

Natural and Cultural Resources

The Brookhaven National Laboratory (BNL) Natural Resource Management Program is designed to protect and manage flora and fauna and the ecosystems in which they exist. The Laboratory's natural resource management strategy is based on understanding the site's resources and maintaining compliance with applicable regulations. The goals of the program include protecting and monitoring the ecosystem, conducting research, and communicating with personnel and the public on ecological issues. BNL focuses on protecting both Federal and New York State threatened and endangered species on site, as well as continuing the Laboratory's leadership role within the greater Long Island Central Pine Barrens ecosystem. Monitoring to determine whether current or historical activities are affecting natural resources is also part of the program. In 2019, deer, vegetation, and soil sampling results were consistent with previous years' results.

The overriding goal of the Cultural Resource Management Program is to ensure that proper stewardship of BNL historic resources is established and maintained. Additional goals of the program include maintaining compliance with various historic preservation and archeological laws and regulations and ensuring the availability of identified resources for research and interpretation. In 2019, six additional buildings were determined to be eligible for listing on the National Register of Historic Places.

6.1 NATURAL RESOURCE MANAGEMENT PROGRAM

The Natural Resource Management Program at BNL promotes stewardship of the natural resources found at the Laboratory and integrates natural resource management and protection with BNL's scientific mission. The Natural Resource Management Plan (NRMP) describes the program strategy, elements, and planned activities for managing the various natural resources found on site. The NRMP is updated every five years, with the most recent update completed in 2016 (BNL 2016).

6.1.1 Identification and Mapping

An understanding of an environmental baseline is the foundation of natural resource management planning. BNL uses digital global positioning systems (GPS) and geographic information systems (GIS) to clearly relate various "layers" of geographic information (e.g.,

vegetation types, soil condition, habitat, forest health, etc.). This is done to gain insight into interrelationships between the biotic systems and physical conditions at the Laboratory.

Mapping associated with tracking impacts from the operation of the Long Island Solar Farm (LISF) at BNL continues to use GPS and GIS as tools to analyze changes to wildlife populations and vegetation. In 2019, natural resource personnel and interns continued to look at use of the LISF site by pollinators, changes in bird use, and changes in vegetation.

A wide variety of vegetation, birds, reptiles, amphibians, and mammals inhabit the BNL site. Through implementation of the NRMP, endangered and threatened species, as well as species of special concern, have been identified as having been resident at BNL during the past 30 years or are expected to be present on site (see Table 6-1). New York State endangered animal species confirmed as currently

Table 6-1. Federal and New York State Threatened, Endangered, Exploitably Vulnerable, and Species of Special Concern at BNL.

Federal and New York State Threatened & Endangered Species, Species of Special Concern, & Species of Greatest Conservation Need			
Common Name	Scientific Name	State Status	BNL Status
Insects			
Comet damer	<i>Anax longipes</i>	SGCN	Confirmed
Rusty patched bumble bee	<i>Bombus affinis</i>	FE	Unlikely
Frosted elfin	<i>Callophrys iris</i>	T	Likely
New England bluet	<i>Enallagma laterale</i>	SGCN	Likely
Little bluet	<i>Enallagma minusculum</i>	T	Likely
Scarlet bluet	<i>Enallagma pictum</i>	T	Likely
Pine Barrens bluet	<i>Enallagma recurvatum</i>	T	Confirmed
Mottled duskywing	<i>Erynnis martialis</i>	SC	Likely
Persius duskywing	<i>Erynnis persius persius</i>	E	Likely
Pine barrens zanclognatha	<i>Zanclognatha martha</i>	SGCN	Confirmed
Black-bordered lemon moth	<i>Marimatha nigrofimbria</i>	SGCN	Confirmed
Fish			
Banded sunfish	<i>Enneacanthus obesus</i>	T	Confirmed
Swamp darter	<i>Etheostoma fusiforme</i>	T	Confirmed
Amphibians			
Marbled salamander	<i>Ambystoma opacum</i>	SC	Confirmed
Eastern tiger salamander	<i>Ambystoma tigrinum tigrinum</i>	E	Confirmed
Fowler's toad	<i>Bufo fowleri</i>	SGCN	Confirmed
Four-toed salamander	<i>Hemidactylium scutatum</i>	SGCN	Confirmed
Eastern spadefoot toad	<i>Scaphiopus holbrookii</i>	SC	Confirmed
Reptiles			
Worm snake	<i>Carphophis amoenus</i>	SC	Confirmed
Snapping turtle	<i>Chelydra serpentina</i>	SGCN	Confirmed
Spotted turtle	<i>Clemmys guttata</i>	SC	Confirmed
Northern black racer	<i>Coluber constrictor</i>	SGCN	Confirmed
Eastern hognose snake	<i>Heterodon platyrhinos</i>	SC	Confirmed
Stinkpot turtle	<i>Sternotherus odoratus</i>	SGCN	Confirmed
Eastern box turtle	<i>Terrapene carolina</i>	SC	Confirmed
Eastern ribbon snake	<i>Thamnophis sauritus</i>	SGCN	Confirmed
Birds (nesting, transient, or potentially present)			
Cooper's hawk	<i>Accipiter cooperii</i>	SC	Confirmed
Sharp-shinned hawk	<i>Accipiter striatus</i>	SC	Confirmed
Grasshopper sparrow	<i>Ammodramus savannarum</i>	SC	Confirmed
Great egret	<i>Ardea alba</i>	SGCN	Confirmed
Whip-poor-will	<i>Caprimulgus vociferus</i>	SC	Confirmed
Northern harrier	<i>Circus cyaneus</i>	T	Confirmed
Black-billed cuckoo	<i>Coccyzus erythrophthalmus</i>	SGCN	Confirmed
Northern bobwhite	<i>Colinus virginianus</i>	SGCN	Confirmed
Prairie warbler	<i>Setophaga discolor</i>	SGCN	Confirmed
Horned lark	<i>Eremophila alpestris</i>	SC	Confirmed
Perigrine Falcon	<i>Falco peregrinus</i>	E	Confirmed
Bald Eagle	<i>Haliaeetus leucocephalus</i>	T	Confirmed
Wood thrush	<i>Hylocichla mustelina</i>	SGCN	Confirmed
Red-headed woodpecker	<i>Melanerpes erythrocephalus</i>	SC	Confirmed
Osprey	<i>Pandion haliaetus</i>	SC	Confirmed
Scarlet tanager	<i>Piranga olivacea</i>	SGCN	Confirmed
Glossy ibis	<i>Plegadis falcinellus</i>	SGCN	Confirmed
Brown thrasher	<i>Toxostoma rufum</i>	SGCN	Confirmed
Blue-winged warbler	<i>Vermivora pinus</i>	SGCN	Confirmed

continued on next page

inhabiting Laboratory property include the eastern tiger salamander (*Ambystoma t. tigrinum*) and the peregrine falcon (*Falco peregrinus*). Endangered plants that have been confirmed on the BNL site include Engelmann spikerush (*Eleocharis engelmannii*), Ipecac spurge (*Euphorbia ipecacuanhae*), dwarf huckleberry (*Gaylussacia bigeloviana*), and whorled loosestrife (*Lysimachia quadrifolia*). Five other New York State endangered species have been identified at BNL in the past or are possibly present including: Persius duskywing (*Erynnis p. persius*), crested fringed orchid (*Plantathera cristata*), prostate knotweed (*Polygonum aviculare* ssp. *buxiforme*), bracken fern (*Pteridium aquilinum* var. *pseudocaudatum*), and possum haw (*Viburnum nudum* var. *nudum*). Eight threatened species in New York State have been positively identified on site and three other species are considered likely to be present. Threatened species include: two fish (*banded sunfish* [*Enneacanthus obesus*] and *swamp darter* [*Etheostoma fusiforme*]); three plants (*stiff-leaved goldenrod* [*Oligoneuron rigida*], *stargrass* [*Aletris farinosa*], and *eastern showy aster* [*Eurybia spectabilis*]); the northern harrier (*Circus cyaneus*) is periodically seen in the fall; and the bald eagle (*Haliaeetus leucocephalus*) is routinely seen visiting the site. Insects listed as threatened include the Pine Barrens bluet (*Enallagma recurvatum*), a damselfly which was confirmed at one of the many coastal plain ponds located on site. Two other damselflies, the little bluet (*Enallagma minusculum*) and the

Table 6-1. Federal and New York State Threatened, Endangered, Exploitably Vulnerable, and Species of Special Concern at BNL (concluded).

Federal and New York State Threatened & Endangered Species, Species of Special Concern, & Species of Greatest Conservation Need			
Common Name	Scientific Name	State Status	BNL Status
Mammals			
Northern long-eared bat	<i>Myotis septentrionalis</i>	FT	Confirmed
Plants			
Small-flowered false foxglove	<i>Agalinis paupercula</i>	R	Confirmed
Stargrass	<i>Aletris farinosa</i>	T	Confirmed
Butterfly weed	<i>Asclepias tuberosa ssp. interior</i>	V	Confirmed
Spotted wintergreen	<i>Chimaphila maculata</i>	V	Confirmed
Flowering dogwood	<i>Cornus florida</i>	V	Confirmed
Pink lady's slipper	<i>Cypripedium acaule</i>	V	Confirmed
Ground pine	<i>Dendrolycopodium obscurum</i>	V	Confirmed
Round-leaved sundew	<i>Drosera rotundifolia var. rotundifolia</i>	V	Confirmed
Marginal wood fern	<i>Dryopteris marginalis</i>	V	Confirmed
Engelman spikerush	<i>Eleocharis engelmannii</i>	E	Confirmed
Ipecac spurge	<i>Euphorbia ipecacuanhae</i>	E	Confirmed
Eastern showy aster	<i>Eurybia spectabilis</i>	T	Confirmed
Dwarf huckleberry	<i>Gaylussacia bigeloviana</i>	E	Confirmed
Winterberry	<i>Ilex verticillata</i>	V	Confirmed
Sheep laurel	<i>Kalmia angustifolia</i>	V	Confirmed
Narrow-leaved bush clover	<i>Lespedeza angustifolia</i>	R	Confirmed
Wild lupine	<i>Lupinus perennis</i>	R	Confirmed
Whorled loosestrife	<i>Lysimachia quadrifolia</i>	E	Confirmed
Bayberry	<i>Myrica pensylvanica</i>	V	Confirmed
Stiff-leaved goldenrod	<i>Oligoneuron rigida</i>	T	Confirmed
Cinnamon fern	<i>Osmunda cinnamomea</i>	V	Confirmed
Clayton's fern	<i>Osmunda claytoniana</i>	V	Confirmed
Royal fern	<i>Osmunda regalis</i>	V	Confirmed
Crested fringed orchid	<i>Plantathera cristata</i>	E	Likely
Green fringed orchid	<i>Platanthera lacera</i>	V	Confirmed
Prostate knotweed	<i>Polygonum aviculare ssp. buxiforme</i>	E	Possible
Bracken fern	<i>Pteridium alquilinum var. pseudocaudatum</i>	E	Possible
Swamp azalea	<i>Rhododendron viscosum</i>	V	Confirmed
Long-beaked bald-rush	<i>Rhynchospora scirpoides</i>	R	Confirmed
New York fern	<i>Thelypteris novaboracensis</i>	V	Confirmed
Marsh fern	<i>Thelypteris palustris var. pubescens</i>	V	Confirmed
Possum haw	<i>Viburnum nudum var. nudum</i>	E	Possible
Virginia chain-fern	<i>Woodwardia virginica</i>	V	Confirmed
Notes: information based on 6 NYCRR Part 182, 6 NYCRR Part 193, and BNL survey data. E = endangered FE=federally endangered FT = federally threatened R = rare SC = species of special concern SGCN = species of greatest conservation need T = threatened V = exploitably vulnerable			

scarlet bluet (*Enallagma pictum*), are likely to be present at one or more of the ponds on site. The frosted elfin (*Callophrys irus*), a butterfly, has been historically present on site due to its preferred habitat and host plant, wild lupine (*Lupinus perennis*).

A number of other species that are listed as rare, of special concern, or exploitably vulnerable by New York State either currently inhabit the site, visit during migration, or have been identified historically.

BNL has one federally threatened species, the northern long-eared bat (*Myotis septentrionalis*) that is found within the forests of the Lab; and the federally endangered rusty-patch bumble bee (*Bombus affinis*) was likely to have been in the area historically. A single bee tentatively identified as *B. affinis* was identified in 2016, but no photo or specimen was kept. Subsequent searches in 2017 and 2018 did not yield evidence for its presence suggesting that the bee is not likely to be present.

6.1.2 Habitat Protection and Enhancement

BNL has administrative processes in place to protect on-site habitats and natural resources. Activities to eliminate or minimize negative effects on endangered, threatened, or sensitive species are either incorporated into Laboratory procedures or into specific program or project plans. Human access to critical habitats, when necessary, is limited, and habitats are enhanced to improve survival or increase populations. Routine activities, such as road maintenance, are

not performed until the planned activities have been evaluated and determined to be unlikely to affect habitat.

6.1.2.1 Salamander Protection Efforts

Many safeguards are in place to protect eastern tiger salamander breeding areas. BNL staff must review any project planned near eastern tiger salamander habitats, and every effort is made to minimize impacts. A map of the breeding areas is reviewed when new projects are proposed. The current map incorporates buffer areas around tiger salamander habitats of 1,000 feet based on guidance from NYSDEC. Other efforts to protect this state-endangered species include determining when adult salamanders are migrating toward breeding locations, when metamorphosis has been completed, and when juveniles are migrating after metamorphosis.

Water quality testing is conducted as part of the routine monitoring of recharge basins, as discussed in Chapter 5. In cooperation with NYSDEC, habitat surveys have been routinely conducted since 1999. Biologists conducting egg mass and larval surveys have confirmed that 26 on-site ponds are used by eastern tiger salamanders. In 2019, surveys confirmed the presence of salamanders in three of the 26 ponds.

6.1.2.2 Banded Sunfish

Banded sunfish protection efforts include observing whether adequate water is present within areas currently identified as sunfish habitat, ensuring that vegetation in their habitat is not disturbed, and evaluating all activities taking place in ponds and the Peconic River on site for potential impacts on these habitats. Drought conditions that lasted from 2015 through early 2017 likely resulted in the extirpation of the banded sunfish from the BNL site. The single known habitat held water throughout 2018 and 2019 could likely sustain sunfish. However, a short survey by NYSDEC personnel did not find sunfish in the pond. Regionally, NYSDEC determined that only a few populations of banded sunfish survived the drought and continues to evaluate the need for restoration efforts.

6.1.2.3 Migratory Birds

A total of 216 species of birds have been identified at BNL since 1948; at least 85 species are known to nest on site. Some of these nesting birds have shown declines in their populations nationwide over the past 30 years. The Laboratory conducts routine monitoring of songbirds along seven permanent bird survey routes in various habitats on site.

In 2019, monthly surveys were conducted starting at the end of April and extending through the end of August. These surveys identified 73 bird species, compared to the 67 species identified in 2018 and 72 species in 2017. A total of 134 bird species have been identified in surveys in the past 20 years; 59 of these species were present in each of the past 20 years. Variations in the number and species identified during each survey may reflect the time of observation, variations in weather patterns between years, and possible changes in the environment.

The three most diverse transects on-site are by the LISF and the Peconic River and the eastern edge of the BNL property. The transects passing through the various forest types on site (e.g., white pine, moist pine barrens, and dry pine barrens) showed a less diverse bird community. Bird survey data are stored in an electronic database for future reference and study. Little data on the effects of a large, utility-scale solar array such as the LISF are present within scientific literature. To assess the effects of the LISF on local bird populations, the collection of migratory bird data in both the Biology Field and Solar Farm transects is important. The LISF vegetation and the way it is managed may play a key role as habitat for migratory birds.

The eastern bluebird (*Sialia sialis*) has been identified as a declining species of migratory birds in North America. This is due to loss of habitat and nest site competition from European starlings (*Sturnus vulgaris*) and house sparrows (*Passer domesticus*). BNL's NRMP includes habitat enhancement for the eastern bluebird. Since 2000, the Laboratory has installed more than 60 nest boxes around open grassland areas on site to enhance their population. The LISF

created nearly 200 acres of suitable habitat for the eastern blue bird. Forty boxes were installed around the northern most portions of the LISF and are routinely used by bluebirds, house wrens, and tree swallows. Bluebirds have also benefited from natural nesting habitat resulting from the 2012 wildland fire that resulted in significant tree mortality.

In 2019, a pair of peregrine falcons (*Falco peregrinus*) successfully nested on the stack of the former High Flux Beam Reactor. The pair took over a common raven's nest and successfully raised two chicks. While the nesting is a great success, the nesting must be discouraged in 2020 to allow the demolition of the stack which is required under the Record of Decision for the Decontamination and Dismantlement of the High Flux Beam Reactor (HFBR).

Migratory birds occasionally cause safety and health concerns, particularly Canada geese (*Branta canadensis*) and several species of migratory birds that occasionally nest on buildings or in construction areas on site. To control the goose population, the Laboratory manages nesting through egg oiling under an annual permit from the U.S. Fish & Wildlife Service. In 2019, 44 nests were treated to reduce the number of goslings. Several pairs of geese were successful at hiding their nests, resulting in more than three dozen goslings being produced and the increase of the estimated goose population to between 130 and 150 birds.

6.1.2.4 Bald Eagle

The bald eagle (*Haliaeetus leucocephalus*) has been increasing in population locally on Long Island with at least eight known nest sites on the island. Bald eagles were sighted numerous times in the area of the Sewage Treatment Plant (STP) and near the National Weather Service offices throughout the fall of 2019, and a pair of adult eagles was routinely observed in late-December visiting an osprey nest. As the eagle population increases on Long Island, the potential for them to nest on the BNL site will increase as well.

6.1.2.5 Northern Long-eared Bat

As discussed in Section 6.1.1, the northern long-eared bat was added to the list of

federally threatened species in 2015. BNL began planning for the eventual listing and put in place actions to minimize the likelihood of impacting this species. The two most likely activities that could impact this bat on the BNL site are building demolitions and prescribed fires. Inspections for the presence of bats may be conducted through either acoustic or visual surveys prior to demolition. Regardless of the outcome of acoustic monitoring (when conducted), a final internal inspection of the buildings is conducted approximately 24 hours prior to demolition to verify the absence of bats. For growing season prescribed fire, acoustic monitoring may be done within the burn unit to determine if there is bat activity. If positive results occur, surveys of the entire burn unit are completed to identify potential roost trees and appropriate protections are put into place to ensure that bats are not impacted by fire. In 2019, two buildings were demolished, and there was no impact to bats. No prescribed fires were conducted in 2019.

6.1.3 Population Management

In addition to controlling resident Canada goose populations described above, the Laboratory also monitors or manages other populations, including species of interest, to ensure that they are sustained and to control invasive species.

6.1.3.1 Wild Turkey

The forested areas of BNL provide good nesting and foraging habitat for wild turkey (*Meleagris gallapavo*). In 2019, the on-site population continued to range between 350 and 500 birds due to successful nesting. Each year, NYSDEC manages a hunting period during the week of Thanksgiving, and a youth-only hunt in May for several areas across Long Island, which typically results in approximately 100 birds taken.

6.1.3.2 White-Tailed Deer

BNL consistently updates information on the resident population of white-tailed deer (*Odocoileus virginianus*). As there are no natural predators on site and hunting is not

permitted at the Laboratory, there are no significant pressures on the population to migrate beyond their typical home range of approximately one square mile. Normally, a population density of ten to 30 deer per square mile is considered an optimum sustainable level for a given area. This would equate to approximately 80 to 250 deer inhabiting the BNL property under optimal circumstances. This was the approximate density in 1966, when BNL reported an estimate of 267 deer on site (Dwyer 1966). The Laboratory has been conducting routine population surveys of the white-tailed deer since 2000.

Deer overpopulation can affect animal and human health (e.g., animal starvation, Lyme disease from deer ticks, and collision injuries to both humans and animals), species diversity (e.g., songbird species reduction due to selective grazing and destruction of habitat by deer), and property damage (e.g., collision damage to autos and browsing damage to ornamental plantings). Deer-related collisions on site decreased in 2019 compared to 2018, po-



4 poster™ tick management system

tentially an indication of decreased population from the 2019 deer harvest.

High deer populations are a regional problem, and the Laboratory is just one area on Long Island with such an issue. Multiple east end towns are now managing deer populations either through culls (aka deer harvests), hunting, or sterilization programs. Under BNL's permit for deployment of the 4-Poster™ tick management system issued by NYSDEC, the Laboratory is required to implement a deer

management program. BNL has been implementing deer management since 2015 and conducting herd reductions every other year. The herd was estimated at between 350 and 450 animals at the end of 2018 and a harvest was conducted in April 2019 during which 250 animals were taken, effectively bringing the population to approximately 200 animals. With reproduction at approximately 60 percent, the population at the end of 2019 was estimated at 300 to 350 deer. Efforts were underway in December 2019 to establish an inter-agency agreement between the Department of Energy (DOE) and the U.S. Department of Agriculture - Wildlife Services that would establish a mechanism for annual population management to more effectively maintain a lower deer population.

6.1.4 Compliance Assurance and Potential Impact Assessment

The National Environmental Policy Act (NEPA) review process at BNL ensures that environmental impacts of a proposed action or activity are adequately evaluated and addressed. The Laboratory uses NEPA reviews when identifying potential environmental impacts associated with site activities, especially projects that may result in physical alterations to the landscape and structures. As appropriate, stakeholders such as EPA, NYSDEC, Suffolk County Department of Health Services (SCDHS), BNL's Community Advisory Council, and the Brookhaven Executive Roundtable are involved in reviewing major projects that have the potential for significant environmental impacts. Formal NEPA reviews are coordinated with the State of New York. There were no higher level NEPA reviews started or completed in 2019.

6.2 UPTON ECOLOGICAL AND RESEARCH RESERVE

The Upton Ecological and Research Reserve (Upton Reserve) consists of 530 acres located on the eastern boundary of the BNL site. The reserve has been designated as an area for the protection of sensitive habitats and a place where researchers can study local ecosystems. The Upton Reserve is home to a wide variety

of flora and fauna. It contains wetlands and is largely within the core preservation area of the Long Island Central Pine Barrens. Based on information from a 1994-1995 biological survey of the Laboratory, experts believe the reserve is home to more than 200 plant species and at least 162 species of mammals, birds, fish, reptiles, and amphibians (LMS 1995).

The Upton Reserve is managed by BNL which also coordinates research projects that occur within the reserve and the larger Pine Barrens. After successfully establishing a Memorandum of Understanding (MOU) with the State University of New York's School of Environmental Science and Forestry (SUNY-ESF), efforts to revisit the 2005-2006 forest health monitoring program resulted in the first year of monitoring during summer 2019 (see education programs below). The MOU with SUNY-ESF will allow for greater levels of research within the Central Pine Barrens and the Upton Reserve.

6.3 MONITORING FLORA AND FAUNA

The Laboratory routinely conducts surveillance monitoring of flora and fauna to determine the effects of past and present activities on site. Because soil contaminated with a radioactive isotope of cesium (Cs-137) was used in some BNL landscaping projects in the past, traces of Cs-137 attributable to past practices and world-wide fallout from above ground nuclear bomb testing can be found in deer and other animals and plants. At the cellular level, Cs-137 takes the place of potassium (K), an essential nutrient. Most tables in this chapter listing Cs-137 also list analytical results for potassium-40 (K-40), a naturally occurring radioisotope of potassium that is commonly found in flora and fauna. Studies indicate that Cs-137 out-competes potassium when potassium salts are limited in the environment, which is typical on Long Island. Including K-40 in tables allows for a comparison with Cs-137 levels and is used, in part, to determine the accuracy of analytical results. The results of the annual sampling conducted under the flora and fauna monitoring program follow.

6.3.1 Deer Sampling

White-tailed deer in New York State are typically large, with males weighing, on average, approximately 150 pounds; females typically weigh approximately 100 pounds. However, white-tailed deer on Long Island tend to be much smaller, weighing an average of 80 pounds. The meat available for consumption from local deer ranges from 20 to 40 pounds per animal. Samples of meat and liver are taken from each deer, when possible, and are analyzed for Cs-137. Data are reported on a wet-weight basis, as that is the form most likely used for consumption.

Since 1996, BNL has routinely collected deer samples from on- and off-site areas. While most off-site samples are the result of car/deer accidents near the Laboratory, samples from deer taken by hunters beyond BNL boundaries or samples from car/deer accidents greater than one mile from BNL have also been made available for analysis. In 1998, a statistical analysis suggested that 40 deer from off site and 25 deer from on site are needed to achieve a statistically sound data set. The number obtained each year has not met this preferred level because sample availability depends on accidents between vehicles and deer and people reporting dead deer. In 2019, a total of 11 deer were taken both on and off the BNL site. Figure 6-1 shows the location of all deer samples taken within a five-mile radius of the Laboratory between 2015 and 2019. Most of the off-site samples are concentrated along the William Floyd Parkway on the west boundary of BNL, whereas historically most on-site samples are collected near the Laboratory's main entrance gate and the developed portions of the site. This distribution is due to the fact that people on their way to work see and report dead deer. Also, vehicle collisions with deer on site occur primarily early or late in the day, when deer are more active and traffic to and from the Lab's Main Gate is greatest.

Based on more than two decades of sampling, deer taken from more than one mile from BNL are used for comparison with populations on and near the Laboratory that could acquire Cs-137 from a BNL source. In 2019,

three deer were obtained on site, five from off-site locations within one mile of the Laboratory, and three from greater than one mile from the BNL boundary, all from car/deer accidents. The analytical results of deer sampling are shown in Table 6-2. Additionally, BNL conducted a population reduction of the local deer herd and conducted batch sampling of the deer in order to determine the safe release of meat for consumption. Table 6-3 provides results of batch sampling.

6.3.1.1 Cesium-137 in White-Tailed Deer

Based on historic and current data, white-tailed deer sampled at or near the Laboratory contain higher concentrations of Cs-137 than deer from greater than one mile off site. This is most likely because the deer graze on vegetation growing in soil where elevated Cs-137 levels are known to exist. Cesium-137 in soil can be transferred to above-ground plant matter via root uptake, where it then becomes available to browsing and grazing animals or is consumed directly with soil while the animal is grazing. Remediation of contaminated soil areas on site occurred under the Laboratory's Comprehensive Environmental Response, Compensation & Liability Act (CERCLA) program, with all major areas of contaminated soil being remediated by September 2005.

In 2019, Cs-137 concentrations in deer meat samples were obtained from three deer on site with a range of values from 0.07 pCi/g, wet weight to 0.28 pCi/g, wet weight, and an arithmetic average of 0.20 pCi/g, wet weight, as shown in Table 6-2. The wet weight concentration is before a sample is dried for analysis and is the form most likely to be consumed. Dry weight concentrations are typically higher than wet weight values. The highest on-site sample in 2019 (0.28 pCi/g, wet weight) was about eight times lower than the highest on-site sample reported in 2018 (2.19 pCi/g, wet weight) and 42 times lower than the highest level ever reported in 1996 (11.74 pCi/g, wet weight).

Cs-137 concentrations in off-site deer meat samples are typically separated into two groups: samples taken within one mile of BNL (five samples) and samples taken farther away (three

samples), as shown in Table 6-2. Concentrations in meat samples taken within one mile ranged from 0.05 pCi/g, wet weight to 0.98 pCi/g, wet weight, with an arithmetic average of 0.42 pCi/g, wet weight. Because deer on site may routinely travel up to one mile off site, the arithmetic average for deer taken on site and within one mile of the Laboratory is also calculated; for 2019, this was 0.34 pCi/g, wet weight. The three deer sampled from greater than one mile from BNL had Cs-137 concentrations ranging between 0.01 pCi/g, wet weight, to 0.08 pCi/g, wet weight, with an arithmetic average of 0.05 pCi/g, wet weight. Figure 6-2 compares the average values of Cs-137 concentrations in meat samples collected in 2019 from four different location groupings. The off-site location group within one mile of the site was higher than the onsite average. The last time this occurred was in 2013. While no definitive explanation can be given to the difference from past results, it could simply be an artifact of low sample numbers and randomness in sample acquisition.

Although not shown on Figure 6-2, Cs-137 concentrations in nine of the 11 meat samples taken both on and off site were below 0.3 pCi/g, wet weight. Figure 6-3 presents the ten-year trend of on-site and near off-site Cs-137 averages in deer meat. The 2019 average is approximately 75 percent lower than the 2011 average and is 25 percent higher than the 2015 value of 0.28 pCi/g wet weight, which was the lowest average seen since trending began in 2000. The higher averages shown are reflective of a significant number of samples taken in the fall when Cs-137 levels are typically higher. However, these sample results continue to indicate the effectiveness of cleanup actions across the Laboratory, with the trend being downward from 2009 to 2019 and the ten-year average being 0.71 pCi/g.

The effectiveness of the BNL soil cleanup program and the reduction of Cs-137 in deer meat was evaluated by Rispoli, et al. (2014). The average Cs-137 content was shown to be statistically lower than before cleanup. Samples taken at distances greater than one mile from the BNL site were shown to remain consistent before and after cleanup, while the on-site and near off-site values were shown to

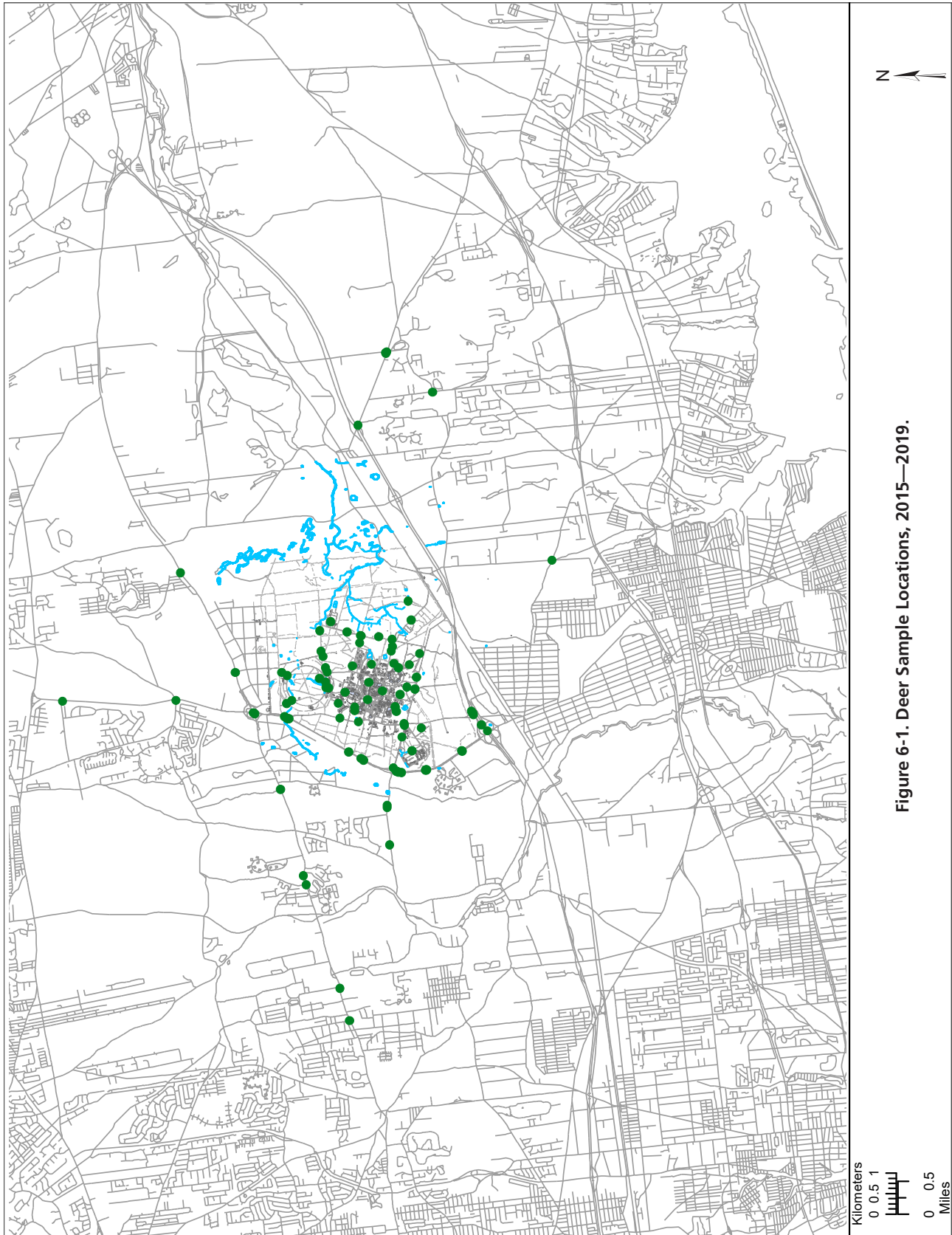


Figure 6-1. Deer Sample Locations, 2015—2019.

CHAPTER 6: NATURAL AND CULTURAL RESOURCES

Table 6-2. Radiological Analyses of Deer Tissue (2019).

Sample Location	Collection Date	Tissue	K-40 pCi/g (Wet Weight)	Cs-137 pCi/g (Wet Weight)
BNL				
Bldg. 750, West Side	2/1/219	Flesh	3.22±0.11	0.28±0.01
		Liver	3.08±0.10	0.09±0.01
Outer RHIC Ring Road, North Gate	3/16/19	Flesh	3.24±0.15	0.24±0.01
		Liver	2.40±0.23	0.07±0.01
Inner RHIC Ring Road, 1005S	5/21/19	Flesh	3.25±0.14	0.07±0.01
		Liver	2.37±0.12	0.02±0.01
< 1 Mile from BNL				
William Floyd Parkway (WFPKWY) and Main Gate	1/13/19	Flesh	3.37±0.12	0.23±0.01
		Liver	1.97±0.18	0.04±0.01
WFPKWY and North Gate	10/26/19	Flesh	3.05±0.20	0.98±0.03
		Liver	2.53±0.21	0.31±0.02
WFPKWY 1/2 mile North of Main Gate	11/11/19	Flesh	3.74±0.23	0.05±0.01
		Liver	2.64±0.18	0.02±0.00
Long Island Expressway Service Road and South Gate	11/12/19	Flesh	3.17±0.20	0.59±0.02
		Liver	2.55±0.18	0.27±0.02
WFPKWY 3/4 mile North of Main Gate	11/13/19	Flesh	2.60±0.19	0.25±0.01
> 1 Mile from BNL				
Rte. 111 Manorville and Halsey Manor Road	5/25/19	Flesh	3.13±0.24	0.07±0.01
		Liver	2.34±0.17	0.04±0.01
Rte. 25 and Church Ln., Middle Island	9/3/19	Flesh	3.62±0.21	0.08±0.01
		Liver	2.32±0.32	0.05±0.02
Rte. 25 Artist Lake, Middle Island, NY*	11/22/19	Flesh	3.55±0.21	0.01±0.01
		Liver	2.86±0.22	ND
Averages by Tissue				
Flesh Averages				
All Samples (11)			3.27±0.62	0.26±0.05
BNL Average (3)			3.24±0.24	0.20±0.02
< 1 Mile Average (5)			3.19±0.43	0.42±0.04
BNL + < 1 Mile Average (8)			3.21±0.49	0.34±0.04
> 1 Mile Average (3)			3.43±0.38	0.05±0.02
Liver Averages				
All Samples (10)			2.51±0.63	0.09±0.04
BNL Average (3)			2.62±0.28	0.06±0.01
< 1 Mile Average (4)			2.42±0.37	0.16±0.03
BNL + < 1 Mile Average (7)			2.51±0.47	0.12±0.03
> 1 Mile Average (3)			2.51±0.42	0.03±0.02

Notes:

All values are shown with a 95% confidence interval.

K-40 Occurs naturally in the environment and is presented as a comparison to Cs-137.

All averages are the arithmetic average with confidence limits using a 2 sigma (95%) propagated error.

* = Denotes an estimated value for Cs-137 based on laboratory qualifiers.

ND = not detected

Table 6-3. Radiological Analysis of Batch Samples From Deer Cull Released for Donation (2019)

Batch Number	Collection Date	K-40 pCi/g±95% C.I.	Cs-137 pCi/g±95% C.I.
Day 1 Batch Sampling			
Batch #1	4/6/19	2.80±0.18	0.04±0.01
Batch #2		3.18±0.32	0.07±0.02
Batch #3		3.15±0.20	0.05±0.01
Batch #4		2.96±0.29	0.20±0.02
Batch #5		2.91±0.28	0.05±0.02
Day 2 Batch Sampling			
Batch #6	4/7/19	2.93±0.16	0.08±0.01
Batch #7		2.83±0.22	0.07±0.01
Batch #8		3.15±0.27	0.05±0.01
Batch #9		3.33±0.30	0.02±0.01
Batch #10		3.01±0.21	0.07±0.01
Batch #11		3.01±0.30	0.07±0.02
Batch #12		3.11±0.27	0.03±0.01
Batch #13		2.71±0.29	0.03±0.01
Batch #14		2.70±0.45	0.11±0.03
Batch #15		3.02±0.27	0.03±0.01
Batch #16		2.91±0.31	0.03±0.02
Batch #17		3.14±0.25	0.05±0.02
Day 3 Batch Sampling			
Batch #18	4/8/19	2.74±0.33	0.05±0.02
Batch #19		3.23±0.28	0.13±0.02
Batch #20		3.05±0.28	0.03±0.01
Batch #21		3.18±0.32	0.06±0.02
Batch #22		2.88±0.32	0.06±0.02
Batch #23		2.96±0.27	0.08±0.01
Batch #24		2.78±0.20	0.04±0.01
Batch #25		2.98±0.17	0.05±0.01
Batch #26		3.16±0.26	0.07±0.01
Day 4 Batch Sampling			
Batch #27	4/9/19	2.93±0.20	0.04±0.01
Batch #28		2.90±0.23	0.05±0.01
Batch #29		2.83±0.24	0.02±0.01
Batch #30		2.80±0.26	0.02±0.01
Batch #31		3.13±0.31	0.06±0.02
Batch #32		3.10±0.27	0.03±0.02
Batch #33		3.14±0.31	0.02±0.01
Day 5 Batch Sampling			
Batch #34	4/10/19	3.04±0.32	0.03±0.01
Batch #35		2.98±0.30	0.10±0.02
Batch #36		3.20±0.28	0.06±0.01
Batch #37		1.99±0.34	0.05±0.03
Batch #38		3.28±0.28	0.19±0.02
Batch #39		2.80±0.26	0.18±0.02
Batch #40		3.35±0.28	0.08±0.01
Batch #41		2.99±0.32	0.07±0.02
Day 6 Batch Sampling			
Batch #42	4/11/19	3.16±0.32	0.09±0.02
Batch #43		3.11±0.28	0.07±0.02
Batch #44		2.95±0.36	0.13±0.02
Batch #45		3.11±0.28	0.06±0.01
Batch #46		3.21±0.24	0.08±0.01
Day 7 Batch Sampling			
Batch #47	4/12/19	3.07±0.26	0.06±0.02
Batch #48		3.28±0.30	0.03±0.01
Batch #49		3.05±0.27	0.04±0.01
Batch #50		2.89±0.41	0.07±0.03
Average Concentration		3.00±2.00	0.06±0.12

Notes:

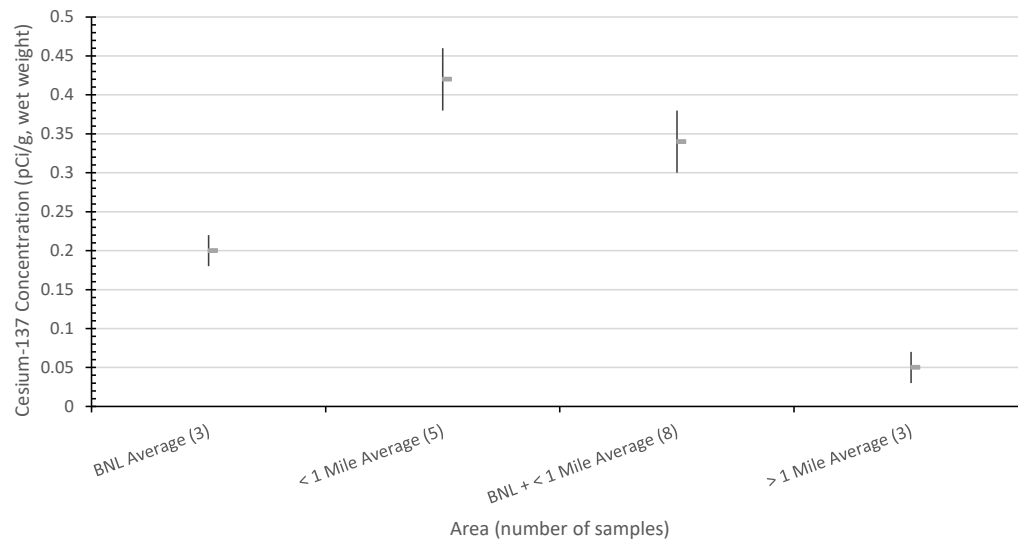
All values are shown with a 95% confidence interval.

K-40 occurs naturally in the environment and is presented as a comparison to Cs-137.

All averages are the arithmetic average with confidence limits using a 2 sigma (95%) propagated error.

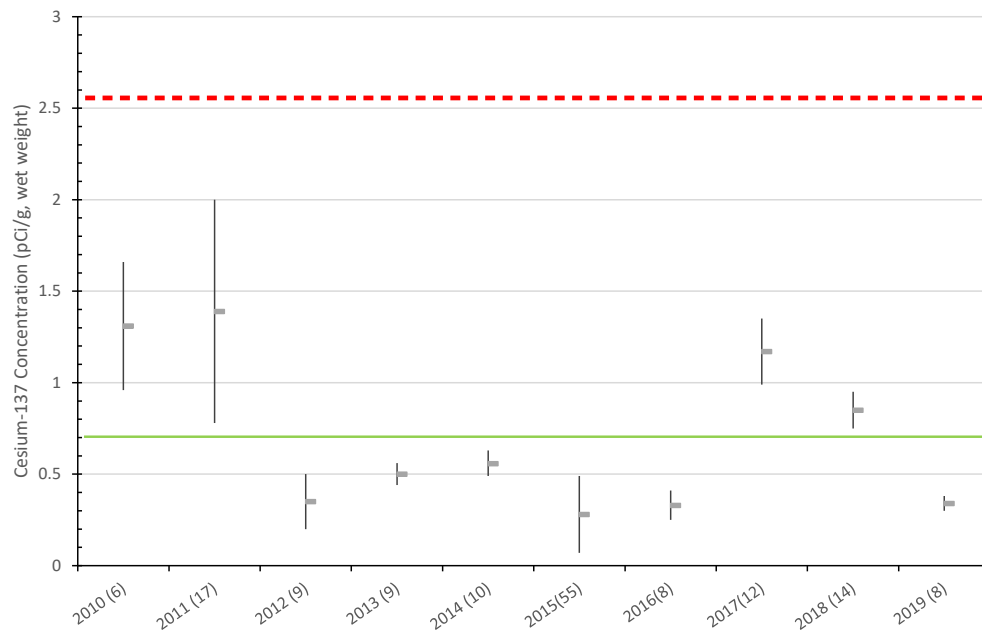
decline. In 2017, while preparing for monitoring associated with the reduction of the deer population, the ten-year average for on-site deer samples was calculated to be 1.0 pCi/g, wet weight, and this value was used to establish an administrative release criterion for deer meat made available for donation.

When possible, liver samples are taken concurrently with meat samples. The liver generally accumulates Cs-137 at a lower rate than muscle tissue. The typically lower values in liver allow the results to be used as a validity check for meat values (i.e., if liver values are higher than meat values, results can be considered questionable and should be confirmed). In liver samples collected on site in 2019, Cs-137 concentrations ranged from 0.02 pCi/g, wet weight to 0.09 pCi/g, wet weight, with an average of 0.06 pCi/g, wet weight. The near off-site Cs-137 concentration in liver ranged from 0.02 pCi/g, wet weight to 0.31 pCi/g, wet weight, with an arithmetic average for off-site liver samples within one mile of 0.16 pCi/g, wet weight. Liver samples from deer taken greater than one mile from BNL ranged from non-detect to 0.05 pCi/g, wet weight with the arithmetic average being 0.03 pCi/g, wet



Notes: Ten year average of onsite and near offsite deer flesh samples is 0.71 pCi/g, wet weight.

Figure 6-2. Comparison of Cs-137 values in deer flesh for onsite, offsite within 1 mile, onsite and near offsite, and offsite greater than 1 mile from the Laboratory.



Notes: Ten year average (solid line) 0.71 pCi/g wet weight.

Figure 6-3. Ten year trend in Cs-137 in deer flesh for samples taken at BNL and within 1 mile of the Laboratory. Average before clean-up (dashed line) 2.57 pCi/g wet weight.

weight. The potential radiological dose resulting from deer meat consumption is discussed in Chapter 8.

The New York State Department of Health (NYSDOH) has formally considered the potential public health risks associated with elevated Cs-137 levels in on-site deer and determined that neither hunting restrictions nor formal health advisories are warranted (NYSDOH 1999).

As mentioned above, BNL has established an administrative release criterion of 1.0 pCi/g, wet weight for meat from deer removed from the Laboratory and donated for consumption. A total of 250 deer were taken during population reductions in 2019. Meat samples were obtained from all deer and composited samples were sent for analysis. Composite samples consisted of comingled samples taken from five deer per sample, resulting in a total of 50 samples. Table 6-3 provides results of all meat samples taken during the population reduction. Results ranged from 0.02 pCi/g, wet weight to 0.20 pCi/g, wet weight with the arithmetic average being 0.06 pCi/g, wet weight. Since all samples were well below the 1.0 pCi/g, wet weight administrative limit, all 5,467 pounds of meat was donated to local food pantries.

With respect to the health of on-site deer based on their exposure to radionuclides, the International Atomic Energy Agency (IAEA) has concluded that chronic dose rates of 100 millirad per day to even the most radiosensitive species in terrestrial ecosystems are unlikely to cause detrimental effects in animal populations (IAEA 1992). A deer containing a uniform distribution of Cs-137 within muscle tissue at the highest levels observed to date (11.74 pCi/g, wet weight, reported in 1996) would carry a total amount of approximately 0.2 μ Ci. That animal would receive an absorbed dose of approximately 3 millirad per day, which is only three percent of the IAEA threshold. The deer observed and sampled on site appear to have no health effects from the level of Cs-137 found in their tissues.

6.3.2 Other Animals Sampled

When other animals, such as wild turkey or Canada geese, are found dead along the roads

of BNL and the immediate vicinity due to road mortality, they are tested for Cs-137. No other animals were sampled in 2019.

6.3.3 Fish Sampling

BNL maintains an ongoing program for collecting and analyzing fish from the Peconic River and surrounding freshwater bodies. Monitoring of the river has been conducted under the environmental surveillance program and the CERCLA post-cleanup program. Surveillance monitoring had occurred during even-numbered years and post-cleanup monitoring occurred in odd-numbered years. However, with the discontinuance of discharges from the STP to the Peconic River in September 2014 and current lack of flow off site, the objectives for the fish monitoring program have changed to reflect the current intermittent presence of water in the on-site portions of the river. Fish are now only sampled under the surveillance program when there is enough water to support a sufficient population of fish that can be sampled without harm to their population and that are of sufficient size for analysis. Based upon the 2016 CERCLA Five-Year Review of the effectiveness of the environmental cleanup and the final supplemental cleanup of a small area within the river during 2017, the Laboratory has discontinued fish monitoring under the CERCLA program. However, when conditions allow, fish sampling will be conducted under the surveillance program for radionuclide content supporting dose to biota and dose to the maximally exposed off site individual. Due to lack of water and fish within the on-site portions of the Peconic River, no fish were sampled in 2019.

6.3.3.1 Fish Population Assessment

The relative sizes of fish caught during annual sampling events are tracked and modifications to future sampling events are made, as necessary, to ensure long-term health of the on-site fish populations. Successful sampling of sufficiently large fish for analysis from 2008 through 2015, even with low water levels in the on-site portion of the Peconic River, indicated that fish populations could maintain themselves. However, the combination of discontinuing STP

discharges to the Peconic River and continued drought conditions resulted in the on-site portions of the Peconic River being totally dry through July 2018 when groundwater levels began to rise. By the end of 2018, water levels were sufficiently high, resulting in off-site flow at station HQ on the east boundary of the Laboratory. In 2019, water levels began to recede, resulting in water being retained only in deeper open water areas.

For fish populations to survive and flourish, water levels must be substantial enough to allow migration of fish and maintain their presence for an extended period to replenish populations. As mentioned above, new criteria for the collection of fish samples have been developed. These criteria will guide the environmental monitoring approach for fish in the future. In order to determine if enough fish are present to support sampling, population assessments are conducted. In 2019, a population assessment was conducted at the end of May and resulted in the capture of 16 chain pickerel and one pumpkinseed from the onsite portions. The largest fish had a length of 85 mm or a little over three inches.

6.3.4 Vegetation Sampling

6.3.4.1 Grassy Plants and Soil

During 2019, grassy vegetation samples were collected from ten locations around the Laboratory (Figure 6-4) and a control location at the NYSDEC hunter check station in Ridge, New York. All samples were analyzed for Cs-137 (see Table 6-4). Cs-137 content in vegetation ranged from non-detectable to 0.07 pCi/g, wet weight at a single location. Soil samples had Cs-137 levels ranging from non-detect to 0.84 pCi/g, dry weight. All values were consistent with historic monitoring and knowledge of cleanup areas. Monitoring results for grassy vegetation and soils were utilized for the annual dose to biota analysis reported in Chapter 8.

6.4 PRECIPITATION MONITORING

6.4.1 Mercury Monitoring of Precipitation

During 2019, precipitation samples were collected quarterly at air monitoring Stations P4 and S5 (Figure 4-2 for station locations). The samples were analyzed for total mercury (Table 6-5) using low-level mercury analysis.

Until 2015, BNL had routinely analyzed precipitation for radiological content. However, with no emissions of significantly long-lived radionuclides from Laboratory operations, the monitoring program objectives were modified to remove testing of precipitation for radiological content beginning in 2016.

Mercury concentrations in precipitation have been measured at BNL since 2007. Analysis of mercury in precipitation is conducted to document mercury deposition that is attributable to off-site sources. This information has been used as a comparison to Peconic River monitoring data and aids in understanding the distribution of mercury within the Peconic River watershed.

Mercury was detected in all the precipitation samples collected at both sampling stations. Mercury ranged from 3.55 ng/L at station P4 in October to 13.1 ng/L at station S5 in July. The 13.1 ng/L concentration is 3.4 times lower than the highest value of 45.1 ng/L, recorded in 2017.

6.5 WILDLIFE PROGRAMS

BNL sponsors a variety of educational and outreach activities involving natural resources. These programs are designed to help participants understand the ecosystem, foster an interest in science, and provide a meaningful experience for interns in preparation for further studies or a career. Wildlife programs are conducted at the Laboratory in collaboration with the DOE, local agencies, colleges, and high schools. Ecological research is also conducted on site to routinely update the natural resource inventory records, gain a better understanding of the ecosystem, and guide management planning.

In 2019, BNL hosted 16 student interns, a graduate student, and two faculty members within the Natural Resources program throughout the year. One intern conducted statistical analysis of bird survey data during the spring, and a second worked on statistics of the 4-Poster™ tick management program in the fall. During summer 2019, 14 interns participated in programs looking at forest health of the Long Island Pine Barrens, pollinator use of

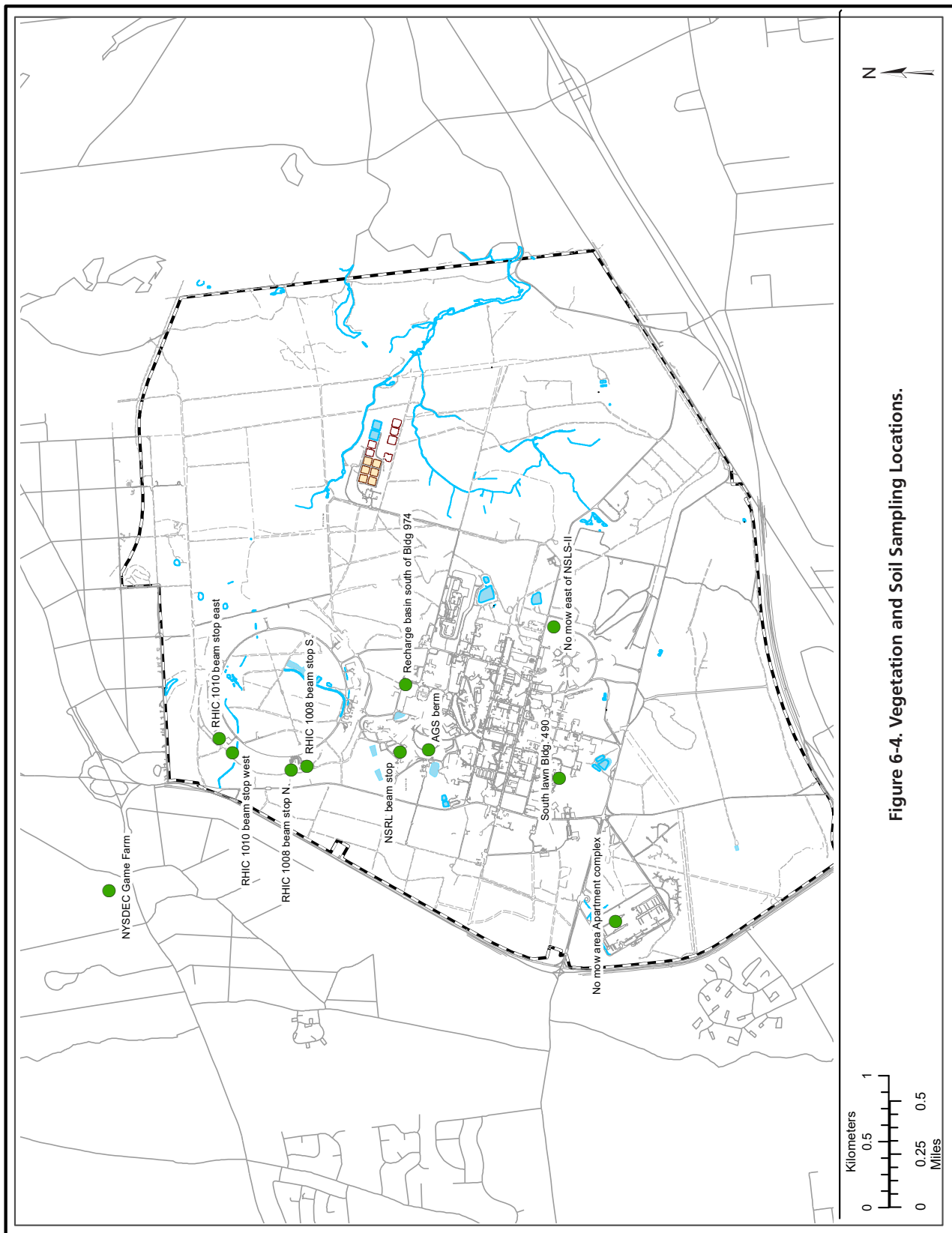


Figure 6-4. Vegetation and Soil Sampling Locations.

Table 6-4. Radiological analysis of grassy vegetation and associated soils.

Location/Matrix	K-40 pCi/g±95% C.I.	Cs-137 pCi/g±95% C.I.
RHIC 1010 Beam Stop West		
Vegetation	2.07±0.61	ND
Soil*	5.90±1.03	0.17±0.07
RHIC 1010 Beam Stop East		
Vegetation	1.67±0.87	ND
Soil*	5.04±0.97	0.12±0.05
RHIC 1008 Beam Stop South		
Vegetation	2.05±0.91	ND
Soil*	4.38±0.81	ND
RHIC 1008 Beam Stop North		
Vegetation	5.91±1.38	ND
Soil*	9.88±1.40	0.10±0.05
NSRL Beam Stop		
Vegetation	5.31±1.07	0.07±0.07
Soil*	6.76±1.16	0.14±0.07
AGS Berm		
Vegetation	5.08±1.02	ND
Soil*	3.58±0.83	0.10±0.07
Recharge Basin S. of Bldg. 974		
Vegetation	5.59±1.04	ND
Soil	2.14±0.64	ND
South Lawn Bldg. 490		
Vegetation	10.2±1.88	ND
Soil	4.83±0.97	0.84±0.12
No Mow East of NSLS-II		
Vegetation	5.32±1.37	ND
Soil*	7.66±1.87	0.18±0.10
No Mow Area Apartment Complex		
Vegetation	3.51±0.99	ND
Soil	5.83±1.25	0.34±0.08
NYSDEC Game Farm (Control)		
Vegetation	1.84±0.84	ND
Soil*	4.72±0.90	0.14±0.08

Notes:

All values are shown with a 95% confidence interval.
 Radiological values for soils are on a 'dry weight' basis.
 K-40 occurs naturally in the environment and is presented as a comparison to Cs-137.

Cs-137 = cesium-137

K-40 = potassium-40

ND = not detected

* = estimated value for Cs-137 based on laboratory qualifiers.

Table 6-5 Precipitation Monitoring (Mercury).

Location/Period	Mercury ng/L
P4	
1/7/19	4.52
4/16/19	5.13
7/12/19	12.2
10/9/19	3.55
S5	
1/7/19	4.04
4/16/19	5.26
7/12/19	13.1
10/9/19	5.01

Notes:

Method detection limit for mercury is 0.2 ng/L.

P4 = precipitation sampler near BNL Apartment area.

S5 = precipitation sampler near BNL Sewage Treatment Plant.

the Long Island Solar Farm, modified feeding effects on effectiveness of the 4-Poster™ tick management devices, and mapping valves and other infrastructure associated with the Laboratory's potable water system. More details are provided below.

- A spring intern worked specifically on developing statistical analysis of bird survey data looking at changes in avian communities using occupancy modelling which provided the intern with experience in coding and statistical analysis.
- A team led by Dr. Murty S. Kambhampati from Southern University at New Orleans worked on two projects, both continuation of projects from previous summers. The first continued work on assessing pollinator use of flowering plants in the LISF. The other continued assessing effectiveness of the 4-Poster™ tick management devices under altered feeding regimes. Both projects are expected to result in published papers once additional data are acquired in 2020. These efforts provided experience to four interns in plant and pollinator identification, data management, and statistics.
- A team led by Joanna Lumsden-Pinto, a

doctoral candidate, and Dr. Martin Doviak, both from SUNY-ESF conducted the first summer of monitoring of forest health across the Central Pine Barrens. This effort is re-visiting the forest health monitoring conducted from 2005 to 2006 and will compare results to determine the trajectory of forest health. This effort provided field experience for eight interns in plant identification, statistics, and data management.

- To better understand the potable water distribution system and other pieces of the utilities infrastructure on site, an intern worked with both Environmental Protection and the Facilities & Operations Divisions to identify and map all shut-off valves to the water system and all manholes associated with underground utilities resulting in updated maps. The effort provided experience with utilities engineering and GIS software.
- A fall intern continued work associated with the 4-Poster™ tick management devices. The study calls for the analysis of photos taken at each device to record deer activity over the seven months that they are deployed. This required sorting over 800,000 photos for presence of deer and conducting statistical analysis on the variation of use between treatments. The effort provided experience working with large data sets, statistical analysis, and presentation skills.

As mentioned above, the MOU with SUNY-ESF initiated the implementation of the second round of forest health monitoring of the Central Pine Barrens of Long Island. It has also resulted in an MOU being established between SUNY-ESF and the Central Pine Barrens Joint Planning and Policy Commission, allowing for greater collaboration between the three entities. Besides the forest health monitoring, an ESF class on Environmental Planning carried out research on some of the research needs associated with management of the Pine Barrens, and a teacher workshop on phyto-remediation was held at BNL.

In 2019, BNL continued to participate in several events in support of ecological education programs including: hosting the Long Island



2019 Forest Health Monitoring Team

Natural History Conference; participation in the Tenth Annual Pine Barrens Discovery Day held at the Wertheim National Wildlife Refuge; and assisting the Central Pine Barrens Commission with “A Day in the Life of the Rivers,” which allowed students from multiple school districts to acquire environmental and biological data about 11 different rivers on Long Island. On separate days, over 70 partner organizations and agencies, over 50 schools, and approximately 2,100 students collected scientific information for analysis to be used to portray the status of the rivers and estuary systems of Long Island. These events provided students hands-on experience with field techniques in catching fish, invertebrate sampling, biodiversity inventory, and water chemistry.

In 2019, BNL entered its 15th year of the Open Space Stewardship Program (OSSP) and worked with 30 schools and nearly 2,500 students. The OSSP enables students to engage in activities to solve problems within their local community through scientific discovery, conservation, and stewardship. The effort integrates outdoor research with school curricula in language arts, civics, community service, and media arts. Participation in OSSP creates an opportunity for many students to enhance their educational experiences as well as to promote the realization that a career in science and technology is accessible with the proper academic coursework and interaction with teachers and field experts who have a passion

for discovery and mentorship.

The Laboratory also hosts the annual New York Wildfire & Incident Management Academy, offered by NYSDEC and the Central Pine Barrens Commission. Using the Incident Command System of wildfire management, this academy trains firefighters in the methods of wildland fire suppression, prescribed fire, and fire analysis. BNL has developed and is implementing a Wildland Fire Management Plan that includes the use of prescribed fire for fuel and forest management. Due to the need for a MOU with the NYSDEC, no prescribed fires were conducted in 2019.

6.6 CULTURAL RESOURCE ACTIVITIES

The BNL Cultural Resource Management (CRM) Program ensures that the Laboratory fully complies with numerous cultural resource regulations. The Cultural Resource Management Plan for Brookhaven National Laboratory (BNL 2013) guides the management for all the Laboratory's historical resources. BNL's cultural resources include buildings and structures, World War I (WWI) earthwork features, the Camp Upton Historical Collection, scientific equipment, photo/audio/video archives, and institutional records. As various cultural resources are identified, plans for their long-term stewardship are developed and implemented. Achieving these goals will ensure that the contributions BNL and the site have made to local and national history and culture are documented and available for interpretation.

In 2019, the Laboratory contracted with Hartgen Archeological Associates to conduct historical architectural reviews of buildings that had recently reached 50 years of age. Several reports were required under the contract and the first report was provided in late 2019, resulting in the increase in number of National Register Eligible buildings. As of the end of 2019, the Laboratory had ten structures or sites that have been determined to be eligible for listing on the National Register of Historic Places: the Brookhaven Graphite Research Reactor (BGRR) complex, the HFBR complex, the 1960s-era efficiency apartments, Berkner Hall, the Chemistry Building, Physics



Berkner Hall



Chemistry Building

Building, Building 515, Building 535, the World War II (WWII) barracks part of Building 120, and the WWI training trenches associated with Camp Upton. The trenches are examples of the few surviving WWI earthworks in the United States. Berkner Hall is eligible due to its construction and design by architect Max O. Urbhan. The Chemistry Building is eligible due to its architecture, association with key scientific discoveries, and design by Marcel Breuer. Buildings 510 (Physics), 515 (Information Technology), and 535 (Instrumentation) were all designed by the Max O. Urbhan architectural group and are associated with significant scientific events. Building 120 is National Register-eligible due to its integrity representing WWII barracks buildings. An interesting outcome of the review was the determination that Building 30 (Brookhaven Center) is not eligible for listing. It was long thought that this building would be eligible for its association with the Civilian Conservation Corps and WWII (Officers Club), and BNL would make it eligible for listing. However, the significant modifications that have taken place at each stage of historic transition have resulted in loss of integrity.

BNL continued to work on issues associated with the 1960s-era apartments, which will be negatively impacted from the development of Discovery Park, and the HFBR Stack which is scheduled for demolition in 2020 and was added to the MOU for the BGRR. Both require compilation of materials documenting aspects of their history for submission to the New York State Historic Preservation Officer. These and other efforts will continue in 2020 as additional reports are received from architectural reviews.

REFERENCES AND BIBLIOGRAPHY

- BNL. 2013. Cultural Resource Management Plan for Brookhaven National Laboratory. BNL-100708-2013. Brookhaven National Laboratory, Upton, NY. May 2013.
- BNL. 2016a. Natural Resource Management Plan for Brookhaven National Laboratory. BNL-112669-2016. Brookhaven National Laboratory, Upton, NY.
- BNL, 2016b. Five-Year Review Report for Brookhaven National Laboratory Superfund Site, April 2016.
- Dwyer, Norval. 1966. Brookhaven National Laboratory. Long Island Forum (reprint), West Islip, NY.
- IAEA. 1992. Effects of Ionizing Radiation on Plants and Animals at Levels Implied by Current Radiation Protection Standards. Technical Report Series No. 332. International Atomic Energy Agency, Vienna.
- LMS. 1995. Phase II Sitewide Biological Inventory Report, Final. Lawler, Matusky & Skelly Engineers. Pearl River, NY.
- NYSDOH. 1999. Deer Meat Contaminated with Cesium-137 at Brookhaven National Laboratory. Bureau of Environmental Radiation Protection, New York State Department of Health, Albany, NY.
- Rispoli, Fred J., Green Timothy, Fasano, Thomas A., Shah, Vishal, 2014. The effect of environmental remediation on the cesium-137 levels in white-tailed deer. Environmental Science and Pollution Research Oct. 2014, 21(19): 11598-11602.