

Helping Solve Local Wastewater Problems



A Guide for West Virginia Watershed Organizations

West Virginia Rivers Coalition
801 N. Randolph Avenue
Elkins, WV 26241

Canaan Valley Institute

Plateau Action Network

Stewards of the Potomac Highlands

Upper Guyandotte Watershed Association

With

Greenbrier River Watershed Association

Eastern Coal Regional Roundtable

Shavers Fork Coalition



September 2005

TABLE OF CONTENTS

1.	INTRODUCTION	1
2.	WASTEWATER PROBLEMS AND SOLUTIONS.....	3
3.	CREATING PARTNERSHIPS TO INVOLVE THE COMMUNITY	5
4.	ASSESSING YOUR WATERSHED’S WASTEWATER NEEDS AND PLANNING AN APPROPRIATE SOLUTION.....	7
4.1	STEP 1: SET THE STAGE FOR YOUR PLAN	7
4.1.1.	<i>Establish a mission or purpose statement</i>	7
4.1.2.	<i>Collect information about the watershed</i>	7
4.1.3.	<i>Identify issues</i>	8
4.1.4.	<i>Collect and assess information.....</i>	8
4.1.5.	<i>Prioritize obstacles and opportunities.....</i>	8
4.1.6.	<i>Determine sensitive areas.....</i>	9
4.1.7.	<i>Document obstacles and opportunities.....</i>	9
4.1.8.	<i>Document the process.....</i>	9
4.1.9.	<i>Establish goals and objectives.....</i>	9
4.2	STEP 2: DEVELOP YOUR PLAN	10
4.2.1.	<i>Select alternatives.....</i>	10
4.2.2.	<i>Develop a plan of action.....</i>	10
4.2.3.	<i>Find funding for your project.....</i>	10
4.2.4.	<i>Prioritize actions</i>	11
4.3	STEP 3: IMPLEMENT AND EVALUATE YOUR PLAN	11
4.3.1.	<i>Revisit and review.....</i>	11
4.3.2.	<i>Celebrate success</i>	11
4.4	CASE STUDY: WASTEWATER TREATMENT COALITION OF McDOWELL COUNTY	12
4.4.1.	<i>The problem.....</i>	12
4.4.2.	<i>A solution.....</i>	12
4.4.3.	<i>Partners.....</i>	13
4.5	CASE STUDY: UPPER GUYANDOTTE RIVER WATERSHED	14
4.5.1.	<i>The problem.....</i>	14
4.5.2.	<i>A solution.....</i>	14
4.5.3.	<i>Partners.....</i>	15
5.	TRADITIONAL SYSTEMS	16
5.1	COLLECTION SYSTEMS	16
5.1.1.	<i>Combined sewer overflows.....</i>	16
5.1.2.	<i>Sanitary sewer overflows.....</i>	17
5.2	TREATMENT PLANTS	17
5.3	CONSIDERATIONS.....	18
6.	ONSITE SYSTEMS.....	19
6.1	SEPTIC TANKS	20
6.2	TREATMENT FIELDS	21
6.2.1.	<i>Low pressure pipe systems</i>	22
6.2.2.	<i>Drip dispersal systems.....</i>	22
6.2.3.	<i>Mound systems</i>	22
6.2.4.	<i>Pretreatment.....</i>	23
6.3	AQUATIC SYSTEMS.....	27
6.3.1.	<i>Lagoons</i>	27
6.3.2.	<i>Wetlands.....</i>	27

7.	CLUSTER AND HYBRID SYSTEMS	29
7.1	SEPTIC TANKS	29
7.2	COLLECTION SYSTEMS	29
7.3	TREATMENT AREAS FOR CLUSTER SYSTEMS	29
7.4	WASTEWATER TREATMENT FACILITIES FOR HYBRID SYSTEMS	30
8.	MANAGEMENT ENTITIES	31
8.1	TRADITIONAL SYSTEMS.....	31
8.2	CENTRALLY MANAGED ONSITE SYSTEMS	31
8.3	CLUSTER AND HYBRID SYSTEMS	31
9.	ENSURING THAT WASTEWATER DISCHARGES ARE CLEAN: LAWS AND AGENCIES.....	33
9.1	LAWS THAT AFFECT WASTEWATER DISCHARGES.....	33
9.1.1.	<i>The federal Clean Water Act</i>	<i>33</i>
9.1.2.	<i>The West Virginia Water Pollution Control Act.....</i>	<i>35</i>
9.1.3.	<i>The West Virginia Groundwater Protection Act.....</i>	<i>35</i>
9.2	TRADITIONAL SYSTEMS.....	35
9.2.1.	<i>Bureau for Public Health permits</i>	<i>35</i>
9.2.2.	<i>NPDES permits.....</i>	<i>35</i>
9.3	ONSITE, CLUSTER AND HYBRID SYSTEMS	37
9.3.1.	<i>West Virginia design standards.....</i>	<i>37</i>
9.3.2.	<i>West Virginia subdivision rules.....</i>	<i>38</i>
9.3.3.	<i>National Pollutant Discharge Elimination System permits</i>	<i>38</i>
9.3.4.	<i>Underground injection control permits.....</i>	<i>38</i>
9.3.5.	<i>Local ordinances and agencies</i>	<i>39</i>
10.	FINDING FUNDING FOR WASTEWATER TREATMENT	40
10.1	TRADITIONAL SYSTEMS.....	40
10.1.1.	<i>Public systems.....</i>	<i>40</i>
10.1.2.	<i>Private systems</i>	<i>42</i>
10.2	ONSITE, CLUSTER OR HYBRID SYSTEMS.....	42
11.	FINDING TECHNICAL ASSISTANCE FOR YOUR COMMUNITY.....	43
11.1	ORGANIZATIONS	43
11.1.1.	<i>West Virginia Rural Water Association.....</i>	<i>43</i>
11.1.2.	<i>Canaan Valley Institute</i>	<i>44</i>
11.1.3.	<i>Rural Community Assistance Program.....</i>	<i>44</i>
11.1.4.	<i>National Environmental Services Center.....</i>	<i>45</i>
11.2	ENGINEERS	46
12.	GLOSSARY.....	47
13.	REFERENCES.....	50
14.	APPENDIX: SEPTIC SYSTEM FLYER FROM STEWARDS OF THE POTOMAC HIGHLANDS	51

TABLE OF TABLES

Table 1: Wastewater problems and solutions addressed by this report	4
Table 2: Problems, causes, and solutions for septic tanks, treatment fields, mound systems, and home aeration units.....	28
Table 3: Secondary treatment standards for wastewater treatment plants.....	36
Table 4: Other limits required for wastewater treatment plants	36

TABLE OF FIGURES

Figure 1: A typical onsite septic tank and treatment field	19
Figure 2: A typical septic tank.....	20
Figure 3: A typical effluent screen	20
Figure 4: A typical treatment field.....	21
Figure 5: Alternatives to gravel-filled trenches	22
Figure 6: A typical mound system.....	23
Figure 7: A typical filter bed	24
Figure 8: A typical single pass system	24
Figure 9: A typical recirculating system.....	25
Figure 10: A typical home aeration treatment unit.....	26
Figure 11: A typical wetland	27
Figure 12: Typical cluster and hybrid systems	30

ACKNOWLEDGEMENTS

The authors wish to thank the West Virginia Department of Environmental Protection’s Nonpoint Source Program for providing Clean Water Act Section 319 funding to support this manual.

We also appreciate the thoughtful comments from external reviewers, including Dave Clark, David Deiterle, Billy Jack Gregg, Mike Johnson, Bob Livingston, Tom Michael, and Ed Winant. We would also like to thank Rick Hertges, Pio Lombardo, and Joyce McConnell.

The authors include Evan Hansen (West Virginia Rivers Coalition), Mark Ehrnschwender (Plateau Action Network), Rob Stull (Canaan Valley Institute), Liz Garland (West Virginia Rivers Coalition), Kelly Jo Drey (Upper Guyandotte Watershed Association), Gary Berti (Canaan Valley Institute), and Paul Burke (Stewards of the Potomac Highlands). The Greenbrier River Watershed Association, Shavers Fork Coalition, and Eastern Coal Regional Roundtable also provided valuable input.

The front page photos were contributed by Rob Stull. Joe Peabody contributed the photos on pages 1 and 3.

ABBREVIATIONS

CFR	Code of Federal Regulations
cfu	colony-forming unit
CSO	combined sewer overflow
CSR	Code of State Rules
CTIC	Conservation Technology Information Center
CVI	Canaan Valley Institute
CWSRF	Clean Water State Revolving Fund
mg/L	milligram per liter
mL	milliliter
N/A	not applicable
NESC	National Environmental Services Center
NODP	National Onsite Demonstration Project
NPDES	National Pollutant Discharge Elimination System
NSFC	National Small Flows Clearinghouse
PSD	public service district
RCAP	Rural Community Assistance Program
RME	responsible management entity
SSO	sanitary sewer overflow
UGWA	Upper Guyandotte Watershed Association
UIC	underground injection control
USEPA	United States Environmental Protection Agency
VISTA	Volunteers In Service To America
WBP	watershed based plan
WVDEP	West Virginia Department of Environmental Protection
WVDHHR	West Virginia Division of Health and Human Resources
WVIJDC	West Virginia Infrastructure and Jobs Development Council
WVPSC	West Virginia Public Service Commission
WVRWA	West Virginia Rural Water Association

1. INTRODUCTION

West Virginians are, as a people, more connected to the land than people in most states. We connect to the land and water for hunting and fishing, relaxation and contemplation. We take comfort in our streams and both depend upon water and respect the power of water. The quality of life in West Virginia is tied closely to the condition of our waterways.

If you have read just this far into this manual, you are truly motivated to do something for yourself and your neighbors to help solve the wastewater problems of our state. It may be just one leaky septic tank, it may be a small town without services, or it may be a floundering wastewater treatment plant polluting your stream. Whatever the issue, you should be commended for taking up the cause and trying to do something for the quality of your and your neighbors' lives. This manual has been written for you, the person who cares.

While the impact of untreated wastewater on local rivers and streams is clear, proper wastewater treatment is also fundamental to maintaining people's health, protecting the quality of drinking water from local wells, and ultimately promoting economic development.



Wastewater problems do have solutions. And if you are beginning to embark on this endeavor, please be warned that this course is not easy. Problems are hard. Solutions do not come easy. But if you are dedicated, persistent, and tenacious for understanding, your journey will be rewarding and your satisfaction will be rich as you see the changes you helped create actually take shape.

West Virginia has some engineering challenges to overcome. This is not Kansas, and the hills we love create costly obstacles to overcome when planning wastewater services. As a result, the cost of providing centralized sewer services to remote locations is often too expensive to residents who live “over the hill” from serviced areas. Another factor working against us is our lack of soils able to treat wastewater. Most home septic systems rely on soil for secondary treatment and without adequate soil, alternative home treatment schemes can be costly.

Traditionally in West Virginia, people have been given two choices: either hook up to a centralized system or install a home septic system. In many cases, these choices can work well and can be cost effective. But it may be cost prohibitive to build sewer lines to smaller, remote towns. And septic systems may not be technically feasible due to space constraints, costs, or soil conditions.

This manual describes situations where these two traditional choices are appropriate, and also introduces alternative approaches helpful for addressing the tough problems we face in West Virginia. Cluster and hybrid systems seem to fit the needs of the mountainous areas where single family units are cost prohibitive, technically difficult, and hard to manage and maintain. Perhaps the biggest obstacle to these cluster systems is the lack of management structures in place to operate and maintain them. If a local entity is motivated to take on this responsibility, these systems can reduce the initial costs to construct reliable wastewater treatment systems and can keep the costs of service to affordable levels for the people who will be paying for the project month after month.

The best approach for your community will depend on the physical conditions of the land, the number of homes or commercial interests to be served, and the proximity to an appropriate existing treatment system with the capacity to accept additional wastewater. The best system will be the approach that is most manageable, cost-effective, and environmentally sound. This manual is geared toward helping you take a constructive and proactive role in working within your local community to address its wastewater needs.

The authors of this manual are concerned about the state's streams and wells, and understand that the health of our residents and the strength of our economy are closely tied to these issues. We realize that people like you will make the effort to solve local wastewater issues. This manual, hopefully, will provide you with some tools, some motivation, and some contacts to help you along your way.

2. WASTEWATER PROBLEMS AND SOLUTIONS

Many West Virginia watersheds face wastewater pollution, which degrades local streams with bacteria and other pollutants, threatening human health. The state's wastewater infrastructure is expanding, but is still not sufficient to treat all the human waste that is created.

Even today, at least \$2.9 billion is needed for centralized sewer systems throughout the state (WVIJDC, 2005). This figure illustrates the scale of the problem in West Virginia. The high cost also suggests a need for alternatives to centralized systems when they are more cost-effective, so long as they are environmentally sound.

As of 2005, 295 community sewage systems provided wastewater collection and/or treatment in West Virginia. Approximately 21% of these systems were collection systems only and conveyed sewage to another utility's treatment system. Approximately 55% of West Virginians were connected to public sewer systems in 2005. The rest either treated wastewater using onsite systems or discharged directly to rivers or lakes through straight pipes (WVIJDC, 2005). Even those with onsite systems are not necessarily treating their wastewater effectively. According to USEPA (2002), an estimated 60% of onsite systems in West Virginia were failing by backing up or by contaminating surface or groundwater.



West Virginia's steep terrain, low population density, and below-average per capita income present unique challenges. Compared with other states, it is often too expensive to build centralized collection systems. Incomes are sometimes so low as to make it difficult to pay for necessary treatment plant upgrades. The state's steep terrain and clay soils often make onsite septic systems unacceptable.

Solutions will be different in different watersheds. In some situations, new centralized systems may be appropriate. In other watersheds, onsite systems may work well. Elsewhere, enforcement actions against existing facilities may provide the incentive for necessary upgrades. In addition, new kinds of wastewater systems—especially managed decentralized onsite or cluster systems—hold great promise for many locations in West Virginia.

This manual is designed to help you decide which systems will work best in your area and to provide information necessary for you to start working toward the implementation of locally developed solutions.

Table 1 lists many common wastewater problems encountered in West Virginia, suggests solutions, and refers you to the relevant sections of this report for more detailed information.

Table 1: Wastewater problems and solutions addressed by this report

Problems	Solutions	Relevant sections in this report
General wastewater problems		
Wastewater problems are not known, or there is a combination of problems	Organize a broad assessment to determine your watershed's existing wastewater infrastructure and to prioritize needs. <ul style="list-style-type: none"> • Review wastewater infrastructure and plans • Perform bacteria and other stream monitoring • Learn about desires of local residents 	Section 4
Wastewater is being discharged without treatment through straight pipe(s)	If the property is isolated, build an onsite system If it is a community problem, consider joint solutions: <ul style="list-style-type: none"> • Cluster or hybrid systems • Traditional collection and treatment systems 	Section 6 Section 7 Section 5
Adequate wastewater infrastructure is needed for new development	Participate in permitting processes to ensure capacity of existing system is sufficient, or to identify needs for new systems.	Section 9
Problems with traditional systems		
Traditional system discharges poorly treated or untreated wastewater	Build community support and raise funds for action <ul style="list-style-type: none"> • Upgrade capacity • Fix infiltration/inflow problems • Remove combined and sanitary sewer overflows 	Sections 9 and 10
Traditional system is processing more wastewater than should be generated by the local population	Help organize an assessment to identify and eliminate infiltration/inflow	Section 4
Problems with onsite systems		
Onsite system(s) are failing	Fix or replace the onsite system(s)	Section 6
	Ensure proper maintenance of the onsite system(s)	Section 6
	If it is a community problem, consider joint solutions: <ul style="list-style-type: none"> • Cluster or hybrid systems • Traditional collection and treatment systems 	Section 7 Section 5
Working onsite system(s) must be maintained	Provide education to ensure the long-term health of the onsite system(s)	Section 6

3. CREATING PARTNERSHIPS TO INVOLVE THE COMMUNITY

Note: This section draws heavily from CTIC (1995).

Building and maintaining effective partnerships are the keys to addressing wastewater issues within a watershed. By creating partnerships, many different individuals and organizations come together to implement solutions at a local level.

Benefits of partnerships include:

- A more creative approach to the management of natural resources,
- An equal and open process minimizing negative social and economic impacts,
- The creation of “local buy in” leading to a sense of individual ownership, and
- A more efficient use of financial resources.

Partnering with other organizations and individuals can positively affect any wastewater project. Watershed partnerships are essential in bridging the gaps between multiple state, federal, and local agencies as well as individuals and other organizations. By bridging these gaps, partnerships bring in more resources, generate publicity, and provide equal access to the process even if there are controversial issues.

Partners chosen to engage in a wastewater-related project will depend on the scope, location, and nature of the problem. However, some skills sets are particularly important:

- Strong local leadership with a thorough understanding of the local social, economic, and environmental context;
- Understanding of the regulatory and management structures at the local and state level;
- Understanding the array of treatment technologies, including traditional and emerging technologies;
- Ability to build additional community support for wastewater projects; and
- Ability to assess the current situation with regard to wastewater treatment.

Generally, the partnership-building process begins with the identification of stakeholders—anyone having a stake in the process. Once identified, they should be invited to the process. Next, the partnership should determine a purpose and set goals. Finally, the partnership should develop a plan, implement it, and evaluate the project’s success.

Choosing partners depends upon the stage of the project. At the beginning, brainstorm a list of every potential group, government agency, and business that may have a potential interest in the community or wastewater project. Do not limit the list to only those who have similar missions and goals; the most creative and fruitful partnerships may bring together less obvious parties or even longstanding “enemies.”

Since wastewater projects are often costly and cross many disciplines and local concerns, it is important to look beyond the traditional partners. Some critical additional partners may be:

- Regional Planning and Development Councils, with an understanding of past studies of possible wastewater treatment systems;
- Public service districts (PSDs), who manage current infrastructure, understand local service boundaries, and track trends in the changing customer base;
- Organizations engaged in housing and economic development, who can provide insight and possible coordination with ongoing projects; and
- Health providers, who can address human health impacts.

The partnership should schedule initial meetings with potential partners to provide background information on the project, work plans, and schedules. Clearly present what you hope partners can contribute and how each partner stands to gain. Do not give up too quickly if a potential partner does not respond. Some may need more time to think it over or to seek approval from others in their office, or they may want to see if the project is going to succeed. Continue to go back and re-invite those who at first declined. Always be prepared to restate your case: what the goals are and what the mutual benefits will be.

The format and formality of a partnership can vary widely. Whether it is simple or complex, it benefits everyone if an agreement is reached beforehand about each entity's role and responsibilities. Document in writing the purpose of the partnership, the roles and tasks of the various partners, the duration of the partnership, and provisions for making changes to the agreement including adding or releasing partners or dissolving the partnership. Negotiate any points of contention so that there is consensus.

Once a partnership is formed, it is time for action. The following section presents instructions on how to use a partnership to assess your watershed's wastewater needs and to plan an appropriate solution. The section also presents case studies in which local partnerships were developed to help solve wastewater problems in West Virginia.

4. ASSESSING YOUR WATERSHED'S WASTEWATER NEEDS AND PLANNING AN APPROPRIATE SOLUTION

Note: This section draws heavily from CTIC (1995).

In many watershed across West Virginia, wastewater needs are not clearly known. There may be one or more centralized treatment plants, many residents may have septic systems, and others may be discharging through straight pipes. But without a comprehensive assessment, the true needs and priorities of the community will be guesswork.

This section presents step-by-step instructions for using the partnership you are creating to assess your watershed's wastewater needs and to plan appropriate solutions. It then presents two case studies where this process is already taking place in West Virginia.

The ultimate goal of developing such a plan is to work toward a healthier watershed. Coming together and developing a plan will benefit all stakeholders involved in the process. Developing a plan can be divided into three basic steps:

1. Identify issues by collecting and assessing information about the project area and by identifying obstacles or opportunities. Also develop goals and objectives.
2. Develop an approach for addressing the goals and objectives by identifying and selecting alternative solutions, recording various approaches for implementing solutions, and determining how to measure the success of the project.
3. Implement your solutions and measure your success.

4.1 Step 1: Set the stage for your plan

Throughout this first step the group will go back and forth between identifying issues, collecting data, assessing information and developing goals and objectives.

4.1.1. Establish a mission or purpose statement

Developing a clear purpose or mission statement is beneficial when forming a partnership. The group's statement should be clear and concise and should define the general goals and responsibilities. A well developed statement, when revisited, will serve as a gauge for determining the effectiveness and progress of the partnership. In order to develop a purpose statement, the group should generate a list of ideas from all stakeholders, discuss ideas and form a draft statement, discuss the draft and revise as needed, and develop a final statement once consensus is reached.

When developing a purpose statement, long and short term goals for the wastewater project should be set. It is important for these goals to be attainable and to include general strategies—i.e. improving water quality within the watershed. The group should also establish goals for specific activities such as assessing the need for new wastewater infrastructure or raising funds to upgrade a wastewater treatment plant.

4.1.2. Collect information about the watershed

Once all partners have developed and agreed upon a mission statement, you can begin to collect necessary information about the watershed. This may include maps, copies of permits from the county health department and West Virginia Department of Environmental Protection (WVDEP), or even

monthly reports from the wastewater treatment facility. After collecting this information, you are ready to begin developing a plan.

The success of your project depends to a large degree on the thoroughness of your assessment. Do not expect to collect all the information about the project area on the first effort; however, it is important to document missing information to be collected at a future date. It is also important to recognize that all plans and projects may not be completed in this specific order. For example, certain partners may be able to complete a portion of the assessment while others are identifying ways to measure success.

Later, your partnership can use the baseline information about the project area to gauge how well the group has met its objectives.

4.1.3. Identify issues

It is important for your watershed partnership to identify and address issues about the watershed or project area including natural resource information, economics, and social structure. When identifying these issues, your group will find certain issues to be based on stakeholder perceptions, and others on facts or science. All issues, including their limitations, should be recognized and addressed by the group. Initially, the group should not place a value to the issue—simply list the concern and begin exploration.

Inviting everyone to the process and providing an opportunity for all concerns to be addressed will take more than publishing an announcement in the local paper. Although this is important to do, it is more effective to make a personal phone call or even hold a face-to-face conversation with each potential partner and stakeholder. Take the time to introduce yourself. A personal invitation shows the group's dedication to the process and lets others know how committed your group is to addressing the issues within the watershed. Personal visits also allow for your group to better explain the mission of the partnership and the purpose of the project.

The economic forces within the project area are important to consider when developing a plan. Your group may want to generate a list of important economic factors such as major employers, what role they can play in the project, and the benefits of including them in the process—both to your group and to the employer. You may also want to consider the interrelated social, economic, and natural resource components of the watershed, including the impact they have on each other and the health of the watershed. Again, it is important to list all concerns and give each equal consideration at this point.

4.1.4. Collect and assess information

Now that all stakeholders and partners have listed all issues, it is time for your group to begin to combine similar issues. Once this is completed, the group can start to research and seek additional information about these issues. You may find it helpful to seek assistance from groups listed in Section 11 of this manual. This may be a great opportunity to form a team of technical advisors or subcommittee to address any technical questions the group may have. In some cases, data already exist for the watershed or project area. Your group may want to acquire these data and combine them with data you have collected. This can serve as a baseline for comparison later.

4.1.5. Prioritize obstacles and opportunities

As your group continues through this process, obstacles as well as opportunities will become apparent. There usually will not be enough time or money to solve all of these issues. The partnership will need

to prioritize issues and focus on ones having the biggest impact toward meeting its goals. A consensus will need to be reached allowing the group to move forward. Your group may begin prioritizing issues by taking certain criteria into consideration. You may want to consider the group's ability to effect change, how long it will take before results will be seen, who is willing to bring about the change needed, and whether the costs will outweigh the benefits.

4.1.6. Determine sensitive areas

Addressing sensitive areas within your project area will have the greatest impact. These areas can be determined by such factors as water supply areas, recreational use designations, or trout stream designations. These areas may be impacted by faulty septic systems, inadequate collection systems, or outdated treatment facilities. Regardless of the area or what is causing the problem, it should be your group's goal to bring in the appropriate resource or partner resulting in the greatest benefit for that area.

4.1.7. Document obstacles and opportunities

As stated above, not all issues can be addressed at one time. It is important for your group to document what obstacles are keeping you from meeting your goals so future partners and resources can be identified and invited into the process. It is crucial to identify and describe both economic and resource impacts to give potential partners a better understanding of the situation. For example, you can describe the situation by stating fishing license sales were down by 30% and 27 miles of stream were impacted by bacteria from an inadequate wastewater treatment facility. Also include in this statement exactly what is keeping the group from addressing this particular issue.

4.1.8. Document the process

In addition to documenting obstacles, it will be of great value to document the entire process. Partners, stakeholders, and funders will want to see documentation in order to support your group's efforts. All information including maps, reports, and existing data should be compiled for future use when applying for grants, developing educational programs, or making basic presentations about your project. Should an organization request a proposal or a newspaper ask for information to include in an article, you will be prepared to respond with the necessary information.

4.1.9. Establish goals and objectives

Once your obstacles and opportunities have been defined and documented, establishing the group's goals and objectives is relatively easy. Going through this process will help clarify the general goals of the group. Goals should be statements of what can realistically be accomplished by the group.

Hints for establishing goals and objectives

- Consider the views of all stakeholders and partners.
- Base goals on reality.
- Break down objectives into manageable tasks.
- State objectives in measurable terms (i.e., decrease faulty septic systems by 95% or reduce inflow and infiltration by 60%).

Keep in mind that these goals and objectives may change as the process evolves. Partners and stakeholders may come and go over time. The important step is to come to consensus and work toward bringing about solutions.

4.2 Step 2: Develop your plan

4.2.1. Select alternatives

During this step, your group will probably rely on your technical advisors or resource teams to investigate available technologies. You can start by generating a list of alternative solutions and how they might help meet the goals set by the partnership. It is not important to assign a ranking to them but try to determine each alternative's effectiveness based on economic, social, or natural resource factors. Basic descriptions of various wastewater treatment technologies are included in Sections 5, 6, and 7 of this manual.

4.2.2. Develop a plan of action

At this point, your partnership has developed a mission statement, goals and objectives, and alternatives for addressing your issues. By developing a plan of action you can begin the process of implementing solutions. However, it is important to put together the information describing who is going to do what, by when, and using what resources. Compiling this information will generate tasks and as well a lead person responsible for making sure the tasks will be completed in a timely manner. This process will get people involved and hold people accountable for their work.

Your group will first need to list all of the objectives set for the project. After each objective, you may want to list the alternatives identified as possible solutions. It is then time to begin thinking about who will accomplish each task and within what time frame.

This information need not be collected right away—give partners time to think about each objective. They may even want to take the objective list home and generate a list of responsibilities and determine time frames to report back to the group at the next meeting. This will allow people time to think about their commitments and responsibilities to the group and project. Once the group has generated all of this information, it is important once again to document the process. At this time, any action items similar in nature may be combined to allow for more efficiency. It is also a great opportunity to reevaluate to see if there are any other resources or partners who could contribute to the process. Lead people assigned to individual tasks should be comfortable with their assignments, and the group as a whole should be in agreement on the direction of the project at this time.

4.2.3. Find funding for your project

Depending on the project, the amount of funds needed will vary tremendously. Section 10 in this manual covers funding options for various wastewater projects.

4.2.4. Prioritize actions

As with the obstacles and opportunities, your group will need to prioritize your actions. There will typically be more actions listed than your group can accomplish within a realistic time frame. It is important to focus on actions providing the biggest return to the watershed. When addressing wastewater issues, your group may initially want to put more value in accomplishing an assessment task than completing any restoration efforts. Consider the following during the prioritization phase:

- Return on investment,
- The group's ability to complete the action,
- Available funding and resources,
- Impact on other actions, and
- The ability to increase the group's motivation.

Spotlighting the work done by your partnership

As your plan evolves, it is important to spotlight the work already accomplished by your partnership. Your work can be shown to the community by:

- Establishing demonstration sites,
- Conducting watershed tours,
- Hosting workshops, and
- Posting signage.

By conducting such events, the community will become more aware of your project, which may ultimately lead to more involvement from stakeholders

4.3 Step 3: Implement and evaluate your plan

To prepare for implementation, your group will need to determine how to measure progress of the project. As stated earlier, it is crucial to compile baseline information in order to measure change as it occurs. As objectives are met, they should be recognized and spotlighted. Doing this will satisfy resource partners and funders and is likely to generate interest from the community.

4.3.1. Revisit and review

As time goes by, your group will need to revisit your objectives to see if they have been met. It is also important for the group to revisit its mission statement to see if it is still going in the same direction. Ask yourselves questions like: Have we been successful? Are there additional partners who can become involved? Should our mission statement be changed?

4.3.2. Celebrate success

Give yourselves the credit you deserve once accomplishments have been made. Be sure to recognize individual volunteers, resource partners, and funders. This will give people ownership of the project and keep everyone motivated to work on additional projects. Most importantly, everyone should be having fun.

4.4 Case Study: Wastewater Treatment Coalition of McDowell County

4.4.1. The problem

The Wastewater Treatment Coalition of McDowell County grew out of flood recovery efforts in 2001 and 2002. Several floods had not only devastated homes and businesses, but also brought to the fore the substandard nature of wastewater treatment throughout the county. Situated in the southern coalfields, the majority of homes in McDowell County still discharge wastewater directly into streams and rivers through straight pipes. The communities, churches, nonprofit organizations, and state agencies working on flood recovery were forced to grapple with wastewater issues as many homes—and subsequently many straight pipes—were in need of repair or replacement.

4.4.2. A solution

In order to define the scope of the problem, coalition members pulled together information from a variety of sources, including:

- The local health department, who had on file septic system permits;
- Local sewage plant operators, who could identify the service areas and capacity of existing treatment plants; and
- WVDEP and coalition members who knew about operating package plants in the county.

With these data and additional assistance from partners, the coalition was able to map all existing systems, providing an accurate “snapshot” of the current state of wastewater treatment in the county. Recognizing that traditional treatment may not be uniformly viable due to physical or economic constraints of their county, the coalition began exploring alternative approaches to treatment technologies. Given the dispersed nature of the county’s communities, the steep, sometimes isolating terrain, and the often rocky substrate, installing sewer lines to a centralized plant is simply too expensive for many families and communities.

Alternatively, considering wastewater treatment on a smaller decentralized scale opened up several options. Less land is needed for treatment and dispersal than in traditional sewer systems, project scope and cost is kept at a locally manageable level, and operation and maintenance demands are substantially lower.

Once treatment options were identified for all of McDowell’s unserved communities, the coalition began the process of prioritizing those communities. They decided to rank communities according to several criteria, including:

- Community willingness: Was the community willing to help pay for the installation and/or long-term maintenance of treatment systems?
- Economic development: Are there any potential development projects that would compliment a proposed wastewater project, and vice versa?
- Floodplain: Are there communities out of the floodplain in need of wastewater treatment?

Community surveys were conducted, interviews were held with elected leaders, and further maps were assessed. In the end, the coalition generated a list of over 90 ranked communities and a preliminary assessment of an appropriate treatment technology for each.

The final Wastewater Treatment Plan was released in March 2005, over two years since the coalition’s inception (Wastewater Treatment Coalition of McDowell County, 2005). In addition to the county

plan, the coalition also installed two wastewater demonstration projects (see the Box in Section 6.2.3.2). The coalition now continues to work towards implementation of its plan with additional partners from engineering firms, state agencies, and other organizations.

4.4.3. Partners

Early partnerships in the coalition were driven by housing needs, human health concerns, and the desire of families to regain basic living standards. The coalition grew to include organizations and agencies engaged in water quality management, economic development, and social services. Key partners include:

- The McDowell County Family Resource Network: Provided coordination and facilitation at the local level.
- The McDowell County Health Department: Provided staff support, background materials, and access to county records and supported installation of demonstration projects.
- Stop Abusive Family Environments: Provided space and on-the-ground support.
- Council for Southern Mountains: Supported community coordination, public outreach, and hosted a demonstration project.
- West Virginia Ministry of Advocacy and Workcamps: Provided critical organizational support, funding, and oversight of demonstration project development.
- Volunteers In Service To America (VISTA) volunteers: Coordinated internal communication, conducted field work, tracked the work of multiple committees, and provided important clerical support.
- White Oak Environmental, Richmorr and Associates, and Stafford Engineering: Provided essential technical expertise.
- McDowell Parks and Recreation and the Elkhorn Watershed Association: Hosted and supported VISTA volunteers, chaired committees, and provided important community networking.
- Mayors of several municipalities, sewer system operators, and Region I Planning and Development Council: Provided support and insight into traditional technical and funding options.
- Canaan Valley Institute (CVI): Provided organizational, financial, and technical assistance throughout the assessment and planning process.

4.5 Case study: Upper Guyandotte River Watershed

4.5.1. The problem

The Upper Guyandotte Watershed Association (UGWA) was founded in 2002 in response to the water quality problems that have negatively affected communities in Wyoming and Raleigh Counties.

The UGWA's mission is to promote "...a cleaner, healthier and more prosperous watershed that is more attractive to all stakeholders and is better managed to withstand the impacts of flooding." The UGWA focuses its work in the Guyandotte River watershed from the headwaters downstream to the mouth of Pinnacle Creek. This 260 square mile area is heavily forested and is home to about 7,500 people.

Many miles of streams in the Upper Guyandotte watershed do not meet state water quality standards for human health; that is, they are not safe for swimming, fishing, or use as a drinking water source. The total maximum daily load report issued by the United States Environmental Protection Agency (USEPA) in 2004 identifies bacteria and metals as the major sources of water pollution. Within the watershed, only the communities served by the Mullens municipal system have public sewer service. That leaves many people relying on inadequate wastewater treatment systems, which are the major sources of bacteria. This widespread contamination contributes to the spread of disease and illness, hinders economic development and the ability to attract tourists, harms aquatic life, and decreases the quality of life for watershed residents.

4.5.2. A solution

UGWA determined that to solve the watershed's wastewater problem, it would first be necessary to catalog the problems. The UGWA took the lead in engaging partners to collaborate on the Upper Guyandotte Wastewater Project Committee. This committee is working to develop a watershed based plan (WBP), a comprehensive nonpoint source pollution reduction plan required before Clean Water Act Section 319 grants can be provided.

The committee has already completed an assessment of the current status of wastewater treatment throughout the watershed, the first step in developing the WBP. This assessment was based on a geographic information system and consisted of:

- Mapping community boundaries and counting individual occupied homes using aerial photos and windshield surveys,
- Recording the relative densities of groups of homes within those communities,
- Reviewing health department records to estimate the number of homes with permitted septic systems, and
- Delineating the current extent of wastewater treatment provided by the one sewage treatment plant in the watershed.

The remaining components of the WBP will be completed by April 2006 and include:

- A description of the wastewater treatment options appropriate for each community. It is anticipated that addressing the bacteria issue will likely require a combination of centralized and decentralized treatment systems.
- A set of prioritization criteria to rank wastewater treatment projects and a schedule for implementation of the WBP.

- An estimate of the amounts of technical and financial assistance needed and the sources of assistance that will be relied upon to implement the WBP.
- A monitoring component to evaluate the effectiveness of the implementation efforts over time.
- Information and education components that will be used to enhance public understanding of the project and encourage their early and continued participation in selecting, designing, and implementing the wastewater treatment projects.
- An estimate of the pollution load reductions expected upon implementation of wastewater treatment. The currently approved total maximum daily load report will be used as a basis for the load reductions that must be implemented to achieve water quality standards.
- A set of criteria that can be used to determine whether load reductions are being achieved and progress is being made towards attaining water quality standards.

The final plan will be professionally published and distributed to relevant stakeholders. The ultimate goal of this project is to attain water quality standards in impaired streams and increase the quality of life for the residents of the watershed.

4.5.3. Partners

Upper Guyandotte Wastewater Project Committee partners will contribute much of the time and expertise required to complete the plan. Project partners include:

- Upper Guyandotte Watershed Association,
- Canaan Valley Institute,
- West Virginia Department of Environmental Protection,
- Wyoming County Commission,
- Rural Appalachian Improvement League, Inc.,
- Wyoming County Health Department,
- Raleigh County Commission,
- Beckley-Raleigh County Health Department,
- Crab Orchard MacArthur PSD,
- City of Mullens,
- Mountain Resource Conservation and Development Council,
- Wyoming County Board of Education,
- West Virginia Conservation Agency,
- Southern Conservation District,
- West Virginia Ministry of Advocacy and Work Camps, Inc.,
- Beaver Coal Company,
- Upper Guyandotte Chapter Trout Unlimited, and
- West Virginia Bureau for Public Health.

5. TRADITIONAL SYSTEMS

Now that you have thought about the wastewater issues in your watershed and the importance of building partnerships to solve them, this section and the next two sections introduce the basic information you need to understand the various kinds of technology used to treat wastewater.

Traditional wastewater collection and treatment systems pipe wastewater from a large number of homes and businesses to a central place for treatment. Treatment plants range from large facilities that process millions of gallons of wastewater per day to smaller package plants, some of which process only a few thousand gallons per day. Centralized systems may be publicly or privately owned.

In these traditional systems, homes and businesses are connected to a large diameter pipe and all wastewater, including solids, flows through the collection system to the treatment plant. Typically, monthly customer fees pay off the system's construction debt and fund ongoing operations and maintenance. These costs, which are usually quite high, limit centralized systems to urban and suburban areas with sufficient population densities and high enough incomes.

Treatment methods vary depending on the size and age of the plant and type of wastewater treated. Treated wastewater is typically discharged directly to a river; therefore, these systems must have National Pollutant Discharge Elimination System (NPDES) permits that specify how much pollution can be released (See Section 9 for more details on NPDES permits).

There are several basic components of centralized systems, with many variations in design and application. These components are described below in general terms.

5.1 Collection systems

Collection systems move wastewater from its source to treatment plants, and are generally the most expensive and problematic parts of traditional systems. Installing a collection system is a disruptive and lengthy process. Because collection systems must transport solids in addition to fluids, pipes must be large enough and must be installed at a certain slope to ensure scouring and movement of solids. Maintaining this slope moves the pipe deeper and requires lift stations to pump the waste back up toward the ground surface. Manholes are required at set intervals for maintenance.

Extra water called infiltration and inflow often finds its way into these pipes through cracks or where pipe segments come together. High levels of infiltration and inflow can send too much water to treatment plants, undermining the system's ability to properly treat wastewater.

The cracks also allow raw sewage to leak out of the collection system into the ground, whenever the water table is below the pipes. Continuous leaks, which allow water movement in both directions, can be suspected if treatment flows rise after heavy rain, although they are not the only cause. Leaks can be found by smoke tests and by sending video cameras into the pipes.

5.1.1. Combined sewer overflows

Usually for historical reasons, combined sewer systems have linked storm and sanitary sewer lines. During dry weather, little or no storm water enters the sanitary sewers, and wastewater is directed to the treatment plant for treatment. But when it rains, storm water combines with sanitary waste, often

exceeding the capacity of the collection pipes. This combined storm water and wastewater overflows directly into a stream. While NPDES permits recognize combined sewer overflows (CSOs), permits include a series of requirements to minimize the numbers of overflows and their effect on water quality. CSOs, when properly identified and incorporated into NPDES permits, are legal.

The 57 combined sewer communities across West Virginia estimate that it will cost over \$1.1 billion to solve these problems (WVIJDC, 2005). Watershed organizations can play an important role in helping to develop long term plans for controlling discharges from CSOs, and for eliminating them entirely.

[USEPA's Combined Sewer Overflow Program](http://cfpub.epa.gov/npdes/home.cfm?program_id=5)

http://cfpub.epa.gov/npdes/home.cfm?program_id=5

5.1.2. Sanitary sewer overflows

Sanitary sewer overflows (SSOs) are similar to CSOs because they result in the discharge of raw sewage to streams. But unlike CSOs, SSOs occur in systems where storm water and wastewater pipes are not connected. Instead, SSOs typically occur because extra water infiltrates into wastewater pipes because they are cracked or because people illegally direct storm water to them. NPDES permits make no mention of SSOs because they are illegal and cannot be permitted. Watershed organizations can play an important role in helping eliminate SSO discharges. Groups can monitor bacteria levels to help identify discharge points, document the frequency with which overflows are occurring, and work with their local utilities to develop long term strategies for eliminating SSOs.

[USEPA's Sanitary Sewer Overflow Program](http://cfpub.epa.gov/npdes/home.cfm?program_id=4)

http://cfpub.epa.gov/npdes/home.cfm?program_id=4

In summary, traditional wastewater treatment systems fall squarely within the NPDES permitting system. Adequately sized, well maintained, and well operated systems should have no problem meeting permit limits and protecting receiving streams. Watershed organizations can monitor permit compliance and can play important roles to help ensure that discharges are clean and that overflows are eventually eliminated.

5.2 Treatment plants

After wastewater is transported to a centralized treatment plant, a screen is used to remove floatables such as toilet paper. The flow is then moved into the treatment stream. Treatment systems will be different in different facilities. Some options include activated sludge, fixed film, and sequencing batch reactors. During treatment, the solids are separated from the effluent and primary microbial treatment occurs, reducing the levels of bacteria, suspended solids, biochemical oxygen demand, and other pollutants. Other steps may be required to remove nitrogen, phosphorus, and other pollutants that may be limited in NPDES permits.

Most facilities are required to disinfect the treated effluent prior to discharge. Typical disinfection options are chlorine, ultra violet light, and ozone. Chlorine in the form of tablets, gas, or chlorine dioxide has some adverse environmental impacts, creates carcinogenic compounds, and usually requires dechlorination. In addition, chlorine gas is a hazardous material. Sufficient exposure to ultra violet light kills infectious organisms. It adds nothing harmful to the effluent, but requires periodic cleaning and bulb replacement. Ozone (O₃) is highly toxic to simple organisms and is an effective disinfectant when bubbled through the effluent. The disinfection process destroys one oxygen atom and leaves only molecular oxygen (O₂) and inert organics in the disinfected effluent, posing no environmental hazard. Both chlorine and ozone have handling issues, operational complexities, and higher costs attached to their use.

The solids in wastewater are often used as part of the treatment process by housing the active microbes, and are also partially digested by those microbes. Ultimately, much of the solids remain as sludge, which must be pulled from the system, treated to stabilize the pH, and disposed of by digesting, hauling to a landfill, or applying to the land.

5.3 Considerations

As with any system, maintenance is critical; failing wastewater treatment plants essentially act as straight pipes. Centralized systems are expensive to construct and operate. A critical mass of ratepayers is necessary to make these systems economically feasible. Across the country, collection systems typically represent about 70% of total construction costs (Lombardo, 2004).

The basic components of the centralized system are not separate steps but a critical balancing act with each affecting the other. As discussed above, collection systems are susceptible to inflow and infiltration. Too much inflow lowers the effectiveness of treatment plants, and sometimes can overwhelm plant capacity, resulting in washouts, sanitary sewer overflows, or bypasses. Sanitary and combined sewer overflows and bypasses route raw sewage directly to rivers and lakes, skipping treatment. Washouts remove many of the working microbes in treatment plants, and it may take weeks for plants to get back to their full effectiveness.

Case study: Extending a traditional system to Kilsyth and Price Hill

The Fayette County Water Quality Coalition was formed after the 2001 floods brought the problems of straight pipes and failed septic systems to the forefront. This informal partnership reviewed data and key water quality stressors in the county. Because Kilsyth and Price Hill are located in the flood plain, onsite systems were not considered to be feasible options.

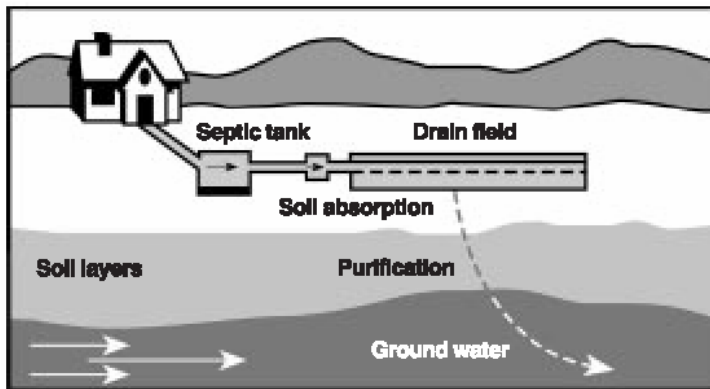
After the coalition presented its concerns to its federal representative, the county, a coalition member, acquired funding through the U.S. Army Corps of Engineers to extend sewer service from Mt. Hope to the communities of Kilsyth and Price Hill. Questions were raised about whether the facility had adequate capacity to accept increased flows; therefore, an additional Small Cities Block Grant was awarded to increase Mt. Hope's treatment plant capacity and sludge handling. Plans and designs are complete and construction is expected in spring 2006.

6. ONSITE SYSTEMS

Onsite treatment systems are designed to treat wastewater at the source. The most common onsite system is composed of a septic tank and a drain field and is owned and maintained by the landowner. As discussed in Section 8.2, a responsible management entity might maintain the onsite systems in a community, although such a system is far less common in West Virginia.

The first component of an onsite system, a septic tank, allows the majority of solids to fall to the bottom and the soaps and greases to float on top. The effluent in between is transported by pump or gravity to the drain or treatment field.

Figure 1: A typical onsite septic tank and treatment field



Source: USEPA, 2002.

Septic tanks for primary treatment of wastewater appeared in the late 1800s. In the 1900s, it became common to discharge effluent from septic tanks into gravel-lined treatment fields (Kreissl, 2000). In addition to traditional septic tanks and treatment fields, many other types of onsite systems are available today. Depending on the conditions found at each site, these newer systems may provide more cost effective, higher quality treatment. This section discusses tanks and several types of treatment processes, each with its own limitations based on site, cost, and local regulations.

USEPA Decentralized Systems Technology Fact Sheets

USEPA has published a series of fact sheets that explain various onsite technologies:

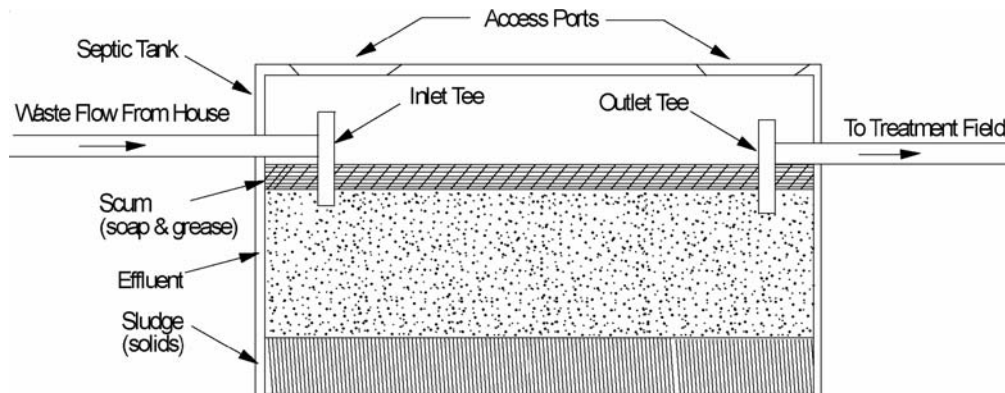
- Aerobic Treatment (USEPA report number 832-F-00-031)
- Low Pressure Pipe Systems (832-F-99-076)
- Mound Systems (832-F-99-074)
- Septage Treatment/Disposal (832-F-99-068)
- Septic System Tank (832-F-00-040)
- Septic Tank - Soil Absorption Systems (832-F-99-075)
- Septic Tank Leaching Chamber (832-F-00-044)
- Septic Tank Polishing (832-F-02-021)
- Septic Tank Systems For Large Flow Applications (832-F-00-079)

These fact sheets are available at www.epa.gov.

6.1 Septic tanks

Septic tanks should be water tight and made of concrete, fiberglass, or polystyrene, and should be installed at or just below the soil surface. Wastewater flows from homes or businesses to the tank inlet tee. The tank should be large enough to provide a 24-hour holding time, allowing the solids to settle and scum to rise. Tanks typically have access ports for inspection and maintenance and may have one or multiple chambers.

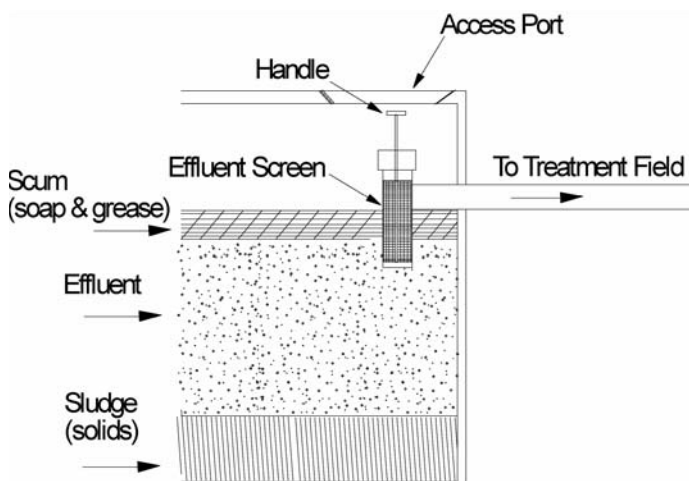
Figure 2: A typical septic tank



Source: Plateau Action Network.

Properly sized, installed, and maintained tanks are seldom a problem. Still, there are many steps people can take to improve their performance, as shown in the educational handout produced by Stewards of the Potomac Highlands and included as an appendix. Effluent filters and screens may be mounted into septic tanks before the outlet. They catch suspended solids and prevent them from moving into and clogging the treatment field. These units are available in different styles and strainer sizes and require periodic inspection and cleaning.

Figure 3: A typical effluent screen

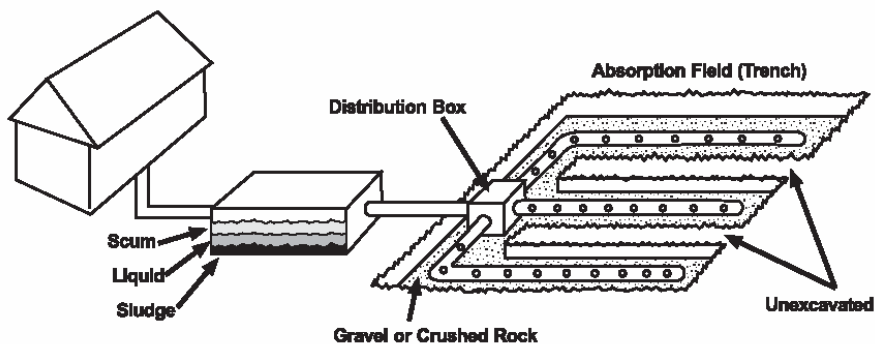


Source: Plateau Action Network.

6.2 Treatment fields

Treatment fields are the most common onsite dispersal system. In technical jargon, these fields are called subsurface wastewater infiltration systems, but they are also known as drain fields, leach fields, or infiltration trenches. Treatment fields are sized by water usage estimates, and are often the source of failure in onsite systems.

Figure 4: A typical treatment field



Source: USEPA, 2002.

Treatment fields disperse wastewater effluent over an area, allowing absorption by the soil. Some subsurface moisture is pulled into the air by evapotranspiration, while the rest moves into and through the soil where treatment and purification occur. After percolating through the soil, the treated water returns to the groundwater, recharging the water table.

Although the theory is sound, studies have shown that only about 33% of the country has proper soils of sufficient depth for treatment fields to work effectively. In West Virginia, this percentage is much lower due to typically thin soil mantles, soil types, depth to bedrock or ground water, geology, and topography (Lombardo, 2004). Over the years, much has been learned about the ultimate fate of wastewater effluent and the interrelationship of these factors (USEPA, 2002). Failure to understand the interplay between these factors can lead to premature failure of treatment fields.

There are a number of other ways to protect and optimize your treatment field:

- Optimize your septic tank to reduce waste flow and chemical loads.
- Do not use septic tank additives. In general these additives provide minor if any benefit to tank processes and many have long-term negative impact on treatment fields.
- Install a curtain drain to keep rainwater from affecting your treatment field. When installed upgradient from a treatment field, a curtain drain channels storm water away, preventing oversaturation and ponding.
- Install an alternate field. Consider installing a second field with a switching valve, and alternating flows from one field to the other. This allows one field to treat while the other rests.

Conventional treatment fields are made up of gravel-filled trenches over which effluent is distributed. Gravity is typically used to distribute the effluent. As shown in Figure 5, alternatives to gravel-filled trenches include polystyrene-wrapped pipe, geotextile-wrapped pipe, and open bottom leaching chambers. These alternatives may have cost advantages as they usually require less excavation and may allow smaller field areas.

Figure 5: Alternatives to gravel-filled trenches



Source: USEPA, 2002.

6.2.1. Low pressure pipe systems

Low pressure pipe systems use a pump or siphon to pressure dose effluent to the treatment field. Pressure dosing forces the effluent completely through the pipe system and creates a more equal distribution of effluent through the field. Also, dosing the field a few times a day allows for resting, more time for the effluent to percolate through the soil, and more chance for oxygen in the soil to rejuvenate the drain field.

Low pressure pipe systems are typically a little more expensive than conventional fields because of the pump or siphon and the extra tank this device uses. However, these systems have many advantages. They can be installed on sloping sites, on sites with high groundwater tables or bedrock, and in soils with slow percolation rates. When used on sites with high groundwater, some additional treatment of the effluent may be required.

6.2.2. Drip dispersal systems

Drip dispersal systems, commonly called drip irrigation, also use pumps to pressure dose effluent to a subsurface absorption field. In this case, the field is made up of small flexible tubes with emitters to force the effluent into the soil. Because the tubes and emitters are so small, disk filters are typically installed after the pump to remove most of the solids.

Installing the drip tubes is fairly easy and they can be placed at a depth of 12-18 inches below the soil using a small plow. This means they can be installed in forested or rocky sites, sites with high bedrock or groundwater tables, or sloping sites. They do require a sophisticated pumping and control system, which adds to the cost. Also, most designers recommend additional treatment beyond a septic tank before using drip dispersal. However, for cluster systems, the cost per house drops rapidly as drip systems are easy to expand (See Section 7 for a description of cluster systems).

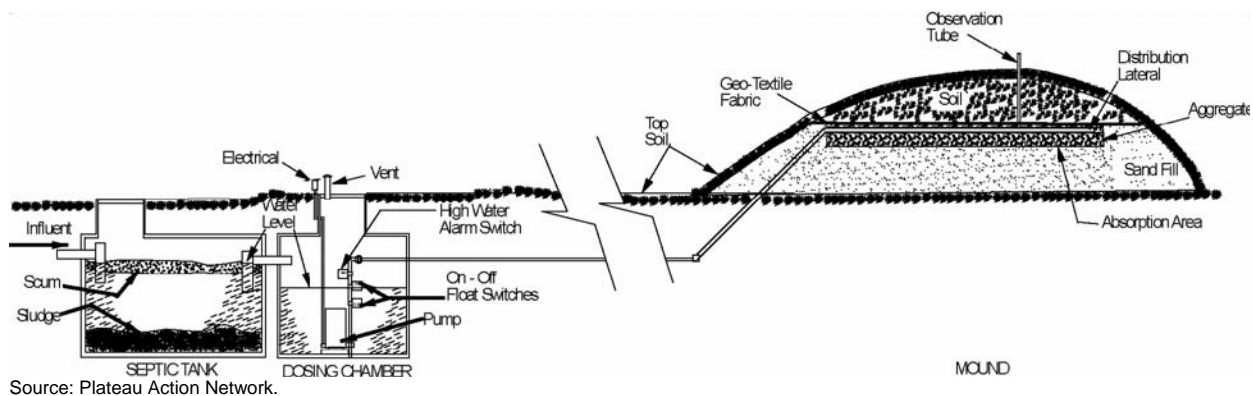
6.2.3. Mound systems

Mound systems—constructed treatment fields that sit above the existing soil surface—are another alternative to conventional treatment fields. These systems are applicable in soils that are not appropriate for conventional fields. For example, mound systems might be most appropriate to drain

septic tanks in soils with fast or slow permeability, in shallow soils over creviced or porous bedrock, or in soils with high water tables.

Mound systems have three basic components: a pretreatment unit or septic tank, a dosing chamber, and an elevated mound. Septic tank effluent is collected in the dosing chamber and is pumped by float switch or timer to the mound. The mound performs the final treatment.

Figure 6: A typical mound system



Source: Plateau Action Network.

Mound systems cost considerably more to install and operate than traditional treatment fields and must be maintained more frequently. Site location may affect drainage patterns. Curtain drains may be required to prevent infiltration from upgrade storm water.

6.2.4. Pretreatment

As mentioned above, additional treatment is sometime required to preserve the soil absorption system. Providing a cleaner effluent before subsurface dispersal can help to prolong the life of the drain field. Further, pretreatment relieves the soil of some of the work required of it, allowing the use of soil dispersal on more restrictive sites. There are several technologies available for providing additional treatment, including single-pass media filters, recirculating media filters, and home aeration treatment units.

6.2.4.1. Single pass media filters

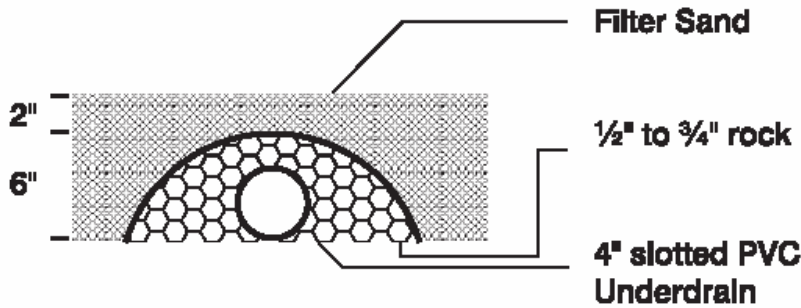
Pretreatment using packed bed filters improves wastewater treatment prior to discharging the effluent to a treatment field or drip dispersal system. In packed bed filters, a fixed film process holds the microorganisms attached to a fixed media and the effluent passes over the media. There are two basic types of packed bed filters: (1) an intermittent or single pass system and (2) a recirculating system.

Historically, the filter media has been washed sand of uniform size. Over the past few years, many other media have been developed, including anthracite, bottom ash, crushed glass, peat, synthetic foam, and recycled textiles. Based on surface area and loading rates, they may allow a decrease in field size, and depending on local availability of materials, they may be cheaper to buy and transport.

Filter beds range from pre-manufactured boxes of plastic or concrete to site-constructed impervious PVC-lined excavations. The bed contains an effluent distribution system on top of the media and an underdrain at the bottom.

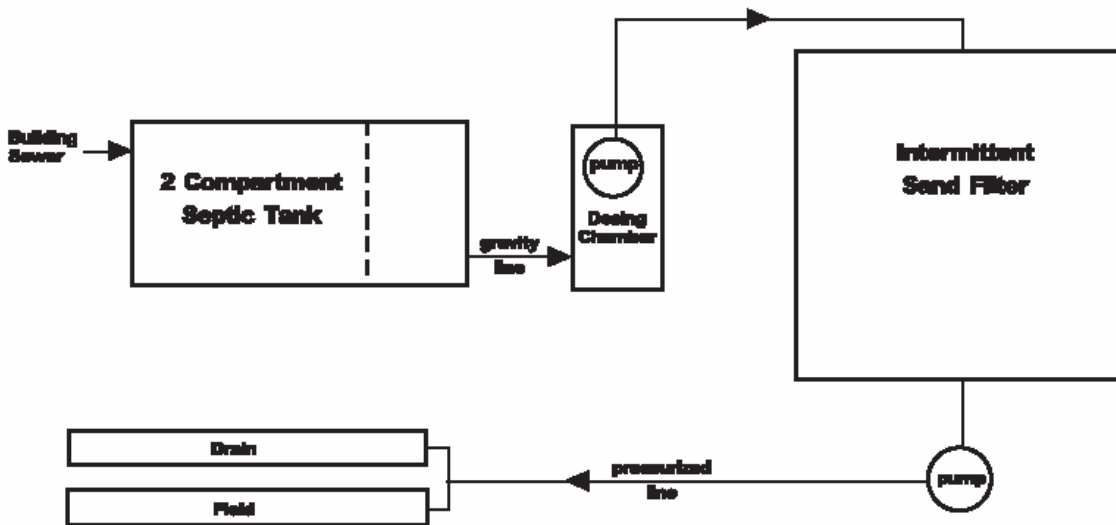
Wastewater is dosed onto the surface by the distribution network and percolated through the media. Filtrate water is collected by the underdrain and piped to further treatment, or discharged to a treatment field depending on the system. “Bottomless” single pass systems allow filtered effluent to infiltrate directly into the soil below. Single pass systems must be properly sized for the wastewater load to ensure proper contact time.

Figure 7: A typical filter bed



Source: USEPA, 2002.

Figure 8: A typical single pass system

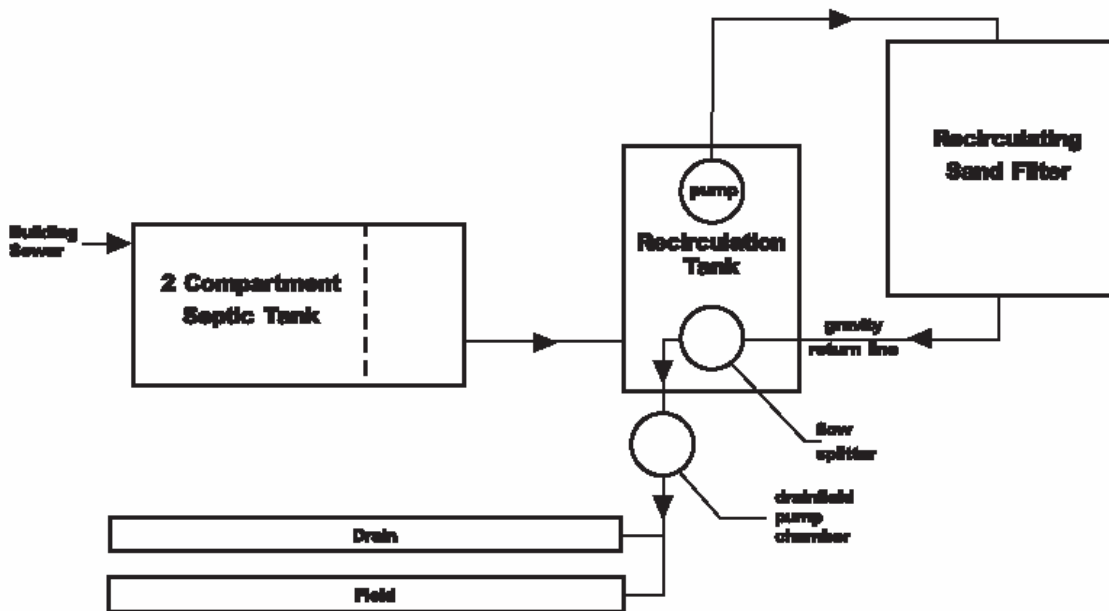


Source: USEPA, 2002.

6.2.4.2. Recirculating media filters

Recirculating systems use a multi-chambered septic tank to collect and separate sludge, scum, and effluent. The effluent flows to a recirculation tank and is pumped on a timer through the distribution system to dose the media. Filtered water is transported back to the recirculation tank via the under drain, which allows the water to be recirculated. A float valve in the under drain return opens when the water level in the recirculation tank reaches a set level and the filtered effluent passed on to the drain field. Multiple passes reduce system size and improve effluent quality, and timer adjustments can provide increased recirculation ratios.

Figure 9: A typical recirculating system



Source: USEPA, 2002.

Case study: A recirculating system in McDowell County

In October 2004, the Wastewater Treatment Coalition of McDowell County installed an Orenco AdvanTex Textile System at the Big Sandy Head Start Center in Big Sandy. The Coalition undertook this project as a demonstration of a new technology that they had learned about during a tour of alternative treatment technologies. This type of treatment system, they believed, would be well suited to address the wastewater needs in their region, where communities often have limited available space. This is the first system of its type to be used in southern West Virginia.

The AdvanTex filter is a watertight fiberglass basin filled with sheets of a specially engineered textile. A pump with programmable controls applies small, even amounts of wastewater to the filter at timed intervals throughout the day. Wastewater is treated by percolation through and between the textile sheets and is recirculated through the filter until it is treated to a very high quality.

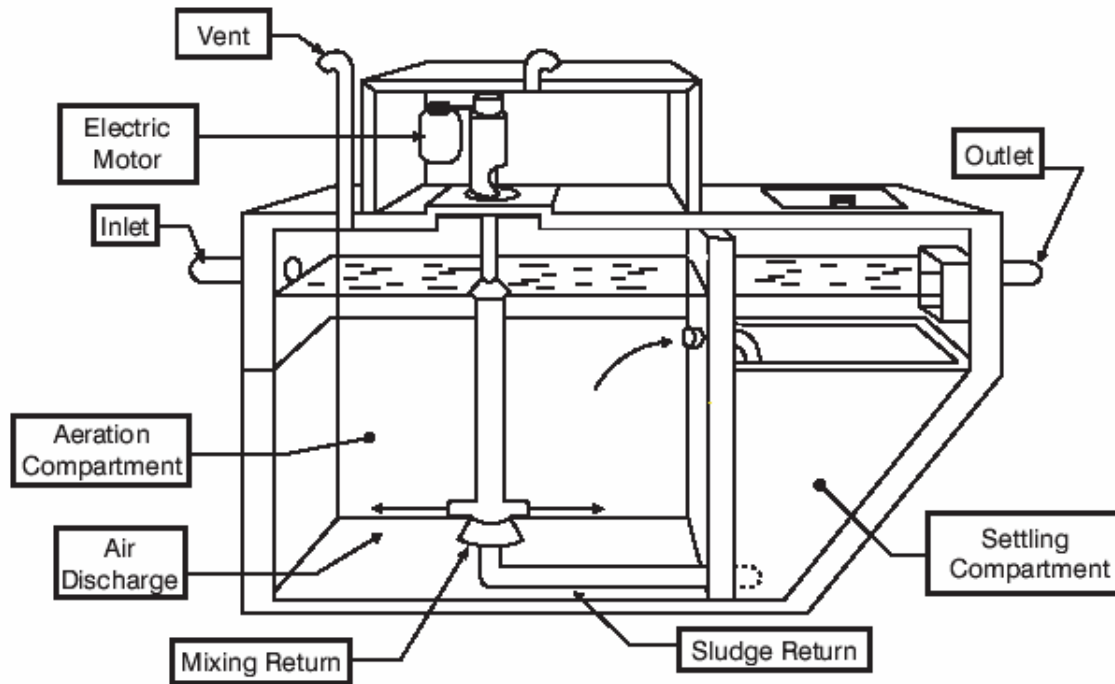
In some states, recirculating effluent through this media reduces the size requirements for drainfield application so that the system may be used in areas with little available space. However, the drainfield for this installation was required to be built using conventional specifications, because current regulations in West Virginia do not allow for reductions in drainfield size despite the quality of the effluent.

Installation was marked with a ceremony in which more than fifty representatives from across the county and the state came together to discuss the efforts of the coalition. The coalition also installed an interpretive sign at the Big Sandy Head Start Center, which educates visitors about this particular treatment alternative. This project was funded by the Presbyterian Disaster Assistance.

6.2.4.3. Home aeration treatment units

Home aeration treatment units are essentially small package plants designed for individual homes. They enable development in many areas where a standard septic system would not be permitted. They are also sometimes placed in-line after a septic tank, when required.

Figure 10: A typical home aeration treatment unit



Source: USEPA, Undated.

Like septic tanks, home aeration units use natural processes to treat wastewater; however, septic tanks use an anaerobic process while home aeration units use an aerobic process. Air is injected and circulated inside the unit to allow this aerobic process to work.

These systems are more sensitive than septic tanks and maintenance is typically beyond the knowledge level of home owners. Home aeration units require regular semi-skilled operations and maintenance—usually by service contract—to ensure proper operation. Inspections every other month are recommended.

Electricity is required at all times to run the aerator. A 500 gallon unit costs \$2,500 to \$9,000 installed, maintenance costs average \$350 per year, and the pumps/aerators last about three years and cost between \$300 and \$460 to replace (USEPA, 2002).

The best use of home aeration units is for pretreatment of effluent before subsurface dispersal. However, in some areas with restrictive site conditions and failing septic systems, they may be used to provide a direct discharge. When discharging directly to a surface water, disinfection is required and some additional treatment such as a media filter is highly recommended. Further, these discharges are regulated more stringently than typical onsite systems because of the risks to the environment and public health.

Like traditional systems, home aeration units that discharge treated water to rivers must have NPDES permits that specify how much pollution can be released (See Section 9 for more details on NPDES permits).

6.3 Aquatic systems

Aquatic systems include lagoons (stabilization ponds) and constructed wetlands. These systems are essentially large basins filled with wastewater, which provide some combination of treatment processes and render wastewater more acceptable for discharge. Aquatic systems require large land areas, fencing to prevent human contact, and typically require additional treatment prior to discharge.

6.3.1. Lagoons

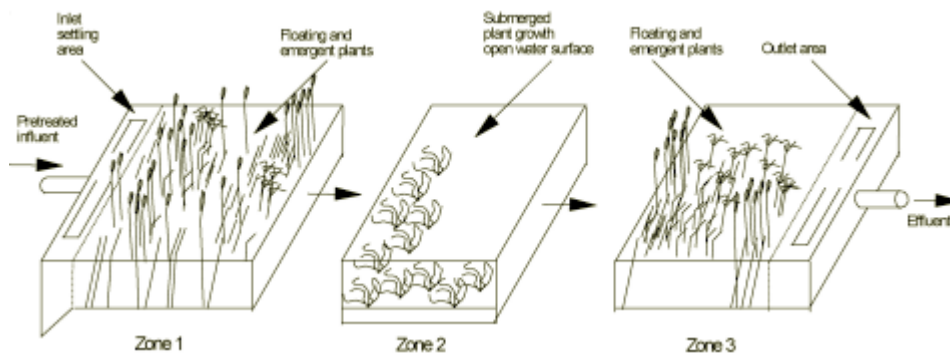
Though typically used for larger developments like subdivisions, lagoons have been successfully used for individual homes. Two types of lagoon are permitted in the United States (USEPA, 2002):

- Facultative (passive) lagoons are large and should be separated into at least three cells. They produce a large quantity of algae, which limits the utility of the effluent without further treatment. For individual homes, operations and maintenance costs are less than \$100 per year, but installation costs can range from \$2,500 to \$7,500 (USEPA, 2002).
- Aerated (aerobic) lagoons have smaller land area requirements because they use mechanical means to augment the treatment process by providing oxygen. They do not produce the algal load of the passive lagoon, but can still cause odor issues during power outages. These systems require energy and a semi-skilled operator. For individual homes, operations and maintenance costs range from \$350 to \$500 per year, but installation costs can range from \$3,000 to \$8,500 (USEPA, 2002).

6.3.2. Wetlands

Free water surface constructed wetlands, like passive lagoons, work best when separated into three zones. The first and last zones are fully vegetated with macrophytes (cattails or bullrushes), while the middle zone contains submerged plants and has an open water surface. Their appealing appearance makes them the preferred choice for individuals with enough land area. They reliably produce an advanced secondary effluent excellent for sub-surface dispersal, but require disinfection for surface discharge or reuse applications. For individual homes, operations and maintenance costs are less than \$100 per year, but installation costs can range from \$2,000 to \$4,000 (USEPA, 2002).

Figure 11: A typical wetland



Source: Plateau Action Network, modified from USEPA, 2002.

Table 2: Problems, causes, and solutions for septic tanks, treatment fields, mound systems, and home aeration units

Problem	Cause	Solution
Septic tanks		
Wastewater back up into house.	Blockage in inlet or outlet at tank. Typically due to high solids level.	Clear inlet and outlet. Check solids level and determine if tank needs pumping.
	Solids blocking drain field piping or drain field saturated.	Clean field drains and allow field to rest.
Treatment fields		
Wastewater back up into house.	Solids blocking drain field piping. Drain field over saturated.	Clean field drains and allow field to rest.
Odors from field.	Field saturation or biomat blockage.	Allow field to rest, or at least reduce loading.
		Look for opportunities to reduce infiltration of water from other sources. Add pretreatment to reduce solid loading.
Ponding or surfacing in field.	Field saturation or biomat blockage.	Allow field to rest, or at least reduce loading.
		Look for opportunities to reduce infiltration of water from other sources. Add pretreatment to reduce solid loading.
Mound systems		
Wastewater back up into house.	Effluent pump not working due to power loss or failure.	Inspect and correct pump problem.
Odors from mound and surrounding area.	Surface water from surrounding area has saturated mound and proper treatment is not occurring.	Install surface water diversion system, e.g. curtain drains, drainage swales, or additional pumps.
Ponding or surfacing around mound.	Mound saturated or biomat blockage.	Reduce load and allow to rest. Add pretreatment to reduce solid loading.
	Mound failure.	Rebuild mound.
Home aeration units		
Wastewater back up into house.	Blockage in inlet or outlet at tank.	Clear inlet.
Odor around tank.	System going septic: air or pump failure.	Check air system for proper operation/mixture.
		Check pump for proper operation.
System bypassing at unit.	Outlet blockage.	Check and clear outlet.
	System overload.	Inspect water and waste stream patterns and habits. Modify water usage to reduce load.
Excessive turbulence in aeration tank.	Diffuser plugged.	Clean diffuser.
	Pipe breakage.	Repair/replace as required.
	Excessive aeration.	Throttle blower.
White, thick billowy foam on aeration tank.	Insufficient mixed liquors/suspended solids.	Avoid wasting solids.
Dark brown/black foam or mixed liquor in aeration tank.	High mixed liquors/suspended solids.	Pump solids.

7. CLUSTER AND HYBRID SYSTEMS

Cluster and hybrid systems are economical solutions for population clusters found in small communities like coal camps or new subdivisions where lot size, soil conditions, depth to bedrock, groundwater, or other constraints prevent a straightforward onsite approach. Cluster and hybrid systems use similar approaches, in that septic tanks are installed for each house and commercial establishment and the entire community's wastewater effluent is then carried to one place for treatment. They differ, however, in where the effluent from the tanks is sent. In cluster systems, the effluent is sent to a community treatment field, while in a hybrid system, the effluent is sent to a traditional wastewater treatment plant.

Cluster systems serving 10 to 300 homes already exist across the country and are becoming the most feasible solution for providing wastewater treatment to many small communities in West Virginia.

Hybrid systems help solve urban or suburban growth issues and can provide effective treatment solutions for new developments. This approach is most appropriate when the population density is high, lots are small, and a treatment facility with adequate capacity is nearby.

7.1 *Septic tanks*

In cluster and hybrid systems, properly sized septic tanks are installed at each home and establishment. Commercial establishments may require additional components (e.g., grease traps for restaurants or equalization tanks for facilities with highly variable flows). Septic tanks collect the solids and household scum, and the effluent enters the collection system using a small pump or gravity flow. Solids are handled as in onsite systems: Individual septic tanks are monitored on a regular basis and solids and scum are pumped when needed.

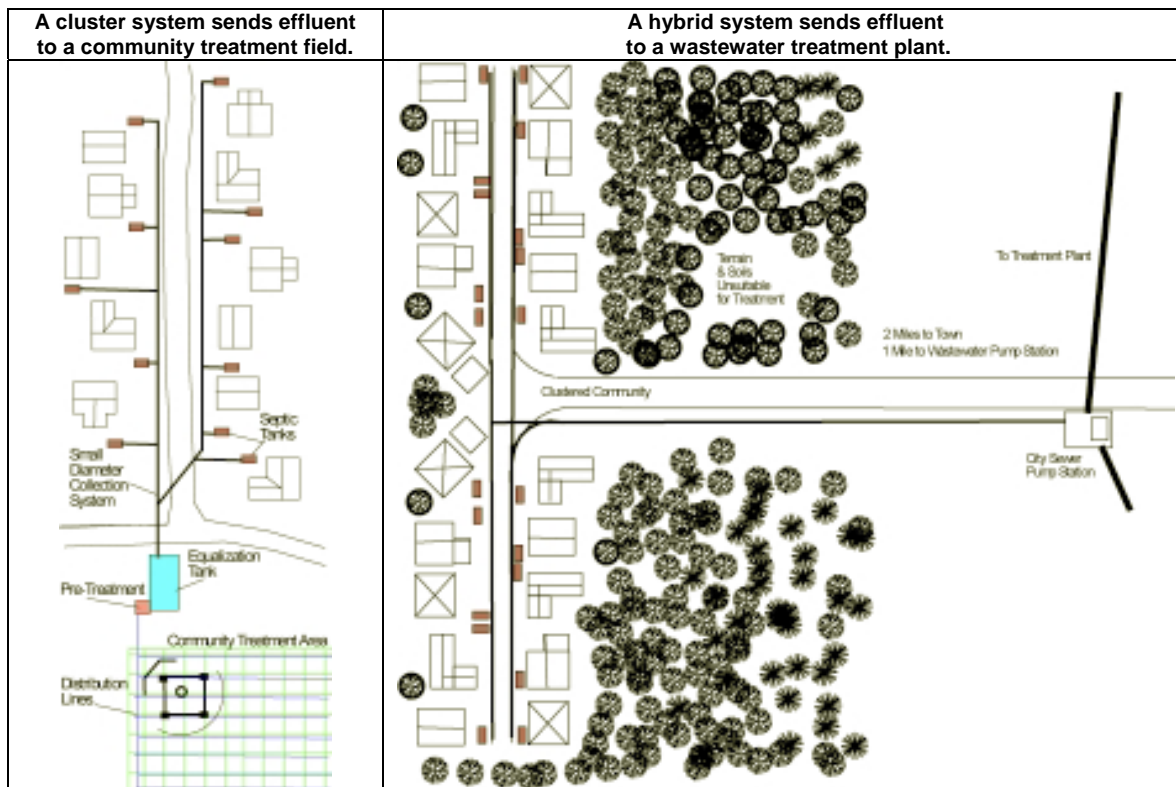
7.2 *Collection systems*

The collection system is a small diameter pipe with clean-outs installed at intervals. As only the effluent is transported, the need for constant slope, manholes, lift stations and their inherent added costs are eliminated. Because the collection system is sealed, inflow and infiltration is rare. The effluent is run through the system using gravity or small pumps. For cluster systems, the collection system sends effluent to the treatment area. For hybrid systems, effluent is sent to a nearby pump station, lift station, or force main for transport to the treatment facility for processing and disinfection.

7.3 *Treatment areas for cluster systems*

For cluster systems, the treatment area and type of treatment varies by community. Typically there is a large equalization tank that collects the effluent so it can be metered out a constant rate to maintain treatment balance. Where possible, a large land area is used for the community treatment field; this could be a park or the school ball field. Where soils or other constraints prohibit conventional soil treatment, other options are available such as wetlands, recirculating sand filters, subsurface drip irrigation, or, when unavoidable, direct discharge to water bodies. See Sections 6.2 and 6.3 for a discussion of these methods.

Figure 12: Typical cluster and hybrid systems



Source: Plateau Action Network.

Case study: A cluster system for Winona

In 2002, the Fayette County Water Quality Coalition and Plateau Action Network, with support from Canaan Valley Institute (CVI) and the National Small Flows Clearinghouse (NSFC), began working with the community of Winona, West Virginia to develop a plan to address their wastewater issues. Winona is located close to the New River National River, managed by the National Park Service.

The National Park Service provided historic water quality data and provided additional testing results for analysis. The citizens reviewed various options, performed self-assessment surveys, helped collect lot-by-lot data, and determined that a cluster system would be a feasible and affordable solution for this community of about 60 closely clustered homes.

Through funding by CVI and NSFC, a preliminary plan was completed and reviewed by the WVDEP. The New Haven PSD accepted responsibility to design and build the system and has selected an engineering firm for this purpose.

7.4 Wastewater treatment facilities for hybrid systems

Effluent in hybrid systems is transported to traditional wastewater treatment facilities. As the solids are already removed and only the effluent is being treated, the overall impact on the existing plant is low.

8. MANAGEMENT ENTITIES

8.1 Traditional systems

Traditional wastewater treatment systems are usually managed by PSDs, utility boards, or municipalities. With state oversight, these entities collect monthly fees from their ratepayers and use these funds to maintain and upgrade treatment plants and collection systems. (State oversight is discussed in Section 10).

8.2 Centrally managed onsite systems

When a community is using onsite systems, responsible management entities (RMEs) can be a viable alternative to homeowners for providing maintenance. RMEs have the potential to provide more consistent and professional services and can lead to better environmental performance.

Guidelines for managing decentralized systems

The current movement to a decentralized approach is supported by the USEPA, as discussed in its Response to Congress on Use of Decentralized Wastewater Treatment Systems (USEPA, 1997). A key point to the successful use of decentralized systems—whether they are onsite, cluster, or hybrid systems—is improved management.

In 2003, the USEPA released its Voluntary National Guidelines for Management of Onsite and Clustered (Decentralized) Wastewater Treatment Systems (USEPA, 2003), which provides five models or levels of management systems that help ensure wastewater is being properly treated.

These and other useful guidance for the management of decentralized systems can be downloaded from <http://cfpub.epa.gov/owm/septic>.

Under existing law, PSDs can maintain septic tanks on private property by negotiating easements and customer agreements with each landowner. This process can be cumbersome if the district wishes to manage a large number of onsite systems. Legislative changes would be necessary to provide the statutory authority to the West Virginia Public Service Commission (WVPSC) to allow management entities access to onsite systems without individual agreements. PSDs that manage onsite systems also do not currently have the ability to put liens on properties for nonpayment.

8.3 Cluster and hybrid systems

Cluster systems have historically been managed by homeowner associations, PSDs, or private operations. Hybrid systems would typically be managed by the entity that manages the existing treatment plant. In contrast to centrally managed onsite systems, legislative changes are not necessary to allow RMEs to efficiently manage cluster or hybrid systems.

Case study: The West Fork On Site Community Cooperative

Residents of four rural communities in Harrison County—Arlington Heights, Dawmont, Glen Falls, and Gore—joined together to find alternatives to failing onsite systems. Located within about three miles of Clarksburg’s central sewer system, the communities originally investigated a sewer line extension, but decided that this option would be too expensive for the communities’ low-income residents.

To identify an alternative solution, community representatives formed a steering committee and requested assistance from the National Onsite Demonstration Project (NODP) at West Virginia University. The NODP had received funding from the Rural Utility Service to work with the West Virginia University College of Law to help rural low income communities find solutions to wastewater management issues. The steering committee worked with the NODP on technical issues and the College of Law on legal issues.

Through this process, the communities decided that the most appropriate and cost-effective solution would be to build and maintain onsite and cluster systems and to create a new RME called the West Fork On Site Community Cooperative. Articles of incorporation and bylaws defined the role of the Cooperative. Among other things, these documents addressed fees charged to customers and facilitated the creation of private legal relationships that are required to manage the communities’ wastewater system. Steps were also taken to provide investment security for public and private funders (McConnell, 2004).

9. ENSURING THAT WASTEWATER DISCHARGES ARE CLEAN: LAWS AND AGENCIES

Watershed organizations faced with wastewater discharges in their waterways typically want to do one of two things: (1) ensure that current discharges are clean or (2) help facilitate the upgrading of existing systems or the building of new systems so that untreated or poorly treated wastewater can be properly treated.

A variety of laws and regulations affect what kinds of sewage treatment facilities are built, how they are paid for, and the standards to which wastewater is treated. A basic understanding of this framework is necessary for organizations to find constructive ways to engage in the process of improving wastewater treatment in their watersheds.

9.1 *Laws that affect wastewater discharges*

9.1.1. The federal Clean Water Act

Wastewater treatment systems, like any other facilities that discharge pollutants to surface water, are governed by the federal Clean Water Act. The Clean Water Act requires water quality standards to be set in all rivers and lakes and requires dischargers to operate under permits to ensure that these standards are not violated.

Water quality standards related to wastewater

Typically, the most important water quality standards in West Virginia that relate to wastewater discharges are the those for bacteria and dissolved oxygen.

The bacteria standard is written for fecal coliform, a type of bacteria found in warm blooded animals. It states: “Maximum allowable level of fecal coliform content for Primary Contact Recreation...shall not exceed 200/100 ml as a monthly geometric mean based on not less than 5 samples per month; nor to exceed 400/100 ml in more than ten percent of all samples taken during the month.” (46 CSR 1, Appendix E, Section 8.31) There is an exception for the Ohio River.

The dissolved oxygen standard is different for warm water streams and trout streams. For warm water streams, the standard states: “Not less than 5 mg/l at any time.” (46 CSR 1, Appendix E, Section 8.12). For trout streams, the standard is stricter: “Not less than 7.0 mg/l in spawning areas and in no case less than 6.0 mg/l at any time.” (46 CSR 1, Appendix E, Section 8.12.3). There are exceptions for the Kanawha and Ohio Rivers.

West Virginia water quality standards are at 46 CSR 1, and can be downloaded from the Secretary of State’s Web site at www.wvsos.com.

Measuring bacteria in your streams

Measuring bacteria in your streams can be an important step toward finding the sources of wastewater pollution. But because bacteria can also be generated by farm animals and wildlife, a monitoring program must be carefully designed and data must be carefully interpreted.

One option for measuring bacteria in your streams is to collect samples and send them to a certified laboratory for analysis. WVDEP lists certified labs in West Virginia at [www.wvdep.org/ item.cfm?ssid=11&sslid=166](http://www.wvdep.org/item.cfm?ssid=11&ssid=11&sslid=166).

Portable incubators are also available; with proper training, these can be used directly by watershed groups to measure bacteria levels. Before investing in this equipment and training, however, consider the costs and benefits of portable incubators versus certified labs. Your group may actually save time, money, and hassle by using labs, and samples analyzed by labs may be more acceptable to government agencies.

NPDES permits restrict the amount of pollutants that point sources are allowed to discharge to rivers and lakes. These permits require wastewater plants to meet discharge limits, and impose even stricter limits when necessary to protect the waters they discharge to. Permits are also enforceable by government agencies and the public. At the federal level, the USEPA plays the primary regulatory role.

While the Clean Water Act directly addresses point sources of pollution such as wastewater treatment plants that discharge to streams through pipes, it only indirectly addresses nonpoint sources such as onsite septic systems.

Point and nonpoint sources of pollution

In a physical sense, point sources discharge through pipes and nonpoint sources run off from land when it rains. But there are gray areas. In a regulatory sense, point sources include several kinds of rain-induced discharges. And nonpoint sources include several kinds of discharges that are directed to streams in pipes or channels.

According to the Clean Water Act: “The term ‘point source’ means any discernible, confined and discrete conveyance, including but not limited to any pipe, ditch, channel, tunnel, conduit, well, discrete fissure, container, rolling stock, concentrated animal feeding operation, or vessel or other floating craft, from which pollutants are or may be discharged. This term does not include agricultural stormwater discharges and return flows from irrigated agriculture.” (Section 1362-14).

Point sources related to wastewater treatment include traditional wastewater treatment plants, cluster systems with surface discharges, and home aeration units with surface discharges. Nonpoint sources include septic systems and cluster systems with underground discharges. Paradoxically, because they cannot be permitted with NPDES permits, straight pipes are also considered to be nonpoint sources.

9.1.2. The West Virginia Water Pollution Control Act

In West Virginia, the Water Pollution Control Act¹ implements the federal Clean Water Act. The West Virginia Department of Environmental Protection sets water quality standards, with approval by the state legislature.² WVDEP also writes NPDES permits.

9.1.3. The West Virginia Groundwater Protection Act

While the Water Pollution Control Act focuses on surface water, the West Virginia Groundwater Protection Act³ protects groundwater from pollution. WVDEP writes underground injection control (UIC) permits, described below, in accordance with this Act.

9.2 Traditional systems

As described in Section 5, traditional collection and treatment systems consist of sanitary sewers that transport wastewater from homes and businesses to a centralized treatment plant. While many systems across West Virginia are adequately sized and well operated and consistently meet their permit limits, others often discharge raw or partially treated sewage, especially when it rains. Watershed organizations can play an important role ensuring that treatment plant discharges are clean, and working locally to increase capacity when needed to handle new flows.

Before a new treatment system can be built, its design must be approved by state agencies and permits must be granted. Two state agencies play important roles: the West Virginia Division of Health and Human Resources (WVDHHR) and WVDEP.

9.2.1. Bureau for Public Health permits

Engineers at WVDHHR's Bureau for Public Health review plant designs; after their approval, a permit is issued. These Bureau for Public Health permits are not subject to public notice and comment. Therefore, it is often difficult for watershed organizations to know when such permits are being sought and to provide input before they are granted.

9.2.2. NPDES permits

WVDEP also reviews the application, and if approved issues an NPDES permit. Permit writers determine the appropriate type of permit and calculate permit limits. If the plant is small (less than 50 thousand gallons per day), it usually qualifies for a general permit. These small plants are often called "package plants." General permits do not undergo public notice and comment. For larger plants, WVDEP prepares a draft individual permit and accepts comments for 30 days. Watershed organizations can get copies of the draft permit and can provide comments to WVDEP. It is especially important to make sure WVDEP permit writers know about any special conditions on the receiving water body. For example, permit writers should know if the receiving stream is a trout stream so they can provide special protections. And permit writers should know all nearby wastewater treatment plants that might affect dissolved oxygen levels in the stream.

¹ West Virginia Code Chapter 22 Article 11.

² Until recently, the West Virginia Environmental Quality Board proposed water quality standards for legislative approval.

³ West Virginia Code Chapter 22, Article 12.

WVDEP's area lists

To find out which NPDES permits are open for public comment in local counties, sign up for the appropriate area lists. WVDEP will e-mail you when draft permits are released, giving you an opportunity to review the permit during the comment period. To sign up, go to www.wvdep.org/MailingLists.cfm.

Traditional systems, if sized appropriately and well maintained, treat wastewater to meet the discharge limits in their NPDES permits. USEPA has set minimum treatment levels for every wastewater treatment plant. These limits, shown in Table 3, are based on the use of secondary treatment.

Table 3: Secondary treatment standards for wastewater treatment plants

Parameter	Concentration	Load
pH	6-9 standard units	N/A
Total suspended solids and biochemical oxygen demand (five-day)	30 mg/L (30-day average) 45 mg/L (7-day average) 85% removal (30-day average)	Calculated based on plant flow

Source: 40 CFR 133.

Secondary treatment standards

<http://cfpub.epa.gov/npdes/techbasedpermitting/sectreat.cfm>

In addition to the secondary standards, NPDES permits for wastewater treatment plants typically include limits for bacteria, nitrogen, and other pollutants, as shown in Table 4.

Table 4: Other limits required for wastewater treatment plants

Parameter	Concentration	Load	Notes
Bacteria (fecal coliform)	200 cfu/100 mL average monthly 400 cfu/100 mL maximum daily	N/A	Water quality based limit to protect against violations of the bacteria water quality standard
Nitrogen (total Kjeldahl nitrogen or ammonia)	Varies	Calculated based on plant flow	Concentration is calculated to protect dissolved oxygen in receiving stream
Dissolved oxygen	6 mg/L	N/A	Dissolved oxygen limits are not always required.
Metals (copper, zinc, etc.)	Varies	Calculated based on plant flow	Metals limits are typically only required when industrial facilities discharge to a treatment plant or when a drinking water plant adds certain chemicals to their water.

In some situations, limits must be more stringent than the secondary standards in Table 3. Typical situations with more stringent limits include:

- When large plants discharge to small streams, discharges may cause violations of water quality standards unless they are cleaner than typical secondary treatment limits.
- When a plant discharges to a clean stream, antidegradation rules may only allow a small amount of additional degradation, which translates into stricter limits.
- When a plant discharges to a stream that is impaired by one or more wastewater-related pollutant, stricter permit limits may be required so as not to make the problem worse.

Permits require self-monitoring, and permittees must report results to the state. WVDEP and USEPA periodically inspect and monitor wastewater treatment plants. If permits are being violated, WVDEP and USEPA may enforce the permits through a variety of means, which range from letters and notices of violation to administrative orders and civil lawsuits. Monitoring data are public information, and watershed organizations can get copies of these data and track permit compliance. The Clean Water Act also provides for citizen enforcement of permits.

9.3 Onsite, cluster and hybrid systems

Some onsite, cluster, and hybrid systems discharge to surface water, while others discharge to groundwater. Some, like septic systems, are tried-and-true technologies, while others are more experimental. For these reasons, the rules under which these systems operate are similar in some respects, and different in others.

Pathways for wastewater to reach receiving waters from onsite, cluster, and hybrid systems

To surface water directly

- Some cluster systems
- Hybrid systems (via traditional wastewater treatment plants)
- Some home aeration units

To groundwater via soil

- Septic systems
- Most cluster systems
- Some home aeration units

To groundwater directly

- Class 5 wells for certain septic systems

9.3.1. West Virginia design standards

West Virginia design standards for septic tanks, mound systems, home aeration units, and several other kinds of onsite systems are specified by state rule.⁴ Among other things, these rules regulate where septic tanks and distribution fields can be located. For example, onsite systems cannot be located in poorly drained or filled areas, with some exceptions, and cannot be close to water supply lines.

⁴ West Virginia design standards are at 64 CSR 47 Section 6.

Other standards specify that there must be at least three feet between any portion of a standard treatment field and seasonal groundwater, bedrock, and any other impermeable layer. Also, septic tank sizes are specified for single family homes based on the number of bedrooms.

Watershed groups involved in onsite wastewater issues would be advised to familiarize themselves with the wide range of state design standards.

9.3.2. West Virginia subdivision rules

In addition to design standards, subdivision rules also impact where onsite systems can be built.⁵ For new developments that use onsite systems, subdivision owners must obtain written approval of a proposed subdivision from the Division of Health before starting construction.

The subdivision rules ensure that enough space is set aside for treatment systems. For example, lots must set aside a minimum onsite disposal area of 10 thousand square feet. No development or structures are permissible on the disposal area except the onsite wastewater system. The subdivision rules include details on which kinds of land can be used for disposal areas based on slope, percolation rates, groundwater levels and other factors.

9.3.3. National Pollutant Discharge Elimination System permits

Onsite, cluster, and hybrid systems that discharge to surface water are point sources and require NPDES permits. The same general principles apply for these NPDES permits as for traditional systems: Limits are imposed, monitoring is required, and agencies and the public can initiate enforcement. Watershed organizations can monitor discharges from permitted facilities and can work with permittees to ensure that discharges are clean.

In contrast, traditional onsite septic systems and most cluster systems discharge via treatment fields to the soil; wastewater then seeps into groundwater. NPDES permits are therefore not required for these systems. Because of the interconnection between groundwater and surface water, these systems, when built in the wrong conditions or poorly maintained, can still pollute local streams and aquifers.

9.3.4. Underground injection control permits

Sometimes, treated wastewater from onsite systems is discharged underground rather than discharged to surface water. WVDEP's UIC program is designed to ensure that this wastewater will not endanger underground drinking water sources. The Division of Water and Waste Management regulates five classes of injection wells. Class 5 wells apply to some onsite wastewater systems. In particular:

“Class 5 wells include...Septic system wells used to inject the waste or effluent from a multiple dwelling, business establishment, community or regional business establishment septic tank. The UIC requirements do not apply to single family residential septic system wells, nor to nonresidential septic system wells which are used solely for the disposal of sanitary waste and have the capacity to serve fewer than twenty (20) persons a day.” (47 CSR 13).

⁵ West Virginia subdivision rules are at 64 CSR 9 Section 8.

West Virginia rules related to ground water protection and UIC permits

- Requirements Governing Groundwater Standards (46 CSR 12)
- Underground Injection Control Fee Schedule (47 CSR 9)
- Underground Injection Control (47 CSR 13)
- Groundwater Protection Act Fee Schedule (47 CSR 55)
- Assessment of Civil Administration Penalties (47 CSR 56)
- Groundwater Quality Standard Variances (47 CSR 57)
- Groundwater Protection Rule (47 CSR 58)
- Monitoring Well Rules (47 CSR 59)
- Monitoring Well Design Standards (47 CSR 60)

Class 5 UIC permits are open for public comment for 30 days, and watershed organizations can play a role in ensuring that permit writers have all available information about local conditions.

For septic tanks, septic tank registration seals must be purchased from WVDEP for \$30 prior to installation.⁶

9.3.5. Local ordinances and agencies

Local ordinances can also influence onsite wastewater decisions. County sanitarians play an important role by inspecting new systems after they are installed, and by following up on complaints about failing septic systems or straight pipes.

⁶ See 47 CSR 55.

10. FINDING FUNDING FOR WASTEWATER TREATMENT

10.1 *Traditional systems*

Huge progress has been made in building treatment plants across the country since the Clean Water Act was passed in 1972. This massive investment has drastically reduced wastewater discharges to rivers and lakes (Adler et al., 1993). But across West Virginia, significant funding is still needed to build new systems.

Many new systems are publicly owned, and are usually referred to as publicly owned treatment works. These systems are typically managed by PSDs, utility boards, or municipalities and serve regions or cities. Other wastewater treatment plants are privately owned and typically serve housing, commercial, or industrial developments. While the design and permitting systems are similar for public and private facilities, financing mechanisms are different.

10.1.1. **Public systems**

As described in Section 8, public wastewater treatment systems are typically managed by a local governing body such as a municipality or PSD. To raise the millions of dollars usually needed for new systems, loans or grants are usually required. Loans are typically paid back over decades by ratepayers who use the system each month.

Many funding sources are available to build and upgrade public systems, including:

- the Clean Water State Revolving Fund (CWSRF),
- the WVIJDC,
- the United States Department of Agriculture Rural Utilities Service,
- the West Virginia Water Development Authority,
- the Small Cities Block Grant Program, and
- the United States Army Corps of Engineers.

In addition to these traditional government funding sources, there are other possibilities. Earmarks to federal legislation—which set aside money for specific projects— can be used to finance traditional wastewater treatment plants. Private banks or local governments often pay for engineering design before primary funding is released. Private foundations might help fund innovative solutions, especially as pilot projects.

According to USEPA, the CWSRF has provided over \$43.5 billion through more than 14,200 low interest loans across the country (USEPA, 2005). In addition to traditional wastewater treatment projects, these funds are also used for nonpoint source pollution control and watershed and estuary management.

[USEPA's Clean Water State Revolving Fund](http://www.epa.gov/owmitnet/cwfinance/cwsrf/index.htm)

www.epa.gov/owmitnet/cwfinance/cwsrf/index.htm

In West Virginia, \$473 million from the CWSRF has been used to finance wastewater projects. An additional \$445 million in general obligation and revenue bonds have also been used for these projects (WVIJDC, 2005).

To qualify for CWSRF loans, an application must be approved by the Technical Committee of the WVIJDC. This committee, chaired by a representative from WVDEP, ensures that applications are complete and that all criteria are met. Other members of the Technical Review Committee include the Bureau for Public Health, WVPSC, and West Virginia Development Office. This committee reviews preliminary applications before permitting processes begin, and determines whether proposed projects are technically feasible and the most cost-effective alternatives.

Once the Technical Committee makes a recommendation for approval, the application is then forwarded to WVIJDC's Funding Committee to review the proposed sources of funding. Upon its approval, a formal recommendation will be made to the WVIJDC. After a 30-day review period, the WVIJDC will either recommend approval of the application or recommend the application be returned for additional information.

While not directly involved in the WVIJDC process, Regional Planning and Development Councils are given copies of all applications submitted to the WVIJDC by the project sponsors.

West Virginia agencies related to wastewater treatment funding

West Virginia Bureau for Public Health
www.wvdhhr.org/bph/

West Virginia Department of Environmental Protection
www.wvdep.org

West Virginia Development Office
www.wvdo.org

West Virginia Infrastructure and Jobs Development Council
www.wvinfrastructure.com

West Virginia Public Service Commission
www.psc.state.wv.us

West Virginia Regional Planning and Development Councils
Separate Web sites for each region

West Virginia Water Development Authority
www.wvwda.org

To help raise funds for traditional wastewater treatment plants or upgrades, watershed organizations can:

- Help educate the community about the need for improved treatment,

- Especially in smaller communities, help government and utility officials navigate through the various government agencies and programs in order to get approval for funding,
- Help find funding through other non-traditional means such as earmarks and grants.

Monthly rates charged to people and businesses that send sewage to treatment plants are set by the local governing body, which is usually a municipality or PSD. The WVPSC is involved with final approval of rate structures in PSDs. Municipal rate structures do not need WVPSC approval unless there is a significant customer protest of the proposed rates, in which case the WVPSC would hold a public hearing.

The role of the West Virginia Public Service Commission

While municipalities generally have a large degree of independence in securing loans and setting rates, PSDs cannot borrow money, set rates, or even build new facilities without the approval of the WVPSC. In particular:

- PSDs cannot borrow money without prior consent and approval from the WVPSC
- PSDs must secure a certificate of public convenience and necessity from the WVPSC before building new systems.

PSDs can only raise rates with the approval of the WVPSC (WVPSC, Undated).

10.1.2. Private systems

Private developers usually pay to build privately owned wastewater treatment facilities when it is not practical to hook up to publicly owned facilities. Private systems typically serve housing, commercial, or industrial developments.

If a private system provides sewer service for a fee, the WVPSC considers it a public utility and regulates the rates. However, WVPSC does not set rates for purely private systems. Because of numerous problems with private systems over the years, such systems are discouraged. Systems designed to serve subdivisions or isolated communities are encouraged to become part of a PSD system. In some cases, developers are paid when they transfer private systems to PSDs, while in other cases they are not. These transfer agreements are subject to PSC approval.

10.2 Onsite, cluster or hybrid systems

Onsite systems are typically privately owned and funded by the owner. For example, a homeowner would be responsible to pay to install a septic system and leach field or a home aeration unit to treat water from his home. The U.S. Department of Agriculture's Rural Development Program can provide low interest loans—and, in unique situations, grants—to homeowners to install septic systems.

It is difficult to use some traditional funding sources for onsite, cluster, or hybrid systems. For example, most CWSRF allocations in West Virginia go to traditional plants (WVDEP, 2005). While there is clearly still a great need to build more traditional treatment plants, there is also a need to devote funds to cluster and hybrid systems when these systems are more appropriate.

Other potential funding sources for these systems include the Rural Utilities Service, U.S. Army Corps of Engineers, earmarks, and private foundations.

11. FINDING TECHNICAL ASSISTANCE FOR YOUR COMMUNITY

There are many resources that you can tap into to help you address your local wastewater problems. Organizations in the following section have expertise on wastewater issues and offer various services. The engineers listed in Section 11.2 are familiar with non-traditional solutions and can also be valuable resources.

11.1 Organizations

11.1.1. West Virginia Rural Water Association

Note: This section draws heavily from the West Virginia Rural Water Association Web site at www.wvrwa.org.

The mission of the West Virginia Rural Water Association (WVRWA) is to assist small and rural water and wastewater utilities in providing the highest quality of water and wastewater service, by improving knowledge, operational skills and technical expertise of utility system personnel and their governing boards.

WVRWA was created in 1985 to provide technical assistance and training to the small water systems of West Virginia. Programs consist of a wastewater program, a ground water protection program, two water circuit rider programs, and the EPA Training and Technical Assistance Program. In 1998, a training specialist joined the WVRWA staff through what is now known as the Hours for Education and Learning Program (H.E.L.P.). A program for wastewater classroom training was added in July of 1999. WVRWA now has nine professionals working in the field providing onsite assistance to small public water and wastewater systems and non-community water systems.

WVRWA is an association of small public water and wastewater systems from throughout the state. Funding for the organization comes from Association dues, grants from Rural Services for the Water Circuit Rider and Wastewater Programs, and USEPA for the Training and Technical Assistance Program and the Groundwater Program.

Other services provided by WVRWA include the publication of a quarterly magazine, Mountain State Water Line, that contains timely and helpful technical information for systems throughout the state. The Association also holds an Annual Technical Conference in the fall of each year that provides an opportunity for small systems personnel to meet and learn from professionals in the water and wastewater fields.

West Virginia Rural Water Association
168 Midland Trail
Hurricane, WV 25526
(304) 562-8585
www.wvrwa.org

11.1.2. Canaan Valley Institute

CVI is a nonprofit, non-advocacy organization committed to helping communities build their capacity to address environmental or economic problems by implementing locally determined solutions. Since 1995, CVI has fostered local decision-making in support of sustainable communities throughout the Mid-Atlantic Highlands of West Virginia, Pennsylvania, Virginia, and Maryland.

CVI can help watershed or community groups address wastewater concerns by helping to:

- Define initial problems and identify partners;
- Select a process framework;
- Develop and implement a thorough assessment of present conditions;
- Introduce and demonstrate alternative approaches to wastewater treatment;
- Synthesize local and regional information into a comprehensive plan; and
- Illustrate and summarize relevant data through geographic information system mapping.

CVI co-sponsored the West Virginia Wastewater Summit in 2004 and has supported the Wastewater Treatment Coalition of McDowell County, the Upper Guyandotte Wastewater Project Committee, and other efforts to build partnerships in West Virginia to solve wastewater problems.

Canaan Valley Institute

P.O. Box 673

Davis, WV 26260

(800) 922-3601

(304) 463-4739

www.canaanvi.org

West Virginia contact: Jenny Newland

11.1.3. Rural Community Assistance Program

Note: This section draws heavily from the Rural Community Assistance Program Web site at www.rcap.org.

After three decades, the Rural Community Assistance Program (RCAP) network has gained considerable knowledge and appreciation of the challenges facing the 45,000 small water systems (systems serving less than 3,300 people) across the nation. One of the many competing interests facing small, rural communities today is the need to comply with federal and state regulations regarding the safety and security of water and waste infrastructure systems. All communities want to be prepared for natural and man-made disasters, but some small, rural water system operators and owners lack the skills, tools and knowledge to safeguard their systems. The RCAP network has always strived to improve the capacity of water system operators to run their plants effectively and efficiently, and so in 2003, expanded training and technical assistance to include safety and security training and planning.

This is achieved by:

- Training water and wastewater operators, officials, utility board members and community leaders in infrastructure safety and security either onsite or in workshops across the country;
- Providing advice and assistance by telephone or online;
- Assisting communities to develop the capacity to conduct vulnerability assessments and generate emergency response plans; and

- An electronic magazine for information sharing, online technical assistance and electronic networking.

RCAP's wastewater programs focus on communities that:

- Have no sewer system;
- Have small sewer systems and have problems operating or maintaining them;
- Have small systems and are violating their discharge permits;
- Need to upgrade their wastewater collection, treatment, or distribution facilities to meet federal Clean Water Act requirements;
- Need an adequate financial base to construct, operate, manage, and maintain facilities, or to meet threats of watershed pollution; and
- Need to prepare United States Department of Agriculture Rural Utilities Service applications for waste disposal grants and loans.

Rural Community Assistance Program

www.rcap.org

11.1.4. National Environmental Services Center

Note: This section draws heavily from the National Environmental Services Center Web site at www.nesc.wvu.edu.

The National Environmental Services Center (NESC) provides technical assistance and information about drinking water, wastewater, environmental training, and solid waste management to communities serving fewer than 10,000 individuals. NESC operates as a repository for water, wastewater, solid waste, and environmental training research. and offers:

- Toll-free technical assistance hotlines and referrals,
- Free quarterly publications,
- Web sites,
- Listservs,
- Discussion groups,
- Free or low-cost educational products,
- Databases with hundreds of entries, and
- Engineering assessments.

Within NESC, the NODP, established in 1993, encourages the use of alternative, onsite and wastewater treatment technologies to protect public health, ensure water quality, and sustain the environment in small and rural communities. Funded through USEPA, NODP focuses on providing communities throughout the country with cost-effective alternatives to full central sewage systems.

National Environmental Services Center

Box 6064

West Virginia University

Morgantown, WV 26506-6064

(800) 624-8301

www.nesc.wvu.edu

11.2 Engineers

Finding an engineer with experience designing cluster or hybrid systems can be challenging. The following engineers have been recommended by people in West Virginia watershed groups because of their knowledge of these systems and their awareness of watershed issues. This is by no means a complete listing. Listing does not imply endorsement. To be included in this list in future printings, please contact the West Virginia Rivers Coalition.

Ayres Associates
1802 Pankratz Street
Madison, WI 53704-4069
(608) 443-1200
Dick Otis
www.ayresassociates.com

Chase Environmental Services
3900 South Mulford Road
Rochelle, IL 61068
(815) 562-6783
Paul Chase
ces9198@aol.com

Lombardo Associates
49 Edge Hill Road
Newton, MA 02467
(617) 332-5477
Pio Lombardo
www.Lombardoassociates.com

National Onsite Demonstration Project
Box 6064
West Virginia University
Morgantown, WV 26506-6064
(800) 624-8301
Clement Solomon
www.nesc.wvu.edu

Stone Environmental, Inc.
535 Stone Cutter Way
Montpelier, VT 05602
(802) 229-4541
www.stone-env.com

TetraTech, Inc.
200 Association Drive
Charleston, WV 25311
(304) 556-4815
Barry Tinning
www.tetrattech.com

David Venhuizen
5803 Gateshead Drive
Austin, TX 78745
(512) 442-4047
waterguy@venhuizen-ww.com
www.venhuizen-ww.com

12. GLOSSARY

This glossary is compiled mostly from USEPA, 2002.

Aerobic: Having molecular oxygen as a part of the environment, or growing or occurring only in the presence of molecular oxygen, as in “aerobic organisms.”

Aerobic treatment unit: A mechanical onsite treatment unit that provides secondary wastewater treatment by mixing air (oxygen) and aerobic and facultative microbes with the wastewater. These units typically use a suspended growth treatment process (similar to activated sludge extended aeration) or a fixed film treatment process (similar to trickling filter).

Alternative onsite wastewater treatment system: An onsite treatment system that includes components different from those used in a conventional septic tank and drain field system. An alternative system is used to achieve acceptable treatment and dispersal/discharge of wastewater where conventional systems may not be capable of meeting established performance requirements to protect public health and water resources. (e.g., at sites where high ground water, low permeability soils, shallow soils, or other conditions limit the infiltration and dispersal of wastewater or where additional treatment is needed to protect ground water or surface water quality). Components that might be used in alternative systems include sand filters, aerobic treatment units, disinfection devices, and alternative subsurface wastewater infiltration systems such as mounds, gravelless trenches, and pressure and drip distribution.

Anaerobic: Characterized by the absence of molecular oxygen, or growing in the absence of molecular oxygen (as in “anaerobic bacteria”).

Biochemical oxygen demand: A commonly used gross measurement of the concentration of biodegradable organic impurities in wastewater. The amount of oxygen, expressed in milligrams per liter (mg/L), required by bacteria while stabilizing, digesting, or treating organic matter under aerobic conditions is determined by the availability of material in the wastewater to be used as biological food and the amount of oxygen used by the microorganisms during oxidation.

Centralized wastewater treatment system: A wastewater collection and treatment system that consists of collection sewers and a centralized treatment facility. Centralized systems are used to collect and treat wastewater from entire communities.

Class 5 injection well: A shallow well used to place a variety of fluids at shallow depths below the soil surface, including domestic onsite wastewater treatment systems serving more than 20 people. USEPA permits these wells to inject wastes below the ground surface provided they meet certain requirements and do not endanger underground sources of drinking water.

Cluster system: A wastewater collection and treatment system under some form of common ownership and management that provides treatment and dispersal/discharge of wastewater from two or more homes or buildings but less than an entire community.

Coliform bacteria: A group of bacteria predominantly inhabiting the intestines of humans or other warm-blooded animals, but also occasionally found elsewhere. Used as an indicator of human fecal contamination.

Constructed wetland: An aquatic treatment system consisting of one or more lined or unlined basins, some or all of which may be filled with a treatment medium and wastewater undergoing some combination of physical, chemical, and/or biological treatment and evaporation and evapotranspiration by means of macrophytes planted in the treatment medium.

Conventional onsite system: A wastewater treatment system consisting of a septic tank and subsurface wastewater infiltration system.

Decentralized system: Onsite and/or cluster wastewater systems used to treat and disperse or discharge small volumes of wastewater, generally from dwellings and businesses that are located relatively close together. Decentralized systems in a particular management area or jurisdiction are managed by a common management entity.

Disinfection: The process of destroying pathogenic and other microorganisms in wastewater, typically through application of chlorine compounds, ultra-violet light, iodine, ozone, and the like.

Dissolved oxygen: The oxygen dissolved in water, wastewater, or other liquid, usually expressed in milligrams per liter (mg/L), parts per million, or percent of saturation.

Drain field: Shallow, covered, excavation made in unsaturated soil into which pretreated wastewater is discharged through distribution piping for application onto soil infiltration surfaces through porous media or manufactured (gravelless) components in the excavations. The soil accepts, treats, and disperses wastewater as it percolates through the soil, ultimately discharging to groundwater.

Effluent: Sewage, water, or other liquid, partially or completely treated or in its natural state, flowing out of a septic tank, subsurface wastewater infiltration system, aerobic treatment unit, or other treatment system or system component.

Effluent filter (also called an effluent screen): A removable, cleanable device inserted into the outlet piping of the septic tank designed to trap excessive solids due to tank upsets that would otherwise be transported to the subsurface wastewater infiltration system or other downstream treatment components.

Effluent screen: See Effluent filter.

Evapotranspiration: The combined loss of water from a given area and during a specified period of time by evaporation from the soil or water surface and by transpiration from plants.

Fixed-film wastewater treatment system: A biological wastewater treatment process that employs a medium such as rock, plastic, wood, or other natural or synthetic solid material that will support biomass on its surface. Fixed-film systems include those in which the medium is held in place and is stationary relative to fluid flow (tricking filter), those in which the medium is in motion relative to the wastewater (e.g., rotating biological disk), and dual process systems that include both fixed and suspended biomass together or in a series.

Graywater: Wastewater drained from sinks, tubs, showers, dishwashers, clothes washers, and other non-toilet sources.

Management entity: An entity similar to a responsible management entity, but managing a limited set of management activities (e.g., homeowners' association, contracted provider of management services).

Non-conventional onsite wastewater treatment system: System using technologies or combinations of technologies that are used where conventional onsite treatment systems cannot meet established performance or prescriptive requirements because of limiting site conditions. Also referred to as alternative onsite wastewater treatment systems.

Onsite wastewater treatment system: A system relying on natural processes and/or mechanical components that is used to collect, treat, and disperse/discharge wastewater from single dwellings or buildings.

Package plant: Term commonly used to describe an aerobic treatment unit serving multiple dwellings or an educational, health care, or other large facility.

Pathogenic: Causing disease; commonly applied to microorganisms that cause infectious diseases.

Percolation: The flow or trickling of a liquid downward through a contact or filtering medium.

Permeability: The ability of a porous medium such as soil to transmit fluids or gases.

pH: A term used to describe the hydrogen ion activity of a system.

Pretreatment system: Any technology or combination of technologies that precedes discharge to a subsurface wastewater infiltration system or other final treatment unit or process before final dissemination into the receiving environment.

Responsible management entity: An entity responsible for managing a comprehensive set of activities delegated by the regulatory authority; a legal entity that has the managerial, financial, and technical capacity to ensure the long-term, cost effective operation of onsite and/or cluster water treatment systems in accordance with applicable regulations and performance requirements (e.g., a wastewater utility or wastewater management district).

Sand filter: A packed-bed filter of sand or other granular materials used to provide advanced secondary treatment of settled wastewater. Sand/media filters consist of a lined (e.g., impervious PVC liner on sand bedding) excavation or structure filled with uniform media placed over an under drain system.

Septage: The liquid, solid, and semisolid material that results from wastewater pretreatment in a septic tank, which must be pumped, hauled, treated, and disposed of properly (i.e., in accordance with 40 CFR Part 503).

Septic tank: A buried, preferably watertight tank designed and constructed to receive and partially treat raw wastewater. The tank separates and retains settleable and floatable solids suspended in the raw wastewater. Settleable solids settle to the bottom to form a sludge layer. Grease and other light materials float to the top to form a scum layer. Solids are stored in the tank, where they undergo liquefaction in which organic solids are partially broken down into dissolved fatty acids and gases. Gases generated during liquefaction of the solids are normally vented through the building's plumbing stack vent.

Sequencing batch reactor: A sequential suspended-growth (activated sludge) process, in which all major steps occur in the same tank in sequential order. These include intermittent-flow batch reactors and continuous-flow systems.

Straight pipe: A discharge of raw sewage into a stream or lake with no treatment, usually through a pipe.

Subsurface wastewater infiltration system: An underground system for dispersing and further treating pretreated wastewater. These systems include the distribution piping/units, any media installed around or below the distribution components, the biomat at the wastewater-soil interface, and the unsaturated soil below.

Total Kjeldahl nitrogen: An analytical method for determining total organic nitrogen and ammonia.

Treatment system: Any technology or combination of technologies (treatment trains or unit processes) that discharges treated wastewater to surface waters, ground water, or the atmosphere.

Water quality criteria: A set of enforceable requirements under the Clean Water Act that establish measurable limits for specific pollutants based on the designated use(s) of the receiving water body. Water quality criteria can be expressed as numeric limits (e.g., pollutant concentrations or mass loads) or narrative descriptions of desired conditions (e.g., no visible scum, sludge, sheens, or odors).

Water quality standards: A set of enforceable requirements under the Clean Water Act that include classification of receiving waters in accordance with their federal or state designated use(s), use-based water quality criteria that establish measurable limits for specific pollutants, and antidegradation provisions to ensure that water quality is maintained or improved.

Water table: The level in saturated soil at which the hydraulic pressure is zero.

13. REFERENCES

- Adler, Robert W., Jessica C. Landman, and Diane M. Cameron. 1993. *The Clean Water Act 20 Years Later*. Natural Resources Defense Council. Washington, DC: Island Press.
- Conservation Technology Information Center (CTIC). 1995. *Building Local Partnerships, A Guide for Watershed Partnerships*. Know Your Watershed Kit Guides. West Lafayette, IN.
- Kreissl, J.F. 2000. Onsite Wastewater Management at the Start of the New Millennium. *Small Flows Quarterly*. 1(1):10-11.
- Lombardo, Pio. 2004. Principal, Lombardo Associates, Inc. Personal communication with author Ehrnschwender.
- McConnell, Joyce E. 2004. *Case Study: Private Cooperative Entity for Management of Community On Site Wastewater System*. Thomas R. Professor of Law, West Virginia University College of Law. USDA – RUS Awards 1002036R and 1002044R. Draft report.
- United States Environmental Protection Agency (USEPA). 2005. Clean Water State Revolving Fund (CWSRF) Web page. www.epa.gov/owmitnet/cwfinance/cwsrf/.
- _____. 2003. *Voluntary National Guidelines for Management of Onsite and Clustered (Decentralized) Wastewater Treatment Systems*. EPA-832-B-03-001. March.
- _____. 2002. *Onsite Wastewater Treatment Systems Manual*. EPA-625-R-00-008. February.
- _____. 1997. *Response to Congress on Use of Decentralized Wastewater Treatment Systems*. EPA-83-R-97-001b. April.
- _____. Undated. *Onsite Wastewater Treatment Systems Technology Fact Sheet 1: Continuous-Flow, Suspended-Growth Aerobic Systems (CFSGAS)*.
- Wastewater Treatment Coalition of McDowell County. 2005. *Wastewater Treatment Plan, McDowell County, West Virginia*. March.
- West Virginia Department of Environmental Protection (WVDEP). 2005. *Intended Use Plan, West Virginia Water Pollution Control Revolving Fund (“CWSRF”), Fiscal Year 2006 (Oct. 1, 2005 - Sept. 30, 2006)*. Submitted to USEPA Region 3. September. Draft.
- West Virginia Infrastructure and Jobs Development Council (WVIJDC). 2005. *2005 Inventory Report*. Draft report scheduled for release in late 2005.
- West Virginia Public Service Commission (WVPSC). Undated. *Top Ten Things County Commissioners Want to Know About PSDs...but are afraid to ask*. August County Commissioner Seminar, Amy Swann, Director, Water/Wastewater Division.

14. APPENDIX: SEPTIC SYSTEM FLYER FROM STEWARDS OF THE POTOMAC HIGHLANDS

Save \$ - Keep Your Septic System Sweet!

How can you keep your septic system working well?

Conserve water. Send the septic system less than 50 gallons per bedroom per day,¹ and under 10 gallons per bedroom per hour: Spread out baths, showers, laundry, etc. (8-min shower@2.5 gallons per minute=20gal, bath=washer=25-40gal, flush=1-7gal²). Drain *hot tubs*³ & *water beds* elsewhere or over several days. Water *softener* salts may or may not hurt;⁴ minimize water with flow-based softener, not timer-based. Electronic softener may work.⁵ Reverse *osmosis* purifiers create 1-9 times as much waste water as the 2-15 gallons of clean water they deliver per day.⁶ Drainfield handles moderate flows forever⁷ (Long Term Acceptance Rate, LTAR). Don't divert wash water (graywater) without treatment; it has lots of bacteria & soap.⁸

Don't flush what kills bacteria:⁹ Paint, chemicals, gas, antifreeze, pesticide, medicine,¹⁰ drain cleaner (11grams), bleach (1.8gal).¹¹

Don't flush what bacteria can't eat: Oil, coffee grounds, plastic, clay-based cat litter (corn-based OK), cigarette butts, paper except toilet paper.¹² These accumulate & must be pumped out. Powdered detergents often include clays (zeolite, montmorillonite) which accumulate or clog soil.¹³ *Hair* flows through & clogs soil. Septic *additives* don't help & may hurt.¹⁴

Install a water meter to measure water use. (Biggest leaks can be toilets: Put food color in tank; does it appear in bowl?)

Find a pumper who will do the following (yellow pages under Septic; they'll find tank electronically if needed): **Measure** sludge & floating layers before pumping. After pumping, **hose walls** & look for leaks.¹⁵ Replace concrete outflow **baffle** (can corrode & let oil through) with PVC tee. **Add a filter** where water leaves tank.¹⁶ Have **distribution box** checked; it can tip or corrode. Have tank pumped **every 3-5 years**. Pump annually if you use a garbage disposal. While pumping, water flowing into tank from drainfield means field is waterlogged. Water trickling from house means a leak, or blockage.

What are alternative costs if your septic system stops working?

The symptom of a problem is water appearing at the lowest overflow point: a plumbing fixture or wet ground, not always odor.¹

Approximate cost

FREE	Conserve water as drastically as possible. ² Better than free: saves \$\$\$. Read water meter daily or weekly.
\$0-500	Make sure storm water doesn't drain into septic system or onto drainfield. ³
\$0-1,500	Go away for as many weeks as you can (vacation, friends, rent a house).
\$1,500	Add pump or siphon ⁴ to send liquid from tank intermittently. This "pressure dosing" can be as good as alternating drainfields. ⁵
\$1,500	Replace any septic tank that lets water leak in.
\$1,500	Add a 2 nd septic tank or replace with a 2-chamber model. ⁶ Add a filter.
\$1,500	Dig & divert flows to a temporary drain line if you have a little space. ⁷ Chamber may be better than gravel. ⁸
\$2,500	Dig & divert flow to another drainfield if you have enough space.
\$3-9,000	Connect septic outflow to community treatment system or drainfield. ⁹
\$10,000	Replace your septic system with a home aerobic unit or other treatment. ¹⁰
\$10,000	Replace soil & drainpipes. (Hydrogen peroxide does <i>not</i> fix drainfield. ¹¹)
\$25,000	Connect to public sewer & pay monthly bills. ¹²

How do septic systems work?	What can go wrong at each step?
1 Water & waste drain to a septic tank (1-2,000 gallons, concrete, fiberglass or polyethylene).	Internal baffles can corrode, break, or leak, so oil & paper wash into drainfield & clog it. Septic gas is dangerous; stay out & don't smoke near it.
2 Solids settle & light things like oil & paper float in the tank. Many ingredients are slowly broken down by bacteria.	(a) Sending water too fast doesn't leave liquid in tank long enough for solids & oils to separate out, & may exceed percolation rate of soil. (b) Omitting pumpouts lets solids or oils build up until they can wash out to drainfield. See step 5.
3 Liquid flows out to a distribution box and then to 300-500 feet of perforated pipes in gravel beds in the soil (drainfield). ¹	Trees & bushes within 20 feet ¹ of drain lines can clog pipes with roots. (Remote camera can inspect pipes.)
4 Liquid spreads through gravel & is then filtered by soil & treated by bacteria. ² Good bacteria digest nutrients & pathogens in the liquid & multiply, forming a valuable biological mat in pores of soil & gravel. ³	(a) Driving on drainfield compresses soil: water can't flow; bacteria can't grow. (b) If water in drainfield (rain plus septic system) exceeds percolation rate of soil, water will back up in pipes or in soil.
5 Bacteria die after a normal lifespan, re-opening pores, and are constantly replaced.	Too many nutrients (from problem 2) make biomat grow faster than it dies; it becomes nearly impermeable, and water rises to surface or backs up into home. (Soil auger can take sample to inspect biomat. ² Infrared photos or sampling devices can measure flows & pollution. ³)
6 Clean liquid flows into groundwater, including any caverns or channels below ground	If pipes were installed too close above rocks, then unfiltered liquid can reach rock channels & pollute groundwater invisibly. If there is initially enough distance, biomat is a self-sealing barrier so invisible pollution does not start later.

Note that central sewers fail more massively: Pipes crack, treatment can fail, sludge goes on soil as thin as 6" over rock; pollution goes in streams & groundwater.¹

©Stewards of the Potomac Highlands, Box 455, Wardensville WV 26851, an environmental nonprofit. Donations welcome but not tax-deductible, since we lobby. **Footnotes**/sources are on PotomacStewards.org. OK to reprint if you reprint this whole flyer.