Water and Waste Disposal, Vital for Your Few Acres

By Stephen Berberich and Elmer Jones

Water is a basic necessity of life. For your small farm or homestead, the success of just about every activity depends on having a safe and unfailing water supply. Careful design and construction of the water system is essential.

Directly related to your water system is a sanitary sewage disposal system. Both should be planned at the same time if possible.

By profiting from current knowledge on rural water and sewage disposal systems, you can have good to excellent water service and sanitary waste disposal at reasonable cost. Private systems can be constructed which will give long satisfactory service without damaging the environment or endangering the health of your family or community. You start by defining your needs.

To estimate water needs, consider the future. Whether you choose to install a new well, reconstruct an old one, tap a spring, or add water to your system from a cistern, reservoir or storage tank, you should plan for any dream projects or goals as well as for your immediate needs.

Research studies have produced this formula for estimating home water needs: The largest water requirement for a single fixture (usually the bathtub or automatic washer) plus 1/4th the requirements for every other fixture (the kitchen sink, the shower, each toilet, etc.) equals your home's peak water demand—those periods when the well and pump must supply water continuously.

The unit of measurement for the formula will be gallons per unit of time, such as gallons per minute, or GPM. After you've

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established a reasonable GPM demand, a water source and delivery system can be set up with capacity to meet the demand.

50 Gallons a Person

Many studies show that home water use is 50 gallons a day per person, an average for people in this country. However, the figure is only an average. Many people use less. Some use much more.

Wells which meet demands of the farmstead home will usually also meet the water demands of a small scale farm operation, one with just a few head of livestock, for example. For more elaborate projects, such as automatic stock watering or extensive irrigation, the water source serving the home may have to be re-tooled to reach higher peak demands of the farm. Or new water sources may have to be developed.

By having a private water system, you should know more about well construction and sanitation than city friends who depend on a municipal water system. However, familiarity with your waterworks does not rule out the threat of water-borne diseases. If one factor in the system is most important it is sanitary protection of the source of your water. Contamination of a source can be caused by sewage, animal wastes, or chemical pollution of various kinds.

Newly constructed wells can lead to contamination of ground water, unless precautions are taken. In the process of

Table of water requirements for individual fixtures to help estimate home water needs

Water Uses	Flow Rate in Gallons per Minute (GPM)
Household Uses	
Bathub, or tub-and-shower combination	8.0
Shower only	4.0
Lavatory	2.0
Toilet—flush tank	3.0
Sink, kitchen—including garbage disposal	4.0
Dishwasher	2.0
Laundry sink	6.0
Clothes washer	8.0
Irrigation, Cleaning and Miscellaneous	
Lawn irrigation (per sprinkler)	5.0*
Garden irrigation (per sprinkler)	5.0
Automobile washing	5.0
Tractor and equipment washing	5.0
Flushing driveways and walkways	10.0
Cleaning milking equipment and milk storage tank	8.0
Hose cleaning barn floors, ramps, etc.	10.0

* Some irrigation sprinklers have more water capacity than shown in this table. If the capacity of your sprinkler is known, substitute that figure.

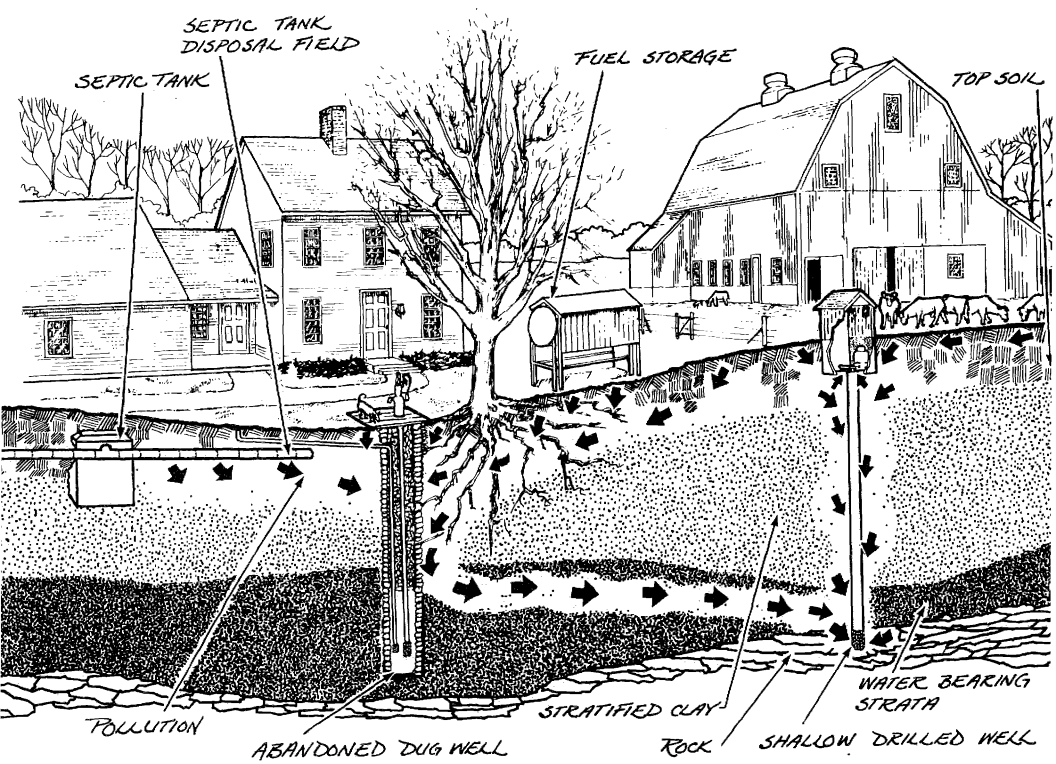
drilling, boring or digging a new well, natural earth barriers to surface and subsurface waters will be disturbed. The well itself can become a low resistance path for contaminants to travel from ground level to below the water table. However, the path can be sealed off with a grout made of neat cement and water.

Your best assurance of the proper installation, materials and location of the new well is to hire a licensed well driller.

Authorized drillers know the water-bearing strata in their locality and should follow state health department regulations.

Sometimes ground water serving a farmstead can become contaminated from nearby wells which are old, poorly constructed, and unable to hold out surface drainage.

Remember this model to help avoid contamination problems: Three things are needed for the entry of surface contaminants into the ground water supply, (1) a contaminant, (2) a transmission path, and (3) a transporting medium. Exam-



Shallow wells can become polluted more readily than deep wells. Note that pollution can come from underground sources as well as surface sources. (Adapted from *American Association for Vocational Instructional Materials*).

ple: (1) harmful bacteria, (2) a well bore, and (3) surface water or rain.

Rebuilding Old Well

It may be more economical to reconstruct an old well than to install a new one from scratch. Before reconstructing the old well, however, ask the following questions: Are there any obvious contamination sources near the well site? Is there excellent drainage? Will the proposed well structure be an adequate barrier against contaminants?

Also before you begin, measure yield of the old well. If the water is laden with sediment, clean out the well before taking a measurement. You can normally have a rural property with an existing water source evaluated by the county health department.

The old well may have been designed for use before electricity was readily available for pumping. It may be inadequate after you add modern pumps and plumbing. However, old wells often can be made deeper to reach a greater flow of water.

With modern well casings and pumping equipment, a reconstructed old well no longer needs a large diameter. A new casing of five inches or less will meet farmstead water needs. In figuring the cost of renovating the well, or installing a new one, add the cost of closing the old well bore properly.

A typical procedure is to backfill the hole with sand, after the new casing is placed and special well-grade gravel is poured around intake screens at the base of the casing. As the sand is filled around the new casing, water will surge into cracks and crevices of the old walls, carrying sand with it. This improves sanitary protection of the new system.

Spring Water

Springs, or natural flows of water from the ground, can also be developed as a water supply source. If you have a good spring on your property, ask these questions before acting:

Is the spring water good quality? Is the flow adequate? Could a gravity feed be set up from the spring? If not, would the cost of pumps and piping be within reason? And finally, because springs and areas of seeping ground water are frequently flooded, can the water source be protected from contamination?

You should have control over any storage reservoir for spring water. If the spring discharges more water than you can use, set up a diverting device for water to go past the reservoir except when needed. Also consider digging diversion ditches around any protective housing for the spring.

One more point on developing your water source. If you plan a business catering to the public such as a campground or a riding stable, your water system probably will have to comply with the Safe Drinking Water Act by following the latest regulations for well construction and sanitation.

Beyond your source of water, performance of the system is determined by other components, specifically the design, size, and maintenance of the pumps, valves, pipes, and storage facilities.

A widely accepted term for storing water is intermediate storage. It applies only to drinkable water held at normal atmospheric pressure in a storage facility carefully designed and constructed to protect quality of the water. A separate pump (besides the well pump) is needed to distribute water through the system.

With intermediate storage, a well yielding less than one gallon per minute can provide good to excellent water service for a home. A three to five GPM well can provide enough water for about an acre of lawn and garden besides home usage.

Intermediate storage at or below ground level usually provides the best per dollar storage. The water is protected from frost, and in summer comes to the spigots at cool temperatures. On the other hand, water stored in overhead tanks or held under pressure can be over ten times more expensive. The water tower or stanchions are costly. And with pressurized tanks, not much water can be held at reasonable cost.

Fire Fighting

Stored water can serve the farmstead in many different ways. It is available during power failures, or used for fighting fires, or for first aid in emergencies. The local fire chief can help you plan adequate storage to handle fires on the farm. For example, if you have 5,000 gallons available, a rural fire department pumper can fight with 500 gallons a minute for 10 minutes.

Lack of available water is a major problem in rural fire control. Sometimes even if water is at the scene it can't be delivered when friction in the plumbing reduces the water pressure.

Friction loss actually affects more than fire protection. Even with adequate well-pump capacity and intermediate storage, friction loss from poorly designed plumbing can mean the difference between a high performance water system and an inefficient one.

In the design and construction of private water systems,

too much emphasis is placed on quantity and quality of the water and not enough on quality of the service. It is unpleasant, to say the least, when competition for water between fixtures becomes a major part of planning household activities.

How would you change your water system if given the chance? Most farmers who cooperated in a dairy farmstead study answered by saying they would like to be able to take showers and be totally unaware of water use in the kitchen.

Replacing Valves

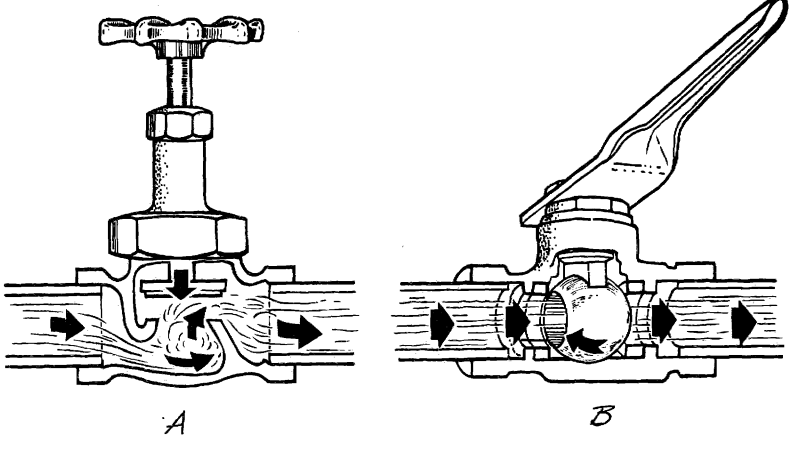
Sometimes much of the friction loss in older water systems is caused by undersize globe valves, also called compression stop valves. They should be replaced with ball-type valves. Small-diameter pipe can also contribute to friction loss. For underground pipes, use at least 1 1/4-inch pipe. You won't save cash with smaller pipe—the same size trenches must be dug.

Water for farm work is related to labor costs. Even with no hired hands, when you need a certain amount of water, you want it pronto! You don't want to waste time and money waiting for it. Minimize friction loss.

With good planning and management, a large area can usually be sprinkler-irrigated at reasonable cost. (Energy requirements will normally be less than one kilowatt hour per 1,000 gallons of water for a well-designed system.)

If you choose crops which have critical watering periods at different times, a larger area can be irrigated than your

Sometimes pressure loss in older water systems is caused by the friction created in undersize globe valves (left). They should be replaced (right) with ball-type valves. (Adapted from *American Association for Vocational Instructional Materials).*



water supply might indicate. A small deep well pump, intermediate storage, and a small pump between storage and sprinklers can do the job.

Water from surface sources such as streams, ponds, lakes, or rainwater stored in cisterns should only be used if ground water is unavailable. Any surface water will be polluted. Contact your local health official about proper treatment and disinfection. Also, tapping surface waters may also involve special water rights problems, so investigate before proceeding.

Creating a farm pond is another way of getting water, especially for non-drinking purposes. You should have full control of the water coming into the pond. If the pond is to be fed from a stream or spring, this may mean excavating for the pond above the level of the source and pumping water up to it. If a watershed drains into your pond, keep the watershed grassed, free of barns and septic systems.

The pond spillway—that part of the pond's banks or dam where excess water exists—should be large enough to handle flooding from heavy rains.

Waste Disposal

As a rural resident, your responsibilities broaden. Besides meeting the needs of your family and the immediate community, you are now a steward of the land and the community in a larger sense. Most pertinent here is that the farm be managed so water is not wasted and the environment not polluted by ill-conceived waste disposal systems.

This versatile farm pond provides beauty, recreation, and limited irrigation.

E. Barker

The 19th century invention of the septic tank-soil disposal system brought the indoor toilet to rural America. A properly functioning, properly located septic system is still a very efficient way of disposing of sewage. Today, it remains the most common type of private sewage system.

The septic system consists of two parts, the septic tank and the soil disposal area, also called the drainage or distribution field.

The septic tank is where sewage solids separate from liquids and where bacteria begin to decompose the solid material. However, the soil disposal area performs most of the sewage treatment. Starting at the outlet pipe of the septic tank, a system, usually consisting of 4-inch corrugated plastic pipe, extends through trenches containing gravel buried beneath the ground's surface.

Discharge from the tank is a gray, somewhat odorous liquid, referred to as septic tank effluent, which carries suspended solids. The effluent goes through the drainage system and passes through holes in the piping. Soil bacteria and fungi then decompose the solids into inert matter. The result should be a clear, bacteria-free and odor-free effluent. But stop—that is only how the system *should* work.

Although the septic system is an old idea, many systems have been poorly designed and constructed. A large portion of those in operation today simply do not work properly, and are serious threats to health and environmental quality.

Clogging Is Villain

Research indicates that with proper design and management, modern septic systems can have nearly infinite life. The research shows that most premature failures are due to clogging of the soil disposal area.

Breakdowns can also result from poor septic tank performance, high soil moisture during construction of the system, failure to properly evaluate soil drainage, or overloading the system. In short, septic system failures are caused by lack of foresight or by neglect.

The inlet to the septic tank should be nonfouling and designed to cause a minimum of turbulence in the tank as sewage enters. From the intake, heavy sewage particles settle into a layer of sludge at the bottom of the tank, and lighter-than-water substances, such as grease and fat, float to the top forming a layer of scum.

Between the scum and sludge layers, there is a zone of clear liquid. The outlet, located at the upper level of the liquid

zone, should permit only a minimum of solids to exit onto the soil disposal area.

However, especially with single compartment septic tanks, turbulence from incoming sewage, gas bubbles rising from the sludge, and the like may allow too much suspended solid material to leave the tank. The soil disposal area then becomes clogged.

Many tanks have two compartments, the second serving as a settling chamber. These tanks can reduce the amount of suspended solids discharged into the soil disposal area by 25 to 30 percent. For any given design, the larger the tank volume, the more suspended solids will be removed.

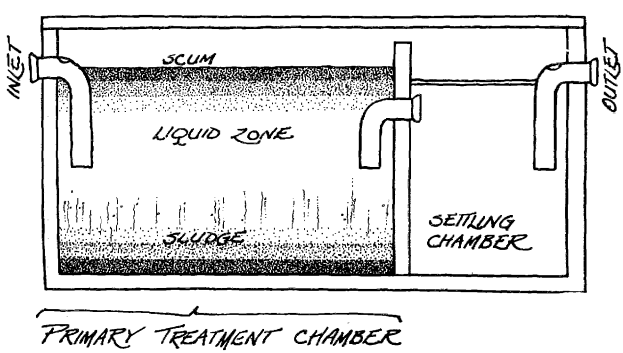
Until you are familiar with how often your septic tank needs pumping out, have the system inspected once a year. Part of the scum and sludge can not be eaten by bacteria and must eventually be cleaned out.

Because the septic action of the tank depends on bacteria, nothing should be flushed into the tank which will kill or retard growth of the bacteria. They will tolerate moderate amounts of soaps, detergents, disinfectants and similar household products. But don't overdo it.

The septic tank should be located on the downhill side of the water source and at least 50 feet away. Size and location of the soil disposal area depends on the terrain and capacity of the soil to absorb sewage liquid, the effluent.

Heavy impervious soil, a high ground water level, or insufficient land area can create problems for the soil disposal area. When soil around the disposal area becomes saturated with moisture, for any reason, decomposition of solid particles in the effluent slows down. The system clogs. Effluent can back up in the septic tank. Ground water can be harmed.

The problem may seem a physical one, but it is really a matter of the wrong chemistry. Organic compounds in sewage



or septic tank effluent need lots of oxygen to decompose properly in the soil. When the soil is loaded with moisture, not enough oxygen is present and the system stalls.

New ways have been developed to keep the purifying action going under difficult circumstances, and still avoid ground water spoilage.

Pressurizing

One way is to pressurize the system. A time-controlled pump sends effluent into the disposal system for only brief periods at a time. Corrugated drainage pipe is not used. Instead, the pump sends effluent through 1- to 1-1/2-inch diameter plastic pipe which has small holes every 30 to 42 inches.

For sandy soils, the pump should be set to eject effluent into the pipes four or five times a day. For heavier soils just once a day may be enough to prevent clogging.

Another way is to alternate between two or more drainage fields by using diverter valves. Alternating offers the advantage of giving the soil of each disposal system a rest. If one system clogs, it can immediately be shut off without stopping operation of the entire septic system.

For many soil types, one disposal system can be used for six months to over a year, before switching to a fresh system—one with enough oxygen in the soil to properly decompose sewage.

Serial Distribution

A third way, the serial distribution system, has proved very effective on soils where there is no risk of polluting the ground water. A series of trench sections are separated by dams or earthen barriers. As effluent flows into the system, the first trench section is forced to fill completely before the liquid can go to the next section.

Flooded sections serve as contact chambers, where bacteria decompose suspended solids. The biological activity continues to improve effluent quality in each succeeding section.

This system is often used on hillsides, but it is equally effective on flat land.

If the serial system should fail, only the first trench usually needs to be replaced. The series of trenches can also be alternated.

The pressure distribution system could be used for subsurface irrigation of shrubs, trees and lawn. Normal amounts of effluent entering the soil from a septic system far exceed what landscape plants would require.

However, if you are hooked into an expensive town water system, consider making the soil distribution system larger, with separate laterals and two-, three-, or four-way diverter valves to accommodate the irrigation. Plant nutrients in sewage effluent make such a system worth considering.

Recycling, Composting

No discussion of waste disposal on the farm would be complete without touching on garbage disposal. Two things here—the compost pile and waste recycling.

With some industrial resources becoming scarce or expensive, recycling will likely get more popular. On your farmstead, you may consider having separate disposal containers for paper, glass, metals such as aluminum and steel, or other categories. In some regions good return rates on these items already make the effort worthwhile.

If you pay for trash collecting, recycling will reduce that expense. If you burn wood for heat, paper is probably more valuable for fuel.

Composting is an ancient art, and a modern science. On the farmstead it can be used to provide fertilizer for the garden or it may be an integral part of raising crops, depending on how much organic material is obtainable.

Leaves, hay, sawdust, crop residues, weeds, grass clippings, kitchen wastes, manure and other organic materials are layered in piles and allowed to ferment. With the aid of oxygen, provided by turning the piles occasionally, the material breaks down quickly into an excellent soil conditioner or fertilizer.

A small compost pile can keep a vegetable patch in top condition. If a lot of composting material is shredded, piled and turned with power equipment, orchards and field crops can also benefit from the additional humus and fertility that compost gives to the soil.

Further Reading:

Planning for an Individual Water System, American Association for Vocational Instructional Materials, Engineering Center, Athens, Ga. 30602. 1973. $6.95.

U. S. Department of Agriculture, *Treating Farmstead and Rural Home Water Systems*, Farmers Bulletin No. 2248, on sale by Superintendent of Documents, U. S. Government Printing Office, Washington, D.C. 20402. 35¢.

U. S. Department of Agriculture, *Water Supply Sources for the Farmstead and Rural Home*, Farmers Bulletin No. 2237, on sale by Superintendent of Documents, U. S. Government Printing Office, Washington, D. C. 20402. 35¢.