# Environmental Management System

# 2

*One of Brookhaven National Laboratory's highest priorities is ensuring that the Laboratory's environmental performance measures up to its world-class status in science. Brookhaven Science Associates, the contractor operating the Laboratory on behalf of the U.S. Department of Energy, takes environmental stewardship very seriously. As part of their commitment to environmentally responsible operations, they have established an Environmental Management System (EMS).*

*An EMS ensures that environmental issues are systematically identified, controlled, and monitored. Moreover, 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) 14001 environmental management standard, with additional emphasis on compliance, pollution prevention, and community involvement.*

*BNL's EMS became officially registered to the ISO 14001 standard in July 2001. Annual audits are required to maintain the registration. The audits are conducted by NSF-International Strategic Registrations, LTD, an accredited ISO 14001 registrar. The purpose of the audits is to validate that the EMS is being maintained and to identify evidence of continual improvement (a requirement of the ISO 140001 standard). In 2002, an EMS Surveillance audit determined that BNL remains in conformance with the ISO 14001 Standard. The audit identified one minor non-conformance, one opportunity for improvement, and strong evidence of continual improvement, including 12 noteworthy practices.*

*In 2002, BNL continued its strong support of the Pollution Prevention Program. This program seeks ways to eliminate waste and toxic materials and is the preferred approach to resolving environmental issues at BNL. Work planning processes incorporate the prevention approach, and benefits continue to accumulate. Pollution prevention projects saved more than $1.5 million and resulted in the reduction or reuse of approximately 2.07 million pounds of waste during 2002. The ISO 14001-registered EMS and the nationally recognized Pollution Prevention Program both contributed to BNL being selected as one of five winners of the "Environmental Facility of the Year" award by Environmental Protection magazine. In selecting BNL, the magazine noted that the winners "used innovative approaches to protect the environment while simultaneously boosting their companies' bottom lines."*

*BNL continues to address legacy issues under the Environmental Restoration Program. The Laboratory is openly communicating with neighbors, regulators, employees, and other interested parties on environmental issues and cleanup progress.*

## 2.1 STEWARDSHIP UNDER BROOKHAVEN SCIENCE ASSOCIATES

The International Organization for Standardization's ISO 14001 is a globally recognized standard that defines the structure of an organization's environmental management system (EMS) for purposes of improving the organization's environmental performance. The process-based structure of ISO 14001 is based on the "Plan-Do-Check-Act" improvement cycle. The standard requires an organization to develop an environmental policy, create plans to implement the policy, implement the plans, check progress and take corrective actions, and review the system annually to ensure its continuing suitability, adequacy, and effectiveness. To gain registration to the standard, an organization must comply with the set of 17 ISO 14001 requirements that are listed and described in Table 2-1.

Brookhaven National Laboratory's EMS is officially registered to the ISO 14001 standard. The Laboratory's EMS was originally registered in July 2001, becoming the first Department of Energy Office of Science laboratory to obtain third-party registration to this globally recognized environmental standard. In order to achieve registration, the Laboratory underwent an independent audit of its environmental management system to verify that the system conformed to all ISO requirements and that it was effectively implemented. The certification also requires BNL to undergo annual audits by an accredited auditing firm to assure that the system is maintained.

In 2002, an EMS Surveillance audit determined that BNL remains in conformance with the ISO 14001 Standard. The audit identified one minor nonconformance, one opportunity for improvement, and strong evidence of continual improvement, including 12 noteworthy practices. In its recommendation for continued certification, NSF International Strategic Registrations, Ltd., an independent third-party environmental review firm from Ann Arbor, Michigan, singled out 14 aspects of BNL's program as being particularly noteworthy. 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. NSF reviewers also noted that BNL's environmental management system was the most thoroughly and systematically implemented program they had encountered to date. BNL's environmental management system received a DOE Pollution Prevention Award for "Excellence in Management," the first organization ever to receive this award.

## 2.2 ENVIRONMENTAL STEWARDSHIP POLICY

The cornerstone of an EMS is a commitment to environmental protection at the highest levels of the organization. The Environmental Stewardship Policy, issued and signed by the Laboratory Director, is a statement of BNL's intentions and principles regarding overall environmental performance. It provides a framework for planning and action and is included in training programs. The Environmental Stewardship Policy is posted throughout the Laboratory and on the BNL website: www.bnl.gov.

The Environmental Stewardship Policy contains the following goals and commitments, focusing on compliance, pollution prevention, cleanup, community outreach, and continual improvement:

- Achieve and maintain compliance with applicable environmental requirements. These requirements include more than 50 sets of local, state, and federal laws and regulations; 13 DOE Directives; eight Executive Orders; and numerous operating permits.
- Integrate pollution prevention/waste minimization, resource conservation, and compliance into BNL activities during planning and decision making. Adopt cost-effective practices that eliminate, minimize, or mitigate environmental impacts. This includes conserving natural resources and ensuring that environmental emissions, effluents, and waste generation are as low as reasonably achievable (ALARA).
- Define, prioritize, and aggressively correct and clean up existing environmental problems. This commitment encompasses removal or treatment of contamination caused by historical practices. It also includes strengthening the environmental monitoring program to ensure that controls designed to protect the environment are working, and to

**Table 2-1. Elements of the Environmental Management System: Implementation of ISO 14001 at BNL.**

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| **Environmental Policy** | The Environmental Stewardship Policy is a statement of BNL's intentions and principles regarding overall environmental performance. It provides a framework for planning and action. In the policy, BNL has reaffirmed its commitment to compliance, pollution prevention, cleanup, community outreach, and continual improvement. |
| **Environmental Aspects and Impacts** | When operations have an environmental aspect, BNL implements the EMS to minimize or eliminate any potential impact. As required by the ISO 14001 Standard, BNL evaluates its operations, identifies the aspects of operations that can impact the environment, and determines which of those impacts are significant. BNL has determined that the following aspects of its operations have the potential to affect the environment:<br>▪ Waste generation<br>▪ Atmospheric emissions<br>▪ Liquid effluents<br>▪ Storage or use of chemicals and radioactive materials<br>▪ Natural resource usage – power and water consumption<br>▪ Historical/cultural resources<br>▪ Environmental noise<br>▪ Disturbances to endangered species/protected habitats<br>▪ Soil activation<br>▪ Historical contamination<br>▪ Other facility-specific compliance aspects. |
| **Legal and Other Requirements** | BNL has implemented and continues to improve the Standards Based Management System (SBMS), a web-based system designed to deliver Laboratory-level requirements and guidance to all staff. New or revised requirements (e.g., new regulations) are analyzed to determine their applicability to the Laboratory, and to identify whether actions are required to achieve compliance. This may involve developing or revising Laboratory documents or operating procedures, implementing administrative controls, providing training, installing engineered controls, or increasing monitoring. |
| **Objectives and Targets** | The Performance Based Management System is designed to develop, align, balance, and implement the Laboratory's strategic objectives, including environmental objectives. Objectives and targets are developed by Fiscal Year (FY). In FY 2002, they included:<br>▪ Maintain and improve the Environmental Management System<br>▪ Achieve full compliance with applicable environmental requirements<br>▪ Invest in Pollution Prevention iniatitives<br>▪ Improve communications, trust, and relationship with stakeholders on environmental programs<br>▪ Fully implement the groundwater protection program<br>▪ Ensure responsible stewardship of natural and historical resources on site. |
| **Environmental Management Program** | Organizations within BNL develop action plans detailing how they will achieve their objectives and targets, and commit the necessary resources to successfully implement both Labwide programs and facility-specific programs. BNL has a Pollution Prevention Program to conserve resources and minimize waste generation. BNL also has a budgeting system designed to ensure that priorities are balanced and that resources essential to the implementation and control of the EMS are provided. |
| **Structure and Responsibility** | All employees at BNL have specific roles and responsibilities in key areas including environmental protection. Environmental and waste management technical support personnel assist the line organizations with their environmental responsibilities. Every BNL employee is required to develop a Roles, Responsibilities, Accountabilities, and Authorities document signed by the employee, their supervisor, and the supervisor's manager. Specifics on environment, safety, and health performance expectations are included in these documents. |
| **Training, Awareness and Competence** | Extensive training on EMS requirements has been provided to staff whose responsibilities include environmental protection. The training program includes general environmental awareness for all employees, regulatory compliance training for select staff, and specific courses for managers, internal assessors, EMS implementation teams, and operations personnel whose work can impact the environment. |
| **Communication and Community Involvement** | BNL continues to improve processes for internal and external communications on environmental issues. The Laboratory solicits input from interested parties such as community members, activists, civic organizations, elected officials, and regulators. Communication is accomplished primarily through the Citizens Advisory Committee and/or the Brookhaven Executive Roundtable. At the core of the communication and community involvement programs are the Environmental Stewardship Policy and the Community Involvement Policy and Plan. |

*(continued on next page)*

**Table 2-1. Elements of the Environmental Management System: Implementation of ISO 14001 at BNL** *(concluded).*

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| **EMS Documentation** | BNL has comprehensive, up-to-date Laboratory-wide environmental documents describing the EMS. A web-based system called the Standards Based Management System (SBMS) provides access to Laboratory-wide procedures and manuals that tell staff how to control processes and perform work at BNL in a way that protects the environment. SBMS has improved the quality, usability, and communication of Laboratory-level requirements. |
| **Document Control** | SBMS contains a comprehensive document control system to ensure the effective management of procedural documents. When facilities require additional procedures to control their work, document control protocols are implemented to ensure that workers have access to the current versions of procedures. |
| **Operational Control** | Operations at the Laboratory are evaluated for the adequacy of current controls to prevent impacts to the environment. As needed, additional administrative or engineered controls are identified and plans for upgrades and improvements are developed and implemented. |
| **Emergency Preparedness and Response** | BNL has an emergency preparedness and response program and specialized staff to provide timely response to hazardous materials or other environmental emergencies. This program includes procedures for preventing, as well as responding to, emergencies. |
| **Monitoring and Measurement** | Effluent and emission monitoring helps ensure the effectiveness of controls, adherence to regulatory requirements, and timely identification and implementation of corrective measures. BNL has a comprehensive, sitewide Environmental Monitoring Program. Results are reported to regulatory agencies and summarized annually in this Site Environmental Report. In addition, BNL tracks and trends its progress and performance in achieving environmental objectives and performance measures. |
| **Nonconformance and Corrective and Preventive Actions** | BNL continues to improve processes that identify and correct problems. This includes implementation of a Lessons Learned Program to prevent recurrences, a robust Self-Assessment Program, and an electronic, web-based assessment and action tracking system. |
| **Records** | EMS-related records, including audit and training records, are maintained to ensure integrity, facilitate retrieval, and protect them from loss. |
| **EMS Audit** | To periodically verify that the EMS is operating as intended, audits are conducted. These audits, conducted as part of the sitewide self-assessment program, are designed to ensure that any nonconformance to the ISO 14001 Standard is identified and addressed. An independent accredited registrar also conducts ISO 14001 registration audits. In addition, compliance with regulatory requirements is verified through routine inspections, operational evaluations, and periodic audits. |
| **Management Review** | In addition to audits, a management review process has been established to involve top management in the overall assessment of environmental performance, the EMS, and progress toward achieving environmental goals. This review also identifies, as necessary, the need for changes to and continual improvement of the EMS. |

provide early detection of a potential threat to the environment (see Section 2.4.3).

- Maintain a positive, proactive, and constructive relationship with neighbors in the community, regulators, DOE, and other stakeholders. Openly communicate with stakeholders about program planning, progress, and performance (see Section 2.4.2).
- Continually improve the environmental management system and performance. Establish appropriate environmental objectives and performance indicators to guide these efforts and measure our progress. To maintain certification, BNL will employ proactive measures to prevent problems. When problems do occur, the approach is to investigate the root cause and take corrective actions as appropriate.

## 2.3 PLANNING

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

### 2.3.1 Environmental Aspects

An environmental aspect is any element of an organization's activities, products, or services than can interact with the environment. As re-

quired by the ISO 14001 Standard, BNL evaluates its operations, identifies the aspects of operations that can impact the environment, and determines which of those impacts are significant. BNL's criteria for significance are based on both actual and perceived impacts of its operations and on regulatory requirements. BNL utilizes several processes to identify and review environmental aspects. Key among these processes is the Work Planning and Control process, which was revised in 2002. Environmental professionals worked closely with the revision team to ensure that environmental requirements were integrated into the process. Aspects and impacts are evaluated annually to ensure that the significant aspects and potential impacts continue to reflect the concerns of stakeholders and changes in regulatory requirements. BNL's list of aspects and significance criteria remained unchanged in 2002.

#### 2.3.2 Legal and Other Requirements

To implement the compliance commitments of the Environmental Stewardship Policy and to meet its legal requirements, BNL has systems in place to review changes in federal, state, or local environmental regulations and communicate those changes to affected staff. A published procedure, the *Requirements Management* subject area, is used to document these reviews and record the actions required to ensure compliance. (Requirements are delivered to all staff through the web-based Standards Based Management System in the form of Laboratory-wide procedures, called "subject areas.")

#### 2.3.3 Objective and Targets

The establishment of environmental objectives and targets is accomplished through the Performance Based Management System. This system is designed to develop, align, balance, and implement the Laboratory's strategic objectives, including environmental objectives. The system drives BNL's improvement agenda by establishing a prioritized set of key objectives, called critical outcomes. BNL works with DOE to clearly define expectations and performance measures. Factors for selecting environmental priorities include:

- Significant environmental aspects
- Risk and vulnerability (primarily, threat to the environment)
- Legal requirements (laws, regulations, permits, enforcement actions)
- Commitments (in the Environmental Stewardship Policy, to regulatory agencies, to the public)
- Importance to DOE, the public, and other stakeholders.

Laboratory-level objectives and targets are developed on a Fiscal Year (FY) schedule. In FY 2002 (October 1, 2001 through September 30, 2002), these objectives included:

- Maintain and improve the Environmental Management System
- Achieve full compliance with applicable environmental requirements
- Invest in pollution prevention initiatives
- Improve communications, trust, and relationships with stakeholders on environmental programs
- Fully implement the groundwater protection program
- Ensure responsible stewardship of natural and historical resources on site.

#### 2.3.4 Environmental Management Programs

Organizations within BNL develop action plans detailing how they will achieve their objectives and targets and commit the necessary resources to successfully implement both Laboratory-wide and facility-specific programs. BNL has a budgeting system designed to ensure that priorities are balanced, and that resources essential to the implementation and control of the EMS are provided.

BNL has several important environmental programs developed and funded to further integrate environmental stewardship into all facets of BNL's missions. The key programs are described below.

##### 2.3.4.1 Compliance

BNL has an extensive program to ensure full compliance with all applicable environmental regulatory requirements and permits. Some programs are routine, such as the National Emission Standards for Hazardous Air Pollutants, National Pollutant Discharge Elimination System, and Re-

source Conservation and Recovery Act (RCRA) compliance programs. Other programs are special projects or initiatives, such as upgrading petroleum and chemical storage tank facilities, upgrading the sanitary sewer system, closing underground injection control devices, retrofitting or replacing air conditioning equipment refrigerants, and managing legacy waste. See Chapter 3 for a thorough discussion of these programs and their status.

#### 2.3.4.2 Groundwater Protection

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. BNL has also developed a Groundwater Protection Contingency Plan that defines an orderly process for taking corrective actions quickly in response to unexpected monitoring results. Key elements of the groundwater program are the full and timely disclosure of any off-normal circumstances and regular communication on the performance of the program. Chapter 7 provides additional details about the Groundwater Protection Management Program and monitoring results for 2002.

#### 2.3.4.3 Waste Management

As a byproduct of the world-class research it conducts, BNL generates a wide range of wastes during normal business. 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 waste, reactive chemicals, and solvents.

The Waste Management Division is responsible for the collection, transportation, storage, and off-site disposal of site-generated wastes. Wastes are managed at a state-of-the-art facility designed especially for managing hazardous, industrial, radioactive, and mixed wastes.

The Waste Management Facility complex is comprised of three-staging areas: a facility for hazardous wastes, regulated by RCRA; a mixed-waste building for wastes that are both hazardous and radioactive; and a reclamation building for radioactive waste. The RCRA and mixed-waste buildings are managed under a permit issued by the New York State Department of Environmental Conservation (NYSDEC). These buildings are utilized for short-term storage of wastes before they are packaged or consolidated for off-site shipment to permitted treatment and disposal facilities. In 2002, BNL generated the following types and quantities of waste from routine operations:

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

These quantities represent significant reductions from previous years, as shown in Figures 2-1a through c. 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 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 (ER) group with oversight by BNL's Waste Management Division. Nonroutine waste includes construction and demolition wastes, environmental restoration wastes, legacy waste, lead-painted debris, lead shielding, and PCB waste. Figures 2-1d through 2-1f show wastes generated under the Environmental Restoration Program and nonroutine operations. Waste generation from these activities varies significantly from year to year. This is to be expected as environmental restoration activities move from remedial investigations and feasibility studies to remedial actions, which change annually based on the progress of the cleanup schedule.

#### 2.3.4.4 Prevention and Minimization

Brookhaven National Laboratory's broad mission is to produce excellent science in a safe, environmentally responsible manner with the cooperation, support, and appropriate involvement

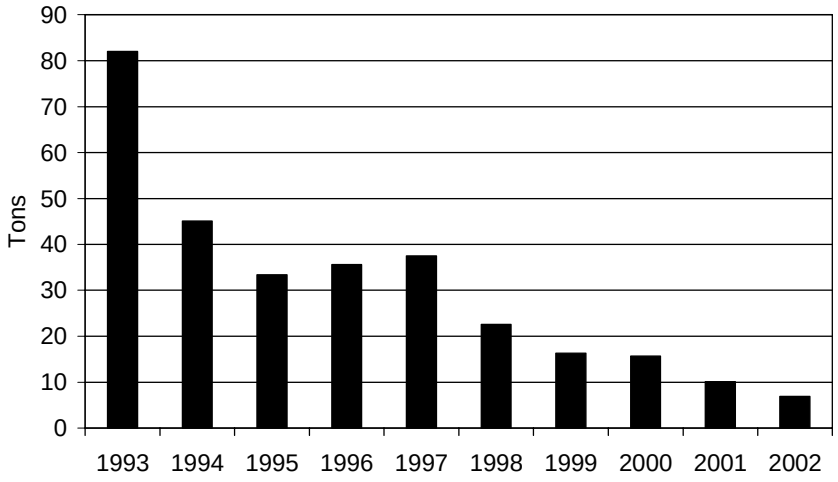


**Figure 2-1a.**
**Hazardous Waste Generation from Routine Operations, 1993–2002.**

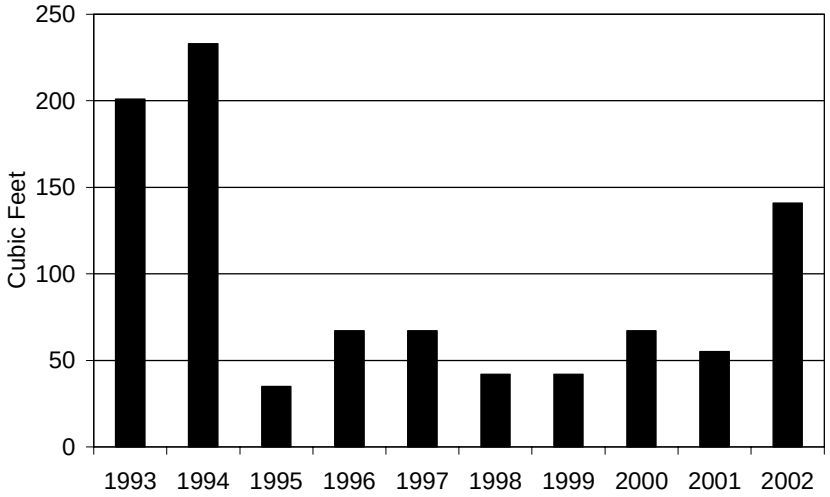


**Figure 2-1b.**
**Mixed Waste Generation from Routine Operations, 1993–2002.**

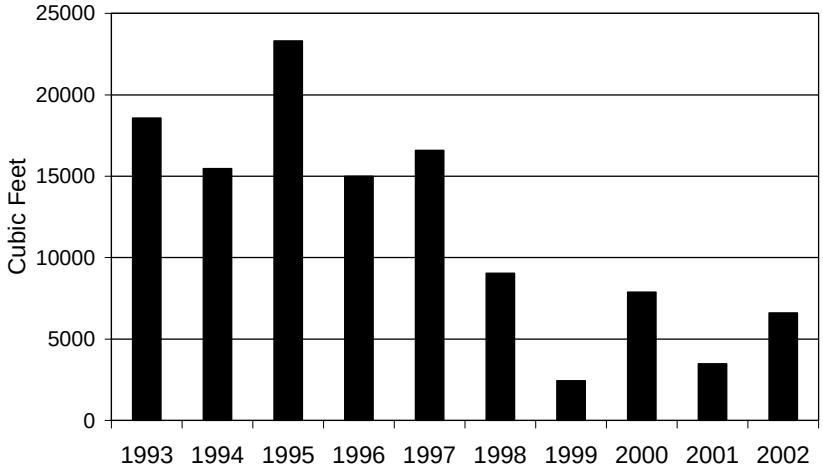


**Figure 2-1c.**
**Radioactive Waste Generation from Routine Operations, 1993–2002.**

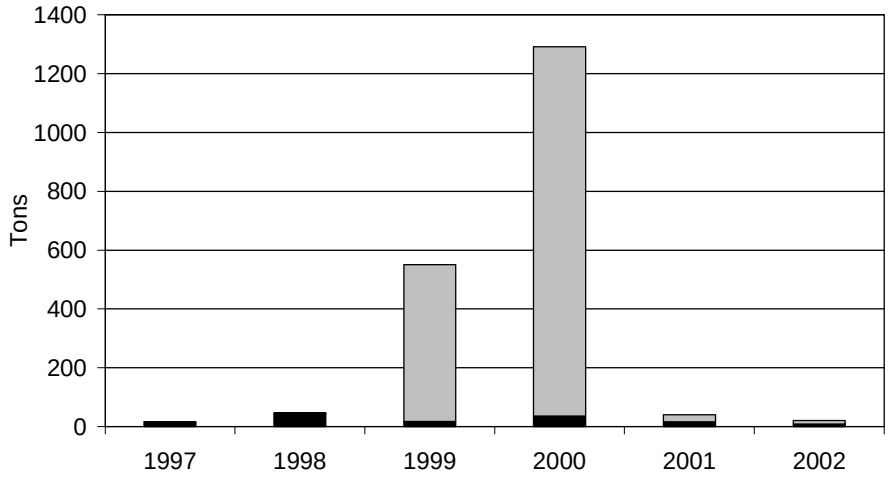


**Figure 2-1d.**
**Hazardous Waste Generation from ER and Nonroutine Operations, 1997–2002.**

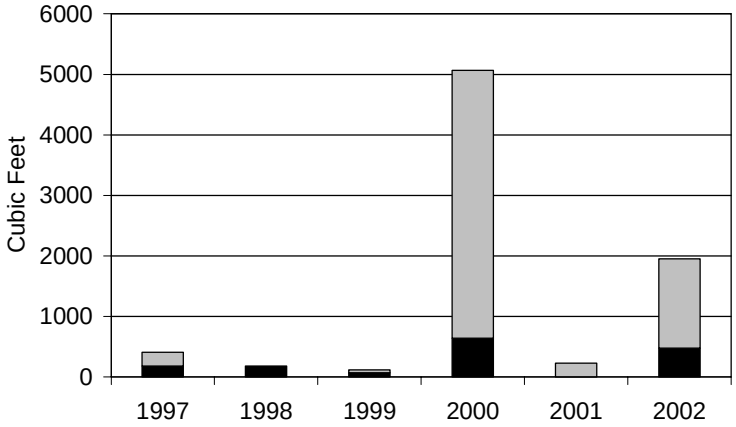


**Figure 2-1e.**
**Mixed Waste Generation from ER and Nonroutine Operations, 1997–2002.**

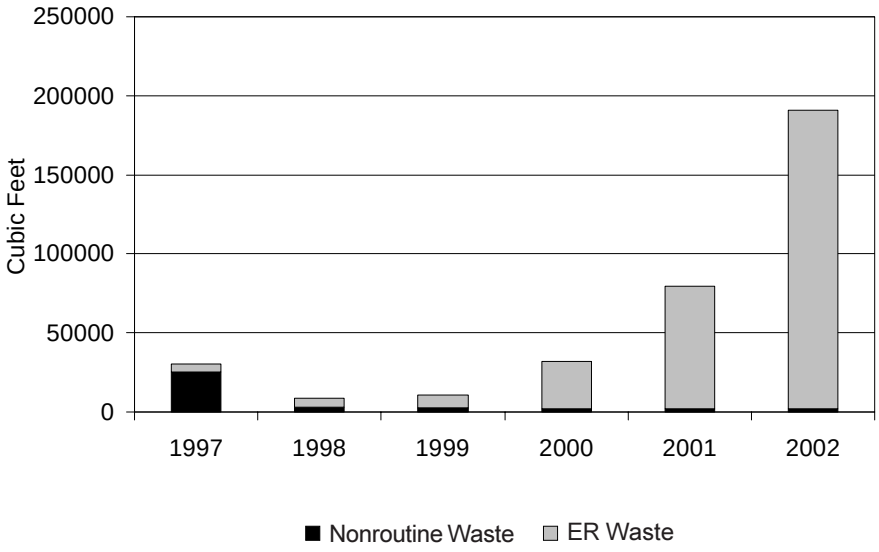


**Figure 2-1f.**
**Radioactive Waste Generation from ER and Nonroutine Operations, 1997–2002.**

of the scientific and local communities. A strong Pollution Prevention (P2) Program is an essential element of successful accomplishment of this mission. The BNL P2 Program reflects the national and Department of Energy pollution prevention goals and policies and represents an ongoing effort to make pollution prevention and waste minimization an integral part of the BNL operating philosophy.

DOE has incorporated pollution prevention and waste reduction goals into Brookhaven Science Associates (BSA's) contract. BSA, in recognition of its environmental stewardship responsibilities, potential for cost savings, and stakeholder concerns, has incorporated pollution prevention elements into the BNL Environmental Stewardship Policy and the Critical Outcomes. Key elements of the P2 Program include the following:

- Eliminate or reduce wastes, effluents, and emissions at the source where possible, and ensure that environmental effluents, emissions, and wastes are as low as reasonably achievable (E-ALARA).
- 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 BNL P2 Council. In January 2002, the P2 Council announced the winners of the "Return on Investment" funding competition. In FY02, the P2 Council funded eight proposals, investing a total of approximately $120,000. The savings generated by the projects is estimated at $268,000, for an average payback period of only five months.

The sustained efforts of the BNL Pollution Prevention and recycling programs have achieved significant reductions in waste generated by routine operations, as shown in Figures 2-1a through 2-1c. This continues a positive trend started in FY01, and is further evidence that pollution prevention planning is well integrated into the work planning process. These positive trends are also driven by the ISO 14001 EMS's emphasis on preventing pollution and establishing objectives and targets to reduce environmental impact.

Implementation of pollution prevention opportunities, recycling programs, and conservation initiatives has significantly reduced both waste volumes and management costs. In 2002 alone, these efforts resulted in more than $1.5 million in cost avoidance or savings and approximately 2.074 million pounds of materials being reduced, recycled, or reused. Table 2-2 describes the projects that were implemented in 2002 and includes the number of pounds of materials reduced, reused, or recycled and the estimated cost benefit of each project.

BNL also has an active and successful solid waste recycling program. The on-site recycling program involves all employees. In 2002, BNL collected more than 209 tons of 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. Table 2-3 shows the total number of tons (or units) of these materials recycled in 2002.

#### *2.3.4.5 Water Conservation*

BNL has a strong water conservation program and has achieved dramatic reductions in water use since the mid 1990s. The Laboratory continuously evaluates water conservation as part of facility upgrades or new construction initiatives. These efforts include more efficient and expanded use of chilled water for cooling and heating, ventilation, and air conditioning systems, and reuse of once-through cooling water for

**Table 2-2. Waste Reduction and Recycling Projects.**

| Waste Description | Project Type | Pounds Reduced, Reused, Recycled, or Conserved in 2002 | Waste Type | Potential Costs for Treatment and Disposal | Cost of Recycle, Prevention | Estimated Cost Savings | Project Description Details* |
|---|---|---|---|---|---|---|---|
| Electrophoretic mini-gels | Microscale Chemical Use | 2,200 | Hazardous Waste - Lab Pack | $10,400 | $1,670 | $8,730 | Minimizing silver waste from silver-staining electrophoretic mini-gels will avoid waste disposal costs and result in lower material costs ($6,000). |
| Hydraulic oil | Product Substitution | 1,000 | Industrial | $17,000 | $7,500 | $9,500 | The retrofit of garbage truck hydraulics with steel-braided hydraulic lines and a vegetable-based hydraulic oil will reduce the number of reportable spills, as well as associated cleanup costs ($15,000). |
| Hydraulic oil | Product Substitution | 3,000 | Industrial | $26,000 | $8,000 | $18,000 | The retrofit of hydraulic lift bays in the Motor Pool Shop to vegetable-based oil minimized the potential for petroleum-based hydraulic oil leaks or spills and subsequent cleanup costs ($20,000). |
| Sewage sludge | Volume Reduction | 234,000 | Radioactive | $910,000 | $193,400 | $716,600 | Disposing of 60,000 gallons of radioactive STP liquid waste through a contractor would have cost $910,000. Instead, the waste was dried using rolloffs, absorbent, and lime and was sent away on rail cars for proper disposal. Also, a second drying bed was built to dry sludge (96% volume reduction) from the anaerobic sludge digester. |
| $CO_2$ snow cleaning | Source Reduction | 0 | Hazardous/Industrial | $5,000 | $5,000 | $0 | Equipment was purchased to evaluate $CO_2$ snow cleaning for NSLS instrumentation and CAD applications. This project is expected to reduce solvent usage (hazardous waste) and aqueous cleaning wastes (industrial waste). Due to a late purchase date, the equipment was not evaluated during this calendar year. |
| Film and other radioisotopic imaging | Substitution | 300 | Hazardous/Industrial | $22,000 | $25,000 | -$3,000 | Replacing the film-based autoradiography and other radioisotopic imaging with a Phosphor Imager reduced the generation of hazardous waste by 200 lb and industrial waste by 100 lb. Additional projected annual savings are $3,000 for supply costs and $15,000 for labor reduction. |
| Digital imaging system | Substitution | 282 | Hazardous/ Radioactive/Industrial | $25,000 | $25,000 | $0 | Using a digital imaging system rather than traditional technology reduced hazardous waste (134 lb), radioactive waste (80 lb), and industrial waste (68 lb). Additional projected savings are annual supply costs of $3,000 and reduced annual labor costs of $20,000. |
| Fluorescence-based assay | Substitution | 200 | Mixed | $30,550 | $22,000 | $8,550 | Development of a fluorescence-based assay for the DNA-dependent protein kinase (DNA-PKcs) to replace current $^{32}P$ assay. |

**Table 2-2. Waste Reduction and Recycling Projects** *(continued)*.

| Waste Description | Project Type | Pounds Reduced, Reused, Recycled, or Conserved in 2002 | Waste Type | Potential Costs for Treatment and Disposal | Cost of Recycle, Prevention | Estimated Cost Savings | Project Description Details* |
|---|---|---|---|---|---|---|---|
| Photographic waste | Segregation | 2,320 | Hazardous | $4,640 | $0 | $4,640 | In 2001, the Photography and Graphic Arts Division implemented a pollution prevention project to segregate hazardous fixer from nonhazardous developer. This reduced the hazardous waste stream by approximately 2,320 lb per year. |
| Photographic waste from X-ray film processor | Source Reduction | 765 | Hazardous | $3,115 | $0 | $3,115 | In 2001, the X-ray film processor at the clinic was replaced with a more efficient processor, reducing hazardous waste generation by 90 gal/year. This avoids the cost of disposal (765 lb) and saves $1,585 in reduced labor costs. |
| Photoresist waste | Source Reduction | 500 | Hazardous | $1,000 | $0 | $1,000 | In 2001, a fully aqueous developer solution was installed in the printed circuit laboratory for processing dry film photoresist. The system replaced a solvent-based process that formerly generated approximately 500 lb of hazardous waste annually. |
| Heavy metal solutions from | Source Reduction | 10,200 | Hazardous | $26,400 | $0 | $26,400 | With funding from the Pollution Prevention Council, in 2001 a xenon pressure cell was installed to allow preparation of samples for protein crystallography without the use of toxic heavy metal solutions. The project is estimated to eliminate 1,200 gallons of heavy metal hazardous waste (10,200 lb). Additionally, approximately $6,000 savings is expected from reduced labor and handling. |
| Lead acid batteries | Recycled | 12,600 | Hazardous | $25,200 | $0 | $25,200 | Estimate 40 lb per battery and avoided disposal costs as hazardous waste. |
| Ion exchange wastewater | Source Reduction | 1,250 | Hazardous and Sanitary Wastewater | $2,500 | $100 | $2,400 | Prefilters were added to the deionization system to polish make-up water entering the ion exchange system. This extended the useful life of the ion exchange resins, requiring less frequent regeneration. The regeneration process generates hazardous and sanitary wastewaters. |
| Smoke Detectors | Source Reduction | 120 | Mixed | $1,050 | $400 | $650 | Forty americium and/or radium smoke detectors were removed from service and returned to the manufacturer. They were replaced with energy-efficient nonrad photoelectric units. This project avoided disposal as mixed waste (5 $ft^3$). |

**Table 2-2. Waste Reduction and Recycling Projects** *(continued)*.

| Waste Description | Project Type | Pounds Reduced, Reused, Recycled, or Conserved in 2002 | Waste Type | Potential Costs for Treatment and Disposal | Cost of Recycle, Prevention | Estimated Cost Savings | Project Description Details* |
|---|---|---|---|---|---|---|---|
| Tritium Exit signs | Source Reduction | 112 | Mixed | $14,700 | $6,000 | $8,700 | Twenty-eight tritium Exit signs were removed from service and returned to the manufacturer. They were replaced with energy-efficient light emitting diode (LED) signs. This project reduced the risk of tritium gas release and avoided disposal of discarded signs as mixed waste (70 $ft^3$). |
| Cooling water | Reuse | 153,000 | Radioactive | $153,000 | $0 | $153,000 | Approximately 18,000 gal (153,000 lb) of cooling water were reused in the main magnet cooling water system, avoiding disposal as radioactive waste water. |
| Short half-life waste | Decay in Storage | 3,950 | Radioactive | $1,575 | $0 | $1,575 | Short half-life isotopes, particularly phosphorus-32 and phosphorus-33, are frequently used in life sciences experiments. Wastes generated from these operations (63 $ft^3$) were managed in accordance with BNL decay-in-storage requirements, rendering the wastes eligible for volumetric release. |
| Filters | Decay in Storage | 1,920 | Radioactive | $6,250 | $0 | $2,410 | Filters from the air handlers in the Linear Accelerator facility become contaminated with beryllium-7, a short-lived isotope eligible for decay. The filters were managed in accordance with the decay-in-storage requirements, surveyed, and declared releasable as industrial waste. |
| Oily waste water | Source Reduction | 6,240 | Industrial | $20,280 | $0 | $20,280 | In 2001, the Pollution Prevention Council funded the installation of automatic oil–water separators on compressor blowdown stations to capture the oily discharge and save disposal and labor costs. Labor savings are estimated at $7,800/yr. |
| Lubricating oil | Energy Recovery | 38,400 | Industrial | $76,800 | $500 | $78,700 | Approximately 4,800 gallons of lubricating oils were collected, tested for suitable use as waste oil fuel, and used for energy production at the Central Steam Facility, eliminating waste disposal costs. The cost of analysis is estimated at $500. Procurement savings are $.50/gallon. |
| Cooling tower chemicals | Source Reduction | 6,375 | Industrial | $15,000 | $0 | $15,000 | Ozone water treatment units were installed on cooling towers at two RHIC experiments to provide biological control of cooling water. These systems eliminate the need for water treatment chemicals (typically toxic biocides), save labor, and reduce analytical costs for monitoring cooling tower blowdown. Savings are estimated at $15,000/year. |

**Table 2-2. Waste Reduction and Recycling Projects** *(continued)*.

| Waste Description | Project Type | Pounds Reduced, Reused, Recycled, or Conserved in 2002 | Waste Type | Potential Costs for Treatment and Disposal | Cost of Recycle, Prevention | Estimated Cost Savings | Project Description Details* |
|---|---|---|---|---|---|---|---|
| Hydraulic oil | Source Reduction | 6,000 | Industrial | $33,000 | $0 | $33,000 | In past years, hydraulic line breaks have caused a significant number of reportable spills and costly response and cleanup. This project, funded in 2001 by the Pollution Prevention Council, replaced hydraulic lines on heavy equipment with steel-braided lines, and replaced the petroleum-based hydraulic oil with vegetable oil, which biodegrades and is subject to fewer reporting requirements if it does spill. This project reduced the frequency of spills and resulting response and cleanup costs. Avoided disposal costs are based on 6,000 lb of industrial waste. Estimated savings from reduced response and cleanup costs are $33,000. |
| Emergency generator | Reuse | 0 | Recycle/Reuse | $0 | $2,686 | $24,000 | A generator was obtained from DOE Fluor-Fernal through the DOE Materials Exchange Service. The cost shown was the fee to transport the generator from Ohio. |
| Brokk model 250 | Reuse | 0 | Recycle/Reuse | $0 | $1,000 | $80,000 | A remotely operated hydraulic excavator from DOE Princeton Plasma Laboratory was obtained through the DOE Materials Exchange Service. The $1,000 was the transportation cost from New Jersey. |
| Blasocut coolant machining | Recycled/Reused | 65,440 | Industrial | $130,880 | $0 | $143,180 | Central Shops Division operates a recycling system that reclaims Blasocut machining coolant and supplies it labwide. Recycling involves aeration, centrifuge, and filtration. The cost of this recycling program is offset by savings in procurement and labor (dilution for use). In 2002, BNL recycled 8,180 gal (65,440 lb) of Blasocut lubricant. This avoided the cost of disposal as industrial waste and the cost for six drums of concentrate ($4,800) and 150 empty drums for waste ($7,500). |
| Used motor oil | Energy Recovery | 37,240 | Industrial | $79,230 | $0 | $79,230 | Used motor oil from the motor pool and the on-site gas station is picked for free up by Strebel's Laundry Service and used to fire their waste oil dryers. During calendar year 2002, 4,655 gallons of oil were picked up, avoiding the cost of disposal and 95 drums for shipping ($50/drum). |
| Office paper | Recycled | 418,200 | Sanitary | $16,728 | $0 | $16,728 | Estimate $80/ton for disposal as trash. |
| Cardboard | Recycled | 314,480 | Sanitary | $12,579 | $0 | $12,579 | Estimate $80/ton for disposal as trash. |

**Table 2-2. Waste Reduction and Recycling Projects** *(continued)*.

| Waste Description | Project Type | Pounds Reduced, Reused, Recycled, or Conserved in 2002 | Waste Type | Potential Costs for Treatment and Disposal | Cost of Recycle, Prevention | Estimated Cost Savings | Project Description Details* |
|---|---|---|---|---|---|---|---|
| Scrap metal | Recycled | 88,000 | Sanitary | $3,520 | $0 | $3,520 | Estimate $80/ton for disposal as trash. |
| Bottles/cans | Recycled | 58,600 | Sanitary | $2,344 | $0 | $2,344 | Estimate $80/ton for disposal as trash. |
| Construction debris | Recycled | 607,160 | Sanitary | $7,590 | $0 | $7,590 | Estimate $25/ton for disposal as trash. |
| **TOTALS** | | **2,073,854** | | **$1,683,331** | **$298,256** | **$1,503,621** | |

* Cost savings of projects funded by the BNL Pollution Prevention Council will be carried on the tracking system for three years.

other systems such as cooling towers. The goal is to reduce the consumption of potable water and reduce the possible impacts of clean water discharges on Sewage Treatment Plant operations. Figure 2-2 shows the eight-year trend of water consumption. The total annual reduction in 2002 compared with 1995 is approximately 700 million gallons.

*2.3.4.6 Energy Management and Conservation*

BNL's Energy Management Group has been in place since 1979. This group works to reduce BNL's energy use and costs by identifying cost-effective, energy efficient projects, by monitoring energy use and utility bills, and by assisting in obtaining the least expensive energy sources possible. The group is responsible for developing, implementing, and coordinating BNL's Energy Management Plan.

BNL has more than 4 million square feet of building space. Many BNL scientific experiments use particle beams generated and accelerated by electricity, with the particles controlled and aligned by large electromagnets. In 2002, BNL used approximately 278 million kWh of electricity, 2.7 million gallons of fuel oil and propane, and 273 thousand cubic feet of natural gas. (Fuel oil and natural gas produce steam at the Central Steam Facility.)

Natural gas use started in 1997 and is reducing the need for fuel oil. Using natural gas reduced emissions, saved energy, and lowered costs (see additional information on fuel use in Chapter 4). BNL is a participant in the Long Island Power Authority's (LIPA) Peak Load Reduction Curtailment 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 for each critical day. The Laboratory's participation is significant to LIPA. BNL's portion represents more than 12 percent of the 95-megawatt load-curtailment program total, making the Laboratory the single largest program contributor.

In 2002, several energy-related projects and initiatives were completed. These included a project to eliminate once-through cooling water use in Building 902 that saves substantial potable water, fuel purchasing strategies that saved nearly $6 million, and the connection of Building 911A to the central chilled water system, eliminating the need for two large, outdated chlorofluorocarbon (CFC) chillers. During 2002, work began on a project that will provide a solar heating system for BNL's swimming pool and the installation of a cover to reduce heat loss. BNL also received $235,000 for new energy conservation projects and studies, including a new compressed air drying system at the Central Chilled Water Facility that will save nearly 30 percent of the energy currently used to produce compressed air.

**Table 2-3. Recycling Program Summary.**

| Recycled Material | 1992 | 1993 | 1994 | 1995 | 1996 | 1997 | 1998 | 1999 | 2000 | 2001 | 2002 |
|---|---|---|---|---|---|---|---|---|---|---|---|
| Mixed paper | 155 | 136 | 197 | 220 | 106 | 196 | 204 | 370 | 336 | 246 | 209 |
| Cardboard | 21 | 81 | 164 | 85 | 101 | 103 | 97 | 124 | 132 | 127 | 157 |
| Bottles/Cans | 12 | 12 | 18 | 11 | 15 | 21 | 22 | 21 | 20 | 29 | 19 |
| Tires | 9 | 21 | 7 | 11 | 17 | 18.6 | 11.5 | 15.2 | 0 | 0 | 3.5 |
| Construction debris | 809 | 495 | 495 | 627 | 837 | 799 | 527 | 352 | 243 | 289 | 304 |
| Used motor oil (gallons) | — | — | 4,000 | 3,350 | 4,275 | 4,600 | 3,810 | 3,570 | 3,295 | 3,335 | 1,920 |
| Metals | 201 | 210 | 33 | 153 | 158 | 266 | 64 | 47 | 534 | 38 | 48 |
| Lead | — | — | — | — | — | 4.4 | 3.7 | 0.7 | 2.5 | 0 | 0 |
| Automotive batteries | — | 5 | 0.81 | 0.72 | 6.8 | 4.3 | 2.1 | 1.1 | 2.2 | 4.8 | 6.3 |
| Printer/Toner cartridges (units) | — | — | — | — | — | — | 1,480/175 | 1,575/510 | n/a | 363 | 449 |
| Fluorescent bulbs (units) | — | — | — | — | 13,664 | 12,846 | 867 | 25,291 | 5,874 | 17,112 | 25,067 |
| Blasocut coolant (gallons) | — | — | — | — | — | — | — | 3,575 | 7,500 | 10,660 | 8,180 |
| Antifreeze (gallons) | — | — | — | — | 55 | 276 | 448 | 145 | 110 | 200 | 0 |
| Tritium Exit signs (each) | — | — | — | — | — | — | — | — | 185 | 190 | 28 |
| Smoke detectors | — | — | — | — | — | — | — | — | — | 171 | 40 |

Notes:
All units are tons unless otherwise noted.
— Denotes either not recycled in that year or data not available.

The National Energy Conservation Policy Act, as amended by the Federal Energy Management Improvement Act of 1988 and the Energy Policy Act of 1992, 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. BNL energy use per square foot in 2002 is 28 percent less than in 1985 (see Figure 2-3).

BNL's Energy Management Group continued their assistance with a demonstration and test of microturbines at the Laboratory in 2002. In cooperation with Keyspan Energy and the Energy Sciences and Technology Department and with financial assistance from the Federal Energy

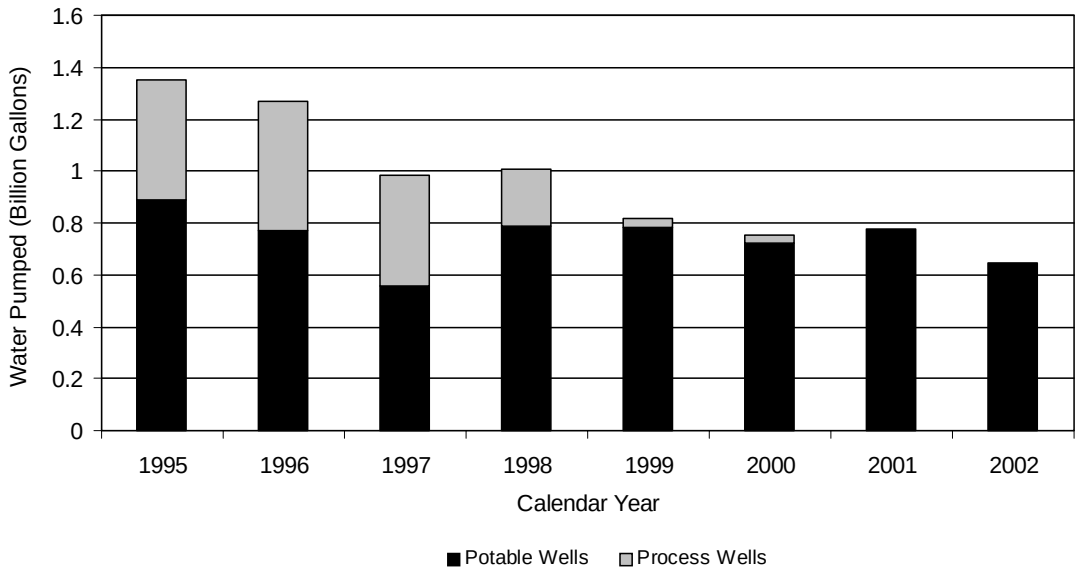


**Figure 2-2. Water Consumption Trend.**

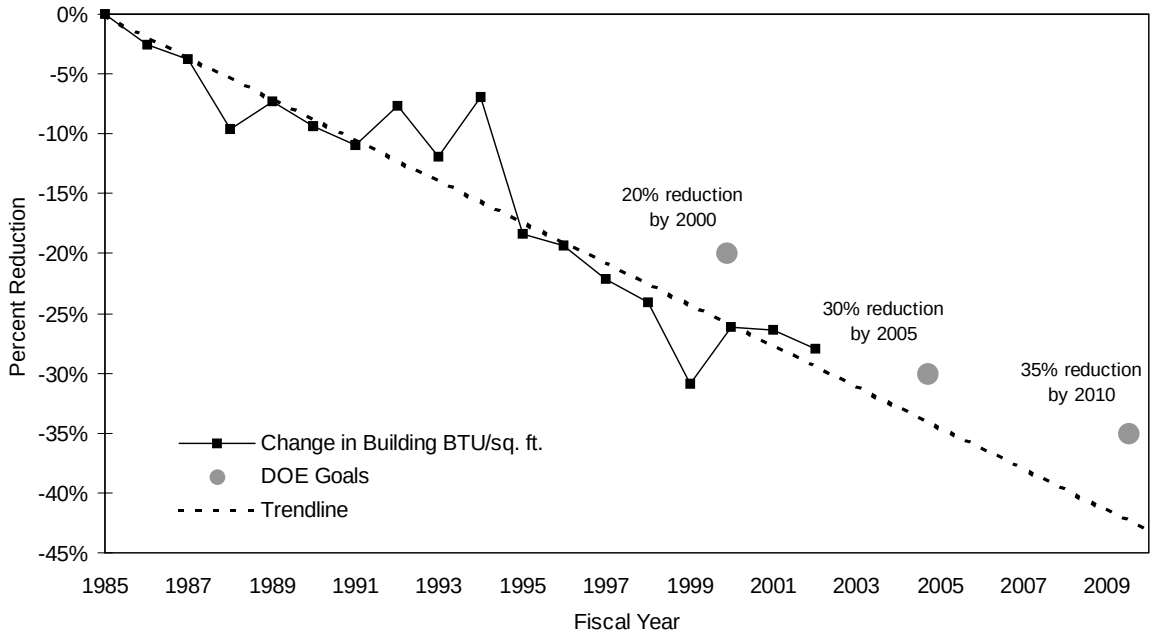


**Figure 2-3. Building Energy Performance Since 1985.**

Management Program, two microturbines were installed at the Laboratory as part of DOE's strategic effort to develop alternatives to large-scale power plants. BNL continues to maintain a contract with New York Power Authority, resulting in an overall cost avoidance of $15 million. BNL will continue to seek out alternative energy sources to meet its future energy needs, support federally required "green" initiatives, and reduce energy costs.

*2.3.4.7 Natural and Cultural Resource Management*

The Laboratory continues to develop, enhance, and implement its Natural Resource Program, building on a foundation established by the Wildlife Management Plan. BNL has begun to develop a Cultural Resource Management Program to identify and manage properties that are determined to be eligible or potentially eligible for inclusion on the National Register of Historic Places. For more information about these programs, see Chapter 6.

*2.3.4.8 Environmental Restoration*

The Comprehensive Environmental Response, Compensation and Liability Act (CERCLA), commonly known as Superfund, was enacted by Congress on December 11, 1980. As part of CERCLA, EPA established the National Priorities List (NPL), which is a list of sites nationwide where cleanup of past contamination is required. BNL is listed on the NPL with 32 other Long Island sites (16 in Suffolk County—see http://www.epa.gov/superfund/sites/npl/ny.htm).

Each step of the Superfund cleanup process is reviewed and approved by DOE, the U.S. Environmental Protection Agency (EPA) and NYSDEC, under a contract called the "Interagency Agreement." This agreement was formalized in 1992. Most of the contamination at BNL is associated with past accidental spills and outmoded practices for handling, storing, and disposing of chemical and radiological material.

BNL follows the CERCLA process, which includes the following steps:

- Conduct a Remedial Investigation to characterize the nature and extent of contamination and assess the associated risks.
- Prepare a Feasibility Study and Proposed Plan to list and evaluate remedial action alternatives and present the proposed alternative.
- Issue a Record of Decision (the remedy/corrective action agreed to by DOE, EPA, and NYSDEC).
- Perform the Remedial Design/Remedial Action, which includes final design, construc-

**Table 2-4. Summary of 2002 Environmental Restoration Activities.**

| Cleanup Project | Operable Unit/ Description | Environmental Restoration Program Actions |
|---|---|---|
| **Soil Projects** | OU I<br>OU II<br>OUVII | ▪ Boneyard project disposed of 1.3 million pounds of waste at Envirocare of Utah, an off-site LLW facility.<br>▪ Completed remediation and restoration of the Building 650 Sump and Sump Outfall soils (AOC 6).<br>▪ Sorted 6,800 cubic yards of soil and disposed of 700 cubic yards of soil from the Chemical Holes project at Envirocare of Utah.<br>▪ Remedial Action Work Plans for the Ash Pit and Meadow Marsh were submitted to regulators.<br>▪ *Phase 2 Landfill 5-Year Review Report* and *Annual Landfill Report* were submitted to regulators. |
| **Groundwater Projects** | OU III | ▪ Completed construction and began routine operations of on-site groundwater treatment system at the Western South Boundary for volatile organic compounds (VOCs).<br>▪ Began construction of an on-site groundwater treatment system Pilot Study for Sr-90 at the Chemical Holes.<br>▪ Continued installation of temporary and permanent monitoring wells for the HFBR tritium plume.<br>▪ Continued characterization and monitoring of tritium in the groundwater from the g-2 activated soil. Further preparation and review of the Engineering Evaluation and Cost Analysis was postponed pending collection of additional data. (This is not included under any specific OU at this time but it is an AOC.)<br>▪ During 2002, 1.3 million gallons of groundwater were treated and 720 pounds of volatile organics were removed. Since the first groundwater treatment system started operating in December 1996, approximately 3,662 pounds of volatile organic compounds have been removed from more than 5.5 billion gallons of groundwater.<br>▪ Completed pre-design characterization and designed five groundwater treatment systems to be installed south of BNL in East Yaphank and Manorville.<br>▪ Significant effort was focused on trying to obtain access to several properties south of BNL for the installation and operation of the planned groundwater treatment systems.<br>▪ Completed characterization of the Magothy Aquifer and submitted a draft Summary Report to the regulators for review. |
| | OU IV | ▪ A petition for system closure was submitted to the regulators for review of the OU IV air sparge and soil vapor extraction soil and groundwater treatment system. The system remains on stand-by.<br>▪ A draft *Five-Year Review Report for OU IV* was submitted to the regulators for review.<br>▪ Continued groundwater monitoring. |
| | OU VI | ▪ Continued monitoring of the EDB plume.<br>▪ Completed pre-design characterization and designed the groundwater treatment system to be installed south of BNL in Manorville. |
| | Groundwater Monitoring | ▪ Completed the *BNL 2001 Groundwater Status Report.*<br>▪ Collected and analyzed 2,065 groundwater samples from 615 monitoring wells.<br>▪ Issued the *Environmental Monitoring Plan, 2002 Update* that reflects implementation of the data quality objectives. |
| **Peconic River** | OU V | ▪ Initiated remedial action for the removal of contaminated soil from the Sewage Treatment Plant sand filter beds, berms, and sludge drying beds. Approximately 450 cubic yards of soil were shipped to Envirocare.<br>▪ Constructed a sediment trap near the BNL southeast boundary to minimize off-site flow of suspended material into the Peconic River.<br>▪ Conducted two pilot studies for evaluation of contaminated sediment removal and wetland restoration techniques along the Peconic River.<br>▪ Conducted baseline human health risk assessment for Peconic River.<br>▪ Prepared a revised Feasibility Study for the Peconic River. |
| **Reactors** | BGRR | ▪ The Below Ground Duct Cooler was removed. The cooler waste was sent Envirocare of Utah.<br>▪ The Above Ground Duct was removed. Sections of concrete duct were size-reduced to meet transportation and disposal site criteria. All duct sections were shipped and buried at Envirocare of Utah in 2002.<br>▪ The Below Ground Duct and associated soils were characterized in accordance with an approved Sampling and Analysis Plan. The characterization data were analyzed as part of the overall BGRR risk assessment and end state determination. |
| | HFBR | ▪ Completed the removal of all nine beam plugs from the Biological Shield.<br>▪ Completed the Preliminary Assessment/Site Investigation Sampling Plan. Successfully transferred experimental equipment for re-use to other sites. Equipment included: 60,000 lb Hot Cell to MIT, two 6,000-gallon LN2 tanks to CAD, and other shipments to the NIST reactor and other universities.<br>▪ Shipped 24 shield blocks to Hanford for disposal.<br>▪ Developed scope, cost, and schedules for five HFBR end-state alternatives ranging from No Action to Greenfields. |

tion specifications, and carrying out the remedy selected.

- The BNL site was initially divided into seven Operable Units (OUs), two of which were later combined to form OU II/VII. Significant progress was made in environmental restoration in 2002. Table 2-4 provides a description of each OU and a summary of environmental restoration actions taken during 2002. The goal of BNL's Environmental Restoration Program is to complete cleanup activities and install all groundwater treatment systems by 2006.

*2.3.4.9 The Facility Review Project*

The Facility Review Project was a comprehensive examination of all site facilities, existing or demolished, to identify any past or current activities with the potential to degrade the environment. During this project, BNL reviewed the entire operating history of the site and more than 900 systems, facilities, and operations including tanks, pipes, sumps, cesspools, storage areas, historical discharges, and current and past operating practices. Twenty-eight individuals from 15 other DOE facilities provided high-level technical and management support during the review. A final report was issued on October 7, 1998 (BNL 1998b).

The report identified 75 issues as having the highest priority due to the potential to contaminate groundwater above drinking water standards. Additionally, more than 1,675 issues that had the potential to impact the environment were identified as needing further evaluation. These were further subdivided into operational and legacy issues. In March 2000, the Facility Review Disposition Project Plan (BNL 2000a) was approved. This three-year project provides the mechanisms needed to rank risk, to schedule, and to resolve the issues identified during the Facility Review Project.

In 2002, significant progress was made to disposition the remaining open operational and legacy issues. Of the original 1,675 issues identified as having the potential to impact the environment, only 36 legacy issues remain open. All other issues were either closed (1,639 issues) because they require no further action, or their management was transferred (332 issues) to an existing program or project. See Table 2-5 for a breakdown of the number of issues and their status.

A Final Report for the Facility Review Disposition Project (FRDP) will be prepared in 2003 and will describe the methods and processes used to disposition all issues identified during the FRDP. In addition, a FRDP Follow-up Project Plan will be developed which will address the disposition of the final 36 legacy issues, as well as tracking the ultimate disposition of all transferred issues.

## 2.4 IMPLEMENTING THE ENVIRONMENTAL MANAGEMENT SYSTEM

### 2.4.1 Structure and Responsibility

All employees at BNL have clearly defined roles and responsibilities in key areas including environmental protection. Every BNL employee is required to develop a Roles, Responsibilities, Accountabilities, and Authorities document signed by the employee, their supervisor, and the

**Table 2-5. Issues Identified in the Facility Review Project, as of December 31, 2002.**

| Category | Rank/Type of Issue | Number | Dispositioned | % Dispostioned |
|---|---|---|---|---|
| **Operational Issues** (Responsible organization exists); 1,175 issues needed further evaluation | Rank 1–3: Potential to impact groundwater, but not above drinking water standards | 176 | 176 | 100% |
| | Rank 4–6: Lower priority, requiring engineering controls or documentation | 999 | 999 | 100% |
| **Legacy Issues** (Responsible organization defunct); 500 issues needed further evaluation | Rank 1–3: Potential to impact groundwater, but not above drinking water standards | 212 | 202 | 95% |
| | Rank 4–6: Lower priority, requiring engineering controls or documentation | 288 | 263 | 91% |
| **Total** | | **1,675** | **1,639** | **98%** |

supervisor's manager. Specifics on environment, safety, and health performance expectations are included in this document.

BSA has clearly defined expectations for staff and management. Under the BSA performance based management model, senior management has communicated their expectation that all line managers and staff take full responsibility and be held accountable for environmental, safety, and health performance. Environmental and waste management technical support personnel assist the line organizations with their environmental responsibilities. The Environmental Compliance Representative program, initiated in 1998, continues to be well received and is an effective means of integrating environmental planning and pollution prevention into the work planning processes of the line organizations. A comprehensive training program for staff, visiting scientists, and contractor personnel is in place, thus ensuring that all personnel are aware of their environmental responsibilities.

#### 2.4.2 Communication and Community Involvement

When BSA was awarded the contract to manage BNL in 1998, they made a commitment to establish an effective partnership between DOE, 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/).

The Environmental Stewardship Policy contains a commitment to maintain a positive, proactive, and constructive relationship with the community and regulators, and to promote open communication on environmental performance. The Community Involvement Policy and Plan was written with input from both internal and external stakeholders; it documents BSA's efforts to ensure that the public will be kept informed of issues; that the Laboratory will actively seek and consider 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 working relationships with regulatory agencies by sharing information and working to resolve issues on plans, priorities, and corrective actions that are important to the regulators. BNL meets regularly with regulators from NYSDEC, EPA Region II, and the Suffolk County Department of Health Services. Suffolk County inspectors have a permanent office on site.

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

In addition, the Community Advisory Council (CAC) was established in September 1998. The Council, which serves in an advisory capacity to the Laboratory Director, consists of representatives from 27 varied stakeholder groups, including civic, business, union, health, education, employee, and environmental organizations. At monthly meetings, both the Roundtable and the CAC are given frequent updates on Laboratory activities, environmental issues, and progress. Feedback and recommendations from the CAC are considered in the Laboratory's decision-making processes.

The CAC closely follows and gives feedback to the Laboratory on remediation activities. These activities include groundwater issues, the final disposition of the Brookhaven Graphite Research Reactor (BGRR), and plans for cleaning up portions of the Peconic River. In 2001, the CAC recommended conducting pilot programs to attempt to minimize impacts to the Peconic River wetlands. In 2002, the CAC tracked the results of the pilot programs including wetland revegetation, electrochemical technology, vacuum guzzling, and phytoremediation, as well as the Peconic River Risk Assessment project. The Laboratory's Pollution Prevention Program generated a great deal of interest within the CAC and plans were undertaken to host a Pollution Prevention Workshop in 2003. Additionally, BNL scientists presented on research on ecosystems and climate, mercury impacts on human health and environment, and processes to encapsulate mercury.

Stakeholders were provided with many other opportunities to learn about and provide input on issues of importance to them. These included working groups, roundtables, and 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. The Laboratory uses a Correspondence and Commitment Tracking System to track and ensure response to communications from interested external parties. Laboratory Envoys, who are well educated about BNL and its issues, regularly interact with individuals and groups in the community, gathering feedback and responding to concerns.

During 2002, BNL hosted more than 29,000 visitors, including students and community members who participated in "Summer Sunday" open houses, science museum visits, high school, college and community tours, and special outreach programs. One Summer Sunday was devoted to increasing the community's appreciation for the environment through activities, demonstrations, literature, and displays. During this event, visitors learned about the Laboratory's initiatives in energy conservation ranging from research involving fuel cells and oil burners to the use of alternate fuel vehicles.

The Laboratory also maintains an informative website, http://www.bnl.gov; issues press releases; and publishes the *Brookhaven Bulletin* (a weekly employee newsletter), *cleanupdate* (a periodic newsletter on environmental cleanup), *Laboratory Link* (a monthly brief on research activities), and e-mail updates to keep the public and employees informed about the Laboratory's science and a wide variety of Laboratory activities and issues, including environmental issues. Chapter 6 discusses additional outreach activities associated with the Natural and Cultural Resources Program.

In 2002, BNL celebrated the thirty-third anniversary of Earth Day with a variety of activities involving BNL staff and the community, including environmental awards, an art contest, a four-mile race, and an on-site Office Swap (for reuse of office products). The Laboratory also participated in an off-site Earth Day celebration. BSA contributed corporate funds in support of these events as part of their commitment to environmental stewardship.

#### 2.4.3 Monitoring and Measurement

Effluent and emissions monitoring helps ensure the effectiveness of controls, adherence to regulatory requirements, and timely identification and implementation of corrective measures. BNL has a comprehensive, sitewide Environmental Monitoring Program. This program identifies potential pathways for exposure of the public and the environment, as well as evaluating what impact BNL activities may be having on the environment. It also ensures compliance with environmental permit requirements.

The monitoring program is reviewed and revised, as necessary, on an annual basis to reflect changes in permit requirements, changes in facility-specific monitoring activities, or the need to increase or decrease monitoring based on the review of previous analytical results. As required under DOE Order 5400.1 (1988), BNL's Environmental Monitoring Plan, Triennial Update (BNL 2002c) outlines annual sampling goals by media and frequency. The 2002 plan also specifies the data quality objectives associated with the monitoring program.

There were a total of 5,381 sampling events of groundwater, potable water, precipitation, air, plants and animals, soil, sediment, and discharges in 2002 under the Environmental Monitoring Program, as shown in Table 2-6. This does not include samples taken to characterize wastes for disposal purposes or nonroutine samples collected in support of restoration characterization activities. Specific sampling programs for the various media are described further in Chapters 3 through 7.

There are three components to the Environmental Monitoring Program: compliance, restoration, and surveillance monitoring.

##### *2.4.3.1 Compliance Monitoring*

Compliance monitoring is conducted to ensure that wastewater effluents, air emissions,

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. Included in compliance monitoring are the following:

- *Air emissions monitoring* is conducted at reactors, accelerators, and other radiological emission sources, as well as the Central Steam Facility. Real-time, continuous emission monitoring equipment is installed and maintained at some of these facilities or samples are collected and analyzed periodically to ensure compliance with regulatory requirements. Analytical data are routinely reported to the permitting authority (see Section 3.5 of Chapter 3 for details).
- *Wastewater discharge monitoring* is performed at the point of discharge to ensure that the effluent complies with release limits in BNL's State Pollutant Discharge Elimination System (SPDES) permits. Fifteen point-source discharges are monitored under the BNL program: five under the Environmental Restoration Program and 10 under the SPDES permit. As required by permit conditions, samples are collected daily, weekly, monthly, or quarterly and monitored for organics, inorganics, or radiological parameters. Monthly reports that provide analytical results and an assessment of compliance for that reporting period are filed with the permitting agency. See Section 3.6 of Chapter 3 for details.
- *Groundwater monitoring* is also performed in accordance with permit requirements. Specifically, monitoring of groundwater is required under the Major Petroleum Facility License for the Central Steam Facility, and the RCRA permit for the Waste Management Facility. Extensive groundwater monitoring is also conducted under the ER program as required under the Records of Decision for many of the Operable Units or Areas of Concern (see Chapter 7 for details). Additionally, to ensure that the Laboratory maintains a viable potable water supply, groundwater is monitored as required by the New York State Department of Health. See Chapter 3 for details on potable water supply monitoring programs and results.

*2.4.3.2 Restoration Monitoring*

Restoration monitoring is performed to determine the overall impact of past operations, to delineate the real extent of contamination, and to ensure that removal actions are effective and that remedial systems are performing as designed under CERCLA and RCRA.

This program typically involves collecting soil and groundwater samples to determine the lateral and vertical extent of the contaminated area. Samples are analyzed for organics, inorganics, and radiological contaminants, and the analytical results are compared with guidance, standards, cleanup goals, or background concentrations. Areas where impacts have been confirmed are fully characterized and, if necessary, remediated to mitigate continual impacts. Followup monitoring of groundwater is conducted in accordance with a Record of Decision.

*2.4.3.3 Surveillance Monitoring*

Pursuant to DOE Order 5400.1, surveillance monitoring is performed in addition to compliance monitoring, to assess potential environmental impacts that could result from routine facility operations. The Surveillance Monitoring Program involves collecting samples of ambient air, surface water, groundwater, flora, fauna, and precipitation. Samples are analyzed for radiological, organic, and inorganic contaminants. Additionally, data collected by thermoluminescent dosimeters (devices to measure radiation exposure) on and off site are routinely reviewed under this program.

Control samples (also called background or reference samples) also are collected on and off the site to compare BNL results to areas that could not have been impacted by BNL operations.

The monitoring programs can be broken down further by the relevant law or requirement (e.g., Clean Air Act) and even further by specific environmental media and type of analysis. The results of monitoring and the analysis of the monitoring data are the subject of the remaining chapters of this report. Chapter 3 summarizes environmental requirements and compliance data, Chapters 4 through 8 give details on media-spe-

**Table 2-6. Summary of BNL 2002 Sampling Program Sorted by Media.**

| Environmental Media | No. of Sampling Events* | Purpose |
|---|---|---|
| Groundwater | 2,345 | To evaluate impacts of past and present operations on groundwater quality, under the Environmental Restoration, Environmental Surveillance, and Compliance programs. |
| On-site recharge basins | 126 | Recharge basins used for wastewater and stormwater disposal were monitored in accordance with discharge permit requirements and for environmental surveillance purposes. |
| Potable water | 148 | Potable water wells and the BNL distribution system were monitored routinely for chemical and radiological parameters to ensure compliance with Safe Drinking Water Act requirements and for environmental surveillance purposes. |
| Sewage Treatment Plant and Peconic River | 364 | The STP influent and effluent and several downstream Peconic River stations were monitored routinely for organic, inorganic, and radiological parameters to assess BNL impacts on the river. The number of samples taken depends on flow—e.g., samples are scheduled for collection at Station HQ one time per month, but if there is no flow, no sample can be collected. See discussion in Chapters 3 and 5. |
| Precipitation | 8 | Precipitation samples were collected from two locations to determine if radioactive emissions have impacted rainfall, and to monitor worldwide fallout from nuclear testing. The data were also used, along with wind speed and direction, temperature, and atmospheric stability, to help model atmospheric transport and diffusion of radionuclides. |
| Air — Tritium | 340 | Silica gel cartridges were used to collect atmospheric moisture for subsequent tritium analysis. These data were used to assess tritium levels downwind of the reactors. Due to several years of nondetectable measurements, and the shutdown of the HFBR, monitoring was reduced from weekly to once per month in several areas of the site in 2000. See discussion in Chapters 4 and 8. |
| Air — Particulate | 468 | Gross alpha/beta and gamma analysis was performed on samples of particulate matter collected from air samples. The purpose is to look for any impact from BNL operations. |
| Air — Charcoal | 104 | Charcoal samples were used to assess for radioiodines, which could be released in emissions. |
| Fauna | 120 | Fish, deer, and small mammals were monitored to assess impacts on wildlife associated with past (or current) BNL operations. |
| Flora | 79 | Since the primary pathway from soils to fauna is via ingestion, vegetation was sampled to assess uptake of contaminants by plants and hence to fauna. This number includes 33 samples taken of farm produce. |
| Soils | 843 | Soil samples were collected from adjacent farms and other local areas to confirm that Laboratory emissions have no impact on surrounding areas. Soil samples were also collected in Environmental Restoration investigative work. |
| Miscellaneous | 290 | Samples were collected periodically from manholes and other locations to assess compliance with regulatory requirements. This number includes samples taken by the ESD field sampling team for Plant Engineering (e.g., collected during sewer line cleanouts). |
| **Total number of sampling events** | **5,381** | This number includes all the samples identified in the EMP (BNL 2002), plus samples collected by the ESD field sampling team as special requests. The number does not include samples collected to monitor Environmental Restoration air and water treatment system processes, or samples taken by the Waste Management Division, waste generators, or Environmental Compliance Representatives for waste characterization purposes. |

*In one sampling event, multiple samples may be collected from a single location. For example, during one sampling event , separate samples for tritium, gross alpha and beta, and VOCs may be collected from a groundwater monitoring well.

cific monitoring data and analysis, and Chapter 9 provides supporting information for understanding and validating the data shown in this report.

### *2.4.4 EMS Assessments*

To periodically verify that the EMS is operating as intended, audits are conducted. These

audits are part of the sitewide self-assessment program and are designed to ensure that any nonconformance to the ISO 14001 Standard is identified and addressed. An independent, accredited registrar also conducts annual ISO 14001 registration audits. In addition, compliance with regulatory requirements is verified through routine inspections, operational evaluations, and focused compliance audits. BNL's Assessment Program consists of several processes.

- *Self-assessment* is the systematic evaluation of internal processes and performance. The approach for the environmental self-assessment program includes evaluating programs and processes within organizations that have environmental aspects. Conformance to ISO 14001 EMS requirements is verified, progress toward achieving environmental objectives is monitored, operations are inspected to verify compliance with regulatory requirements, and the overall effectiveness of the EMS is evaluated. Environmental experts routinely participate in these assessments. Management also conducts assessments to evaluate Laboratory environmental performance from a programmatic perspective, to determine if there are Laboratory-wide issues that require attention, and to facilitate the identification and communication of best management practices used in one part of the Laboratory that could improve performance in other parts. Laboratory management also routinely evaluates progress on key environmental improvement projects. BNL periodically teams with the local DOE office to perform assessments to facilitate the efficiency of assessment activities and ensure that the approach to performing the assessments meets DOE expectations.
- *Independent assessments* are performed by staff who do not have line responsibility for the work processes. These assessments verify the effectiveness and adequacy of management processes (including self-assessment programs) at the division, department, directorate, and Laboratory levels. Special investigations are also conducted to identify the root causes of problems, corrective actions, and lessons learned.

The Laboratory's Assessment Program is augmented by programmatic, external audits conducted by DOE. Staff from the offices of Battelle Memorial Institute and BSA subcontractors also perform periodic independent reviews. An independent third party conducts ISO 14001 registration audits of the environmental management system.

From June 4 through June 7, 2002, an ISO 14001 EMS Surveillance Audit was conducted by NSF-ISR, Ltd, an independent and accredited ISO 14001 registrar. The independent registrar determined that BNL's EMS remains in conformance with the ISO 14001 standard. The auditors identified one minor nonconformance, one opportunity for improvement, strong evidence of continuous improvement, and 12 noteworthy practices. A corrective action report that BNL prepared for the minor nonconformance was accepted by the auditor and will be tracked to closure.

BNL is also subject to extensive oversight by external regulatory agencies (see Chapter 3). Results of all assessment activities related to environmental performance are included, as appropriate, throughout this report.

### 2.5 ENVIRONMENTAL STEWARDSHIP AT BNL TODAY

BNL now has unprecedented knowledge of its potential environmental vulnerabilities and current operations due to programs such as the Facility Review Project, process evaluations, the work planning and control system, and the management systems for groundwater protection, environmental restoration, and information management. Compliance assurance programs are improving BNL's compliance status. Pollution prevention projects have reduced costs, minimized waste generation, and reused and recycled significant quantities of materials.

The Laboratory is openly communicating with neighbors, regulators, employees, and other interested parties on issues and progress. To regain and maintain stakeholder trust, BNL must continue to deliver on commitments and demonstrate real improvements in environmental performance. This annual Site Environmental Report is an important communication mechanism,

as it summarizes BNL's environmental programs and performance for the 2002 calendar year. Additional information about BNL's environmental programs is available on BNL's website at http://www.bnl.gov. Environmental project plans, status reports, procedures, and other environmental information are accessible to the general public at http://www.bnl.gov/esd/. The Laboratory continues to pursue other mechanisms to communicate data in a more user friendly, visual, and timely manner.

The existing BNL Environmental Management System is viewed as exemplary within DOE. BNL is the first DOE Office of Science national laboratory to obtain third-party registration to ISO 14001. Due to external recognition of BNL's knowledge and unique experience implementing the ISO 14001 EMS program, several DOE facilities and private universities have invited BNL to extend its outreach activities and share its experiences, lessons learned, and successes. As noted above, BNL's environmental programs and projects have been recognized with regional and national awards.

Audits have consistently observed a high level of management involvement, commitment, and support for environmental protection and the EMS. Audits and EMS management reviews have noted the following improvements made since BSA began managing the Laboratory:

- The EMS has been strengthened, integrated with other BNL management systems, and formalized.
- Line ownership for environmental stewardship has been established, key roles and responsibilities have been identified and clarified, and expectations have been made explicit.
- A comprehensive environmental training program has been implemented.
- From the process evaluations, BNL has an improved understanding of environmental aspects, waste streams, and applicable requirements.
- There is much greater formality with regard to control of EMS documents, manuals, and procedures. Procedures and requirements have been updated, and environmental management programs have been improved.
- BNL has been very successful in achieving environmental goals and Critical Outcomes. There have been successes in ISO 14001 registration and recertification, compliance improvements (e.g., facility modifications, implementation of SBMS, enhanced operational controls), and increased environmental knowledge and awareness on the part of management, employees, and visiting scientists.
- Communication on environmental issues has improved, occurs at the highest levels of management, and reporting is more formal. Managers are better informed about environmental aspects, issues, and performance.
- Core EMS teams representing many organizations have been formed. A consensus process is used to develop the system, improving acceptance and support.
- There has been strong penetration of the EMS throughout organizations, and cultural change has been sweeping.
- For more than 50 years, the unique, leading-edge research facilities at BNL have made many innovative scientific contributions possible. Today, BNL continues its research mission while paying much closer attention to cleaning up and protecting the environment. The Laboratory's environmental motto, which was generated in an employee suggestion contest, is "Exploring Earth's Mysteries … Protecting Its Future." This reflects BNL's desire to balance world-class research with environmentally responsible operations.

## REFERENCES AND BIBLIOGRAPHY

BNL. 1997. Brookhaven National Laboratory Site Treatment Plan. Brookhaven National Laboratory, Upton, NY. January 1997.

BNL. 1998a. Areas of Concern at Brookhaven National Laboratory, Upton, New York–A Reference Handbook. Brookhaven National Laboratory, Upton, NY. June 1998.

BNL. 1998b. BNL Facility Review Final Report, Review of Potential Environmental Release Points. Brookhaven National Laboratory, Upton, NY. October 7, 1998.

BNL. 1999. Site Environmental Report for Calendar Year 1997. BNL-52553. Brookhaven National Laboratory, Upton, NY. February 1999.

BNL. 2000a. Facility Review Disposition Project Plan. Brookhaven National Laboratory, Upton, NY. March 2000.

BNL. 2000b. Final Report, EPA Phase II Process Evaluation Project. Brookhaven National Laboratory, Upton, NY. June 2000.

BNL. 2002. BNL Environmental Monitoring Plan 2002, Triennial Update. Brookhaven National Laboratory, Upton, NY.

DOE Order 430.2. 1996. In-House Energy Management. U.S. Department of Energy, Washington, DC. June 13, 1996 (expired June 13, 2000).

DOE Order 435.1. 1999. Radioactive Waste Management. U. S. Department of Energy, Washington, DC. July 7, 1999.

DOE Order 5400.1. 1988. General Environmental Protection Program. U.S. Department of Energy, Washington, DC. Change 1: 6-29-90.

EPA/DOE. 1998. Memorandum of Agreement by and between the Environmental Protection Agency and the United States Department of Energy. EPA and DOE. March 23, 1998.

Executive Order 13148. Greening of the Government Through Leadership in Environmental Management. April 22, 2000.

ISO. 1996. ISO 14001, Environmental Management Systems – Specification with Guidance for Use. First Edition. International Organization for Standardization. Geneva, Switzerland. September 1, 1996.

Meinhold, C.B. and A.F. Meinhold. 2001. Radiological Emissions and Environmental Monitoring for Brookhaven National Laboratory, 1947-1961. DOE Contract No. DE-AC02-98CH10866. Brookhaven National Laboratory, Upton, NY. May 2001.

Sanok, William J. 2001. "Integrated Pest Management Assessment – Brookhaven National Laboratory." Cornell Cooperative Extension of Suffolk County. August 2001.

Schymura, Maria J., Ph.D. 2001. "Assessing Cancer Risk among Former and Current Brookhaven National Laboratory Workers." New York State Cancer Registry, New York State Department of Health. April, 2001.

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