

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 3 years. In 2015, an EMS surveillance 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 2015, pollution prevention projects resulted in more than \$81.1 million in cost avoidance or savings and resulted in the reduction or reuse of approximately 26.1 million pounds of waste. Also in 2015, the Pollution Prevention Program funded six new proposals, investing approximately \$17,000. Anticipated annual savings from these projects are estimated at approximately \$20,000, for an average payback period of slightly less than 1 year. The ISO 14001-registered EMS and the nationally recognized Pollution Prevention Program continue to contribute to the Laboratory's success in promoting pollution prevention.

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, and Health (ES&H) 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 450.4A, *Integrated Safety Management Policy*, are:

- **DEFINE THE SCOPE OF WORK.** Missions are translated into work, expectations are set, tasks are identified and prioritized, and resources are allocated.
- **ANALYZE THE HAZARDS.** 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 AND CONTINUOUS IMPROVEMENT.** Feedback information on the adequacy of controls is gathered; opportunities for improving the definition and planning of work are identified and implemented.

The seven Guiding Principles of Integrated Safety Management, also as defined by DOE P 450.4A, are:

- **LINE MANAGEMENT RESPONSIBILITY FOR SAFETY.** Line management is directly responsible for the protection of the workers, the public, and the environment.
- **CLEAR ROLES AND RESPONSIBILITIES.** Clear and unambiguous lines of authority and responsibility for ensuring safety are established and maintained at all organizational levels within the Department and its contractors.
- **COMPETENCE COMMENSURATE WITH RESPONSIBILITIES.** Personnel possess the experience, knowledge, skills, and abilities that are necessary to discharge their responsibilities.
- **BALANCED PRIORITIES.** Resources are effectively allocated to address safety, programmatic, and operational considerations. Protecting the workers, the public, and the environment is a priority whenever activities are planned and performed.
- **IDENTIFICATION OF SAFETY STANDARDS AND REQUIREMENTS.** Before work is performed, the associated hazards are evaluated and an agreed-upon set of safety standards and requirements is established which, if properly implemented, will provide adequate assurance that the workers, the public, and the environment are protected from adverse consequences.
- **HAZARD CONTROLS TAILORED TO WORK BEING PERFORMED.** Administrative and

engineering controls to prevent and mitigate hazards are 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 are 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 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.

On September 15, 2015, the third edition of the ISO 14001 Standard was issued, marking a significant revision from the existing standard. The major changes in the new Standard involve increased upper management ownership and involvement in the EMS; addition of risk assessment and planning for future environmental impacts both on and by the facility; and a stronger emphasis on continual improvement and environmentally sustainable operations. BNL must certify to the new standard by September 2018, or sooner.

In June 2015, an ISO 1400: 2004 and OHSAS

18001: 2007 surveillance audit was conducted by auditors from NSF International Strategic Registrations (OHSAS 18001 results are not included in this report). The audit identified two opportunities for improvement: 1) to consider simplifying documentation for Environmental/ OSHAS-related management systems, program descriptions, and linkages to other institutional policies; and 2) to consider clarifying the process employed for the graded approach of the “Effectiveness Review” as it applies to Environmental/ OSHAS systematic nonconformities. As a result, BNL maintains its certification to the current version of these standards.

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 <https://www.bnl.gov/esh/policy.php>. The goals and commitments are as follows:

- **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 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 goal, the Laboratory's performance in 2015, 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 2015, BNL's environmental objective included maintaining ISO 14001 and OHSAS 18001 certifications.

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

CHAPTER 2: ENVIRONMENTAL MANAGEMENT SYSTEM

Table 2-1. Executive Order 13693 Goals: Status Summary for Fiscal Year (FY) 2015.

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 (2015 target: 19 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—a decrease of 41.4 percent against the FY 2008 baseline. This total is in accordance with the Consolidated Energy Data Report. However, this value does not reflect adjustments by the Sustainable Performance Office for the Long Island Solar Farm (LISF). BNL estimates the total FY 2015 GHG value to be approximately 99,000 MtCO₂e. 	<ul style="list-style-type: none"> Continuing efforts for FY 2016 include 15 MW of hydro-power, the LISF, the 500 kW on-site photovoltaic (PV) research array, Renewable Energy Credit (REC) purchases, and energy intensity reduction through the Utility Energy Service Contract (UESC) Phase I, which was completed in May 2015. Savings and performance have been verified during the UESC Phase I, and BNL will likely initiate a Phase II effort in FY 2016. Due to encouraging results of a “right-sized” Combined Heat and Power (CHP) study in 2015, a follow-on study will be pursued in FY 2016.
25 percent Scope 3 GHG reduction by FY 2025 from a FY 2008 baseline (2015 target: 6 percent).	<ul style="list-style-type: none"> Scope 3 GHG emissions have increased by 0.4 percent from the FY 2008 baseline of 20,136 MtCO₂e to 20,207 MtCO₂e in FY 2015. 	<ul style="list-style-type: none"> Planned efforts include continued promotion of the “Two for Tuesdays” rideshare initiative; encouraging greater use of BlueJean teleconferencing services; improving metrics for telework and compressed work scheduled using PeopleSoft HR time reporting records; completing the Commuter Choice website; and changing the standard allowable rental in domestic and foreign travel standard procedures from a mid-size to a compact vehicle.
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 2015 energy intensity was 243,130 Btu/GSF. This level represents a cumulative reduction of 24.9 percent from the FY 2003 baseline of 323,780 Btu/GSF. The UESC Phase I was completed in May 2015. Some of the energy savings are reflected in the FY 2015 energy intensity value. 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. 	<ul style="list-style-type: none"> As savings and performance for UESC Phase I are verified. BNL will likely initiate a Phase II effort in FY 2016 to address the latest Energy Intensity reduction goal of 25 percent. Continued emphasis will be placed on the importance of building temperature setback in FY 2016.
Energy Independence and Security Act Section 432 energy and water evaluations.	<ul style="list-style-type: none"> 100 percent completed within last 4 years. 25 percent of buildings were surveyed by VFA in FY 2015; the reporting format has been revised to better emphasize potential energy projects. 	<ul style="list-style-type: none"> Green Energy Surveys are in process and on schedule. BNL will continue with the cost-effective Energy Survey/Facility Condition Assessment (FCA) approach in FY 2016 and beyond.
Meter all individual buildings for electricity, natural gas, steam, and water where cost-effective and appropriate.	<ul style="list-style-type: none"> The status of individual building metering is: electric, 100 percent (of appropriate meters); natural gas, 100 percent; steam, 93.3 percent; and chilled water, 100 percent. 	<ul style="list-style-type: none"> Additional meter installations are on-going. BNL is investigating 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 and opportunity to improve data center performance and metering.
At least 15 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.	<ul style="list-style-type: none"> BNL achieved the goal in FY 2015 and currently has 22 percent of square footage classified as HPSB. 	<ul style="list-style-type: none"> BSA will continue to design new construction renovations greater than 5,000 gross square feet to meet the HPSB requirements.

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Table 2-1. Executive Order 13693 Goals: Status Summary for Fiscal Year (FY) 2015. (continued).

DOE Goal	BNL Performance Status	BNL Planned Actions and Contributions
All new construction, major renovations, and alterations of buildings greater than 5,000 gross square feet must comply with Guiding Principles.	<ul style="list-style-type: none"> ▪ All recently completed projects obtained LEED certifications 	<ul style="list-style-type: none"> ▪ HPSB requirements will be included in the conceptual design for the Building 725 renovation.
Efforts to increase regional and local planning coordination and involvement.	<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 2015. ▪ A Sustainability Awareness and Engagement team was established to enhance the BNL Site Sustainability Program and foster a culture of sustainability across the Laboratory. Using smaller working groups, materials and tools were developed, including videos, posters, and a new BNL Sustainability website. ▪ Deer management successfully reduced the deer population by approximately 300. ▪ The Laboratory made a commitment to implement best management practices established by the Pollinator Task Force and has begun to review implementation strategies for the Laboratory site. ▪ 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. 	<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. ▪ In FY 2016, the BNL Sustainability website will be reviewed and updated as necessary. ▪ The deer management strategy will need to be revisited due to financial risks of performing a maintenance cull in FY 2016. ▪ The Laboratory will continue to work to implement best management practices established by the Pollinator Task Force. ▪ The Laboratory will continue to support local and federal efforts to reduce reliance on petroleum.
Net Zero Buildings: Percentage of existing buildings on site above 5,000 gross square feet intended to be energy, waste, or water net-zero buildings by FY 2025.	<ul style="list-style-type: none"> ▪ n/a 	<ul style="list-style-type: none"> ▪ BSA will begin evaluating existing net-zero buildings to see what technologies exist to help achieve this goal.
Net Zero Buildings: Percentage of new buildings greater than 5,000 gross square feet entering the planning process designed to achieve energy net-zero beginning in FY 2020.	<ul style="list-style-type: none"> ▪ n/a 	<ul style="list-style-type: none"> ▪ BSA will begin evaluating existing net-zero buildings to see what technologies exist to help achieve this goal.
Data Center Efficiency: Establish a power usage effectiveness 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"> ▪ An initial power utilization effectiveness (PUE) study indicated current PUE to be above 1.6. Additional electric meters and one new chilled water meter were installed in FY 2014. Efforts to identify and install additional metering continued so that a more accurate PUE for each data center can be measured and monitored. ▪ A comprehensive evaluation of the metering for the main data center in Building 515 was completed. The PUE for FY 2014 was determined to be 1.41. ▪ Power usage was based on actual metered energy for over 94 percent of the total energy use. Approximately 6 percent was estimated based on empirical data. 	<ul style="list-style-type: none"> ▪ BNL is investigating the need for additional sub-meters for any IT loads that are not on the uninterruptible power circuits. ▪ There is a potential project under development that will relocate the existing data center to a new building. The new facility will be designed to achieve the lowest PUE that is cost-effective.

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Table 2-1. Executive Order 13693 Goals: Status Summary for Fiscal Year (FY) 2015. (continued).

DOE Goal	BNL Performance Status	BNL Planned Actions and Contributions
Goal 3: Clean & Renewable Energy		
“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 2016/2017, working towards 25 percent by FY 2025.	<ul style="list-style-type: none"> n/a 	<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.
“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.	<ul style="list-style-type: none"> BNL purchased 43 million kWh of RECs, which equals 8.94 percent of BNL’s total usage of electric and thermal energy. When the NSERC output is added, the total is 9.1 percent. The LISF began operations in November 2011 and in FY 2015, provided 51.43 million kWh/yr of clean renewable energy to Long Island. The on-site NSERC solar array became operational in May 2014. In FY 2015, NSERC produced ~720,000 kWh. 	<ul style="list-style-type: none"> A CHP using biomass fuel is not practical at BNL. However, new requirements as part of EO 13693 will count the thermal energy from a CHP as “clean” energy. BNL recently learned of approval for Sustainability Performance Office Funding Opportunity announcement (SPOFOA) funding to install an additional 200 kW of solar PV at the NSERC facility in FY 2016. RECs will be purchased as necessary to fully meet the goal.
Goal 4: Water Use Efficiency and Management		
36 percent potable water intensity (gallons per gross square foot) reduction by FY 2025 from a FY 2007 baseline. (2015 target: 16 percent).	<ul style="list-style-type: none"> Annual water use intensity has decreased from 101.2 gallons per square foot to 86.1 gallons per square foot, a 14.9 percent water usage reduction since base year 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’s Water Management Plan will continue to be implemented, and BNL will continue to utilize water-efficient processes and plumbing fixtures to conserve water. Reconstruction of Well House No. 12 (in design) 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.
30 percent water consumption (gallons) reduction of industrial, landscaping, and agricultural (ILA) water by FY 2025 from a FY 2010 baseline. (2015 target: 10 percent).	<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		
20 percent reduction in annual petroleum consumption by FY 2015 relative to a FY 2005 baseline; maintain 20 percent reduction thereafter. (2015 target: 20 percent).	<ul style="list-style-type: none"> This goal was surpassed with a 53 percent reduction in petroleum consumption. 	<ul style="list-style-type: none"> This goal should be considered part of 5.3, which measures GHG emissions.
10 percent increase in annual alternative fuel consumption by FY 2015 relative to a FY 2005 baseline; maintain 10 percent increase thereafter. (2015 target: 10 percent).	<ul style="list-style-type: none"> This goal was not met. The FY 2005 baseline was very high, and the Laboratory’s ability to purchase alternative fuel vehicles was not sufficient to increase the already high baseline. 	<ul style="list-style-type: none"> This goal should be considered part of 5.3, which measures GHG emissions.
30 percent reduction in fleet-wide per mile greenhouse gas emissions reduction by FY 2025 from a FY 2014 baseline. (2015 target: N/A; 2017 target: 4 percent)	<ul style="list-style-type: none"> FY14 Baseline: 706.87 gCO₂e/mile FY15 actual: 671.25 gCO₂e/mile 95 percent of light duty vehicles ordered through the US General Services Administration (GSA) in FY 2015 were alternative fuel vehicles. n/a 	<ul style="list-style-type: none"> All new orders of leased vehicles are alternative fuel vehicles when available. The overall gCO₂e/mile of the fleet will also decrease as older vehicles are replaced with newer, more fuel-efficient models. All new orders of leased vehicles are alternative fuel vehicles when available. No actions planned for FY 2016.

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Table 2-1. Executive Order 13693 Goals: Status Summary for Fiscal Year (FY) 2015. (concluded).

DOE Goal	BNL Performance Status	BNL Planned Actions and Contributions
75 percent of light duty vehicle acquisitions must consist of alternative fuel vehicles (AFV). (2015 target: 75 percent).	<ul style="list-style-type: none"> 95 percent of light duty vehicles ordered through the GSA in FY 2015 were alternative fuel vehicles. 	<ul style="list-style-type: none"> All new orders of leased vehicles are alternative fuel vehicles when available.
50 percent of passenger vehicle acquisitions consist of zero emission or plug-in hybrid electric vehicles by FY 2025. (2015 target: N/A).	<ul style="list-style-type: none"> n/a 	<ul style="list-style-type: none"> No actions planned for FY 2016.
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"> BNL has met the intent of this goal and has incorporated the required provisions and clauses within its contracts. 	<ul style="list-style-type: none"> BNL will be converting its online purchasing to Vinimaya. A minimum of 24 vendor catalogues are expected to be available by the end of FY 2016. In addition, "kits" will be created that will direct purchasers toward Environmentally Preferable Purchasing (EPP) products.
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"> During FY 2015, BNL's annual diversion rate of non-hazardous solid waste was approximately 77 percent, aided tremendously by the amount of recycling during the decommissioning of the National Synchrotron Light Source I (NSLS). 	<ul style="list-style-type: none"> BNL will evaluate the economic feasibility of food waste composting as a method of further reducing waste sent to the Town's transfer station.
Divert at least 50 percent of construction and demolition materials and debris.	<ul style="list-style-type: none"> The Laboratory recycles over 95 percent of its construction, demolition, and woody debris. 	<ul style="list-style-type: none"> During FY 2016, BNL plans to mine concrete debris from the Borrow Pit (the on-site concrete debris storage area) and generate Recycled Concrete Aggregate (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 UESC (Phase I) was awarded on October 22, 2013 and completed in May 2015. It is estimated to result in a nearly 11 percent reduction in energy intensity. Estimated annual energy savings are ~\$1.2 million. Savings to date are currently being verified, but are on track to match or exceed the estimate. Energy conservation measures include: improved efficiency of supplying chilled water; lighting upgrades throughout the Laboratory; and installation of building controls with enhanced temperature setback. 	<ul style="list-style-type: none"> Preliminary audits for additional scope (a potential Phase II) were completed by two independent ESCOs during FY 2015. BSA management feels it is prudent to further evaluate/verify the savings from the Phase I effort before making recommendations on Phase II.
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.

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 2015.

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, 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. Due to the relatively small quantities and infrequent generation of mixed waste, BNL has reduced its waste storage footprint by consolidating hazardous and mixed wastes into its RCRA waste building. In 2015, BNL generated the following types and quantities of waste from routine operations:

- Hazardous waste: 5.0 tons
- Mixed waste: 15 ft³
- Radioactive waste: 3,700 ft³

Hazardous waste from routine operations in 2015 increased from 2014 generation rates, as shown in Figure 2-1a. This was not attributed to any one source, but rather due to small increases

in generation throughout the Laboratory. Mixed waste generation decreased from 2014 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 increased slightly from 2014 rates, which is primarily attributed to increased 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 2015, BNL continued to reduce the inventory of legacy waste materials through laboratory cleanouts. Wastes from facility decommissioning activities resulted primarily from the demolition of BNL's former Waste Concentration Facility, Building 811. This waste stream consisted of building debris and surrounding soils. 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 is an essential element for the successful accomplishment of the Laboratory's broad mission. The 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 2015, and provides the number of pounds of materials reduced, reused, or recycled, as well as

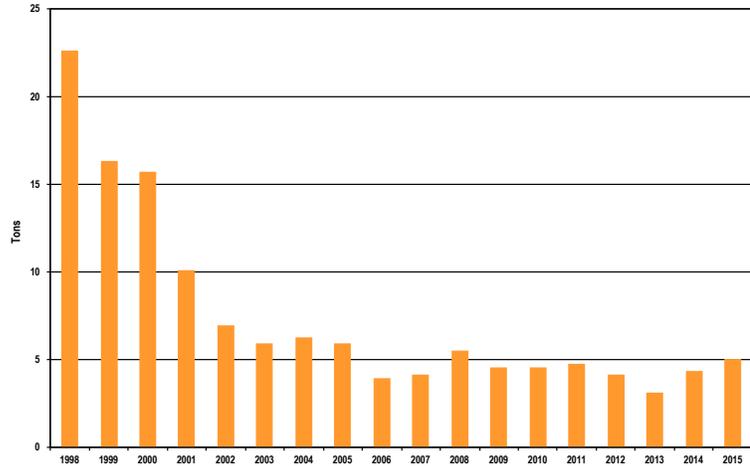


Figure 2-1a. Hazardous Waste Generation from Routine Operations, 1998 – 2015.

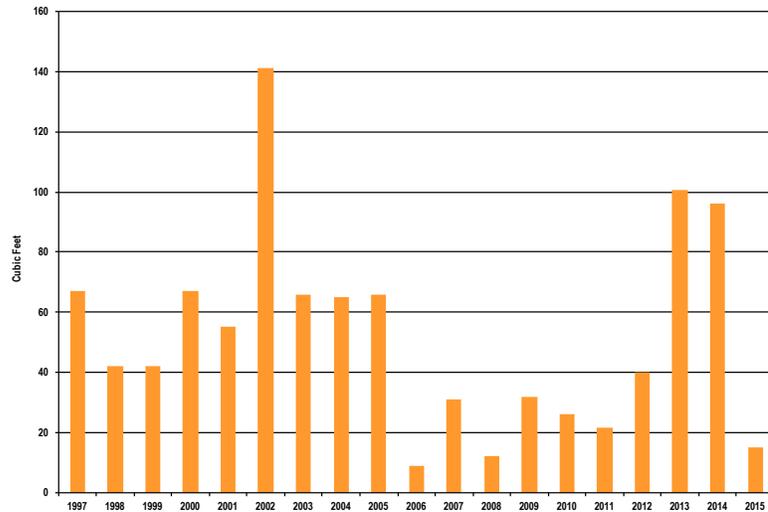


Figure 2-1b. Mixed Waste Generation from Routine Operations, 1998 – 2015

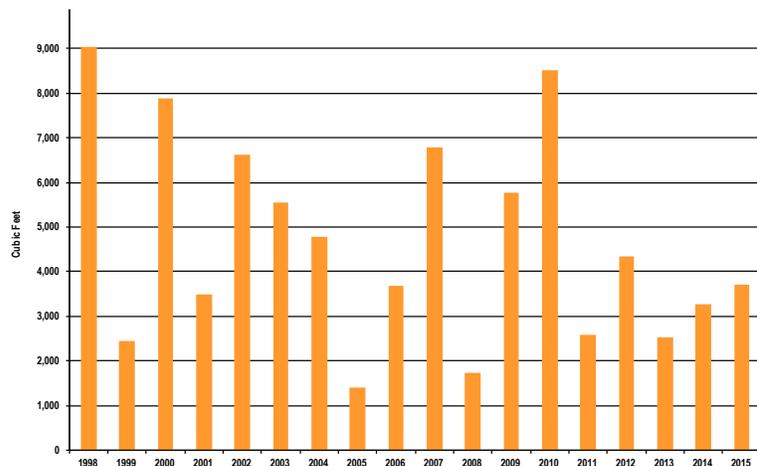


Figure 2-1c. Radioactive Waste Generation from Routine Operations, 1998 – 2015.

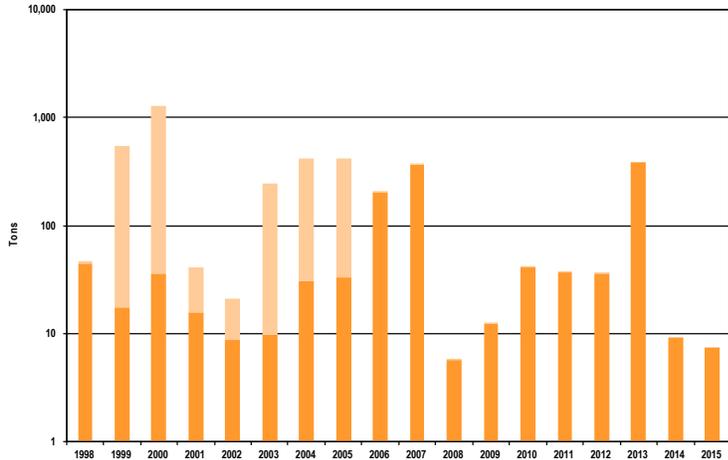


Figure 2-1d. Hazardous Waste Generation from ER and Nonroutine Operations, 1998 – 2015.

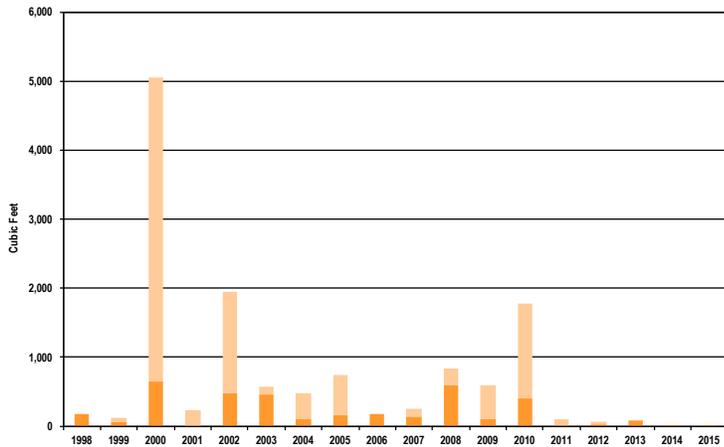


Figure 2-1e. Mixed Waste Generation from ER and Nonroutine Operations, 1998 – 2015.

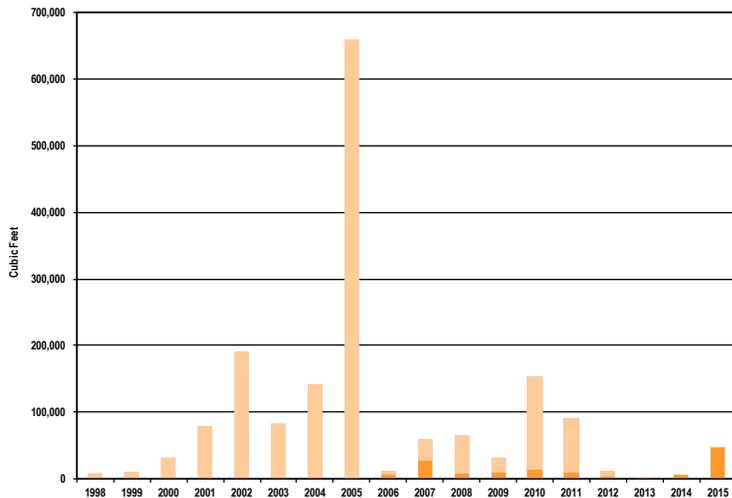


Figure 2-1f. Radioactive Waste Generation from ER and Nonroutine Operations, 1998 – 2015.

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 2015, these efforts resulted in more than \$81.1 million in cost avoidance or savings and approximately 26.1 million pounds of materials being reduced, recycled, or reused annually. Two major pollution prevention projects in 2015 included the National Synchrotron Light Source (NSLS) Stabilization and Hazard Removal Project and the Utility Energy Services Contract (UESC) project, which included energy-efficient lighting, new building controls and commissioning, and an energy-efficient chiller project.

With the completion and start-up of the NSLS-II in September 2014, the NSLS facility ceased operation and the process of repurposing the facility commenced. Laboratory-developed stabilization and hazard removal plans were developed with the objectives of recovering the value of NSLS assets to the extent practicable, and enabling the facility to be reused for a new purpose. The removal plans included:

- The removal of more than \$76 million in NSLS equipment for reuse at NSLS-II, elsewhere on the BNL campus, or elsewhere in the DOE complex.
- More than 1.5 million

Table 2-2. BNL Pollution Prevention, Waste Reduction, and Recycling Programs, 2015.

Waste Description	Type of Project	Pounds Reduced, Reused, Recycled or Conserved in 2015	Waste Type	Potential Costs for Treatment and Disposal	Cost of Recycle, Prevention	Estimated Cost Savings	Project Description Details
Utility Energy Service Contract (UESC)*	Greenhouse Gas Reduction and Energy Conservation	15,448,400	Greenhouse gas	\$0	\$750,000.00	\$1,380,000	UESC includes: Installed energy efficient lighting and controls in 17 buildings; Energy management control upgrades in 9 buildings; installation of an energy efficient 1,250 ton electric centrifugal chiller at the Central Chilled Water Facility.
NSLS Stabilization Project	Equipment Reuse	N/A	Industrial waste	\$0	\$0	\$76,000,000	Equipment reuse at NSLS-II, Collider Accelerator, and Argonne National Laboratory.
NSLS Stabilization Project	Recycling	497,216	Industrial waste	\$1,243,040	\$0	\$1,571,203	Lead recycling at NSLS: Lead was surveyed and shipped to a recycling facility rather than shipped as hazardous waste.
NSLS Stabilization Project	Size Reduction/ Recycling	N/A	Low-Level Radiological Waste	N/A	\$0	\$200,000	Accelerator component disassembly effectively reduced the quantity of low-level radiological waste to 25 percent of the original volume.
Electronic Reuse	Reuse	49,450	Electronic waste	\$123,625	\$0	\$123,625	BNL tracks electronic equipment and takes a reuse credit for transfer of equipment to another user.
Building demolition recycling	Recycling	7,000,000	Industrial waste	\$308,595	\$0	\$308,595	On-site demolition products (steel and concrete) are segregated, recycled, and reused.
Animal bedding conveying system	Composting	11,200	Low-level Radiological Waste	\$110,880	\$0	\$110,880	Animal bedding material is no longer sent to the 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 radiological waste.
Lead acid batteries	Recycled	3,800	Universal waste	\$9,500	\$0	\$9,500	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 (957), the Special Ejection Magnet (912A), and the Relativistic Heavy Ion Collider Research Facility (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, 2015. (continued).

Waste Description	Type of Project	Pounds Reduced, Reused, Recycled or Conserved in 2015	Waste Type	Potential Costs for Treatment and Disposal	Cost of Recycle, Prevention	Estimated Cost Savings	Project Description Details
Blasocut machining coolant	Recycled/ Reused	20,400	Industrial waste	\$49,470	\$0	\$54,270	The Central Shops Division operates a recycling system that reclaims Blasocut machining coolant and supplies it Laboratory-wide. In 2015, 2,550 gallons (20,400 lb) of Blasocut lubricant were recycled. Recycling involves aeration, centrifuge, and filtration. This avoids the 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	15,596	Universal waste	\$795,396	\$15,000	\$780,396	Fluorescent bulbs are collected and sent to a recycling facility under the Universal Waste exemption rule.
Used motor oil	Energy Recovery	10,560	Industrial waste	\$24,504	\$0	\$24,504	Used motor oil from the motor pool and the on-site gas station is given to Strebels Laundry Service to fire their boilers. In 2015, they collected 1,320 gallons of oil at no charge to BNL, which avoided the costs for disposal and 24 shipping drums (\$50/drum).
Office paper	Recycled	182,580	Industrial waste	\$9,585	\$0	\$11,868	Cost avoidance based on \$105/ton for disposal as trash, plus \$25/ton.
Cardboard	Recycled	24,820	Industrial waste	\$1,303	\$0	\$1,799	Cost avoidance based on \$105/ton for disposal as trash, plus \$40/ton.
Electronic Waste	Recycled	84,560	Electronic waste	\$211,400	\$0	\$245,224	Cost avoidance based on \$105/ton for disposal as trash, plus \$800/ton revenue.
Metals	Recycled	1,970,516	Industrial waste	\$103,452	\$0	\$165,746	Cost avoidance based on \$105/ton for disposal as trash, plus \$120/ton revenue.
Bottles/cans	Recycled	44,180	Industrial waste	\$2,319	\$0	\$2,319	Cost avoidance based on \$105/ton for disposal as trash.
Construction debris	Recycled	744,740	Industrial waste	\$39,099	\$0	\$58,462	Cost avoidance based on \$52/ton difference for disposal as trash.
TOTALS				\$3,044,169	\$765,000	\$ 81,116,328	

* The UESC is a 10-year contract with a projected life of 20 years. The 10-year annual payments were divided over 20 years to normalize the savings. This contract ends September 1, 2023

pounds of material were shipped off site for recycling, resulting in more than \$600,000 in returns to the project.

- The preferential use of material recycling saved almost \$200,000 in transportation and disposal of this material as construction and demolition debris.
- BSA's radiological survey processes were used to effectively release and recycle approximately 95 percent of the more than 1,000,000 pounds of equipment removed from the NSLS accelerator enclosures.
- Many beryllium-containing components were shipped back to the manufacturer for disassembly and reuse, thus avoiding potential contamination and hazardous waste handling.
- Accelerator component disassembly and segmentation was highly effective in further reducing the quantity of low-level radiological waste. Waste disposal was only 25 percent of the volume predicted in the hazard removal project budget, resulting in a cost savings of approximately \$200,000.
- Approximately 10,000 pounds of chemicals, gasses, and experimental samples were collected and disposed of through the Waste Management program as hazardous or other-regulated waste. The program also paid for waste disposal of unneeded chemicals, and avoided the potential of future legacy waste issues.
- Several thousand pounds of lead-acid batteries were collected from uninterrupted power supplies (UPS) from equipment and computer systems and sent for recycling.

In addition, BSA collaborated with representatives of Argonne National Laboratory in carrying out the removal and transfer of NSLS components (such as X-Ray ring RF cavities, power supplies, and magnets) with a total replacement value of \$2 million. Shipment of these components to Argonne is planned for early 2016.

For the UESC project, BNL established a contract with National Grid for infrastructure upgrades designed to reduce the Laboratory's annual energy costs by \$1.3 million, emergency intensity by 11 percent, and GHG emissions

by over 7,000 metric tons. Under the terms of the UESC, National Grid facilitated \$12.2 million in third-party financing for DOE to implement lighting and other emergency upgrades at the Laboratory. The loan is being repaid by the savings generated by the upgrades. During the project, the UESC team upgraded lighting systems in 18 buildings; replaced and enhanced emergency management controls in 9 buildings; and installed a new 1,250 ton high-efficiency water chiller at the Central Chilled Water Facility (CCWF) to provide cooling water for Laboratory processes and buildings.

The Laboratory also has an active and successful solid waste recycling program, which involves all employees. In 2015, BNL collected approximately 737 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. With the aid of the UESC and NSLS projects, the 2015 annual recycling rate reached 77 percent.

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. Through an annual maintenance program, conventional plumbing fixtures are replaced with low flow devices.

The Laboratory's goal is to reduce the consumption of potable water and reduce the possible impact of clean water discharges on Sewage Treatment Plant (STP) operations. Figure 2-2 shows the 17-year trend of water consumption. Total water consumption in 2015

Table 2-3. BNL Recycled Program Summary, 2000-2015.

Recycled Waste *	2000	2001	2002	2003	2004	2005	2006	2007	2008	2009	2010	2011	2012	2013	2014	2015
Mixed paper	336	246	209	182	185	193	184	177	151	127	174	186	142	160	150	91
Cardboard	132	127	157	176	179	143	135	121	147	152	141	126	100	97	78	12.4
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
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
Construction debris	243	289	304	334	367	350	297	287	302	312	416	256	380	304	351	372
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
Metals	534	44	48	193	128	559	158	382	460	91	131	84	278	174	256	986
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
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
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
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
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
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
Animal Bedding (composted)	n/a	n/a	0	0	0	0	6.3	19.6	42	41	52	54	3.3	30	10	15
Tyvek (lbs)	n/a	n/a	0	0	0	0	0	0	0	84	60	92	105	0	0	0
Recycling Rate (%)	65	54	57	60	61	63	62	64	68	59	63	59	63	76	58	77
Demolition Projects																
Metals	n/a	n/a	8	23	11	6	35	0	0	0	0	0	60	90	0	0
Concrete	n/a	n/a	891	590	3,000	328	5,505	6175	0	0	4,050	0	4,050	3,500	4,000	0
Construction and debris	n/a	n/a	790	388	1,200	157	818	0	0	0	0	0	0	0	0	0

Notes: All units are tons, except where noted.

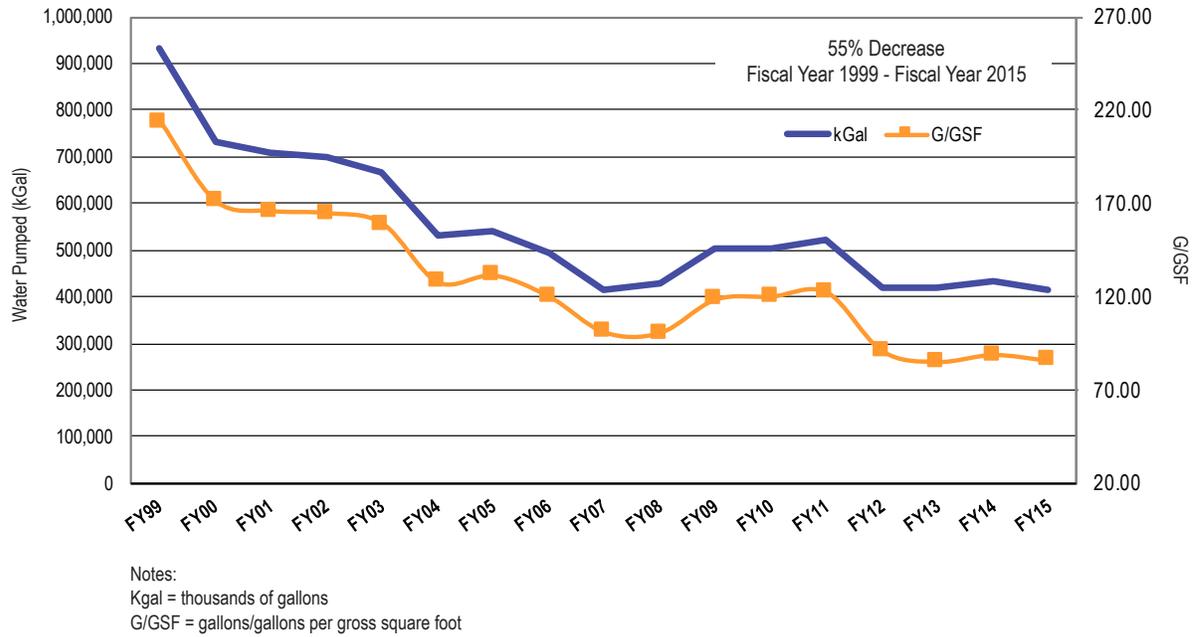


Figure 2-2. Annual Potable Water Use, 1999-2015.

was approximately 4 percent less than in 2014. In each of the past 9 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 4.8 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 2015, BNL used approximately 282 million kilowatt hours (kWh) of electricity, 65,000 gallons of fuel oil, 15,000 gallons of propane, and 646 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. However, 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 2015, this scheduling reduced the electric demand by 25 MW, saving approximately \$1.2 million in electric 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 \$27.5 million in 2015. BNL's energy supply also includes approximately 120 million kWh of clean, renewable energy credits (RECs) received through the Long Island Solar Farm (LISF) and purchased 43 million kWh of RECs in 2015. 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 DOE/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 four 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). The 500 kW phase one array is currently generating approximately 520,000 kWh/year of electricity. In 2015, BNL received funding from the Sustainability Performance Office (SPO) to help BNL expand the NSERC by an additional 430 kW.

To reduce energy use and costs at non-research facilities, several additional activities

were undertaken by the BNL Energy Management Group in 2015:

- *NYPA Power Contract*: Third full year of a 10-year contract that includes 15 MW of renewable (nearly zero GHG) hydropower. This contract is estimated to save in excess of \$26 million per year compared to prevailing energy rates, with an option to renew for an additional 5 years. Actual savings in 2015 were \$27.5 million.
- *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.
- *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 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 and some exceed the original estimates.
- *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.
- *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 these 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 \$5 million per year using natural gas compared to oil and \$400k compared to purchasing directly from National Grid.
- *Energy Savings:* 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 2015 was approximately 25 percent less than in 2003, producing annual savings of \$2.7 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 building design to reduce energy consumption

per square foot. Current goals are to reduce energy consumption per square foot, relative to 2003, by 2 percent per year from FY 2006-FY 2015. Further, EO 13693 and associated orders have set even more stringent requirements, including increased use of renewable energy and reductions in transportation fuels that go significantly beyond the previous goal of a 30 percent reduction by FY 2015, compared to FY 2003. As shown in Figure 2-3, BNL's energy use per square foot in 2015 was 24.9 percent less than in FY 2003. It is important to note that energy use for 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 2011), 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

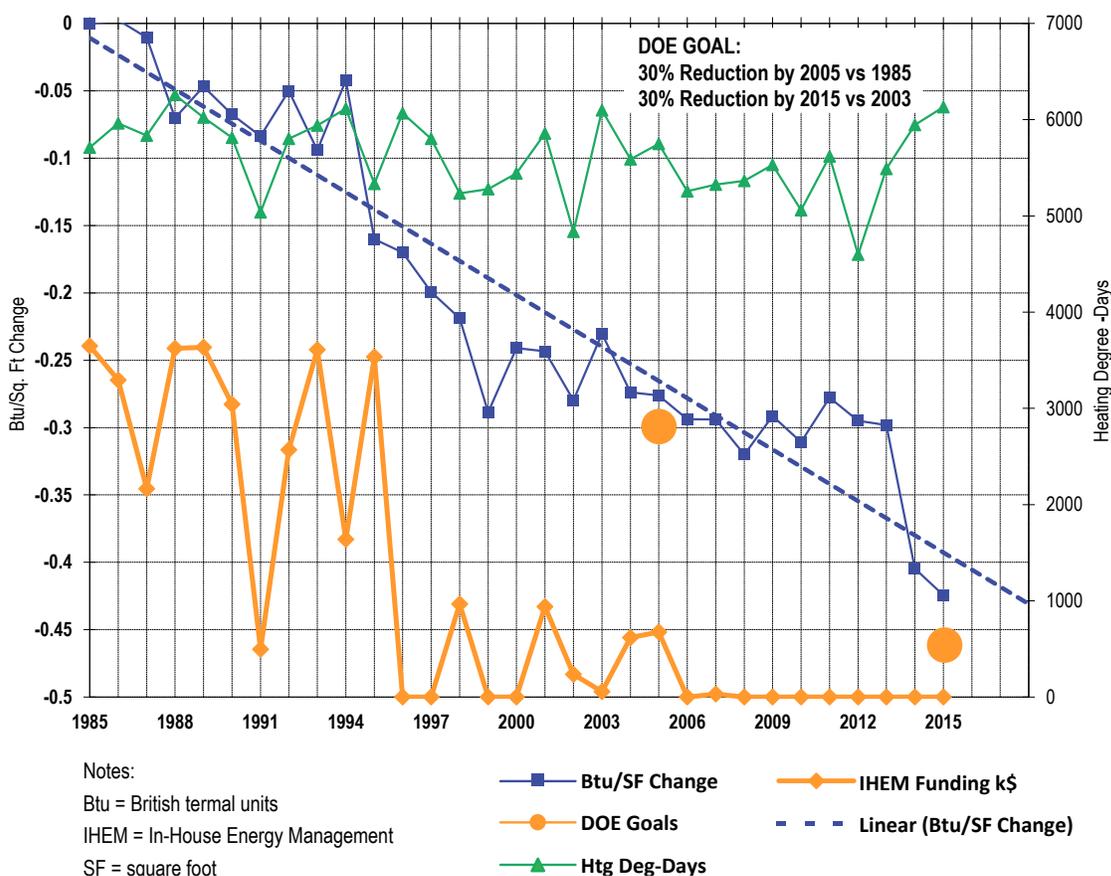


Figure 2-3. BNL Building Energy Performance for 2015 (Btu/SF Change Percent vs. Baseline Years).

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 2015, BNL’s 11 active groundwater

treatment systems removed approximately 94 pounds of volatile organic compounds (VOCs) and 1 mCi of strontium-90 (Sr-90), and returned 1.2 billion gallons of treated water to the sole source aquifer. The North Street Treatment System was shut down and placed in an operationally-ready stand-by mode in 2013, but placed back into operational mode due to a rebound in VOC concentrations. In addition, two new groundwater extraction wells that were installed in the Industrial Park in 2014 and became operational in early 2015. The Building 452 Freon-11 Treatment System met the cleanup goals in 2015, and a Petition for Shutdown was submitted to the regulators. Re-characterization of the Sr-90 plume at the former Hazardous Waste Management Facility (FHWMF) found Sr-90 concentrations up to 302 pCi/L and determined that the plume extended approximately 800 feet downgradient of the facility. Also in 2015, long-term surveillance and maintenance (S&M) of

the Laboratory’s Brookhaven Graphite Research Reactor (BGRR) and the High Flux Beam Reactor (HFBR) continued. In accordance with the ROD, demolition of the HFBR stack will be completed by the end of FY 2020.

Post-cleanup monitoring of Peconic River surface water, sediment, fish, and wetland vegetation continued in 2015, and the results are reported in Chapter 6 of this report. Monitoring and control of invasive species was performed at three Peconic wetland areas that were remediated in 2011. This monitoring continued through 2015, resulting in meeting all federal requirements.

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.

Table 2-4. Summary of BNL 2015 Environmental Restoration Activities.

Project	Description	Environmental Restoration Actions
Soil Projects	Operable Unit (OU) I/II/III/VII	<ul style="list-style-type: none"> Performed monitoring and maintenance of institutional controls for cleanup areas.
Groundwater Projects	OU III/IV/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). 94 pounds of VOCs and 1 mCi of Sr-90 were removed during the treatment of 1.2 billion gallons of groundwater. Since the first groundwater treatment system started operating in December 1996, approximately 7,370 pounds of VOCs and 31 mCi of Sr-90 have been removed, while treating over 25 billion gallons of groundwater. Collected and analyzed approximately 1,517 sets of groundwater samples from 732 monitoring wells. Installed 76 temporary wells and collected multiple samples from each location.
Peconic River	OU V	<ul style="list-style-type: none"> Performed post-cleanup monitoring of Peconic River surface water, sediment, and fish.
Reactors	Brookhaven Graphite Research Reactor (BGRR)	<ul style="list-style-type: none"> Continued long-term surveillance and maintenance, including removal of asbestos floor tiles in sample room, and repairs to roof drainage.
	High Flux Beam Reactor (HFBR)	<ul style="list-style-type: none"> Continued long-term surveillance and maintenance, including repairs to several areas of the HFBR annex roof.
	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 safety enhancements to stack ladder and platforms.
	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.

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 (BNL 2014). The SCR Office 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. The SCR Office also works to maintain relationships with BNL employees and external stakeholders that

include neighbors, 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 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 the Laboratory's 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 in the monthly community e-newsletter, *LabLink*, 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 SCR 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 2015.
 - *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 2015, more than 5,000 visitors participated in the program.
 - *PubSci*: BNL's quarterly 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

2015, science-interested community members and BNL researchers discussed science topics that included the "Climate from Earth to Sky, Tracking the Data of our Changing Planet," and "The Dark Universe: Exploring the Mysterious Invisible Ripples through the Cosmos."

- *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 2015 with a showing of "Zoolander," a film paired with a BNL physicist's research, and "The Day After," a film related to climate science featuring discussion by one of the BNL's premiere climate researchers.

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 bi-weekly 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 monthly e-newsletter, *LabLink*,

found on the Stakeholder Relations webpage at www.bnl.gov/lablink. *LabLink*, which keeps 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 2015, 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:

- *Natural Resources Program:* In January and October, the CAC received updates on the BNL's natural resources, including: the status of the flora and fauna on site, deer management and the 4-Poster tick control system, deer and fish sampling, bat surveys, intern projects, and research at the LISF and NSERC facilities. The CAC was also provided with 2015 sampling data from the Peconic River and the path forward was discussed with regulators.
- *Ecological Recovery of the Peconic River:* In April, the CAC received a comprehensive presentation on the significant progress made over the past 15 years. Following the 2004/2005 original cleanup, NYSDEC wetland permit requirements for revegetation and invasive species control were met in 2006 and approved in 2007, and federal invasive species monitoring and control requirements were met in 2008. Following the 2010/2011 supplemental cleanup of three areas, NYSDEC wetland permit requirements for revegetation and invasive species control were met in 2012 and approved in 2013. Federal invasive species monitoring and control requirements were met in 2014 and 2015.
- *FHWMF Perimeter Soils:* In March and November, the CAC was given an update on the Phase 3 of cleanup of contaminated soils as a result of historical operations.
- *FHWMF Sr-90 Groundwater Characterization:* In September and November, the CAC was briefed on characterization work needed to define the extent of Sr-90 in the groundwater in the vicinity of the FHWMF.
- *2014 Site Environmental Report:* In September, 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 the radiological dose assessment was explained.
- *2014 Annual Groundwater Update:* The CAC received a presentation in November on the highlights of the annual report including the current status of treatment systems and VOC remediation. Updates on the Building 452 Freon-11 treatment system, FHWMF, and Chemical Holes were provided.
- *Community Wildfire Protection Plan:* The CAC and general public were invited to attend a December meeting seeking public input on the Community Wildfire Protection plan. The plan is a community driven process that addresses wildfire risk, reduces threats to life and property, and enables future funding of mitigation activities.
- *Peconic River Update:* A December presentation was given to the CAC regarding monitoring the extent of mercury contamination in sediment at the PR-WC-06 area. Also included in the discussion were the next steps to: develop a cleanup proposal, obtain approval from regulators, develop a detailed plan, develop permitting documents, Title D disposal justification, and conduct the cleanup.

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. The monitoring program is reviewed and revised, as necessary or on an annual basis, to reflect changes in permit requirements, changes in facility-specific monitoring activities, or the need to increase or decrease monitoring based on a review of previous analytical results.

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.

As shown in Table 2-5, in 2015 there were 7,758 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), accelera-

tors, 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 authority. 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 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 are 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

Table 2-5. Summary of BNL Sampling Program Sorted by Media, 2015.

Environmental Media	No. of Sampling Events(a)	Purpose
Groundwater	1,517 (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, Groundwater Status Report, for further detail.
On-Site Recharge Basins	64	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	48 ES 191 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)	490	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	18	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	260	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	416 ES/C 55 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)

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Table 2-5. Summary of BNL Sampling Program Sorted by Media, 2015. (concluded).

Environmental Media	No. of Sampling Events(a)	Purpose
Fauna	400	Fish and deer are monitored to assess impacts on wildlife associated with past or current BNL operations. See Chapter 6 for further detail.
Flora	12	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	331	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	948	Samples are collected periodically from potable water fixtures and dispensers, manholes, spills, to assess process waters, and to assess sanitary discharges.
Groundwater Treatment Systems and Remediation Monitoring	1,407	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 14 operating groundwater treatment systems. See discussion in Chapter 7.
State Pollutant Discharge Elimination System (SPDES)	328	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	588	Flowcharts are exchanged weekly as part of BNL's SPDES permit requirements to report discharge flow at the recharge basin outfalls.
Floating Petroleum Checks	102	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	446	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)	137	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	7,758	The total number of sampling events includes all samples identified in the Environmental Monitoring Plan (BNL 2015), 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

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, audits are conducted as part of BNL's Self-Assessment Program. The audits are designed to ensure that any nonconformance to the ISO 14001 Standard is identified and addressed. In addition, compliance with regulatory requirements is verified through routine inspections, operational evaluations, and focused compliance audits. BNL's Self-Assessment Program consists of several processes:

- Self-assessment is the systematic evaluation of internal processes and performance. The approach for the environmental self-assessment program includes evaluating programs and processes within organizations that have environmental aspects. Conformance to the Laboratory's EMS requirements is verified, progress toward achieving environmental objectives is monitored, operations are inspected to verify compliance with regulatory requirements, and the overall effectiveness of the EMS is evaluated. BNL environmental staff routinely participate in these assessments. Laboratory management conducts assessments to evaluate BNL environmental performance from a programmatic perspective, to determine if there are Laboratory-wide issues that require attention, and to facilitate the identification and communication of "best management" practices used in one part of the Laboratory that could improve performance in other parts. BNL management also 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.
- Independent assessments are 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. These assessments verify the effectiveness and adequacy of management processes (including self-assessment programs) at the division, department, directorate, and Laboratory levels. Special investigations are also conducted to identify the root causes of problems, as well as identify corrective actions and lessons learned.

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 also 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

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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.

In 2015, BNL received a Gold level GreenBuy Award for achieving excellence in Sustainable Acquisition. Participation in this program leverages the Federal government's purchasing dollars to achieve mission goals while improving the marketplace for greener products and reducing the environmental impact of DOE operations.

For more than 60 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.

REFERENCES AND BIBLIOGRAPHY

- BNL. 2011. Natural Resource Management Plan for Brookhaven National Laboratory. BNL-71870-2003. Brookhaven National Laboratory, Upton, NY.
- BNL. 2013a. Cultural Resource Management Plan for Brookhaven National Laboratory. BNL-100708-2013. Brookhaven National Laboratory, Upton, NY. May 2013.
- BNL 2013b. Brookhaven National Laboratory Soil and Peconic River Surveillance and Maintenance Plan. Brookhaven National Laboratory, Upton, NY. March 2013.
- BNL 2013c. Groundwater Protection Contingency Plan—Response to Unexpected Monitoring Results. Environmental Monitoring Procedure EM-SOP-309. Brookhaven National Laboratory, Upton, NY. August 2013.
- BNL. 2014. Community Involvement Policy and Plan. Brookhaven National Laboratory, Upton, NY. BNL. 2015. Environmental Monitoring Plan 2016 Update. Brookhaven National Laboratory, Upton, NY.
- DOE Order 436.1, 2011. Departmental Sustainability. U.S. Department of Energy, Washington, DC. May 2, 2011.
- DOE Order 458.1 Admin Chg 3, 2013. Radiation Protection of the Public and Environment. U.S. Department of Energy, Washington, DC. January 15, 2013.
- Executive Order 13639, 2015. Planning for Federal Sustainability in the Next Decade. US Department of Energy, Washington, DC. March 15, 2015.
- Executive Order 13514, 2009. Federal Leadership in Environmental, Energy, and Economic Performance. US Department of Energy, Washington, DC. October 5, 2009.
- Executive Order 13423, 2009. Strengthening Federal Environmental, Energy and Transportation Management. U.S. Department of Energy, Washington, DC. January 24, 2007.
- ISO 2004. ISO 14001, Environmental Management Systems – Specification with Guidance for Use. First Edition. International Organization for Standardization. Geneva, Switzerland.