Unit X:

Non-point Sources of Pollution

Unit X Non-point Pollution
Introduction

As discussed in the Chapter 9, nonpoint sources of pollution are difficult to trace back to an original source because they tend to be diffused over the landscape. This makes identification and treatment difficult. In contrast, most point sources of pollution, such as contaminants from a discharge pipe, can be treated before entering a body of water. Examples of nonpoint sources include failed septic systems, stormwater runoff, and agricultural runoff. Types of nonpoint source pollution correspond to land use. Nonpoint source pollution derived from an urban area in a watershed differs from that coming from a more rural or agricultural area. Residents contribute to the pollution in a watershed just by performing common activities, such as walking dogs, feeding ducks and geese, or fertilizing lawns. Individually these activities may not seem significant, but when added together with all the neighbors, these activities may pose serious threats to the health of the watershed.

The Narrow River has been seriously impacted by nonpoint source pollution. Construction and rapid growth patterns have had a profound effect on the Watershed's hydrology and estuary. Changes in land use over the last hundred years, from forested to residential, have increased the kinds and amounts of harmful substances which can degrade water quality. These pollutants get into our waters in many different ways, including groundwater seepage, surface stream flow, and stormwater runoff. The following sources of nonpoint source pollution have been identified for the Narrow River watershed: a) stormwater runoff from roads, lawns, construction sites and other impervious surfaces; b) erosion and sedimentation; c) septic systems; d) domestic animal and wildlife waste.

A) Stormwater Runoff

Stormwater runoff is often a major concern in watersheds, especially as development increases. The increase in impervious surfaces, such as roads, rooftops, and parking lots, inhibits infiltration and causes excess runoff. Areas of high traffic flow and dense housing produce a great amount of polluted stormwater runoff. As stormwater pours off these impervious surfaces, it picks up pollutants, such as oil from roads, and washes them into the nearest storm drain, stream, or pond. Runoff also carries sewage overflow from backed up septic systems, fertilizers, and pesticides off lawns and gardens, and soil and sediment from construction sites.

B) Erosion and Sedimentation

Sediment carried by runoff enters waterbodies through storm drains, stream flow, and overland flow during rain events. An increase of sediment and organic matter in the water column can reduce the amount of light needed for aquatic plant and animal growth, smother insects and other aquatic organisms, injure fish, decrease the amount of available oxygen, and transport other contaminants which adhere to soil particles. Soil erosion transports many other contaminants such as heavy

metals, nutrients, pesticides, and fertilizers. Some watersheds are especially susceptible to soil erosion and sedimentation if they have steep slopes and easily erodible soils.

C) Septic Systems

Many residential neighborhoods in the Narrow River Watershed were originally developed to cater to seasonal occupation. Consequently, the septic systems for these housing developments were designed to handle seasonal or part-time waste loads. Also known as Individual Septic Disposal Systems, or ISDS's, these septic systems have been in operation for as long as thirty to forty years. Many of the ISDS's are now too old and too small to efficiently dispose of current waste loads. Components of these antiquated systems can crack and leak, or the soils in the leach field can become clogged. This results in discharges of untreated waste to the ground surface and surface runoff, or into the groundwater and ultimately to the River. New septic systems can also "fail" when they are not pumped regularly or kept in good working order. Failing septic systems have long been identified as the major source of pollution in the Narrow River. Contamination from septic systems has caused the entire River to be closed to shell fishing. It has also caused excessive growth of aquatic plants in the River resulting in impaired water quality. Recent sewer construction in the watershed has produced an improvement in septic-related contamination. However, isolated cases of septic system failure are still contributing to problems in the River. Investigations are currently being done to identify and repair failing septic systems near Mumford Road.

Although sanitary sewer systems can relieve most of the pollution associated with old or improperly maintained ISDS's, they are not always the best answer. As sewer installations become increasingly available, development pressures may increase. With increase in development other nonpoint sources of pollution such as runoff will also increase. Also, most of the water from sewered homes may be discharged outside the watershed. This does not allow for any groundwater infiltration.

D) Pet and Wildlife Waste

In many developed watersheds, pet and waterfowl waste have been found to be a significant source of bacterial and nutrient contamination. Feeding wildlife encourages them to stay in one area and attracts larger numbers, adding to a greater waste load to the waterbody.

In the Narrow River Stormwater Management Study Problem Assessment and Design Feasibility study, the authors determined that public education was one of the main ways to mitigate nonpoint source pollution. The Narrow River Preservation Association has published a second edition of The Narrow River Handbook – A Guide to Living in the Watershed. This handbook gives detailed information for Narrow River Watershed residents about how they can mitigate their effects on the Watershed. For more

information, and a copy of the handbook, please contact NRPA, P.O. Box 8, Saunderstown, RI, 02874; (401) 783-6277; nrpa@netsense.net.

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ACTIVITY I: SILTY SYLVIA GOES ON A TRIP

OBJECTIVE: Students will understand the process of soil erosion and be able to identify different types of erosion.

METHOD: Students will role play three characters in a story about the erosion process. A follow-up discussion will clarify points.

MATERIALS: three energetic students, "Silty Sylvia Goes on a Trip" story

BACKGROUND INFORMATION:

1. Sediment that results from soil erosion represents the largest (in volume) non-point source of pollution nationwide.

2. Soil is the material naturally found on top of the Earth's surface, which sustains vegetation. Erosion is the process of moving that soil from its original position. Sediment is soil that has been transported away from its original location. Sedimentation is the deposition or accumulation of sediment on the ground or in the water.

3. Soil erosion causes sedimentation. Bare, unprotected soil is the primary cause of soil erosion.

4. Erosion begins with the impact of a single raindrop on bare ground. The energy of this impact causes detachment, or dislodgement of soil particles. Runoff transports or carries the soil particles away.

5. There are three types of erosion:

    a. sheet erosion – Water moves over the soil surface in thin layers like a sheet; also called "invisible erosion" because you can't see it happening.

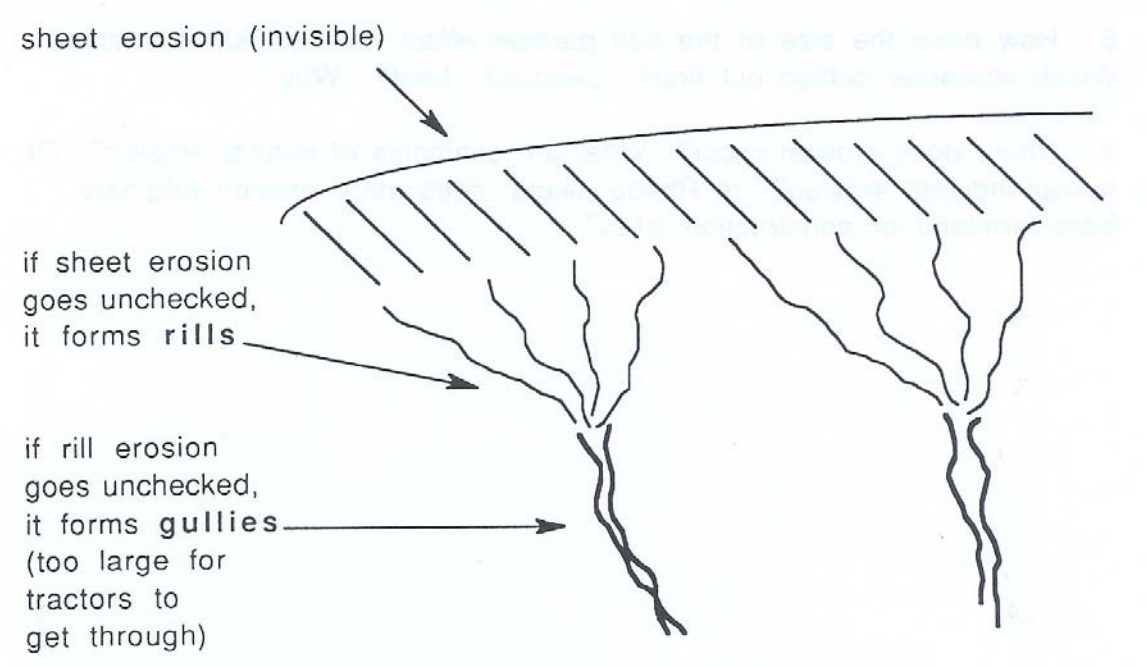
    b. rill erosion – As water picks up speed moving downhill, the sheets begin to form rills or small channels.

    c. gully erosion – If left unchecked, water picks up more speed and the rills become larger, forming gullies.

1. Sand particles are heavier than silt and clay soil particles, and therefore settle out of the water more quickly than the other two. Clay particles can take more than 24 hours to settle out of still water. In areas that have predominantly clay soils (southeastern United States), rivers choked with sediment are actually "red" from the clay because the particles are so small that they do not fall to the bottom unless the water is perfectly still for a long period of time.

2. Soil erosion occurs <u>naturally</u> on mountain slops, in stream beds, and in deserts. Soil erosion is <u>human-induced</u>, occurring on cropland, lawns, gardens, and construction sites.

1. (**state how much soil erodes from various places in your state** [*In Rhode Island, an average of 6 tons/acre/year of soil erodes from cropland, while 50 tons/acre/year erodes from construction sites.*])



PROCEDURE:

2. Read "Silty Sylvia Goes on a Trip", having the students role play the three characters.

3. Discuss the definitions of soil, erosion, sediment, and sedimentation. How were these represented by characters and their actions in the story?

4. How does soil erosion originate? How did it start in the story?

5. Draw the diagram of the three types of erosion on the board. In what order do they occur? Why? Ask the characters to try to remember when they were acting out sheet, rill, and gully erosion. How did each of these types of erosion feel? How are they

different? How does one lead to another? Emphasize that erosion progressively worsens if left unchecked.

6. How does the size of the soil particle affect its movement? Which character moved fastest? Slowest? Why?

7. How does the size of the soil particle effect how quickly it settles? Which character settled out first? Second? Last? Why?

8. Where does erosion occur? What are examples of natural erosion? Of human-induced erosion? In (**your state** [*Rhode Island*]), does more erosion originate from farmland or construction sites?

“Silty Sylvia Goes on a Trip”

The Characters:

Sammy Sand – a large particle of soil that doesn’t like to move around very quickly

Silty Sylvia – a medium particle of soil that is lighter than Sammy Sand

Carl Clay – a very small particle of soil that is very light and is easily held in suspension

The Story:

Sammy Sand, Silty Sylvia, and Carl Clay are good friends and live at the top of a steep hill above a river. They like to hang around together.

(have characters stand together, holding hands)

One day, a bulldozer arrives and removes all the vegetation that was living with them.

(A fourth student can volunteer to be the bulldozer)

That night, a very big thunderstorm passes over their hill

(have the rest of the students in the class make sound effects throughout the story)

It rains over three inches in just a few hours. With the first few raindrops that landed, three friends were slightly agitated.

(have characters drop their hands and begin moving their bodies while standing in place – Sammy Sand moves slowly, while Carl Clay bounces around quickly)

As the rain intensifies, all three characters slowly begin to move away from each other toward the crest of the hill as if they are floating slowly across a lake. What is happening to them? Sheet erosion! Carl Clay is still moving faster than Sammy Sand. Soon the rain is pouring down and the soil particles reach the edge of the steep hill. As they go over the edge, small rills begin to form. For each particle, it feels like they are riding down the rapids of a white-water stream.

(have characters move around as if they are in rapids without a boat; Sammy Sand is still moving more slowly than the others; the rest of the class is still making sound effects)

As they all progress further down the hill, the water begins to form small gullies which progressively get larger. The soil particles all feel as if they are now in a tornado.

(sound effects!)

As they approach the bottom of the hill, a flat area causes the water to calm down enough that Sammy Sand falls to the bottom.

(Sammy Sand "falls" down safely, to sit or lie on the floor)

However, the water is still moving slowly toward the river and Silty Sylvia and Carl Clay are still bouncing around in the water. Soon they enter the river and are swept away by the current. The next day, when the rain has stopped and the river slows down, Silty Silvia settles to the bottom of the channel as the river goes around a bend. But Carl Clay is still floating…. Eventually the river splashes into a wide, still lake. Finally, Carl is able to settle out to the bottom of the lake.

ACTIVITY II: **FACTORS AFFECTING EROSION**

OBJECTIVE: Students will be able to identify and explain the five factors that affect the amount of erosion that occurs at a given time.

METHOD: Divided into five groups, students will brainstorm how their assigned factor might affect the amount of erosion that occurs. Students will then present their findings at the end of the brainstorming session.

MATERIALS: paper, crayons or markers

BACKGROUND INFORMATION:

Five factors affect the amount of soil erosion that occurs:

rainfall intensity – The amount and type of rainfall that occurs in each area of the country affects the amount of potential erosion; (**compare rainfall intensity in your state to another region of the country** [*rainfall in the South and Midwest is much more intense than it is in Rhode Island, and therefore has a greater potential to cause erosion*]).

soil texture – Soils have differing values of erodibility; in general, silty soils are more erodible than sands and clays due to the fine texture and the way the soil is held together. (**describe how the erodibility of your state's soils compares with the rest of the nation** [*Some Rhode Island soils are the most erodible soils known in the country.*])

slope – Length and steepness of slope greatly affect the amount of erosion. Long and/or steep slopes are likely to have more erosion than flat, short, slopes.

cover – The type of vegetative cover growing in the soil will affect the amount of erosion. Generally, the more cover over the soil surface, the less erosion that will occur. For example, grass or turf is much more protective than a crop like potatoes or corn.

plowing factor – The way a crop field is plowed can affect the amount of erosion. Plowing across the slope creates mini ridges that help slow down runoff water, while plowing up and down the slope creates perfect paths for the water to runoff at a higher speed.

PROCEDURE:

1. Divide the students into five groups. Assign each group one of the five factors affecting erosion. Ask the students to discuss their factor and try to determine how it can affect the amount of erosion that occurs.

2. Have students illustrate their findings and present to the rest of the class what they discussed.

ACTIVITY III: LET'S STOP THE SEDIMENT – CONSTRUCTION SITE

OBJECTIVE: Students will understand why sediment is a pollutant in water bodies, and identify methods for controlling erosion on different sites.

METHOD: Students will use a local development proposal for a subdivision site, preferably on sloping land, near water, to determine where erosion is most likely to occur, and what methods could be used to control the erosion.

MATERIALS: site plan maps of a local development proposal*, soil survey sheets**, copy of decision*, paper, pencils, crayons or markers

BACKGROUND INFORMATION:

1. When erosion occurs in a field, some sediment is deposited elsewhere in the same field. Some is deposited in the nearest water bodies.

2. Largest particles (sand and stones) settle out first, while smaller particles (silts and clays) are usually transported to nearby streams or rivers and stay suspended until the water pools and becomes very still.

3. Sediment is considered a source of pollution because it:

   - creates dirty water
   - fills up drinking water reservoirs
   - clogs storm drains
   - "chokes" streams (lowers dissolved oxygen levels – detrimental to fish)
   - changes the flow path of streams
   - fills road ditches
   - carries other pollutants

4. Downstream flooding can result when sediment clogs a drain, changes the flow path of a stream, or fills road ditches or water bodies. Removing sediment or repairing the damages caused by sedimentation can be expensive.

5. Erosion on construction sites can be controlled by:

   - not clearing steep areas
   - covering bare areas quickly with at least a temporary vegetation or mulch
   - working in phases (only work on small areas at a time, instead of clearing the entire property all at once)
   - using conservation practices such as sediment basins, check dams, diversions, silt fences, hay bales, etc.

PROCEDURE:

1. Where does sediment go when it erodes?

2. Why is sediment a source of pollution? What problems does it create?

3. Discuss methods used to control erosion at construction sites.

4. Divide students into small groups to analyze a local development proposal. Pass out the proposal maps of the site and the soil survey sheets. Explain the development proposal briefly to students (see the decision which outlines subdivision regulations in your area). Encourage students to discuss these regulations and their effectiveness. Have each group focus on a separate section of the site.

5. Have each group identify areas where erosion would occur due to the development, highlighting areas they feel are of special concern. Have students choose methods for controlling the erosion.

6. Have each group draw a detailed map of their section, indicating areas where erosion would occur and illustrating their plan for erosion control. Have each group share their plans with the rest of the class. Compare and discuss.

* Collect site plan and decision from local planning office

** Soil survey sheets of the site are available from your local office of the USDA Natural Resources Conservation Service.

ACTIVITY IV: LET'S STOP THE SEDIMENT - FARMS

OBJECTIVE: Students will be able to illustrate and demonstrate how to control soil erosion using different conservation farming practices.

METHOD: Students will first draw pictures showing a variety of conservation practices. They will then use these pictures to create their own models to demonstrate the effects of installing these practices.

MATERIALS: "Lines on the Land" video*, paper, crayons or markers, pictures of various conservation practices*, five plastic seedling flats, potting soil, seeds (corn and rye grain), sod, grass clippings, woodchips, or other mulch material, watering can, bucket, plastic (garbage bags work well)

BACKGROUND INFORMATION:

1. Erosion on farmland can be controlled by:

   - planting winter cover crops such as winter rye
   - conservation tillage
   - rotating crops
   - stripcropping
   - maintaining field borders
   - terracing
   - building diversions and waterways to break the slope
   - vegetating concentrated drainage ways to prevent gullying

2. At home, you can control erosion by making sure your yard is well vegetated at all times, especially during the winter. Plant your garden across the slop is it is on a hill, and plant winter cover crops to hold the soil during the time when the crop plants are not in the ground.

PROCEDURE:

1. Show students the "Lines on the Land" video. Discuss conservation practices such as contour plowing, strip cropping, cover cropping, terracing, etc.

2. Have students draw pictures of various conservation practices. Any photographs or drawings you can find depicting conservation practices will be helpful to the students.

3. Have students work in four or five groups to demonstrate the effects of the following practices in the seedling flats: contour plowing, cover cropping, mulching, or permanent vegetation such as sod. Line the bedding trays with the plastic and then potting soil.

4. The first two flats will demonstrate the effects of contour plowing and planting on soil erosion. Make furrows in one flat parallel to the long edge of the flat, about two inches apart. In the other, make furrows parallel to the short edge of the flat, also about two inches apart. Plant corn seeds in furrows about ½ inch apart.

5. The next flat will demonstrate the effects of strip cropping with sod. Cut strips of sod about 4 inches wide, laying them in the flat crosswise, alternating with sections of soil that are also about 4 inches wide. (The sod strips should be perpendicular to the long sides of the flat.) Make two furrows in each soil section and plant corn seeds about ½ inch apart.

6. The next flat will demonstrate the effects of mulching. Make furrows in parallel to the short edge of the flat, about two inches apart. Plant corn seeds in furrows about ½ inch apart. Lay the mulch material lightly over the flat. It should be no more than ½ inch thick so the corn is able to germinate and grow up through the mulch.

7. The next two flats will demonstrate the effects of cover cropping. In one flat, plant the rye seeds uniformly, sprinkling them quite densely, about ¼ to ½ inch apart. In the other tray, leave the soil bare for comparison.

8. Set the trays in a sunny window and water as needed. When the corn and rye seedlings are about six inches tall, proceed with the demonstration. Prop each flat up at the same angle and position a bucket at the bottom end. Prop flats up so the slope runs down lengthwise (so the water and soil will have a longer distance to travel). Use a watering can to apply "rain" to the models. Collect the water and sediment in the bucket.

9. How did planting crops along the contour (parallel to the short edge of the flat) compare to planting crops parallel to the downward slope (the long edge)?

10. Compare the effects of mulching and strip cropping to the flat where corn was planted along the contour, but with no other erosion control practices. If these are much more effective in controlling soil erosion, why doesn't every farmer use these methods?

11. How did the rye cover crop compare with the bare soil? What season is this part of the demonstration depicting?

12. Controlling erosion also helps to control water pollution, because nutrients and chemicals travel with sediment and water. This will be the focus of the next two activities.

* Videos and booklets on various conservation practices are available from your local office of the USDA Natural Resources Conservation Service.

* Copies of your state's Soil Survey, loose soil survey sheets, and GIS maps are all available from your local office of the USDA Natural Resources Conservation Service.

ACTIVITY V: NUTRIENTS, PESTICIDES, AND DRINKING WATER QUALITY

OBJECTIVE: Students will understand how drinking water can become polluted from excess nutrients or pesticides. Students will learn how water quality is protected by different practices that reduce pollution from nutrients and pesticides.

METHOD: Students will assist with using the aquifer model from Unit IV, "Water Resources", to demonstrate the movement of pollutants and water movement through the soil and into a well.

MATERIALS: aquifer model (see Unit IV, Activity IV), watering can, red Kool-Aid crystals, turkey baster, small mesh bag made of old pantyhose or other finely meshed material

BACKGROUND INFORMATION:

1. Nutrients occur naturally in the environment. Decomposers turn natural decaying material into nutrients that can be used by plants.

2. Excess concentrations of nutrients in the environment come from:

   fertilizers applied on farms, home lawns, gardens, parks, golf courses, cemeteries, etc.
   septic systems
   animal wastes from livestock (manure), pets, and wildlife

3. Nitrogen and phosphorus are the two common nutrients which cause problems in the environment:

Nitrogen dissolves in rainfall or irrigation water and leaches to the groundwater. All three sources in #2 can produce excess Nitrogen. Nitrogen, in the form of nitrate, can be harmful to humans. Excess nitrates in our drinking water can limit our ability to carry oxygen in our blood. It is especially harmful to infants. The national drinking water standard set by the EPA dictates that nitrate levels should not exceed 10 ppm (parts per million).

Phosphorous attaches to soil particles via chemical attraction. When soil erosion occurs and sediment enters water bodies, the phosphorous is carried with it. Phosphorous comes from fertilizers; it is also used in some detergents and can thus enter the groundwater through faulty septic systems. Excess phosphorous in a water body can cause algae blooms. When the algae die, the decomposition of the dead matter can lower the dissolved oxygen concentration such that fish and other aquatic animal life are threatened. This process is called eutrophication.

4. People use fertilizers to encourage faster, stronger plant growth. It is not clear-cut that they always cause pollution. It may depend on how they are used.

5. To prevent nitrogen from polluting the groundwater:

   - use organic fertilizers such as compost or well rotted manure
   - use only recommended amounts of fertilizer at the time the plants need the nutrients
   - minimize use of fertilizers on sensitive sites, like very sandy soil over high water tables, or on very steep slopes
   - do not over irrigate; schedule irrigation according to crop needs, soil capacities, and weather conditions
   - do not use automatic watering devices for your lawn
   - do not apply fertilizer before a heavy rain
   - store manure in concrete or other impervious material
   - pick up dog waste and put it trash
   - keep septic system working properly (frequent pumping)

6. To prevent phosphorous from polluting the groundwater:

   - control soil erosion
   - keep septic system working properly
   - do not use detergents that contain phosphate

7. **Pesticides** are human-made and natural compounds applied to crops, animals, and buildings to minimize damage by certain pests. They can by herbicides, insecticides, fungicides, nematacides, or rodenticides. Sometimes pesticides are used to maintain a necessary yield. Other times, insect damage does not reduce the crop yield; it only affects the appearance of the crop. Farmers still have to use pesticides in this case because of consumer demand for perfect, bug-free produce.

8. Pesticides get into groundwater by leaching (similar to nitrates) and by runoff with soil erosion (similar to phosphorous).

9. To prevent pesticide contamination of surface and groundwater:

   - rotate crops to minimize the need for insecticides; most insects are crop-specific and will leave if desired crop is not present
   - use varieties resistant to as many pests as possible; this can especially reduce the use of fungicides
   - use organic methods such as natural predators, organic pesticides, hand-picking insects off plants, cultivation techniques
   - use integrated pest management (IPM): monitor insect populations and spray only as needed; use organic methods whenever possible
   - if you must use pesticides, use only according to directions
   - do not apply pesticides before a heavy rain
   - avoid or minimize pesticide use on sensitive sites such as highly leachable soils over high water tables or on very steep slopes

- maintain high levels of soil organic matter, which helps tie-up and break down the pesticides, lessening the chance that they will enter the groundwater
- observe proper handling of pesticides, and do not rinse equipment or mix chemicals near a well or surface water body

10. How can you help at home?

- help educate your family that it is okay to eat foods that aren't perfect; buy organic produce, support organic farmers
- minimize use of pesticides at home: hand pick insects off plants, pull up weeds by hand, use resistant crop varieties, etc.
- if you must use pesticides at home, use them only according to directions; measure the amount needed very carefully and never apply more than the recommended amount; more is NOT better

PROCEDURE:

1. Discuss nutrients and their effect on water quality:
   - What are the two main nutrients that cause problems in the environment?
   - Where do they come from?
   - Do they occur naturally? When do we consider them pollutants?
   - How do they enter the groundwater?
   - How do they harm use and other organisms?

2. Discuss pesticides and their effect on water quality:

   - What are pesticides?
   - Why are they used?
   - How do pesticides pollute the groundwater?

3. Use the model aquifer from Unit IV, Activity IV, "Testing Out an Aquifer". The current activity works best with clear water in the model aquifer. If the model still has colored water in it, have students help pump it dry with the turkey baster, and then add fresh, clear water with the watering can.

4. About three inches away from the well, place a dense spot, about one inch diameter, or red Kool-Aid crystals on the gravel surface, to represent excess fertilizer or pesticides. Gently sprinkle "rain" on the crystals. What happens when you continue to let it rain while you pump water from the well? How did the "pollutant" travel into the well? Extract some "polluted" water from the well and place in a clear jar so all students can inspect its color.

5. Pump the model dry and add fresh water once more. Fill the mesh bag with Kool-Aid crystals and bury in the gravel two inches deep, not too far from the well, to simulate a septic tank. Does the "pollutant" travel into the well when it rains and the well is pumped?

6. How can you prevent nutrients from polluting the water? Discuss farming practices, septic system maintenance, and other home practices. Consider both nitrogen and phosphorous.

7. How can pesticide contamination be prevented? Discuss alternatives such as organic farming, integrated pest management, and proper handling of pesticides. How can consumers have an impact on farming practices?

ACTIVITY VI: MAKING YOUR OWN FERTILIZER: COMPOST MAGIC

OBJECTIVE: Students will learn how different materials can provide nutrients for plants when they are decomposed. They will learn how organic fertilizer is created through composting, and how different factors influence the composting process.

METHOD: Students will build and maintain a compost pile in the school yard and conduct their own experiments to test how different factors influence the process.

MATERIALS: appropriate site on school grounds, shovels, digging and pitch forks, compost materials, water source (hose or watering cans)

BACKGROUND INFORMATION:

1. Composting is the art of ecologically converting organic "waste" materials into fertilizer. This process occurs in nature; composting promotes biological decomposition under controlled conditions.

2. Decomposition occurs primarily by microorganisms such as bacteria and fungi. They break down highly organized matter into smaller, simpler molecules that become available as nutrients for plants. As the microorganisms eat their way through the pile of organic matter, they give off heat. This heat speeds the decomposition process.

3. Compost is made by piling up alternate layers of carbon materials, nitrogen materials, and soil. Carbon materials are dried, dead, or brown plant matter. Nitrogen materials are fresh, green, or recently living plant materials. The layering provides a good mixture of nutrients for plants. The soil is important to add because it provides the microorganisms. It is analogous to adding yeast to bread dough.

Carbon Materials	Nitrogen Materials
dried leaved	kitchen scraps
straw	manure
dried grass	fresh lawn clippings
sawdust	freshly pulled weeds

   Do not include human, dog, or cat feces, animal products, plants treated with pesticides, or any toxic materials. There are all kids of compost materials lying around just waiting to be used. Check stables for manure and straw, the school cafeteria for food waste, and landscapers for leaves, grass clippings, and weeds.

4. Microorganisms need air and water. Thus the compost pile needs to be kept moist and aerated. It should not be too dense or wet.

5. The pile should be a minimum of 3' x 3' x 3' for optimum decomposition and adequate heat retention. If the pile is higher than six feet it will become too compressed and thus deprived of air.

6. The pile should be a rectangular shape, not a giant pyramid. The latter will allow heat, moisture and nitrogen to escape.

7. The pile can be "turned" on occasion to speed up decomposition. "Turning" helps aerate, stir up and chop up the compost pile. The more frequently a pile is turned the more quickly it decomposes. If a pile is turned every few days, it may only take 3 to 4 weeks to become compost. If a pile is never turned, it may take a good 5 or 6 months to decompose, depending on materials used and weather conditions.

8. It is best to start a pile in the fall when many materials are available. Also, this ensures a usable product by spring, when it will be needed for starting a garden.

PROCEDURE:

1. Using digging forks, have students loosen the ground where the pile will be (at least 3' x 3' in area). Discuss why the pile needs to be at least that large.

2. Begin layering materials, lightly watering each layer if materials are dry. Start by laying down a carbon layer, such as straw, dead leaves, or other dried (brown) plant matter. Next add a nitrogen layer, such as manure, fresh (green) plant matter, fresh lawn clippings, or kitchen scraps. Then add a layer of topsoil. Discuss the reason for each layer, focusing on nutrient contents and plant needs. Why is topsoil needed?

3. Repeat the carbon-nitrogen-soil sequence until the pile is at least three feet high. Do not make the pile taller than six feet.

4. Use shovels, digging or pitch forks to "turn" the pile weekly, monthly, or whenever possible. Take a forkful of materials from the top of the pile and place them on an empty spot of ground next to the pile. Continue adding materials from the original pile to the new pile until the original pile is gone. Discuss the importance of "turning" the pile.

5. As you turn the pile, constantly fork material out to the corners and edges to maintain a rectangular shape. Discuss why a pyramid shape is not desirable.

6. Monitor the state of the pile each week. Keep track of how often you turn the pile and how long the pile takes to decompose. Students can build other piles and turn them more or less frequently to compare the rates of decomposition (as long as materials used are comparable).

7. Keep the compost moist, but not soaked. If rain is a problem, cover with a large plastic tarpaulin. Discuss the need for maintaining the proper amount of moisture.

8. When the compost is complete, distribute in bags to students to bring home for their gardens, use in the classroom for plantings, or better yet, start a spring garden at the school. Cool season crops such as radishes, lettuce, spinach, and peas can be planted in April and should mature before or by the end of school.

9. What are the advantages of using compost as opposed to inorganic chemical fertilizers? What are the advantages of chemical fertilizers? Why do more farmers use the latter? Why are more and more farmers starting to use compost?

ACTIVITY VII: **STORMWATER RUNOFF**

OBJECTIVE: Students will learn how stormwater runoff is a non-point source of pollution. They will learn how treatment systems are being developed to reduce the impact that polluted runoff from roads and parking lots have on our surface waters.

METHOD: Students will design their own stormwater treatment system on paper and then create a three-dimensional model to depict how the process works.

MATERIALS: poster paper, pencils, crayons or markers, shallow aluminum pie plate, deeper plastic tray, egg carton-shaped foam rubber, toothpicks, green and brown paint, soil, watering can

BACKGROUND INFORMATION:

1. Oil, gasoline, road salt, heavy metals, sediment, and litter are deposited onto parking lots and roads. When it rains, water moves across the pavement quickly and picks up many or all of these contaminants. This contaminated stormwater flows into storm drains.

2. In many areas, storm drains flow directly into surface streams and rivers. Sometimes storm drains flow into sewage treatment plants. Other times storm drains are diverted into detention basins.

3. Detention basins slow the flow of water and allow sediments and many contaminants to settle out. The cleaner water travels through outflow pipes into further basins, streams or other water bodies. Some detention basins are constructed wetlands. The plants can filter out additional contaminants and thus these wetlands result in cleaner water than mere settling basins.

4. Another feature of stormwater management systems is catch basins to trap oil and grease. These are helpful because oil and grease usually do not settle out in detention basins and may not be used by plants in constructed wetlands.

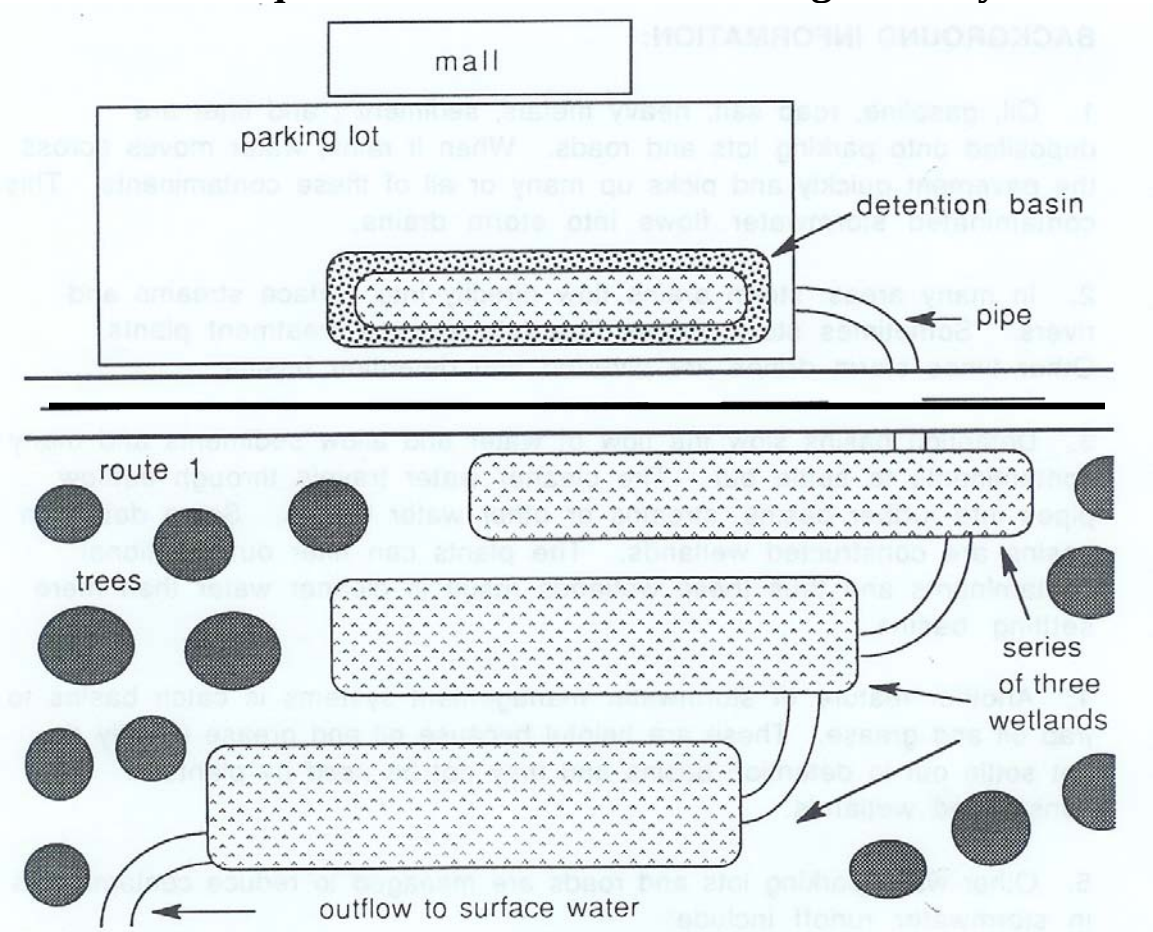
5. Other ways parking lots and roads are managed to reduce contaminants in stormwater runoff include:

    a. frequent sweeping and disposal of sediments at landfills
    b. use of sodium free de-icing salts
    c. restricted transport of hazardous materials
    d. limits on the use of herbicides, pesticides, and fertilizers

6. In Southeastern Massachusetts, the Emerald Square Mall has a “state-of-the-art” stormwater management system. Stormdrains lead to a detention basin where some contaminants settle out. The water is then piped into a series of three constructed wetland basins designed to filter out the rest of the contamination.

Emerald Square Mall also uses catch basins, frequent sweeping, sodium free de-icing salts, and limits the use of herbicides, pesticides, and fertilizers.

Emerald Square Mall Stormwater Management System



PROCEDURE:

1. What are the common contaminants carried by stormwater runoff? Where do they originate? Where does stormwater runoff usually end up?

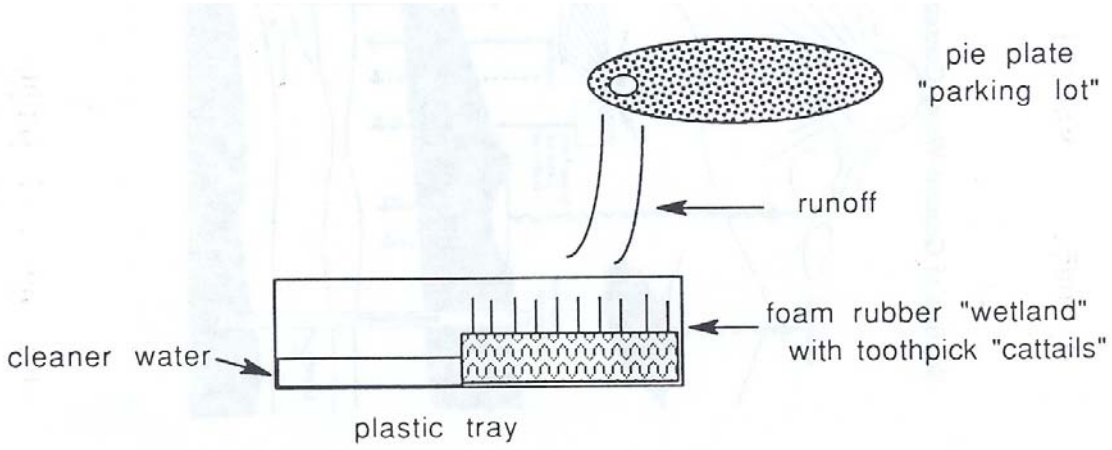
2. Discuss the use of detention basins, constructed wetlands, and other practices that reduce the contamination in stormwater runoff.

3. Sketch the Emerald Square Mall design on the board. Have students design their own stormwater management system. Share and discuss the students' designs.

4. Build a three-dimensional model of a stormwater management system. Cut the piece of egg carton-shaped foam rubber so that it is half the size of the plastic tray. Paint the tips of the toothpicks green and brown to simulate cattails. Stick the

"cattails" into the foam rubber to create a "wetland". Place the "wetland" into one end of the plastic tray.

5. The aluminum pie plate represents a parking lot. Cut a hole, about one inch in diameter, on the edge of the "parking lot", to simulate a storm drain. Place a small amount of soil on the "parking lot". Hold the "storm drain" over one end of the "wetland" and sprinkle "rain" from the watering can onto the "parking lot". The sediment should be trapped by the "wetland" and eventually, cleaner water should seep out of the foam rubber into the empty half of the plastic tray. Continue supplying "rain" until this occurs.



Water Quality Protection

SAFE AND HEALTHY LIVES
IN SAFE AND HEALTHY
COMMUNITIES

Rhode Island Department of HEALTH

UNIVERSITY OF Rhode Island

Residential Series
March 2004

What You Can Do About Nonpoint Source Pollution

RHODE ISLAND IS A STATE RICH IN WATER RESOURCES. From our freshwater lakes and ponds, rivers and streams, and abundant groundwater resources to our coastal ponds, estuaries, Narragansett Bay, and the Atlantic Ocean, our water resources sustain our livelihood. Our land use activities affect the quality of these water resources. There are many things that each of us can do to protect water resources. In this factsheet, we focus on Nonpoint Source Pollution.

What is nonpoint source pollution?

Unlike pollution that is discharged from industrial and sewage treatment plants, nonpoint source pollution, or NPS, comes from widespread sources on the landscape. Examples of NPS include: failing or improperly managed septic systems; leaking sewers; animal waste that is not managed properly; fertilizers and pesticides that are not used, stored and disposed of properly; leaking underground storage tanks; cars that are leaking oil and anti-freeze; fuel spills; and the list goes on. While the amount of pollution generated by an individual home may appear to be small the total effect from home to home throughout a watershed is significant.

To understand how NPS affects water quality, consider the water cycle and how water moves in the environment. When precipitation falls to the earth's surface, it can evaporate, soak into the ground, or travel over the land surface towards surface water bodies and the ocean. As rainfall, snowmelt, or excessive irrigation water moves over or below the land's surface, it can pick up and carry away natural and man-made pollutants – or NPS. These pollutants can end up in surface waters or move through the soil to groundwater resources impacting water quality.

What is the effect of NPS on our waters?

The US Environmental Protection Agency considers NPS the leading threat to water quality in the Nation. The specific water quality impacts will depend upon the pollutant. As watersheds become developed, urbanization and an increase in paved surface areas such as parking lots, driveways and rooftops increase stormwater runoff causing precipitation to run off quickly into surface waters resulting in:

- Overall reduction in groundwater recharge
- Long-term lowering of groundwater tables and loss of stream flow during dry weather
- Increased erosion of stream banks
- Increased water quality impacts caused by pollutants associated with urban runoff
- Flooding—especially more frequent "flash" flooding

Nutrients can upset the delicate balance of the aquatic ecosystem. Nutrients come from the natural breakdown of human and animal wastes and from fertilizers applied to residential, agricultural, recreational, and commercial landscapes. Nutrients that are transported to a surface water body can cause a boom in plant and algae growth. This rapid plant growth reduces water clarity, alters aquatic habitat, and robs the water of oxygen as bacteria breakdown the decomposing plants and algae. Excess phosphorus encourages plant growth in freshwater and excess nitrogen encourages plant growth in saltwater. In addition, nitrate-nitrogen is a drinking water contaminant and should not exceed the Federal Drinking Water Standard of 10 milligrams per liter (or 10 parts per million).

Pathogens, or disease causing organisms, include viruses, parasites, and protozoa (single-celled microscopic organisms). Sources of pathogens include human and animal waste. A common source of pathogens in stormwater runoff is pet waste. When pet waste is not picked up and properly disposed of, stormwater runoff can carry it into storm drains and surface waters. Failing or improperly managed septic systems can also contribute pathogens to ground and surface waters.

Sediment can be carried in runoff and deposited into surface waters from construction sites, agricultural and recreation fields, home lawns and gardens, and from roads receiving winter sand and salt applications. These sediments can destroy aquatic habitats, smother feeding and breeding grounds, clog fish gills, and make the water cloudy or turbid. Additionally, some pollutants, such as phosphorus, bacteria, and some chemicals attach to soil particles and can travel to surface waters with the eroding sediments.

Many man-made, or synthetic, chemicals are harmful to both humans and aquatic organisms. Sources of these contaminants include automobile fluids, fuels, many household cleansers and disinfectants, pesticides, and many more. One quart of oil can contaminate up to two million gallons of drinking water! MTBE, a gasoline additive, is showing up in groundwater throughout the Nation, impacting both public and private drinking water supplies.

Heavy metals that are found in stormwater runoff include cadmium, chromium, copper, lead, mercury, and zinc. These metals are often contained in gasoline, tires, brake pads, corroded metals, paint, motor oil, and wood preservatives.

De-icing salts applied during winter and their improper storage can result in contamination of surface and ground waters. Drinking water with elevated sodium or chloride levels may be a concern for people on low sodium diets.

What can I do to reduce NPS?

Once NPS enters our water resources, it can be very difficult and expensive to clean up. The best approach is for each of us to take actions that reduce these pollutants and prevent them from entering water resources. Each of us makes a difference. Together, we can keep our waters healthy. The first step is to take a close look at our everyday activities in and around the home and yard and note where changes can be made to reduce the potential for NPS.

Below are some specific steps you can take to reduce nonpoint source pollution around your home.

Yard and Garden - see our website www.healthylandscapes.org for more information

- Choose the right plant for the right spot. Sustainable and native plants that tolerate the given site conditions specific to your yard reduce the need for intensive inputs such as fertilizers, pesticides and irrigation water.
- Recycle your yard waste. Grass clippings, leaves and plant prunings are all valuable sources of mulch or ingredients for compost. Yard waste is a pollutant when washed directly into storm drains and surface waters.
- Use fertilizers and pesticides responsibly. Base fertilizer

applications on soil test recommendations and consider using organic sources of fertilizer. Correctly identify a pest and treat with alternative to chemical options where possible. Avoid using pesticides as a preventative measure. Measure the area to be treated or fertilized, calibrate your spreader, and avoid applying or handling fertilizers or chemicals on paved surfaces or near drinking water wells, storm drains and surface waters.

- Water wisely. Use a rain gauge to measure weekly rainfall and make up the difference (about one inch of water needed per week in the summer) with irrigation. Water during early morning hours and one long, slow watering event each week is best. Wet leaves at night increase risk of plant disease. Be sure in-ground sprinkler systems have a manual control option. Use low-flow soaker hoses and drip irrigation for vegetable gardens and beds.
- Reduce runoff from your yard and increase groundwater recharge. Reduce paved surface areas around your yard. Direct roof runoff and other concentrated runoff to areas that can allow it to settle and soak into the ground. Options include rain gardens, border beds of shrubs and groundcovers, and placement of crushed stone.
- Reduce soil erosion. Keep it planted and mulched. Protect the soil by maintaining perennial vegetative cover, winter cover crops, mulch, or crushed stone in heavy traffic areas.
- Pick up after your pets. Pick up solid waste and properly dispose of it in the trash, flush it down the toilet, or through proper burial methods. Do not locate dog runs or yards near drinking water wells, storm drains or surface waters. Do not encourage resident waterfowl. Refer to factsheet *Pet Waste and Water Quality* for more information.
- Use and dispose of fuels and hazardous products properly. Do not store or maintain fuels and motorized equipment near a drinking water well, storm drain or surface water.

Proper use, storage and disposal of household hazardous products - Refer to factsheet *Household Hazardous Products* for more information.

- Carefully follow the product label directions for use and storage.
- Keep products in their original, labeled containers and in cool, dry well-ventilated areas that are out of reach of children and animals.
- Buy only what you need. Give surplus products to friends, neighbors and groups who can use them.
- Look for non-toxic alternatives. For example, latex, water-based paints.
- Do not pour paints, used oil, cleaning solvents, polishes, pool chemicals, insecticides, and other household chemicals down the drain, in the yard, or on the street.
- Dispose of household hazardous waste properly (contact the RI Eco-Depot) and recycle wastes where possible.

Septic System Maintenance

- Have your septic system inspected annually and pumped as needed.
- Avoid using chemical and other septic system additives.
- Place only toilet paper in the toilet.
- Conserve household water, reducing the amount of wastewater entering the septic system.
- Spread major water-using chores out evenly during the day and week.
- Don't pour hazardous household products down the drain.
- Compost kitchen wastes rather than use a garbage disposal.

Vehicle Maintenance

- Consider car pooling or public transportation where possible. Consider walking or riding a bicycle when traveling short distances. Driving less reduces the amount of pollution your automobile generates.
- Recycle used motor oil and do not pour waste oil on the ground or down storm drains. Used motor oil can often be accepted and recycled at local sanitation departments, service stations, or the RI Eco-Depot.
- Keep up with car maintenance to reduce leaking of oil, antifreeze, and other hazardous fluids.
- Hand-wash your car on the lawn. Do not leave the hose running while washing the car. If you are unable to keep car wash runoff from leaving the driveway or yard, consider taking your car to a commercial car wash facility.

Water Conservation – refer to factsheet *Water Conservation in and around the Home* for more information

- Use low-flow and water saving fixtures and appliances.
- Repair plumbing leaks promptly.
- Use dishwashers and clothes washers only when fully loaded.
- Take short showers instead of baths and avoid letting faucets run unnecessarily when shaving or brushing your teeth. Catch the water in a bucket as you wait for it to get hot and use it to water plants.

Other Areas Where You Can Make a Difference

- Participate in clean-up activities in your neighborhood.
- Write or call your elected representatives to inform them about your concerns and encourage legislation to protect water resources.
- Get involved in local planning and zoning decisions and encourage your local officials to develop erosion and sediment control ordinances and wastewater management programs or sponsor hazardous waste pick-up days.
- Promote environmental education. Help educate people in your community about ways in which they can help protect water quality. Involve community groups.

• • •

For More Information:

University of Rhode Island Cooperative Extension Home*A*Syst Program
Offers assistance, information, and workshops on residential pollution prevention including private well water protection, septic system operation and maintenance, landscaping for water quality protection, and actions residents can take to reduce pollution. 401-874-5398 www.uri.edu/ce/wq

Refer to our website www.healthylandscapes.org for more information on sustainable landscaping and stormwater runoff control.

RI Department of Health, Office of Drinking Water Quality
Offers assistance and information on private well water testing and state certified water testing laboratories.
401- 222-6867 http://www.health.ri.gov/environment/dwq/Home.htm
For a listing of HEALTH's certified private laboratories in Rhode Island http://www.health.ri.gov/labs/instate.htm

URI CE GreenShare Program
(401) 874-2900 www.uri.edu/ce/ceec
The GreenShare Program provides scientifically accurate and environmentally sound information on management of suburban and urban landscapes. Integrated pest management, pollution prevention and sustainable landscaping are the guiding principles of all GreenShare programs. The Sustainable Trees and Shrubs publication is available on-line at: http://www.uri.edu/ce/factsheets/sheets/sustplant.html

The URI Plant Protection Clinic identifies insects on plants and in the home, and will diagnose plant diseases.
www.uri.edu/ce/ceec/plantclinic.html

Rhode Island Resource Recovery Corp.,
Rhode Island Eco-Depot
For information on household hazardous waste disposal, non-toxic alternatives and recycling.
(401) 942-1430 ext. 241 www.rirrc.org/site/ecodepot/eco_main.asp

Adapted from: "Do's & Don'ts Around the Home" by Robert Goo. EPA Journal Article, November/December 1999, EPA-22K-1005. "What is Nonpoint Source (NPS) Pollution? Questions and Answers." 1997. www.epa.gov/owow/nps/qa.html

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This project is a collaboration of the staff at HEALTH and the University of Rhode Island Cooperative Extension Water Quality Program.

Rhode Island Department of HEALTH

UNIVERSITY OF Rhode Island

Septic System Information
for Rhode Islanders

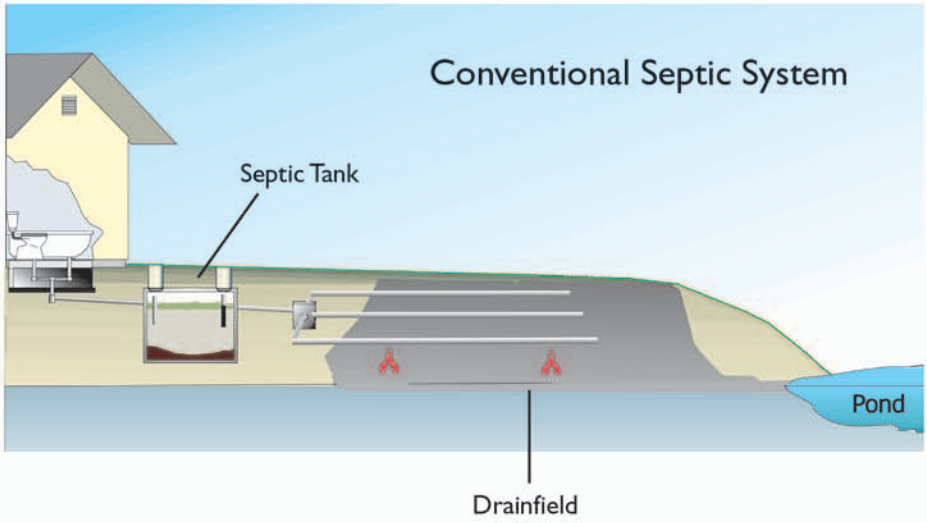
WHAT'S IN YOUR BACKYARD?

Forty percent of Rhode Islanders get their drinking water from groundwater or small local reservoirs. Outdated cesspools and failing septic systems are a major source of pollution to these water supplies. What you flush down your toilet directly affects the water you drink and the waters you fish, swim, and boat in.

What YOU can do.
- **Inspect your septic regularly**
- **Pump and repair it as needed**
- **If you have a cesspool, plan to replace it**

CONVENTIONAL SEPTIC SYSTEMS

When properly designed, installed, and maintained, septic systems help keep your water supply safe. They replenish groundwater, and they are cost effective. All septic systems need regular maintenance. It is much less expensive to keep them operating properly through regular inspections and pumping than it is to replace them if they fail. With proper care a conventional septic system can last at least 25 years or longer.



There are two major parts to a conventional septic system

THE SEPTIC TANK

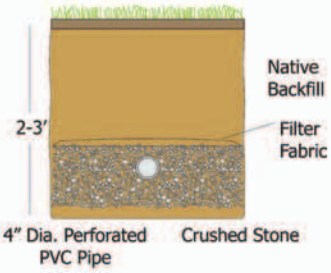
The septic tank separates solids from liquids before sending wastewater to the drainfield. A layer of sludge settles at the bottom and a layer of scum forms at the top, so only the clearest wastewater goes into the ground. Keeping solids in the tank and out of the drainfield is the best way to prolong system life.

Modern Tank features include:
- Water tight tank, solids gradually build up and must be pumped out regularly
- Access risers allow easy entry for inspection
- A low cost effluent filter helps keep solids in the tank to protect your drainfield

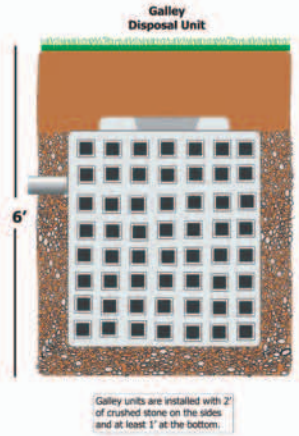
THE DRAINFIELD

Drainfields distribute the wastewater to the soil. Two types commonly used are disposal trenches and seepage pits.

A **Trench**-type drainfield consists of two or more parallel stone-lined ditches, each with a perforated pipe that allows incoming liquid wastewater to seep into the soil. A distribution box located between the tank and the drainfield splits wastewater flow to the different lines.



Seepage Pits are bottomless concrete box-like structures with open, grated sides. Two types are commonly used. "Galleys" are 4' x 4' X 4' units installed as deep as 10 feet below ground. "Flow diffusers" are shallow 8' X 4' x 2' units. Both types of seepage pits are generally installed in a series of three or more. Liquid effluent flows directly from the tank into the seepage pit where it seeps out the side walls and bottom.



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Rhode Island Regional Water Quality Program
University of Rhode Island College of Environment & Life Sciences
Department of Natural Resources Science
Cooperative Extension On-Site Wastewater Training Center

ALTERNATIVE SEPTIC SYSTEM

New technologies treat wastewater before it reaches groundwater. These alternative systems provide an extra treatment step that conventional systems are not designed to do. Enhanced treatment systems are available for even the most difficult sites and in environmentally sensitive areas.

CESSPOOLS

A cesspool is nothing more than a covered pit that receives wastewater and allows it to drain into the surrounding soils. This might be a stone-walled pit, perforated concrete chamber, or leaking steel tank. Cesspools don't treat wastewater. Solids and liquids seep directly through the soil into the groundwater. This poses a threat to surrounding bodies of water and nearby wells. Not sure what's in your backyard? Chances are you have a cesspool or other substandard system if your house was built before 1970.

FAILING SEPTIC SYSTEMS

Septic systems fail when wastewater effluent is unable to seep into the ground. Common causes of failure are:

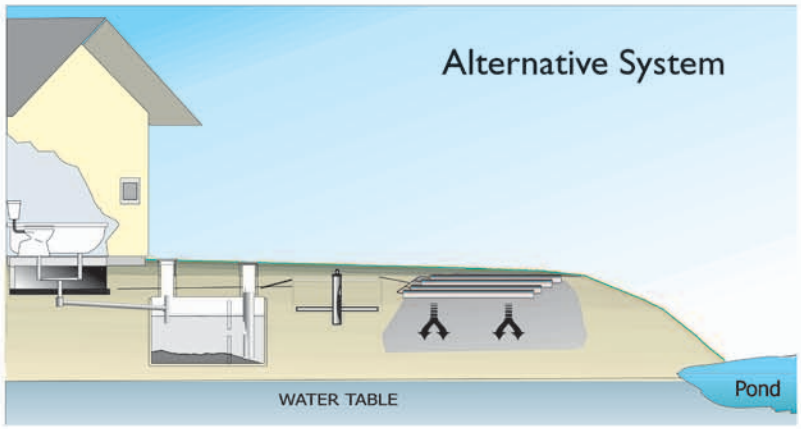
- Overloading with too much water.
- Improper disposal of solids or grease.
- Tank full of solids, drainfield clogged with solids.
- High water table flooding the drainfield.
- Broken pipes, tree roots or other damage.

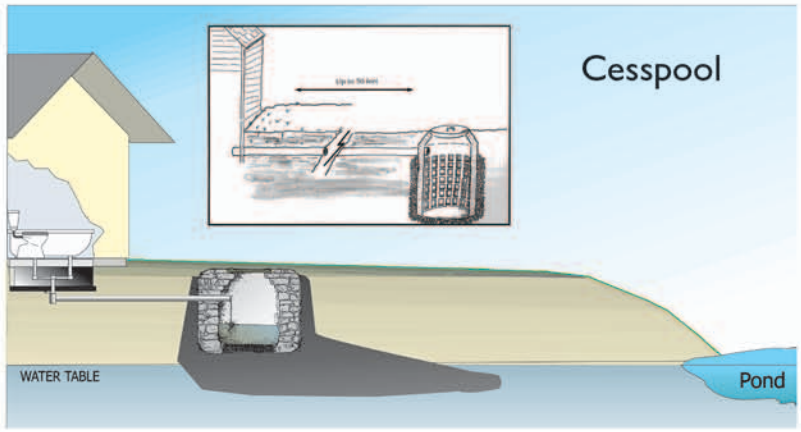
Your system may be failing if you have:

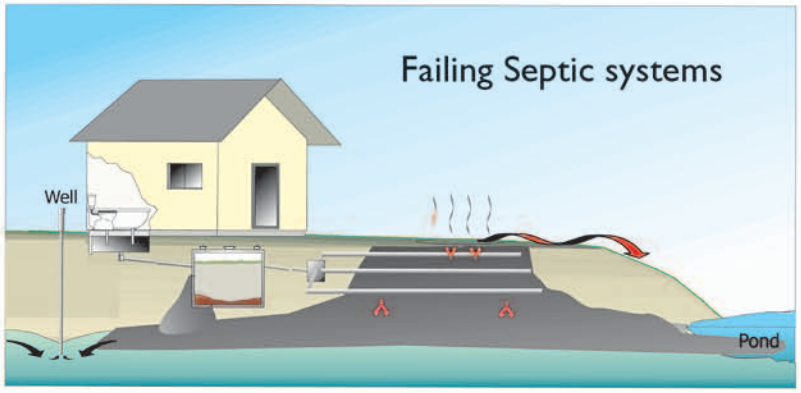
- Sluggish drains or odor
- Wastewater backups into house
- Squishy patches above drainfield
- Lush grass above drainfield

Even if you don't notice any problem, your system can still be polluting groundwater. In very sandy or wet soils effluent may reach the groundwater too quickly. Leaking tanks or broken pipes allow wastes to seep into drinking water without treatment.

Even new systems can fail due to faulty design or poor installation. Common causes are use of poor quality stone or gravel fill, improperly sealed tank seams and plugs, and soil compaction or structural damage by heavy equipment driven over the system.







FIND OUT WHAT'S IN YOUR BACKYARD

To keep drinking water safe, and maintain property values, many RI towns require regular system maintenance. Financial assistance may be available for repairs. Contact your town hall to learn more. For technical information contact URI Cooperative Extension at 874-4558/5950 or http://www/uri.edu/.

Cooperative Extension in Rhode Island provides equal opportunities in programs and employment without regard to race, color, national origin, sex, or preference, creed or disability. This publication is supported by URI Cooperative Extension, College of the Environment and Life Sciences, University of Rhode Island. Partial funding for this project provided by CSREES, Project 92- EWQI-1-1040 and the EPA Block Island/Green Hill Pond Watershed National Community Decentralized Wastewater Treatment Demonstration Project.

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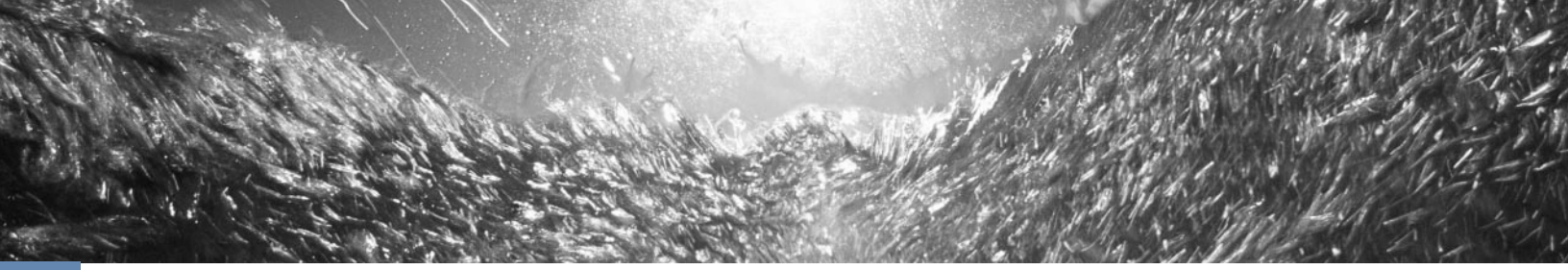

Water Quality Protection

SAFE AND HEALTHY LIVES
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Residential Series
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Pet Waste

RHODE ISLAND IS A STATE RICH IN WATER RESOURCES. From our freshwater lakes and ponds, rivers and streams, and abundant groundwater resources to our coastal ponds, estuaries, Narragansett Bay, and the Atlantic Ocean, our water resources sustain our livelihood. Our land use activities affect the quality of these water resources. There are many things that each of us can do to protect water resources. In this factsheet, we focus on Pet Waste and Water Quality. To find out more about other ways of reducing pollution, refer to the factsheet *What You Can Do About Nonpoint Source Pollution.*

What do you do?

- When you take your dog for a walk or empty the kitty litter box, do you leave pet waste on the sidewalk, along the edge of the street, or dispose of it directly into a storm drain?

- When riding your horse, does it deposit manure in or near a stream or pond along your trail route?

- Do you keep a few livestock and pile the manure in areas exposed to rainfall and snowmelt?

- Do your trips to the park always end in feeding the geese and ducks?

If you can answer "yes" to any of these questions, you may be surprised to learn that these everyday activities, which are a normal part of caring for your pets and livestock, can be a source of water pollution. It may be difficult to picture how one dog or one horse depositing a small amount of animal waste here and there can result in potential water pollution. However, studies have shown that the cumulative impact of waste from all the pets, livestock, and resident waterfowl within a watershed can have a significant impact on water quality and may also cause human health risks.

What are the concerns?

Pet waste and livestock manure left on the ground, exposed to rainfall and snowmelt, or disposed of in storm drains can mix with runoff and eventually enter lakes, streams, Narragansett Bay, coastal ponds, or drinking water reservoirs. Animal waste can pose several water quality concerns. It is a potential source of nutrients and pathogens (disease-causing organisms), which can degrade water quality making it unsafe and undesirable for drinking, swimming, boating, fishing, shellfishing, scenic value, and aquatic life. Refer to factsheet *What You Can Do About Nonpoint Source Pollution* for more information about the effects of nonpoint source pollution.

What are some solutions?

There are safe practices for handling and disposing of pet waste. In doing so, you are protecting both the environment and your health.

Pick up after your pet

When walking the dog, take a plastic bag and scooper for picking up solid waste. Many communities have "pooper scooper" laws requiring immediate pet waste removal. Call your town hall about pet waste laws in your community.

Pet waste should also be collected daily from your own yard. Pet waste should not be deposited or left near drinking water wells,

storm drains, surface water bodies, or children's play areas. Keep these areas clean.

What should you do with pet waste? No solution is perfect, but here are a few choices:

1. Flush pet waste down the toilet.
The water from your toilet goes to either a sewage treatment plant or a septic system. Both are designed to treat human waste. To prevent plumbing problems or serious septic system malfunction, **don't flush debris such as rocks, sticks, or cat litter.** Cat feces may be scooped out and flushed down the toilet, but used litter should be put in a securely closed bag and then disposed of in the trash.

2. Bury pet waste in the yard.
Dig a hole or trench that is:
- At least 5 inches deep
- Away from vegetable gardens
- Away from any lake, stream, ditch, or drinking water well
- Preferably in grass or wooded areas (excluding fruit or nut trees that you eat from)

Microorganisms in the top layer of soil will break down the waste. Don't add pet waste to your compost pile, because the pile will not get hot enough to kill disease organisms.

You can install an in-ground pet waste disposal system or digester, which works like a small septic tank. Check local laws that may restrict their use, design, or location. Pet waste digesters may be a suitable alternative when site conditions are favorable. An enzyme powder and water are used to assist with the decomposition. Pet waste digesters require a deep hole and do not function well in heavy clay or compacted soils, or at temperatures below 40 degrees F. During winter months, an alternative disposal method will be needed. A pet waste digester system should not be located near a drinking water well, storm drain, surface water, or vegetable garden.

Both pet waste digesters and straight burial are not recommended at sites where there is a high water table within 18 inches or less from the ground surface.

3. Put pet waste in the trash.
If you dispose of pet waste in the trash, wrap it carefully in a sealed bag so it will not spill during trash collection. While cat feces can be managed using options 1 or 2, used cat litter should be disposed of in the trash. Do not flush cat litter down the toilet or bury it in the yard.

What about dog yards and runs? Dog yards and runs should never be located near a drinking water well (including your neighbor's) or immediately upslope of a surface water body. Ideally, the area should be fairly level and well vegetated away from vegetable gardens and children's play areas. Collect and dispose of pet waste as suggested above.

Don't feed the waterfowl!

Feeding waterfowl encourages more birds than natural food supplies can support. These large flocks also deposit large quantities of waste in and around surface waters that can significantly degrade water quality.

Keep livestock manure and bedding piles protected from the weather

If you have horses or other livestock and stockpile or compost the manure and bedding waste, keep the storage areas sheltered from the weather and away from drinking water wells or other nearby surface waters. Do not allow rainfall or snowmelt to mix with the pile and wash it off-site.
Depending on the amount of manure and bedding waste generated on a daily basis and the amount of land you own or have access to, it may be necessary

to think about some options for handling, utilizing, or disposing of the animal waste properly. **Contact the USDA Natural Resources Conservation Service and your local Conservation District at (401) 828-1300 for more information and assistance with the following points.**

Livestock manure can be a valuable source of plant fertilizer and soil organic matter. However, when it is over-applied or applied at the wrong times, it can be a source of ground and surface water pollution. If you have more manure than you can use, consider finding others who can use it. In addition to neighbors with gardens, nurseries and fields used to produce hay, corn, and other field crops can be candidates for using surplus manure.

Temporary Storage Area.
Protect waste storage areas from the weather and keep stormwater runoff from roofs, driveways, and other areas away. Lining the storage area helps prevent leaching of nutrients and pathogens into the groundwater, and never locate a manure storage area near a drinking water well, storm drain, or surface water.

Compost the manure.
Compost is high in organic matter and provides a more stable, slow release of plant nutrients. Depending on your situation, you may have the space and some small equipment to compost the manure. This option may also depend on how much bedding and feed waste is generated, as this reduces the need for imported ingredients to do the composting process.

What about animal pens and corrals?
These areas are usually small and occupied daily. They are concentrated sources of nutrients and pathogens that could pollute water resources. Ideally, locate pens in areas that are level and well vegetated. If space allows, having more than one pen to rotate animals between, along with planting a less palatable grass mixture, can help maintain some degree of vegetative cover. This will also help reduce erosion and runoff. Surround the outside of the animal pen with a good vegetative buffer and pick up solid waste periodically. Where there is adequate pastureland, proper grazing management is key towards balancing plant nutrients and animal waste.

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Diseases that can be transmitted from pet waste to humans include:

- Campylobacteriosis – A bacterial infection carried by dogs and cats that causes diarrhea in humans.
- Cryptosporidiosis – A parasitic infection that causes diarrhea and abdominal pain.
- Giardiasis – A protozoan infection of the small intestine that can cause diarrhea, cramping, fatigue, and weight loss.
- Salmonellosis – The most common bacterial infection transmitted to humans by other animals. Symptoms include fever, muscle aches, headache, vomiting, and diarrhea.
- Toxocariasis – Roundworms usually transmitted from dogs to humans, often without noticeable symptoms, but can cause vision loss, a rash, a fever, or a cough.
- Toxoplasmosis – A protozoan parasite carried by cats that can cause birth defects such as mental retardation and blindness if a woman becomes infected during pregnancy. It is also a problem for people with depressed immune systems. Symptoms include headache, muscle aches, and lymph node enlargement.

For More Information:

University of Rhode Island Cooperative Extension Home*A*Syst Program
Offers assistance, information, and workshops on residential pollution prevention including private well water protection, septic system operation and maintenance, landscaping for water quality protection, and actions residents can take to reduce pollution.
401-874-5398 www.uri.edu/ce/wq

RI Department of Health, Office of Drinking Water Quality
Offers assistance and information on private well water testing and state certified water testing laboratories.
401- 222-6867 http://www.health.ri.gov/environment/dwq/Home.htm
For a listing of HEALTH's certified private laboratories in Rhode Island http://www.health.ri.gov/labs/instate.htm

USDA Natural Resources Conservation Service
Your local Conservation Districts
For technical assistance with the management of livestock manure and waste
401-828-1300 www.ri.nrcs.usda.gov

Adapted from "Pet Waste and Water Quality," University of Wisconsin, Extension, 1993. "Pet Waste and Water Quality," Rutgers Cooperative Extension. FS922. "Clean Waters Starting in Your Home and Yard," University of Connecticut Sea Grant Extension Program and Cooperative Extension System's NEMO Project, 1999.

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