Recycling RSF Effluent to Conserve Water

CONTRIBUTING WRITERS

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Miracle Mountain Wilderness Park in McDowell County, West Virginia, faced two major problems—a water shortage and a lack of wastewater treatment. The system was directly discharging wastewater from an old metal oil storage tank to an extended outlet pipe down the mountain slope. Water for toilet flushing and washing at the park's public lodge and caretaker's cabin is supplied from the collection of roof runoff by a cistern. During dry seasons, a nearby community supplies water with their fire department's water tanker.

The lodge at Miracle Mountain Wilderness Park, McDowell County, West Virginia.

When the nonprofit Miracle Mountain Corporation, consisting of a group of local citizens, approached the staff of the National Onsite Development Program's (NODP) Phase III project for a more effective method for environmentally sound wastewater treatment and disposal, NODP funded the installation of a Recirculating Sand Filter (RSF) Plant Model 60 with a Blue Water Recycling System, to treat the lodge and cabin's 600 gallons per day to tertiary standards and supply water to the lodge for toilet-flushing. Overall, this technology saves up to 50 percent of the park's water use and demonstrates an effective way to reuse wastewater onsite, providing an excellent opportunity to educate residents about wastewater treatment technology and water conservation.

Project Objectives

The NODP and the Miracle Mountain Corporation set four objectives for the project:

1. Correct a direct discharge from the lodge and caretaker's house at Miracle Mountain Wilderness Park.
2. Provide public education about wastewater treatment to the park's visitors.
3. Reclaim water for toilet use because of the potential for severe water shortages from the rainwater/cistern system during the summer months.
4. Demonstrate recirculating sand filter technology and hillside trench installation as two solutions for mountainous site conditions.

From Ruin to Restoration

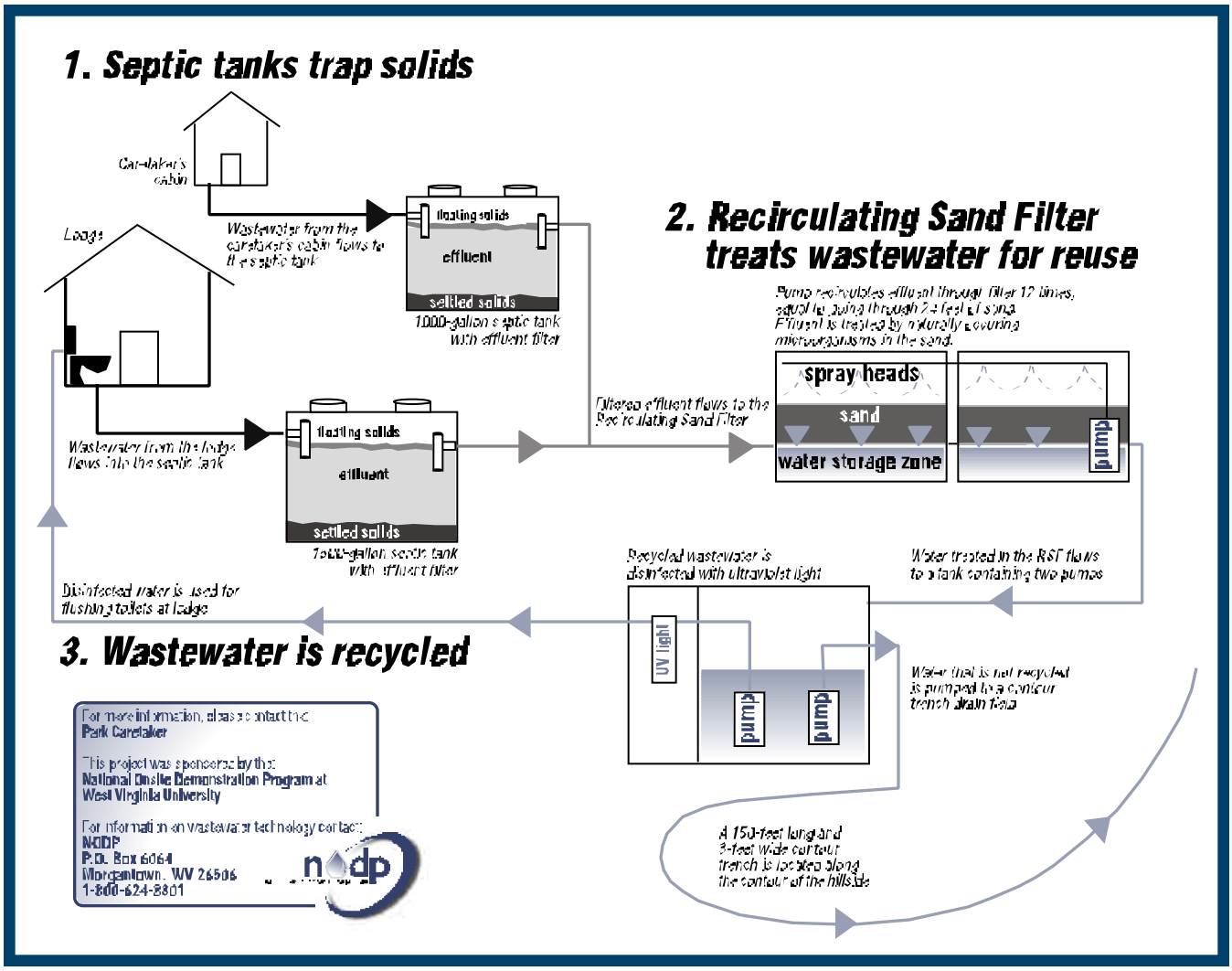
U.S. Steel Corporation employees built Miracle Mountain Wilderness Park in the 1930's. This 29-acre recreational facility had been abandoned and repeatedly vandalized. In 1989, McDowell County citizens joined together to establish the Miracle Mountain Wilderness Park Corporation to begin the park's restoration for recreational use. This facility is now used for outings, parties, picnics, weddings, and reunions.

After leasing the area from the Pocahontas Land Corporation, the park's nonprofit corporation began restoring the park, including the pavilion, ball field, picnic areas, playground, game areas, hiking trails, scenic overlook, lodge, and caretaker's house. A major challenge after this work had been completed was the need to upgrade the park's wastewater treatment system and conserve water from the limited water supply.

Wastewater Treatment: Finding an Effective Solution

The existing onsite wastewater system transported effluent from the main lodge and the caretaker's cabin to a single metal tank converted from oil storage to a "septic tank," located on a bench of land below the lodge. Collection pipes ran along the top of the ground. While partially covered with soil, the tank was not buried and was thus in a somewhat precarious position. Septic tank effluent flowed directly from an extended outlet pipe down the slope of the mountain without further treatment.

Water is supplied from the collection of roof runoff by a cistern to the main lodge, which has restroom and kitchen facilities, and a one-bedroom caretaker's cabin, which includes a kitchen, living room, and restroom. The cistern consists of three tanks, each with a holding capacity of 5,000 gallons, for a total capacity of 15,000 gallons. During dry seasons, the nearby City of Gary supplements the water supply by bringing in water with their fire department's water tanker. The cistern water is used for toilet flushing at both the main lodge and caretaker's cabin and for providing water to the caretaker's shower.



System Description

NODP representatives visited Miracle Mountain and recommended a system to effectively treat the wastewater while demonstrating low-cost, low-maintenance technology that could be used throughout the county and surrounding areas. With funding from NODP, the park hired ASHCO-A-Corporation, in Morgantown, West Virginia, to design and install a recirculating sand filter (RSF) followed by a "blue water" recycling system to treat the system's 600 gallons per day to tertiary standards. Water that is not recycled is pressure dosed to a final disposal trench located on the contour of the hillside. (See schematic)

With this new system, the wastewater from the caretaker's house is delivered via gravity to a 1,000-gallon septic tank located near the house. Likewise, the wastewater from the lodge is delivered via gravity to a 1,500-gallon septic tank located near the house. Sludge settling and decomposition occur in the septic tanks. Then, the effluent passes through an effluent filter, one per septic tank, and flows via gravity to the new RSF unit, through a common, small-diameter gravity sewer line.

Once the septic tank effluent reaches the RSF, it mixes in the bottom zone. A pump in the bottom zone pumping effluent onto a sand filter operates intermittently 24 hours per day, seven days per week. This effluent trickles through the media, where it is treated by naturally occurring microorganisms populating the filter. After passing through the filter media a number of times (in this design—12 times), the treated effluent is stored in the bottom, where it mixes with incoming septic tank effluent. Highly treated effluent then flows via gravity through a ball valve to a pump tank containing two pumps.

The first pump sends effluent to a contour trench drainfield, and the second pumps the clear effluent to flush the lodge's toilets. The recycling system consists of effluent being pumped by this pump through an ultraviolet disinfection unit with a pressure tank and pressure switch maintaining water supply to the toilets. When the pressure in the tank drops to 28 pounds per square inch (PSI), the pump turns on and takes the pressure tank up to 48 PSI, at which point the pump turns off. This disinfected water is then used on demand for flushing toilets, decreasing the park's water use and thus conserving water. The disinfected water used in the toilets is colored blue with dye tablets—thus the term "blue water" recycling system—to remind users that it is treated water; moreover, each toilet has a sign by it labeling the toilet water unsuitable for human consumption. Any treated effluent that is not used by the blue water system is pressure dosed to a contour trench disposal system. The contour trench was designed with a relatively small trench bottom area of 450 square feet and is dosed at one gallon per day per square foot because the soil on

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the property was rapidly permeable.

This technology demonstrates an effective way to reuse wastewater onsite and saves up to 60 percent of the park's water use because the majority of the park's day-use visitors use water mostly for flushing. Given the limited availability of water from the park's rainwater collection system during dry periods, the wastewater treatment system may eventually eliminate the need for periodic tanker truck fillings of the park's cisterns and educates the park's visitors about the value of water and options for wastewater reuse. The second technology demonstrated—a pressure dosed contour trench—is also appropriate for the area as an alternative to direct discharges in this mountainous region.

Miracle Mountain's recirculating sand filter system uses two septic tanks (1,000 and 1,500 gallons).

Operating, Monitoring, and Maintaining the System—Lessons Learned

A telemonitoring system was installed initially, allowing the operational status of the wastewater treatment system to be monitored remotely via phone lines. A telemonitor calls service personnel regularly to let them know the system is fully operational and immediately calls in an emergency, particularly if the water gets too high or low. The telemonitoring system installed had to be abandoned because problems with the electrical supply at the park caused the control panel to fail. This was thought to be due to power surges and/or lightning, and if computer-based telemonitors are to be used, careful attention to this problem is necessary. A standard electromechanical panel replaced the telemonitoring panel in the final configuration.

An unanticipated problem arose in the blue water recycling system pump design. During periods of heavy park use, (50–100 visitors), the pressurized pumping system back to the toilets would lose pressure, resulting in a lack of water for toilet flushing. This was determined to be a flaw in the pump specification. The initial pump chosen (incorrectly) was a sewage pump with an internal cut-off switch to protect against overheating. If park visitors used the toilets many times in quick succession, the resulting on/off pump cycles to maintain pressure in the line resulted in significant heat generation. This heat cut off the pump operation. The problem was solved with a high-head well pump used in drinking water well applications.

One other problem encountered was the presence of small pieces of plastic that clogged the small toilet valve orifices inside the toilet. This happened twice during initial startup and was suspected to be due either to a lack of flushing the long run of plastic pipe used to bring recycled wastewater back to the lodge, or by materials getting suspended in the pump tank during initial startup and testing of the system.

Maintenance procedures are required for this system every six months and include inspection of the RSF media and raking of the media if necessary, and inspection and replacement of UV bulbs once a year. Pumps in the system are expected to last somewhere between 7–10 years.

Outcomes

Onsite systems or direct discharge serve many communities, clusters of development, and individual homes in southern West Virginia, and this low-cost, low-maintenance RSF technology could eventually be used throughout the surrounding geographical area. To aid in these educational efforts, the Miracle Mountain Corporation erected a sign describing how the wastewater system operates. The group also plans to develop a brochure detailing the project, including how the system functions.

"This wastewater system has already increased use of the park," Miracle Mountain Caretaker Shelby Thompson said. Therefore, the Miracle Mountain Wilderness Park Corporation hopes to expand the recreational area by constructing a shower-house with additional restroom facilities for visitors staying overnight. However, a more secure water source will be needed if the park chooses this option.

As the park becomes better known and existing facilities are upgraded, the number of visitors is expected to increase once again, allowing for more educational opportunities about proper wastewater treatment and alternative wastewater treatment technologies.

A system such as the one described would probably not be installed unless water reuse is an important consideration in the design. Areas where water bills are extremely high or water resources are limited (as was the case here) are probably the main instances in which the added cost is justified. In addition, in areas where highly treated effluent for nitrogen reduction are required, the added $2,000 to $4,000 cost of disinfecting and recycling treated effluent for toilet use may be justified and may lower the total hydraulic load on the environment.

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