



BROOKHAVEN NATIONAL LABORATORY

# 2002 Site Environmental Report

SUMMARY

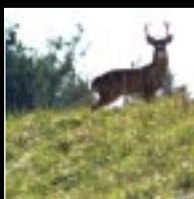
# exploring earth's mysteries...



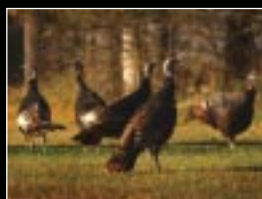
a



b



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e

## ABOUT THE COVER

The beautiful nature photos selected for the front and back covers of the Brookhaven National Laboratory 2002 Site Environmental Report depict some of the wildlife on site. The Laboratory is home to a wide variety of plants, birds, reptiles, amphibians, and mammals including some protected species.

*Front cover, Brown Thrasher.*

*Back cover, right to left,*

*a. green frog surrounded by pollen  
in the Peconic River;*

*b. Eastern Towhee sitting on a scrub pine;*

*c. white-tailed deer buck on a hill;*

*d. wild turkeys on a grassy field;*

*e. Canada goose with goslings near  
a stream on site.*

*Cover Wildlife Photography by Roger Stoutenburgh  
Graphic Design by Patricia Yalden*

## ABOUT THE SUMMARY

The 2002 Site Environmental Report (SER) Summary provides highlights from the Brookhaven National Laboratory 2002 SER. The report and the 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 the compact disc included with this summary and on the internet at <http://www.bnl.gov/esd/ser.htm>. For additional copies of this summary, please write or call:

Brookhaven National Laboratory  
Environmental and Waste Management Services Division  
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Upton, NY 11973-5000  
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# 2002 Site Environmental Report

## SUMMARY

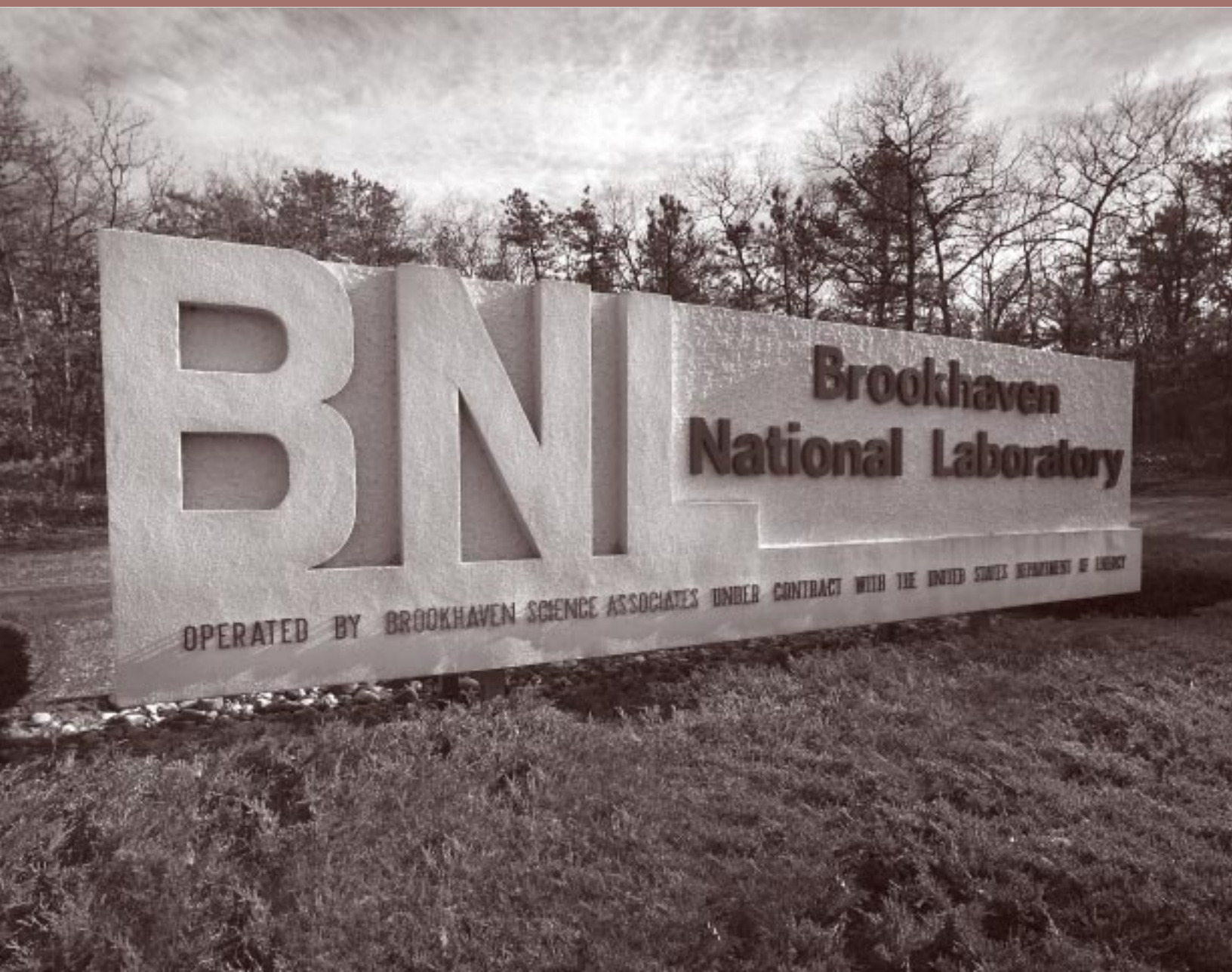
Message from the Laboratory Director .....	3
Preface .....	4
BNL Mission .....	5
About Brookhaven National Laboratory .....	6
Scientific Discoveries .....	6
BNL History .....	7
Facilities and Operations .....	8
Location, Population, and Economics .....	10
Site Description .....	11
Ecological Resources .....	12
Cultural Resources .....	14
Environmental Management System .....	16
Environmental Management Programs .....	18
Pollution Prevention and Waste Minimization .....	18
Water Conservation .....	18
Energy Management and Conservation .....	18
Compliance .....	20
Waste Management .....	25
Groundwater Protection .....	26
Environmental Restoration .....	28
Natural Resource Management .....	29
Radiation and Brookhaven .....	31
Quality Assurance .....	32
Communication, Outreach, and Involvement .....	32
Reader Survey .....	34

protecting  
its future



EXPLORING EARTH'S MYSTERIES  
...PROTECTING ITS FUTURE

A MESSAGE FROM THE LABORATORY DIRECTOR





When I became Director of Brookhaven National Laboratory in April 2003, I was already somewhat familiar with the site, having worked on collaborations here at several points during my 36-year career at IBM. As I remembered from those visits, the 5,300-acre BNL site is a special one, featuring forests of oak and pine, abundant wildlife, including deer, fox, and turkey, and some of the brightest minds in science conducting research at some truly extraordinary machines. I appreciate the importance of respecting our environment and minimizing our impact on it as much as possible. As Director, I expect nothing less than excellence from our employees and visitors, both in terms of the science carried out here and in our role as responsible stewards of the environment.

In 2002, the Laboratory continued to demonstrate environmental leadership across the Department of Energy (DOE) complex by having our environmental management system (EMS) recertified to the globally recognized ISO 14001 standard. In 2001, BNL became the first DOE Office of Science, and the first Long Island-based organization, to achieve third-party registration to the ISO 14001 standard. In 2002, the Laboratory also received recognition for its EMS from the staff of *Environmental Protection* magazine, naming BNL as one of five "Facilities of the Year."

We continued to make substantial progress in addressing historical issues in 2002, removing hundreds of tons of radioactive soils and waste from the site, completing construction of a new groundwater treatment system, and conducting an important pilot study that will help guide the cleanup of the Peconic River.

BNL was also successful in terms of our commitment to limiting current and future impacts to the environment. Pollution prevention projects in 2002 saved more than \$1.5 million and resulted in the reduction or reuse of more than 2 million pounds of industrial, sanitary, hazardous, and radioactive waste. We also saw a promising increase in the number of pollution prevention proposals submitted by scientific staff, and eight projects, funded at an initial cost of approximately \$120,000, are expected to save the Laboratory more than \$268,000 each year.

The annual publication of the Site Environmental Report is just one of many ways the Laboratory keeps our neighbors, regulators, employees, and other interested parties informed about environmental issues and progress at the site. Communication with these groups has become an integral part of our operations, and must remain so if we intend to be successful in our scientific endeavors. So, as we continue to set grand challenges for ourselves, both in terms of scientific advances and operational excellence, we keep in mind our motto, "Exploring Earth's Mysteries...Protecting Its Future."

A handwritten signature in dark ink that reads "Praveen Chaudhari". The signature is written in a cursive, flowing style.

Praveen Chaudhari, Laboratory Director



## PREFACE

This summary is an overview of the Brookhaven National Laboratory (BNL) 2002 Site Environmental Report (SER) and includes an electronic copy of the full report on the compact disk inside the back cover. The report and the summary can also be found on the Internet at <http://www.bnl.gov/esd/SER.htm>. Both the SER and the SER Summary are written to meet the requirements and guidelines of the U.S. Department of Energy (DOE) under DOE Order 231.1, *Environment, Safety and Health Reporting*.

The SER (full report) is intended to be technical in nature and includes detailed information and data on the status of BNL's environmental programs and performance; compliance performance with applicable federal, state, and local environmental laws and regulations; on-going restoration efforts; and any impacts, both past and present, that Laboratory operations have had on the environment.

This SER Summary is intended for public use as part of DOE's commitment to conveying environmental performance to people living near DOE sites and to other interested stakeholders. It was designed to give an overview of BNL's mission, scientific discoveries, site statistics, and ecological and cultural resources; BNL's Environmental Management System; the Environmental Management Program; quality assurance; and communication and outreach activities.

Throughout this SER Summary, Brookhaven National Laboratory will be referred to as BNL, the Laboratory, or the site. Other common usage includes Site Environmental Report (SER), U.S. Department of Energy (DOE), and U.S. Environmental Protection Agency (EPA).



# mission

BNL's broad mission is to produce excellent science in a safe, environmentally responsible manner with the cooperation, support, and appropriate involvement of the scientific and local communities. The Laboratory plays a lead role in the DOE Science and Technology mission and contributes to the DOE missions in Energy Resources, Environmental Quality, and National Security. The fundamental elements of BNL's role in support of these key DOE missions are:

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

It is BNL's policy to integrate environmental stewardship into all facets of its missions and operations. The Laboratory's Environmental Stewardship Policy, which is posted throughout the site, represents the highest level of commitment to conducting research and operational activities in a manner that protects the ecosystem and the health of employees on site and of the general public.

Issued and signed by the Laboratory Director, the Laboratory's Environmental Stewardship Policy is a statement of BNL's intentions and principles regarding overall environmental performance and provides a framework for planning and action.

## ENVIRONMENTAL STEWARDSHIP POLICY

IT IS BROOKHAVEN NATIONAL LABORATORY'S (BNL'S) POLICY TO INTEGRATE ENVIRONMENTAL STEWARDSHIP INTO ALL FACETS OF THE LABORATORY'S MISSIONS.

WE WILL MANAGE OUR PROGRAMS IN A MANNER THAT PROTECTS THE ECOSYSTEM AND PUBLIC HEALTH.

IN SUPPORT OF THIS POLICY, BNL MAKES THE FOLLOWING COMMITMENTS:

WE ARE COMMITTED TO ACHIEVING COMPLIANCE WITH APPLICABLE ENVIRONMENTAL REQUIREMENTS.

IN CONSIDERATION OF THE POTENTIAL IMPACTS OF OUR ACTIVITIES ON THE ENVIRONMENT, WE WILL INTEGRATE POLLUTION PREVENTION/WASTE MINIMIZATION, RESOURCE CONSERVATION, AND COMPLIANCE INTO ALL OF OUR PLANNING AND DECISION MAKING. WE WILL ADOPT COST-EFFECTIVE PRACTICES THAT ELIMINATE, MINIMIZE, OR MITIGATE ENVIRONMENTAL IMPACTS.

WE WILL DEFINE, PRIORITIZE, AND AGGRESSIVELY CORRECT AND CLEAN UP EXISTING ENVIRONMENTAL PROBLEMS.

WE WILL WORK TO CONTINUALLY IMPROVE OUR ENVIRONMENTAL MANAGEMENT SYSTEM AND PERFORMANCE.

WE WILL ESTABLISH APPROPRIATE ENVIRONMENTAL OBJECTIVES AND PERFORMANCE INDICATORS TO GUIDE THESE EFFORTS AND MEASURE OUR PROGRESS.

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.

IN ADDITION TO MY ANNUAL REVIEW OF BNL'S PROGRESS ON ENVIRONMENTAL 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.

# about Brookhaven National Laboratory



## SCIENTIFIC DISCOVERIES

BNL conducts research in physics and in chemical, biological, biomedical, and environmental sciences, as well as energy technologies. BNL also builds and operates major world-class research facilities available to academic, industrial, and government scientists. Approximately 3,000 scientists, engineers, technicians, and support staff work at BNL, and more than 4,000 guest researchers from all over the world visit the site each year to participate in scientific collaborations.

Some examples of current research at BNL include:

- Homeland security initiatives
- Pollution-eating bacteria
- Asbestos-digesting foam
- Cleaner, more efficient oil burners
- Large-scale studies of the effect of increased carbon dioxide on ecosystems
- Structural studies of the Lyme disease protein for new vaccines
- Studies of the brain, including the roots of drug addiction, psychiatric disorders, and metabolism
- Promising cocaine addiction treatments
- Investigation of the basic building blocks of matter
- Testing the standard model of physics, a theory which attempts to explain the fundamental forces of nature such as gravity



## BNL HISTORY

Established in 1947, BNL is a multi-program national laboratory operated for DOE by Brookhaven Science Associates, a not-for-profit partnership between Battelle Memorial Institute and the Research Foundation of the State University of New York on behalf of the State University of New York at Stony Brook. Brookhaven Science Associates began operating the Laboratory on March 1, 1998 under DOE Contract No. DE-AC02-98CH10886. From 1947 to 1998, BNL was operated by Associated Universities, Incorporated. Prior to 1947, the site was 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. Many of the cultural resources from the military era are preserved in the Camp Upton Museum.



*Raymond Davis Jr., a retired chemist, was one of the recipients of the 2002 Nobel Prize in Physics. He shares the prize with Masatoshi Koshihara of Japan, and Richard Giacconi of the United States.*



## N O B E L P E A C E P R I Z E

Some important scientific discoveries at BNL include:

- the use of L-dopa to treat Parkinson's disease
- work on magnetically levitated (Maglev) trains
- the radionuclide thallium-201, used in millions of heart stress tests each year
- the radionuclide technetium-99m, used to diagnose heart disease
- X-ray angiography for non-invasive 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

In 2001, BNL was ranked as one of the top five major institutions worldwide for its advances in environmental research and received three Energy 100 Awards from DOE for scientific and technological achievements. In 2002, BNL chemist Raymond Davis, Jr. and two colleagues won the 2002 Nobel Prize in Physics for detecting solar neutrinos, which are ghostlike particles produced in the nuclear reactions that power the sun. Also in 2002, a BNL atmospheric chemist, Peter Daum, was one of four recipients of Southampton College's first annual environmental leadership awards for research on strategies to control the nation's air quality problems.

## FACILITIES AND OPERATIONS

Most of BNL's facilities are located near the center of the site. The developed area is approximately 1,650 acres and includes:

- 500 acres originally developed by the Army (as part of Camp Upton) and still used for offices and other operational buildings
- 200 acres occupied by large, specialized research facilities
- 550 acres occupied by outlying facilities, such as the Sewage Treatment Plant, research agricultural fields, housing facilities, and fire breaks
- 400 acres of roads, parking lots, and connecting areas.

The balance of the site, approximately 3,600 acres, is mostly wooded and represents the native Pine Barrens ecosystem. In November 2000, DOE set aside 530 acres of undeveloped land at BNL as the Upton Ecological and Research Reserve (Upton Reserve). The reserve is managed by the U.S. Fish & Wildlife Service.

BNL's three research reactors (the Brookhaven Graphite Research Reactor, the High Flux Beam Reactor, and the Brookhaven Medical Research Reactor) are no longer operating. In addition to the scientific facilities, other facilities provide basic utilities and environmental services. All of these facilities must undergo periodic environmental review as part of the Environmental Management Program.

- *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. Water from three wells located along the western boundary of the site is treated with a lime softening process to remove naturally occurring iron. Water from the three wells along the eastern section of the developed site is treated with carbon to ensure that volatile organic compound levels meet regulatory standards. The plant is also equipped with dual air-stripping towers to ensure that volatile organic compounds are below New York State drinking water standards.
- *Central Chilled Water Plant.* This facility provides chilled water sitewide for air conditioning and process refrigeration via underground piping. The

plant has a large refrigeration capacity with once-through cooling, and reduces the need for local refrigeration plants.

- *Central Steam Facility.* This dual-fuel-fired plant provides high-pressure steam for facility and process heating sitewide. Both natural gas and fuel oil can be used to produce the steam, which is distributed to other facilities through underground piping. Condensate is collected and returned to the Central Steam Facility for reuse, to conserve water and energy.
- *Major Petroleum Facility.* This facility provides reserve fuel for the Central Steam Facility during times of peak operation. With a total capacity of 1.8 million gallons, the Major Petroleum Facility primarily stores No. 6 fuel oil. The 1997 conversion of the Central Steam Facility 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, 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 Management Facility.* This facility is a state-of-the-art complex for managing the wastes generated through BNL's research and operations. The facility began operation in December 1997 and was built with advanced environmental protection systems and features. It houses two areas that have permits from the New York State Department of Environmental Conservation for storing hazardous wastes prior to shipment for treatment and disposal at other licensed facilities.
- *Fire Station.* The BNL Fire Department provides on-site fire suppression, emergency medical services, hazardous material response, salvage, and damage control. The fire station houses six response vehicles. The fire rescue group responds within five minutes to any emergency in the core area of the Laboratory and within eight minutes to emergencies in the outer areas of the site.



## The Major Scientific Facilities at BNL



5. Heavy Ion Transfer Line (HITL). The HITL connects the Tandem Van de Graaff and the AGS Booster. This interconnection permits ions of intermediate mass to be injected into the AGS where they can be accelerated to an energy of 15 GeV. These ions then are extracted and sent to the AGS experimental area for physics research.

6. Radiation Therapy Facility (RTF). Part of the Medical Research Center, the RTF is a high-energy dual x-ray mode linear accelerator for radiation therapy of cancer patients. This accelerator delivers therapeutically useful beams of x-rays and electrons for conventional and advanced medical radiotherapy techniques.

7. Brookhaven Medical Research Reactor (BMRR). The BMRR was the world's first nuclear reactor built exclusively for medical research applications and therapy. It produced neutrons in an optimal energy range for experimental treatment of a type of brain cancer known as glioblastoma multiforme. This reactor stopped operating in December 2000.

8. Scanning Transmission Electron Microscope (STEM). This 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.

9. National Synchrotron Light Source (NSLS). The NSLS utilizes a linear accelerator and booster synchrotron as an injection system for two electron storage rings which operate at energies of 750 MeV vacuum ultraviolet (VUV) and 2.5 GeV (x-ray). The synchrotron radiation produced by the stored electrons is used for VUV spectroscopy and x-ray diffraction studies.

10. 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 and materials development as well as expanded the knowledge base of physics, chemistry, and biology. A leak in the fuel storage pool was discovered in 1997. Since that time, the HFBR has not been in operation and was permanently shut down in November 1999.

11. Tandem Van de Graaff and Cyclotron. These two facilities are used in medium-energy physics investigations and for producing special nuclides. The heavy ions from the Tandem Van de Graaff also can be injected into the AGS Booster for physics experiments.

12. Brookhaven Graphite Research Reactor (BGRR). No longer in operation, the BGRR was used for scientific exploration in the fields of medicine, biology, chemistry, physics, and nuclear engineering.

1. Relativistic Heavy Ion Collider (RHIC). RHIC is one of the world's largest and most powerful accelerators. RHIC's main physics mission is to study particles smaller than atoms.

2. Alternating Gradient Synchrotron (AGS). The AGS is used for high-energy physics research and accelerates protons to energies up to 30 GeV, and heavy-ion beams to 15 GeV. A 200 MeV Linear Accelerator, described below, serves as a proton injector for the AGS booster and also supplies a continuous beam of protons for radionuclide production by spallation reactions in the Brookhaven Linac Isotope Producer (BLIP) facility.

3. AGS Booster. The AGS Booster is a circular accelerator, 200 meters in circumference, that receives either a proton beam from the Linac, or heavy ions from the Tandem Van de Graaff. The AGS Booster accelerates proton particles and heavy ions before injecting them into the AGS ring. This facility became operational in 1992.

4. Linear Accelerator (Linac) and Brookhaven Linac Isotope Producer (BLIP). The Linac provides beams of polarized protons for the AGS and for the Relativistic Heavy Ion Collider. BLIP utilizes the excess beam capacity of the Linac to produce radioisotopes used in research and medical imaging. It is one of the key production facilities in the nation for radioisotopes which are crucial to clinical nuclear medicine. It also supports research on new diagnostic and therapeutic radiopharmaceuticals.



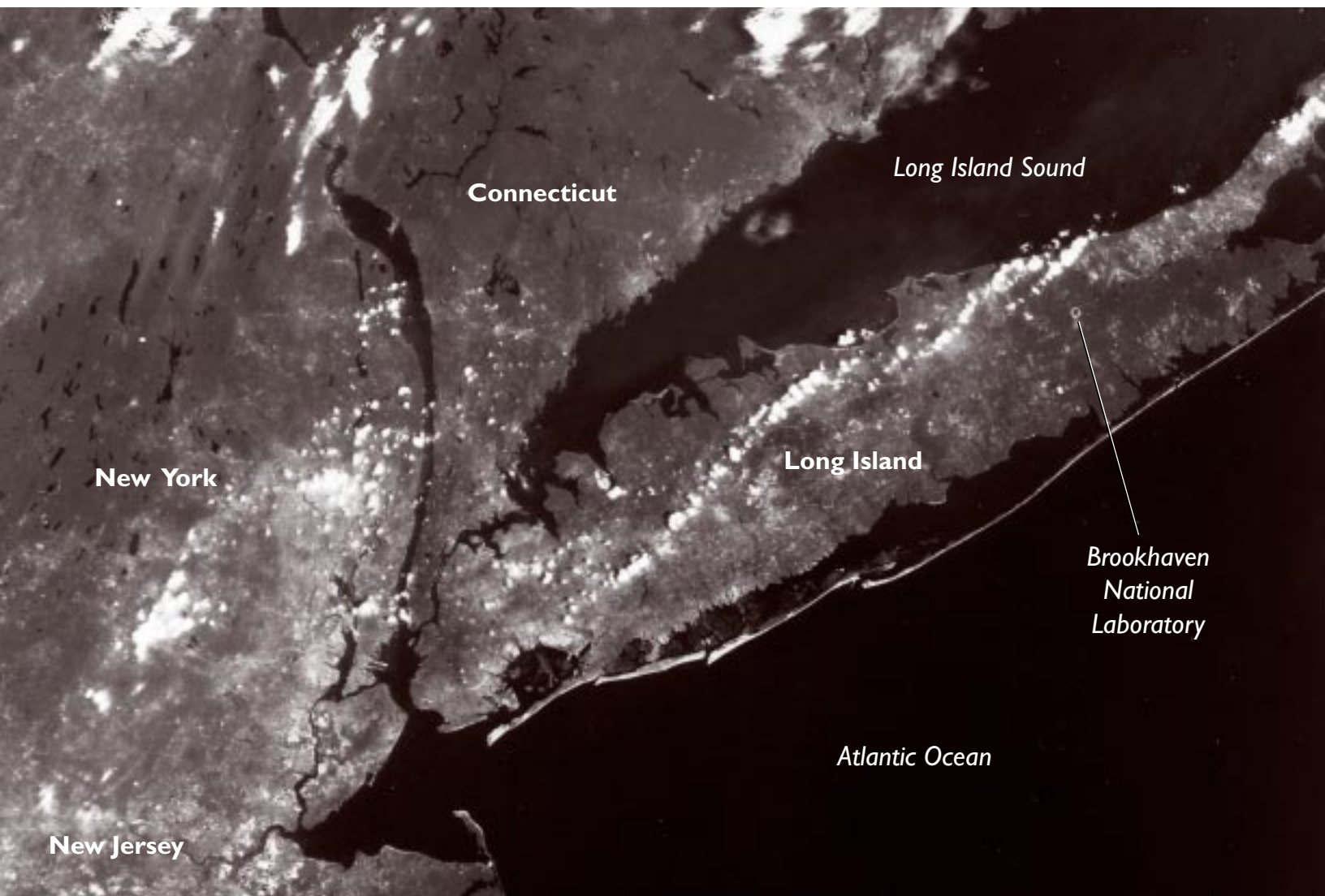
## LOCATION, POPULATION, AND ECONOMICS

BNL is in Suffolk County on Long Island, New York, about 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. More than 75 percent of the Laboratory's approximately 2,900 employees live within a 15-mile radius of BNL. Approximately 150 people reside long-term in apartments and cottages on site, and many of the approximately 4,000 scientists and students who visit each year stay in the Laboratory's short-term housing. Besides the resident staff and visiting scientists, more than 29,000 visitors participated in educational outreach activities conducted on site in 2002.

BNL is the largest employer on eastern Long Island, with an annual budget of approximately \$450 million.

Most of this budget directly supports the local economy through wages and purchases of materials and services. In fiscal year 2002, BNL purchased more than \$31 million worth of supplies and services from Long Island businesses. Construction of new buildings, repair of the Laboratory's aging infrastructure, and environmental cleanup accounted for a large part of the local expenditures. Employee salaries, wages, and fringe benefits accounted for 58 percent, or almost \$269 million, of BNL's total budget in 2002. Most of the Laboratory's employees live and shop locally in Suffolk County and throughout Long Island. An independent Suffolk County Planning Commission report 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 Long Island's economic health.

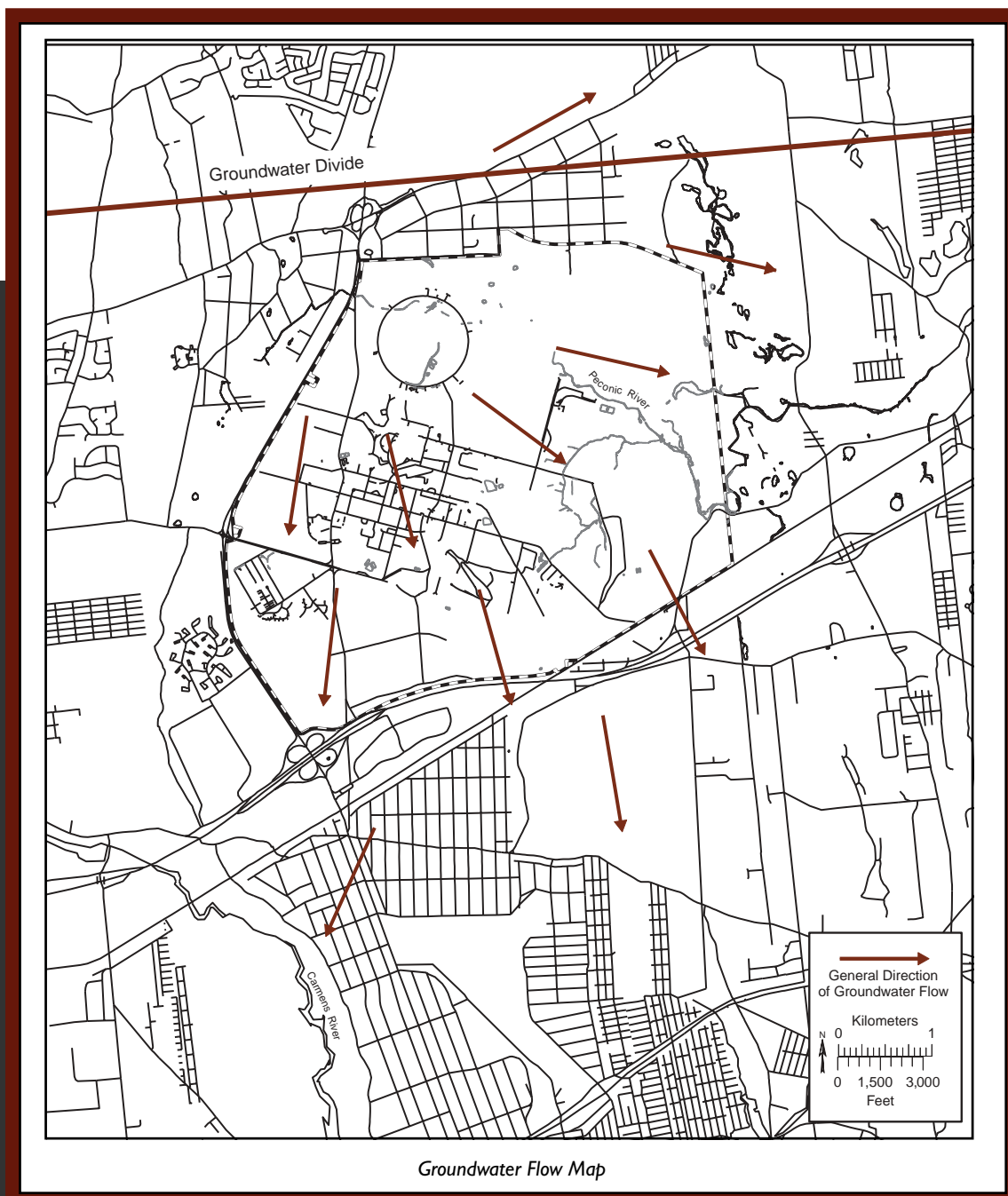
*Satellite photo showing location of Brookhaven National Laboratory. The small circle is the Relativistic Heavy Ion Collider Accelerator.*



## SITE DESCRIPTION

The BNL property is located in the oak/chestnut forest region of the Coastal Plain of Long Island, New York, and makes up about 5 percent of the 100,000-acre New York State-designated region known as the Central Pine Barrens. Part of the Peconic River, which runs through BNL, is designated “scenic” by the New York State Wild, Scenic, and Recreational River System Act. The marshy areas in the northern and eastern sections of the site are part of the headwaters of the Peconic River. The Long Island Regional Planning Board

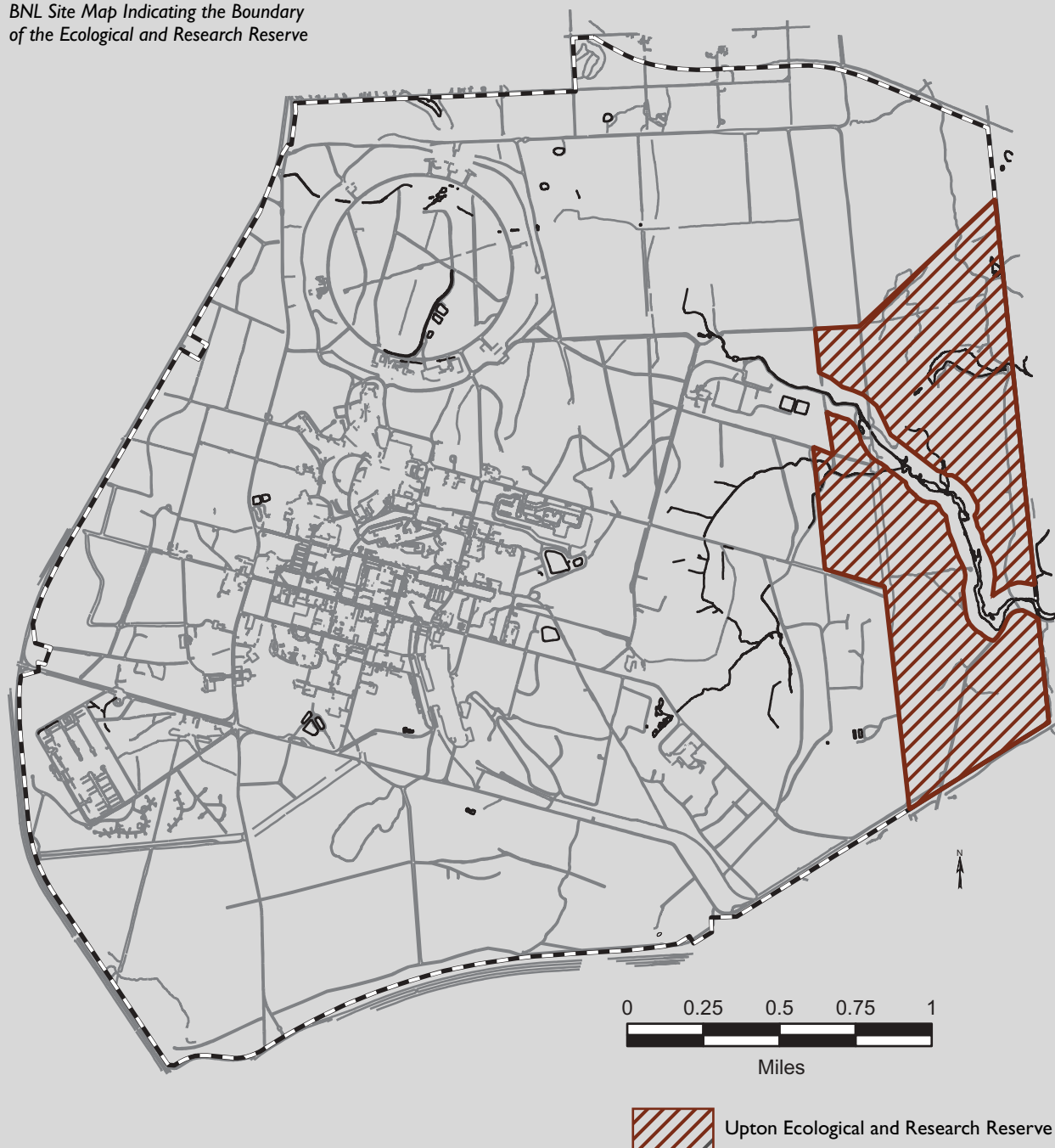
and Suffolk County have identified the BNL site as overlying a deep-flow recharge zone for Long Island groundwater. Depending on the height of the water table relative to the base of the riverbed, the Peconic River both recharges to, and receives water from, the sole source aquifer system beneath Long Island. In times of sustained drought, the river water typically recharges to the groundwater; with normal to above-normal precipitation, the river receives water from the aquifer. In 2002, there was no flow of the Peconic River off site, due to drought conditions.



## ECOLOGICAL RESOURCES

More than 230 plant species and 15 mammal species have been identified at BNL. These include species common to mixed hardwood forests and open grassland habitats, and some New York State threatened, endangered, and species of special concern. Precautions are in place to protect BNL's on-site habitat and natural resources. Details regarding BNL's Natural Resource Management Program, including monitoring and sampling, can be found on pages 29-30.

*BNL Site Map Indicating the Boundary of the Ecological and Research Reserve*





The white-tailed deer population changes from year to year, due to varying winter conditions and food supply. An optimal population for deer in this type of habitat would be 10 to 30 deer per square mile. Estimates of the deer population at BNL began in 1966 and have fluctuated from a low of 85 deer per square mile in 1992 to a high of 236 per square mile in the winter of 2000–2001. In the winter of 2001–2002, the deer population was estimated at 195 per square mile. The lack of natural predators and on-site hunting explain the high population figures at BNL. Because there are more deer than can be optimally sustained, they are smaller than deer elsewhere in the state. Other wildlife species of interest that inhabit the site include wild turkey, red fox, eastern box turtle, and red-tailed hawk.



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



*Swamp Darter (Etheostoma fusiforme).*  
This fish was released immediately after the picture was taken.



*Tiger Salamander (Ambystoma t. tigrinum).*

At least 85 species of birds are known to nest at BNL, and an additional 130 species have been documented as visiting the site. These numbers can be attributed to BNL's location in the Atlantic Flyway and to the scrub/shrub habitats that offer food and rest to migratory songbirds.

Permanently flooded retention basins and other watercourses support amphibians and aquatic reptiles. Recent ecological studies at the BNL site have confirmed 17 breeding sites for the New York State-endangered eastern tiger salamander in ponds and recharge basins. Ten species of fish have been identified as native to the site, including some New York State threatened species, such as the banded sunfish and the swamp darter.

In November 2000, DOE established the Upton Ecological and Research Reserve at BNL. DOE then entered into an Inter-Agency Agreement with the U.S. Fish & Wildlife Service to manage the reserve. A technical advisory group (TAG) made up of local land management agencies was formed to assist BNL and the U.S. Fish & Wildlife Service with technical expertise and to provide input into decision making. At 530 acres, the reserve makes up 10 percent of the Laboratory's property and is located on the eastern portion of the site, within the Core Preservation Area of the Pine Barrens. The Pine Barrens land in the reserve creates a unique ecosystem of forests and wetlands, providing a habitat for plants, mammals, birds, reptiles, and amphibians. As part of its commitment to protecting the environmental assets of its sites, DOE is providing the U.S. Fish & Wildlife Service with \$200,000 a year over a five-year period to conduct research and resource management programs for the conservation, enhancement, and restoration of wildlife and habitat in the Upton reserve. In 2002, this funding helped support activities in outreach, conservation, and habitat protection. Four grants, selected by the TAG, were also awarded to support Pine Barrens-related research. Details regarding these activities and the research grants can be found at <http://www.bnl.gov/esd/reserve/default.htm>. DOE, BNL, and the U.S. Fish & Wildlife Service continue to work with neighbors of the Upton Reserve, environmental organizations, regulatory agencies, and other stakeholders to develop a comprehensive, ecosystem-based Natural Resource Management Plan for BNL and the Upton Reserve.

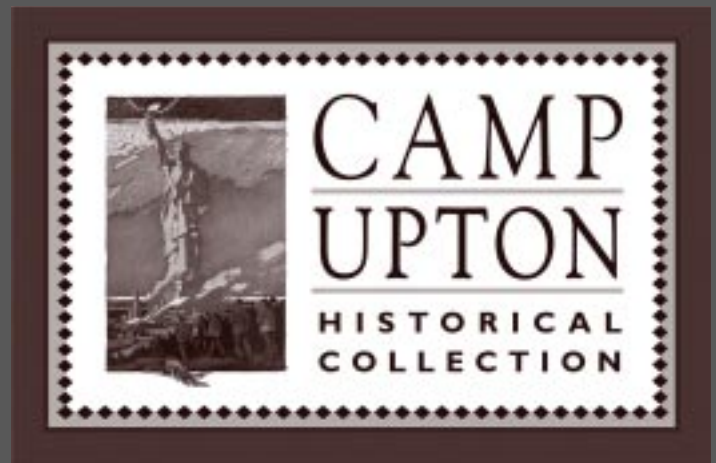
## CULTURAL RESOURCES

The Cultural Resource Management Program at BNL is being developed to ensure that the Laboratory fully complies with numerous cultural resource requirements. BNL is working toward meeting an accelerated schedule for development of the BNL Cultural Resources Management Plan, including having a draft plan submitted to DOE by December 2003. Development of a formal plan will guide the management of all of BNL's cultural resources. Along with achieving compliance with applicable regulations, one of the major goals of the Cultural Resource Management Program is to fully assess both known and potential cultural resources. The range of BNL cultural resources includes buildings and structures, World War I earthwork features, the Camp Upton Historical

Collection, scientific equipment, photo archives, and institutional records. As cultural resources are identified, plans for their long-term stewardship are developed and implemented. Achieving these goals will ensure that the contributions BNL and the BNL site have made to our history and culture are documented and available for interpretation.

BNL has three structures or sites that have been determined to be eligible for listing on the National Register of Historic Places: the Brookhaven Graphite Research Reactor complex, the High Flux Beam Reactor complex, and the World War I training trenches associated with Camp Upton. As part of developing the management plan, several projects were initiated in 2002. In one project, BNL contracted with an outside company to evaluate the on-site

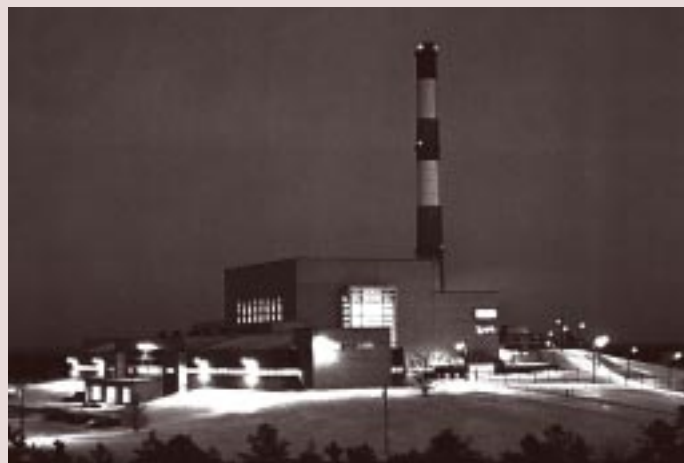
# CAMP UPTON



*E-Co. 302 Ammunition Train Camp, Upton, L.I., 1918*

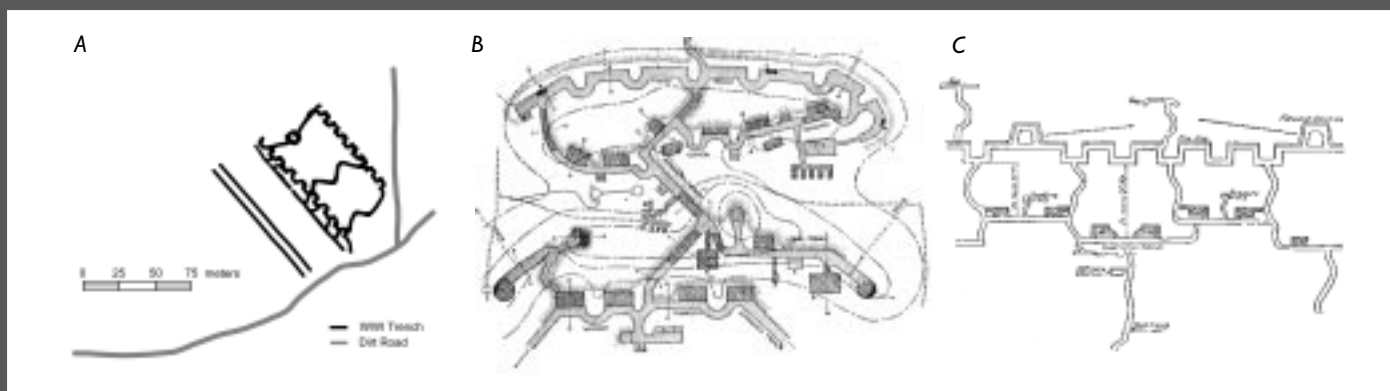


World War I features for National Register eligibility and preservation or restoration concepts. This project included mapping the World War I training trenches and many of the remaining Camp Upton footprint foundations. Ten separate trench and three foundation complexes were surveyed as part of this effort. This project provides insight into one of BNL's most unique cultural resources, because BNL trenches may be the only surviving examples of World War I earthworks in the United States. Another contracted project that produced valuable results was the inventory and cataloging of the Camp Upton Museum Collection according to museum standards.



*The Laboratory is currently working to finalize a video of the history of the Brookhaven Graphite Research Reactor.*

*Exhibit A shows the result of mapping Trench 6. An overhead view was produced that provides a complete perspective of how this particular trench network was arranged. Exhibits B and C present two diagrams of trench construction methods, from British and American army field manuals. When the trench layout is compared to the two field manual methods, similarities become quite apparent. At the far right is a recent photograph depicting how the trenches appear today, approximately 85 years later.*





# environmental management system

In order for BNL's Environmental Management System to continue to maintain registration to the ISO 14001 standard, not only do environmental policies and procedures have to be accurately documented, but employees must also follow them. During an audit, employees may be asked questions like "what is included in BNL's environmental policy?" or "how do you find out what environmental requirements apply to your job?" Employees are expected to be aware of and to follow these key points:

- Compliance Assurance

Make sure you know how to comply with the environmental regulations that apply to your job. The Standards-Based Management System will help you do this by providing the procedures that must be followed. (The Standards-Based Management System is a document management tool the Laboratory uses to develop and integrate programs and demonstrate BNL's conformance to requirements in order to perform work safely and efficiently.)

- Pollution Prevention

Central Shops now cleans parts without hazardous solvents by using a new, more effective process. Think—how can my work be redesigned to use less hazardous materials? Pollution Prevention techniques reduce disposal costs, minimize the chance of spills, lead to a safer workplace, and eliminate regulatory requirements.

- Clean-up

The amount of money BNL spends today to clean up the results of past disposal practices is the best illustration of the importance of pollution prevention.

- Continuous Improvement

To improve our environmental performance, we measure our levels of emissions and effluents, set goals to reduce them, and work to achieve these goals. Get involved! Make suggestions on how to reduce emissions. If a procedure doesn't make sense or won't work for you, then help change it.

Employees who live in the surrounding communities are our best ambassadors. By sharing our accomplishments with our neighbors, we can allay community concerns.

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

improving the organization's environmental performance. It requires the development of an environmental policy, creation of plans to implement the policy, implementation of the plans, methods to check progress and take corrective actions, and annual reviews of the system to ensure its continuing suitability, adequacy, and effectiveness. To gain registration to the ISO 14001 standard, an organization must comply with 17 requirements.

BNL was the first DOE Office of Science laboratory to obtain official, third-party registration to the ISO 14001 standard, which happened in July 2001. To achieve this, the Laboratory's Environmental Management System was audited independently to verify that the system conformed to all ISO requirements and that it was effectively implemented. The certification

**NSF-ISR****NSF International Strategic Registrations, Ltd.****NSF-ISR**

A Subsidiary of NSF International  
789 North Zeeb Road, Ann Arbor, Michigan 48105  
(888) NSF-9000

## *Certificate of Registration*

This certifies that the Environmental Management System of

### **Brookhaven National Laboratory**

Upton L.I., NY 11973-5000

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

### **ISO 14001:1996**

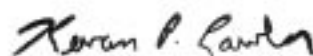
#### **Scope of Registration:**

The scope of registration includes the Environmental Management System for The Biology Department, Medical Department, Brookhaven UNAC Isotope Producer and Target Processing Laboratory, Collider - Accelerator Department, Superconducting Magnet Division, Reactor Division, Environmental Restoration Division and the Waste Management Division of the Brookhaven National Laboratory.

#### **Industrial Classification:**

SIC: 8999

Certificate Number: 69521-E2  
Certificate Issue Date: 09/25/2000  
Date of Initial Registration: 08/25/1999



Kevan P. Lawlor  
NSF-ISR



Environmental Management  
System Registered to  
ISO 14001:1996



NSF-ISR's Registration  
Program is Accredited by the  
American National Standards  
Institute - Registrar  
Accreditation Board

Authorized Registration and Accreditation Marks

requires BNL to be audited annually by an accredited auditing company to assure that the system is maintained. The audits are conducted by NSF-International Strategic Registrations, LTD, an independent, third-party environmental review group. The purpose of the audits is to validate that BNL's system is being maintained and to identify evidence of continual improvement. In 2002, a surveillance audit determined that BNL remains in conformance. The audit reviewers identified one minor nonconformance, one opportunity for improvement, and strong evidence of continual improvement, including 14 particularly noteworthy practices. These included BNL's comprehensive use of computer technology to help provide environmental guidance, the thoroughness of the Laboratory's experimental project reviews, and its systems for identifying environmental protection

priorities and tracking issues. The reviewers also noted that BNL's Environmental Management System was the most thoroughly and systematically implemented program they had encountered to date.

The Laboratory was the first organization to win a DOE Pollution Prevention Award for "Excellence in Management," in recognition of the BNL Environmental Management System. Because of BNL's knowledge and unique experience implementing the ISO 14001 Environmental Management System program, several DOE facilities and private universities have invited the Laboratory to extend its outreach activities and share its experiences, lessons learned, and successes.

Further information regarding the Laboratory's Environmental Management System can be found at <http://www.bnl.gov/esh/ems/>.

# environmental management programs

BNL's Environmental Management Program consists of several Laboratory-wide and facility-specific environmental programs. The Laboratory maintains a comprehensive monitoring program to protect human health and the environment by monitoring potential pathways of exposure, measuring potential environmental impacts from Laboratory operations, and providing data to check compliance with regulations and allowable limits.

## **POLLUTION PREVENTION AND WASTE MINIMIZATION PROGRAM**

BNL's Pollution Prevention Program seeks ways to stop or minimize the generation of waste and the accompanying need to dispose of toxic materials. It is integrated into all planning and decision making at the Laboratory, and reflects the national and DOE pollution prevention goals and policies. It represents an ongoing effort to make pollution prevention and waste minimization an integral part of the BNL operating philosophy.

The pollution prevention and waste minimization projects implemented through 2002 have saved more than \$1.5 million and caused the reduction or reuse of more than 2 million pounds of waste (see Figure A). BNL's ISO 14001 registered Environmental Management System and its nationally recognized Pollution Prevention Program both contributed to BNL being selected as one of five winners of "Environmental Facility of the Year" by *Environmental Protection* magazine in 2002. The magazine noted that the winners "used innovative approaches to protect the environment while simultaneously boosting their companies' bottom lines."

The key elements of the Pollution Prevention Program are:

- Eliminate or reduce wastes, effluents, and emissions at the source where possible, and ensure that the remaining environmental effluents, emissions, and wastes are As Low As Reasonably Achievable.
- Procure environmentally preferable products (also known as "affirmative procurement").
- Conserve natural resources and energy.
- Reuse and recycle materials.
- Achieve or exceed BNL/DOE waste minimization, pollution prevention, recycling, and affirmative procurement goals.
- Comply with applicable requirements (e.g., New York State Hazardous Waste Reduction Goal, Executive Orders).
- Reduce waste management costs.
- Identify funding mechanisms for evaluating and implementing pollution prevention opportunities.
- Implement pollution prevention projects.
- Improve employee and community outreach and awareness of pollution prevention goals, plans, and progress.

Proposals for funding pollution prevention opportunities are submitted to the Laboratory Pollution Prevention Council. In January 2002, the council announced eight winners of the "Return on Investment" funding competition. With a total investment of about \$120,000, the savings generated by the winning projects are estimated at \$268,000, for an average payback period of only five months. This continues a positive trend started in FY01, and is further evidence that pollution prevention planning is well integrated into the work planning process at BNL.

## **WATER CONSERVATION PROGRAM**

BNL has a strong Water Conservation Program and has achieved dramatic reductions in water use since the mid 1990s (see Figure B). The Laboratory continuously evaluates water conservation as part of building upgrades and new construction projects. In 2002, the Laboratory reduced water use by 700 million gallons compared to 1995 usage.

## **ENERGY MANAGEMENT AND CONSERVATION PROGRAMS**

BNL's Energy Management Group works to reduce BNL's energy use and costs by identifying economical energy-efficient products, monitoring energy use and utility bills, and helping to obtain the least expensive energy sources possible.

In 2002, BNL used approximately 278 million kilowatt-hours of electricity, 2.7 million gallons of fuel



oil and propane, and 273 million cubic feet of natural gas. Natural gas use started in 1997 and is reducing BNL's reliance on fuel oil. BNL has an agreement with the Long Island Power Authority to reduce electrical demand throughout the summer, in return for a rebate. The Laboratory is the single largest program contributor, saving more than 12 percent of the program's total (see Figure C).

In 2002, several completed energy-related projects included a water project that saved substantial potable water; fuel purchasing strategies that saved nearly \$600,000; and the retirement of two large, out-dated chlorofluorocarbon chillers. BNL also received \$235,000 for new energy conservation projects and studies, including one that will save nearly 30 percent of the energy now used to produce compressed air.

The National Energy Conservation Policy Act requires federal agencies to apply energy conservation measures and improve federal building design to reduce energy consumption per square foot. Current goals are to reduce energy consumption per square foot, relative to 1985, by 20 percent in 2000, 30 percent by 2005, and 35 percent by 2010. The Laboratory's energy use per square foot in 2002 was 28 percent less than in 1985.

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

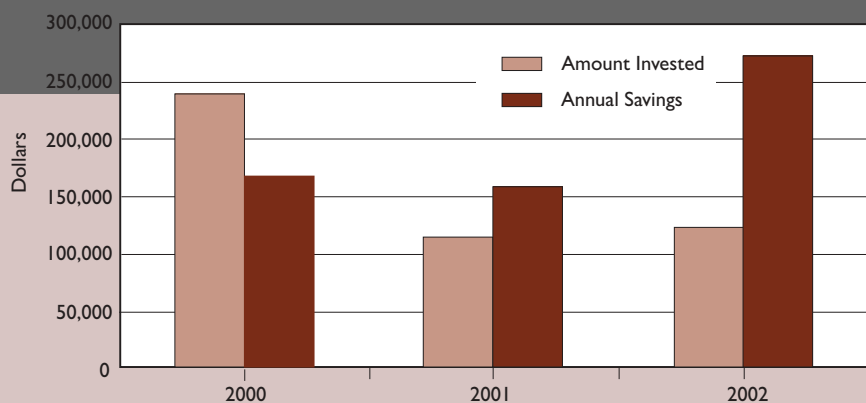


Figure A. Pollution Prevention Investments

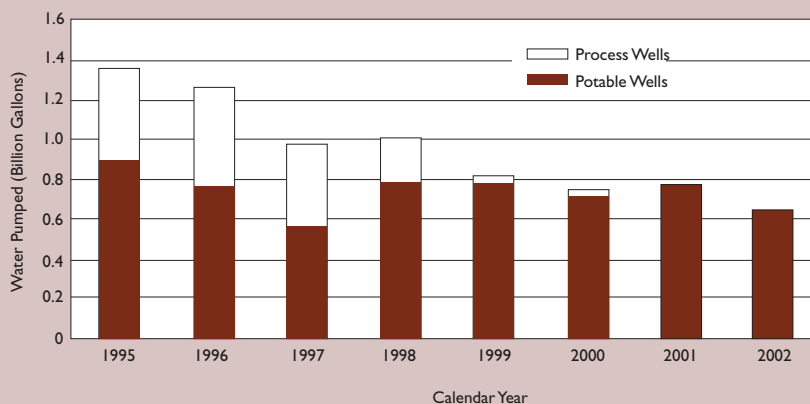


Figure B. Water Consumption Trend

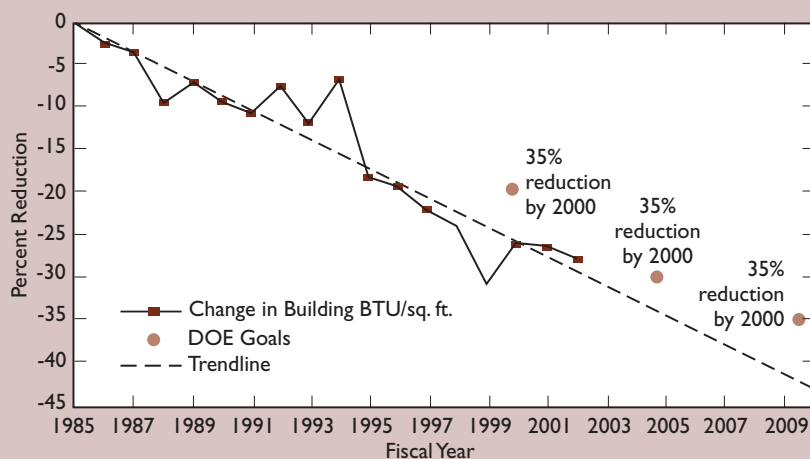


Figure C. Building Energy Performance Since 1985

## COMPLIANCE PROGRAM

BNL has an extensive program in place to ensure full compliance with all applicable environmental regulatory requirements and permits. BNL must comply with over 50 sets of federal, state, and local environmental regulations; numerous site-specific permits; equivalency permits for operation of seven groundwater remediation systems; and several other binding agreements. Major federal environmental laws include the Clean Air Act, Clean Water Act, Oil Pollution Act, Safe Drinking Water Act, and the Resource Conservation and Recovery Act, among many others. The Laboratory is committed to achieving and maintaining full compliance with these environmental requirements and agreements to help eliminate or minimize any impact Laboratory operations might have on the environment. Under the BNL Environmental Monitoring Program, compliance monitoring is conducted to ensure that wastewater effluents, air emissions, and groundwater monitoring data comply with regulatory limits.

### AIR MONITORING

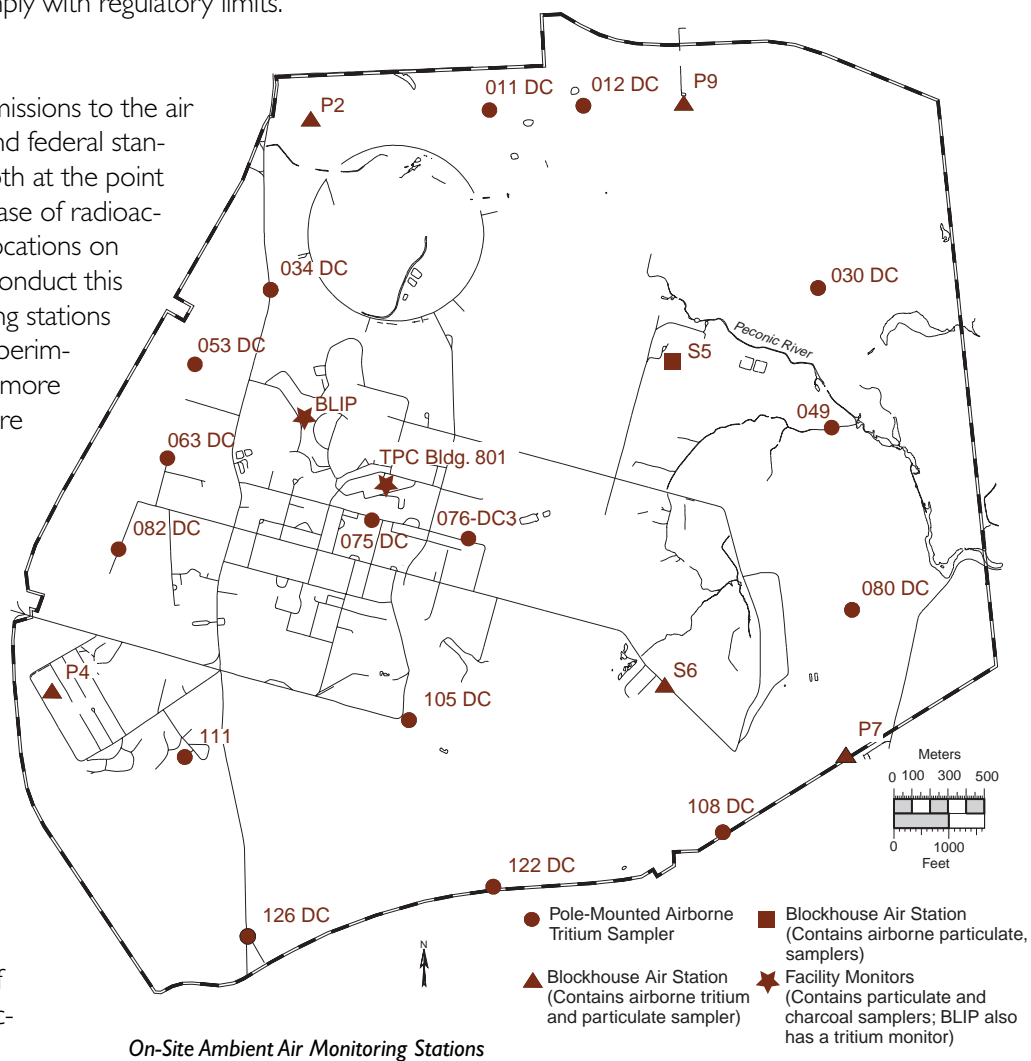
The Laboratory's emissions to the air are governed by state and federal standards and monitored both at the point of emission and, in the case of radioactive elements, at many locations on the Laboratory site. To conduct this monitoring, air monitoring stations are in place around the perimeter of the site. In 2002, more than 900 air samples were collected for radiological analysis and continuous monitoring was performed for conventional pollutants. The monitoring results from these samples show that BNL's air emissions were well below the standards set by regulators to protect human health.

### Nonradiological Air Emissions

BNL has a variety of conventional, nonradioactive air emission sources.

Boiler emissions from the Central Steam Facility, which supplies steam for heating and cooling to BNL major facilities, and spray painting and metal cleaning operations are some examples. The Central Steam Facility is the only Laboratory emission source that requires continuous monitoring for nonradiological emissions, based on EPA rules. In 2002, boiler emissions of nitrogen oxides, carbon monoxide, and sulfur dioxide were all within permit limits, although they were considerably higher in 2002 than in 1999 when natural gas was the predominant fuel in use. Compared to 2001, when a spike in the cost of natural gas caused a greater use of fuel oil, fuel use and emissions declined significantly in 2002.

Under BNL's preventive maintenance program, refrigeration and air conditioning equipment containing ozone-depleting substances is regularly inspected and maintained. In 2002, approximately 1,000 pounds of



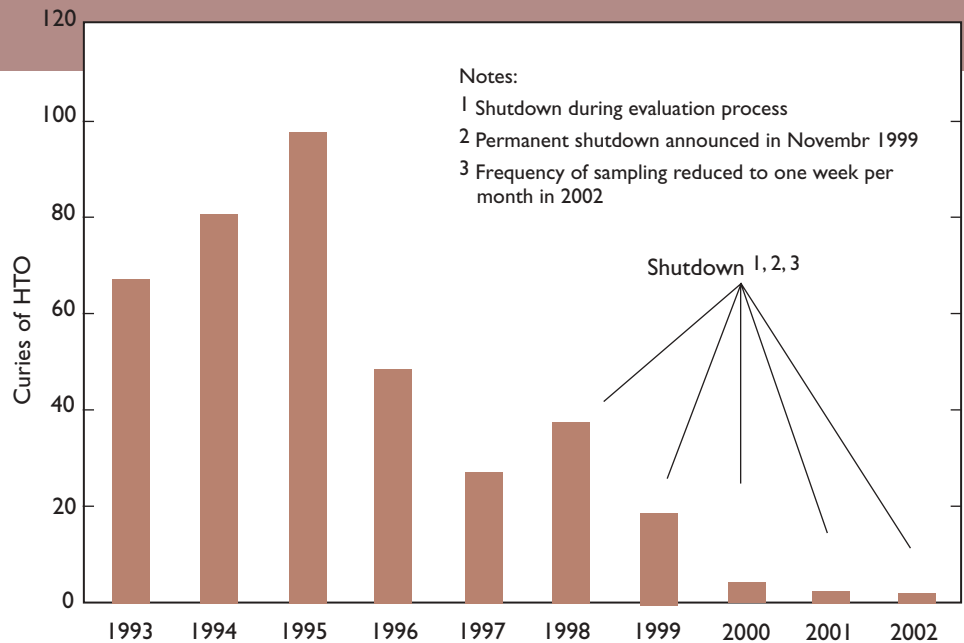
ozone-depleting refrigerants were recovered for recycling. All nonradiological emissions in 2002 met the requirements of the Clean Air Act.

### Radiological Air Emissions

Air samples are collected to test radiological air quality. Under the National Emission Standards for Hazardous Air Pollutants (part of the Clean Air Act), facilities that could deliver an annual radiation dose greater than 0.1 mrem to a member of the public must be continuously monitored for emissions.

Facilities that could deliver an annual radiation dose below 0.1 mrem require periodic monitoring. BNL has one facility that requires continuous monitoring, the Brookhaven Linac Isotope Producer. Periodic monitoring is conducted at the Target Processing Lab, the High Flux Beam Reactor, and the Brookhaven Medical Research Reactor.

Results for 2002 show that the airborne radionuclide levels around the Laboratory were no different than the levels taken from control locations reported by the New York State Department of Health. (Control locations are areas in New York *not* located near nuclear facilities.) With the permanent shutdown of the Laboratory's last two operating reactors, the High Flux Beam Reactor (in 1999) and the Brookhaven Medical Research Reactor (in 2000), the already-low levels of radionuclides emitted from these facilities will continue to decline over time as the fuels and the reactor contents (such as water) are placed into stable storage mode.



High Flux Beam Reactor Tritium Emissions, Ten-Year Trend (1993 – 2002)



Air Emissions Release Points Subject to Continuous Monitoring



## External Radiation Measurements

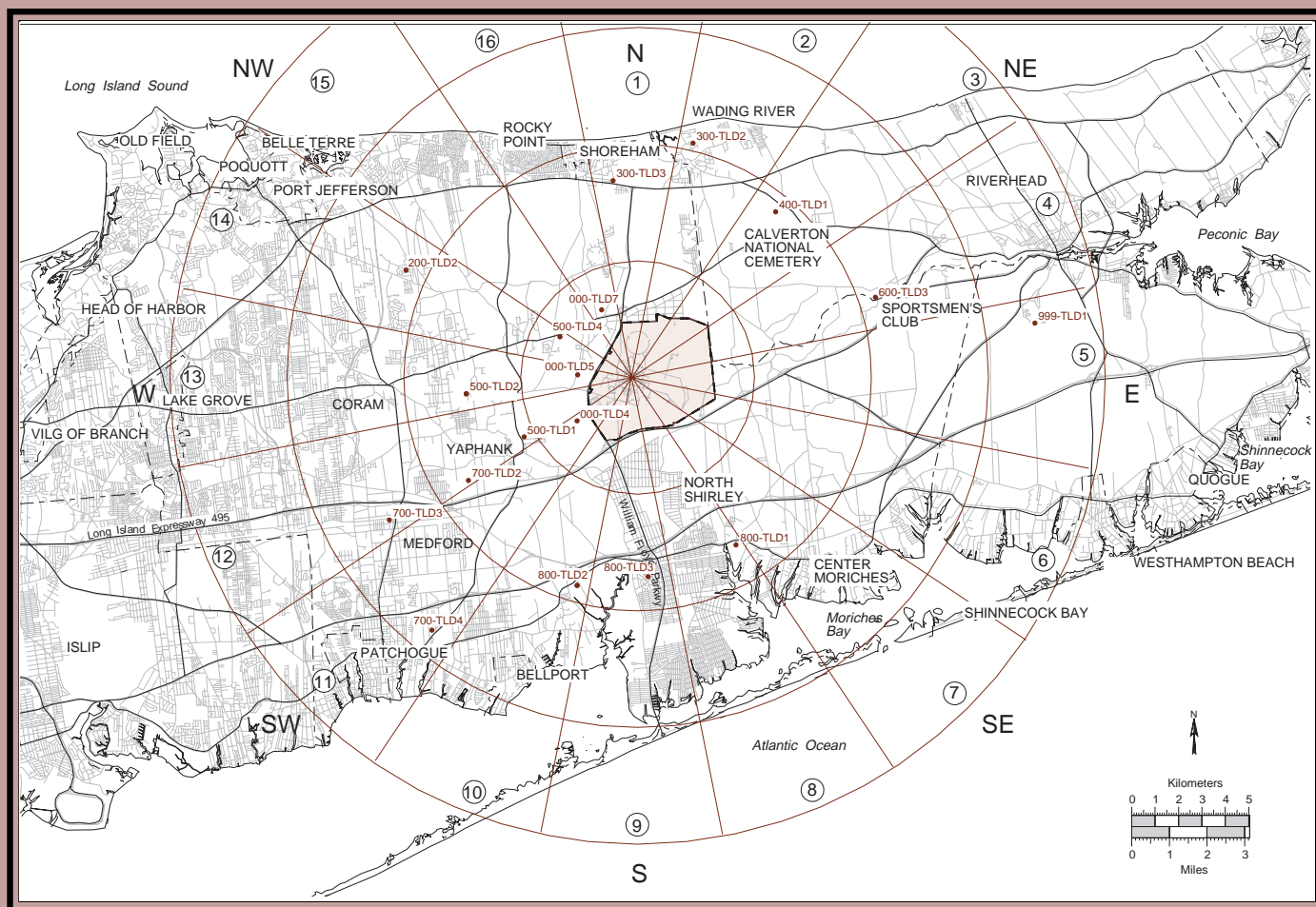
BNL monitors external radiation exposure at 41 on-site and 18 off-site locations with the use of thermoluminescent dosimeters. These devices measure all sources of ionizing radiation, including cosmic and terrestrial radiation, and any contribution from Laboratory operations. In 2002, monitoring results showed that Laboratory operations had no impact on the external radiation levels that were measured on the Laboratory site or in the surrounding area.

## Potable Supply Wells

The quality of the BNL potable water supply is monitored as required by the Safe Drinking Water Act, and test results are reported to the Suffolk County Department of Health Services. BNL also prepares an annual Water Quality Consumer Confi-

dence Report that is distributed to all employees and guests on site. This report is available at <http://www.bnl.gov/bnlweb/pubaf/water/reports.htm>.

Because the potable supply wells are near known or suspected groundwater contamination and source areas, BNL conducts additional testing of the potable supply wells. Monitoring results for 2002 showed that all drinking water at BNL fully complied with all drinking water requirements. Off-site, most neighboring residents south and east of the Laboratory receive their household water from the public water supply, which is regulated by the Suffolk County Department of Health Services. A few residents in these areas still use wells, having declined free hookup to the public water supply. The U.S. Department of Energy offers these households free yearly testing of their well water.



Off-Site TLD Locations

## **SURFACE WATER QUALITY**

Some BNL operations discharge wastewater to surface waters or to groundwater recharge basins. Some of these wastewaters may contain very low levels of radiological, organic, or inorganic contaminants. Monitoring, pollution prevention, and careful operation of treatment facilities helps ensure that these discharges comply with all applicable requirements and that employees, the public, and the environment are protected.

The BNL Sewage Treatment Plant discharges treated wastewater to the headwaters of the Peconic River, which flows through the Laboratory grounds. On the BNL site, the Peconic River is an intermittent stream. During most of the year, the river generally runs dry before reaching the site



boundary. Off-site flow only occurs during heavy periods of precipitation. Due to severe drought conditions in the spring and summer of 2002, there was no off-site flow recorded.

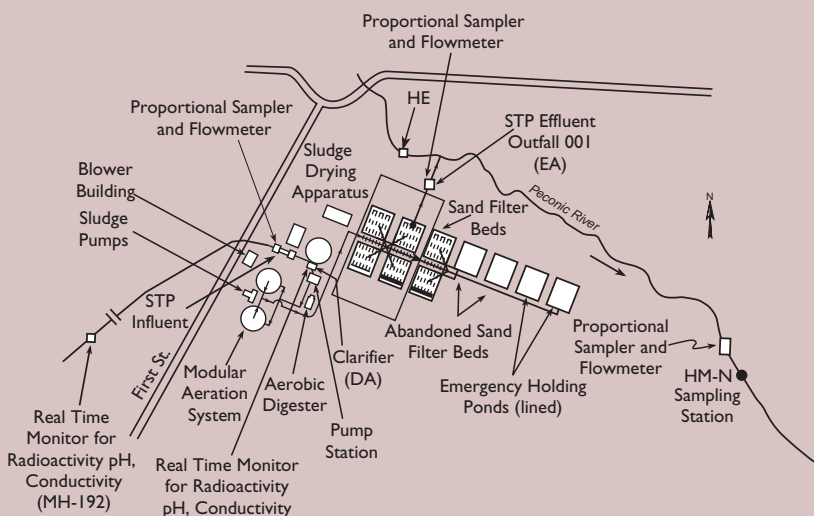
### **Nonradioactive Discharges**

Discharges from Laboratory operations are released and monitored under a permit from the New York State Department of Environmental Conservation either as surface water releases to the Peconic River after processing at the Sewage Treatment Plant, or (from certain facilities on site) to recharge basins. To assess the impact of this discharge on the quality of the river, BNL routinely monitors surface water at several locations upstream and downstream at the point of discharge. Treated water at

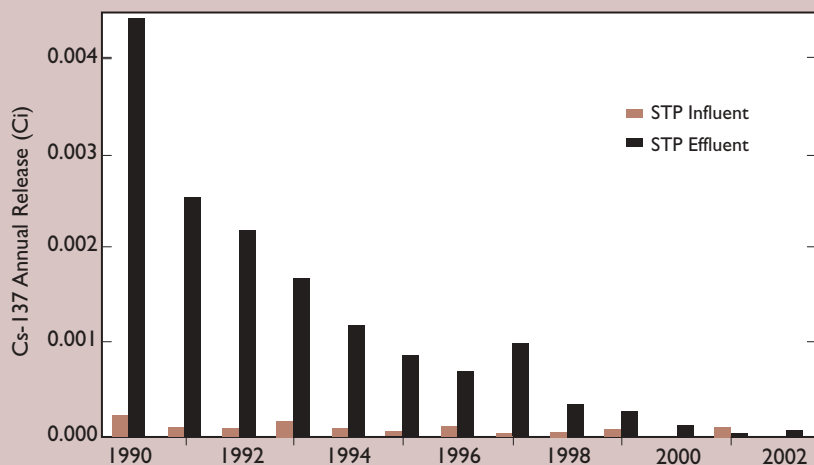
the Sewage Treatment Plant is tested for 21 inorganic compounds and 38 volatile organic compounds by the BNL Analytical Services Laboratory and contractor laboratories. In 2002, 364 samples were collected to monitor organic, inorganic, and radiological levels in treated water at the Sewage Treatment Plant and water in the Peconic River. Also, 126 samples were collected from discharges to on-site recharge basins. In 2002, BNL achieved a compliance rate of greater than 99 percent for discharges.

Samples of water and sediment from the Peconic River and nearby ponds are collected routinely at several locations on and off the site. The Carmans River and other bodies of water are used as control locations against which the Peconic River water is compared. Monitoring results showed that no organic compounds were routinely detected in river water samples above the minimum detection limits. Analysis of metals data showed that aluminum, copper, iron, lead, selenium, and zinc were present in concentrations that exceeded water quality standards at locations both upstream and downstream of the Sewage Treatment Plant. Silver and mercury were also detected above water quality standards at a location immediately downstream of the Sewage Treatment Plant. Because many of the metals occur both upstream and downstream of the Sewage Treatment Plant, these are attributed to natural sources such as soils and to transport of these soils in the water. Since silver and mercury are highest immediately downstream of the plant, these are attributable to elevated levels in sediment deposited by historical Laboratory operations. The Peconic River is being evaluated under the Environmental Restoration Program for cleanup and removal of these contaminants.

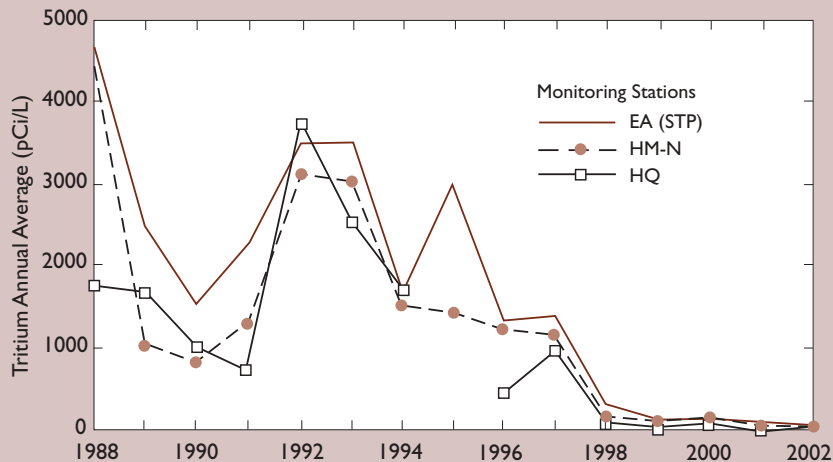
Nonradiological analytical results of recharge basin discharges in 2002 showed that most levels, except for aluminum and iron, complied with respective groundwater discharge or water quality standards. Aluminum and iron are natural compounds of soil. Under the Laboratory's Environmental Surveillance Program, an investigation of lead concentrations in soil samples collected at the Central Steam Facility continued in 2002. Investigation activities included the collection of more than 100 soil samples that were used to define the area of contamination.



*Schematic showing the Laboratory's Sewage Treatment Facility*



*Cesium-137 in the Sewage Treatment Plant Influent and Effluent (1990 – 2002)*



Notes:  
There were no samples collected at monitoring Station HQ in 1987, 1995, and 2002 due to low water table conditions.  
NYSDrinking water Standard is 20,000 pCi/L

*Sewage Treatment Plant/Peconic River Annual Tritium Concentrations (1988– 2002)*

## Radioactive Discharges

Radionuclide measurements were performed on surface water samples collected from the Peconic River. Except for single detections of gross alpha levels at two downstream monitoring stations, radiological analysis of all the samples showed that all detected levels were below the drinking water standard. Past operations at the Laboratory resulted in the deposition of low concentrations of alpha-emitting nuclides in the soils and sediments downstream of the BNL Sewage Treatment Plant. These soils and sediments are the most likely contributors to the detection of gross alpha activities, when they become resuspended in the water due to erosion. Tritium analytical results were below detectable levels at all stations. Strontium-90 results showed trace levels at all locations, but this is typical all over the world, probably due to atmospheric fallout from past nuclear testing.

Radiological results of recharge basin discharges in 2002 showed that extremely low levels of gross beta activity were detected in most of the basins, and all were less the drinking water standard. Tritium was not detected in any basin above minimum detection limits.

## Sediment Analysis

Past releases have deposited "heavy metals" (such as mercury and silver), polychlorinated biphenyls (PCBs), and low levels of radioactivity in some Peconic River sediments on and near the Laboratory site. These locations continued to be monitored in 2002 under the Laboratory's Environmental Surveillance Program. Sediment monitoring results indicated that the concentrations of radionuclides in local waterways, including Flanders Bay and Peconic Bay, and Jamaica Bay and Lloyd Harbor (comparison locations), were consistent with global fallout patterns.

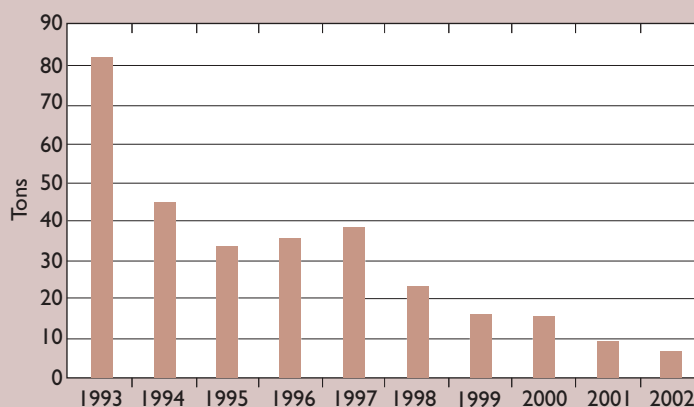
## WASTE MANAGEMENT

BNL has an active and successful Solid Waste Recycling Program managed by the Plant Engineering Division that involves participation from all employees. In 2002, BNL collected more than 209 tons of office paper for recycling. In addition to paper, the recycling program collects many other kinds of materials, including cardboard, bottles and cans, construction debris, motor oil, scrap metals, lead, automotive batteries, printer and toner cartridges, fluorescent light bulbs, machine coolant, and antifreeze.

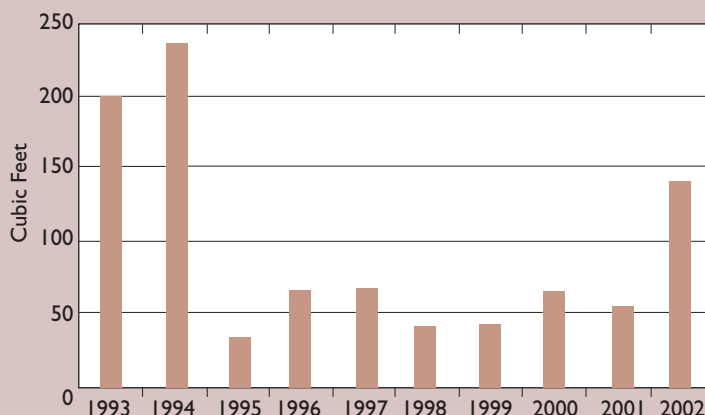
The Waste Management Division is responsible for collecting, transporting, storing, and disposing of site-generated hazardous, industrial, and radioactive wastes. Wastes are managed at a state-of-the-art facility comprised of three buildings: a facility for hazardous wastes, regulated by the Resource Conservation Recovery Act; a mixed-waste building for wastes that are both hazardous and radioactive; and a reclamation building for radioactive waste. The buildings are managed under a permit issued by the New York State Department of Environmental Conservation. These buildings are used for storing wastes before they are packaged or consolidated for off-site shipment to licensed treatment and disposal facilities. In 2002, BNL generated the following types and quantities of waste from routine operations (these quantities represent significant reductions from previous years):

- Hazardous Waste: 6.9 tons
- Mixed Waste: 141 cubic feet
- Radioactive Waste: 6,613 cubic feet.

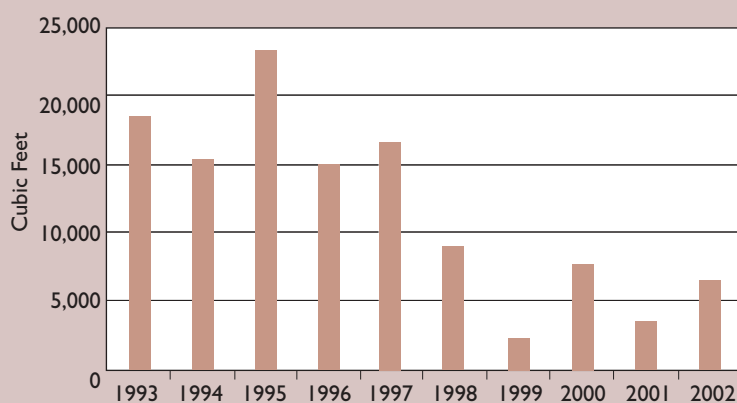
Routine operations are defined as ongoing industrial and experimental operations. The picture is not complete however, without consideration of wastes generated from “nonroutine” or one-time events, such as lab cleanouts or demolition projects, and waste generated from environmental restoration activities. BNL is currently cleaning up facilities and areas containing radioactive and chemical contamination resulting from historical operations. Waste recovered through restoration and decommissioning activities is managed by the Environmental Restoration Division with oversight by BNL’s Waste Management Division. The amount of nonroutine waste changes significantly from year to year because some years the waste comes from planning and studies, and other years from actual cleanup activities.



*Hazardous Waste Generation from Routine Operations, 1993 – 2002*



*Mixed Waste Generation from Routine Operations, 1993 – 2002*



*Radioactive Waste Generation from Routine Operations, 1993 – 2002*

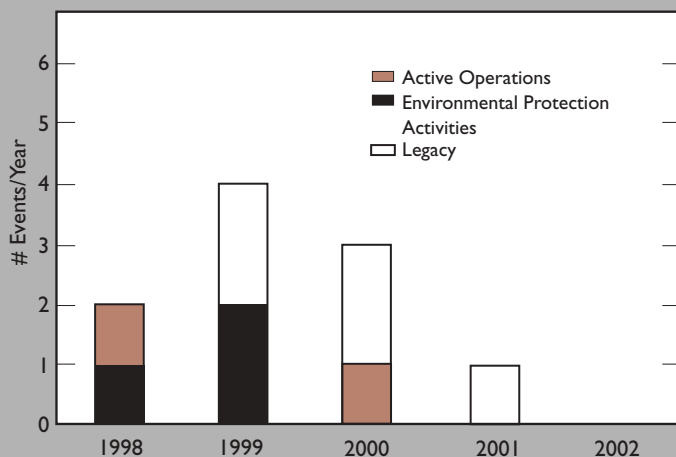


## GROUNDWATER PROTECTION MANAGEMENT PROGRAM

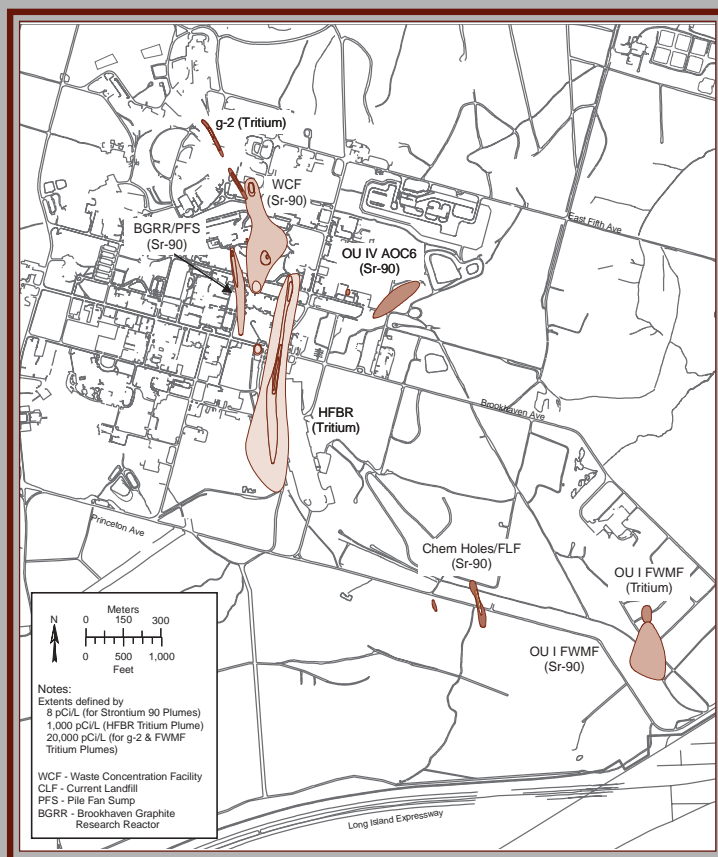
On Long Island, groundwater is a vital resource. BNL's Groundwater Protection Management Program is designed to prevent impacts to groundwater and to restore groundwater quality by integrating pollution prevention efforts, monitoring groundwater restoration projects, and communicating on performance.

The Laboratory has made significant investments in environmental and groundwater protection, and is making real progress in achieving its goal of preventing any new groundwater impacts. The BNL Groundwater Protection Contingency Plan ensures that appropriate and timely actions are taken if unusual or off-normal results are observed. The contingency plan provides guidelines for evaluating the source of the problem, notifying stakeholders, and implementing appropriate corrective actions. Since 1998, BNL has installed

several hundred permanent and temporary monitoring wells as a result of a comprehensive evaluation of known or potential contaminant source areas. Using this enhanced monitoring system, BNL identified ten new areas of groundwater contamination during 1998 through 2001. No new impacts were identified during 2002. It is important to note that five of the ten identified impacts were determined to be from historical (or "legacy") contaminant releases. In all ten cases, BNL thoroughly investigated the cause of the contamination and took corrective actions, as necessary, to eliminate or limit the scale of these impacts. BNL will continue efforts to prevent new groundwater impacts, and is vigilant in measuring and communicating its performance.



Groundwater Protection Performance, 1998 – 2002



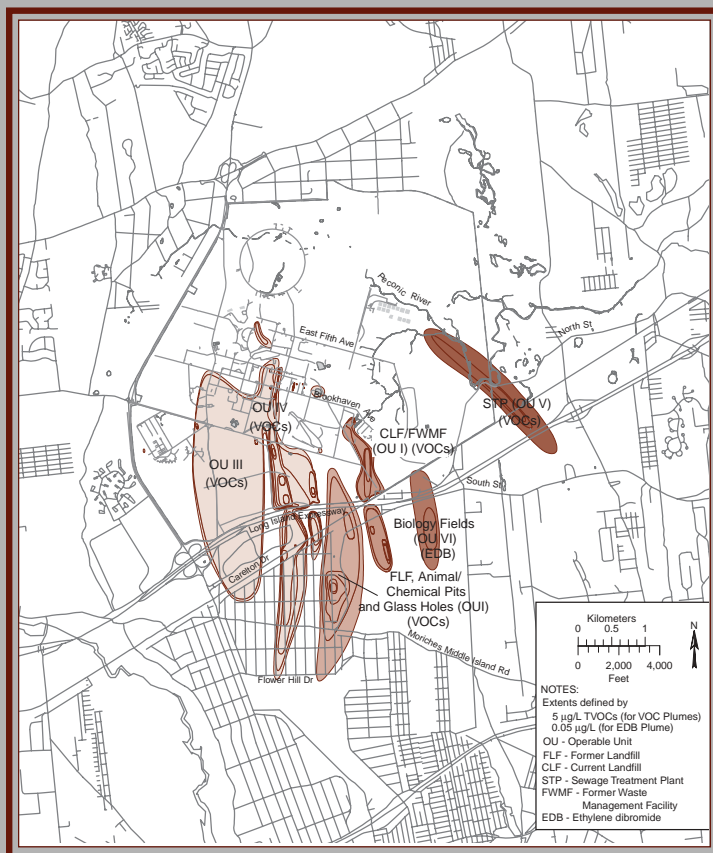
Extent of Radionuclide Plumes

## Groundwater Monitoring

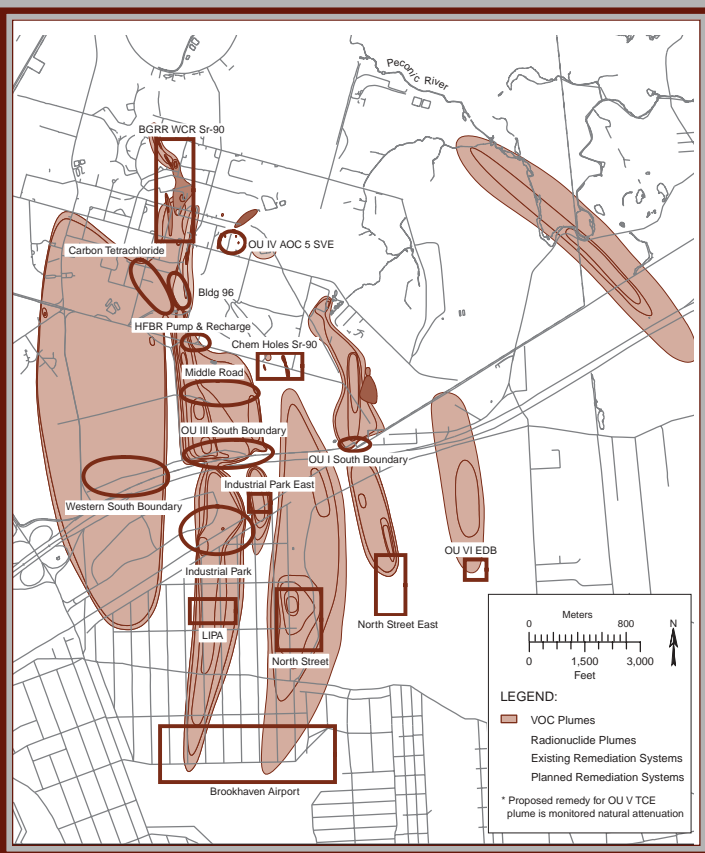
BNL's groundwater monitoring network is designed to evaluate the impacts of groundwater contamination from historical and current operations and to track cleanup progress. Groundwater monitoring is a means of verifying that protection and restoration efforts are working. Groundwater monitoring is focused in two general areas: 1) Environmental Surveillance, designed to satisfy DOE and New York State monitoring requirements for active research and support facilities, and 2) Environmental Restoration monitoring related to BNL's obligations under the federal Comprehensive Environmental Response, Compensation, and Liability Act. Monitoring program elements include data quality objectives, plans and procedures, sampling and analysis, quality assurance, data management, and the installation, maintenance,

and abandonment of wells. These elements are integrated to create a cost-effective monitoring system and to ensure that water quality information is available for review and interpretation in a timely manner.

In 2002, BNL collected groundwater samples from 745 monitoring wells during 2,345 individual sampling events. As the result of detailed groundwater investigations conducted over the past 15 years, six significant volatile organic compound plumes and eight radionuclide plumes have been identified. (A plume is a body of contaminated groundwater flowing from a specific source.) Detailed descriptions and maps related to groundwater monitoring are included in the 2002 BNL *Groundwater Status Report*, which can be accessed at [http://webeims.b459.bnl.gov/gw\\_home/gw\\_home.asp](http://webeims.b459.bnl.gov/gw_home/gw_home.asp).



Extent of VOC Plumes



Locations of BNL Groundwater Remediation Systems

## ENVIRONMENTAL RESTORATION

BNL is committed to defining, prioritizing, and aggressively correcting and cleaning up existing environmental problems. Areas of the site where past activities have caused groundwater, soil, and sediment contamination continued to undergo cleanup in 2002 under the Laboratory's Environmental Restoration Program. The cleanup goals for groundwater are to: 1) prevent or minimize plume growth, and 2) reduce contaminant concentrations in the Upper Glacial aquifer to below regulatory standards within 30 years. State and federal regulatory agencies oversee this program, and the Suffolk County Department of Health Services also plays a significant role. The Laboratory is openly communicating with neighbors, regulators, employees, and other interested parties on environmental issues and cleanup progress.

An overview of restoration program progress in 2002 includes:

- Removed and shipped 1.3 million pounds of waste from the Former Waste Management Facility to Envirocare, Inc. (a waste disposal company in Utah).
- Excavated contaminated soil from the Building 650 Sump and Sump Outfall areas, resulting in 1854 cubic yards of debris and soil being shipped to Envirocare, Inc.
- Excavated contaminated soil from the Sewage Treatment Plant sand filter beds, berms, and sludge drying beds, resulting in 450 cubic yards of soil being shipped to Envirocare.
- Conducted two pilot studies to evaluate techniques to restore contaminated sediment and wetlands along the Peconic River; conducted a baseline human health risk assessment for the Peconic River; and prepared a Peconic River Feasibility Study.
- Removed the below ground duct cooler and the above ground duct from the Brookhaven Graphite Research Reactor and shipped the waste to

Envirocare. The below ground duct and associated soils were characterized in accordance with an approved sampling and analysis plan as part of an overall risk assessment and end state determination.

- High Flux Beam Reactor restoration projects included the removal of nine "beam plugs" from the reactor's biological shield; completion of the preliminary assessment/site inspection sampling plan; shipment of 24 shield blocks off site; and the development of a scope, cost, and schedule for five High Flux Beam Reactor end-state alternatives.
- Continued progress was made in restoring groundwater quality. Seven groundwater remediation systems were in operation by the end of 2002, with the addition of the Western South Boundary system. To date, 10 of 17 planned groundwater treatment plants have been constructed, including a strontium-90 groundwater treatment system installed in early 2003 as part of a pilot project.
- During 2002, 720 pounds of volatile organic compounds were removed from the groundwater and more than one billion gallons of treated groundwater were returned to the aquifer. Since active treatment of groundwater began in 1997, BNL's treatment systems have removed a total of 3,662 pounds of volatile organic compounds while treating four billion gallons of water. Although it is expected to take up to 10 years of aquifer treatment before widespread improvements in groundwater quality at BNL are achieved, some noticeable improvements in groundwater quality are evident in several locations (see maps on Page 26-27). Groundwater remediation activities are expected to continue until approximately 2030. Detailed information on these treatment systems can be found in the *2002 BNL Groundwater Status Report* at [http://webeims.b459.bnl.gov/gw\\_home/gw\\_home.asp](http://webeims.b459.bnl.gov/gw_home/gw_home.asp).



## NATURAL RESOURCE MANAGEMENT PROGRAM

The Natural Resource Management Program was designed to promote stewardship of the natural resources found at the Laboratory, as well as to integrate natural resource protection with BNL's mission. To meet this purpose, the Laboratory has a Wildlife Management Plan that describes the program strategy, elements, and planned activities. The plan and related information about natural resources at the Laboratory can be found at <http://www.bnl.gov/esd/wildlife>. Understanding the environmental baseline is the foundation of natural resource management planning and helps us to understand how the varying parts of an ecosystem interact. Through funding managed by the U.S. Fish & Wildlife Service, the types of plants growing at BNL were mapped using a system of plant identification called the National Vegetation Standard. The map clearly identifies areas where major categories of plants grow and is useful for predicting areas where key animal species may be found, based on the presence of suitable habitat.

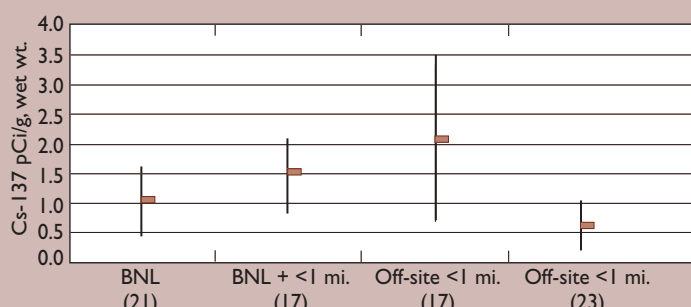
BNL's Natural Resource Management Program commits the Laboratory to manage its programs to protect the environment. To assess the impact of past and current operations on local wildlife and vegetation, each year the Laboratory and its regulatory agencies collect and analyze fish, deer, and vegetation on site, near the Laboratory, and from comparison locations farther from BNL.

### Deer Sampling

Working with the New York State Department of Environmental Conservation and the U.S. Fish & Wildlife Service, BNL continued to measure radioactivity in deer killed in auto accidents or by off-site

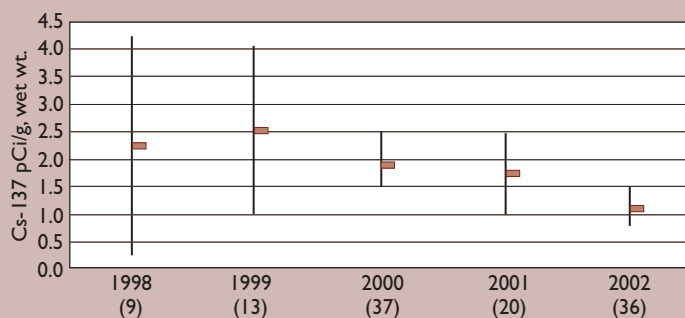
hunters. As in past years, and as might be expected because of historical low-level cesium-137 contamination in some BNL soil, cesium-137 concentrations in deer meat were somewhat greater in deer sampled on site and within one mile of the site compared to those deer sampled from farther away. No other Laboratory-generated radionuclides were detected in the analyzed deer samples. The level of cesium-137 detected in all but two samples was low and is not considered harmful to the deer. The two higher samples were found to be twice as high as any value previously seen in the monitoring program. BNL notified the public, submitted the samples to the New York State Department of Health for reanalysis, reviewed its sampling practices and historic documents concerning contaminated soils at BNL, and performed an assessment of fenced areas containing cesium-137 contamination. When the sample was reanalyzed by New York State, the cesium-137 level found was about one-third the value originally reported by BNL. After careful review, BNL discovered that the detector used for the original analysis produced incorrect readings. Steps to prevent this type of event from recurring were immediately taken.

BNL began testing deer bones (when available) for strontium-90 content in 2000 and continued this analysis in 2002. Strontium-90 levels were comparable in both on-site and off-site samples, suggesting that the likely source is not localized. Strontium-90 is found in similar amounts all over the world and is likely the result of world-wide fallout from past nuclear weapons testing. BNL will continue to test for strontium-90 in bone to build baseline information on this radionuclide and its presence in deer on and around the Laboratory site.



Averages are reported for samples collected on site, on site plus off site within 1 mile of BNL, off site but within 1 mile, and off site greater than one mile. Numbers in parentheses indicate the number of samples in that data set. All values are shown with a 95% confidence interval. A statistical outlier was removed from two of the data sets.

Comparison of Cs-137 Average Concentrations in Deer, 2002



Averages are reported 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. Two statistical outliers were removed from each year's data set. There is no significant difference between years, except between 2000 and 2002 averages.

Five-Year Cs-137 Concentration Trends in Deer Meat at BNL and within 1 Mile



## Fish Sampling

Working with the New York State Department of Environmental Conservation Fisheries Division, BNL maintains an ongoing program for collecting and analyzing fish from the Peconic River and surrounding freshwater ponds and rivers. Because years of sampling on site has depleted the number of larger fish, BNL has suspended on-site sampling to allow the fish populations to recover and mature.

Off-site sampling results showed that cesium-137 was identified at low levels in all samples taken from the Peconic River system in off-site control locations, with the exception of one brown bullhead, which had a level slightly higher, but still below the minimum detection limit. Cesium-137 in all fish species analyzed has been declining compared to past values. The heavy metals, PCBs, and radioactive contaminants in the Peconic River are a result of historic BNL effluent discharges, with most of these contaminants being released between the late 1950s and early 1970s. Since New York State began measuring radionuclide levels in Peconic River fish in 1974, there has been a continuing decrease in radionuclide concentrations in all fish species tested. The levels in fish do not exceed any standards that may constitute a health risk to people who eat them.

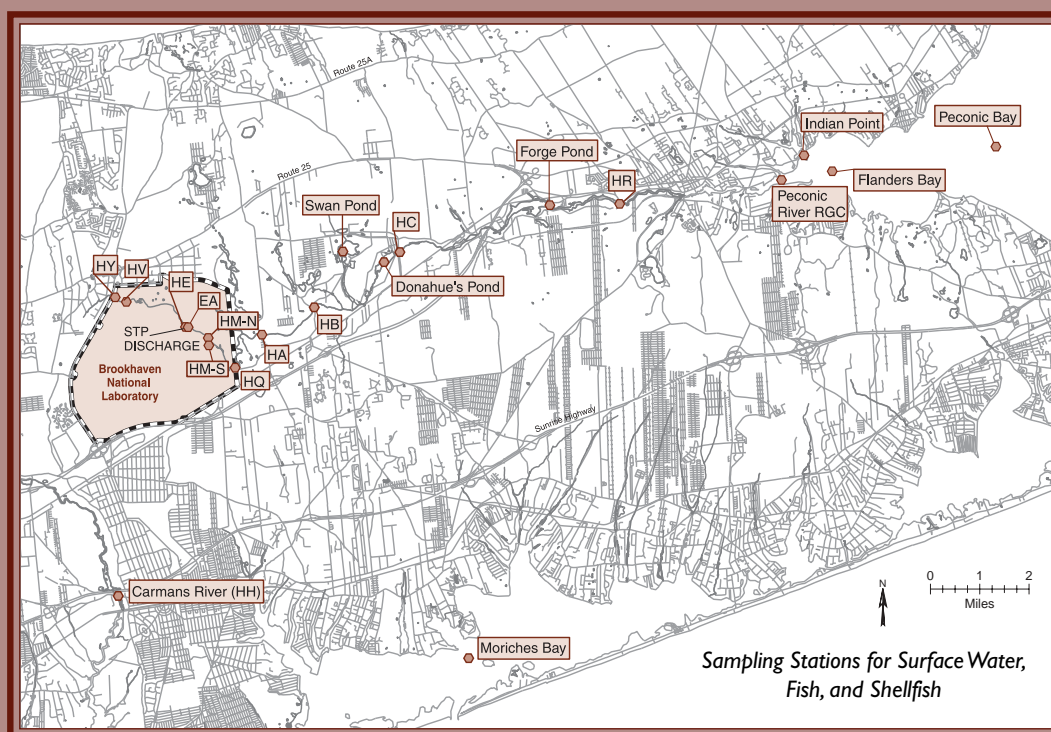
## Marine/Estuarine Sampling

Yearly sampling of mussels, sediment, and seawater from the Peconic Bay, Flanders Bay, and Moriches Bay

continued in 2002. Public concern that BNL's discharges and ongoing restoration work may affect the clamming industry has been the basis for this sampling program. Since sampling began in 1992, no BNL-generated nuclides have been detected in marine shellfish samples. Most of the metal analysis data collected indicated that metals were at background levels, and no pesticides or PCBs were detected in any vegetation, sediment, or water samples. The pesticide DDT's breakdown products, DDD and DDE, were detected in various samples, as was chlordane or its breakdown products. These pesticides were used historically across Long Island, including at BNL.

## Vegetation Sampling

Farm and garden vegetables were sampled from farms near BNL and from an on-site garden. As in past years, no radionuclides attributable to BNL operations were observed in farm products off site. Potassium-40, which occurs naturally, was the only radionuclide detected in all of the produce samples both on and off site. BNL plans to discontinue farm vegetation sampling off site because there is no longer a source for potential release from the BNL site and because historic data indicate the absence of any BNL-related radionuclides in off-site farm vegetation. BNL will continue to sample on-site garden vegetables because cesium-137 is occasionally detected in various vegetables grown on site.



Radiological materials are used in many research activities conducted at the Laboratory. This section explains Brookhaven Lab's 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 Brookhaven Lab?*

The largest hypothetical radiation dose that a member of the public could receive in 2002 from all pathways potentially affected by Brookhaven Lab operations—including air, water, deer, and fish at the Laboratory—is 2.5 millirems. This is about one percent of the dose Long Island residents receive from natural sources of radiation each year, and three 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.

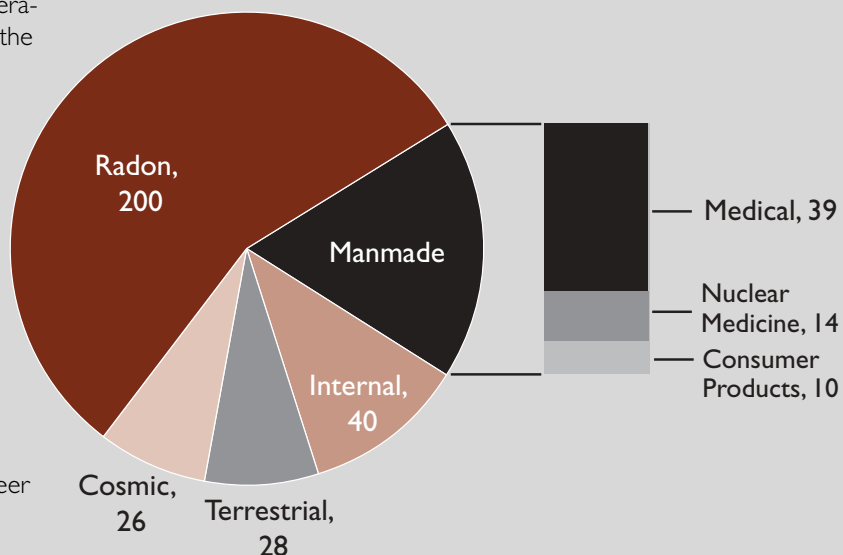
The largest portion of this worst-case dose (2.3 millirems, or 92 percent) would result from eating deer meat. (Testing of deer

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 Brookhaven Lab 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 0.1 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 2002 was 0.1 millirem.

The internal radiation dose from drinking groundwater was expected to be zero. No radionuclides at levels above the EPA'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 above 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.



# quality assurance

BNL uses its on-site Analytical Services Laboratory and four off-site, contract laboratories to analyze its environmental samples. All the labs are certified by New York State and are subject to oversight that includes state and national performance evaluation testing, review of quality assurance programs, and audits.

BNL received a combined score of 96.2 percent “overall satisfactory” for the 573 radiological and nonradiological performance evaluation tests carried out in 2002. BNL’s overall satisfactory score in radiological testing was 97 percent, an improvement over 2001. In nonradiological performance evaluation testing under the New York State Environmental Laboratory Approval Program (potable and nonpotable water), BNL received a satisfactory rating of 96.8 percent.

The multilayered components of quality assurance that are monitored at BNL ensure that all analytical data reported for the SER are reliable and of high quality.

# communication, outreach, and community involvement

When Brookhaven Science Associates was awarded the contract to manage BNL in 1998, they made a commitment to establish an effective partnership between the U.S. Department of Energy, the Laboratory, and a full range of community members to address issues that affect quality of life in the community. At the core of the communication and community involvement programs are the Environmental Stewardship Policy and the Community Involvement Policy and Plan, available at <http://www.bnl.gov/community/>. Both policies contain a commitment to maintain a positive, proactive, and constructive relationship with the community and regulators, and to promote open communication on environmental performance. Additionally, the Community Involvement Policy and Plan, written with input from both internal and external stakeholders, documents Brookhaven Science Associates’ efforts to ensure that the public is kept informed of issues; that the Laboratory actively seeks and considers input from regulators, stakeholders, and

the general public; and that opportunities will continue to be provided for an open, two-way exchange of information, knowledge, and perspectives.

The Laboratory continues efforts to improve relationships with regulatory agencies by sharing information and working to resolve issues on plans, priorities, and corrective actions that are important to the regulators. The Laboratory meets regulators from the New York State Department of Environmental Conservation, the U.S. Environmental Protection Agency Region II, and the Suffolk County Department of Health Services, which has a permanent office on site.

Another forum for communication is the Brookhaven Executive Roundtable, which was established by the U.S. Department of Energy in August 1997. The Roundtable includes staff from the offices of local, state, and federal elected officials, regulatory agencies, and representatives from the U.S. Department of Energy and the Laboratory. In addition, the

Community Advisory Council was established in September 1998, meets monthly, and serves in an advisory capacity to the Laboratory Director. It consists of representatives from 27 varied stakeholder groups, including civic, business, union, health, education, employee, and environmental organizations.

The Roundtable and the Community Advisory Council are given updates on Laboratory activities, environmental issues, and progress. Feedback and recommendations from the Community Advisory Council are considered in the Laboratory's decision-making processes. The council closely follows and gives feedback to the Laboratory on remediation activities, including groundwater issues, the decommissioning of the Brookhaven Graphite Research Reactor, and plans for cleaning up portions of the Peconic River. In 2001, the council recommended conducting pilot programs to attempt to minimize impacts to the Peconic River wetlands, and in 2002, they tracked the results of the pilot programs, as well as the Peconic River Risk Assessment project. The Laboratory's Pollution Prevention Program generated a great deal of interest from the Community Advisory Council, and plans were undertaken to host a workshop in 2003.

Stakeholders are provided with many other opportunities to learn about and provide input on issues of importance to them—from working groups, to roundtables, to one-on-one interactions with managers and subject matter experts. Input is actively sought to help the Laboratory make better decisions

that take the community's values and perspectives into account. Public outreach activities include briefings to local civic and community groups; meetings and presentations to local, state, and federal regulators and elected officials; and regular interactions with the business and educational communities.

Laboratory Envoys, who are well educated about Laboratory science as well as Laboratory issues, regularly interact with individuals and groups in the community, gathering feedback.

During 2002, BNL hosted more than 29,000 visitors, including students and community members who participated in BNL Summer Sunday open houses; science museum visits; high school, college, and community tours; and special outreach programs. The Environmental Services Division hosted a BNL Summer Sunday with the goal of increasing the community's appreciation for the environment through activities, demonstrations, literature, and displays. Visitors learned about the Laboratory's initiatives in energy conservation ranging from research surrounding fuel cells and oil burners to the use of alternative-fuel vehicles. The Laboratory also maintains an informative website, [www.bnl.gov](http://www.bnl.gov); issues press releases; and publishes the *Bulletin* (a weekly employee newsletter), *cleanupupdate* (a periodic newsletter on environmental cleanup), *Laboratory Link* (a monthly brief on research activities), and e-mail updates, to keep employees and the public informed about the Laboratory's science and a wide variety of Laboratory



*The "Your Environment" Art Contest challenged local students to create a poster depicting environmental stewardship on Long Island. The winning posters are published on the back cover.*

*The Annual Environmental Stewardship Award Ceremony honors employees who have shown outstanding efforts in environmental stewardship.*



*In 2002, BNL participated for the first time in the Heckscher Spring Festival at Heckscher State Park. The event offered a unique opportunity for BNL to join with other local organizations to promote environmental stewardship to the general public.*





activities and issues, including environmental issues.

In 2002, BNL celebrated the thirty-third anniversary of Earth Day with a variety of activities involving BNL staff and the community. Events included the environmental stewardship awards ceremony recognizing BNL employees who have been chosen by their peers for their outstanding efforts in environmental stewardship; a student art contest, where children from local schools were invited to prepare a poster depicting the importance of protecting Long Island's environment; a four-mile race with proceeds donated to local charities, and an on-site office swap (for reuse of office products). Staff from the Environmental Services Division also participated in the Heckscher Spring Festival, which was a unique opportunity for BNL to join other local

organizations to promote environmental responsibility and appreciation.

To maintain stakeholder trust, BNL must continue to deliver on commitments and demonstrate real improvements in environmental performance. The annual Site Environmental Report is an important communication mechanism, as it summarizes BNL's environmental programs and performance for the prior calendar year. The Laboratory will continue to pursue mechanisms to communicate data in a more user friendly, visual, and timely manner. Additional information about BNL's environmental programs is available on BNL's website at [www.bnl.gov](http://www.bnl.gov). Environmental project plans, status reports, procedures, and more are accessible to the general public at <http://www.bnl.gov/esd/>.



BROOKHAVEN NATIONAL LABORATORY

## 2002 Site Environmental Report

### SUMMARY

Please help guide us in providing the information you would like to know about the Laboratory by filling out this feedback form and mailing it to

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

Name \_\_\_\_\_

Address \_\_\_\_\_

\_\_\_\_\_

Phone \_\_\_\_\_

Affiliation, if any \_\_\_\_\_

Comments \_\_\_\_\_

\_\_\_\_\_

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\_\_\_\_\_

☐ Please add me to your mailing list.



In celebration of the 33rd anniversary of Earth Day, students from local schools in grades 3-5 were invited to participate in BNL's fourth annual "Your Environment" art contest. The goal of the contest was to raise student awareness about environmental stewardship, pollution prevention, and waste minimization, and to challenge them to develop artwork that focused on cleaning up and protecting Long Island's environment. The three winning posters shown above were created by a) Shelby Jacoy, Grade 4, Ridge Elementary School; b) Ashley Powell, Grade 4, West Middle Island Elementary School; and c) Mariana Debbe, Grade 4, Laddie A. Decker Sound Beach School.

