



2014 SITE ENVIRONMENTAL REPORT SUMMARY

PREFACE

In accordance with DOE Order 231.1B, Environment, Safety and Health Reporting of the U.S. Department of Energy (DOE), Brookhaven National Laboratory (BNL) prepares an annual Site Environmental Report (SER). The report is written to inform the public, regulators, employees, and other stakeholders of the Laboratory's environmental performance during the calendar year in review. Volume I of the SER summarizes environmental data; environmental management performance; compliance with applicable DOE, federal, state, and local regulations; and performance in restoration and surveillance monitoring programs. BNL has prepared annual SERs since 1971 and has documented nearly all of its environmental history since the Laboratory's inception in 1947.

Volume II of the SER, the Groundwater Status Report, is also prepared annually to report on the status and performance of groundwater treatment systems at the Laboratory. It includes detailed technical summaries of groundwater data and its interpretation, and is intended for internal BNL users, regulators, and other technically oriented stakeholders. In addition, a summary of Volume I is prepared each year to provide a general overview of this report.

Both SER Volumes I and II, as well as this summary, are available in print and as downloadable files on the BNL web page at <http://www.bnl.gov/esh/ser/>. An electronic version on compact disc containing the full report is distributed with each printed report.

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Long Island Sound



Brookhaven National Laboratory

*Satellite photo showing location of BNL.
The small circle is the Relativistic Heavy
Ion Collider, known as RHIC.*

ABOUT BROOKHAVEN NATIONAL LABORATORY

Established in 1947, Brookhaven National Laboratory is a multi-program research institution managed for the U.S. Department of Energy by Brookhaven Science Associates (BSA), a partnership formed by Stony Brook University and Battelle Memorial Institute. BSA has been managing and operating the Laboratory under a performance-based contract with DOE since 1998. From 1947 to 1998, BNL was operated by Associated Universities, Incorporated. Prior to 1947, the site operated as Camp Upton, a U.S. Army training camp, which was active from 1917 to 1920 during World War I and from 1940 to 1946 during World War II.

One of 10 national Laboratories under DOE's Office of Science, BNL has a history of outstanding scientific achievements

for over 60 years. BNL's broad mission is to produce excellent science and advanced technology in a safe and environmentally sound manner with the cooperation, support, and involvement of its scientific and local communities. The Laboratory operates large-scale, world-class facilities for studies in physics, chemistry, biology, medicine, applied science, and advanced technologies.

BNL's 5,265-acre site is located in Brookhaven Township in Suffolk County, approximately 60 miles east of New York City. The Laboratory is one of the five largest high-technology employers on Long Island, with approximately 3,000 scientists, engineers, and support staff, as well as more than 4,000 visiting researchers from around the world each year. With a budget of over \$696 million, the Laboratory has a significant economic impact on New York State.

RESEARCH AT BNL

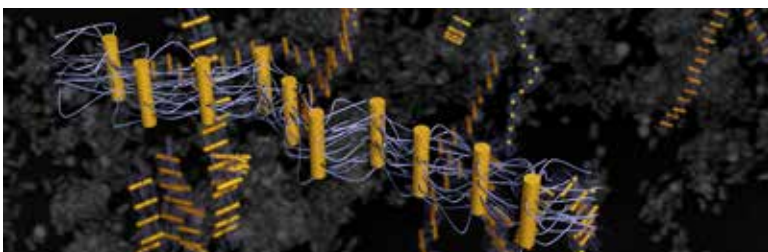
The Laboratory is one of the world's leading research institutions. BNL's research themes stem directly from the Laboratory's core capabilities which include: particle physics; nuclear physics; accelerator science and technology; condense matter physics and materials science; chemical and molecular science; biological systems science; applied nuclear science and technology; applied materials science and engineering; chemical engineering; systems engineering and integration; and large-scale user facilities and advanced instrumentation. More information on research at BNL can be found at <https://www.bnl.gov/science/index.php>.



Energy Security:

Blazing innovative trails toward a sustainable future powered by solar, wind, hydrogen, and other renewable sources.

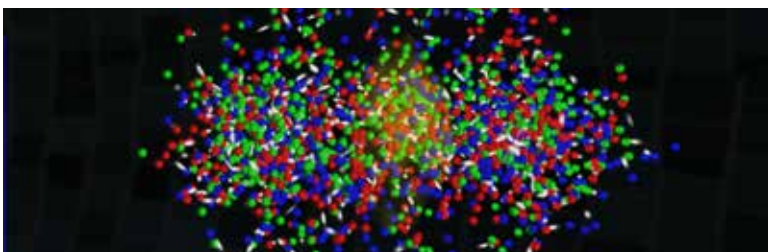
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Photon Sciences:

Focusing ultra-bright light to reveal the structures of materials critically important to biology, technology, and more.

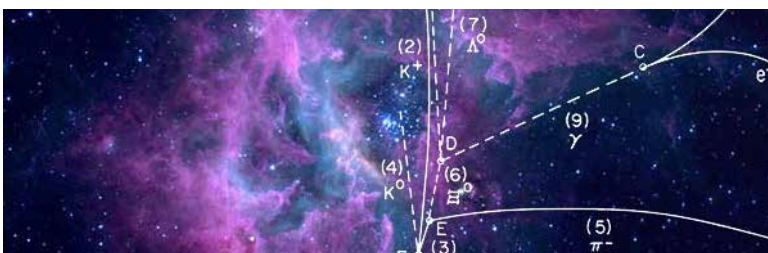
<https://www.bnl.gov/science/photon-science.php>



Quark Matter (QCD):

Colliding subatomic particles to recreate matter from the dawn of time, and study the force that gives shape to visible matter in the universe today.

<https://www.bnl.gov/science/QCD-matter.php>



Physics of the Universe:

Exploring cosmic mysteries across the smallest and largest scale imaginable, from neutrinos to dark energy.

<https://www.bnl.gov/science/physics.php>



Climate, Environment,

& Biosciences: Mapping climate change, greenhouse gas emissions, and plant biology to protect our planet's future.

<https://www.bnl.gov/science/climate.php>

RESEARCH AWARDS

To date, researchers working at BNL have received eight Nobel Prizes, National Medals of Science, Enrico Fermi Awards, Wolf Foundation Prizes, R&D 100 awards, as well as other recognitions for discoveries made wholly or partly at BNL. Some significant discoveries and developments made at the Laboratory include



new forms of matter, subatomic particles, technologies that fuel leading experimental programs around the world, and life-saving medical imaging techniques for diagnosis and treatment of disease. More information on the Laboratory's Nobel Prizes can be found at <https://www.bnl.gov/about/awards/>.



Aerial photograph of the BNL site.

BNL FACILITIES AND OPERATIONS

Most of the Laboratory's principal facilities are located near the center of the site. The developed area is approximately 1,820 acres:

- 500 acres originally developed by the Army (as part of Camp Upton) and still used for offices and other operational buildings
- 200 acres occupied by large, specialized research facilities
- 520 acres used for outlying facilities, such as the Sewage Treatment Plant, research agricultural fields, housing facilities, and fire breaks
- 400 acres of roads, parking lots, and connecting areas
- 200 acres occupied by the Long Island Solar Farm
- Approximately 3,400 acres, which is mostly wooded and represents the native pine barrens ecosystem.

All research and support facilities at the Laboratory must undergo periodic environmental reviews as part of BNL's Environmental Management Program. BNL's major scientific facilities are briefly described.

MAJOR SCIENTIFIC FACILITIES AT BNL

- **Alternating Gradient Synchrotron (AGS).** The AGS is a particle accelerator used to propel protons and heavy ions, such as gold or iron, to high energies for physics research. The Linear Accelerator (Linac) serves as a proton injector for the AGS Booster.
- **AGS Booster.** The AGS Booster is a circular accelerator used for physics research and radiobiology studies. It receives either a proton beam from the Linac or heavy ions from the Tandem Van de Graaff and accelerates these before injecting them into the AGS ring for further acceleration. The Booster also serves as the energetic heavy ion source for the NASA Space Radiation Laboratory, which is used to simulate the harsh cosmic and solar radiation environment found in space.
- **Center for Functional Nanomaterials (CFN).** The CFN provides state-of-the-art capabilities for the fabrication and study of nanoscale materials, with an emphasis on atomic-level tailoring to achieve desired properties and functions. The overarching scientific theme of the CFN is the development and understanding of nanoscale materials that address the nations' challenges in energy security.
- **Linear Accelerator (Linac) and Brookhaven Linac Isotope Producer (BLIP).** The Linac provides beams of polarized protons for the AGS and RHIC. The beam is also used to produce radioisotopes for research and medical imaging at the BLIP. The BLIP is one of the nation's key production facilities for radioisotopes, which are crucial to clinical nuclear medicine. The BLIP also supports research on new diagnostic and therapeutic radiopharmaceuticals.
- **Interdisciplinary Science Building (ISB).** The Interdisciplinary Science Building is a new world-class research facility where scientists work to drive breakthrough solutions to the nation's energy challenges.
- **National Synchrotron Light Source (NSLS).** The NSLS uses a linear accelerator and booster synchrotron as an injection system for two electron storage rings that provide intense light spanning the electromagnetic spectrum from the infrared through x-rays. The properties of this light and the 80 specially designed experimental stations, called beamlines, allow scientists to perform a large variety of experiments.
- **National Synchrotron Light Source II (NSLS-II).** The NSLS-II facility is scheduled to start full-time operation in 2015 and will provide sophisticated new tools that will allow scientists to see materials at the scale of a nanometer, or one billionth

of a meter—a capability not available at any other light source in the world. Working at the nanoscale, researchers will focus on some of the nation’s most important scientific challenges, including developing materials for clean and affordable energy production, molecular electronics, and high-temperature superconductors.

- **Relativistic Heavy Ion Collider (RHIC).** The RHIC accelerator drives two intersecting beams of heavy ions or protons head-on to form subatomic collisions. What physicists learn from these collisions may help us understand more about why the physical world works the way it does, from the smallest subatomic particles, to the largest stars.
- **Tandem Van de Graaff.** The Tandem Van de Graff accelerators are used to bombard materials with ions for manufacturing and testing purposes, and to supply RHIC with heavy ions.

The following facilities help support BNL’s science and technology mission by providing basic utility and environmental services.

SUPPORT FACILITIES AT BNL

- **Central Chilled Water Plant.** This plant provides chilled water sitewide for air conditioning and process refrigeration via underground piping. The plant has a large refrigeration capacity and reduces the need for local refrigeration plants and air conditioning.
- **Central Steam Facility (CSF).** This facility provides high-pressure steam for facility and process heating sitewide. Either natural gas or fuel oil can be used to produce the steam, which is conveyed to other facilities through underground piping. Condensate is collected and returned to the CSF for reuse, to conserve water and energy.
- **Major Petroleum Facility (MPF).** This facility provides reserve fuel for the CSF during times of peak operation. With a total capacity of 2.3 million gallons, the MPF primarily stores No. 6 fuel oil. The 1997 conversion of CSF boilers to burn natural gas as well as oil has significantly reduced the Laboratory’s reliance on oil as a sole fuel source when other fuels are more economical.
- **Fire Station.** The Fire Station houses six response vehicles. The BNL Fire Rescue Group provides on-site fire suppression, emergency medical services, hazardous material response, salvage, and property protection.
- **Sewage Treatment Plant (STP).** This plant treats sanitary and certain process wastewater from BNL facilities prior to discharge into nearby groundwater recharge basins. The plant has a design capacity of 3 million gallons per day. Effluent is monitored and controlled under a permit issued by the New York State Department of Environmental Conservation (NYSDEC).
- **Waste Management Facility (WMF).** This facility is a state-of-the-art complex for managing the wastes generated from BNL’s research and operations activities. The facility was built with advanced environmental protection systems and features.



Center for Functional Nanomaterials (CFN).



Interdisciplinary Science Building (ISB).



National Synchrotron Light Source II (NSLS-II).

- **Water Treatment Plant (WTP).** The potable water treatment plant has a capacity of 5 million gallons per day. Potable water is obtained from five on-site wells. Three wells located along the western boundary of the site are treated at the WTP with a lime-softening process to remove naturally occurring iron and by the addition of sodium hypochlorite for bacterial control. The plant is also equipped with dual air-stripping towers to ensure that volatile organic compounds (VOCs) are at or below New York State drinking water standards. Two wells located along the eastern section of the developed site are treated by the addition of sodium hydroxide to increase the pH of the water to make it less corrosive, and by the addition of sodium hypochlorite to control bacteria.

Environmental, Safety, Security, and Health Policy

Brookhaven National Laboratory

This document is a statement of Brookhaven National Laboratory's (BNL) Environmental, Safety, Security, and Health (ESSH) policy. BNL is a world leader in scientific research and performs this work in an environmentally responsible and safe manner.

I expect every employee, contractor, and guest to take personal responsibility for adhering to the following principles:

ENVIRONMENT

We protect the environment, conserve resources, and prevent pollution.

SAFETY

We maintain a safe workplace, and we plan our work and perform it safely. We take responsibility for the safety of ourselves, coworkers, and guests.

SECURITY

We protect people, property, information, computing systems, and facilities.

HEALTH

We protect human health within our boundaries and in the surrounding community.

COMPLIANCE

We achieve and maintain compliance with applicable ESSH requirements.

COMMUNITY

We maintain open, proactive, and constructive relationships with our employees, neighbors, regulators, DOE, and our other stakeholders.

CONTINUAL IMPROVEMENT

We continually improve ESSH performance.

In addition to my annual review of BNL's progress on ESSH goals and adherence to this policy, I invite all interested parties to provide me with input on our performance relative to this policy, and the policy itself.

Doon Gibbs, Director
April 15, 2013



BNL'S ENVIRONMENTAL MANAGEMENT SYSTEM

An Environmental Management System (EMS) was established at BNL in 2001 to ensure that environmental issues are systematically identified, controlled, and monitored. An EMS also provides mechanisms for responding to changing environmental conditions and requirements, reporting on environmental performance, and reinforcing continual environmental improvement.

The cornerstone of the Laboratory's EMS is BNL's Environment, Safety, Security, and Health (ESSH) Policy shown on the left. This policy makes clear the Laboratory's commitments to environmental stewardship, the safety and health of its employees, and the security of the site. Specific environmental commitments in the policy include compliance, pollution prevention, conservation, community outreach, and continual improvement in ESSH performance. The policy is posted throughout the Laboratory and on the BNL website at <http://www.bnl.gov/ESHQ/ESSH.asp>. It is also included in all training programs for new employees, guests, and contractors.

The Laboratory's EMS was designed to meet the rigorous requirements of the globally recognized ISO 14001 Environmental Management Standard. BNL was the first laboratory under the DOE Office of Science to become officially registered to this standard. Certification requires the Laboratory to undergo annual audits by an accredited registrar to assure that the systems are maintained and to identify evidence of continual improvement. In 2014, an EMS re-certification audit determined that BNL remains in conformance with the ISO 14001 standard.

Executive Order 13514, "Federal Leadership in Environmental, Energy, and Economic Performance," sets sustainability goals for federal agencies and focuses on making improvements in environmental, energy, and economic performance. It requires federal agencies to set a greenhouse gas emissions reduction target, increase energy efficiency, reduce fleet petroleum consumption, conserve water, reduce waste, support sustainable communities, and leverage federal purchasing power to promote environmentally responsible



Headwaters of the Peconic River.

products and technologies. Each governmental facility is required to have a Site Sustainability Plan (SSP) that details the

strategy for achieving these long-term goals and to provide an annual updated status.

BNL'S ENVIRONMENTAL MANAGEMENT PROGRAM

BNL's Environmental Management Program consists of several Laboratory-wide and facility-specific environmental monitoring and surveillance programs. These programs identify potential pathways of public and environmental exposure and evaluate the impacts BNL activities may have on the environment. An overview

of the Laboratory's environmental programs and a summary of performance for 2014 follows. A complete discussion for each program can be found in the full report on the compact disk in the back of this summary booklet.

POLLUTION PREVENTION PROGRAM

BNL's Pollution Prevention (P2) Program is an essential element for the successful accomplishment of the Laboratory's broad mission. The P2 Program reflects national and DOE pollution prevention goals and policies, and represents an ongoing effort to make pollution prevention and waste minimization an integral part of BNL's operating philosophy. The overall goal of the P2 program is to integrate pollution prevention and waste minimization, resource conservation, recycling, and affirmative procurement (environmentally preferable products) into all planning and decision making at the Laboratory.

An important function of the P2 program is to encourage management and staff at BNL to develop P2 recommendations for possible funding. In 2014, two new proposals were funded, for a combined investment of approximately \$9,000. The anticipated an-

nual savings from these projects is estimated at \$10,000, with an average payback period of approximately one year.

The implementation of pollution prevention opportunities, recycling programs, and conservation initiatives has significantly reduced both waste volumes and management costs at the Laboratory. In 2014, these efforts resulted in more than \$4 million in cost avoidance or savings and approximately 35.5 million pounds of materials being reduced, recycled, or reused annually.

BNL also has an active and successful solid waste recycling program, which involves all employees. In 2014, the Laboratory collected approximately 150 tons of office paper for recycling. Cardboard, bottles and cans, construction debris, motor oil, scrap metals, lead, automotive batteries, electronic scrap, fluorescent light bulbs, and drill press/machining coolant were also recycled.

ENERGY MANAGEMENT AND CONSERVATION

BNL's Energy Management Group works to seek alternative energy sources to meet the Laboratory's future energy needs, support federally required "green" initiatives, and reduce energy costs by identifying and implementing cost-effective, energy-efficient projects; monitoring energy use and utility bills; and assisting in obtaining the least expensive energy sources possible.

BNL maintains more than 4.9 million square feet of building space, as well as many scientific experiments that require electricity, fuel oil, propane, and natural gas. In 2014, the Laboratory used approximately

290 million kilowatt hours (kWh) of electricity, 89,000 gallons of fuel oil, 12,000 gallons of propane, and 670 million ft³ of natural gas. Fuel oil or natural gas is used whenever each fuel is least expensive.

BNL continues to participate in the New York Independent System Operator (NYISO) Special Case Resource (SCR) Program, an electric load reduction curtailment program, in which the Laboratory reduces its electrical demand during critical days throughout the summer when NYISO expects customer demand to meet or exceed the available supply. In return, BNL receives a rebate for each megawatt



Aerial View of the Long Island Solar Farm at Brookhaven National Laboratory.

reduced on each curtailment day, resulting in savings of approximately \$1.7 million in electric costs in 2014 and helping to maintain the reliability of the Long Island Power Authority electric system to meet all of its users' needs. BNL's contract with the New York Power Authority (NYPA) resulted in an overall cost avoidance of \$25.3 million in 2014.

Built in 2011, the Long Island Solar Farm (LISF) is the largest solar photovoltaic (PV) array (32 MW) in the Northeast, and spans 195 acres with 164,000 panels, with an anticipated annual output of

44 million kWh. Operation of the LISF results in an avoidance of approximately 31,000 tons of carbon per year over its 30- to 40-year expected life span. The actual output for the first three operational years was an average of 54 million kWh/year. BNL is also building an on-site solar test array which will be used for solar research. The first phase, a 500 kW array is currently generating approximately 520,000 kWh/year of electricity. The remaining 500 kW is expected to be completed in 2016-2017.

WATER CONSERVATION PROGRAM

The goal of BNL's water conservation program is to reduce the consumption of potable water on site. Water is supplied to the Laboratory site via five groundwater wells, with the majority being used for process cooling at the Laboratory's major scientific facilities.

Water conservation is a major focus of sustainability efforts under BNL's water conservation program. Water consumption has been reduced by approximately 53 percent since 1999, and more than 80 percent of water consumed each year by the Laboratory is returned and recharged to the groundwater at potable water quality.



BNL Water Storage Tower.

WASTE MANAGEMENT PROGRAM

As a byproduct of the world-class research it conducts, BNL generates a wide range of wastes, including office wastes (e.g., paper, plastic, etc.), aerosol cans, batteries, paints, and oils. However, the Laboratory's unique scientific activities also generate "specialized" waste streams that are subject to additional regulation and special handling, including radioactive, hazardous, and mixed waste. BNL's Waste Management Facility (WMF) is used for collecting, storing, transporting, and managing the disposal of these specialized wastes.

In 2014 non-routine hazardous and radioactive waste from on-going industrial and experimental operations decreased from 2013 rates, while mixed waste generation increased due to increased activities at BNL's Collider Accelerator Department (CAD). Also in 2014, the Laboratory continued to reduce the inventory of legacy waste materials on site through laboratory cleanouts. Wastes from facility decommissioning activities included some remaining debris and equipment from the former Hot Shop and the former Brookhaven Medical Research Reactor. Other non-routine wastes included the disposal of lead-contaminated debris, lead shielding, and polychlorinated biphenyl (PCB) wastes.

COMPLIANCE MONITORING PROGRAM

Compliance monitoring is conducted at BNL to ensure that air emissions, wastewater effluents, and groundwater quality comply with more than 100 sets of federal, state, and local environmental regulations, numerous site-specific permits, and 12 equivalency permits.

The Laboratory has a variety of conventional, nonradioactive air emission sources that are subject to federal or state regulations, including boiler emissions from the BNL Central Steam Facility (CSF) and ozone-depleting substances, such as refrigerants and halon. With the exception of one nitrogen oxide emission exceedance, emission of nitrogen oxides, carbon monoxide, and sulfur dioxide from the CSF were all within permit limits in 2014. There were no discharges of Halon 1211 from portable fire extinguishers or Halon 1301 from accidental or fire induced activation of fixed fire suppression systems in 2014.

To ensure that the Laboratory maintains a safe drinking water supply, BNL's potable water supply is monitored as required by the Safe Drinking Water Act, which is administered by the Suffolk County Department of Health Services. The Laboratory is also subject to the same requirements as a municipal water supplier and must prepare an annual Consumer Confidence Water Quality Report. As in previous years, all drinking water requirements were met in 2014.

Wastewater monitoring is performed at the point of discharge to ensure that the effluent complies with release limits in the Laboratory's State Pollutant Discharge Elimination System permit and monthly Discharge Monitoring Reports that provide analytical results and an assessment of compliance are filed with the New York State Department of Environmental Compliance (NYSDEC). In 2014, most of the



Aerial photograph of the Waste Management Facility.



Demolition of Building 811.

liquid effluents discharged to surface water and groundwater met applicable SPDES permit requirements. There were eight excursions above permit limits; four occurred at BNL's Sewage Treatment Plant and four occurred at on-site recharge basins. These excursions were reported to NYSDEC and corrective actions were taken.

Groundwater monitoring is performed to comply with regulatory operating permits under the Major Petroleum Facility License for BNL's CSF and a Resource Conservation and Recovery Act permit for

BNL's Waste Management Facility. Extensive groundwater monitoring is also conducted under the Comprehensive Environmental Response, Compensation and Liability Act program. In 2014, groundwater monitoring at BNL's Major Petroleum Facility continued to show that current oil storage and transfer operations are not affecting groundwater quality.

BNL follows federal, state and local regulations that address the management of storage facilities containing chemicals, petroleum, and other hazardous materials, and address the requirements for reporting releases that do occur. Efforts to reduce the number and minimize the severity of spills on site continued in 2014, however, there were 11 spills that met regulatory agency reporting criteria.

AIR QUALITY PROGRAM

Under the requirements of the Clean Air Act, BNL monitors radioactive emissions at three facilities on site to ensure compliance with the requirements. Environmental Protection Agency regulations require continuous monitoring of all sources that have the potential to deliver an annual radiation dose greater than 0.1 mrem to a member of the public; all other facilities capable of delivering any radiation dose require periodic confirmatory sampling. During 2014, Laboratory facilities released a total of 7,535 curies of short-lived radioactive gases. Oxygen-15 and carbon-11 emitted from the Brookhaven Linac Isotope Producer, BNL's only facility subject to EPA's continuous monitoring requirements, constituted more than 99.9 percent of radiological air emissions on site.

The severity of the spills were minor and cleaned up to the satisfaction of NYSDEC.

A number of federal, state, and local agencies oversee BNL activities. In addition to external audits and oversight, the Laboratory has a comprehensive self-assessment program in place to review operations. In 2014, BNL was inspected by federal, state, or local regulators on ten occasions. Areas inspected included BNL's STP, wastewater discharges to other regulated outfalls and recharge basins, hazardous waste management facilities, regulated petroleum and chemical bulk storage facilities, and the potable water system. Immediate corrective actions were taken to address any issues raised during the inspections.

The Laboratory conducts ambient radiological air monitoring to verify local air quality and assess possible environmental and health impacts from BNL operations. Air monitoring stations around the perimeter of the site measure tritium and gross alpha and beta airborne activity. Results for 2014 continued to demonstrate that on-site radiological air quality was consistent with results from locations in New York State that are not located near radiological facilities.

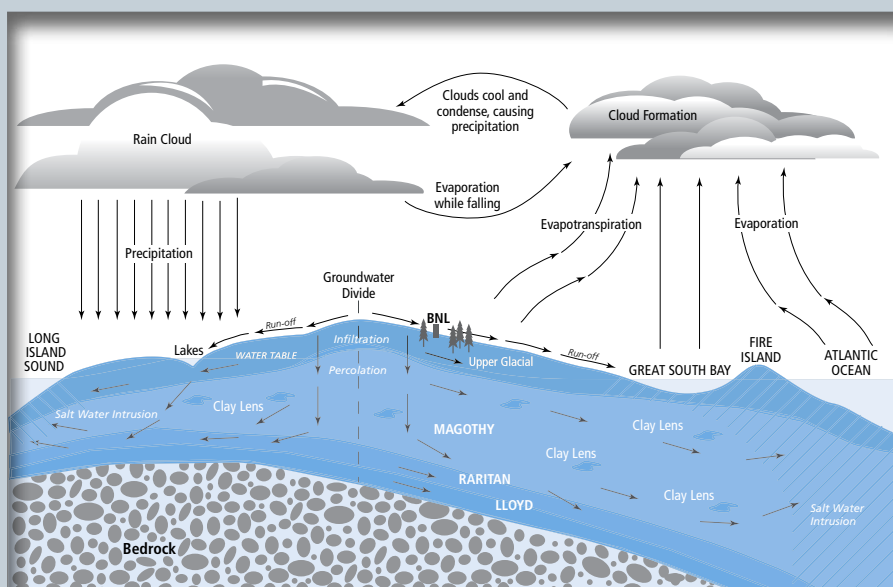
Various state and federal regulations governing nonradiological releases require facilities to conduct periodic or continuous emissions monitoring to demonstrate compliance with emission limits. The CSF is the only BNL facility that requires monitoring. In 2014, there was one excess opacity measurement recorded by CSF Boiler 6 during

LONG ISLAND'S 'SOLE SOURCE' AQUIFER IS BNL'S WATER SOURCE

The Long Island aquifer system is made up of three primary formations. From the surface to approximately 150 feet down is the Upper Glacial aquifer, from 150 to 1,000 feet is the Magothy, and from 1,000 to about 2,000 feet is the Lloyd. Drilled into the Upper Glacial, BNL's five in-service drinking-water wells draw up to 1,000 gallons per minute, or about 1.34 million gallons of water a day for use as drinking water, process cooling water, or fire protection.

Long Island's aquifer system is one of 78 "sole source" aquifers in the nation recognized under the aquifer-protection program authorized by the U.S. Safe Drinking Water Act. An assessment of the source water used by BNL's public water system is performed annually by the New York State Department of Health.

Each year, BNL publishes an annual Water Quality Consumer Confidence Report. In addition to reminding consumers of the importance and need to protect drinking-water sources, the report's purpose is to inform consumers where their water comes from, what analytical tests are conducted, what the test results reveal, and how those results compare to state standards. In 2014, as in the past, BNL's drinking water was in full compliance with all county, state, and federal regulations. Additional information regarding the complete analysis can be found at <https://www.bnl.gov/water/reports.php>.



Precipitation Cycle in the Area of Brookhaven National Laboratory.

scheduled service work on the continuous opacity system, and five excess opacity measurements recorded by CSF Boiler 7. Two of the Boiler 7 excess opacity readings occurred during boiler startup and were due to unknown causes; two excess readings were the result of a blower motor failure; and one excess opacity reading occurred during startup after the blower motor was replaced. During quarterly quality assurance tests of the opacity monitors for Boilers 6 and 7, multiple 6-minute periods greater than 20 percent opacity were also recorded. All of the excursions were documented in quarterly

WATER QUALITY SURVEILLANCE PROGRAM

Monitoring, pollution prevention, and careful operation of water treatment facilities ensure that discharges comply with all applicable requirements and that the public, employees, and the environment are protected. Wastewater generated from operations at the Laboratory is discharged after treatment to surface waters via BNL's Sewage Treatment Plant (STP) and to groundwater via on-site recharge basins. Some wastewater may contain very low levels of radiological, organic, or inorganic contaminants. If the wastewater contains constituents above permit limits or other discharge standards, it must be held to determine the appropriate means for disposal.

The Laboratory's STP is monitored for radiological and nonradiological contaminants. In 2014, the average gross alpha and beta activity levels in the STP discharge were within the typical range of historical levels and well below New York State Drinking Water Standards (NYS DWS). Tritium, cesium-137, strontium-90, or other gamma-emitting nuclides attributable to historical BNL operations were not detected throughout the year. Monitoring of the STP effluent showed that, except for isolated incidents of noncompliance for metals, organic and inorganic parameters were within State Pollutant Discharge Elimination System (SPDES) effluent limitations or other applicable standards, and no volatile organic compounds (VOCs) were detected.

Discharges to recharge basins are sampled throughout the year for analyses of gross alpha and beta activity, gamma-emitting radionuclides, and tritium. Each recharge basin is a permitted point-source discharge under the Laboratory's SPDES permit. In 2014, there were no reported gamma-emitting nuclides attributable to BNL operations in any discharges to recharge basins, and tritium was within method detection limits. Disinfection byproducts continue to be detected at very low concentrations due to the use of chlorine and bromine for the control of algae and bacteria. Inorganics (i.e., metals) were detected; however, their presence is due primarily to sediment run-off in stormwater discharges.

Site-Wide Air Emissions and Monitoring Systems Performance Reports submitted to NYSDEC.

Because natural gas prices were lower than residual fuel oil prices throughout 2014, BNL's CSF used natural gas to supply more than 99.3 percent of the heating and cooling needs of the Laboratory's major facilities. As a result, emissions of particulates, oxides of nitrogen, sulfur dioxide, and volatile organic compounds (VOCs) were well below the respective regulatory permit criteria pollutant limits.



Modular Aeration Tank at BNL's Sewage Treatment Plant.

To assess the potential impact of STP discharges on the water quality of the Peconic River, surface water monitoring is conducted at several locations upstream and downstream of the discharge point. Radiological data from Peconic River surface water sampling in 2014 showed that the average concentrations of gross alpha and gross beta activity from off-site locations and control locations were indistinguishable from BNL on-site levels, and all detected levels were below the applicable NYS DWS.

Inorganic data from Peconic River samples collected upstream, downstream, and at control locations demonstrated that elevated amounts of aluminum and iron detected in the river are associated with natural sources. Concentrations of silver, copper, lead, and zinc detected were consistent with concentrations found in the STP discharge, and were within BNL SPDES permit limits.

GROUNDWATER PROTECTION MANAGEMENT PROGRAM

BNL has made significant investments in environmental protection programs over the past 20 years and continues to make progress in achieving its goal of preventing new groundwater impacts and remediating previously contaminated groundwater. No new impacts to groundwater quality were discovered during 2014.

The Laboratory's extensive groundwater monitoring well network is used to evaluate progress in restoring groundwater quality, to comply with regulatory permit requirements, and to monitor active research and support facilities where there is a potential for environmental impact. In 2014, BNL collected groundwater samples from 756 permanent monitoring wells and 67 temporary wells during 1,737 individual sampling events.

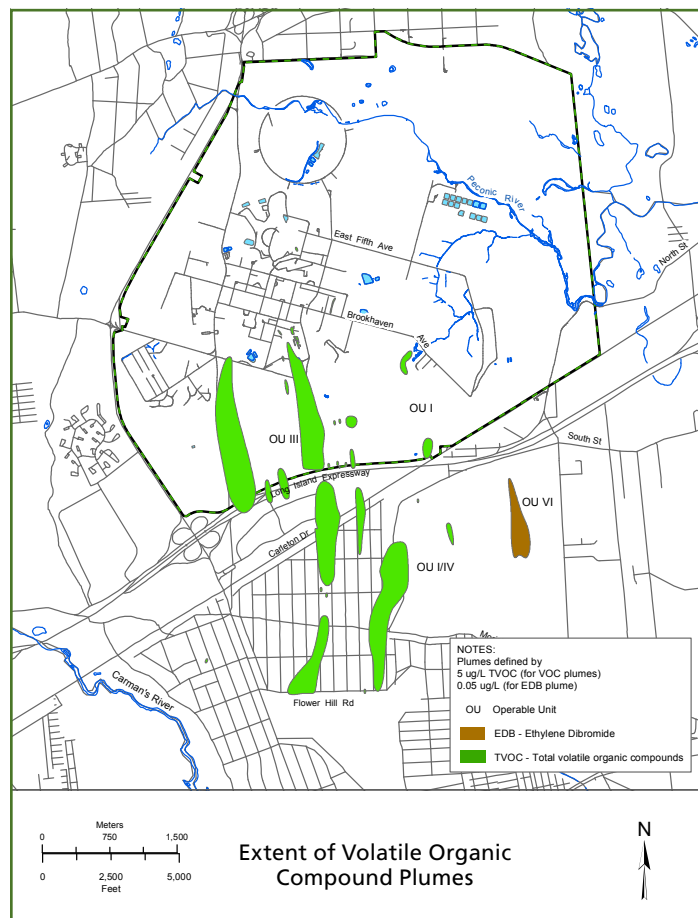
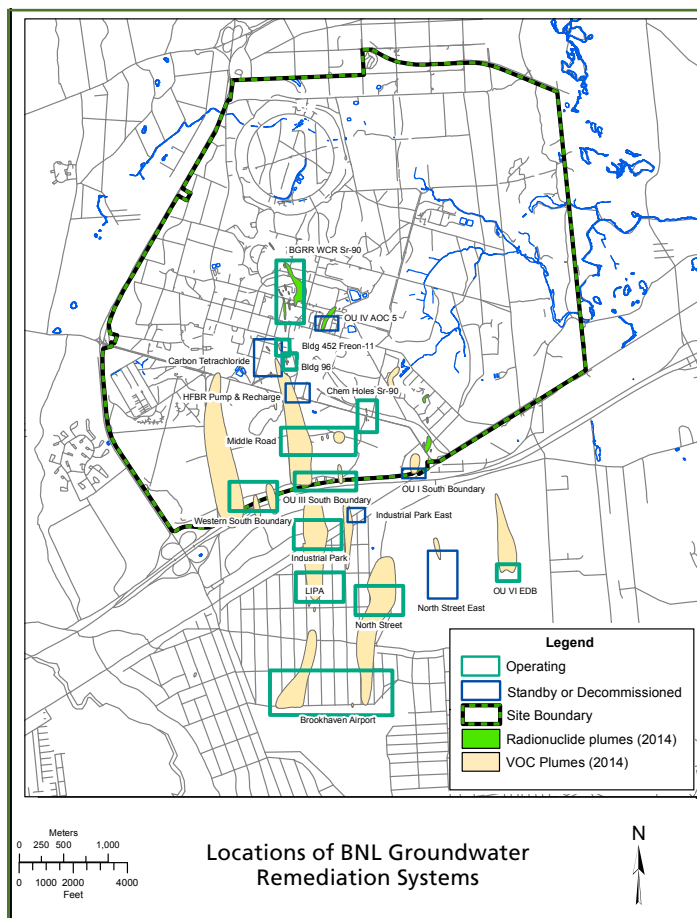
RADIOLOGICAL DOSE ASSESSMENT PROGRAM

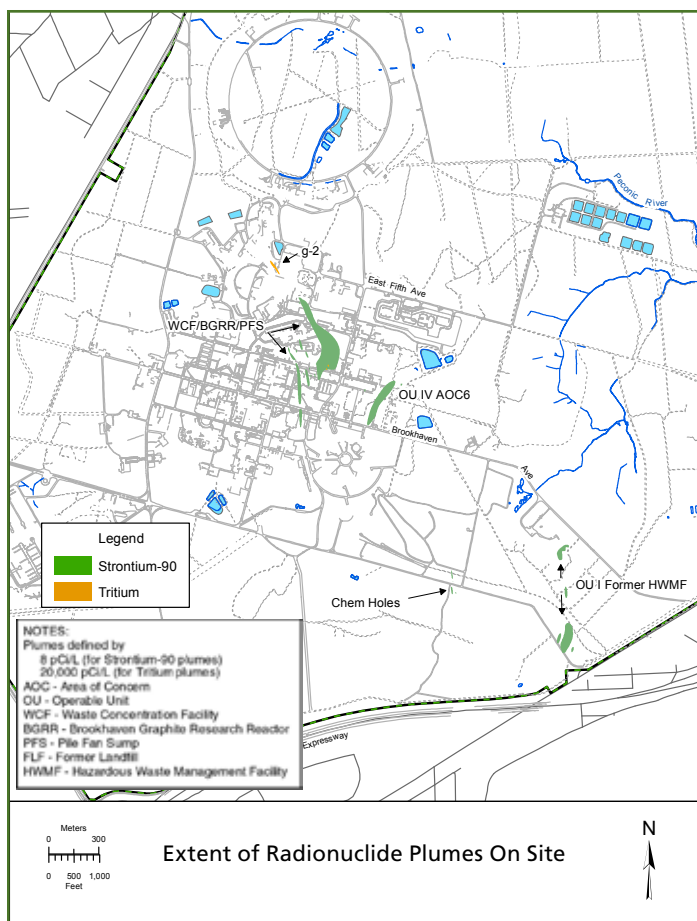
The Laboratory routinely reviews its operations to ensure that any potential radiological dose to members of the public, BNL workers, visitors, and the environment is "As Low As Reasonably Achievable" (ALARA). The potential radiological dose is calculated to the Maximally Exposed Off-Site Individual (MEOSI), which is defined as the largest possible dose to a person at a residence, office, or school beyond

BNL continues to make significant progress in restoring groundwater quality. During 2014, approximately 143 pounds of volatile organic compounds (VOCs) and approximately 1.2 mCi of strontium-90 were removed while treating almost 1.2 billion gallons of groundwater. With the treatment of approximately 23 billion gallons of groundwater since the start of active remediation in 1996, 7,276 pounds of VOCs have been removed from the aquifer, and noticeable improvements in groundwater quality are evident in a number of on- and off-site areas.

A detailed Groundwater Status Report is provided as Volume II of the Site Environmental Report, and provides a comprehensive summary of data collected, as well as an evaluation of Groundwater Protection Program performance during the calendar year.

the BNL site boundary. For dose assessment purposes, the pathways include direct radiation exposure, inhalation, ingestion, immersion, and skin absorption. Radiological dose assessments at the Laboratory have consistently shown that the effective dose equivalent from operations is well below the EPA and DOE regulatory dose limits for the public and the environment. The dose impact from all BNL activities

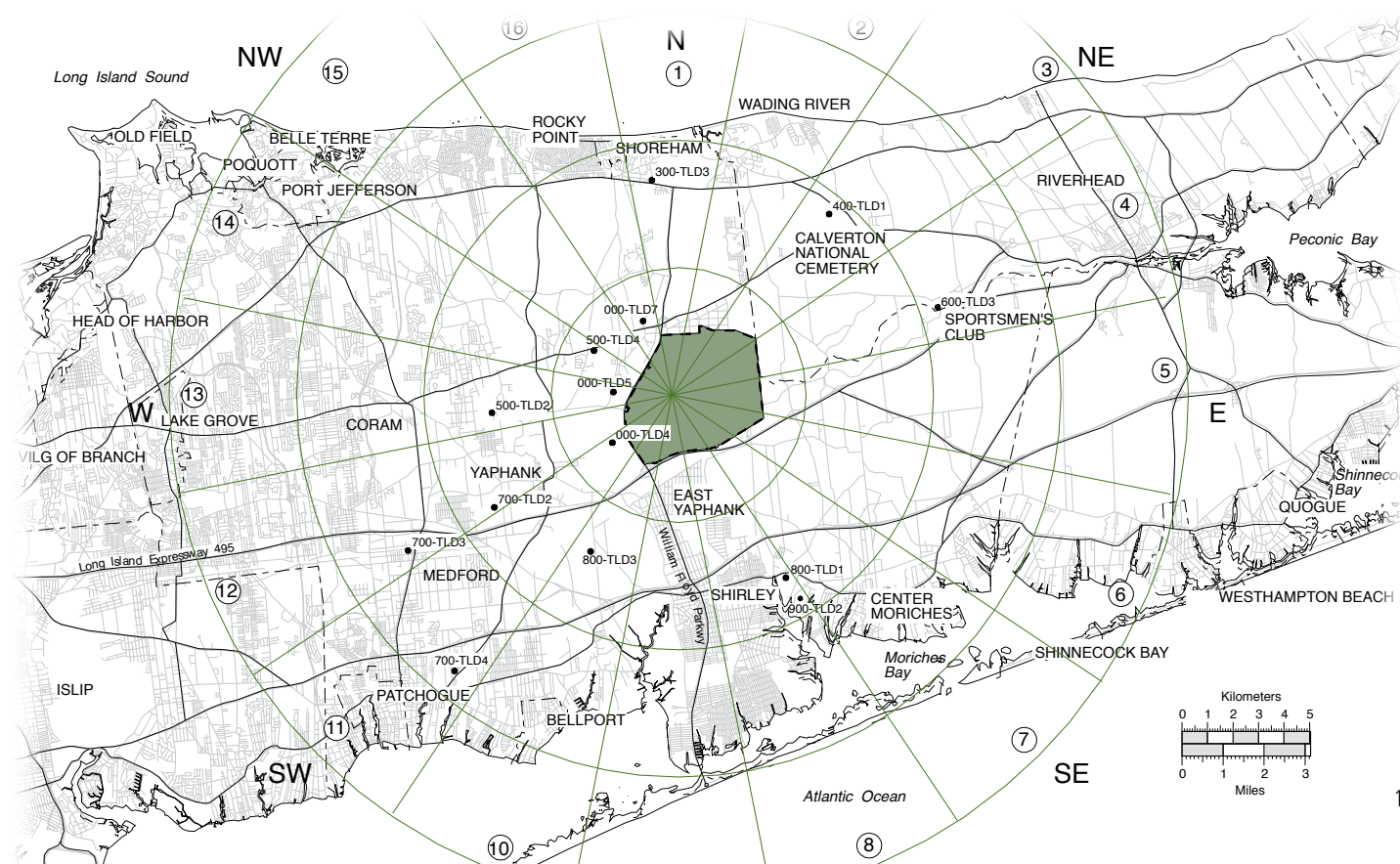




in 2014 was comparable to natural background radiation levels.

To measure direct radiation from Laboratory operations, 58 environmental thermoluminescent dosimeters (TLDs) were deployed, of which 9 were placed in known radiation areas and 15 off-site areas in 2014. An additional 30 TLDs were placed in a lead-shielded container for use as reference and control TLDs for comparison purposes. The average dose of all TLDs showed there was no additional contribution above the natural background radiation to on-and off-site locations from BNL operations.

The annual on-site external dose from all potential sources, including cosmic and terrestrial radiation, was estimated as 69 ± 9 mrem (690 ± 90 μ Sv) and the annual off-site external dose was estimated as 69 ± 8 mrem (690 ± 80 μ Sv). The ingestion pathway dose was estimated as 2.80 mrem (28 μ Sv) from the consumption of deer meat and 6.3×10^{-2} mrem (0.63 μ Sv) from consumption of fish caught in the vicinity of the Laboratory. The dose from the air inhalation pathway attributable to BNL operations was 2.85×10^{-1} mrem (2.9 μ Sv), which is less than 4 percent of EPA's annual regulatory air inhalation dose limit of 10 mrem (100 μ Sv). The total dose to the MEOSI from all pathways was estimated as 3.15 mrem (32 μ Sv), which is less than 4 percent of DOE's 100-mrem limit. Doses to aquatic and terrestrial biota and also from short-term projects, such as remediation work and waste management disposal activities, were also evaluated and found to be well below the regulatory limits.



NATURAL RESOURCE MANAGEMENT PROGRAM

BNL's Natural Resource Management Program was designed to promote stewardship of the natural resources found on site and to integrate natural resource management and protection with the Laboratory's scientific mission. The goals of the program include protecting and monitoring the ecosystem on site, conducting research, and communicating with the public, stakeholders, and staff members regarding environmental issues.

BNL conducts routine monitoring of flora and fauna to assess the impact, if any, of past and present activities on the Laboratory's natural resources. Generally, deer sampled on site or within 1 mile of the Laboratory contain higher concentrations of cesium-137 (Cs-137) than deer sampled from more than 1 mile off site. This is most likely because on-site deer consume small amounts of contaminated soil and graze on vegetation growing in soil where elevated Cs-137 levels are known to exist. The average on-site concentration in 2014 in deer meat was 0.60 pCi/g, wet weight (wet weight is before a sample is dried for analysis and the form most likely to be consumed). The average concentration of Cs-137 in deer meat taken from off site was 0.56 pCi/g, wet weight. The New York State Department of Health (NYSDOH) has formally reviewed the potential public health risk associated with elevated levels of Cs-137 in on-site deer and determined that neither hunting restrictions nor formal health advisories are warranted.

BNL maintains an ongoing program for collecting and analyzing fish from the Peconic River and surrounding freshwater bodies. Sampling is now alternated each year either as part of BNL's routine surveillance monitoring program or sampling is performed as part of the post-cleanup monitoring for the Peconic River remediation project. In 2014, results from surveillance monitoring of fish from the Peconic River showed low levels of Cs-137, whereas Cs-137 was not detected

in samples from the Carmans River (control location). Levels of Cs-137 in all fish species were within the range of results historically seen from the Peconic River.

Metals analysis of fish in 2014 focused on mercury due to its known health risk. In general, there is a trend of decreasing mercury levels in fish downstream from BNL's STP, with the highest concentration of 0.73 mg/kg measured in a composite of brown bullhead on site. Polychlorinated biphenyl (PCB) analysis in fish was discontinued off site, but continued to be performed for fish on site. Very low levels of Aroclor-1254 and -1260 were detected in several samples.

Radiological analysis of sediments from three Peconic River locations showed low levels of Cs-137, ranging from 0.32 pCi/g to 5.49 pCi/g, which are consistent with previous analyses of the river sediments. Analysis of sediment for mercury identified values ranging from 0.33 mg/kg to 7.40 mg/kg. The 7.40 mg/kg value was from a sample taken at the on-site PR-WC-06 area, and was above the 2.0 mg/kg clean-up goal. This result, along with the fact that concentrations above 2.0 mg/kg were seen at this location in the past, resulted in an effort to determine the extent of mercury in sediment around this point. Additional samples were taken late in 2014 within two locations, one upstream and one downstream, still with values above 2.0 mg/kg. Additional sampling is planned for 2015.

Water column sampling for mercury and methyl mercury was performed at 6 of 14 Peconic River sampling locations in June and July, including BNL's STP outfall. The general trend of total mercury in Peconic River water samples decreased with increasing distance downstream from the STP. Methyl mercury concentrations fluctuated between sampling periods and between both on- and off-site locations.



Eastern Hognose Snake (Heterodon platyrhinos).



Banded Sunfish (Enneacanthus obesus). This fish was released immediately after the photo was taken.



Eastern Tiger Salamander (Ambystoma t. tigrinum).

*Some examples of
NYS Threatened,
Endangered, Exploit-
ably Vulnerable, and
Species of Special
Concern at BNL.*

UPTON ECOLOGICAL AND RESEARCH RESERVE

The Upton Ecological and Research Reserve is managed by BNL and the Foundation for Ecological Research in the Northeast (FERN). The property, 530 acres, is located on the eastern boundary of BNL and 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.

Research supported by FERN in 2014 included preparing the results of research on leopard frogs for publication, in which a new species, *Rana (Lithobates) kauffeldi*, was described from locations on Staten Island (Feinberg, et. al 2014). Other research supported by FERN included continued investigation into bat populations on Long Island that were impacted by white-nosed syndrome and the funding of a leopard frog identification guide to help differentiate the newly discovered species of leopard frog.



Wildlife Photos Taken at BNL.

WILDLIFE PROGRAMS

The Laboratory sponsors a variety of educational and outreach activities involving natural resources. These programs are designed to help participants understand the ecosystem and to foster interest in science. Wildlife programs are conducted at BNL in collaboration with DOE, local agencies, colleges, and high schools. Ecological research is also conducted on site to update the current natural resource inventory, gain a better understanding of the ecosystem, and guide management planning. In 2014, research included continued work on statistical analysis of migratory bird data and data associated with Cs-137 in deer; tracking eastern box turtles to determine home range sizes; acoustic and mist net bat surveys; impact assessments related to the construction and operation of the Long Island Solar Farm on site; and statistical analysis of long-term ecological and environmental monitoring data.

WORLD WAR I TRENCHES

From 1917 through 1920, the site of what is now the Laboratory was the U.S. Army's Camp Upton. Named for Civil War General Emory Upton, Camp Upton was one of 16 U.S. Army training camps. Here, recruits mostly from the New York metropolitan area were trained for the famed 77th Infantry Division, also known as the Liberty Division, which began leaving Camp Upton for fighting in France in March 1918.

Training included marching, weapons-use and, among other techniques, trench warfare. Trench warfare was a form of combat in which armies dug zig-zagging lines of interconnected ditches. Within these trenches, troops lived in muddy water, among rats and lice while defending their territory and combating their opponents.

The trenches shown here may be some of the only surviving examples of WWI earthworks in the U.S., and they have been determined to be eligible for listing on the National Register of Historic Places.



CULTURAL RESOURCE MANAGEMENT PROGRAM

The goal of BNL's Cultural Resource Management Program is to ensure the proper stewardship of BNL and DOE historic resources. Additional goals include maintaining compliance with various historic preservation and archeological laws and regulations, and ensuring the availability of resources to Laboratory personnel and the public for research and interpretation.

Cultural resource management activities performed in 2014 included submitting a Section 106 review concerning the planned demolition of four structures on site to the New York State Historic Preservation Office (NYSHPO); loaning the Long Island History Museum materials from the Camp Upton Collection covering both World War I and WW II for their display on "Long Island at War;" and a presentation on the 'History of the BNL Site' was developed and presented to BNL's Community Advisory Council.



COMMUNICATION AND COMMUNITY OUTREACH

In support of BNL's EMS commitment to communication and community involvement, the Laboratory's External Affairs and Stakeholder Relations (EASR) Office maintains relationships with BNL employees, key stakeholders, neighbors, elected officials, regulators, and other community members. The goals are to provide an understanding of BNL's science and operations, including environmental stewardship and restoration activities, and to incorporate community input in the Laboratory's decision making.

To create opportunities for effective dialogue between the Laboratory and its stakeholders, several forums for communication and involvement have been established.

- The Brookhaven Executive Roundtable (BER), established in 1997 by DOE's Brookhaven Site Office, meets routinely to update local, state, and federal elected officials, regulators, and other government agencies on environmental and operational issues, as well as scientific discoveries and initiatives.
- The Community Advisory Council (CAC), established by BNL in 1998, advises Laboratory management primarily on environmental, health, and safety issues related to the Laboratory that are of importance to the community.
- Monthly teleconference calls are held with parties to the Laboratory's Interagency Agreement and other federal, state, and local regulators to keep them up-to-date on project status. The calls also provide the opportunity to gather input and feedback and to discuss emerging environmental findings and initiatives.
- The Stakeholder Relations Office website is used to host links to the CAC webpage, which contains meeting agendas and past meeting presentations and minutes. Stakeholder Relations also manages several outreach programs that provide opportunities for stakeholders to become familiar with the Laboratory's facilities and research projects.
 - *Tour Program*: Opportunities to learn about BNL are offered to college, university, professional, and community groups. Tour groups visit the Laboratory's scientific machines and research facilities and meet with scientists to discuss research.
 - *The Speakers' Bureau*: Speakers are provided for educational institutions and community organizations, such as Rotary Clubs, civic organizations, school assemblies, and professional societies, to update them on Laboratory research and operations accomplishments, including environmental stewardship.
 - *Summer Sundays*: Held on four Sundays each summer, these open houses enable the public to visit BNL science facilities, experience hands-on activities, and learn about research projects and environmental stewardship programs.
 - *PubSci*: BNL's new quarterly science café and conversation series where the Laboratory's distinguished scientists appear at public venues to discuss cutting-edge topics and research in an informal setting.
 - *ScienceOnScreen*: A new partnership program with the Huntington Cinema Arts Centre that gives BNL scientists an opportunity to present classic, cult, or documentary movies that serve as a "jumping-off" point to discuss their research.



Summer Sundays at BNL.

The Laboratory participates in various outreach events throughout the year that include festivals, workshops, BNL's Earth Day celebration, and the Suffolk County Planning Federation Conference. Brown bag lunch meetings for employees are held periodically and cover topics of interest, including project updates, newly proposed initiatives, wildlife management concerns, and employee benefits information.

BNL's Media & Communications Office issues press releases to news and media outlets, and publishes weekly employee newsletters—*Brookhaven This Week* and *The Brookhaven Digest*. In addition, the Director's Office web-based publication, the *Monday Memo*, is issued bi-weekly to employees and focuses on administrative topics important to the Laboratory population.

The Laboratory maintains an informative website at www.bnl.gov, where these publications, as well as extensive information about BNL's science and operations, past and present, are posted. In addition, employees and the community can subscribe to the Laboratory's e-mail news service at <https://lists.bnl.gov/mailman/listinfo/bnl-announce-1>. Community members who have questions or comments can "Let us know" by clicking on the link found under "Listening to you" on the Stakeholder Relations Office website at www.bnl.gov/stakeholder/. Community members can also subscribe to the monthly e-newsletter, *LabLink*, found on the Stakeholder Relations webpage at www.bnl.gov/lablink. *LabLink*, which keeps the community informed about happenings at BNL, explains some of the science behind Laboratory research, and invites subscribers to educational and cultural events.