NEW JERSEY
FARM-A-SYST
A FARMSTEAD WATER QUALITY ASSESSMENT SYSTEM

#4 Fact Sheet: Reducing the Risk of Groundwater Contamination by Improving Petroleum Product Storage

1. Storage tank location

Large numbers of underground storage tanks exist in New Jersey that federal and state regulations do not cover. Commonly, this group consists of residential heating oil tanks, non-residential tanks of less than 2000 gallons for storing heating oil, and farm or residential tanks of less than 1100 gallons storing motor fuel. State and federal regulations apply to the underground storage of heating oil for non-residential onsite consumptive use if the aggregate capacity is over 2000 gallons, motor fuel tanks over 1100 gallons for farm or residential use, and the underground storage of hazardous substances and hazardous waste, including waste oil. **This publication only addresses *unregulated* storage tanks.** Whether your tank is regulated or not, it is important to comply with recommended groundwater protection practices.

The most important aspect of your liquid petroleum storage tank location is how close it is to your drinking water well. It is recommended that petroleum storage tanks be located at least 100 feet from a drinking water well.

Even though diesel fuel and fuel oil are more dense than gasoline and move more slowly through the soil, they, too, will eventually reach groundwater.

Every site has unique geologic and hydrologic conditions that can affect groundwater movement. How quickly the petroleum product reaches groundwater will also depend upon local soils. The more permeable the soil (sands and gravels, for example), the faster the rate of downward movement to groundwater.You may choose to locate a new tank more than 100 feet away from your well, to provide reasonable assurance that subsurface flow or seepage of contaminated groundwater will not reach your well. If possible, the tank should also be located downslope from the well. Figure 1 illustrates petroleum product seepage into soils.

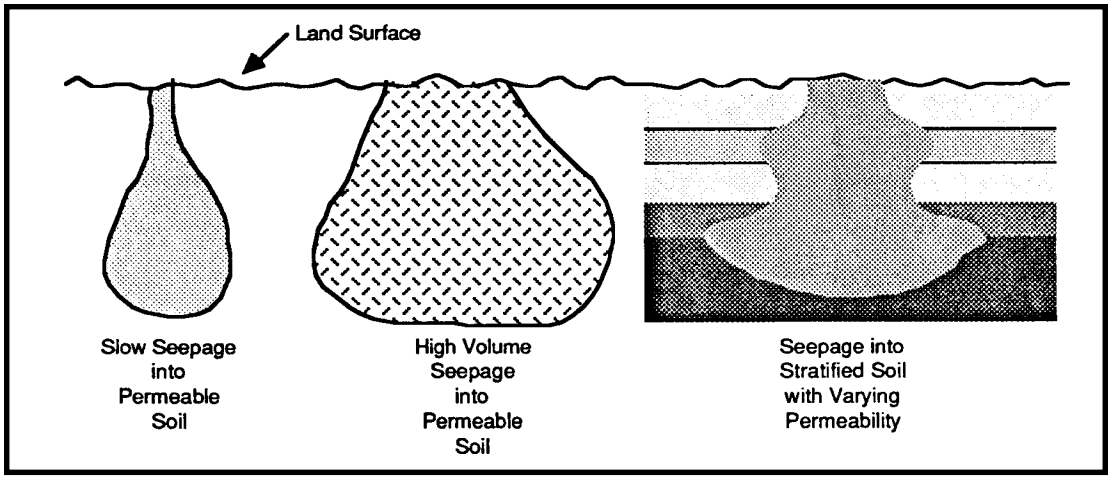

Figure 1: Petroleum product seepage into soils. *Source: Underground Tank Corrective Action Technologies, EPA/625/6-87-015, January 1987.*

For glossary, see page 2 of Worksheet #4.

If you have an above-ground tank, follow existing regulations for underground storage tanks as a guide. To protect against explosion and fire, do not locate tanks (especially above-ground tanks) closer than 25 feet to existing buildings. Previous regulations for siting above-ground storage tanks were concerned more with the explosion potential of tanks than the groundwater pollution potential. State agencies have revised above-ground storage tank regulations to better protect groundwater.

New storage tank location

Along with maintaining adequate distance from your drinking water well, choose a location for a new tank based on the following considerations:

- **Soil characteristics.** Highly corrosive clays, wet soils, cinders and acid (low pH) soils can significantly speed up the rate of corrosion of underground metal tanks and piping. Using industry recommended backfill, such as pea gravel or 1/2" to 1/4" crushed rock or clean washed sand during installation can decrease the negative effects of surrounding soils.

- **Soil stability.** Assess the ability of the underlying soil to support both underground and above-ground tanks. For special tank locations, such as hillsides, be sure to properly anchor and hold tanks in place. Be sure that pipes cannot twist or break if the tank is bumped or disturbed. Connect piping to tanks using "flexible connectors" to reduce chance of leakage.

  Regardless of soil conditions, locate above-ground tanks over an impermeable liner made of concrete or one of the newer synthetic fabrics (required on farms for tanks with capacities of greater than 1100 gallons). Build a collection device for spills.

- **Current and previous land use.** Sites that contain abandoned pipes and tanks, agricultural drainage tiles or waste materials pose special installation problems. Any metal already in the ground at your chosen site will increase corrosion rates for the new tank.

- **Traffic.** Assess traffic patterns around the tank. Determine whether the location of the tank or dispenser will block movement of farm vehicles during refueling or cause special problems if any work needs to be done on the tank. Protect piping from collisions with farm and fuel vehicles.

- **Depth to groundwater.** Floodways or areas where the water table is close to the surface are poor locations for storage tanks. Tanks placed in such areas require special installation. To reduce pollution potential, an above-ground tank may be preferable to an underground tank.

2. Tank design and installation

Whenever you install a fuel storage tank, carefully follow the manufacturer's recommended practices for installation. Proper installation is one sure way to minimize the leaking potential of the tank or the piping connected to it. Even scratches in a metal tank caused by careless installation can increase corrosion and tank deterioration.

Underground tanks

It is recommended that all new underground petroleum storage tanks and related piping must be constructed of non-metallic materials such as fiberglass reinforced plastic or steel wrapped with polyethylene, or have corrosion protection. Double-walled tanks and piping can provide added protection at a higher cost. Methods of corrosion protection include interior lining and "sacrificial anodes."

A sacrificial anode is a special material connected to the tank with a greater tendency to corrode than the tank material. The anode will typically protect the tank for up to 30 years although tanks may fail sooner depending on the soil conditions. Interior lining is made of noncorrosive synthetic materials. Interior lining is unaffected by small corrosion holes in the tank shell. Anytime metal piping is use with a metal tank, the piping should be electrically isolated from the tank using dielectric isolation bushings. Metal piping should also be corro sion protected.

Other recommended protective equipment includes spill and overfill protection and daily or continuous discharge monitoring systems. Spill protection typically consists of a catch basin for collecting spills when the tank is filled. Overfill protection is a warning or prevention of an overfill such as an automatic shutoff or buzzer. Spill and overfill protection are important; they can prevent a number of small releases over a long period of time from polluting the groundwater.

Above-ground tanks

Construction codes for above-ground tank installation seek to reduce the potential for both pollution and fire. Requirements include 1) enclosing the tank within a secure 6-foot fence or well-ventilated building constructed of noncombustible material; and 2) constructing a fire wall between the fuel dispensing area and the tank.

To decrease pollution potential, place farm tanks within a secondary containment structure consisting of a dike and a pad (required for tanks with capacity greater than 1100 gallons). All piping should be above ground within the dike or may go over the dike wall, but it must be placed below ground within 10 feet of the dike wall. Above-ground piping must be made of steel and coated to prohibit corrosion. Any below-ground piping may be either steel or fiberglass, but steel must be coated and cathodically protected. Above ground storage tanks are now manufactured which are secondarily contained - fulfilling the requirements for a contained area and a firewall.

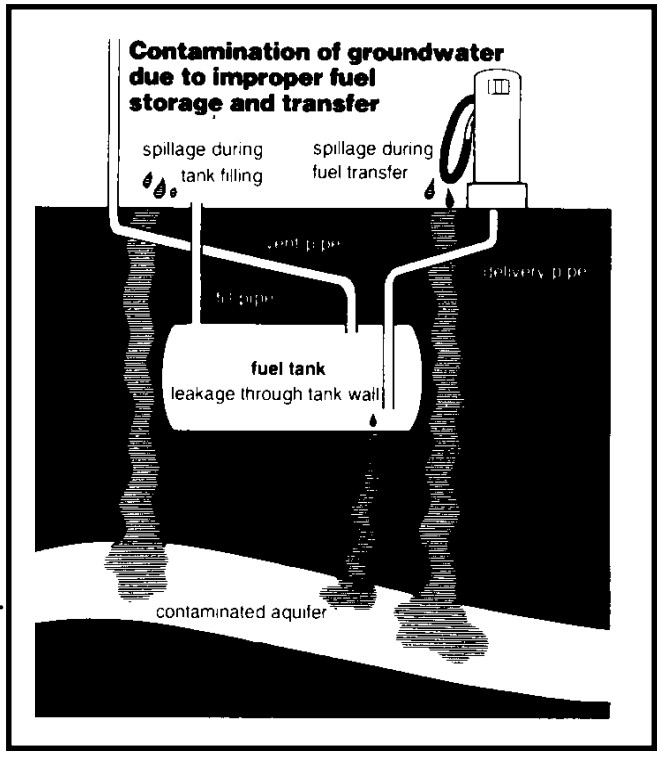

Figure 2: Contamination of groundwater due to improper fuel storage and transfer. *Source: Handling and Underground Storage of Fuels, Cooperative Extension Service, Michigan State University, Extension Publication WQ01. Reprinted February 1986.*

3. Monitoring

Leak detection is essential for the identification of a leak and the minimization of contamination of ground and surface waters. Rapid detection hastens cleanup operations and reduces owner liability and costs. Select the tank location carefully to ensure ease of installation and reliability of chosen leak-detection methods. Test the tank and piping periodically for leaks, and measure the tank inventory on a monthly (or more frequent) basis to help detect leaks before major problems develop. Some signs of a leaking tank system are obvious without any form of monitoring. These signs include: unusual amounts of water in the tank, unusual odors in water supplies, petroleum products in basements or drainage areas in homes, dead or stressed vegetation, and an unusual increase in fuel usage.

Since cleanup of gasoline leaks is always costly and often not totally effective, it is important to constantly monitor underground tank systems containing petroleum products. If you already have a petroleum storage tank on your farm, be especially aware of the age of your tank as well as the need to establish a leak-detection program. Figure 2 shows how groundwater can be contaminated by underground tanks.

> Since most tanks used on farmsteads are bare steel, tank corrosion or piping problems will cause leaks sooner or later. If your tank is more than 20 years old, or if you don't know its age, make a special effort immediately to determine whether leaks exist.

You can test tank integrity by such methods as precision testing/tightness testing and volumetric analysis. It is recommended that tightness tests be performed on new installations and on unregulated tank systems periodically, especially those in sensitive areas and for older tanks.

Even when a tank has been tested and proven tight, good practice requires that you have a method for regularly detecting leaks.

> You may install such internal or external monitoring methods as groundwater monitoring wells, vapor monitoring, automatic tank gauging or other methods.
>
> Measuring tank inventories is an inexpensive and easy way to help detect leaks. Leakage is apparent when there is any decrease in level over time without any withdrawal of fuel or an increase in water in the tank. While inventory measurement will not detect very small leaks, it will at least provide a warning that further investigation may be necessary.
>
> If you use a measuring stick to measure tank liquid level, be sure that the stick does not puncture or damage the bottom of the tank. New tanks should have a "striker plate" used for "sticking" to prevent damage.

The closer the tank is to the farmstead's drinking water well, the more important it is to quickly identify a leaking tank system.

Leaks and spills

If you find a leak or spill from any tank—whether it be above or below ground, or even a vehicle-mounted tank—state law requires that you immediately notify the 24-hour hotline of New Jersey Department of Environmental Protection (609-292-7172), your local fire department, and your local health department. By law, unreported discharges are liable for penalties. Take whatever actions are necessary to remedy the problem, according to recommendations you receive when you report the spill or leak.

4. Tank closure

Tanks no longer in use can cause problems for owners and operators many years later. They will continue to corrode and, if they still contain gas or oil, will likely contaminate groundwater.

> Try to determine the location of any unused tanks on your property. Also, try to find out whether the tanks still hold product or have holes. According to the National Fire Prevention Code and New Jersey Uniform Construction code, unregulated, nonoperational underground storage can be left in the ground if properly abandoned. Local construction code officials should be contacted prior to closure of a tank for information on local ordinances and permits. Proper abandonment of the tank includes draining the tank and piping of product, cleaning to remove residues and degassing. If left in place, the abandoned tank should be filled with an inert substance, such as sand, foam, or a cement slurry. However, it is recommended that tank owners choose tank removal rather than abandonment in place.

Before pulling a tank, always notify your local fire department at least one month before you have the tank pulled, to ensure that precautions are taken to prevent an explosion or other problem. Deaths have occurred due to improper closure.

If you are concerned that your unused tank has been leaking, consult the NJDEP - Bureau of Field Operations to determine if further investigation is warranted. If there is groundwater pollution in your area, your neighbors will be sure to suspect the tank as its cause.

CONTACTS AND REFERENCES

Who to call about...

EPA regulations

EPA Hotline, 1-800-424-9846

Petroleum product storage, tank testing methods and suppliers

NJDEP - Bureau of Field Operations, CN 028, 401 E. State Street, Trenton, NJ 08625, (609) 633-0708.

Petroleum product spills

NJDEP 24-hour Environmental Action Hotline, (609) 292-7172.

The following list of NJDEP regional offices can provide information and advise on the managment of underground storage tanks. NJDEP regional offices:

Northern district (Hunterdon, Morris, Passaic, Somerset, Sussex, and Warren counties): 1259 Rt. 46, Bldg 2, Parsippany, NJ 07054, (201) 299-7570.

Metro district (Bergen, Essex, Hudson, and Union counties): 2 Babcock Place, West Orange, NJ 07052, (201) 669-3960

Central district (Burlington, Mercer, Middlesex, Monmouth, and Ocean counties): 300 Horizon Center, Route 130 South, Robbinsville, NJ 08691, (609) 426-0700.

What to read about...

Publications are available from sources listed at the end of the reference section. (Refer to number in parentheses after each publication.)

Tank design, installation and site selection

Underground Storage Tanks. Rutgers Cooperative Extension Fact Sheet 522. (1)

Petroleum product storage and handling

Handling and Underground Storage of Fuels. 1986. Cooperative Extension Service, Michigan State University. Extension Bulletin WQ01. (4)

Tank regulations, tank testing, tank closure, financial responsibilities

Groundwater Protection Practices for Unregulated Underground Storage Tanks. 1992. NJ Department of Environmental Protection. (3).

UST Inventory Control and Manual Tank Gauging. 1993. US Environmental Protection Agency. EPA/908-B-93-001. (2).

Publications available from...

1. Your county offices of Rutgers Cooperative Extension (found in the blue pages of your phone book) or the Publications Distribution Center, Cook College, Rutgers University, PO Box 231, New Brunswick, NJ 08903, (732) 932-9762.

2. Public Information Center, U.S. Environmental Protection Agency, 401 M Street S.W., Washington, D.C., 20460., (202) 260-2080.

3. New Jersey Department of Environmental Protection, Bureau of Water Supply Planning, CN 029, Trenton, NJ 08625, (609) 633-1179.

4. Michigan State University Cooperative Extension Service, MSU Bulletins, 10B Agricultural Hall, Michigan State University, East Lansing, MI, 48824-1039, (517) 355-0240.

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The New Jersey Farmstead Assessment System is a cooperative project of the USDA Natural Resources Conservation Service, Rutgers Cooperative Extension, and New Jersey Department of Environmental Protection.

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Written by Pat Walsh, Department of Agricultural Engineering, University of Wisconsin-Madison, and University of Wisconsin-Extension, Cooperative Extension.

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Technical review provided by Kevin Kratina, Bureau Chief, Bureau of Underground Storage Tanks, New Jersey Department of Environmental Protection.

While technical reviewers provided guidance in copy revisions and assisted in assuring accuracy of content, the views expressed in this publication are those of the author and do not necessarily reflect the views of either the technical reviewers or the agencies they represent.

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NJFAS–4F *Reducing the Risk of Groundwater Contamination by Improving Petroleum Product Storage* 12/95

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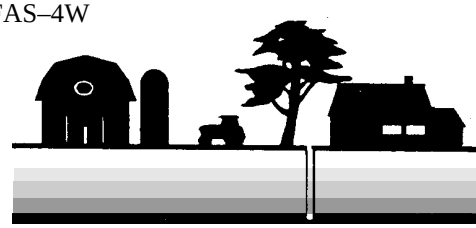

NEW JERSEY
FARM-A-SYST
A FARMSTEAD WATER QUALITY ASSESSMENT SYSTEM

#4 Worksheet: Assessing the Risk of Groundwater Contamination from Petroleum Product Storage

Why should I be concerned?

Above-ground and underground storage of liquid petroleum products such as motor fuel and heating fuel presents a threat to public health and the environment. Nearly one out of every four underground storage tanks in the United States may now be leaking, according to the U.S. Environmental Protection Agency. If an underground petroleum tank is more than 20 years old, especially if it's not protected against corrosion, the potential for leaking increases dramatically. Newer tanks and piping can leak, too, especially if they weren't installed properly.

Even a small gasoline leak of one drop per second can result in the release of about 400 gallons of gasoline into the groundwater in one year. Even a few quarts of gasoline in the groundwater may be enough to severely pollute a farmstead's drinking water. At low levels of contamination, fuel contaminants in water cannot be detected by smell or taste, yet the seemingly pure water may be contaminated to the point of affecting human health.

Preventing tank spills and leaks is especially important because of how rapidly gasoline, diesel and fuel oil can move through surface layers and into groundwater. Also, vapors from an underground leak that collect in basements, sumps or other underground structures have the potential to explode. Selling property with an old underground tank may also be difficult.

Petroleum fuels contain a number of potentially toxic compounds, including common solvents, such as benzene, toluene and xylene, and additives, such as ethylene dibromide (EDB), methyl tertiary butyl ether (MTBE) and organic lead compounds. EDB is a carcinogen (cancer-causer) in laboratory animals, and benzene is considered a human carcinogen.

This worksheet focuses on storage of gasoline, kerosene and liquid heating fuels. It does not apply to LP (liquid propane) gas, since leaks vaporize quickly and do not threaten groundwater.

The goal of Farm•A•Syst is to help you protect the groundwater that supplies your drinking water.

How will this worksheet help me protect my groundwater?

- It will take you step by step through your petroleum product storage practices.
- It will rank your activities according to how they might affect the groundwater that provides your drinking water supplies.
- It will provide you with easy-to-understand rankings that will help you analyze the "risk level" of your petroleum product storage practices.
- It will help you determine which of your practices are reasonably safe and effective, and which practices might require modification to better protect your drinking water.

How do I complete the worksheet?

Follow the directions at the top of the chart on the next page. It should take you about 15-30 minutes to complete this worksheet and figure out your ranking.

Information derived from Farm•A•Syst worksheets is intended only to provide general information and recommendations to farmers regarding their own farmstead practices. It is not the intent of this educational program to keep records of individual results.

Glossary

Petroleum Product Storage

These terms may help you make more accurate assessments when completing Worksheet #4. They may also help clarify some of the terms used in Fact Sheet #4.

Cathodic protection: One of several techniques to prevent corrosion of a metal surface by reversing the electric current that causes corrosion. A tank system can be protected by sacrifical anodes or impressed current. (See **sacrificial anodes** and **impressed current**.)

Corrosion: Deterioration of a metallic material ("rust") due to a reaction with its environment. Damage to tanks by corrosion is caused when a metal underground tank and its underground surroundings act like a battery. Part of the tank can become negatively charged, and another part positively charged. Moisture in the soil provides the connecting link that finally turns these tank "batteries" on. Then, the negatively charged part of the underground tank system—where the current exits from the tank or its piping—begins to deteriorate. As electric current passes through this part, the hard metal begins to turn into soft ore, holes form, and leaks begin.

Corrosion protection: One method of corrosion protection is cathodic protection. Steel tanks can be protected by coating them with a corrosion-resistant coating combined with "cathodic" protection. Steel underground tanks can also be protected from corrosion if they are bonded to a thick layer of noncorrosive material, such as fiberglass-reinforced plastic. Also, the corrosion problem can be entirely avoided by using tanks and piping made completely of noncorrosive material, such as fiberglass.

Galvanized: The result of coating an iron or steel structure with zinc. Galvanized materials do not meet corrosion protection requirements.

Impressed current: This protection system introduces an electric current into the ground through a series of anodes that are not attached to the underground tank. Because the electric current flowing from these anodes to the tank system is greater than the corrosive current attempting to flow from it, the underground tank is protected from corrosion.

Interior lining: A lining for petroleum storage tanks made of noncorrosive synthetic materials that can be effective in protecting metal tanks.

Inventory control: Measuring and comparing the volume of tank contents regularly with product delivery and withdrawal records to help detect leaks before major problems develop.

Sacrificial anodes: Pieces of metal attached directly to an underground tank that are more electrically active than the steel tank. Because the anodes are more active, electric current runs from the anodes rather than from the tank. The tank becomes the cathode (positive electrode) and is protected from corrosion. The attached anode (negative electrode) is "sacrificed" or consumed in the corrosion process.

Secondary containment: A system such as a sealed basin and dike that will catch and hold the contents of a tank if it leaks or ruptures.

Soil permeability: The quality that enables soil to transmit water or air. Low permeability soils have fine-textured materials like clays that permit only slow water movement. Moderate or high permeability soils have coarse-textured materials like sands that permit rapid water movement.

Spill and overfill protection: Spill protection usually consists of a catch basin for collecting spills when the tank is filled. Overfill protection is a warning or prevention of an overfill, such as an automatic shutoff or buzzer. These precautions can prevent a number of small releases over a very long period of time from polluting the groundwater.

Tank tightness testing: A procedure for testing a tank's ability to prevent accidental release of any stored substance into the environment, or intrusion of groundwater into an underground tank.

Worksheet #4

Petroleum Product Storage: Assessing Drinking Water Contamination Risk

1. Use a pencil. You may want to make changes.
2. For each category listed on the left that is appropriate to your farmstead, read across to the right and circle the statement that **best** describes conditions on your farmstead. (Skip and leave blank any categories that don't apply to your farmstead.)
3. Then look above the description you circled to find your "rank number" (4, 3, 2 or 1) and enter that number in the blank under "your rank."
4. Directions on overall scoring appear at the end of the worksheet.
5. Allow about 15-30 minutes to complete the worksheet and figure out your risk ranking for petroleum product storage practices.

	LOW RISK (rank 4)	LOW-MOD RISK (rank 3)	MOD-HIGH RISK (rank 2)	HIGH RISK (rank 1)	YOUR RANK
LOCATION (all tanks)					
Position of tank in relation to drinking water well	Tank downslope more than 100 feet from well in medium- or fine-textured soils (silt loam, loam, clay loams, silty clay) with low permeability.*	Tank downslope more than 100 feet from well in coarse-textured soil (sands, sandy loam) with high permeability.*	Tank at grade or upslope more than 100 feet from well in medium- or fine-textured soils (silt loam, loam, clay loams, silty clay) with low permability.*	Tank at grade or upslope less than 100 feet from well in coarse-textured soil (sand, sandy loams) with high permeability.*	____
Tank location and local land use (leakage potential)	Well-drained soils. Water table always beneath tank. Above-ground tank more than 50 feet from buildings.	Moderately well-drained soils. Only occasionally high water table.	Located more than 50 feet from buildings. Medium- or fine-textured soils (silt loams, loam, clay loams, silty clay) saturated seasonally.	Located near buildings and in area with fine-textured soils (clay loams, silty clay) often saturated.	____
DESIGN AND INSTALLATION (all tanks)					
Type and age of tank/corrosion protection	Non-metallic tank, tank clad with non-corrosive material or tank protected from rust by cathodic protection.	Steel tank less than 20 years old, coated with paint or asphalt.	Coated steel tank 20 or more years old OR bare steel tank less than 20 years old.	Bare steel tank 20 or more years old.	____
Spill and tank overfill protection	Impermeable catch basin plus automatic shutoff.	Impermeable catch basin plus overfill alarm.	Impermeable catch basin or concrete catch pad.	No protection.	____

* Low permeability soils, like clay, allow water to flow through slowly. High permeability soils, like sand and gravel, allow much faster water movement.

	LOW RISK (rank 4)	LOW-MOD RISK (rank 3)	MOD-HIGH RISK (rank 2)	HIGH RISK (rank 1)	YOUR RANK
DESIGN AND INSTALLATION (all tanks) (cont.)					
Piping	Piping protected from rust by cathodic protection and electrically isolated from tank, sloped back to tank. Check valve at pump (not at tank).	Piping galvanized but not electrically isolated from tank. Pipe drains back to tank. Check valve at pump.	Pipe galvanized, not electrically isolated or bare. Piping sloped back to tank, but check valve is located at tank (foot valve).	Piping and tank not isolated and of dissimilar metallic materials or unisolated pipe bare, cannot drain freely to the tank or all pressure pipe systems.	_____
Tank installation	Installed by state-certified installer and installed according to recommendations provided with new tank by seller.	Installed according to recommendations provided with new tank by seller.	No information on installation.	Installed without backfill, setback, secondary containment, anchors and other protections, or by untrained individual.	_____
DESIGN AND INSTALLATION (above-ground tanks only)					
Tank enclosure	Tank surrounded by 6-foot tall noncombustible building or fence with lock. Building well-ventilated. Fire-wall in place if setbacks do not conform to code.	Tank surrounded by low fence with lock. Fire wall in place if setbacks do not conform to code.	Tank surrounded by low fence. No lock. No firewall.	No enclosure.	_____
Secondary containment	Tank placed within concrete or synthetic dike with pad able to hold 125% of tank capacity.	Tank placed within dike and pad made of low permeability soils*, able to hold 125% of tank capacity.	Tank placed on pad.	No secondary containment.	_____

* Low permeability soils, like clay, allow water to flow through slowly. High permeability soils, like sand and gravel, allow much faster water movement.

	LOW RISK (rank 4)	LOW-MOD RISK (rank 3)	MOD-HIGH RISK (rank 2)	HIGH RISK (rank 1)	YOUR RANK
MONITORING (all tanks)					
Tank integrity testing and leak detection monitoring	Regular (monthly) leak monitoring.	Daily inventory control and annual tank tightness testing.	Occasional inventory control and periodic tank tightness testing.	No inventory control, testing or monitoring.	____
TANK CLOSURE (underground tanks)					
Unused tank	Tank taken from ground. Excavation checked for evidence of contamination.	Tank filled with inert material and excavation checked for evidence of leaking.	Tank removed or filled with inert material. Excavation not checked for contamination.	Tank left in ground and not properly abandoned.	____

TOTAL ☐

Use this total to calculate risk ranking on back page of worksheet.

What do I do with these rankings?

Step 1: Begin by determining your overall petroleum product storage risk ranking. Total the rankings for the categories you completed and divide by the number of categories you ranked:

_____ divided by _____ equals [ ]*
total of rankings; # of categories ranked; risk ranking

*Carry your answer out to one decimal place.

3.6–4=low risk, 2.6–3.5=low to moderate risk, 1.6–2.5=moderate to high risk, 1–1.5=high risk

This ranking gives you an idea of how your petroleum product storage **as a whole** might be affecting your drinking water. This ranking should serve only as a **very general guide, not a precise diagnosis.** Because it represents an **averaging** of many individual rankings, it can mask any **individual** rankings (such as 1's or 2's) that should be of concern. (See Step 2.)

Enter your boxed petroleum product storage risk ranking on page 1 of Worksheet 12. Later you will compare this risk ranking with other farmstead management rankings. Worksheet #11 will help you identify your farmstead's site conditions (soil type, soil depth and bedrock characteristics), and Worksheet #12 will show you how these site conditions affect your risk rankings.

Step 2: Look over your rankings for individual activities:

- **Low-risk** practices (4's): ideal; should be your goal despite cost and effort
- **Low-to-moderate-risk** practices (3's): provide reasonable groundwater protection
- **Moderate-to-high-risk** practices (2's): inadequate protection in many circumstances
- **High-risk** practices (1's): inadequate; pose a high risk of polluting groundwater

Regardless of your overall risk ranking, any individual rankings of "1" require immediate attention. Some concerns you can take care of right away; others could be major—or costly—projects, requiring planning and prioritizing before you take action.

Find any activities that you identified as 1's and list them under "High-Risk Activities" on pages 6-7 of Worksheet #12.

Step 3: Read Fact Sheet #4, *Improving Petroleum Product Storage,* and consider how you might modify your farmstead practices to better protect your drinking water.

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