum* | | Wild Turkey | *Melaegris gallopavo* |
| Canada Rush | *Juncus canadensis* | | Northern Mockingbird | *Mimus polyglotta* |
| Eastern Red Cedar | *Juniperus virginiana* | | Song Sparrow | *Melospiza melodia* |
| Japanese Honeysuckle | *Lonicera japonica* | | Eastern Towhee | *Pipio erythrophthalmus* |
| Birdfoot Trefoil | *Lotus corniculatus* | | Common Grackle | *Quiscalus quiscula* |
| Whorled Loosestrife | *Lysimachia quadrifolia* | | Chipping Sparrow | *Spizella passerina* |
| Switchgrass | *Panicum virgatum* | | American Robin | *Turdus migratorius* |
| Virginia Creeper | *Parthenocissus quinquefolia* | | White-Breasted Nuthatch | *Sitta carolinensis* |
| Pitch Pine | *Pinus rigida* | | European Starling | *Sternus vulgaris* |
| English Plantain | *Plantago lanceolate* | | Mourning Dove | *Zenadia macroura* |
| Common Plantain | *Plantago major* | | Woodchuck | *Marmota monax* |
| Big-toothed Aspen | *Populus grandidentata* | | White-tailed Deer | *Odocoileus virginianus* |
| Dwarf Cinquefoil | *Potentilla canadensis* | | | |




- NYSDEC Freshwater Wetland
- NYSDEC Carman's River WSRR
- NYSDOS Significant Coastal Fish and Wildlife Habitat
- Site Boundary
- Site Radius (2 miles)

DATA SOURCES:

1. NYSDEC freshwater wetlands from CUGIR (cugir.library.cornell.eud).
2. NYSDEC WSRR from NYSDEC.
3. NYSDOS SCFWH from NY Geographic Information Gateway (opdgig.dos.ny.gov).
4. Base Map is USA Topo Maps courtesy of ESRI and USGS.
5. Site Boundary digitized from Site Plan prepared by PWGC, dated 9/17/2017.
6. Site Radius obtained using Buffer Tool on Site Boundary.

N

1 in = 2,500 ft

0 750 1,500 3,000 Feet

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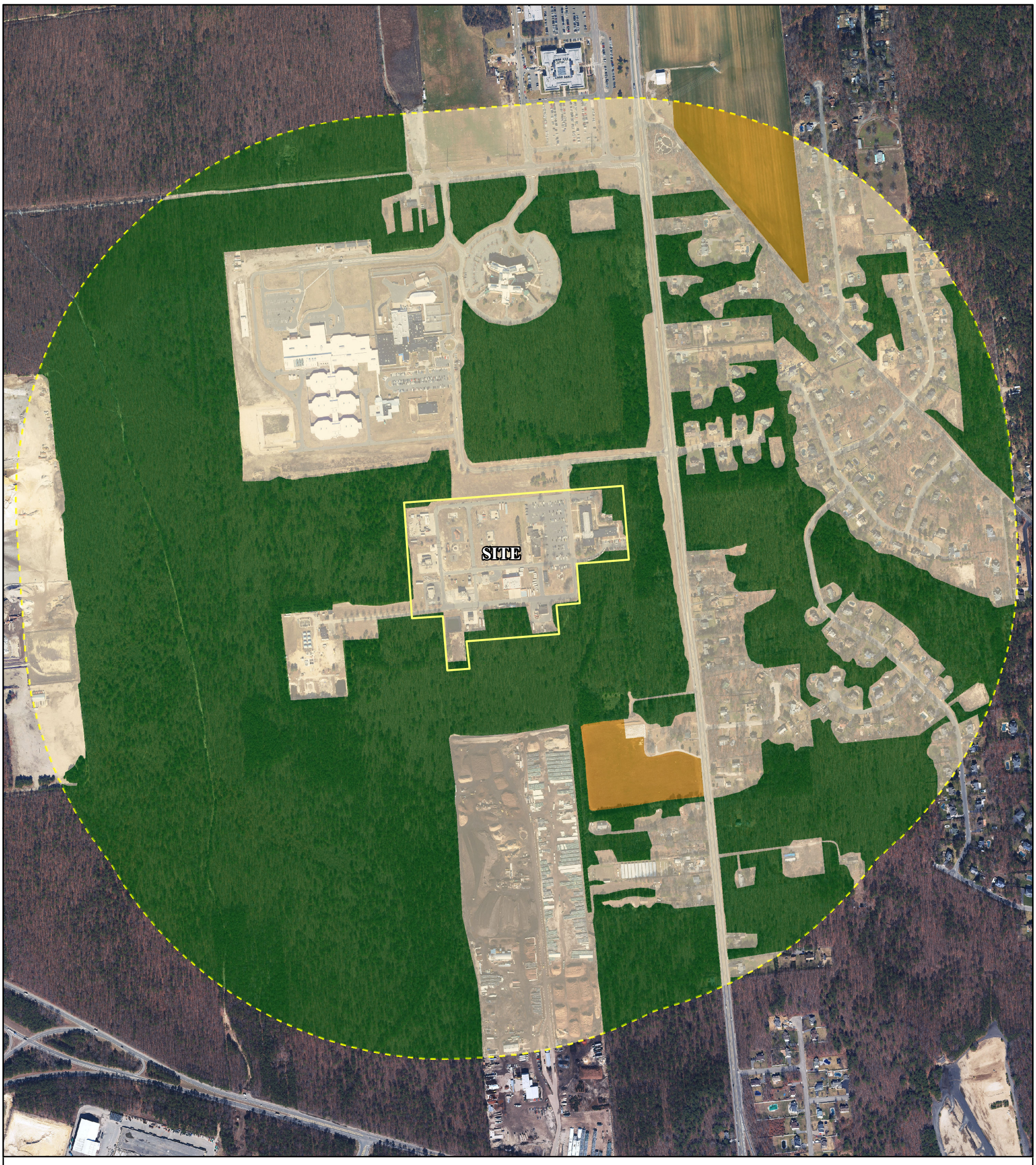
Date: 7/10/2018 | Revised: | Scale: As Noted | Figure 1




Land Cover Type
- Pitch Pine - Oak Forest (465 acres)
- Cultural - Agriculture (20 acres)
- Cultural (336 acres)

Site Boundary
Site Radius (1/2 mile)

NOTES :
1. Land Cover Type digitized from 2016 orthoimage with ground truthing 7/7/2018 by Land Use Ecological Services, Inc.
2. Site Boundary digitized from Site Plan prepared by PWGC, dated 9/17/2017.
3. Site Radius obtained using Buffer Tool on Site Boundary.
4. 2016 orthoimages from NYSGIS Clearinghouse (gis.ny.gov).

N
1 in = 700 ft
0 220 440 880 Feet

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