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The 580 sycamore trees that surround the main part of the PNNL campus and are a hallmark of the laboratory are healthier today because of water-efficient irrigation.

Pacific Northwest National Laboratory (PNNL) operates an award-winning grounds maintenance program that comprises a comprehensive landscape and irrigation management program. The program has helped the laboratory reduce its water use for irrigation by 30%.

PNNL is located in Richland, Washington, and is managed and operated by Battelle for the U.S. Department of Energy (DOE). PNNL scientists and engineers perform research on a variety of subjects, including energy and national security. PNNL has more than 4,200 staff members, sits on 600 acres, and houses 2 million square feet of facilities.

The laboratory is located in an arid region of the state, receiving only eight inches of precipitation annually. It has more than 100 acres of turf and landscaped areas and nearly 50 acres of wild, undeveloped areas.

Cost and Savings

The PNNL landscape and irrigation management program has resulted in the following annual savings:

- 30% reduction in water consumption for turf irrigation
- 15 million gallons of water reclaimed from the cooling ponds for irrigation
- \$30,000 in reduced wastewater fees from reclaiming cooling pond water instead of sending it to the wastewater treatment plant
- 200,000 kilowatt-hours (kWh) of electricity saved from reducing water pumping from the Columbia River

The U.S. Department of Energy's (DOE) Federal Energy Management Program (FEMP) facilitates the Federal Government's implementation of sound, cost-effective energy management and investment practices to enhance the nation's energy security and environmental stewardship.

PACIFIC NORTHWEST NATIONAL LABORATORY GROUNDS MAINTENANCE

Best Management Practice Case Studies #4 and #5 — Water Efficient Landscape and Irrigation



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Project Components

PNNL has developed a comprehensive grounds maintenance program, which began in 2000. The program encompasses sound landscape design and maintenance of the plants and efficient application of water to these plants. The original goal of the program was to rejuvenate the existing landscape while saving water and energy. Jeff Lettau, Certified Grounds Manager, who heads the grounds maintenance program, recognized that the existing landscape had problems.

By the year 2000, the 35-year-old landscape was showing its age. Many areas had developed problems, including clumping roots under the landmark sycamore trees, compacted and water-resistant soil, and overgrown shrubs. PNNL developed a master plan that guided strategies and research of state-of-the-art techniques to remedy these issues while maintaining the landscape's beauty.

Trees

Prior to the comprehensive landscape management program at PNNL, many of the site's trees were watered with an outdated flood irrigation technique. The bubble-style irrigation heads watered trees at the base of the trunk, causing the tree roots to clump around the trunk instead of developing a broad root network. As part of the program, this system was replaced with sprinklers. Trees naturally have a small network of roots, called feeder roots, that spread just below the surface of the ground outwards beyond the outer leaves of the tree. This perimeter is called the "dripline." The feeder roots capture and soak up rain that falls beyond the dripline. By replacing the old style bubbler irrigation with sprinklers, PNNL replicates how



The improved irrigation system applies water to the soil at the sycamore trees' drip lines, which replicates how trees receive water naturally from rain.

trees naturally receive water from rain. The trees are now more disease and drought resistant, and water used for irrigation has been reduced by 40%.

Turf

PNNL has extensive lawns throughout the campus totaling more than 100 acres. Through the master planning process, PNNL found that the turf was being overwatered; frequent and shallow watering created a highly compacted and water

resistant soil. The compacted soil created an anaerobic condition in the root zone, which stunted the roots.

Anaerobic soil is devoid of oxygen. In compacted and wet areas, the oxygen gets “squeezed” out of the soil. When organic materials in the soil break down in anaerobic conditions, hydrogen sulfide is produced, causing a harsh environment for the plant’s root system, a foul smell, and black soil.

To fix this problem, the lawns are now aerated and then topdressed with sand, which breaks up the compacted soil to allow oxygen and water to penetrate. The frequency of aeration and topdressing depends on the condition of the



PNNL has expansive areas of turf grass on its campus.

soil. Flat areas are typically aerated annually. But for areas with high traffic and compacted soil or areas that have steep slopes, aeration and topdressing is applied more frequently throughout the growing season. Aeration and topdressing has created a much longer root depth, improving the health of the lawn and decreasing the amount of water needed by 30%.

Other better management techniques used on PNNL grounds include:

- Cutting the grass with mulching mowers, which reduces the need for fertilizers, helps retain moisture, reduces labor time for bagging and disposing of turf clippings, and also limits soil compaction because the mulching mowers are significantly lighter than the industrial mowers previously used.
- Allowing grass to grow longer— between 3 and 3.5 inches—in the summer months. This is beneficial because the longer grass shades roots and slows evaporation by keeping the root system cool.
- Testing soils to determine the exact fertilizer needs.
- Applying a 10% solution of mild liquid dish soap to the soil periodically to correct its water resistant nature. The soap helps the water molecules bind to the soil, thereby allowing the soil to retain moisture. The frequency of application is driven by the soil condition. For most areas, the soap solution is sprayed on once per year. For areas with steep slope or compacted soil, more frequent application is needed.

Xeric and Native Landscaping

PNNL grounds personnel are converting water-intensive and problematic landscaping into xeric and native areas. Xeric landscapes use native and low-water consuming plants that require minimal irrigation.

A particular challenge for the PNNL groundskeepers was the high-water-use landscaping adjacent to parking lots and streets. These areas have been changed to low-water landscaping. The groundskeepers planted urbanite ash trees in such areas because this species of tree can tolerate the summer heat and is very drought resistant. Evergreen shrubs in parking medians have been replaced with bunchgrass, which is well adapted to the local climate because of its low water requirements and high resistance to diseases.

In addition to being inefficient, the old sprinkler system had high maintenance costs because the sprinkler heads were vulnerable to damage from passing cars. The new sprinkler systems have heads that deliver water directly to the plants' roots and are not placed on the edge of the turf area, making them less vulnerable to damage.

To further reduce water use while maintaining aesthetics, PNNL is creating gardens to feature native plants from eastern Washington. In addition, the laboratory is adding walkways throughout the campus to encourage staff and visitors to walk from one building to another instead of



PNNL grounds personnel converted this parking median from traditional turf shrub landscape to a xeric landscape with native bunchgrass.

driving. Thus, the laboratory hopes to reduce its overall carbon footprint and promote healthy physical activity at the same time.

Irrigation System Improvements and Controls

PNNL performed a comprehensive maintenance program to upgrade the campus-wide irrigation system. Water output was tested along with sprinkler coverage so that the system could be fine-tuned to ensure broken sprinkler heads were repaired and all sprinkler heads were set correctly for efficient and effective coverage.

The laboratory has also begun installation of a “smart” watering system that allows grounds maintenance workers to control irrigation to all landscaping zones from one central location. Maintenance workers set an optimal water schedule for each landscape zone at the central office, from which control signals are sent out via a wireless network to sprinklers. This centralized system also allows for quick changes based on weather conditions. The system will be enhanced with a weather-based system that will download weather data from a local weather station. Data such as rainfall amounts, wind speed, and humidity will be taken into account to determine the optimal water needs for the plants in real time.

Cooling Pond Water Reuse

PNNL has large cooling ponds that are used as heat reservoirs for a portion of the campus' air conditioning system in the summer months. About 15 times during the summer months, these ponds reach a maximum operating temperature of 85°F. At this point, warm water from the



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Mike Schlender, director of Pacific Northwest National Laboratory's Operational Systems Directorate, stands in front of the sprayers at the cooling ponds. The water in the ponds is reused for irrigation, saving 15 million gallons of fresh water a year.

pond must be removed and replaced with cool water from the Columbia River. This cool makeup water volume varies with cooling needs, but in some cases can approach 1 million gallons per day. Instead of dumping this warm pond water into the local sewer system, PNNL reuses it for irrigation. The pond water is checked for safety, then pumped into the irrigation system to water the grounds. It is estimated that 15 million gallons of fresh river water is diverted from turf irrigation by reusing the pond water.

Award-Winning Program

PNNL has won several awards for this comprehensive program including:

- FEMP Federal Energy and Water Management Award in 2002
- Energy Management Achievement Award from DOE in 2002
- Association of Washington Business Environmental Excellence Award in Resource Conservation in 2003.



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“Is there a better way? This question winds its way through everything we do on the laboratory campus grounds.”

— Jeff Lettau, CGM, PNNL Ground Maintenance Team Lead

For More Information

FEMP Water Efficiency: <http://www.eere.energy.gov/femp/program/waterefficiency.html>

Water Efficiency Best Management Practices: http://www.eere.energy.gov/femp/program/waterefficiency_bmp.html

Photo credit: Jeffrey A. Lettau