



EnviroScape

*Patent No. 5,427,530*®

# USER'S GUIDE

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# WETLANDS

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JT&A gratefully acknowledges the students and environmental educators whose imagination and insight inspired the design and development of several activities in the EnviroScape Wetlands, especially Kevin Hasoup, Jill Hollenbeck, Minh Le, Abbie Marvel, Kristin Morgan, Sara Russell, Heather Sherwood, Nicole Silicato, Rikki Timmons, Stephen Walter, and David Wilkins of the class of 1997 at Milford High School, Milford Delaware; their teacher, David Grobinski; and mentors, Ray Hunt and Gary Kreamer, Delaware Division of Fish and Wildlife; and Pearl Burbage, Delaware Division of Water Resources.

Many thanks, too, to members of the review committee who stayed with this project through many drafts and whose suggestions greatly improved the final model.

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# CHECK FOR CONTENTS!

AGES 5 AND OVER

The following components are included in the EnviroScape® Wetlands unit (item 71005CW). Please use this list to verify that all items are included in your model. **Should any item be missing, please notify us within 10 working days by call 703-631-8810, ext. 10.** Reporting missing items past 10 days may result in an additional charge. Thank you, and enjoy learning with EnviroScape!

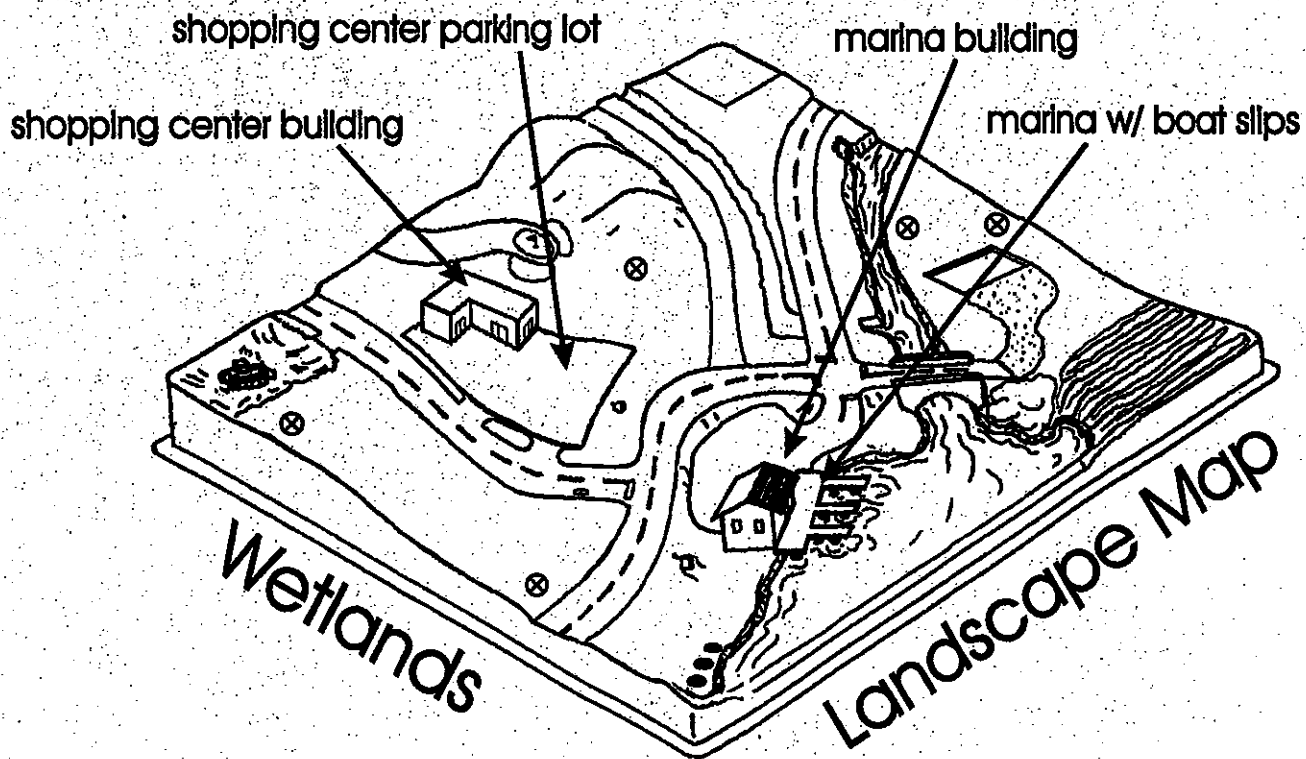
Please make sure your EnviroScape® WETLANDS unit includes (*turn over for wetlands diagram*).

- |  |   |   |
|--|---|---|
| <input type="checkbox"/> 1 wetlands landscape map w/storm pipe (clear tube) [6017] | <input type="checkbox"/> 1 measuring cup [6018]                                   | <input type="checkbox"/> 1 barn [5012]  |
| <input type="checkbox"/> 1 clear rectangular base* [5058]                          | <input type="checkbox"/> 2 felt packs ( <i>constructed wetlands</i> ) [5044]      | <input type="checkbox"/> 1 factory w/clear tube connected [5014]                                      |
| <input type="checkbox"/> 1 shopping center building w/parking lot [5030]           | <input type="checkbox"/> 1 cotton swab pack ( <i>wetland plant roots</i> ) [6019] | <input type="checkbox"/> 2 golf flags [5004]  |
| <input type="checkbox"/> 1 marina building w/boat slips [5029]                     | <input type="checkbox"/> 2 spray bottles (8 oz.) [6020]                           | <input type="checkbox"/> 3 cows [5007]  |
| <input type="checkbox"/> 3 bridges [5002]  | <input type="checkbox"/> 1 eco-spout [5015]                                       | <input type="checkbox"/> 2 cars [6021]  |
| <input type="checkbox"/> 2 round trees [5005]                                      | <input type="checkbox"/> 1 clay stick [5052]                                      | <input type="checkbox"/> 1 bulldozer [6013]   |
| <input type="checkbox"/> 3 tall trees [5006]                                       | <input type="checkbox"/> 1 Wetlands User's Guide [5050]                           | <input type="checkbox"/> 1 squirt bottle [6022]   |
| <input type="checkbox"/> 1 sponge pack ( <i>wetlands</i> ) [5043]                  | <input type="checkbox"/> 1 vinyl bag ( <i>contains accessories</i> )              | <input type="checkbox"/> 1 water tray [6038]  |
| <input type="checkbox"/> 1 rubber plug (#3) [5001]                                 | <input type="checkbox"/> 2 houses [5010]  | <input type="checkbox"/> 3 round shaker containers containing green & red drink mix, and cocoa [6023] |
|  |   | <input type="checkbox"/> 1 spoon and sponge [5060]  |

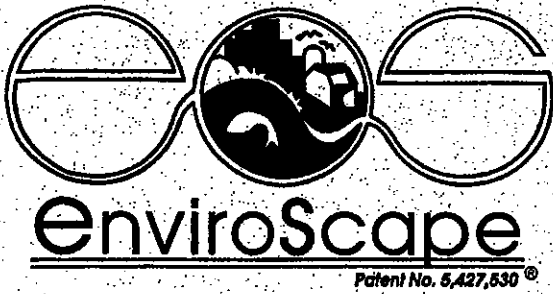
Replacement parts can be purchased at your local stores, or by calling us at (703) 631-8810, ext. 10 or go to our website: [www.envirosapes.com](http://www.envirosapes.com) and download an order form.

**IMPORTANT:** If you're not 100% satisfied, you can return your EnviroScape® WETLANDS to us for a full refund less shipping costs. **CONDITIONS:** The model must be returned within ten (10) working days; all parts must be included (the cost of missing or broken parts not previously identified to us will be deducted from any refund); and the model and its parts must be clean and in resalable condition. **Returns should be sent to:** EnviroScape, c/o JT&A, inc., 14524-F Lee Road, Chantilly, VA 20151.

## You Will Need Water Before You Begin!



⊗ Holes for use with Groundwater unit. If you plan to use the groundwater unit with your wetlands model, make sure these holes are unplugged.



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www.enviroscales.com

## To EnviroScape® WETLANDS Users:

Thank you for using EnviroScape® Wetlands — one in a series of EnviroScape® models available.

Please take care to note the following:

1. **Constructed Wetland Packet.** Please make sure the model's surface is very wet before you place the adhesive felt pieces on the model, and never leave the felt pieces on the model for an extended period of time. This should alleviate potential sticking to the model.
2. **Storm Drain.** This improved design allows for better demonstration of runoff into storm drains. Place the small clear pipe in the drainage area (cover pipe with clay if desired). The runoff will collect in the storm drain and flow through the drainpipe area.
3. **Use with the Groundwater Component.** There are holes drilled in the Wetlands landscape map that allow for use with the groundwater component. Cover the holes with clay or the yellow plugs (5 plugs included), should you not wish to use.
4. **Let us know about your experience with EnviroScape Wetlands!** Send us any hints or suggestions you may have that we can share with other users — or improvements you'd like to see made. And don't forget to send us photos and stories of your events to share with others as well!
5. **Visit our website at [www.enviroscales.com](http://www.enviroscales.com) for "User Tips"** (located under Program Support) and to sign-up for our "E-mail List," so you can receive information via email regarding other tips, programs, conferences and MORE . . . relating to the EnviroScape program.

We look forward to hearing about your experience with EnviroScape and to helping you meet your environmental education needs.

Sincerely,

Carlene Bahler  
President

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For additional resources and current information on EnviroScape products, visit us at <http://www.envirosapes.com> or call us at 703/631-8810.

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EnviroScape® is a registered trademark and patented product of JT&A, inc., patent number 5,427,530. EnviroScape Riparian Kit intends to create awareness of riparian issues as a whole, not to single out any industry or land use as a contributor to riparian degradation. Mention of trade names or other products does not constitute endorsement.

# NOTES TO THE FACILITATOR

*T*his activity guide is written for use with the EnviroScape Wetlands landscape. The riparian kit may also be used with other scenarios, including the EnviroScape Nonpoint Source unit.

In addition to showing you how to set up and operate the riparian kit, this guide provides basic information about riparian issues. It is not, however, a comprehensive guide to riparian issues, and it assumes that you are already familiar with nonpoint sources of pollution using the EnviroScape Nonpoint Source unit.

# NOTES TO THE FACILITATOR

## How to Use This Guide

*T*his guide is written for easy reading and understanding. We recommend that each facilitator read through the guide at least once before demonstrating the model.

The guide is a teaching aid — you will want to follow its instructions while demonstrating the model. Experience shows that after two or three demonstrations, you will probably not use the guide during demonstrations. It will remain, however, one of your most important references.

**A SPECIAL NOTE:** Although each demonstration provides for individual activities, you may choose to combine a number of these activities into one major activity depending on your needs.

## Suggested Activities

EnviroScope can be used to demonstrate all types of wetlands. Among those who can tell you about specific wetlands and the wetland plants found in your area are

- local, state or district conservation offices;
- local, state or federal Extension Service or Natural Resources Conservation Service offices; and
- other state or federal agencies, such as the Environmental Protection Agency, the Fish and Wildlife Service, and state departments of natural resources, conservation and environment.

In fact, after you've demonstrated the basic wetlands concepts using **EnviroScope**, you may want to invite a representative from one of these agencies to talk to your group about local wetland landscapes.

- Begin your demonstration with a list of the **values** and **functions** of wetlands. Following the demonstration, ask the participants to list them again.
- Find out your local rainfall amounts and patterns. When do the heavy rains occur? What is the average amount of rainfall during a rainfall event? Perhaps 90 percent of rainfalls average less than 1 inch, but frequent, small storms may be significant from a nonpoint source pollution standpoint.
- Find out the types of wetlands and wetland plants common to your area.
- Demonstrate the model with a story — invite your audience to describe what they think this landscape was like 50 years ago, 100 years ago, before colonial times. Tell a story about land uses.

# **Why are wetlands important?**

**Because these areas have unique  
functions and values.**

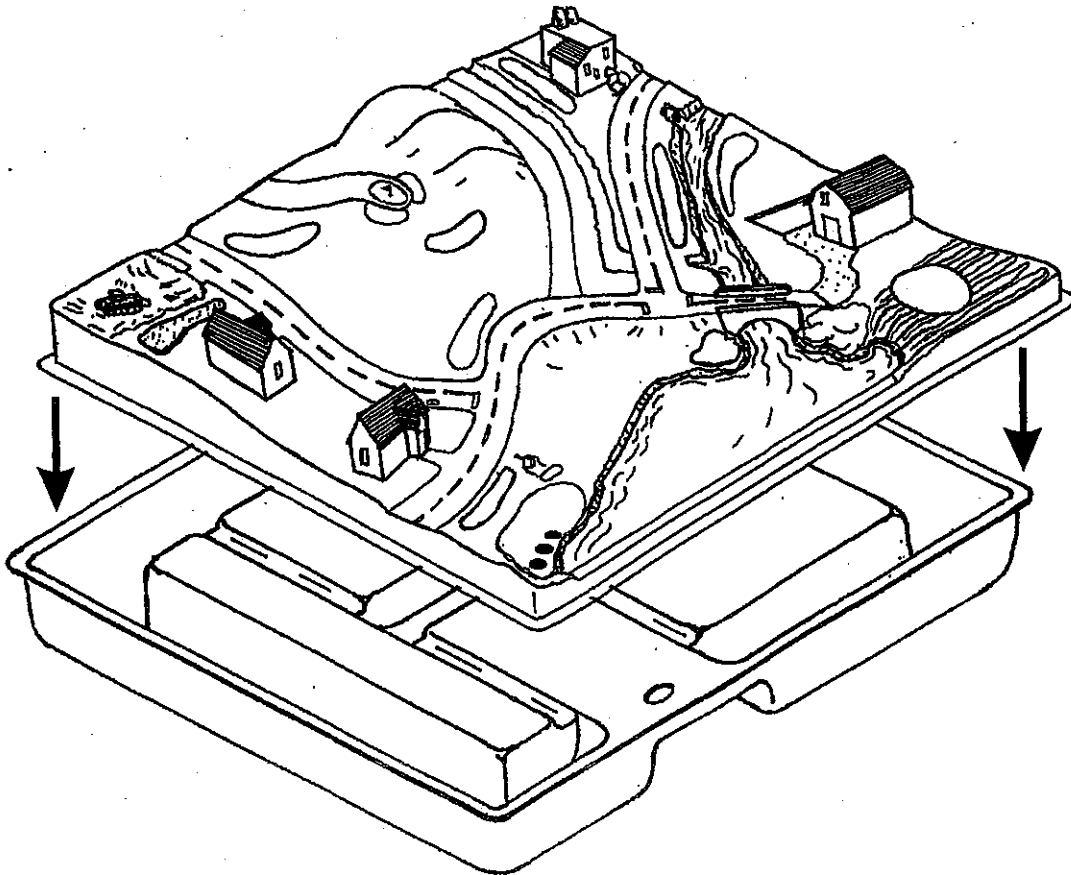
# DEMONSTRATION 1

## HOW WETLANDS WORK

**FACILITATOR'S NOTE:** This demonstration is an overview of the basic functions and values of a wetland.

### **STEP 1: Prepare the Model**

1. Remove all items from the case.
2. Place the EnviroScape Wetlands landscape on the base as shown below.

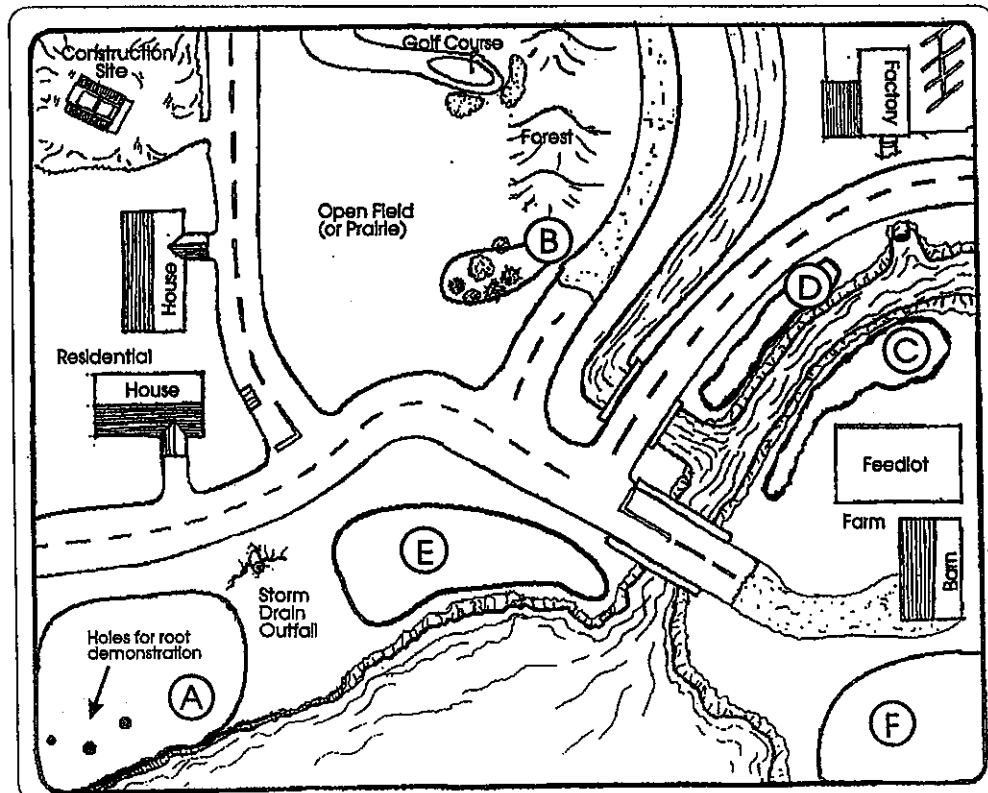


## HOW WETLANDS WORK . . .

**NOTE:** if you do not have EnviroScape Groundwater, skip Step 3.

3. Place the groundwater liner in the base of the model as instructed in the EnviroScape Groundwater operating guide. If your wetlands map has not yet been adapted for use with the groundwater unit, please call us at 703-631-8810.
4. Place the houses, barn and factory (the industrial plant) on the model.
5. Add the bridges, vehicles and golf flags (use clay to form a mound and insert the golf flag in the mound).
6. Place **wetlands A through F** (sponges) on the model as indicated in the diagram below.
7. Place trees on the model using clay to form tree trunks: put two tall trees in the trunks in the forest, put one tall tree in the forested **wetland (B)** and place the round trees in the residential area.
8. Insert cotton swabs through the slit in **wetland A** and through the holes in the wetland A area of the landscape. The top half of each swab stays above the model; the bottom half shows through the base.

### Wetlands Location Key




#### Wetlands

- A. shoreline marsh
- B. forested wetland
- C. riverine wetland by farm
- D. riverine wetland by the highway
- E. shoreline wetland
- F. farm site wetland

9. **IMPORTANT NOTE:** Slide the open container under the drain in the bottom of the waterbody.
10. Put the plug in the waterbody's drain. (It is not necessary to force the plug.)
11. Fill two water bottles half full with water. Place your eco-spout sprinkler head on one water bottle, and set the other aside for later use.
12. To illustrate soil, sprinkle 1/2 tsp of cocoa on the construction site and on the banks above and along the shoreline.
13. To illustrate pesticides (red drink mix) and fertilizer (green drink mix), sprinkle 1/2 tsp of each on lawns, and the golf course.
14. To illustrate oils and grease, squirt a few drops of the oil and sludge mixture on highways, roads, parking lots and driveways.
15. Place wildlife stickers on **wetland B** (optional).

## **STEP 2: Check Your Audience's Awareness**

Ask your audience what they think of when they hear the word "WETLAND." Their answers will give you a good indication of their perceptions and cognitive levels.

 **SUGGESTION: *have your audience write down what they think a wetland is and share their answers with one another.***

What do you think of when you hear  
the word *Wetland*?

Do you know where your nearest  
wetland is?

**STEP 3: Give a Brief Overview of Wetlands**

Wetlands are found throughout the world: in dry (arid) regions and in wet (humid) regions; in cool, temperate and very hot (tropical) regions; in the middle of fields and forests; and near rivers, lakes or oceans. Because wetlands are found in so many places, they are hard to describe, and even more difficult to define.

✓ ***But wetlands have some common characteristics:***

- **Wetlands are a link between waterbodies and the land.** We call them transitional areas when they bridge the gaps between land areas and water systems. Before the land ends and water begins, we find “wetlands.”
- **Wetlands are the middle or intermediate lands.** On one side is higher, dry land. On the other side is water. In the middle is the wetland, which is land that may be permanently or seasonally flooded.
- **The soils in a wetland support a certain type of vegetation.** Most plants, trees or shrubs that grow in a wetland are specially adapted to water — they are *hydrophytic* or *water-loving* plants.

✓ **You can recognize wetlands by looking for the following characteristics:**

- **Water on the surface or in the root zone.** This water causes the flooding, ponding or spongy, saturated conditions that we associate with many types of wetlands.
- **Wetland soils** usually hold water longer than other soils; that is, the soils drain poorly or are strongly influenced by water and may lack oxygen.
- **The plants, trees or shrubs that grow in the wetlands** — and wetland animals and microbes — are those that can live only in water or those that can adapt to alternating wet and dry conditions.

**IN OTHER WORDS**, water, soils and vegetation are the most important ways to identify wetlands. Each of these components interacts with, and influences, the other two. Along with the wetland's microbial content — the many "critters" that live in the water, soil and air — these components create the conditions that determine the nature and functions of a particular wetland.

**M**icrobial activity makes the wetland a "biological supermarket" that can support a rich variety of plants and animals. Wetlands contribute in very important ways to the food chain and biodiversity.

- **Water.** An area between water and dry land is considered a wetland if it is saturated (soaked through) with water long enough during the growing season to affect the vegetation and soil. Often the wetland is in a lowland area, where the water table is quite high. Standing water may not always be present in some wetlands, but the root zone will be saturated during some portion of the growing season.

■ **Soils.** Not surprisingly, the soils in a wetland will often look and feel wet. The Natural Resources Conservation Service classifies wetland soils as *hydric* soils. These soils occur in areas with high water tables or where frequent, long-lasting flooding or ponding occurs. Wetland soils are usually high in clay or peat content, but some wetlands will have sandy soils even though sand does not hold water as easily as other soils do.

■ **Vegetation.** Plants found in wetlands are usually hydrophytes (water-loving plants). They are particularly well adapted to growing in soils that are periodically or permanently saturated with water. Some wetland plants and trees cannot grow anywhere else. Over time, these plants influence the quality of the water and soil resources. They also provide habitat for many wildlife species.

## What Else Do Wetlands Offer?

✓ ***Wetlands also provide a home to 5,000 plant species, 190 species of amphibians and a third of all native bird species.***

- Animals use wetlands for breeding, nesting and feeding, and even as escape routes. Nearly half of our threatened and endangered species, such as the whooping crane and the prairie fringed orchid, live in wetlands or depend on them.
- Moreover, the wildlife and plants that live in the wetland are valuable parts of the wetland ecosystem — and a source of aesthetic and recreational pleasure.
- Wetland plants and animals are fun to observe and give us a sense of wildness and adventure. Look how famous John James Audubon became for his many portraits of wetland birds. Many people hunt, fish, hike or enjoy watching birds and wildlife in the wetlands.

## ✓ *Types of wetlands and wetland plants*

Typical wetland plants include reeds, sedges, rushes and some grasses; shrubs and trees, such as willow, cottonwood, sycamore, pine and cedar; other plants, such as smartweeds, water lilies, pondweeds and cattails.

Of course, the wetland plants found in your region will vary with the climate and type of wetland.

There are many different descriptions and types of wetlands — so many that we will not attempt to list them all. Some wetland managers and scientists classify wetlands simply as coastal wetlands or inland wetlands.

- **Inland wetlands** — are either wet prairies, northern peatlands, southern deepwater swamps and other forested wetlands, freshwater and brackish marshes, or riparian ecosystems. About 80 percent of the wetlands in the 48 states are inland wetlands.
- **Coastal wetlands** — are salt and freshwater marshes and mangrove swamps.

Wetlands are also classified as seasonal, temporary, semipermanent and permanent. See the glossary and recommended resources at the end of this guide for more extensive descriptions of wetland types commonly found in the United States.

Think about that wet meadow by the interstate, or the low, wet place along the creek or in your field. Wetlands appear in many different landscapes — and in many different shapes. And they're found in all parts of the world except Antarctica.

### ✓ *Wetlands are among our most productive areas.*

They perform many useful functions that we are now beginning to recognize and appreciate. Here are some of the many functions and values of wetlands:

#### Functions

- Absorb and hold water
- Slow speed of flooding
- Replenish surface and groundwater supplies
- Intercept runoff
- Remove and process nutrients
- Filter pollutants (chemical and organic wastes)
- Reduce sediment loads
- Bind soil to wetland plant roots
- Provide food resources and habitat for birds, fish and amphibians

#### Values

- Flood storage and control
- Protection of property values
- Water quality and availability
- Erosion control and shoreline buffering
- Protection of endangered species
- Provide recreational opportunities for camping, boating, hunting, and fishing
- Inspiration for art and literature
- Education/Aesthetics

**Of course, some functions support several values!**

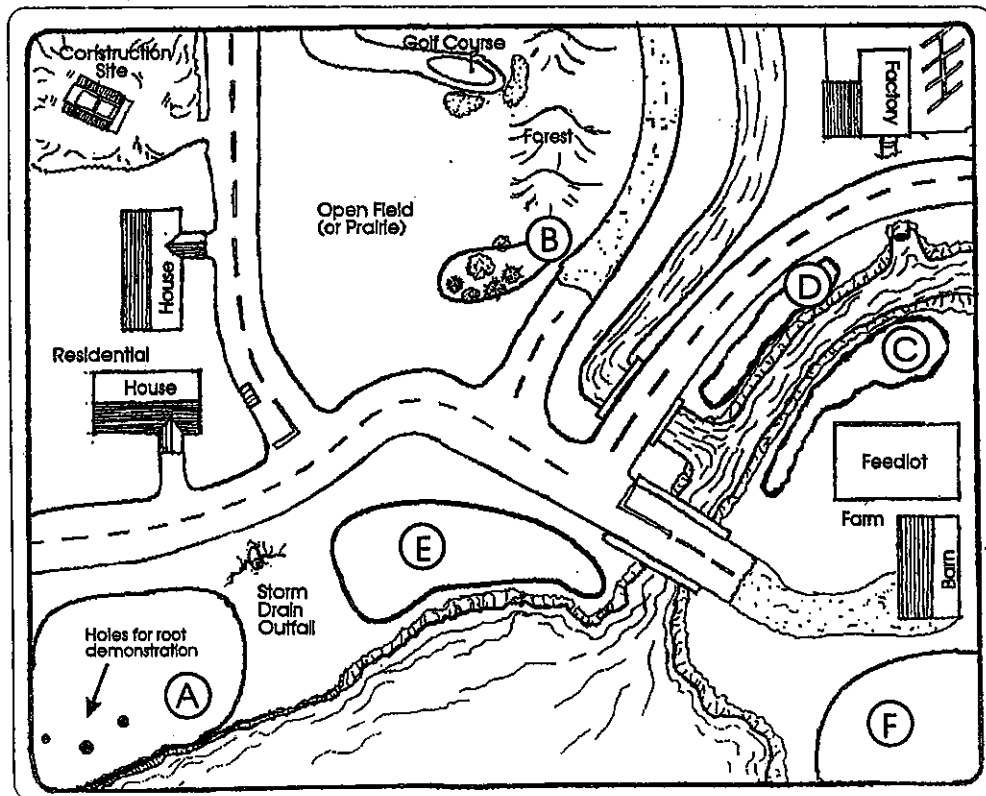
## STEP 4: Perform Activities

 *Let's take a look at some wetland functions and values.  
Get your audience involved in these activities!*

### ✓ **ACTIVITY 1: DEMONSTRATE WATER-HOLDING, ABSORBING CAPACITY**

- Record the amount of water in each bottle (make sure they are the same measure).
- Using the bottle with the Eco-Spout, make it rain above and directly over **wetland E**. Continue the rain until the bottle is empty.

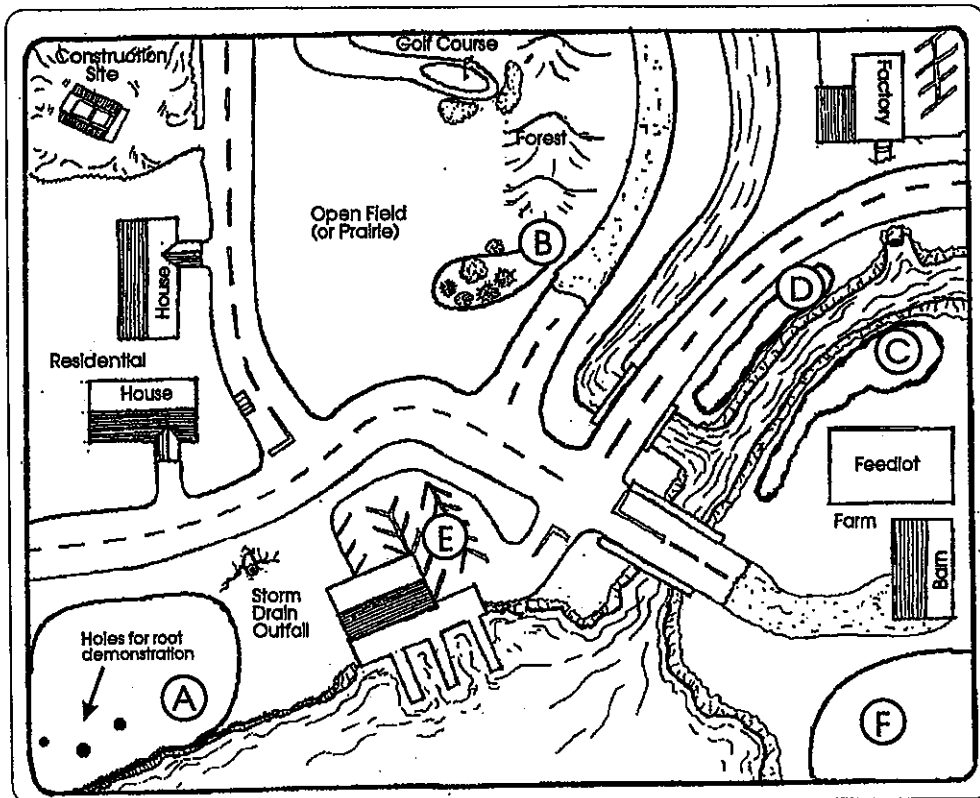
### Wetlands Location Key



#### Wetlands

- A. shoreline marsh
- B. forested wetland
- C. riverine wetland by farm
- D. riverine wetland by the highway
- E. shoreline wetland
- F. farm site wetland

## Marina and Wetlands Key



### Wetlands

E. marina development

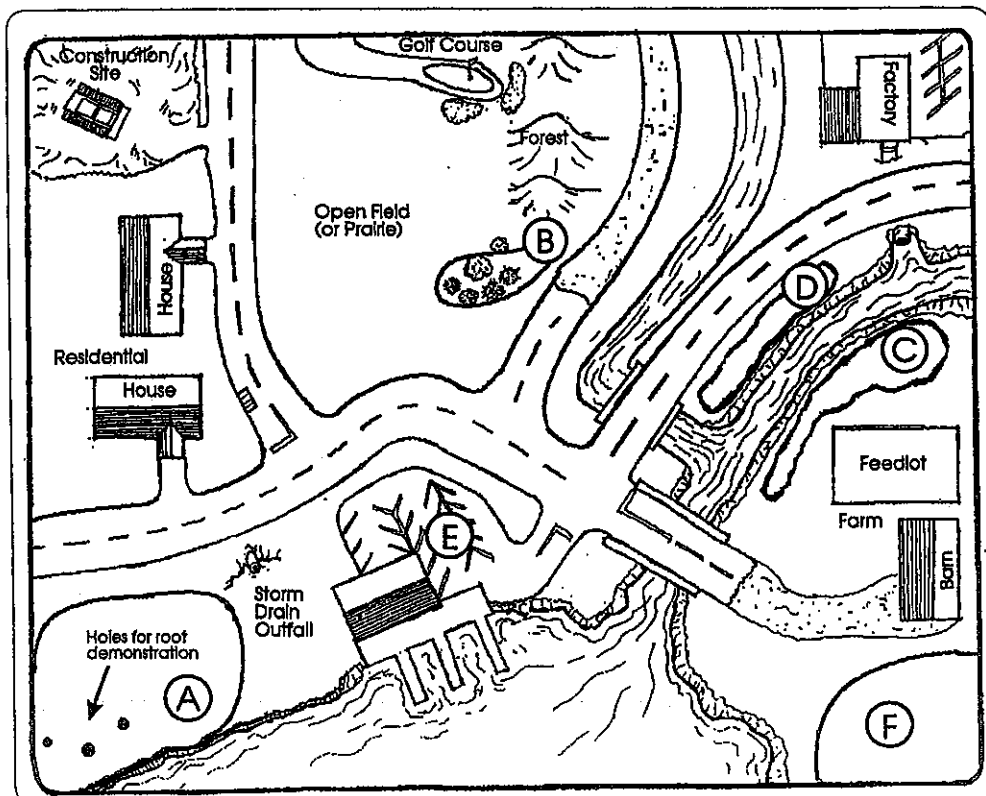
- Drain the waterbody into the measuring cup and record the amount.
- Replace the plug.
- Build a marina where the wetland was — that is, replace **wetland E** with the marina development (marina docks and building).
- Place the Eco-Spout on the second water bottle and make it rain over this area again. Continue the rain until the bottle is empty.
- Drain the waterbody into the measuring cup and record the amount.
- Discuss.

Replacing the wetland with a marina increased the amount of runoff because the marina does not hold water as efficiently as the wetland did.

✓ **ACTIVITY 2: DEMONSTRATE FLOOD REDUCTION AND EROSION CONTROL**

- Replace plug and fill waterbody with approximately 1/4 cup of water.
- Refill your water bottles as needed.
- Make it rain by the wetlands along the streambanks (wetlands C and D)
- Discuss.

**Flood and Erosion Key**



**Wetlands**

- C. riverine wetland by farm
- D. riverine wetland by highway

A wetland's water-holding ability may be useful during large rainstorms. Note how the wetlands along the riverbank absorb some of the water — storing it and thereby slowing the rate of flooding.

Wetlands serve as temporary storage for water, and they empty slowly — like a clogged drain. It is this slow release that helps downstream communities plan for flood management and keeps water flowing in times of drought.

By holding water temporarily, wetlands further protect the quality of the water because they also absorb some pollutants. Then, when the water is released, it will carry fewer pollutants with it to the waterbody. And finally, by slowing the velocity or speed of runoff, wetlands can help reduce streambank erosion.

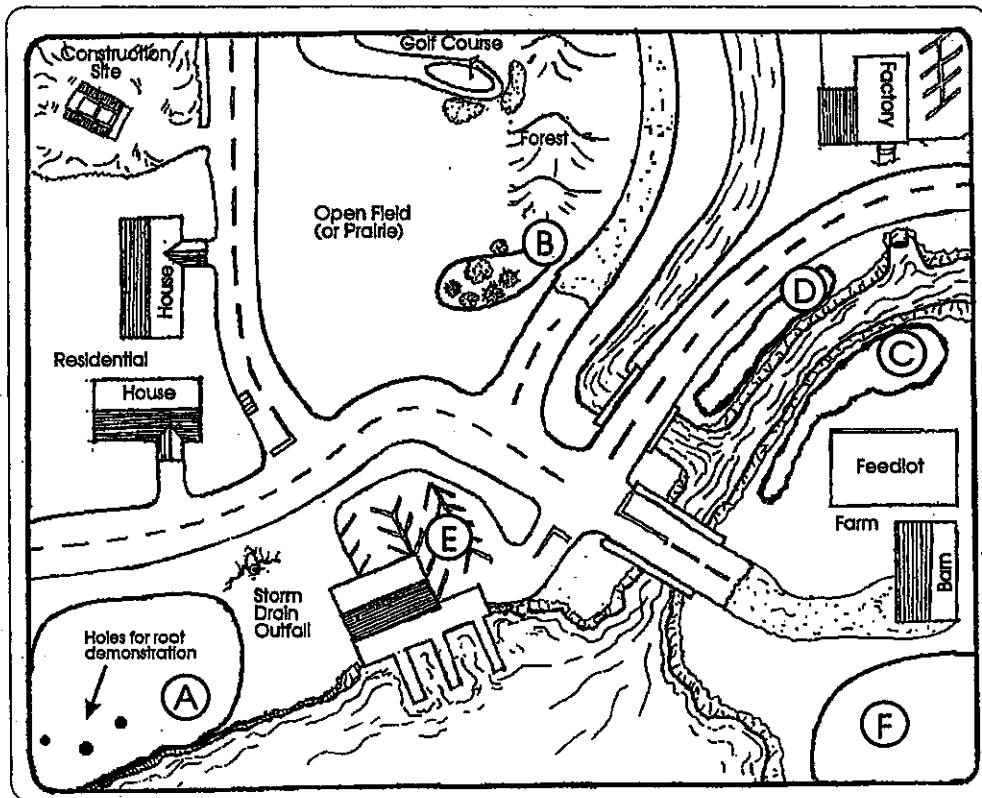
In seasons of prolonged, heavy downpours, this function may not work: wetlands do not have unlimited or long-time water storage capacity to prevent flooding. However, without the wetlands, flooding would be worse.

### ✓ **ACTIVITY 3: DEMONSTRATE SEDIMENT HOLDING AND FILTERING**

- Make it rain on the residential and construction areas and over the shoreline area (**wetland A**).
- Discuss.

First, see how the shoreline marsh absorbs and filters some of the runoff from the construction site and residential area. By absorbing some of the sediment-carrying runoff and allowing time for the sediment to settle, wetlands reduce the volume of sediments traveling to the waterbody.

## Shoreline Marsh Key



### Wetlands

A. shoreline marsh

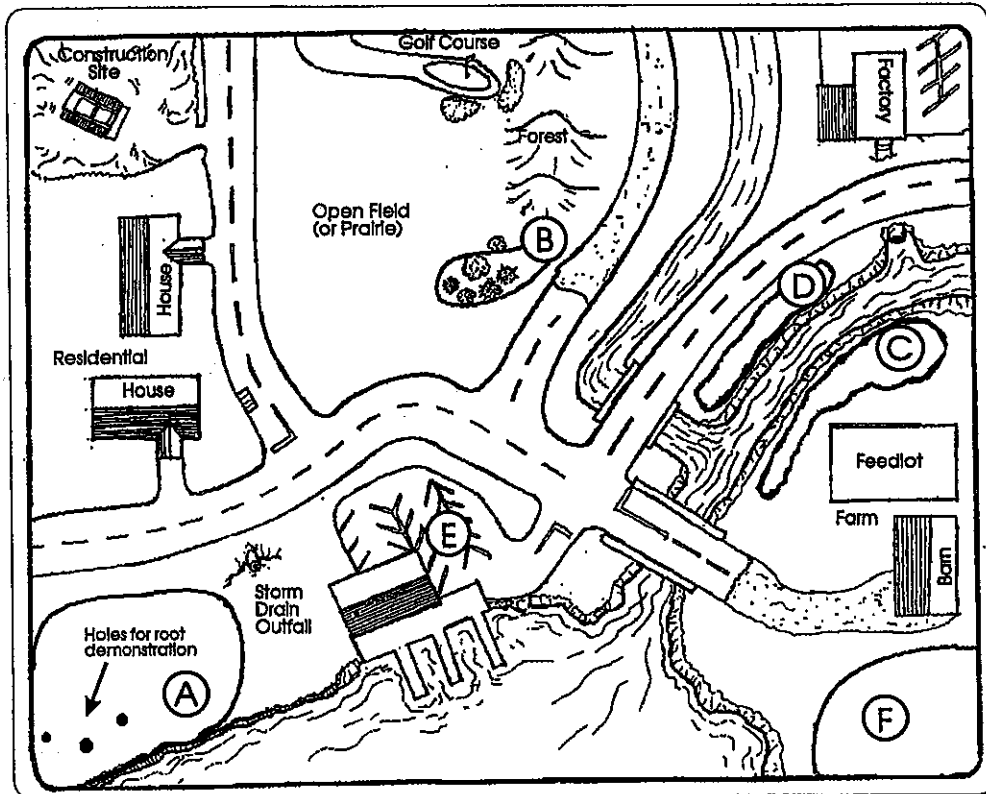
Now look beneath the model at the corner by **wetland A**. See how the wetland plants soak up some of the runoff — and how the fertilizers and sediments soak into the root structure beneath the surface. The wetland plants can use some of these nutrients; the wetland itself will hold the soil.

Excess nutrients running off the land (e.g., from overfertilized lawns, recreational areas or agricultural fields) are taken up by wetland plants to help them grow and reproduce, which in turn provides food and a place to live — habitat — for plants and wildlife. Without the wetland's capacity for using some nutrients, too many nutrients would get through, thereby potentially degrading the quality of the waterbody.

✓ **ACTIVITY 4: DEMONSTRATE WILDLIFE HABITAT**

- Remove the forested wetland (wetland B).
- Discuss.

**Forested Wetland Key**



Wetlands

B. forested wetland

■ **How important are wetlands to wildlife?**

- When a wetland disappears, so does wildlife habitat.
- While some species may be successful in the quest for another home, many will not survive.

- Many animals depend on wetland habitats for survival; according to a recent study by the National Audubon Society, 43 percent of endangered species in the United States depend on wetlands for survival.
- Moreover, the wildlife and plants that live in the wetland are valuable parts of the wetland ecosystem — and a source of aesthetic and recreational pleasure.

Wetland plants and animals are important to one another, fun to observe and give us a sense of wildness and adventure. They are part of the food chain, and they have important cultural and recreational values.

## **STEP 5: Summary Discussion**

In **all** these wetland areas, you have seen **wetlands working to improve water quality**. As rain soaks into each of the wetlands, the wetland traps sediment and other materials and filters out impurities before this water enters the aquifer; the same process also helps prevent sediment, nutrients and other chemicals from traveling downstream into surface waters.

**Wetlands help purify the environment;  
as someone once said,  
“they are the kidneys of  
our watersheds.”**

# DEMONSTRATION 2

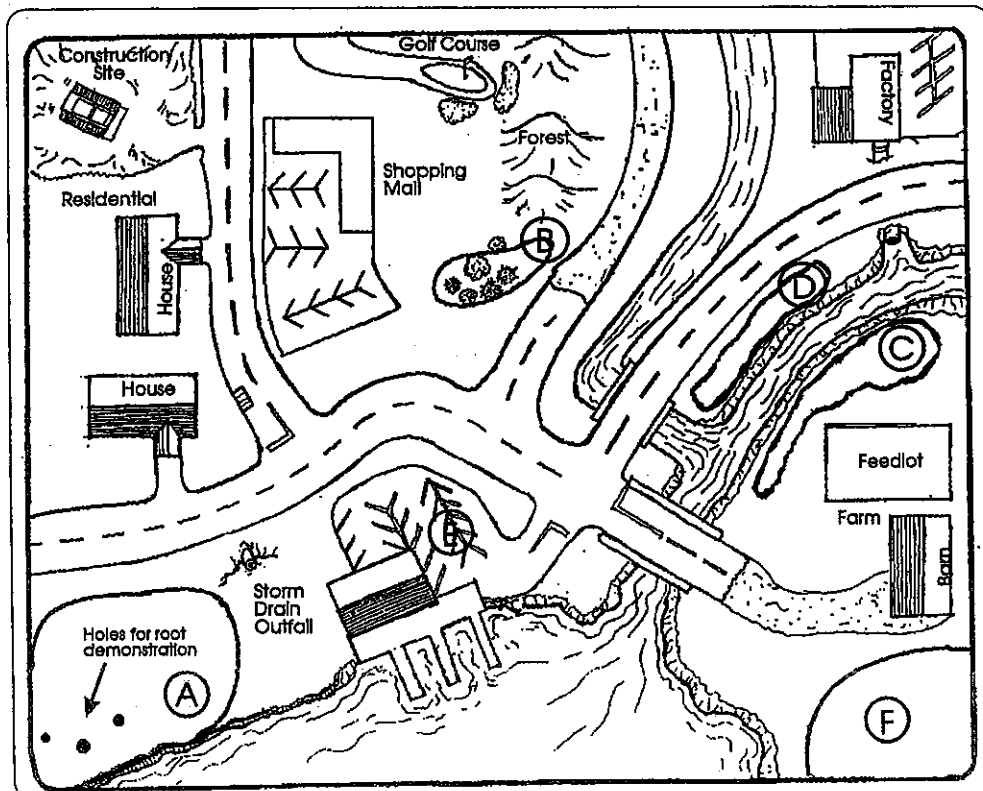
## HOW WE AFFECT WETLANDS

**FACILITATOR'S NOTE:** This demonstration shows how our activities on the land affect wetlands — what we do at home and in business and development — and how constructed wetlands may help in some areas.

### STEP 1: Prepare the Model

1. Wipe excess materials and water off the model. Remove plug and drain waterbody. Empty water drainage container.
2. Place the shopping mall (parking lot and building) on the open field or prairie.

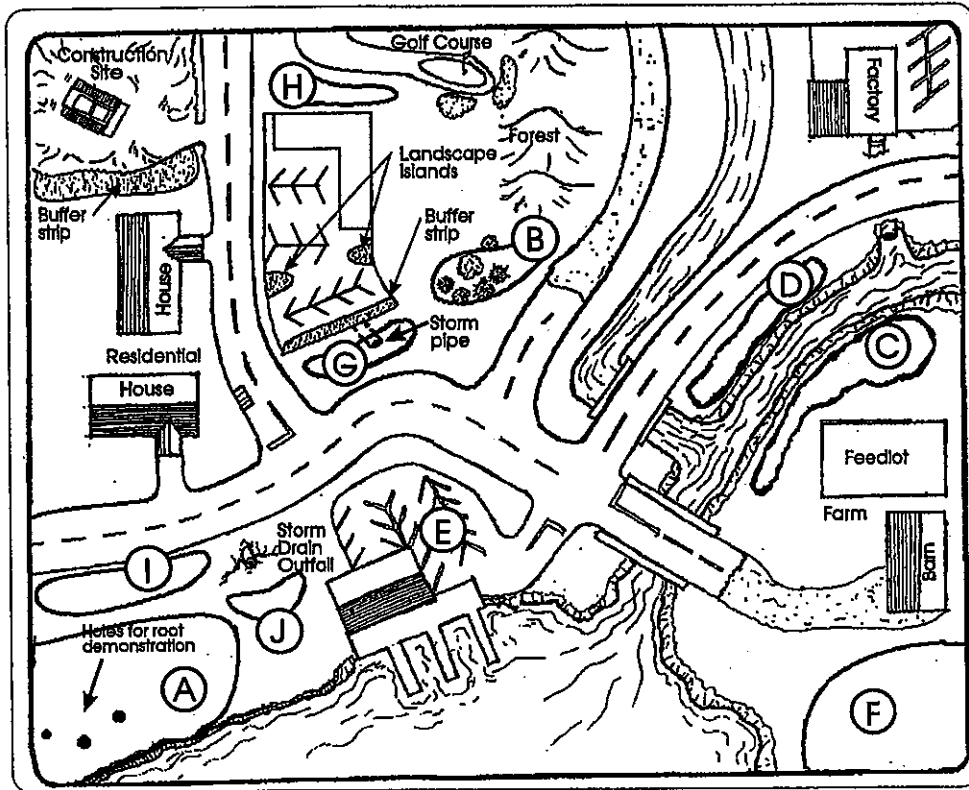
### Shopping Mall Key



#### Wetlands

- A. shoreline marsh
- B. forested wetland
- C. riverine wetland by farm
- D. riverine wetland by highway
- E. marina development
- F. farm site wetland

## Shopping Mall Key



### Wetlands

- I. constructed wetland below residential area
- J. constructed wetland by storm drain outfall

3. Place constructed wetlands I and J on the model.
4. Place a grass buffer strip by the construction site as shown in the above diagram.
5. **IMPORTANT NOTE:** Slide the open container under the drain in the waterbody.
6. Put the plug in the waterbody's drain. (Do not force the plug.)
7. Make sure the two water bottles are filled with water.
8. To illustrate soil, sprinkle 1/2 tsp of cocoa on the construction site and on the banks above and along the shoreline.

9. To illustrate pesticides (red drink mix) and fertilizer (green drink mix), sprinkle 1/2 tsp of each on lawns in the residential area and on the golf course.
10. To illustrate oils and grease, squirt a few drops of the oil and sludge mixture on the parking lot, highways, roads and driveways.

## **STEP 2: Check Your Audience's Awareness**

- What activities negatively affect wetlands?
- What activities help protect wetlands?

## **STEP 3: Perform Activities**

### **✓ ACTIVITY 1: DEVELOP A SHOPPING CENTER**

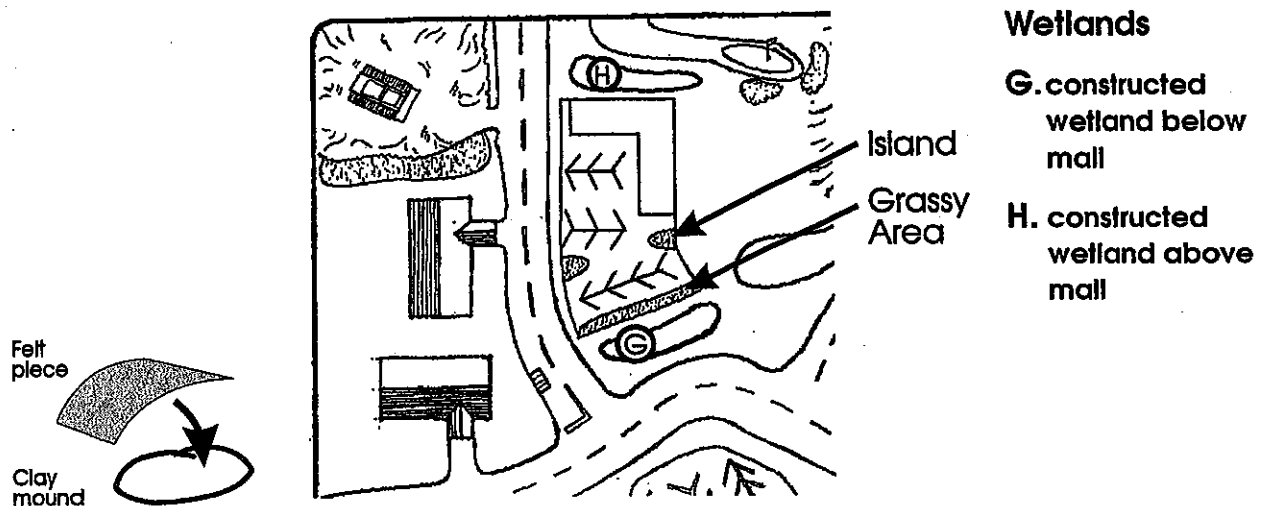
- Explain that we own the open field (or prairie) between the residential road and the golf course, and that we've developed a shopping center and parking lot on the rectangular area of the model.
- Make it rain above and around the shopping center.
- Discuss.

The flat surface of the mall's parking lot increases the rate of runoff, and the concentration of buildings and human activity in the area increases the amount of sediments and other contaminants in the runoff. Also note that this runoff forms a pool of water at the base of the shopping center.

## How can we handle this runoff and prevent the pool of water from becoming an unattractive and potentially dangerous place?

- Place **constructed wetland H** on the model above the shopping center.
- Make landscape islands by placing small pieces of felt over small mounds of clay, and place them on the side edges of the parking lot.
- Plant grass (use a felt strip) along the bottom edge of the parking area.
- Make it rain.
- Discuss.

### Shopping Mall Key

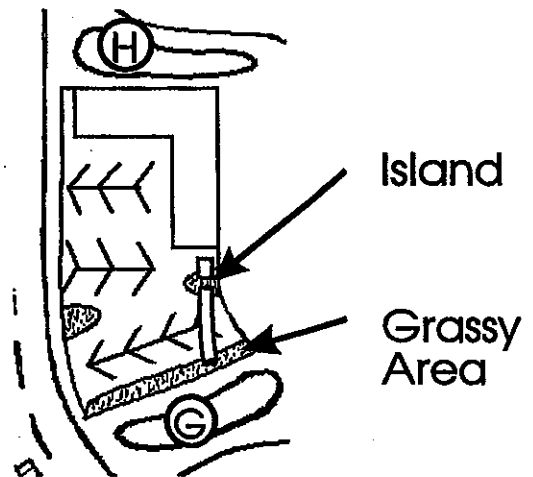


- The constructed wetland above the mall filters and reduces runoff from the golf course.
- The landscaping changes in the shopping center help filter and slow runoff from the mall itself.
- The grassed parking lot buffer also helps filter pollutants from the runoff.

We still have a pool of water, sediments and pollutants below the mall and more runoff than before — is there anything more we can do?

**Perhaps we can add some wetland characteristics to the pool of water.**

- Place **constructed wetland G** where the pool of water is.
- Using some clear tubing and clay, create a recessed storm drain in one of the landscape islands. Make sure the pipe drains through the grassy area and the constructed wetland.
- Make it rain.
- Discuss.



We've created a stormwater detention system at the base of the mall, thus adding the water-absorbing, sediment-trapping and filtering characteristics of a wetland.

- The storm drain helps divert some of the runoff through the grassy area to pretreat water going into the constructed wetland.
- Such a constructed wetland will not have all the characteristics of a natural wetland, but perhaps some wildlife will find refuge here; the wetland will help protect the environment, and it is more attractive than the untreated pool it replaces.
- The constructed wetland above the mall reduces the amount of runoff to the mall area and also helps slow the rate of runoff from areas above the mall, thereby filtering out pollutants from the upland area.
- To reduce the stormwater volume, we can reuse the stormwater from the detention system to irrigate the mall's green spaces.

**Careful planning must precede development choices.**

✓ **ACTIVITY 2: CONSTRUCTED WETLANDS**

- Make it rain in the residential area and above the shoreline.
- Discuss.

**See how these constructed wetlands help us better manage what we do on the land.**

- The constructed wetland (I) below the residential area serves as a filter for the pollutants (including trash) that result from our daily activities. This filtering occurs **before** our wastewater and runoff reach the larger wetland or the waterbody.
- The constructed wetland (J) at the storm drain outfall is a filter — it helps trap pollutants before the water reaches the waterbody.

**SUGGESTION:** Pour some used oil (a mixture of cocoa and water) down the storm drain to emphasize this point.

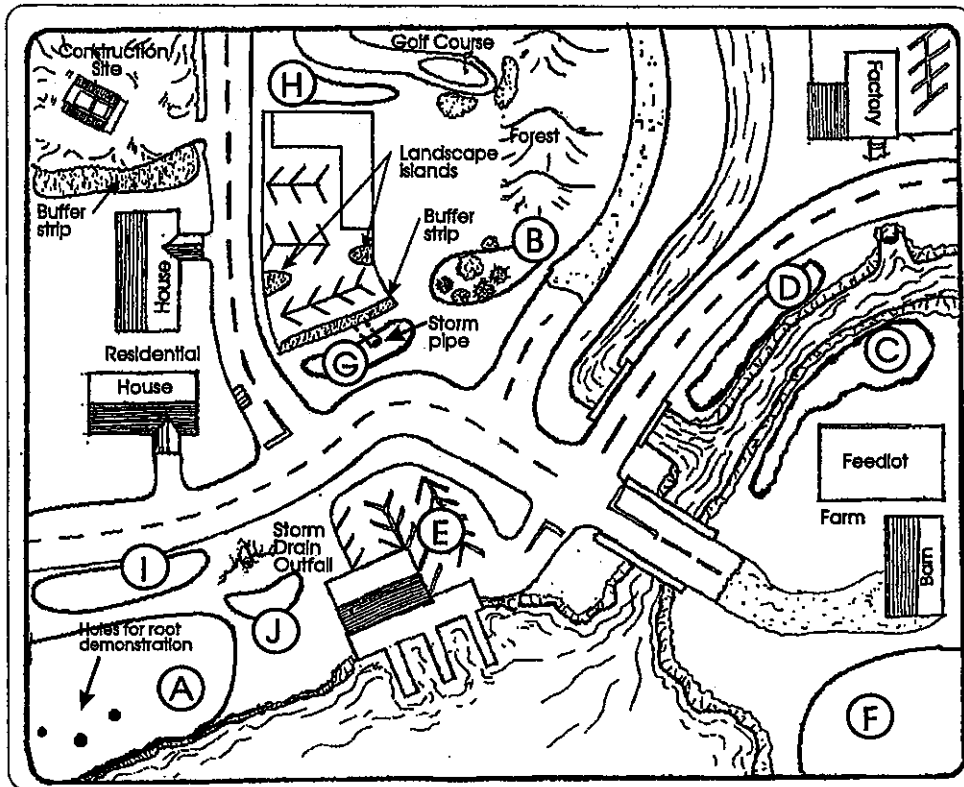
In addition, if we construct these wetlands as green, open spaces, they may attract birds and discourage people from dumping trash in the area.

■ **Construction Site**

- Make it rain over the construction site.

See how the buffer strip helps hold the soil and filter out pollutants. This strip of grass — or in some cases, construction workers may use a black silt fence to help hold soil — helps protect the constructed wetland at the base of the residential area.

## Construction Site Key



### Wetlands

- I. constructed wetland below residential area
- J. constructed wetland by storm drain outfall

## Always remember:

**No matter where we are or what we do for a living, we must learn to manage the chemicals and other materials we put on the land!**

**Wetlands are natural buffers, but don't expect them to do everything! They can't manage all the oils and grease, chemicals and fertilizers we put on the land. A simple rule for our activities is this:**

***Use only what you need.***

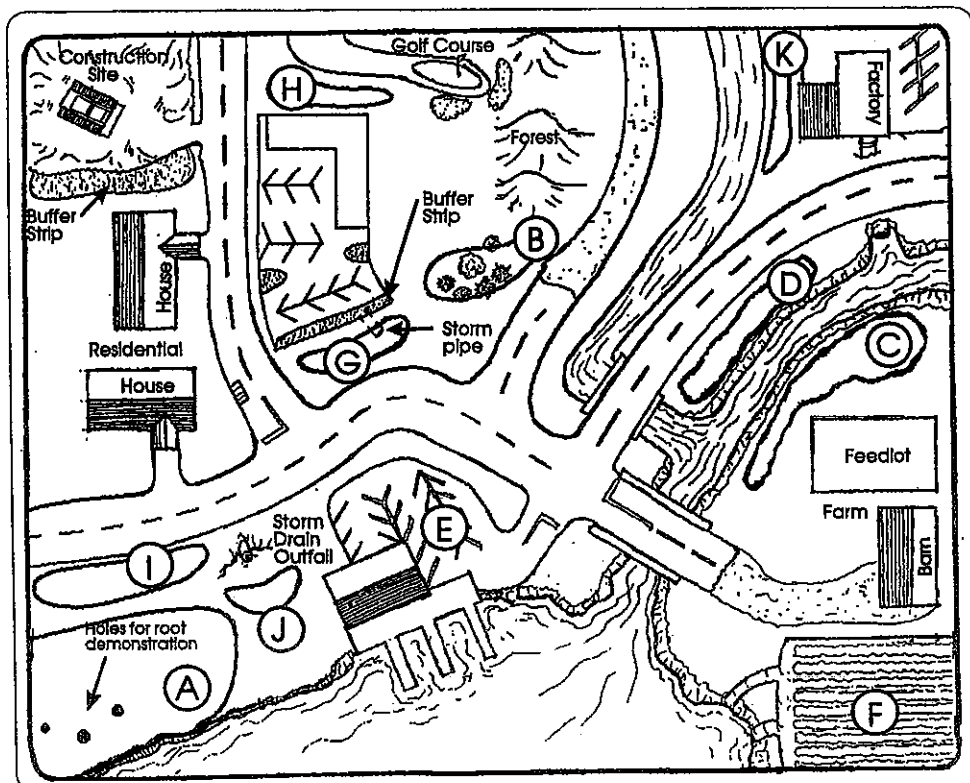
## ✓ ACTIVITY 3: FARMING A WETLAND

- Develop the wetland by the farm into a corn field by removing wetland F.
- Because corn is not a "wet crop," we'll need to drain the field — form drainage ditches out of clay to drain the field to the waterbody.
- Place soil (cocoa), fertilizers and pesticides (drink mixes) on the field.
- Make it rain.
- Discuss.

Notice how the corn field drains, carrying the soil, fertilizer and pesticides directly to the waterbody.

The practice of draining wetlands for conversion to agricultural use is **not** allowed today. However, it was done in the past, and many existing drainage ditches and drained wetlands are the result.

### Farm Site Key



Wetlands  
F. farm site wetland

- What happens to the landscape when wetlands are drained?
- To the wildlife in the area?
- To water quality?

✓ **ACTIVITY 4: RESTORING A WETLAND**

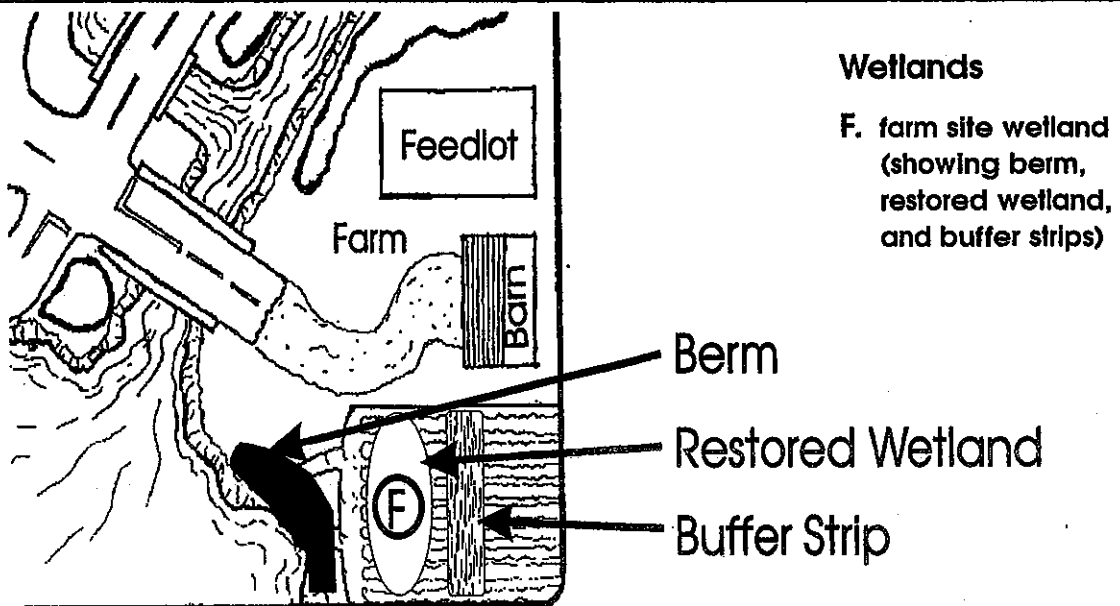
Crops that are not naturally “wet crops,” such as the corn we’ve planted, may not grow well when farmed in a wetland area.

Or perhaps you notice that runoff from this field is carrying too many nutrients or too much topsoil to the waterbody. Or that wildlife is no longer abundant on your farm.

☞ **What can you do to restore the wetland?**

- Restore the site by putting the wetland back in working condition. Place a berm where the corn field drains and put a wetland on the part of the field nearest the waterbody.
- Use buffer strips between the wetland and the field to help take up any excess nutrients and pesticides.

**Farm Site Key**



- Place soil (cocoa) on the wetland.
- Make it rain.
- Discuss.

Returning a wetland as nearly as possible to its natural condition is called **restoration**. Complete restoration is difficult. In some cases, the best we can do will only partially restore wetland values and functions.

As we ease up on the conditions causing the alteration, the wetland's ability to provide shelter for birds and other animals, or to hold water on the floodplain will improve. Wildlife may return, and a diversity of plant life may begin to thrive.

**What other wetland areas  
could we restore?**

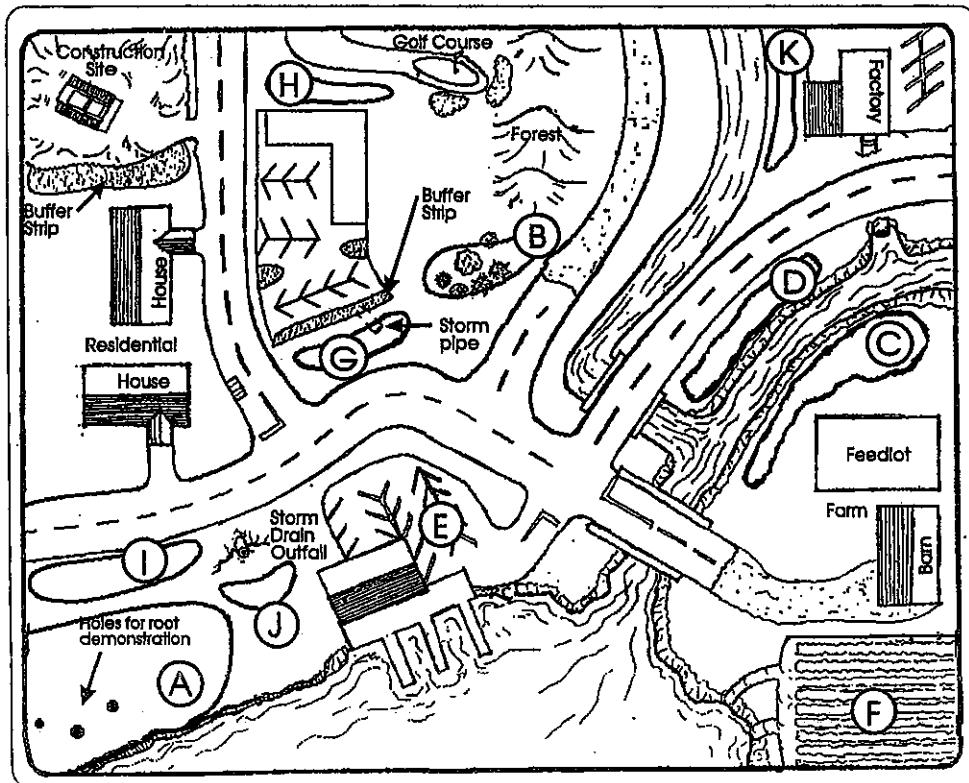
# OPTIONAL ACTIVITIES

The following activities are optional; you may or may not choose to use them in your demonstrations. Should you discover other optional activities, please let us know so we can share them with other EnviroScape users.

## ✓ OPTIONAL ACTIVITY 1: STORMWATER CONTROL

- Place wetland K on model.
- Place oil on the parking lot by the industrial plant.
- Make it rain.
- Discuss.

### Factory Site Key



#### Wetlands

K. constructed wetland by factory

## OPTIONAL ACTIVITIES . . .

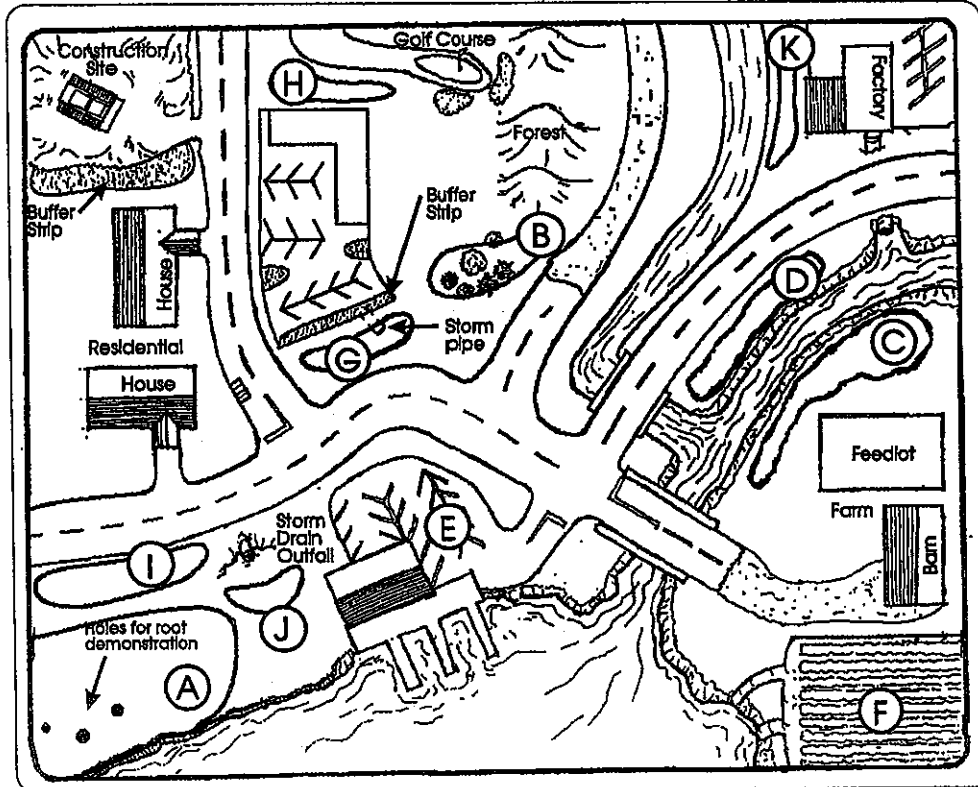
This wetland may have been constructed by the industrial plant as a stormwater detention area — similar to the stormwater systems we discussed at our shopping center.

As you can see, this constructed wetland holds the runoff temporarily and filters it before releasing it to the stream.

### ✓ **OPTIONAL ACTIVITY 2: FILTERING**

- Mix up manure (using cocoa and water).
- Place **wetland C** on the model.
- Place manure in feedlot.
- Make it rain by feedlot.
- Discuss.

## Manure Storage Key



Wetlands

C. riverine wetland  
by farm

■ **Watch how the wetland filters some of the runoff from the feedlot.**

Some feedlots are experimenting with constructed wetlands as a way to help manage animal wastes.

Note, however, that stormwater should always be pretreated before it is released into a wetland. Adding a buffer strip between the feedlot and the constructed wetland is one way to provide pretreatment.

Using constructed wetlands to help manage animal waste requires technical expertise.

# CLEAN-UP

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

- Drain the lake into the container beneath it.
- Remove the container and dispose of its contents in a sink.
- Clean the container and plug. Let dry thoroughly.
- Remove the felt strips from the model as soon as **the demonstration is finished**. Wash 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, vehicles, buildings and other small components and wash separately with soap and water. Store carefully in container when dry.
- Remove the trees from their trunks and let them dry before placing in container.
- Repack all small components and ingredients in the rectangular container.
- Clean the model thoroughly. The unit can be washed with dish soap and water and rinsed directly under a faucet. Do not use any detergents or cleaners.
- Let the EnviroScape model dry completely. Then repack it and all its components in the carrying case.

 ***Again, only use dish soap and water.***

# A FINAL NOTE

## Wetland Connections to Groundwater

The connections between groundwater and wetlands are constant and complicated because wetlands are common areas for groundwater **recharge** and **discharge**.

When the flow of water is from the wetland to groundwater, the wetland may prevent some pollutants (e.g., soil, phosphorus, heavy metals) from entering groundwater — thus allowing the groundwater to **recharge** at a better quality. However, a wetland used to recharge groundwater can also contaminate groundwater (especially if the wetland is a degraded or constructed wetland). Contamination occurs when the recharge water carries excess solvents, gasoline, pesticides, nitrates or other contaminants.

When shallow groundwater flows into a wetland, the process is called groundwater **discharge**. The groundwater may contain nutrients of use to wetland plants. Water that discharges to the wetland (or other surface areas), if not consumed, eventually flows to surface waterbodies or evaporates.

**NOTE:** These connections are presented in greater detail in EnviroScape's Groundwater Component.

# WETLANDS BACKGROUND

## Definitions and Classification of Wetlands

Federal regulations\* define wetlands as "areas which are inundated or saturated by surface or groundwater at a frequency and duration sufficient to support, and that under normal circumstances do support, a prevalence of vegetation typically adapted for life in saturated soil conditions."

The U.S. Environmental Protection Agency (EPA) and the U.S. Army Corps of Engineers use this definition to administer Section 404 of the Clean Water Act. The U.S. Department of Agriculture also uses this definition to make determinations about wetlands on agricultural lands.

Anyone seeking to work in a wetland, even if the work is to restore or enhance the wetland, must follow the prescribed regulatory and legal procedures. A permit is usually necessary to build on a wetland — whether it be a shopping mall, a single family residence, a boat dock or something much smaller.

The U.S. Fish and Wildlife Service uses the following definition:

*Wetlands are lands transitional between terrestrial and aquatic systems where the water table is usually at or near the surface or the land is covered by shallow water. Wetlands must have one or more of the following attributes: (1) at least periodically, the land supports predominantly hydrophytes, (2) the*

*substrate is predominantly undrained hydric soils, or (3) the substrate is nonsoil organic matter with water or covered by shallow water at some time during the growing season each year.*

The U.S. Fish and Wildlife Service groups wetlands into five ecological systems:

- **Palustrine wetlands** are dominated by trees, shrubs and persistent erect-rooted plants.
- **Lacustrine wetlands** are associated with lakes or reservoirs.
- **Riverine wetlands** are characterized by fresh-flowing waters (river channels).
- **Estuarine wetlands** are mixed fresh and salt water tidal wetlands, usually partially enclosed by land.
- **Marine wetlands** are exposed to the waves and currents of the ocean or sea.

Some wetland managers and scientists classify wetlands simply as inland or coastal wetlands.

- **Inland wetlands** — are either wet prairies, northern peatlands, southern deepwater swamps and other forested wetlands, freshwater and brackish marshes, or riparian ecosystems. About 80 percent of the wetlands in the 48 states are inland wetlands.
- **Coastal wetlands** — are salt and freshwater marshes and mangrove swamps.

\*subject to congressional legislation

# GLOSSARY

## Selected Types of Wetlands in the United States\*

■ **Pocosin Wetlands.** Found along the lower Atlantic Coastal Plain from Virginia to Florida, pocosin wetlands are evergreen scrub-shrub bogs with highly organic soils (mucks or peat). Fetterbush, wax myrtle, pond pines, red bays and sweet bays are common shrubs and small trees. The Indian (Algonquin) word *pocosin* means "swamp on a hill."

■ **Prairie Potholes.** Found in North and South Dakota, Minnesota and Canada, prairie potholes are surface depressions formed by glacial activity, which now depend on runoff from precipitation and groundwater for recharge. Those that depend on precipitation fluctuate in response to wet and dry cycles. Those that are fed by groundwater have a more stable water level. Prairie potholes are classified according to their water permanence and quality and their vegetative cover. Cattails and bulrushes indicate water quality and permanence; various other marsh grasses may also appear. Most potholes are freshwater, although saline and alkaline types are common in the western and northern Great Plains.

■ **Floodplain Wetlands.** Found typically along major rivers and their tributaries, floodplain wetlands were formed by meandering river channels, scour action during flooding, and blocked depressional areas. Vegetation in and around these wetlands can be bottomland forest or herbaceous vegetation. Some of the largest floodplain wetlands are found in the Midwest.

■ **Peatlands.** These wetlands contain soils partially composed of decomposing plants. They are found throughout the United States but they are particularly dominant in northern Minnesota. Bogs and fens are typical of peatlands. (Bogs are watered by precipitation; fens receive some moisture from groundwater.) Plants in peatlands are acid tolerant trees or shrubs (e.g., tamarack, red cedar, black spruce, sphagnum moss). Fens have more diverse plants including sedges, grasses and reeds.

■ **Sand Hills.** Found in South Dakota and Nebraska, the Sand Hills (of which only 5 percent are wetlands) actually contain a variety of wetland types: seasonally flooded basins, wet meadows, shallow and deep marshes, open lakes and freshwater ponds, and some artificial (constructed) wetlands.

■ **Playa Lake Wetlands.** These alkaline flats include Death Valley and the Mojave Desert. Other playas are found primarily in eastern New Mexico and northern Texas. Pondweeds, arrowheads and cattails grow in the playas, which are called lakes or playas or playa basins, though they are really wetlands. Seasonal basins or temporary shallow lakes, the playa wetlands occur and endure according to rainfall. There are some 20,000 to 30,000 playas in the region, but no permanent rivers or streams.

■ **Bottomland Hardwoods.** These forested wetlands flank the rivers of the southeastern United States. They are riparian ecosystems that contain flood tolerant species such as oak, gum, cypress, elm, ash, and the bald cypress, which has developed knees or aerial

\* Adapted from A.W. Stone and A.J. Lindley Stone, *Wetlands and Ground Water in the United States* (Concord, NH: The American Ground Water Trust, 1994).

roots. These plants must withstand flooding for between 20 and 150 days a year. The bottomland hardwoods have been much altered to allow for human settlement, farming and transportation.

■ **Northeastern Swamps and Bogs.**

Swamps occur in low, poorly draining areas and are dominated by woody vegetation, such as hemlock, white pine, red maple, and larch. Bogs are dominated by spongy mats of sphagnum moss, with some evergreens, heath species (leatherleaf) and bog sedges. Peat bogs are the most common.

■ **Cypress Dome Wetlands.** These deepwater swamps or hardwood forested wetlands in southern Georgia and Florida

have been very long in forming. Named from the shape of the formation — the oldest and tallest trees grow in the center — the cypress domes grow in depressions that may have formed from older wetlands.

■ **Permafrost/Tundra Wetlands.** Alaska is home to 75 percent of all wetlands in the United States, and Alaskan wetlands are also the least disturbed or altered by human activity. Permanent frost (permafrost) conditions are continuous in the north, discontinuous in the south. The organic accumulations in Alaskan wetlands are called "muskegs" — a term for peatlands that do not receive much water from groundwater or streamflow.

## Popular General Terms Used to Describe Wetlands

■ **bog:** a spongy wetland, usually matted with sphagnum moss; characterized by nutrient-poor, acidic soils and little or no inflow and outflow capacity

■ **bottomland:** lowlands near streams and rivers (floodplains)

■ **marsh:** a frequently or always inundated wetland containing largely herbaceous vegetation: reeds, rushes and cattails

■ **muskeg:** large Canadian or Alaskan peatland or bog

■ **peatland:** a generic term for a wetland accumulating decayed plant matter

■ **playa:** marshlike pond in southwestern United States

■ **pothole:** marshlike shallow pond in North and South Dakota and Canada

■ **slough:** a swamp or shallow lake system in northern and midwestern states; a shallow marsh in southeastern states; often seen as an area of dead water containing woody vegetation: trees and shrubs.

■ **swamp:** wetlands dominated by trees and shrubs; in Europe a forested fen or reed-dominated wetland

■ **vernal pool:** shallow, intermittently flooded wet meadow, generally dry in summer and fall

■ **wet meadow:** grassland with waterlogged soils, but without standing water most of the year

■ **wet prairie:** similar to a marsh but intermediate to a marsh and wet meadow

## Other Terms Used in EnviroScape Demonstrations

- **benefits:** the advantages or good that results from something or some activity
- **best management practices (BMPs):** methods or techniques that landowners, farmers, householders and others can use to control pollution from nonpoint sources
- **biodiversity:** the variety and interactions of multiple species and a marker of ecosystem health
- **clarifier tanks:** large water-holding tanks used during wastewater treatment; water remains in the tank until impurities settle out
- **emergent wetlands:** dominated by grasses, herbaceous, nonwoody vegetation, these wetlands may be flooded during most of the growing season
- **functions:** activities or processes that fulfill some purpose; here, the natural processes of wetlands
- **nonpoint source pollution (NPS):** pollution — largely rainfall or snowmelt contaminated from many sources — that does not come from a pipe; runoff contaminated by sediments, dissolved nutrients, organic wastes, heavy metals, or septic tank effluent
- **percolation:** the passage of a solvent through a permeable substance, for example, as water oozes or trickles through soil or gradually moves down through the soil into the groundwater aquifer
- **permeable:** having pores or openings that permit liquids or gases to pass through; for example, sand and clay are permeable but glass is not; paving materials are usually not permeable
- **publicly owned treatment works (POTWs):** plants designed to receive and treat wastewater before it is discharged into streams or other receiving waters
- **stewardship:** the activity of caring for and managing another's resources or financial affairs; in ecological terms, a steward is one who cares for the land and water and serves them, aware of their usefulness and values
- **vadose zone:** unsaturated zone
- **value:** the usefulness or good that a person or thing fulfills; an expression of appreciation or esteem