

DISCOVERY IN ACTION



Scientists and engineers at Pacific Northwest National Laboratory help protect and restore the environment with discoveries that lead to cleaner air, soil and water. Researchers pictured here are taking samples as part of a project to monitor the Columbia River. It is one of many examples of PNNL's environmental research over the decades, which extends into areas such as sustainable development, environmental monitoring, understanding the impacts of human activities, and providing technology and management solutions to those who steward and rely upon the nation's natural resources.

Putting science to work: From cleaning up Hanford to protecting the planet

This is the second of a 12-part series that showcases some of the scientific challenges PNNL has tackled over its 50-year history and highlights its vision for the future. PNNL is one of 10 national laboratories overseen by the U.S. Department of Energy's Office of Science and has been managed by Battelle since its inception in 1965. Through this enduring partnership—and by working closely with clients and collaborators—PNNL builds upon its legacy to advance science and solutions that improve the lives of Tri-Citians and people around the world. This edition focuses on PNNL's work to address environmental challenges and protect natural resources.

PACIFIC NORTHWEST NATIONAL LABORATORY

When a 65-foot crack was discovered in the Wanapum Dam in February, Grant County Public Utility District called in Pacific Northwest National Laboratory's aquatic research experts to determine whether lowering the water for the repair would increase the risk to endangered salmon.

PNNL researchers evaluated adult salmon passage through the quickly modified fish ladder along the Columbia River, and the results provided the assurance needed to allow it to continue operating through the salmon migration season and dam repair process.

"This is just one example of how we draw upon our scientific heritage to address a broad range of 21st Century environmental and ecological challenges," said Jud Virden,

associate laboratory director for PNNL's Energy and Environment Directorate. "We have nearly 1,000 professionals committed to research for a healthier planet, including wildlife and habitat restoration, sustainable development, land and water resource management, and balancing the operational requirements of industry with environmental stewardship."

PNNL may be better known locally for supporting DOE by developing ways to treat complex environmental contamination, especially at the Hanford Site. Its researchers have spent decades understanding how contaminants move and developing ways to stop their movement, thereby protecting human health and the environment from exposure.

"With our expertise in waste forms, waste processing and subsurface geochemistry, PNNL

is committed to delivering scientifically defensible solutions to help reduce the cost and risk of Hanford cleanup," Virden said.

In the 1970s, PNNL researchers were pioneering work in vitrification—a process for turning mixed waste into a stable glass waste form suitable for disposal. The innovations provided the foundation for technology applied today at DOE's Savannah River Site, and eventually at Hanford, to deal with millions of gallons of tank wastes from the Cold War weapons programs.

More recently at Hanford, PNNL researchers developed a novel high-performance computing code that provides workers with an unencumbered view of the subsurface. This makes it easier to detect leaks in underground waste storage tanks, potentially saving DOE a projected \$5 billion over the life of the tank waste project.

Beyond Hanford

As early as 1979, PNNL researchers were sampling and analyzing pollutants from industrial centers—such as carbon gases from coal-fueled plants—and studying the concentration and transformation of pollutants in the atmosphere. The data is used to develop regional air pollution

models to better determine and resolve the environmental impacts of fossil fuels.

On the international front, PNNL led efforts to collect and maintain information on the 1986 Chernobyl Nuclear Power Plant accident in Ukraine. Scientists analyzed the levels of radiation after the plume arrived in the United States and used research aircraft to collect air samples of the fallout.

At the Marine Sciences Laboratory in Sequim, Wash., PNNL scientists have spent more than 45 years conducting research related to marine and coastal resources, environmental chemistry, water resources modeling, ecotoxicology and biotechnology. This facility, located on the Strait of Juan de Fuca, remains DOE's only marine research laboratory.

In response to the 1989 Exxon Valdez oil spill in Alaska, the PNNL team in Sequim conducted ecological assessments and other studies. Then PNNL followed up later to gauge the success of cleanup activities.

Long before this year's quick fix at Wanapum Dam, PNNL had a proven track record of providing science and technology to improve fish passage and survival along the Columbia River Basin's system of hydroelectric dams. Performing research since the early 1990s

Owned by the U.S. Department of Energy; operated by Battelle; and supported by academic, industrial and governmental collaborators, Pacific Northwest National Laboratory is celebrating 50 years of inspiring and enabling the world to live prosperously, safely and securely. Interdisciplinary teams at PNNL address many of America's most pressing issues in energy, the environment and national security through advances in basic and applied science. With an annual budget of about \$1 billion and nearly 4,300 staff members, Battelle is the largest employer in the Tri-Cities.

Learn more about PNNL at www.pnnl.gov and through stories to commemorate 50 years of scientific discovery contributed by employees, retirees and the community at www.celebrate.pnnl.gov.

for DOE, the U.S. Army Corps of Engineers, Bonneville Power Administration, and public and private utilities, PNNL's research assists in the development and operation of environmentally sustainable hydropower—keeping the lights on across the Pacific Northwest.

"At PNNL, we have a unique ability to rally interdisciplinary teams, collaborate with public and private partners, and leverage funding with the shared vision of providing new knowledge, viable answers and a meaningful understanding of today's environmental challenges," Virden said.

PNNL's environmentally focused research and development takes a broad look at

interrelated factors—such as biology, hydrology, chemistry, engineering and economics—to gain a clear view of environmental impacts from population growth, resource exploitation and other complex issues. With this knowledge, researchers can also propose solutions.

"In support of DOE, we help inform decision makers and provide the basis for driving innovation that leads to a cleaner future, a restored environment and a stronger economy," Virden said. "Looking forward, I am proud that PNNL will continue to put science to work on environmental challenges—from cleaning up Hanford to protecting the planet."



Late PNNL researcher Richard Fitzner studied factors that enhanced or reduced survival of broods of Great Basin Canada geese, which included using radio transmitters to follow their movement on the 120-square-mile Arid Land Ecology Reserve. The area was renamed the Fitzner/Eberhardt Arid Lands Ecology Reserve to commemorate Fitzner and fellow researcher Les Eberhardt after they died in a 1992 plane crash while studying the area. PNNL's work at ALE began in the 1960s and has encompassed plant and animal ecology, geology, surface and groundwater hydrology, climate, soils and soil/water interactions, and contaminant transport.



PNNL researchers developed highly sensitive equipment for measuring radioactivity. This early 1970s counting room contains eight multidimensional gamma ray spectrometers that permit the direct analysis of radionuclides in environmental samples at levels comparable to—and even less than—that of their natural radioactivity. Even today, PNNL builds upon a legacy that began in the 1940s. Before Battelle began managing the laboratory as a separate entity from the Hanford project in 1965, some of the same scientists were supporting the nation's nuclear weapons mission with advancements in chemical processing and nuclear materials separations.



PNNL researchers are studying the hazards migrating fish face as they travel to and from the ocean. The data collected by PNNL's Sensor Fish can help boost fish survival rates. This photo from 2000 shows the initial Sensor Fish design, which has since been updated to be smaller and more rugged, and to provide more detailed information. Data collected from the device is helping make conventional hydropower and newer, small hydro facilities more fish friendly. This research helped redesign conventional dams to increase power generation while also reducing the impacts to fish and habitat and improving water quality.



At the U.S. Department of Energy's Environmental Molecular Sciences Laboratory, located on PNNL's Richland campus, researchers integrate theory, experiment and numerical simulation to understand the movement of contaminants in the subsurface. Researchers around the world have access to this national user facility's more than 100 experimental instruments, from microscopes to spectrometers to a supercomputer. Scientists use the nuclear magnetic resonance spectrometer shown here to investigate radiologically active samples, leading to an enhanced understanding of radionuclide behavior in the environment.