Virginia
Wetland Resources

Wetlands cover about 4 percent of Virginia (Dahl, 1990). These wetlands support rich biotic communities in freshwater, saltwater, and brackish-water settings across the State. Well-known Virginia wetlands include the extensive estuarine marshes behind the coastal barrier islands and the forested wetlands along tidal rivers and in the Great Dismal Swamp (fig.1).

Wetlands have many chemical, physical, and biological functions. They benefit entire ecosystems, including resident human populations (Hershner, 1992). Wetlands trap waterborne sediments and retain nutrients and toxic chemicals by filtering them out of inflowing water and storing or transforming them. Wetlands also can recharge ground-water supplies or serve as points of ground-water discharge to the surface. Coastal-zone and flood-plain wetlands mitigate the effects of flooding caused by tides and runoff by reducing flow velocity, storing water temporarily, and releasing it gradually. Vegetation in riparian wetlands maintains stream channels by stabilizing the banks, and vegetated tidal wetlands act as buffers against storm tides and waves, thus impeding erosion. One of the most important functions of wetlands is to provide habitat for waterfowl, terrestrial and aquatic animals, and a wide variety of plant life. Wetlands in Virginia provide food, shelter, and resting places for migratory birds, as well as breeding areas and nurseries for many animals, including those of particular economic interest in Virginia such as blue crabs, muskrat, fish, ducks, and geese. Many rare and endangered plant species are adapted to hydrologic conditions present only in wetlands.

Virginia's wetlands have considerable esthetic, historic, archeological, recreational, and economic value (Hershner, 1992). Humans have inhabited the coastal wetlands of Virginia for thousands of years, and unique cultures have developed there. Wetlands provide outdoor educational and recreational opportunities such as birdwatching, hiking, and canoeing. They also support the hunting, fur trapping, commercial and sport fishing, lumbering, and tourist industries, which benefit the economy of the State.

TYPES AND DISTRIBUTION

Wetlands are lands transitional between terrestrial and deep-water habitats where the water table usually is at or near the land surface or the land is covered by shallow water (Cowardin and others, 1979). The distribution of wetlands and deepwater habitats in Virginia is shown in figure 2A; only wetlands are discussed herein.

Figure 1. Wetlands in the Great Dismal Swamp, a palustrine forested wetland. *(Photograph by Virginia Carter, U.S. Geological Survey.)*

Wetlands can be vegetated or nonvegetated and are classified on the basis of their hydrology, vegetation, and substrate. In this summary, wetlands are classified according to the system proposed by Cowardin and others (1979), which is used by the U.S. Fish and Wildlife Service (FWS) to map and inventory the Nation's wetlands. At the most general level of the classification system, wetlands are grouped into five ecological systems: Palustrine, Lacustrine, Riverine, Estuarine, and Marine. The Palustrine System includes only wetlands, whereas the other systems comprise wetlands and deepwater habitats. Wetlands of the systems that occur in Virginia are described below.

System	Wetland description
Palustrine	Nontidal and tidal-freshwater wetlands in which vegetation is predominantly trees (forested wetlands); shrubs (scrub-shrub wetlands); persistent or nonpersistent emergent, erect, rooted herbaceous plants (persistent- and nonpersistent-emergent wetlands); or submersed and (or) floating plants (aquatic beds). Also, intermittently to permanently flooded open-water bodies of less than 20 acres in which water is less than 6.6 feet deep.
Lacustrine	Nontidal and tidal-freshwater wetlands within an intermittently to permanently flooded lake or reservoir larger than 20 acres and (or) deeper than 6.6 feet. Vegetation, when present, is predominantly nonpersistent emergent plants (nonpersistent-emergent wetlands), or submersed and (or) floating plants (aquatic beds), or both.
Riverine	Nontidal and tidal-freshwater wetlands within a channel. Vegetation, when present, is same as in the Lacustrine System.
Estuarine	Tidal wetlands in low-wave-energy environments where the salinity of the water is greater than 0.5 part per thousand (ppt) and is variable owing to evaporation and the mixing of seawater and freshwater.
Marine	Tidal wetlands that are exposed to waves and currents of the open ocean and to water having a salinity greater than 30 ppt.

Palustrine wetlands comprise about 72 percent of the wetland area of Virginia (Tiner and Finn, 1986). Estuarine wetlands comprise about 23 percent of the State's wetlands. Lacustrine wetlands in freshwater ponds comprise most of the remaining 5 percent. Only a few hundred acres of marine and riverine wetlands exist in Virginia. Palustrine forested wetlands (swamps) are the most abundant type of wetland in Virginia, accounting for about 60 percent of the total wetland area in the State. Estuarine emergent wetlands (tidal marshes) are the second-most abundant type of wetland, comprising about 8 percent of the wetlands in the State (Tiner and Finn, 1986).

Virginia has many different types of wetlands. Salt marshes include the extensive estuarine wetlands along the Chesapeake Bay that are characterized by vegetation tolerant of brackish to salty water. Other tidal marshes include estuarine wetlands located along freshwater parts of tidal rivers. Interdunal swales are topographic depressions among sand dunes on the Atlantic coast that contain palustrine emergent or scrub-shrub wetlands. Virginia's Atlantic

white cedar swamps, red spruce swamps, and cypress-tupelo swamps and its nontidal flood-plain forests are palustrine forested wetlands that have seasonally occurring standing water and flood-tolerant trees. Pocosins are palustrine scrub-shrub wetlands that are slightly elevated above the surrounding landscape and have flat topography and poor natural drainage. Virginia's bogs, fens, and wet meadows are palustrine emergent wetlands that are often underlain by organic soils. The presence and composition of plant communities in the wetlands of Virginia are determined by factors such as the extent and duration of flooding, climate, type of soil, and ground- and surface-water chemistry.

About 72 percent of the wetland area in Virginia, including all the estuarine wetlands and most of the large nontidal wetlands, is in the Coastal Plain (fig. 2*A* and 2*B*) (Tiner and Finn, 1986). Extensive estuarine wetlands have developed in low-lying areas along the shores of the Chesapeake Bay and its tributaries and behind the barrier beaches of the Atlantic coast. Palustrine wetlands are distributed throughout the State and are located primarily in bottom lands and in flood plains along stream channels, especially in headwater areas. About 22 percent of the wetlands in Virginia are in the Piedmont, and most of the remaining wetland area is in the Appalachian Plateaus (Tiner and Finn, 1986; Harlow and LeCain, 1991).

HYDROLOGIC SETTING

Virginia's wetlands (fig. 3*A*–3*C*) are formed and maintained by water supplied by precipitation, overland runoff from precipitation, local and regional ground-water flow, and tides. Precipitation supplies adequate moisture for wetland formation and maintenance and ranges statewide from 36 to 52 inches per year (Prugh and Scott, 1986). Precipitation does not have a strong seasonal pattern during the year, but 80 to 85 percent of evaporation from open bodies of water occurs from April to October. That period coincides with the higher transpiration rates of the growing season.

Annual and seasonal fluctuations in local precipitation and evapotranspiration rates combine with local differences in geology, topography, and soil characteristics to create short- or long-term changes in the interactions of ground water and surface water in wetlands. These changes can result in alternating flooded and dry conditions, especially in small wetlands (Winter, 1992; Phillips and Shedlock, 1993). Additionally, larger wetlands (tidal and nontidal) can interact with regional ground-water flow systems. In tidal wetlands, a major source of water is tidal inundation. Overland runoff and ground-water discharge can be important secondary sources. The major sources of water in nontidal wetlands are precipitation and ground-water discharge.

Virginia includes five physiographic provinces: the Coastal Plain, Piedmont, Blue Ridge, Valley and Ridge, and Appalachian Plateaus (fig. 2*B*). Each province is characterized by geologic features, landforms, and soils that directly affect the hydrology of wetlands.

Coastal Plain.—The Coastal Plain is relatively flat, rising from below sea level to about 50 feet above sea level on the Delmarva Peninsula east of the Chesapeake Bay and to about 200 feet above sea level on the upper Coastal Plain west of the Chesapeake Bay. This province is underlain by an extensive and locally complex

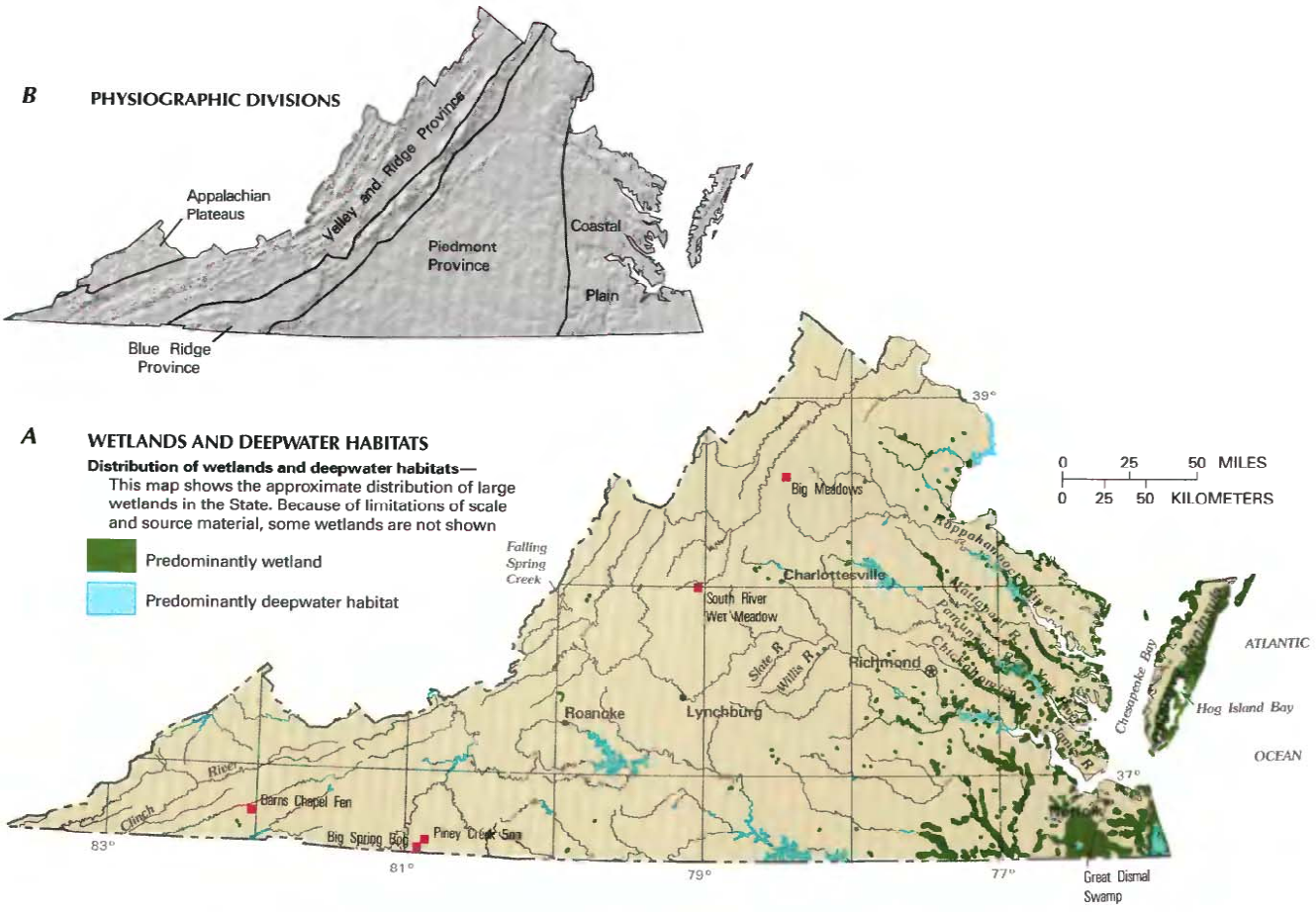

Figure 2. Wetland distribution in Virginia and physiography of the State. ***A***, Distribution of wetlands and deepwater habitats. ***B***, Physiography. *(Sources: A, T.E. Dahl, U.S. Fish and Wildlife Service, unpub. data, 1991. B, Physiographic divisions from Fenneman, 1946; landforms data from EROS Data Center.)*

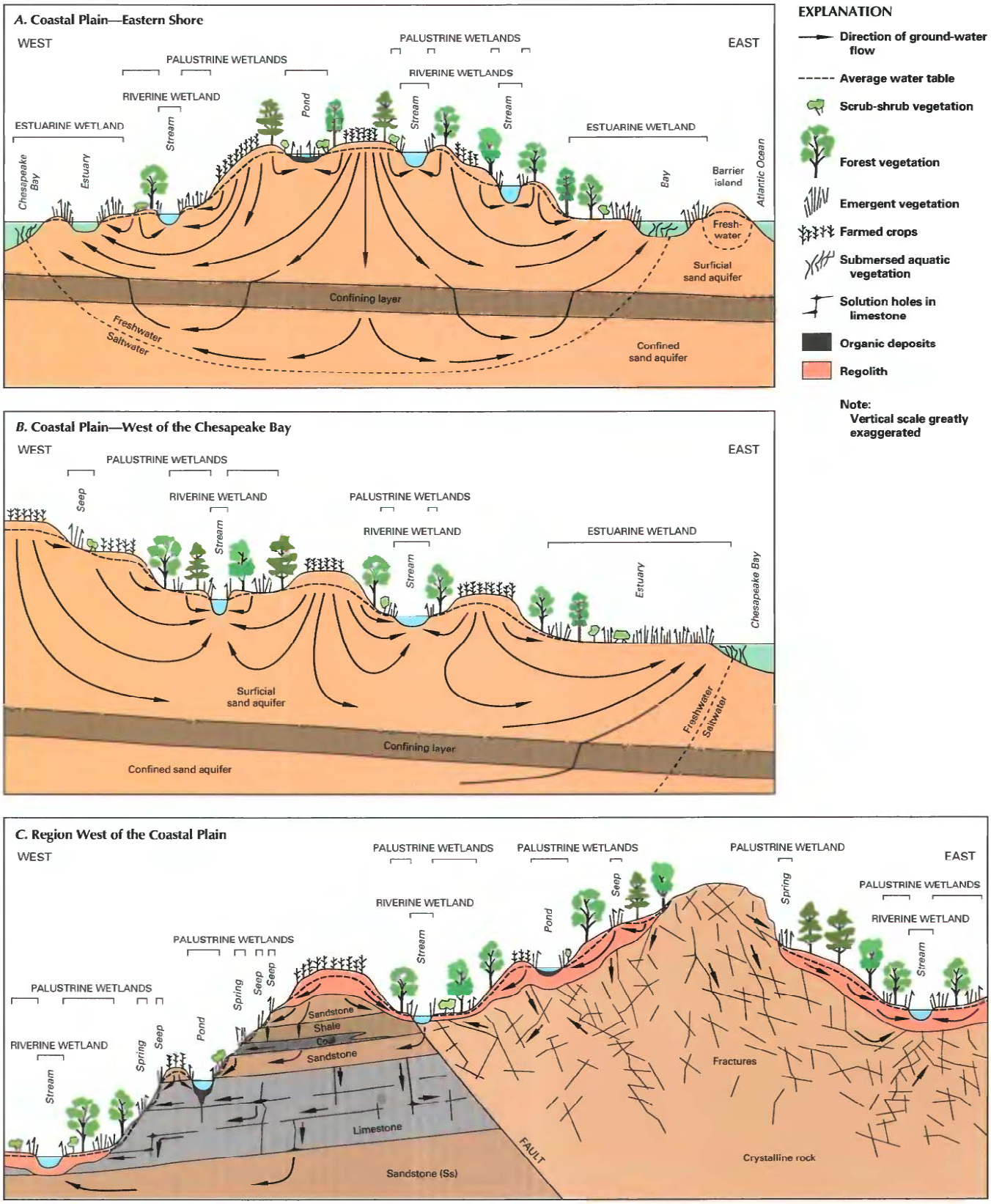

Figure 3. Generalized geohydrology of wetlands in Virginia. ***A***, Coastal Plain—Eastern Shore. ***B***, Coastal Plain—west of the Chesapeake Bay. ***C***, Region west of the Coastal Plain. *(Sources: A, Based on information in Harsh and Laczniak, 1986; Richardson, 1992; and M.J. Focazio, written commun., 1993. B, Based on information in Back, 1966; Harsh and Laczniak, 1986; and Winter, 1992. C, Based on information in Heath, 1984.)*

surficial aquifer composed primarily of unconsolidated sediments. Below the surficial aquifer are several confined aquifers and confining layers.

Coastal Plain wetlands are maintained by precipitation, overland runoff, flooding from streams, and ground-water discharge. Wetlands in the Coastal Plain generally intersect the water table of the surficial aquifer. Recharge of the surficial aquifer in the Coastal Plain is mainly by infiltration of precipitation in interstream areas (Heath, 1984). Discharge occurs by evapotranspiration and by seepage to wetlands, streams, estuaries, wells, ditches, and the ocean.

Many Coastal Plain wetlands are in local and regional groundwater discharge areas of coastal and riparian zones. Low-lying areas of the Coastal Plain contain extensive wetlands in the form of seagrass beds, salt and brackish marshes, and tidal freshwater marshes and swamps. These wetlands have complex hydrology; streamflow, local and regional ground-water flow, and tidal flow all are components. Nontidal wetlands of the Coastal Plain are maintained by local and regional ground-water flow systems and storm-related flooding. The area of forested wetlands in flood plains often is reduced by artificial draining and conversion of the land for agricultural and urban uses.

The Coastal Plain can be divided into two subregions of differing geohydrology: the Eastern Shore, on the Delmarva Peninsula (fig. 3*A*) and the area of the Coastal Plain west of the Chesapeake Bay (fig. 3*B*). On the Eastern Shore, the surficial sand aquifer overlies eastward-dipping confined aquifers and confining layers. The center of the Delmarva Peninsula is poorly drained and has small depressional palustrine wetlands (Delmarva bays) and narrow bands of palustrine wetlands along ditches and streams. Extensive brackish and saline estuarine wetlands are located along the eastern shore of the peninsula behind a barrier-island complex and on the western shore of the peninsula.

West of the Chesapeake Bay, several major aquifers crop out and dip to the east under the bay and the Delmarva Peninsula. In this region, large freshwater swamps dominated by cypress, red maple, black gum, and tupelo gum trees are located along the many tidal rivers (Virginia Sea Grant College Program, 1989). Numerous nontidal freshwater forested wetlands also are in the region, especially along the boundary between the sediments of the Coastal Plain and the higher altitude crystalline rocks of the Piedmont.

The Coastal Plain of Virginia has many notable wetlands. They include the extensive tidal freshwater marshes and swamps along the Chickahominy River, the salt marshes behind the coastal barrier islands that protect Hog Island Bay, and the forested wetlands along the Mattaponi, Pamunkey, James, and York Rivers, as well as those in the Great Dismal Swamp. This swamp (fig. 1) is the largest nontidal freshwater wetland in the State.

West of the Coastal Plain.—West of the Coastal Plain, there is considerably more topographic relief. The gently rolling hills of the Piedmont are generally less than 800 feet above sea level. The mountains of the Blue Ridge rise to more than 1,600 feet. Altitudes in the Valley and Ridge range from about 400 feet in the valleys to about 1,500 feet on the ridges. The valleys and mountains of the Appalachian Plateaus range from 1,500 to more than 3,000 feet above sea level. The aquifers west of the Coastal Plain generally are unconfined; in highly fractured, saturated crystalline or sedimentary bedrock; and overlain by regolith of irregular thickness (Meng and others, 1985). Regolith, which forms the land surface nearly everywhere, is a layer of unconsolidated, mostly fine-grained material composed of fragmented, weathered bedrock and alluvium overlying unweathered bedrock.

Wetlands west of the Coastal Plain are generally small and localized (fig. 3*C*). Their location and size are controlled mainly by topography, precipitation, and ground-water availability. Much of the precipitation in this province is transported to surface depressions and streams by overland runoff (Heath, 1984). Much of the ground water available to wetlands is held in the regolith (Powell and Abe, 1985; Wright, 1990; Harlow and LeCain, 1991). Topographically high areas (ridges) function as aquifer recharge areas (Harlow and LeCain, 1991). Water infiltrates the surface, seeps into the regolith, and flows downward and laterally through fractures and solution cavities in the shallow bedrock. If the vertical hydraulic conductivity of the bedrock is negligible, water is discharged wherever the water table intersects the land surface, forming springs or seeps on hill slopes and fens in closed topographic depressions. If the conductivity is appreciable, ground water follows a stairstep path through the regolith, fractures, bedding planes, and coal seams, eventually discharging to streams. With increasing depth, ground water flows primarily in a lateral direction. Deep, regional groundwater flow is not a significant source of moisture for wetlands in this region.

Wetlands west of the Coastal Plain are commonly found along riparian valleys and other low areas of the ground surface, which typically overlie fracture zones in the bedrock. Water is more likely to discharge into these depressions than into other areas because fracture zones are major pathways of ground-water movement (Heath, 1984).

Types of wetland west of the Coastal Plain include flood-plain marshes and swamps, seeps, fens, and excavated farm ponds. Notable wetlands in this region include the Slate River and Willis River wetlands in the Piedmont; Big Spring Bog, Piney Creek Bog, Big Meadows and South River Wet Meadow in the Blue Ridge; and Barns Chapel Fen, Falling Spring Creek, and the Clinch River floodplain wetlands in the Valley and Ridge (U.S. Fish and Wildlife Service, 1990; T.J. Rawinski, Virginia Department of Conservation and Recreation, written commun., 1993).

TRENDS

In the 1780's, wetlands covered about 1,849,000 acres (more than 7 percent) of Virginia (Dahl, 1990). By the mid-1980's, about 1,075,000 wetland acres remained in Virginia—a loss of about 42 percent in 200 years (Dahl, 1990). Inventories published in 1989 by the Virginia Institute of Marine Science and the FWS estimated that there were approximately 215,000 acres of vegetated tidal wetlands and 673,192 acres of vegetated nontidal wetlands remaining in Virginia (Virginia Department of Conservation and Recreation, 1989).

Agriculture, industrial and urban development, and recreation have led to the draining, dredging and ditching, filling, diking, and damming of wetlands in Virginia. These practices—combined with human activities that affect water quality and natural phenomena that result in erosion, saltwater inundation, and botanical succession—have contributed to the widespread wetland loss and degradation and some wetland generation. The estimated annual loss of all wetland types between 1955 and 1977 was about 3,000 acres (Tiner, 1987), amounting to a total wetland loss of about 6 percent during that period. Eighty percent of estimated losses of freshwater vegetated wetlands (mostly palustrine forested systems) occurred in the Coastal Plain.

Major causes of nontidal wetland loss have been direct conversion to agriculture (about 45 percent), channelization and ditching (about 27 percent), and lake and pond creation (about 25 percent) (Tiner, 1987). Between 1955 and 1977, pond construction and beaver impoundment resulted in an estimated 170-percent (35,000 acres) increase in freshwater pond acreage across the State, mostly in upland areas. Major causes of tidal wetland loss have been urbanization (about 43 percent), inundation by submersion, dredging, or impoundment (about 36 percent), agricultural conversion (about 5 percent), and pond creation (about 5 percent).

Small areas of wetland have been created in recent times, especially by flooding during road, lake, and pond construction and,

most recently, by the establishment of compensatory wetland-mitigation sites. New wetlands also have formed on sediments deposited by storms and dredging activities in coastal areas.

Management policies and rationales generally reflect the latest technical understanding within the field but not necessarily the latest scientific understanding. For example, up to the early years of the 20th century, wetlands were considered to be habitat for noxious pests and management policies focused on eliminating the undesirable habitat value or the wetland itself. In the last 25 years, numerous other wetland functions of significant potential value to natural and human systems have been identified (Hershner, 1992), and regulations have been changed to reflect this understanding. Implementation of the 1972 Virginia Wetlands Act and the 1972 Federal Clean Water Act markedly reduced the rate of human-induced tidal wetland loss. Between 1972, when the Wetlands Act was enacted, and 1977, the annual rate of tidal wetland loss decreased from between 400 and 600 acres to 20 acres or less (Dawes, 1978). Still, however important wetlands may be environmentally, they present a volatile issue because of development pressure (Virginia Sea Grant College Program, 1989), and the demand for space for an expanding human population has resulted in increasing conversion of wetlands into developed landscapes (Hershner, 1992).

CONSERVATION

Many government agencies and private organizations participate in wetland conservation in Virginia. The most active agencies and organizations and some of their activities are listed in table 1.

Federal wetland activities.—Development activities in Virginia wetlands are regulated by several Federal statutory prohibitions and incentives that are intended to slow wetland losses. Some of the more important of these are contained in the 1899 Rivers and Harbors Act; the 1972 Clean Water Act and amendments; the 1985 Food Security Act; the 1990 Food, Agriculture, Conservation, and Trade Act; the 1986 Emergency Wetlands Resources Act; and the 1972 Coastal Zone Management Act.

Section 10 of the Rivers and Harbors Act gives the U.S. Army Corps of Engineers (Corps) authority to regulate certain activities in navigable waters. Regulated activities include diking, deepening, filling, excavating, and placing of structures. The related section 404 of the Clean Water Act is the most often-used Federal legislation protecting wetlands. Under section 404 provisions, the Corps issues permits regulating the discharge of dredged or fill material into wetlands. Permits are subject to review and possible veto by the U.S. Environmental Protection Agency, and the FWS has review and advisory roles. Section 401 of the Clean Water Act grants to States and eligible Indian Tribes the authority to approve, apply conditions to, or deny section 404 permit applications on the basis of a proposed activity's probable effects on the water quality of a wetland.

Most farming, ranching, and silviculture activities are not subject to section 404 regulation. However, the "Swampbuster" provision of the 1985 Food Security Act and amendments in the 1990 Food, Agriculture, Conservation, and Trade Act discourage (through financial disincentives) the draining, filling, or other alteration of wetlands for agricultural use. The law allows exemptions from penalties in some cases, especially if the farmer agrees to restore the altered wetland or other wetlands that have been converted to agricultural use. The Wetlands Reserve Program of the 1990 Food, Agriculture, Conservation, and Trade Act authorizes the Federal Government to purchase conservation easements from landowners who agree to protect or restore wetlands. The Consolidated Farm Service Agency (formerly the Agricultural Stabilization and Conservation Service) administers the Swampbuster provisions and Wetlands Reserve Program. The Natural Resources Conservation Service (NRCS) (formerly the Soil Conservation Service) determines compliance with Swampbuster provisions and assists farmers in the identification of wetlands and in the development of wetland protection, restoration, or creation plans.

Table 1. Selected wetland-related activities of government agencies and private organizations in Virginia, 1993

[Source: Classification of activities is generalized from information provided by agencies and organizations. •, agency or organization participates in wetland-related activity; ..., agency or organization does not participate in wetland-related activity. MAN, management; REG, regulation; R&C, restoration and creation; LAN, land acquisition; R&D, research and data collection; D&I, delineation and inventory]

Agency or organization	MAN	REG	R&C	LAN	R&D	D&I
FEDERAL						
Department of Agriculture						
Consolidated Farm Service Agency	...	•	...	...	...	...
Natural Resources Conservation Service	...	•	•	...	•	•
Department of Commerce						
National Oceanic and Atmospheric Administration	•	•	...	...	•	•
Department of Defense						
Army Corps of Engineers	...	•	•	...	•	•
Department of the Interior						
Fish and Wildlife Service	•	...	•	•	•	•
Geological Survey	...	...	...	...	•	...
National Biological Service	...	...	...	...	•	...
National Park Service	•	...	•	•	•	•
Environmental Protection Agency	...	•	...	...	•	•
STATE						
College of William and Mary						
Virginia Institute of Marine Science	...	...	...	...	•	•
Department of Conservation and Recreation						
Division of Natural Heritage	•	...	...	•	...	•
Division of State Parks	•	...	...	•	...	...
Department of Environmental Quality	•	•	•	...	•	•
Department of Game and Inland Fisheries	•	...	...	•	...	...
Department of Transportation	•	...	•	...	•	•
Virginia Joint Venture Board	...	...	•	•	...	...
Virginia Marine Resources Commission	•	•	•	...	•	•
Virginia Outdoors Foundation	...	...	...	•	...	...
Virginia Polytechnic Institute and State University	...	...	...	...	•	...
SOME COUNTY AND LOCAL GOVERNMENTS	•	•	...	•	...	•
PRIVATE ORGANIZATIONS						
Chesapeake Bay Foundation	•	...	...	•	...	...
Ducks Unlimited	•	...	•	•	•	...
Friends of the Rivers of Virginia	...	...	...	...	•	...
The Lower James River Association	•	...	...	...	...	...
The Nature Conservancy	•	...	...	•	•	...

The 1986 Emergency Wetlands Resources Act and the 1972 Coastal Zone Management Act and amendments encourage wetland protection through funding incentives. The Emergency Wetlands Resources Act requires States to address wetland protection in their Statewide Comprehensive Outdoor Recreation Plans to qualify for Federal funding for State recreational land; the National Park Service provides guidance to States in developing the wetland component of their plans. Coastal and Great Lakes States that adopt coastal-zone management programs and plans approved by the National Oceanic and Atmospheric Administration are eligible for Federal funding and technical assistance through the Coastal Zone Management Act.

State wetland activities.—Activities in both tidal and nontidal wetlands in the State of Virginia are regulated through the Department of Environmental Quality's Water Division by means of the Virginia Water Protection Permit. This permit is issued to ensure compliance with the State Water Control Law and serves as the certification of Virginia's compliance with section 401 of the Federal Clean Water Act. To obtain this permit and other permits showing compliance with the Virginia Wetlands Act and section 404 of the Federal Clean Water Act, a Joint Permit Application is submitted to the Virginia Marine Resources Commission.

The Virginia Marine Resources Commission has ultimate regulatory authority for the coastal resources included in the State Wetlands Act, the Federal Chesapeake Bay Preservation Act, and the State Coastal Primary Sand Dune Protection Act (Bradshaw, 1991). Local governments have the option of adopting prescribed zoning ordinances and forming citizen wetlands boards to regulate their own tidal wetlands. The Commission retains an oversight and appellate role in those localities, and the Virginia Institute of Marine Science has an advisory role in the permitting process. Virginia has no laws that apply specifically to nontidal wetlands. However, the Water Control Board (now called the Department of Environmental Quality, Water Division) adopted a wetlands policy in 1974 (revised in 1982) that covers both nontidal and tidal wetlands. In addition, the Scenic Rivers Act of 1970 prevents certain activities in designated riparian areas that include wetlands, and the Endangered Species Act of 1972 provides habitat preservation and protection in wetlands and elsewhere. The Chesapeake Bay Preservation Act, which is implemented by local governments, calls for establishment of protective buffers around tidal and nontidal wetlands adjacent to surface waters or tidal wetlands in Virginia's coastal plain.

In 1990, the Division of Soil and Water Conservation of the Virginia Department of Conservation and Recreation began to gather and update all existing data on the wetlands of Virginia with the goal of creating a single, comprehensive data base (Virginia Department of Conservation and Recreation, 1990). This project has been designed to conform with the standards of the FWS National Wetland Inventory project. National Wetland Inventory data for about three-fourths of the State have been digitized. Information for the eastern part of the State is older and less detailed than the western part, and about one-fourth of the eastern inland part of the State is currently (1993) being reinventoried and digitized. Another comprehensive project to map wetland locations was conducted by the NRCS, which inventoried wetlands down to less than one-fourth of an acre at different scales. This information has not been standardized or published collectively but is available through county NRCS offices.

Private wetland organization activities.—Private organizations with interests in wetlands in Virginia are active in policy planning, the development of regulations, advocacy, land acquisition and management, environmental education, and research. A few of the many such organizations in the State are The Nature Conservancy, the Chesapeake Bay Foundation, the Friends of the Rivers of Virginia, The Lower James River Foundation, and Ducks Unlimited. The State and The Nature Conservancy jointly administer the Virginia Natural Heritage Program, which identifies natural areas, including wetlands, for conservation planning.

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