



Managing the Farmstead to Minimize Groundwater and Well Contamination

In 1986-87, the Federal Cooperative Extension System released a report identifying groundwater quality as one of eight priority issues critical to economic, social, and environmental progress. In the United States, approximately 50 percent of the population depends on groundwater for drinking. In Kansas, the numbers are even higher — nearly 70 percent of the population depends on groundwater. About 80 percent is served by public water systems that are carefully regulated, treated and monitored. The rest, nearly a half million people, get their water from private water systems with the individual users responsible for the safety of the system. To nearly all rural Americans, drinking water and groundwater are the same. Most private water systems and many public systems are on or near farmsteads or in areas close to agricultural activities.

Results from a recent study in Kansas show cause for concern. Phase I (1985-86) of the Farmstead Well Survey, a cooperative effort of Kansas State University and the Kansas Department of Health and Environment, examined 104 wells and found 28 percent of the wells were high in nitrates, 8 percent had detectable levels of pesticides, and 2 wells had detectable levels of volatile organic compounds (VOCs). Phase II (1987) of this study involved 84 wells and showed 32 percent with high nitrates, 11 percent with detectable pesticides and 4 wells with detectable VOCs. Results from Extension water quality clinics show bacterial contamination in 25 to 30 percent of over 1,500 wells tested.

This publication addresses how to manage agricultural activities around the farmstead to minimize potential contamination of wells and groundwater.

Potential Contaminants

Many potential groundwater contaminants exist around the farmstead. Figure 1 shows a farmstead, potential sources of contamination, and water movement. The potential for contamination by bacteria or viruses, or both, is great. Most farms rely on septic systems for disposal of human wastes. Septic systems are a source of microbial contaminants that could end up in the groundwater. In addition, livestock is part of many farm enterprises. Most livestock operations have grain storage and thus the potential for rodent populations.

Dead animal carcasses, wastes produced by the livestock, and the likelihood of a rodent population all create the potential for bacteria and virus contamination.

Nitrates in groundwater also are a major concern in farming operations. A search of the farmstead for possible sources of nitrates generally will verify the concern. Most farmers depend on commercial fertilizer to supply needed nitrogen to crops. This fertilizer is sometimes stored on the farm, at least temporarily, and represents a concentrated source of nitrates with potential for accidental spill or release. Many irrigators inject nitrogen through irrigation systems, with large quantities of nitrogen stored near wells in many cases. Livestock operations generate large amounts of manure and other wastes, which are also concentrated sources of nitrates and other nutrients. A livestock area no longer in use can be a source of groundwater contamination. Human wastes passing through septic tanks and lateral fields also can be a source of nitrates at concentrated levels.

Many producers rely on pesticides to protect crops and/or livestock from pests such as weeds, insects and diseases. The term pesticides refers to herbicides, insecticides, fungicides, rodenticides, and other products. As a group they represent a small portion of the groundwater contaminants today and are largely attributable to the agricultural industry, though homeowners also use large amounts of pesticides. Pesticides often are stored on the farmstead and the handling, mixing and application of these products create the potential for groundwater contamination.

In addition to these major contaminants, the typical farmstead has several other potential groundwater contaminants. Most farm operations use large amounts of petroleum products including diesel fuel, gasoline, motor oil and other lubricants. Storage, handling, and disposal of these products all pose potential avenues for groundwater contamination. Many farmsteads have several outbuildings, large lawns, fences, grain storage facilities, and livestock confinement areas. All require maintenance and upkeep, which can require the use of fairly large quantities of cleaning agents, paints and preservatives, lawn care chemicals and other products. The storage, handling, mixing, application and disposal of products like this all increase the risk of groundwater contamination.

Routes of Contamination

All of these potential contaminants can enter groundwater by leaching through the soil or by surface runoff to a point where direct contamination occurs. Leaching is the movement with percolating rainwater or irrigation water of potential contaminants through the soil. The leachability of contaminants varies considerably and can be influenced by factors such as rainfall, temperature, soil depth, soil texture and other soil properties, as well as the properties of the contaminant such as half-life and solubility. Contaminants also may move to groundwater directly. This process is possible in spills or leaks of liquid contaminants. In any case, movement of contaminants through the soil to groundwater is a complex process.

In some cases, even with proper use of chemicals and nutrient sources, contaminants may reach groundwater by leaching. In most cases where these contaminants are found in groundwater, however, they have contacted the groundwater supply through direct routes or concentrated processes such as spills or leaks; backsiphoning into wells; substandard well construction; poor well maintenance; and improper storage, handling, mixing, application and disposal of fertilizers, manures, pesticides and other products. Direct groundwater contamination also may occur through old or abandoned wells, including irrigation wells or oil and gas fields.

Management Strategies to Minimize Contamination Risks

Developing and implementing management strategies on the farmstead can minimize the risks of groundwater contamination. The first step is to locate all abandoned wells and properly plug them. Abandoned wells should never be used as disposal sites as they are direct routes for contaminants to reach the groundwater aquifer and may quickly affect wells in use.

Microbial Contaminants. A quality sanitation program on the farmstead can go a long way toward preventing groundwater contamination by bacteria or viruses. Cleanliness around grain storage and handling facilities and prompt and proper disposal of garbage discourage rodent population buildup. If livestock is part of the operation, routine waste removal and disposal should be practiced. Prompt removal of dead animals from the premises should be a priority. Confined feeding areas should be located away from wells and manure should not be stockpiled near any water source. A major source of microbial contamination of groundwater and wells is improper disposal of domestic wastewater, particularly the use of cesspools, abandoned wells, or other subsurface excavations. A cesspool is any subsurface excavation into which wastewater flows and seeps directly into the ground. Cesspools have been shown to cause both bacterial and nitrate contamination, and they are illegal in

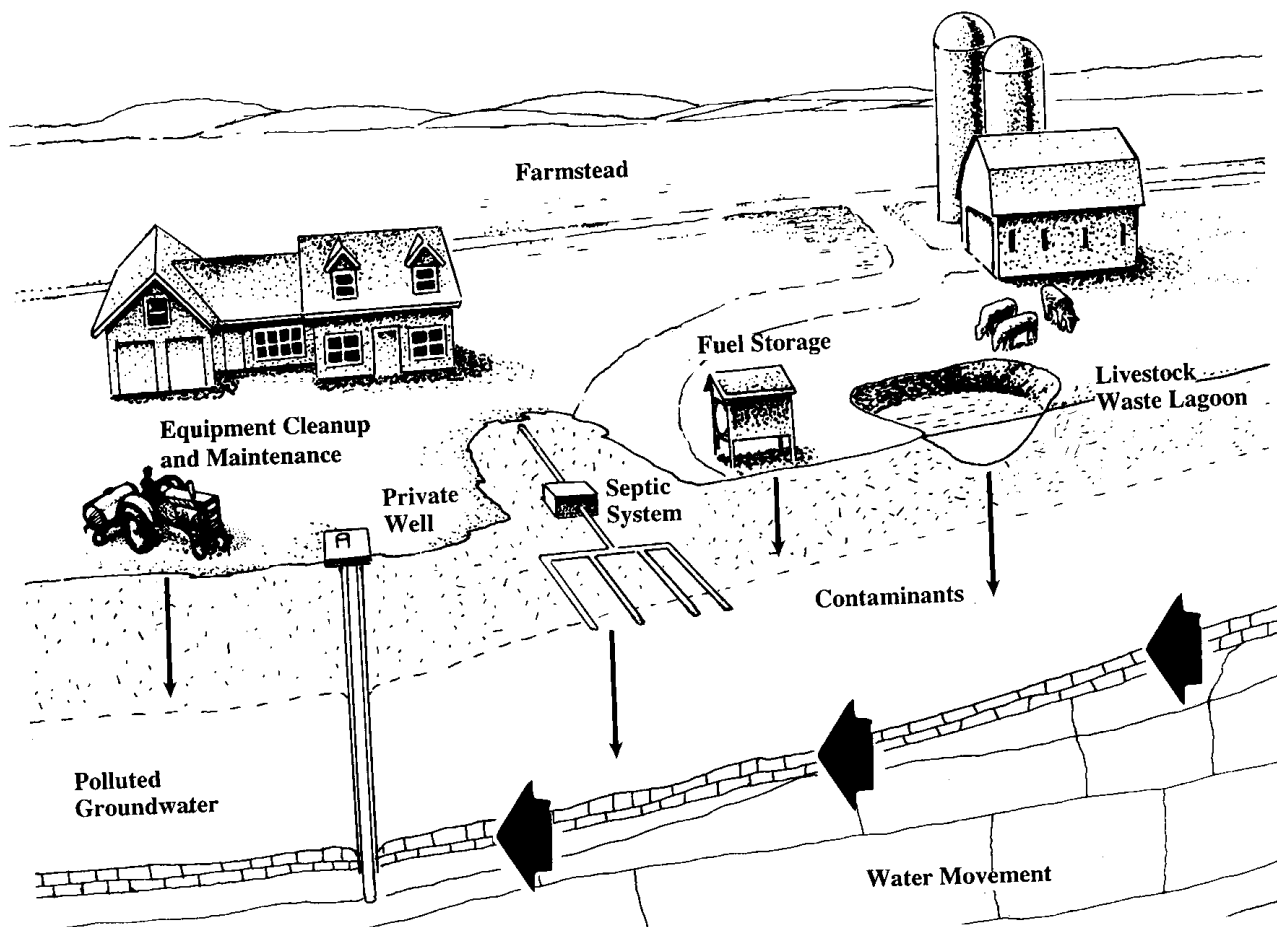


Figure 1. Many potential groundwater contaminants exist around the farmstead.

Kansas. Any existing cesspools should be abandoned, cleaned and filled. Contact the Kansas Department of Health and Environment in Topeka for guidelines.

Wells should be properly located, constructed and maintained. Wells should be located as far as practical but at least 200 feet (500 is desirable) from livestock confinement areas and septic system lateral fields. Many areas have specific regulations that should be consulted before constructing new wells. Well casings and well heads should be maintained and tight. This keeps small animals and rodents out and prevents direct contamination from surface water by runoff from rainfall. Wells constructed since 1975 are subject to Kansas well construction regulations. These requirements are available from the Kansas Department of Health and Environment.

Nitrates. Nitrates in groundwater can come from many sources, but around the farmstead the main concerns are fertilizers, animal wastes and the domestic wastewater system. If nitrogen fertilizers are stored on the farm, they should be kept away from wells. On farms where fertigation (applying fertilizers through the irrigation system) is practiced, check valves should be installed to prevent backsiphoning into the well. Kansas law requires that all irrigation wells be registered and that check valves be installed where fertilizer is injected into the irrigation system. The State Board of Agriculture can provide more information on these regulations.

Animal wastes are a source of nitrates that potentially could reach groundwater. Livestock confinement areas (where wastes accumulate) should be located away from all wells, even little-used or abandoned wells, as wastes entering a well could contaminate the water supplying aquifer with nitrates and bacteria. (This includes pet confinement areas: One case of high nitrate well water has been traced to wastes from a dog kennel entering an improperly constructed well.) A good practice is to regularly dispose of animal wastes by spreading them on production fields. Large stockpiles of manure should not be allowed to accumulate without proper storage conditions. All wells on the farm should be properly constructed and maintained and unused or abandoned wells should be properly plugged or capped to prevent the inadvertent introduction of raw wastes into the aquifer.

Most farms rely on septic tanks and lateral fields to treat and dispose of household wastes. These wastes can be high in nitrates as well as other contaminants. Wells should be located at least 200 feet from septic systems. Septic tanks and lateral fields should be properly designed and meet local sanitary specifications. County Health Departments have specific regulations.

Pesticides. Concern about contamination of groundwater by pesticides is justified. Potential pesticide contamination is a particular concern to farm families because their own or a neighbor's well may be affected. Once a well is contaminated, the water could be unusable for several years unless it is cleaned, generally at great expense. The well and

the area around it are especially vulnerable to pesticide contamination. Pumping water from a well creates a drawdown area near the well and thus alters groundwater flow. This drawdown area is called a cone of depression. When pesticides are mixed and handled improperly near the well, the soil may become saturated and unable to adsorb and degrade pesticides effectively. Pesticide saturation of the soil in the drawdown area greatly increases the chance of pesticides leaching to groundwater.

Using the following strategies will minimize the potential for pesticide contamination:

- Do not store, mix or handle pesticides near the well.
- When loading spray equipment with water, fill the tank at least 300 feet from the well and fill tanks downslope from the well to avoid runoff contamination.
- Always use check valves on water pumping equipment to prevent backsiphoning into the well during filling. If anti-backsiphoning equipment is not used, always keep the water supply hose above the sprayer tank water level and never leave the filling operation unattended.
- Load and mix pesticides into the tank after arriving in the field to be sprayed.
- Properly dispose of rinse water and containers. Pesticide containers should be triple-rinsed and disposed of according to label instructions and current state and local requirements (check with local authorities). Rinse water should be put in the spray tank and applied to the field. **Never** dispose of pesticide containers in abandoned wells, cisterns, pit silos or other excavations.
- Clean sprayer (inside and outside) while in the field, if possible, and spray rinse water onto the field.
- Alternative pesticides may be available to do the job. If so, select the one with the least environmental risk. Labels contain groundwater contamination warnings.
- In case of pesticide spillage, keep people away and confine the spill. Use absorbent material such as soil, sawdust, or cat litter to soak up the spill. Shovel all contaminated material into a leak-proof container and dispose of properly (check with state or local authorities). Do not hose down the area as the chemical will be spread.
- **Always** read and follow label directions and precautions. **Never** apply pesticides at rates exceeding label recommendations.

Following these management strategies will greatly reduce the risk of potential contamination by pesticides.

Other Contaminants. Farms often have large amounts of petroleum products, cleaning agents, paints, preservatives, lawn and home-care chemicals, and other products in storage. These products should never be stored, mixed or used in the proximity of wells. Never use abandoned wells as disposal sites for empty or partially used containers of these products. Do not dump used motor oil on the ground. Used oil should be taken to an approved recycling center. Many communities have such a facility. If feasible, fuel

storage tanks should be located on a containment area of compacted, low permeability soil. In the event of a spill, the fuel should be cleaned up promptly and then contaminated soil removed and spread over a field surface at low rates. State law requires reporting of any spill with potential to cause environmental damage. The Kansas Department of Health and Environment has a 24-hour, spill response unit. Finally, lawn and home-care chemicals should always be mixed and applied according to label directions.

Summary

A balance must be achieved between the nation's parallel needs for profitable agricultural production and safe water. Both needs can be met successfully if action is taken to increase understanding and implement responsible management programs. It is important for the agricultural community to recognize that groundwater quality is not just a production issue. Likewise, it is important for the population served by agriculture to understand that this is not just an environmental issue. Working together, the farm community and other interested groups can preserve the continued supply of good-quality water while maintaining agricultural productivity and profitability.

As major users of groundwater, farmers and ranchers are inextricably tied to the groundwater-quality issue. Efficient, effective use of fertilizers, manures and pesticides has increased farm productivity and economic viability, but improper or inefficient use of these production inputs leads to potential groundwater contamination. Farmers and ranchers must realize their daily decisions and actions in the running and maintenance of their operations can affect groundwater quality and their own water supply. Through increased knowledge and careful management, the risk of groundwater contamination can be greatly reduced with little cost or trouble.

For more information on water quality and testing consult other Kansas Cooperative Extension Service publications or contact the Kansas Department of Health and Environment.

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