



## **Assessing and Reducing the Risk of Groundwater Contamination from AGRICULTURAL CHEMICAL STORAGE AND HANDLING**

### **Why should I be concerned?**

Kentucky's groundwater is one of its most vital resources. It supplies drinking water for hundreds of thousands of Kentuckians. Groundwater is the source of water for drinking water wells, springs, and some municipal, or "city," water supplies. All of us do things at our homes every day which can possibly pollute the groundwater. Nobody wants to pollute the groundwater, but if we are not careful and educated about how we manage our day-to-day home or farmstead activities, we can do just that—pollute the groundwater that serves as drinking water for many families. Even if nobody in your community uses groundwater for drinking water, you need to be concerned. This is because groundwater that underlies your home may travel a long way and eventually end up as another family's drinking water.

The storage and handling of agricultural chemicals is one activity which can contaminate the groundwater. Agricultural chemicals include pesticides and fertilizers. Both pesticides and fertilizers play an important role in agriculture. They increase farm production, and they enable farmers to manage more acres with less labor. They also benefit non-farm families by helping the American farmer provide inexpensive, desirable food products.

**The KY•A•Syst program is for your benefit only. No information from this publication needs to leave your home. KY•A•Syst does not attempt to offer legal advice or solutions to individual problems but rather to raise general awareness about groundwater protection strategies. Questions about individual problems should be addressed to the appropriate professional.**

However, agricultural chemicals are occasionally showing up where they're not wanted—in the groundwater. If these chemicals are not handled carefully around the home or farmstead, they can seep through the ground after a leak or spill, or they can enter the groundwater directly during mixing and loading. Taking voluntary action to prevent agricultural chemical contamination of groundwater will help assure the continued availability of these chemicals for responsible use by farmers and homeowners.

**The goal of KY•A•Syst is to help you protect the groundwater that supplies drinking water for many families.**

### **How will this publication help me protect the groundwater?**

Part I of this publication will help you protect the groundwater by asking you questions about your agricultural chemical storage, handling, and disposal practices. These questions will help you identify activities or structures on your property which may put groundwater at a high risk of being contaminated. Part II of the publication will give suggestions on how to reduce the risk of groundwater contamination by improving agricultural chemical storage and handling.

# Part I. Assessing the Risk of Groundwater Contamination from Agricultural Chemical Storage and Handling

## Instructions:

Circle the number in front of the appropriate item that **best** describes your home or farmstead. (Skip and leave blank any categories that don't apply to your home or farmstead.)

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## PESTICIDE STORAGE

### How much of each pesticide do you store?

- 4 None stored at any time.
- 3 Less than 1 gallon or less than 10 pounds of each pesticide.
- 2 More than 1 gallon or more than 10 pounds of each pesticide.
- 1 More than 30 gallons or more than 100 pounds of each pesticide.

### Are the pesticides you store liquid or dry formulations?

- 4 No liquids, all dry.
- 3 Some liquids, mostly dry.
- 2 Mostly liquids, some dry.
- 1 All liquids.

### How "leachable" are the pesticides you store in the greatest quantities? (See attached Pesticide Leachability Chart.)

- 4 No chemicals stored.
- 3 Chemicals classified as having low leaching potential.
- 2 Chemicals classified as having medium leaching potential.
- 1 Chemicals classified as having high leaching potential.

### What type of spill or leak control do you have in your pesticide storage area?

- 4 Impermeable surfaces (such as sealed concrete, which does not allow spills to soak into soil), curbs, and sloped floors installed to contain leaks and spills.
- 3 Impermeable surface with curb installed has some cracks, allowing spills to get to the soil **OR** impermeable surface without cracks and no curb installed.
- 2 Semi-permeable surface (wooden floor, asphalt, clay) has some cracks. Spills could contaminate wood or soil.
- 1 Permeable surface (gravel or dirt floor), no curve or slope. Spills could contaminate floor or soil.

## FERTILIZER STORAGE

### Dry formulation

#### How much dry formulation fertilizer do you store?

- 4 None stored at any time.
- 3 Less than one ton.
- 2 Between 1 and 20 tons.
- 1 More than 20 tons.

#### What type of storage do you use for the dry formulation fertilizer?

- 4 Covered on impermeable surface (such as sealed concrete or asphalt). Spills contained.
- 3 Covered on clay soil. Spills are collected immediately.
- 2 Partial cover on clay soils. Spills not collected.
- 1 No cover on loamy soils. Spills not collected.

## **Liquid formulations**

### **How much liquid formulation fertilizer do you store?**

- 4 None stored at any time.
- 3 Less than 55 gallons.
- 2 Between 55 and 1500 gallons.
- 1 More than 1500 gallons.

### **What type of storage do you use for the liquid formulation fertilizer?**

- 4 Sealed concrete or other impermeable secondary containment that doesn't allow spills to contact soils.
- 3 Clay-lined secondary containment. Most of spill can be recovered.
- 2 Somewhat permeable soils (loam). No secondary containment. Most of spill cannot be recovered.
- 1 Permeable soils (sandy soils). No secondary containment.

## **PESTICIDE AND FERTILIZER STORAGE**

### **What is the condition of the pesticide or fertilizer containers you have in storage?**

- 4 Original containers, clearly labeled. No holes, tears, or weak seams. Lids tight.
- 3 Original containers old. Labels partially missing or hard to read.
- 2 Containers old but patched. Metal containers show signs of rusting.
- 1 Containers have holes or tears that allow pesticides to leak. No labels (against federal regulations).

### **What type of security do you have around the pesticides or fertilizers you store?**

- 4 Fenced or locked area separate from all other activities.
- 3 Fenced area separate from most other activities.
- 2 Open to activities that could damage containers or spill pesticides or fertilizers (stored in machinery storage areas, farmshop).
- 1 Open access to pesticides or fertilizers—in plain view (stored in open shed).

## **MIXING AND LOADING PRACTICES**

### **Where is the pesticide or fertilizer mixing/loading area in relation to the location of any wells, springs, cisterns, sinkholes, or streams?**

- 4 150 feet or more downslope from any well, spring, cistern, sinkhole, or stream.
- 3 100 to 150 feet downslope from any well, spring, cistern, sinkhole, or stream.
- 2 20 to 100 feet downslope or 100 to 500 feet upslope from any well, spring, cistern, sinkhole, or stream.
- 1 within 20 feet of any well, spring, cistern, or sinkhole or within 100 feet upslope of any well, spring, cistern, sinkhole, or stream (existing wells must meet separation requirements in effect at the time of construction).

### **What type (if any) of mixing and loading pad (spill containment) do you have?**

- 4 Concrete mixing/loading pad with curb/sloped floor keeps spills contained. Sumps allow collection and transfer to storage. **OR** All mixing/loading done at site of application.
- 3 Concrete pad with curb/sloped floor keeps spills contained. No collection sump.
- 2 Concrete pad with some cracks keeps some spills contained. No curb/sloped floor or sump.
- 1 No mixing/loading pad.

### **What water source do you use to mix your pesticides or fertilizers?**

- 4 Separate water tank.
- 3 Hydrant away from well, spring, or cistern (greater than 150 ft).
- 2 Hydrant near well, spring, or cistern (less than 150 ft).
- 1 Directly obtained from well, spring, or cistern.

**Do you use backflow prevention devices or methods on your water supply?**

- 4 Anti-backflow device installed or 12-inch air gap maintained between hose and top of tank.
- 3 Anti-backflow device installed. Hose in tank above water line.
- 2 No anti-backflow device. Hose in tank above water line.
- 1 No anti-backflow device. Hose in tank below water line.

**Is somebody present during the filling of pesticide or fertilizer tanks/sprayers?**

- 4 Always.
- 3 Frequently.
- 2 Sometimes.
- 1 Seldom or never.

**What type of handling system is used with your pesticides or fertilizers?**

- 4 Closed system for all liquid and dry product transfers.
- 3 Closed system for most liquids. Some liquids and dry products hand poured.
- 2 Non-closed system, semi-closed systems (metered pumps and minibulks).
- 1 All liquids and dry products hand poured.

**CLEANUP AND DISPOSAL PRACTICES**

**Where do you wash out your sprayer, and what do you do with pesticide or fertilizer rinsate?**

- 4 Sprayer washout in the field. Rinsate used in next load and applied to labeled crop.
- 3 Equipment washed out on pad at farmstead. Rinsate used in next load and applied to labeled crop.
- 2 Equipment washed out on farmstead. Rinsate sprayed at least 150 feet from well, spring, cistern, sinkhole, or stream.
- 1 Equipment washed out at farmstead. Rinsate drained or discarded at farmstead or in nearby field (may be illegal in Kentucky.)

**What do you do with empty pesticide containers?**

- 4 Triple-rinsed containers recycled through rinse-and-return program, returned to dealers, or taken to permitted landfill. Bags returned to supplier.
- 3 Unrinsed containers and empty bags taken to municipal landfill or transfer station.
- 2 Disposal of unrinsed or triple rinsed containers or empty bags on farmstead (may be against Kentucky regulations.)
- 1 Disposal of partially filled plastic or paper containers on farmstead (may be against Kentucky regulations.)

**SITE EVALUATION**

**What type of soil is on your property?**

- 4 Fine-textured or "heavy" soils (clays).
- 3 Medium-textured soils (silt loam).
- 2 Medium- to coarse-textured soils (loam, sandy loam).
- 1 Coarse-textured soils (sands).

**After a 1-inch rain in April, how long do you (or farmers in your area) have to wait to get into the field?**

- 4 More than four days.
- 3 Four days.
- 2 Three days.
- 1 Zero to two days.

**How sensitive is your region of the state to groundwater contamination (see map at end of publication)?**

- 4 Low sensitivity.
- 3 Moderate sensitivity.
- 2 High sensitivity.
- 1 Very high sensitivity.

**Does your property lie above or near any active/abandoned underground coal mines?**

- 4 No underground mining is being done below or near your property.
- 3 Underground mining is currently being done.
- 2 An underground mine was abandoned underneath or near your property more than ten years ago.
- 1 An underground mine was abandoned underneath or near your property more than twenty years ago.

**If your property does lie above or near any active/abandoned underground coal mines, what type of mine is it, and how deep is the mine? (See Part II for more information.)**

- 4 No underground mining is being done below or near your property.
  - 3 Underground mine is more than 400 feet deep.
  - 2 Underground mine is 200 to 400 feet deep.
  - 1 Underground mine is less than 200 feet deep. Mine is a "longwall" type mine.
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## What do I do with these rankings?

Take a look at your rankings for the individual questions you answered.

For Questions Where You Received A:	The Risk of Contaminating Groundwater Is:
4	Low
3	Low to Moderate
2	Moderate to High
1	High

Use this table to list any questions from Part I where you received a "1" (high risk activity or structure), or that were identified as being against Kentucky regulations. Next, write down the first step that can be taken to better the situation. Then read Part II of this publication, "Reducing the Risk of Groundwater Contamination by Improving Agricultural Chemical Storage and Handling." This will help you to improve any problem areas (1's or 2's) which were identified.

<b>Activity or structure identified as high risk ("1")</b>	<b>What is the first step that can be taken to solve the problem?</b>
<i>Example: equipment washed out on farmstead.</i>	<i>Start to wash out equipment in the field, and use rinsate on labeled crop.</i>

9

## Part II. *Reducing* the Risk of Groundwater Contamination by Improving Agricultural Chemical Storage and Handling

### AGRICULTURAL CHEMICAL STORAGE

If stored safely in a secure location, agricultural chemicals (pesticides and fertilizers) pose little danger to groundwater or the environment. Common sense suggests keeping agricultural chemicals in their original containers with their attached labels. Keep pesticides and fertilizers dry and out of the way of activities that might rip open a bag or puncture a liquid storage container.

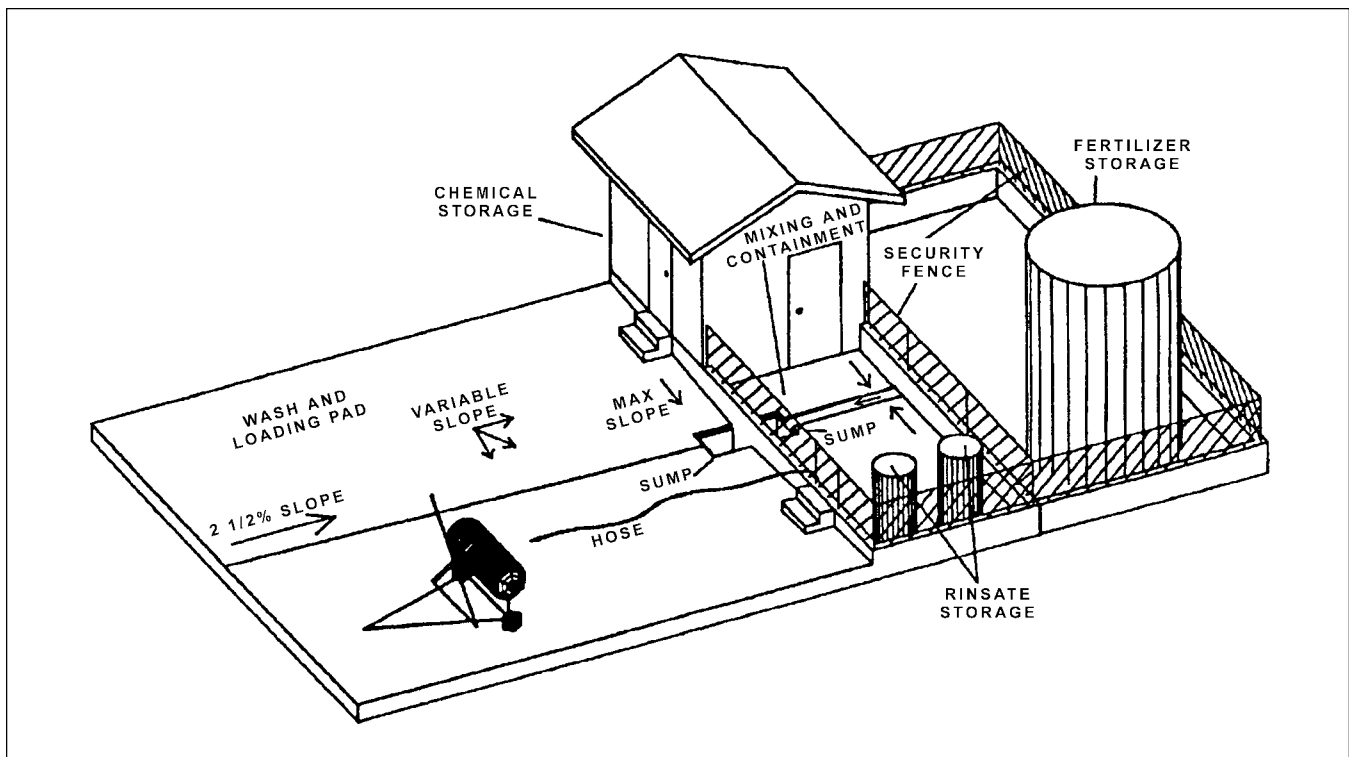
- Do not store fertilizers and pesticides in the same area.
- Do not store agricultural chemical containers on earthen floors or in places of frequent use.
- An impermeable floor, such as sealed concrete, with a raised circumference curb is desirable for pesticide and fertilizer storage. If a spill does occur, the floor will virtually eliminate the potential for the release of chemicals into surface or groundwater.
- A mixing/loading pad provides for secondary containment during the transfer of pesticide and fertilizer to spreading equipment, spraying equipment, or nurse tanks. It is a good practice to provide a cover for the mixing/loading pad to preclude problems associated with the disposal of rain water that falls onto the pad and flows into the storage sump.
- Store piles of dry bulk fertilizer on an impermeable surface under cover or in a building.
- Treat dry fertilizer impregnated with a pesticide as a pesticide and store it under cover, protected from rain.
- Use proper storage recommendations even if chemicals are on site only for a short period (such as in the spring time before planting). Even "seasonal" storage can result in spills or leaks that can potentially pollute the groundwater.

#### Building a new storage facility

While building new facilities just for pesticides or fertilizer storage may be expensive, it may be safer than trying to adapt areas meant for other purposes. Keep these simple principles in mind:

- Locate the pesticide or fertilizer storage buildings downslope and at least 150 feet away from any well, spring, cistern, sinkhole, or stream. Separation from the well, spring, or stream should be greater if the site has many sinkholes or "sinking" or "losing" streams.

- Slope the area around the building so that surface water will drain to a confined holding area in the event of a fire.
- The mixing and loading area should be close to your storage facility, to minimize the distance that chemicals are transported for sprayer filling.
- The finished grade of the building exterior should be 3 inches below the building's floor and sloped to provide surface drainage away from the building. The subsoil should have a low permeability (clay soils).
- Provide pallets to keep large drums or bags off the floor. Shelves for smaller containers should have a lip to keep the containers from sliding off. Steel shelves are easier to clean than wood if a spill occurs. Consider storing paper containers on the top level of shelves to prevent the potential for liquids from above dripping onto the paper container and causing contamination of the product. Store plastic and metal containers on the middle shelves and store glass containers on the bottom to reduce the potential for the container to be dropped or broken.
- If you plan to store large bulk tanks, provide a containment area large enough to confine at least 125 percent of the displaced volume of the largest container plus the displaced volume of all other storage tanks inside the containment area. Bulk tanks should be elevated so that any leaks can be seen easily.
- Keep the building locked and clearly labeled as a pesticide or fertilizer storage area. Preventing unauthorized access to pesticides and fertilizers reduces the chance of accidental spills or theft. Labels on the outside of the building give firefighters and other emergency service providers information about pesticides or fertilizers during an emergency response to a fire or a spill.
- Provide adequate road access for deliveries and emergency equipment.
- Keep pesticides separate to prevent cross-contamination. Herbicides, insecticides, and fungicides should be kept on separate shelves or in separate areas within the building.
- Sound containers are your first defense against a spill or leak. Most large bulk liquid fertilizer containers are manufactured from steel. There are many factors that determine the life expectancy of a steel fertilizer storage container. First to be determined is, how corrosive is the liquid being stored? How thick is the steel? There is little question that most forms



**Figure 1.** Farm-sized fertilizer facility. *Source: ASAE paper number 89-1613*

of liquid fertilizer are quite corrosive. The exact life of a container is difficult to predict, but many have failed after fewer than 20 years of use. Plastic fertilizer containers are less affected by the corrosive nature of most forms of liquid fertilizer, but are affected by direct sunlight. Again, a good defense against a serious spill is to have a secondary containment capability. If a tank is accidentally punctured or cracked, or if corrosion causes a leak in the container, the fertilizers will be confined to the immediate area and will be more easily recovered.

### Modifying an existing storage facility

You may find the above principles to be expensive and difficult to apply to your current storage, but, compared to the cost of a major accident or a lawsuit, storage improvements are a bargain. The above recommendations are also important points to remember when remodeling or making improvements to existing storage facilities.

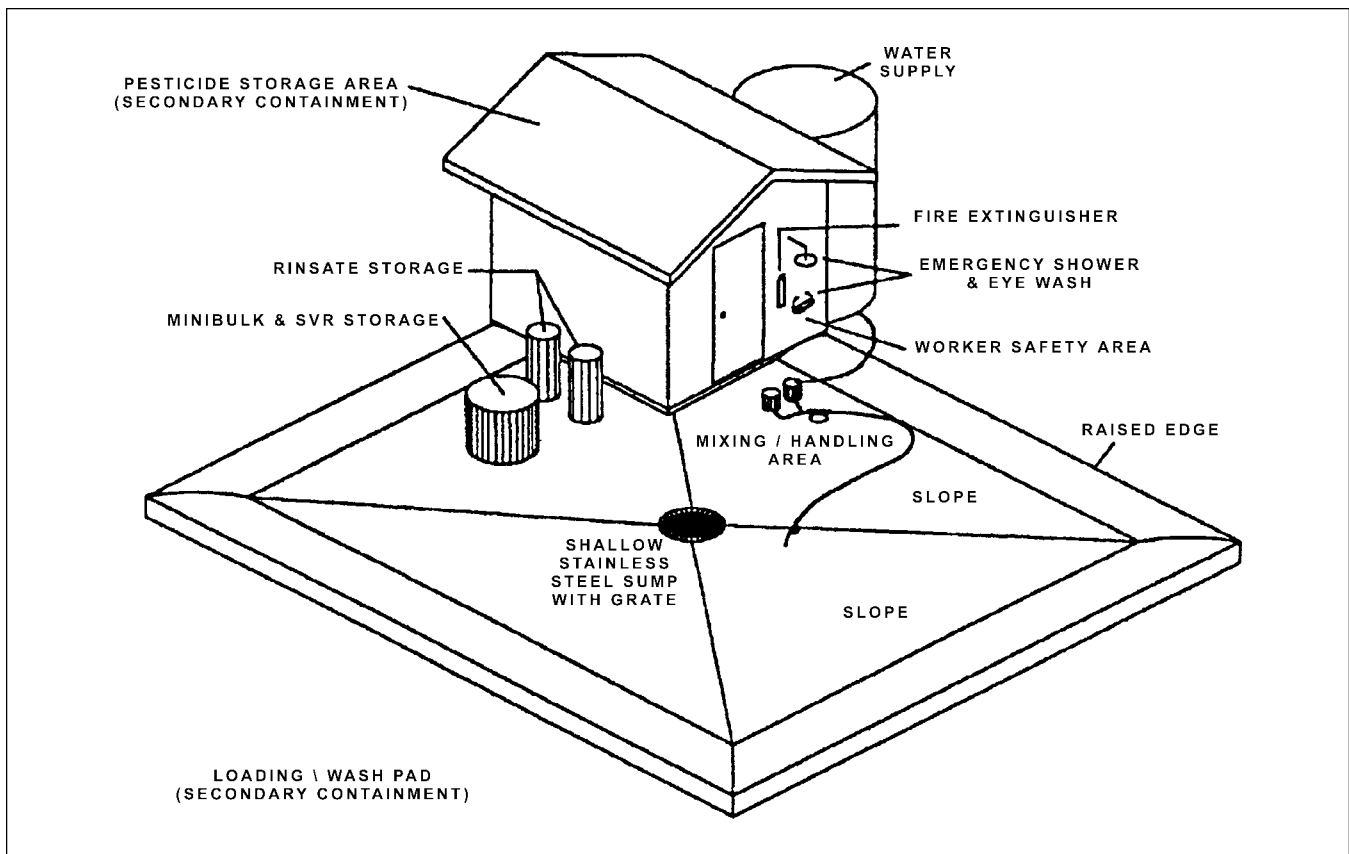
The cheapest alternative you may have is to reduce or eliminate the amount of pesticide and fertilizer that is stored on your farm. You may prefer not to store any pesticide and fertilizer but to have it delivered to the field and applied immediately. If custom application is not practical, consider how you can protect the pesticides and fertilizer you keep on hand. Sound containers are your first defense against a spill or leak.

If you do mix and fill on the farmstead, you should have a solid, secondary confinement facility. The secondary containment space should have enough volume to hold 125 percent of the contents of the largest container, plus the displaced volume of any other storage tanks in the area.

Ideally, your pesticide and fertilizer storage areas should be separate from other activities. If the building must also serve as a machine shed or as housing for livestock, you may find it difficult to meet all the requirements for safe storage. Remodeling existing facilities that serve other uses may be less expensive than building a new facility, but remodeling can be complicated. When existing buildings must accommodate other activities, using them to store pesticides or fertilizers could compromise the safety of people and the environment. Storing chemicals in a separate facility reduces the risk associated with fire or accidental spills. Never store pesticides or fertilizers inside a well or spring house or in a facility containing an unused well.

You can reduce potential damage by anticipating fire and spill emergencies. Fires in a storage area present a special hazard to people and the environment. If containers are damaged, the stored chemicals may be carried away by water and spread over a large area. Consider where the water will go and where it might collect if a fire should occur. In making the storage area secure, also make it accessible, allowing you to remove





**Figure 2.** Farm-sized pesticide facility. *Source: D.W. Kammel and D. O'Neil*

pesticides and fertilizers in a hurry. Making your local firefighters aware of the chemicals you store could help prevent a catastrophe if there ever was a fire on your property.

Windows and doors can be labeled to alert firefighters to the presence of agricultural chemicals stored in the structure. It's a good idea to keep a separate list of the chemicals and amounts stored. Keep a copy of the list in the house or away from the storage area.

## MIXING AND LOADING PRACTICES

Groundwater contamination can result from small quantities of chemical spilled regularly in the same place. Spills of dry pesticides and fertilizers should be promptly and completely cleaned up and placed immediately into the application equipment. Cleaning up spills of liquid chemicals can be much more difficult. Small quantities spilled regularly in the same place can go unnoticed, but the chemicals can build up in the soil and eventually reach groundwater. By mixing and loading on an impermeable surface, such as sealed concrete, you can contain and reuse most spilled pesticides and fertilizers.

### A mixing and loading pad

Spills are most probable during loading and mixing. Containing chemical spills and leaks requires an impermeable (waterproof) surface (such as concrete) for mixing and loading. A concrete pad should be large enough to accommodate your equipment and to contain leaks from bulk tanks, wash water, and spills from transferring chemicals to the sprayer or spreader.

Locate the pad adjacent to the storage area. Make sure that water from any water wells or springs moves away from the pad. At sites where runoff could reach a well, spring, cistern, or sinkhole, construct a diversion to direct runoff to another area.

The size of the pad depends on the equipment you use. It should provide space around the parked equipment for washing and rinsing. The pad should also provide enough area to contain drips from nozzles on the sprayer. The chemicals and rinse water should have a confined area, such as a sump, for settling before transfer to rinsate storage tanks. Having several separate rinsate storage tanks allows you to keep rinse water from different fertilizer or chemical mixes separate. That way, it can be used for mixing water on subsequent loads.

Care must be taken to prevent cross-contamination of the rinsate (don't mix rinsate from one chemical with rinsate from a different chemical).

### **Better management on your existing mixing and loading site**

Pesticide and fertilizer spills and leaks are bound to occur from time to time. Even if you don't have an impermeable mixing and loading pad, you can minimize contamination by following some basic guidelines:

- Avoid mixing and loading pesticides and fertilizers near any well, spring, cistern, sinkhole, or stream. One way to do this is to use a nurse tank to transport water to the field for mixing and loading.
- Avoid mixing and loading on gravel driveways or other surfaces that allow spills to sink quickly through the soil. A clay surface is better than sand.
- Install an anti-backflow device on the water source used for mixing chemicals. Never put the hose in the sprayer tank. Provide an air gap of 6 inches (or twice the inside diameter of the hose) between the hose and the top of the sprayer tank.
- Always have someone with the sprayer tank when filling it up.
- Only a certified applicator should perform operations.
- Use rinsate for mixing subsequent loads. Spray the last rinsate load on the labeled/recommended crop.
- Whenever possible, mix pesticides/fertilizers at the site of application. Rotate mixing areas to avoid any possibility for a pesticide buildup in any one location.
- When a rinse pad is not available, rinse and flush application equipment over a labeled/recommended crop, and take caution not to exceed the labeled/recommended rate of application and rotating rinse areas.

### **SPILL CLEANUP**

For dry spills, promptly sweep up and reuse the pesticide or fertilizer as it was intended. Dry spills are usually very easy to clean up. Dry pesticide-impregnated fertilizer is considered a pesticide and, if spilled, should be recovered and applied to the target crop as it was intended.

For liquid spills, recover as much of the spill as possible and reuse as it was intended. Some contaminated soil may be required to be removed and field applied if possible.

The Kentucky Environmental Release Reporting and Cleanup Law (KRS 224.01-400) requires that spills into the environment in a quantity that may present a danger to the public health or welfare must be reported.

To report, call the Environmental Response Team of

the Department for Environmental Protection at 502-564-2380 or 1-800-928-2380. If you are unsure if the quantity spilled is reportable, call 502-564-2150 for information.

Remove the spilled material and contaminated soil no matter what the quantity, and dispose of as it was intended.

Have an emergency response plan for the site. This plan will include emergency notification numbers, methods, and safeguards for transfer and mixing of pesticides and fertilizers, equipment inspection procedures, and details of spill containment procedures. Know where the runoff water will go, how to handle your particular chemicals, and whom to call for help.

## **CONTAINER DISPOSAL**

### **Fertilizers**

Bulk deliveries of anhydrous ammonia, liquid fertilizers, and dry bulk fertilizers have reduced the need to dispose of containers. Many farmers do, however, use bagged fertilizers and burn the bags in the field. Burning of bags is illegal according to Kentucky regulations (KAR 63:005). Bundle bags and dispose of them in an approved landfill.

### **Pesticides**

Unwashed and improperly stored containers can lead to groundwater contamination by allowing chemical residues to leak onto the ground. Some basic guidelines can help avoid similar problems:

- As often as possible, purchase chemicals in returnable containers and minibulks, and take them back to the dealer for reuse. Some pesticides are now available in dissolving packaging. Let your dealer know that you are interested in this type of waste reduction technology.
- Pressure-rinse or triple-rinse liquid pesticide containers immediately after use, since residue can be difficult to remove after it dries. Spear-type nozzles are available that will pressure-rinse and puncture plastic containers in one step. Pour rinse water into the spray tank. Puncture containers and store them in an enclosed container or building until you can take them to an approved municipal landfill or recycling facility.
- Recycle plastic and metal containers whenever possible (use "rinse-and-return" program if available in your county).
- Shake out bags, bind or wrap them to minimize dust, and take them to an approved public landfill.
- Do not bury or burn pesticide containers/fertilizer bags on the farm or homestead.

## OTHER MANAGEMENT FACTORS

Reducing pesticide and fertilizer waste makes financial as well as environmental sense, but it means more than just reducing spills. It also means buying only what you need to apply, keeping records of what you have on hand, and using older products first. **Buying only what you need makes long-term storage unnecessary.** In addition, you avoid cold weather problems, which can make some pesticides unusable.

Keeping records may seem like a task unrelated to groundwater contamination, but knowing what you've used in the past and what you have on hand allows you to make better purchasing decisions. Keep records of past field application rates and their effectiveness. Along with field records, you can add information such as the manufacturer's name and address, product's EPA registration number, chemical types, and handling precautions. This information can be important if you must respond quickly to an accident.

Using older products first keeps your pesticide inventory current and effective. Before using chemicals that have been stored for a few years, check with your county Extension agent about possible restrictions on their use.

## A FEW WORDS ABOUT YOUR SITE

The way home or farmstead practices such as pesticide or fertilizer storage and handling affect the groundwater depends in part on the type of soil and bedrock that is on your property.

### How do soils affect the potential for groundwater contamination?

Soil characteristics are important in determining whether a contaminant breaks down to harmless compounds or leaches into groundwater. In general, the soil on your property may act as a filter that prevents contaminants from reaching the groundwater. Different soils have different abilities to "filter" contaminants. Areas with soils that let water flow through them quickly have a greater risk of groundwater contamination. This is because the soil doesn't get a long enough chance to absorb or "grip" the contaminant, and it may flow to the groundwater with leaching rainwater. On the other hand, soils that allow water to flow through slowly will do a better job of protecting the groundwater, but pose a higher risk of contaminating streams because the water will run off and may carry pollutants with it.

Sandy soils have large spaces between individual particles and therefore let water pass through quickly. Contaminants from your property can flow with this

water. Because of this, sandy soils have a greater potential to pollute groundwater than clays.

Clay soils, on the other hand, have smaller spaces between individual particles and therefore water passes through slowly. Slower-moving water allows contaminants a greater chance to be absorbed by or "grip" onto the soil. Because of this, clays do a better job of protecting the groundwater. Since water moves through a clay soil slowly, there is a higher chance of runoff. This can result in surface water (stream) contamination. In other words, there is a tradeoff between groundwater and surface water protection. If your site has a clay soil, it will do a better job of protecting the groundwater, but you must also look out for surface water contamination.

In Kentucky, the type of bedrock on your property is more important than the type of soil in determining your site's ability to protect the groundwater.

### How does the bedrock on your site affect the potential for groundwater contamination?

Bedrock is the rock that lies underneath the soil on your property. Like the soil, different types of bedrock have different abilities to protect (or not protect) the groundwater from pollution. Knowing the bedrock which underlies your property is therefore important because it can tell you if you live in an area that is sensitive to groundwater contamination. Many areas of Kentucky have large springs, sinkholes, caves, and "disappearing" or "losing" streams. These areas are called karst and are especially sensitive to groundwater contamination. This is because the bedrock is dissolved by water, and large conduits and caves are formed underground. These conduits and caves allow pollution to flow very quickly from the surface to the groundwater. Basically, karst areas may act like a sewer system which connects your home or farmstead to the groundwater. Look at the map at the end of this publication to see if you live in a region of the state which has a low, medium, high, or very high sensitivity of groundwater contamination. If you live in an area which has a high or very high sensitivity (karst areas), you need to be especially careful with how you manage your home or farmstead pollution sources. This means being very careful around sinkholes and water resources (wells, springs, streams, etc.). **Do not dump garbage into sinkholes, or you will contaminate the groundwater that serves as drinking water for many families.**

### Potential effects of underground mining

Underground coal mining done underneath or near your property may result in the subsidence, or settling, of your property. This settling may cause damage to

structures as well as put groundwater at risk of being contaminated. The settling causes cracks in the land that can then allow pollution from the soil surface to enter the groundwater. The chance of subsidence occurring on your property depends on when the underground mining occurred, the depth of the mine, and what type of mining was done. Depending on the type of underground mining done, different precautions are taken by mining companies to prevent subsidence. "Room and pillar" mining leaves pillars in the mines that support the land above when the mine is abandoned. As time passes, there is a greater risk that these pillars can degrade and result

in the subsidence, or settling, of the land above. Certain types of "longwall" mines do not provide pillars. Therefore, these mines have a greater chance of resulting in subsidence. The depth of the mining also affects the chance that subsidence will occur. Deeper mines (greater than 400 feet) are less likely to cause subsidence than shallow mines (less than 200 feet). Information regarding the type and depth of underground coal mines may be obtained from the Department of Mines and Minerals at 606-254-0367 (ask for the Map Room). Be prepared to describe the location of your property in as much detail as possible (use a topographical map if possible).

# PESTICIDE LEACHABILITY CHART

The pesticides listed on this chart are identified by brand name, common name, and rating for movement by leaching (low, medium or high). Identify the pesticides stored on your farmstead from the listing below. Note the "leachability factor" for each pesticide you store. Use the rankings from the pesticides you store in the greatest quantities to complete the "Leachability" section on Part I of the publication.

## HERBICIDES

Ally	metsulfuron	—	Laddock	atrazine &	High
	methyl	—		bentazon	High
Amiben	chloramben	—	Lariat	alachlor &	Med
Amitrol T	amitrole	Med		atrazine	High
Arsenal	imazapyr	High	Lasso EC	alachlor	Med
Assert	imazethabenz	High	Lexone	metribuzin	High
Assure	quizalopof-ethyl	Low*	Lorox	linuron	Med
Atrazine	atrazine	High	Lorox Plus	linuron &	Med
Balan	benefin	Low		chlorimuron	—
Banvel	dicamba	High	Marksman	dicamba &	High
Basagran	bentazon	High		atrazine	High
Bicep	metolachlor &	Med	MCPA Amine	MCPA amine	—
	atrazine	High	MCPA Ester	MCPA ester	Low
Bladex	cyanazine	Med	Option	fenoxaprop	Low
Blazer	acifluorfen	Med	Pinnacle	thifensulfuron	—
Bronco	glyphosphate &	Low	Poast	sethoxydim	—
	alachlor	Med	Pramitol	prometon	High
Buctril	bromoxynil	Low	Princep	simazine	High
Buctril-Atrazine	bromoxynil &	Low	Prowl	pendimethalin	Low
	atrazine	High	Pursuit	imazethapyr	—
Butyrac 200	2,4-DB amine	Med*	Pursuit Plus	imazethapyr &	—
Butyrac	2,4-DB ester	Low*		pendimethalin	Low
Casoron	dichlorbenil	High	Reflex	fomesafen	High
Classic	chlorimuron	—	Rescue	naptalam &	—
Cobra	lactofen	—		2,4-DB	Med*
Command	clomazone	Med	Roundup	glyphosphate	Low
Commence	trifluralin &	Low	Salute	metribuzin &	High
	clomazone	Med		trifluralin	Low
Crossbow	triclopyr &	Med	Scepter	imazaquin	—
	2,4-D ester	Low*	Sencor	metribuzin	High
Curtail	clopyralid &	High	Sinbar	terbacil	High
	2,4-D amine	Med	Sonalan	ethalfuralin	Low
Curtail M	clopyralid &	High	Spike	tebuthiuron	High
	MCPA ester	Low	Stinger	clopyralid	High
Dual	metolachlor	Med	Storm	bentazon &	High
Eptam	EPTC	Med		acifluorfen	Med
Eradicane	EPTC	Med	Surflan	oryzalin	Low
Eradicane Extra	EPTC	Med	Sutan+	butylate	Med
Evik	ametryn	Med	Sutazine+	butylate &	Med
Extrazine II	atrazine &	High		atrazine	High
	cyanazine	Med	2,4-D amine	2,4-D amine	Med
Fusilade	fluazifop	Low	2,4-D ester	2,4-D ester	Low*
Galaxy	bentazon &	High	Tillam	pebulate	Med
	acifluorfen	Med	Tordon	picloram	High
Genate Plus	butylate	Med	Treflan	trifluralin	Low
Genep	EPTC	Med	Turbo	metolachlor &	Med
Goal	oxyflurfen	Low*		metribuzin	High
Gramoxone Extra	paraquat	Low	Velpar	hexazinone	High
Harmony Extra	thifensulfuron	—	Weedar	MCPA amine	—
	& tribenuron	—	Weedmaster	dicamba &	High
Hoelon	diclofop	Low		2,4-D amine	Med
Kerb	pronamide	Low	Weedone-2,4-DP	dichlorprop-ester	Low*
			Whip	fenoxaprop	Low

**INSECTICIDES**

Ambush	permethrin	Low	Captan	captan	Low
Aqua 8-Parathion	parathion	Low	Carbamate	ferbam	Med
Asana XL	esfenvalerate	Low	Champion	copper-fixed	—
Carzol	formetanate	Low	Crotothane	dinocap	Low**
Counter	terbufos	Low	Cyprexdodine	acetate	Low**
Cygon	dimethoate	Med	Daconil	chlorothalonil	Low
Cythion	malathion	Low	Dithane	mancozeb	Low
Diazinon	diazinon	Med*	Duter	tin	—
DiSyston	disulfoton	Low	Dyrene	anilazine	Low
Dyfonate II	fonofos	Med	Kelthane	dicofol	Low**
Dylox	trichlorfon	High	Kocide	copper hydroxide	—
Force	tefluthrin	—	Magnetic 6	sulfur	—
Furadan	carbofuran	High	Maneb	maneb	Low**
Guthion	azinphos-methyl	Low	Maneb & Zinc	maneb & zinc	—
Imidan	phosmet	Low	Manzate	mancozeb	Low
Knox-Out	diazinon	Med*	Merteck	thiabendazole	—
Lannate	methomyl	High	Orbit	propiconazole	Med**
Lindane	lindane	Med	Penncozeb	mancozeb	Low
Lorsban	chlorpyrifos	Low	Polyram	metiram	Low**
Malathion	malathion	Low	Ridomil	metalaxyl	High
Malathion/ methoxychlor	malathion & mehoxychlor	Low —	Ronilan	vinclozalin	Low**
Methoxychlor	methoxychlor	—	Rovral	iprodione	Low*
Orthene	acephate	Low	Rubigan	fenarimol	High
Parathion	parathion	Low*	Super Six	sulfur	—
Pennacap-M	methyl parathion	Low Low	Super Tin	tin	—
Pounce	permethrin	Low	Telone II	dichloropropene	Med
Sevin	carbaryl	Low	Terrachlor	PCNB	Low*
Thimet	phorate	Low	Tersan	benomyl	High
Thiodan	endosulfan	Low	That F	sulfur	—
Vydate	oxamyl	Low	Thiolux	sulfur	—
			Tilt	propiconazole	Med**
			Top Cop	basic copper sulfate	—
			Topsin	thiophanate methyl	Low**
			Triphenyl Tin	triphenyl hydroxide	— —
			Triple Tin	triphenyltin hydroxide	—
			Vitavax	carboxin	Low
			Vortex	dichloropropene & methyl- isothiocyanate	Med Med

**FUNGICIDES**

\*The rating is an estimate, but reasonably accurate compared to estimated ratings footnoted \*\*, which are a guess. Adapted from Becker, R.L., et al. 1990, Pesticides: Surface Runoff, Leaching, and Exposure Concerns. Minnesota Extension Service. Data were derived from U.S. Dept. of Agriculture SCS/ARS Pesticides Properties Data Base, Version 1.9, August 1989, developed by R.D. Wauchope et al., and ratings derived by D.W. Goss.

# CONTACTS AND REFERENCES

## Who to call about...

### Fertilizer storage

County Extension agent ..... check local listing  
Ky. Division of Conservation ..... 502-564-3080

### Fertilizer spills

Ky. Dept. for Environmental Protection  
(Emergency Response Team)  
(for information) ..... 502-564-2150  
(for emergency) ..... 502-564-2380  
(for emergency) ..... 1-800-928-2380

### Health and safety information of chemicals

Chemical Referral Center ..... 1-800-262-8200

### Pesticide applicator certification training

Univ. of Ky., Dept. of Entomology ..... 606-257-5955  
(for study materials)  
Ky. Division of Pesticides ..... 502-564-7274  
National Pesticide  
Telecommunications Network ..... 1-800-858-7378

### Pesticide container recycling

*For questions about starting county-wide program*

The Agricultural Container  
Research Council ..... 703-836-2283  
Ky. Dept. of Agriculture  
(Division of Pesticides) ..... 502-564-7274  
Ky. Fertilizer and Ag. Chemicals Assoc. .... 606-263-1679

For county-wide (bulk quantity) recycling of empty, rinsed containers

Tri-Rinse, Inc. .... 314-647-8338

For general information or educational materials

The Agricultural Container  
Research Council ..... 410-757-9488

### Pesticide disposal

Ky. Division of Waste Management ..... 502-564-6716  
National Pesticide  
Telecommunications Network ..... 1-800-858-7378

### Pesticide exposures

The Ky. Regional Poison Center  
of Kosair Children's Hospital ..... 1-800-722-5725  
In Metro Louisville ..... 589-8222  
National Pesticide  
Telecommunications Network ..... 1-800-858-7378

### Pesticide storage and handling

County Extension agent ..... check local listing  
County SCS office ..... check local listing  
Ky. Dept. of Ag., Div. of Pesticides ..... 502-564-7274

### Pesticide spills, spill site management, cleanup

CHEMTREC Pesticide Emergency Hotline .. 1-800-424-9300  
(emergency calls only)  
Disaster Emergency Service (24 hour);  
State Coordinating Agency for Disasters  
and Emergencies ..... 502-564-7815

Ky. Dept. of Ag., Div. of Pesticides ..... 502-564-7274  
Ky. Dept. of Human Resources ..... 502-564-4537  
Ky. Dept. of Environmental Protection ..... 502-564-2150  
(for information)

### What is KY•A•Syst?

KY•A•Syst is a series of publications which will help you assess *and improve* how effectively your home or farmstead practices protect the groundwater. The publications ask you about your home or farmstead structures and activities. Your answers will help you see how your practices might be affecting the groundwater. Each publication then gives suggestions about things you can do to improve your home or farmstead practices to better protect the groundwater.

The topics of the program include:

- Drinking Water Well Condition
- Agricultural Chemical Storage and Handling
- Petroleum Product Storage
- Household Waste Management
- Household Wastewater Treatment
- Livestock Waste Storage
- Livestock Yards Management
- Silage Storage
- Milking Center Wastewater Treatment

Some of these topics apply only to people who have farms, and others apply to both farm-owners and non-farm owners. ***This program is a completely voluntary program: it is an assessment you can perform in the privacy of your own home. No information from the publications needs to leave your home. The goal of KY•A•Syst is to help you protect the groundwater that supplies drinking water for many families.***

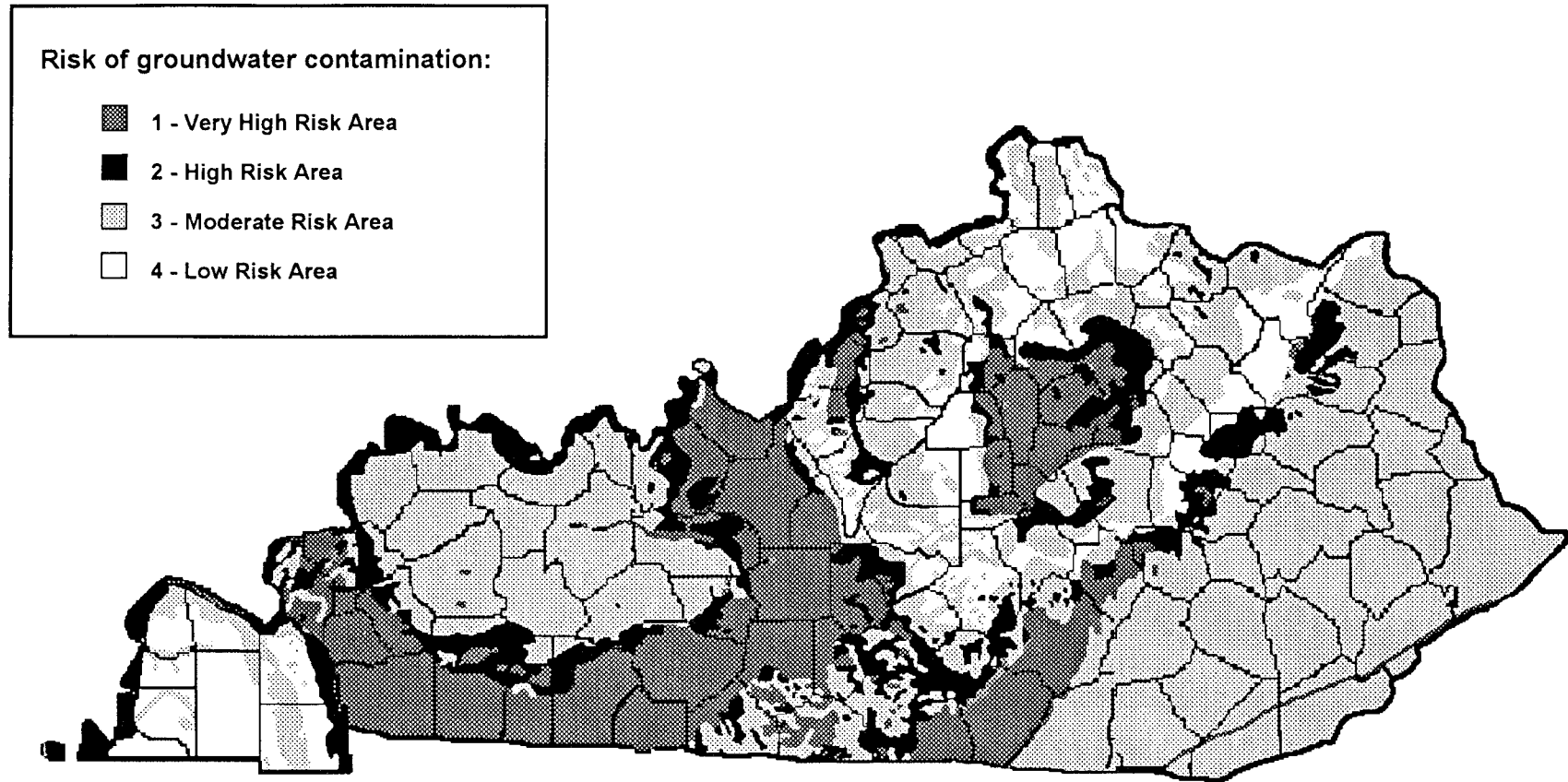
Edited and compiled by Mark Dravillas, former Extension Associate for Water Quality, and Tom Ilvento, former Associate Extension Professor in Sociology, University of Kentucky Cooperative Extension Service. Based on materials from the National Farm•A•Syst Program, University of Wisconsin (author: David Kammel, University of Wisconsin, Madison). Special thanks to the University of Kentucky Department of Agricultural Engineering and Department of Agronomy for technical review and comments.

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The KY•A•Syst project is coordinated by the Kentucky Cooperative Extension Service in collaboration with various Kentucky state and federal organizations and agricultural commodity and environmental groups.

KY•A•Syst publications can be obtained at your county Cooperative Extension Service office. For additional information on the KY•A•Syst program, contact Marla Barnett at (606) 257-2735 or Dr. Curtis W. Absher at (606) 257-1846.

# Groundwater Sensitivity Map



Reproduced from a map created by Division of Water - Groundwater Branch : Frankfort, Ky.

This map shows the potential for groundwater contamination in the different areas of Kentucky. Find the county you live in to determine how sensitive your region is to groundwater contamination.