RESEARCH AND DEMONSTRATION CENTER ON-LOT SYSTEMS AND SMALL FLOW TECHNOLOGIES
DELAWARE VALLEY COLLEGE
DOYLESTOWN, PA

Project Funding Provided by:
Pennsylvania Dept. of Environmental Protection

Thomas J. Ridge, Governor
Commonwealth of Pennsylvania

James M. Seif, Secretary
Department of Environmental Protection
Executive Summary:

On-lot system technology components in use or under evaluation have reviewed nationally and internationally form published reports and direct contact with researchers, regulators, and industry. Six system technologies (A through F) were selected for study. These technologies consist of various primary treatment, secondary treatment, and soil based treatment components.

Technology A - Constructed wetlands
Technology B - Denitrification system coupled with at grade soil absorption
Technology C - Evaluation of four different types of sand filters
Technology D - Intermittent sand filter with time dosed soil distribution
Technology E - Intermittent sand filter with trickle irrigation
Technology F - Septic tank effluent with time dosed soil distribution

Full scale systems have been constructed on the campus of Delaware Valley College in the Fall of 1996. The technologies could provide options for 21 million acres in Pennsylvania. The technologies under study offer potential for communities to utilize non prime agricultural soils for on-lot wastewater systems. The project is due to conclude in the Fall of 1999. The following slides show construction of the various technologies.

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AERIAL VIEW OF THE CAMPUS WHERE SYSTEMS ARE LOCATED
SOIL PROFILE DESCRIPTIONS WERE WRITTEN FOR EACH LOCATION. DRAINAGE CLASSES INCLUDE WELL DRAINED MODERATELY WELL DRAINED, SOMEWHAT POORLY DRAINED, AND POORLY DRAINED
PROFILE BEING WRITTEN FOR TECHNOLOGY F
PROFILE BEING WRITTEN FOR TECHNOLOGY B
PERMEABILITY TESTING FOR EACH SITE INCLUDED BOTH PERCOLATION TESTING AND HYDRAULIC CONDUCTIVITY TESTING. HERE SITE D IS BEING TESTED.
Two cell wetland system. Each cell is approximately 17 feet by 17 feet. Designed for 400 gallons per day, the cell in the foreground is the infiltration cell and the cell in the background is the treatment cell.
TECHNOLOGY A - CONSTRUCTED WETLAND

Treatment cell in foreground is completely lined with 20 mil PVC liner.
Second cell is an infiltration cell. It is lined only along the edges. The bottom is open. The infiltration cell is filled with aggregate.
Here the first cell has now been filled with aggregate and the second cell has a mulch layer over the aggregate and is ready for planting.
System ready for planting. Effluent enters first cell from septic tank and is distributed by a header pipe buried along the full length of the first cell. The effluent then travels horizontally through the cell and into the second infiltration cell by way of the concrete flow control box in the center of the photo.
Completed system with plants. Flow is horizontal from treatment cell in foreground to infiltration cell in background.
Small community system handling three homes. Each home has its own denitrification sand filter (foreground) with effluent then going to two at grade pressure distribution beds (background).
Septic tank in foreground sends effluent to rock filter tank (left background). From rock filter tank effluent is pumped to sand filter tank (right background) for nitrification then back to rock filter tank for denitrification.
Side view of one of systems. This site has three homes each with its own denitrification system feeding two common at grade pressure distribution beds.
After passing through the denitrification systems the effluent is sent to at grade pressure distribution beds. Here vegetation has been removed and ridges and furrows are being placed in the bed on contour to prevent effluent migration downslope.
Close up of unit used to make ridges and furrows in the bed.
Another view of bed after ridges and furrows have been made on contour.
Here stone is being placed on a prepared bed.
Pressure distribution pipe within bed area.
TECHNOLOGY B - DENITRIFICATION SAND FILTER WITH AT- GRADE PRESSURE DISTRIBUTION

Soil cover being placed over beds.
Construction of different types of sand filters for effluent treatment.
TECHNOLOGY C - SAND FILTER BANK

Interior view of sand filter.
Sand filter bank during construction. Gravity, upflow, intermittent, and recirculating sand filters are being tested. Also round, rectangular, and rectangular two compartment septic tanks are being tested. Some septic tanks also have filters installed at the outlet.
Sampling box for sand filters being installed in foreground.
TECHNOLOGY D - SOMEWHAT POORLY DRAINED SOIL WITH SAND FILTER EFFLUENT AND AT GRADE PRESSURE DISTRIBUTION

Stone being placed in bed. Bed construction similar to Technology B.
TECHNOLOGY D - SOMEWHAT POORLY DRAINED SOIL WITH SAND FILTER EFFLUENT AND AT GRADE PRESSURE DISTRIBUTION

Beds are time dosed as opposed to demand dosed. Time of day and amount of dose can be adjusted with this controller. Currently beds are dosed four times per day at 70 gallons per dose.
Completed beds on somewhat poorly drained soils. Three beds have been constructed on this wooded site.
Wooded site on slopes ranging from 14 to 21 percent. Soils are moderately well drained.
Installation of trickle irrigation tubing using vibratory plow. Site receives 400 gallons per day sand filter effluent. Emitters occur every two feet in tubing. System doses 10 times per day. Three systems have been constructed.
Tubing has been installed over one site. Look closely and you can see ends of tubing still to be connected in the foreground of picture. Minimal site disturbance during installation.
Controller being installed for trickle irrigation system.
TECHNOLOGY F - WELL DRAINED SITE WITH AT GRADE PRESSURE DISTRIBUTION

Site receives septic tank quality effluent. Bed construction shown in the photo. Three beds were constructed.
TECHNOLOGY F - WELL DRAINED SITE WITH AT GRADE PRESSURE DISTRIBUTION

Beds being covered with soil.
TECHNOLOGY F - WELL DRAINED SITE WITH AT GRADE PRESSURE DISTRIBUTION

Three completed beds.
SAMPLING

Installation of zero tension lysimeters at one, two, three, and four feet beneath the beds. All beds have two lysimeters at each depth.