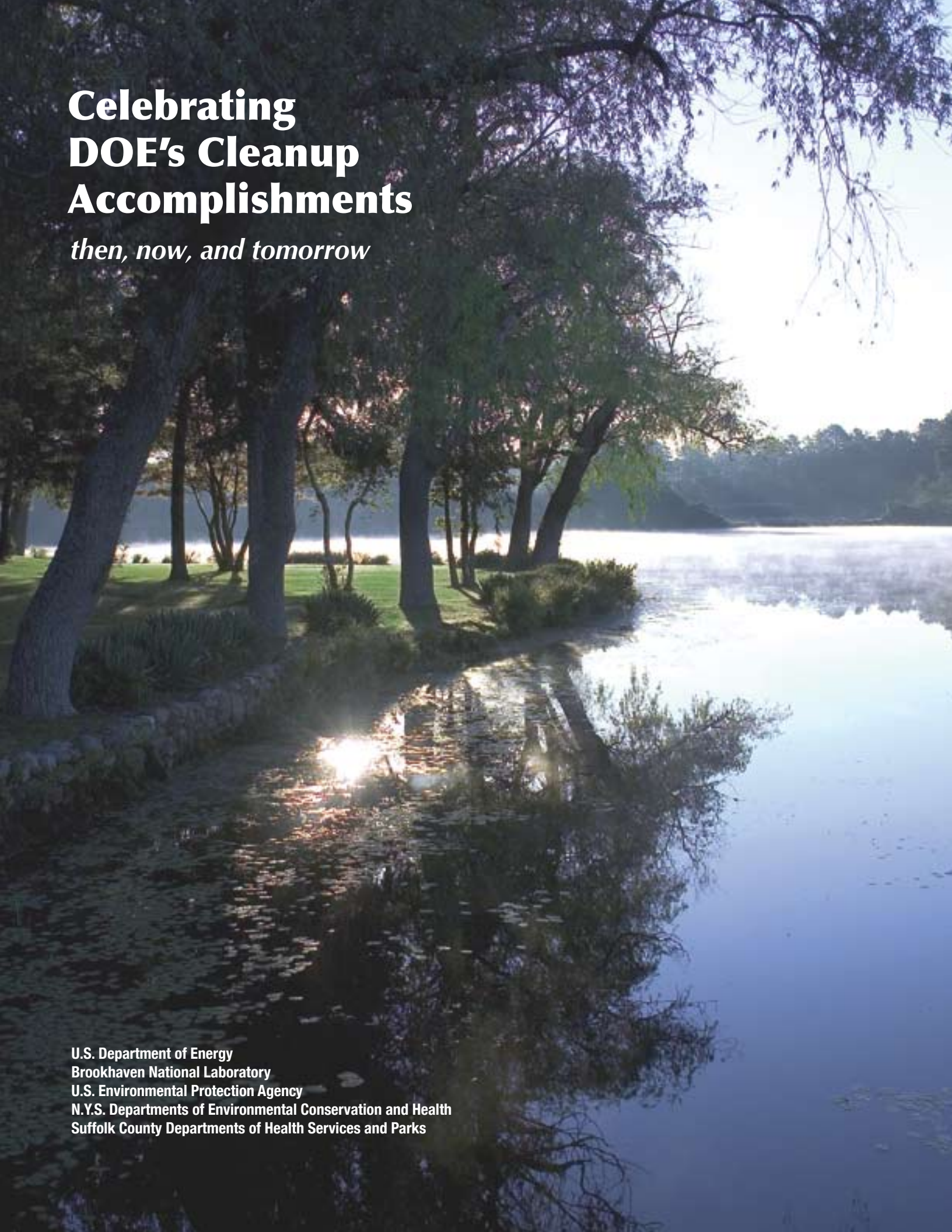


Celebrating DOE's Cleanup Accomplishments

then, now, and tomorrow

U.S. Department of Energy
Brookhaven National Laboratory
U.S. Environmental Protection Agency
N.Y.S. Departments of Environmental Conservation and Health
Suffolk County Departments of Health Services and Parks

Celebrating DOE's Cleanup Accomplishments

October 2005

A Message from DOE:

The U.S. Department of Energy and Brookhaven National Laboratory met their commitments to address the high-risk, high-priority environmental impacts on and near the BNL site. Environmental management construction work is finished, including all soil, groundwater, and Peconic River projects.

This milestone is made by many. The dedication and support of the regulatory agencies and local governments helped turn process into performance, words into action, and naysayers into believers. Numerous civic organizations, advocacy groups, community members, and other stakeholders provided helpful perspectives and made insightful demands as cleanup strategies were developed. With conviction and resolve, they all worked toward the common goal of restoring the island's cherished natural resources.

Because we share the vision, we humbly and gratefully share the success. Congratulations for a remarkable achievement!

On October 14, 2005, the U.S. Department of Energy (DOE) and Brookhaven National Laboratory management (the Lab) will celebrate a momentous milestone: the completion of major environmental restoration projects on and near the Brookhaven National Laboratory (BNL) site. The high-priority cleanup work that was defined in a 1992 agreement among DOE and regulatory agencies is now finished, including soil, groundwater, and Peconic River cleanup projects, as well as several decommissioning projects at the Brookhaven Graphite Research Reactor. While long-term treatment and monitoring efforts remain, DOE and the Lab are at the end of a remarkable 13 years of hard work. Remaining decommissioning activities at the graphite reactor and the High Flux Beam Reactor will be completed by 2009.

The totality of what has been accomplished at BNL is not only measured by the hundreds of millions of dollars spent on cleanup or by the millions of hours worked by the staff at BNL, but is also measured by the many relationships that were created and nurtured throughout the cleanup process. To reach this point, DOE and the Lab worked closely with regulatory agencies in developing a framework for addressing the contamination in and near BNL. They eventually gained the support of the community by openly sharing information, proactively soliciting extensive input on cleanup decisions, and giving real-time feedback on how that input was used.

By working in cooperation with the community, regulatory agency staff, and government leaders on each project, DOE and the Lab determined the extent and magnitude of the contamination, developed plans on how best to address it, and turned those plans into actions. Gallon-by-gallon, shovel-by-shovel, system-by-system, and project-by-project, incremental but progressive achievements were made. The culmination of those efforts is the milestone now being celebrated.

The cleanup succeeded for many reasons, not the least of which was DOE's investment of $353 million, and the 2.65 million person-hours worked by DOE, Lab, and contractor staff. Remaining focused on the mission of restoring the environment, being mindful of the sensitivity of the Long Island ecological system, understanding the regulators' and stakeholders' expectations, and having a full appreciation of the diverse perspectives that exist among the neighboring communities and advocacy groups, DOE and the Lab not only completed the cleanup, but they completed it early.

Overall, the work can be broken down into four main categories that are detailed below: groundwater, Peconic River, soil, and Brookhaven Graphite Research Reactor projects.

"We greatly improved the quality of Brookhaven National Laboratory's natural environment and its surrounding areas. For that we are proud. As a good neighbor on Long Island, we continually strive for a cleaner environment, and will assure it through our pollution prevention, waste minimization and environmental protection programs."

Rod Rimando
DOE project director for Brookhaven cleanup

DOE's investment in cleanup at BNL between 1992 and 2005:

- ✓ **$353 million**
- ✓ **2.65 million person-hours**

Background

BNL was placed on the U.S. Environmental Protection Agency's (EPA) National Priorities List in 1989 due to known releases or threatened releases of hazardous substances, pollutants, or contaminants to the environment at the site. The entire cleanup proceeded under the rigorous process set by the Federal Comprehensive Environmental Response, Compensation & Liability Act of 1980.

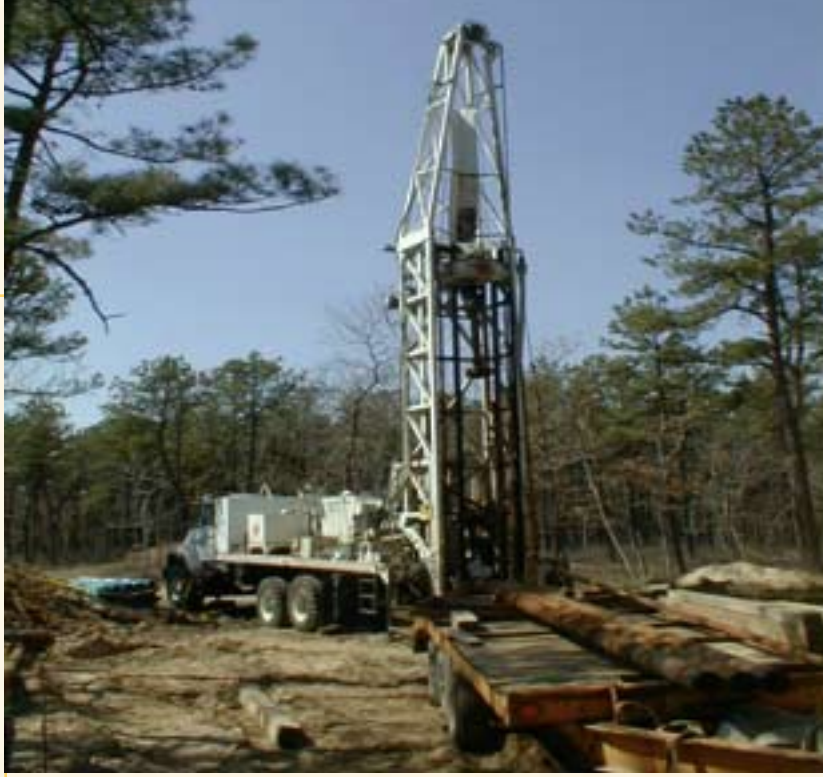
In 1992, DOE entered into a formal tri-party interagency agreement with EPA and the

N.Y. State Department of Environmental Conservation (DEC), under which the three agencies would guide all aspects of the investigation and cleanup process. The N.Y. State Department of Health and Suffolk County Departments of Health Services and Parks also played key roles.

Cleanup activities at BNL began in earnest following the 1991 establishment of what was then the Lab's Office of Environmental Restoration (OER), now known as Environmental Restoration Projects. Initial cleanup efforts focused on removing known sources of contamination (to prevent additional contaminants from getting into groundwater) and installing boundary groundwater treatment systems (to prevent additional groundwater contamination from moving off site).

Addressing immediate concerns gave OER time to complete a comprehensive environmental investigation. The investigation included extensive sampling and analysis of groundwater, soil and sediment on and off the BNL site. With all these data in hand, OER was able to construct a detailed "picture" of the extent of contamination, set priorities, and move forward with dozens of significant cleanup projects.

Work being done in an area with several groundwater monitoring wells in place.



One of the drill rigs used to install the off-site groundwater sampling and treatment wells.

Groundwater

From the outset, DOE and the Lab considered the protection of human health to be the most important goal. Because the greatest threat to human health was groundwater contamination, the focus was on addressing contamination sources (like landfills and underground tanks), cleaning up existing contamination, and thereby protecting Long Island's sole-source aquifer, a vital resource.

Chemical Groundwater Contamination

The more common chemical pollutants found in the groundwater are in a group called volatile organic compounds (VOCs), which are organic chemicals used in a wide variety of industrial and consumer products. At BNL, carbon tetrachloride, for example, was found in refrigeration fluid and propellants for aerosol cans, in pesticides, in cleaning fluids and degreasing agents, in fire extinguishers, and in spot removers. Use of VOCs at BNL dates back to the 1940s, when they were accidentally spilled onto the ground or improperly disposed. Because of these releases to the environment, the contaminants eventually got into the groundwater.

In 1996, shortly after extensive off-site groundwater contamination was discovered, DOE funded the connection of more than 1,500 homes south and east of BNL to public water supplies as a precautionary measure. Fortunately, testing of 800 private wells by the Suffolk County Department of Health Services found no contamination attributable to BNL. Nevertheless, DOE and the Lab took corrective measures to restore the contaminated groundwater.

In order to develop a detailed picture of the nature and extent of contamination, more than 3,000 temporary and permanent groundwater monitoring wells were installed on and off the BNL site between 1990 and 2005. Several groundwater treatment systems were constructed along the BNL's southern boundary to prevent additional contaminants from moving off of the site, and 12 other systems were built on site and south of BNL to complete the comprehensive network of cleanup systems.

In all, 16 treatment systems were installed between 1997 and 2005. By 2005, the systems had cleaned more than eight billion gallons of water and removed more than 5,000 pounds of solvents from the aquifer. While the Lab is still in the early stages of groundwater cleanup, the cleanup program's effectiveness can be seen by the shrinking of key areas of groundwater containing contaminants at levels above drinking water standards.

From the outset, DOE and the Lab considered the protection of human health to be the most important goal.

The community south of BNL played

DOE, BNL, elected officials and community leaders mark the opening of the first off-site groundwater treatment system.

a significant role in determining the locations of two treatment systems that were to be constructed in their neighborhood. Many community members were unhappy with the locations originally proposed for those treatment systems. During a series of community meetings, they asked: Why did a treatment building need to be located in the residential neighborhood, so close to homes? Why did another have to be placed on the same side of a street where children often play?

They proposed solutions – in the first case, couldn't the water be piped 3,000 feet south to Brookhaven-Calabro Airport, where a treatment building was already being constructed? In the second case, couldn't the location for the treatment building be moved across the street, so the children could safely play?

The groundwater project and DOE staff listened, and found they could accommodate the community's wishes and save money in the long term. This solution involved installing piping beneath neighborhood roads–also a concern to some residents. The Lab took extra precautions in hiring a contractor and required that the roads be repaved to exacting Town standards. The project was completed to the satisfaction of the community, the Lab, DOE, and the regulatory agencies.

Radiological Groundwater Contamination

In 1997, radioactive tritium was detected in groundwater monitoring wells south of BNL's High Flux Beam Reactor. An investigation determined that the spent fuel pool in the basement of the reactor building had been leaking for at least a decade, resulting in an approximately 2,200-foot "plume," or area of contaminated groundwater above the drinking water standard, stretching south from the reactor. The outcry from many Long Islanders, including elected officials, eventually resulted in the firing of Associated Universities, Inc. (the company that had managed BNL for 50 years) and the permanent closure of the reactor. In 1998, Brookhaven Science Associates, a nonprofit, limited-liability company founded by Stony Brook University and Battelle Memorial Institute, was hired by DOE to manage and operate the Lab.

Initially, the pool was drained and a pumping system was set up at the southern edge of the plume to ensure that the plume would never approach the site boundary. This system was placed on standby once enough data was collected to determine the extent of the tritium above drinking water standards. A second pumping system was placed near the reactor building to remove groundwater containing the highest tritium concentrations. The strategy was effective: by 2005, the tritium plume -- an issue that defined the Lab in the late 1990s -- was less than a third of its former size.

Other on-site areas of groundwater containing radioactive strontium-90 were identified, and a pilot program was conducted in 2003 to determine the best method of addressing these areas. Based on that pilot project, two treatment systems have been installed and are operating.

Peconic River Project

In the spring of 2000, the Lab's Peconic River cleanup project team faced a significant decision. Over the previous five years, the team had conducted several rounds of sampling and analysis to define the extent of contamination in river sediment. They commissioned a study of potential health impacts and developed various cleanup strategies.

When the Lab and DOE released a proposed plan for

Below and following page, left to right: Peconic River before and during cleanup (1-3), being replanted (4), river after cleanup completion (5), "threatened" banded sunfish returned to the river

1. 

2. 

3. 

comment, the plan recommended excavation of the sediments, including some located in sensitive wetland areas that supported thriving ecosystems. It also recommended cleaning up certain areas in Suffolk County parkland adjacent to the BNL site.

The Lab's Community Advisory Council (CAC), a group of local civic, environmental, community, business leaders, and employees interested in the Lab and the cleanup, and the wider community voiced great concern about the plan. They recommended moving forward with cleaning up BNL's sewage treatment plant, the original source of contamination, and investigating less disruptive technologies that could be used in the river. DOE, the Lab, and regulatory agencies agreed with this strategy, and the sewage treatment plant cleanup began.

Banded Sunfish

The project team decided on a two-pronged approach: they explored alternative technologies, including phytoremediation (using plants to remove contaminants from sediments), vacuum guzzling (removing pockets of contamination using a large vacuum device), and electrochemical remediation (using electric current to concentrate contaminants for removal). The team also piloted excavating and replanting a small stretch of the river to determine whether it would be successful. Of the four technologies studied, the pilot excavation was the most successful.

The team also conducted additional sampling to better delineate the extent of contamination and its potential impact on the environment and human health.

In the end, a plan was developed that addressed the concerns of regulators, as well as the community. The plan included targeting specific areas within the river where contaminants were concentrated, as well as conducting the cleanup using low-impact conventional construction equipment. Roads constructed through the forest to enable access to the river would be removed following the completion of the project, and, to the maximum extent possible, the Lab agreed not to bring in topsoil to replace removed sediment. Instead, sediment would be taken from designated "open water" areas of the river to complete the restoration process following confirmatory sampling. In addition, banded sunfish, a New York State "threatened" species, would be removed from the river, kept in a holding pond, and then returned to the river in a habitat suitable for the species.

The CAC closely followed all of the activities related to the river project. When the second plan was put out for public comment in 2004, they, along with many others in the community, supported it.

To complete the cleanup of the river in the Suffolk County parkland, DOE and the Lab worked closely with the Parks Department, Suffolk County legislature, the Pine Barrens Commission, and many other key agencies. All of this groundwork was imperative before DOE and the Lab could negotiate crucial access agreements with property owners.

In 2005, the cleanup of both the on- and off-

BNL's Community Advisory Council

The following organizations are represented on the Community Advisory Council in 2005:

- Affiliated Brookhaven Civic Organizations
- Brookhaven Retired Employees Association
- Citizens Campaign for the Environment
- Community Health & Environment Coalition
- East Yaphank Civic Association
- Environmental Economic Roundtable
- Friends of Brookhaven
- Huntington Breast Cancer Coalition
- International Brotherhood of Electrical Workers - Local 2230
- Lake Panamoka Civic Association
- Long Island Association
- Long Island Pine Barrens Society
- Long Island Progressive Coalition
- Longwood Alliance
- Longwood Central School District
- Neighbors Expecting Accountability and Remediation
- Peconic River Sportsmen's Club
- Ridge Civic Association
- Suffolk County Fire, Rescue & Emergency Services
- Town of Brookhaven
- Town of Riverhead
- User Executive Committee
- Wading River Civic Association

And individual members representing the communities of:
education, health care, science & technology, & senior citizens

4.

5.

6.

More than 55,000 cubic yards of contaminated soil and debris have been removed from the BNL site and sent to permanent storage facilities

site portions of the river was completed, and the river was replanted. While it will take some time for the river to fully recover, improvements can already be seen, and much of the local wildlife has returned.

Surface and Soil Projects

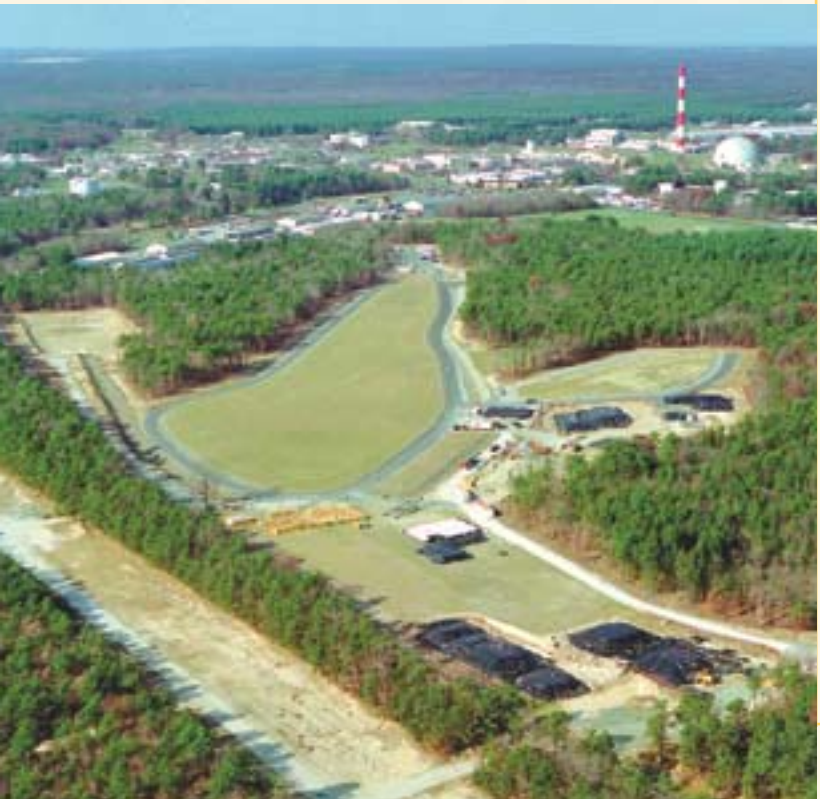
Major surface and soil cleanup projects at BNL began in 1994 with the removal of several out-of-service 100,000-gallon aboveground waste tanks. After this project was completed, the Lab and DOE initiated the capping of three landfills on site. These landfills had been identified as continuing sources of groundwater contamination, as VOCs that had been discarded in the unlined landfills over the years were being carried by rainwater into the ground. The capping process cut off that source of contamination, and allowed the Lab to make headway in cleaning up groundwater.

In 1997, a second soils project addressed a series of landfill pits that were used in the 1960s for disposal of laboratory chemicals and glassware. This project was one of the most challenging from a worker safety perspective, as many of the containers held unstable or water- or air-reactive chemicals that could catch fire or even explode upon excavation. Careful planning and execution resulted in the project being completed successfully and safely.

The largest and most complicated BNL surface/soil cleanup project took place from 2003 to 2005. It involved the decommissioning and decontamination of BNL's former Hazardous Waste Management Facility, which was used from 1947 to 1997 as a central receiving, processing, and storage facility for radioactive and hazardous waste generated at BNL. Contaminants at the facility included the radioactive elements strontium-90 and cesium-137. Eight contaminated buildings were demolished, more than 13,000 cubic yards of soil and underground structures were removed from the site, and an important wetland area was restored as part of the project.

In all, more than 55,000 cubic yards of contaminated soil and debris have been removed from the BNL site and sent to permanent storage facilities.

Aerial view of capped landfills



Surface and Soil Project Hghlights

- ✓ Landscape soils: In 2000, the Lab began excavating isolated areas of landscaping soils on site. About 2,800 cubic yards of soils containing low levels of cesium-137 were excavated from twelve separate areas.
- ✓ Bldg. 650 sump and sump outfall: An estimated 1,800 cubic yards of contaminated concrete, piping, and soil was removed from this building and associated drainage area in 2003.
- ✓ Underground storage tank removal: This project, completed in June 2005, included the removal, transportation, and disposal of six underground storage tanks and approximately 4,000 cubic yards of soil and debris.
- ✓ Meadow marsh: The project consisted of removing sediment contaminated with heavy metals from an area used in the 1960s to test sewage treatment methods. Since the site had since become an important habitat for the endangered tiger salamander, many were removed and later returned to the site after the cleanup was complete and habitat restored.

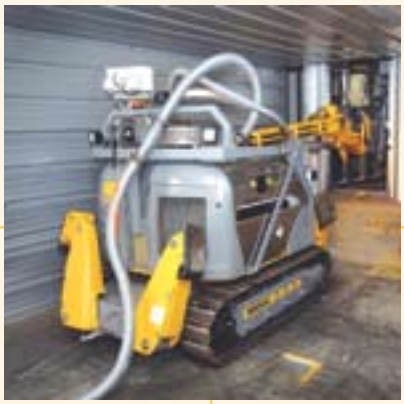
Brookhaven Graphite Research Reactor Project

In April 2005, DOE, the Lab, and the regulatory agencies agreed on a final cleanup plan for the Brookhaven Graphite Research Reactor (BGRR), the world's first reactor built solely to perform scientific research on peaceful uses of the atom. The reactor, which operated from 1949 to 1969, is part of a complex that includes several small support buildings.

The $96.8 million plan, developed with substantial input from the CAC and other community members, calls for dismantling the 700-ton, 25-foot-high graphite core of the reactor known as the pile. The 5,000 tons of concrete and steel shielding that surround the core will also be dismantled and sent to a disposal facility along with the pile.

The reactor's pile and shield contain more than 99 percent of the remaining radiological inventory in the BGRR complex. That's because several significant interim cleanup actions have been completed over the past 10 years. These actions include:

• *Pile fan sump removal*: This 27,000-pound concrete box


From left to right: Removal of the pile fan sump, remotely operated robot known as a BROKK manipulator, removal of the aboveground air ducts

was removed in 2000. It was used to collect rainwater and other drainage from the reactor's fanhouse and exhaust stack. Sampling showed that water leaked from the sump into surrounding soil.

• *Aboveground concrete air ducts*: In 2000, these 50-year-old ducts, which carried reactor-cooling air to the fanhouse, were cut into nine sections using diamond-wire saws. The duct sections, each of which weighed up to 167,800 pounds, were packaged and sent off site to a licensed disposal facility.

• *Fanhouse*: Five large cooling fans were removed from this structure located near the reactor in 1999. These fans weighed in excess of 26,000 pounds each, and were used to pull exhaust air out of the reactor pile.

• *Below-ground air ducts, exhaust filters, and primary liner cleanup*: Cooling air left the reactor pile through below-ground steel-lined ducts that contained copper coolers and a filter system. In a project completed in 2004, the project team removed the filters and contaminated portions of the liner using a remotely operated robot known as a BROKK manipulator. This project was a major radiological challenge, and demonstrated the use of innovative technologies that minimized worker exposure and allowed a safe completion of the project.

U.S. Senator Charles Schumer with then-secretary of Energy Bill Richardson. Senator Schumer was instrumental in obtaining funding for excellerated cleanup at BNL.

• *BGRR fuel canal, canal house and water treatment house removal*: These above- and below-ground structures, which handled spent reactor fuel and cooling water, were demolished and removed in a project completed in 2005. Contaminated soil found below the fuel canal was also excavated, and the area was backfilled and covered with an asphalt cap.

The Lab and DOE are now completing detailed planning for removing the pile and shield, and work is expected to be completed in 2007. These plans will incorporate controls to protect human health and the environment.

Stakeholder Involvement

Many community members have been interested in following the cleanup process at BNL since the contamination was first discovered. Some of these individuals formed groups that focused on providing the Lab and DOE with a community perspective on the cleanup.

Suffolk County Executive Steve Levy (left) and Jean Mannhaupt, CAC member and administrator of the EPA's technical advisory grant.

In 1996, the Lab formed a community working group in response to community requests. This citizen's group consisted of civic leaders and others interested in learning more about the Lab's activities and operations. Many individuals from this original group eventually joined other interested stakeholders in the Community Advisory Council, which was formed in 1998. Currently, the CAC includes representatives from 27 community, civic, employee, environmental, business, and health related organizations.

Each month, the CAC holds meetings that are open to the public. They set their own agendas, and advise the Laboratory director on issues important to the community. Their interests frequently focus on environmental issues, especially those related to the cleanup. Their opinions have provided a broad spectrum of viewpoints that the Lab and DOE have considered when making decisions about the cleanup. Elected officials and regulatory agency personnel have noted the value of the group's opinions and input.

In 2000, the CAC initiated an effort to obtain additional funding to accelerate the cleanup at BNL, and that effort, along with the extensive work by BNL, DOE, elected officials, and the regulators, resulted in the cleanup being completed three years earlier than originally anticipated.

In May 1999, the U.S. Environmental Protection Agency awarded Neighbors Expecting Accountability and Remediation (NEAR) a three-year, $50,000 Technical

operations at the Lab, and to ensure protection of the environment and the health and safety of community residents and Lab workers.

To date, pollution prevention projects have saved more than $1.6 million and have resulted in the reduction or reuse of approximately 2.3 million pounds of waste.

Future

Now that all the construction work has been completed, what remains is long-term treatment of groundwater, continued monitoring, and regular reviews to ensure the cleanup remedies remain effective. In addition, the decommissioning of the graphite reactor and planning for the future decommissioning of the High Flux Beam Reactor are moving forward.

For several decades following the completion of restoration, decontamination, and decommissioning work, the Lab will be responsible for long-term environmental operations, safety, and security (LEOSS) at several sites on and near BNL.

LEOSS activities include those necessary to protect human health and the environment from residual hazards, such as monitoring, maintenance, land-use controls, and information management (including records maintenance), as well as other activities to ensure that the implemented remedies remain effective over time.

Examples of projects that will be covered under LEOSS include the operation and maintenance of on- and off-site groundwater cleanup systems, where treatment and monitoring will continue for up to 70 years, monitoring of the closed and capped landfills, and post-cleanup monitoring of the Peconic River and Brookhaven Graphite Research Reactor.

The scope of the cleanup that was required at BNL due to historical practices has spurred the Lab to ensure that its current and future environmental performance measures up to its world-class status in science, and that the environmental mistakes of the past do not happen again. To that end, it has implemented an environmental management system (see below) to ensure that environmental issues are systematically identified, controlled, and monitored.

In addition, the Lab has built up an award-winning pollution prevention (P2) program to reduce the amount and toxicity of waste generated by current operations. The BNL 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 the Lab's operating philosophy. The overall goal of the P2 program is to create a systems approach that integrates pollution prevention and waste minimization, resource conservation, recycling, and environmentally preferable procurement into all planning and decision making at the Laboratory. To date, pollution prevention projects have saved more than $1.6 million and have resulted in the reduction or reuse of approximately 2.3 million pounds of waste.

Environmental Stewardship Today

The Lab and DOE take environmental stewardship very seriously. As part of the Lab's commitment to environmentally responsible operations, it established the BNL Environmental Management System (EMS). The Lab's EMS ensures that environmental issues are systematically identified, controlled, and monitored. Moreover, the 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 EMS registration, and recertification audits of the entire EMS occur every 3 years. The most recent EMS recertification audit, in 2004, determined that the Lab remains in conformance with the ISO 14001 Standard.

The cornerstone of the Lab's EMS is a Laboratory Environmental Stewardship Policy. In 2004, BNL incorporated the principles of this Laboratory-wide policy into a comprehensive Environmental, Safety, Security, and Health Policy that makes clear BNL's commitments to environmental stewardship, the safety of its employees, and the security of the site. Specific environmental commitments include compliance, pollution prevention, cleanup, and community outreach.

Several aspects of the Lab's EMS are captured in BNL's standards-based management system, an electronic library of procedures that guides all activity on the BNL site. Procedures guiding experimental reviews and storage, handling, and disposal of laboratory-generated waste help keep current operations from impacting the environment.

One measure of an effective EMS is recognition of good environmental performance. In 2004, BNL operations led to seven awards from diverse stakeholder groups.