Facts to Consider

Between 1982 and 1997, Texas led the nation in LOSS of rural lands with 3.1 million acres of farm, ranch, and forest being converted to other land uses (e.g. housing development or recreational use).

Conversion issues have been compounded by the fact that much of these lands have been FRAGMENTED into smaller sections, and subsequently, more landowners. Much of this conversion can be contributed to pressure landowners’ have faced in recent years to sell their agriculture lands, mainly due to increasing land values and loss of profitability in agriculture enterprises.

In 2007...

- Fewer than 50% of agriculture holdings less than 500 acres reported generating a profit
- The average appraised market value of farm, ranch and forest land was $1,196 per acre - 140% increase over a 10 year period!
Texas landowners are responsible for managing the drinking water from their private wells. To protect your water supply, you need to keep records on each well, manage potential sources of contamination, and test your water at least once a year.

**Keep records**

Record the location of all wells on your property, and keep a file on each well. Each well will have a unique identification number assigned by the driller. Use this number to track historical information, which may be available from the following sources:

- **Texas Water Development Board Groundwater Database**: Registered water-well drillers must submit reports to the state for each well they drill. More than 130,000 wells have been recorded in the TWDB groundwater database since 2001. Your well may be listed at [http://wiid.twdb.state.tx.us/ims/wwm_drl/viewer.htm](http://wiid.twdb.state.tx.us/ims/wwm_drl/viewer.htm).

**Manage potential sources of contamination**

Materials from many common facilities can contaminate a water well. Take steps to protect your well water from them. According to Texas law, the wellhead must be at least:

- **50 feet** from any septic tank, cistern, property boundary, and/or nonpotable well
- **100 feet** from your septic drainfield or any leach field
- **150 feet** from any feed storage area, pesticide or fertilizer storage area, or shelter or yard for pets or livestock.
- **250 feet** from a manure stack or liquid waste disposal system
Test the water

Contaminants such as arsenic and radionuclides can occur naturally in wells. Well water can also be contaminated by environmental disturbances or human activities such as oil and gas exploration.

Have your well water tested for the contaminants that are most likely to be in it. At a minimum, have the water tested every year for nitrate, total dissolved solids (TDS), and E. coli or fecal coliform (bacteria from human or animal waste).

Also have the water tested whenever you suspect contamination; when you notice a change in the water’s color, taste, or odor; after the pump or well is maintained; and after anyone who drinks the well water experiences a suspicious illness.

To find a laboratory, call your county health department or choose a certified drinking water laboratory from the National Environmental Laboratory Accreditation Program at http://www.tceq.texas.gov/goto/certified_labs.

For more information

- Texas Well Owner Network: http://twon.tamu.edu/
- List of licensed well driller/pump installers: http://www.license.state.tx.us/License-Search/
- Texas Groundwater Protection Committee: http://www.tgpc.state.tx.us/WaterWells.php
- County AgriLife Extension office: http://counties.agrilife.org/
- Diane Boellstorff: dboellstorff@tamu.edu (979) 458-3562
- Drew Gholson: dgholson@tamu.edu (979) 845-1461

Acknowledgment

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Nonpoint Source funding from the Texas State Soil and Water Conservation Board and the
U.S. Environmental Protection Agency under Agreement No. 13-08.
If you store or use pesticides on your land and get your drinking water from a well, you need to follow basic practices to reduce the risk of pesticides contaminating your drinking water. Federal law mandates that pesticide users follow the instructions on the manufacturer's label to reduce contamination of the environment. Improper use or misapplication of a pesticide can be punishable by a fine or pesticide license revocation.

Depending on how toxic it is, a pesticide entering a water supply can affect the health of people or animals in two ways:

- **Acute illness** results from a short period of exposure, such as from a spill or back-siphonage accident.
- **Chronic illness** occurs after prolonged or repeated exposures to small amounts of some chemicals.

The underground water that supplies wells and springs is called groundwater. It is the source of drinking water for many Texans. Millions of gallons of groundwater may be located under the typical homesite, farm, or ranch. Groundwater aquifers can be polluted by leakage from fuel tanks, livestock pens, septic systems, and fertilizer and pesticide storage areas.

The management decisions you make on your property can significantly affect your drinking water and your family’s health. They can also affect your potential legal liability and property value.

The following questions (Table 1) may help you identify potential risks associated with pesticide storage and handling. If you answer yes or don’t know the answer to any question, you may have a high-risk situation on your property. Information on how to address each situation follows.
Table 1. Questions to help determine whether a water well is at risk of contamination by pesticides.

<table>
<thead>
<tr>
<th>YES</th>
<th>NO</th>
<th>QUESTIONS</th>
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<tbody>
<tr>
<td></td>
<td></td>
<td>1. Do you store pesticides on your property?</td>
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<td>2. Are chemicals stored in an unlocked area that is open to children, animals, or vandals?</td>
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<td>3. Are the labels missing from your pesticide containers, or do the containers have holes or tears that allow chemicals to leak?</td>
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<td>4. Does your pesticide storage area have a gravel or dirt floor?</td>
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<td>5. Are your pesticide storage and mixing areas upslope or less than 150 feet downslope from your drinking water well?</td>
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<td>6. Do you mix and load pesticides on a surface such as soil or gravel that allows spills to seep into the ground, or on a surface without a curb to catch spills?</td>
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<td>7. Do you fill the sprayer tank directly from a water well?</td>
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<td>8. Do you fill the sprayer tank with a hose that does not have a check valve, or put the hose in the tank below the liquid line during filling?</td>
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<tr>
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<td>9. Do you wash out the sprayer tank and dump the rinse water less than 150 feet from a water well?</td>
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<tr>
<td></td>
<td></td>
<td>10. Do you ever dispose of partially filled pesticide containers on your property?</td>
</tr>
</tbody>
</table>

1. **Do you store pesticides on your property?**

   By using less pesticide, we can reduce waste. Don’t buy more than you need; keep records of what is on hand; and use older products first. Other waste-reduction measures include:
   - Buy the least amount of product needed to avoid having to store leftovers for long periods.
   - Before using older chemicals that have been stored, check with your county Extension agent about possible updated risks, current restrictions on their use, and the availability of possibly safer or more effective alternative products.
   - Follow the instructions on the label regarding who can use a product, how to use it, how long it will remain effective, what temperature range in storage will ensure product integrity, what to do after a spill or chemical exposure, what number to call in an emergency, and where, how, how much, and how often it may be used.

   For information on how to use a specific pesticide, contact your county Extension agent, the Texas Department of Agriculture, or your pesticide sales representative.

2. **Are chemicals stored in an unlocked area that is open to children, livestock, or vandals?**

   Prevent unauthorized access to pesticides to reduce the risk of spills, theft, and accidental contact (for example, by children). The best protection is a locked storage cabinet or building intended only for pesticide storage and located away from other activities.

3. **Are the labels missing from your pesticide containers, or do the containers have holes or tears that allow chemicals to leak?**

   The first defense against spills or leaks is a sound container. Pesticide containers should have no holes, tears, or weak seams.

   Proper labels on all pesticide containers are necessary to keep information at hand if an accident occurs. Labeling will also help you manage inventory and use older products first.
4. **Does your pesticide storage area have a gravel or dirt floor?**

A storage facility with a gravel or dirt floor will allow spilled pesticides to soak into the soil. Follow these guidelines to protect your well water:

- Store pesticides in a secure, properly constructed building.
- Locate the storage building at least 150 feet downslope of the wellhead.
- Never store chemicals in the well house.
- Make sure that the floor is made of impervious material such as concrete.
- Build a curb around the floor to trap spills and prevent them from spreading.
- To keep leaking chemicals from reaching the ground, install a secondary containment floor made of an easily cleaned material such as sealed cement or glazed ceramic tile around the storage building.
- Grade the soil so that the finished soil grade is 3 inches below the floor and sloped to drain away from the building.
- Choose a site where the subsoil is as impermeable as possible.
- Inside the storage facility, keep large drums or bags on pallets and off the floor.
- Use shelves with lips for smaller containers to keep them from sliding off.
- Use steel shelves, which are easier to clean than wood if a spill occurs.
- Store dry products above liquids to prevent wetting from spills.
- To prevent cross-contamination, keep different types of pesticides (herbicides, insecticides, and fungicides) on separate shelves or in separate areas.
- Check the pesticide product labels for expiration dates, and dispose of all out-of-date products properly.

Take precautions to be ready in case fire breaks out in the storage facility:

- Label windows and doors to alert firefighters to the presence of pesticides.
- Keep a list of the stored chemicals and amounts in a separate location.
- Know where the runoff water would go and where it might collect if a fire breaks out.

5. **Are your pesticide storage and mixing areas upslope or less than 150 feet downslope from your drinking water well?**

The pesticide storage facility should be downslope and at least 150 feet away from your water well. To minimize the distance that chemicals are transported, locate the mixing and loading area close to the storage facility.

The mixing/loading area should be more than 10 feet downslope or 100 feet upslope of the well. If runoff from your mixing/loading area threatens your well, build a diversion to direct the water to a safe area.

6. **Do you mix and load pesticides on a surface such as soil or gravel that allows spills to seep into the ground, or on a surface without a curb to catch spills?**

When transferring pesticides to spraying equipment or mobile tanks, protect against spills by using a waterproof mixing or loading pad. Although small amounts spilled regularly in the same place can go unnoticed, the chemicals can build up in the soil and eventually leach to the water table.

To reduce the potential for release, line any engineered structures that include a sump to collect spilled liquid or drainage water. Do not pour the rinse water (rinsate) down a dry well.

Minimize the risk of contamination by following these basic guidelines:

- Mix pesticides at least 150 feet downslope of a wellhead.
- Do not mix pesticides on a gravel driveway or other surface that will allow spills to move quickly through the soil.
- If you are using a restricted-use or limited-use pesticide, a trained and licensed applicator must supervise the mixing and application.
- Consider using a closed handling system, which is a system designed by the manufacturer to prevent the pesticide from contacting people or the environment. The system will transfer the pesticide directly from a storage container to the application equipment.

The label is the authoritative source of information on best practices for mixing, loading, and storing a product.
7. Do you fill the sprayer tank directly from a water well?

Avoid filling a sprayer tank directly from your water well. Instead, use a mobile tank to transport the water to the mixing and loading site. Or, fill the sprayer tank from a faucet away from the well to reduce the risk of contaminating your water supply.

8. Do you fill a sprayer tank with a hose that does not have a check valve, or put the hose in the tank below the liquid line during filling?

Backflow is the reverse flow of a liquid caused by the sudden creation of a vacuum, much like sucking water through a straw. If a well pump shuts off while you are filling a pesticide sprayer, and the end of the hose is submerged in the pesticide mixture, backflow can siphon the mixture backward through the hose and into your well.

Install anti-backflow devices on all faucets. If you use a faucet without a backflow prevention device, maintain at least a 6-inch air gap between the end of the hose and the top of the sprayer tank.

9. Do you wash out the sprayer tank or dump the rinse water less than 150 feet from a water well?

Rinse the sprayer in the field, where there is little risk of contaminating your well with rinsate. When possible, use the rinsate to mix the next load. Spray the last rinsate load on the appropriate crop.

10. Do you ever dispose of partially filled pesticide containers on your property?

Significant amounts of pesticide can leak into the soil from a partially filled container. Follow these guidelines to reduce the chances of accidentally releasing pesticides into the environment:

- Buy products in returnable containers, and return them to the dealer whenever possible.
- Dispose of non-returnable containers at a permitted landfill.
- Because pesticide residue can be difficult to remove from application equipment, pressure-rinse or triple-rinse containers immediately after use. This rinse water can be reused in mixing subsequent loads.
- Do not bury or burn pesticide bags or containers.
- Participate in the Environmental Protection Agency’s banned pesticide buy-back program. For information on whether the program is available in your area, contact the local county Extension agent.

The product label explains how to dispose of containers and excess chemicals properly.

Publications on best management practices for specific crops, pests, and pesticides are posted on the AgriLife Extension Service Bookstore at [http://agrilifebookstore.org/](http://agrilifebookstore.org/).

For more information


Texas Department of Agriculture: [http://www.texas-agriculture.gov/RegulatoryPrograms/Pesticides](http://www.texas-agriculture.gov/RegulatoryPrograms/Pesticides)

Texas Department of Licensing and Regulation: [http://www.license.state.tx.us/index.htm](http://www.license.state.tx.us/index.htm)


Texas Well Owner Network: [http://twon.tamu.edu](http://twon.tamu.edu)

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During severe droughts, people rely heavily on groundwater—the water held underground in aquifers. An aquifer can become depleted when more water is pumped out of it than is replenished by rainfall or other water sources. If the water level drops below the point of your pump intake, the pump could be damaged.

To protect your well equipment and water supply when the water level is low, follow these practices:

• Monitor your pump. Water levels that are low or recover slowly will make your pump cycle on and off rapidly and burn out the motor. Low water levels can also cause submersible pumps to overheat and damage PVC drop-pipes. If your pump is rapidly cycling on and off, turn it off. You may need to reduce your future pumping rate or lower the pump if the water level does not rise.

• If your pump sounds like it is sucking air, let it rest. When the water level drops, your well may begin to produce sand and air bubbles. Indications that the well may go dry include sand in the toilet tank and milky-looking tap water that clears after a short time.

• Depending on the depth of the well, you may be able to lower the pump. This procedure will require help from a licensed pump installer. The Texas Department of Licensing and Regulation maintains a list of licensed well drillers and pump installers at [http://www.license.state.tx.us/LicenseSearch/](http://www.license.state.tx.us/LicenseSearch/).

• Have the well water tested regularly during and after a drought. As the water level falls, air will enter the aquifer and change its chemistry. Oxygen in the aquifer will increase concentrations of naturally occurring contaminants such as arsenic. If your well normally contains low concentrations of arsenic, expect it to increase during a drought. The concentrations of other contaminants, such as total dissolved solids or salinity, may also change.

• Add a pumped-water storage tank if you have a low-yielding well. Adding a storage tank will help meet peak demand when your water needs exceed the pump's capacity.

• Work with your neighbors to schedule heavy water use. If everyone does laundry on Saturday, all the wells may go dry on Sunday. Distribute heavy water use over the week to help individual wells recover and to maintain the water supply in your area.

• Conserve water to preserve your well’s resources during drought.
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Animal Manure Storage to Protect Groundwater

If not managed properly, animal manure and process-generated wastewater can contaminate groundwater, which is the underground water that replenishes wells and springs. It is the source of drinking water for many Texans.

Millions of gallons of groundwater may be located under the typical home site, farm, or ranch. This water can be polluted by materials from fuel tanks, livestock pens, septic systems, and storage areas for manure, wastewater, fertilizers, or pesticides.

The management decisions you make on your property can significantly affect the quality of your drinking water and your family’s health. These decisions can also affect your potential legal liability and the value of your property.

To protect your groundwater supplies, store manure and wastewater in an environmentally sound manner until you can apply it to land for crop production. The safety of storing large amounts of manure in one place for extended periods depends on:

- The physical and chemical characteristics of the soil in the storage area, as well as those of the geologic materials underground
- The design and construction of the storage site, including the control of potential drainage and seepage

An animal feeding operation is a lot or facility where animals are held and fed for a total of 45 days or more in any 12-month period. Any feeding operation can qualify as a concentrated animal feeding operation (CAFO) if it significantly pollutes water resources. To operate, CAFOs must have permits from the Texas Commission on Environmental Quality (TCEQ).

CAFOs are defined according to the type and number of animals on a site. If you have more than 150 horses, 300 head of beef cattle, or 200 head of dairy cattle, contact the TCEQ to determine if you need a water-quality protection permit.

The requirements may differ by county; for example, Bosque, Comanche, Erath, Hamilton, Hopkins, Johnson, Rains, and Wood Counties allow fewer livestock on site than do other Texas counties.

Texas law requires that a water well-head be separated from any livestock yard, feeding operation, or manure storage and...
Table 1. Questions to help landowners determine whether the storage of livestock manure may be threatening their well water.

<table>
<thead>
<tr>
<th>YES</th>
<th>NO</th>
<th>QUESTIONS</th>
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<tbody>
<tr>
<td>☐</td>
<td>☐</td>
<td>1. Do you store animal manure and wastewater on your property for more than 90 days?</td>
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<tr>
<td>☐</td>
<td>☐</td>
<td>2. Do you store manure and wastewater on your property for shorter periods (30 to 90 days)?</td>
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<td>3. Do you store manure and wastewater closer than 150 feet from a water well?</td>
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<td>4. Do you use lagoons or basins for manure and wastewater storage?</td>
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<td>5. Do you know how to have manure tested and how to calculate the appropriate land application rates?</td>
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<tr>
<td>☐</td>
<td>☐</td>
<td>6. Are any abandoned manure and wastewater storage facilities on your property?</td>
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</tbody>
</table>

use area by at least 150 feet. However, to protect your well water, also adopt management practices that further reduce the potential for contamination.

The questions in Table 1 may help you identify potential risks associated with storing animal manure and wastewater. Many of these situations can lead to contamination of your drinking water.

If you answer yes or do not know the answer to any question, you may have a high-risk situation on the property. Information on how to address each question follows.

1. **Do you store animal manure and wastewater on your property for more than 90 days?**

   Animal manure can be stored in solid, slurry, or liquid states:
   - **Solid** manure is stacked against walls and on slabs.
   - **Slurry** is pumped into containment areas.
   - **Liquid** manure is held in tanks or manure storage ponds or lagoons, where some manure solids may settle out and accumulate in the bottom as sludge.

   Liquid and slurry storage systems are self-contained. Manure and wastewater can contaminate groundwater if the storage systems are not structurally sound or are not emptied when needed.

   Liquid storage systems use pumps and pipes or flushed manure channels to convey manure and wastewater from the barn and alleys to the storage structure. These must be installed properly and main-

tained carefully to ensure that they do not leak or overflow.

   Each time a steel or concrete structure is emptied, carefully check it for cracks or leaks in seals that should be watertight. Repair all damage immediately. Likewise, check the embankments and bottom of emptied manure storage basins to make sure that the liner materials are not, damaged, cracked or eroded.

   Although seepage from in-ground manure and wastewater storage facilities is not always easy to recognize, there are some telltale signs. A pit may be leaking if:
   - Liquids must be added to the wastewater before it can be agitated and pumped. A crust should form over a liquid storage pit, which will minimize evaporation.
   - The pit does not fill to the level that it was designed to reach in a specific period. For example: A pit was designed to store manure from a set number of animals for 120 days. It may be leaking if it receives the designated manure amounts but does not fill to the design level in 120 days.

   Some solid manure facilities are designed to allow seepage from the stack. They must collect and treat the waste seepage. Do not use them on sites with coarse-textured soils, fractured bedrock, or shallow water tables.

   The best way to handle seepage is to channel it into a watertight holding pond or storage tank. If a holding pond cannot be built, another option is to erect a roof over the manure storage structure to keep
rain out of the stack. Roofed storage systems must have extra bedding to absorb and retain the liquid part of the manure.

2. **Do you store manure and wastewater on your property for shorter periods (30 to 90 days)?**

   Short-term (usually 30 to 90 days) storage facilities allow producers to hold manure and wastewater when:
   - Bad weather makes applying the manure unfeasible
   - Crops are growing and the land is unavailable for applying manure
   - Not enough land is available to handle frequent hauling and utilization of manure
   - There is not enough time to apply all the manure

   Stacking manure in or near fields even short-term is not recommended. No matter how it is done, the exposed storage can contaminate surface water and groundwater. If you stack manure in fields often, build a short-term storage facility.

   Another disadvantage of short-term storage is that the manure must be handled twice. However, short-term storage structures can be designed to facilitate handling as well as effectively protect surface water and groundwater.

   To store manure for extended periods, open housing such as a pole shed is often used. The roof will keep rain off the manure. These sheds are relatively safe for water quality if:
   - They are protected from surface water runoff
   - Enough bedding is provided to absorb liquids and reduce seepage
   - They are cleaned as often as possible

   In bad weather or busy work periods, do not scrape the manure into piles in the animal lot. It poses risks to herd health and water sources. Instead, haul the manure to a long-term storage facility.

   Compared to short-term techniques, long-term storage practices and structures can better protect water quality and handle unplanned events such as major storms.

3. **Do you store manure and wastewater closer than 150 feet from a water well?**

   Texas regulations require that all animal manure and wastewater storage facilities be at least 150 feet from a water well. However, to keep the farm’s water supply safe, a separation distance of 250 feet or more from the well is strongly recommended.

   For temporary manure stacks and earthen storage facilities, the minimum separation distance should be at least 250 feet.

   Make every effort to meet the current recommendations and exceed the regulations whenever possible.

4. **Do you use lagoons or basins for manure and wastewater storage?**

   The TCEQ implements the regulations governing CAFOs. Even if your lagoons or holding ponds are not subject to CAFO rules, following them can protect your groundwater from seepage.

   TCEQ regulations require that CAFO wastewater retention facilities be made of compacted or original soil that allows less seepage than would 1.5 feet of soil that is clayey and has a hydraulic conductivity of \(1 \times 10^{-7}\) cm/sec, as designed and documented by a licensed Texas professional engineer.

   Also, fence any animal manure and wastewater storage structures that may create a safety hazard for animals and humans.

   For more information on lagoon management, see the Texas A&M AgriLife Extension Service publications *Proper Lagoon Management to Reduce Odor and Excessive Sludge Accumulation* (E-9) and *Closure of Lagoons and Earthen Manure Storage Structures* (B-6122).

5. **Do you know how to have manure tested and how to calculate the appropriate land application rates?**

   If managed properly, manure can safely be applied to the land to provide nutrients for crops. Apply solid and liquid manure to land using rates and methods that prevent it from polluting surface water and groundwater.

   Stored manure can be easily tested to determine its nutrient levels. When taking samples of manure, make sure that they are representative of the source. Collect and thoroughly mix at least 10 subsamples to produce one composite sample for analysis.

   Have the soil and manure analyzed so you can provide the nutrients that the crop needs. Do not apply more manure than the crop needs. Credit the manure nutrients in the fertilizer program for the field.
Instructions for collecting soil samples are available in the Texas A&M AgriLife Extension Service publication titled, *Testing Your Soil: How to Collect and Send Samples* (E-534).

For more information, see the AgriLife Extension publications *Managing Crop Nutrients through Soil, Manure and Effluent Testing* (E-536) and *Using Animal Manure and Wastewater for Crops and Pastures: Know and Take Credit for your N, P and K* (E-47).

6. Are any abandoned manure and wastewater storage facilities on your property?

Completely empty all abandoned storage structures. Remove the liners of earthen manure and wastewater storage facilities to a depth of about 2 feet and spread them over disposal areas. Fill and level the remaining hole.

Also remove the manure packs from structures and lots that are no longer used, and apply the manure to land at agronomic rates. If manure is stacked in fields, remove it as soon as conditions permit.

Contaminants in the well water may be odorless, tasteless, and invisible to the naked eye. To detect any contamination, have your well water tested every year. Have it analyzed for nitrates and *E. coli* contamination, the most likely constituents to pollute groundwater from manure handling. The Texas Well Owner Network: Texas Well Owner's Guide to Water Supply recommends well water treatment options if water quality has been compromised.

You can be fined for any significant surface water or groundwater contamination, and the TCEQ could require corrective measures. Contact the local Natural Resources Conservation Service office or your county Extension agent for information about local ordinances and state regulations.

**Summary**

Follow these management practices to help prevent stored animal waste from contaminating your groundwater:

- Store manure and wastewater in facilities built according to accepted engineering standards.
- Empty liquid manure pits often enough to prevent waste from flowing over the top.
- Check pipes, manure pits, storage structures, and other storage or conveyances for signs of leaks or deterioration.
- Make sure that your manure storage facility is at least 150 feet (preferably 250 feet) from any water well, stream, or pond.
- Calculate your manure and wastewater application rates according to the results of soil and manure tests and the needs of the crop to be grown.

**For more information**


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Photo by Kristine Uhlman, former Texas A&M AgriLife Extension Program Specialist-Water Resources

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