

EnviroScape

Patent No. 5,427,530[®]

USER'S GUIDE

WATERSHED/NONPOINT
SOURCE POLLUTION



EnviroScape® Watershed/Nonpoint Source is the first in a series of models developed by JT&A, inc. We gratefully acknowledge the contributions and encouragement of individuals with the U.S. Environmental Protection Agency, the U.S. Department of Agriculture, the Terrene Institute, and Ron White, as well as many experts throughout the country who reviewed EnviroScape Watershed/Nonpoint Source model and made valuable suggestions.

The model base and carrying case are 100 percent made in the United States of America.

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Patent No. 5,427,530

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WARNING!

PACKING: Do not overload your case or shoulder bag with extra materials — this could cause damage to the case, bag and/or EnviroScape[®] model.

SAFETY: EnviroScape[®] contains small parts which may present a choking hazard to children under 3.

JT&A, inc, or any of its distributors or manufacturers, will not be held responsible for any damage resulting from use of any products on EnviroScape[®] other than those recommended, or from failure to follow the recommended cleaning and operating procedures and warnings.

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SPECIAL NOTE: It is not the intent of EnviroScape® to single out any industry or area as a contributor to water pollution, but to create awareness of nonpoint source pollution as a whole.

ORGANIZATION OF THIS GUIDE

This Guide contains two (2) demonstrations. The first shows **How Water Pollution Occurs**; the second, **How You Can Prevent Water Pollution**. We recommend that you follow this order in your presentations.

You may also choose to demonstrate additional activities.

The concepts discussed here are not an exhaustive list, but they are the basic concepts that should be covered.

The **Evaluation Methods** section that immediately follows this introduction addresses ways in which you can determine levels of water pollution awareness among your audience before and after each demonstration. It also includes a list of **Related Activities** that can be used to supplement the basic learning activities.

The **Facilitator's Role** section discusses the part you play in the success of the program and is followed by the demonstrations, which are presented step by step for ease of understanding and use.

Additional facilitator aids included with the model are an **Operating Guide**, which is a quick set-up reference guide, and a **Location Key (Diagrams A and B)** for each demonstration.

ORGANIZATION OF THIS GUIDE . . .

A comprehensive **Glossary** of technical or uncommon terms is also included to help your audience articulate its new awareness.

We encourage you to join our EnviroScape® ListServe — email us at info@EnviroScapes.com say "I'd like to subscribe to your ListServe." You will receive news, activities and specials on EnviroScape. We would also be delighted to share your EnviroScape activities with other users.

EVALUATION METHODS

Experience indicates that levels of water pollution awareness fluctuate a great deal among different potential EnviroScape® audiences; age alone is not a reliable determinant.

For example, a group of suburban fourth graders may know more about pollution than a group of urban business people. You will need to know how your group's level of awareness changes with each demonstration.

Methods of evaluation can include

- Before and after discussions, a series of questions presented to the group for everyone's consideration.
- Before and after "tests": true or false, multiple choice, fill-in or matching questions focusing on the facilitator's perception of audience sophistication.
- "Essays" on water pollution prior to and following the demonstration to let audience members see what they didn't know and subsequently learned.
- Drawing certain Best Management Practices (BMPs), for example, berms, fences, manure containment structure, vegetation strips or others.

NOTES



RELATED ACTIVITIES

Additional related activities can be as numerous and varied as the facilitator wants and the particular audience requires. They can be adapted for the full range of ages (K-adult) and organized very simply or with high degrees of complexity. A list of 10 such activities is provided below and on the following pages, for suggestion only. Please feel free to develop your own, or to modify, add to or subtract from this list.

Your participation will give us information to improve the model and will allow us to share your suggestions with others.

Suggested Related Activities

1. Visit local waterbodies, noting the sight and smell of pollution.
2. Attend a meeting of your local Water Board or Lake Association.
3. Visit a sewage treatment plant.
4. Visit a local industrial plant and see how it handles waste and toxic substances. Also talk to the compliance officer at the plant.
5. Visit a farm and observe Best Management Practices (BMPs) in action.
6. Visit a home — or your own: discuss good and bad habits that relate to the environment.
7. Talk to your local Natural Resource Conservation Service (NRCS) office.

8. Invite guest speakers to your organization or classroom!

SUGGESTED SPEAKERS:

- Local ecologist, environmentalist, or soil conservation district representative (state, local or federal representative from the Environmental Protection Agency [EPA], Natural Resource Conservation Service [NRCS] or Forest Service [FS] offices)
- Farmer
- Compliance officer with a corporate or municipal facility
- Lake Association member
- Water Board member
- Toxic handler (check with Fire Department)
- City or county planner

9. Extracurricular activities can be helpful, for example:

- Art projects (drawing a watershed, point and nonpoint sources, etc.)
- Geography (tracing a local river to the ocean, etc.)
- Language arts (research projects, creative writing stories, letters to local governments, etc.)
- Math (graphs, pie charts, etc., of rainfall, local river depth)
- Health (research diseases related to water pollution)

FACILITATOR'S ROLE

EnviroScape® is interactive: it takes you and everyone in your demonstration group to make it work. Basic structures, vehicles, bridges and trees can be placed in appropriate locations — there are enough props to get you started, but you, the facilitator, must “keep the ball rolling” by being prepared with the information you want to present. We recommend that you read through the guide to become familiar with the steps involved and the basic information provided prior to demonstrating.

This guide is presented in step-by-step form so that you can follow along as you demonstrate. It gives you freedom to present as much information as you deem appropriate, and to adapt the information you present to different audience levels. The demonstrations can last from 15 minutes to an hour, depending on how involved you want to get. They can also be repeated as your audience develops new levels of awareness.

Key information is presented throughout the demonstrations. This information is basic. There’s more to tell than is contained in this guide. We recommend that you visit our website at www.enviroscapecom.com and look at the Additional Resources we have available. The glossary at the end of this guide is also an important resource.

The effectiveness of the EnviroScape® depends on your enthusiasm in learning about water pollution and in getting the audience involved.

Experiment with your own ingredients or best management practices! EnviroScape® allows you to use different materials and to have your audience bring in their own soil, even little boats and cars. It's a flexible tool, so you can decide on the best way to adapt the model for your audience!

AN IMPORTANT NOTE. EnviroScape® was developed as an educational tool to increase awareness of water pollution. It is not our intent to promote any regulations or to abolish any practices that are discussed in this guide. Our intent is to promote awareness by showing sources of water pollution, what is currently being done to manage these, and what can be done to better manage potential pollutants.

 We can make a difference in our environment by better managing potential water pollutants.

Enjoy this learning experience!

DEMONSTRATION 1:

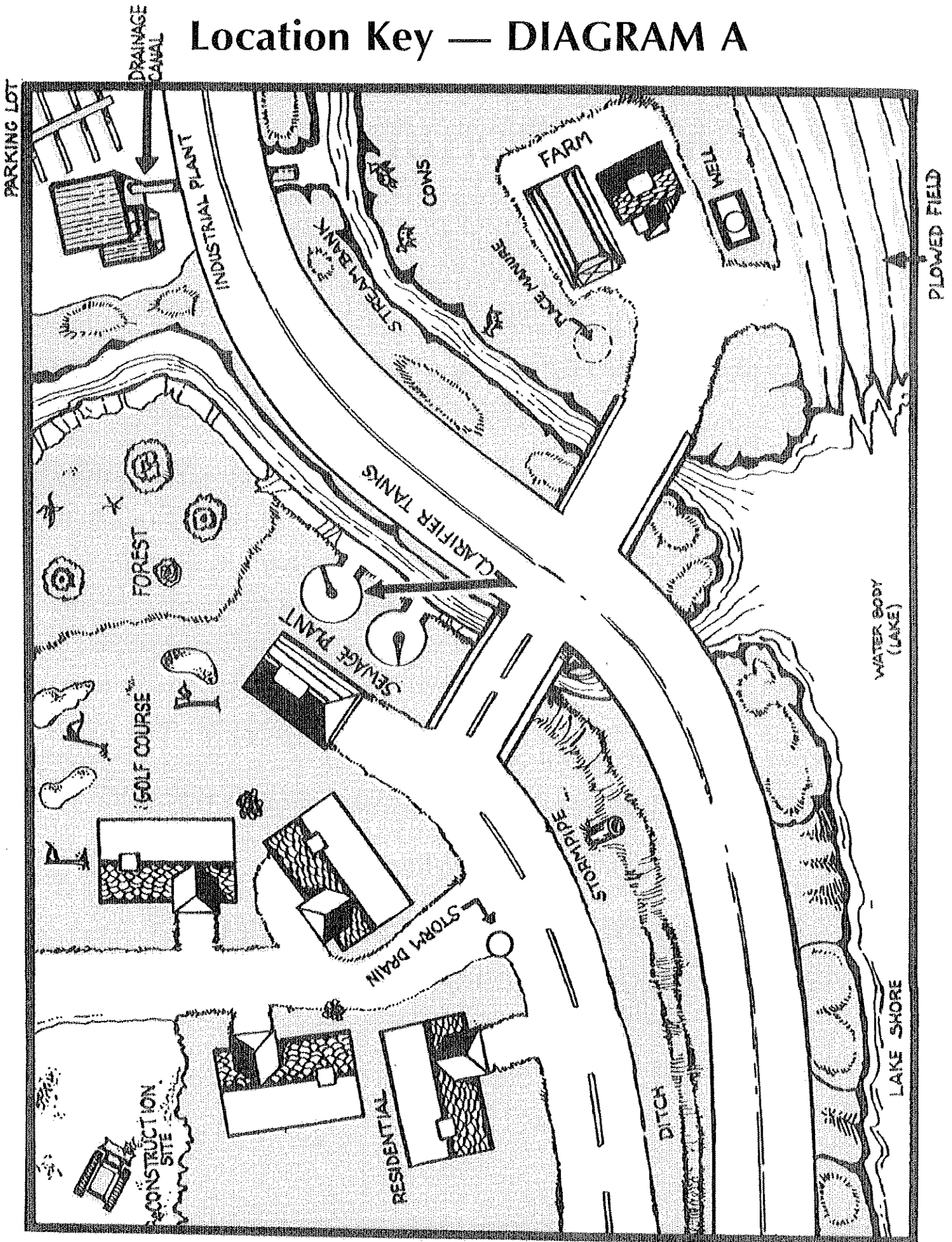
HOW WATER POLLUTION OCCURS

Facilitator's Note: This demonstration shows the origin of both point and nonpoint sources of water pollution and how a watershed works. *(See Diagram A on next page as needed.)*

Here's a summary of the steps that follow:

- Step 1: Prepare the Model
- Step 2: Check Your Audience's Awareness
- Step 3: Discuss the Watershed
- Step 4: Discuss Sources of Water Pollution
- Step 5: Demonstrate Point Source Pollution
(3 activities are provided)
- Step 6: Discuss Nonpoint Source Pollution
- Step 7: Demonstrate Nonpoint Source Pollution
- Step 8: Discuss What Happens When it Rains
- Step 9: Demonstrate Turbidity
- Step 10: Discuss Home Activities that Contribute to
NPS Pollution
- Step 11: Discuss Storm Drains
- Step 12: Summary Review

Location Key — DIAGRAM A



Step 1: Prepare the Model

1. Place EnviroScape® on a sturdy table.
2. Remove the plastic containers and box from the case.
3. Remove all items from the plastic containers and box.
4. Place buildings on model in spaces provided (see **Diagram A**).
5. Place the bridges, vehicles, golf flags and cows on the model; make golf mounds and holders for golf flags using clay provided.
6. Use the clay to place the tall (evergreen) trees in the clear-cut forest and the round (deciduous) trees in the residential area.
7. Make sure your storm drain and pipe are connected properly.
8. **IMPORTANT NOTE:** Slide the open container under the drainage hole in the lake bottom.
9. Put the plug in the lake's drainage hole and fill the lake with approximately 1 cup of water. **DO NOT PRESS TOO HARD ON THE PLUG.**
10. Fill spray bottle with water and put spray nozzle in "mist" position.

Step 2: Check your audience's awareness

A simple check can be to ask your audience what they think of when they hear the word "pollution." Their answers will give you a good indication of their perceptions and cognitive level. Other ideas are presented in the **Evaluation Methods** section.

Pollution?

What do you think of when you hear this word?

Step 3: Discuss the Watershed

- **What is a watershed?** A watershed is a region or area draining to a particular watercourse or body of water.
- **What is a waterbody?** A waterbody is any river, lake, stream, ocean, pond or basin; waterbodies receive runoff waters from a watershed.

✓ *Everyone lives in a watershed —*

- Watersheds drain rainfall and melting snow into the nearest waterbody that lies at the lowest point of the watershed.
- Watersheds can be small or large, and most are interconnected, eventually draining to the ultimate waterbodies — the bays, gulfs or oceans. Two-thirds of the United States lies within the larger watershed that drains to the Gulf of Mexico. Most of us live in a much smaller watershed that is located within our community.

- EnviroScape® is a model of a watershed with the lake (or river, bay or ocean) serving as the waterbody.
- Water cycles continuously through our environment. It's recycled through evaporation which enters our air and is then cycled back to the land as rainfall, snow or other precipitation.

Step 4: Discuss Sources of Water Pollution

There are two sources of water pollution:

1. **Point Source (PS)** or
2. **Nonpoint Source (NPS).**

✓ *We begin with Point Source Pollution*

Point Source is pollution that flows from pipes or comes from specific points, such as (point to these on the model):

- Industrial Plant in top right corner
- Sewage Treatment Plant located at the base of the forest and golf course
- Stormwater Drain located on the residential road between the houses

Let's show you what we're talking about . . .

Step 5: Demonstrate Point Source Pollution

 **Get your audience involved in these activities!**

✓ **PS ACTIVITY #1: Industrial Plant**

- Point out Industrial Plant
- Squirt sludge mixture in the top of the industrial plant and watch it run from the plant to the stream or river.
- Discuss

As you can see, the wastes from the industrial plant directly enter the waterbody, adding to the pollution.

This pollution happens because the plant is out of compliance — either it hasn't obtained written authorization (a permit) or it is violating its permit. It is therefore subject to penalties.

If it were in compliance, the wastes/contaminants would be treated to remove pollutants within the facility before discharging the cleaned wastewater.

All industrial plants in this country must comply with government regulations and secure applicable permits. The permits allow them to discharge a maximum percentage of pollutants. If the maximum limit is exceeded, the plant is violating its permit.

✓ **PS ACTIVITY #2: Sewage Treatment Plant**

- Point out Sewage Treatment Plant
- Squirt sludge mixture in each clarifier tank (the two round indentations in front of the treatment plant)
- Spray water into clarifier tanks to make them overflow
- Discuss

👉 ***Explain how this could be a Combined Sewer Overflow or an Upset***

- It's common for water to overflow clarifier tanks. This overflow is normally treated wastewater that flows 24 hours a day into receiving waters.
- **A Combined Sewer Overflow (CSO)** is when excess flow bypasses treatment. Some treatment systems in cities have stormwaters flowing into the wastewater treatment plant. When rainfall is excessive, too much stormwater runoff goes to the treatment plant and the excess flow is bypassed directly to the river, stream or lake.
- **An Upset** is when water is not treated adequately because of a plant malfunction. Sometimes, the biological processes that are used to treat wastewater stop working, and the waste is not treated properly. Incompletely treated wastewater is discharged to the river, stream or lake.

✓ **PS ACTIVITY #3: Stormwater Drain and Sewer Pipe**

- Point out stormwater drain
- Pour some oil (using the sludge mix) down the drain
- Discuss

Most storm drains are directly connected to storm sewers. Therefore, they are considered Point Sources because they are part of a piping system and are subject to federal, state and local regulation. Some storm drains are connected to a water treatment plant. If this occurs, the water tends to overflow with the water treatment during a storm event.

However, storm drains often carry water (or melting snow) directly off the land into the waterbody.

You'll understand the importance of these drains once we've discussed nonpoint source pollution; it will be discussed in more detail in Step 11.

 ***Why are these three things potentially harmful?***

Let's look at nonpoint source pollution first and then we'll talk about the specific dangers.

Step 6: Discuss Nonpoint Source Pollution

Nonpoint source pollution does not result from a discharge at a specific, single location, but generally results from land runoff, drainage or seepage, after a rain event.

Nonpoint sources come from many different human activities on and with the land, and occur when rainfall (or melting snow) carries contaminants, such as fertilizers and pesticides, oils, grease and trash, from yards, fields and roads to the nearest waterbody.


EnviroScape® shows 10 sources of nonpoint source pollution:

1. construction site
2. streambanks and lakeshore
3. forest
4. plowed fields
5. lawns and golf course
6. crops
7. highways, roads and parking lot
8. manure
9. cows and other domestic animals
10. household practices and waste disposal

Now, let's see what we're talking about . . .

Step 7: Demonstrate Nonpoint Source Pollution

(if needed, refer to Diagram A for location key)

 **Add your ingredients first.** We recommend getting your audience involved in placing these ingredients (representing soil, oils, fertilizer and pesticides) on the model.

1. To illustrate soil, sprinkle 1/2 tsp of cocoa (or soil) on
 - construction site
 - lakeshore
 - forest
 - plowed field on the farm
2. To illustrate pesticides (red drink mix) and fertilizer (green drink mix), sprinkle 1/2 tsp of each on
 - lawns and golf course
 - plowed field on the farm
3. To illustrate oils and grease, squirt a few drops of cocoa and water mixture on
 - highway and roads
 - industrial plant parking lot
4. Make manure by mixing small amounts of cocoa and water into a paste.
 - Place 1 tsp of manure on the grass next to the road on the farm.
 - You can also make pet waste to place on the lawns.
5. **Optional:** Make tiny bits of “trash” out of paper, styrofoam, toothpicks and other materials and place them at various locations in the watershed, particularly the ditch in front of the houses.

☞ ***Make it rain!*** Spray each area using the spray bottle filled with water to simulate rain. We recommend getting your audience involved in making it rain — discuss what's happening.

Step 8: Discuss What Happens When it Rains

Watch the rain (or melting snow) as it runs off the streets, parking lots and the land. You can see it pick up the soil and contaminants, carrying them to the waterbody.


This flow is called runoff.

✓ *Why Does this Happen?*

- **Construction Site:** There is no vegetation or silt fencing on the construction site to hold the soil, and therefore it erodes or wears away and is carried off by the runoff into the waterbody.
- **Lawns and Golf Course:** When too much pesticide or fertilizer is used, it may not be absorbed by the plants and therefore can be carried off by the rain into the waterbody. These chemicals can also seep into the ground, reaching the groundwater.
- **Highways, Roads, and Parking Lots:** collect oil and antifreeze from vehicles paved surfaces and other contaminants such as salt used to melt snow and ice. Rain (or melting snow) can carry these contaminants into the waterbody; they can also seep into groundwater.
- **Streambanks and Lakeshore:** Bareground banks with no vegetation to hold the soil are subject to erosion by water, wind and snowmelt.

HOW WATER POLLUTION OCCURS . . .

- **Forest Clearings:** A forest that has been cleared of its trees leaves its soil vulnerable to being washed away by the rain or melting snow. Even wind can carry soil away. Clearing the trees is the only problem shown here — transportation processes, that is, construction of roads to carry the timber, can add to the runoff. Many times, timber logs are pulled along the roads, causing more erosion and disruption of the land.
- **Plowed Fields:** If fields are not plowed properly — or if no vegetation or plants remain — rain can carry loose soil into the waterbody.
- **Crops:** Farm lands are like lawns and gardens — improperly or excessively used pesticides or fertilizers are washed into waterbodies by the rain.
- **Manure:** Daily spreading of animal waste is a common practice on farms since manure is a natural fertilizer. It's the improper allocation (overapplying) or applying at the wrong time of year (when ground is frozen) that leaves water at risk during a storm — excess manure and the contaminants within it can easily be carried away by rain into the waterbody.

 ***All these areas — not just one in particular — can contribute to what goes into the waterbody.***

☞ **Briefly review these nonpoint sources of pollution.**

✓ **Why are these sources potentially harmful?**

The invisible components of the runoff may be damaging, such as

- nutrients
- toxic substances (toxins)
- bacteria
- even the soil itself

Too much of these things can kill fish, shellfish, wildlife or plants and degrade the quality of the water we depend on.

✓ **But, how does this happen? . . .**

☞ **Let's take NUTRIENTS first.** Though nutrients are essential to life, excessive nutrients can adversely affect the fish and plant life in the water. Nutrients that are found in some fertilizers, for example, nitrogen and phosphorus, can speed up the aging process of the lake (eutrophication) by causing sudden and excessive growth of algae and aquatic plants. Excessive growth of algae and plants can crowd the waterbody, suffocating plant life.

And when these plants die and decay, they deplete the oxygen needed by the fish and other aquatic life. This lack of oxygen can kill the fish.

So, excess nutrients are potential pollutants; not nutrients themselves.

Then there's BACTERIA

- Bacteria are microscopic organisms. Some bacteria are helpful, but certain species can cause diseases such as typhoid fever and dysentery in humans who come in contact with them.
- For example, a combination of an open cut on a person and harmful bacteria in the water can cause an internal or external infection.
- Swimmer's itch is caused by a tiny microscopic bacteria found in the water. This bacteria causes a lot of itching on the skin and can create sores on the body.
- Bacteria can also infect shellfish, making them inedible. Therefore, when a person eats raw oysters or fish that are infected with this bacteria, he or she could become ill. Salmonella is one example of fish poisoning.
- Bacteria can also harm other aquatic organisms.
- Health risks in water can close or restrict the use of shellfish beds and beach areas.

 **And TOXIC SUBSTANCES also are found in the runoff**

- Toxins are poisonous substances. Examples are metal compounds and chemicals.
- Toxins can be found in different substances, such as household cleaners and pesticides used on crops, lawns, gardens, parks and other vegetation. If these substances are on our lawns, crops or streets, when it rains, they are picked up by the runoff and carried to the waterbody.
- Other sources of toxic substances are chemicals, such as sulfuric acid, nitric acid and carbonic acid emitted from burning fossil fuels such as coal. These chemicals fall to the earth as acid rain.
- Too many toxic substances in the water can cause allergic reactions and illness in humans who contact the water. Fish can also ingest these toxics, which can ultimately affect the food chain by affecting what other animals and humans eat.

Even SOIL itself can cause problems

As we have learned, when soil is washed off our land, it often carries many nutrients, toxic substances and bacteria with it to the water. However, soil by itself can be dangerous to the water.

Soil becomes sediment in the water (it settles at the bottom of the lake): soil washed from streets, construction sites and eroding land builds sediment on the bottom of the lake or stream.

Eventually, the depth of the lake decreases and may

- **Affect recreational uses of the water** — it can impede boating and it will also necessitate costly dredging to maintain shipping channels, marinas and other harbors.
- **Cause flooding.** Soil washed from streets, construction sites and eroding land also blocks storm drains and causes flooding.
- **Kill fish.** The cloudy, darkened water also absorbs more solar heat, which raises the temperature in the water — this results in reduced oxygen.
- **Disrupt reproduction habits** — the spawning of the fish. Heavy sedimentation inhibits the production of and deposit of eggs by fish.

Step 9: Demonstrate Turbidity

Let's visit the cows for a moment

Stir up the sediment in the lake with your finger

Note: sometimes sediment doesn't need to be suspended in the water by movement; sediment particles can remain suspended in water without being stirred up.

This cloudy effect caused by stirring up the sediment can happen when cows walk in the streams and lakes — they stir up sediment. This is called turbidity. Turbidity can be caused by both point sources and nonpoint sources of pollution.

Turbidity creates a cloudy effect that decreases the light so that plants can't get enough sunlight for growth; they die, depleting the oxygen level needed for fish to survive. This turbidity (also known as suspended sediment) can smother fish and impair the ability of aquatic life to find food.

Cows and other domestic animals can also enter the stream and deposit their waste in the waterbody. This action raises the nutrient and bacteria levels in the water. The animals can also cause erosion of the bank by trampling the vegetation.

One or two cows are not a major source of pollution; but herds of cows or large groups of animals do pose a potential threat to the water.

In summary, nutrients, toxic substances, bacteria and even soil that enter our waterbodies by way of runoff, can affect the stability of the fish habitat; this, in turn, affects the food chain of other beings, including humans.

Now, let's talk about us for a minute . . .

Step 10: Discuss Home Activities

Point out the Houses and Residential Area

✓ *All of us — in our everyday activities — are polluters.*

It's how we dispose of and handle our detergents, fertilizers, pesticides, pet wastes, oil, paints and brake fluids that determine if they're carried by stormwater runoff to a nearby lake, stream, bay, wetland or pond.

The amounts of these wastes may seem negligible, but multiplied by the number of acres, lots and homes in a community, they create significant pollution — enough to pollute the neighborhood stream to the point where it's not fit for humans or fish.

✓ *Here are some examples of how we pollute at home:*

- **Improper or careless use and disposal of household chemicals, oils, cleaning solutions.** Many of us unknowingly use toxic chemicals on yards, cars, boats, lawn furniture and houses. One rainstorm can carry chemicals directly into a river, lake or stream, where they can be harmful to all forms of wildlife.
- **Excessive use of water.** The water you use washing your car or watering the lawn adds to the runoff of water off the land; this runoff may pick up oils, nutrients, bacteria and toxic substances along the way to a waterbody.

HOW WATER POLLUTION OCCURS

- **Failure to maintain septic systems and overuse of systems.** Too often, homeowners with septic tanks forget that whatever goes down the drain or toilet ultimately finds its way into the soil (and groundwater) or remains in the septic tank until it is pumped out. A malfunctioning septic system may not be effective in removing disease-causing bacteria, some toxic chemicals or nutrients. What happens? The drinking water can become contaminated. Nutrients can fuel the growth of plant life and algae in lakes, rivers and estuaries, limiting recreation and affecting aquatic life.
- **Abandoned wells** are another source of pollution because trash, oils, chemicals and other contaminants can be dumped into them. Be sure to seal a well that is no longer in use.
- **Even pet wastes** must be disposed of properly. Pet wastes left on lawns, sidewalks, patios or in street gutters can be washed into surface waters, causing significant bacterial contamination and boosting the nutrient level. **Again, it's not one, two or even three dogs that pose the greatest threat — it's the total number of pets,** the accumulation of all pet waste, that we're concerned about. When you think about how each of us can control this one small potentially harmful pollutant — then you know that we can make a difference.

✓ **OPTIONAL NPS ACTIVITY: Wind Erosion**

- Place soil on the construction site, clearcut forest and plowed field.
- Wave a piece of cardboard, a small portable fan, or blow on the soil to create the wind.
- Discuss

Wind is another carrier of nonpoint source pollutants because it blows the soil, nutrients and oils off the land and ultimately into the waterbody.

One-third of the nutrients found in the Chesapeake Bay are reportedly from air pollutants consisting of pollutants from car exhausts and industrial smoke stacks that evaporate into the air.

**What pollutants are found in
the waterbodies in your
neighborhood?**

Step 11: Discuss Storm Drains

Remember the storm drain we talked about?

- It's a point source since it's connected to a piping system.

What does it carry?

- It carries the runoff from the land and takes it directly to the waterbody. In other words, it carries nonpoint source pollution to the waterbody.

So, it's a point source that carries nonpoint sources. Make sense?

There isn't an easy answer to this one. It has been argued both ways for quite some time. Since we know it's connected to the pipe system and since it's regulated by the federal government, it's been accepted as a point source in most cases.

It's interesting to note that most stormwater systems were originally built to move water to the nearest waterbody as quickly as possible with no treatment. Also, stormwater in some small towns is not necessarily regulated. It's still a nonpoint source.

Step 12: Summary Review

Nonpoint Sources and Point Sources are ways in which pollutants enter our water. Point sources come from specific places that we can identify and control through permits. Nonpoint sources come from areas that are more general and everyday to us, like our neighborhoods, our communities and farms. Nonpoint sources are difficult to control.

We all live in a watershed that contributes pollutants, either by point sources or nonpoint sources, to a waterbody.

Nonpoint sources of pollution generate over 50% of all water pollution. Although nonpoint source pollution is such a big problem, it's controlled by voluntary efforts.

✓ *Yes, that's right . . .*

Nonpoint sources of pollution are addressed in recent Clean Water Act provisions (1987) that require state NPS management programs to address the problem, but this pollution is ultimately controlled by mainly voluntary efforts of state and federal agencies and individuals. Nonpoint source pollution is not yet regulated by the federal government.

Point sources of pollution, however, have been regulated by the federal government under the Clean Water Act for over 20 years. Although this regulation has improved our environment, there's still a long way to go — nonpoint source pollution is the major source of water pollution today.

Why are we emphasizing pollutants, such as runoff, pet wastes and cows entering streams, as sources of pollution when they haven't been stressed as major pollution-causing problems before? NPS pollution was perceived as minor 20 years ago compared to the Point Source pollution. Now that we have focused our efforts on controlling Point Source pollution, we're beginning to recognize the effects of NPS pollution as a major source.

What are We Doing, and What Can We Do About Nonpoint Source Pollution?

 ***Turn the page and start Demonstration 2: Preventing Water Pollution.***

If you are not planning to begin Demonstration 2 at this time, go to page 49 for CLEAN-UP.

NOTES . . .

Lined writing area consisting of 21 horizontal lines.

DEMONSTRATION 2:

PREVENTING WATER POLLUTION

Facilitator's Note: This demonstration illustrates practical solutions for keeping pollutants from entering the waterbody.

(See Diagram B for a location key for this demonstration on next page.)

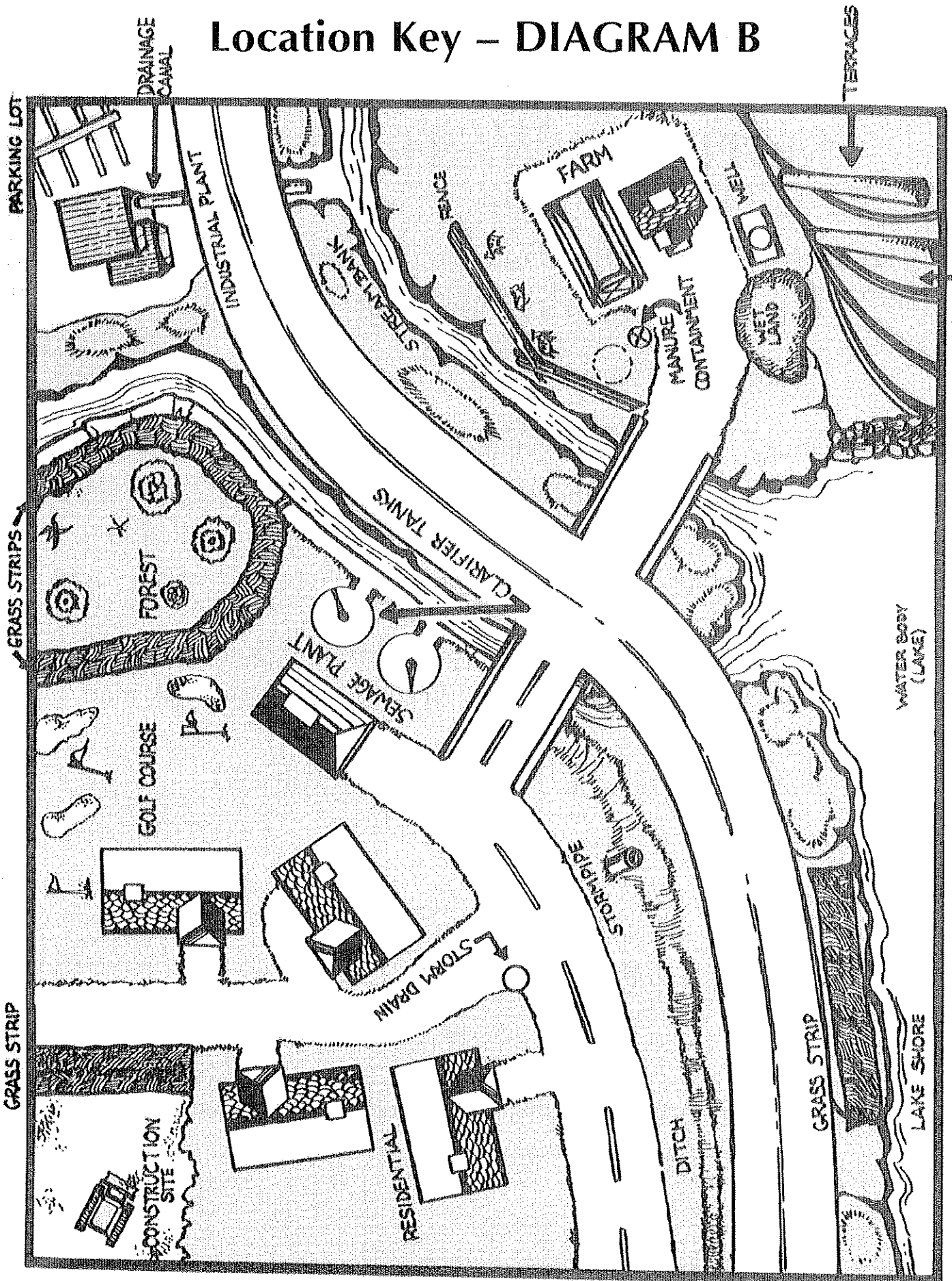
Best Management Practices, commonly referred to as BMPs, are systems, activities and structures that can prevent nonpoint source pollution. BMPs are not 100% capable of eliminating pollution, but each one helps to reduce and prevent pollution.

BMPs can be pollutant- and site-specific; therefore, a single BMP may not remove all pollutants found in runoff at a certain location.

Here's a summary of the steps that follow:

- Step 1: Prepare the Model
- Step 2: Check Your Audience's Awareness
- Step 3: Prepare and Place the BMPs
- Step 4: Add Ingredients to the Model
- Step 5: Demonstrate the BMPs (9 activities are provided)
- Step 6: Summary

Location Key – DIAGRAM B



BERM
 PLOWED FIELD
 CONTOUR PLOWING

Step 1: Prepare the Model

When the initial demonstration is completed:


1. Remove the plug from the bottom of the lake and allow the water to drain into the container beneath it.
2. Remove water and grime from the model by wiping it with paper towels or a sponge. It is not necessary to clean the unit completely at this stage; however, too much left-over grime may obscure the effects of your BMPs.
3. Empty the container and replace it under the lake.
4. Replace the plug in the lake. **DO NOT PRESS DOWN TOO HARD ON THE PLUG.**
5. Refill lake with approximately 1 cup water.

Step 2: Check Your Audience's Awareness


 **Ask your Audience for Suggestions on
*How We Can Prevent Nonpoint Source Pollution.***

 ***Write them down.***

Step 3: Prepare and Place the BMPs

 **Get the group involved in making the BMPs and placing them.**

1. **Fence in the Livestock:** Place fence along the stream around the cows in the pasture (position it to illustrate keeping the cows from entering the stream).
2. **Build a Dam:** Make your own berm (small dam) by molding a piece (1/2 stick) of clay. You may want to add rocks, grass, and sticks to the clay for a more realistic look.
 - Fit this berm across the end of the plowed field where the field begins to enter the lake.
3. **Plant Vegetation:** Remove the backing from the felt grass strips and place the strips along the edge of the roadway above the lake, beside the construction site, and a long grass strip around the lower half of the clearcut forest. The grass strips must be snugly fitted to the model to prevent seepage. It is **not** necessary for the surface to be completely dry for this step.
4. **Restore a Wetland:** Remove the backing from the felt wetland and place the wetland on area to the right of the plowed field, between the road and the field; or place the wetland between the field and the lake in place of the berm.
5. **Manage the Manure:** Place the manure containment bin on the grass next to the road on the farm.

 **Experiment! Make any other BMPs your audience suggested or you might have in mind.**

Step 4: Add Your Ingredients to the Model

1. To illustrate soil, sprinkle 1/2 tsp of cocoa (or soil) on
 - construction site
 - lakeshore
 - forest
 - plowed field on the farm
2. To illustrate fertilizer (green drink mix) and pesticides (red drink mix), sprinkle 1/2 tsp of each on
 - lawns and golf course
 - plowed field on the farm
3. To illustrate oils and grease, squirt a few drops of the cocoa and water mixture on
 - highway and roads
 - industrial plant parking lot
4. Make manure (if more is needed) by mixing cocoa and water.

Step 5: Demonstrate Best Management Practices (BMPs) Activities

✓ **BMP ACTIVITY #1: Construction Site**

- Point out construction site
- Spray with rain
- Point out the BMP (grass/vegetation strip)
- Discuss

To find out more about current construction practices, contact your local planning office or your state environmental protection agency.

Grass prevents loose soil from washing to waterbodies in runoff and therefore, the soil does not become sediment in the waterbody.

Neighboring yards with healthy lawns can assist in filtering sediment flowing in that direction. Parks and green spaces serve the same function.

Straw bales, silt fencing and plastic covers placed on the edges of a site are other examples of best management practices that prevent sediment movement.

Straw or silt fencing are temporary measures used during construction. Following the completion of construction, groundcover, such as grass, shrubs and trees, should be planted as permanent vegetation.

✓ **BMP ACTIVITY #2: Streambanks / Lake Shore**

- Point out lakeshore
- Spray with rain
- Point out the BMP (grass/vegetation strip)
- Discuss

To find out more about streambanks and lake shores, contact your state Environmental Protection Agency or local Department of Agriculture offices.

See how the vegetation strip along the lakeshore prevents soil from washing into the waterbody. Vegetation can limit runoff and filter out nutrients.

Planting trees, grass and other vegetation helps prevent runoff.

Loose logs or rock retaining walls are other ways to prevent runoff along streambanks and lakeshore.

✓ **BMP ACTIVITY #3: Forest**

- Point out forest
- Spray with rain
- Point out the BMP (grass or vegetation strips)
- Discuss

To find out more about current forestry practices, contact your state forestry office or environmental protection agency.

See how the vegetation strips prevent runoff and erosion.

You can't simply stop cutting down trees. It's not that easy since timber gives us paper, paper products, wood for furniture and other products.

The proper management of cutting trees allows us to provide paper, wood and other wood and paper products without damaging the environment.

 Here are a few suggested Best Management Practices for forests:

- **Plant surrounding terrain heavily with vegetation;** plant grass as appropriate to retard erosion (shown here).
- **Cut timber selectively** — leave young trees and other vegetation in place to hold moisture.
- **Take measures while building roads for transporting the timber.** Before permanent erosion controls are installed and vegetation is able to grow, use temporary measures (hay or straw bales and silt fences) to protect the area from erosion during rain (or melting snow). These measures can be removed after vegetation has grown.

✓ **BMP ACTIVITY #4: Farm Area**

- Point out farm area
- Spray with rain
- Point out the BMPs (berm and wetland)
- Discuss

To find out more about current farming practices, contact your local Soil Conservation Service, Natural Resources Conservation Service, or other local U.S. Department of Agriculture offices.

Notice how the **berm** prevents the soil from entering the waterbody.

Also notice how the **wetland** filters out a lot of the sediment and other substances found in the runoff — preventing them from entering the waterbody.

- Sediment can be filtered out by the wetland as it slows down the speed of the runoff, thereby promoting settling of the sediment in the wetland.

- A wetland can be described as a natural filtration system for nutrients, pesticides and other substances. In this instance, destroying a wetland could result in increased nonpoint source pollution by taking this filter away. Wetlands can remove nutrients, oil and grease, and bacteria from stormwater runoff.

Discuss other preventive measures

- **Use contour plowing** to direct runoff away from lake. Plow across the field instead of down the field so that it slows down the water and reduces polluted runoff.
- **Practice conservation tilling methods.** Tilling only enough to plant seeds leaves plant residue, such as cornstalks, on the surface. This residue then helps to hold the soil and nutrients, retarding runoff.
- **Use vegetative filter strips** along the edge of the field (grass, shrubs, trees) to hold soil on land.

For crops, you should

- **Use fertilizers and pesticides** appropriately and according to soil test results.
- **Plant cover crops.** In between producing crops, you can plant cover crops such as plants that restore nutrients to the soil. These covers hold the soil in place, reducing runoff. They can also reduce the need for additional fertilizer.
- **Rotate crops.** Farmers have found that giving the land a rest reduces the need for both fertilizer and pesticides. Gardeners are learning to divide their plots into parts and leave a portion of them unplanted (fallow) during each season.

✓ **BMP ACTIVITY #5: Driveways and Highways**

- Point out the driveways and highways
- Spray with rain
- Discuss

For more information about driveways and highways, contact your state highway department or your state environmental protection agency.

Permeable surfaces on parking lots, driveways and sidewalks prevent excess oils from being washed off into our water. These surfaces allow stormwater to soak into the ground and not wash off our land. Other BMPs — our good habits — are also the best management practices for problems on our driveways and roads.

👉 **Give some examples:**

- Prevent oil leakage from vehicles through regular preventive maintenance.
- When changing your own oil, use a dropcloth or other protection under your car.
- Recycle used oil at participating service centers; don't pour it down sinks or in storm sewers — we now know where this oil goes!

✓ **BMP ACTIVITY #6: Cows and Other Domestic Animals**

- Point out cows enclosed by fence
- Discuss

👉 **A simple solution? Yes and No.** You can keep the cows out of the stream by fencing them in. But with the fence in place, another source must be provided to the cows for drinking water, such as stock tanks. Shaded areas should also be provided to keep the cows cool. All these can be costly to the farmer.

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It works though. Keeping the cows out of the streams prevents sediment from being stirred up (turbidity) and protects the streambank from being eroded from trampling. It also ensures that cow wastes will not be deposited directly into the stream.

✓ **BMP ACTIVITY #7: Manure Containment**

- Place manure (made from recipe) in manure containment structure
- Make it rain and see how runoff from manure is contained
- Discuss


Check with your local soil conservation or extension agent to find out the newest ways to store and manage manure.

☞ **Manure can be a great fertilizer.**

- **Using a manure container** is part of a best management practice. When gathering manure, you can store it temporarily in a manure container.
- **But then, you need to manage it.** Solid animal wastes can be applied or spread on the ground as fertilizer; and liquid manure can be applied to fields through the irrigation system. Take care not to overapply!
- **Daily spreading of animal waste or manure containment** is a common practice for handling animal waste and reduces the need to use additional fertilizers. The important concept to stress is the proper application of waste to fields — **DON'T OVERAPPLY!**
- **Also, don't spread manure on frozen ground** because the spring runoff will carry it to the waterbody. So, in colder climates, use concrete storage containers (with a floor or bottom) to store manure until it can be used for fertilizer.

✓ **BMP ACTIVITY #8: Lawns and Golf Course**

- Point out lawns and golf course
- Discuss

 **Many things can help prevent runoff from lawns and golf courses.** This is a short list (more information can be found in *Handle With Care* – available on our website at envirosapes.com).

- Use fertilizers and pesticides sparingly and according to label directions and soil testing. Remember, the more you apply on land, the more may be entering the water.
- Don't use a grass catcher when you mow your lawn. Grass clippings left on your lawn will decompose and provide natural fertilizer, reducing the need for applying fertilizer.
- Have your soil tested; find out what it and your grass and plants really need. A clay soil may need organic matter worked into it, not fertilizer.
- Never dump grass or other organic material into a waterway; don't remove grass clippings within 50 feet of a waterway.
- Do not fertilize if a heavy rain is predicted, especially in areas subject to flooding.
- Don't mow your grass too short! For grass to be effective in filtering out nutrients and holding soil, you need to leave enough of it there.
- Choose plants that are suited to your area, and you will save on water, fertilizers and pesticides.
- Lawns, rock gardens and shrubs encourage infiltration of stormwater and create a haven for wildlife.
- Don't dispose of grass clippings, leaves or other items down the storm drains.

✓ **BMP ACTIVITY #9: Household Activities**

- Point out Residential Area
- Discuss

More information on activities at home can be found in Handle With Care.

☞ **Again, good everyday habits are the best management practices for household activities. Some examples are:**

- **Be a smart shopper.** Read the label and find the least toxic product that will do the job. Buy biodegradable, recyclable products whenever possible. Buy multipurpose products; for example, a detergent that cleans and whitens. Buy nonaerosol sprays.
- **Use household chemicals properly.** Use the product only when necessary and use only the amount needed. Clean up any spills. Don't apply chemicals near wells and waterbodies unless instructions permit such use.
- **Dispose of chemicals properly.** Don't burn or bury leftover chemicals or their containers. Stuff used paint cans with papers and let them dry before putting them in the trash. Never flush household chemicals down the drain or pour them on the ground or into storm drains. Instead, place them in bottles or cans and check with your local city or county authority about how and where to dispose of them properly.

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PREVENTING WATER POLLUTION . . .

- **Clean up after pets.** To keep surface runoff free of pet waste contamination, clean up after pets by picking up wastes and disposing of them in the trash or by flushing them down the toilet. Regulations requiring collection and proper disposal of pet wastes from yards, parks, roadways and other urban areas can help prevent this problem.
- **Use less water.** Wash your car only when necessary and use a bucket instead of the hose to save water. Or go to a commercial car wash that uses water efficiently and disposes of runoff properly.
- **Maintain your septic tank properly.** This practice is very important because drinking water polluted by this source can contain bacteria and viruses that cause dysentery, hepatitis and even typhoid fever. A malfunctioning septic tank can also increase the growth of weeds and algae in lakes, rivers and estuaries, limiting recreation and affecting aquatic life.
- **Plant groundcover,** for example, grass, shrubs or other vegetation, to protect soil from eroding off your lawn.
- **And don't litter.** Recycle! Your community should have a recycling center and program to help you.

Optional Activities

✓ **BMP OPTION 1: Terraces (molded of clay)**

- Make your own terrace (roll clay into cylinders and lightly press it horizontally across the plowed field.)
- Sprinkle soil, fertilizer and pesticide on the field
- Spray area with rain
- Discuss

Terracing holds moisture and soil, thus (1) slowing runoff and preventing erosion and (2) allowing nutrients to be absorbed by the land.

✓ **BMP OPTION 2: Mulch on Plowed Field**

- Place mulch on plowed field to simulate conservation tillage (use absorbent materials to simulate mulch, for example, sawdust, tissues, or shredded sponge)
- Sprinkle soil, fertilizer and pesticide on the field
- Spray with rain
- Discuss

When farmers till the field only enough to plant seeds, they leave residue from crops, such as cornstalks, in place. This residue holds the soil in place, preventing erosion and further runoff of nutrients. This practice is called conservation tillage.

Step 6: Summary Discussion of Preventing Water Pollution

We've discovered different ways of properly managing potential pollutants. Note the word "potential." The nutrients, bacteria, potential toxic substances and soil aren't pollutants until they affect our environment.

So, potential pollutants can be managed properly by us so that they remain only potential.

Although BMPs cannot entirely control all pollutants in the runoff, they can reduce pollution and contribute to a total pollution prevention system.

To encourage discussion, we recommend asking your audience

- What they have learned from these demonstrations,
- What they think of now when they hear the word pollution, and
- What benefits are gained by reducing and preventing water pollution?

This completes your basic EnviroScape® demonstrations.

CLEAN-UP

✓ *When the EnviroScape® sessions are completely finished:*

- Drain the lake into the container beneath it.
- Remove buildings and dry completely.
- **Remove the felt strips from the model as soon as the demonstration is finished.** Rinse them separately with water; dry before storing. Felt strips should not be left to dry on the model as they may stick to the surface of the model. You can reuse the felt strips, but they will need to be replaced after a short time.
- Remove the bridges, fence, vehicles, golf flag, cows and manure container and rinse separately with water. Store carefully in container when dry.
- Remove the clay berm and terraces; rinse with water, and dry before storing.
- Remove the trees and let them dry before placing in container.
- Remove the container and dispose of its contents in a sink.
- Clean the container and plug. Let dry thoroughly.
- Repack all small components and ingredients in the rectangular containers.
- Clean the model thoroughly. The unit can be rinsed with water. **Do not use any harsh detergents or cleaners that contain lemon, fruit or rind oils.**
- Let the EnviroScape® model dry completely. Then repack it and all its components in the foam-padded box or carrying case.



Again, rinsing with **WATER ONLY** is recommended.

NOTES

GLOSSARY

- **acid rain:** Rainfall that contains toxic chemicals, such as mercury, that have escaped into the air from burning fossil fuels.
- **algae:** Green water plants; any of a large group of (mostly) aquatic organisms that contain chlorophyll but lack special water-carrying tissues. Through the process of photosynthesis, algae produce the majority of food and oxygen in water environments.
- **algal:** Of or related to algae.
- **aquifer:** An underground, water-bearing bed of permeable rock, sand or gravel. Aquifers contain large amounts of groundwater that feed into wells and springs.
- **aquatic life:** Organisms that live and grow in, or frequent, water.
- **bacteria:** Microscopic organisms of many different shapes, generally without chlorophyll. Some bacteria are helpful (as in a fermentation process), but certain species can cause diseases such as swimmer's itch, pneumonia or typhoid fever, among others.
- **bareground banks:** River or stream banks that have no vegetation (no plant covering) to hold the soil against erosive action.
- **berm:** A narrow shelf, ledge or "barricade," typically at the top or bottom of a slope; a mound or wall of earth; for example, small dams or ridges.
- **best management practices (BMPs):** Systems, activities and structures that human beings can construct or practice to prevent nonpoint source pollution.
- **biodiversity:** A multiplicity of different, mutually dependent living things characteristic of a particular region or habitat.
- **cadmium:** Bluish-white toxic metal or metallic element used especially in protective plating and in bearing metals.
- **clarifier tanks:** Holding tanks associated with wastewater and sewage treatment centers. Wastewater in these tanks is treated to remove harmful substances before being released into a watershed.
- **chlorophyll:** Green photosynthetic coloring matter found in most plants.
- **Clean Water Act:** The federal Clean Water Act (formerly referred to as the Federal Water Pollution Control Act) has been a public law since 1972. It requires the development of comprehensive programs for preventing, reducing or eliminating the pollution of the navigable waters and groundwaters and improving the sanitary condition of surface and underground waters.
- **coliform:** A bacteria carried in human and animal wastes.
- **combined sewer overflow (CSO):** What happens when too much stormwater flows into the wastewater treatment plant. The excessive stormwaters added to the wastewater already in the system cause the excessive, still untreated waters to bypass treatment and flow directly into the lakes, rivers or streams. Some overflow of treated waters is normal; the CSO event allows untreated waters to overflow.
- **compliance:** The act of fulfilling an official requirement; submission to operative laws, regulations, practices, terms or conditions.
- **compliance officer:** One who plans, manages or oversees a company's submission to laws, regulations and practices; a person delegated to ensure a company's conformity with the law.

■ **compost:** A mixture of soil and decayed organic matter (food and animal wastes) used for fertilizing and conditioning land.

■ **conservation tillage:** A practice or method of plowing in which crop residue is left on the field as protective mulch or cover instead of being plowed under.

■ **ecology:** A branch of science concerned with the interrelationship of organisms with their environment.

■ **effluent:** Waste materials or pollution discharged into the environment, usually as smoke, industrial refuse or sewage.

■ **environment:** The complex of one's surroundings; the climatic, soil-related and life-related factors that act on organisms or ecological communities and ultimately determine their form and survival.

■ **environmental movement:** An organized or grass roots, public or private movement or group acting to preserve the quality and continuity of life through the conservation of natural resources; to prevent, eliminate or reduce pollution; to enhance beneficial land uses.

■ **Environmental Protection Agency (EPA):** a division or office of government, either federal or state, responsible for safeguarding and managing a region's natural resources and quality of life. The U.S. EPA is an agency of the federal government; the names of state EPAs vary from state to state.

■ **erosion:** The gradual wearing down of land by water, wind or melting snow. Soil losses, for example, from streambanks and forests, hilly ground, lawns and farm fields.

■ **eutrophication:** The premature aging of a waterbody from too many nutrients and too little oxygen. For example, nitrogen and phosphorus found in some fertilizers can cause sudden and excessive growth of algae and aquatic plants. Then, when these plants die and decay, they deplete the oxygen needed by the fish and other aquatic life.

■ **food chain:** An arrangement of the organisms in an ecological community according to the order of predation in which each uses the next (usually lower) member as a food source.

■ **Forest Service (FS):** An agency of the federal government located within the Department of Agriculture that manages and protects our forests, wooded areas and timber resources.

■ **groundwater:** The supply of fresh water found beneath the earth's surface (usually in aquifers); often used to supply drinking water to wells and springs.

■ **habitat:** The physical environment or typical place within which a plant or animal naturally or normally lives and grows.

■ **lead:** Soft, bluish-gray poisonous metal often used in pipes, batteries and cable sheaths. Formerly used as a stabilizer in paint.

■ **mercury:** A heavy silver-white poisonous metallic element sometimes found as a contaminant in rainfall (that is, in acid rain).

■ **minimum tillage:** A practice of plowing or turning the soil only enough to plant new crops, while leaving plant residue on the surface as compost.

■ **mulch:** A protective covering (as of sawdust, compost or paper) spread or left on the ground. Mulch prevents evaporation, maintains even soil temperature, prevents erosion, controls weeds and enriches the soil.

■ **municipal:** of or pertaining to a particular city, political unit or locality.

■ **noncompliance:** A condition of not submitting to applicable laws, regulations, terms or conditions.

■ **nonpoint source (NPS):** Pollution that cannot be traced to a specific origin or starting point, but seems to flow from many different sources. NPS pollutants are generally carried off the land by stormwater (or melting

snow) runoff. The commonly used categories for nonpoint sources are agriculture, forestry, urban, mining, construction, dams and channels, land disposal and saltwater intrusion.

■ **National Pollutant Discharge Elimination System (NPDES):** Federal operating permits issued by EPA to industrial facilities (to help these facilities comply with the Clean Water Act).

■ **nutrients:** Substances or ingredients that nourish or promote growth and repair the natural destruction of organic life.

■ **organic:** Of, relating to or derived from living things; relating to, produced with or based on the use of plant and animal fertilizers rather than chemically formulated fertilizers or pesticides.

■ **permeable:** A surface or material that has pores or openings that allow liquids to penetrate or pass through.

■ **pesticide:** An agent used to destroy insects and other pests that are harmful to crops or other vegetation.

■ **photosynthesis:** The use of radiant energy and especially light to combine or synthesize chemical compounds — particularly the formation of carbohydrates in the chlorophyll-containing tissues of plants exposed to light.

■ **point source (PS):** Pollution discharged into waterbodies from specific, identifiable pipes or points, such as an industrial facility or municipal sewage treatment plant.

■ **pollutants:** Solid, liquid or gaseous substances that contaminate the local or general environment.

■ **pollution:** The condition of being polluted. A generic word for any type of contamination of water, land or air.

■ **precipitation:** A deposit on earth in the form of hail, rain, sleet and snow.

■ **runoff:** That portion of precipitation that remains on the land until it ultimately reaches streams, rivers, lakes or other waterbodies; especially water from rain or melted snow that flows over the surface.

■ **sediment:** Matter that settles to the bottom of a liquid; deposited by water, wind or glaciers.

■ **septic tank:** A holding tank for collecting residential wastewaters. Used as an alternative to municipal sewer systems in some localities. Wastewater collected in septic tanks must be treated before being released into the watershed.

■ **sewage treatment plant:** A facility (usually municipal) that treats sewer waste to remove harmful substances before discharge.

■ **spawning:** The production and deposit of eggs by fish within their aquatic habitat.

■ **Natural Resources Conservation Service (NRCS):** A federal agency responsible for safeguarding and managing a region's soil resources. NRCS operates within the Department of Agriculture and maintains local offices throughout the country.

■ **tillage:** The operation of plowing, sowing seed or raising crops; cultivating land.

■ **toxic:** Poisonous substances harmful to living things. Of, relating to or caused by poison.

■ **turbid:** Thick or cloudy with, or as if with, sediment.

■ **turbidity:** Cloudiness; characterized by obscurity.

■ **upset:** A waste/sewage treatment plant malfunction. In an upset, untreated or incompletely treated wastewater enters the watershed.

GLOSSARY . . .

■ **vegetative/vegetation filter strips:**

Plantings used to trap water (and the substances it carries) to prevent it from running off the land; a BMP that helps prevent nonpoint source pollution.

■ **waterbody:** A land basin filled with water. Any river, lake, stream or ocean that receives runoff waters from a watershed.

■ **watershed:** A region or area that may contain several rivers, streams or lakes that ultimately drain to a particular watercourse or body of water.

■ **water table:** The upper limit of the portion of the ground wholly saturated with water.

■ **wastewater treatment plant:** Sometimes synonymous with sewage treatment plant, but often an industrial treatment facility that processes the water to remove toxic and hazardous wastes.

■ **wetlands:** Lands or areas, such as tidal flats or swamps, that are often or periodically saturated with water. Wetlands contain much soil moisture and plants that grow well in that condition.