

Environmental Management System

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Brookhaven Science Associates (BSA), the contractor operating the Laboratory on behalf of the Department of Energy (DOE), takes environmental stewardship very seriously. As part of its commitment to environmentally responsible operations, BSA has established the Brookhaven National Lab (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, which encompasses ideals such as compliance, pollution prevention, and community involvement. Annual audits by an independent third party are required to maintain an EMS registration; an audit of the entire EMS occurs every three years. In 2018, an EMS certification audit determined that BNL conforms to the revised ISO 14001:2015 Standard.

The Laboratory continues its strong support of its Pollution Prevention Program, which seeks ways to eliminate waste and toxic materials on site. In 2018, pollution prevention projects resulted in nearly \$3.8 million in cost avoidance or savings and resulted in the reduction or reuse of approximately 3.2 million pounds of waste. Additional support was provided to line organizations for lab cleanouts and disposal of chemicals.

The ISO 14001-registered EMS continues to contribute to the Laboratory's success in promoting pollution prevention. As a testament to its strong environmental program, the Lab received the Green Electronics Council's Electronic Product Environmental Assessment Tool (EPEAT) Award.

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

2.1 INTEGRATED SAFETY MANAGEMENT, ISO 14001, AND OHSAS 18001

The Laboratory's Integrated Safety Management System (ISMS) integrates environment (i.e., environmental protection and pollution prevention), safety, health, and quality (ESH&Q) management into all work planning and execution. The purpose of BNL's ISMS is to ensure that the way we work integrates DOE's five Core Functions and seven Guiding Principles into all work processes. The

five Core Functions, as defined by DOE P 450.4, Safety Management System Policy, are:

- Define the scope of work: Missions are translated into work, expectations are set, tasks are identified and prioritized, and resources are allocated.
- *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, also as defined by DOE P 450.4, 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 shall be tailored to the work being performed and associated hazards.
- *Operations authorization:* The conditions

and requirements to be satisfied for operations to be initiated and conducted shall be clearly established and agreed upon.

The integrated safety processes within ISMS contributed to BNL achieving ISO 14001 and Occupational Health and Safety Assessment Series (OHSAS) 18001 registrations. The ISO 14001 Standard is globally recognized and defines the structure of an organization's EMS for purposes of improving environmental performance. OHSAS 18001 mirrors the ISO 14001 structure for purposes of improving safety and providing a safe and healthy workplace that is 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 has been officially registered to the ISO 14001 Standard since 2001 and registered to the OHSAS 18001 Standard since 2006. The Laboratory was the first DOE Office of Science Laboratory to achieve both registrations. Each certification requires the Laboratory to undergo annual audits by an accredited, third-party registrar to assure that the systems are maintained. BNL's external certification organization, ERM Certification Verification Services, conducted an external certification audit of BNL's conformance to the ISO 14001 and OHSAS 18001 Standards in July 2018. The reassessment determined that the Laboratory was in full conformance to the standard and, therefore, recertification was received. OHSAS 18001 audit results are not included in this report.

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, states the

Laboratory's commitment to environmental stewardship, the safety of the public and BNL employees, and the security of the site. The policy continues as a statement of the Laboratory's intentions and principles regarding overall environmental performance. It provides a framework for planning and action and is included in employee, guest, and contractor training programs. The ESSH Policy is posted throughout the Laboratory and on the BNL website at <http://www.bnl.gov/esh/policy.php>. The Policy's goals and commitments focus on compliance, pollution prevention, community outreach, and continual improvement:

- *Environment:* We protect the environment, conserve resources, and prevent pollution.
- *Safety:* We maintain a safe workplace, plan our work, and perform it safely.
- *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; evaluate applicable legal and other requirements; establish objectives and targets; create action plans to achieve the objectives and targets; and identify and address risks and opportunities that can impact the success of the EMS.

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 uses its work planning process to identify and review environmental aspects associated with activities. A Process Assessment Procedure is used for facilities and equipment or for deeper analysis of activities not sufficiently covered by work planning. Evaluations are documented on work plans and Process Assessment Forms (PAFs).

Environmental professionals work closely with Laboratory personnel to ensure that work plans, PAFs, and other related reviews thoroughly capture all aspects, requirements, and associated environmental controls. Aspects and impacts are evaluated annually to ensure that they continue to reflect stakeholder concerns and changes in regulatory requirements.

2.3.2 Compliance Obligations

To implement the compliance commitments of the ESSH Policy and meet its legal requirements, BNL has systems in place to review changes in federal, state, or local environmental regulations and communicate those changes to affected staff. 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 May 2018, Executive Order (EO) 13834, Efficient Federal Operations, replaced EO 13693, Planning for Federal Sustainability in the Next Decade, which established sustainability goals for federal agencies with a focus on greenhouse gas (GHG) reductions across the government. However, implementing instructions for EO 13834 were not issued during 2018. The Laboratory continues to follow the guidance, recommendations, plans, and numerical targets set forth in EO 13693.

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, which can be found in Appendix E and identifies the DOE SSP goals, the Laboratory's performance in 2018, 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);
- Compliance obligations (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 2018, BNL's environmental objectives included maintaining ISO 14001 and OHSAS 18001 certifications, the Laboratory's performance in purchasing environmentally preferable items, and reducing the overall hazard footprint by reducing chemical inventories.

2.3.4 Environmental Management Programs

The Environmental Protection Division (EPD) takes on the largest role for developing action plans for implementing institutional

environmental priorities, while other organizations within BNL develop action plans as applicable to their operations. The plans detail how the organization 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 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, monitoring drinking water systems for emerging contaminants, 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.)

2.3.4.2 Groundwater Protection

BNL's Groundwater Protection Program is designed to prevent negative impacts to groundwater and restore groundwater quality by integrating pollution prevention efforts, monitoring, groundwater restoration projects, and communicating performance. The Laboratory has developed a Groundwater Protection Contingency Plan (2018) that defines an orderly process for quickly verifying the results and taking corrective actions in response to unexpected

monitoring results (BNL 2018). 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 2018.

2.3.4.3 Waste Management

Due to the world-class research it conducts, 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, industrial, and mixed waste. BNL's Waste Management Facility (WMF), operated by the 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, industrial, and mixed waste in Building 855, regulated by RCRA, and a reclamation building for radioactive material in Building 865. The RCRA building is

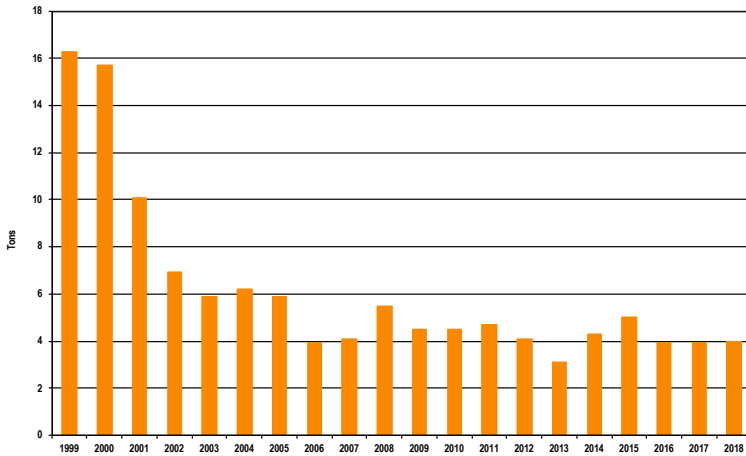


Figure 2-1a. Hazardous Waste Generation from Routine Operations, 1999 – 2018.

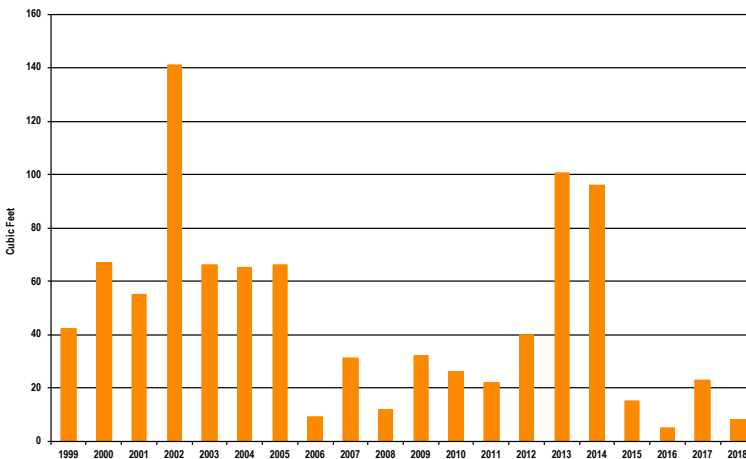


Figure 2-1b. Mixed Waste Generation from Routine Operations, 1999 – 2018.

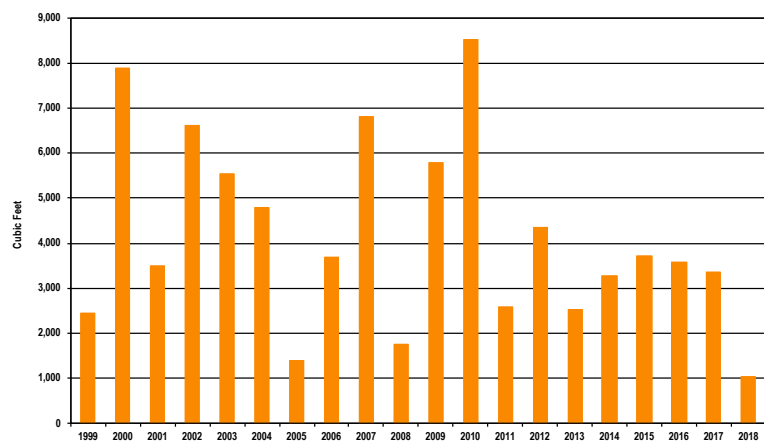


Figure 2-1c. Radioactive Waste Generation from Routine Operations, 1999 – 2018.

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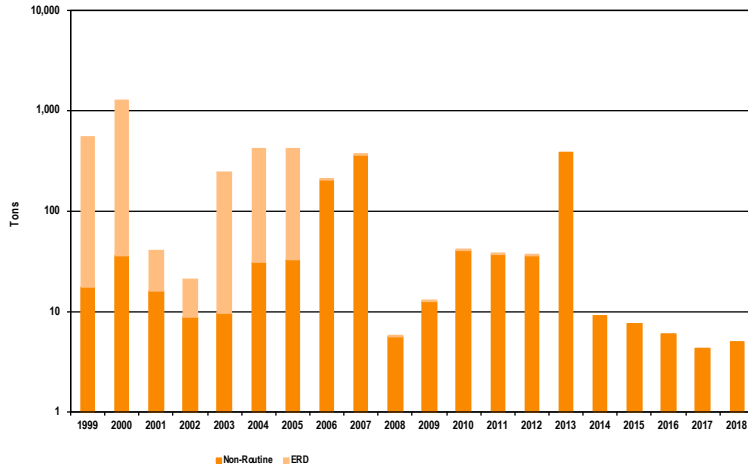


Figure 2-1d. Hazardous Waste Generation from ER and Nonroutine Operations, 1999 – 2018.

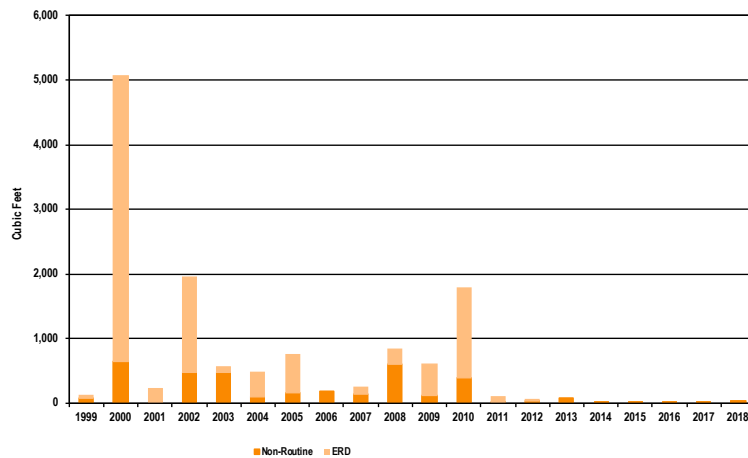


Figure 2-1e. Mixed Waste Generation from ER and Nonroutine Operations, 1999 – 2018.

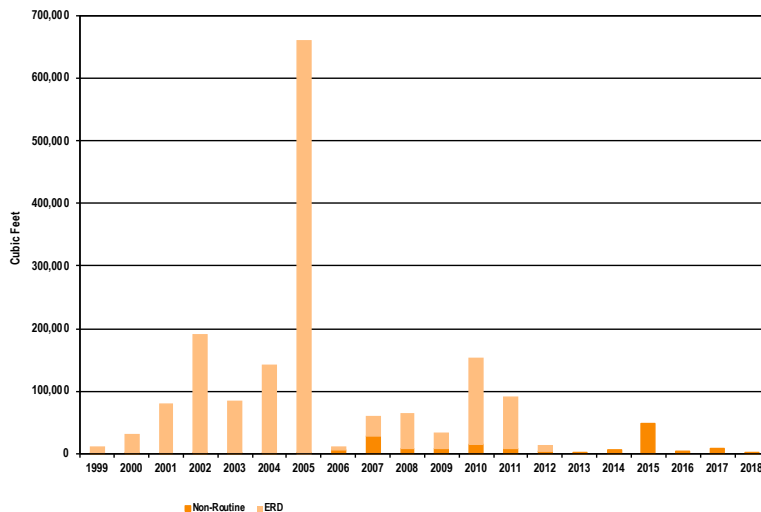


Figure 2-1f. Radioactive Waste Generation from ER and Nonroutine Operations, 1999 – 2018.

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. Waste can either be generated from routine operations, defined as ongoing industrial and experimental operations, or from non-routine, defined by that generated by remediation projects, facility decommissioning activities, or one-time events (e.g., lab cleanouts). In 2018, BNL generated the following types and quantities of waste from routine operations:

- Hazardous waste: 4 tons
- Mixed waste: 8 ft³
- Radioactive waste: 1,021 ft³

Hazardous waste from routine operations in 2018 stayed consistent from 2017 generation rates, as shown in Figure 2-1a, based on stable generating activities over the year as compared to the year before. Mixed waste generation decreased from 2017 rates, as shown in Figure 2-1b. The change is due to fluctuations in operations at BNL's accelerator facilities. Though the radioactive waste quantity shown in Figure 2-1c for routine operations decreased significantly from the year before, the change is still indicative of routine fluctuations of the generating process.

BNL's inventory of legacy waste has been significantly reduced over the years.

Figures 2-1d through 2-1f show waste generated from non-routine operations. Waste generation from these activities can vary significantly from year to year as various decommissioning and remedial actions are conducted. Non-routine waste generation in 2018 mainly consisted of hazardous waste associated with the demolition of Building 134.

2.3.4.4 Pollution Prevention and Waste Minimization

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

Pollution prevention and waste reduction goals have been incorporated into the DOE contract with BSA, into BNL's ESSH Policy, the PEMP 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, as practicable;
- 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 2-1 describes the P2 projects implemented through 2018, and provides the number of pounds of materials reduced, reused, or recycled, as well as the estimated cost benefit of each project.

The implementation of pollution prevention opportunities, recycling programs, and conservation initiatives has reduced both waste volumes and management costs. In 2018, these efforts resulted in nearly \$3.8 million in cost avoidance or savings and approximately 3.2 million pounds of materials being reduced, recycled, or reused annually.

The Laboratory has an active and successful solid waste recycling program, which involves all employees. In 2018, BNL collected approximately 559 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 2-2 shows the total number of tons (or units) of the materials recycled. The baseline recycling rate goal for federal facilities is 50 percent; since 2000, BNL's annual average recycling rate has consistently ranged above this baseline. The 2018 annual recycling rate was 69 percent.

In 2018, BNL's sustainability program was honored by receiving the Green Electronics Council's Electronic Product Environmental Assessment Tool (EPEAT) Award for purchasing EPEAT-registered electronic products which meet strict environmental criteria that address the full product lifecycle, from energy conservation to toxic materials to product longevity and end-of-life management.

2.3.4.5 Water Conservation

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

Table 2-1. BNL Pollution Prevention, Waste Reduction, and Recycling Programs.

Waste Description	Type of Project	Pounds Reduced, Reused, Recycled or Conserved in 2018	Waste Type	Potential Costs for Treatment and Disposal	Revenue/(Cost) of Recycle, Prevention	Estimated Cost Savings	Project Description Details
Office Paper	Recycled	130,260	Regular Trash	\$7,685	(\$6,500)	\$1,185	Cost avoidance was based on \$118/ton for disposal as trash. Cost to recycle was \$6,500 (\$13,000 flat fee for paper/cardboard combined).
Cardboard	Recycled	148,800	Regular Trash	\$8,779	(\$6,500)	\$2,279	Cost avoidance was based on \$118/ton for disposal as trash. Cost to recycle was \$6,500 (\$13,000 flat fee for paper/cardboard combined).
Bottles/Cans	Recycled	20,420	Regular Trash	\$1,205	\$0	\$1,205	Cost avoidance was based on \$118/ton for disposal as trash.
Printer Toner Cartridges	Recycled	2,118	Regular Trash	\$125	\$0	\$125	Printer toner cartridges were picked up by vendor for recycling, saving the cost to dispose as regular municipal solid waste.
Metals	Recycled	1,117,800	Regular Trash	\$65,950	\$88,756	\$154,706	Cost avoidance was based on \$118/ton for disposal as trash, plus \$88,756 revenue (various pricing).
Electronic Waste	Recycled	106,520	Electronic Waste	\$6,285	\$42,608	\$48,893	Cost avoidance was based on \$118/ton for disposal as trash, plus \$42,608 revenue based on \$0.40/lb.
Electronic Reuse	Reuse	43,591	Electronic Waste	\$3,491,000	(\$25,283)	\$3,465,717	The Laboratory tracked electronic equipment and took a reuse credit for transfer of equipment to another user. Savings were based on the cost to purchase a new version of the item minus the scrap value of that item.
Building 452 Oil Skimmer	Source Reduction	15,516	Industrial Waste	\$6,708	(\$9,623)	(\$2,915)	Reduced oily water waste stream (non-halogenated oil) from air compressors by skimming off oil and leaving water phase. Water may be discharged to sanitary system. In 2018, 1,800 lbs. of skimmed oil were sent to vendor for re-processing/reuse as well as 13,716 lbs. of oil contaminated with water due to other system problems unrelated to compressor skimming. The total cost to process this waste at the vendor was \$9,623.
Used Motor Oil	Energy Recovery	18,432	Industrial Waste	\$6,755	(\$1,280)	\$5,475	Used motor oil from Building 452 and the motor pool was given to Sirebel's Laundry Service to fire their boilers. In 2018, they collected 2,560 gallons (18,432 lbs) of oil at \$0.50 /ga, which avoided the costs for disposal and 52 shipping drums (\$120/drum).

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Table 2-1. BNL Pollution Prevention, Waste Reduction, and Recycling Programs (concluded).

Waste Description	Type of Project	Pounds Reduced, Reused, Recycled or Conserved in 2018	Waste Type	Potential Costs for Treatment and Disposal	Revenue/(Cost) of Recycle, Prevention	Estimated Cost Savings	Project Description Details
Blasocut Machining Coolant	Recycled/ Reused	23,392	Industrial Waste	\$86,580	\$0	\$86,580	Central Shops Division operated a recycling system that reclaimed Blasocut machining coolant and supplied it Laboratory-wide. In 2018, 2,942 gallons (23,392 lb.) of Blasocut lubricant were recycled. Recycling involved aeration, centrifuge, and filtration. This avoided cost of disposal as industrial waste as well as the cost of buying 59 drums of concentrate (\$1357/drum) and empty drums for shipping (\$120/drum).
Building Demolition Recycling	Recycling	1,430,400	C&D Debris	\$52,383	(\$52,750)	(\$368)	On-site demolition products (steel and concrete) were segregated, recycled, and reused. Materials collected during 2018 were from the demolition of Building 134 and included 664 tons of construction and demolition (C&D) debris, 52 tons of metal sent for recycling, and 100 Y (196 tons) of concrete retained for crushing and reuse onsite during 2019. Cost for disposal was based on all materials landfilled at a cost of \$57.50/ton. Instead, the steel was recycled, generating \$10.3K revenue and the remaining C&D was sent for recycling at a cost of \$63,050.
Construction Debris - Concrete	Recycled	0	C&D Debris	\$0	\$0	\$0	No concrete was crushed during 2018.
Tires	Recycled	17,745	Regular Trash	\$1,047	\$0	\$1,047	Truck tires were sent for recycling from the motor pool. Cost savings were based on cost to dispose of as trash.
Lead Acid Batteries	Recycled	29,580	Universal Waste	\$7,987	\$0	\$7,987	Avoided universal waste disposal costs for lead and sulfuric acid batteries.
Fluorescent Bulbs	Recycled	4,560	Universal Waste	\$6,156	(\$1,751)	\$4,405	Fluorescent bulbs were collected and sent to a recycling facility under the Universal Waste exemption rule. Savings were in comparison to cost to dispose of them as hazardous waste.
Garnet	Recycled	42,000	Industrial Waste	\$56,700	(\$2,000)	\$54,700	Garnet used in machine shop was sent for recycling. Cost savings were based on cost to dispose of as Regulated Industrial Waste.
Animal Bedding Conveying System	Composting	3,840	Medical Waste	\$1,303	\$0	\$1,303	Animal bedding material was conveyed to a dumpster that was emptied and composted at the stump dump. Savings were calculated on the assumption that the material would be disposed of as Regulated Medical Waste.
TOTALS		3,154,974		\$3,806,646	\$25,677	\$3,832,323	

Table 2-2. BNL Recycled Program Summary, 2006-2018.

Recycled Waste	2006	2007	2008	2009	2010	2011	2012	2013	2014	2015	2016	2017	2018
Mixed paper	184	177	151	127	174	186	142	160	150	91	89	84	65
Cardboard	135	121	147	152	141	126	100	97	78	12.4	73	74	74
Bottles/Cans	27.7	24.4	19.6	23.7	24	22.5	18	16.5	17.1	22.1	11	7.9	10.2
Tires	32.5	19.9	34.5	15.5	10.1	9.2	10	7.1	7.6	5.4	6.4	5.2	8.8
Construction Debris	297	287	302	312	416	256	380	304	351	372	266	0	0
Used motor oil	11.1	8.1	6.0	7.2	6.8	5.7	6.3	6.2	8.0	5.3	10.9	12.5	9.3
Metals	158	382	460	91	131	84	278	174	256	737	426	621	559
Automotive & UPS batteries	5.5	2.5	2.7	4	1.6	2.1	2	2.1	1.4	1.9	1.4	0.6	15
Printer/Toner cartridges	0	0	1.5	1.7	2.1	2.1	2.1	5.6	1.1	1.0	n/a	1.2	1.1
Fluorescent bulbs	5.9	12.7	18.4	6.3	4.4	10.1	7.9	6.8	9.9	8.0	4.8	2.5	2.3
Blasocut coolant	15.9	9.7	13.4	15.2	19.3	22.6	22.4	22.6	19.4	10.2	9.4	7.8	11.7
Smoke detectors (each)	0	0	0	0	0	0	0	0	0	0	0	0	0
Electronic reuse	0	0	16.3	11.4	12	11.6	3.2	1.4	10.5	25	17	19	21.7
Scrap electronics	70.3	40.5	48.9	17	16.7	19.9	30.9	23	29.3	42	24	23.1	53.3
Garnet	---	---	---	---	---	---	---	---	---	---	---	20.5	21
Animal Bedding (composted)	6.3	19.6	42	41	52	54	3.3	30	10	15	11	2.3	1.9
Recycling Rate (%)	62	64	68	59	63	59	63	76	58	77	74	69	69
Demolition Projects													
Metals	35	0	0	0	0	0	60	90	0	0	0	0	51.5
Concrete	5,505	6175	0	0	4,050	0	4,050	3,500	4,000	0	4200	3500	0
Construction and debris	818	0	0	0	0	0	0	0	0	0	0	0	664

Notes: All units are tons, except where noted.

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

The Laboratory's goal is to reduce the consumption of water and reduce the possible impact of clean water dilution on STP operations. Figure 2-2 shows the 18-year trend of water consumption. Total water consumption in 2018 was down slightly from 2017. The water intensity (gallon/gross square foot) also continues to decrease. In each of the past ten years, the water consumption total was approximately half the 1999 total—a reduction of nearly a half billion gallons per year.

2.3.4.6 Energy Management and Conservation

Since 1979, the Laboratory's Energy Management Group has been working to reduce energy use and costs by identifying and implementing cost-effective, energy-efficient projects; monitoring energy use and utility bills; and assisting in obtaining the least expensive energy sources possible. The group is responsible for developing, implementing, and coordinating BNL's energy management efforts and assisting DOE in meeting the energy and sustainability goals in EO 13693, DOE Order 436.1, and the Secretary's initiatives. The Laboratory's SSP addresses all aspects of the DOE energy, water, transportation, and other sustainability goals.

BNL has more than 4.9 million square feet of building space. Many scientific experiments at the Laboratory use particle beams generated

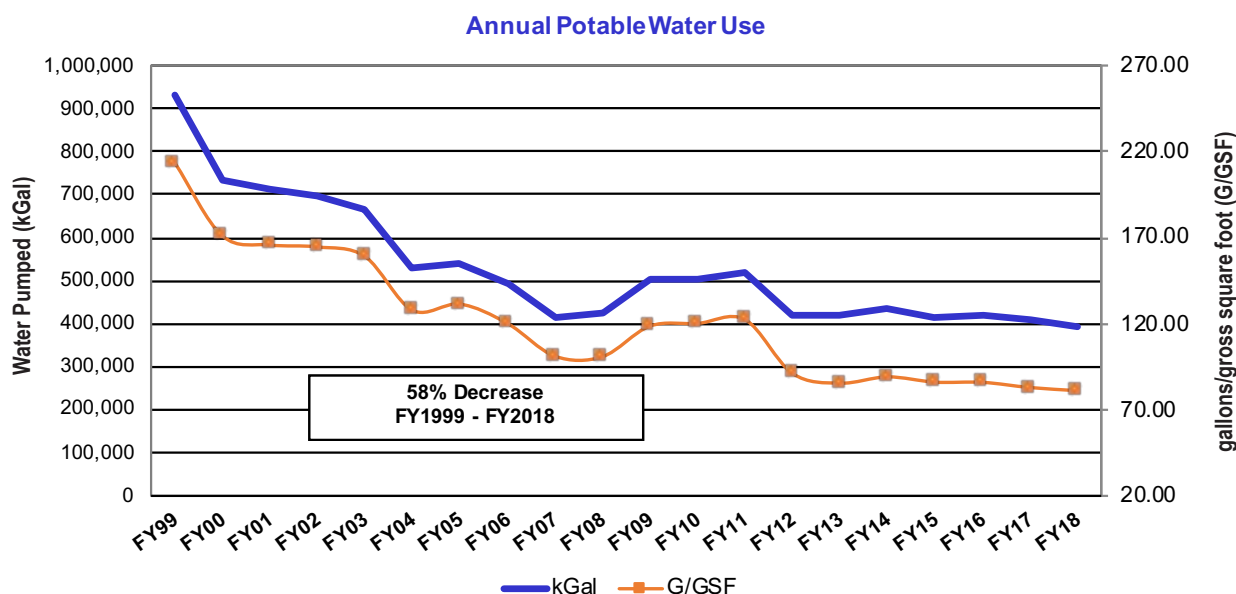


Figure 2-2. Annual Potable Water Use, 1999-2018.

and accelerated by electricity, with the particles controlled and aligned by large electromagnets. In 2018, BNL used 263 million kilowatt hours (kWh) of electricity, 61,565 gallons of fuel oil, 16,071 gallons of propane, and 645 million cft 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 have been historically used whenever each respective fuel is least expensive. In 2018, natural gas prices were lower than fuel oil prices for most of the year. As a result, natural gas was used to meet over 98 percent of the heating and cooling needs of the Laboratory's major facilities. 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 expects customer demand to meet or exceed the available supply. In return, BNL sometimes receives a rebate for each mega-watt

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 to avoid peak demand periods. This scheduling reduced the electric demand by 25 MW, saving approximately \$1.0 million in electric demand costs and helping to maintain the reliability of the Long Island Power Authority (LIPA) electric system to meet all its users' needs. BNL also maintains a contract with the New York Power Authority that resulted in an overall cost avoidance of \$27.7 million.

In 2018, BNL's energy supply includes approximately 120 million kWh of clean, renewable hydropower energy, 1.1 million kWh of on-site generated solar photovoltaic (PV), and 62.6 million kWh of purchased renewable energy certificates (REC). 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 Long Island Solar Farm (LISF) on BNL property. The array is currently the largest solar 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 annual output for 2018 was 46.6 million kWh and resulted in an avoidance of approximately 30,200 tons of carbon. At the time of the installation, the estimated annual output was 44 million kWh. The actual output for the first six operational years was an average of 51.5 million kWh/year, substantially above the estimated annual average value. 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 photovoltaic (PV) systems, as well as research and development for solar power storage and inverter efficiencies. The Federal Energy Management Program 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 solar PV research array as part of the Northeast Solar Energy Research Center (NSERC). In 2016, the array was increased to 816 kW with substantial funding assistance from the Sustainability Performance Office (SPO). In 2018, the NSERC generated 1,095,183 kWh of electricity for use on site. To reduce energy use and costs at non-research facilities, several activities were continued or undertaken by the BNL Energy Management Group in 2018:

- *NYPA Power Contract:* Seventh full year of a 10-year contract that includes 15 MW of renewable (nearly zero GHG) hydropower. This contract saved \$27.7 million in 2018.
- *DOE Sustainability Initiative:* The Energy Management Group continues to provide substantial support to the Federal/DOE-wide Sustainability Initiative and has created a BNL Sustainability Leadership Team. The team has developed a formal site-wide sustainability program beyond DOE requirements, participates in one of three subcommittees for DOE on sustainability initiatives, and provides numerous evaluations and estimates on energy use, GHG, renewable energy, and energy-efficiency options.
- *Substantial progress on several initiatives included in BNL's annual SSP:* New electric and steam meter installations; funding for energy conservation initiatives; new energy-efficient lighting installed in parking lots and offices; the purchase of RECs in meeting BNL's SSP goal; and training various parties on energy conservation initiatives.
- *Utility Energy Services Contract (UESC):* A UESC contract/project was completed in 2015 with the National Grid which installed energy-efficient lighting, new building controls, and an energy-efficient water chiller. The environmental benefits of this UESC were estimated to include electrical savings of 3,549,114 kWh/year, fuel savings of 89,541 mm Btu/year, a GHG reduction of 7,022 MT-CO₂e, and a building energy intensity reduction of 11 percent. To date, actual energy savings meet or exceed the original estimates. Through a comprehensive Measurement and Verification process, BNL has been able to verify that actual energy savings were within a few percent of the original projections for the first two years of operation.
- *UESC II:* BNL initiated an Investment Grade Audit (IGA) for a potential second UESC effort. The IGA will identify energy cost savings as well as detailed construction cost estimates. If the results of the IGA are favorable, the project could begin in fiscal year 2020.
- *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 has achieved compliance in the EPA Portfolio Manager program. BNL is currently on target to meet or exceed the HPSB goal.
- *Renewable Energy:* Project support continues for the LISF and NSERC facilities and annual purchases of REC's to meet targeted goals.
- *The Central Chilled Water Facility (CCWF):* The CCWF continues to utilize a 3.2-million-

gallon chilled water storage tank to reduce peak electric demand by producing and storing chilled water during the night.

- *Natural Gas Purchase Contract:* BNL is currently saving approximately \$4 million per year using natural gas compared to oil.
- *Energy Savings:* As mentioned above, 25 MW of demand is rescheduled each year to avoid coinciding with the utility summer peak, saving over \$1.0 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 or LED fixtures as appropriate. 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 2018 was approximately 29 percent less than in 2003, producing annual savings of \$2.6 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 of 2007, requires federal agencies to apply energy conservation measures and improve federal building design to reduce energy consumption per square foot (Energy Intensity). Current goals included with EO 13693 are to reduce energy consumption per square foot, relative to 2015, by 25 percent by the year 2025. As shown in Figure 2-3, BNL's energy use per square foot in 2018 was 29 percent less than in FY 2003. Going forward, BNL will be comparing the current Energy Intensity values to the new base year of 2015. It is important to note that energy use for most buildings and facilities at the Laboratory is largely weather dependent. In 2018, energy use at the Lab decreased five percent from the base year of 2015.

2.3.4.7 Natural and Cultural Resource Management Programs

Through its Natural Resource Management Plan (BNL 2016), BNL continues to enhance its Natural Resource Management Program in cooperation with the Foundation for Ecological Research in the Northeast 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 Inter-agency Agreement (IAG). This agreement was formalized in 1992. Although not a formal signatory of the IAG, the Suffolk County Department of Health Services (SCDHS) also plays a key role in the review process.

Most of the contamination at the Laboratory is associated with past accidental spills and outmoded practices for handling, storing, and disposing of chemical and radiological material. BNL follows the CERCLA process, which includes the following steps:

- Conduct a remedial investigation to characterize the nature and extent of contamination and assess the associated risks;
- Prepare a feasibility study and proposed plan to identify and evaluate remedial action alternatives and present the proposed alternative;
- Issue a Record of Decision (ROD), which is the 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 corrective action selected.

In 2018, BNL's nine active groundwater treatment systems removed approximately 62 pounds

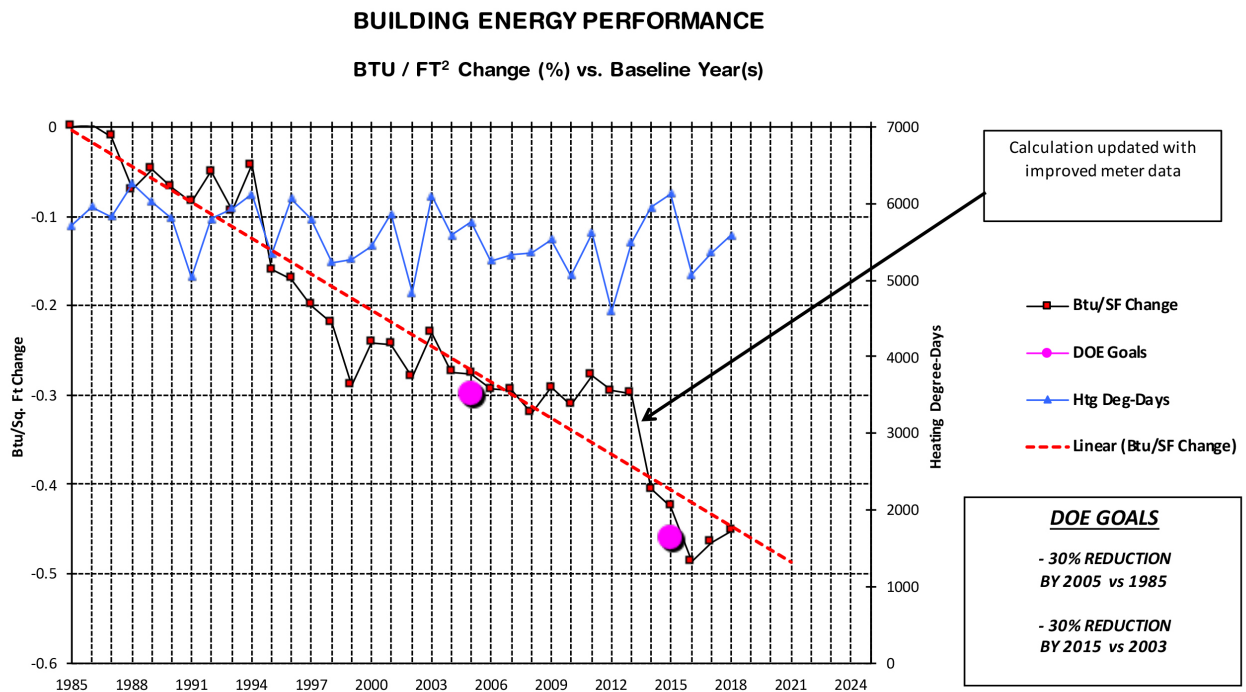


Figure 2-3. BNL Building Energy Performance for 2018 (Btu/SF Change Percent vs. Baseline Years).

of volatile organic compounds (VOCs) and 0.6 mCi of strontium-90 (Sr-90) and returned 0.8 billion gallons of treated water to the sole source aquifer. Following submittal of a modification to the Western South Boundary Groundwater Treatment System to the regulators in June 2018, the installation of four new extraction wells and associated piping and controls was completed which will allow for the capture and treatment of deeper VOCs and the ability to meet the OU III ROD cleanup goals. The system became operational in March 2019. Based on the ethylene dibromide (EDB) characterization performed in 2018 and the fate and transport model recommendation, two additional extraction wells will be needed for the North Street East Groundwater Treatment System to ensure that the cleanup goals will be met. Due to the declining Sr-90 concentrations over the last several years in the Chemical Holes Groundwater Treatment System, a petition for shutdown was submitted to the regulators in March 2018 and subsequently approved. The system was placed in standby mode

in July 2018. Likewise, a petition for closure of the HFBR Tritium Pump and Recharge System was submitted to the regulators in July 2018 and approved in March 2019.

Following the 2017 detection of Per- and polyfluoroalkyl substances (PFAS) in samples from three of the five BNL potable supply wells, BNL's records search identified eight areas where firefighting foam had been released to the ground during the period of 1966 through 2008. To determine whether foam releases at these eight areas had impacted groundwater quality, BNL began a multiphase characterization effort beginning in May 2018. This effort, which is still in progress, includes the installation and sampling of temporary wells, permanent monitoring wells, and on-site groundwater treatment systems. During 2018 and early 2019, approximately 460 groundwater samples were collected and analyzed for 21 PFAS compounds. Two of the eight identified foam release areas (the current and former firehouses) identified concentrations of combined PFOS/PFOA significantly

above the EPA health advisory level of 70 ng/L with a maximum concentration of 12,440 ng/L. Two of the remaining six areas, identified combined perfluorooctane sulfonate (PFOS) and perfluorooctanoic acid (PFOA) concentrations above the health advisory level, with levels up to 128 ng/L, but significantly less than the levels at the current and former firehouses. To date, high levels of PFAS were not identified in the monitoring wells or treatment system extraction wells along the site boundary. Only one well, located near the BNL eastern boundary, had a combined PFOS/PFOA concentration above 70 ng/L. This result was 122.9 ng/L.

Also in 2018, long-term surveillance and maintenance of the Brookhaven Graphite Research Reactor (BGRR) and the HFBR continued. In accordance with the ROD, planning was underway for demolition of the HFBR stack by the end of fiscal year 2020. The groundwater systems operated in accordance with the Operations and Maintenance manuals, while the Peconic and surface soil cleanup areas were monitored via the Soil and Peconic River Surveillance and Maintenance Plan (BNL 2013b). Institutional controls were also monitored and maintained for the cleanup areas in accordance with the RODs to help ensure the remedies

Table 2-3. Summary of BNL 2018 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/V/VI	<ul style="list-style-type: none"> Continued operation of seven groundwater treatment systems that remove volatile organic compounds (VOCs), and two systems that remove strontium-90 (Sr-90). 62 pounds of VOCs and 0.6 mCi of Sr-90 were removed during the treatment of 0.8 billion gallons of groundwater. Since the first groundwater treatment system started operating in December 1996, approximately 7,589 pounds of VOCs and 33 mCi of Sr-90 have been removed, while treating approximately 27 billion gallons of groundwater. Collected and analyzed approximately 1,017 sets of groundwater samples from 569 monitoring wells. Installed 121 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 vegetation.
Reactors	Brookhaven Graphite Research Reactor (BGRR)	<ul style="list-style-type: none"> Continued long-term surveillance and maintenance, including minor resealing of the engineered cap, and repair to loose gasket material on former office windows.
	High Flux Beam Reactor (HFBR)	<ul style="list-style-type: none"> Continued long-term surveillance and maintenance, including repair to an outside awning and vent and sorbent pads were used to soak-up residual hydraulic fluid inside the building.
	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, repair of the aviation lights on the stack and safety cable tie-offs were installed around the three stack platforms. Planning is underway for demolition of the stack in 2020.
	Brookhaven Medical Research Reactor (BMRR)	<ul style="list-style-type: none"> Continued surveillance and maintenance activities.
Former Buildings 810/811	Former Radiological Liquid Processing Facility	<ul style="list-style-type: none"> Completed excavation and off-site disposal of residual contaminated soil north of the former facility.
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.

remain protective of human health and the environment. An annual evaluation of these controls was submitted to the regulators. Table 2-3 provides a description of each Operable Unit, and a summary of environmental restoration actions taken. See Chapter 7 and SER Volume II, Groundwater Status Report, for further details.

2.4 IMPLEMENTING THE ENVIRONMENTAL MANAGEMENT SYSTEM

2.4.1 Structure and Responsibility

All employees at BNL have clearly defined roles and responsibilities in key areas, including environmental protection. Supervisors are required to work with their employees to develop and document Roles, Responsibilities, Accountabilities, and Authorities (R2A2). BSA has clearly defined expectations for management and staff which must be included in the R2A2 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. Environmental Compliance Representatives (ECRs) are deployed to organizations throughout the Laboratory as 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 commitment to open communication and community involvement, the Stakeholder and Community Relations (SCR) Office develops best-in-class communications, science education, government relations, and community involvement programs that advance the science and science education missions of the Laboratory. SCR contributes to the public's understanding of science, enhances

the value of the Laboratory as a community asset, and ensures that internal and external stakeholders are properly informed and have a voice in decisions of interest and importance to them. SCR also works to maintain relationships with BNL employees and external stakeholders, such as 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 Stakeholder Relations Office participates in or conducts on- and off-site meetings which include discussions, presentations, roundtables, and workshops. Stakeholder Relations staff attend local civic association meetings, canvass surrounding neighborhoods, conduct Laboratory tours, and coordinate informal information sessions and formal public meetings, which are held during public comment periods for environmental projects.

BNL's Internal Communications Office manages programs to increase internal stakeholder awareness, understanding, and support of Laboratory initiatives; fosters two-way communications; and updates internal stakeholders on BNL priorities, news, programs, and events.

The SCR's Office of Educational Programs manages various education initiatives and programs that support the scientific mission at BNL and the DOE. Programs include Summer Science Explorations for grades four through 12, the Science Learning Center, internships, contests in science, technology, engineering, or math, and postdoctoral programs.

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, such as the following:

- 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 26 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 typically meets monthly, except for July and August. The CAC is one of the primary ways the Laboratory keeps the community informed. Meetings are open to the public and are announced on the BNL homepage calendar and on the Stakeholder Relations website which links to the CAC webpage, meeting agendas, and past meeting presentations and minutes. An opportunity for public comment is provided at each meeting. 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 update them on project status. The calls also provide the opportunity to gather input and feedback and to discuss emerging environmental findings and initiatives.
- 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 2,000 visitors in 2018.

- *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 2018, more than 4,500 visitors participated in the program.
- *PubSci*: BNL's science café and conversation series features distinguished Laboratory scientists who appear at public venues to discuss cutting-edge topics and research in an informal setting. During 2018, science-interested community members and BNL and Stony Brook University researchers discussed topics such as Personalizing Medicine, the Building Blocks of Matter, and Illumination--the Secret Chemistry of Oil Paintings.

The Laboratory also participates in and hosts various outreach events throughout the year such as festivals, workshops, BNL's Earth Day celebration, the World Science Festival, the City of Science, the New York City Maker Faire, 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 printed weekly employee newsletters, such as *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 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.

Community members can ask questions or comments by clicking on the "Let us know" link found under "Listening to you" on the Stakeholder

Relations website at www.bnl.gov/stakeholder/. Community members can also subscribe to the weekly e-newsletter, *Brookhaven This Week*, found on the Media Communications webpage at www.bnl.gov/, which keeps Lab employees and the community informed about happenings at BNL, explains some of the science behind Laboratory research, and invites subscribers to educational and cultural events.

2.4.2.2 Community Involvement in Cleanup Projects

In 2018, BNL updated stakeholders on the progress of environmental cleanup projects, additional initiatives, and health and safety issues via mailings, briefings, and presentations given at CAC and BER meetings. These topics included the following:

- *Natural & Cultural Resources:* The CAC received updates on BNL's natural resources, such as the status of flora and fauna on site; specifics about the Peconic River post-cleanup surveillance; Cesium-137 in deer, terrestrial vegetation, and soil; and mercury in precipitation.
- *Groundwater Update:* The group was also informed of the annual groundwater update; the general status of plumes and remediation systems/system optimization; completion of Western South Boundary (WSB) off-site VOC characterization; WSB groundwater modeling simulation results; path forward for WSB; response to Suffolk County Department of Health Services (SCDHS) request for additional 1,4-Dioxane characterization and characterization of low-level perfluorinated compounds (PFCs) detected in BNL supply wells; and an update on ethylene dibromide (EDB) detections in the North Street East Monitoring Well.
- *Environmental Updates:* The CAC also received updates on the following environmental cleanup topics: PFAS and 1,4 Dioxane sampling; cleanup of contaminated soil in the area of Building 811; EDB plume; western south boundary treatment modifications; demolition of the HFBR Stack; and PFAS in groundwater.

2.4.3 Monitoring and Measurement

DOE Order 436.1 requires DOE sites to maintain an EMS which conforms to the ISO14001 Standard for Environmental Management Systems. BNL's EMS specifies requirements for conducting general surveillance to determine impact from site operations to the environment. 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.

BNL's EMS includes an Environmental Monitoring Program (EMP) which 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 EMP defines how the Laboratory will monitor effluents and emissions to ensure the effectiveness of controls, adherence to regulatory requirements, and timely identification and implementation of corrective measures. The plan uses the EPA Data Quality Objective approach for documenting the decisions associated with the monitoring program. In addition to the required triennial update, an annual electronic update is also prepared. The monitoring programs are reviewed and revised, as necessary, to reflect changes in permit requirements, changes in facility-specific monitoring activities, or the need to increase or decrease monitoring based on a review of previous analytical results.

As shown in Table 2-4, in 2018, there were 5,390 sampling events of groundwater, potable water, precipitation, air, plants and animals, soil, sediment, and discharges under the Environmental Monitoring Program. Specific sampling programs for the various media are described further in Chapters 3 through 8.

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

2.4.3.1 Compliance Monitoring

Compliance monitoring is conducted to ensure that wastewater effluents, air emissions, and groundwater quality comply with regulatory and

permit limits issued under the federal Clean Air Act, Clean Water Act, Oil Pollution Act, SDWA, and the New York State equivalents. Included in compliance monitoring are the following:

- Air emissions monitoring is conducted at reactors (no longer in operation), accelerators, and other radiological emission sources, as well as the CSF. Real-time, continuous emission monitoring equipment is installed and maintained at some of these facilities, as required by permits and other regulations. At other facilities, samples are collected and analyzed periodically to ensure compliance with regulatory requirements. Analytical data are routinely reported to the permitting agencies. See Chapters 3 and 4 for details.
- Wastewater monitoring is performed at the point of discharge to ensure that the effluent complies with release limits in the Laboratory's SPDES permits. Twenty-four point-source discharges are monitored: 12 under BNL's SPDES Permit and 12 under equivalency permits issued to the Environmental Restoration Program for groundwater treatment systems. As required by permit conditions, samples are collected daily, weekly, monthly, or quarterly, and monitored for organic, inorganic, and radiological parameters. Monthly discharge monitoring reports 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 SPDES permit for the Sewage Treatment Plant (STP). 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 samplings are 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 (i.e., devices that measure radiation exposure) strategically positioned on and off site is routinely reviewed under this program. Control samples (also called background or reference samples) are collected on and off the site to compare Laboratory results to areas that could not have been affected by BNL operations.

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

through 8 give details on media-specific monitoring data and analysis, and Chapter 9 provides supporting information for understanding and validating the data shown in this report.

2.4.4 EMS Assessments

To periodically verify that the Laboratory's EMS is operating as intended, assessments are conducted as part of BNL's Self-Assessment Program. Self-assessment is the systematic evaluation of internal processes and performance. Two types of assessments are conducted: the ISO 14001 Standard conformance assessment and the regulatory compliance assessments.

- The approach for the ISO14001 program self-assessment includes evaluating programs and processes within organizations that have environmental aspects to verify conformance to the ISO14001 Standard. The assessment is performed by qualified external assessors or BNL staff members who

do not have line responsibility for the work processes involved. Progress toward achieving environmental objectives is monitored, as are event-related metrics to determine the overall effectiveness of the EMS. The assessment determines if there are Laboratory-wide issues that require attention, as well as facilitates the identification and communication of best management practices used in one part of the Laboratory that could improve performance in other parts.

- Compliance assessments are also performed by BNL staff members who do not have line responsibility for the work processes involved to ensure that operations are in compliance with Laboratory requirements that reflect external compliance requirements. These assessments verify the effectiveness and adequacy of management processes (including self-assessment programs) at the division, department, directorate, and

Table 2-4. Summary of BNL Sampling Program Sorted by Media, 2018.

Environmental Media	No. of Sampling Events(a)	Purpose
Groundwater	1,504	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	50	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	54 ES 229 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)	122	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	8	Precipitation is monitored for mercury to document impacts to ecological systems and compare to STP discharges. See Chapter 4 for further detail.
Air – Tritium	234	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	328 ES/C 48 NYSDOH	Samples are collected to assess impacts from BNL operations and to facilitate reporting of emissions to regulatory agencies. Samples are also collected for the New York State Department of Health Services (NYSDOH) as part of its program to assess radiological air concentrations state-wide. See Chapter 4 for further detail.

(continued on next page)

Table 2-4. Summary of BNL Sampling Program Sorted by Media, 2018 *(concluded)*.

Environmental Media	No. of Sampling Events(a)	Purpose
Fauna	18	Fish and deer are monitored to assess impacts on wildlife associated with past or current BNL operations. See Chapter 6 for further detail.
Flora	14	Vegetation is sampled to assess possible uptake of contaminants by plants and fauna, since the primary pathway from soil contamination to fauna is via ingestion. See Chapter 6 for further detail.
Soils	197	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	276	Samples are collected periodically from potable water fixtures and dispensers, manholes, spills, to assess process waters, and to assess sanitary discharges.
Groundwater Treatment Systems Monitoring	741	Samples are collected from groundwater treatment systems and as long-term monitoring after remediation completion under the Comprehensive Environmental Response, Compensation, and Liability Act (CERCLA) program. The Laboratory has 11 operating groundwater treatment systems. See discussion in Chapter 7.
State Pollutant Discharge Elimination System (SPDES)	308	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	555	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	492	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)	110	To ensure that the concentrations of contaminants reported in the Site Environmental Report are accurate, additional samples are collected. These samples detect if contaminants are introduced during sampling, transportation, or analysis of the samples. QA/QC samples are also sent to the contract analytical laboratories to ensure their processes give valid, reproducible results.
Total number of sampling events	5,390	The total number of sampling events includes all samples identified in the Environmental Monitoring Plan (BNL 2018), 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.

C = Compliance

ES = Environmental Surveillance

Laboratory levels. Special investigations are conducted to identify the root causes of problems, as well as identify corrective actions and lessons learned if regulatory noncompliance or impact occurs to correct the problem and prevent reoccurrence.

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

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

2.5 ENVIRONMENTAL STEWARDSHIP AT BNL

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

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

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

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