2004

Site Environmental Report

BROOKHAVEN NATIONAL LABORATORY

Summary

ABOUT THE COVER

The beautiful photograph on the front and back cover of this report was taken by Dr. Tim Green, Natural and Cultural Resources Manager, at Brookhaven National Laboratory (BNL). The cover design and report layout was prepared by Patricia Yalden of the Photography & Graphic Arts Division.

The water lily serenely depicted in this photograph was taken at Zeke's Pond, a coastal plain pond located on site. As part of the recent Peconic River cleanup at BNL, summer intern students relocated fish and wildlife to the pond and its surrounding area, providing them with a pristine and undisturbed environment in which to thrive. Ecology research being conducted at Zeke's pond includes studying its water and soil chemistry, and the make-up of its biotic community.

The 2004 Site Environmental Report (SER) Summary provides highlights from the Brookhaven National Laboratory 2004 SER full report. The report and summary are written to meet the requirements and guidelines of the U.S. Department of Energy and the informational needs of the public.

The full report is available on compact disc included with this summary and both the full report and the summary are available on line at http://www.bnl.gov/esd/ser.asp. For additional copies of this summary, please write or call:

Brookhaven National Laboratory
Environmental & Waste Management Services Division
Attention: SER Project Coordinator
Building 120
P.O. Box 5000
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A MESSAGE FROM THE LABORATORY DIRECTOR

In 2004, the Laboratory made great progress under its environmental management program. BNL's Environmental Management System (EMS) is the Laboratory's commitment to environmentally responsible operations. The cornerstone of an EMS is a Laboratory Environmental Stewardship Policy. In 2004, BNL incorporated the principles of its previous Laboratory-wide Environmental Stewardship Policy into a comprehensive Environmental, Safety, Security, and Health (ESSH) Policy. I signed this policy to make clear BNL's commitments to environmental stewardship, the safety of its employees, and the security of the site. A recertification audit of our EMS in June determined that BNL remains in conformance, and the auditors highlighted five examples of continual improvement since the Laboratory achieved this globally recognized International Organization for Standardization (ISO) 14001 Environmental Management Standard in 2001.

BNL operations led to several awards from a diverse stakeholder group, including an EPA Environmental Quality Award, a DOE Office of Science Best in Class Award, DOE's Pollution Prevention Award, a White House Closing the Circle Award, a DOE Office of Science Pollution Prevention Award, a Long Island Pine Barrens Society Award, and the Evelyn Liblit Environmental Stewardship Award. In addition, the Laboratory was accepted into the EPA's Performance Track Program, which recognizes top environmental performance among participating U.S. facilities. This program is EPA's "gold standard" for facility-based environmental performance. I am proud of these achievements, which represent additional evidence that the Laboratory's EMS is working.

BNL's pollution prevention program continues to be a success. To date, pollution prevention projects have saved more than $1.6 million and resulted in the reduction or reuse of approximately 2.2 million pounds of waste. In 2004, the Laboratory invested approximately $86,000 in eight new pollution prevention proposals, which are expected to save the Laboratory approximately $60,500 annually, with an average payback period of 1.3 years.

In 2004, BNL continued to clean up contaminated soil and groundwater on site. Since the beginning of active groundwater remediation in 1996, the Laboratory has removed 4,808 pounds of chemicals from the aquifer by treating approximately 8.4 billion gallons of groundwater.

Under the Laboratory's Environmental Restoration Program, legacy issues continue to be addressed. With the input of BNL's key stakeholders and the community, significant progress was made to advance cleanup projects in 2004. In March, cleanup of portions of the Peconic River, both on and off the site, began. Remediation plans include the removal, treatment, and disposal of sediment containing contaminants such as mercury and PCBs. The long-term plan includes habitat restoration and long-term monitoring of surface water, sediment, and fish. Also, in August, a draft plan for the cleanup of the Brookhaven Graphite Research Reactor (BGRR) was submitted to the community for comment.

These are just some of the highlights of the achievements and advances made within BNL's environmental management program in 2004. The Laboratory, with the help of our stakeholders and community, will continue to deliver on our commitment to environmental performance in 2005 and beyond.

Praveen Chaudhari,
Laboratory Director

2004

Site Environmental Report Summary

BROOKHAVEN NATIONAL LABORATORY

PREFACE

Each year, Brookhaven National Laboratory (BNL) prepares an annual Site Environmental Report (SER) in accordance with the U.S. Department of Energy (DOE) Order 231.1A, Environment, Safety and Health Reporting. The report

is written to inform the public, regulators, Laboratory employees, and other stakeholders of BNL's environmental performance during the calendar year in review. The report summarizes the Laboratory's environmental data; environmental management performance; compliance with applicable DOE, federal, state, and local regulations; and restoration and surveillance monitoring programs. BNL has prepared SERs since 1971 and has documented nearly all of its environmental history since the Laboratory's inception in 1947.

This summary provides a general overview of the SER for 2004 and includes the full report on CD, which can be found on the inside back cover of this booklet. The summary is intended for public distribution in support of BNL's educational and community outreach and as part of DOE's commitment to conveying environmental performance to people living near DOE facilities and to other interested stakeholders. Both the full report and the summary also are available as downloadable files on the BNL web page at http://www.bnl.gov/esd/SER.asp.

EXPLORING EARTH'S MYSTERIES
...PROTECTING ITS FUTURE

BNL'S ENVIRONMENTAL, SAFETY, SECURITY, AND HEALTH POLICY

BNL's Environmental, Safety, Security, and Health (ESSH) Policy is signed by the Laboratory director and posted throughout the site. Specific environmental commitments in the policy include compliance, pollution prevention, cleanup, community outreach, and continual improvement.

BROOKHAVEN NATIONAL LABORATORY

Environmental, Safety, Security, and Health Policy

This policy is consistent with BNL's research interests, ethics, and shared values.

We commit to continual improvement in environmental, safety, security, and health (ESSH) performance. We will set goals, measure progress, and communicate results. Compliance with this policy is the responsibility of every employee, contractor, and guest. Specifically, we commit to the following:

- **Employees, Contractors and Guests:** We will provide a safe and healthy workplace, striving to prevent injuries and illnesses, promoting healthy lifestyles, and encouraging respect for the environment. We will ensure our employees, contractors, and guests have the awareness, skills, and knowledge to carry out this policy.
- **Compliance:** We will meet all applicable ESSH laws and BNL Standards Based Management System, Integrated Safety Management, and Integrated Safeguards and Security Management requirements.
- **Integration:** We will integrate ESSH principles into our research and operations activities. We will integrate hazard prevention/reduction, pollution prevention/waste minimization, resource conservation, security, and compliance into all of our planning and decision-making. We will adopt cost-effective practices that eliminate, minimize, or mitigate environmental impacts and control safety, security, and health risks and vulnerabilities.
- **Security:** We will work in compliance with DOE's ISSM Program and systematically integrate safeguards and security into management and work practices at all levels, so that the laboratory missions are accomplished in a safe and secure manner.
- **Sustainable Development:** We will strive to conserve resources and minimize or eliminate adverse ESH effects and risks that may be associated with our research and operations. We will manage our programs in a manner that protects the ecosystem and employee/public health.
- **Stakeholders:** We will work with our stakeholders to help them address their ESSH needs. We will maintain a positive, proactive, and constructive relationship with our neighbors in the community, regulators, DOE, and our other stakeholders. We will openly communicate with stakeholders on our progress and performance.
- **Community and Government:** We will participate in community and government ESSH initiatives. We will define, prioritize, and aggressively prevent, correct, and/or clean up existing environmental, security, and occupational safety and health problems.

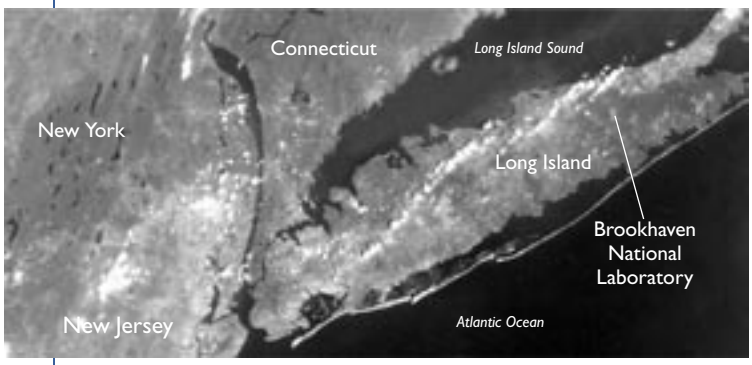
In addition to my annual review of BNL's progress on ESSH goals and adherence to this policy, I invite all interested parties to provide me with input on our performance relative to this policy, and the policy itself.

Praveen Chaudhari

April 19, 2004
Praveen Chaudhari, *Director*

ABOUT BROOKHAVEN NATIONAL LABORATORY

Brookhaven National Laboratory is one of ten national laboratories overseen and primarily funded by the Office of Science of the U.S. Department of Energy. The Laboratory conducts research in the physical, biomedical, and environmental sciences, as well as in energy technologies and national security. BNL also builds and operates major scientific facilities that are available to university, industry, and government researchers. BNL is operated and managed by Brookhaven Science Associates (BSA), a limited-liability company founded by Stony Brook University, the largest academic user of Laboratory facilities, and Battelle, a nonprofit, applied science and technology organization, under a performance-based contract. From 1947 to 1998, BNL was operated by Associated Universities Incorporated. Prior to



Satellite photo showing location of BNL. The small circle is the Relativistic Heavy Ion Collider (RHIC).

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.

BNL's broad mission is to produce world-class science in a safe and environmentally sound manner with the cooperation, support, and appropriate involvement of its scientific and local communities. The Laboratory has a staff of approximately 2,700 scientists, engineers, technicians, and support staff, and over 4,000 guest researchers visit annually.

The fundamental elements of the Laboratory's role in support of the four DOE strategic missions are the following:

- 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 develop advanced technologies that address national needs and initiate their transfer to other organizations and to the commercial sector.
- To disseminate technical knowledge to educate future generations of scientists and engineers.
- To maintain technical capabilities in the nation's workforce and 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. Approximately 150 people live in apartments on site, and many of the scientists and students who visit each year stay in the Laboratory's dormitories. More than 75 percent of BNL's employees live in Suffolk County.

BNL is one of the five largest high-tech employers on Long Island. With an annual budget of approximately $454 million, the Laboratory has a major, positive economic impact on Long Island and New York State. An independent Suffolk County Planning Commission concluded that BNL's spending for operations, procurement, payroll, construction, medical benefits, and technology transfer spreads throughout Long Island's economy, making BNL vital to the local economic health. BNL's total procurement budget in 2004 was approximately $160 million. In 2004, BNL purchased $26.7 million worth of supplies and services from Long Island businesses. Approximately $22.4 million was spent on 3,000 purchases in Suffolk County, and approximately $4.3 million went toward 507 purchases made in Nassau County. In addition, Laboratory employees do most of their personal shopping locally. Employee salaries, wages, and fringe benefits account for almost 61 percent, or about $279 million, of the Laboratory's total annual budget.

Research and Discoveries at BNL

BNL is home to many world-class research facilities and scientific departments which attract resident and visiting scientists in many fields from all over the world. To date, six Nobel Prizes have been awarded to BNL researchers and scientists associated with BNL (http://www.bnl.gov/bnlweb/history/nobel/). Listed below are just some examples of current research and discoveries at the Laboratory. Further information can be found at http://www.bnl.gov/bnlweb/research_list.asp.

BNL's National Synchrotron Light Source is a major user facility, drawing close to 2,500 visiting researchers each year. They use the Light Source's intense beams of x-rays and ultraviolet light to carry out a wide range of studies in diverse scientific fields.

The Positron Emission Tomography (PET) facility is used to conduct brain research, including how drugs, mental illness, nicotine, alcohol, and even normal aging affect the brain.

A view of the superconducting magnets at BNL's Relativistic Heavy Ion Collider. As gold particles zip along the collider's 2.4 mile long tunnel at nearly the speed of light, 1,740 of these magnets guide and focus the particle beams.

Examples of Current Research

- Investigation of new nanostructures, objects on the scale of a billionth of a meter
- High-temperature superconductors, materials that, below a certain temperature, conduct electricity with no resistance
- New states of matter being produced at the Relativistic Heavy Ion Collider
- Nanoparticles that may lead to catalytic converters that are better at cleaning auto exhaust
- Medical imaging techniques to investigate the brain mechanisms underlying drug addiction
- New methods of understanding the earth's climate
- Research into how infections begin, which may lead to better prevention in the future

BNL Discoveries

- L-dopa, used to treat Parkinson's disease
- Magnetically levitated (maglev) trains
- Pioneering work using X-rays and neutrons to study biological specimens, leading to the modern science of structural biology
- The radionuclide thallium-201, used in hundreds of thousands of heart stress tests each year
- The radionuclide technetium-99m, used to diagnose heart disease and other ailments
- X-ray angiography for noninvasive heart imaging
- Pioneering solar neutrino studies seeking the answer to the mystery of the "missing" neutrinos from our solar system's sun, and neutrino bursts from supernovae
- The strong focusing principle, crucial to the function of all modern particle accelerators

Aerial photograph of the BNL site

BNL Facilities and Operations

The Laboratory's 5,265 acres are mostly wooded and part of the native Long Island Pine Barrens ecosystem. Most of BNL'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 U.S. Army (as part of Camp Upton) and still used for offices and other operational buildings
- 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
- 200 acres occupied by large, specialized research facilities

Construction of the Center for Functional Nanomaterials (CFN) is planned to start in the spring of 2005, with building occupancy and technical equipment installation to begin in early 2007. One of five nanotechnology centers approved by DOE, it will provide researchers with state-of-the-art capabilities to fabricate and study nanoscale materials. The existing major scientific facilities at BNL are briefly described on the following page. The three former research reactors (the Brookhaven Graphite Research Reactor, the High Flux Beam Reactor, and the Brookhaven Medical Research Reactor) are no longer operating. Other facilities, which are briefly described below, support BNL's science and technology mission by providing basic utility and environmental services. All of the research and support facilities must undergo periodic environmental review as part of BNL's Environmental Management Program.

- 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. 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 facility for reuse, to conserve water and energy.
- Fire Station. The BNL Fire Rescue Group provides on-site fire suppression, emergency medical services, hazardous material response, salvage, and property protection. The fire rescue group responds within 5 minutes to any emergency in the core area of the Laboratory and within 8 minutes to emergencies in the outer areas (Relativistic Heavy Ion Collider and eastern portions of the site).
- Major Petroleum Facility. This facility provides reserve fuel for the Central Steam Facility during times of peak operation. With a total capacity of 2.3 million gallons, the facility stores primarily No. 6 fuel oil. The 1997 conversion of the facility's boilers to burn natural gas as well as oil has significantly reduced BNL's reliance on oil as a fuel source.
- Sewage Treatment Plant. This facility treats sanitary and certain process wastewater from BNL facilities prior to discharge into the Peconic River, similar to the operations of a municipal sewage treatment plant. 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.
- Waste Concentration Facility. This facility was previously used for the receipt, processing, and volume reduction of aqueous radioactive waste. At present, the facility houses equipment and auxiliary systems required for the storage and transfer of Liquid Low-Level Radioactive Waste.
- Waste Management Facility. This facility is a state-of-the-art complex for managing the wastes generated from BNL's research and operations activities. It was built with advanced environmental protection systems and features, and began operation in December 1997.
- Water Treatment Plant. The potable water treatment facility has a capacity of 5 million gallons per day. Potable water is obtained from six on-site wells. Three wells located along the western boundary of the site are treated with a lime softening process to remove naturally occurring iron. The plant is also equipped with dual air-stripping towers to ensure that volatile organic compounds are below New York State drinking water standards. Three wells located along the eastern section of the developed site are treated with carbon to ensure that volatile organic compound levels meet the drinking water standards. BNL's water met all drinking water standards in 2004.

Major Scientific Facilities at BNL

- *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 metals ions, and 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. Current RHIC experiments include the Solenoidal Tracker at RHIC (STAR), a detector used to track particles produced by ion collisions; the PHENIX detector, used to record different particles emerging from collisions; the Broad Range Hadron Magnetic Spectrometer (BRAHMS), used to study particles as they pass through detectors; and PHOBOS, an experiment based on the premise that when new collisions occur, new physics will be readily identified.
- *Alternating Gradient Synchrotron (AGS).* The AGS is a particle accelerator used to propel protons and heavy ions to high energies for physics research. The AGS is capable of accelerating protons and heavy ions, such as gold and iron. The Linear Accelerator, part of the AGS complex, 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. This new facility is used to simulate the harsh cosmic and solar radiation environment found in space.
- *Linear Accelerator (Linac) and Brookhaven Linac Isotope Producer (BLIP).* The Linac provides beams of polarized protons for the AGS and RHIC. The excess beam capacity is 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.
- *Heavy Ion Transfer Line (HITL).* The HITL connects the Tandem Van de Graaff and the AGS Booster. This interconnection enables the transport of ions of intermediate mass to the AGS Booster, where they are accelerated before injection into the AGS. Ions are then extracted and sent to the AGS experimental and RHIC areas for physics research.
- *Radiation Therapy Facility (RTF).* Part of the Medical Research Center, the RTF is a high energy dual x-ray mode linear accelerator used for radiation therapy for cancer patients. This accelerator delivers therapeutically useful beams of x-rays and electrons for conventional and advanced medical radiotherapy techniques.
- *Brookhaven Medical Research Reactor (BMRR).* The BMRR was the world's first nuclear reactor built exclusively for medical research and therapy. It produced neutrons in an optimal energy range for experimental treatment of a type of brain cancer known as glioblastoma multiforme. The BMRR was shut down in December 2000 due to a reduction in medical research funding.
- *Scanning Transmission Electron Microscope (STEM).* The STEM facility includes two microscopes, STEM 1 and STEM 3, used for biological research. Both devices allow scientists to see the intricate details of living things, from bacteria to human tissue.
- *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, enable scientists to perform a large variety of experiments.
- *High Flux Beam Reactor (HFBR).* The HFBR was one of the premier neutron physics research facilities in the world. Neutron beams produced at the HFBR were used to investigate the molecular structure of materials, which aided in pharmaceutical design, materials development, and expanded the knowledge base of physics, chemistry, and biology. The HFBR was permanently shut down in November 1999.
- *Tandem Van de Graaff and Cyclotron.* These accelerators are used in medium energy physics investigations and for producing special nuclides. The Tandem Van de Graaff accelerators are used to bombard materials with ions for manufacturing and testing purposes, and supply the RHIC with heavy ions. The cyclotrons, operated by the Chemistry Department, are used for the production of radiotracers for use in Positron Emission Tomography (PET) and Magnetic Resonance Imaging (MRI) studies.
- *Brookhaven Graphite Research Reactor (BGRR).* The BGRR was the first peace-time reactor to be constructed in the United States following World War II. It was used for scientific exploration in the fields of medicine, biology, chemistry, physics, and nuclear engineering. The BGRR is currently being decommissioned under the Environmental Restoration Program.

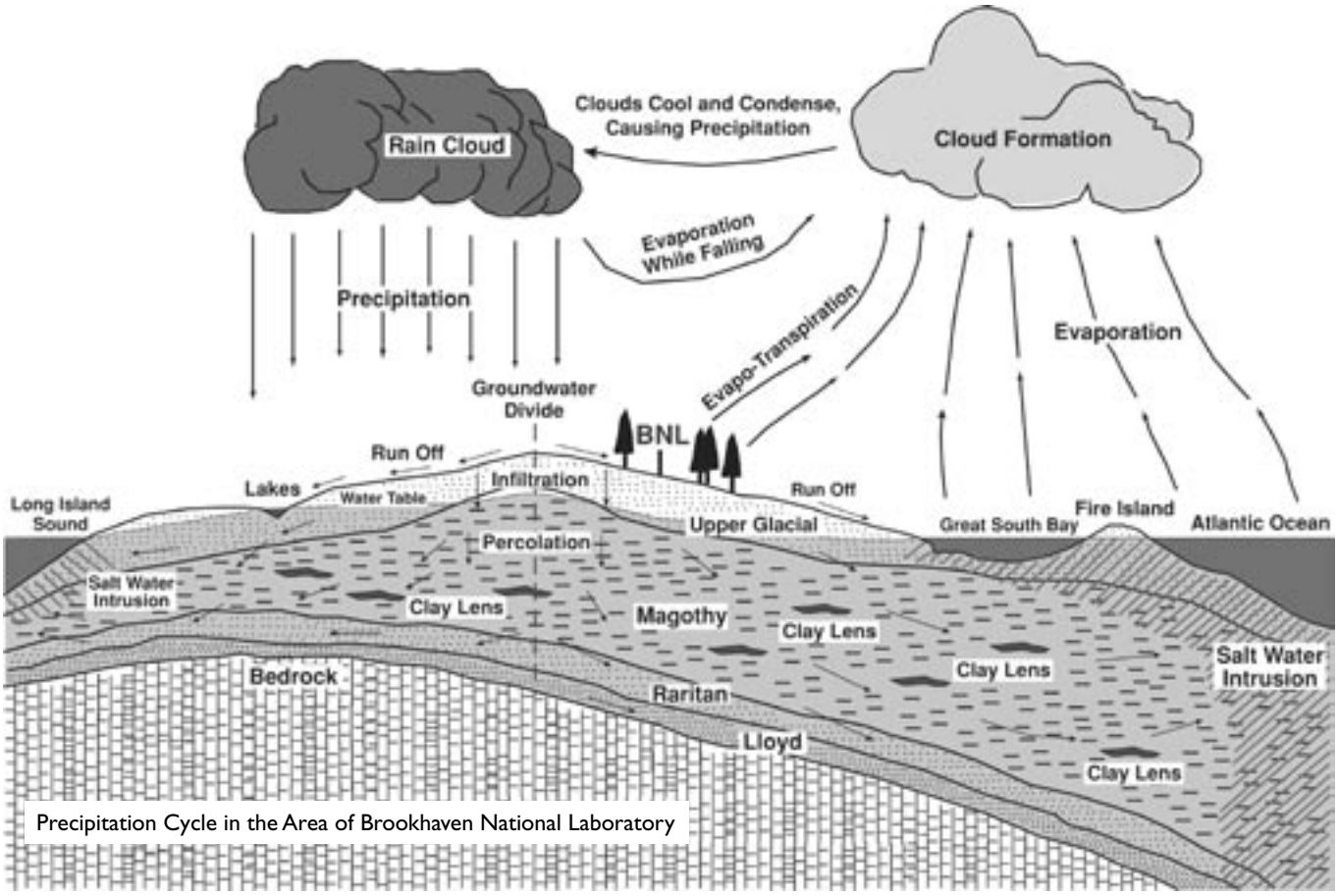
Hydrology and Geology of the BNL Site

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 sole source aquifer system beneath Long Island. Long Island's aquifer system is one of 72 sole source aquifers in the nation recognized under the aquifer protection program authorized by the U.S. Safe Drinking Water Act.

The terrain of the BNL site is gently rolling, with elevations varying between 44 and 120 feet above mean sea level. Depth to groundwater from the land surface ranges from 5 feet near the Peconic River to about 80 feet in the higher elevations of the central and western portions of the site. The hydrology and geology of the local area are well defined. Studies in the vicinity of the Laboratory indicate that the uppermost Pleistocene deposits, composed of highly permeable glacial sands and gravel, are between 120 and 250 feet thick. Water penetrates these deposits readily and there is little direct runoff into surface streams unless precipitation is intense. These sandy deposits store large quantities of water in the Upper Glacial aquifer. On average, about half of the annual precipitation is lost to the atmosphere through evapotranspiration and the other half percolates through the soil to recharge the groundwater.

The BNL site overlaps a deep-flow recharge zone for Long Island groundwater. Precipitation and surface water that recharge within this zone have the potential to replenish the deep Magothy and Lloyd aquifer systems lying below the Upper Glacial aquifer. It is estimated that up to 40 percent 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. This groundwater system is the primary source of drinking water for both on- and off-site private and public supply wells.

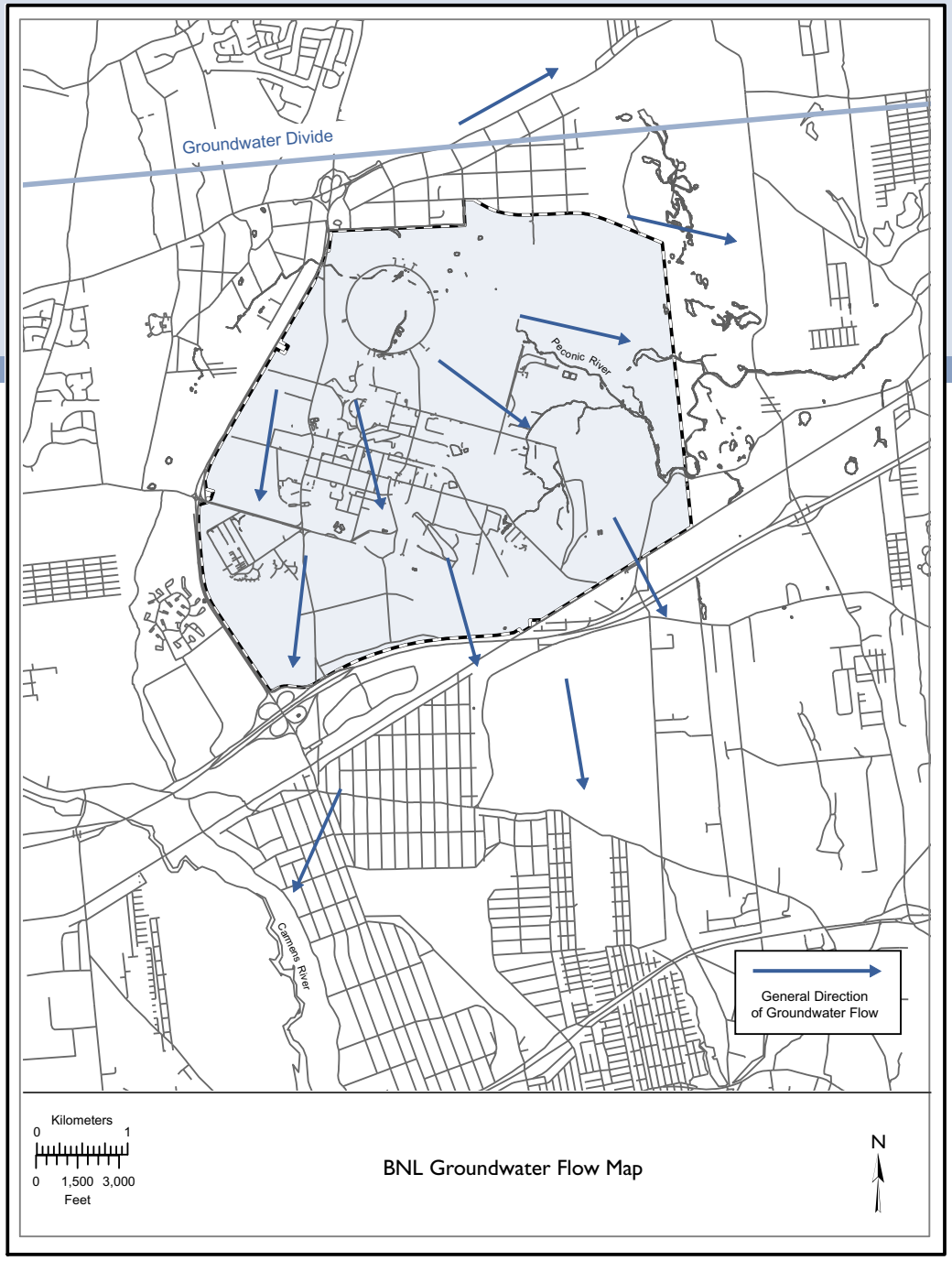
During 2004, BNL used approximately 1.4 million gallons of groundwater per day to meet potable water needs and heating and cooling requirements. Approximately 75 percent of the water pumped from BNL supply wells is returned to the aquifer through on-site recharge basins and permitted discharges to the Peconic River. Under normal hydrologic conditions, most of the water discharged to the river recharges to the Upper Glacial aquifer before leaving the BNL site. Human consumption,



Precipitation Cycle in the Area of Brookhaven National Laboratory

evaporation (cooling tower and wind losses), and sewer line losses account for the remaining 25 percent. An additional 4.1 million gallons of groundwater are pumped each day from remediation wells for treatment and then returned to the aquifer by way of recharge basins.

Groundwater flow direction across the site is influenced by natural drainage systems that flow eastward along the Peconic River, southeast toward the Forge River, and south toward the Carmans River. Pumping from on-site supply wells affects the direction and speed of groundwater flow, especially in the central, developed areas of the site. The main groundwater divide on Long Island is aligned generally east–west and lies approximately one-half mile north of BNL. Groundwater north of the divide flows northward and discharges to the Long Island Sound. Groundwater south of the divide flows east and south, discharging to the Peconic River, Peconic Bay, south shore streams, Great South Bay, and Atlantic Ocean. In most areas at the Laboratory, the horizontal velocity of groundwater is approximately 0.75 to 1.2 feet per day. This means that groundwater travels for approximately 20 to 22 years as it moves from the central, developed area of the site to the BNL southern boundary.



Eastern Hognose Snake (Heteroden platyrhinos)

Eastern Tiger Salamander
(Ambystoma t. tigrinum)

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

BNL's Natural Resource Management Program

BNL's Natural Resource Management Program promotes stewardship of the natural resources found at the Laboratory by integrating natural resource management and protection with BNL's scientific mission. BNL's *Natural Resource Management Plan* describes the program strategy, elements, and planned activities for managing the various resources found on site. The goals of the program include protecting and monitoring the ecosystem, conducting research, and communicating with staff and the public on ecological issues. BNL focuses on protecting New York State threatened and endangered species, and continuing the Laboratory's leadership role within the greater Long Island Central Pine Barrens ecosystem. The plan and related information can be found at http://www.bnl.gov/esd/wildlife/.

A wide variety of vegetation, birds, reptiles, amphibians, and mammals inhabit the BNL site. The only New York State endangered species confirmed at the Laboratory is the eastern tiger salamander, although the Persius duskywing butterfly and the crested fringed orchid have been identified in the past. Four New York State threatened species identified at BNL include the banded sunfish, swamp darter fish, stiff goldenrod plant, and northern harrier. The frosted elfin butterfly has been identified as possibly being at BNL, based on historic documentation and the presence of its preferred habitat and host plant (wild lupine). In addition, stargrass has historically been found and is likely to persist. Several other species that are listed by New York State as rare, species of special concern, or exploitably vulnerable are known to inhabit the site, visit during migration, or have historically been identified at BNL.

Activities to eliminate or minimize any negative effects that Laboratory operations may cause to these species are either incorporated into BNL procedures or into specific program or project plans. Environmental restoration projects remove pollutant sources that could contaminate habitats; access to critical habitats is limited; and in some cases, habitats are enhanced to improve survival or increase populations. In addition, routine activities that may affect habitat (such as road maintenance) are not performed until evaluated.

In 2004, college interns performed surveys of eastern tiger salamander ponds and conducted drift fence surveys to develop a better understanding of salamander movements and habitat needs; the radio telemetry study of the eastern hognose snake's movement and habitat use, which began in 2003, continued; banded sunfish were captured and moved to protected locations prior to the startup of the Peconic River cleanup; and the New York State Department of Environmental Conservation worked with BNL to trap and release wild turkey from the Laboratory to other locations on Long Island. In addition, an aerial infrared deer population survey was conducted of three properties, including the Laboratory, Wertheim National Wildlife Refuge (south of BNL), and Rocky Point Wildlife Area (northwest of BNL). The results of the survey indicated a lower deer population than was previously thought, using an existing ground-based survey methodology. Using a revised method, results indicated that the deer population was approximately 497 on site and immediately off site.

Canada Goose (Branta canadensis)

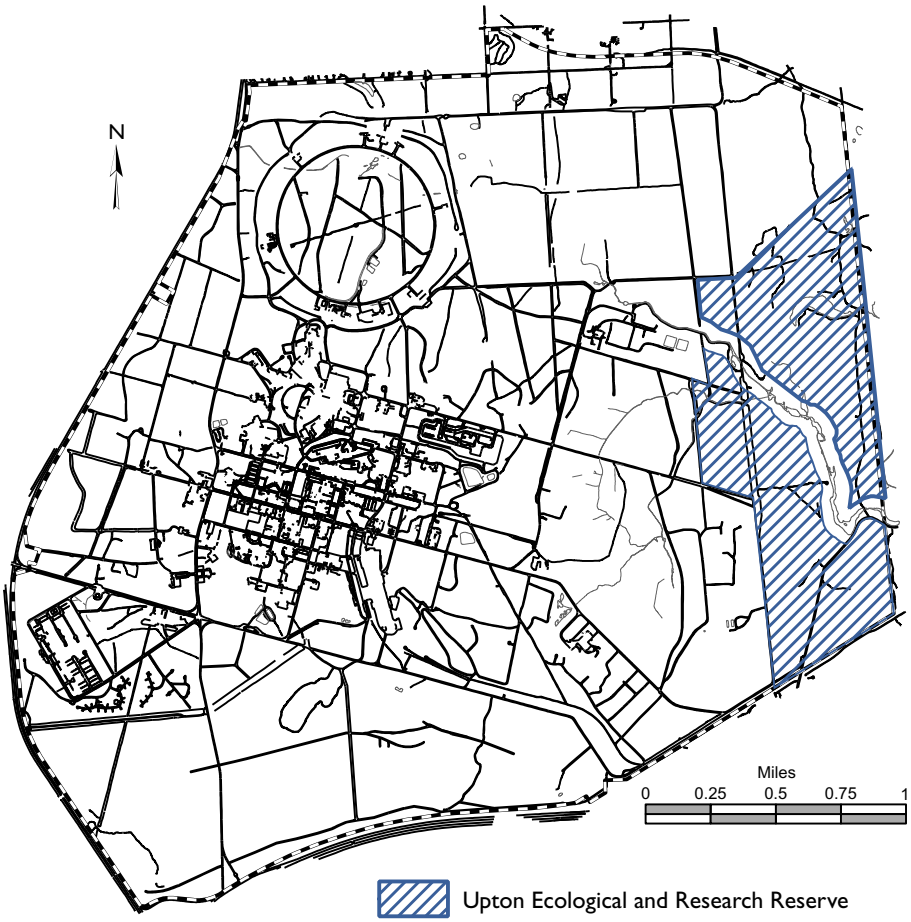
Wild Turkey (Meleagris gallapavo).

White-tailed Deer (Odocoileus virginianus).

Upton Ecological and Research Reserve

In November 2000, the Upton Ecological and Research Reserve (Reserve) was established on site by DOE. The 530-acre Reserve, managed by the U.S. Fish and Wildlife Service, is used to conduct resource management programs for the conservation, enhancement, and restoration of wildlife and habitat. Additional information about the Reserve can be found at http://www.bnl.gov/esd/reserve/.

Several projects were funded and conducted in 2004 within the Reserve, including the development of a research database and forest health monitoring protocols, conducting surveys of dragonflies and damselflies, radio telemetry work to track the eastern hognose snake and spotted turtle, and analyzing the water chemistry of coastal plain ponds. Also in 2004, BNL conducted its first prescribed fire on the reserve, treating approximately seven acres to improve germination and survival of oak seedlings. The fire also reduced forest fuels that tend to increase the likelihood and severity of wildfires. Post-fire monitoring is being conducted to determine whether the prescribed fire is having the expected beneficial effects.



Student Interns Conducting Research on the Reserve

BNL's Cultural Resource Management Program

The goal of BNL's Cultural Resource Management (CRM) Program is to ensure that proper stewardship of BNL and DOE historic resources is established and maintained, and to maintain compliance with numerous cultural resource regulations. BNL cultural resources include buildings and structures, remnants of World War I earthworks, the Camp Upton Historical Collection, scientific equipment, photo/audio/video archives, and institutional records. As cultural resources are identified, plans for their long-term stewardship are developed and implemented to ensure that the contributions BNL and the Laboratory site have made to U.S. history and culture are documented and available for interpretation.

In 2004, several structures at BNL were surveyed and evaluated for their architectural significance. The goal of the project was to identify key architectural features and assist BNL in developing management strategies for the future treatment of these structures. The evaluation concluded that Berkner Hall and the Chemistry Building are architecturally significant resources that appear to be eligible for listing on the National Register of Historic Places. The Brookhaven Graphite Research Reactor complex, High Flux Beam Reactor complex, and World War I training trenches associated with Camp Upton have already been determined to be eligible for listing on the National Register of Historic Places.

Berkner Hall is an excellent example of Expressionist-style architecture as it was applied to public buildings in the mid-twentieth century, and is representative of the work of the noted U.S. architectural and engineering firm of Urbahn Architects. Berkner Hall also possesses significance as an example of precast concrete slab construction and engineering. The Chemistry Building is a significant example of the conceptual work of Marcel Breuer, a major figure in twentieth-century architecture, who developed the conceptual design of the building.

Another goal of the CRM program is to formalize an oral history program for the Laboratory. In 2004, a BNL Historian conducted four video interviews that included a long-time employee of the Chemistry Department and three individuals associated with the early development and construction of the National Synchrotron Light Source.

Archeological Sites Surveyed in 2004

a

b

c

a. Foundation/cellar hole at Weeks Campbell Archeological Site (circa late 1800s).
b. Brickwork uncovered at Weeks Campbell Archeological Site .
c. Locust wood fence post identified at W. J. Weeks House Site (circa 1830s).
d. Foundation wall stone – W. J. Weeks House Site.

Another contracted project performed in 2004 was the archeological evaluation of two sites at BNL that are believed to date to the 1800s: the Weeks Campbell site and the W.J. Weeks House site. The goal of the evaluations was to determine the horizontal and vertical boundaries of cultural deposits; to obtain information on the structure, function, cultural/historical context, significance, and integrity of each site; and to make recommendations for site preservation and protection. The archeological study consisted of archival research and field investigations.

Evidence indicates that the Weeks Campbell site was mainly occupied from the late nineteenth–early twentieth century. The site has a relatively high degree of integrity, with several surface and subsurface features (agricultural landscape markers, the brick walkway, and the foundation/cellar hole). The W.J. Weeks House site was dated from the mid- to late-nineteenth century. Both sites may be eligible for listing on the National Register; recommended protective measures were instituted.

d

As part of a commitment to environmentally responsible operations, BNL management has established an Environmental Management System (EMS). An EMS ensures that environmental issues are systematically identified, controlled, and monitored. In addition, an EMS provides mechanisms for responding to changing environmental conditions and requirements, reporting on environmental performance, and reinforcing continual improvement. The Laboratory's EMS was designed to meet the rigorous requirements of the globally recognized International Organization for Standardization (ISO) 14001Environmental Management Standard, with additional emphasis on compliance, pollution prevention, and community involvement.

In 2004, an EMS Recertification Audit determined that BNL remains in conformance with the ISO 14001 Standard. In its recommendation for continued certification, the auditors from NSF-International Strategic Registrations, Ltd. highlighted five examples of BNL's continued improvement, some of which include BNL's methods for documenting management input, internal auditing practices, and the work planning and environmental review process. The auditors also identified five minor nonconformances and three opportunities for improvement. A corrective action plan was prepared to track the minor nonconformances to closure.

In 2004, the ISO14001:1996 Standard was revised. The new standard, ISO 14001:2004, places a greater emphasis on the EMS as a tool to manage environmental aspects and on improved environmental performance. During future audits at BNL, the auditors will assess BNL's conformance with the new standard.

One measure of an effective EMS is recognition of good environmental performance. In 2004, BNL operations led to several awards from a diverse stakeholder group.

- EPA Environmental Quality Award for developing and managing the Upton Ecological and Research Reserve, a 530-acre conservation area on the BNL site.
- DOE Office of Science Best in Class Award, DOE Pol-

NSF-ISR

NSF International Strategic Registrations, Ltd.

NSF-ISR

A Subsidiary of NSF International
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 460 Brookhaven Avenue
P.O. Box 5000
Upton L.I., NY 11973-5000 US

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:

ANAB ACCREDITED

Certificate Number: 69525-E3
Certificate Issue Date: 08/10/2005
Company Initial Date: 07/10/2001
Registration Date: 06/25/2004
Expiration Date*: 06/24/2007

Christian B. Lupo

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

lution Prevention Award, and White House Closing the Circle Award in recognition of leadership and management in developing and integrating the Environmental Management System into BNL's operational and business systems.

- DOE Office of Science Pollution Prevention Accomplishment Award for implementing an innovative process, Mixed Waste Elimination through Process Modification.
- Long Island Pine Barrens Society award for "Outstanding Contribution to Long Island's Environment" for BNL's comprehensive cleanup of contamination within the Pine Barrens on site, and for BNL programs of research, education, and community involvement.
- Evelyn Liblit Environmental Stewardship Award for BNL's commitment to environmental protection and its very successful and longstanding recycling program. The award was presented by the Waste Reduction and Management Institute of Stony Brook University.

In addition, BNL was accepted into EPA's prestigious Performance Track Program in 2004. The program recognizes top environmental performance among participating U.S. facilities of all types, sizes, and complexity, both public and private. Performance Track was established by the Environmental Protection Agency as the "gold standard" for facility-based environmental performance. The program requires that sites commit to several improvement goals for a 3-year period and report on the progress of the goals annually. BNL's current goals include increasing land and habitat conservation, reducing radioactive air emissions, reducing the use of ozone-depleting substances (ODS), and reducing the use of hazardous materials.

Progress toward these goals included the recovery of 16 acres of land toward a 30-acre goal by 2006; an emission reduction of 27 percent, toward a goal of 30 percent by 2006; reduction of the ODS inventory to 67,135 pounds, toward a goal of 65,500 pounds by 2006; reduction of 67 pounds of mercury inventory by removing and disposing of mercury thermometers, mercury-bearing devices, and elemental mercury from research laboratory spaces.

What You Need to Know

- How your work can impact the environment
- How these impacts can be prevented
- What to do in case of emergency
- What the consequences of not following procedures could be
- How your actions can improve Brookhaven's environmental performance

Your Responsibilities

- Follow environmental requirements
- Prevent pollution, or "P2"
- Suggest improvements
- Look at problems as opportunities—and help solve them!

BNL's Environmental Management Program consists of several Laboratory-wide and facility-specific environmental programs, which further integrate environmental stewardship into all facets of BNL's mission. BNL has a comprehensive Environmental Monitoring Program that includes monitoring the air, drinking water, surface water, groundwater, soil, sediment, and flora and fauna. The program identifies potential pathways for exposure of the public and employees, evaluates what impact BNL operations have on the environment, and ensures compliance with environmental permit requirements.

Energy Management and Conservation Program

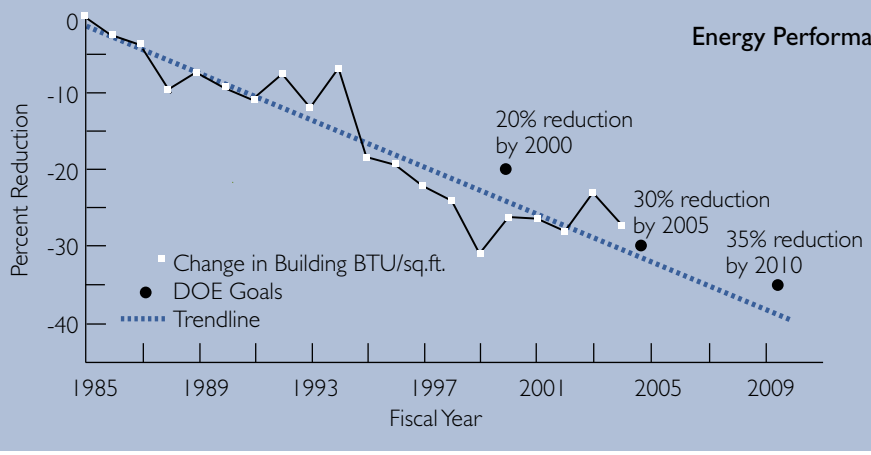
Since 1979, BNL's Energy Management Group has been working to reduce energy use and costs by identifying cost-effective and energy-efficient projects, monitoring energy use and utility bills, and assisting in obtaining the least expensive energy sources possible. In 2004, the Laboratory used approximately 276 million kilowatt hours of electricity, 4.5 million gallons of fuel oil, 39.1 thousand gallons of propane, and 710 thousand ft^3 of natural gas. Due to market conditions, fuel oil was predominately used in 2004, resulting in a cost savings of approximately $940,000.

BNL is a participant in the Long Island Power Authority (LIPA) Peak Load Reduction Curtailment Program. Through this program, the Laboratory has agreed to reduce electrical demand during critical days throughout the summer when LIPA expects customer demand to meet or exceed the company's available supply. In return, BNL receives a rebate for each megawatt reduced on each critical day. In 2004, participation in this program produced a rebate for BNL of $24,000. The Laboratory's participation is significant to LIPA, representing more than 12 percent of the 95-megawatt load-curtailment program total and making the Laboratory one of the largest program contributors.

BNL also maintains a contract with the New York Power Authority (NYPA). Participation in NYPA's 2004 Load Curtailment Program produced a rebate worth $1 million, due to reduced operations at the Laboratory's Relativistic Heavy Ion Collider.

The National Energy Conservation Policy Act requires federal agencies to apply energy conservation measures and to improve federal building design to reduce energy use per square foot. Current goals at BNL are to reduce energy consumption per square foot, relative to 1985, by 20 percent in 2000, 30 percent by 2005, and 35 percent by 2010. BNL's energy use per square foot in 2004 was 23 percent less than in 1985.

BNL will continue to seek alternative energy sources to meet its future energy needs, support federally required "green" initiatives, and reduce energy costs.



Pollution Prevention Program

The overall goal of BNL's Pollution Prevention (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 at the Laboratory.

Employees submit proposals for P2 projects to the BNL P2 Council each year. In 2004, the Laboratory invested approximately $86,000 in eight newly funded P2 projects, with an annual anticipated savings of $60,500 and an average payback period of 1.3 years.

P2 projects, recycling programs, and conservation initiatives have greatly reduced both waste volumes and management costs at BNL. To date, more than $1.6 million were saved and approximately 2.2 million pounds of materials were reduced, recycled, or reused.

Waste Management Program

Wastes are produced as a byproduct of the research BNL conducts. These wastes include materials common to many businesses and industries, such as aerosol cans, batteries, paints, and oils. However, BNL's unique scientific activities also generate waste streams that are subject to additional regulation and special handling, including radioactive, hazardous, and mixed waste.

BNL's Environmental and Waste Management Services Division is responsible for the collection, transportation, storage, and off-site disposal of waste generated at the Laboratory. The BNL Waste Management Facility is used for the short-term storage of these wastes before they are packaged or consolidated for off-site shipment to permitted treatment and disposal facilities. In 2004, BNL generated the following types and quantities of waste from routine operations:

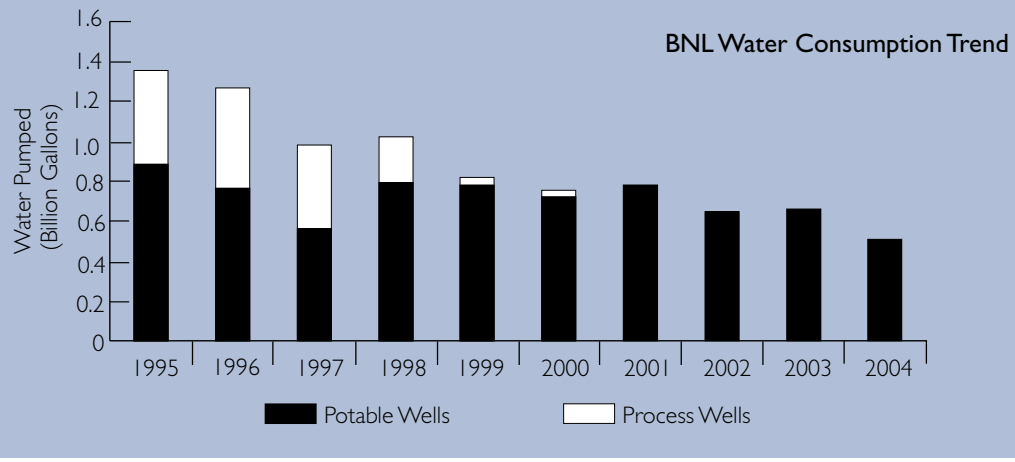
- Hazardous waste: 6.2 tons
- Mixed waste: 65 ft^3
- Radioactive waste: 4,786 ft^3

These quantities represent a significant reduction from previous years. BNL will continue to clean up facilities and areas containing radioactive and chemical contamination to reduce these quantities further.

Water Conservation Program

BNL has a strong Water Conservation Program in place. The Laboratory evaluates water conservation efforts when planning facility upgrades and new construction projects. Among these efforts is more efficient and expanded use of chilled water for cooling, ventilation, and air conditioning.

Water conservation initiatives have greatly reduced potable (drinking) water use at the Laboratory since the mid 1990s. As of 2004, BNL used less than half the water used in 1995—a drop of 800-plus million gallons.



Regulatory Compliance Program

BNL's Regulatory Compliance Program ensures that the Laboratory complies with more than 100 sets of federal, state, and local environmental regulations; several site-specific permits; equivalency permits to operate groundwater remediation systems; and several other binding agreements. BNL is committed to maintaining full compliance with these requirements and agreements to help eliminate or minimize any impact Laboratory operations may have on the environment. Under this program, compliance monitoring is conducted to ensure that air emissions, wastewater effluents, and groundwater monitoring data comply with regulatory and permit limits issued under the federal Clean Air Act, Clean Water Act, Oil Pollution Act, Safe Drinking Water Act, and the New York State equivalents.

- Compliance monitoring for air emissions is conducted at the Central Steam Facility, reactors, accelerators, and other radiological emissions sources. Results of air emissions monitoring in 2004 showed that nitrogen oxides, carbon monoxide, and sulfur dioxide were all within permit limits. Radiological monitoring showed that there was negligible dose to the public from BNL operations.
- Compliance monitoring of wastewater discharges is performed to ensure that the effluent complies with release limits under BNL's State Pollutant Discharge Elimination System (SPDES) permit. In 2004, wastewater discharges from the Laboratory's Sewage Treatment Plant complied with SPDES limits in greater than 99 percent of the samples taken. Six SPDES excursions occurred, which included two elevated iron readings traced to incorrect placement of a sample collection probe, two elevated methylene chloride readings due to analytical laboratory cross-contamination, and two excursions related to total suspended solids, due to incorrect placement of sampling equipment. Each of these issues was investigated and reported to the New York State Department of Environmental Conservation (NYSDEC) and the Suffolk County Department of Health Services (SCDHS).
- Compliance monitoring of groundwater is required under the Major Petroleum Facility License and the Resource Conservation and Recovery Act permit. The license requires BNL to monitor groundwater in the vicinity of aboveground storage tanks for floating products and volatile and semivolatile organic compounds. In 2004, monitoring continued to demonstrate that current oil storage and transfer operations at the Major Petroleum Facility did not impact groundwater quality.

  As required by SCDHS, compliance monitoring is also performed to ensure that the Laboratory maintains a viable potable (drinking) water supply. BNL conducts monitoring for bacteria, inorganics, organics, pesticides, and radiological contaminants. In 2004, BNL's potable water supply complied with all drinking water requirements.
- Any release of petroleum products to soil is reportable to both NYSDEC and SCDHS. In 2004, there were 30 reportable spills of petroleum products or antifreeze. Nineteen spills were petroleum releases less than 5 gallons, four were small-volume antifreeze spills, two larger spills were discovered during tank removals, four spills resulted from failed equipment, and one spill was a release of oil from two transformers that were contaminated with polychlorinated biphenyls (PCBs). All releases were cleaned up or addressed to the satisfaction of NYSDEC and SCDHS.
- A number of federal, state, and local agencies oversee BNL activities. Twelve external environmental audits were conducted by regulatory agencies in 2004, including inspections of petroleum and chemical storage, air emissions from the Central Steam Facility, Hazardous Waste Management facilities, Sewage Treatment Plant operations, other regulated outfalls and recharge basins, and the potable water system. Minor administrative deficiencies found during two Resource Conservation and Recovery Act/hazardous waste compliance inspections were corrected before the inspectors left the site. Four conditions that required corrective action were identified during an annual inspection of the Major Petroleum Facility, and one issue was found during an inspection of the Chemical Bulk Storage Facilities; all five of these conditions are being corrected in accordance with NYSDEC directives.

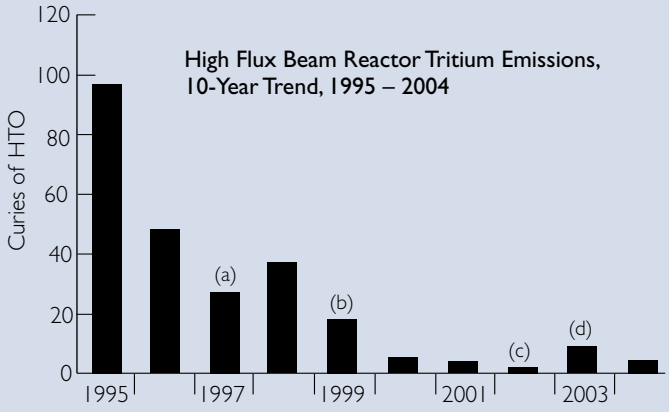
Air Quality Program

BNL monitors radioactive emissions at several facilities on site to ensure compliance with the requirements of the Clean Air Act. During 2004, BNL facilities released a total of 2,711 curies of radioactive gases with short half-lives (less than 30 minutes). Environmental Protection Agency (EPA) regulations require continuous monitoring of all facilities that have the potential to deliver an annual radiation dose greater than 0.1 mrem to a member of the public. The Brookhaven Linac Isotope Producer (BLIP) is the only BNL facility in this category. Oxygen-15 (half-life: 122 seconds) and carbon-11 (half-life: 20.48 minutes) emitted from the BLIP made up more than 99.8 percent of air emissions in 2004.

Facilities capable of delivering smaller radiation doses (below 0.1 mrem) require only periodic, confirmatory monitoring. At BNL, this monitoring is conducted at one active facility, the Target Processing Laboratory, and two inactive facilities, the Brookhaven Medical Research Reactor (BMRR) and the High Flux Beam Reactor. In 2004, BNL filed a petition with EPA to discontinue emission monitoring at the BMRR, because sampling has consistently shown no detectable emissions of radionuclides, even with building ventilation turned on.

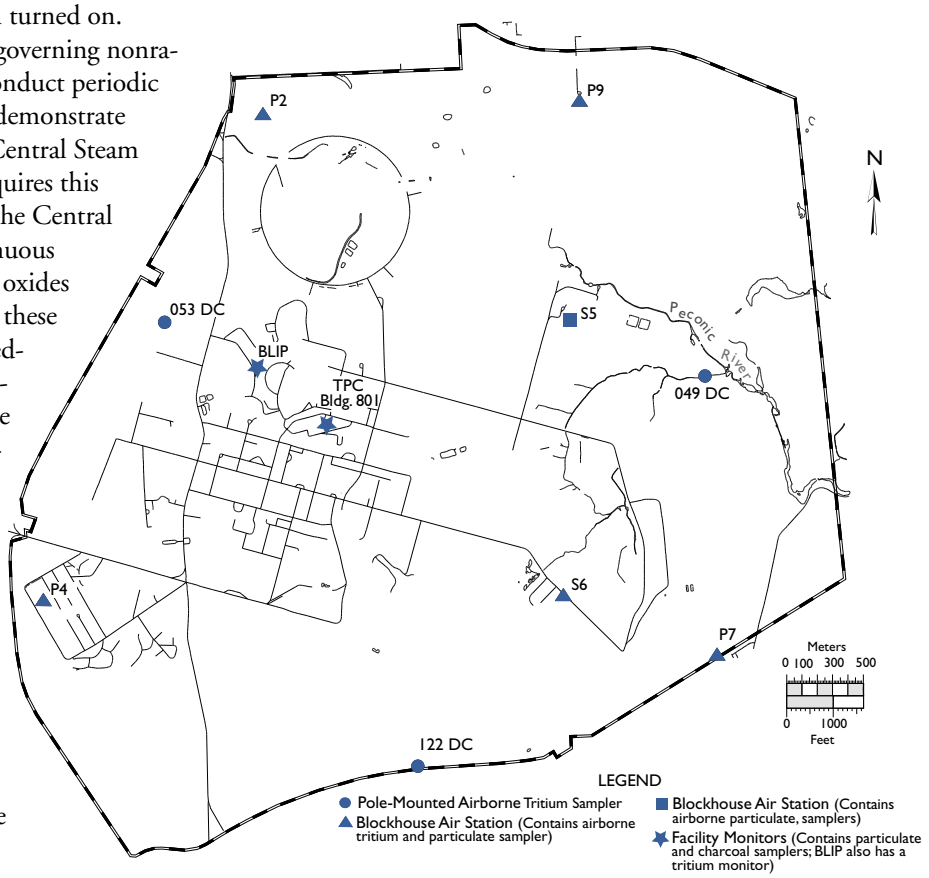
Various state and federal regulations governing nonradiological releases require facilities to conduct periodic or continuous emission monitoring to demonstrate compliance with emission limits. The Central Steam Facility is the only BNL facility that requires this monitoring. Two of the four boilers at the Central Steam Facility are equipped with continuous emission monitors to measure nitrogen oxides and opacity (visible "smoke"). In 2004, these boilers had no measured emission exceedances above the regulatory limits, for nitrogen oxides. Opacity exceedances were reported to the New York State Department of Environmental Conservation; all but two occurred during boiler startup or soot blowing operations—times when opacity exceedances are most likely.

Since natural gas prices were higher than residual fuel prices throughout 2004, BNL used residual fuel for most heating and cooling. As a result, annual facility emissions of particulate matter, nitrogen oxides, and sulfur dioxide were considerably higher than in years when natural gas was the primary fuel, because natural gas burns "cleaner" than residual fuel.



Notes:
(a) Shut down during evaluation process
(b) Permanent shutdown announced in November 1999
(c) Frequency of sampling reduced to one week per month in 2002
(d) Temporary increase due to decommissioning activities

The Laboratory conducts radiological air monitoring on site to verify local air quality and assess possible environmental and health impacts from BNL operations. Air monitoring stations around the perimeter of the BNL site measure tritium and gross alpha and beta airborne activity. Results measured in 2004 showed that on-site radiological air quality was consistent with results from locations in New York State (analyzed by New York State Department of Health) that are not located near radiological facilities.



BNL On-Site Ambient Air Monitoring Stations

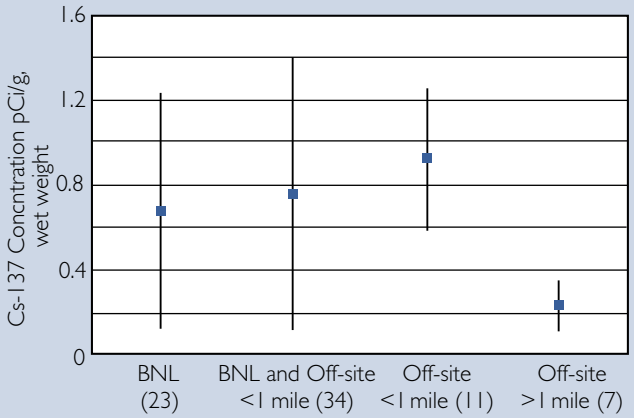
Natural Resource Management Program

Under BNL's Natural Resource Management Program, the Laboratory conducts routine monitoring of flora and fauna to access the impact, if any, of past and present activities on the Laboratory's natural resources.

- In 2004, deer and fish sampling results were consistent with previous years. Deer sampled on the BNL site contain higher concentrations of cesium-137 than deer sampled from greater than 1 mile from the BNL boundary off site. This is most likely the result of deer consuming contaminated soil and grazing on vegetation growing in soil where elevated cesium-137 levels are known to exist. On- and off-site sampling of fish showed low levels of cesium-137, pesticides, and mercury.
- The calculated maximum hypothetical radiation doses for a person eating locally caught deer and fish were estimated at 1.3 mrem and 0.37 mrem, respectively. The annual dose from deer meat is based on a consumption estimate of 64 pounds per person per year, and the annual dose from fish is based on a consumption estimate of 15 pounds per person. Both estimates are very conservative and are based on New York State Department of Health (NYSDOH) guidance. Hunting is not allowed at the Laboratory, and NYSDOH has determined that no restrictions on hunting or consumption of deer near BNL are needed. NYSDOH has also evaluated data on Peconic River fish and concluded that the existing general fish advisory for all New York State freshwater ponds and rivers (eating no more than a half-pound per week), is sufficient.
- Since 2000, BNL has been removing areas of contaminated soil at BNL. With the completion of the Peconic River project and site-wide soil cleanup projects in 2005, fish and deer contaminant levels are expected to drop further.
- Annual sampling of vegetation and sediment in the Peconic River and a control location on the Carmans River was conducted in 2004. (On-site portions of the Peconic River were not sampled because the river cleanup project was underway.) Low levels of cesium-137 were found in sediments at all locations, except Forge Pond. Aquatic vegetation taken from off-site locations did not have detectable levels of cesium-137.

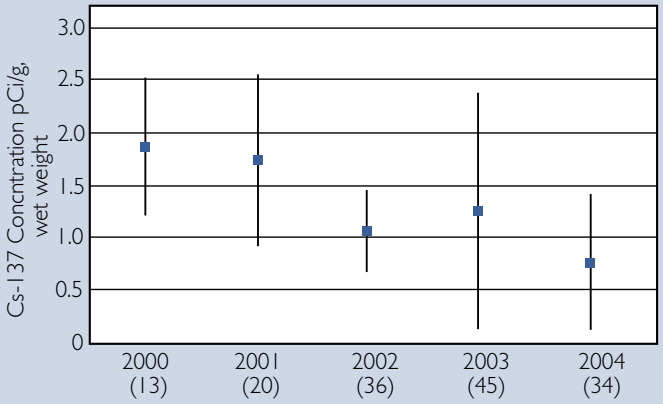
  Most of the data for vegetation and sediment analyses in 2004 indicated metals at background levels. Off site, levels of arsenic, cadmium, chromium, and nickel were higher than the Suffolk County Department of Health Services cleanup objectives in sediment at Swan Pond, and chromium was higher than the cleanup objectives at the Lower Lake sampling location on the Carmans River. No other metals were above cleanup objectives in either sediment or vegetation.

  DDT was one of the pesticides used widely in the 1950s and 1960s, and residual amounts are still detected on Long Island, as well as elsewhere in the United States. Monitoring in 2004 showed that sediments from Swan Pond contained low levels of the DDT breakdown products DDE and DDD. A water sample from Swan Pond contained very low levels of DDE. Sediments taken at station HC on the Peconic River contained low levels of alpha-BHC, Lindane, Heptachlor, DDT, and the PCB Aroclor-1254. A water sample from station HC had detectable levels of DDT, and low levels of the PCB Aroclor-1254 were detected in a vegetation sample from Lower Lake on the Carmans River.
- In 2004, precipitation samples were collected quarterly at two air monitoring stations and analyzed for radiological content. In general, radioactivity in precipitation comes from naturally occurring radionuclides in dust and from activation products that result from solar radiation. Samples at both locations showed small amounts of radioactivity above the minimum detection limit, similar to values reported in previous years. No tritium or other radionuclides were detected.



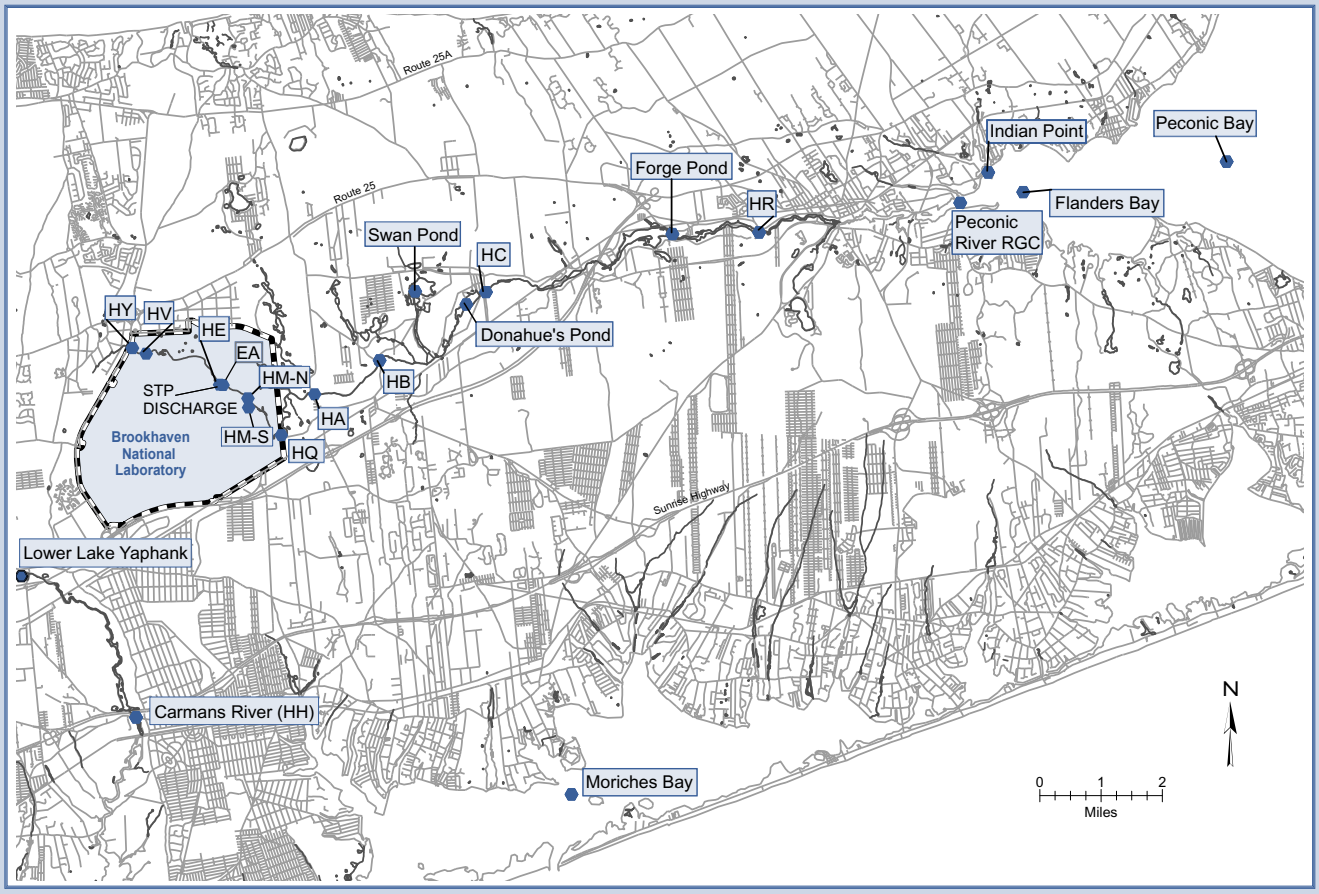
Notes:
Averages are shown for samples collected at BNL and within a 1-mile radius. Numbers in parentheses indicate the number of samples in that data set.
All values are shown with a 95% confidence interval.

Comparison of Cesium-137 Average Concentrations in Deer, 2004



Notes:
Averages are shown for samples collected at BNL, on site and off site within a 1-mile radius, off site but within a 1-mile radius, and off site geater 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.

Five-Year Cesium-137 Concentration Trends in Deer Meat at BNL and within 1 Mile of BNL, 2000 – 2004



BNL Sampling Stations for Surface Water, Fish, and Shellfish

Groundwater Protection Management Program

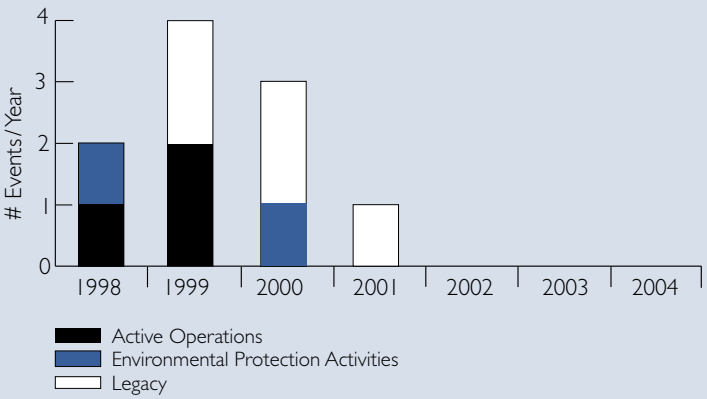
BNL's Groundwater Protection Management Program is designed to prevent any further contamination to groundwater and to restore groundwater quality by integrating pollution prevention efforts and through groundwater restoration projects. BNL's Groundwater Protection Contingency Plan describes an orderly process for quickly taking corrective actions in response to unexpected monitoring results. Key elements of the program are the full and timely disclosure to the public of any off-normal occurrences, and regular communication regarding the performance of the program.

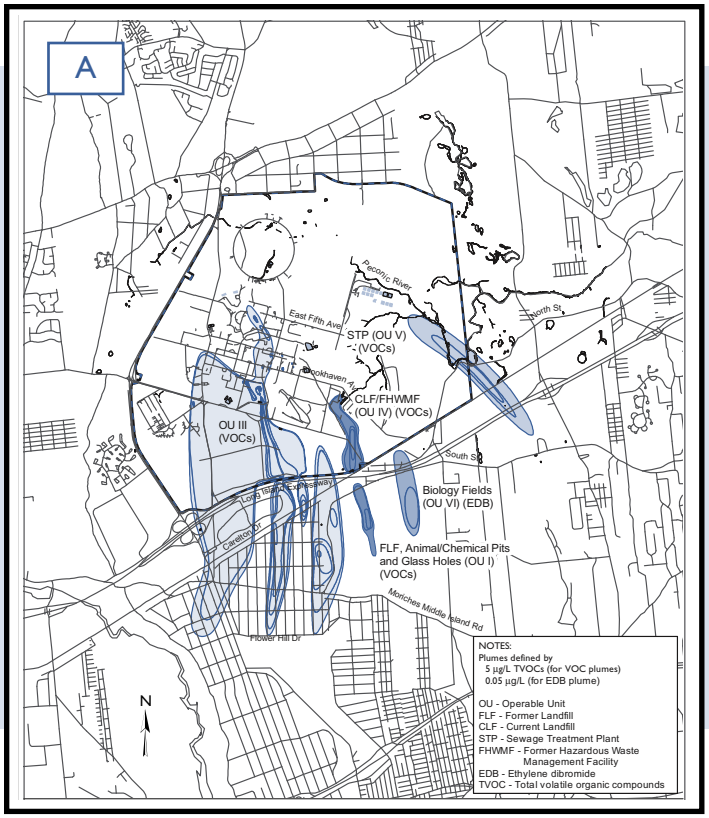
BNL's extensive groundwater monitoring well network is used to evaluate progress in restoring groundwater quality, to comply with regulatory permit requirements, to monitor active research and support facilities, and to assess the quality of groundwater entering and leaving the BNL site. In 2004, BNL collected groundwater samples from 828 on-site and off-site monitoring wells during 2,207 individual sampling events. BNL has not detected any new impacts to groundwater quality since 2001.

BNL 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. Among the active facilities that have groundwater monitoring programs are the Sewage Treatment Plant and Peconic River area, Biology Agricultural Fields, Waste Management Facility, Central Steam Facility and adjacent Major Petroleum Facility, Alternating Gradient Synchrotron, Relativistic Heavy Ion Collider, Waste Concentration Facility, Supply and Material Area, and several other smaller facilities. Inactive facilities include the former Hazardous Waste Management Facility, two former landfill areas, the Brookhaven Graphite Research Reactor, High Flux Beam Reactor, and the Brookhaven Medical Research Reactor. As the result of detailed groundwater investigations conducted over the past 15 years, six significant volatile organic compound (VOC) plumes and eight radionuclide plumes have been identified.

In 2004, 125 wells at 10 active research and support facilities were monitored. Although no new impacts to groundwater were discovered, groundwater quality continues to be impacted from older releases at four facilities. Tritium continues to be detected at concentrations above the drinking water standard in wells immediately downgradient of the Alternating Gradient Synchrotron facility, and in one well immediately downgradient of the Brookhaven Linear Isotope Producer. However, the

Groundwater Protection Performance, 1998 – 2004



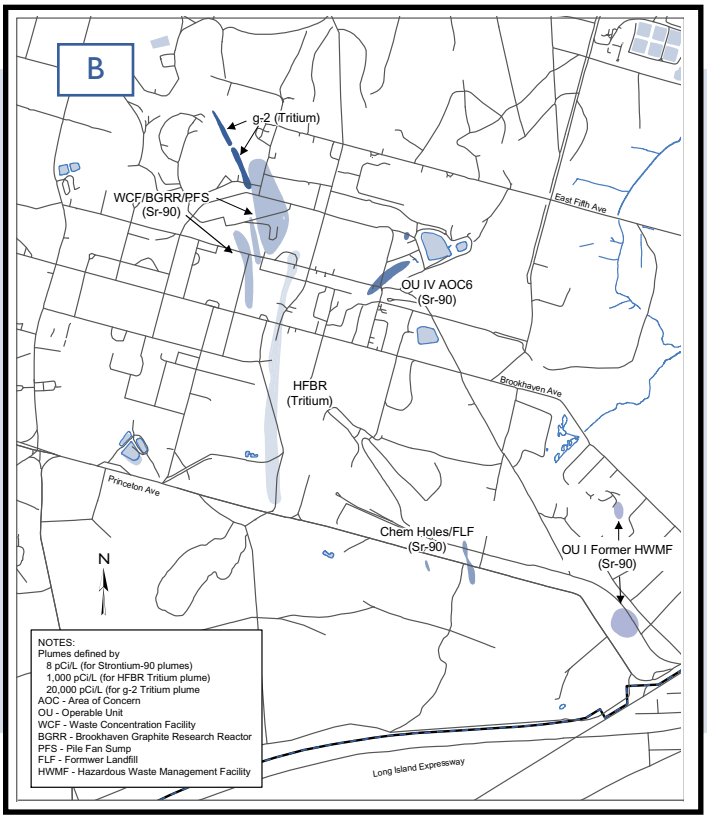


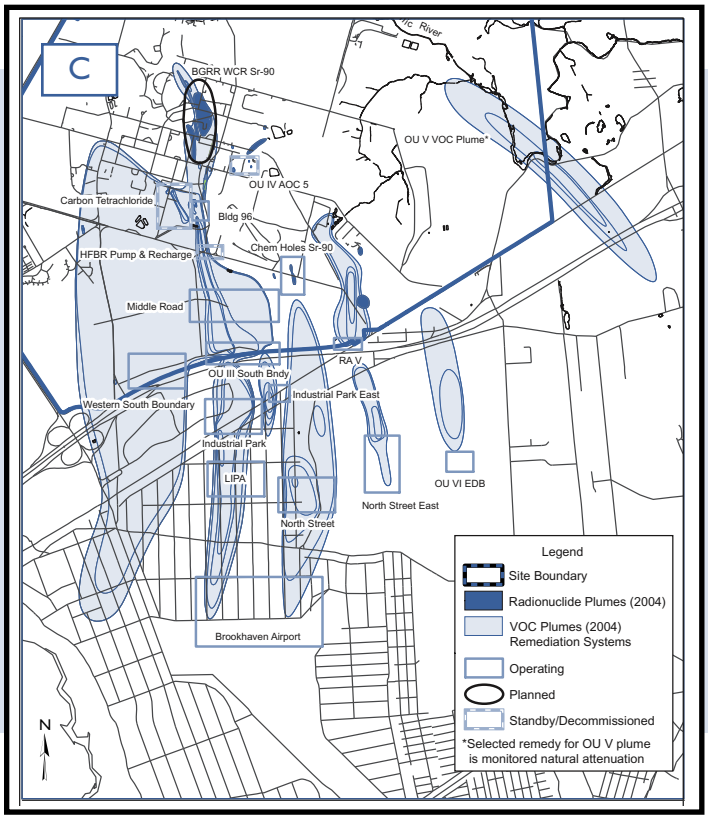
tritium concentrations are much lower than those observed in 2003. Monitoring data suggest that the continued release of tritium from these source areas is due to residual tritium being flushed out of the unsaturated zone close to the water table by natural water table fluctuations. As in previous years, VOCs associated with historical petroleum and solvent spills were detected in several monitoring wells directly downgradient of the Motor Pool and Service Station area, but at concentrations lower than those detected in 2003.

Monitoring data in 2004 from 703 on-site and off-site wells indicate that Laboratory restoration activities are effectively capturing and treating groundwater contamination. The construction of all groundwater treatment systems was completed in 2004, bringing the total number of active systems to 16. In the former Building 96 area, significant reductions in VOC concentrations allowed three of four treatment wells to be shut down and placed in standby mode in July 2004. In December 2004, BNL began to treat the remaining high levels of VOCs in the former Building 96 "silt zone" source area using an in-place method of chemical oxidation. The operation of the Operable Unit (OU) III Carbon Tetrachloride Treatment System has also significantly reduced VOC levels in groundwater near a former underground storage tank source area. As a result, the treatment system was shut down and placed in standby mode in August 2004. Construction of a strontium-90 groundwater treatment system for the Brookhaven Graphite Research Reactor and Waste Control Facility area was completed in December 2004. Although high levels of tritium were periodically detected in groundwater immediately downgradient of the High Flux Beam Reactor during 2004, the continued release of tritium appears to be due to residual tritium that is being flushed out of the lower unsaturated zone by natural water table fluctuations.

During 2004, 12 groundwater remediation systems removed 652 pounds of volatile solvents from on- and off-site groundwater, returning approximately 1.5 billion gallons of clean water to the Upper Glacial aquifer. Since the beginning of active groundwater remediation activities in December 1996, BNL has removed 4,808 pounds of volatile solvents from the aquifer by treating nearly 8.4 billion gallons of groundwater.

A. Extent of Volatile Organic Compound Plumes
B. Extent of Radionuclide Plumes On Site
C. Locations of BNL Groundwater Remediation Systems





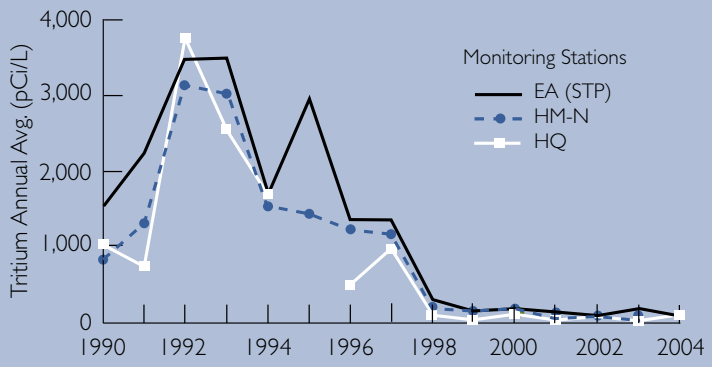
Water Quality Program

BNL discharges wastewater treated at the Sewage Treatment Plant (STP) into the headwaters of the Peconic River and 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 help ensure that wastewater discharges comply with all applicable requirements and that the public, employees, and the environment are protected.

To assess the impact of discharges on the quality of the Peconic River, surface water is monitored at several locations upstream and downstream of the STP discharge points. The Carmans River, located west of BNL, is monitored for comparative purposes, because it is not affected by BNL operations. In 2004, the average radioactivity levels of the STP discharge were within the typical range of historical levels and were well below drinking water standards. Tritium releases to the Peconic River fell below levels reported in 2002 and are expected to continue to decline, after a brief increase in 2003, following the preparatory steps for decommissioning and decontaminating the High Flux Beam Reactor. There were no detections of cesium-137 or strontium-90 in the treated wastewater. Traces of tritium were found immediately downstream of the Sewage Treatment Plant, but in amounts below the minimum (measurable) detection limit. No other radionuclides attributed to BNL operations were detected. Nonradiological monitoring of the treated wastewater showed that, with the exception of isolated incidents involving metals that occur naturally in local sediment, organic and inorganic measures were within the State Pollutant Discharge Elimination System limits or other applicable standards.

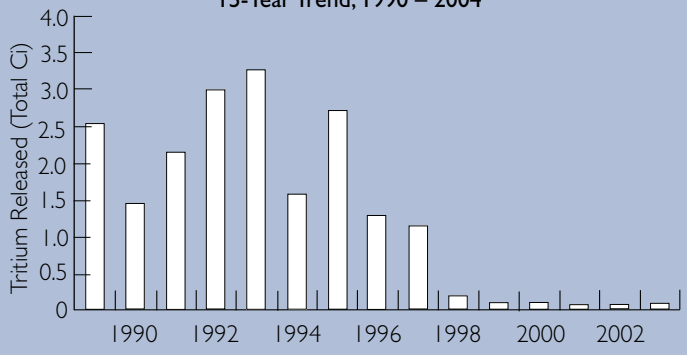
On-site recharge basins are used to discharge "clean" wastewater streams, including once-through cooling water, stormwater runoff, and cooling tower blowdown, and are suitable for direct replenishment of the groundwater aquifer. Radiological analyses in 2004 showed that the low levels of radioactivity detected in all of the basins were not due to BNL operations, but to natural terrestrial/geological or cosmic sources.

Sewage Treatment Plant/Peconic River
Annual Average Tritium Concentrations, 1990 – 2004



Notes:
There were no samples collected at monitoring station HQ in 1995 and 2002 due to low water table conditions.
NYS Drinking Water Standard is 20,000 pCi/L.

Tritum Released to the Peconic River,
15-Year Trend, 1990 – 2004



A very low level of tritium, detected only in a single sample, was attributed to inaccuracies of the analytical method. Nonradiological analyses showed low concentrations of volatile organic compounds, which were most likely due to cross-contamination of the samples at the contract analytical laboratory. Lead at the Central Steam Facility recharge basin, attributed to accumulating sediment, continued to be monitored in 2004. The completed remedial plan previously in place for this facility was revised and resubmitted to the regulatory agencies in March. The review is pending.

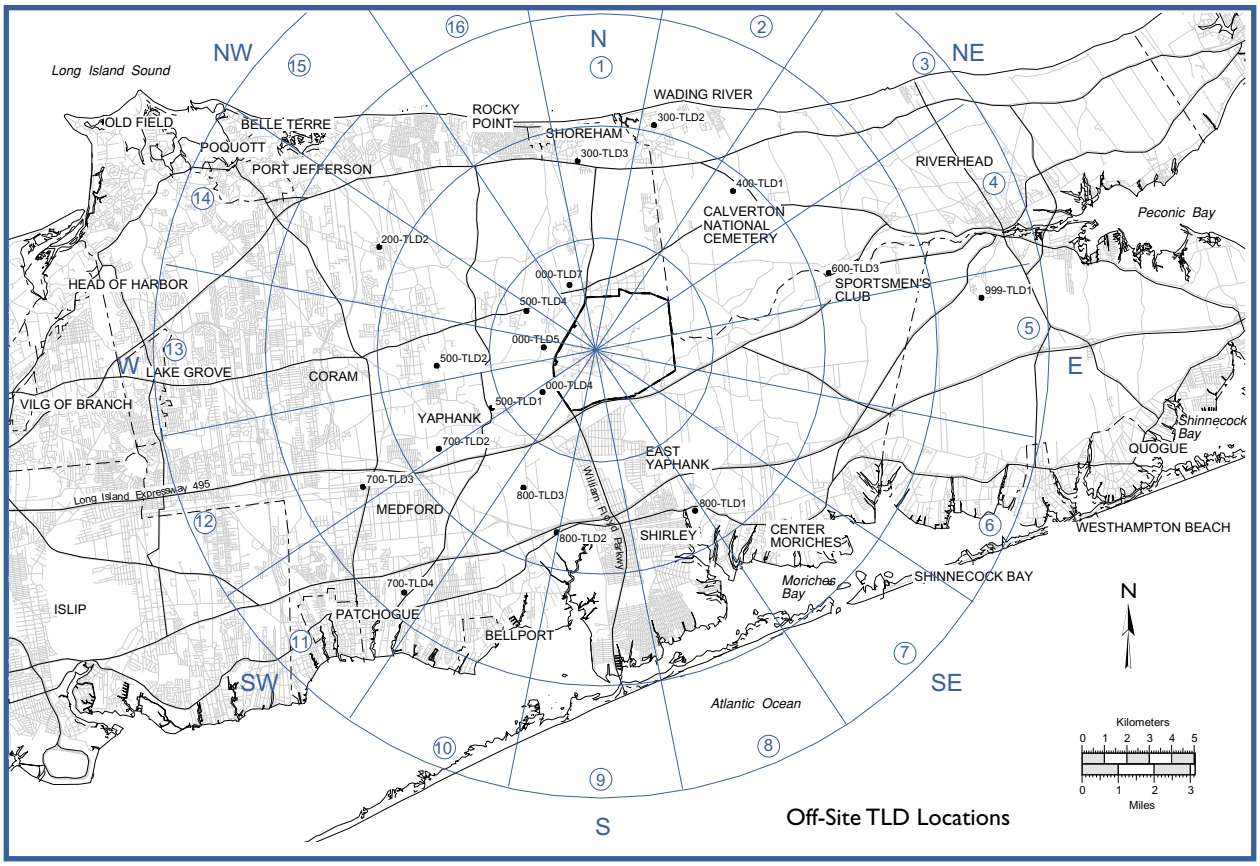
Radiological Dose Assessment Program

BNL routinely assesses its operations to ensure that any potential radiological dose to members of the public, BNL workers, 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 BNL have consistently shown that the "effective dose equivalent" from Laboratory operations is well below the Environmental Protection Agency and DOE regulatory dose limits for the public and the environment. The dose impact from all BNL activities in 2004 was found to be insignificant compared to natural background radiation levels.

Thermoluminescent dosimeters (TLDs), used to measure the possible impact of direct exposure from BNL operations, are placed on site and in the surrounding community. In 2004, the average doses from 56 on-site and 16 off-site TLDs showed there was no additional contribution to dose from BNL operations above natural background radiation. The annual on-site external dose from all potential sources, including cosmic and terrestrial radiation, was 66 ± 11 mrem, whereas and the annual off-site external dose was 62 ± 10 mrem.

The total annual dose to the MEI from all pathways was estimated as 1.72 mrem (17.2 µSv). The effective dose to the MEI from air emissions was calculated as 4.40E-2 mrem (0.44 µSv). The ingestion pathway dose was estimated as 1.31mrem (13.1 µSv) from consumption of deer meat and 0.37 mrem (3.7 µSv) from consumption of fish caught on site at BNL. The BNL dose from the air inhalation pathway was 0.4 percent of the Environmental Protection Agency's annual regulatory dose limit of 10 mrem (100 µSv), and less than 2 percent of DOE's annual dose limit of 100 mrem (1,000 µSv) from all pathways. Doses to aquatic and terrestrial biota were also evaluated and found to be well below the regulatory limits.

Remediation and waste management projects conducted in 2004 were also evaluated for radiological emissions and dose impact. There was no significant dose or radiological risks to members of the public, BNL workers, or the environmental from these activities.



DOSE IN PERSPECTIVE

Radiological materials are used in many research activities conducted at the Laboratory. This fact sheet explains Brookhaven National Laboratory's (BNL) maximum possible contribution to the radiation dose that a member of the public might receive in any given year and compares that dose to other typical radiation exposures.

What radiation dose might I receive each year?

The radiation dose received by a person is commonly expressed in "rem" or "millirem" (a millirem is one-thousandth of a rem). The average U.S. (and Long Island) resident's radiation dose from natural sources is approximately 300 millirems per year. This originates from natural cosmic and terrestrial radiation, radon, and minerals in food, water, and air. The average U.S. resident is also exposed to about 60 millirems per year from manmade sources, including medical procedures and consumer products. People who smoke tobacco receive a much higher dose, as do people who live in areas where radon is prevalent in the soil or at high altitudes where cosmic radiation is not so effectively shielded by the atmosphere.

Here are some examples of radiation doses from common sources, in millirem per year:

- Cigarette smoking (one pack per day) — 1,300
- Radon from the ground — 200
- Minerals in water, food, and air — 40
- Cosmic radiation — 26
- Chest x-ray — 9
- Fallout from historical worldwide nuclear weapons testing — 1

What radiation dose might I receive from BNL?

The largest hypothetical radiation dose that a member of the public could receive in 2004 from all pathways potentially affected by Laboratory operations—including air, water, deer, and fish — is 1.72 millirems. This is less than 1 percent of the dose Long Island residents receive from natural sources of radiation each year, and 3 percent of the limit set by DOE for man-made sources of radiation. The radiation dose is calculated for a hypothetical person living at the Laboratory boundary for the entire year, eating 64 pounds of local deer meat and 15 pounds of fish caught on site.

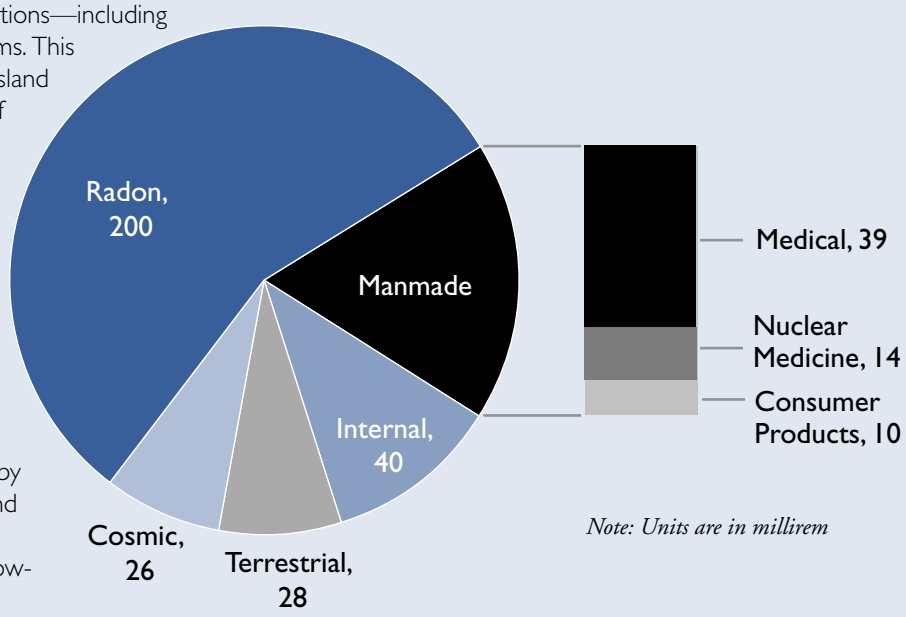
The largest portion of this worst-case dose (1.31 millirems) would result from eating deer meat. (Testing of deer killed by cars on and near Laboratory grounds, and by hunters near the site, shows elevated amounts of cesium-137 in the meat.) However, a person could eat four times as much (256 pounds) and still not exceed the New York State Department of Health "action level" of 10 millirems. In 1999, the state department of health formally concluded that there was no reason to issue health restrictions on consumption of deer taken near the Laboratory. (Hunting is not allowed on site, but deer typically range up to one mile.) The N.Y. State Department of Environmental Conservation and BNL have informed hunters of the test results so they may make their own decisions about whether to eat meat from deer taken near the site.

The radiation dose a person would receive from eating 15 pounds of fish containing cesium-137 at the highest level seen in any part of the Peconic River system would be 0.37 millirem. This dose can be compared to the dose of about 40 millirems a person receives annually from naturally occurring radionuclides in food, air, and water.

The maximum credible radiation dose a member of the public could receive due to Laboratory air emissions in 2004 was 0.04 millirem.

The internal radiation dose from drinking groundwater was expected to be zero. No radionuclides at levels above the Environmental Protection Agency's drinking water standards have been detected off the Laboratory site. On site, there are pockets of groundwater that contain radionuclides; these areas are regularly monitored and drinking water is not drawn from these areas.

For a person to be exposed to even the low levels cited in this fact sheet is an extremely unlikely "worst case" scenario. In reality, it is unlikely that anyone receives the maximum dose from any one pathway, and implausible that anyone receives all of the individual pathway doses together.

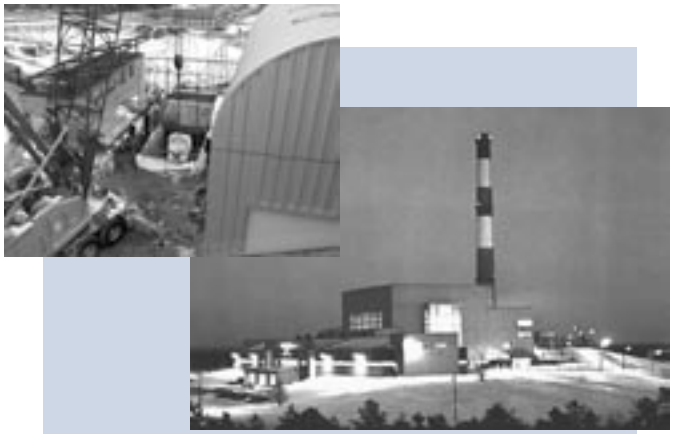


Note: Units are in millirem

BNL is committed to defining, prioritizing, and aggressively correcting and cleaning up existing environmental problems. Under the Environmental Restoration Program, monitoring is performed to determine the overall impact of past operations, to determine the extent of contamination, and to ensure remedial systems are performing as expected. In 2004, cleanup plans were proposed for areas of the site where past activities have caused contamination, and several large cleanup projects that have been of significant importance to BNL stakeholders were proposed or started.

Listed below are some of the achievements made in BNL's environmental management program during 2004:

- In May 2004, DOE and BNL encouraged public input to ensure that the cleanup decision for affected portions of the Peconic River, both on and off site, was considerate of community expectations and protective of human health and the environment. The preferred alternative recommended that 6 to 12 inches of sediment be removed from areas where contaminants had been deposited. Sediment would also be removed from areas identified as "preferential" sources of methylmercury, the form of organic mercury found in the environment that accumulates in fish and human tissue. Since part of the off-site area targeted for cleanup is located within Suffolk County parkland, the plan set more stringent cleanup goals for that area, giving the county the greatest flexibility for future use of the property. The $11.5 million project is expected to result in an estimated 92 percent reduction of mercury and 93 percent removal of PCBs in on- and off-site river sediment. The cleanup plan includes habitat restoration and long-term monitoring of surface water, sediment, and fish to evaluate the effectiveness of the cleanup.
- In August 2004, a draft plan for cleanup of the Brookhaven Graphite Research Reactor (BGRR) was submitted to the community for comment. The preferred alternative called for the removal of the reactor pile and biological shield, accessible pockets of contaminated soil, and the fuel canal structure. It also called for the completion of actions that are currently underway or planned for this facility, followed by long-term response actions, including water-infiltration management, surveillance and maintenance, and institutional controls. The plan would result in the removal of more than 99 percent of the radionuclides found within the BGRR compound.
- In December 2004, DOE sought public comment on plans to remove chemical solvents from portions of the Magothy aquifer just south of the Laboratory that had been impacted by past operations on site. The recommendation was to operate groundwater extraction wells for approximately 10 years to capture high concentrations of chemicals and prevent additional contamination from entering the Magothy aquifer. The cleanup plan also called for 55 years of continued monitoring to ensure the proposed remedy is working. The plan also addressed strontium-90 groundwater contamination on site, and called for 10 years of active treatment, followed by up to 70 years of monitoring and data analysis, to ensure that the cleanup is working and that contamination does not reach the site boundary.
- During 2004, groundwater cleanup continued with the installation of the off-site groundwater treatment systems in the area south of the Laboratory. Efforts included building, installation of pumping and recharge wells, installation of pipe, and road restoration. Significant effort was made to address the needs of the community in this area, to lessen the potential impacts of existing groundwater contaminants.



BNL's Brookhaven Graphite Research Reactor is currently undergoing decommissioning.

Peconic River Area D demonstration site re-vegetation.

QUALITY ASSURANCE PROGRAM

The BNL Quality Assurance and Quality Control Program ensures that all analytical information reported is reliable and of high quality, and that all environmental monitoring information meets quality assurance and quality control objectives. Samples are collected and analyzed in accordance with Environmental Protection Agency methods and standard operating procedures. Quality control in the contract analytical laboratories is maintained through daily instrument calibrations, efficiency and background checks, and testing for precision and accuracy. Data are verified and validated before they are used to support decision making.

In 2004, the Laboratory used the BNL Analytical Services Laboratory and five off-site contract laboratories to analyze environmental samples. All analytical laboratories were certified by New York State for the tests they performed for BNL, and were subject to oversight that included state and national performance evaluation testing, review of quality assurance programs, and audits. The BNL Analytical Services Laboratory stopped performing analyses in January of 2004. For the remainder of the year, all samples were sent to off-site contract analytical laboratories.

Four of the contract laboratories participated in several national and state performance evaluation testing programs in 2004. Results of the tests provide information on the quality of a laboratory's analytical capabilities. The two contract laboratories performing radiological analyses had "average overall satisfactory" scores (as defined by the independent testing organizations) of 96 and 87 percent. The overall satisfactory scores for the three contract laboratories that performed nonradiological testing ranged from 94.2 to 97.9 percent. The contract laboratories received an "acceptable" rating for a combined average overall satisfactory score of 93.9 percent on the radiological and nonradiological performance evaluation tests performed.

COMMUNICATION AND COMMUNITY INVOLVEMENT PROGRAM

One goal of BNL's Environmental Management System is to ensure the Laboratory's commitment to communications and community outreach. Through this commitment, BNL develops and maintains positive, proactive, and constructive relationships with its employees, regulators, and the community; promotes open and honest communication on environmental performance; and actively seeks and considers input from stakeholders. To help build these relationships, Laboratory staff regularly participate in on- and off-site meetings to discuss projects with regulators, elected and appointed officials, legislative committees, employees, and community members. Presentations, roundtables, workshops, canvassing, on-site tours, and official public comment periods all help to ensure input is gathered so that issues important to stakeholders are addressed and the values of the community are considered.

The Brookhaven Executive Roundtable, established in 1997, meets bimonthly with BNL and DOE representatives to update staff from the offices of local, state, and federal elected officials and regulatory agencies on the Laboratory's science initiatives, and operations and environmental issues. The Community Advisory Council, established in 1998, provides input to the Director of the Laboratory on issues of importance to the community, including environmental stewardship and remediation activities. Members are representatives from many stakeholder groups, including civic, health, environmental, union, business, education, and employee organizations. The Community Advisory Council meets each month in sessions open to the public, and sets its own agenda in cooperation with the Laboratory.

Communication with employees helps ensure that staff are familiar with the Laboratory's environmental policy, understand how their work can impact the environment, and know what can be done to prevent such impacts. BNL encourages information flow from management to employees and back up to management, recognizing that employees are an excellent source of information, issues, and ideas. Employees and retirees regularly interact with their neighbors and community groups, acting as the Laboratory's envoys. They provide information about Laboratory science, gather feedback, and respond to concerns.

The Laboratory maintains an informative website at http://www.bnl.gov; issues press releases and e-mail updates; and publishes *discover Brookhaven* (the Laboratory's science magazine), the *Bulletin* (a weekly employee newsletter), and *Laboratory Link* (a monthly brief on research activities) to keep the public and employees informed about the Laboratory's research, activities, and issues, including those related to the environment. Members of the community can subscribe to BNL's e-mail update service at http://lists.bnl.gov/mailman/listinfo/bnl-announce-l.

During 2004, the Laboratory hosted more than 30,600 visitors to the site, including students, teachers, and other community members who participated in "Summer Sunday" open houses, science-museum visits, site tours, and other outreach programs, including natural resource programs.

Under the Natural Resource Management Program, wildlife programs are conducted at BNL in collaboration with DOE, local agencies, colleges, and high schools. In 2004, the Environmental and Waste Management Services Division (EWMSD) hosted seven student interns and two high school teachers during the summer. The interns conducted surveys and performed analyses. The teachers, working under a new DOE Office of Education Program called Laboratory Science Teacher Professional Development, conducted water quality surveys and developed lesson plans that will be shared with other science teachers.

In addition, members of EWMSD and other BNL departments volunteered as speakers for schools and civic groups and provided on-site ecology tours. EWMSD also hosted events in association with Earth Day and provided activities to educate Laboratory employees and the general public on the environment and conservation during a Summer Sunday event in July.

BNL Celebrates Earth Day

"Your Environment" Art Contest Winners

2004 Environmental Stewardship Award Winners

In 2004, BNL celebrated Earth Day with a variety of employee and community activities, including environmental stewardship awards, a student art contest involving children from local elementary schools, and a 4-mile run. The Laboratory also participated with other local organizations and businesses in the two-day Heckscher State Park Spring Festival, using interactive displays to promote environmental awareness. BSA contributed corporate funds in support of these events as part of their commitment to environmental stewardship.

Heckscher State Park Spring Festival

Acronyms and Abbreviations

AGS	Alternating Gradient Synchrotron
ALARA	As Low As Reasonably Achievable
BGRR	Brookhaven Graphite Research Reactor
BLIP	Brookhaven Linac Isotope Producer
BMRR	Brookhaven Medical Research Reactor
BNL	Brookhaven National Laboratory
BRAHMS	Broad Range Hadron Magnetic Spectrometer
BSA	Brookhaven Science Associates
CRM	Cultural Resource Management
Cs-137	cesium-137
DOE	U.S. Department of Energy
EMS	Environmental Management System
EPA	U.S. Environmental Protection Agency
ESH	environment, safety, and health
ESSH	environmental safety, security, and health
EWMSD	Environmental & Waste Management Services Division
HFBR	High Flux Beam Reactor
HITL	Heavy Ion Transfer Line
ISO	International Organization for Standardization
ISSM	Integrated Safeguards & Security Management
Linac	Linear Accelerator
LIPA	Long Island Power Authority
maglev	magnetically levitated
MEI	Maximally Exposed Individual
MRI	Magnetic Resonance Imaging
NSF-ISR	NSF-International Strategic Registrations, Ltd.
NSLS	National Synchrotron Light Source
NYPA	New York Power Authority
NYSDEC	New York State Department of Environmental Conservation
NYSDOH	New York State Department of Health
ODS	ozone-depleting substance
OU	Operable Unit
PET	Positron Emission Tomography
P2	Pollution Prevention
PCBs	polychlorinated biphenyls
RHIC	Relativistic Heavy Ion Collider
RTF	Radiation Therapy Facility
SCDHS	Suffolk County Department of Health Services
SER	Site Environmental Report
SPDES	State Pollution Discharge Elimination System
Sr-90	strontium-90
STAR	Solenoidal tracker at RHIC
STEM	Scanning Transmission Electron Microscope
STP	Sewage Treatment Plant
TLDs	thermoluminescent devices
VOC	volatile organic compound

Index

2004 Site Environmental Report Reader Response Form

The 2004 Site Environmental Report (SER) Summary provides highlights from the Brookhaven National Laboratory 2004 SER full report. The report and summary are written to meet the requirements and guidelines of the U.S. Department of Energy and the informational needs of the public.

BNL welcomes your comments, suggestions for improvements, or any questions you may have. Please fill in the information below, and mail your response form to:

Brookhaven National Laboratory
Environmental & Waste Management Services Division
Attention: SER Project Coordinator
Building 120
P.O. Box 5000
Upton, NY 11973-5000

Name _____

Address _____

_____

Phone _____

E-mail _____

Comments, Suggestions, or Questions

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☐ I would like to be added to your Environmental Issues mailing list.

BROOKHAVEN
NATIONAL LABORATORY

SER Project Coordinator
Environmental & Waste Management Services Division
Building 120
Brookhaven National Laboratory
PO Box 5000
Upton, NY 11973-5000

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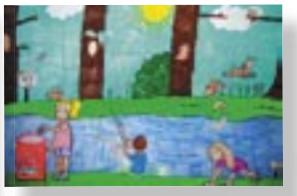

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In honor of Earth Day 2005, students from local schools in grades 3-5 were invited to participate in BNL's annual "Your Environment" art contest. The goal of the contest is to challenge students to develop artwork that focuses on cleaning up and protecting Long Island's environment.

The winning posters shown above were created by: a) Angelina Tice, Coram Elementary School, b) Julia Freed, Dayton Avenue Elementary School, c) Samantha Valentine, Ridge Elementary School, and d) Amber McIntyre, West Middle Island Elementary School.


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