

# Minnesota

## Wetland Resources

Minnesota is famous for its many lakes; wetlands in the State, however, cover more than three times the area of lakes. About one-fifth of Minnesota is wetland. These wetlands provide numerous benefits to the people and wildlife of the State. Wetlands provide flood control by temporarily retaining stormwater runoff, and they reduce erosion of lakeshores and streambanks. Wetlands improve downstream water quality by capturing suspended particulates, dissolved nutrients, and contaminants such as heavy metals and agricultural pesticides. Wetlands provide essential habitat for waterfowl, furbearers, and other wildlife (Carter and others, 1979). Minnesota's wetlands also are especially valuable for their vegetation. Many of the State's rarest plant species and most distinctive plant communities are found only in wetlands (Coffin and Pfannmuller, 1988). Probably the rarest type of wetland in the State is a type of peatland called a calcareous fen (fig. 1).

### 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 Minnesota is shown in figure 2A; only wetlands are discussed herein.

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 Minnesota are described below.

System	Wetland description
Palustrine .....	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 .....	Wetlands within an intermittently to permanently flooded lake or reservoir. Vegetation, when present, is predominantly nonpersistent emergent plants (nonpersistent-emergent wetlands), or submersed and (or) floating plants (aquatic beds), or both.
Riverine .....	Wetlands within a channel. Vegetation, when present, is same as in the Lacustrine System.

Most Minnesota wetlands are categorized as palustrine because they have vegetation that remains standing all year. Most of these wetlands have an organic soil and are thus peatlands. A simplified definition of organic soil is one with an upper layer of partly decomposed plant material (peat) at least 12 inches (Wright and others, 1992) to 16 inches (Cowardin and others, 1979) thick. Peatlands cover about 6 million acres in Minnesota (Minnesota Department

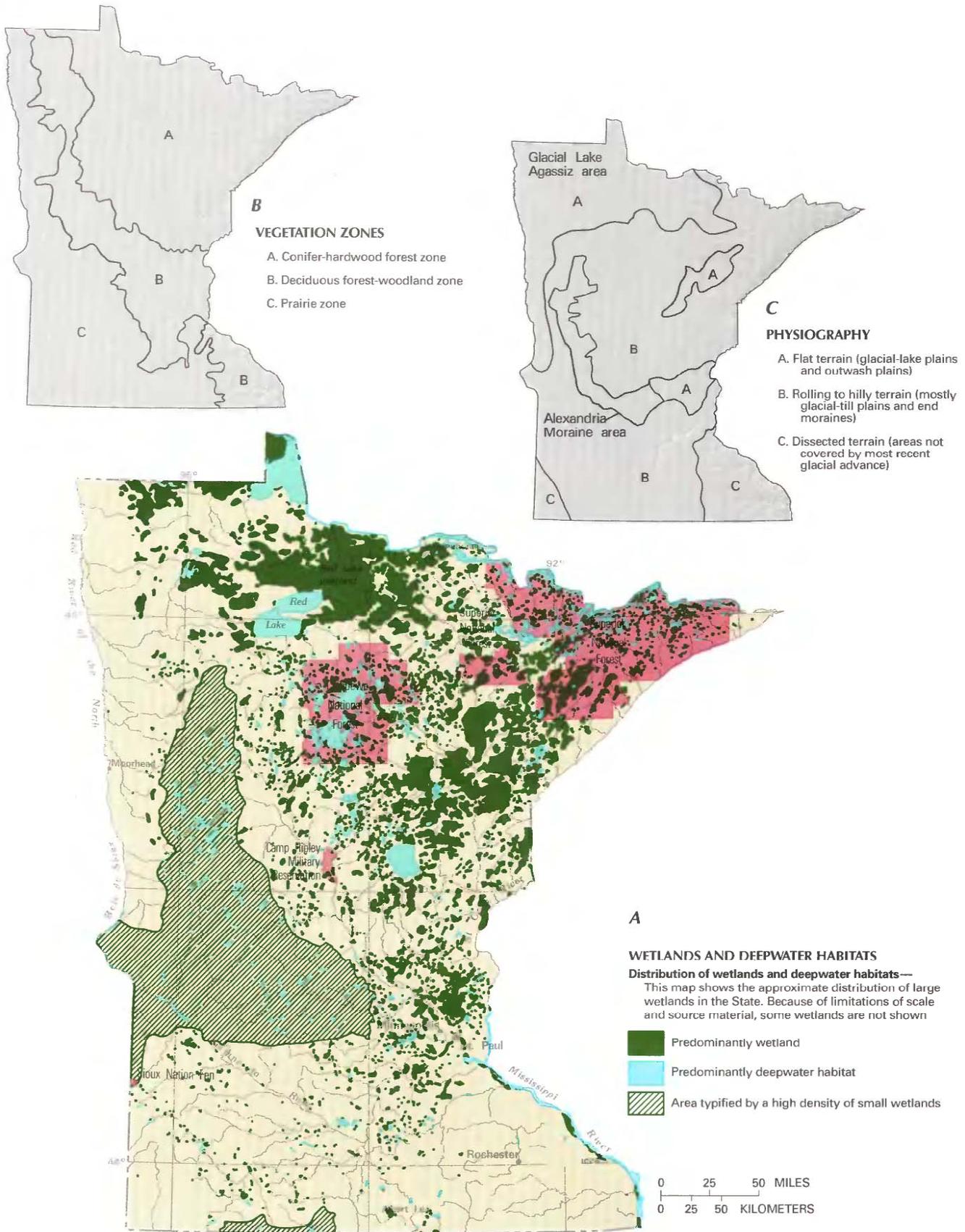
of Natural Resources, 1984), although estimates range from about 5.2 million acres (Anderson and Craig, 1984) to about 7.2 million acres (Minnesota Department of Natural Resources, 1978) and depend on the definition chosen for organic soil and on data compilation methods. Palustrine wetlands on mineral soil cover about 3.5 million acres (Anderson and Craig, 1984). The total acreage of palustrine wetlands in Minnesota, both peatlands and mineral-soil wetlands, is thus about 9.5 million acres.

Peatlands can be categorized as either fens or bogs. Sometimes the word "bog" is informally applied to peatlands in general, but most peatlands in Minnesota are more properly called fens. Fens are peatlands that receive nutrients from ground water or runoff that has contacted mineral soil. Fens exist statewide but are more common in the north, where conditions are more favorable for peat accumulation. There are many different types of fens, corresponding to the wide range of possible hydrologic, climatic, and nutrient conditions. Open fens (persistent-emergent wetlands) in the conifer-hardwood forest zone (fig. 2B) commonly have sedge-dominated communities. Swamp-forest fens (forested or scrub-shrub wetlands) in this zone typically are covered by larch, black spruce, or northern white cedar, with an understory of low shrubs, sedges, and mosses (Glaser, 1992; Minnesota Department of Natural Resources, 1993). Fens in the prairie and deciduous forest-woodland zones typically have a scattered cover of shrubs such as willow and dogwood and a continuous ground cover of various sedges, grasses, and forbs (scrub-shrub or persistent-emergent wetlands). A rare type of these fens is a calcareous fen (fig. 1), which receives upwelling ground water rich in calcium carbonate.

Bogs are peatlands that receive nutrients only from precipitation and windblown dust. Consequently, bog water has low nutrient concentrations, and a continuous mat of sphagnum moss acidifies the water (Gorham and others, 1985). Bogs have a low diversity of species because few plants are adapted to these low-nutrient, acid conditions (Glaser and others, 1981; Glaser, 1992). Bogs in Minnesota typically are peat mounds covered by black spruce with an understory of broad-leaved evergreen shrubs and sphagnum moss (forested wetlands). Some bogs have a stunted tree and shrub community (scrub-shrub wetland) near the center. Nonforested patches of bog dominated by sedge (persistent-emergent wetlands) are less common but can occur where the peat is too wet for black spruce



**Figure 1.** Sioux Nation Fen. This type of wetland, a patterned calcareous fen, is rare in Minnesota. (Photograph by James E. Almendinger, U.S. Geological Survey.)



**Figure 2.** Wetland distribution and related biotic and physical features in Minnesota. **A.** Distribution of wetlands and deepwater habitats. **B.** Vegetation zones. **C.** Physiography. (Sources: A, T.E. Dahl, U.S. Fish and Wildlife Service, unpub. data, 1991. B, Minnesota Department of Natural Resources, 1993. C, Adapted from Wright, 1972.)



tered fen sometimes develops in which the vegetation structure forms alternating ridges and troughs oriented at right angles to the direction of this slow surface flow. The ridges and troughs may be 10 to 50 feet wide (Heinselman, 1963), with the ridges occupied by low shrubs and the troughs by sedges or pools. The vast fens of the Red Lake peatland provide the regional setting atop which bogs can develop. Bogs in the Red Lake peatland have formed on peat mounds raised above the influence of upwelling ground water (Siegel and Glaser, 1987; Glaser, 1992; Siegel, 1992). The flow of fen water around the bogs can cause them to have a streamlined shape, rounded on the upgradient margin and extended to a long tail on the downgradient margin.

The second example of the influence of ground-water hydrology on wetlands is calcareous fens (fig. 3B), which are rare in Minnesota. Calcareous fens typically have significant amounts of upwelling ground water rich in calcium carbonate and surface slopes that drain excess water (Curtis, 1971; Eggers and Reed, 1987; Thompson and others, 1992). These wetlands can be found in the Minnesota River Valley on terraces at the base of the bluffs that form the valley wall. The high water table in the bluffs provides the necessary hydraulic pressure to force ground water to upwell at the fen. The fens generally lie above flood stages of the Minnesota River and slope toward the river, protecting against inundation from the river and providing drainage of excess water from the fen. As much as 25 feet of peat can accumulate over the zone of upwelling ground water. Calcareous fens are sensitive not only to activities such as ditching or filling but also to more subtle causes of degradation. For example, pumping nearby wells could lower the natural hydraulic pressures under the fen and reduce the amount of upwelling ground water, and changing the land use in the ground-water recharge area upgradient from the fen could change both the quantity and quality of the water available to the fen. Calcareous fens demonstrate that simply protecting the area of the wetland itself is not enough to ensure that the wetland will remain undamaged.

**TRENDS**

Most changes in Minnesota wetlands during the last 150 years have been caused by human activities. Estimates of wetland acreages before settlement of the area by Europeans in the mid-1800's range from about 15 to 18 million acres; as much as one-half (by area) of Minnesota's original wetlands might have been lost since presettlement times (Anderson and Craig, 1984; Tiner, 1984; Dahl, 1990). Most of the wetland loss has been the result of drainage for agriculture. By the early 1980's, more than 70 percent of Minnesota's originally poorly drained mineral soils in the prairie zone had been drained (Anderson and Craig, 1984). The loss of wetlands in the largely agricultural basin of the Minnesota River may cause increased flushing of water, nutrients, and soil from the uplands into the river ecosystem. The northern peatlands also have been affected by human activities. During the early 1900's, several northern counties went bankrupt as a result of funding the ditching of peatlands on the Glacial Lake Agassiz plain. Because of the flat landscape, the ditches were largely ineffective in draining the peatlands; however, ditching might have altered peatland vegetation hundreds of feet from the ditches (Glaser and others, 1981; Bradof, 1992). Small areas of peatland have been mined for horticultural purposes, logged for black spruce, or cultivated for specialty crops. The use of peat as a fuel, however, has not been economical to date (Keirstead, 1992).

Wetlands are sensitive to climate change also. About 7,000 years ago the water table in parts of Minnesota was as much as 20 feet lower than at present, and many prairie potholes were probably dry (Digerfeldt and others, 1992). The climate then became increasingly moist, and by 4,500 years ago peat began to form in the remnant Glacial Lake Agassiz plain (Glaser and others, 1981). Because

the western boundary of the Red Lake peatland is apparently controlled by the climatic moisture supply, the peatland might be diminished by warmer and drier climates resulting from natural climate cycles or, hypothetically, human-induced global warming. Such drier climates also could desiccate shallow prairie potholes, as in the past.

**CONSERVATION**

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

*Federal wetland activities.*—Development activities in Minnesota 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

**Table 1.** Selected wetland-related activities of government agencies and private organizations in Minnesota, 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
<b>FEDERAL</b>						
Department of Agriculture						
Consolidated Farm Service Agency .....	...	●	...	...	...	...
Forest Service .....	●	...	●	●	●	●
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 .....	...	●	...	...	●	...
<b>STATE</b>						
Board of Water and Soil Resources .....	...	●	●	...	...	●
Department of Military Affairs .....	●	...	●	●	●	●
Department of Natural Resources						
Division of Fish and Wildlife .....	●	...	●	●	●	●
Division of Forestry .....	●	...	...	●	...	●
Division of Minerals .....	●	●	●	...	●	●
Division of Waters .....	...	●	...	...	●	●
Office of Planning .....	...	●	...	...	...	...
Department of Transportation .....	●	●	●	●	●	●
Environmental Quality Board .....	...	●	...	...	...	...
Pollution Control Agency .....	...	●	...	...	...	...
University of Minnesota .....	...	...	...	...	●	...
<b>COUNTY AND LOCAL</b>						
Counties and cities .....	●	●	●	●	...	●
Soil and water conservation districts .....	...	●	●	...	...	●
Townships .....	...	●	●	...	...	...
Watershed districts .....	...	●	●	...	...	●
<b>SOVEREIGN NATIONS</b>						
Native American tribes .....	●	...	●	...	●	●
<b>PRIVATE ORGANIZATIONS</b>						
Ducks Unlimited .....	...	...	●	●	...	...
Izaak Walton League .....	...	●	...	...	...	...
National Audubon Society .....	●	...	●	●	●	...
The Nature Conservancy .....	●	...	●	●	●	...

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 (EPA), 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 (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.

The 1986 Emergency Wetlands Resources Act and the 1972 Coastal Zone Management Act and amendments encourage wetland protection through funding incentives. The Emergency Wetland 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 (NPS) provides guidance to States in developing the wetland component of their plans. Coastal 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.

Federal agencies research wetlands and manage those on public land under their jurisdiction. The U.S. Forest Service (FS) is responsible for more than 2.8 million acres, with an unknown acreage of wetlands, in the Chippewa and the Superior National Forests and supports research in peatland ecology and hydrology. The NPS manages over 140,000 acres in Minnesota, with an unknown acreage of wetlands. The FWS manages about 500,000 acres, much of which is wetland, in 12 National Wildlife Refuges and numerous smaller waterfowl production areas in Minnesota. The Corps has wetland-management and restoration programs, especially in the Mississippi River lowlands. The EPA laboratory in Duluth is studying effects of sedimentation and agricultural chemicals on prairie potholes. The U.S. Geological Survey, with cooperative funding from State agencies, is studying the hydrology of small agricultural wetlands and calcareous fens.

*State and local wetland activities.*—The centerpiece of Minnesota's efforts to protect wetlands is the Wetland Conservation Act of 1991, which works toward a no-net-loss goal. The intent of the law is to avoid or minimize wetland losses; where wetland loss is unavoidable, the loss must be mitigated by replacement with a wetland of equal public value. The law also provides funds for per-

manent easements to some privately owned wetlands and for public education. The law promotes wetland preservation by allowing tax-exempt status for wetlands of high value. The law essentially fills the gap in wetland protection between larger, deepwater habitats, which are already protected by Minnesota statute, and agricultural wetlands that are already covered by the Federal "Swampbuster" provisions. The Board of Water and Soil Resources is the State agency responsible for promulgating rules to determine wetland value and to mitigate wetland losses, and local governmental units are responsible for carrying out the rules (table 1). Also included in the legislation are provisions to prohibit degradation of calcareous fens and to protect about 150,000 acres of ecologically significant peatlands.

The Department of Natural Resources has a variety of responsibilities concerning wetlands and administers about 5.3 million acres of State land, almost one-half of which may be wetlands, in addition to about 3 million acres of lakes. The Department's Division of Waters oversees permit applications for nearly all activities below the ordinary high-water level in the "protected waters and wetlands" of the State, which include virtually all water bodies that have open water or nonwoody vegetation, are deeper than about 6 inches, and are larger than 10 acres (2.5 acres in incorporated areas). The Department's Division of Fish and Wildlife acquires lands and currently (1993) manages over 700,000 acres, a significant portion of which are wetlands (Tom Landwehr, Minnesota Department of Natural Resources, oral commun., 1993). Within the Division of Fish and Wildlife, the Natural Heritage program identifies and classifies natural biologic communities, including wetlands; the Scientific and Natural Areas program acquires sites of ecological significance to the State, notably rare wetland types such as patterned fen and calcareous fen; and the Ecological Services section performs environmental reviews and will help develop a Statewide Comprehensive Wetland Conservation Plan. The Department of Natural Resources' Division of Forestry helps manage most State-owned land and also is chairing a public and private interagency committee to develop nonregulatory best-management practices to protect wetlands from forestry activities. The Department's Division of Minerals is responsible for applying the rules of the 1991 Wetland Conservation Act on lands from which metallic minerals or peats are mined. The Division of Minerals also sponsored a survey of peat deposits in the State, including their type, distribution, and thickness (Minnesota Department of Natural Resources, 1981). The Department of Natural Resources' Office of Planning is responsible for the State Comprehensive Outdoor Recreation Plan document required by Federal legislation and coordinates the environmental review process within the Department of Natural Resources.

Other State agencies also are involved with wetland protection or management. The Environmental Quality Board determines which activities affecting wetlands are subject to the environmental review process. The Water Quality Division of the Pollution Control Agency reviews permit applications for all discharges to wetlands and other waters of the State, pursuant primarily to sections 401 and 402 of the Federal Clean Water Act. The Pollution Control Agency also produces a biennial report monitoring statewide water quality, pursuant to section 305(b) of the act. The Department of Transportation is responsible for applying the Wetland Conservation Act rules to all State transportation projects that affect wetlands; this responsibility involves wetland impact assessment as well as wetland restoration and creation. The Department of Military Affairs manages the 53,000-acre Camp Ripley military reservation and has an active program of wetland management in cooperation with other State agencies.

*Sovereign nation wetland activities.*—Tribal councils of Native American people in Minnesota strive to create, restore, or enhance wetlands for waterfowl and wild rice production, particularly on reservations or on traditionally harvested lands. The U.S. Bu-

reau of Indian Affairs helps provide funding for wetland projects through the Circle of Flight and Water Resources program.

*Private wetland activities.*—The National Audubon Society manages three wildlife sanctuaries that contain wetlands, conducts a public education program about wetlands, and is performing research for the EPA by investigating the effectiveness of past wetland-mitigation efforts. The Nature Conservancy actively seeks to purchase and protect ecologically significant wetlands. Ducks Unlimited provides funds for wetland restoration and for State or Federal agencies to purchase and manage wetlands for waterfowl production. The Izaak Walton League also provides funds for wetland restoration or creation. Private organizations that are involved in the protection of Minnesota wetlands include the Fish and Wildlife Legislative Alliance, Minnesota Conservation Federation, Minnesota Native Plant Society, Minnesota Waterfowl Association, Pheasants Forever, Project Environment Foundation, Sierra Club, Trout Unlimited, and others.

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