FROM WATERSHED TO WELL

FALL 2005

water resources   waste management   community development

Sludge Can Be An Asset

By Patrick Pinkson-Burke, Resource Manager
Grant Writer at RCAP Solutions

Dewatered sludge cake

Once you pull the plug or flush the toilet — what happens to the wastewater? Does it simply disappear, never to be seen again?

Managing Public Waste

Ever since the beginning of civilization, humans have had to do something with the waste they generate. Whether it is the waste from meals, or human waste, man has sought controlled methods of disposal.

Pre-historic man dug pits near their dwellings to collect human waste.

To help move wastes emptied into the streets, the Romans first constructed storm and waste channels. Although the primary function of these was storm water drainage, the Roman practice of dumping refuse in the streets caused significant quantities of organic matter to be carried along with the rainwater runoff.

During the 16th and 17th centuries in Europe, wastes were simply thrown out the window into the streets. This was one of the contributing factors of the outbreak of bubonic plague in 1644.

One reason for the popularity of wide brim hats was to protect the populace from liquids and garbage being emptied out the windows above.

By the 18th century, there was renewed construction of storm sewers, mostly in the form of open channels or street gutters. At first, disposing of any waste in these sewers was forbidden, but by the nineteenth century it was recognized that community health could be improved by discharging human waste into the

storm sewers for rapid removal. Development of municipal water-supply systems and household plumbing brought about flush toilets and the beginning of modern sewer systems.

At the beginning of the 20th century, in suburbs and rural areas, the septic tank was introduced as a means of treating domestic sewage from individual households. Cities and industries began to recognize that discharge of sewage directly into streams

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caused health problems. This led to the construction of some sewage-treatment facilities. However, because of the abundance of water to dilute effluent, and the presence of sizable social and economic problems during the first half of the 20th century, few municipalities and industries provided actual wastewater treatment.

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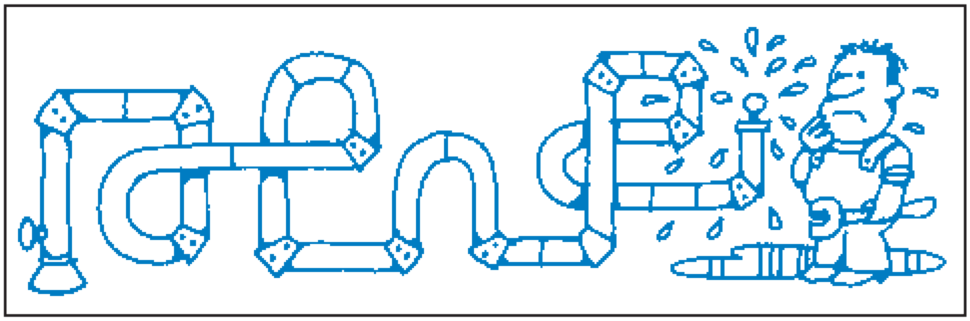
Waste Management Comes of Age

During the 1950s and 1960s, the U.S. government encouraged the prevention of pollution by providing funds for the construction of municipal waste-treatment plants, water-pollution research, and technical training and assistance. New processes were developed to treat sewage, analyze wastewater, and evaluate the effects of pollution on the environment. In spite of these efforts, however, expanding population and industrial and economic growth caused the pollution and health difficulties to increase.

To create a coordinated effort to protect the environment, the National Environmental Policy Act (NEPA) was signed into law on January 1, 1970. In December of that year, a new independent body, the Environmental Protection Agency (EPA), was formed to bring under one roof all of the pollution-control programs related to air, water, and solid wastes. In 1972 the Water Pollution Control Act Amendments expanded the role of the federal government in water pollution control and significantly increased federal funding for construction of waste-treatment works. Congress has also created regulatory mechanisms and established uniform effluent standards.

Current Waste Management



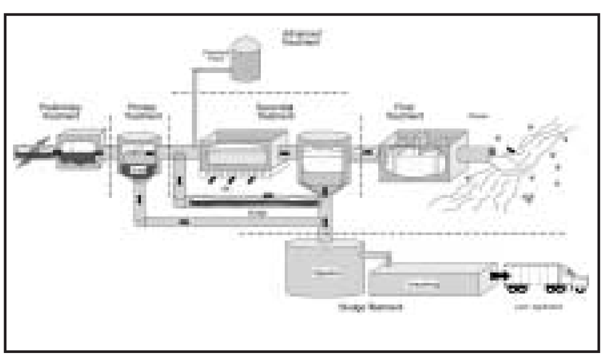
Now, liquid wastes are removed from our homes and buildings using a system of pipes. In urban and dense population centers, these pipes connect to a municipal sewer and wastewater treatment system. In rural areas, the pipes usually connect to a septic tank and leach field.

Septic System Waste Collection

Septic tank holdings must be emptied on a regular basis (annually or bi-annually) in order to prevent the system from failure. The cost of having a septic system cleaned regularly is relatively inexpensive ($150 to $250 each time). A well maintained septic system will last many years (decades). Replacing a failed septic system may cost several thousand dollars. *[See related article: "On-Site Household Wastewater Disposal."]*

Municipal Sludge

The liquid or septage removed from the septic tank is taken to a local wastewater treatment facility and mixed with other wastewater brought through the sewer lines. Through a series of settling ponds, skimmers, aeration ponds and separation systems, the solids are divided and removed from the liquids. These solids—known as sludge or biosolids—are collected and handled in various ways, one of which is described more extensively in the article in this issue entitled *"Reed Bed Technology."*



Sludge is composed of a mixture of human waste, grease, organic materials, food and other materials collected from sewers and septic systems. It is processed. The liquid waste remaining is essentially water that is tested and treated to make sure it meets all federal clean water guidelines and is then pumped into local streams/waterways.

The goals of sludge treatment are to:

- Stabilize the sludge and reduce odors,
- Remove some of the water and reduce volume,
- Decompose some of the organic matter,
- Reduce volume, and
- Kill disease causing organisms and disinfect the sludge.

If handled and treated properly, sludge can be a valuable source of nitrogen and trace minerals. Sludge from industrial sources may also contain toxic materials. Various types of sludge need to be handled and treated in distinctly different methods.

Primary sludges, material that settles out during primary treatment, often have a strong odor and require treatment prior to disposal. Secondary sludges are the extra microorganisms from the biological treatment processes.

Untreated sludges contain about ***97% water***. Settling the sludge and decanting off the separated liquid removes some of the water and reduces the sludge volume to a 96%-to-92% water content. More water can be removed by using sand drying beds, vacuum filters, filter presses, and centrifuges resulting in sludges with between 80%-to-50% water. This dried sludge is called a sludge cake.

Dewatered sludge can be:

- Buried,
- Used as 'daily cover' in lined, monitored landfills,
- Incinerated at approved facilities,
- Sprayed on regulated, non-food agricultural crops (hay fields, forests, field corn, etc.) or
- Composted.

What is "Daily Cover"?

Refuse buried in a sanitary landfill must be covered daily in order to minimize the attraction of rodents, wildlife, and disease-carrying insects. Daily cover also reduces the blowing of the refuse beyond the working face and contamination of stormwater runoff. In the United States, landfill regulations typically require 15 cm of daily cover. Where possible, cover soil is stockpiled during landfill construction and obtained from areas adjacent to the landfill.

Amoozegar, Barlaz, Rubin, North Carolina State University, The Water Resources Research Institute.

The most common complaints about sludge used in fields are:
1) Its smell and
2) The public perception/fear of any toxins or heavy metals that the sludge may contain.

Compost in the cold giving off heat

While studies have shown that treated sludge from wastewater treatment facilities contains little if any pathogens, toxins or heavy metal, the public in general is averse to its use—especially if homes and/or bodies of water are nearby.

Sludge Compost

Making compost is not magic. Nature does it regularly in our forests, fields, and streams. The American Heritage Dictionary defines compost as ". . . a mixture of decaying organic matter, as from leaves and manure, used to improve soil structure and provide nutrients."

Composting sludge stabilizes it and helps to reduce odors. The process of composting generates high heat, which kills disease-causing organisms. Following treatment, the finished, stabilized compost is often spread on fields, returning organic matter and nutrients to the soil. Various methods have been developed to compost sludge.

Five things are needed to make compost: nitrogen, carbon, water, air, and time. The combination of these five elements results in decomposition, which generates heat. A compost pile is monitored to maintain a steady temperature of between 140 degrees and 165 degrees. Too hot, and all the micro-organisms are killed-off; too cold, and the process slows down and doesn't kill the pathogens. Aerobic (with air) and anaerobic (without air) digestion may be used to decompose organic matter.

Aerobic composting occurs in controlled locations—usually outside or under an open building. The sludge is mixed with a source of carbon (often leaves or wood chips), piled into long rows (windrows) that contain perforated pipe, and monitored for temperature and moisture.

Air is pumped through the pile using blowers. The micro-organisms contained in the sludge

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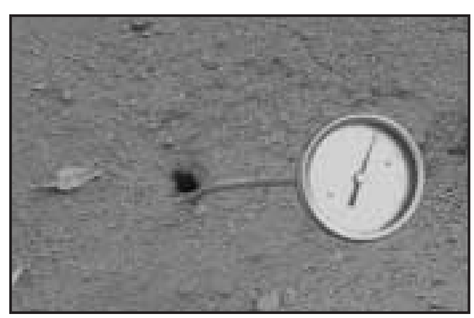

Measuring the internal temperature of sludge composting in process

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combine with oxygen and cause the pile to quickly heat-up to between 140 degrees and 165 degrees Fahrenheit.

The compost is monitored regularly for moisture and temperature until the temperature begins to drop (usually in 7-10 days). The pile is turned again replenishing the oxygen and the process repeated.

After several turnings and moisture additions, the compost process begins to slow down. At this time, the compost is moved to a curing area, where it is monitored. It usually remains in the curing area for 3 to 6 months, after which it is screened to remove any large materials that didn't compost or breakdown. Then the compost is ready to be used.

Close-up of blowers for aerating compost

Screening compost

Anaerobic compost is made with micro-organisms that do not like air. Initially, the materials will be colonized by aerobic bacteria, but when they have used up the air and begin to die off, they will gradually be replaced by the anaerobic bacteria.

Anaerobic composting tends to release noxious gases that are quite disagreeable. For this reason, anaerobic composting takes place in a closed building or vessel with air filtering systems. Because the pile does not need to be turned, anaerobic composting is less labor intensive. However, the process takes longer to finish. It also yields larger quantities of compost that is rich in nitrogen.

The pile is monitored regularly for moisture and to determine if the process is still working. When the compost process slows, the material is moved to a curing area for further monitoring and eventual screening.

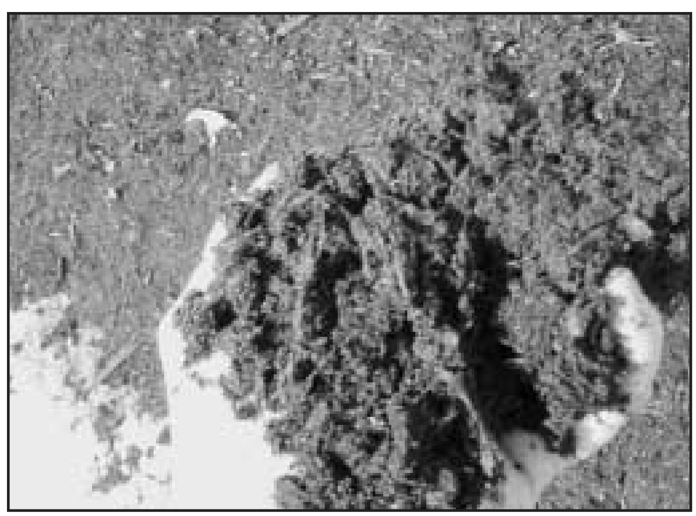
The main advantage of anaerobic composting is that it uses much less space. However, the building and filtering equipment is expensive.

The Benefits of Composted Sludge

Composted sludge, from either aerobic or anaerobic processes, can be used in a variety of agricultural uses.

- It makes a valuable soil amendment, returning nitrogen and other elements to the soils.
- It can be bagged and sold in nurseries.
- It can generate income for wastewater treatment facilities.

In summary, the act of composting sludge transforms waste from a cost with no tangible return into a valuable resource for the community. ■



End product—sludge compost

Gaining Control Over Sludge Disposal Costs

by C. Jeff Allio, Water Resources & Community Development Specialist

Sludge disposal costs in Farmington Township, Pennsylvania, greatly exceed budgeted amounts.

Current operations involve the sludge treatment package plant holding liquid sludge that is then hauled by a private firm to a large public wastewater treatment plant 20 miles away, over the border in Jamestown, NY. The hauler charges approximately $0.10 per gallon to move the sludge. At 1000 gallons a week, costs accumulate rapidly.

Researching ways to help reduce these operating expenses, the Farmington Township operator came to the conclusion that a reed bed sludge management approach could eliminate hauling costs, reduce the bulk and weight of the residual sludge (achieving some cost savings at disposal) and provide solid material for composting.

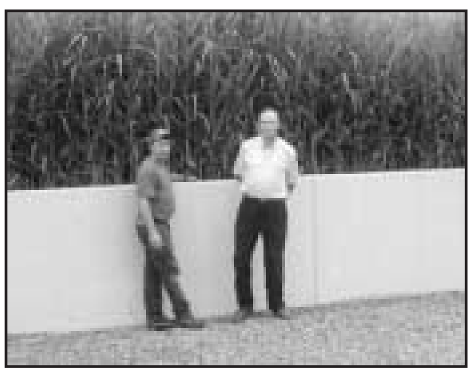
Current Operations

As part of an overall needs assessment, RCAP visited the treatment plant to learn more about current operations and to review the management and financial practices. The main issues are:

- The current plant is four years old.
- Carrying costs are high because construction came in over budget.
- Haulage further increases general operating expenses.
- The plant is under-utilized. It was designed to serve up to 80 equivalent dwelling units (EDU) but is currently serving only 65 EDUs.

Developing a plan

Early in the project, RCAP met with the three Farmington Township supervisors, the Township secretary and the operator of the sewage treatment plant. All agreed that RCAP's role would be to work with the community to develop a plan to build a low-cost reed bed storage chamber to convert liquid sludge to solid material. The reed bed approach would store the sludge and allow it to dry, thereby creating a product whose overall disposal cost is lower and resulting in a useable product. The storage unit could hold sludge material for as long as ten years—allowing haulage disposal funds to be reinvested in the facility's development and, hopefully, to actually generate revenue from the operation. RCAP further suggested that this effort be part of developing a comprehensive best management process to work toward zero waste and zero discharge. The community representatives agreed with this suggestion.



North Warren Reed Bed. On the left, Dave Enos, Plant Operator and Marvin Bergstron, Township Supervisor

Building on a Good Idea

RCAP offered to research construction plans for a reed bed storage facility and adopt it for use in Farmington. RCAP noted that the Township would have to run the draft plans by an engineer to supervise calculations and to get DEP approval. In addition, RCAP proposed several entrepreneurial initiatives that the operator could implement to save money and to generate revenues to improve the efficiency of the operation, including:

- Becoming a disposal site for septage haulers;
- Being the coordinator for on-lot septic management and;
- Composting dry material into a beneficial use material—for sale.

RCAP determined that a significant savings (as much as $6,000 per year) could be achieved if they could eliminate hauling sludge to a treatment plant in Jamestown, NY. This savings could leverage a ten year loan to construct some of the initiatives mentioned above.

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Gaining Control Over Sludge Disposal Costs

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If a reed bed can be built by in-house design and construction labor, Farmington Township may be eligible for additional self-help grants. Northwest Pennsylvania Regional Planning Commission (NWPA RPC) distributes small grants to promote self-help projects and in the past, Farmington Township has received financial assistance from the Commission to put a new roof over the existing sludge pit. It is encouraging that NWPA RPC has commented that it is looking forward to having RCAP's assistance regarding a proposed land application of bio-solids from the dried reed bed process.

Building Coalitions

RCAP Solutions suggested that partnering with a local non-profit watershed group might position the Township for additional grants to implement planned activities and to involve the community in more sustainable living practices. RCAP also proposed that the Farmington Township operator make contact with local school and local environmental organizations to develop a community committee to support converting the sludge into a beneficial use product.

Drawing on the Experiences of Others

RCAP Solutions agreed to research possibilities of other communities providing information to assist in designing the Farmington reed bed storage unit. Through the Northwest and Southwest Pennsylvania DEP offices RCAP obtained names of other communities using reed bed systems. Along with two representatives from the Farmington sewage treatment plant, RCAP visited Girard Borough in northwestern Pennsylvania as well as North Warren, ten miles from Farmington, to see a reed bed storage facility in operation.

Using the Girard plant design plans as an example, RCAP is in the process of preparing a rough draft for review by Farmington officials and an engineer before submitting the proposal for regulatory approval. RCAP also plans to set up a field trip in the future to the City of Butler where composted solid material from their sewage treatment plant is sold to a nursery for soil amendments (fertilizer).

Design Update

As this issue was going to press, RCAP submitted a reed bed design to the Small Flows Institute in Morgantown, West Virginia for review and comment. In their opinion the proposed facility is adequate for meeting the needs of Farmington Township. RCAP has scheduled a meeting with Farmington Township officials to obtain their comments and an approval to turn over this proposal to their engineer for submission to PA DEP.

The Farmington Township reed bed sludge storage unit has been designed to handle the current demand of 1000 gallons of flow of 5% solids sludge mixture from a sludge holding tank once a week. The 5% mixture will be pumped up 20 vertical feet from the bottom of the sludge holding tank and along a distance of 300 feet to the future site of the storage cell.

"Sludge solids" are solids left over from the evapo-transporation of the liquids by the uptake of wetland plants [phragmites] planted in a stored cell.

The current, small, activated sludge treatment plant, Farmington

The storage area will be a trapezoidal bermed and lined 5000 square foot pond in a pit excavated from a site adjoining the sewage treatment plant. The designer projects a little over 400 1.5 millimeter coatings of sludge solids will be added to the wetland cell each week and a life expectancy of 8 years of use before solids need to be extracted.

RCAP specialists are currently researching alternative native plant species before a decision is reached regarding final selection of the plant take-up medium.

RCAP recommends that in five years another storage pit be built to provide flexibility in servicing and maintaining the pumping infrastructure of the initial one and to extend the time before the first cell needs to be emptied of solid material, thus saving more money for the composting operation capitalization. The working life of the first cell will most likely be extended ten to twelve years with the second reed bed installed. Alternative coatings of sludge materials can be directed to the second bed. ■

Reed Bed Technology,

Finding an innovative approach to sludge management

Prepared by The Soil Association

What are Reed Beds?

Reed bed treatment systems are wetland ecosystems that have been artificially engineered and are self contained. They are designed to optimize the micro-biological, chemical and physical processes that occur naturally in wetlands.

How Do They Work?

Reed beds work by the cleansing power of three main elements: soil dwelling microbes, the physical and chemical properties of the base material (soil, sand or gravel), and finally the plants themselves. The choice of base material is dependent upon the particular type of waste that needs processing.

Wetland plants transfer atmospheric oxygen down through their roots in order to survive in water-logged conditions. This creates both aerobic and anaerobic soil conditions, allowing an enormous diversity of microbial species to flourish.

The plants (commonly Phragmites australis reeds) have three functions. Firstly, their very extensive root systems create channels for the wastewater to pass through. Secondly, the roots introduce oxygen down into the body of soil and provide an environment where aerobic bacteria can thrive. These organisms are necessary to break down many types of compound, in particular the oxidation of ammonia to nitrate (ammonia can be found in high concentrations in sewage and other nutrient-rich wastes). Finally, the plants themselves take up a cer-

Phragmites australis

tain amount of nutrients from the wastewater, which acts as a natural fertilizer.

Microbes are the most important part of the process. These bacteria and fungi can use organic pollutants as a food source, degrading a wide range of organic chemical products and turning them into harmless components. Here are just some of the elements that can be processed by reed beds: excessive Biological Oxygen Demand (BOD) such as caused by algal bloom, Chemical Oxygen Demand (COD) problems such as an overload of phosphates, ammonia, sewage and solvents amongst others. Even heavy metals can be transformed from a toxic, mobile state and fixed in the soil via complex chemical reactions.

Peak time or sudden heavy loads can be dealt with thanks to the absorption capacity of the soil. If retained in the reed bed for long enough even compounds such as PCBs (Polychlorinated Biphenyls) can be processed.

How are Reed Beds Constructed?

To construct a reed bed you need to dig out and line a hole. The lining is needed to prevent leaking of any wastewater into the surrounding soil or watercourses. The size of the hole will depend on the volume and flow rate of the waste water. The appropriate size will vary (on average you need five square meters per person in a household). Next the hole is filled with gravel, soil or sand—the exact mix of ingredients for the base depends on which substances will need processing. The reeds are then planted into this mix. Wastewater is delivered either over the surface of the system (vertical flow), or by a feeder trench at the front end of the system (horizontal flow).

What is the Difference Between Horizontal Flow and Vertical Flow?

Horizontal flow reed beds work particularly well for low strength effluents, or effluents that have been pre-treated. Whilst not effective in reducing ammonia they will almost always reduce BOD (Biochemical Oxygen Demand) and SS (Suspended Solids) levels. They are particularly useful in converting nitrates into nitrogen gas, which completes the nitrogen cycle.

An example of particularly effective use of the horizontal flow would be to treat the discharge from a sewage treatment plant,

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Reed Bed Technology

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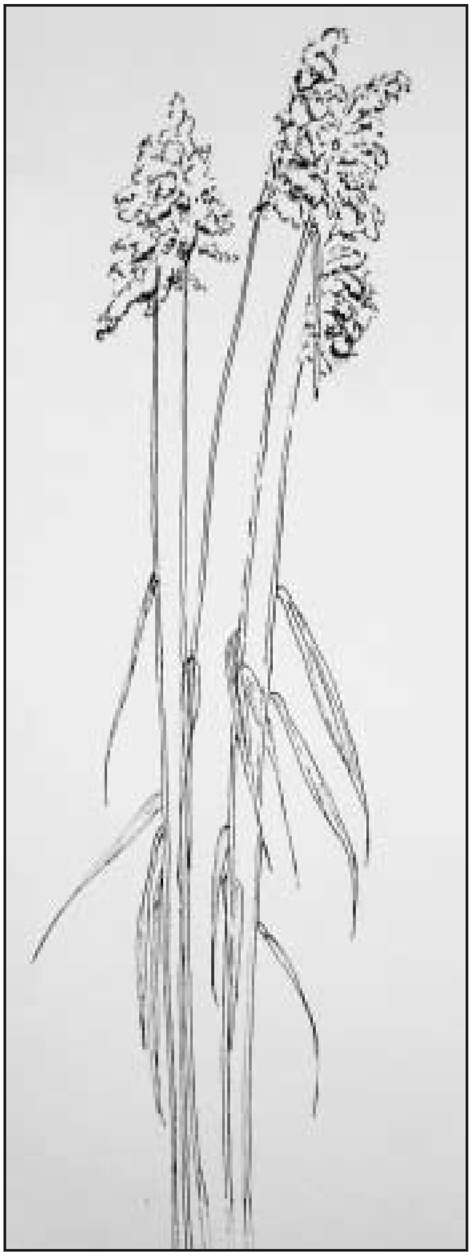


Phragmites australis

which fails to meet the discharge standard.

Vertical flow reed bed systems are much more effective than horizontal flow reed beds in reducing BOD and SS levels and also in eliminating smells and reducing ammonia levels. They can be considerably smaller and will also cope with much stronger effluents.

The two styles of system, horizontal and vertical, can be combined for the full treatment of domestic sewage, dirty water and sludge.

How Does the Process Work?

Effluent is first fed into a septic tank to remove solid material, which would choke the root system of the reed bed. An already installed septic tank may be suitable.

A feeder tank collects liquid effluent from the septic tank by simple gravity flow, but the flow onto the surface of or through the reed bed is often controlled by a pump. Only the liquid is allowed to pass into the reed bed for treatment. The reed bed is acting as a fixed-film filter with built in sedimentation.

Although treatment occurs all year round within the reed bed, the level of treatment is increased during the summer months. Reed beds are suitable for seasonally affected applications such as peak summer loads from campsites, as well as for normal household use.

The treated effluent from the reed bed will need to be discharged to ground, ditch or water course. This will be subject to consent from the relevant authority. Contact the Environment Agency (EA) www.environment-agency.gov.uk or the Scottish Environmental Protection Agency (SEPA) http://www.sepa.org.uk/ for details.

After 3 to 5 growing seasons the established reeds can be cut down to encourage new growth from the rhizomes. ■

Courtesy of: http://www.soilassociation.org/web/sa/saweb.nsf/0/389070b49f7aa3b280256ec2003613ce?OpenDocument

SOIL ASSOCIATION · ORGANIC STANDARD ·

The Soil Association was founded in 1946 by a group of farmers, scientists and nutritionists who observed a direct connection between farming practice and plant, animal, human and environmental health.

Today the Soil Association is the UK's leading organic organization, with over 140 staff based in their Bristol headquarters, in regional centers and working as certification inspectors across the country.

Benefits of a reed bed sewage system

A well designed, fully functioning reed bed system is a means of sewage treatment that:

- is efficient and cheap to run
- relies on biological processes
- returns solid matter to the soil
- recycles liquids in the form of purified water
- produces reeds which can be harvested for compost
- avoids the need for chemical treatment
- encourages awareness of sewage disposal processes.

Courtesty of: http://www.hdra.org.uk/factsheets/fr5.htm

Wastewater Sludge:
finding a low cost solution in Woodstock, NY

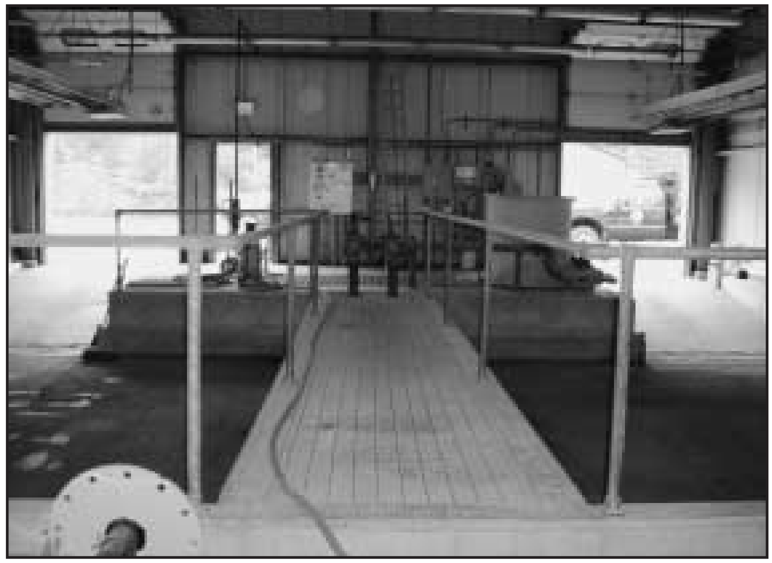
By Candace Balmer, Water Resources and Community Development Specialist

The Problem and Potential Solutions

The Woodstock, NY Environmental Commission (WEC) invited RCAP Solutions, Inc. (RCAP) to participate in a meeting to discuss a problem at the municipal wastewater treatment plant. The sludge drying beds at the plant have never worked as they were designed. The beds had to be retrofitted with propane dryers after the original vacuum system failed to perform. Woodstock wanted RCAP to assist in exploring using reed bed technology to replace the existing drying beds and eliminate the operation and maintenance costs associated with the propane heaters (over $15,000 annually).

RCAP suggested that the Town might benefit by inviting one or more engineering firms to conduct a facility walk-through and give their educated opinion. This would allow the Town to get some feedback at no initial cost. The firms would then be allowed to propose a work plan to fix the problem. RCAP provided the name of several reputable firms in the area with strong wastewater and reed bed expertise.

Following an initial walk-through and a discussion of options by the first engineering firm that was contacted, Woodstock was very impressed with their experience and approach, and asked them to evaluate the cost of three alternatives: rehabilitating the drying beds, constructing reed beds to dry the sludge, or installing a belt filter press to dewater the sludge mechanically. Although a new press was affordable when measured against the cost of propane drying, at an estimated cost of $120,000, it would still constitute a large capital expenditure for the district. RCAP inquired whether a used belt filter press would be acceptable. The engineer noted that they had recently located a used belt filter press in very good condition for another small community in the Catskill Mountains, at a cost of less than $20,000 installed. They agreed to see if they could locate a similar unit.



The dual drying beds have never worked properly

Proposed Belt Filter Press

Selecting the Belt Filter Press Process

The engineers evaluated the performance of the marginally effective sludge drying beds and

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Belt Filter Press

A Belt Filter Press is a Biosolids/sludge dewatering device that applies mechanical pressure to a chemically conditioned slurry, which is sandwiched between two tensioned belts, by passing those belts through a serpentine of decreasing diameter rolls. The machine can actually be divided into three zones: gravity zone, where free draining water is drained by gravity through a porous belt; wedge zone, where the solids are prepared for pressure application; and pressure zone, where medium, then high pressure is applied to the conditioned solids.

Typically, a belt filter press receives a slurry ranging from 1 – 4 % feed solids and produces a final product of 12 – 35 % cake solids. Performance depends on the nature of the solids being processed.

Wastewater Sludge: a low cost solution in Woodstock, NY

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presented their findings and recommendations at the next WEC meeting. Based on their engineering study, they concluded that the reed bed would be the most costly solution, largely because of construction costs associated with the shallow bedrock in the area and also because of concerns over the high water table. Regarding a used press, the engineers indicated that they had, in fact, just learned of three used belt filter presses for sale.

As another option, the engineers offered to conduct a no-cost pilot test of a solar-heated adaptation of the sludge drying bed. NYS Energy Research and Development Agency (NYSERDA) had expressed interest in funding the modification if the pilot tests proved promising. The Supervisor was concerned that the process would take too long and the outcome was uncertain. Thus, after reviewing the three alternatives, the Town decided to pursue the purchase of a used belt filter press because it was the least expensive, simplest and probably the quickest solution.

Obtaining Equipment

The consultant was able to locate a used belt filter press in good condition at the Village of Delhi Wastewater Treatment Plant for $10,000, including numerous spare parts. It had been reconditioned in 2003, but was being replaced because the plant has expanded their operation to take in dairy and other farm waste and the Village needed something bigger.

The Supervisor suggested that the Woodstock Wastewater Operator take a look at the belt filter press and make his recommendation. After visiting the site, the Operator did have some concerns regarding wash water for the press, since the well at the Woodstock facility is not a high producer. The engineer assured him that, since process wastewater can be used to rinse the press, operation and maintenance would have no impact on the well.

The belt filter press will eliminate the need for the operators to manually shovel sludge

The Town decided to purchase the press. They also engaged the engineer to guide its transfer and installation and to demonstrate its operation for a total of $2,000. Other costs to the Town include transportation of the press and replacement of the door to the sludge drying area to accommodate the press.

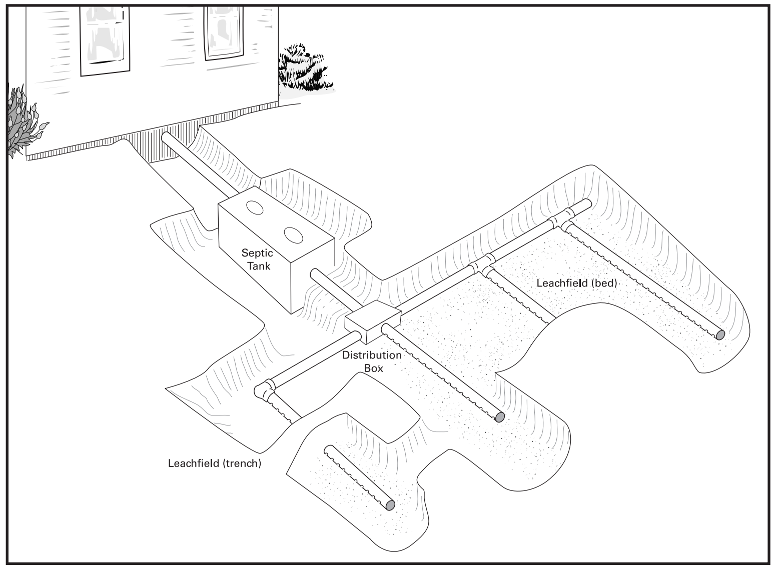
Because of the involvement of RCAP Solutions, Woodstock will soon be installing a technology that solves their sludge drying problem for a very reasonable investment. The RCAP Specialist used her knowledge of the community and the array of possible engineering solutions to guide the process, and to see that the community received appropriate engineering advice. ■

Operators manually shovel the dried sludge from the existing drying beds into trucks for offsite disposal

On-Site Household Wastewater Disposal

by Richard H. Clough, CAE
Executive Director, Granite State Designers and Installers Association

Excerpted from: "On-site Wastewater Disposal System Installation Manual" distributed by State of New Hampshire, Department of Environmental Services, Subsurface Systems Bureau and supplemented with additional information from NH DES.



The essential features of a typical system are the sewer drain line leading from the building, treatment/septic tank, an effluent line leading from the septic tank to a distribution box, the distribution box itself, the disposal field, and surrounding soil that will accept treated effluent.

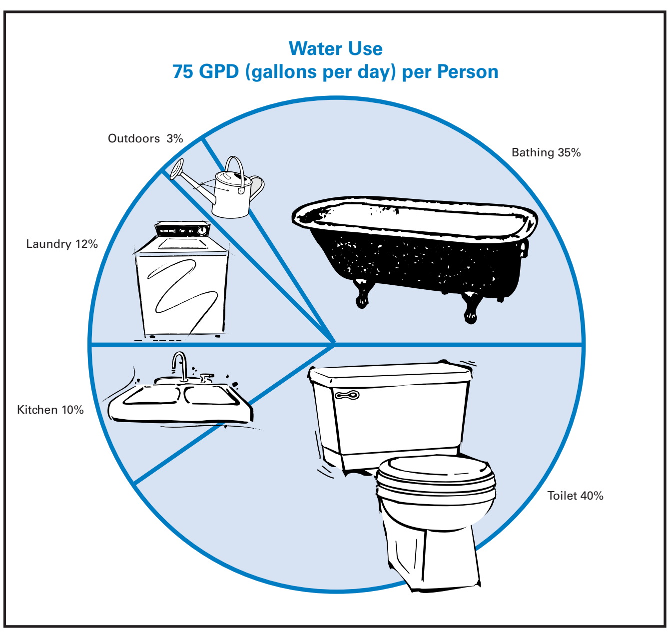
The Challenge

Normal household wastewater consists of all the liquid household waste generated from the toilet, bath and laundry. This material is composed of about 99 percent liquids and about one percent solids. The small percentage of solids and microorganisms in wastewater are the cause of health hazards and nuisances.

An On-site Solution

A septic system is a two part treatment and disposal system designed to condition untreated liquid household waste (sewage) so that it can be readily dispersed and percolated into the subsoil. Percolation through the soil accomplishes much of the final purification of the effluent, including the destruction of disease-producing bacteria. A properly functioning septic/wastewater system is one which will not allow harmful pollutants to accumulate to dangerous levels in the environment.

The treatment/septic tank functions as a conditioning device to provide for primary treatment of [household] wastewater. It provides the first step in the process by removing larger solid materials, decomposing solids by bacterial action, and storing sludge and scum. The liquid between sludge and scum is then passed along to the leaching area for final treatment and absorption into the ground. A properly maintained septic system will adequately treat your household sewage.



Components of the System

The Treatment/Septic Tank

Raw wastewater is detained in the treatment tank long enough for it to be rendered more suitable for discharge to the disposal area. If raw wastewater were to be discharged directly to the disposal area, the pore spaces between the soil particles would quickly become clogged by the solid materials contained in the wastewater and would either cause back-ups in the plumbing system into the house or come to the surface of the ground near the disposal area.

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On-Site Household Wastewater Disposal

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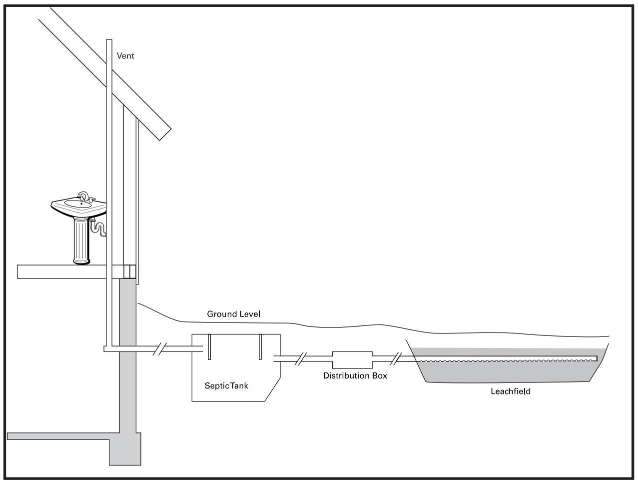
To minimize likelihood of such an occurrence, raw wastewater is held for a period of one to three days in the septic/treatment tank and subjected to a combination of physical, chemical and biological actions, which result in the conversion of most of the solid materials to liquids or gases. Gases escape either through the house plumbing vent or by mixing with the effluent.

The clarified liquid is then channeled to the disposal field. Some of the solids remain in the tank as sludge or scum and must be removed periodically before they accumulate to the point where they will be carried over into the disposal field.

The Effluent Line from the Treatment Tank to the Leach Field

The effluent line is a water tight pipeline which conveys the treatment tank effluent to the disposal area. Flow is usually by gravity but may be pumped in certain instances. There should be a drop in elevation between the treatment tank and disposal field of



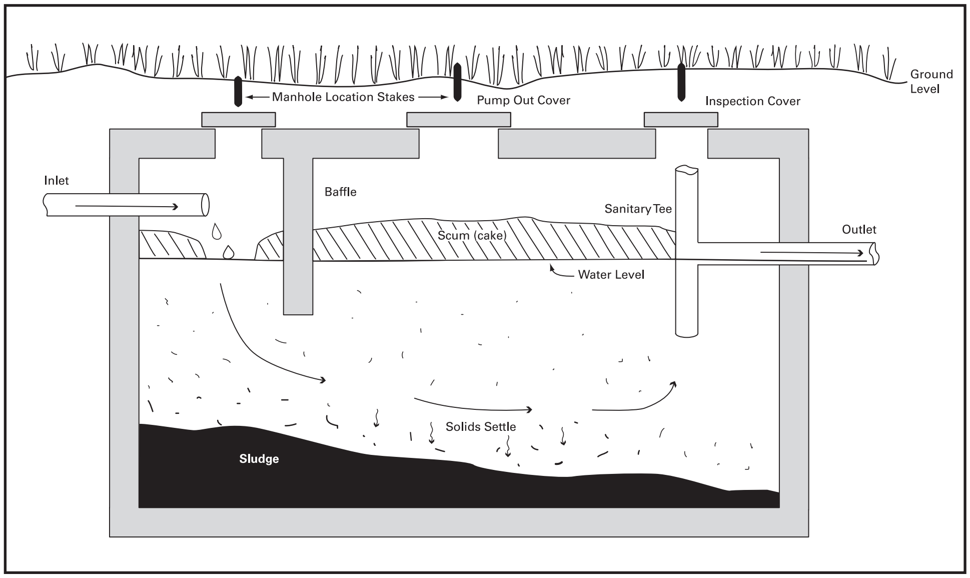
1/8 inch per foot or more with a gravity effluent line. This drop is to prevent a sluggish disposal area. The drop also prevents occasional large peak flows from backing up during periods of stress and causing the liquid level in the septic tank from rising above the baffles.

The Distribution Box (not always necessary)

When more than one disposal line is required through the disposal area, or multiple disposal areas are used, a means of distribution is needed to assure use of the entire area. This can be accomplished by using a distribution box. A distribution box is a small tank with a single inlet, and several outlets below the inlet. Distribution boxes should be insulated, include adequate flow baffles, be carefully installed level, and installed to minimize shifting or settling.

The Disposal Area, a.k.a. Leach Field

The disposal area which disperses wastewater to the ground once it passes through the distribution box may vary from five to 20 or more feet wide. In trench type systems, water flows through perforated parallel piping where effluent seeps into the receiving soil. The size of this leaching area will vary depending upon expected loading. Care should be given during the system installation to assure piping is level, to accept wastewater in equal amounts throughout the entire leaching area.



Proprietary Disposal Devices: As an alternative to trenching leaching systems, some designers are using a variety of proprietary devices to provide open areas, or void space, in the soils into which effluent from septic tanks can be introduced, and then absorbed by the soil. Septic system rules [in N.H.] allow for a reduction in the size of the disposal area when these proprietary products are used because they create an unmasked interface between the effluent and the soil. The various proprietary products have advantages due to smaller required footprints, and ease of installation.

Bed Disposal Area

A disposal area acts as an underground retention area. Stone (1 1/2" nominal in diameter) is typically used in the construction of a bed to provide void space for the storage of effluent and to allow it to drain slowly through the soil. Bed size is calculated by multiplying the expected volume of wastewater expressed in gallons per day by the size rating parameter determined by the soil evaluation.

The conditioned wastewater effluent from the treatment tank is discharged into the soil at a shallow depth by means of the bed disposal area. The disposal area serves the function of absorbing the effluent load from the treatment tank, serving as a temporary storage area during periods of large water use, and providing additional treatment of the effluent.

The Soil

The soil into which the effluent is discharged, serves three additional purposes:

- To distribute and absorb the effluent.
- To provide microorganisms and oxygen for the treatment of the unstable compounds, bacteria and solids.
- To provide chemical and cation exchange reactions to remove nutrients from the wastewater.

Disposal of liquids into the soil from a disposal area is through soil pores, between soil aggregates and through root channels. The soil pores vary in size with soil texture. Soil texture, soil structure, moisture content, and root penetration also effect the liquid movement through the soil.

Size of the soil pores influences the permeability rate, which in turn determines the amount of wastewater the soil can absorb. Soils with very fine textures (silts and silty clay) can absorb effluent only at a very slow rate, while sandy soils with coarse textures can absorb larger quantities of effluent. The texture of the soil is an important factor in determining the suitability of a particular soil for wastewater disposal.

The liquid movement from a disposal area into the surrounding soil is by gravitational and hydrostatic pressure, as well as capillary or matrix tension. Coarse textured soils (sands, or loamy sands) rely on the large pores for water movement and are primarily influenced by gravitational pressure. Finer textured soils (silt loams, silts, silty clay loams) mostly depend upon the smaller capillary pores for water movement. In small pores, capillary attraction tends to retard the pull of gravity and slow the percolation rate. Only in the larger soil pores does the water move with any degree of speed. ■

What should I do to maintain my septic system?

- Know the location of your septic tank and leaching area.
- Inspect your tank yearly and have the tank pumped as needed and at least every three years.
- Do not flush bulky items such as throw-away diapers or sanitary pads into your system.
- Do not flush toxic materials such as paint thinner, pesticides, or chlorine into your system as they may kill the bacteria in the tank. These bacteria are essential to a properly operating septic system.
- Repair leaking fixtures promptly.
- Be conservative with your water use and use water-reducing fixtures wherever possible.
- Keep deep-rooted trees and shrubs from growing on your leaching area.
- Keep heavy vehicles from driving or parking on your leaching area.

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The Price for Failure is Steep

The price for septic leech field failure is steep in two ways. More than 1200 people in the US die each year from contaminated water, and failing septic systems are a leading source of waterborne disease outbreaks in the country today. In a 2000 EPA report, 31 states listed septic systems as their second greatest potential source of groundwater contamination. Septic system replacement is also very expensive, with costs often running from $5,000 to $20,000 or more. Fortunately, there are some highly effective steps you can take to eliminate this problem.

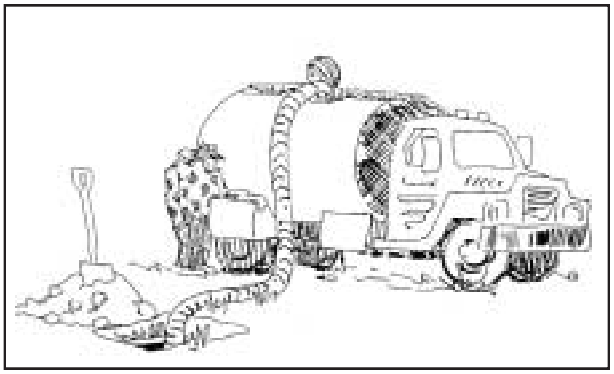
...Let's look at why septic systems fail. When a system fails, the tank itself doesn't fail—the drainfield soil fails. In most cases, the soil fails when it gets plugged up with solids and won't allow liquid to pass through it. For example, it can get plugged with solids from the tank if the tank hasn't been pumped—or with lint from a washing machine. [Various inexpensive filters can be installed in the system to capture these before they float through the tank into pipe that makes up the leech field and plug the holes in the perforated pipe.]

http://www.laundry-alternative.com/septic_leech_field.html

Diagrams are taken from "Understanding Septic Systems", published by RCAP Solutions

Hauling Septage to a Municipal Wastewater Treatment Plant

by Bob Morency, Water Resources Specialist



What happens to the septage that is pumped from household septic systems? Residents in rural areas not served by sewer systems tend to think that once you call the pumper truck, have the job done, and watch it go down the road, that's the end of the story. However, this material is potentially hazardous to the environment, and, as such, needs to be safely handled.

We met recently with Mr. Peter Labonte, Superintendent of the North Conway (New Hampshire) Water Precinct's Wastewater Treatment Plant to learn about how septage is handled in this rural area of the Northeast.

RCAP: *Peter, first let me say "thanks" for inviting us to your facility, and for sharing your experience with septage. How do septic haulers in this region get rid of their cargo?*

Peter Labonte: Septage haulers have few options in this part of New Hampshire and adjacent Maine. In the past, towns maintained septage lagoons, where haulers could discharge septage from the town, but many of these have closed, due to stricter regulations. The Mount Washington Valley is fortunate to have this facility. In the southern part of New Hampshire, much of the septage goes to Massachusetts. As a whole, New Hampshire exports 25% of our septage.

Our facility accepts waste from towns within about a 50-mile radius. In the busiest season, we accept around 300,000 gallons per month. For homeowners in the North Conway Water Precinct, there is no charge, due to the fact that Precinct members already pay taxes to support the facility. Users in other towns pay through the fees charged by the haulers. It's built in to their invoices.

RCAP: *What effect, if any, does septage have on the waste handling capacity of the plant here?*

P.L.: The addition of septage to the plant increases the load on the plant by a relatively small amount. Our facility was designed with growth in mind, so it is unlikely that we will reach design capacity anytime soon, even with the growth that we are experiencing right now. I could imagine that a small plant might see a large effect, though, so it may not be an option for all.

RCAP: *Are there financial benefits to the Precinct in accepting septage?*

P.L.: There is considerable financial benefit to the Precinct from this source of revenue, although off the top of my head, I don't know what percentage of our operating revenue this represents. The dumping fee is $100.00 per 1000 gallons (10 cents per gallon). This has recently gone up to 10 cents per gallon from 7 cents.

RCAP: *How is the Precinct paid?*

P.L.: Each hauler maintains an account, and we bill them by the month.

Detail taken from the back of the North Conway pumper

RCAP: *What are some technical issues that arise from taking in this material?*

P.L.: I'm glad you asked, because these issues explain why dumping here is not free. First, the larger solids are removed by a rotomat screen device, which filters out large solids (plastics, diapers, and other inorganics.). This facility is separate from the point where sewage (from the municipal collection system) enters the plant, and has to be overseen by an employee during the offloading. We don't test or pretreat the septage, since we have found that pH isn't a problem. Relative to sewage, septage is concentrated by a factor of 50, so, after we screen out the large solids, we have to dilute and treat it with chemicals before we add it to the municipal sewage stream. The resulting sludge, which settles out during the primary treatment process is dried and sent to the municipal landfill. Want some?

RCAP: *I'll pass on that one, but thanks again for the tour and for sharing your knowledge with our readers.*

P.L.: Sure, drop in anytime. ■

NEW! Small Loans Available for Water and Wastewater Systems

RCAP Solutions (Resources for Communities And People) is pleased to announce that it now has funds available to make predevelopment and capital improvements loans of under $100,000. The loans are intended to be a fast and cost effective source of funds to rural water and wastewater systems.

Funding priorities include loans to alleviate emergency situations; to correct deficiencies resulting in non-compliance with health and sanitation regulations; to extend or enlarge existing facilities; and to improve facilities in economically disadvantaged communities. **Requests for emergency assistance can be processed within 14 days from receipt of a completed application.**

The loan fund was initially capitalized by a $500,000 grant from the Rural Utility Service (USDA-RD) with a $250,000 match Community Resource Group, Inc., RCAP Solutions' sister agency serving the southern US. CRG, manager of the loan fund, is an established CDFI and has lent over $12 million to water and wastewater systems since 1992.

Eligible projects must be located in a rural area (under 50,000 population). The applicant must be:

- A public body, such as a municipality, county, district, authority, or other political subdivision of a state, territory or commonwealth;
- An organization operated on a not-for-profit basis, such as an association, cooperative, or private corporation.
- Indian tribes on federal and state reservations and other federally recognized Indian tribes.

Specific loan purposes

1. ***Predevelopment*** expenses of borrowers that are necessary and essential to secure permanent financing for major water and wastewater capital improvements (projects that significantly exceed $100,000 in total cost) within a rural community.
2. ***Short-term, small capital improvement projects*** that will serve to preserve, improve, or enhance water or wastewater disposal services of a water or wastewater system, and are not part of the regular operations and maintenance activities of a utility.

Loan terms and conditions

Amounts: up to $100,000

Length (amortization/maturity): Up to 10 years

Current Interest rates from 4.9% to 5.9% depending upon the length of the loan:

Security: varies by customer but often a pledge of revenues

Origination fee: 1% of the amount borrowed (minimum of $100)

Other costs: Out-of-pocket expenses for attorney fees, filing fees, etc. (generally less than $100.00 for most loans)

Environmental Review Requirements

Before RLF loan funds can be obligated projects must complete the RUS Environmental Review process as provided in 7 CFR 1794. This will be accomplished with the assistance of the RUS State Environmental Coordinator in the state where the proposed loan is originated.

Where can I get more information?

If you have questions or need additional information, contact information is on the back page of this issue or call Ted Kuchinski, RCAP Solutions' Loan Manager at 800/488-1969 ext 6635. ■

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This publication was developed under a grant from the Department of Health & Human Services, Office of Community Services (HHS/OCS).
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