

Environmental Management System



One of Brookhaven National Laboratory's highest priorities is ensuring that its commitment to environmental protection is as strong as its passion for science. Brookhaven Science Associates (BSA), the contractor operating the Laboratory on behalf of DOE, takes environmental stewardship very seriously. As part of its commitment to environmentally responsible operations, BSA has established the BNL 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. Annual audits are required to maintain an EMS registration; an audit of the entire EMS occurs every three years. In 2016, an EMS reassessment audit determined that BNL remains in conformance with the ISO 14001: 2004 Standard.

The Laboratory continues its strong support of its Pollution Prevention Program, which seeks ways to eliminate waste and toxic materials on site. In 2016, pollution prevention projects resulted in more than \$1.6 million in cost avoidance or savings and resulted in the reduction or reuse of approximately 7.9 million pounds of waste. Also in 2016, the Pollution Prevention Program funded seven new proposals, investing approximately \$11,000. Anticipated annual savings from these projects are estimated at approximately \$18,000, for an average payback period of slightly less than one year. An additional \$9,000 was spent on funding lab cleanouts and disposal of chemicals. The ISO 14001-registered EMS and the nationally recognized Pollution Prevention Program continue to contribute to the Laboratory's success in promoting pollution prevention. As a testament to its strong environmental program, the Laboratory received three environmental awards in 2016: US EPA's Northeast Regional Federal Green Challenge Leadership Award for the NSLS-I Decommissioning Project, US DOE's Gold Level Green Buy Award, and the Green Electronics Council's EPEAT (Electronic Product Environmental Assessment Tool) Award.

BNL continues to address legacy environmental issues, and openly communicates with neighbors, regulators, employees, and other interested parties on environmental issues and cleanup progress on site.

2.1 INTEGRATED SAFETY MANAGEMENT, ISO 14001, AND OHSAS 18001

The Laboratory's Integrated Safety Management System (ISMS) integrates Environment (environmental protection and pollution prevention), Safety, Health, and Quality (ESH&Q)

management into all work planning and execution. The purpose of BNL's ISMS is to ensure that the way we do work integrates DOE's five Core Functions and seven Guiding Principles into all work processes. The five Core Functions, as defined by DOE P 450.4, *Safety*

Management System Policy, are:

- **DEFINE THE SCOPE OF WORK:** Missions are translated into work, expectations are set, tasks are identified and prioritized, and resources are allocated.
- **IDENTIFY AND ANALYZE HAZARDS ASSOCIATED WITH THE WORK:** Hazards associated with the work are identified, analyzed, and categorized.
- **DEVELOP AND IMPLEMENT HAZARD CONTROLS:** Applicable standards and requirements are identified and agreed-upon; controls to prevent/mitigate hazards are identified; the safety envelope is established; and controls are implemented.
- **PERFORM WORK WITHIN CONTROLS:** Readiness is confirmed and work is performed safely.
- **PROVIDE FEEDBACK ON ADEQUACY OF CONTROLS AND CONTINUE TO IMPROVE SAFETY MANAGEMENT:** Feedback information on the adequacy of controls is gathered; opportunities for improving the definition and planning of work are identified and implemented; line and independent oversight is conducted; and, if necessary, regulatory enforcement actions occur.

The seven Guiding Principles, also as defined by DOE P 450.4, are:

- **LINE MANAGER CLEARLY RESPONSIBLE FOR ES&H:** Line management is directly responsible for the protection of the public, the workers, and the environment.
- **CLEAR ES&H ROLES AND RESPONSIBILITIES:** Clear and unambiguous lines of authority and responsibility for ensuring safety shall be established and maintained at all organizational levels within the Department and its contractors.
- **COMPETENCE COMMENSURATE WITH RESPONSIBILITIES:** Personnel shall possess the experience, knowledge, skills, and abilities that are necessary to discharge their responsibilities.
- **BALANCED PRIORITIES:** Resources shall be effectively allocated to address safety, programmatic, and operational considerations. Protecting the public, the workers, and the environment shall be a priority whenever

activities are planned and performed.

- **IDENTIFY ES&H STANDARDS AND REQUIREMENTS:** Before work is performed, the associated hazards shall be evaluated and an agreed-upon set of safety standards and requirements shall be established which, if properly implemented, will provide adequate assurance that the public, the workers, and the environment are protected from adverse consequences.
- **HAZARD CONTROLS TAILORED TO WORK BEING PERFORMED:** Administrative and engineering controls to prevent and mitigate hazards shall be tailored to the work being performed and associated hazards.
- **OPERATIONS AUTHORIZATION:** The conditions and requirements to be satisfied for operations to be initiated and conducted shall be clearly established and agreed upon.

The integrated safety processes within ISMS contributed to BNL achieving ISO 14001 and Occupational Health and Safety Assessment Series (OHSAS) 18001 registrations.

The ISO 14001 Standard is globally recognized and defines the structure of an organization's EMS for purposes of improving environmental performance. OHSAS 18001 mirrors the ISO 14001 structure for purposes of improving safety and providing a safe and healthy workplace, free from recognized hazards for all operations. The process-based structure of the ISO 14001 and OHSAS 18001 Standards are based on the "Plan-Do-Check-Act" improvement cycle. Both standards require an organization to develop a policy, create plans to implement the policy, implement the plans, check progress and take corrective actions, and review the system periodically to ensure its continuing suitability, adequacy, and effectiveness.

The Laboratory's EMS, as a whole, was officially registered to the ISO 14001 Standard in July 2001, and was the first DOE Office of Science Laboratory to obtain third-party registration to this environmental standard. BNL was officially registered to the OHSAS 18001 Standard in 2006, and was again the first DOE Office of Science Laboratory to achieve this registration. Each certification requires the Laboratory to undergo annual audits by an

accredited registrar to assure that the systems are maintained.

An ISO 14001 and OHSAS 18001 reassessment audit was conducted by auditors from NSF International Strategic Registrations in April 2016 (OHSAS 18001 audit results are not included in this report). The reassessment determined that the Laboratory was in full conformance to the standard and received recertification.

2.2 ENVIRONMENTAL, SAFETY, SECURITY, AND HEALTH POLICY

The cornerstone of an EMS is a commitment to environmental protection at the highest levels of an organization. BNL's environmental commitments are incorporated into a comprehensive Environmental, Safety, Security, and Health (ESSH) Policy. The policy, issued and signed by the Laboratory Director, makes clear the Laboratory's commitment to environmental stewardship, the safety of the public and BNL employees, and the security of the site. The policy continues as a statement of the Laboratory's intentions and principles regarding overall environmental performance. It provides a framework for planning and action and is included in employee, guest, and contractor training programs. The ESSH Policy is posted throughout the Laboratory and on the BNL website at <http://www.bnl.gov>. The goals and commitments focusing on compliance, pollution prevention, community outreach, and continual improvement include:

- **ENVIRONMENT:** We protect the environment, conserve resources, and prevent pollution.
- **SAFETY:** We maintain a safe workplace, and we plan our work and perform it safely. We take responsibility for the safety of ourselves, coworkers, and guests.
- **SECURITY:** We protect people, property, information, computing systems, and facilities.
- **HEALTH:** We protect human health within our boundaries and in the surrounding community.
- **COMPLIANCE:** We achieve and maintain compliance with applicable ESSH requirements.
- **COMMUNITY:** We maintain open, proactive, and constructive relationships with our employees, neighbors, regulators, DOE, and

other stakeholders.

- **CONTINUAL IMPROVEMENT:** We continually improve ESSH performance.

2.3 PLANNING

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

2.3.1 Environmental Aspects

An "environmental aspect" is any element of an organization's activities, products, and services that can impact the environment. As required by the ISO 14001 Standard, BNL evaluates its operations, identifies the aspects that can impact the environment, and determines which of those impacts are significant. The Laboratory's criteria for significance are based on actual and perceived impacts of its operations and on regulatory requirements.

BNL utilizes several processes to identify and review environmental aspects. Key among these is the Process Assessment Procedure. This is an evaluation that is documented on a Process Assessment Form consisting of a written process description, a detailed process flow diagram, a regulatory determination of all process inputs and outputs, identification of pollution prevention opportunities, and identification of any assessment, prevention, and control measures that should be considered.

Environmental professionals work closely with Laboratory personnel to ensure that environmental requirements are integrated into each process. Aspects and impacts are evaluated annually to ensure that they continue to reflect stakeholder concerns and changes in regulatory requirements.

2.3.2 Legal and Other Requirements

To implement the compliance commitments of the ESSH Policy and to meet its legal requirements, BNL has systems in place to review changes in federal, state, or local environmental regulations and to communicate those changes

to affected staff. Laboratory-wide procedures for documenting these reviews and recording the actions required to ensure compliance, are available to all staff through BNL's web-based Standards-Based Management System (SBMS) subject areas.

Signed in March 2015, Executive Order (EO) 13693, *Planning for Federal Sustainability in the Next Decade*, establishes sustainability goals for federal agencies and focuses on greenhouse gas (GHG) reductions across the government. In addition to guidance, recommendations, and plans, which are due by specific due dates, EO 13693 has set numerical targets for the agencies.

DOE Order 436.1, *Departmental Sustainability*, provides requirements and responsibilities for managing sustainability within DOE to ensure facilities are working towards sustainability goals established in its Strategic Sustainability Performance Plan (SSPP) pursuant to EO 13639. Each DOE facility is required to have a Site Sustainability Plan (SSP) in place detailing the strategy for achieving these long-term goals and due dates, and to provide an annual status. The requirements influence the future of the Laboratory's EMS program and have been incorporated into BNL's SSP. Table 2-1 identifies the DOE SSP goals, the Laboratory's performance in 2016, and future planned actions and contributions.

2.3.3 Objectives and Targets

The establishment of environmental objectives and targets is accomplished through a 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 the Performance Evaluation Management Plan (PEMP). BSA works closely with DOE to clearly define expectations and performance measures. Factors for selecting environmental priorities include:

- Meeting the intent and goals of EO 13693
- Significant environmental aspects
- Risk and vulnerability (primarily, threat to the environment)

- Legal requirements (laws, regulations, permits, enforcement actions, and memorandums of agreement)
- Commitments (in the ESSH Policy) to regulatory agencies, and to the public
- Importance to DOE, the public, employees, and other stakeholders

Laboratory-level objectives and targets are developed on a fiscal year (FY) schedule. For FY 2016, BNL's environmental objective included maintaining ISO 14001 and OHSAS 18001 certifications and improving the Laboratory's performance in purchasing environmentally preferable items.

2.3.4 Environmental Management Programs

Each organization within BNL develops an action plan detailing how they will achieve their environmental objectives and targets, as well as commit the resources necessary to successfully implement both Laboratory-wide and facility-specific programs. BNL has a budgeting system designed to ensure that priorities are balanced and to provide resources essential to the implementation and control of the EMS. The Laboratory continues to review, develop, and fund important environmental programs to further integrate environmental stewardship into all facets of its missions.

2.3.4.1 Compliance

BNL has an extensive program to ensure that the Laboratory remains in full compliance with all applicable environmental regulatory requirements and permits. Legislated compliance is outlined by the Clean Air Act, National Emission Standards for Hazardous Air Pollutants (NESHAPs), Clean Water Act (e.g., State Pollutant Discharge Elimination System [SPDES]), Safe Drinking Water Act (SDWA), Resource Conservation and Recovery Act (RCRA), and other programs. Other compliance initiatives at the Laboratory involve special projects, 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 facilities. (See Chapter 3 for a list of regulatory

Table 2-1. BNL Site Sustainability Plan: Status Summary for Fiscal Year 2016.

DOE Goal	BNL Performance Status	BNL Planned Actions and Contributions
Goal 1: Greenhouse Gas (GHG) Reduction		
50 percent Scope 1 and 2 GHG reduction by FY 2025 from a FY 2008 baseline (2016 target: 22 percent).	<ul style="list-style-type: none"> ▪ The FY 2008 baseline was 205,628 MtCO₂e. In FY 2015, BNL's Scope 1 and 2 GHG emissions totaled 120,583 MtCO₂e. According to the Dashboard calculations, in FY 2016, BNL's Scope 1 and 2 GHG emissions totaled 131,414 MtCO₂e—a decrease of 36 percent against the FY 2008 baseline. ▪ BNL is currently meeting/exceeding this goal. 	<ul style="list-style-type: none"> ▪ An updated economic evaluation of a Combined Heat and Power (CHP) Plant was completed in September. The evaluation concluded that while there were a number of benefits from CHP, including a substantial GHG reduction, it was not economically viable at this time with the current low energy rates. BHSO and BSA met to discuss the results and it was agreed to periodically review the business case and wait until conditions change substantially before reconsidering CHP. It was also agreed to start the preliminary process for a potential Utility Energy Service Contract (UESC) Phase II project. A second phase will provide for additional GHG reductions.
25 percent Scope 3 GHG reduction by FY 2025 from a FY 2008 baseline (2016 target: 7 percent).	<ul style="list-style-type: none"> ▪ Scope 3 GHG emissions increased by 14.5 percent from the FY 2015 (3,004 MtCO₂e), and were 17 percent higher than the FY 2008 baseline value. ▪ This goal is currently not being met primarily due to the recent increase in electricity transmission loss factor from eGrid. 	<ul style="list-style-type: none"> ▪ Some activities planned for FY 2017 include conducting and communicating the results of a survey on Blue Jean video conferencing and its impact on business travel; modifying the standard allowable rental vehicle from mid-size to compact; evaluating the potential of diverting food waste to a local vendor; and working with Human Resources on evaluating GHG reduction from telework/ compressed work schedules. ▪ BNL will seek approval from the DOE Sustainability Office (SPO) to use a new series of emission factors to calculate commuting GHG emissions from model year 2009 and later passenger cars and light duty vehicles. ▪ BNL will follow up with the SPO to determine if the most accurate eGrid factors are being utilized to determine the electricity transmission loss factor.
Goal 2: Sustainable Buildings		
25 percent energy intensity BTU/GSF (British Thermal Units Per Gross Square Foot) reduction in goal-subject buildings, achieving 2.5 percent reductions annually by FY 2025 from a FY 2015 baseline.	<ul style="list-style-type: none"> ▪ BNL's FY 2016 energy intensity was 215,179 Btu/GSF. This level represents a cumulative reduction of 33 percent from the FY 2003 baseline of 323,780 Btu/GSF, and a 10.7 percent reductions from the new 2015 baseline. ▪ The UESC Phase I was completed in May 2015. The actual first year savings were verified to be within 2 percent of the original projections. A savings/reduction of approximately 7,000 MtCO₂e was accomplished. ▪ The Temperature Setback Policy was communicated to the Laboratory during Earth Day events and presentations to Facility Project Managers (FPMs)/Facility Complex Managers (FCMs), and Laboratory management. ▪ BNL is currently meeting this goal. 	<ul style="list-style-type: none"> ▪ BNL plans to initiate a UESC Phase II effort in FY 2017. However, the ability to find cost-effective projects in the current low-cost energy environment will be difficult. ▪ BNL's low energy rates and high construction costs make it difficult to find cost-effective projects. Further, virtually all new buildings added in recent years are for scientific research and are more energy intensive than the buildings that were demolished.
Energy Independence and Security Act Section 432 energy and water evaluations.	<ul style="list-style-type: none"> ▪ Green Energy Surveys were continued in 2016 and are on schedule. ▪ Desktop energy audits were completed on a few buildings that missed the four-year cycle. ▪ BNL is currently meeting this goal. 	<ul style="list-style-type: none"> ▪ BNL will continue with the cost effective Energy Survey/ Facility Condition Assessment (FCA) approach in FY 2017 and beyond.
Meter all individual buildings for electricity, natural gas, steam, and water where cost-effective and appropriate.	<ul style="list-style-type: none"> ▪ Additional meter installations are ongoing. ▪ Advanced metering installations/upgrades were completed for 11 electric, 2 steam, and 2 chilled water loads. ▪ BNL is currently meeting this goal. 	<ul style="list-style-type: none"> ▪ BNL is continuing its investigation into the need for additional sub-meters for and IT loads that are not on the uninterruptable power circuits. A potential project to relocate/ consolidate BNL data centers provides an opportunity to improve data center performance and metering.

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CHAPTER 2: ENVIRONMENTAL MANAGEMENT SYSTEM

Table 2-1. BNL Site Sustainability Plan: Status Summary for Fiscal Year 2016. (continued).

DOE Goal	BNL Performance Status	BNL Planned Actions and Contributions
<p>At least 17 percent (by building count or gross square feet) of existing buildings greater than 5,000 gross square feet to be compliant with the revised Guiding Principles for High Performance Sustainable Buildings (HPSB) by FY 2025, with progress to 100 percent thereafter.</p>	<ul style="list-style-type: none"> ▪ BNL has approximately 27 percent of its gross square footage compliant with the Guiding Principles for HPSB ▪ BNL is currently meeting/exceeding this goal. 	<ul style="list-style-type: none"> ▪ In FY 2017, the area being renovated in Building 924 will be compliant with the Guiding Principles. The 30,000 gross square foot Building 180 demolition will also raise the percentage of compliant space. ▪ In addition, the Guiding Principles will be factored into the preliminary designs of the Core Facility Revitalization and the Science User Support Center projects. ▪ BNL will continue to work towards 100 percent compliance.
<p>Efforts to increase regional and local planning coordination and involvement.</p>	<ul style="list-style-type: none"> ▪ The Discovery Park project continued to receive high visibility among state and local agencies and was a key element in several regional economic development initiatives in FY 2016. Alternative 2A, an informal public-private partnership, was accepted by DOE on June 7. ▪ Deer management was not implemented in 2016, however, the 4-poster project to reduce the tick population continued in anticipation of a management action to take place in FY 2017. ▪ BNL has implemented several strategies established by the Pollinator Task Force and several research programs related to the pollinator program. ▪ BNL continued to support local and federal efforts to reduce reliance on petroleum by supporting programs and events to reduce the use of single occupancy vehicles. ▪ The Sustainable Brookhaven website was reviewed and updated to ensure the information was complete and up-to-date. ▪ BNL is currently meeting this goal. 	<ul style="list-style-type: none"> ▪ Efforts to continue the realization of Discovery Park will continue to move forward with support from local, regional, and federal stakeholders. ▪ The deer management strategy will be implemented in FY 2017 with a goal to minimize the deer herd to approximately 250 animals on site. ▪ BNL will continue to work to implement best management practices established by the Pollinator Task Force and continue pollinator-related research. ▪ BNL will continue to support local and federal efforts to reduce reliance on petroleum. ▪ BNL will continue to maintain the Sustainable Brookhaven website.
<p>Net Zero Buildings: 1 percent of existing buildings on site above 5,000 gross square feet intended to be energy, waste, or water net-zero buildings by FY 2025.</p>	<ul style="list-style-type: none"> ▪ The Modernization Project Office (MPO) hosted net zero energy training for 28 Facilities and Operations staff members from MPO, utilities, and Integrated Facility Management. Three potential buildings are planned for further evaluation for Net-Zero designation. 	<ul style="list-style-type: none"> ▪ BNL will continue to engage Laboratory employees on techniques to meet these requirements. ▪ BNL will further evaluate buildings for Net-Zero designation using the NSERC as the renewable energy source and will consult with BHSO on the most appropriate building(s).
<p>Net Zero Buildings: All new buildings (above 5,000 gross square feet) entering the planning process designed to achieve energy Net-Zero beginning in FY 2020.</p>	<ul style="list-style-type: none"> ▪ MPO hosted Net Zero energy training and it was attended by 28 F&O staff members from MPO, utilities, and IFM. BNL does not currently have any buildings designated Net Zero. 	<ul style="list-style-type: none"> ▪ BNL will continue to engage Laboratory employees on techniques to meet these requirements. ▪ BNL will ensure these requirements are included in future designs.
<p>Goal 3: Clean & Renewable Energy</p>		
<p>“Clean Energy” requires that the percentage of an agency’s total electric and thermal energy accounted for by renewable and alternative energy shall be not less than 10 percent in FY 2001-2017, working towards 25 percent by FY 2025.</p>	<ul style="list-style-type: none"> ▪ BNL’s clean energy requirement for 2016 was approximately 44 million kWh. In 2016, BNL purchased 48.9 million kWh of RECs and the NSERC facility produced 0.55 million kWh for a total of a 49.4 million kWh, exceeding the 10 percent goal. 	<ul style="list-style-type: none"> ▪ Planned actions include continued operation and expansion of the Northeast Solar Energy Research Center (NSERC) facility; REC purchases, as necessary, to meet both the Renewable and new Clean Energy Goals; and continued investigation and analysis of a CHP if economics (energy rates) justify the effort.

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Table 2-1. BNL Site Sustainability Plan: Status Summary for Fiscal Year 2016. *(continued).*

DOE Goal	BNL Performance Status	BNL Planned Actions and Contributions
<p>“Renewable Electric Energy” requires that renewable electric energy account for not less than 10 percent of a total agency electric consumption in FY 2016/2017, working towards 30 percent of total agency electric consumption by FY 2025.</p>	<ul style="list-style-type: none"> ▪ BNL purchased 48.9 million kWh of RECs in 2016. ▪ The NSERC facility (Solar PV) produced 0.55 million kWh for a total of 49.4 million kWh, exceeding the 10 percent goal. ▪ The NSERC facility was expanded by 324 kW in 2016 with the help of SPO funding. The peak output is currently 781 kW. 	<ul style="list-style-type: none"> ▪ Planned actions include continued operation and expansion of the NSERC facility, as well as REC purchases, as necessary, to meet both the Renewable and Clean Energy Goals.
Goal 4: Water Use Efficiency and Management		
<p>36 percent potable water intensity (gallons per gross square foot) reduction by FY 2025 from a FY 2007 baseline (2016 target: 18 percent).</p>	<ul style="list-style-type: none"> ▪ In FY 2016, BNL’s potable water usage was approximately 417 million gallons—about the same in FY 2015, and near the Laboratory’s record low usage of 412 million gallons in the base year FY 2007. ▪ Annual water use intensity has decreased from 101.2 gallons per square foot to 86.0 gallons per square foot, a 15.0 percent water usage reduction since base year FY 2007. ▪ The Sewage Treatment Plant (STP) modification to recharge treated effluent to groundwater became operational in October 2014. Approximately 80 percent of BNL’s total water usage is recharged/recycled to the source groundwater beneath the site. 	<ul style="list-style-type: none"> ▪ BNL will continue to implement the Laboratory’s Water Management Plan. ▪ BNL will continue to utilize water-efficient processes and plumbing fixtures to conserve water. ▪ Reconstruction of Well House No. 12 (in design, with a planned FY 2020 construction start) and reduction of Water Treatment Plant (WTP) filter back-wash cycles could reduce BNL’s water usage by 3 percent to 5 percent. ▪ It is expected that increased science activities, with their need for accelerator cooling, will increase water consumption due to cooling tower evaporation.
<p>30 percent water consumption (gallons) reduction of industrial, landscaping, and agricultural (ILA) water by FY 2025 from a FY 2010 baseline (2016 target: 12 percent).</p>	<ul style="list-style-type: none"> ▪ No permanent landscaping or agricultural water use. 	<ul style="list-style-type: none"> ▪ n/a
Goal 5: Fleet Management		
<p>30 percent reduction in fleet-wide per mile greenhouse gas emissions reduction by FY 2025 from a FY 2014 baseline (2016 target: 3 percent; 2017 target: 4 percent).</p>	<ul style="list-style-type: none"> ▪ A 41 percent reduction from the FY 2014 baseline; goal was exceeded. 	<ul style="list-style-type: none"> ▪ BNL will continue to replace petroleum-fueled vehicles with alternative fuel vehicles and regularly replace old vehicles with newer, more efficient vehicles.
<p>20 percent reduction in annual petroleum consumption by FY 2015 relative to a FY 2005 baseline; maintain 20 percent reduction thereafter (2016 target: 20 percent).</p>	<ul style="list-style-type: none"> ▪ BNL is meeting this goal and will maintain a minimum of the 20 percent target. 	<ul style="list-style-type: none"> ▪ BNL will continue to replace petroleum-fueled vehicles with alternative fuel vehicles.
<p>10 percent increase in annual alternative fuel consumption by FY 2015 relative to a FY 2005 baseline; maintain 10 percent increase thereafter (2016 target: 10 percent).</p>	<ul style="list-style-type: none"> ▪ This goal was met; 168 percent increase. 	<ul style="list-style-type: none"> ▪ BNL will continue to replace gasoline vehicles with alternative fuel vehicles and look for opportunities for other types of alternative fuels.
<p>75 percent of light duty vehicle acquisitions must consist of alternative fuel vehicles (AFV). (2016 target: 75 percent).</p>	<ul style="list-style-type: none"> ▪ 100 percent of light duty vehicle acquisitions were alternative fuel vehicles. 	<ul style="list-style-type: none"> ▪ BNL will acquire any future vehicles as alternative fuel, whenever possible.
<p>50 percent of passenger vehicle acquisitions consist of zero emission or plug-in hybrid electric vehicles by FY 2025. (2016 target: 4 percent).</p>	<ul style="list-style-type: none"> ▪ No passenger vehicles were acquired as plug-ins or zero emission vehicles (ZEVs). 	<ul style="list-style-type: none"> ▪ BNL will monitor the offerings in the future to see what options are available.

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Table 2-1. BNL Site Sustainability Plan: Status Summary for Fiscal Year 2016.

DOE Goal	BNL Performance Status	BNL Planned Actions and Contributions
Goal 6: Sustainable Acquisition		
Promote sustainable acquisition and procurement to the maximum extent practicable, ensuring BioPreferred and biobased provisions and clauses are included in 95 percent of applicable contracts.	<ul style="list-style-type: none"> • BioPreferred and biobased provisions and clauses are currently included in 95 percent of BNL's applicable contracts. 	<ul style="list-style-type: none"> • BNL's goal is to attain 100 percent compliance with this goal by ensuring that the BioPreferred and biobased provisions and clauses are contained in 100 percent of applicable contracts and will continue to make progress in 2017.
Goal 7: Pollution Prevention and Waste Reduction		
Divert at least 50 percent of non-hazardous solid waste, excluding construction and demolition debris.	<ul style="list-style-type: none"> • BNL achieved its highest recorded recycling/diversion rate at 79 percent. 	<ul style="list-style-type: none"> • BNL will evaluate the viability of diverting its food waste to an off-site composter.
Divert at least 50 percent of construction and demolition materials and debris.	<ul style="list-style-type: none"> • BNL diverts over 95 percent of its construction debris to an on-site borrow pit for future conversion to recycled concrete aggregate (RCA). 	<ul style="list-style-type: none"> • A concrete crusher is scheduled to come on site during the first quarter of 2017 to convert the construction debris to RCA.
Goal 8: Energy Performance Contracts		
Annual targets for performance contracting to be implemented in FY 2017 and annually thereafter as part of the planning of section 14 of EO 13693.	<ul style="list-style-type: none"> • A \$12.8 million UESC Phase I was completed in May 2015. Preliminary audits for additional scope (a potential Phase II) were completed by two independent Energy Service Companies (ESCOs) in FY 2015. • BNL felt it would be prudent to further evaluation/verify the savings from the Phase I effort before making final recommendations on a Phase II. • The first full year of operation of the UESC Phase I project was completed in May 2016. The energy savings were verified to be within 2 percent of the original projections. 	<ul style="list-style-type: none"> • Given the verification of the savings from the UESC Phase I project, BNL will proceed with the development of a UESC Phase II project during FY 2017. • The final scope will be determined in FY 2017 and the process to initiate an Investment Grade Audit in FY 2018 will begin. If economically justified, design and construction is estimated to begin in late 2019.
Goal 9: Electronic Stewardship		
Purchases: 95 percent of eligible acquisitions each year are EPEAT-registered products.	<ul style="list-style-type: none"> • The contract governing the procurement of printers, laptops, and desktop computers ordered through the BNL E-Pro system requires that they have an EPEAT "Gold" certification. 	<ul style="list-style-type: none"> • The Laboratory will continue to require that all printers, laptops, and desktop computers ordered through the E-Pro System have an EPEAT "Gold" certification.
Power management: 100 percent of eligible PCs, laptops, and monitors have power management enabled.	<ul style="list-style-type: none"> • All systems in the BNL domain that are capable of power management have the setting enabled. 	<ul style="list-style-type: none"> • BNL will continue to evaluate the feasibility of extending the desktop computer power management policy to other operating systems.
Automatic duplexing: 100 percent of eligible computers and imaging equipment have automatic duplexing enabled.	<ul style="list-style-type: none"> • BNL has published Managed Printing Guidelines, which recommend the use of network/department-wide printers configured for black ink only and duplex printing. 	<ul style="list-style-type: none"> • The majority of printers and copiers are not centrally managed. BNL will continue to communicate the importance and benefits of duplex printing.
End of Life: 100 percent of used electronics are reused or recycled using environmentally sound disposition options each year.	<ul style="list-style-type: none"> • Electronics are reused on site to the maximum extent possible and are then disposed of through an R2 certified recycler. 	<ul style="list-style-type: none"> • BNL will continue to evaluate methods of increasing computer life spans and to dispose of electronics through an R2 certified recycler.
Data Center Efficiency: establish a Power Usage Effectiveness (PUE) target in the range of 1.2-1.4 for new data centers and less than 1.5 for existing data centers.	<ul style="list-style-type: none"> • BNL recently completed an evaluation of our existing data centers on site in response to the Data Center Optimization Initiative (DCOI). Our internal assessment identified eight data centers that meet the new DCOI criteria; BNL had two data centers based on previous definition. 	<ul style="list-style-type: none"> • Meeting the PUE of 1.5 for the existing data centers will require a significant investment. Four of the eight existing data centers will require installation of new metering. • BNL will work to identify the actions and resources needed to meet the PUE 1.5 requirement for the eight existing data centers and, if cost effective, will begin the process of obtaining potential funding. • BNL will work towards consolidation of existing data centers with a goal of a PUE of 1.5 or less. • The data center associated with the CFR project is in the design phase and it targeting a PUE of 1.2 in accordance to the recent DCOI.

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Table 2-1. BNL Site Sustainability Plan: Status Summary for Fiscal Year 2016. (concluded).

DOE Goal	BNL Performance Status	BNL Planned Actions and Contributions
Goal 10: Climate Change Resilience		
Update policies to incentivize planning for, and addressing the impacts of climate change.	<ul style="list-style-type: none"> BNL policies are updated as required to address the impacts of climate change. 	<ul style="list-style-type: none"> Efforts in this area will continue in FY 2017. A team will be chartered in FY 2017 to review the DOE Guidance, assess the site to determine any risks from climate change, and perform a more detailed vulnerability assessment of the site if it is determined to have significant risks associated with climate change.
Update emergency response procedures and protocols to account for projected climate change, including extreme weather events.	<ul style="list-style-type: none"> All Office of Emergency Management (OEM) plans and procedures were reviewed and updated in FY 2016, as required by DOE Order 151.1C. In FY 2016, OEM provided preparedness and operational planning to deal with severe weather events. BNL OEM implemented the Severe Weather Plan for four major events. 	<ul style="list-style-type: none"> All OEM plans and procedures will be reviewed or updated on an annual basis, as required by DOE Order 151.1C. OEM will conduct an FY 2017 annual exercise. This exercise will be a severe event, beyond design basis (hurricane) site-wide exercise that is required by DOE Order 151.1C, and will be conducted once every five years. For FY 2017, OEM will incorporate the new DOE Order 151.1C into plans and procedures, which includes changing the Hazard Materials Program to incorporate all hazards.
Ensure workforce protocols and policies reflect projected human health and safety impacts of climate change.	<ul style="list-style-type: none"> The Laboratory has a number of workforce policies and programs in place that reflect our understanding of climate change and its projected impact on human health and safety; in particular, severe weather events. 	<ul style="list-style-type: none"> The Laboratory will continue to evaluate its workforce policies and programs in light of our understanding of climate changes and its projected impact on human health and safety. Specifically, the Laboratory will continue to contemplate how to utilize the Flexible Work Arrangements Program as a tool in showing efforts to reduce the carbon footprint. In addition, the Laboratory will be adding more mechanisms for recognizing and rewarding employees who demonstrate the Laboratory Value of Environmental stewardship.
Ensure Laboratory management demonstrate commitment to adaptation efforts through internal communications and policies.	<ul style="list-style-type: none"> During FY 2016, there was increased communication regarding green purchasing, green cleaning procedures, networked printing, Laboratory's use of leased alternative fuel vehicles, and other sustainable practices. Web articles were generated on the OS1 cleaning methodology, Earth Day, ride sharing, and the 2016 DOE Sustainability Award, in addition to the Sustainable Brookhaven website. 	<ul style="list-style-type: none"> BNL will support Version 2.0 of the Site Sustainability website with promotion via the Monday Memo, internal home page, newsletters, main gate sign, and posters. We will also promote Earth Day, other sustainability efforts, and feature sustainability through "My Voice Was Heard" video and poster series. Features on sustainability are planned for the Laboratory's 70th/Camp Upton 100th anniversary. BNL will work with the Environment, Safety and Health Directorate to effectively deliver sustainability messages on housekeeping best practices, recycling, and other relevant topics.
Ensure that Laboratory climate adaptation and resilience policies and programs reflect best available current climate change science, updated as necessary.	<ul style="list-style-type: none"> BNL has an active research program in climate change and capabilities to measure meteorological conditions on site. BNL has made investments to build up a regional climate modeling capability that will be able to inform management on how climate-associated risks may change in the future. 	<ul style="list-style-type: none"> BNL will maintain active research programs in climate change science. BNL will operate the on-site meteorological station and publish data and an annual report. BNL will continue LDRD-funded efforts to build regional climate modeling capability. BNL will hire new joint appointments with expertise in regional climate modeling.

programs to which BNL subscribes, and a thorough discussion of these programs and their status.)

2.3.4.2 Groundwater Protection

BNL's Groundwater Protection Program is designed to prevent negative impacts to

groundwater and to restore groundwater quality by integrating pollution prevention efforts, monitoring, groundwater restoration projects, and communicating performance. The Laboratory has developed a Groundwater Protection Contingency Plan that defines an orderly process for quickly verifying the results and

taking corrective actions in response to unexpected monitoring results (BNL 2013c). Key elements of the groundwater program are full, timely disclosure of any off-normal occurrences, and regular communication on the performance of the program. Chapter 7 and SER Volume II, *Groundwater Status Report*, provide additional details about this program, its performance, and monitoring results for 2016.

2.3.4.3 Waste Management

As a byproduct of the world-class research conducted, BNL generates a wide range of wastes. These wastes include materials common to many businesses and industries, such as office wastes (e.g., paper, plastic, etc.), aerosol cans, batteries, paints, and oils. However, the Laboratory’s unique scientific activities also generate “specialized” waste streams that are subject to additional regulation and special handling, including radioactive, hazardous, and mixed waste. BNL’s Waste Management Facility (WMF), operated by the Environmental Protection Division (EPD), is responsible for collecting, storing, transporting, and managing the disposal of these specialized wastes. This modern facility was designed for handling hazardous, industrial, radioactive, and mixed waste and is comprised of two staging areas: a facility for hazardous waste and mixed waste (both hazardous and radioactive) in Building 855,

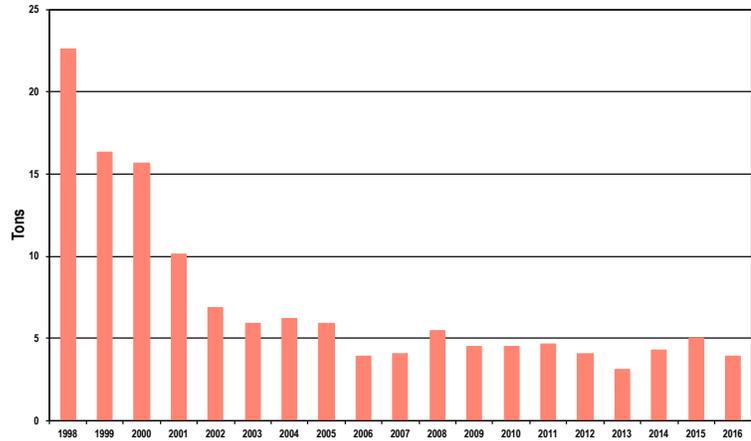


Figure 2-1a. Hazardous Waste Generation from Routine Operations, 1998 – 2016.

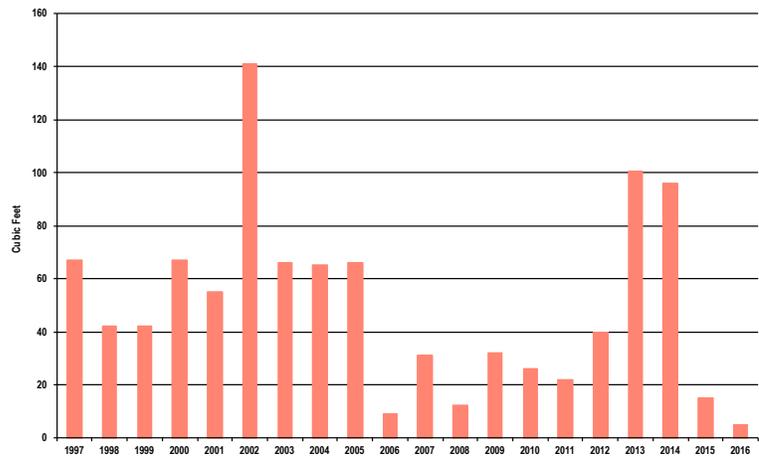


Figure 2-1b. Mixed Waste Generation from Routine Operations, 1998 – 2016.

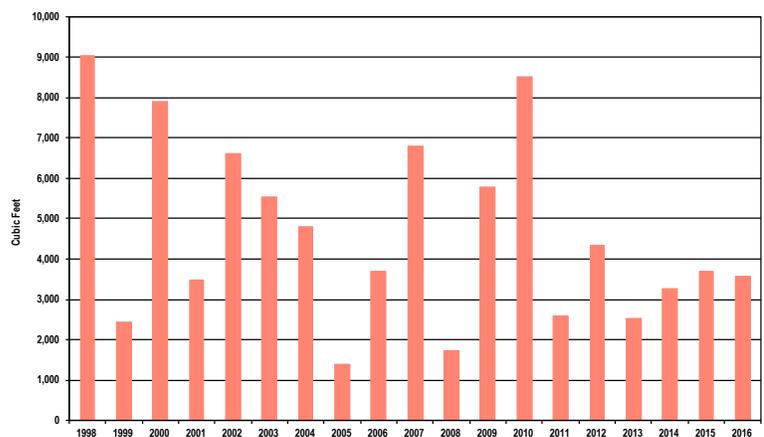


Figure 2-1c. Radioactive Waste Generation from Routine Operations, 1998 – 2016.

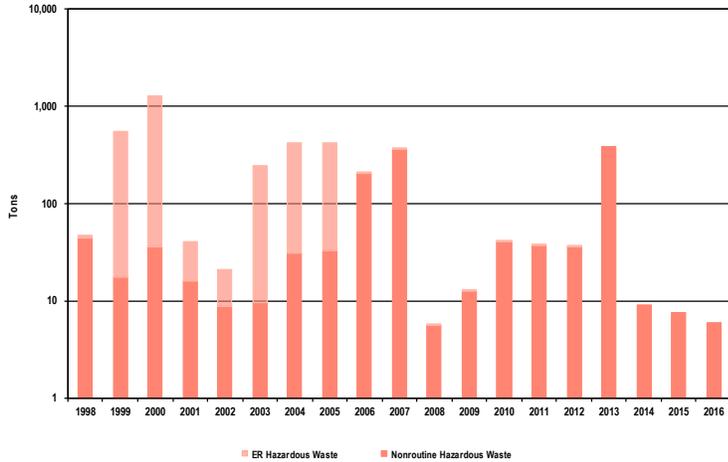


Figure 2-1d. Hazardous Waste Generation from ER and Nonroutine Operations, 1998 – 2016.

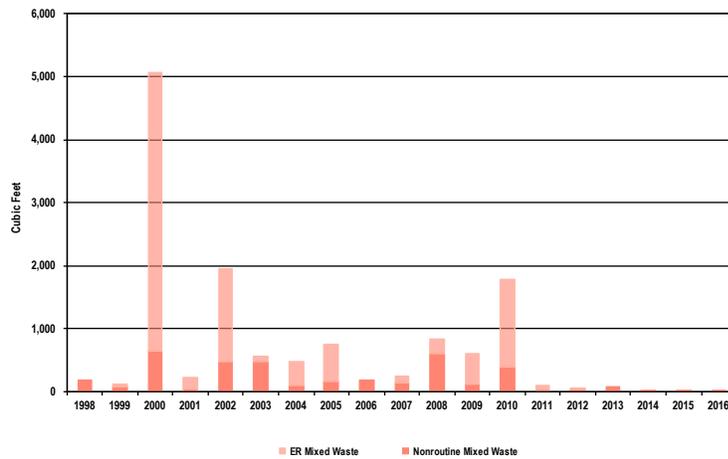


Figure 2-1e. Mixed Waste Generation from ER and Nonroutine Operations, 1998 – 2016.

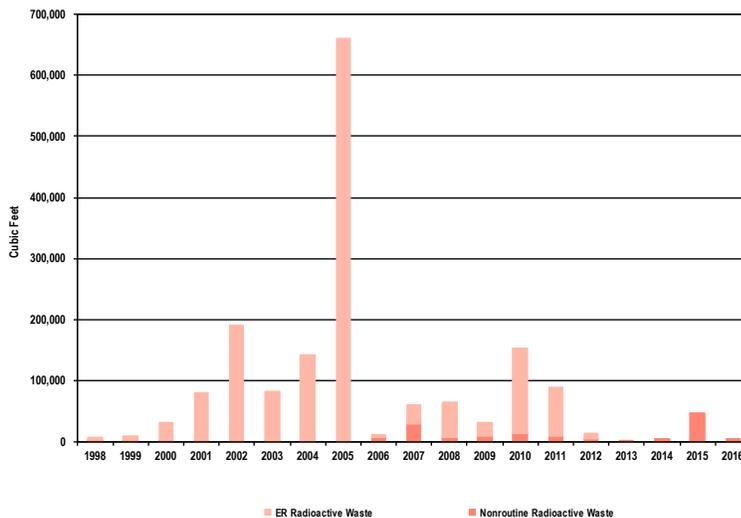


Figure 2-1f. Radioactive Waste Generation from ER and Nonroutine Operations, 1998 – 2016.

regulated by RCRA, and a reclamation building for radioactive material in Building 865. The RCRA building is managed under a permit issued by the New York State Department of Environmental Conservation (NYSDEC). These buildings are used for short-term storage of waste before it is packaged or consolidated for off-site shipment to permitted treatment and disposal facilities. In 2016, BNL generated the following types and quantities of waste from routine operations:

- Hazardous waste: 3.9 tons
- Mixed waste: 5 ft³
- Radioactive waste: 3,562 ft³

Hazardous waste from routine operations in 2016 decreased from 2015 generation rates, as shown in Figure 2-1a. This was not attributed to any one source, but rather due to small decreases in generation throughout the Laboratory. Mixed waste generation decreased from 2015 rates, as shown in Figure 2-1b. This is mainly due to fluctuations in operations at BNL’s accelerator facilities. As shown in Figure 2-1c, the radioactive waste quantity for routine operations decreased slightly from 2015 rates, which is also primarily attributed to fluctuations in operations at BNL’s accelerator facilities. Routine operations are defined as ongoing industrial and experimental operations. Wastes generated by remediation projects, facility decommissioning activities, or one-time events (e.g., lab cleanouts) are considered non-routine.

In 2016, BNL continued to reduce the inventory of legacy waste materials through laboratory cleanouts. Wastes from facility decommissioning activities were primarily from the demolition of BNL's former Waste Concentration Facility and equipment from the former Cyclotron in Building 901. Other non-routine wastes included the disposal of lead-contaminated debris, lead shielding, and polychlorinated biphenyl (PCB) wastes. Figures 2-1d through 2-1f show waste generated from non-routine operations. Waste generation from these activities has varied significantly from year to year. This is expected, as various decommissioning and remedial actions are conducted.

2.3.4.4 *Pollution Prevention and Waste Minimization*

The BNL Pollution Prevention (P2) Program reflects national and DOE pollution prevention goals and policies, and represents an ongoing effort to make pollution prevention and waste minimization an integral part of BNL's operating philosophy.

Pollution prevention and waste reduction goals have been incorporated into the DOE contract with BSA, into BNL's ESSH Policy, the Performance Evaluation Management Plan associated with the Laboratory's operating contract with DOE, and BNL's SSP. Key elements of the P2 Program include:

- Eliminate or reduce emissions, effluents, and waste at the source where possible, and ensure that they are "as low as reasonably achievable"
- Procure environmentally preferable products (known as "affirmative procurement")
- Conserve natural resources and energy
- Reuse and recycle materials
- Achieve or exceed BNL/ DOE waste minimization, P2, recycling, and affirmative procurement goals
- Comply with applicable requirements (e.g., New York State Hazardous Waste Reduction Goal, Executive Orders, etc.)
- Reduce waste management costs
- Implement P2 projects
- Improve employee and community awareness of P2 goals, plans, and progress

The BNL P2 and recycling programs have achieved reductions in waste generated by routine operations, as shown in Figures 2-1a through 2-1c. This continues a positive trend, and is further evidence that pollution prevention planning is well integrated into the Laboratory's work planning process. These positive trends are also driven by the EMS emphasis on preventing pollution and establishing objectives and targets to reduce environmental impacts. Table 2-2 describes the P2 projects implemented through 2016, and provides the number of pounds of materials reduced, reused, or recycled, as well as the estimated cost benefit of each project.

The implementation of pollution prevention opportunities, recycling programs, and conservation initiatives has reduced both waste volumes and management costs. In 2016, these efforts resulted in more than \$1.6 million in cost avoidance or savings and approximately 7.9 million pounds of materials being reduced, recycled, or reused annually.

The Laboratory has an active and successful solid waste recycling program, which involves all employees. In 2016, BNL collected approximately 426 tons of scrap metal for recycling. Cardboard, office paper, bottles and cans, construction debris, motor oil, lead, automotive batteries, electronic scrap, fluorescent light bulbs, and drill press/machining coolant were also recycled. Table 2-3 shows the total number of tons (or units) of the materials recycled. The baseline recycling rate goal for federal facilities is 50 percent; since year 2000, BNL's annual average recycling rate has consistently ranged above this baseline. The 2016 annual recycling rate reached 74 percent.

During 2016, BNL's sustainability program was honored by receiving three Environmental Awards:

- US EPA's Northeast Regional Federal Green Challenge Leadership Award for the NSLS-I Decommissioning Project. The planning process for the decommissioning of this facility resulted in significant amounts of materials to be reused, repurposed, or recycled, resulting in a minimum amount of waste. The process saved taxpayers millions of

Table 2-2. BNL Pollution Prevention, Waste Reduction, and Recycling Programs.

Waste Description	Type of Project	Pounds Reduced, Reused, Recycled or Conserved in 2016	Waste Type	Potential Costs for Treatment and Disposal	Cost of Recycle, Prevention	Estimated Cost Savings	Project Description Details
Building 535 Basement Cleanout	Equipment Reuse	N/A	Industrial Waste	\$0	\$0	\$195,000	National Synchrotron Light Source II spare and used equipment was repurposed within other divisions and all salvaged metal was recycled.
Building 729 Cleanout	Equipment Reuse	N/A	Industrial Waste	\$0	\$0	\$79,930	The NISUS undulator was disassembled and parts were repurposed within other divisions and all salvaged metal was recycled.
Building 452 Oil Skimmer	Source Reduction	2,400	Industrial Waste	\$2,800	\$650	\$2,150	Reduces oily-water waste stream (non-halogenated oil) from air compressors by skimming off oil and leaves water phase. Water may be discharged to sanitary system.
Lift Station/ Stormwater Sump Wet Vacuum	Source Reduction	420	Industrial Waste	\$5,820	\$750	\$5,070	Allowings personnel to remove stormwater from tank sumps and tank berms.
Propane Cylinder Recycling System	Recycling	50	Hazardous Waste	\$2,000	\$850	\$1,150	With an approved de-valving system, the empty canisters can be properly de-valved and disposed of as scrap metal.
Electronic Reuse	Reuse	33,644	Electronic Waste	\$84,110	\$0	\$84,110	The Laboratory tracks electronic equipment and takes a reuse credit for transfer of equipment to another user.
Building Demolition Recycling	Recycling	6,000,000	Industrial Waste	\$264,510	\$0	\$264,510	On-site demolition products (steel and concrete) are segregated, recycled, and reused.
Animal Bedding Conveying System	Composting	11,400	Low-level Radiological Waste	\$112,860	\$0	\$112,860	Animal bedding material is no longer sent to sanitary sewer; it is now conveyed to a dumpster that is emptied and composted at the stump dump. The sanitary sludge was previously sent out as low-level radioactive waste.
Lead Acid Batteries	Recycled	1,720	Universal Waste	\$4,300	\$0	\$4,300	Avoids hazardous waste disposal costs for lead and sulfuric acid.
Cooling Tower Chemicals	Source Reduction	6,000	Industrial Waste	\$12,000	\$0	\$12,000	Ozone water treatment units were installed on cooling towers at the National Space Radiation Laboratory (Building 957), the Special Ejection Magnet (Building 912A) and the Relativistic Heavy Ion Collider Research Facility (Building 1004) for 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.

(continued on next page)

Table 2-2. BNL Pollution Prevention, Waste Reduction, and Recycling Programs.

Waste Description	Type of Project	Pounds Reduced, Reused, Recycled or Conserved in 2016	Waste Type	Potential Costs for Treatment and Disposal	Cost of Recycle, Prevention	Estimated Cost Savings	Project Description Details
Blasocut Machining Coolant	Recycled/ Reused	21,840	Industrial Waste	\$49,470	\$0	\$54,270	Central Shops Division operates a recycling system that recclaims Blasocut machining coolant and supplies it Laboratory-wide. In 2015, 2,550gal (20,400 lb) of Blasocut lubricant were recycled. Recycling involves aeration, centrifuge, and filtration. This avoids cost of disposal as industrial waste and an avoided cost of buying 6 drums of concentrate (\$800/drum) and 51 empty drums for shipping (\$50/drum).
Fluorescent Bulbs	Recycled	9,604	Universal Waste	\$489,804	\$15,000	\$474,804	Fluorescent bulbs are collected as sent to a recycling facility under the Universal Waste exemption rule.
Used Motor Oil	Energy Recovery	21,840	Industrial Waste	\$47,987	\$0	\$47,987	Used motor oil from the motor pool and the on-site gas station is given to Strebels Laundry Service to fire their boilers. In 2016, they collected 2,350 gallons of oil at no charge to BNL, which avoided the costs for disposal and 47 shipping drums (\$50/drum).
Office Paper	Recycled	177,020	Industrial Waste	\$9,294	\$0	\$11,506	Cost avoidance based on \$105/ton for disposal as trash, plus \$25/ton.
Cardboard	Recycled	145,020	Industrial Waste	\$7,614	\$0	\$10,514	Cost avoidance based on \$105/ton for disposal as trash, plus \$40/ton.
Electronic Waste	Recycled	47,780	Electronic Waste	\$119,450	\$0	\$138,562	Cost avoidance based on \$105/ton for disposal as trash, plus \$800/ton revenue.
Metals	Recycled	851,470	Industrial Waste	\$44,702	\$0	\$95,790	Cost avoidance based on \$105/ton for disposal as trash, plus \$120/ton revenue.
Bottles/Cans	Recycled	22,100	Industrial Waste	\$1,160	\$0	\$1,160	Cost avoidance based on \$105/ton for disposal as trash.
Construction Debris	Recycled	531,820	Industrial Waste	\$27,921	\$0	\$41,748	Cost avoidance based on \$52/ton difference for disposal as trash.
TOTALS		7,884,128		\$1,285,801	\$17,250	\$1,637,422	

Table 2-3. BNL Recycled Program Summary, 2000-2016.

Recycled Waste *	2000	2001	2002	2003	2004	2005	2006	2007	2008	2009	2010	2011	2012	2013	2014	2015	2016
Mixed paper	336	246	209	182	185	193	184	177	151	127	174	186	142	160	150	91	89
Cardboard	132	127	157	176	179	143	135	121	147	152	141	126	100	97	78	12.4	73
Bottles/Cans	19.5	29.3	19	23	22	22.1	27.7	24.4	19.6	23.7	24	22.5	18	16.5	17.1	22.1	11
Tires	0	0	3.5	12.3	11	12.8	32.5	19.9	34.5	15.5	10.1	9.2	10	7.1	7.6	5.4	6.4
Construction debris	243	289	304	334	367	350	297	287	302	312	416	256	380	304	351	372	266
Used motor oil (gallons)	3,296	3,335	1,920	3,920	3,860	4,590	2,780	2,020	1,500	1,568	1,700	1,145	1,585	1,550	2,000	1,320	2,730
Metals	534	44	48	193	128	559	158	382	460	91	131	84	278	174	256	737	426
Automotive batteries	2.2	4.8	6.3	4.6	5	4.6	5.5	2.5	2.7	4	1.6	2.1	2	2.1	1.4	1.9	1.4
Printer/Toner cartridges (units)	n/a	363	449	187	105	0	0	0	3,078	1,251	4,132	4,186	4,100	11,233	2,174	2,037	n/a
Fluorescent bulbs (units)	5,874	17,112	25,067	13,611	12,592	7,930	11,740	25,448	36,741	10,223	8,839	20,220	15,727	13,540	19,807	15,956	9,604
Blasocut coolant (gallons)	n/a	n/a	8,180	5,030	6,450	3,890	3,970	2,432	3,340	3,810	4,830	5,660	5,610	5,650	4,850	2,550	2,350
Antifreeze (gallons)	n/a	n/a	0	165	325	0	0	0	0	0	0	0	700	822	0	0	0
Tritium exit signs (each)	n/a	n/a	28	181	142	0	0	0	0	0	0	18	0	0	0	0	0
Smoke detectors (each)	n/a	n/a	40	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Road base	n/a	n/a	2,016	0	2,666	0	0	0	0	0	0	0	0	0	0	0	0
Electronic reuse	n/a	n/a	0	0	0	0	0	0	16.3	11.4	12	11.6	3.2	1.4	10.5	25	17
Scrap electronics	n/a	n/a	0	0	0	6.1	70.3	40.5	48.9	17	16.7	19.9	30.9	23	29.3	42	24
Animal Bedding (composted)	n/a	n/a	0	0	0	0	6.3	19.6	42	41	52	54	3.3	30	10	15	11
Tyvek (lbs)	n/a	n/a	0	0	0	0	0	0	0	84	60	92	105	0	0	0	0
Recycling Rate (%)	65	54	57	60	61	63	62	64	68	59	63	59	63	76	58	77	74
Demolition Projects																	
Metals	n/a	n/a	8	23	11	6	35	0	0	0	0	0	60	90	0	0	0
Concrete	n/a	n/a	891	590	3,000	328	5,505	6,175	0	0	4,050	0	4,050	3,500	4,000	0	4,200
Construction and debris	n/a	n/a	790	388	1,200	157	818	0	0	0	0	0	0	0	0	0	0

Notes: All units are tons, except where noted.

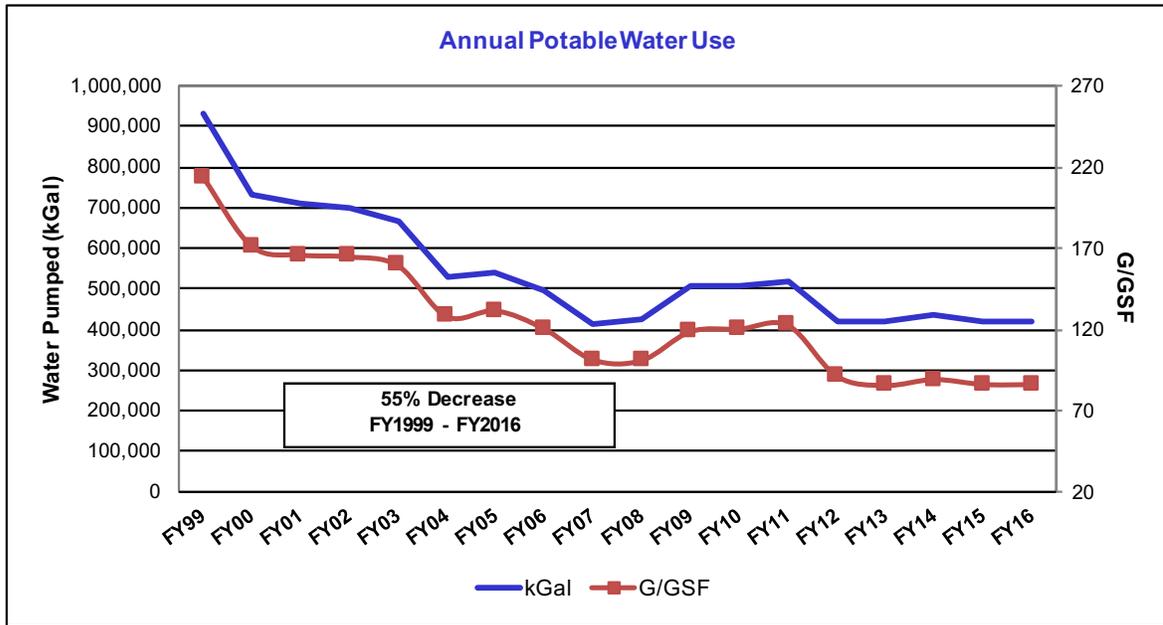


Figure 2-2. Annual Potable Water Use, 1999-2016.

dollars and the work was carefully planned and without injury and with full respect for the environment.

- US DOE’s Gold Level Green Buy Award for voluntarily purchasing “greener products” that reduce environmental impacts. This award acknowledges the efforts of Laboratory divisions (such as Staff Services, Grounds, Custodial Services, and the Modernization Project Office) that make sustainable product purchasing decisions.
- The Green Electronics Council’s EPEAT (Electronic Product Environmental Assessment Tool) Award for purchasing EPEAT-registered electronic products which meet strict environmental criteria that address the full product lifecycle, from energy conservation to toxic materials to product longevity and end-of-life management.

2.3.4.5 Water Conservation

BNL’s water conservation program has achieved dramatic reductions in water use since the mid 1990’s. The Laboratory continually 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 (HVAC) systems, and

reuse of once-through cooling water for other systems, such as cooling towers. Treated (near drinking water quality) effluent from BNL’s Sewage Treatment Plant (STP) is recharged (recycled) back to the aquifer, returning well over 100 million gallons per year. Through an annual maintenance program, conventional plumbing fixtures are replaced with modern low flow devices.

The Laboratory’s goal is to reduce the consumption of water and reduce the possible impact of clean water dilution on STP operations. Figure 2-2 shows the 18-year trend of water consumption. Total water consumption in 2016 was essentially the same as 2015. However, the water intensity (gallon/square foot) was slightly less. In each of the past ten years, the water consumption total was approximately half the 1999 total—a reduction of nearly a half billion gallons per year.

2.3.4.6 Energy Management and Conservation

Since 1979, the Laboratory’s Energy Management Group has been working to reduce energy use and costs by identifying and implementing cost-effective, energy-efficient projects; monitoring energy use and utility bills; and assisting in obtaining the least expensive energy sources possible. The group is responsible for

developing, implementing, and coordinating BNL's energy management efforts and assisting DOE in meeting the energy and sustainability goals in EO 13693, DOE Order 436.1, and the Secretary's initiatives. The Laboratory's SSP addresses all aspects of the DOE energy, water, transportation, and other sustainability goals.

BNL has more than 4.9 million square feet of building space. Many scientific experiments at the Laboratory use particle beams generated and accelerated by electricity, with the particles controlled and aligned by large electromagnets. In 2016, BNL used approximately 269 million kilowatt hours (kWh) of electricity, 669,000 gallons of fuel oil, 14,476 gallons of propane, and 460 million ft³ of natural gas. Fuel oil and natural gas produce steam at the Central Steam Facility (CSF). Responding to market conditions, fuel oil and natural gas is historically used whenever each respective fuel is least expensive. In 2016, there was a need to remove oil from one of the storage tanks; it was used to fire the boilers at the CSF until it was entirely consumed. This resulted in increasing the Laboratory's oil consumption and lowering the use of natural gas during that period. Given the price disparity between natural gas and oil, the Laboratory will continue to purchase natural gas over oil, further reducing GHG emissions. Additional information on natural gas and fuel oil use can be found in Chapter 4.

BNL continues to participate in available electric load reduction curtailment programs. Through this program, the Laboratory has agreed to reduce electrical demand during critical days throughout the summer when New York Independent System Operator (NYISO) expects customer demand to meet or exceed the available supply. In return, BNL sometimes receives a rebate for each megawatt reduced on each curtailment day. The Laboratory strives to keep electric loads at a minimum during the summer by scheduling operations at the Relativistic Heavy Ion Collider (RHIC) to avoid peak demand periods. In 2016, this scheduling reduced the electric demand by 25 MW, saving approximately \$1.2 million in electric demand costs and helping to maintain the reliability of the Long Island Power Authority (LIPA) electric

system to meet all of its users' needs. BNL also maintains a contract with the New York Power Authority (NYPA) that resulted in an overall cost avoidance of \$29.2 million in 2016. In addition, BNL's energy supply includes approximately 120 million kWh of clean, renewable energy credits (RECs) received through the Long Island Solar Farm (LISF) and purchased 49 million kWh of RECs for 2016. The Laboratory will continue to seek alternative energy sources to meet its future energy needs, support federally required "green" initiatives, and reduce energy costs.

In 2011, BP Solar completed construction of the LISF on BNL property. The array is currently the largest solar photovoltaic (PV) array (32 MW) in the Northeast and spans 195 acres with more than 164,000 panels. BNL worked extensively with LIPA, BP Solar, the State of New York, and other organizations to evaluate the site and develop the project with LIPA purchasing the output through a 20-year Power Purchase Contract. The estimated annual output of 44 million kWh results in an avoidance of approximately 31,000 tons of carbon per year over its 30- to 40-year life span. The actual output for the first five operational years was an average of 52.2 million kWh/year, substantially above the estimated annual average value of 44 million kWh/year. As an outcome of constructing this large array on site, the Laboratory has developed a solar research program that looks at impacts of climate change on large utility-scale PV systems, as well as research and development for solar power storage and inverter efficiencies. The Federal Energy Management Program (FEMP) recognizes the importance of the efforts of BNL and the DOE Brookhaven Site Office to host the LISF, and provides credit toward BNL's SSP renewable energy goal.

In May 2014, the Laboratory completed the installation of the first phase of the 1 MW solar PV array as part of the Northeast Solar Energy Research Center (NSERC). In 2016, the array was increased to 816 kW with substantial funding assistance from the Sustainability Performance Office (SPO), and the NSERC generated approximately 553,715 kWh of electricity. To reduce energy use and costs at non-research

facilities, several additional activities were continued or undertaken by the BNL Energy Management Group in 2016:

- *NYPA Power Contract*: Fourth full year of a ten-year contract that includes 15 MW of renewable (nearly zero GHG) hydropower. This contract saved \$29.2 million in 2016.
 - *DOE Sustainability Initiative*: The Energy Management Group continues to provide substantial support to the Federal/DOE-wide Sustainability Initiative, and has created a BNL Sustainability Leadership Team. The team has developed a formal site-wide sustainability program beyond DOE requirements, participates in one of three subcommittees for DOE on sustainability initiatives, and provides numerous evaluations and estimates on energy use, GHG, renewable energy, and energy-efficiency options.
 - *Substantial Progress on Several Initiatives included in BNL's annual SSP*: New electric and steam meter installations; funding for energy conservation initiatives; new energy efficient lighting installed in parking lots and offices; the purchase of RECs in meeting BNL's SSP goal; and training various parties on energy conservation initiatives.
 - *Utility Energy Services Contract (UESC)*: A UESC contract/project was completed in 2015 with National Grid that installed energy-efficient lighting, new building controls, and an energy-efficient water chiller. The environmental benefits of this UESC were estimated to include: electrical savings of 3,549,114 kWh/year, fuel savings of 89,541 mmBtu/year, a GHG reduction of 7,022 MTCO_{2e}, and a building energy intensity reduction of 11 percent. To date, actual energy savings meet or exceed the original estimates. Through a comprehensive Measurement and Verification (M&V) process, BNL was able to verify that actual energy savings were within a few percent of the original projections.
 - *Energy Conservation*: Energy and water evaluations are completed for 25 percent of the site each year. Cost-effective projects are identified and proposed for funding, as appropriate.
 - *High Performance Sustainability Buildings (HPSB)*: Substantial completion of various energy and water conservation projects to achieve compliance in the EPA Portfolio Manager program. BNL is currently on target to meet or exceed the HPSB goal.
 - *Renewable Energy*: Continued project support for the LISF and NSERC facilities, and annual purchases of REC's to meet targeted goals.
 - *Central Chilled Water Facility (CCWF) Phase-II*: The CCWF Phase-II project, which included the installation of two new chillers and three additional chiller bays for future loads, was completed in 2011. Since that time, three additional chillers were installed, including one in 2015 through the UESC project. Chilled water is provided to BNL buildings and processes, such as the NSLS-II and the data center, using modern energy-efficient chillers. The CCWF also utilizes a 3.2 million gallon chilled water storage tank that is used to reduce peak electric demand by producing and storing chilled water during the night.
 - *Natural Gas Purchase Contract*: BNL is currently saving approximately \$4 million per year using natural gas compared to oil.
 - *Energy Savings*: As mentioned above, 25 MW of demand is rescheduled each year to avoid coinciding with the utility summer peak, saving over \$1.2 million in electricity charges. In addition, work continues in the replacement of aging, inefficient T-40 fluorescent lighting fixtures with new, high efficiency T-8 lighting fixtures. Typically, 200 to 300 fixtures are replaced annually, saving tens of thousands of kWhs each year and reducing costs by several thousand dollars. Due to continued conservation efforts, overall facilities energy usage for 2016 was approximately 33 percent less than in 2003, producing annual savings of \$3 million.
- The National Energy Conservation Policy Act, as amended by the Federal Energy Management Improvement Act of 1988 and the Energy Policy Acts of 1992 and 2005, as well as the Energy Independence and Security Act (EISA) of 2007, requires federal agencies to apply energy conservation measures and to improve federal

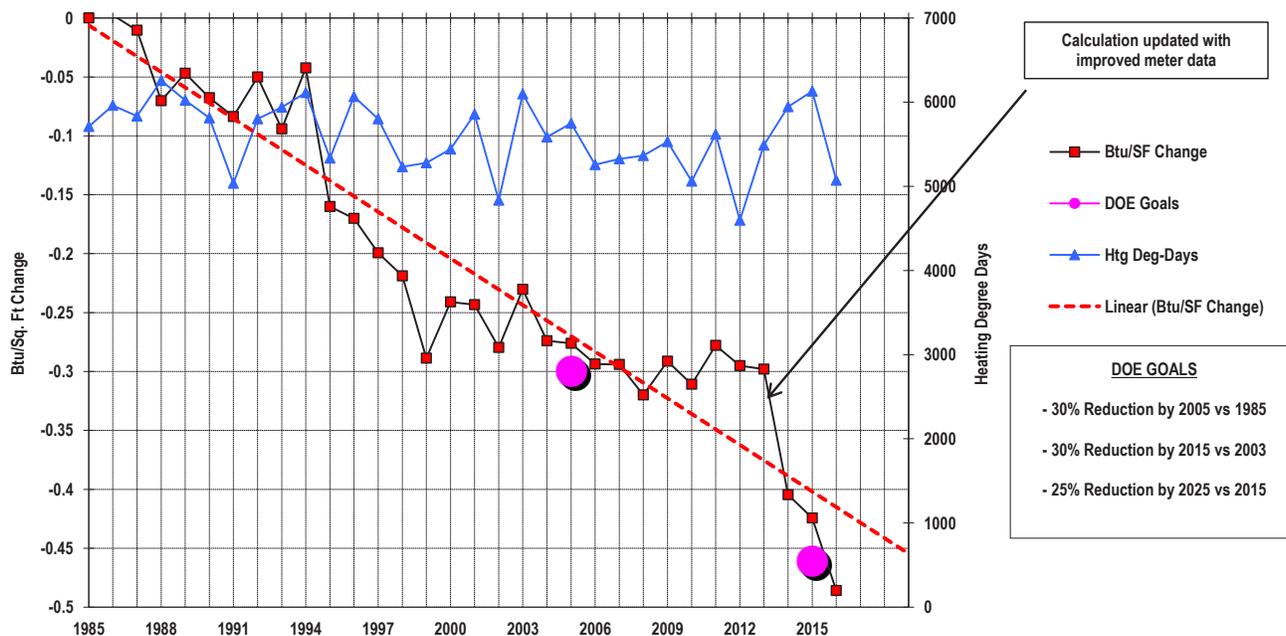


Figure 2-3. BNL Building Energy Performance for 2016 (Btu/SF Change Percent vs. Baseline Years).

building design to reduce energy consumption per square foot. Current goals included with EO 13693 are to reduce energy consumption per square foot, relative to 2015, by 25 percent by the year 2025. As shown in Figure 2-3, BNL’s energy use per square foot in 2016 was 33 percent less than in FY 2003. It is important to note that energy use for most buildings and facilities at the Laboratory is largely weather dependent.

2.3.4.7 *Natural and Cultural Resource Management Programs*

Through its Natural Resource Management Plan (BNL 2016), BNL continues to enhance its Natural Resource Management Program in cooperation with the Foundation for Ecological Research in the Northeast (FERN) and the Upton Ecological and Research Reserve. The Laboratory also continues to enhance its Cultural Resource Management Program. A BNL Cultural Resource Management Plan (BNL

2013a) was developed to identify and manage properties that are determined to be eligible or potentially eligible for inclusion on the National Register of Historic Places. See Chapter 6 for further information about these programs.

2.3.4.8 *Environmental Restoration*

The Comprehensive Environmental Response, Compensation and Liability Act (CERCLA), commonly known as Superfund, was enacted by Congress in 1980. As part of CERCLA, EPA established the National Priorities List, which identifies sites where cleanup of past contamination is required. BNL was placed on the list with 27 other Long Island sites, 12 of which are in Suffolk County. Each step of the CERCLA cleanup process is reviewed and approved by DOE, EPA, and NYSDEC, under an Interagency Agreement (IAG). This agreement was formalized in 1992. Although not a formal signatory of the IAG, the Suffolk County

Department of Health Services (SCDHS) also plays a key role in the review process. Most of the contamination at the Laboratory 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 identify and evaluate remedial action alternatives and present the proposed alternative
- Issue a Record of Decision (ROD), which is

the remedy/corrective action agreed to by DOE, EPA, and NYSDEC

- Perform the Remedial Design/Remedial Action, which includes final design, construction specifications, and carrying out the remedy selected

In 2016, BNL’s 11 active groundwater treatment systems removed approximately 63 pounds of volatile organic compounds (VOCs) and 0.8 mCi of strontium-90 (Sr-90), and returned 0.9 billion gallons of treated water to the sole source aquifer. The Building 452 Freon-11 Treatment System was shut down and placed in an operationally-ready stand-by mode, and 16 temporary wells were installed to better define

Table 2-4. Summary of BNL 2016 Environmental Restoration Activities.

Project	Description	Environmental Restoration Actions
Soil Projects	Operable Unit (OU) II/III/VI	<ul style="list-style-type: none"> ▪ Performed monitoring and maintenance of institutional controls for cleanup areas.
Groundwater Projects	OU III/VI	<ul style="list-style-type: none"> ▪ Continued operation of nine groundwater treatment systems that remove volatile organic compounds (VOCs), and two systems that remove strontium-90 (Sr-90). ▪ 63 pounds of VOCs and 0.8 mCi of Sr-90 were removed during the treatment of 0.9 billion gallons of groundwater. Since the first groundwater treatment system started operating in December 1996, approximately 7,455 pounds of VOCs and 32 mCi of Sr-90 have been removed, while treating approximately 26 billion gallons of groundwater. ▪ Collected and analyzed approximately 1,460 sets of groundwater samples from 547 monitoring wells. ▪ Installed 34 temporary wells and collected multiple samples from each location.
Peconic River	OU V	<ul style="list-style-type: none"> ▪ Procurement activities were initiated for clean-up in 2017 of mercury-contaminated sediment in a small area on BNL property.
Reactors	Brookhaven Graphite Research Reactor (BGRR)	<ul style="list-style-type: none"> ▪ Continued long-term surveillance and maintenance, including abatement of asbestos paint on the side of the below ground duct doghouses, re-sealing of the engineered asphalt cap (performed every five years), and replacement of the below ground duct entry door.
	High Flux Beam Reactor (HFBR)	<ul style="list-style-type: none"> ▪ Continued long-term surveillance and maintenance, including removal of asbestos-containing material on the experimental level floor.
	Stack (Building 705)	<ul style="list-style-type: none"> ▪ Continued long-term surveillance and maintenance, including pump-out of the stack drain tank, collection and disposal of stack paint chips on the grounds, and preparing for minor repairs and maintenance of the aviation lights on the stack.
	Brookhaven Medical Research Reactor (BMRR)	<ul style="list-style-type: none"> ▪ Continued surveillance and maintenance activities.
Buildings 810/811	Radiological Liquid Processing Facility	<ul style="list-style-type: none"> ▪ Demolished Buildings 810 and 811. Removed contaminated soil and concrete.
Building 801	Inactive Radiological Liquid Holdup Facility	<ul style="list-style-type: none"> ▪ Performed routine surveillance and maintenance of the facility.
Building 650	Inactive Radiological Decon Facility	<ul style="list-style-type: none"> ▪ Performed routine surveillance and maintenance of the facility.

VOC concentrations in the on-site portion of the Western South Boundary plume. Following a 2016 request from NYSDEC, a one-time sampling event for the solvent stabilizing compound 1,4-dioxane was conducted in January 2017 at 22 on- and off site monitoring wells. Although 1,4-dioxane was detected in 17 of the 22 wells, all concentrations were below the current NYS standard of 50 µg/L for unspecified organic contaminants. Also in 2016, long-term surveillance and maintenance (S&M) of the BGRR and the HFBR continued. In accordance with the ROD, demolition of the HFBR stack will be completed by the end of fiscal year 2020. Also in 2016, procurement activities were initiated to select a contractor to clean up mercury-contaminated sediment in a small area on BNL property. The excavation work will be performed in the summer of 2017.

The groundwater systems operate in accordance with the Operations and Maintenance (O&M) manuals, while the Peconic and surface soil cleanup areas are monitored via the Soil and Peconic River Surveillance and Maintenance (S&M) Plan (BNL 2013c). Institutional controls are also monitored and maintained for the cleanup areas in accordance with the RODs to help ensure the remedies remain protective of human health and the environment. An annual evaluation of these controls is submitted to the regulators.

Table 2-4 provides a description of each Operable Unit (OU), and a summary of environmental restoration actions taken. See Chapter 7 and SER Volume II, *Groundwater Status Report*, for further details.

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. Supervisors are required to work with their employees to develop and document Roles, Responsibilities, Accountabilities, and Authorities (R2A2s), which are signed by two levels of supervision. BSA has clearly defined expectations for

management and staff which must be included in this document. Under the BSA performance-based management model, senior managers must communicate their expectation that all line managers and staff take full responsibility for their actions and be held accountable for ESSH performance. Environmental and waste management technical support personnel assist the line organizations with identifying and carrying out their environmental responsibilities. The Environmental Compliance Representative Program, initiated in 1998, 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 also in place, thus ensuring that all personnel are aware of their ESSH responsibilities.

2.4.2 Communication and Community Involvement

In support of BNL's EMS commitment to communication and community involvement, the Stakeholder and Community Relations (SCR) Office develops best-in-class communications, science education, government relations, and community involvement programs that advance the science and science education missions of the Laboratory. SCR contributes to public understanding of science and enhances the value of the Laboratory as a community asset and ensures that internal and external stakeholders are properly informed and have a voice in decisions of interest and importance to them. SCR also works to maintain relationships with BNL employees and external stakeholders that include neighbors, community organizations, business leaders, elected officials, and regulators to provide an understanding of the Laboratory's science and operations, including environmental stewardship and restoration activities, and to incorporate community input into BNL's decision-making process.

To facilitate stakeholder input, SCR's Stakeholder Relations Office participates in or conducts on- and off-site meetings which include discussions, presentations, roundtables, and workshops. Stakeholder Relations staff attend

local civic association meetings, canvass surrounding neighborhoods, conduct Laboratory tours, and coordinate informal information sessions and formal public meetings, which are held during public comment periods for environmental projects. BNL's Internal Communications Office manages programs to increase internal stakeholder awareness, understanding, and support of Laboratory initiatives, fosters two-way communications, and updates internal stakeholders on BNL priorities, news, programs, and events.

2.4.2.1 Communication Forums

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

- The Brookhaven Executive Roundtable (BER), established in 1997 by DOE's Brookhaven Site Office, meets routinely to update local, state, and federal elected officials and their staff, regulators, and other government agencies on environmental and operational issues, as well as scientific discoveries and initiatives.
 - The Community Advisory Council (CAC), established by BNL in 1998, advises Laboratory management primarily on environmental, health, and safety issues related to BNL that are of importance to the community. The CAC is comprised of 27 member organizations and individuals representing civic, education, employee, community, environmental, business, and health interests. The CAC sets its own agenda in cooperation with the Laboratory and meets monthly, except for July and August. The CAC is one of the primary ways the Laboratory keeps the community informed. Meetings are open to the public and are announced on the BNL homepage calendar and on the Community Relations website. An opportunity for public comment is provided at each meeting and organizations interested in participating on the CAC are encouraged to attend meetings and make their interest known.
 - Monthly teleconference calls are held with parties to the Laboratory's Interagency Agreement and other federal, state, and local regulators to keep them up-to-date on project status. The calls also provide the opportunity to gather input and feedback and to discuss emerging environmental findings and initiatives.
- The Stakeholder Relations Office website is used to host links to the CAC webpage, which contains meeting agendas and past meeting presentations and minutes. Stakeholder Relations also manages several outreach programs that provide opportunities for stakeholders to become familiar with the Laboratory's facilities and research projects. Outreach programs include:
 - *Tour Program*: Opportunities to learn about BNL are offered to college, university, professional, and community groups. Tour groups visit the Laboratory's scientific machines and research facilities and meet with scientists to discuss research. Agendas are developed to meet the interests of the groups, and may include sustainability and environmental stewardship issues. Tours were provided for more than 3,000 visitors in 2016.
 - *Summer Sundays*: Held on four Sundays each summer, these open houses enable the public to visit BNL science facilities, experience hands-on activities, and learn about research projects and environmental stewardship programs. In 2016, more than 4,500 visitors participated in the program.
 - *PubSci*: BNL's science café and conversation series where the Laboratory's distinguished scientists appear at public venues to discuss cutting-edge topics and research in an informal setting. During 2016, science-interested community members and BNL researchers discussed the "Cutting Edge of Chemistry & the Reactions Powering the World."
 - *Science On Screen*: A continued partnership program with the Huntington Cinema Arts Centre that gives BNL scientists an opportunity to present classic, cult, or documentary movies that serve as a "jumping-off" point to discuss their research returned in 2016 with a showing of "The Martian," a film paired with a BNL physicist's

research that highlighted the work done at the NASA Space Radiation Lab.

The Laboratory participates in various outreach events throughout the year that include festivals, workshops, BNL's Earth Day celebration, the World Science Festival, and the Port Jefferson Mini-Maker Faire. Brown bag lunch meetings for employees are held periodically and cover topics of interest, including project updates, newly proposed initiatives, wildlife management concerns, and employee benefits information.

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

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

2.4.2.2 Community Involvement in Cleanup Projects

In 2016, BNL updated stakeholders on the progress of environmental cleanup projects, additional initiatives, and health and safety issues via mailings and briefings and presentations given at CAC and BER meetings. These topics included:

- *Alternating Gradient Synchrotron Environmental Assessment (AGS)*: The CAC was informed that an Environmental Assessment was needed due to proposed changes, including moving the Accelerator Test Facility (ATF) to Building 912 for more space and upgrades to ATF-II (upgrading to higher energy and incorporating a CO₂ laser, experimental halls and beamlines, and a state-of-the-art photocathode electron gun).
- *Natural Resources Program*: The CAC received updates on the status of flora and fauna on site, deer management and the 4-Poster tick control system; forest management (Southern Pine Beetle); fish sampling; LISF research, and the status of threatened and endangered species on site.
- *The Peconic Optimization Plan*: The CAC was updated on the cleanup of the Peconic River, the extent of contamination, the remedy optimization plan, and the path forward.
- *NSLS Hazard Removal Project*: The CAC received a presentation on the project close-out report on Building 725. The report focused on the removal of NSLS accelerators, beamlines, and associated research systems and equipment.
- *BNL's Environmental Management System Audit Results*: The results of the 2016 external assessment were discussed. Fifteen positive practices, two opportunities for improvement, and no nonconformances were identified, and the Laboratory was recommended for recertification to the ISO14001 Standard.
- *Environmental Restoration Updates*: The CAC was provided with updates on the Building 811 Demolition Project; the Former Hazardous Waste Management Facility Sr-90 Plume, VOCs at the Western South Boundary; and the CERCLA Five Year Review.
- *2015 Site Environmental Report*: The CAC received a presentation on the Laboratory's environmental impact for the previous year. Updates on the BNL's EMS and opportunities for improvement, pollution prevention projects implemented during the year, waste generation, and energy management and conservation were discussed. Air and water

quality monitoring results were provided and radiological dose assessment was explained.

- *Natural & Cultural Resources Update:* The CAC was updated on deer management efforts; Peconic River post cleanup fish monitoring results; and how the Laboratory is protecting pollinators on site.
- *Nanoscience Environment, Safety, and Health at the Center for Functional Nanomaterials:* Because nanomaterial work is performed in several facilities on site, the CAC was given a presentation explaining the requirements of DOE Order 456.1, “The Safe Handling of Unbound Engineered Nanoparticles,” which establishes requirements to ensure that the work involving unbound engineered nanoparticles occurs in a safe and secure manner that protects workers, the public, and the environment. BNL’s Standards-Based Management System procedure, “Nanoscale Particle ESH,” was also discussed.
- *2015 Annual Groundwater Update:* The CAC received a presentation on the highlights of the annual report, including the current status of groundwater treatment systems, and remediation of VOC and Sr-90 plumes. Also included was an update on the Surveillance and Maintenance of the BGRR and the HFBR.
- *Community Wildfire Protection Plan:* The CAC and general public were updated on the current status of the Community Wildfire Protection plan. The plan is a community-driven process that addresses wildfire risk, reduces threats to life and property, and enables additional funding for mitigation activities.

Working closely with the community, employees, elected officials, and regulatory agency representatives, DOE and BNL continue to openly share information on issues, projects, and programs and welcome all input and feedback offered.

2.4.3 Monitoring and Measurement

The Laboratory monitors effluents and emissions to ensure the effectiveness of controls, adherence to regulatory requirements, and timely identification and implementation of corrective

measures. BNL’s Environmental Monitoring Program is a comprehensive, sitewide program that identifies potential pathways for exposure of the public and employees, evaluates the impact activities have on the environment, and ensures compliance with environmental permit requirements.

DOE Order 436.1 requires DOE sites to maintain an EMS. An EMS specifies requirements for conducting general surveillance monitoring to evaluate the effects, if any, from site operations. DOE Order 458.1 Admin Chg 3, (2013), *Radiation Protection of the Public and Environment*, requires DOE sites to maintain surveillance monitoring for determining radiological impacts, if any, to the public and environment from site operations. An extensive environmental monitoring program is one component of the Laboratory’s EMS, and the BNL’s Environmental Monitoring Plan describes this program in detail. The plan uses the EPA Data Quality Objective approach for documenting the decisions associated with the monitoring program. In addition to the required triennial update, an annual electronic update is also prepared. The monitoring programs are reviewed and revised, as necessary, to reflect changes in permit requirements, changes in facility-specific monitoring activities, or the need to increase or decrease monitoring based on a review of previous analytical results.

As shown in Table 2-5, in 2016 there were 5,785 sampling events of groundwater, potable water, precipitation, air, plants and animals, soil, sediment, and discharges under the Environmental Monitoring Program. Specific sampling programs for the various media are described further in Chapters 3 through 8.

The Environmental Monitoring Program addresses three components: compliance, restoration, and surveillance monitoring.

2.4.3.1 Compliance Monitoring

Compliance monitoring is conducted to ensure that wastewater effluents, air emissions, and groundwater quality comply with regulatory and permit limits issued under the federal Clean Air Act, Clean Water Act, Oil Pollution Act, SDWA, and the New York State equivalents. Included in compliance monitoring are the

following:

- Air emissions monitoring is conducted at reactors (no longer in operation), accelerators, and other radiological emission sources, as well as the CSF. Real-time, continuous emission monitoring equipment is installed and maintained at some of these facilities, as required by permits and other regulations. At other facilities, samples are collected and analyzed periodically to ensure compliance with regulatory requirements. Analytical data are routinely reported to the permitting agencies. See Chapters 3 and 4 for details.
- Wastewater monitoring is performed at the point of discharge to ensure that the effluent complies with release limits in the Laboratory’s SPDES permits. Twenty-four point-source discharges are monitored: 12 under BNL’s SPDES Permit, and 12 under equivalency permits issued to the Environmental Restoration Program for groundwater treatment systems. As required by permit conditions, samples are collected daily, weekly, monthly, or quarterly and monitored for organic, inorganic, and radiological parameters. Monthly discharge monitoring reports (DMRs) that provide analytical results and an assessment of compliance for that reporting period are filed with the NYSDEC. See Chapter 3, Section 3.6 for details.
- Groundwater monitoring is performed to comply with regulatory operating permits. Specifically, monitoring of groundwater is required under the Major Petroleum Facility License for the CSF, the RCRA permit for the Waste Management Facility, and the State Pollutant Discharge Elimination System (SPDES) permit for the Sewage Treatment Plant. Extensive groundwater monitoring is also conducted under the CERCLA program (described in Section 2.4.3.2 below). Additionally, to ensure that

Table 2-5. Summary of BNL Sampling Program Sorted by Media, 2016.

Environmental Media	No. of Sampling Events(a)	Purpose
Groundwater	1,642 (b)	Groundwater is monitored to evaluate impacts from past and present operations on groundwater quality, under the Environmental Restoration, Environmental Surveillance, and Compliance sampling programs. See Chapter 7 and SER Volume II, <i>Groundwater Status Report</i> , for further detail.
On-Site Recharge Basins	73	Recharge basins used for wastewater and stormwater disposal are monitored in accordance with discharge permit requirements and for environmental surveillance purposes. See Chapter 5 for further detail.
Potable Water	38 ES 204 C	Potable water wells and the BNL distribution system are monitored routinely for chemical and radiological parameters to ensure compliance with Safe Drinking Water Act requirements. In addition, samples are collected under the Environmental Surveillance Program to ensure the source of the Laboratory’s potable water is not impacted by contamination. See Chapters 3 and 7 for further detail.
Sewage Treatment Plant (STP)	498	The STP influent and effluent and several upstream and downstream Peconic River stations are monitored routinely for organic, inorganic, and radiological parameters to assess BNL impacts. The number of samples taken depends on flow. For example, samples are scheduled for collection at Station HQ monthly, but if there is no flow, no sample can be collected. See Chapters 3 and 5 for further detail.
Precipitation	12	Precipitation samples are collected from two locations to determine if radioactive emissions have impacted rainfall, and to monitor worldwide fallout from nuclear testing. The data are also used, along with wind speed, wind direction, temperature, and atmospheric stability to help model atmospheric transport and diffusion of radionuclides. See Chapter 4 for further detail.
Air – Tritium	204	Silica gel cartridges are used to collect atmospheric moisture for subsequent tritium analysis. These data are used to assess environmental tritium levels. See Chapter 4 for further detail.
Air – Particulate	264 ES/C 48 NYSDOH	Samples are collected to assess impacts from BNL operations and to facilitate reporting of emissions to regulatory agencies. Samples are also collected for the New York State Department of Health Services (NYSDOH) as part of their program to assess radiological air concentrations statewide. See Chapter 4 for further detail.

(continued on next page)

CHAPTER 2: ENVIRONMENTAL MANAGEMENT SYSTEM

Table 2-5. Summary of BNL Sampling Program Sorted by Media, 2016. (concluded).

Environmental Media	No. of Sampling Events(a)	Purpose
Fauna	10	Fish and deer are monitored to assess impacts on wildlife associated with past or current BNL operations. See Chapter 6 for further detail.
Flora	14	Vegetation is sampled to assess possible uptake of contaminants by plants and fauna, since the primary pathway from soil contamination to fauna is via ingestion. See Chapter 6 for further detail.
Soils	58	Soil samples are collected as part of the Natural Resource Management Program to assess faunal uptake, during Environmental Restoration investigative work, during the closure of drywells and underground tanks, and as part of preconstruction background sampling.
Miscellaneous	389	Samples are collected periodically from potable water fixtures and dispensers, manholes, spills, to assess process waters, and to assess sanitary discharges.
Groundwater Treatment Systems Monitoring	921	Samples are collected from groundwater treatment systems and as long-term monitoring after remediation completion under the Comprehensive Environmental Response, Compensation, and Liability Act (CERCLA) program. The Laboratory has 11 operating groundwater treatment systems. See discussion in Chapter 7.
State Pollutant Discharge Elimination System (SPDES)	320	Samples are collected to ensure that the Laboratory complies with the requirements of the New York State Department of Environmental Conservation (NYSDEC)-issued SPDES permit. Samples are collected at the STP, recharge basins, and four process discharge sub-outfalls to the STP.
Flow Charts	559	Flowcharts are exchanged weekly as part of BNL's SPDES permit requirements to report discharge flow at the recharge basin outfalls.
Floating Petroleum Checks	103	Tests are performed on select petroleum storage facility monitoring wells to determine if floating petroleum products are present. The number of wells and frequency of testing is determined by NYSDEC licensing requirements (e.g., Major Petroleum Facility), NYSDEC spill response requirements (e.g., Motor Pool area), or other facility-specific sampling and analysis plans.
Radiological Monitor Checks	348	Daily instrumentation checks are conducted on the radiation monitors located in Buildings 569 and 592. These monitors are located 30 minutes upstream and at the STP. Monitoring at these locations allows for diversion of wastes containing radionuclides before they are discharged to the Peconic River.
Quality Assurance/Quality Control Samples (QA/QC)	80	To ensure that the concentrations of contaminants reported in the Site Environmental Report are accurate, additional samples are collected. These samples detect if contaminants are introduced during sampling, transportation, or analysis of the samples. QA/QC samples are also sent to the contract analytical laboratories to ensure their processes give valid, reproducible results.
Total number of sampling events	5,785	The total number of sampling events includes all samples identified in the Environmental Monitoring Plan (BNL 2016), as well as samples collected to monitor Environmental Restoration (CERCLA) projects, air and water treatment system processes, and by the Environmental Protection Division Field Sampling Team as special requests. The number does not include samples taken by Waste Management personnel, waste generators, or Environmental Compliance Representatives for waste characterization purposes.

Notes:

(a) A sampling event is the collection of samples from a single georeferenced location. Multiple samples for different analyses (i.e., tritium, gross alpha, gross beta, and volatile organic compounds) can be collected during a single sample event.

(b) Also includes sampling events from temporary wells.

C = Compliance

ES = Environmental Surveillance

the Laboratory maintains a safe drinking water supply, BNL's potable water supply is monitored as required by SDWA, which is administered by SCDHS.

2.4.3.2 Restoration Monitoring

The Environmental Restoration Program operates and maintains groundwater treatment systems to remediate contaminant plumes both on and off site. BNL maintains an extensive network of groundwater monitoring wells to verify the effectiveness of the remediation effort. Modifications to groundwater remediation systems are implemented, as necessary, based upon a continuous evaluation of monitoring data and system performance. Additionally, surface water, sediment and fish sampling is conducted to verify the effectiveness of the Peconic River cleanup efforts. Peconic River monitoring is coordinated with the Surveillance Monitoring Program to ensure completeness and to avoid any duplication of effort.

Details on the Peconic River monitoring program are provided in Chapter 6, and details on groundwater monitoring and restoration program are provided in Chapter 7 and SER Volume II, *Groundwater Status Report*.

2.4.3.3 Surveillance Monitoring

Surveillance monitoring is performed in addition to compliance monitoring, to assess potential environmental impacts that could result from routine facility operations. The BNL Surveillance Monitoring Program involves collecting samples of ambient air, surface water, groundwater, flora, fauna, and precipitation. Samples are analyzed for organic, inorganic, and radiological contaminants. Additionally, data collected using thermoluminescent dosimeters (devices to measure radiation exposure) strategically positioned on and off site is routinely reviewed under this program. Control samples (also called background or reference samples) are collected on and off the site to compare Laboratory results to areas that could not have been affected 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-specific 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 Laboratory's EMS is operating as intended, assessments are conducted as part of BNL's Self-Assessment Program. Self-assessment is the systematic evaluation of internal processes and performance. Two types of assessments are conducted: the ISO 14001 Standard conformance assessment and the regulatory compliance assessments.

- The approach for the ISO14001 program self-assessment includes evaluating programs and processes within organizations that have environmental aspects to verify conformance to the ISO14001 Standard. The assessment is performed by qualified external assessors, or BNL staff members who do not have line responsibility for the work processes involved. Progress toward achieving environmental objectives is monitored, as are event-related metrics in order to determine the overall effectiveness of the EMS. The assessment determines if there are Laboratory-wide issues that require attention, as well as facilitates the identification and communication of "best management" practices used in one part of the Laboratory that could improve performance in other parts.
- Compliance assessments are also performed by BNL staff members who do not have line responsibility for the work processes involved, to ensure that operations are in compliance with Laboratory requirements that reflect external compliance requirements. 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 conducted to identify the root causes of prob-

lems, as well as identify corrective actions and lessons learned if regulatory noncompliance or impact occurs in order to correct the problem and prevent reoccurrence.

- BNL management routinely evaluates progress on key environmental improvement projects. The Laboratory and DOE periodically perform assessments to facilitate the efficiency of assessment activities and ensure that the approach to performing the assessments meets DOE expectations.

The Laboratory's Self-Assessment Program is augmented by programmatic, external audits conducted by DOE. BSA staff and subcontractors also perform periodic independent reviews, and an independent third party conducts ISO 14001 registration audits of BNL's EMS. The Laboratory is subject to extensive oversight by external regulatory agencies (see Chapter 3 for details). Results of all assessment activities related to environmental performance are included, as appropriate, throughout this report.

2.5 ENVIRONMENTAL STEWARDSHIP AT BNL

BNL has extensive knowledge of its potential environmental vulnerabilities and current operations due to ongoing process evaluations, the work planning and control system, and the management systems for groundwater protection, environmental restoration, and information management. Compliance assurance programs have improved the Laboratory's compliance status and pollution prevention projects have reduced costs, minimized waste generation, and reused and recycled significant quantities of materials. BNL is openly communicating with neighbors, regulators, employees, and other interested parties on environmental issues and progress. To maintain stakeholder trust, the Laboratory will continue to deliver on commitments and demonstrate improvements in environmental performance. The Site Environmental Report is an important communication mechanism, as it summarizes BNL's environmental programs and performance each year. Additional information about the Laboratory's environmental programs is available on BNL's website at <http://www.bnl.gov>.

Due to external recognition of the Laboratory's knowledge and unique experience implementing

the EMS program, BNL is often asked to share its experiences, lessons learned, and successes. The Laboratory's environmental programs and projects have been recognized with international, national, and regional awards and audits have consistently observed a high level of management involvement, commitment, and support for environmental protection and the EMS.

For 70 years, the unique, leading edge research facilities and scientific staff at BNL have made many innovative scientific contributions possible. Today, BNL continues its research mission while focusing on cleaning up and protecting the environment.

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