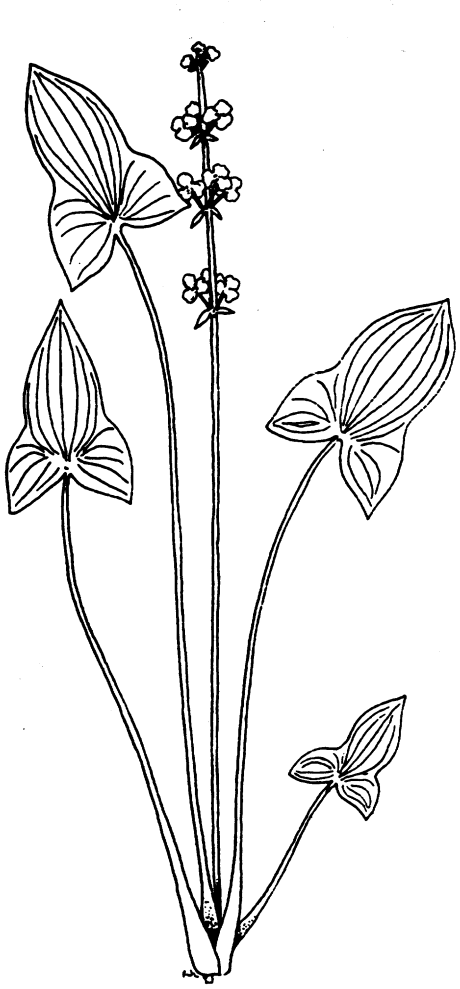
GEORGIA

*A*dopt-A-Stream

Department of Natural Resources
Environmental Protection Division
Summer 2006

Wetland Monitoring



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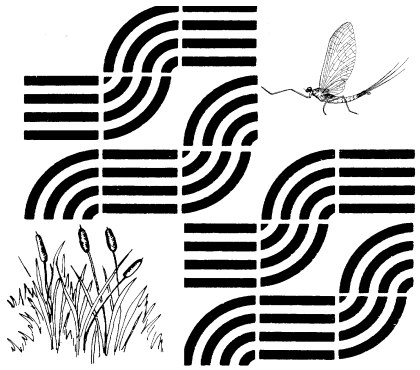

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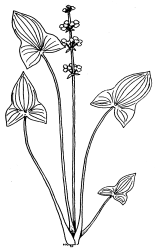

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Glossary

Georgia Wetlands

Various assessments of Georgia's wetlands have identified from 4.9 to 7.7 million acres, including more than 600,000 acres of open water habitat found in estuarine, riverine, palustrine, and lacustrine environments. Estimates of wetland losses since colonial settlement beginning in 1733 and expanding over the next two and one-half centuries are between 20-25% of the original wetland acreage.

Georgia has approximately 100 miles of shoreline along the south Atlantic, with extensive tidal marshes separating the barrier islands from the mainland. Georgia's coastline and tidal marshes are well preserved compared to other South Atlantic states.

Georgia's interior ranges in elevation from sea level to 4,788 feet in the Blue Ridge Mountain Province. At the higher elevations, significant, pristine cool-water streams originate and flow down steep to moderate gradients until they encounter the lower elevations of the Piedmont Province. Many of the major tributaries originating in the mountains and piedmont have been impounded for hydropower and water supply reservoirs. These man-made lakes constitute significant recreational resources and valuable fishery habitat. Palustrine wetlands in floodplains and beaver ponds are found in Piedmont river corridors. At the fall line, streams flowing southeasterly to the Atlantic Ocean or south-southwesterly to the Gulf of Mexico have formed large floodplains as each encounters the soft sediments of the upper Coastal Plain.

Other significant wetlands found in the state are associated with blackwater streams originating in the Coastal Plain, lime sinkholes, springheads, Carolina bays, and the Okefenokee Swamp, a bog-swamp covering approximately one-half million acres in south Georgia.

In the flatwoods of the lower Coastal Plain, seven tidal rivers originate in the ancient shoreline terraces and sediments of the Pleistocene age. Scattered throughout the flatwoods are isolated depressional wetlands and drainages dominated by needle-leaved and broad-leaved tree species adapted to long hydroperiods.

Due to considerable variation in the landscape in topography, hydrology, geology, soils, and climatic regime, the state has one of the highest levels of biodiversity in the eastern United States. It provides a diversity of habitats for nearly 4,000 vascular plant species and slightly less than 1,000 vertebrate species. Numerous plant and animal species are endemic to the state, and of these, many of the rarer species are dependent upon wetlands for survival.

Introduction

The Georgia Adopt-A-Wetland program is designed to heighten awareness of the nature, functions, and values of wetlands in Georgia. Much like Adopt-A-Stream, the Adopt-A-Wetland manual will guide volunteers in adopting a wetland and monitoring it. This manual involves getting to know the chosen wetland and its watershed, learning the importance of wetland functions and values, and monitoring wetland hydrology, plants and soils.

Before monitoring your wetland, be sure to obtain a copy of ***Getting To Know Your Watershed***. ***Getting To Know Your Watershed*** is the first in a series of manuals produced by Georgia Adopt-A-Stream. Whether you have a stream, wetland, lake or river you wish to monitor, this manual will guide you through the important first steps. Included in this manual is all the information and activities you will need to adopt a stream, wetland or lake!

Wetlands are areas where water is the primary factor controlling the environment and the associated plant and animal life.

These transitional habitats occur between upland and aquatic environments where the water table is at or near the surface of the land, or where the land is covered by shallow water that may be up to six feet deep (U.S. Fish and Wildlife Service). Legal definitions may be broad, including areas which meet the following criteria: vegetation similar to that of traditional wetlands, soils heavily influenced during some portion of the year by water, and complete ground or surface water saturation during a portion of the growing season.

Chapter 1

GETTING STARTED

The first step in the Adopt-A-Wetland program is to get to know your wetland and why you should care about its health. Volunteers will become familiar with their wetland through visual assessments and watershed identification. They will work with local partners to foster community and local government involvement with the protection and study of wetlands. Participants commit to adopt their wetland for at least one year, but data collection over several years allows for better analysis of changes.

Level I activities include:

- Identifying a wetland to adopt
- Creating a Who to Call for Problems List
- Registering with Georgia Adopt-A-Wetland
- Conducting a Watershed Survey and Map Assessment
- Assigning the broad classification of the wetland type
- Locating the wetland on a USGS topographic map or the National Wetlands Inventory maps (NWI)
- Assessing the values and functions of your wetland
- Regular visual assessments, gathering general information about the hydrology, vegetation, and soils.

Identify A Wetland to Adopt

Wetlands are not as common and easy to find as streams and creeks. For this reason, it is advisable to work with a local partner who may own land where a wetland is located or contact a government agency for permission to work on publicly owned land. By purchasing a USGS topographical quadrangle of the area of interest, you may learn if a wetland is present. A better estimation of wetland location will be found on a NWI map (National Wetland Inventory). These quadrangles correlate to the USGS topo maps

and are specifically made to identify and classify wetlands. Both the topographic and NWI maps may be purchased at the State Geological Survey office in the Agriculture Building in downtown Atlanta (404-656-3214). For more details on maps, review our manual, ***Getting To Know Your Watershed***.

Some general guidelines to follow for selection of a wetland:

- Select a wetland meaningful to you or your group.
- Select a wetland, which has **easy, safe, and legal** access.
- Select a project that you can have fun with.

How Do I Know If I Am In A Wetland

There are several wetland **indicators** you may use to determine if your area of interest is a wetland. Wetland professionals look for the presence of **hydrophytes** (water-tolerant plants), **hydric soils** (soils that have been saturated with water for a long period of time), and **hydrology**. Below are a variety of indicators you can use to determine if you have a wetland.

Hydrology:

- Presence of standing water or soggy soils.
- Dark-colored water marks on tree trunks.
- Leaves on the ground are gray or darkly stained.

Hydrophytic Vegetation:

- **Buttressing** of tree trunks, where the base of the tree is enlarged to provide support.
- **Knees** or other adventitious growth that allows support and/or ability to access oxygen from the surface.
- An abrupt change in plant communities often paired with a visual drop in elevation.

The presence of hydrophytic plants may indicate that you are in a wetland. Plant guides and resources can be obtained through our website at www.georgiaadoptastream.com.

Hydric Soils:

- Soil colors may be gray, greenish, or blue-gray.
- Surface soils may be dark brown or black from decayed organic matter.
- Soils will “ribbon” when squeezed in your hand.
- Soils may be saturated with water, but may not if it is the dry season.

Water does not have to be present at all times for the area to be a wetland. In fact, many wetlands look like dry forests or meadows during the dry season. That is why it is

important to look at the plants and soils. If water is present during the growing season, plants that cannot tolerate water will not grow and plants that can tolerate water may grow. When water saturates soil for several days, the chemistry of the soil will change, causing some of the characteristics listed above. These characteristics remain long after the water is gone, thus leaving a good clue that water has saturated that soil for a long period of time.

The easiest indicator is standing water. Other indications that water has been present include **watermarks** on rocks and tree trunks, and discolored leaves that look partially decomposed.

For those with an eye for plants, a change of plant communities may be seen as the upland transitions to a lower elevation. Plants commonly seen near wet sites, such as red maple or cinnamon fern, may be present. Some plant adaptation may be obvious, such as **buttressed** trees that are characterized by the expansion of the base of the tree. Some plants will put out roots or **knees** that rise above the water level to aid in oxygen exchange during flooded conditions.

When a soil is **saturated** with water for a period of time (hours to days, depending on the conditions), the soil will develop anaerobic conditions (low to no oxygen). These conditions lead to the development of characteristics listed above that allow for their identification.

At this point, it is only important to know if you have a wetland. Through the study of your wetland and the use of this manual, your understanding of wetland soils, vegetation, and hydrology will grow.

Find Local Partners

Local partners can help make your project a success in many ways. They can offer technical advice, donate equipment, or facilitate access to a wetland. Contact groups in your area which may be interested in hands-on helping with the project or who may be willing to sponsor your group through donated equipment (e.g. rubber boots) or permission to work on their property.

Examples of local partners with wetland access may include:

- Large private landowners such as timber companies who may have wetlands on their property.
- Government agencies like the Department of Natural Resources Wildlife Resources Division, who have large management areas.
- Municipalities who may have wetlands available for your group to adopt.
- Environmental education centers.
- Schools that may have outdoor classrooms located near or in a wetland.
- Small private landowners like farmers.

Register With Georgia Adopt-A-Wetland

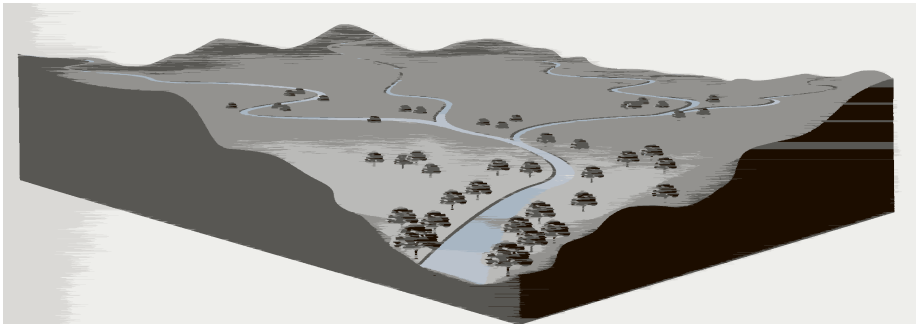
When you have found the wetland area of interest and identified the landowner as a partner, the next step is to obtain the manual, ***Getting To Know Your Watershed,*** from Georgia Adopt-A-Stream. This manual will take you through the steps of identifying your wetland, determining the name of your wetland, obtaining maps, determining which watershed you are in, naming your group, setting goals, making a "Who To Call List," and informing your local government.

Getting To Know Your Watershed also contains the Registration form and information on how to register your wetland with Georgia Adopt-A-Wetland. Registering is important so that your group is officially recognized as part of this program. You will be placed on our mailing list and will receive an official group and site number.

Conducting The Watershed Survey and Map Assessment

A **watershed** includes the entire land area drained by a certain stream or river. Hills and mountains determine in which direction water flows; a drop of rain falling on one side of a hill may eventually find its way to a stream, river, or groundwater system that creates your wetlands. If the drop of rain falls on the other side of the hill, it will follow a different path to a different stream or river. Looking at a topographical map will help you determine the area that makes up your watershed.

Water draining into your wetland may carry with it soil, fertilizer from lawns and fields, oil and gas from parking lots and roads, or anything which comes in contact with the water. Land activities which may alter hydrology in your wetland's watershed may also have an effect, e.g. dredging and filling in or near a wetland, road building, draining for agriculture, etc. Waterways drain water from land in the surrounding area, so every activity on the land may have an impact on the stream or groundwater feeding your wetland.



To conduct the Watershed Survey and Map Assessment, you will need a copy of the manual, ***Getting To Know Your Watershed***.

Determining The Type Of Wetland You Have

Determine if the wetland is an **open system** (exchange of water, sediment, nutrients, pollution, organisms and energy with surrounding areas is easy) or a **closed system** (not as much exchange with the surrounding areas). The majority of Georgia's wetlands are open systems such as coastal marshes and river and stream corridors. If the system is an open wetland, then chances are that the wetland will be affected by land use in the watershed.

Closed system wetlands generally receive their water from precipitation or groundwater, so exchange with the local watershed is limited. However, contamination of groundwater or changes in groundwater levels due to watershed land-disturbing activities may seriously affect the wetland's hydrology (drying it up or flooding it). Neither type of system is immune to filling or dredging, so it's important to note activities around the wetland, which may contribute sediment or drain the site.

Classify Your Wetland

Once the Watershed Survey and Map Assessment has been conducted, use the following chart to classify your wetland. If a wetland is not associated with a body of water (such as the ocean or a river, stream or lake), it is considered to be palustrine.

Wetlands are found on nearly every continent, have many names (bogs, swamps, fens, pocosins, etc.) and many characteristics. They may be shallow, slow-moving water systems, deep riverine systems, or areas which are dry except for a short period of time in the growing season. Open wetland systems have significant flows of energy and material both into and out of them. Substances such as sediment, nutrients, pollution, and organisms (dead and alive) make up material flows. Energy flows refer to sunlight, food energy and moving water. Most of the wetlands in Georgia are open systems that exchange materials with their surrounding environments. Examples of open systems in Georgia include coastal salt marshes and river and stream corridors.

Closed systems, on the other hand, have little or no exchange of materials with their surrounding areas. Precipitation is the main source of water and evaporation is the main loss of water. Nutrients are generally tied up in plants and animals living in the wetland. Closed wetland systems found in Georgia include cypress ponds, granite outcrops communities and Carolina bays.

Georgia has four major groups of wetlands: coastal marshes, bog swamps, and riverine and isolated wetlands (Simkins et al. 1991). The largest and most complex of these systems is the coastal marsh. It may be divided into three functional classes: salt, brackish, and freshwater marshes. The dominant vegetation differs in each class, with Spartina alterniflora (saltmarsh cordgrass) making up the majority of a salt marsh, Juncus roemarianus (needle rush) dominating brackish areas, and a wide diversity of vegetation found in freshwater marshes.

The second-largest type of wetland in Georgia is the bog swamp. The most famous

Georgia bog swamp is the Okefenokee swamp in the southeastern part of the state. It is approximately 427,000 acres in size and receives about 85% of its water from precipitation!

Riverine wetlands (also referred to as riparian wetlands) are usually associated with floodplains or bottomlands adjacent to rivers. Rivers spilling out of their banks during periods of rain deposit sediment, nutrients, and organic materials in these floodplains. As a result, the soils are rich in nutrients and desirable for agricultural lands. The draining of wetlands for agriculture has accounted for the greatest loss of these areas. Red rivers in the mountains and piedmont region are the most productive riparian wetlands in Georgia. In the coastal plain, the riverine wetland type changes to black rivers, characterized by waters dark from tannic and humic acid inputs.

Major Categories	General Location	Wetland Types
Coastal Wetlands		
Marine (undiluted salt water)	Open Coast	Shrub wetland, salt marsh, mangrove swamp
Estuarine (salt/freshwater mix)	Estuaries (deltas, lagoons)	Brackish marsh, shrub wetland, salt marsh, mangrove swamp
Inland Wetlands		
Riverine (associated with rivers & streams)	River channels & flood plains	Bottomlands, freshwater marsh, delta marsh
Lacustrine (associated with lakes)	Lakes & deltas	Freshwater marsh, shrub and forest wetlands
Palustrine (shallow ponds & freshwater wetlands)	Ponds, peatlands, uplands, groundwater seeps	Ephemeral ponds, tundra peatland, groundwater spring oasis, bogs

Classification system developed by Cowardin (1979) and used by U.S. Fish and Wildlife Service

Wetland Functions and Values

Now that you have determined the broad classification of your adopted wetland, ask yourself, “Just how important is this ecosystem?” Wetlands of any size have values and functions, which are beneficial to human society or are of intrinsic importance.

Wetland **functions** are those processes that occur in a wetland system irrespective of human activity. Depending on the wetland type, functions include floodwater storage, erosion control, water purification, sediment trapping, chemical and organic waste processing, nutrient removal, groundwater discharge and recharge, and animal and plant habitat. These characteristics will continue to occur regardless of man’s presence.

Wetland **values** are those ecosystem processes that are perceived to have a positive impact on people. Values may change over time as the perception of human society changes over time. Wetland values and resources for humans may include food, fuel, timber and fiber harvest, recreation, aesthetics, and education. Of course, wetland functions can and should be “valued” by society, but that is not always the case.

Using the following chart, check off the Functions and Values of the wetland you wish to adopt. You may have to do a little research into local history and uses of your wetland to complete the chart. Use local **County Soil Surveys** to get an idea of land use and soil types. Your local Extension Service Agent or USDA -Natural Resources Conservation Service office can help you with maps and County Soil Surveys. Also, consider how the community generally regards your wetland area. Remember, not all functions are necessarily values and vice versa!

Rank the characteristics from 1 - 5 (with 5 being the most important) to get an idea of which functions and values are considered more important. Photocopy the following chart and try to rank the functions and values of your wetland once a year. It will be interesting to see if the values change (due to change in community perception) or if the functions change as the land use within the watershed is altered.

Wetland Characteristic	***Wetland Function?***	***Value To Your Community?***
Recreational Values □ hunting permitted? □ fishing for food or sport? □ nature trails or wildlife observation points?		
Fish, Wildlife and Plant Habitat □ wetland in migratory bird pathway? □ nesting of birds in wetland? □ habitat for mammal, birds, fish, amphibians and reptiles?		
Intrinsic □ only “natural” or green area in community? □ site for scientific research? □ habitat for endangered or threatened species?		
Economic □ timber, fish, shellfish production? □ tourist attraction? □ timber or vegetation harvested?		
Educational □ nature preserve or county park? □ nature center or interpretive trail which is easily accessible? □ historical artifacts in or around wetland?		
Flood Storage □ located in headwaters of the watershed? □ downstream in watershed? □ is it a riverine wetland? □ is it large enough to store and diminish flood waters?		
Groundwater Recharge and Discharge □ recharge for community’s drinking water supply? □ does the community rely heavily on groundwater for water supply?		
Erosion Control: Channel and Shoreline □ does a prominent river or stream run through the community? □ wetland associated with river, coast or lake?		
Water Purification: Surface and Groundwater □ filter runoff water and release clean water? □ trap polluted runoff or excess nutrients?		

Chapter 2

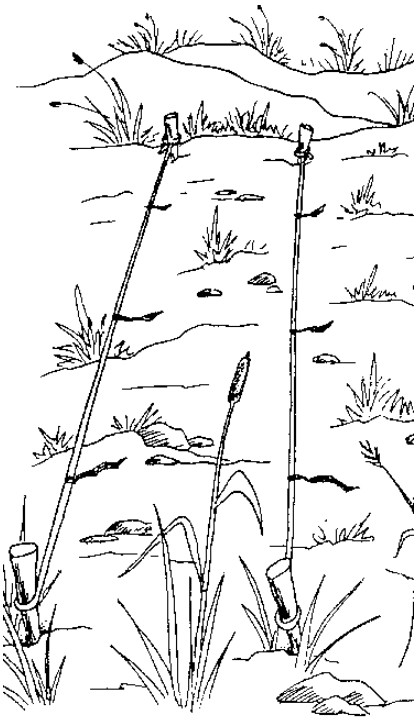
CONDUCTING THE VISUAL SURVEY FOR SOIL, VEGETATION AND HYDROLOGY

Vegetation, soils, and the hydrology of a wetland tell you about the transition from aquatic to upland habitats. Noting the plants, soil and hydrology can help **delineate** or define the border of the wetland. Fill out the visual data sheets provided at the end of this chapter so that you can become familiar with current and changing conditions of your wetland. Completing the data sheets will help you assess the general characteristics of the adopted wetland. The visual survey notes dominant vegetation cover, color and texture of the soils, and water depth and conditions. Make note of wildlife sighted or signs of wildlife.

For groups just getting to know their wetland, *surveying once a month* is a good idea. This will familiarize you with the ever-changing wetland habitat and hydrology. Monthly variations in the water level may be drastic or barely noticeable. After you feel well acquainted with your site, **visual surveys should be done quarterly** (once every 3 months or once each season).

To consistently gather information from the same area, your group should set up a **transect** (a line) along which you will collect the vegetation, soils, and hydrological data. As a rule, the transect should run from an upland point to the water source (if the wetland is associated with a body of water) or into an area of the wetland that contains all the wetland indicators (if the wetland is palustrine). The length of the transect and the number of stations along the transect can vary depending on the size of your Adopt-A-Wetland group and the amount of time your group can commit to the visual survey. The transect should contain at least one upland station, one wetland station and one transitional station. If the wetland is large or contains a variety of conditions that cannot be assessed along one transect, you may want to run several parallel transects.

Setting Up A Transect



1. Stake out a starting point on the upland side of your adopted wetland. The stake may be metal, treated wood, or PVC pipe.

2. Use twine or measuring tape to run a straight line from the upland, into the wetland. Use a compass to get a heading of the transect (example: north 20 degrees). Be sure to include representative sites or zones in the wetland. Remember that you want the transect to cover the transition from upland to wetland. Stop the transect at running or deep water, or when you are sure you are well into the wetland.

3. Measure the length of your transect.

4. To set up survey stations, divide the transect length by a desired number of stations (such as 3, 5 or 10) *minus one* (don't forget your starting point!). The resulting quotient will be the length between stations.

Example:

- Length of transect is 60 feet
- Number of stations desired is 3, so 60 ft /2 = 30 ft
- A survey station will be placed every 30 feet along the transect
- Name the stations (1, 2, 3, etc.). For this transect there will be 3 stations—the starting point, ending point, and halfway in between.

At each survey station, measure an area of 5 ft. radius, using the point on your transect as the center. Take your soil, vegetation and hydrology data from within this 5 ft. radius for each survey station. Use the information below as directions to fill out the data forms. There are also sample data forms following the blank data forms in this manual.

Vegetation Survey

Certain plants have adapted to life in wetland soils. These plants are called **hydrophytes** or water-loving vegetation. They have developed certain modified characteristics over time to aid in the movement of oxygen to plant parts, which are either underwater or in soil that has little or no oxygen. Oxygen is necessary for plants to carry out metabolic processes. Examples of adaptations include aerenchyma tissue, water roots, and the ability to pump oxygen to the roots forming a rhizosphere. **Aerenchyma** tissue has air or pore spaces in plant roots and stems. This allows the

diffusion of oxygen from aerial portions to the roots. Some hydrophytes may produce water roots, or roots that are produced above the soil line, growing in the water. These roots have greater contact with dissolved oxygen in the water column than those roots in the soil. Root growth is facilitated by having an area around the tip which is oxidized - the **rhizosphere**.

For the vegetation survey, consider three general plant layers for your tally: trees, shrubs, and the herbaceous layer. Trees are woody perennials which usually have a main stem or trunk, while shrubs are woody perennials with several stems branching from the base. The herbaceous layer will consist of all other vegetation, such as vines, grasses and soft-stemmed plants.

Look at these three layers within your 5 ft. radius survey station. Identify the three most abundant species in each layer and estimate the percent dominance of each. Record the names of these plants and the % dominance on your data form.

Vegetation can also be classified as obligate wetland, facultative wetland, facultative, or upland. The classification indicates the frequency with which you can expect to find a species of plant in a wetland.

- Obligate wetland - found in wetlands 99% of the time
  Example - *Taxodium distichum*, baldcypress
- Facultative wetland - occurs in wetlands 67% - 99%
  Example - *Fraxinus pennsylvanica*, green ash
- Facultative - equally likely to be found in wetland and nonwetland
  Example - *Pinus palustris*, longleaf pine
- Obligate upland - found 99% of time in upland
  Example - Quercus alba, white oak

Note: Some plants which are found only in uplands in one region of the country may be found in wetlands in other regions of the country.

Below is a sample list of Georgia plants and their wetland indicator status. Common names will vary. For the complete list of wetland plants and their wetland indicators, go to the Fish & Wildlife Service National Wetland Plant List at www.nwi.fws.gov/

Characteristic Plants for Salt Marshes

Common Name	**Scientific Name**	**Wetland Indicator**
Saltmarsh cordgrass	*Spartina alterniflora*	OBL
Saltmeadow cordgrass	*Spartina patens*	FACW
Blackgrass	*Juncus gerardii*	FACW+
Virginia glasswort	*Salicornia virginica*	OBL

Characteristic Plants for Freshwater Marshes		
Common Name	**Scientific Name**	**Wetland Indicator**
Soft-stem bulrush	*Scirpus validus*	OBL
Cattail	*Typha spp.*	OBL
Arrow-head	*Sagittaroria spp.*	OBL
Buttonbush	*Cephalanthus occidentalis*	OBL

Characteristic Plants for Wet Meadows		
Common Name	**Scientific Name**	**Wetland Indicator**
Wool grass	*Scirpus cyperinus*	OBL
Jewelweed, Touch-me-not	*Impatiens capensis*	FACW
Soft rush	*Juncus effusus*	FACW+
Sensitive fern	*Onoclea sensibilis*	FACW+

Characteristic Plants for Forested Wetlands		
Common Name	**Scientific Name**	**Wetland Indicator**
Red maple	*Acer rubrum*	FAC
Black willow	*Salix nigra*	OBL
Green ash	*Fraxinus pennsylvanica*	FACW
Spice bush	*Lindera benzoin*	FACW
Swamp azalea	*Rhododendron viscosum*	FACW+
Chinese privet*	*Ligustrum sinense*	FAC
Cinnamon fern	*Osmunda cinnamomea*	FACW+

Characteristic Plants for Forested Wetlands		
Royal fern	*Osmunda regalis*	OBL

Characteristic Plants for Shrub Swamps		
Common Name	**Scientific Name**	**Wetland Indicator**
Buttonbush	*Cephalanthus occidentalis*	OBL
Pepperbush	*Clethra alnifolia*	FACW
Common alder	*Alnus serrulata*	FACW+
Skunk cabbage	*Symplocarpus foetidus*	OBL
Marsh fern	*Thelypteris thelypteroides*	FACW+

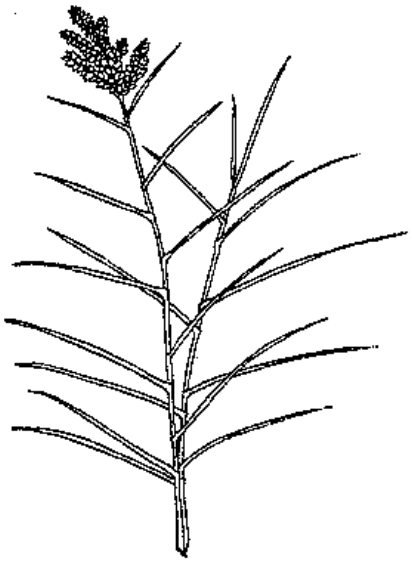
Characteristic Plants for Bogs and Fens		
Common Name	**Scientific Name**	**Wetland Indicator**
Sphagnum moss	*Sphagnum spp.*	OBL
Pitcher plant	*Sarracenia spp.*	OBL
Slash pine	*Pinus elliottii*	FACW
Toothache grass	*Ctenium aromaticum*	FACW

** exotic or invasive plants which may be found in wetlands*

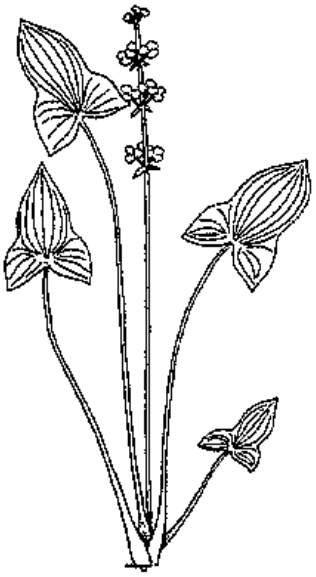
What do these wetland plants look like?

There are several excellent wetland plant identification guides available - just check out your local bookstore for guides with good descriptions and pictures. Here are just a few to help get you started (with permission from *A World in Our Backyard*). Also check out our website, which has links to many wetland sites: www.georgiaadoptastream.com.

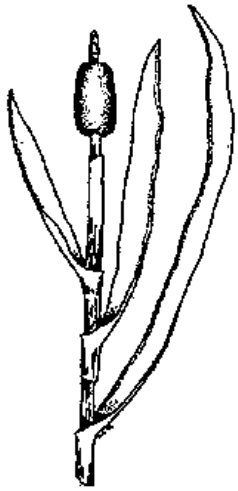
Alder



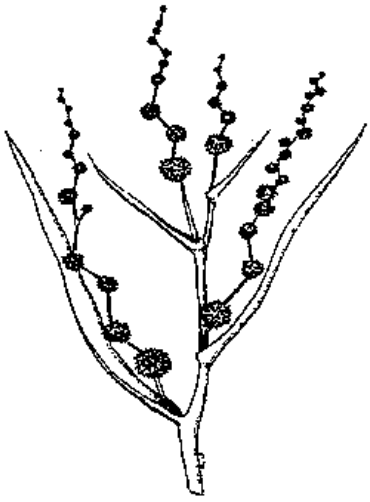
spike grass



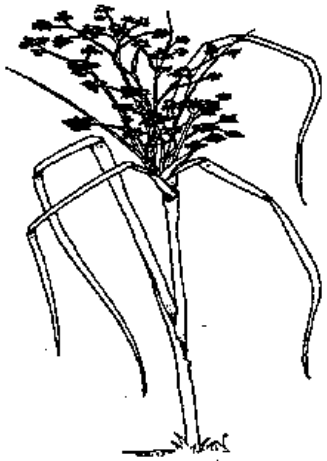
arrowhead



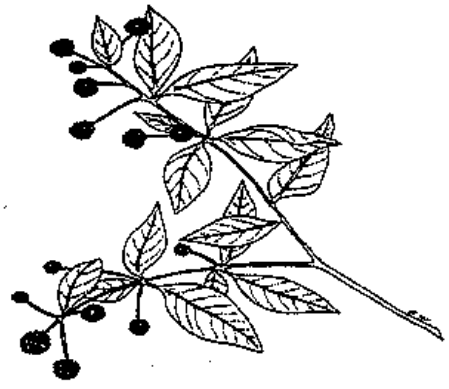
broad-leaved cattail



burreeds

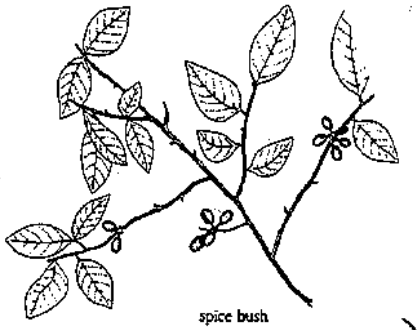


woolgrass

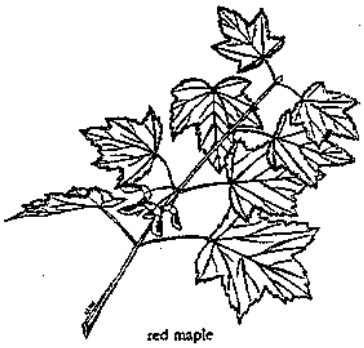


buttonbush

Common Wetland Plants, continued



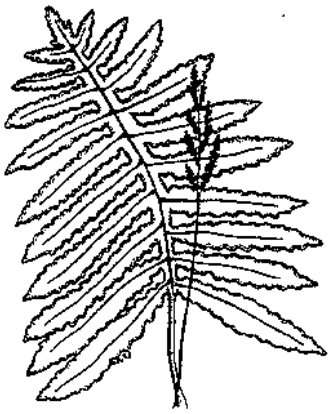
spice bush



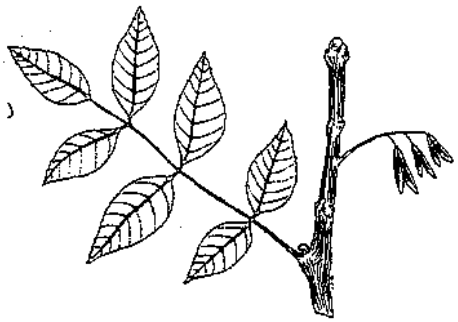
red maple

jewelweed

smooth cordgrass



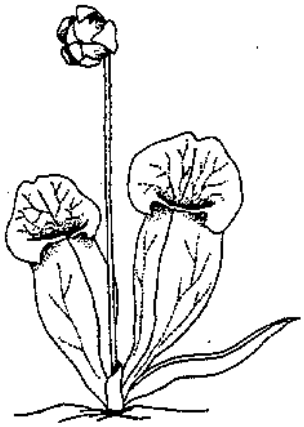
sensitive fern



green ash

leatherleaf

arrow arum



pitcher plant

Soil Survey - Getting the Soil Sample

Wetland Soils

Soils have a distinctive look to them when they have been regularly flooded with water, even for only a short period of time. **Hydric soils** are defined as soils characterized by, and showing the effects of, the presence of water. Some of these characteristics include a soil's color. Even if the soil is not wet at the time you sample, if it has been flooded long enough for the oxygen to have been used up by microbes and wetland plants (become anaerobic), the color will be changed. Taking soil samples at upland, wetland and transitional stations will help you learn to recognize the difference between an upland and a hydric soil.

- Using a sharp shooter or small shovel, dig a hole about 18 inches deep. Make a smooth, clean surface along the inside of the hole so you can note the changes in the soil from the surface down to the bottom.
- Using the soil chart from the visual survey packet, identify the soil colors.
- Feel the texture and determine if the soil is sticky and smooth like clay, gritty like sand, or somewhere in between. Some wetland soils **ribbon** or stick together, oozing between your fingers in a ribbonlike strand when squeezed.
- Does the soil smell like rotten eggs? Sulfur gas and methane are sometimes formed in anaerobic atmospheres and give off this distinctive smell. Also note the degree of wetness.
- Does water drip from the soil when you squeeze it? Is there standing water in the hole? Can you determine whether the soil is organic or mineral?

Note this information on the data sheets provided.

If there is standing water on the soil, gently bring the spade to the surface with the soil sample resting on the blade and observe.

Major Wetland Soil Type	**Characteristics**
Organic- soils contain more than 10% of partially decomposed plants within at least 1.5 feet of the ground's surface.	Black muck or black to dark brown peat
Mineral- soils that contain little or no organic material	gleyed - neutral gray, greenish, or bluish gray mottled - soil has splotches of brown, orange, red or yellow

Wetlands Soils Color Chart

Hydric soils may appear dark brown or black if there is a build up of organic matter. Often times they have a grayish background and mottled (speckled) with red, orange, and yellow from iron in the soil OR black from manganese in the soil. The color of the soil and its location will help identify your wetland's boundaries.

WET **DRY**

1. Gray (light) + White
(GLEY 1 7/N)

2. Olive green (light) + White
(5Y 8/3)

3. Peach
(7.5 YR 8/8)

4. Goldenrod
(10 YR 8/8)

5. Gray
(GLEY 2 7/5 PB)

6. Brown + Gray
(2.5Y 7/2)

7. Tan
(7.5YR 7/8)

8. Bittersweet
(10R 6/8)

9. Black
(GLEY 1 2.5/N)

10. Black + Sepia
(10YR 4/2)

11. Olive green + Raw Sienna
(2.5Y 4/6)

12. Burnt Sienna
(10R 4/8)

13.

Sea green + Gray
(GLEY 1 7/5G)

14. Forest green + Gray
(5Y 6/2)

15. Pine green + Gra
(GLEY 2 8/10G)

16. Sky blue + Cornflower +Gray
(GLEY 2 6/5 B)

Notice the letters and numbers indicated in the parentheses under each color name above. This information relates to the color information in the Munsell Color Chart, which professionals use to identify hydric soils. Dominant hues for soil are red, yellow –red and yellow (R, YR, Y). The first number before the "/" refers to the degree of darkness of the soil color, ranging from 0 (black) to 10 (white). The second number refers to the strength of the color, beginning with 0 (neutral gray) and increasing to 8.

From *Wonders of Wetlands,* with permission

Considering the Hydrology

Hydrology is the study of the behavior of water in the atmosphere, on the earth's surface, and underground. The **hydroperiod** in a wetland is the seasonal and cyclical pattern of water in a wetland. It also helps designate into which wetlands classification an area will be placed (lacustrine, palustrine, etc.). Landscape position and hydrology determine water depth, flow patterns, and the duration and frequency of flooding or saturation in a wetland. Topography, proximity to other bodies of water, and depth to the water table are all factors that influence wetland hydrology.

The frequency, depth and duration of flooding in a wetland are defining factors in the area's characteristics of vegetation, soils, and wildlife. A wetland with deep, slow-moving or stagnant waters will have markedly different vegetation and habitat from a wetland with shallow, fast-moving water.

Water may enter a wetland in several ways, including:

- Direct precipitation
- Surface water runoff from brooks, streams, and rivers
- Springs or seeps-- places where the water table intersects with the land surface
- Flood waters from upstream and adjacent surface water bodies such as rivers, ponds, and lakes
- Tidal flow and storm surges in coastal areas
- Underground water sources such as groundwater or springs

In low-lying areas, groundwater may lie just below the soil surface (high water table), keeping soils saturated from below.

Complete the hydrology survey form by measuring the depth of the water at each of the stations. If water is not present, note the hydrologic indicators. DO NOT WADE INTO DEEP OR SWIFTLY-MOVING WATER. If your transect survey station is at the edge of deep water, take your depth measurement there.

When is water present at your site – in all four seasons or just spring? How long is the water there? What is the likely source? All of these are questions that will help you understand the ecology of your wetland.

Drawing Conclusions

Since wetlands are so diverse in their appearance and apparent quality, you will need to draw conclusions about your adopted wetland's overall health based on its wetland classification type. For example, saltwater intrusion in an estuarine wetland may not be considered poor quality, as this is typical for some marshes at high tide. On the other hand, saltwater intrusion into a freshwater marsh following a storm event may change the wetland's original quality, as vegetation which is not adapted to brackish water dies. If this change results in a severe loss of habitat or erosion, it may be considered lower in quality. However, not all changes are negative. Some are natural

and expected fluctuation in wetland characteristics. Most decreases in wetland quality will be the result of man-made disturbances such as road building, dredging, or filling.

Using information in this manual and the resources listed in the Appendix, you will continue to learn more about your wetland.

Send Results

As you collect your data for your group, be sure to make copies for your local partners, Regional Training Center, local government, and Georgia Adopt-A-Wetland. Many people will be interested in your educational and informative experiences. Send your survey results to Georgia Adopt-A-Wetland once a quarter.

Litter Pick Up

Although frequently wetlands are not easily accessible to people who aren't trying to get there, trash and debris from nearby communities may be littering your area. Removing this litter is a quick and easy way to instantly make a difference in wetland quality and aesthetics.

Bring trash bags with you during your quarterly visual surveys and pick up litter. Your group may be split up into several teams (e.g. a litter team, vegetation team, soils team, etc.). If there are items too large for your group to safely handle, contact your local city or county public works or fire department and ask if they can assist your group. Always be careful of sharp objects - wear gloves to protect your hands!

Public Outreach

It is very important for your group to let the community know what you are doing to protect and preserve their resources. Give at least one presentation during the course of your project. Contact the local newspaper or television station and invite them along for a visual survey. Write articles for a school newspaper or newsletter and be sure to keep a scrapbook of your activities to show off at environmental fairs! Many groups from canoe clubs to civic organizations have newsletters and are interested in water stewardship. Each time you give a presentation or write an article, please keep track of it and let us know! We also keep a scrapbook of activities.

Return To:
Georgia Adopt-A-Stream – Wetland Adoption
4220 International Parkway, Suite 101
Atlanta, GA 30354

Wetland Monitoring

Use this form to record important information about vegetation, soils, and hydrology in your wetland. By keeping accurate and consistent records of your visual observations, you can document current conditions and changes in wetland characteristics.

Wetland Name: | **Group Name:**

AAS-S-

Site Number: | **Members Present:**

Date: | **County:**

Weather Conditions:

☐ Clear ☐ Cloudy ☐ Rain ☐ Rain within last 24 to 48 hours?

Visual Survey

Water Source: ☐ Precipitation ☐ Groundwater ☐ Stream/river /lake ☐ Coastal Other _____

Name of associated river/stream/lake:

Name General Wetland Classification: _____ Circle type of system | Open System | Close System

Surface Water Appearance:

☐ clear	☐ milky / gray	☐ none	☐ rotten eggs
☐ muddy	☐ green	☐ natural	☐ sewage
☐ oily	☐ brown	☐ gasoline or oil	☐ chemical
☐ foamy	☐ black	☐ chlorine	☐ other: _____
☐ scum	☐ other: _____		

Odor:

Wetland Buffer: (within 25 ft. from wetland)

	Excellent	Good	Fair	Poor
Natural Vegetative Cover	☐	☐	☐	☐
Bank Stable- no erosion	☐	☐	☐	☐
Undisturbed land	☐	☐	☐	☐

Impacts To Wetland:

☐ Artificial water control	(dam, dyke, etc)	☐ Dumping of sand, dirt, gravel	
☐ Eroded banks		☐ Trash	
☐ Dredging		☐ Clearing of vegetation	
☐ Algal blooms	(Indicates nutrients)	☐ Other:	

Transect Locations

Location of transect upland point _____

Length of transect _____ ft.

Compass bearing along transect _____ (degrees)

Numbers of stations along transect _____

Location of transect wetland point _____

Vegetation Survey

At each sampling station, look at the area within a 5 foot radius from the point along your transect. Identify the 3 dominant species in each layer. Record species name (cypress, red maple, lizard tail, cattail, etc.) and wetland indicator status (obligate, FacWet, Fac, Upland) if known.

Layers	Station 1	Station 2	Station 3
Tree			
Shrub			
Herbaceous Layer			

Vegetation Survey

Layers	Station 4	Station 5	Station 6
Tree			
Shrub			
Herbaceous Layer			

How many plant communities (obvious changes in vegetation) do you see along your transect?

Soil Survey

To collect your soil sample, use a spade or small shovel to dig an 18-inch-deep hole at each transect station. Using the soil color chart, determine the representative color of the soil at each transect (including upland areas). Fill in your observations in the following table:

	Station 1	Station 2	Station 3
Color (from Color Chart)			
Smell			
Degree of wetness (wet, damp, dry)			
Texture (clay, sandy, sticky)			

Soil Survey

	Station 4	Station 5	Station 6
Color (from Color Chart)			
Smell			
Degree of wetness (wet, damp, dry)			
Texture (clay, sandy, sticky)			

Observations of wetland soil:
Are there any defined layers to the wetland soil? If so, describe.

Is there mottling (concentrated areas of red or yellow soil)?

How deep do the plant roots go? _____ (Inches)

Is there standing water in the hole? _____ How many inches to the surface? ____ (Inches)

What organisms are living in the soil?

From *A World in Our Backyard*, with permission

Hydrology Survey

Answer the following questions. Depending on the time of year, precipitation amounts, and various other factors, a wetland may appear dry.

	Station 1	Station 2	Station 3
Depth of surface Water			
If no surface water, is water filling the hole?			
Surface Water Movement (slow, fast, none)			
If no water, name hydrology indicators (water marks, drift lines, sediment deposits, water stained leaves, drainage patterns)			

	Station 4	Station 5	Station 6
Depth of surface Water			
If no surface water, is water filling the hole?			
Surface Water Movement (slow,fast, none)			
If no water, name hydrology indicators (water marks, drift lines, sediment deposits, water stained leaves, drainage patterns)			

Sample Form

Return To:
Georgia Adopt-A-Stream – Wetland Adoption
4220 International Parkway, Suite 101
Atlanta, GA 30354

Wetland Monitoring

Use this form to record important information about vegetation, soils and hydrology in your wetland. By keeping accurate and consistent records of your visual observations, you can document current conditions and changes in wetland characteristics.

Clayton County Wetland
Wetland Name:

Clayton Critter Watch AAS-G-100
Group Name:

AAS-S-222
Site Number:

Harold Harbert and Kim Morris-Zarneke
Members Present:

6/26/01
Date:

Clayton
County:

Weather Conditions:

x	Clear		Cloudy		Rain		Rain within last 24 to 48 hours?

Visual Survey

Water Source:										
	x	Precipitation		Groundwater	x	Stream/river /lake		Coastal	Other	_____

Name of associated river/stream/lake: Pate's Creek

Name General Wetland Classification:	Riverine	Circle type of system	Open System	Close System

Surface Water Appearance:

	clear		milky / gray
	muddy		green
	oily	x	brown
	foamy		black
	scum		other: _____

Odor:

x	none		rotten eggs
x	natural		sewage
	gasoline or oil		chemical
	chlorine		other: _____

Wetland Buffer: (within 25 ft. from wetland)	**Excellent**	**Good**	**Fair**	**Poor**
Natural Vegetative Cover	x			
Bank Stable- no erosion	x			
Undisturbed land		x		

Impacts To Wetland:

x	Artificial water control	(dam, dyke, etc.)		Dumping of sand, dirt, gravel
	Eroded banks			Trash
	Dredging			Clearing of vegetation
	Algal blooms	(indicates nutrients)		Other:

Sample Form

Transect Locations

Location of transect upland point Hill Behind Turtle Cove, Tied to Small Tulip Poplar

Length of transect 82 ft.

Compass bearing along transect 130 (degrees)

Numbers of stations along transect 3

Location of transect wetland point At cane and rush transition, to the right of the red maple

Vegetation Survey

At each sampling station, look at the area within a 5 foot radius from the point along your transect. Identify the 3 dominant species in each layer. Record species name (cypress, red maple, lizard tail, cattail, etc.) and wetland indicator (obligate, FacWet, Fac, Upland) if known.

Layers	Station 1	Station 2	Station 3
Tree	Tulip Poplar (FacW) White Oak (FacU) Loblolly Pine (Fac)	Tulip Poplar (FacW) Basswood (FacU)	Red Maple (Fac)
Shrub	none	Chinese Privet (Fac) Sweet Gum (Fac+) River Cane (FacW)	Blackberry (Fac)
Herbaceous Layer	Chickweed (FacU) Virginia Creeper (Fac) Dog Grass (unknown)	Dog Grass (unknown)	Dog Grass Soft Rush (FacW+) Sedge (FacW) Honey Suckle (Fac)

How many plant communities (obvious changes in vegetation) do you see along your transect? Three

Sample Form
Soil Survey

To collect your soil sample, use a spade or small shovel to dig an 18-inch hole at each transect station. Using the soil color chart, determine the representative color of the soil at each transect (including upland areas). Fill in your observations in the following table:

	Station 1	Station 2	Station 3
Color (from Color Chart)	Burnt Sienna	Burnt Sienna	Black / Sepia mixed with Burnt Sienna
Smell	none	none	sulphur
Degree of wetness (wet, damp, dry)	damp	damp	Squishy wet
Texture (clay, sandy, sticky)	clay	clay	Clay, ribbons when squeezed

Sample Form
Hydrology Survey

Answer the following questions. Depending on the time of year, precipitation amounts, and various other factors, a wetland may appear dry.

	Station 1	Station 2	Station 3
Depth of surface Water	none	none	none
If no surface water, is water filling the hole?	none	none	Yes. Filled hole to the top
Surface Water Movement (slow, fast, none)	none	none	none
If no water, name hydrology indicators (water marks, drift lines, sediment deposits, water stained leaves, drainage patterns)	none	none	None that could be seen

Appendix A

- Resource List
- Supporting Programs
- EPA Wetland Fact Sheets
- Wetland Plants of Georgia
- Hydric Soils of Georgia information

Wetland Resources

- Army Corps of Engineers Wetland Delineation Manual, 1987

  U.S. Army Corps of Engineers
  Waterways Experiment Station
  3909 Halls Ferry Road
  Vicksburg, MS 39180-6199
  or www.sas.usace.army.mil/permit.htm

- Army Corps of Engineers, Wetland Information 404-763-7933
- Wetland Plant List (National) www.nwi.fws.gov/Ecology
- United States Environmental Protection Agency

  Wetlands/Oceans/Watersheds 404-562-9355 or
  www.epa.gov/OWOW/wetlands

  Wetland Hotline 800-832-7828 /

  Wetlands Regulation Center www.wetlands.com/regs/tlpge01c.htm

- Natural Resources Conservation Service - Wetland Science Institute www.pwrc.nbs.gov/wetsci.
- Field Indicators of Hydric Soils In The United States – a guide to identifying and delineating hydric soils - NRCS
- *Wetland Plants of Georgia* contact your local cooperative extension service office and ask for publication # 411
- *Izaak Walton League of America, Handbook for Wetlands Conservation and Sustainability*
- *Model Wetland Protection Ordinance and Landowners' Guide to Wetlands and Watersheds*, GA Dept. of Community Affairs

  Office of Coordinated Planning
  1200 Equitable Building
  100 Peachtree Street
  Atlanta, GA 30303

- Wetlands and Agriculture, Swampbuster in the Food Securities Act. Call your local NRCS office for more information.
- *Wetlands*, by William Mitsch and James Gosselink (can order at any bookstore).
- *A Field Guide to Wetland Characterization and Wetland Plant Guide* by Ken Pritchard, Adopt A Beach. 1991. Call Washington State Cooperative Extension at 206-296-3900
- *Field Guide to Coastal Wetland Plants of Southeastern US by R.W.Tiner, University of Massachusetts Press, 1993.*
- *UGA Cooperative Extynresion Service – www.ces.uga.edu*
- U.S. Fish and Wildlife Service 706-613-9493 or www.fws.gov
- Georgia Environmental Protection Division – 404-675-6240

- DNR Coastal Resources Division 912-264-7218
- Georgia Natural Heritage Program, DNR Wildlife Resources Division 770-918-6411
- Joseph W. Jones Ecological Research Center in Newton, GA 912-734-4706
- Terrene Institute – facts and resource materials about wetlands – www.terrene.org
- County Soil Surveys (call local Natural Resource Conservation Service office for a copy)
- National Wetland Inventory Maps (NWI) and Topo maps available at Georgia Geological Suvrey map office 404-656-3214; or www.nwi.fws.gov (with some practice, you can download maps) Topo maps are also available at www.topozone.com
- Aerial photographs and/or plat maps located at your local government planning office or tax assessor's office

Programs Mentioned In This Manual

WOW! The Wonders of Wetlands, An Educator's Guide

Produced by Environmental Concern, Inc. and The Watercourse, this book is a resource book with background material for teachers and wetland related activities for grades K-12. Each activity includes curriculum planning information. The activities are hands-on and are a good model for learning wetland ecology, values, and functions.

A World In Our Backyard, A Wetlands Education and Stewardship Program

Developed by the New England Interstate Water Pollution Commission with funding provided by the US EPA - Region 1. This resource material is focused mainly on wetlands in New England for educators. It suggests ways of studying wetland characteristics, why wetlands are important, and how students and teachers can help to protect a local wetland resource. This guide encourages students to become familiar with a local wetland and advocate its protection through stewardship activities.

Texas Wetlands: A Conservation Education Guide

The Texas Wetlands guide is a source of information relating to Texas wetlands for use as a tool by educators and youth group leaders. It contains species information and references pertaining to wetlands and wetland materials. The guide was designed to be used in conjunction with the Texas Wetlands video and Aquatic WILD classroom curriculum activities. The main focus of this wetland guide is to increase knowledge of wetlands and use this knowledge as a "stepping stone to teaching young people about the importance of preserving the fragile balance found in nature."

Save Our Streams - Handbook for Wetland Conservation and Sustainability

The Izaak Walton League of America has created a handbook to help people become wetland stewards by learning how wetlands function and to encourage forming partnerships between community stakeholders from the regulatory, business and the general public to protect wetlands. The monitoring techniques outlined in this manual are very thorough. This is a good reference for those volunteers who are more focused on gathering data or more scientifically inclined. To order a copy, call (301) 548-0450.

Georgia's Wetland Treasures

This is a book of information about wetlands written specifically for educators in Georgia. This book will expand on the information in this manual and provide activities for teachers and students. To obtain a copy, contact Janet Evans with DNR Coastal Resources Division at (912) 264-7218 or janet@ecology.dnr.state.ga.us

Glossary Of Wetland Related Terms

Aerenchyma tissue – special tissue with pore spaces a plant has in its roots and stems to allow for the diffusion of oxygen.
Algae – simple plants which do not grow true roots, stems, or leaves and which live mainly in water, providing a base for the food chain.
Algal bloom – a heavy growth of algae in and on a body of water as a result of high nitrate and phosphate concentrations from farm fertilizers and detergents.
Alkalinity – a measure of the negative ions available to react and neutralize free hydrogen ions. Some of most common of these include hydroxide (OH), sulfate (SO_4), phosphate (PO_4), bicarbonate (HCO_3) and carbonate (CO_3)
Anaerobic – living, active or occurring in the absence of oxygen.
Assemblage – the set of related organisms that represent a portion of a biological community (e.g., benthic macroinvertebrates).
Benthic – pertaining to the bottom (bed) of a water body.
Bog – a wetland characterized by waterlogged soils and dominated by spongy mosses.
Brackish water – water that contains a mix of fresh and salt water.
Carolina Bay – wetlands found on the east cost of the US fed by rainwater and ground water.
Closed system wetland - is a wetland where there is little exchange of water, sediment, nutrients, pollution, organisms and energy with surrounding systems.
Community – a group of plants and animals inhabiting a given area.
Cypress swamp – a wetland environment common throughout the SE US in which cypress trees are a dominant species.
Delineate – to decide where something begins and ends.
Designated uses – state-established desirable uses that waters should support, such as fishing, swimming, and aquatic life. Listed in state water quality standards.
Dissolved oxygen (DO) – oxygen dissolved in water and available for living organisms to use for respiration.
Downstream – the direction the water is flowing
Dredge – to remove sediments from the streambed to deepen or widen the channel.
Ecoregion – geographic areas that are distinguished from others by ecological characteristics such as climate, soils, geology, and vegetation.
Effluent – an out-flowing branch of a main stream or lake; waste material (i.e. liquid industrial refuse, sewage) discharged into the environment.

Emergent plants – plants rooted underwater, but with their tops extending above the water.
Endangered species – a life form that faces extinction
Erosion – the wearing away of land by wind or water.
Erosion Control – is the preventing of the wearying away or loss of material.
Estuarine – an area associated with an estuary
Estuary – the lower course of a river where the current is met by the ocean tides.
Eutrophication – the natural and artificial addition of nutrients to a water body, which may lead to depleted oxygen concentrations. Eutrophication is a natural process that is frequently accelerated and intensified by human activities.
Fen – low, flat swampy land. Also called a bog or marsh.
Fish kill – the sudden death of fish due to the introduction of pollutants or the reduction of dissolved oxygen concentration in a water body.
Floating plants – plants that grow free-floating, rather than being attached to the streambed.
Floodplain – a low area of land surrounding streams or rivers that holds the overflow of water during a flood.
Flow – the direction of movement of a stream or river.
Groundwater – a supply of fresh water under the earth's surface that forms a natural reservoir.
Groundwater Discharge – the outflow of water from the groundwater source.
Groundwater Recharge – the addition of water to the groundwater supply by natural filtration that tends to raise the water table.
Headwaters – the origins of a stream.
Herbaceous Layer – this layer consists of all vegetation except trees and shrubs. Examples of plants found in the herbaceous layer include: vines, grasses, and soft-stemmed plants.
Hydric Soil – soil characterized by the presence of water.
Hydrology – the study of the behavior of water in the atmosphere, on the earth’s surface and underground.
Hydrophytes – water loving vegetation
Hypoxia – depletion of dissolved oxygen in an aquatic system.
Impoundment – a body of water contained by a barrier, such as a dam.
Lacusterine – having to do with lakes.
Land uses – activities that take place on the land, such as construction, farming, or tree clearing.
Leaching – the process in which material in the soil (such as nutrients, pesticides, chemicals) are washed into lower layers of soil or are dissolved

and carried away by water.
Macroinvertebrate – organisms that lack a backbone and can be seen with the naked eye.
Marsh – a wetland characterized by soft, wet, low-lying land marked by herbaceous vegetation.
Nonpoint source pollution – pollution that cannot be traced to a specific point, but rather from many individual places (e.g., urban and agricultural runoff).
Nutrient – substance that is necessary for growth of all living things (i.e. phosphorous, nitrogen and carbon).
Open system wetland – is a wetland where the exchange of water, sediment, nutrients, pollution, organisms and energy with surrounding systems occurs naturally/easily.
Organic Waste - wastes derived from living organisms.
Palustrine – having to do with small non-tidal wetlands dominated by trees, shrubs, persistent emergents or emergent mosses and lichens.
Permeable – porous; having openings through which liquid or gaseous substances can penetrate.
Pesticide – a chemical that kills insects and rodents. Pesticides can poison aquatic life when they reach surface waters through runoff.
pH – a numerical measure of the hydrogen ion concentration used to indicate the alkalinity or acidity of a substance. Measured on a scale of 1.0 (acidic) to 14.0 (basic); 7.0 is neutral.
Phosphorus – a nutrient that is essential for plants and animals.
Photosynthesis – the chemical reaction in plants that utilizes light energy from the sun to convert water and carbon dioxide into simple sugars. This reaction is facilitated by chlorophyll.
Point source pollution – a type of pollution that can be tracked down to a specific source such as a factory discharge pipe.
Pollutant – something that makes land, water or air dirty and unhealthful.
Reagent – a substance or chemical used to indicate the presence of a chemical or to induce a chemical reaction to determine the chemical characteristics of a solution.
Rhizosphere – a zone of increased microbial growth and activity that surrounds the roots of a plant.
Riparian – of or pertaining to the banks of a body of water.
Riparian Wetland – a wetland that typically occurs or grows along the banks of rivers and streams.
Riparian zone – the vegetated area on each bank of a body of water.
Riverine – associated with rivers, streams and their floodplains.
Runoff – water, including rain and snow, which is not absorbed into the ground but instead flows across the land and eventually runs into streams

and rivers. Runoff can pick up pollutants from the air and land, carrying them into the stream.
Salt Water Intrusion – the movement of salt water into a wetland that is predominately fresh water.
Saturated – inundated; filled to the point of capacity or beyond.
Sediment – soil, sand, and materials washed from land into waterways. Other pollutants may attach to sediment and be carried into the stream.
Sedimentation – when soil particles (sediment) settle to the bottom of a waterway.
Septic tank – a domestic wastewater treatment system into which wastes are piped directly from the home; bacteria decompose the organic waste, sludge settles to the bottom of the tank, and the treated effluent flows out into the ground through drainage pipes.
Submergent plants – plants that live and grow fully submerged under the water.
Substrate – refers to a surface. This includes the material comprising the streambed or the surfaces to which plants or animals may attach or upon which they live.
Surface water – precipitation which does not soak into the ground or return to the atmosphere by evaporation or transpiration and is stored in streams, lakes, wetlands, and reservoirs.
Swamp – a saturated lowland or seasonally flooded bottomland characterized by trees and wood vegetation.
Taxon (plural taxa) – a level of classification within a scientific system that categorizes living organisms based on their physical characteristics.
Taxonomic key – a quick reference guide used to identify organisms. They are available in varying degrees of complexity and detail.
Threatened Species – a life form that is still abundant in the wild, but is likely to become a endangered due to threats it faces in it wild.
Tolerance – the ability to withstand a particular condition, e.g., pollution-tolerant indicates the ability to live in polluted waters.
Topography – surveying the physical features of a region often to create topographical maps that note elevation across a given landscape.
Toxic substances – poisonous matter (either chemical or natural) which causes sickness, disease and/or death to plants or animals.
Transect – marked line along which scientific sampling or surveying is done.
Tributaries – a body of water that drains into another, typically larger, body of water.
Turbidity – murkiness or cloudiness of water, indicating the presence of some suspended sediments, dissolved solids, natural or man-made chemicals, algae, etc.

Upstream – opposite direction of the water flow.
Water cycle – the cycle of the earth's water supply from the atmosphere to the earth and back which includes precipitation, transpiration, evaporation, runoff, infiltration, and storage in water bodies and groundwater.
Water Purification – filtering of water to trap pollution and excess nutrients
Water roots – roots that that are produced above the above the soil line that grown down into the water.
Water table – the upper level of groundwater.
Watershed – land area from which water drains to a particular water body.
Waterway – a natural or man-made route for water to run through (such as a river, stream, creek, or channel).
Wetland – an area of land that is regularly wet or flooded, such as a marsh or swamp.