



# 2009 Site Environmental Report

**SUMMARY**

BROOKHAVEN NATIONAL LABORATORY



The photo on the cover of this report is an Eastern bluebird (*Sialia sialis*) taken on site. The eastern blue bird has been identified as one of the declining species of migratory birds in North America. The decline is due to loss of habitat and to nest site competition from European starlings (*Sturnus vulgaris*) and house sparrows (*Passer domesticus*). BNL has been maintaining bluebird boxes on site since 2001 with great success. Approximately 40 to 50 nest boxes are utilized every year. Although a mildly invasive plant, the Great or Common mullein (*Verbascum thapsus*), also shown the photo, provides good habitat for bluebirds and other bird species in open fields and woodland edges.

The Brookhaven National Laboratory 2009 Site Environmental Report is a public document that is distributed to various U.S. Department of Energy sites, local libraries, and local regulators and stakeholders. The report is available to the general public on the internet at <http://www.bnl.gov/ewms/ser/>. A summary of the report is also available and is accompanied by a compact disk containing the full report. To obtain a copy of the report or summary, please write or call:

Brookhaven National Laboratory  
Environmental Protection Division  
Attention: SER Project Coordinator  
Building 120  
P.O. Box 5000  
Upton, NY 11973-5000  
(631) 344-3711



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BROOKHAVEN NATIONAL LABORATORY

2009 SITE ENVIRONMENTAL REPORT

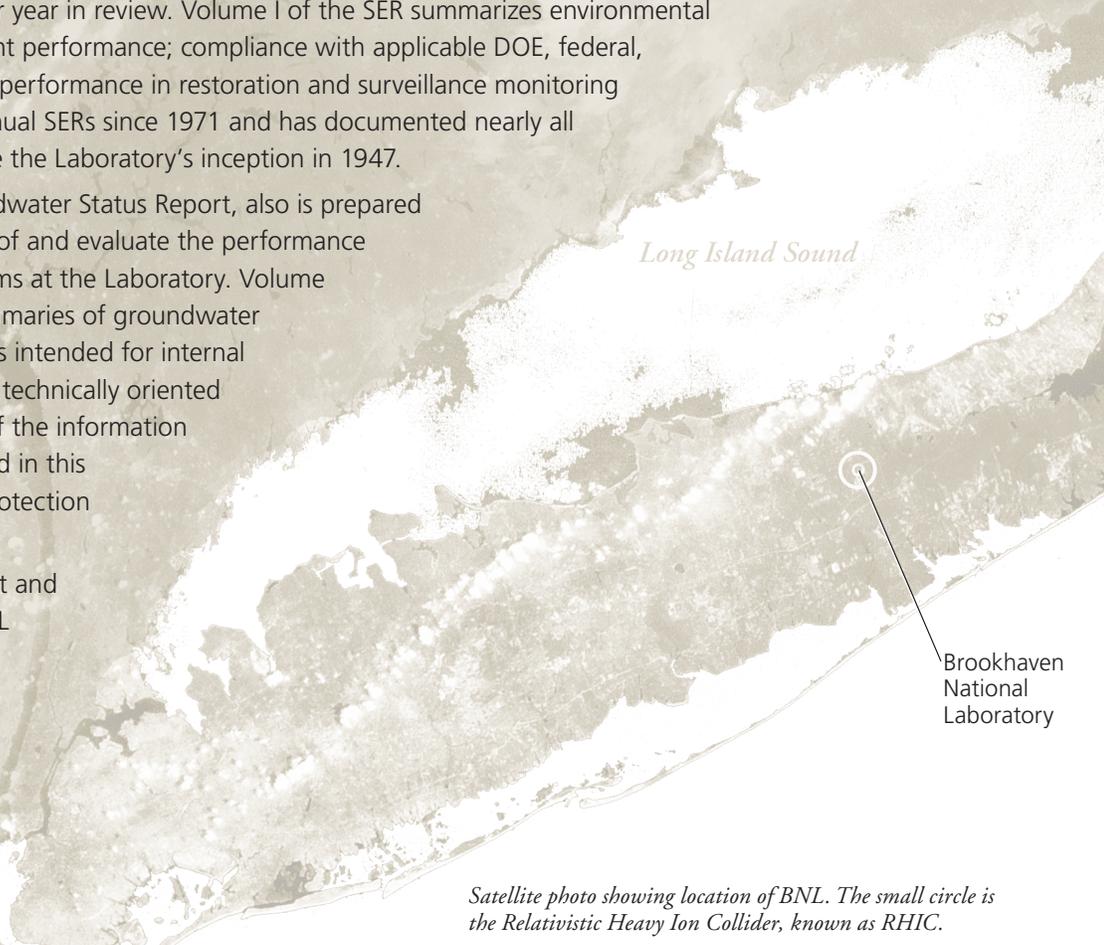
SUMMARY

## PREFACE

Each year, Brookhaven National Laboratory (BNL) prepares an annual Site Environmental Report (SER) in accordance with U.S. Department of Energy (DOE) Order 231.1A, Environment, Safety and Health Reporting. 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, also is prepared annually to report on the status of and evaluate the performance of groundwater treatment systems at the Laboratory. Volume II includes detailed technical summaries of groundwater data and its interpretation, and is intended for internal BNL users, regulators, and other technically oriented stakeholders. A brief overview of the information contained in Volume II is included in this summary under Groundwater Protection Management.

Both reports are available in print and as downloadable files on the BNL web page at <http://www.bnl.gov/ewms/ser/>. An electronic version on compact disc is distributed with each printed report. This summary provides a general overview of Volume 1, and is distributed with a compact disc containing the full report.



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, BNL is a multi-program national laboratory managed for DOE's Office of Science by Brookhaven Science Associates, a partnership formed by Stony Brook University and Battelle Memorial Institute. For more than 60 years, the Laboratory has played a lead role in the DOE Science and Technology mission. BNL manages its world-class scientific research with particular sensitivity to environmental issues and community concerns. The Laboratory's motto, "Exploring Life's Mysteries...Protecting its Future," and its Environmental, Safety, Security and Health Policy reflect the commitment of BNL's management to fully integrate environmental stewardship into all facets of its mission and operations.

The Laboratory's Environmental, Safety, Security, and Health (ESSH) Policy makes clear BNL's commitments to environmental stewardship, the safety of its employees, and the security of the site. Specific environmental commitments in the policy include compliance, pollution prevention, cleanup, community outreach, and continual improvement.

New Jersey

The ESSH Policy is posted throughout the site, on the BNL website at <http://www.bnl.gov/ESQH/ESSH.asp>, and is included in all training programs for new employees, guests, and contractors.

BNL's broad mission is to carry out basic and applied research in long-term programs in a safe and environmentally sound manner with the cooperation, support, and involvement of its scientific and local communities. The fundamental elements of the Laboratory's role in support of DOE's strategic missions in energy resources, environmental quality, and national security are:

- To conceive, design, construct, and operate complex, leading-edge, user-oriented research facilities in response to the needs of DOE and the international community of users.
- To carry out basic and applied research in long-term, high risk programs at the frontier of science.
- To develop advanced technologies that address national needs and to transfer them to other organizations and to the commercial sector.
- To disseminate technical knowledge to educate future generations of scientists and engineers; to maintain technical currency in the nation's workforce; and to encourage scientific awareness in the general public.

BNL is located on Long Island, 60 miles east of New York City. The Laboratory's 5,265-acre site is near Long Island's geographic center and is part of the Town of Brookhaven, the largest township (both in area and population) in Suffolk County. The Laboratory is one of the five largest, high-technology employers on Long Island, with approximately 2,700 employees that include scientists, engineers, technicians, and administrative personnel. More than 75 percent of BNL employees live and shop in Suffolk County. In addition, BNL annually hosts an estimated 4,000 visiting scientists, more than 30 percent of whom are from New York State universities and businesses. The visiting scientists and sometimes their families, as well as visiting students, reside in apartments and dormitories on site or in nearby communities.

A recent economic impact report found that BNL is a significant contributor to the Long Island and New York State economy. In fiscal year 2009, the Laboratory spent \$212 million on purchases of goods and services. Of this total, \$75.2 million was spent on purchases from New York State companies, including \$62.7 million from Long Island companies. This spending directly supported approximately 295 full-time jobs throughout New York State, including 255 full-time jobs with vendors and contractors on Long Island.

### BNL FACILITIES AND OPERATIONS

Most of the Laboratory's principal facilities are located near the center of the site. The developed area is approximately 1,650 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
- 550 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

The balance of the site, approximately 3,600 acres, is mostly wooded and represents the native pine barrens ecosystem, of which 530 of these acres are part of the Upton Ecological Reserve.

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

## Environmental, Safety, Security, and Health Policy

Brookhaven National Laboratory

*This document is a statement of BNL's ESSH policy. BNL is a world leader in scientific research and strives to demonstrate excellence in protecting people, property, and the environment.*

*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.*

Signed: September 6, 2006  
Sam Aronson, Director



*Aerial photograph of the BNL site.*

### 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.
- **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, currently under construction, will be a new state-of-the-art medium energy electron storage ring designed to deliver world-leading intensity and brightness, and will produce x-rays more than 10,000 times brighter than the current NSLS.
- **Relativistic Heavy Ion Collider (RHIC).** The RHIC is a world-class scientific research facility. The RHIC accelerator drives two intersecting beams of gold ions, other heavy metal ions, and/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.
- **Scanning Transmission Electron Microscope (STEM).** The STEM facility includes two microscopes that are used for biological research. Both devices allow scientists to see the intricate details of living things, from bacteria to human tissue.
- **Tandem Van de Graaff and Cyclotrons.** The Tandem Van de Graaff accelerators are used to bombard materials with ions for manufacturing and testing purposes, and to supply RHIC with heavy ions. The cyclotrons are used for the production of radiotracers for use in Positron Emission Tomography (PET) and Magnetic Resonance Imaging (MRI) studies.

### RESEARCH AND DISCOVERIES AT BNL

The Laboratory is one of the nation's—and the world's—leading research institutions. Six Nobel Prize-winning discoveries have been made at BNL (<http://www.bnl.gov/bnlweb/history/nobel/>). In the last 60 years, Brookhaven scientists have made many discoveries, developments, inventions, and innovations. Further information can be found at [http://www.bnl.gov/bnlweb/research\\_list.asp](http://www.bnl.gov/bnlweb/research_list.asp).

#### Scientific Discoveries

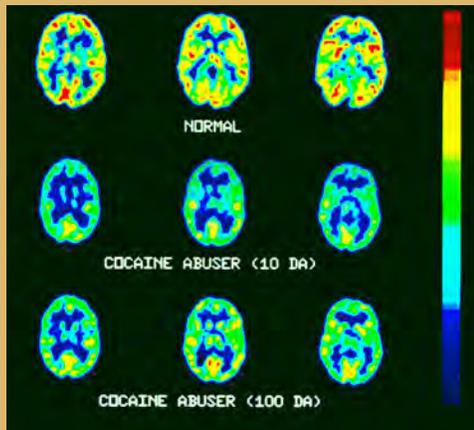
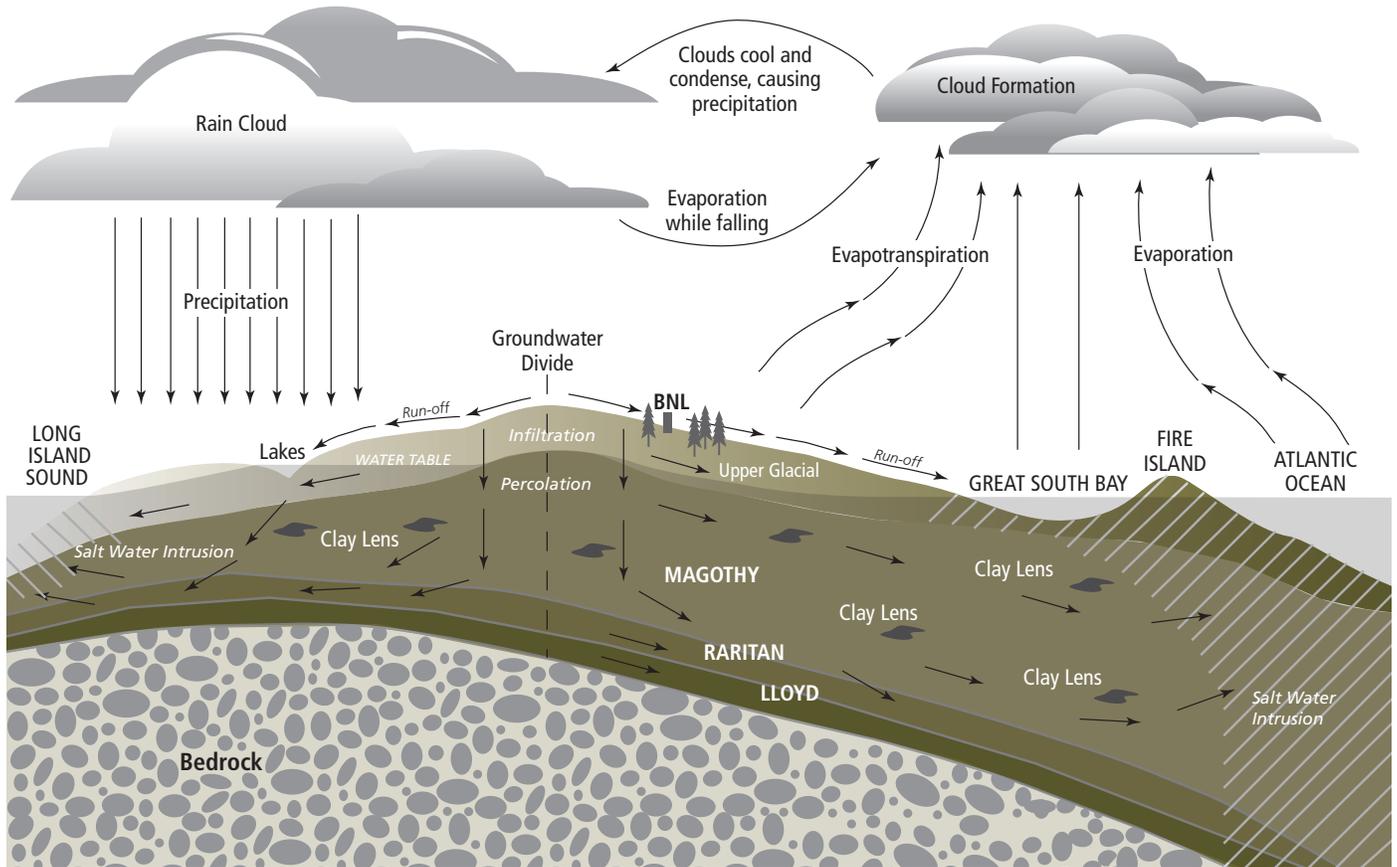
- *Courant-Snyder strong focusing principle, critical to the design of all modern particle accelerators.*
- *Theories and experiments to determine the mechanisms underlying high-temperature superconductors.*
- *Study of the effects of radiation on biological systems, important to cancer treatment and prevention, and to human space travel.*
- *Important studies of the brain, including those uncovering the roots of psychiatric disorders, brain metabolism, and drug addiction.*
- *Large-scale studies of the effect of increased carbon dioxide on ecosystems.*
- *The discovery of a perfect liquid, a type of matter thought by scientists to have existed microseconds after the Big Bang.*
- *The development of thallium-201, now used in hundreds of thousands of heart stress-tests each year.*
- *X-ray and neutron scattering facilities that have made possible countless studies of molecular structures important to disease.*
- *Use of L-dopa for the treatment of Parkinson's disease (the gold standard for treatment).*
- *X-ray angiography for non-invasive heart imaging.*
- *Environmentally cleaner, more efficient oil burners and devices to aid clean and efficient oil-burning.*
- *Development of chemically inert tracers and detectors to track the environmental impact of power plants.*

## HYDROLOGY AND GEOLOGY OF THE BNL SITE

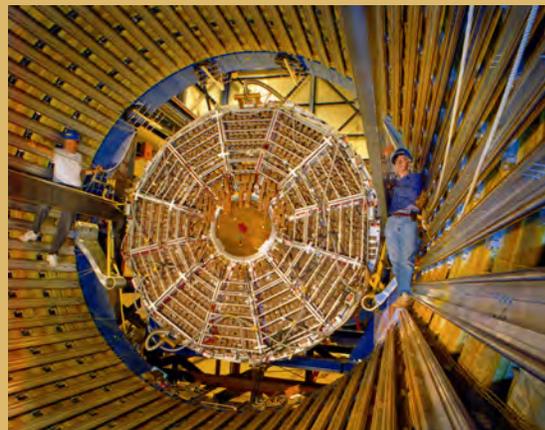
BNL is situated on the western rim of the shallow Peconic River watershed. The marshy areas in the northern and eastern sections of the site are part of the headwaters of the Peconic River. The Peconic River both recharges to, and receives water

from, the underlying Upper Glacial aquifer. In times of sustained drought, the river water recharges to the groundwater; with normal to above-normal precipitation, the river receives water from the aquifer. Long Island's aquifer system is one of 73 sole source aquifers in the nation recognized under the

*Precipitation Cycle in the Area of Brookhaven National Laboratory*



*PET scans of a normal and cocaine abuser. A normal brain (top) and cocaine abusers brain, 10 and 100 days after taking the drug. Normal metabolic activity is blunted in the drug abuser.*



*Inside the STAR Detector at BNL's Relativistic Heavy Ion Collider. The STAR detector tracks and analyzes thousands of particles, such as protons, neutrons, and ions that may be produced in each collision inside the detector.*



*BNL Laboratory researchers study catalysts that could help improve the performance of fuel cells.*

aquifer protection program authorized by the U.S. Safe Drinking Water Act. This groundwater system is the primary source of drinking water for both on- and off-site private and public supply wells.

The site is located within a defined deep-flow recharge zone for Long Island. Precipitation and surface water that recharge within this zone have the potential to replenish the Magothy and Lloyd aquifer systems lying below the Upper Glacial aquifer. It has been estimated that up to two-fifths of the recharge from rainfall moves into the deeper aquifers. The extent to which groundwater on site contributes to deep-flow recharge has been confirmed through the use of an extensive network of shallow and deep wells installed at BNL and surrounding areas.

During 2009, the Laboratory used approximately 1.43 million gallons of groundwater per day to meet potable water needs and heating and cooling requirements. Approximately 75 percent of the water pumped from BNL supply wells is returned to the aquifer through on-site recharge basins and permitted discharges to the Peconic River. Under normal hydrologic conditions, most of the water discharged to the river recharges to the Upper Glacial aquifer before leaving the site. Human consumption, evaporation (cooling tower and wind losses), and sewer line losses account for the remaining 25 percent. An additional 3.4 million gallons of groundwater are pumped each day from remediation wells. The water is treated to remove contaminants and then returned to the aquifer by way of recharge basins or injection wells.

## BNL'S ENVIRONMENTAL MANAGEMENT SYSTEM

The Laboratory's Integrated Safety Management System (ISMS) integrates management of the environment (i.e., environmental protection and pollution prevention), safety, and health issues into all work planning. BNL's ISMS contributed to BNL being the first Laboratory under the DOE Office of Science to achieve registration under both the International Organization for Standardization (ISO) 14001 Standard (for the Laboratory's Environmental Management System) and the Occupational Safety and Health Assessment Series (OHSAS) 18001 Standard (for the Laboratory's Safety and Health Program). Both standards require an organization to develop a policy, create plans to implement the policy, implement the plans, check progress and take corrective actions, and review the system periodically to ensure its continuing suitability, adequacy, and effectiveness.

### ENVIRONMENTAL AWARDS

One measure of an effective EMS is recognition of good environmental performance. In 2009, BNL was recognized with the following awards:

- DOE awarded BNL a Pollution Prevention (P2) STAR Honorable Mention for pollution prevention practices for Total Nitrogen Reduction at the Laboratory's Sewage Treatment Plant using on-site cafeteria wastes.
- BNL received its third Silver Level Award for Electronics Recycling from the Office of the Federal Environmental Executive for reusing or recycling approximately 81,000 pounds of electronics.



## NSF International Strategic Registrations

789 North Dixboro Road, Ann Arbor, Michigan 48105  
(888) NSF-9000

### Certificate of Registration

This certifies that the Environmental Management System of

### Brookhaven National Laboratory

Building 860  
E. 5th Street

Upton L.I., New York, 11973-5000 USA

has been assessed by NSF-ISR and found to be in conformance to the following standard(s):

### ISO 14001:2004

#### Scope of Registration:

Facilities, experiments, and operations managed by Brookhaven Science Associates at Brookhaven National Laboratory in accordance with the Environmental Management System.

#### Industrial Classification:

IAF: 34  
SIC: 8733  
NACE:



Certificate Number: 69525-E4  
Certificate Issue Date: 10-Dec-2007  
Company Initial Date: 10-Jul-2001  
Registration Date: 18-Jun-2007  
Expiration Date\*: 17-Jun-2010

Christian B. Lupo, General Manager  
NSF-ISR, Ltd.

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An Environmental Management System (EMS) was established at BNL in 2001 to ensure that environmental issues are systematically identified, controlled, and monitored. The Laboratory's EMS also provides mechanisms for responding to changing environmental conditions and requirements, reporting on environmental performance, and reinforcing continual environmental improvement. Annual independent audits, which are required to maintain the registrations, are conducted to validate that these standards are being maintained and to identify evidence of continual improvement. In 2009, an EMS and OHSAS surveillance audit determined that the Laboratory continues to conform to these standards.

The planning requirements of the ISO 14001 Standards require BNL to identify the environmental aspects and impacts of its activities, products, and services; to evaluate applicable legal and other requirements; to establish objectives and targets; and to create action plans to achieve the objectives and targets.

To implement compliance commitments and legal requirements, BNL has systems in place to review changes in federal, state, or local environmental regulations and to communicate those changes to affected staff. DOE Order 450.1A, Environmental Protection, established federal requirements for pollu-

tion prevention, reduction of toxic chemical use, purchase of environmentally preferred products, electronic stewardship, and the implementation of an Environmental Management System (EMS). The Laboratory's EMS objectives and targets have been established to mirror these requirements.

DOE Order 430.2B, Departmental Energy, Utilities, and Transportation Management, established federal requirements for certain criteria, and requires an annual certification and submission of an Executable Plan. The Executable Plan provides a roadmap on how the Laboratory intends to meet these requirements. Both orders incorporate the goals of Executive Order 13423, Strengthening Federal Environmental, Energy and Transportation Management.

Executive Order 13514, signed in 2009, sets sustainability goals for federal agencies and focuses on making improvements in their environmental, energy, and economic performance. It also requires federal agencies to set a 2020 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 products and technologies. These requirements will direct the future of BNL's EMS program and most have already been incorporated within the program.

# 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 Laboratory activities may have on the environment. An overview of BNL's environmental programs and a summary of performance for 2009 follows:

## POLLUTION PREVENTION PROGRAM

BNL's Pollution Prevention (P2) Program reflects the national and DOE pollution prevention goals and policies, and represents an ongoing effort to make pollution prevention and waste minimization an integral part of the Laboratory's operating philosophy. The overall goal of the P2 Program is to create a systems approach that integrates pollution prevention and waste minimization, resource conservation, recycling, and affirmative procurement into all planning and decision making.

An important function of the P2 Program is to seek funding to implement pollution prevention projects. Five P2 proposals were funded in 2009, for a combined investment of approximately \$24,000. The anticipated annual savings from these projects is estimated at \$33,650, for an average payback period of approximately 0.7 years. The BNL P2 and recycling programs have achieved significant reductions in waste generated by routine operations. This continues a positive trend and is further evidence that pollution prevention planning is well integrated into the Laboratory's work planning process.

The implementation of pollution prevention opportunities, recycling programs, and conservation initiatives has significantly reduced both waste volumes and management costs. In 2009, these efforts resulted in more than \$5.5 million in cost avoidance or savings and approximately 17.9 million pounds of materials being reduced, recycled, or reused annually.

The Laboratory also has an active and successful solid waste recycling program, which involves all employees. In 2009, BNL collected more than 127 tons of office paper for recycling. Cardboard, bottles and cans, construction debris, motor oil, scrap metals, lead, automotive batteries, electronic scrap, fluorescent light bulbs, drill press machine coolant, and antifreeze were also recycled.

## ENERGY MANAGEMENT AND CONSERVATION

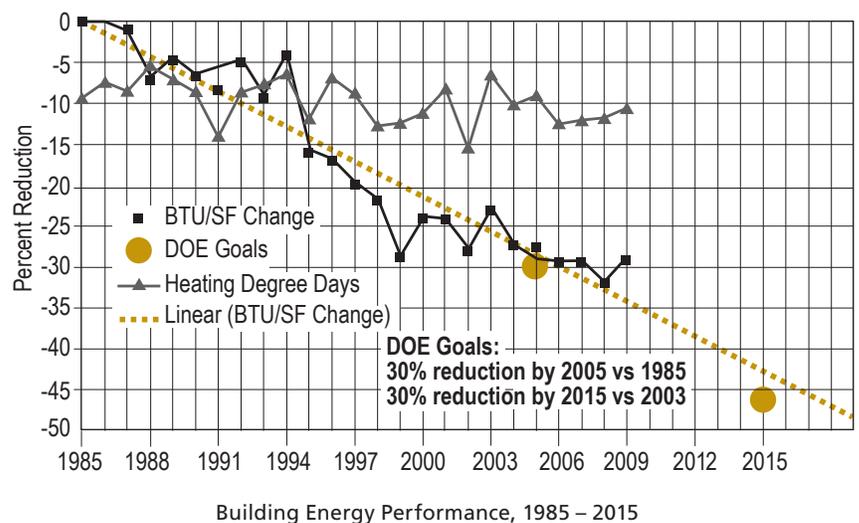
Since 1979, BNL's Energy Management Group has been working to reduce energy use and costs by identifying cost-effective, energy-efficient projects, monitoring energy use and utility bills, and assisting in obtaining the least expensive energy sources possible. The group is responsible for developing, implementing, and coordinating BNL's Energy Management Plan and assisting DOE in meeting the energy goals in DOE Order 430.2B and the Secre-

tary's Transformational Energy Action Management (TEAM) initiative.

The Laboratory has more than 4 million square feet of building space. In 2009, BNL used approximately 257 million kilowatt hours (kWh) of electricity, 2.8 million gallons of fuel oil, 36 thousand gallons of propane, and 257 million cubic feet of natural gas. Due to market conditions, fuel oil and natural gas were used whenever each respective fuel was least expensive.

BNL is a participant in the New York Independent System Operator (NYISO) Special Case Resource Program, which is an electric load reduction curtailment program. Through this program, the Laboratory has agreed to reduce 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 reduced on each curtailment day. The Laboratory continues to keep electric loads at a minimum during the summer, by scheduling some operations during cooler weather to avoid peak demand periods. This scheduling allowed the Laboratory to save \$4.5 million in electric costs in 2009 and greatly helps maintain the reliability of the Long Island Power Authority (LIPA) electric system to meet all of its users' needs.

LIPA issued a Request for Proposals in 2008 for 50 MW of solar photovoltaic (PV) generating projects. The construction of a 32 MW solar array at the Laboratory site by BP Solar was one of two projects selected by LIPA for development and is expected to provide a substantial renewable source of power for LIPA customers.



BNL also maintains a contract with the New York Power Authority (NYPA) that resulted in an overall cost avoidance of \$26 million in 2009. The Laboratory will continue to seek alternative energy sources to meet its future energy needs, support federally required “green” initiatives, and reduce energy costs.

Federal agencies must apply energy conservation measures and improve federal building design to reduce energy consumption per square foot. Current goals are to reduce energy consumption per square foot, relative to 2003, by 2 percent per year from FY06–FY15. In 2007, an Executive Order increased the target reduction to 3 percent per year, which is a 30 percent reduction by the end of FY2015. Further, DOE Order 430.2B and the Secretary’s TEAM initiative have set even more stringent requirements, including renewable energy and transportation fuels that go significantly beyond the previous goal of a 30 percent reduction by 2005, compared to 1985. As shown on the chart on the previous page, BNL’s energy use per square foot in 2009 was over 30 percent less than in 1985 and 8 percent less than in 2003.

To reduce energy use at non-research facilities, other activities also were undertaken in 2009. These activities included:

- Continued development of a sitewide Utility Energy Services Contract (UESC) that will reduce the Laboratory’s overall energy intensity (Btu/ft<sup>2</sup>) by 11 percent and will save over \$2 million/year in energy costs.
- 25 MW of demand was rescheduled to avoid coinciding with the utility summer peak, saving several million dollars in electricity charges.
- A demonstration project for a solar hot water combination system at BNL’s Brookhaven Center is nearly complete.
- Work continued in the replacement of aging, inefficient T-40 fluorescent lighting fixtures with new, efficient T-8 and T-5 units; two to three hundred fixtures are typically replaced annually, saving tens of thousands of kWhs and reducing costs by several thousand dollars.
- Due to continued conservation efforts, overall facilities energy usage for FY09 was approximately 8 percent less than in FY03, saving over \$1.8 million.
- Efficient fuel purchasing strategies (buying and storing oil and burning the least expensive fuel) saved over \$2 million, compared to purchasing only oil as it is consumed.
- Over 25,000 gge (gasoline gallon equivalents) of natural gas were used in place of gasoline for the Laboratory’s vehicle fleet.

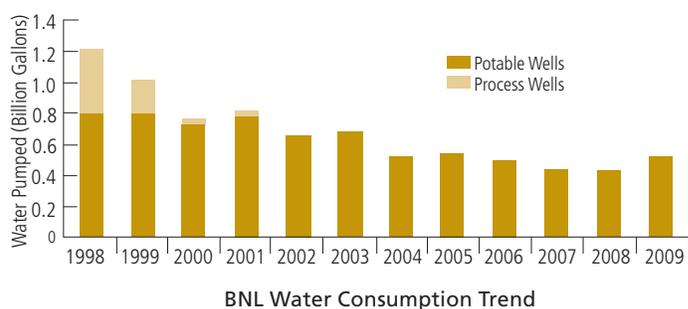
BNL is working on its annual Executable Plan (soon to be called the Strategic Sustainability Performance Plan [SSSP]) for energy, transportation, and water management. The plan includes strategies, energy costs, and indicators and goals, including energy use/square foot and an overall carbon reduction of 28 percent. The plan will also document the Laboratory’s efforts to reduce energy use and costs to the lowest cost-effective levels.

In February 2009, the New York Power Authority (NYPA) agreed to provide 15 MW of low-cost hydropower to BNL, for a period of up to 15 years. Estimated savings are approxi-

mately \$8 million per year. In addition, the hydropower will help stabilize electric rates and keep them competitive with other DOE Laboratories.

### WATER CONSERVATION PROGRAM

BNL’s water conservation program has achieved dramatic reductions in water use since the mid 1990s. The Laboratory continually evaluates water conservation as part of facility upgrades or new construction initiatives. The goal is to reduce the consumption of potable water and reduce the possible impact of clean water discharges on BNL’s Sewage Treatment Plant operations. The slight rise in 2009 was due to a failed thermostatic control valve at BNL’s Collider-Accelerator department. During the past 8 years, water consumption at the Laboratory was less than half the 1998 total—a reduction of nearly a half-billion gallons per year.



### WASTE MANAGEMENT PROGRAM

BNL generates a large range of wastes. These wastes include materials common to many businesses and industries, such as aerosol cans, batteries, paints, and oils. However, the Laboratory’s unique scientific activities also generate waste streams that are subject to additional regulation and special handling, including radioactive, hazardous, and mixed waste.

Collecting, storing, transporting, and disposing of waste generated at the Laboratory is the responsibility of BNL’s Waste Management organization. Key to the management of wastes generated is the Waste Management Facility. This modern facility was designed for handling hazardous, industrial, radioactive, and mixed waste and is comprised of three staging areas: a facility for hazardous waste, regulated by the Resource Conservation and Recovery Act (RCRA); a mixed-waste building for material that is both hazardous and radioactive; and a reclamation building for radioactive material. The RCRA and mixed-waste buildings are managed under a permit issued by the New York State Department of Environmental Conservation. These buildings are used for short-term storage of waste before it is packaged or consolidated for off-site shipment to permitted treatment and disposal facilities.

### COMPLIANCE MONITORING PROGRAM

BNL has an extensive program in place to ensure compliance with all applicable environmental regulatory and permit requirements. The Laboratory must comply with more than 100 sets of federal, state, and local environmental regulations,

numerous site-specific permits, 17 equivalency permits for the operation of 14 groundwater remediation systems, and several other binding agreements. Instances of noncompliance are reported to regulatory agencies and corrected expeditiously.

In 2009, emissions of nitrogen oxides, carbon monoxide, and sulfur dioxide from BNL's Central Steam Facility were all within permit limits. There were 24 individual opacity excursions noted.

Approximately 1,232 pounds of ozone-depleting refrigerants were recovered from refrigeration equipment for reuse by other DOE facilities or federal agencies. These reductions included the disposition of eight cylinders of Halon 1301 from fixed fire suppression systems removed from operation and eight cylinders of Halon 1301 associated with portable fire extinguishing systems. These materials have been transferred to storage for shipment to the Department of Defense Ozone Depleting Substances Reserve.

Monitoring of the Laboratory's potable water supply showed that all drinking water quality requirements were met in 2009. Most of the liquid effluents discharged to surface water and groundwater met applicable State Pollutant Discharge Elimination System (SPDES) permit requirements; however, two minor excursions occurred during the year and were reported to New York State Department of Environmental Compliance (NYSDEC) and the Suffolk County Department of Health Services (SCDHS). Groundwater monitoring at BNL's Major Petroleum Facility continued to demonstrate that current oil storage and transfer operations are not affecting groundwater quality.

The Laboratory continues to reduce the number and severity of spills on site. In 2009, there were 11 reportable spills of petroleum products, antifreeze, or chemicals. While the total number of spills increased by two from 2008, the severity of releases was less. All releases were cleaned up to the satisfaction of NYSDEC.

Nine external environmental audits were conducted in 2009 by federal, state, and local agencies that oversee BNL activities.

- NYSDEC conducted its formal inspection of the Laboratory's air compliance program; there were no violations noted. However, NYSDEC issued a warning notice in October for failure to report opacity violations within 2 days of the date of occurrence.
- NYSDEC conducted its annual inspection of BNL's Major Oil Storage Facility. Four conditions that required corrective action included: painting some sections of tank 611-06 and associated piping; provide confirmation that all "tell-tails" are inspected and documented properly; registration and follow-up inspection of a new 1,000 gallon aboveground bio-diesel tank; and evaluation of the cathodic protection system servicing tanks 611-03, 611-05, and 611-06, to ensure that it is providing adequate protection. In addition, an inspection of the Laboratory's underground storage facilities and other smaller satellite fuel storage tanks identified the need to conduct and document testing of the automatic line-leak detectors for the tanks located at BNL's on-site service station. All conditions have been corrected.



- NYSDEC conducted an inspection of BNL's Chemical Bulk Storage facilities. Three issues were identified that required corrective action: the need to paint a section of tank 635-01; re-calibration or replacement of remote level gauges associated with tanks 624-05 thru -08; and properly terminating the atmospheric vent associated with tank 634-02 within the tank containment area. These issues were corrected in accordance with the NYSDEC request.
- SCDHS collected samples and conducted its annual inspection of the BNL potable water system; no issues were identified.
- SCDHS conducted quarterly inspections of the Laboratory's Sewage Treatment Plant to evaluate operations and sample the effluent; no performance or operational issues were identified.
- SCDHS inspected several of BNL's SPDES-regulated outfalls and collected samples; no issues were identified.

Each year, several DOE assessments and inspections are performed at BNL. The DOE Brookhaven Site Office (BHSO) and the DOE Chicago Office evaluated the Laboratory's readiness to declare conformance to DOE Order 450.1A in December 2008. This order, along with its companion DOE Order 430.2B, established new requirements for DOE facilities in the areas of energy and water conservation, improved fleet management, and other sustainable practices. Order 450.1A requires DOE facilities to have an EMS that includes objectives and targets supporting the sustainability goals of the order, and the energy, water, fleet, and other goals of Order 430.2B. Overall, the assessment found that the EMS culture at BNL was strong due to the prior long-term establishment of an ISO 14001-registered EMS, and is clearly in conformance with DOE Order 450.1A. The Laboratory formally declared its conformance to these new requirements in April 2009. In addition, the DOE Chicago Office conducted an assessment of BNL's Environmentally Preferable Purchasing (EPP) program as part of the BHSO independent oversight program. The findings of this assessment indicated that, although an improvement plan was prepared with actions to comply with the requirements related to the EPP requirements of DOE Order 450.1A, BNL was behind schedule on implementation of the actions. While the Laboratory committed to have all ac-

tions completed by early October 2009, one action remained opened at the end of 2009. This action, to revise and issue a procurement subject area which includes requirements for EPP, was not completed until 2010.

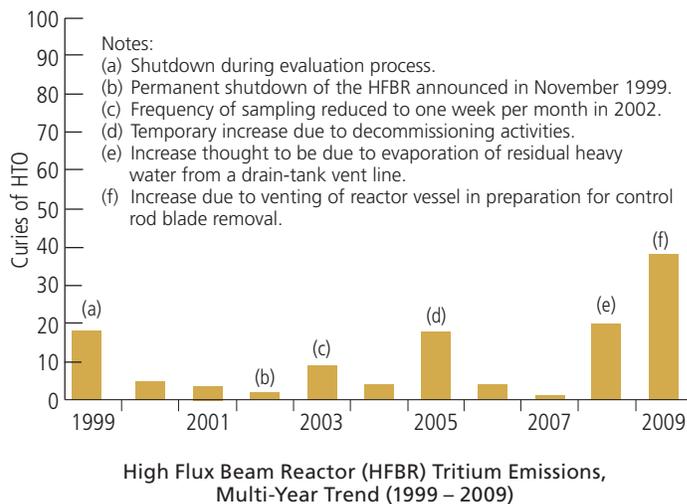
BNL conducted a programmatic self-assessment on several aspects of its environmental management program. The self-assessment focused on requirements related to properly managing wastes generated at the Laboratory, including hazardous, industrial, mixed, radioactive, radioactive-regulated medical waste, and regulated medical waste. During the self-assessment, two Noteworthy practices, seven Nonconformances, and three Observations were noted. A corrective action plan was prepared to address the non-conformances.

### AIR QUALITY PROGRAM

BNL monitors radioactive emissions at three facilities on site to ensure compliance with the requirements of the Clean Air Act. During 2009, Laboratory facilities released a total of 1,833 curies of short-lived radioactive gases. The Environmental Protection Agency (EPA) 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 sampling. Although the dose to the public is less than 0.1 mrem and monitoring is not required by EPA, BNL's Brookhaven Linear Isotope Producer (BLIP) is continuously monitored. Oxygen-15 (half-life: 122 seconds) and carbon-11 (half-life: 20.48 minutes) emitted from the BLIP constituted more than 97.9 percent of radiological air emissions on site in 2009. The combined emissions were approximately 31 percent lower than 2008 levels, due to operation at lower energy levels.

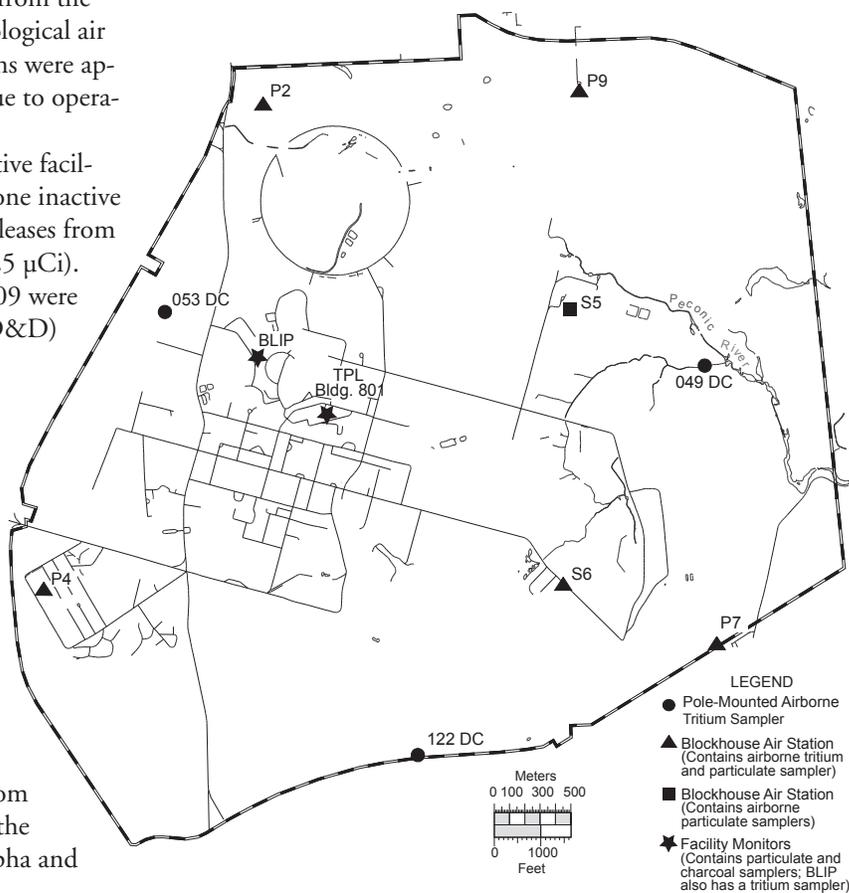
Monitoring was also conducted at one other active facility, the Target Processing Laboratory (TPL), and one inactive facility, the High Flux Beam Reactor (HFBR). Releases from the TPL in 2009 continued to be very small (0.025  $\mu$ Ci). The rise in tritium releases from the HFBR in 2009 were due to decontamination and decommissioning (D&D) activities that included the removal of control rod blades; draining of tritiated heavy water from the reactor vessel, piping systems, and the fuel canal; and the opening of contaminated piping systems to allow for the removal of residual volumes of tritiated heavy water. From 2002 through 2008, emissions from the HFBR facility were monitored at a frequency of one week per month. In 2009, the monitoring frequency was increased to bi-weekly to better account for changes in tritium emissions during the D&D activities.

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 2009 continued to demonstrate that on-site radiological air qual-



ity was consistent with off-site measurements and 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 monitoring to demonstrate compliance with emission limits. BNL's Central Steam Facility (CSF) is the only facility that requires monitoring. Two of the four boilers at the CSF are equipped with continuous emission monitors to measure opacity and nitrogen oxide (NO<sub>x</sub>) emissions. Opacity levels cannot exceed 20 percent, except for one 6-minute period per hour of



BNL On-Site Ambient Air Monitoring Stations

not more than 27 percent opacity. In 2009, there were no exceedances of the NO<sub>x</sub> emission standards for either boiler.

In 2009, opacity measurements in Boiler 6 were exceeded during 16 periods. Twelve excess opacity readings occurred during an initial soot blowing cycle after the boiler was brought on line while combusting natural gas. Since opacity readings began to rise immediately after the boiler was fired with natural gas, it appears that the natural cleansing affect of natural gas caused these opacity excursions. Four other excess opacity readings were the result of dust build-up on the optical head assembly, and subsequent cleaning of the assembly returned opacity levels back to normal. Changes in the sequence of the soot blowing cycle for Boilers 6 and 7 have proven effective in eliminating most opacity exceedances due to soot blowing.

Because natural gas prices were lower than residual fuel oil prices from May through December 2009, BNL used natural gas for most heating and cooling needs during these months. As a result, annual facility emissions of particulate matter, nitrogen oxides, and sulfur dioxide were considerably lower than in years when residual fuel oil was predominantly used.

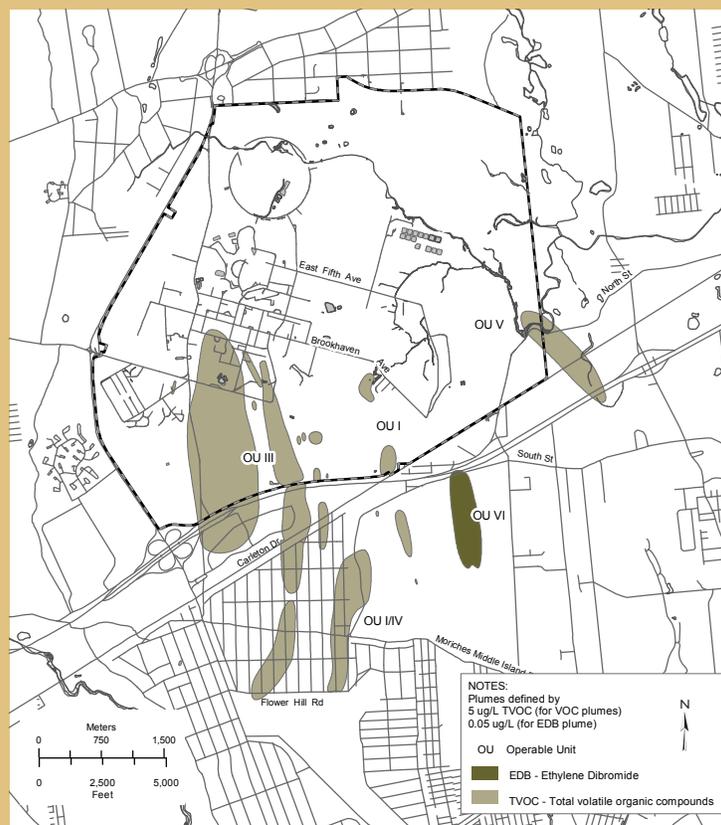
### GROUNDWATER PROTECTION PROGRAM

The mission of the Laboratory's Groundwater Protection Program is to protect and restore the aquifer system at BNL. The four key elements that make up the program are:

- Pollution prevention – preventing the potential pollution of groundwater at the source.
- Monitoring - monitoring the effectiveness of pollution-prevention efforts, as well as progress in restoring the quality of degraded groundwater.
- Restoration - restoring groundwater quality that BNL has impacted.
- Communication - communicating the findings and the results of the program to regulators and other stakeholders.

BNL's extensive groundwater monitoring well network is used to evaluate progress in restoring groundwater quality, to comply with regulatory permit requirements, to monitor active research and support facilities, and to assess the quality of groundwater that enters and exits the site. The Laboratory monitors research and support facilities where there is a potential for environmental impact, as well as areas where past waste handling practices or accidental spills have already degraded groundwater quality. In 2009, the Laboratory collected groundwater samples from 806 on- and off-site monitoring wells during 1,800 individual sampling events.

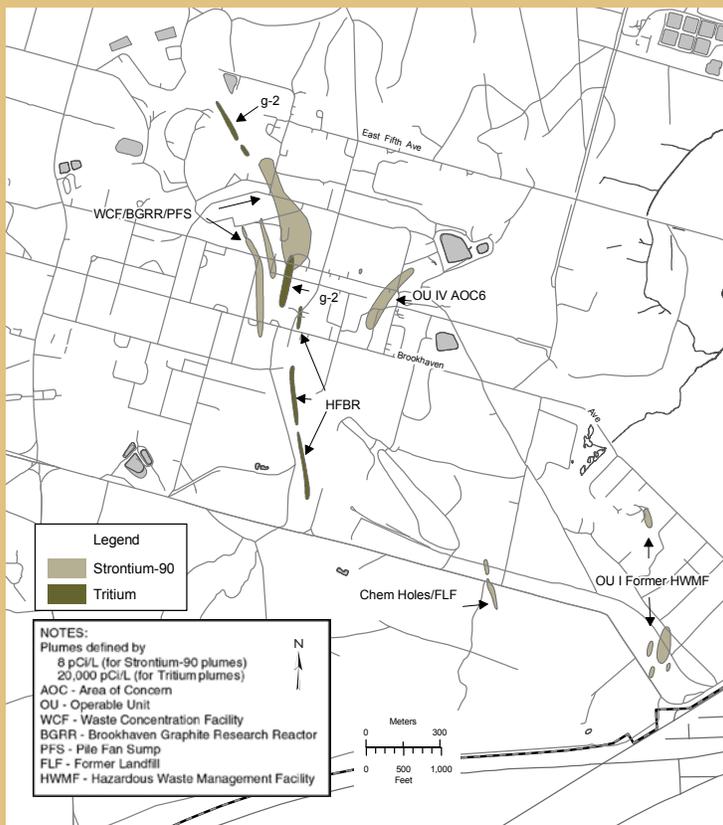
Under the environmental surveillance program, 10 active research and support facilities were monitored during 2009. Although no new impacts to groundwater quality have been discovered since 2001, groundwater quality continues to be impacted from past releases at two facilities: the former g-2 experiment within the Alternating Gradient Synchrotron (AGS) facility, and the Upton service station facility. Tritium continues to be detected at concentrations above the 20,000 pCi/L drinking water standards (DWS) in wells monitoring the g-2 source area. A short-term spike in tritium levels was observed in October 2009, and appears to be related to the flushing of



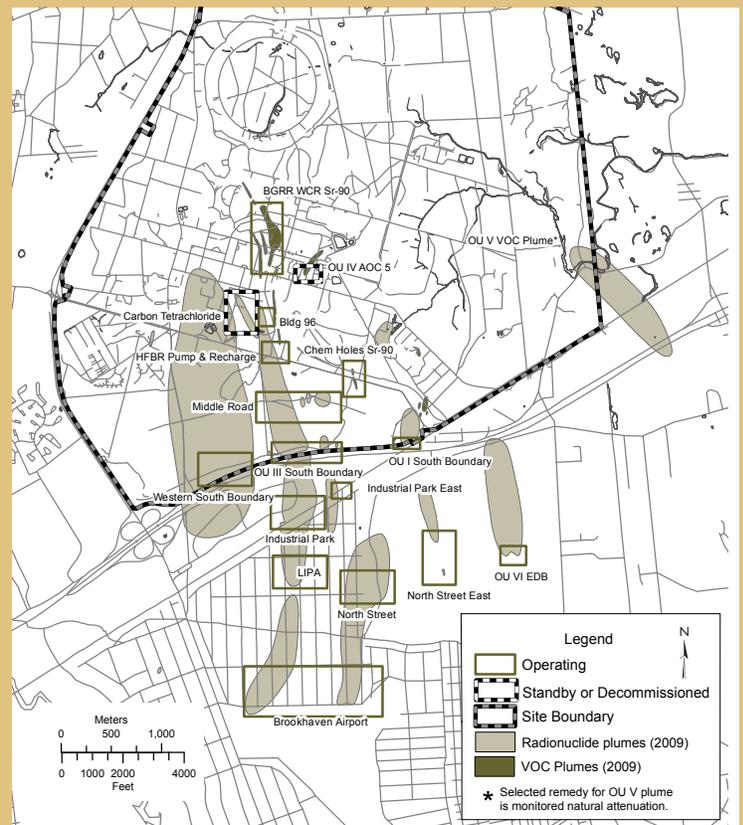
Extent of Volatile Organic Compound Plumes.

residual tritium from the deep vadose zone following significant natural periodic fluctuations in the local water table. As a result of natural radioactive decay and dispersion in the aquifer, the g-2 tritium plume is breaking up into discrete segments. At the Upton service station, volatile organic compounds (VOCs) associated with historical petroleum and solvent spills continue to be detected in the groundwater at concentrations above the applicable DWS. The levels of VOCs are expected to decrease over time by means of natural attenuation.

The primary mission of the Laboratory's Comprehensive Environmental Response, Compensation and Liability Act (CERCLA) groundwater program is to operate and maintain groundwater treatment systems and prevent additional groundwater contamination from migrating off site. During 2009, BNL continued to make significant progress in restoring groundwater quality with the removal of approximately 229 pounds of VOCs and approximately 1.9 mCi of strontium-90 (Sr-90) with the treatment of more than 1.6 billion gallons of groundwater. To date, 6,363 pounds of VOCs have been removed from the aquifer, and noticeable improvements in groundwater quality are evident in the Operable Unit (OU) I South Boundary, OU III South Boundary, OU III Industrial Park, OU III Industrial Park East, OU III North Street, OU IV, Building 96, and Carbon Tetrachloride areas. OU locations are designated as part of the CERCLA program to identify significant known or potential source areas of contamination. For each OU, a feasibility study was conducted to analyze and evaluate cleanup alternatives. Also to date, two of the treat-



Extent of Radionuclide Plumes On Site.



Locations of BNL Groundwater Remediation Systems.

ment systems have removed approximately 21 mCi of Sr-90.

Annually, a comprehensive report is issued detailing the results from groundwater samples collected to monitor the environmental remediation efforts, the effectiveness of the treatment systems, and environmental surveillance of current BNL experiments and operations. The report is issued as the Groundwater Status Report, Volume 2, of the Site Environmental Report.

### WATER QUALITY SURVEILLANCE PROGRAM

BNL discharges treated wastewater into the headwaters of the Peconic River via the Sewage Treatment Plant (STP), and non-contact cooling water and storm water runoff to groundwater via recharge basins. Some wastewater may contain very low levels of radiological, organic, or inorganic contaminants. Monitoring, pollution prevention, and careful operation of treatment facilities ensure that these discharges comply with all applicable requirements and that the public, employees, and the environment are protected.

To assess the potential impact of discharges on the water quality of the Peconic River, surface water monitoring is conducted at several locations upstream and downstream of the STP discharge. The Carmans River, located to the west of BNL, is monitored as a geographical control location for comparative purposes, as it is not affected by Laboratory operations.

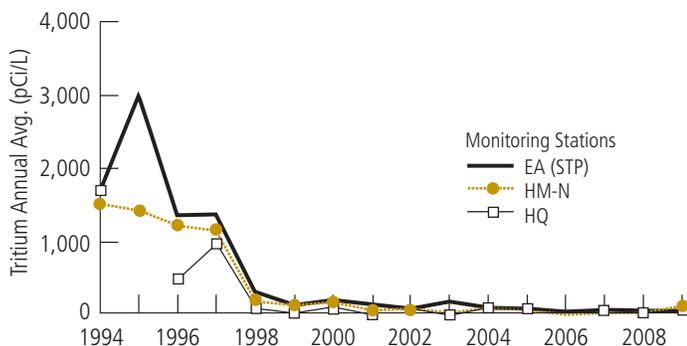
In 2009, the average gross alpha and beta activity levels in the STP discharge were well below drinking water standards

(DWS). Tritium was detected only once in the STP effluent at a concentration above the minimum detectable activity (490 pCi/L), which is less than 3 percent of the DWS. Although this was a low level of detection, it may have been attributed to work to ready BNL's High Flux Beam Reactor (HFBR) for decontamination and decommissioning. Tritium was also detected twice in the influent, but at levels just above the minimum detectable activity. In 2009, analysis of the STP effluent and the Peconic River continued to show no detections of cesium-137 (Cs-137), strontium-90 (Sr-90), or other gamma-emitting nuclides attributable to BNL operations.

The STP is also monitored for nonradiological contaminants. In 2009, nonradiological monitoring of the STP effluent showed that, except for isolated incidents of noncompliance, organic and inorganic parameters were within State Pollutant Discharge Elimination System (SPDES) effluent limitations or other applicable standards. Two volatile organic compounds (VOCs), methyl chloride and acetone, were detected in the STP effluent, but at very low levels.

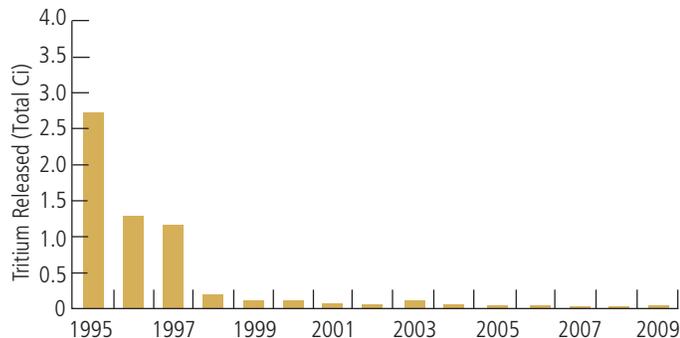
Discharges to recharge basins are sampled throughout the year for analyses of gross alpha and beta activity, gamma-emitting radionuclides, and tritium. Each recharge basin is a permitted point-source discharge under the Laboratory's SPDES permit. In 2009, there were no reported gamma-emitting nuclides attributable to BNL operations in any discharges to the recharge basins. Tritium was detected in a single sample at a very low level, but with high uncertainty. This basin receives discharges from BNL's Collider-Accelerator complex.

Low concentrations of disinfection byproducts were periodically detected in discharges to several of the basins throughout the year. Sodium hypochlorite and bromine, used to control bacteria in the drinking water and algae in on-site cooling towers, lead to the formation of VOCs, including bromoform, chloroform, dibromochloromethane, and dichlorobromomethane. Bromoform and acetone were detected above the minimum detection level for most recharge basins. In most instances, acetone was also found as a contaminant in the contract analytical laboratory, as evidenced by detections in blank samples.

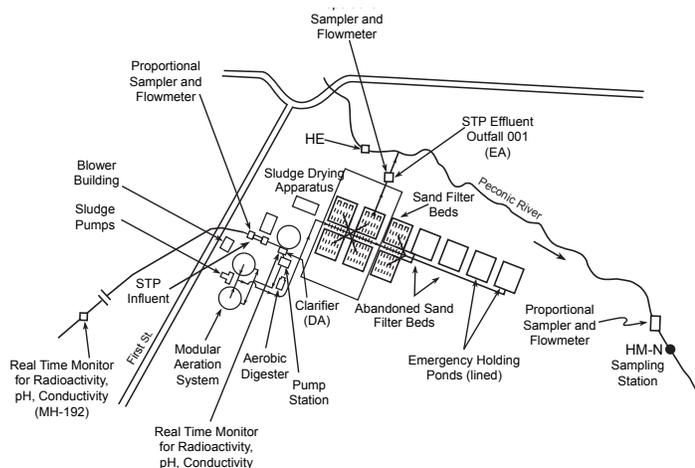


Notes:  
 NYS Drinking Water Standard is 20,000 pCi/L.  
 See sampling stations on page 17.

Sewage Treatment Plant/Peconic River  
 Annual Average Tritium Concentrations, (1994–2009)



Tritium Released to the Peconic River, 15-Year Trend, (1994–2009)



Schematic of BNL's Sewage Treatment Plant (STP)

## RADIOLOGICAL DOSE ASSESSMENT PROGRAM

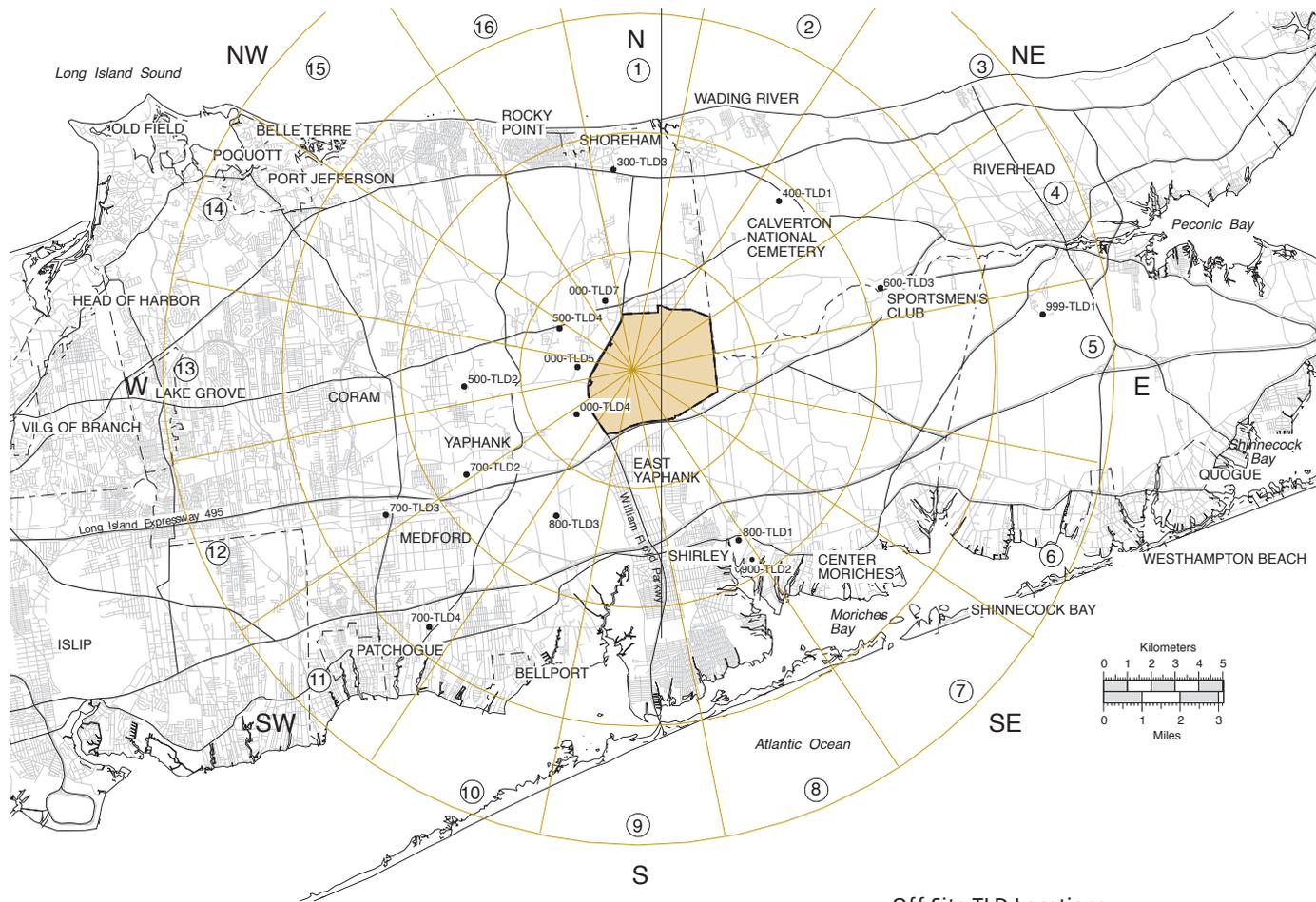
BNL routinely assesses its operations to ensure that any potential radiological dose to members of the public, BNL workers, visitors, and the environment is “As Low As Reasonably Achievable” (ALARA). The potential radiological dose is calculated as the largest possible dose to a hypothetical Maximally Exposed Individual (MEI) at 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 Environmental Protection Agency (EPA) and DOE regulatory dose limits for the public and the environment. The dose impact from all BNL activities in 2009 was comparable to natural background radiation levels.

To measure direct radiation from Laboratory operations, thermoluminescent dosimeters (TLDs) are used. TLDs used at BNL contain calcium fluoride and lithium fluoride crystals. Accuracy is verified by exposing a TLD to a known source of radiation. Fifty-eight TLDs are placed on site and 14 TLDs are placed in surrounding communities. An additional 30 TLDs are placed in a lead-shielded container for use as reference and control TLDs for comparison purposes. In 2009, the average doses from all TLDs showed there was no additional contribution to on- and off-site locations from Laboratory operations.

The annual on-site external dose from all potential sources, including cosmic and terrestrial radiation, was  $71 \pm 10$  mrem ( $710 \pm 100$   $\mu$ Sv), and the annual off-site external dose was  $67 \pm 7$  mrem ( $670 \pm 70$   $\mu$ Sv). The effective dose to the MEI from air emissions was  $7.20E-2$  mrem ( $0.72$   $\mu$ Sv). The ingestion pathway dose was estimated as  $7.10$  mrem ( $71$   $\mu$ Sv) from consumption of deer meat and  $0.17$  mrem ( $1.7$   $\mu$ Sv) from consumption of fish caught in the vicinity of the Laboratory. The total dose to the MEI from all pathways was estimated as  $7.34$  mrem ( $73$   $\mu$ Sv). The dose from the air inhalation pathway attributable to BNL operations was less than 1 percent of EPA's annual regulatory dose limit of 10 mrem ( $100$   $\mu$ Sv), and the total dose was less than 8 percent of DOE's annual dose limit of 100 mrem ( $1,000$   $\mu$ Sv) from all pathways. Doses to aquatic and terrestrial biota were also evaluated and found to be well below the regulatory limits.

As a part of the National Emission Standards for Hazardous Air Pollutants (NESHAPs) review process at BNL, any source that has the potential to emit radioactive materials is evaluated for regulatory compliance. In 2009, the following radiological sources were evaluated for potential contribution to the overall site dose:

- A preliminary NESHAP evaluation was performed in 2008 for the removal of the graphite pile and bioshield at BNL's Brookhaven Graphite Research Reactor (BGRR). In 2009, based on the results of waste characterization studies, smear results, and radiological inventory of the graphite pile and biological shield, the effective dose equivalent to the MEI from this project was estimated to be  $1.33E-02$  mrem/year. The facility will be continuously monitored for radionu-



Off-Site TLD Locations

clides during the removal of these materials, which is expected to be completed by 2011.

- Underground waste lines, which were abandoned in 1961, were used to transfer radioactive liquid waste from the BNL Hot Laboratory in Building 801 to the Waste Concentration Facility. In 2009, remediation work began on the removal of the waste transfer lines, steam line, soil below the pipes, a portion of the concrete culvert, and the non-acid off-gas pipe under the High Flux Beam Reactor (HFBR). The effective dose equivalent to the MEI from this project was estimated to be  $1.38\text{E-}03$  mrem/year.
- A NESHAPS compliance review for venting of the radioactive gases used in the gallium trichloride experiment in Building 555 was performed. A conservative estimate of effective dose equivalent to the MEI was estimated to be  $2.37\text{E-}08$  mrem/year.
- An investigation and characterization of the Brookhaven Avenue cesium-137 contamination at the Waste Loading Area within the former Hazardous Waste Management Facility was reviewed for compliance to determine the source term. The effective dose equivalent to the MEI was estimated to be  $6.67\text{E-}05$  mrem/year.
- A NESHAPS dose assessment was performed for the potential release of carbon-11 (half-life: 20 minutes) in an “Accident” scenario for inclusion in the Safety Analysis Report of BNL’s cyclotron. A conservative estimate of effective

dose equivalent to the MEI was estimated to be  $2.64\text{E-}04$  mrem/year.

- The HFBR reactor vessel, primary cooling water system, and fuel canal were drained in 2009. Control rod blades and beam plugs were also removed and shipped off site to a licensed disposal facility. Tritium levels in the reactor building were much higher than in previous years due to the remediation work being performed. The effective dose equivalent to the MEI for tritium was estimated to be  $1.92\text{E-}4$  mrem/year.
- A new stack was installed at the Brookhaven Linear Isotope Producer (BLIP) facility in order to comply with American National Standards Institute standards. In addition, a new emission sampling system was installed and will be tested during 2010.

#### NATURAL AND CULTURAL RESOURCE MANAGEMENT PROGRAM

The BNL 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, conducting research, and communicating with the public, stakeholders, and staff members regarding environmental issues. Precautions are taken to protect and enhance

habitats and natural resources on site. Activities to eliminate or minimize negative effects on sensitive or critical species (such as the eastern tiger salamander, eastern hognose snake, and banded sunfish) are incorporated into procedures or into specific programs or project plans. Restoration efforts continue to remove pollutant sources that could contaminate habitats. In some cases, habitats are enhanced to improve survival or increase populations. The Laboratory also monitors and manages other wildlife populations, such as white-tailed deer and Canada geese.

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

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 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 or formal health advisories are warranted. Testing of deer bones for strontium-90 (Sr-90) indicated background levels. Sr-90 is present in the environment at background levels as a result of worldwide fallout from nuclear weapons testing.



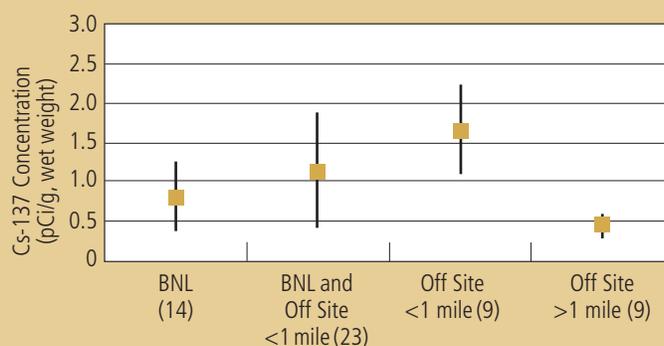
Eastern Hognose Snake (*Heteroden platyrhinos*).



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

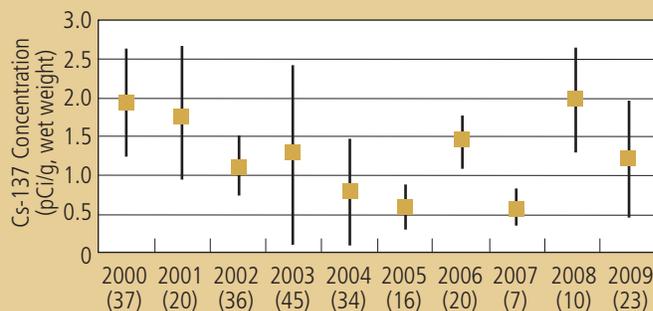


Eastern Tiger Salamander (*Ambystoma t. tigrinum*).



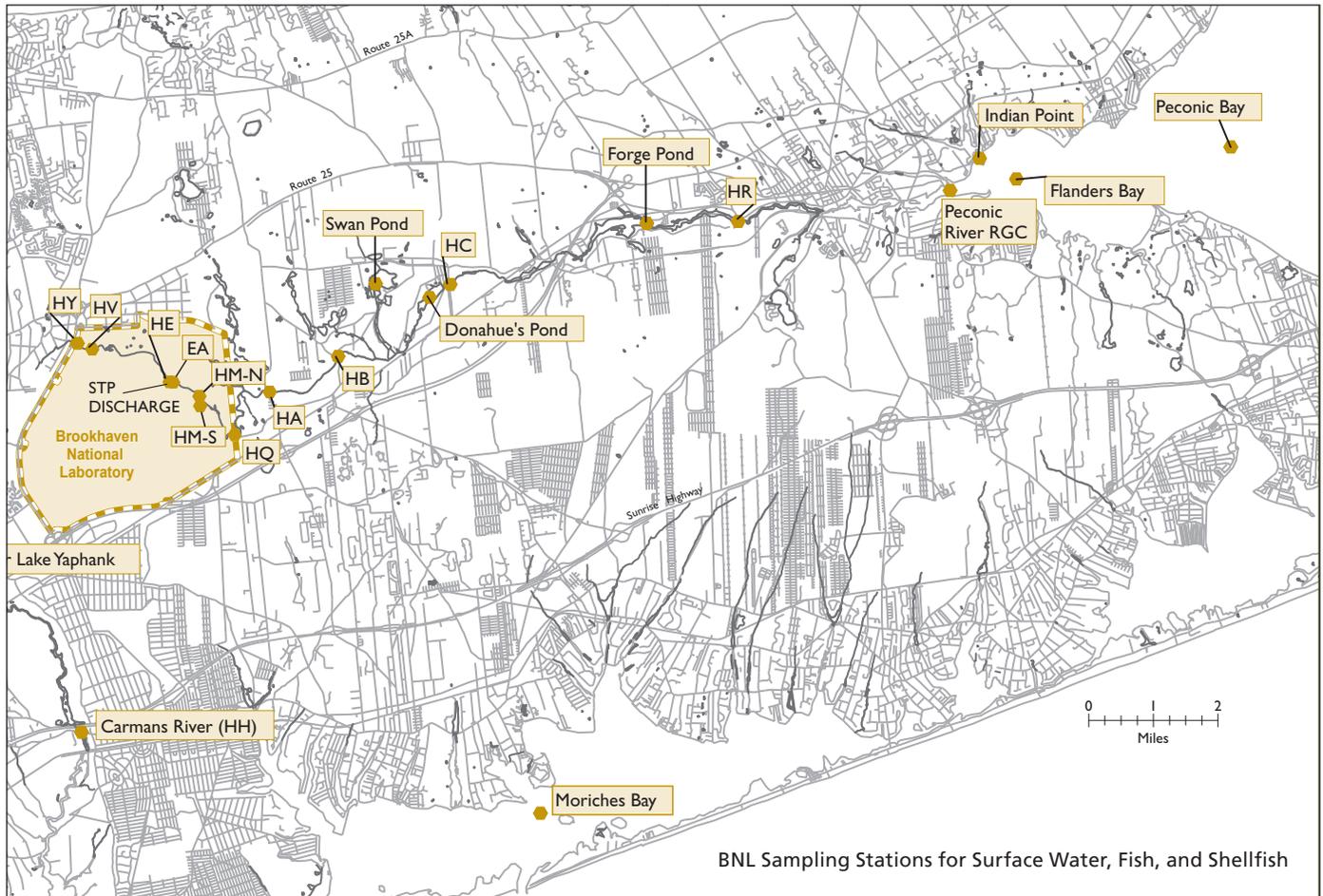
Notes: Averages are shown for samples collected at BNL, on site and off site within 1 mile, off site but within a 1-mile radius, and off site greater than a 1-mile radius. Numbers in parentheses indicate the number of samples in that data set. All values are shown with a 95% confidence interval.

#### Comparison of Cesium-137 Average Concentrations in Deer, 2008



Notes: Averages are shown for samples collected at BNL, and within 1 mile. Numbers in parentheses indicate the number of samples in that data set. All values are shown with a 95% confidence interval.

#### Ten-Year Trend of Cesium-137 Concentrations in Deer Meat at BNL and within 1 Mile of BNL



In 2009, Cs-137 was detected at low levels in all but two samples of fish collected from the Peconic River and appears to be declining compared with historic values. The cleanup of both on- and off-site portions of the Peconic River in 2004 and 2005 removed approximately 88 percent of Cs-137 in the river sediment that was co-located with mercury contamination. Natural decay and the removal of this contamination are expected to result in further decreases.

Nonradiological analysis of fish in 2009 indicated that all concentrations for metals are considered safe and do not pose any health risks to humans or other animals that may consume fish. Due to its known health risk, mercury is the metal of most concern. A trend of decreasing mercury content downstream from BNL's Sewage Treatment Plant (STP) is evident. Pesticide analysis in fish was discontinued in 2008, since several years of sampling detected pesticides in only a few fish far off site. Polychlorinated biphenyl (PCB) analysis in fish was also discontinued off site, but continued to be performed for fish on site. Two fish samples tested positive for PCBs. Historically, PCBs have been found in both fish and sediment at BNL and periodically at other locations in the Peconic River. The cleanup of the Peconic River has removed most PCBs within the sediments on site.

Annual sampling of sediment, vegetation, and water in the Peconic River and a control location on the Carmans River was conducted in 2009. On- and off-site aquatic vegetation

and sediments contained low levels of Cs-137 and metals in amounts that were consistent with levels detected in previous years.

Under the Peconic River remediation project, sediment from the Peconic River was remediated to remove mercury and associated contaminants from the river. Most samples in 2009 met BNL's mercury cleanup goal of 2.0 mg/kg. Five samples in a known area of higher mercury concentrations were sampled; one sample exceeded the cleanup goal. Sediment sampling was also conducted to evaluate elevated water column mercury concentrations at one station within the Peconic River and identified a small section of the river on site which will receive cleanup in 2010.

Water column sampling for mercury and methylmercury was performed at 20 Peconic River sampling locations, BNL's STP and one reference location on the Connetquot River in 2009. Along the Peconic River, the general trend of total mercury in water samples decreased with increasing distance downstream from the STP. Methylmercury concentrations increased slightly from the STP to the site border; then decreased downstream of the site border.

A five-year periodic confirmatory sampling of local farm vegetables was completed in 2009. Samples from vegetables grown in the BNL garden plot continue to support historic analyses that there are no Laboratory-generated radionuclides in on-site produce.

## UPTON ECOLOGICAL AND RESEARCH RESERVE

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

Research in 2009 included continued investigation into the microbial world of soils located within a number of the earlier established Forest Health Plots and experimental areas at BNL. Microbial research carried out by a scientist at Dowling College in 2007 identified several new species of fungus and bacteria that had not previously been known. In 2008, the work was expanded to develop a microbial community profile of the Pine Barrens. This work has resulted in a small National Science Foundation Grant to further investigate and isolate new bacteria. The work will continue in 2010, with genetic analysis of the microbes to further refine the microbial community structure. Additional work included an aquatic invertebrate survey of the Carmans River and the development of a DVD documenting the various sampling protocols used within the Open Space Stewardship Program sponsored by the Office of Education 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 2009, BNL and FERN hosted 19 interns and one faculty member who worked on a variety of projects, some of which include: invertebrate distribution surveys of the Carmans River, small mammal and flying squirrel surveys, the quantification of nitrogen in soils, and surveying dragonflies and damselflies.

Research on dragonflies species continued in 2009 with teachers including: a comparative study between their diversity and water quality and vegetation of man-made and man-modified ponds, and genetic variations of species between ponds at BNL; determining the effects of lunar cycles on night active birds, such as whippoorwill and other nightjars; work to develop and conduct a bathymetric study of Lake Arrowhead on the Baiting Hollow Boy Scout Camp; and a GIS study of BNL's contours and sanitary systems. These studies are designed to help teachers develop out-of-classroom experience for their students that meet state curriculum requirements.

## *Cultural Resource Management Program*

The goal of BNL's Cultural Resource Management Program (CRMP) 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 2009 included two field studies to evaluate the proposed

Long Island Solar Farm project site; an archaeological survey on 33 acres formally occupied by the World War I Camp Upon Remount Facility, in order to assess the overall potential of the area for the presence of cultural resources; an architectural and archeological data recovery/assessment of a standing Civilian Conservation Corps era privy; identifying and relocating artifacts from BNL's Brookhaven Graphite Research Reactor and High Flux Beam Reactor; and outreach activities, including a presentation on the Laboratory's cultural resources and tours of the on-site WWI trenches.



### 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.

## COMMUNICATION AND COMMUNITY INVOLVEMENT

Communication and community involvement are commitments under BNL's EMS. The Laboratory maintains relationships with its 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 facilitate effective dialogue between the Laboratory and key 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 and regulatory agencies on environmental and operational issues, as well as on scientific discoveries and initiatives. The Community Advisory Council (CAC), established by BNL in 1998, advises the Laboratory Director, primarily on environmental, health, and safety issues related to the Laboratory that are of importance to the community. The CAC is composed of approximately 27 member organizations representing business, civic, education, employee, community, environmental, and health organizations. The CAC sets its own agenda in cooperation with the Laboratory and meets monthly in sessions that are open to the public. Weekly phone calls with regulators keep them up-to-date on project status, obtain feedback and input, and provide an opportunity to discuss emerging environmental findings and obtain feedback and input on them. The Community Relations Office website is used to host links to important cleanup documents and to announce public meetings.

The Community Relations Office manages several outreach programs that provide opportunities for stakeholders to become familiar with the Laboratory's facilities and research projects and new initiatives, while helping to identify issues of concern in the community. The Envoy Program educates employee volunteers regarding Laboratory issues and provides a link to local community organizations. Feedback shared by Envoys helps BNL gain a better understanding of local community concerns. The Speakers' Bureau Program provides speakers for educational and other organizations, such as Rotary Clubs, civic organizations, and professional societies, to update the community about Laboratory research and/or operations, including environmental efforts and cleanup status. The Summer Sundays Program enables the public to visit BNL science facilities,

experience hands-on activities, and learn about research projects and environmental stewardship initiatives.

In 2009, BNL stakeholders had the opportunity to provide input for three projects that were subject to public participation notice. These projects included: a Notice of Intent to Modify, issued by New York State Department of Environmental Restoration that established a public comment period on the renewal of the Laboratory's State Pollutant Discharge Elimination System permit; a Notice of Availability announcing that the Final Operable Unit III Explanation of Significant Differences for the Building 96 Remediation, which established a change to the cleanup remedy, was complete; and a legal notice announcing the completion of an Environmental Assessment and Finding of No Significant Impact (FONSI) to construct and operate a solar array project on site.

The Community Relations Office also provides lunchtime tours each month to offer employees the opportunity to learn about the Laboratory's science facilities, program areas, and activities outside the scope of their jobs. Brown bag lunch meetings, held periodically with employees, have covered topics on Laboratory research, history, cleanup project status, and newly proposed initiatives. Specifics topics of interest, such as health benefits or wildlife management concerns, have also been covered.

BNL's Media and Communications Office issues press releases and publishes *The Bulletin*, a weekly employee newsletter. A Director's Office web-based publication is issued bi-weekly, focusing on topics important to the Laboratory. BNL maintains an informative website at <http://www.bnl.gov>, where these publications, as well as extensive information about science and operations, past and present, are posted. Employees and the community can also subscribe to the Laboratory's e-mail update service at <http://lists.bnl.gov/mailman/listinfo/bnl-announce-1>.

In addition, BNL participates in various annual events, such as a week-long celebration in honor of Earth Day, Earth Day Festivals, and the Brookhaven Town's Longwood Fair. These events are hosted by the Environmental Protection Division.

Working closely with the community, employees, elected officials, and regulatory agency representatives, DOE and BNL continue to openly share information on issues and projects and provide feedback on how that input was used.

*Summer Sundays at BNL ▶*



*Annual "Your Environment" Art Contest ▼*





One of many events BNL hosts each year in honor of Earth Day is the "Your Environment" art contest. Students from local schools in grades 3-5 are asked to create a poster focusing on a specific environmental theme. The winning students receive a \$100 gift check and all students who enter receive a Certificate of Participation.

The winning posters for this year's contest were created by

- a) Joseph Schneider, Charles E. Walter Elementary School;
- b) Robert Russo, Coram Elementary School;
- c) Deasha Loftin, Frank P. Long Intermediate School;
- d) Carolyn Formichelli, Ridge Elementary School;
- e) Gabrielle Kaufman, West Middle Island Elementary School; and
- f) Madison Steedman, Verne W. Critz Elementary School.

