PDHonline Course H120 (1 PDH)

A Wetland Primer for Design Professionals

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Course Content

Course Introduction

An understanding of wetlands is increasingly important for design professionals, including architects, engineers, land surveyors and landscape architects. This course will acquaint you with the changed perception of wetlands in North America, contemporary definitions of wetlands, and types of wetlands found on this continent. Upon completion of this course, you will be familiar with key federal legislation and publications that have led to increasing protection of wetlands. In addition, you will understand the broad characteristics of wetlands and their value to society.

A pond in Iowa. (All photographs Copyright Patrick C Garner 2006)

A Short History of Wetlands

Wetland scientists estimate that in the mid-1600s there were more than 215 million acres of wetlands across North America. By the mid-1980s, 120 million acres -- or more than half of the original total of the country's wetlands -- had been filled, drained or converted to farmland. Wetland losses continue to this day in many parts of North America.

Early settlers considered wetlands to be “dismal swamps.” The Virginia Assembly in 1764 chartered the Dismal Swamp Company, authorizing a party that included George Washington, to drain over 40,000 acres of wetlands. The company’s purpose was to harvest the timber that was otherwise inaccessible.

Our early history is a litany of efforts to alter, dredge or otherwise “recapture” these swamps. Deep wetlands were considered useless for agriculture, habitat for “wild beasts,” and an impediment to the settlers’ grand, continental vision of progress.

Reflecting this belief, Congress in the mid-1800s passed the Swamp Wetlands Act, legislation that gave fifteen states 65 million acres of federal wetlands as “reclamation” to be used for “constructive” purposes. This law had one purpose: to encourage wholesale draining of vast wetlands. In a similar spirit, much of the wetlands that bordered major cities such as Baltimore, Boston, Chicago and New Orleans were either filled for building or lost to impacts from secondary alterations such as dams, river deepening or construction of levees that each, dramatically, altered sensitive ecosystems nearby.

Later under the aegis of “flood control,” the U.S. Army Corps of Engineers adopted a similar mission. Over the course of a hundred years, hundreds of thousands of acres of wetlands along major rivers such as the Missouri and Mississippi were isolated by earthen levees and converted to farmland and home sites. Similar “reclamation” occurred in numerous states as roads, railroads and a growing population spread west. Hundreds of miles of the Missouri River were straightened to ease river commerce, its banks armored by riprap and retaining walls. Consequently, natural floodplains that adjoined the rivers were lost, increasing the flooding impacts downstream from large storm events.

The march of progress was rapid. Progressing westward during the 19th century, in state by state, wetlands were converted to other uses. In some states, the impacts were greater than others. Wetland scientists estimate that over 90% of Iowa’s wetlands have been lost to agricultural conversions.

Much of the catastrophic damage to New Orleans by Hurricane Katrina in August of 2005 resulted the loss of marsh surrounding the city—marsh, which had historically protected it from storm surge. Federal officials now estimate that some 2,000 square miles of the Louisiana wetlands have disappeared since the 1930s due to development and the construction of levees and canals. Much of the marsh alteration was also a byproduct of earlier straightening and deepening of the Mississippi River by the Corps of Engineers. Thousands of years of sediment replacement from annual flooding of the freshwater marshes--a necessity for the particular biota in these systems—was abruptly ended when the river was “improved” for better navigation. The vast natural marshes rapidly died back.

From the smallest to the largest waterway, rivers everywhere were altered, dammed and narrowed; the increased energy was used to propel early turbines. Estuaries and swamps were turned into farms and early industrial complexes. By the nineteenth century, harnessed rivers had become the backbone of the industrial revolution.

After World War II, with increased momentum following the publication of Rachel Carson’s *Silent Spring*, biologists, conservationists and interdisciplinary scientists began to analyze the values and functions of wetlands. By the 1970s—following the confirmation that wetlands played a key role in pollution attenuation, stormwater mitigation and wildlife habitat—individual states began to enact laws to protect wetlands. In the late 1980s, in response to the 1977 Federal Clean Water Act (CWA), formerly known as the 1972 Federal Water Pollution Control Act, the Corps of Engineers itself abruptly reversed course. The agency, once one of the most efficient national organizations at “controlling” wetlands, became driven by a new environmental agenda.

In 1987 the Corps Environmental Laboratory in Vicksburg, Mississippi, issued a groundbreaking technical report entitled, *Corps of Engineers Wetlands Delineation Manual*. The *Manual* was the most comprehensive definition of wetlands published. Today the *Manual* continues to have a broad influence on state legislation, academic studies and federal wetland protection. (Note that in 2009, the Corps began issuing regional supplements to the *Manual.* Before using older copies of the *Manual*, a user should contact the Corp to obtain the latest, working version.)

Internationally, scientists today conduct research into the most arcane facets of wetlands, from precipitation influences on hydrophilic plants to hydrogeomorphic impacts on wetland communities. International wetland symposiums in places as diverse as Amsterdam, Hong Kong and Pretoria are held yearly. The study of wetlands has become a broad field around the world, with entire university programs now focused on the many facets of wetlands.


This wetland, in central Massachusetts, floods in late winter and spring, and becomes completely dry by late summer. By August many people viewing this location would never imagine that this site is a wetland.

So What Are Wetlands?

Most of us believe we know exactly what constitutes a wetland. The common sentiment is, "Where there is water there is a wetland." If your feet get wet, it's a safe bet that you are walking through a wetland. If you are standing beside a river or overlooking a lake, you are certain of yourself when you call these areas wetlands. The fallacy of beliefs like this is that many wetlands are not wet throughout the year, and appear to be upland areas at times.

Consequently, in the recent past these "common sense" get-your-feet-wet definitions led to constant disagreements. One farmer's wetland was another farmer's prime apple orchard. Court litigation over wetlands was no longer unusual. As the value of wetlands became increasingly apparent, scientists and regulators demanded a more thorough, and more consistently reliable definition. Botanists, hydrologists and soil scientists, working independently or in teams, studied fluctuations in ground water, soil saturation and the predilection of certain plants and animals to inhabit wetland areas. As studies began to proliferate, scientists tied together the effects of water saturation on elements as different as microbial activity and chemical change during anaerobic conditions. The common thread to all of these seemingly unrelated studies was water.

Aiding this search for a reliable definition, scientists by the mid-1970s adopted a multidisciplinary approach to wetland study. In 1979 the U.S. Fish and Wildlife Service (FWS) issued a report that sought to define and classify wetlands. The FWS *Classification of Wetlands and Deepwater Habitats of the United States* [Cowardin, et al.] was an influential precursor to the 1987 *Corps of Engineers Wetlands Delineation Manual.* Consequently, these documents, along with a growing body of academic papers, rapidly drove wetland understanding from a vague, arguable generalization to an internationally accepted scientific definition.

The 1987 Corps *Manual*—essentially, the regulatory bible of wetlands—defined wetlands as:

"... those areas that are inundated or saturated by surface or ground water at a frequency and duration sufficient to support, and under normal circumstances do support, a prevalence of vegetation typically adapted for life in saturated soil conditions. Wetlands generally include swamps, marshes, bogs and similar areas."

Another widely referenced definition is found in the *Field Guide to Nontidal Wetland Identification*:

"...wetlands lie along the natural soil wetness continuum between the better drained, rarely flooded uplands and the permanently flooded deep waters of lakes, rivers and coastal embayments." [Tiner, 1988]

A general theme runs through these and other wetland definitions. That is, all wetlands are characterized by three common components:

- *Hydrology,*
- *Hydrophilic (water adapted) vegetation, and*
- *Hydric soils (that is, soils modified in nature by constant saturation).*

An old Colonial-era weir release spring flows from a pond in New England.

Values And Functions of Wetlands

What wetland definitions do *not* do is define the values and functions of wetlands. An understanding of wetland functions, and the subsequent understanding of the value of wetlands to humans, plants and animals, is what has driven local, state and national laws to pass wetland protection laws over the last three decades. (However, federal laws such as the Clean Water Act have not stopped wetland alterations. The country is still experiencing losses. Statistically, the majority of losses are now the result of agricultural activities and residential expansion.)

The *functions* of wetlands are a scientific—versus societal—assessment of what happens within wetlands, that is, an analysis of wetland functions on a purely physical basis. These natural functions include activities as diverse as biochemical changes and morphological plant adaptation. An example of biochemical change occurs within hydric soils. Such wetland soils typically contain thousands of microbes per square foot. These microbes "process" carbons and other nutrients that filter through the soil from surface organic processes. Aerobic and anaerobic conditions in turn increase or decrease the level of microbial activity, altering the color and chemistry of soils. Consequently, the level of biochemical activity influences chemical transport in soils, as well as chemical transformations. These *functions* in turn allow us to analyze their *values* to society, key values such as pollution attenuation. [These topics are addressed in more detail in an advanced online wetland course by the same author.]

What are these *values* and how does contemporary society regard wetlands? Unlike America's early settlers, we now recognize that the values of wetlands are numerous. Broadly, wetlands:

1) mitigate flooding,
2) provide habitat for numerous animals,
3) protect private and public water supplies,
4) mitigate storm and flood damage,
5) prevent pollution,
6) recharge groundwater, and
7) protect fisheries and shellfish habitat.

In addition, wetlands often provide sanctuary for rare or endangered species, and provide educational, aesthetic and recreational opportunities, such as boating, hunting, fishing and other sports activities.

Types of Wetlands

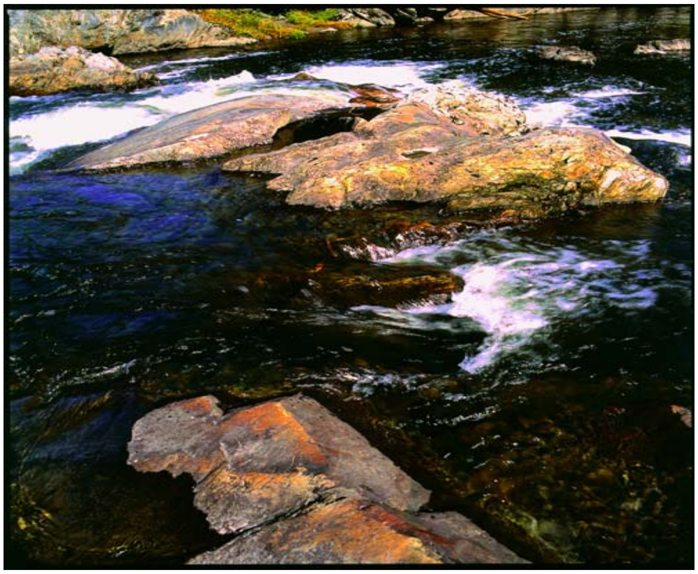
Although federal definitions of wetlands tend to compress wetland types into four categories—marshes, bogs, swamps "and similar areas"—scientists generally acknowledge that wetlands fall into two broad categories: marine wetlands and freshwater systems (otherwise called, coastal and inland wetlands). Wetlands associated with lakes, rivers and marshes (freshwater systems) account for ninety percent of the nation's remaining wetlands.

The varying types of wetlands are largely a byproduct of what is called a Wetland Water Budget—the total annual quantity of water available to a given wetland. By definition, every wetland system is saturated, or flooded, for a period of time. That period might vary between two weeks and ten months or more, depending on the type of wetland. This period of saturation is called a Wetland Hydroperiod. When the hydroperiod is short, wetlands tend to be marginal, and are often mistaken for uplands. When the hydroperiod is long, wetlands tend to be characterized by bogs, deep swamps and extensive riverine systems.

Generally recognized types of inland wetlands follow:

Rivers & Streams

Many inland wetlands lie along or beside rivers and streams. Although the magnitude of rivers varies from region to region, and from watershed to watershed, associated wetlands often form a rich ecosystem in these areas. Many riverine systems have extensive flood plains, while others snake through wide freshwater marshes that are frequently inundated from storm flows, snow melt and ground water fluctuations. Animals, both mammals and amphibians, often depend on these aquatic corridors, particularly during breeding cycles.


The upper Lamoille River in Vermont, a wild trout fishery.

Bogs

Bogs are primarily found in formerly glaciated portions of North America such as the Northeast, north-central states and Canada. Underlain with peat, often lacking mineral soils, bogs are characterized by constant saturation from high ground water, large open areas of water, knolls of evergreen trees and transitional lands dominated by low shrubs.

Lakes and Ponds

Known as lacustrine systems, lakes and ponds vary in size from “kettle holes” to vast bodies of water such as the Great Lakes. Although the deep waters of these areas are not classified as wetlands, the often shallow waters besides lakes and ponds harbor diverse communities of hydrophilic vegetation and water-dependent animals such as turtles, salamanders and freshwater shellfish.

Swamps and River Floodplains

Among the public, these areas are often the least understood wetlands. Commonly dry in summer, they may hold six feet of moving water for short periods during winter and spring floods. Although in late summer they may appear to be uplands, they often have ground water within two feet of the surface. Since for many months each year they appear to be “high and dry,” the majority of historic alteration has occurred in these wetlands. Hundreds of thousands of acres of these flood plain areas have been deforested and converted to agricultural lands. The same saturated conditions that allow hydrophilic vegetation to thrive have encouraged agricultural conversion. In their natural condition, hardwood trees, evergreens and wetland shrubs that thrive in sandy, alluvial soils, typically dominate swamps and flood plains.

Wet Meadows and Marshes

Unlike swamps and flood plains, marshes are characterized by wetland shrubs, and by soft-stemmed herbaceous plants such as cattails. Seasonal fluctuations in water are typical, with levels varying from six inches to six feet. In deeper marshes, vegetation may be characterized by floating aquatics such as water lilies. Regional variations in these wetlands may be great. Examples are as diverse as the Everglades in Florida, and prairie potholes in the upper Midwest. Wildlife habitat values are high, with these areas sheltering alligators and rare amphibians in the South, while providing rich duck habitat in New England and the Midwest. Many wet meadows are drier regimes, tending to appear to an inexperienced viewer as vast areas of grasslands.

Types of coastal wetlands:

Tidal Salt Marshes
The hydrology and chemistry of tidal salt marshes varies dramatically from inland marshes. Salt marshes are inundated on a regular tidal cycle by the ocean, and consequently saturated on an almost constant basis. They represent some of the most productive ecosystems worldwide, and are a product of soil salinity, nitrogen limitations, and the constant accretion and depletion of organic sediments washed into their coastal terraces from both the sea and adjoining inland areas.

Tidal Freshwater Marshes
These areas are unique ecosystems that combine features of salt marshes and inland marshes. They have increased diversity of plant types because of decreased salinity. Wildlife tends to use freshwater marshes more than salt marshes for similar reasons. Freshwater marshes are also nurseries for young fish and many species of birds. These previously vast transitional marshes have also been subject to large losses in past centuries, as expanding urban areas -- often lying close to many of these marshes—considered them convenient and inexpensive real estate for expansion.

Mangrove Wetlands
Mangroves exist in tropical and subtropical areas, and where found, largely displace tidal and freshwater marshes. In the continental United States, they are common only in Florida and Puerto Rico. The dominant plant is the mangrove, a large, woody, salt-tolerant shrub or tree, of which there are numerous species. Biodiversity is minimal, yet these wetlands play a key role in protecting adjoining uplands from unusual tides and from hurricane action.

Course Summary
Scientists, working internationally, have agreed on universally accepted definitions for various wetland communities. Although misunderstood in the past, wetlands -- because of their numerous values and function—are now commonly protected by federal, and often local and state, legislation. The federal 1977 Clean Water Act has driven this legislation.

There are many types of wetlands, defined primarily by whether they are found in coastal or inland regimes. Types of wetlands are further influenced by their hydroperiod. Wetlands provide numerous values for humans, including flood and stormwater mitigation, water supply and prevention of pollution.

[A highly recommended follow up course, by the same author, is called ADVANCED WETLANDS PRIMER: FIELD EVALUATION & PERMITTING CONSIDERATIONS FOR DESIGN PROFESSIONALS. The advanced course examines wetland delineation methods, survey methodology and strategies for avoiding regulatory liability during project design.]

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