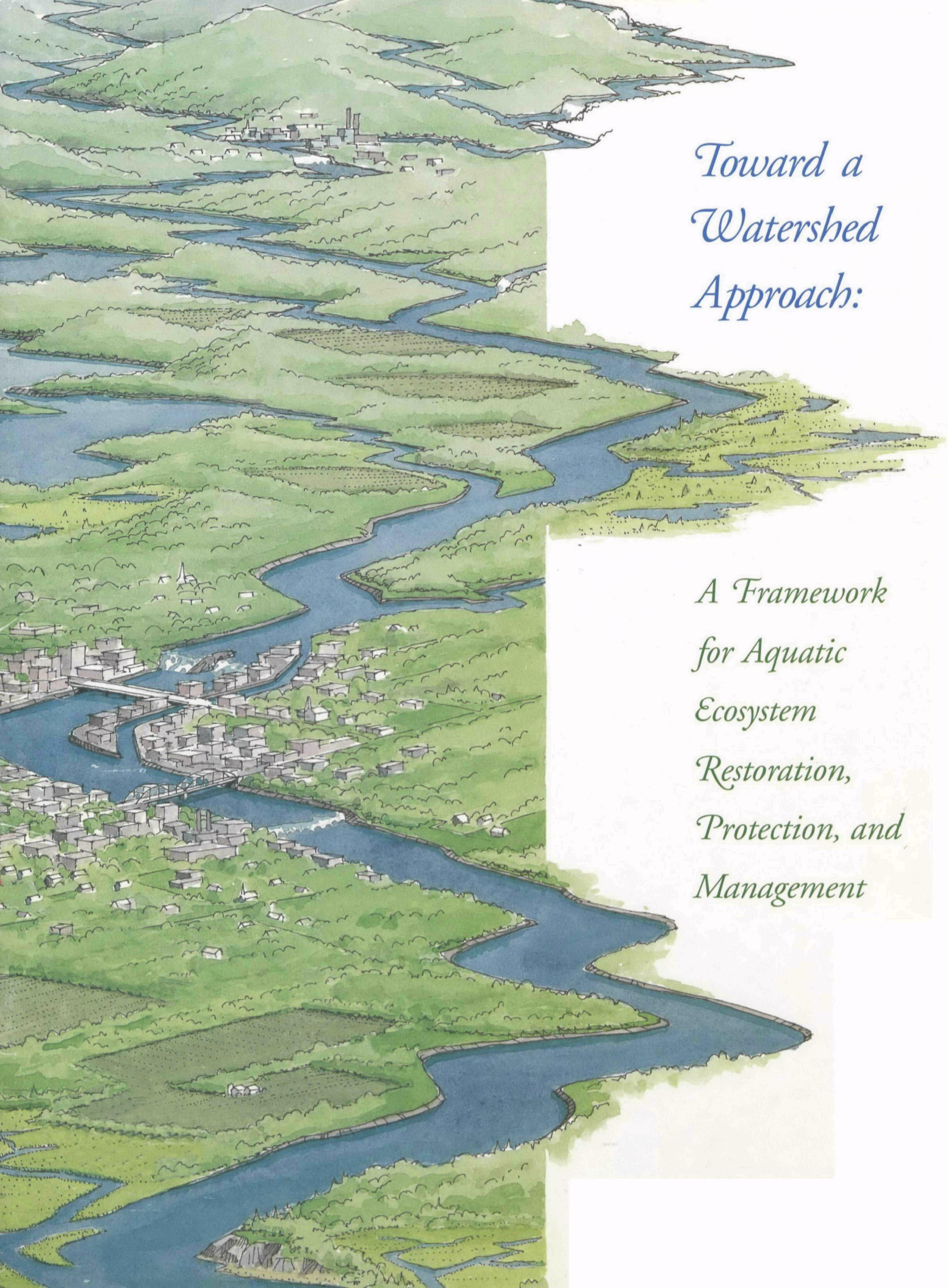


Toward a Watershed Approach:

A Framework for Aquatic Ecosystem Restoration, Protection, and Management

Coastal America was established two years ago as a unique partnership among Federal, State, and local governments and private alliances to collaboratively address site-specific coastal environmental problems. In those two years, more than 20 Federal agencies and more than 100 non-Federal partners have become involved in Coastal America projects around the U.S. coastline, restoring wetland habitat and fish passage and protecting critical areas for endangered species and other wildlife. To date, more than $30 million has been committed to Coastal America with over 60 projects in 20 States.

In keeping with the ongoing commitment of the Executive Office to ecosystem-based natural resource protection and management, Coastal America has developed this document on aquatic ecosystem protection and restoration through watershed-based resource management approaches. The underlying themes that Coastal America wishes to emphasize are two-fold: (1) aquatic ecosystems, which are intrinsically related to the hydrogeologic characteristics of watersheds, are most effectively addressed in a watershed context; and (2) truly comprehensive watershed approaches can only succeed with the collaboration and cooperation of the full range of parties with jurisdiction over, and interest in, the resources at stake.

January 1994

Foreword

To the earliest inhabitants of the continent, the North American wilderness offered an immeasurable wealth and abundance of natural resources. Native American communities long prospered from the bounty and beauty of the wildlife and resources that surrounded them, providing them with ample supplies of food, water, shelter, and clothing. Later, 17th-century traders and pioneers from Europe came to explore the vast areas of coastal shoreline and seemingly endless forests, and settle along deep, wide rivers and countless protective coves, harbors, and bays. Fish, fowl, and wildlife were plentiful food sources; land to clear for settlements and farming was abundant; and freshwater supplies surrounded the early settlers and Native American populations.

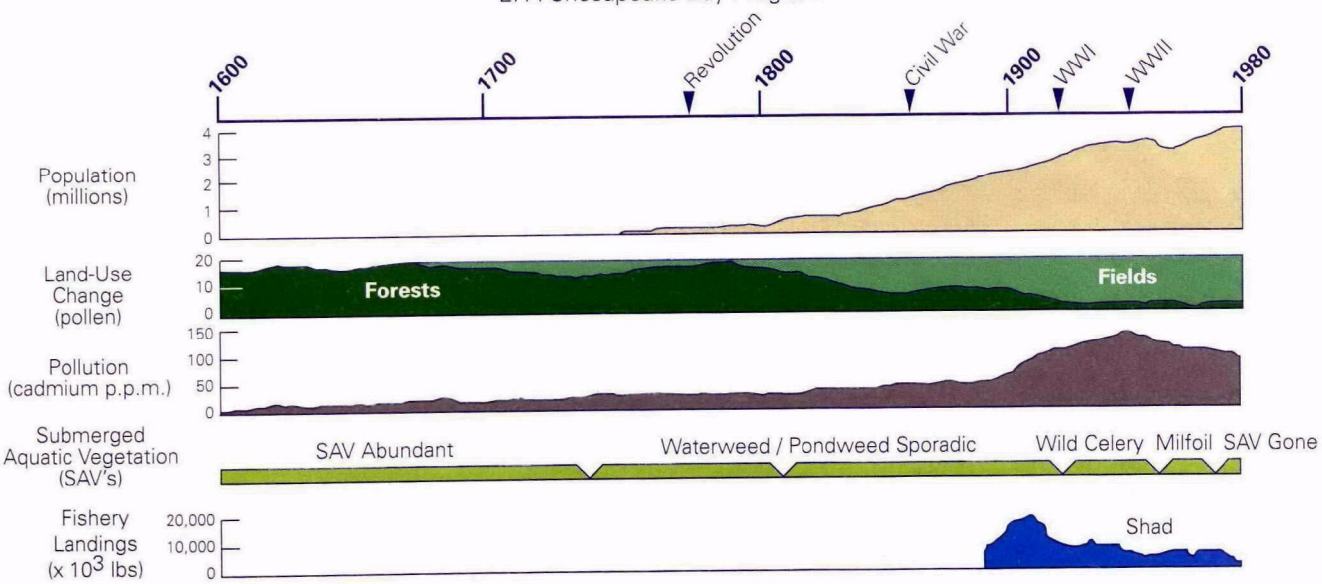
As decades passed, settlements along the coastlines and inland water routes grew, and new industries to supply communities with goods and services burgeoned. The impacts of growing populations on the natural surroundings eventually became evident, as deforestation, erosion, overhunting, and use of waterways as waste streams began to exact their toll.

Today, American bays, estuaries, rivers, aquifers, and watersheds are no longer the clean, pristine, and biologically diverse areas first explored and inhabited by Native Americans and settled by Europeans. As an example, the figure below summarizes a number of historical features and changes in Chesapeake Bay from 1600 to 1980. This graphic depicts population trends and land use changes from forested land to farming, with corresponding trends for aquatic vegetation and fishery landings, each of which reflects an ecosystem in decline.

Over 50% of the original riparian habitat in this country has been inundated, channelized, dammed, riprapped, farmed, overgrazed, or altered by other land uses.

– Natural Resources Defense Council, 1993

Time History of Northern Chesapeake Bay
EPA Chesapeake Bay Program



During this same period of time, across the country, changes in land uses along the rivers and their tributaries eventually led to the degradation of environmental resources throughout their watersheds. In riverine and near-shore areas that lack flushing and free exchange with ocean waters, contaminants from the upland areas accumulated in the water and sediments, adversely affecting the health of aquatic ecosystems. Deforestation for agricultural and urban development resulted in sharp decreases in species abundance and diversity. At the water's edge, growing communities filled or otherwise destroyed vast areas of once ecologically productive estuarine and wetland areas, primarily for infrastructure development, including residential, agricultural, and commercial development, as well as the construction of roads and railways. In many locations, agricultural and ranching concerns diverted large volumes of fresh water from rivers for irrigation, resulting in decreased freshwater inflow to estuaries and increased saltwater intrusion into estuarine and riverine ecosystems. At the same time, there has been a massive, although gradual, infusion of toxic chemicals into the river systems from refineries and other industries, municipal sewage discharges, return irrigation water, accidental oil spills, and oil and grease washed by rain into rivers and coastal waters.

Fish and wildlife populations dependent on coastal and wetland habitat have declined significantly. Upstream, dams and other obstructions have cut off migrating fish from their spawning grounds, and alterations in freshwater flow and salinity as well as pollution have contributed extensively to the demise of many coastal fisheries.

Clearly, the economic benefits made possible by the development and exploitation of the Nation's natural resources have been at a high ecological cost. However, we now recognize that we must sustain our natural resources in order to ensure continued economic growth. The call to restore and protect our watersheds has never been stronger, as there is no substitute for the water resources upon which we are so critically dependent for our very existence.

More than half of U.S. wetland acreage has been lost since the time of European colonization; 22 states have lost 50% or more of their "original" wetlands, and 10 have lost over 70%.

– Natural Resources Defense Council, 1993

During this century, commercial fish harvests from major U.S. rivers have declined by more than 80% in the Missouri and Delaware Rivers, more than 95% in the Columbia River, and 100% in the Illinois River.

– Institute for Environmental Studies, 1993

Toward a Watershed Approach: A Framework for Aquatic Ecosystem Restoration, Protection, and Management

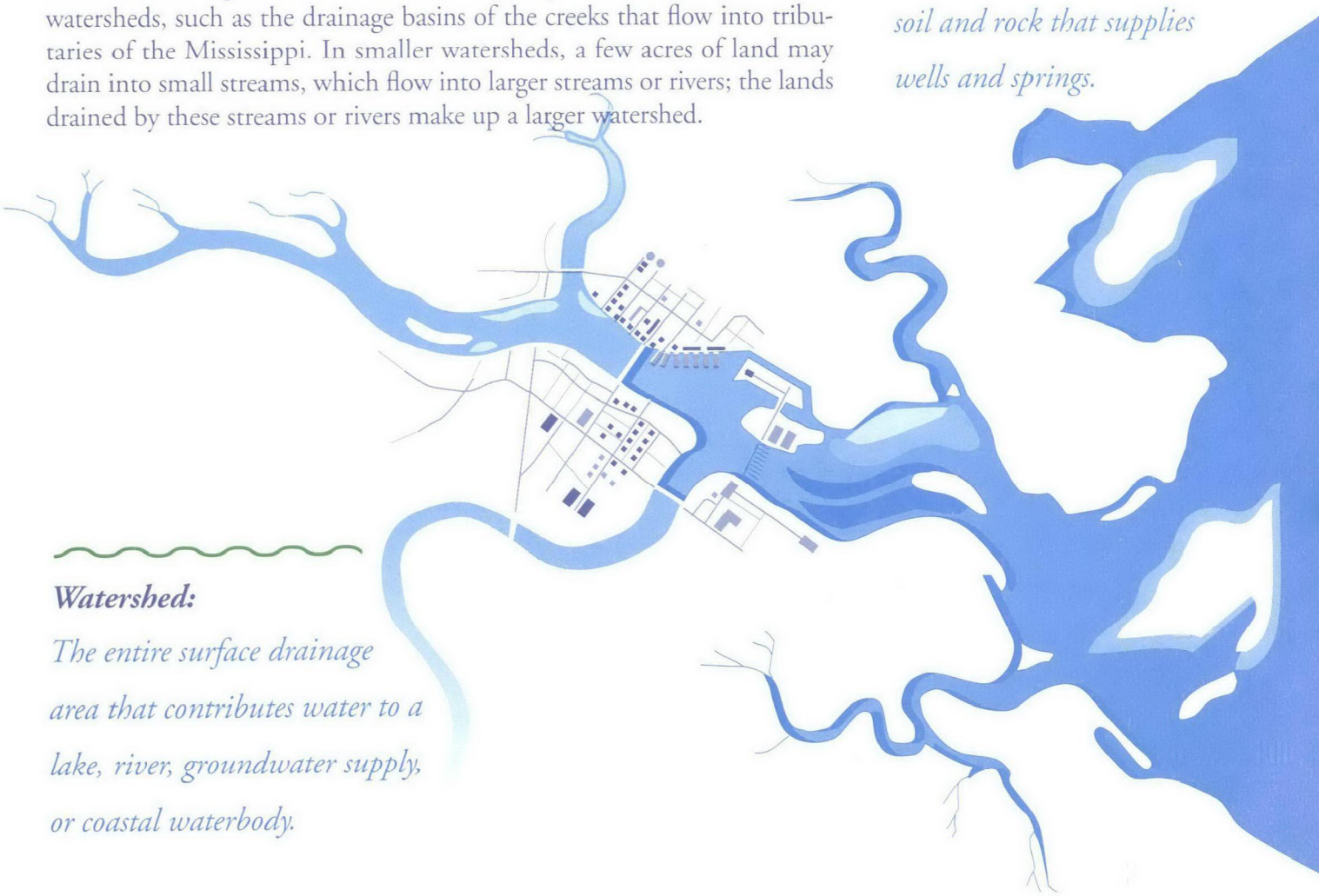
The critical situation facing the health of America's water resources and aquatic ecosystems is not the result of a single activity on or near a lake, river, or stream. Instead, it is the combined and cumulative result of many individual activities throughout a waterbody's entire natural drainage area, or watershed.

What is a Watershed?

WATER from falling rains and melting snows generally drains into ditches, streams, wetlands, groundwater supplies, lakes, or coastal waters. A watershed includes the area of land over which water drains to these waterbodies. A watershed may be large or small; the Mississippi River, for example, drains a one-million-square-mile watershed made up of thousands of smaller watersheds, such as the drainage basins of the creeks that flow into tributaries of the Mississippi. In smaller watersheds, a few acres of land may drain into small streams, which flow into larger streams or rivers; the lands drained by these streams or rivers make up a larger watershed.

Ground Water:

Water beneath the earth's surface between saturated soil and rock that supplies wells and springs.



Watershed:

The entire surface drainage area that contributes water to a lake, river, groundwater supply, or coastal waterbody.

You are always in a watershed, no matter where you are on the land surface of the planet. Even in the middle of the driest of terrains, the land surrounding you at any given time drains to a stream, river, lake, aquifer, reservoir, or directly to coastal waters. Your watershed may be covered with forest or farmland, or be almost entirely developed.

Watershed boundaries are defined by the topographic features that dictate natural drainage patterns within an area. They are not defined by any international, state, or county borders, or by the public or private ownership boundaries that they may cross.

Watersheds provide useful geographic units for resource management aimed at protecting the health of aquatic ecosystems. The types of aquatic ecosystems supported within a particular watershed are determined by a number of natural features:

- the slope of the basin from its highest points to its lowest;
- the amount, frequency, and intensity of rainfall or snowmelt that normally occurs within the watershed;
- the types of soils that cover the basin's topographic features; and
- the vegetation and associated animal communities found in different areas of the basin.

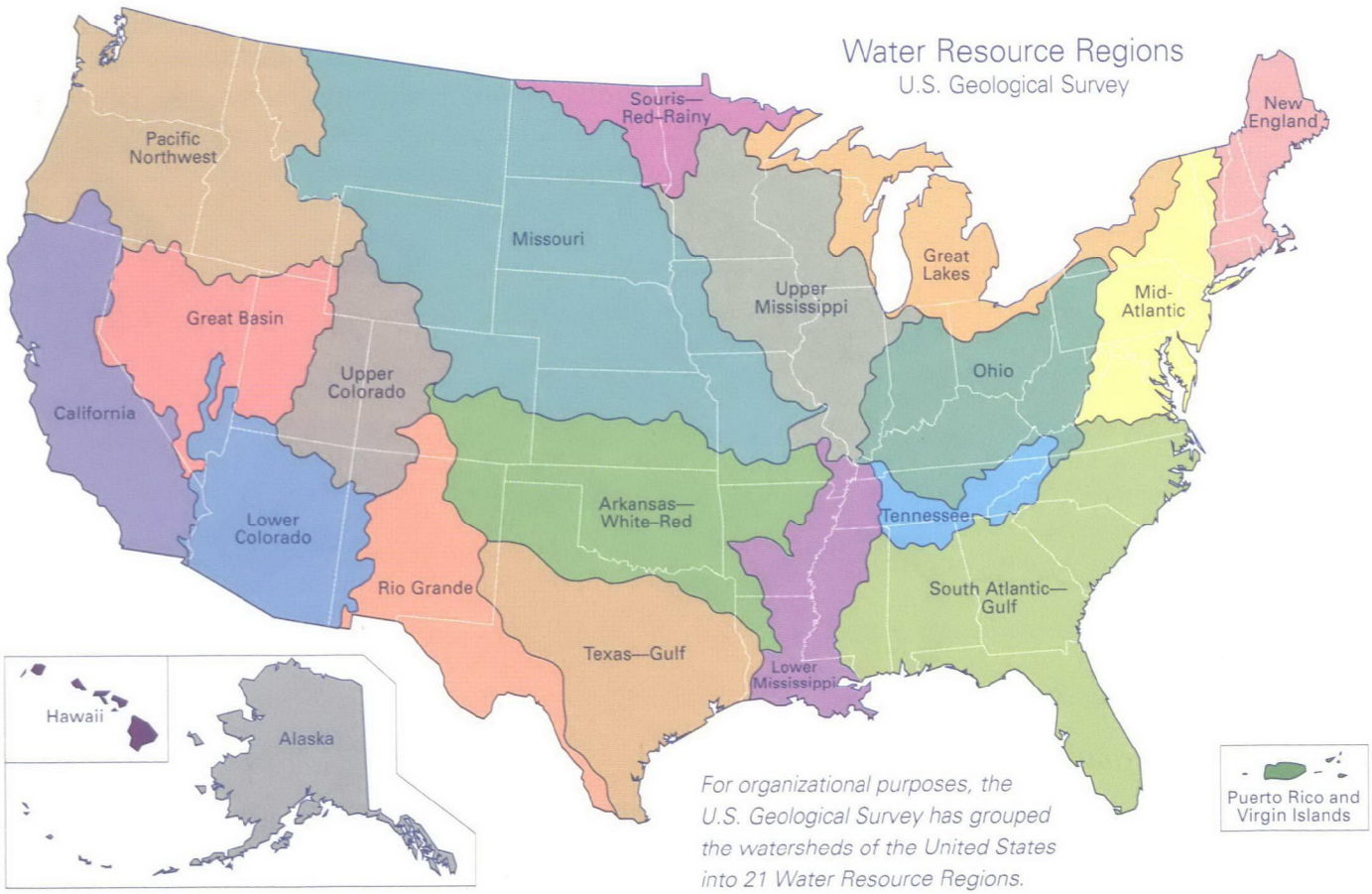
These same factors also determine potential land uses within the watershed.

Aquifer:

A geological formation of permeable rock, gravel, or sand containing or conducting ground water, especially one that supplies wells or springs.

Ecosystem:

A biological community together with the physical and chemical environment with which it interacts.



For organizational purposes, the U.S. Geological Survey has grouped the watersheds of the United States into 21 Water Resource Regions.

Water: The Downhill Run

At the watershed's highest points, underground springs, falling rain, and melting snows feed the headwaters of streams. By force of gravity, all water runs downhill to the streams and rivers within the watershed, and is eventually carried to the oceans. This freshwater network is the very lifeblood of all living communities, including human society. Rivers provide drinking water for many cities, as well as water for other domestic and industrial uses; they also serve as transportation corridors and provide food, recreation, and scenic beauty. The water's downhill pathway is also integral to the health of aquatic and terrestrial resources throughout the basin. For example, the timing and quantity of stream flow and water storage in aquifers and wetlands result in a complex pattern of fast and slow currents, eddies, and backwater pools, creating a rich variety of aquatic habitats that harbor diverse communities of plants and animals. Even periodic natural flooding plays an important role in structuring habitat and providing conditions for various plant and animal species throughout much of a river system. Flooding changes existing vegetation and reconfigures landforms in active river channels, and the silt-laden floodwaters provide the rich soils commonly found in river floodplains.

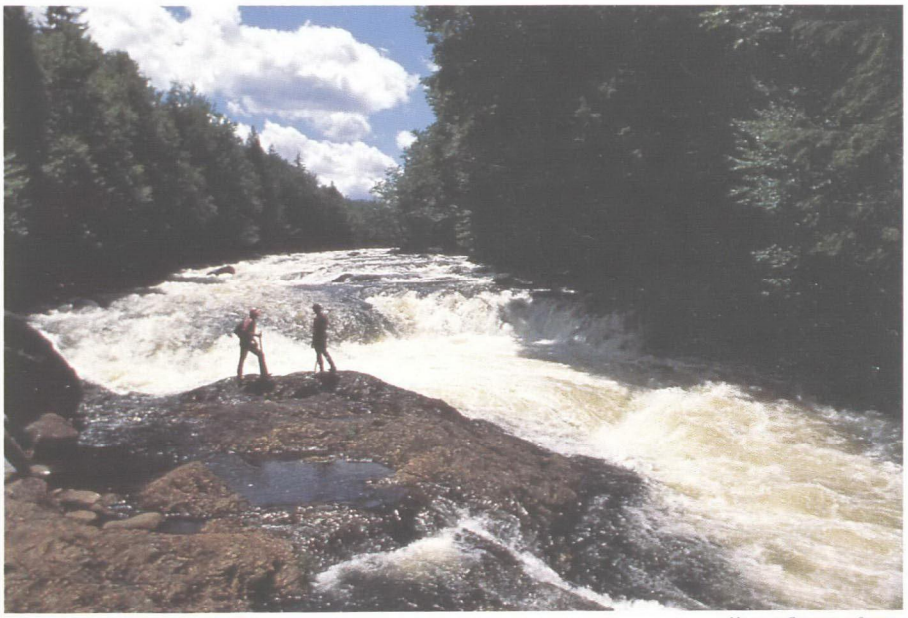
When the natural variation in stream flow or water table level (aquifer depth) is altered by dams, canals, or channelization, many natural characteristics of the varied wetland and riverine habitats and their diverse flora and fauna disappear. For example, the Everglades ecosystem in South Florida has been extensively altered by the diversion of fresh water for agriculture and other uses. Many plant and animal species that once thrived throughout the Everglades cannot survive in the increasingly saline aquatic environment, and have disappeared from the area.

Headwaters:

Upper tributaries of a river or stream; the water from which a river or stream rises.

Floodplain:

The lowlands adjoining rivers or streams or the shorelines of oceans or lakes that may be inundated by floodwaters.



National Geographic Society

Raquette Falls, New York

Problems also arise as a result of the use of rivers and their tributaries as waste streams. Historically, streams and rivers have served as dumping sites for the refuse, waste water, and runoff from towns and cities across the country. Coastal waters are the ultimate receptacle for these wastes as they flow downstream. Especially vulnerable are estuaries, valuable nursery and feeding grounds for a host of fish, waterfowl, and other wildlife species. Over two-thirds of all commercially important fish and shellfish species, such as flounder, shrimp, oysters, and clams, depend on these shallow, protective coastal waters for part or all of their lives. Migrating birds find essential feeding grounds and resting stops in the salt marshes and mudflats of the Nation's estuaries. Pollution and destruction of wetlands and marshes have significant negative impacts on the fish and wildlife that depend on these normally productive areas.

Estuary:

The area of coastal waters where fresh water from rivers and other upland sources meets and mixes with salt water from the ocean.

Vegetation and Soil: Moving Mountains

DEPENDING on the amount and type of vegetation, the soil characteristics, the slope of the basin, and the amount and velocity of water drainage, significant amounts of topsoil, sediments, and other particles may be carried by rivers and streams from the headwaters to lower portions of the watershed. Streamside and riverside vegetation can play an important role in anchoring soil, catching silt, filtering out pollutants, and absorbing nitrogen and phosphorus, which, in over-abundance, promote harmful algal blooms. The biotic complexity provided by both wetland and riparian vegetation is essential to the ecological health of watersheds. The diversity of habitat required to support a rich community of organisms is supplied by variation in the river's velocity and temperature, patches of rock and gravel of different sizes, piles of branches and leaves, small dams formed by dead trees, and a multitude of other distinct niches created by the complex interplay between water movement, geologic events, and riparian vegetation. Maintaining a green belt of vegetation along our waterways also helps prevent erosion and the silting of streams, keeps the water cool for aquatic species, and provides shelter, hiding places, and nesting sites for countless species of fish and wildlife.

"Soil is the most fundamental resource, and its loss the most serious of all losses .... The day will come when the ownership of land will carry with it the obligation to so use and protect it with respect to erosion that it is not a menace to other landowners and the public."

– ALDO LEOPOLD

Riparian:

Of, or relating to, the terrestrial area adjacent to the banks of a stream, river, lake, or wetland.

The occurrence of certain natural disturbances to stream flow and vegetation is also essential to the health of the watershed. For example, landslides occur at a magnitude and frequency characteristic of a specific landscape and geologic setting. Landslides deliver new sediment and gravel to river channels where they are sorted by flowing waters. These areas serve as spawning beds for salmon, as well as habitats for aquatic insects. Landslides at natural intervals are thus integral to the health of certain fish populations. However, increases in landslide frequency and magnitude within a watershed as a result of poor land use management, such as road-building on steep, unstable slopes, result in harmful downstream impacts on the riparian vegetation, on fish populations, and on an array of other organisms using the riverine corridor.

When forest fires, logging, road-building, or any residential, industrial, or agricultural development activities destroy the trees that anchor the soil along the water's edge, silt washes into the stream, altering streambed habitat as it settles out and depriving fish and aquatic insects of oxygen, often smothering them. Similarly, unchecked water that runs off rangeland or farmland into streams and rivers cuts gullies and carries away topsoil. The displaced topsoil, with other debris, can enter streams and then settle out in lakes and reservoirs where it can reduce their holding capacity, increase the costs of water filtration, interfere with hydroelectric plants, and spoil recreational uses of the waterbodies, in addition to disrupting the aquatic ecosystem.

"To protect your rivers, protect your mountains."

– Emperor Yu of China
1,600 B.C.

San Francisco Bay Watershed, California

Many natural and human processes affect our watersheds.

"The window of opportunity to reverse the trend in declining water resources is closing because of the extent of the loss of watershed processes upon which those resources depend."

– Dr. James Karr, Director
Institute for Environmental Studies,
Seattle, Washington

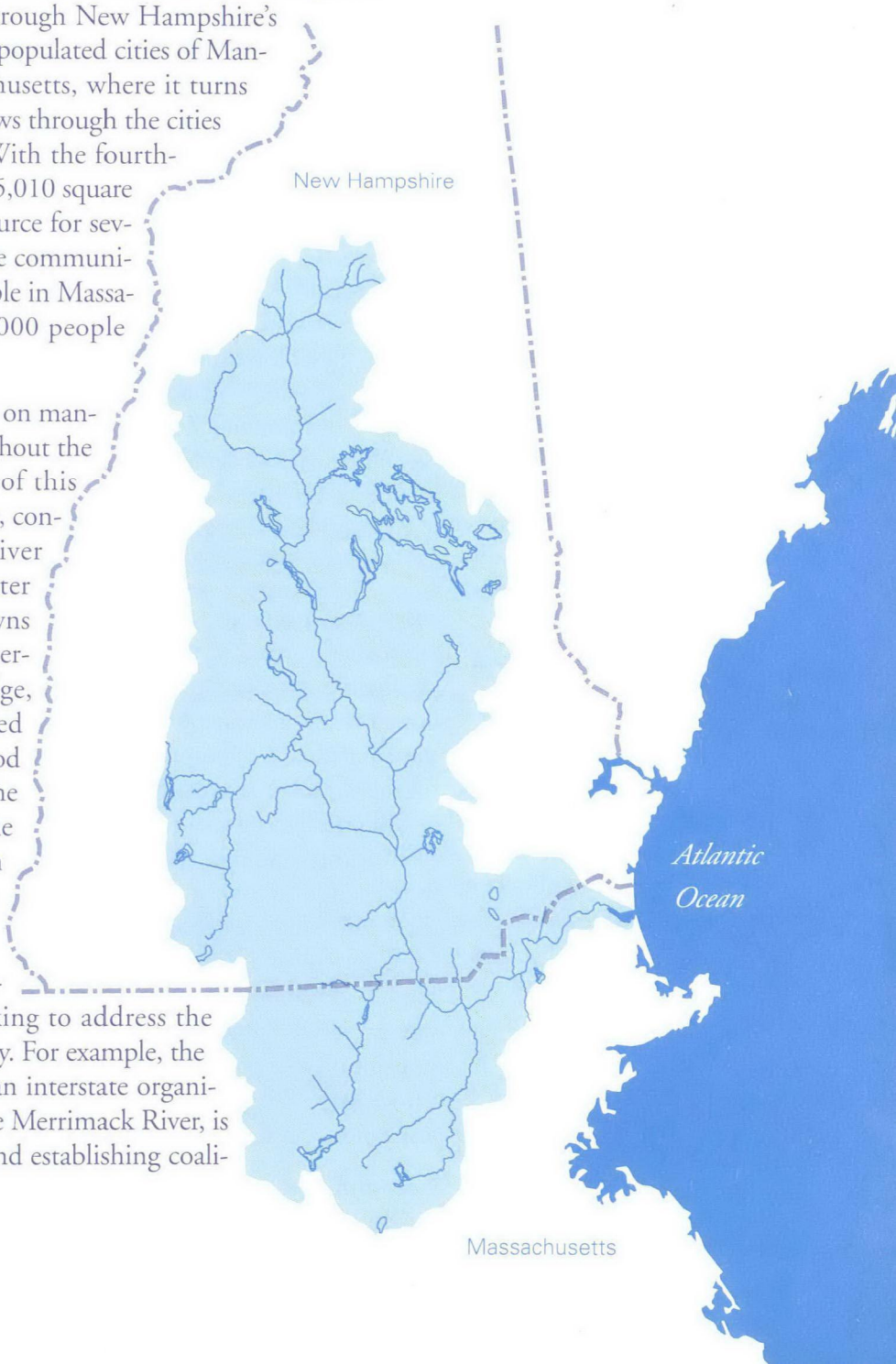
How Do We Affect Watersheds and Their Living Resources? Piecing It All Together: Portraits of Three Watersheds

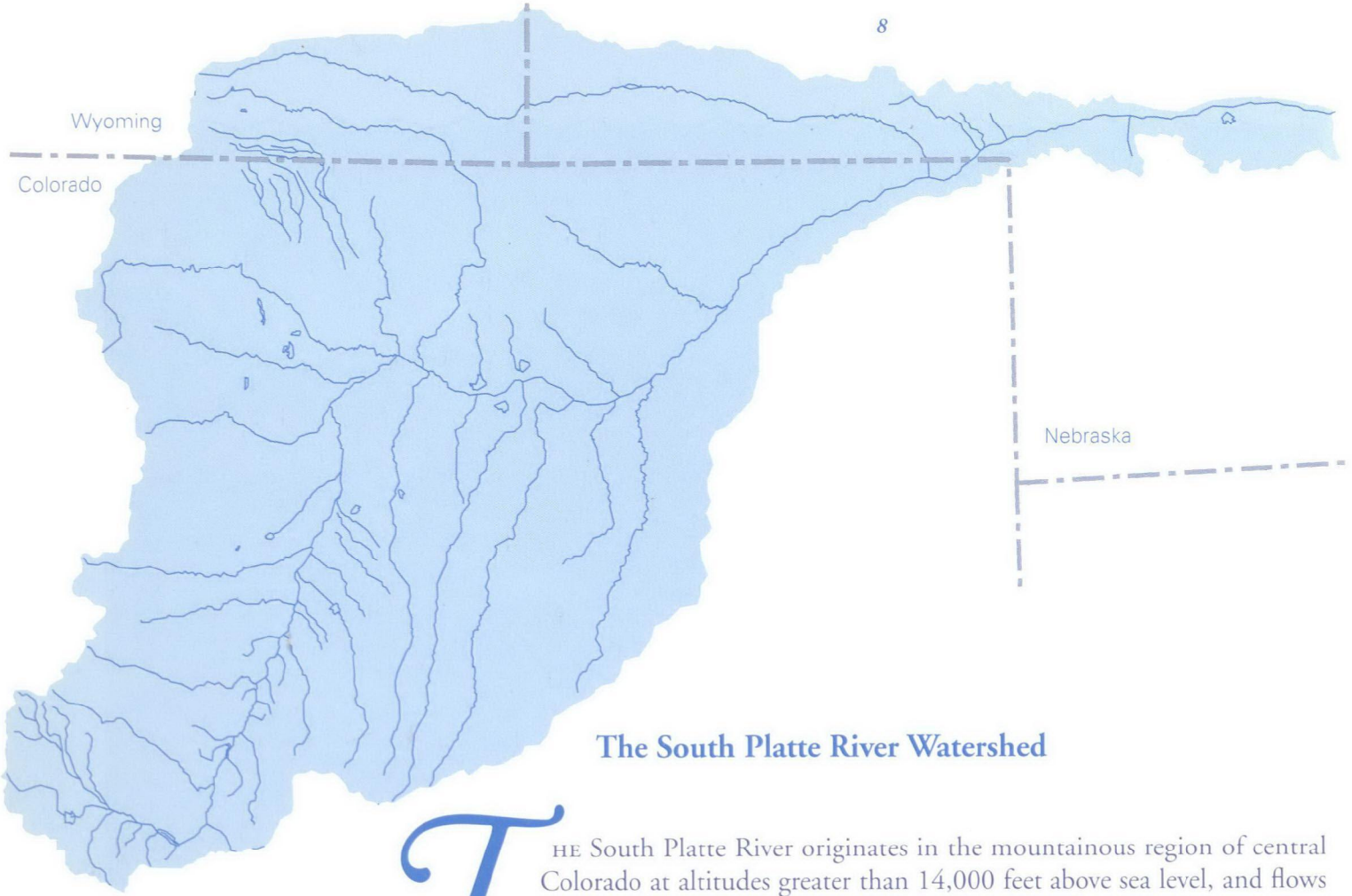
The Merrimack River Watershed

THE Merrimack River is formed by the confluence of the Pemigewasset and Winnipesaukee Rivers in Franklin, New Hampshire. It flows south through New Hampshire's capital, Concord, past its most populated cities of Manchester and Nashua, and into Massachusetts, where it turns sharply east toward the Atlantic and flows through the cities of Lowell, Lawrence, and Haverhill. With the fourth-largest basin in New England, covering 5,010 square miles, the river is the drinking water source for several Massachusetts and New Hampshire communities, supplying more than 237,000 people in Massachusetts alone. Approximately 1,484,000 people lived in the basin in 1980.

A long history of economic dependence on manufacturing and service industries throughout the basin resulted in severe degradation of this important water resource. In the 1930's, contamination along the length of the river made it too polluted for domestic water supply uses. Raw sewage from the towns and communities located along the riverbanks, paper mill waste, tannery sludge, and other pollutants had been dumped into the river untreated over a long period of time. By the end of World War II, the Merrimack was recognized as one of the 10 most polluted rivers in the nation because of human use of this river as a waste stream.

Today, governmental agencies and citizen groups in the watershed are working to address the issues affecting river life and water quality. For example, the Merrimack River Watershed Council, an interstate organization dedicated to the protection of the Merrimack River, is building a citizenry alert to the issues and establishing coalitions to protect and restore the river.





The South Platte River Watershed

The South Platte River originates in the mountainous region of central Colorado at altitudes greater than 14,000 feet above sea level, and flows generally eastward for 270 miles through the populous Front Range urban corridor and across Colorado's eastern plains. The South Platte continues into Nebraska, where it joins with the North Platte to become the Platte River, which then flows into the Missouri River. A number of tributaries join the South Platte as it flows north- and eastward toward the plains. The total area of the entire South Platte River basin covers 23,900 square miles.

Severe water quality problems in the upper reaches of the South Platte and its tributaries are the result of the mining of rich deposits of ores since 1859. Loadings of metals, including zinc, copper, and manganese, from the large number of active and abandoned mining sites contribute to chronic toxicity problems in certain tributaries to the South Platte, suppressing the number and size of fish that can thrive in that environment. Some upstream tributaries in the South Platte basin are altogether devoid of fish populations as a result of acid mine drainage. Further downstream, around the Denver metropolitan area, water diversions and waste water discharges are the major impacts due to high residential and vacationing populations within the basin. After the South Platte leaves the urbanized area, the primary impacts on the river are related to agricultural activities. Application of fertilizers, pesticides, and herbicides are all sources of water quality degradation affecting both surface-water sources and groundwater reserves. In addition, although precipitation rates are low in this region, erosion is a significant problem in many areas. Impacts of degraded water quality on fish throughout the watershed range from reported fish kills on specific tributaries to restrictions on fishing and reduced distribution of fishery habitat for many species.

Communities in the South Platte watershed are now taking action to improve the quality of the river. For example, the Denver metropolitan wastewater authority has significantly reduced the toxicity of its wastewater by removing toxic pollutants, to the benefit of downstream waters.

The San Francisco Bay Watershed

THE Sacramento and San Joaquin river watersheds drain California's Central Valley—40 percent of the State's land area—into San Francisco Bay, emptying into an approximately 1,200-square-mile marsh region. Since the mid-19th century, one-third of the Bay has been converted to dry land by filling, 90 percent of the Bay's wetlands has been destroyed, and more than 60 percent of its freshwater inflow has been diverted, mainly for irrigation.

So productive were the Bay's fisheries in 1875 that the Bay region supplied 93 percent of the State's commercial fishery products. By 1950, the entire fishery was almost depleted. A similar story may be told of the waterfowl, shorebirds, and game that once abounded in the region. As a result of gold mining and flood protection, extensive levees throughout the delta eventually excluded tides and floodwaters from 90 percent of the marsh, vastly changing its physical character, vegetation, and fauna. Nineteenth-century hydraulic mining in the drainage areas of the rivers deposited tens of millions of cubic meters of earth and rock into the Bay. This reduced its depth and changed its shape and circulatory patterns. In addition, dams above the delta blocked fish from their spawning grounds upriver and reduced the freshwater inflow to less than 40 percent of historic totals, thus contributing to the demise of Bay fisheries. These problems have been compounded by massive discharges of agricultural wastewater, much of it containing contaminants and toxic elements from fertilizers and pesticides. Untreated urban runoff, containing substantial quantities of oil and grease washed by rain through storm drains into the Bay, and spills of industrial chemicals add further to the stress on the estuarine ecosystem.

Recognizing the severe degradation of the Bay's resources, San Francisco Bay was designated an estuary of national significance in 1987. A comprehensive management plan has been developed, and partnership efforts are underway to restore the Bay and its watershed.

Tygart Valley, West Virginia

National Geographic Society

Back to Basins: Using Nature As Our Guide

OVER the past several decades, government agencies and citizen groups have recognized that efforts to reverse the trends of environmental degradation must be undertaken in a basin-wide context, to address the whole spectrum of activity and resource use throughout the watershed, from the headwaters to the receiving waters. Traditional environmental protection activities that do not consider the entire drainage area cannot successfully restore or protect downstream aquatic ecosystems from the impacts of basinwide activities.

"A good doctor treats the patient, not the disease."

– ARISTOTLE

State and local governments, as well as citizen and other non-governmental initiatives, have played a valuable role in watershed-based protection, often organizing and spearheading efforts at local levels before Federal agencies become involved. Federal agencies also have a long history of attempting to address many of these problems through a watershed approach, working within the limitations of their respective mandates.

State Initiatives

As the "front line" administrators of most pollution control and coastal protection programs, several coastal States are taking the lead in realigning their water quality programs along watershed boundaries. For example, North Carolina's "whole basin approach" to water quality protection focuses on coordinating and integrating all program activities for each of the State's 17 major river basins, including permitting, monitoring, modeling, and wasteload allocations; nonpoint source assessments; special intensive studies; and planning. Managers focus resources on conducting these activities one basin at a time in an effort to develop basin management plans that assess all priority problem areas and pollutant sources within the system. These plans will then provide a basis for management decisions such as National Pollutant Discharge Elimination System (NPDES) permit renewals, enforcement, and monitoring. The stated goal of this effort is to develop basinwide strategies that protect surface water quality and use while allowing for sound economic planning. North Carolina anticipates that it can adopt the whole basin approach with minimal changes to the structure of the current water quality program through increased information exchange and coordination across agency programs, as well as the use of more complex water quality modeling, data interpretation, and database management.

Nonpoint Sources:
Diffuse sources of contaminants or pollutants that cannot be attributed to a single discharge point (e.g., agricultural runoff, storm water runoff, deposition from the atmosphere).

Another example of a watershed protection effort that goes beyond water quality protection is the Minnesota Department of Natural Resources (DNR) integrated resource management approach to maintain biodiversity over entire watersheds, landscapes, and ecoregions. Using this approach, DNR's focus will shift from jurisdictional entities, such as State forests, to ecological land units. A first step in the process—for which the goal is to sustain entire ecological systems—has been to identify high-priority landscape areas such as large watersheds, forest areas, and prairie/farmland landscapes. These areas are then the focus of integrated management efforts involving a full range of State and Federal agencies, local governments, and private sector organizations. While this initiative is in its early stages, there are indications that Minnesota's efforts to reorganize its major natural resources agencies along ecosystem lines will result in increased emphasis on watershed management and protection throughout the State.

Non-Governmental Efforts

NON-GOVERNMENTAL watershed protection programs have played an increasingly important role in protecting valuable areas for wildlife and other purposes, as pressures have risen to limit public expenditures for maintenance and development of parks and protected areas. For instance, the Nature Conservancy (TNC) acquires and maintains carefully targeted areas of unique ecological importance, and has actively promoted the acquisition of riparian lands for the purpose of creating buffers or conservation easements along rivers, streams, and wetlands throughout the country. Since 1975, TNC also has been refining procedures for identifying and ranking natural areas to focus its acquisition and management activities on properties containing rare or threatened species or ecosystems, and has compiled this information for many States on a hydrologic unit (watershed) basis.

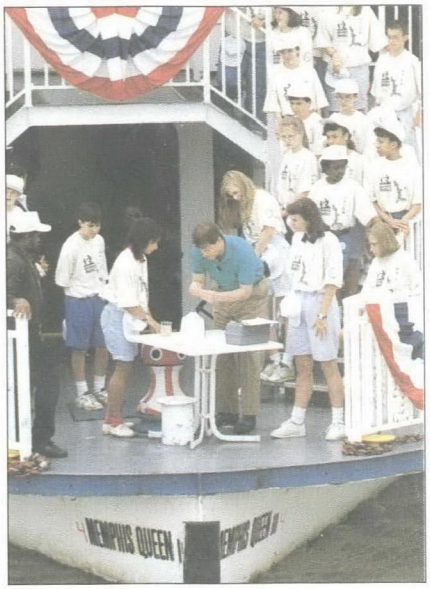
Local citizen groups have been very effective at helping to restore watersheds. For example, watershed restoration of the Mattole River in California was begun by a small group of about a dozen people residing in the Mattole watershed. This group, called the Mattole Watershed Salmon Support Group (MWSSG) initiated erosion control, reforestation, fishery habitat repair, and habitat enhancement. Later, a larger group known as the Mattole Restoration Council was formed for long-range planning and active watershed restoration through consensual decision-making. The group's guiding principle in watershed restoration has been to imitate natural processes as closely as possible. Early activities included a citizen-con-

ducted fishery habitat inventory throughout the watershed. Citizens also inventoried the remaining old growth forests, and more recently, systematically identified sources of erosion in the watershed and prescribed remedial actions. In the estuary, the MWSSG has attached driftwood structures to the riverbanks to provide shade and shelter to juvenile king salmon and steelhead, and a two-year effort is underway to create a fishery enhancement plan. Schoolchildren as well as local residents and landowners have been extensively involved in the restoration work, especially in the release of young salmon.

As another example of citizen watershed protection efforts, in 1987, approximately 200 people representing private citizens, conservation and environmental organizations, elected officials, university faculty, and government convened to identify ways to solve resource management problems related to the Illinois River. Participants agreed that the river needed to be managed as a system and that soil erosion and sedimentation were major problems affecting functions of the river, including recreational use, fish and wildlife protection, and flood conveyance. Following up on the recommendations that resulted from this meeting, the Illinois River Coalition/Father Marquette Compact was organized by citizens from five river counties to build a regional consensus and tap governmental resources for river restoration. The Heartland Water Resources Council was organized to focus on managing and restoring the river in the area around Peoria. The Soil and Water Conservation task force, made up of the elected directors of seven conservation districts along the river, as well as advisors from industry, State and Federal agencies, and conservation organizations, began working to accelerate the implementation of conservation practices throughout the watershed. The task force also receives grants and equipment from the Caterpillar Tractor Company and funding from the Illinois Department of Energy and Natural Resources to accomplish its training and technology transfer activities.

Finally, a number of volunteer citizen monitoring efforts, such as Save Our Streams, have helped collect water quality data needed to assess impacts of management actions throughout watersheds, as well as to educate local communities about what they can do to protect their water resources. Recently, as part of the Mississippi River Project '93, more than 1,000 students in the ten States along the Mississippi and more than 1,000 students in other areas conducted water quality sampling for this major initiative for the Year of the Gulf of Mexico. This project's goal was to help students better understand the important relationship between the river and the Gulf into which it flows. It also demonstrated that we are all connected through our water resources, and that we each can be a part of the solution to problems that threaten them.

Student volunteers and Vice President Gore analyze water samples from the Mississippi River. *(Mississippi River Project, 1993)*



Federal Efforts

FEDERAL agencies with responsibilities for infrastructure development, resource management, and environmental protection programs also have supported or administered some type of watershed protection or management planning. In many cases, their efforts involve active participation by a range of parties with an interest in the resource issues being addressed, and often these agencies work as a team with other Federal and State agencies to resolve such issues.

For example, ecosystem-based management of natural resources, which frequently is accomplished through watershed approaches, is essential to achieving sustainable agricultural production that ensures environmental quality while meeting society's changing needs. The U.S. Department of Agriculture (USDA) initiatives related to watershed and aquatic resource quality include education and technical assistance provided to State and local levels, research and development, and database development and evaluation. USDA's Soil Conservation Service (SCS) watershed approach, which focuses on agricultural landowners in small watersheds, is a comprehensive planning process that considers all resources in the watershed—soil, water, air, plants, and animals—while including social, cultural, and economic factors. The process tailors workable solutions to ecosystem needs through the participation and leadership of stakeholders in the resources. The resulting watershed plans contain goals to be attained to address defined resource problems and identification of Federal, State and local sources of technical, educational, and funding assistance for achieving those goals.

The concept of watershed dynamics and functions is also integral to Army Corps of Engineers (COE) flood control and navigation projects, since both demand an understanding of the routes, amounts, and velocities of water as it drains from uplands to streams, rivers, wetlands, and coastal areas. Consequently, watersheds have been incorporated into COE planning activities as fundamental hydrogeographic units to be considered in regional planning efforts, thus assuring that the collective effects of all anticipated activities (flood control, navigation, agriculture, transportation, natural resource management, housing, etc.) can be properly evaluated. To this end, the COE is currently revising its environmental planning guidance to give full attention to the importance of ecosystem management via watersheds. The COE also is promoting a new class of projects, the benefits of which will improve the environment by restoring fish and wildlife habitats within a watershed that either have been degraded by a COE project or that could be effectively restored through a COE project.

In addition to the COE projects described above, the Department of Defense (DOD) manages more than 300 major installations on approxi-

mately 25 million acres across the United States. Environmental planning, special environmental enhancement projects, and consultation with outside agencies are incorporated into the installation management process to ensure the best protection and conservation of natural resources possible on DOD property. As a result, environmental impacts are minimized, nonpoint source pollution is reduced, hazardous waste production is controlled, and sensitive resource areas such as wetlands are afforded special protection. As a key member of the local community, DOD provides a Federal link in a watershed management approach that is essential to responsible stewardship of the diversity of resources throughout the ecosystem.

The DOD program includes a special initiative, the Legacy Resource Management Program (Legacy), designed to identify, protect, and enhance the management of natural and cultural resources. Approximately 600 projects have been funded since the program's inception in 1991. For example, Legacy has funded restoration of some 1,600 acres of bottomland hardwood wetlands at Barksdale Air Force Base, Louisiana. Another Legacy-funded project is the acquisition of the last remaining 225 acres of low elevation old growth spruce forest in the Puget Trough by the Department of the Navy, to ensure conservation of natural habitat vital to the Northwest Pacific watershed ecology. This effort, located at Naval Radio Station (T), Jim Creek, Washington, ensures a buffer of virgin old growth around lakes, creeks, and wetlands, not only preserving the area's essential water supply but also preserving the unique wildlife habitat.

Jim Creek, Washington

Traditionally, the National Oceanic and Atmospheric Administration's (NOAA) Coastal Zone Management (CZM) program has served as the foundation for watershed protection in State-defined "coastal zones." Recently, Congress passed the Coastal Zone Act Reauthorization Amendments of 1990 (CZARA) to give special protection to coastal waters in light of increasing beach closures, shellfish harvesting prohibitions, and the loss of biological productivity. CZARA is a joint NOAA-Environmental Protection Agency (EPA) effort that requires State water quality agencies to work with coastal zone management agencies to develop coastal nonpoint source pollution control programs that "restore and protect coastal waters." This provides an opportunity for States to build on EPA's Section 319 nonpoint source management programs under the Clean Water Act (CWA) and the land use management expertise of programs approved under the Coastal Zone Management Act to control nonpoint source contributions to coastal waters on a watershed scale.

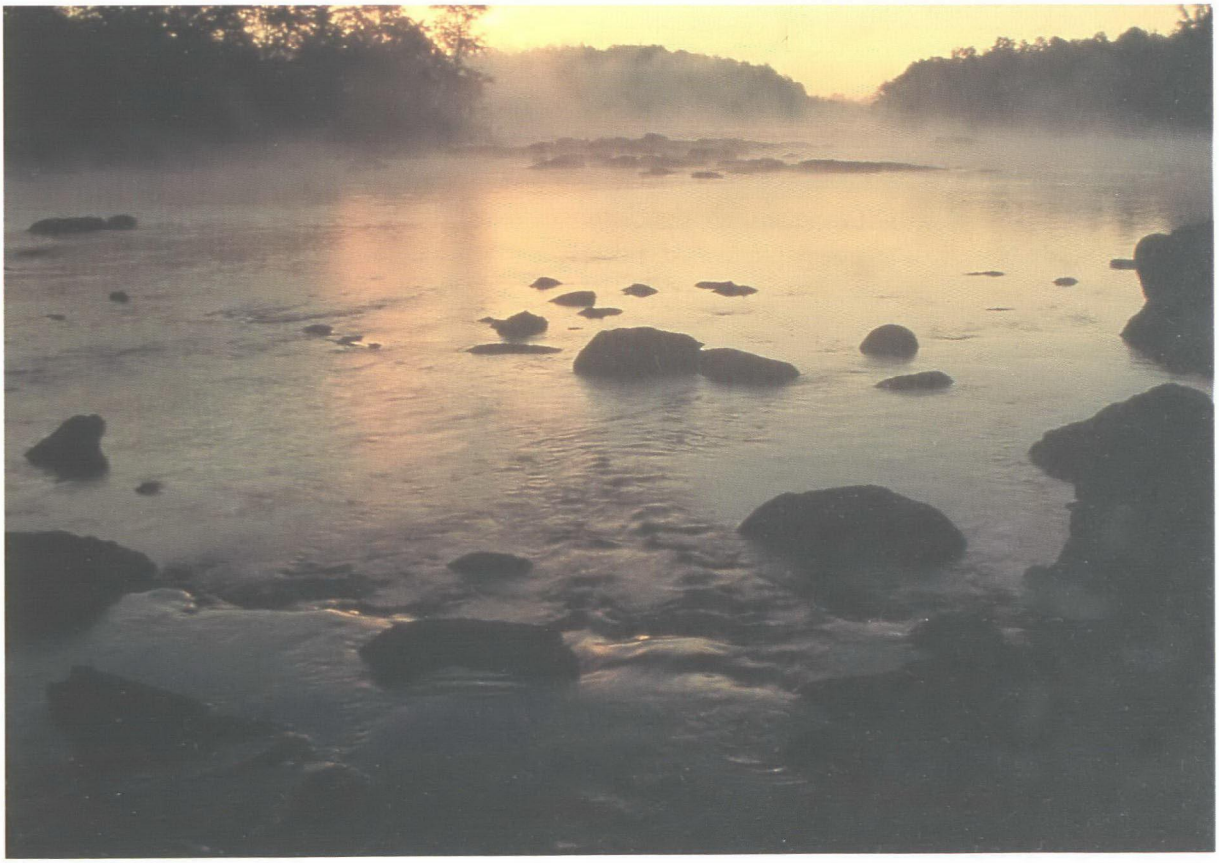
The Department of Interior has a number of programs that use a watershed approach in addressing specific issues. For example, the U.S. Geological Survey uses hydrologic units in evaluating the quantity and quality of our Nation's waters. The U.S. Fish and Wildlife Service's (FWS) habitat restoration and wildlife protection programs also use a watershed approach. In the Partners for Wildlife program, the FWS works with private landowners to restore valuable habitats, for instance, by fencing cattle out of stream beds to restore habitat for endangered freshwater mussels and other stream-dwelling species. The FWS Interjurisdictional Rivers Program was established to help correct the effects of past land management practices on a basin scale by working with a range of parties with a stake in the watershed resources. The FWS Bay/Estuary Program uses a watershed/ecosystem approach, focusing on important coastal watersheds to restore, protect, and enhance living resources. Some of the program's actions thus far include restoration of fish passage and important habitats through partnerships with other agencies and local interests. One specific goal of the Bay/Estuary Program is to protect the ecosystem and thus avert the need for new listings under the Endangered Species Act.

Several EPA programs under the CWA require or support watershed or "areawide" planning and management. For instance, EPA efforts to assure the attainment of water quality standards under the CWA incorporate wasteload and load allocations for point and nonpoint sources to a waterbody based on its total capacity to assimilate contaminant loadings from its watershed. EPA's National Estuary Program (NEP) aims to protect and restore water quality and living resources in estuaries and their drainage basins. Comprehensive management plans for NEP sites are developed through a partnership of Federal, State, and local agencies responsible for protecting and managing estuarine resources and the citizens and businesses who depend on the estuary for their livelihoods and quality of life. Activities to protect and improve water quality and living resources of the estuary are defined in these plans for the entire surrounding land area or watershed of each NEP site.

EPA is currently leading a major effort to promote watershed protection as the basic framework for the water quality programs it administers or supports. The key elements of this approach are the (1) formation of partnerships among people with an active interest in the watershed (the stakeholders); (2) joint identification of the problems or primary threats to human and ecosystem health; and (3) implementation of problem-solving actions in an integrated fashion. While this is not a new concept, it is intended to provide a new focus and framework for integrating ongoing programs around hydrologically defined areas and move beyond improving chemical water quality to include measures of ecological health (i.e., physical quality, habitat quality, and biological quality).

Vision of the Future: A New Perspective

In general, the current Federal and State structure for decision-making that affects or protects the environment is stratified by environmental media programs, as well as by political and administrative jurisdictions. Air laws and regulations protect air quality and control harmful emissions to the atmosphere. Water laws and regulations protect water quality, controlling discharges of pollutants to U.S. waters and promoting pollution prevention efforts. Waste disposal laws and regulations govern the way in which solid and hazardous wastes are managed and disposed. Endangered species laws protect threatened and endangered species. These statutes and authorities and the resulting government programs have not traditionally encouraged cross-media, multi-institutional, ecosystem-based approaches among all the various agencies with responsibilities that affect watersheds. In many cases, existing regulations may obstruct these types of approaches.



Savannah River, Georgia

It is increasingly clear that threats to aquatic resources cannot adequately be addressed, nor can problems posed by freshwater diversions, wetlands destruction, or conflicts between endangered species habitat and industry be solved, without a more integrated watershed approach to the management and protection of those resources. Today's challenges include addressing not only the direct sources of pollution, but also the significant pollution problems that come from literally millions of nonpoint sources. Downstream and coastal waters are seriously impacted by the effects of activities carried out higher in the watershed. Safe drinking water supplies must be maintained, and aquatic habitats restored and protected, while at the same time meeting the infrastructure needs of our society. These challenges require innovative, cooperative solutions on an ecosystem level. They require consideration of the condition and capacities of landscapes within the entire watershed. They also require collaborative attention from the full range of decision-makers who impact or protect those resources and from stakeholders who live, work, or own land in watersheds and have an interest in resource health and integrity.

We need an improved framework at National, regional, State, and local levels to better integrate efforts that could contribute to watershed restoration, protection, and management and to encourage such efforts already underway. In addition, government agencies at all levels must work more closely with each other and with the private sector to solve common problems. We must develop environmental solutions using a holistic approach that considers the interconnectedness of surface water, ground water, and aquatic and related land resources. These solutions must be undertaken in a geographic context that addresses the whole spectrum of activity and resource use throughout the watershed. Finally, sustainable development must be the unifying principle for all future approaches to managing natural resources.

Sustainable Development:

Meeting the needs of the present without compromising the ability of future generations to meet their needs.

– Our Common Future, 1987

New Directions

THE concept of watershed-based environmental protection has been included in congressional debate on the reauthorization of the Clean Water Act, with many advocates emphasizing the need for a stronger watershed framework in the management and protection of our Nation's aquatic resources. Specific proposals include providing authority for voluntary watershed planning at the State level to protect water quality and the living resources supported by the waters. Watershed plans are to characterize waters and land uses of the watershed, identify water quality problems and goals for watershed management, allocate needed load reductions among point and nonpoint sources, and identify financial resources and institutional arrangements necessary for implementation.

The current administration also has endorsed the concept of cross-agency ecosystem management initiatives, and supports an ecosystem framework through which Federal agencies, State, local, and tribal governments, the public, and Congress can work together to develop specific strategies, refocus current programs and resources, and identify cost-effective investments in the economic and ecological health of a region.

Another current model for integrated site-specific coastal ecosystem restoration is the collaborative partnership known as Coastal America. Through this partnership, the full spectrum of infrastructure agencies, resource management agencies, environmental protection agencies (both Federal and State), local, private, and citizen interests have joined forces to restore coastal ecosystems. The partnership provides a framework for many of the parties conducting activities throughout the watershed that affect the aquatic ecosystem to collaboratively resolve the problems that threaten the watershed's aquatic resources.

Through these and similar partnership efforts we are addressing the problems facing our Nation's aquatic ecosystems and living resources from a new perspective. The future of our aquatic ecosystems and the fish and wildlife that depend on them lies in integrated and collaborative decision-making on a watershed basis and in an ecosystem context. By these means we can protect and support clean, abundant habitats and water resources, healthy ecosystems, and continued use of our waterways for our economic and environmental benefit, from the beginning to the end.

A Model for Watershed-Based Aquatic Ecosystem Protection

"Every drop of rain that runs off these lands flows toward the bay. So does the discharge from every sewage pipe, industrial outfall, and uncontained oil spill, every styrofoam coffee cup casually tossed into a drainageway. When soil erodes from farmland, or from a forest bulldozed for development, the sediment can head only in one direction—bayward. This is what we mean by the drainage basin, or watershed, of Chesapeake Bay. And on such a map the bay appears neither dominant nor long and broad; just a smallish pool of water on the receiving end of all our activities, wise and foolish, across the vast lands of the watershed."

–Tom Horton
Turning the Tide

Satellite Image of the Chesapeake Bay Watershed

Earth Satellite Corporation

The Chesapeake Bay Partnership

SUCCESSFUL watershed management requires interagency/intergovernmental cooperation and coordination beyond what has typically been practiced. Such collaboration has much to do with the successful efforts to address the health of Chesapeake Bay using a watershed approach.

Chesapeake Bay, largest of the United States' 130 estuaries and second-largest in the world, is a shallow estuary receiving water from a 64,000-square-mile drainage basin that includes portions of the states of New York, Pennsylvania, Delaware, Maryland, West Virginia, Virginia, and all of the District of Columbia.

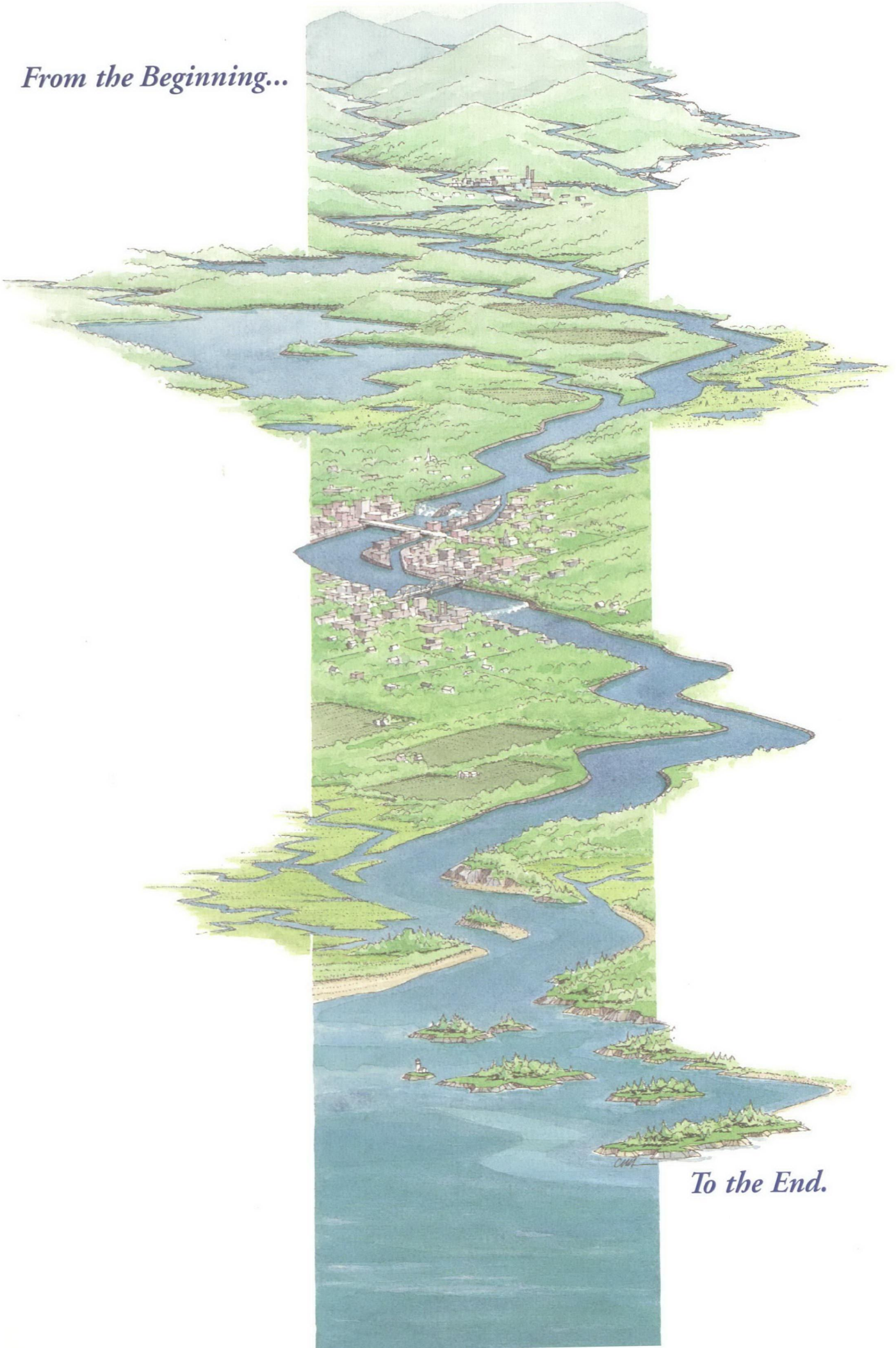
With a population of 13 million people living within its watershed, the Bay's waters support 295 species of finfish, 45 species of shellfish, and 2,700 plant species. The Bay also is home to 29 species of waterfowl and is a major resting ground along the Atlantic Migratory Bird Flyway. Approximately one million waterfowl winter in the Bay's basin each year. The Chesapeake is also a major recreational and commercial resource, with two of the five major North Atlantic ports in the United States located on its shores.

The rivers and streams draining into the Bay, and the Bay itself, have suffered from the effects of more than two centuries of steady growth, from increasing pollution and runoff, and from accumulation of sediment and industrial wastes. The first signals of ecosystem imbalance in the bay were precipitous declines in populations of its fish, shellfish, and waterfowl noted in the 1970's. By 1978, a sharp decline in submerged aquatic vegetation (SAV), especially in the Bay's upper reaches, also indicated that the Bay was in trouble. Studies concluded that nutrient enrichment, much of which is contributed by agricultural activities both upland and nearshore and treated sewage, was the primary factor in the decline of SAV beds. As a consequence of nutrient enrichment, there were also increases in the duration and extent of low levels of dissolved oxygen and subsequent loss of habitat.

The Chesapeake Bay Program was formed in 1983 with representatives from Virginia, Maryland, Pennsylvania, the District of Columbia, EPA, and the Chesapeake Bay Commission signing the first Chesapeake Bay Agreement to restore the Bay as a single ecosystem. The partnership also involves the active participation of other Federal agencies (such as FWS, NOAA, and SCS), local governments, citizens, and businesses. A revised Agreement, signed in 1987, contained a commitment by the parties to reduce the amount of nutrients reaching the Bay by 40 percent by the turn of the century. On a broader level, the Agreement clearly established that the productivity, diversity, and abundance of the estuary's aquatic plants and animals would be used as the ultimate measurement of the Bay's condition. In 1992, amendments to the Agreement reaffirmed the 40 percent commitment and directed that specific nutrient reduction goals be set for each of the Bay's major tributaries. Tributary strategies are under development now, refocusing efforts to reduce nutrients and restore habitat at the watershed level.

The aim of the Chesapeake Bay Program is to produce actions that restore the Bay. Installing fish ladders, planting trees, enacting growth management legislation, improving sewage treatment plants, and providing assistance to farmers and homeowners to reduce nutrient pollution from runoff are all activities that occur through the program. The program guides and coordinates the restoration actions of literally hundreds of Federal, State, and local government agencies, and works with dozens of business, civic, agricultural, scientific and technical, and environmental organizations throughout the entire watershed of the Chesapeake to create or place their endeavors in an effective pattern. The results have been very positive. More than 175 miles of fish habitat have been made accessible through fish passage improvements; phosphorus levels have been reduced by 16 percent, although nitrogen levels have not changed; striped bass populations are recovering through restricted fishing and stocking efforts; submerged aquatic vegetation has increased 58 percent since 1984; noncompliance rates among water quality permittees have dropped by 70 percent; and toxic emissions and releases have been reduced by 43 percent.

From the Beginning...



To the End.

We're All Part of the Problem—We're All Part of the Solution

Get Involved in the Protection of Your Watershed!

In Your Home or Workplace

- Sort trash to separate recyclable material from garbage.
- Recycle newspapers and other paper/cardboard.
- Install more insulation and keep furnaces in good repair.
- Conserve energy: Turn off lights and other electrical appliances when they are not in use.
- Set a reasonable temperature for heating and cooling.
- Use biodegradable, low-phosphate detergents.
- Carefully monitor what is poured down your household drains.
- Never dump motor oil, paints, or chemicals of any kind in gutters, storm drains, or sinks.
- Buy products in pumps, not aerosols.
- Use biodegradable plastic garbage bags.
- Use water conservation devices in your home.
- Check product labels for environmental safety and look for alternatives to hazardous products.
- Buy products made of or packaged in recycled paper or in refillable packages.
- Avoid products from companies not environmentally responsible.

In Your Yard

- Reduce water-thirsty lawn areas by increasing plant beds, natural areas, and ground covers.
- Landscape with swales (low areas) and berms (elevated areas) to catch and filter runoff.
- Water your lawn only when it looks dry.
- Mow grass frequently so that no more than one-third of the blade is clipped at one time.
- Compost household and yard waste.
- Use non-hazardous products or alternative methods for pest control on your property.
- Establish a zone of native plants between your lawn and the shoreline.

In Your Community

- Return bottles and cans to a store or recycling center.
- Take your own bags to the market.
- Cut back on auto use and support mass transit.
- Encourage the development of bike paths and carpool lanes.
- Support land uses that minimize loss of habitats and impacts to waterways and wetlands.
- Support local environmental groups that work to protect watershed resources.