PROTECTING AND RESTORING WETLANDS: A GUIDE FOR LAND TRUSTS

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PREFACE

This guide has been written to help land trusts protect and restore wetlands and related aquatic and riparian ecosystems. References are provided to land trust websites for readers who wish more detailed information. Chapter 1 provides examples of how land trusts are now protecting and restoring wetlands. Chapter 2 discusses wetland inventory and mapping in greater depth. Chapter 3 discusses wetland assessment. Chapter 3 considers wetland restoration. Chapter 4 addresses construction of trails and boardwalks. Chapter 5 discusses wetland festivals. Chapter 6 concludes with suggestions how federal, state, and local governments could encourage and help land trusts protect and restore wetlands.

The guide has been written as part of a two-year Association of State Wetland Managers, Inc. (ASWM) project to strengthen land trust and local government wetland protection and restoration programs.

BASIS FOR GUIDEBOOK

The guide draws upon a review of the wetland literature and websites (see bibliography). It draws upon interviews with land trust staff concerning local wetland protection and restoration efforts. It draws upon earlier question and answer guides by the author pertaining to the roles of land trusts in protecting and restoring wetlands. Finally, it draws upon a series of workshops concerning the roles of governments and land trusts.

ACKNOWLEDGEMENTS

This guide has been prepared as part of a grant to ASWM from the U.S. Environmental Protection Agency, Wetlands Division to examine the status and trends in state programs and to build the capacity of state, tribal, and local wetland programs. Special appreciation is extended the Wetlands Division staff for their support and assistance. Funding support has also been provided by the National Oceanic and Atmospheric Administration Coastal Services Center. This support is also gratefully acknowledged.

Much of the case study material in this guide has been derived from publications and the websites of the Land Trust Alliance. We greatly appreciate their assistance and strongly recommend their publications. Anyone wishing more information should contact them directly at Land Trust Alliance, 1331 H Street, NW, Suite 400, Washington, DC 20005, 202-638-4725, info@lta.org.

Thanks also goes to the many individuals who shared their perceptions on particular topics and provided review of the draft, especially Jeanne Christie of ASWM for her helpful comments, and Sharon Weaver for her editorial and document formatting assistance.

DISCLAIMER

The report was prepared with partial funding support from grant number X7-83266801-0 from the U.S. Environmental Protection Agency, Office of Wetlands, Oceans, and Watersheds, Wetlands Division. The opportunity to share our views on this subject is much appreciated. The ideas contained herein are the author's and should not be attributed to the U.S. Environmental Protection Agency or ASWM.

Cover Photo: Great Salt Lake Shorelands Preserve Visitor Center. The Nature Conservancy. See http://nature.org/wehrewework/northamerica/states/utah/misc/art10381.html.

All photos are from Internet websites listed by the photos unless otherwise indicated. We do not list usually list the photographer's name, only web address of the site. Please contact us, if there are any errors or if you do not wish a photo from the web to be included in this guide.

EXECUTIVE SUMMARY

In the last decade, the 1600 land trusts in the U.S. have played an increasingly important role in protecting wetlands, primarily through fee acquisition and conservation easements. They have also mapped, assessed, restored and managed wetlands. They have undertaken educational programs, constructed trails and boardwalks and restored wetlands. Land trusts are key to strong local wetland protection and restoration programs.

WHAT CAN LAND TRUSTS DO TO PROTECT AND RESTORE WETLANDS?

Options (which are explored in greater depth below) include:

- **Buy or otherwise acquire in fee wetlands.** Acquisition of open space and wildlife habitat is a principal goal of most land trusts. Wetlands and related ecosystems (e.g. riparian habitat) often constitute a major portion of remaining community open space and wildlife habitat.

- **Persuade landowners to adopt conservation easements for wetlands and related ecosystems; negotiate and accept such easements.** Acquisition of conservation easements for wetlands and other areas has also been an important role for land trusts.

- **Map or help map wetlands.** Some land trusts have prepared wetland maps to help them and landowners, local governments and others protect and restore wetlands.

- **Assess or help assess the biodiversity, habitat, and other functions and values of wetlands in a community or for specific areas.** Increasingly, land trusts are carrying out habitat and biodiversity surveys.

- **Prioritize potential wetland and related ecosystem restoration sites for fee acquisition, easements, intensive land management, other protection or restoration measures.** Many larger land trusts are prioritizing their own lands and other open space lands.

- **Actively manage wetlands.** Land trusts are increasingly managing their wetlands such as restoration of natural hydrology, creation of buffers, construction of boardwalks, and removal of exotic species.

- **Provide wetland interpretative programs.** These include wetland walks, programs for school children, and wetland festivals.

- **Help local governments undertake conservation planning.** These are often part of broader comprehensive land use planning or watershed planning efforts.

- **Educate and work with landowners.** Land trusts are educating landowners with regard to wetland functions and values, benefits of protection and restoration, management options techniques.

- **Comment on regulatory permits at federal (e.g., Section 404), state, and local levels.**

- **Persuade communities to adopt wetland protection regulations, draft such regulations, lobby for adoption.**

- **Buy, assemble, and hold land for other conservation entities until purchase is possible.**

- **Construct and operate visitor centers.**

- **Construct boardwalks and trails to make wetlands accessible to the public.**

- **Restore wetlands.**
- **Organize and manage mitigation banks and other mitigation projects.**
- **Orchestrate wetland protection and restoration projects by other governmental and nongovernmental entities.**
- **Monitor wetlands throughout a community, report violations.**
- **Carry out or assist wetland and related ecosystem research.**

HOW CAN FEDERAL AGENCIES, STATES, AND LOCAL GOVERNMENTS ENCOURAGE AND HELP LAND TRUSTS PROTECT AND RESTORE WETLANDS?

Options (which are explored in more detail below) include:

- **Provide continued and strengthened tax incentives** for wetland protection and other open space objectives at all levels of government. These include income tax, gift tax, estate tax, and real estate tax incentives. Tax incentives are the lifeblood of land trust open space protection efforts.
- **Provide detailed, accurate, and up-to-date wetland maps.**
- **Provide trusts with wetland practical and accurate wetland assessment models and training in the use of such models.**
- **Provide trusts with information suggesting location of endangered species, areas of special biodiversity, other features important in establishing protection and management priorities and plans for land trust lands and communities as a whole.**
- **Provide training programs** in mapping wetlands, assessment wetlands, managing wetlands, restoring wetlands, creating mitigation banks, other management.
- **Provide "how to" manuals** pertaining to boardwalk construction, control of exotics, other management topics.
- **Provide case studies** of wetland protection and restoration by land trusts regionally and nationally.
- **Conduct joint research with trusts in exotic weed control, use of fire, restoration, assessment techniques, use of GIS systems, other topics of interest.**
- **Help land trusts establish or manage mitigation banks.**
- **Provide land trusts with educational materials** suggesting how wetland protection and restoration will benefit landowners as well as society, wetland functions and values, other relevant topics.

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CHAPTER ONE: ABOUT TRUSTS

Land Trusts

Land Trusts[1] are local, regional, or statewide not-for-profit corporations organized by members of the public and landowners under the laws of particular states to work with landowners to protect open spaces--natural, recreational, agricultural, historic, archaeological, and cultural sites. There are approximately 1600 land trusts nationally (1537 in 2003) with over 800,000 members. A survey of land trusts in 2000 by the Land Trust Alliance indicated that wetlands were among the most common types of land protected by trusts (52% protected wetlands). See http://www.caledonia.org.uk/socialland/land_trusts.htm.

The Sonoran Institute land trust website describes the functions of land trusts. See http://www.sonoran.org/resources/terms/si_glossary_trusts.html:

> Land trusts serve many functions in a community. They provide information on private, voluntary action landowners can take to protect their land while meeting their financial needs. Land trusts often perform natural and cultural resource inventories of individual properties. In addition, they may accept donations of land or conservation easements, typically holding the land 'in perpetuity'. Larger land trusts may broker purchases on behalf of differing interests, such as buying and then selling private land to a city or county for a local park, pooling funds from public and private entities for land purchases, or ensuring that private property is purchased by a conservation-oriented buyer.
>
> A local land trust provides an effective partner when protecting significant community resources. Although not a substitute for local land-use planning and regulation, land trusts can provide the leadership, commitment, and flexibility that are essential to effective community stewardship.

Land trusts have been formed in every state. As of the end of 2003, local and regional land trusts had protected 9,361,600-acres of natural areas. National land trusts have protected an additional 25 million acres. Land trust members are often motivated and influential members of a community. They are in a position not only to lobby for government funds for acquisition of wetlands and related ecosystems but to persuade their neighbors and other members of the community to protect and restore wetlands. They can map and assess wetlands, prepare community land and water plans, and encourage adoption of regulations and other protective measures.

Photo: Jeanne Christie, ASWM

Because they rely upon persuasion and landowner tax incentives, land trusts often avoid the negative connotations associated with zoning and other regulatory approaches to land use.

Some lands trusts like the Wetland Conservancy in Oregon operate statewide. Others are more regional like the Compact of Cape Cod Conservation Trusts, Inc. See http://www.compact.cape.com/. Still others focus upon specific landscape features. For example, the Katy Prairie Conservancy in Texas is a land trust formed to help preserve a broad sweep of wetlands and uplands west and northwest from Houston.

[1] A land trust is a "nonprofit organization that, as all or part of its mission, actively works to conserve land by undertaking or assisting in land or conservation easement acquisition, or by its stewardship or such land or easements." This definition has been taken from the Land Trust Alliance. See http://www.lta.org/aboutlt/census.shtml.

The primary role of most land trusts is to purchase or otherwise acquire and protect open space lands. They are experts in working with landowners to help them protect their lands. Land trusts also acquire easements. Many local land trusts are playing an increasingly important role as advocates and educators at the local level to assist community land and water planning efforts. See more detailed discussion of their roles below.

How Are Land Trusts Formed?

Typical steps in forming a land trust include:

- Organize a group of interested individuals who will serve as a board of directors and (usually) unpaid staff.
- Incorporate as a not-for-profit corporation in the state. Usually incorporation forms can be obtained from the Department of Corporations or Department of State. This may often be done at minimal cost with the help of a local lawyer (donated help is common).
- Apply for 501(c)(3) status with the IRS (the IRS requires a $500 fee).
- Operate the trust with a board of directors and volunteers or a combination of volunteers and paid staff.

Land Trusts and Wetlands

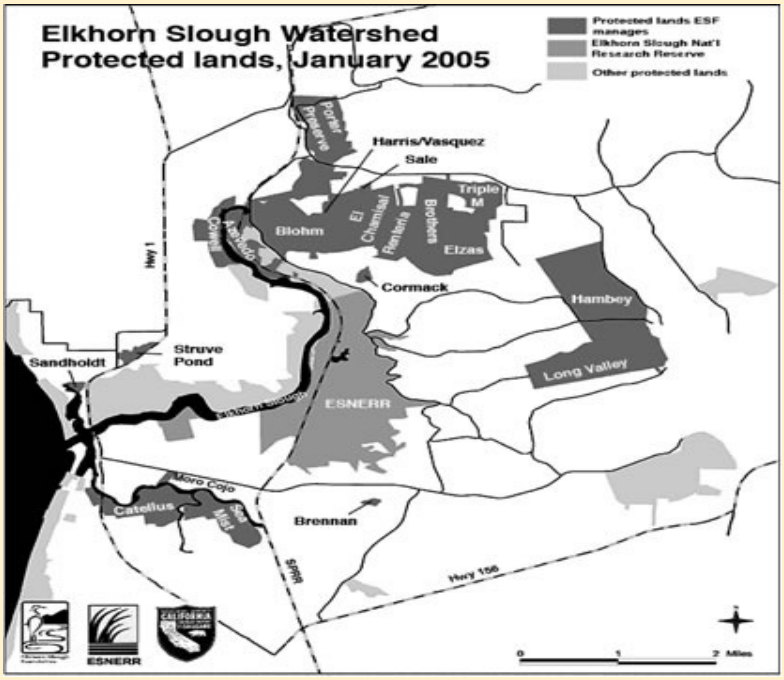
Some land trusts, like the Wetlands Conservancy in Oregon, have been formed primarily to protect wetlands. Other examples of land trusts focusing primarily upon wetlands include:

- The Bolsa Chica Land Trust, California (http://www.bolsachicalandtrust.org/). This land trust is devoted to the protection of Bolsa Chica wetlands in southern California.

- Ballona Wetlands Land Trust, California (www.ballona.org/position.html). This land trust was formed to protect the Ballona Wetlands, also in southern California.

- Huntington Beach Wetlands Conservancy, California (http://www.hbwc.org/). This land trust is dedicated to the protection of California's Huntington Beach wetlands.

- Wetland Habitat Alliance of Texas, Texas (http://www.whatduck.org/homepage.htm). This is a nonprofit organization dedicated to the preservation, enhancement, restoration and creation of wetland habitat in Texas.



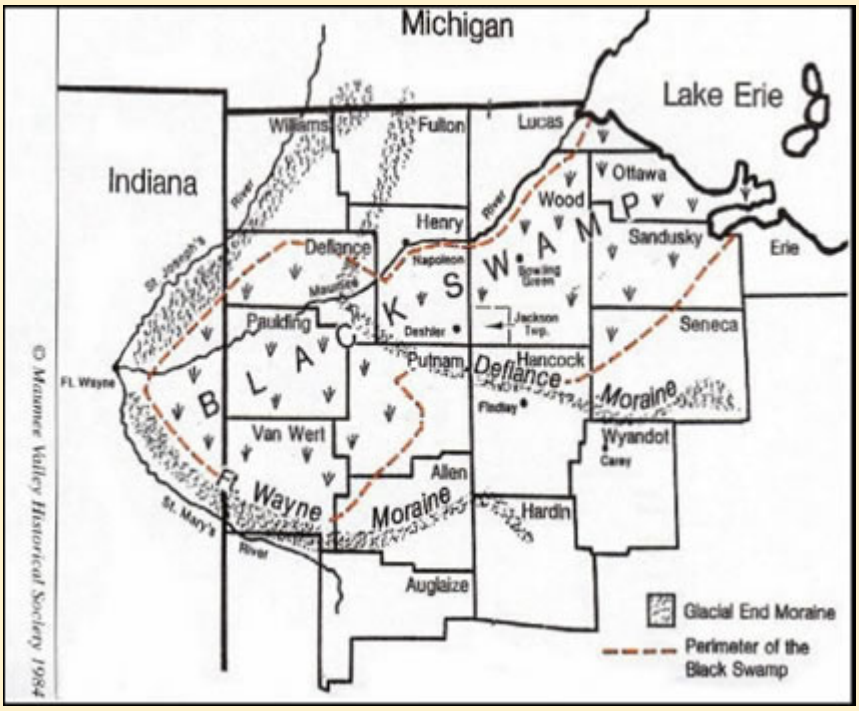
Protected areas, Elkhorn Slough, California
Photo: http://www.elkhornslough.org/protectedMap.htm

- Big Thicket Natural Heritage Trust, Texas (http://www.btatx.org). This Texas Land Trust has been formed to protect and preserve the land, water, scenic beauty, plants, wildlife, biodiversity and natural and historic communities of the Big Thicket swamp.

- Elkorn Slough Foundation, California (http://www.elkhornslough.org/). The Elkhorn Slough Foundation is a not for profit organization dedicated to the conservation and restoration of Elkhorn Slough and its watershed. It works in partnership with a broad range of organizations.

- Limberlost Swamp Remembered, Indiana (http://our.tentativetimes.net/gspnews/swamper1.html). This a land trust in Indiana formed to restore the famous "Limberlost" Swamp described by Jean Statton Porter in her novels.

- Black Swamp Conservancy, Ohio (http://www.blackswamp.org/). The mission of this land trust is to protect natural and agricultural lands. Protection of the remnants of Black Swamp, at one time a massive wetland, is a goal.



Former extent of Black Swamp in Northwestern Ohio
Photo: http://www.blackswamp.org/BSC_Swamp.html

- Great Swamp Conservancy (http://gscincny.tripod.com/index.html). The goal of this land trust is to foster environmental education, preserve biological diversity and conserve and manage natural resources in the Oneida Lake and Lake Ontario Watersheds with a focus on 36,000 acres on the south eastern shore of Oneida Lake, New York. This area is home to what the Iroquois called Great Swamp. The Conservancy hopes to return a portion of the wetlands to their original state through partnerships with landowners, local, federal, and state governments, tribes and non-profits.

Many other land trusts have been formed to protect rivers and adjacent lands such as the Battenkill Conservancy (Vermont), Scenic Hudson (New York), McKenzie River Trust (Oregon), Brandywine Conservancy (Pennsylvania), and the Land Trust for the Little Tennessee (North Carolina). Others have been formed to protect ecosystems with large wetland components. See, for example, Katy Prairie Conservancy http://www.katyprairie.org/home.html which is attempting to protect many wetlands as part of a prairie ecosystem near Houston.

Protection of wetlands is often one of the priorities of other land trusts. For example, in 1999 the Little Traverse Conservancy in Michigan purchased a 135-acre Mud Lake Bog. The bog is a peatland which formed in a glacial kettle hole. The bog is prime habitat for woodcock, ruffed grouse, mink and raptors. The Conservancy plans to retain the title to the property and to maintain an existing boardwalk at the southern end for educational purposes. The Conservancy will allow public access for activities such as bird watching, walking, cross-country skiing and photography.

Often rare and "vulnerable" wetlands are a protection priority for land trusts. See Appendix A. Some examples vulnerable wetland types protected by land trusts include the following (see photos below):

Some statewide land trusts also play major wetland protection roles like the Massachusetts Audubon Society which maintains Wellfleet Bay Wildlife Sanctuary on Cape Cod and has undertaken a broad range of wetland protection and education efforts over a period of years. Much of the 1,000-acre Wellfleet Bay preserve is coastal and estuarine wetland. The Sanctuary has constructed a beautiful Nature Center, many trails, and a wetland boardwalk at the site. It provides extensive educational programs.

A number of national environmental land trusts/environmental organizations also acquire and protect wetlands at the regional and local levels. Examples include:

- The Nature Conservancy (http://nature.org/). The Conservancy was founded in 1951. It is dedicated to protecting the diversity of life on earth. Since then it has worked to help protect more than 117 million acres of land and 5,000 miles of river around the world. It is the largest international nonprofit environmental organization with about 1 million members and supporters and more than 1,500 volunteers. It has 3,200 employees. It bases its acquisition and management priorities upon a science-based plan. It has acquired and protects and manages hundreds of wetlands throughout the nation. It also conducts research on these properties.

Great Swamp Conservancy Nature Center, New York
Photo: http://gscincny.tripod.com/index.html

The Placer County Land Trust is protecting vulnerable vernal pools in Placer County, California
http://www.lta.org/regionallta/s_pacific.htm

The Genesee Land Trust manages Hipp Brook Preserve in Rochester, New York a hydrologically sensitive swamp, as a nature preserve. http://www.geneseelandtrust.org/p-hipp_brook.html

- National Audubon Society (http://www.audubon.org/). The Audubon Society has over 500 local chapters. Local chapters have undertaken wetland protection efforts for over 400,000-acres including the preparation of many sanctuaries. The Society focuses primarily upon protection of bird habitat. It has undertaken a variety of wetland protection initiatives including wetland campaigns, the preparation of educational and guidance materials, and the publication of wetland newsletters.

- Ducks Unlimited (http://www.ducks.org/). Ducks Unlimited (DU) conserves, restores, and manages wetlands and associated habitats for North America's waterfowl. These habitats also benefit other wildlife and people. Since its inception in 1937 DU has conserved more than 9.4 million acres of waterfowl habitat in North America. DU supporters have raised more than $1.6 billion since l937. Ducks Unlimited has helped landowners restore tens of thousands of acres across the nation. It has more than 700,000 members. Its 2005 goal was to conserve 177,000-acres and it exceeded this goal by conserving more than 220,000-acres. It also conducts research focusing on issues pertaining to design and effectiveness of wetland and waterfowl conservation programs, primarily through the Institute for Wetland and Waterfowl Research.

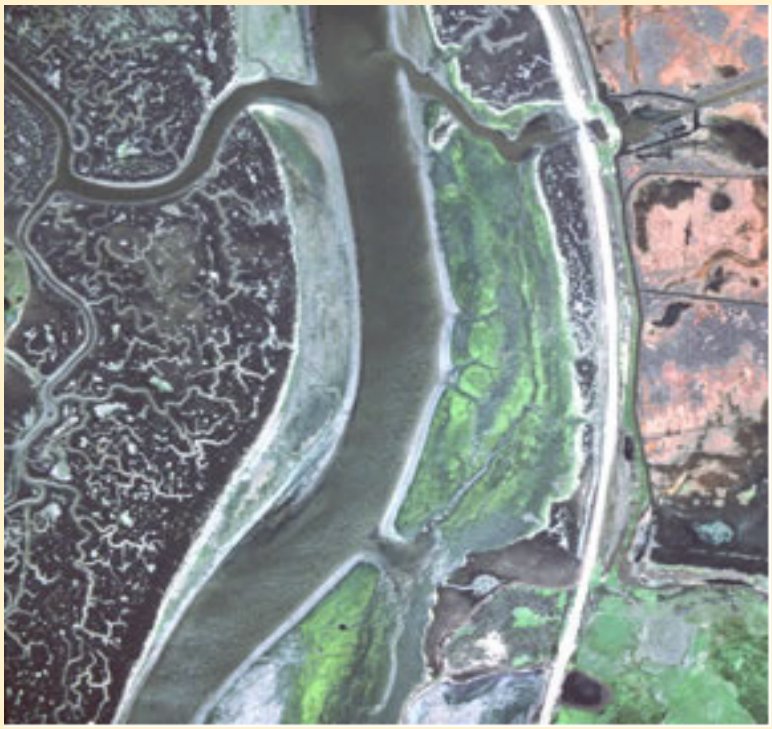
- The Trust for Public Lands (http://www.tpl.org/). The Trust for Public Lands (TLP) is a national nonprofit land conservation organization formed in l972. It conserves lands for people to enjoy as parks, gardens, and natural areas and to ensure livable communities. TPL has worked with landowners, communities and government agencies to complete more than 3,000 land conservation projects in 47 states, protecting more than 2 million acres. It has helped states craft and pass almost 300 ballot measures, generating over $19 billion in conservation-related funding. TPL has acquired many wetlands and has led efforts to protect others such as the Okeefenokee Swamp, the Ballona wetlands (California), Auroa wetlands (Ohio), and Chisago wetlands (Minnesota). It also conducts research concerning conservation issues and conservation practices.

- The Conservation Fund (http://www.conservationfund.org/). The Conservation Fund (Fund)) is a national nonprofit land conservation organization. Since 1985 the Conservation Fund and its partners have protected more than 5 million acres including many wetlands. The Fund has dual goals of promoting economic development and environmental protection.

The Land Trust for the Little Tennessee in Macon County, North Carolina has purchased large amounts of vulnerable floodplain. It purchased a 21-acre parcel at Coweeta Bottoms shown here in 2003 to protect one half mile of wetland and river frontage. http://www.ltlt.org/properties.html

The Lowcountry Open Land Trust in Charleston, South Carolina protects 85 properties covering 10,564 acres of natural, scenic and rural land including many wetlands. http://www.lolt.org/protected_detail.asp?AreaID=3

- Land Trust Alliance (http://www.lta.org/). The Land Trust Alliance (formed in 1982) is a national membership organization with over 1,227 local, regional, and national land trust members. While not a land trust itself, it serves as an umbrella for land trusts across the nation. The Alliance provides a broad range of training services. In 1990 the Alliance organized, with the Hastings College of Law in San Francisco, the Land Conservation Law Institute to provide legal advice to land trusts. It publishes a quarterly newsletter, Exchange, and also holds an annual national Land Trust Rally every year. The Rally typically includes sessions on wetlands. Land Trust Alliance, 1331 H Street, NW, Suite 400, Washington, DC 20005, 202-638-4725, info@lta.org



The Elkhorn Slough Foundation working with a broad range of organizations has done much to protect and restore vulnerable estuarine and coastal wetlands in Elkhorn Slough, California. Photo: www.elkhornslough.org/research/GIS.HTM

CHAPTER TWO: OVERVIEW OF PROTECTION AND RESTORATION TECHNIQUES

Why Protect and Restore Wetlands?

Photo: Jeanne Christie, ASWM

Protection of wetlands is a common land trust goal because:

- Wetlands often constitute an important portion of community undeveloped open spaces.
- Wetlands are havens for biodiversity—a principal concern of many land trusts.
- Wetlands are principal bird watching areas. Many land trust members are bird watchers.
- Wetlands are of great interest to students and teachers. Land trusts often wish to provide educational and research opportunities.
- Wetlands are some of the most seriously threatened areas in a community and in need of protection.
- Because of federal, state, and local wetland regulations, many landowners are willing to donate rather than develop their lands.

Land trust open space inventories often reveal that wetlands are priority acquisition areas. For example, The Compact of Cape Cod Conservation Trusts, Inc. has undertaken a comprehensive wildlife habitat mapping and assessment project for Cape Cod. This inventory indicates that wetlands are prime open space including 20,000 acres of salt marsh, shrub swamp, forested swamp, bog, and fresh marsh.

Techniques

Land trusts are using a wide variety of techniques to help protect and restore wetlands:

- Acquire wetlands in fee by donation from landowners and protect and manage these lands. This is the most common and important role for land trusts.
- Acquire conservation easements from landowners. This is also an important role for many land trusts.
- Inventory and map wetlands along with other habitat types. Examples include wildlife inventory carried out by Cape Cod Conservation Trust described above.
- Identify priority acquisition sites.
- Identify priority restoration sites.
- Restore wetlands.
- Construct and operate boardwalks, trails and interpretative facilities. Examples include Corkscrew Swamp in Florida (National Audubon Society), and Wellfleet Bay Sanctuary (Massachusetts Audubon Society).
- Provide wetland educational programs. Examples include the Georgia Conservancy, Corkscrew Swamp, and Wellfleet Bay Sanctuary.
- Conduct wetland fests, bird festivals. An example is the Horicon Marsh Bird Festival.
- Help landowners restore wetlands. Ducks Unlimited has helped landowners with hundreds of projects.
- Help landowners and government entities monitor and control invasive species.
- Take leadership roles in promoting local wetland protection plans, regulations, and acquisition. Examples include the Oregon Wetland Conservancy and the Tipp of the Mitt Watershed Council.

These and other roles will be now considered more specifically:

Acquire Fee

A principal wetland role of land trusts continues to be acquisition and protection of specific wetlands in fee. Land trusts use a variety of techniques to persuade landowners to donate lands or conservation easements to the trust or a governmental unit. A trust may:

- Offer the landowner **income tax** incentives spread out over five years for donation of lands or conservation easements to the trust. Land trusts often persuade landowners to donate their wetlands in fee or conservation easements to the land trusts by showing them how they can benefit from income and estate tax incentives. Donated lands and conservation easements meeting Internal Revenue Code section 170(h) criteria are charitable gifts, Donation of an or fee easement to qualified land trust or governmental unit generally provides federal and state income tax benefits equal to the reduction in fair market value caused by granting of the easement or fee interest. There are limits to how much may be taken as a deduction each year but deductions may be spread over a period of years.

- Offer the landowner **estate tax** incentives for donation of fee interests or easements to the trust. To the extent that the remaining lands (in the case of donation of fee interest) or the restricted value (easement) is lower than fair market value, the estate will be subject to a lower tax. The Taxpayer Relief Act of 1997 provides an additional incentive for landowners to grant conservation easements. Executors of estates can exclude 40 percent of the value of land subject to donation of qualified easement from the taxable estate. This exclusion is phased in over a five-year period. In 1998, landowners could exclude up to $100,000 under this provision. The amount increased to a maximum of $500,000 in 2002. The full benefits of the law are available for easements that reduce the fair market value of property by at least 30 percent. Smaller deductions are available for easements that reduce property value by less than 30 percent.

Restored wetlands protected by easement in Camden County, Georgia http://www.galandtrust.org/Coastal_Programs.htm

- **Buy** wetlands in fee or conservation easements **through "bargain sales**". A bargain sale is a sale at less than fair market value. The difference between the fair market value and the sale value is considered a donation to the land trust and may be subtracted from adjusted gross income. Donors can deduct an amount up to 30 percent of their adjusted gross income of the year of the gift when they sell to a land trust at less than appraised market value. Donations in excess of fair market value can be applied to federal taxes for the next five years, subject to some restrictions. Many state income tax laws provide similar benefits.

Acquire Conservation Easements

Many land trusts acquire, by donation, bequest, or purchase, conservation easements for wetlands. For example, the Delta Land Trust (http://www.deltalandtrust.org/wetlands_restoration.html) Partners in Perpetuity Program established in 1990 has accepted 53 conservation easements covering over 18,000 acres.

A conservation easement is a voluntary legal agreement permanently restricting the use of land between a landowner and qualified land trust or governmental entity. The landowner retains ownership and restricted use of the property. A wetland conservation easement typically prohibits all filling or drainage of the wetland although certain other activities such as limited timber harvest may be permitted. The easement may apply to all or only a portion of a property.

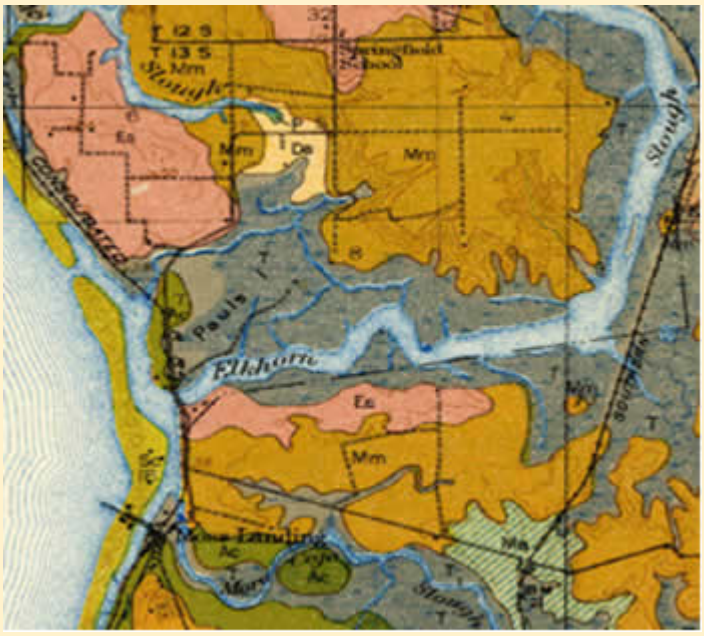
Some of the factors considered by land trusts in deciding whether to acquire a conservation easement include (see http://www.stormwatercenter.net/Assorted%20Fact%20Sheets/ Tool2_Conservation/ ConservationEasements.htm):

- Natural resource value - Does the property provide a critical habitat or important environmental aspects worth preserving?
- Uniqueness of the property – Does the property have unique traits worth preserving?
- Size of land - Is the land large enough to have a natural resource or conservation value?
- Financial considerations - Are funds available to meet all financial obligations?
- Perpetuity - Is the conservation agreement a perpetual one?
- Land trusts mission - Does the property align with the land trust's mission and organization specific criteria?

A qualified not-for-profit, tax-exempt conservation organization or a federal, state, or local government holds the easement. The precise nature of the restrictions in the conservation easement is worked out between the holder of the easement and the landowner. Typically the easement does not grant the public access to the land. The landowner can use, bequeath, or sell the land subject to the easement. The restrictions on use of the land transfer to the new owner.

A land trust may also be able to persuade a landowner to donate a conservation easement to the trust or a government entity because this will also lower real estate taxation of lands. Real estate taxes are based upon fair market value and a conservation easement generally lowers fair market value. A few states directly order local assessors to reduce taxes. For example, Minnesota Statutes 2000, 273.11 (Subd. 11—Valuation of restored or preserved wetland) provides that "(w)etlands restored by the federal, state, or local government, or by a nonprofit organization, or preserved under the terms of a temporary or perpetual easement by the federal or state government, must be valued by assessors at the wetland value." "Wetland value" is defined to "not reflect potential uses" which would violate the terms of the easement.

A land trust may also be able to persuade landowners to enroll in other open space real estate taxation programs offered by states even where the landowner does not donate a conservation easement for a property. However, such programs often offer only temporary relief for open space activities. A landowner deciding to withdraw lands from the program needs to pay all or a portion of the reduced taxes.



Historical map of Elkorn Slough, California
www.elkhornslough.org/research/GIS.HTM

Prepare or Acquire Wetland Maps, GIS Data Bases

Many land trusts are mapping wetlands and developing databases including establishment of GIS systems to help them identify open space acquisition and management priorities in a community. For example, the Elkhorn Slough Foundation is cooperating with the Elkhorn Slough National Estuarine Research Reserve to create an extensive time-series of wetland maps and digital images for the Slough including a library of digital aerial imagery from the 1930's through the present. See www.elkhornslough.org/research/ GIS.HTM

To begin their wetland mapping efforts, land trusts typically start with National Wetland Inventory (NWI) maps from the U.S. Fish and Wildlife Service. Wetland maps may also be acquired from state wetland agencies or local zoning boards. Land Trusts often find that they need more accurate maps and additional information pertaining to specific issues such as endangered plants and animals. Some land trusts carry out their own wetlands inventories. If so, they usually utilize a combination of the use of existing wetland maps, air photos, and field surveys. For example, The Compact of Cape Cod Conservation Trusts has established a Geographic Information System based wildlife habitat mapping and assessment project for all Cape lands. Of the 31 wildlife habitat types mapped in the inventory, 21 are wetlands. Areas are being ranked to help other land trusts, local governments, and others acquire and protect these areas (http://www.compact.cape.com/).

Some other examples of the land trusts with mapping and GIS efforts include:

- Sonoma Land Trust. Founded in 1976, the Trust has protected more than 10,000-acres of baylands, wetlands, redwoods, oak chaparral, agricultural lands and other lands in Sonoma County, California. The Land Trust conducted a Sonoma Land Trust Coastal Area Parcel study using GIS which was focused on determining the feasibility of acquiring lands. See http://www.sonomalandtrust.org/.
- Land Trust of Santa Cruz County. This land trust has been building a GIS since 1997. The program began with ArcView GIS software. The GIS is designed to help the trust select land protection projects through GIS analysis. See http://www.esri.com/news/arcnews/summer99articles/20-landtrusts.html.
- The Southeast Alaska Land Trust has undertaken GIS mapping for the Mendenhall Wetland State Game Refuge. See http://www.seawead.org/flotsam/accretion.pdf.

Many of the GIS and mapping efforts have been part of broader mapping or GIS programs and not simply confined to wetlands. For example, the Vermont Land Trust and Vermont River Conservancy assisted Berlin, Vermont in preparing a natural community map for the 661-acre watershed of Berlin Pond. See http://www.berlinvt.org/Summary.htm.

Assess Wetlands

A number of land trusts and related watershed councils have developed or helped develop wetland assessment methods to evaluate biodiversity, habitat, and other functions and values of wetlands to the community. For example, the Clinton River Watershed Council in Michigan has developed wetland assessment protocols which include a five basic step Rapid Assessment Method. The steps include (see website below for more detail):

- Locate wetlands.
- Determine which wetland functions you want to assess.
- Record wetland characteristics using Rapid Assessment Method (RAM) data sheets.
- Assess the degree to which each wetland performs each function.
- Create a wetland protection plan.

The Council works with local land trusts and local governments to acquire and manage lands. See, for example, "Wetland Stewardship for Local Governments" a Council publication, which is available on the web at http://www.crwc.org/programs/watershedmgmt/scwetlands/scwofficials.html.

Many land trusts carry out site-specific assessments of wetlands. For example, the Columbia Land Trust is protecting and restoring through acquisition and easements a variety of wetlands. It states on its website http://www.columbialandtrust.org/stewardship.htm:

> "Columbia Land Trust evaluates every property for its conservation value, as well as the threats to these values. A stewardship plan is developed and implemented based on this analysis to include detailed annual monitoring. The stewardship program, therefore, requires a high level of intimacy with the land.
>
> Stewardship of the land will mean finding out what hidden assets exist. By getting our noses in the rocks, our hands in the streams and our eyes to the trees we will discover a lot about our conserved lands. And perhaps, we will discover something about ourselves as well."

Prioritize Acquisition, Restoration, Management

Many land trusts are prioritizing their acquisition, restoration and management efforts. Examples include the Columbia Land Trust (see above) and the Wetlands Conservancy in Oregon, which is preparing a Greatest Wetlands Statewide Conservation Plan. See http://www.wetlandsconservancy.org/oregons_greatest.html. The Nature Conservancy utilizes a rigorous science-based ecosystem approach to target potential acquisition sites including but not limited to wetlands. See http://www.nature.org/tncscience/. Its approach is called Conservation by Design. The Conservancy describes this approach on its website at http://www.nature.org/tncscience/strategies/:

> Under Conservation by Design**,** the Conservancy identifies a portfolio of high priority sites in each ecoregion—places that collectively capture the biological diversity of the region. The Conservancy then develops customized conservation strategies to manage these portfolios to ensure the long-term survival of their native life and natural communities—not just those that are threatened. Taken together, these portfolios represent a Conservation Blueprint—a detailed picture of the places that must be protected and their corresponding strategies—that represents a benchmark against which the Conservancy can measure its success.

Actively Manage Wetlands Owned by a Trust

In some instances, little management is needed for wetlands acquired by land trusts. Natural wetlands are self-sustaining systems. For example, "healing" often quickly occurs after a flood or hurricane although trees may be toppled and leaves blown off.

However, minimal levels of active management such as picking up litter is needed for sites open to the public. The management needs, of course, depend upon the specifics of the situation, threats and stresses, and the desires of the land trust. But common additional activities carried out by land trusts may include:

- Restoration or enhancement of the wetland if degraded,
- Control of exotic or nuisance plant and animal species,
- Design, construction, and maintenance of trails and boardwalks.
- Construction of bird nesting platforms and birdhouses, and
- Active wetland management, in some instances, such as controlled burns.

For example, the Branford, Connecticut Land Trust on its website states its land management policy:

> The general property management policy of the Branford Land Trust is to leave land in its natural state, allowing natural processes to take place undisturbed. However, intervention may be allowed to encourage natural diversity, to prevent degradation of natural systems, or to allow for appropriate human use.

The Columbia Land Trust is Assessing and Protecting Lands Along Willapa Bay, Washington. http://www.columbialandtrust.org/projects/coast.htm

The Branford Trust has undertaken a variety of land management measures to enhance the value of selected properties such as erection of osprey nesting platforms. See http://www.branfordlandtrust.org/animalhab.html. The trust also utilizes a system of volunteer land stewards to help manage individual properties. The stewards must visit there agreed upon property at least twice a year. Responsibilities of the stewards include (see http://www.branfordlandtrust.org/propman.html):

- Identifying inappropriate use. This could include activities such as camping, vandalism, dumping, building, setting fires, hunting and motorized vehicles.
- Identifying encroachment problems such as neighbors, horses or stray animals, boundaries or malicious trespass issues such as cutting wood or stealing stones from walls. Watching for safety hazards or hazardous materials.
- Assessing actual property use and visitation to the extent possible. Determining additional needs such as signs, boundary or other markers and access issues.
- Biological and ecological monitoring. The Tract Steward should, to the best of their ability, monitor the parcel for maintenance in its natural state or according to the donor's wishes stated in the deed. Checking for erosion, siltation, over-browsing, non-native or invasive species. Identifying, if possible, any rare or threatened plants, birds or animals.
- Providing tract and trail maintenance if the property has a trail. Take out litter. Checking status of trails with regard to erosion and keep paths clear for hiking. Checking trail markers. Determining if there are maintenance issues that would require a scheduled work party.
- In addition, Work Parties are scheduled to accomplish property management goals where larger efforts are needed.

Branford Land Trust, Branford, Connecticut, Educational Activities. Photo: Bob Perron, Branford land Trust http://www.branfordlandtrust.org/learn.html

Many land trusts have established exotic plant control initiatives such as the Coastal Mountains Land Trust (Maine) which has established a "Weed Team". See http://www.coastalmountains.org/htm/volunteers.htm. See also the invasive plant article on the website of the Greater Worcester (Massachusetts) Land Trust at http://www.cyberonic.com/~gwlt/invasive.html. See the Branford Land Trust listing of invasive plants and animals at http://www.branfordlandtrust.org/naturalresources/appendix3.html. The Center for Natural Lands Management is a nonprofit tax-exempt organization in California organized, in part, "to own and/or manage lands in an ecologically beneficial manner consistent with federal and state environmental laws". It emphasis is upon "long term responsibility for managing environmentally sensitive lands. Without this commitment, mitigation lands often become degraded through inappropriate uses and the invasion of exotic species." See http://www.cnlm.org/cms/index.php?option=com_content&task=view&id=92&Itemid=79.

Work With Children

Many land trusts with wetlands have established wetland educational programs for primary and secondary school children. See, for example, the Natural Lands Trust at http://www.natlands.org/categories/category.asp?fldCategoryId=3.

Help Local Governments Undertake Conservation Planning

Increasingly land trusts are assisting local governments to undertake conservation planning. For example, the Triangle Land Conservancy in North Carolina has conducted conservation assessments for five significant landscapes—Deep-Cape Fear River, Neuse River Lowlands, Neuse River—Mark's creek, Richland Creek, and Lower Swift Creek. Triangle Land Conservancy Staff have also played critical roles in the creation of local government-sponsored conservation plans for New Hope Creek and Little River. See http://www.tlc-nc.org/planning.shtml.

The Louisville/Jefferson County Environmental Trust, formed in 1997, works closely with Metro Louisville. It promotes voluntary methods of land preservation, coordinates Louisville Metro agencies that manage natural areas, advises the Metro Council on land conservation and educates the community about the

need to protect natural areas and agricultural lands. It holds easements on 10 privately owned properties and has preservation agreements on wetlands. Trust staff is located in the Metro Planning and Design department. See http://www.louisvilleky.gov/PlanningDesign/Environmental+Trust/.

The Wetlands Conservancy in Oregon has underway a project to identify, map and gather information on Oregon's most valuable wetlands. The Conservancy has established a project website. The Conservancy is also convening interested groups and parties in different areas of the state to develop and implement strategies to conserve valuable wetlands. See http://www.wetlandsconservancy.org/oregons_greatest.html.

Educate and Assist Property Owners

Land trusts are using a variety of techniques to persuade landowners to protect their lands. A trust may:

- **Provide outdoor education for** landowners with regard to functions and values of wetlands.
- **Provide plaques** and other types of community recognition for landowner conservation efforts.
- Help landowners **find funding** from federal and state agencies, other sources to protect or restore wetlands.

For example, the Branford, Connecticut Land Trust undertakes a broad range of community outreach and public education activities such as a spring lecture series, annual hikes, the Branfrod Festival, educational activities in the Branford school system, maintenance of an environmental library, and publication of a quarterly newsletter.

Comment on Regulatory Permits at Federal (e.g., Section 404), State, and Local Levels

Some local land trusts such as the Galveston Bay Foundation conduct wetland permit reviews. (See www.galvbay.org/3-0.cfm.) Its activities are focused on the Galveston Bay watershed. Other activities of this foundation include advocacy, education, conservation, and research.

Persuade Communities to Adopt Wetland Protection Plans and Regulations; Draft Such Regulations; Lobby for Adoption

A remnant o Black Swamp in Ohio purchased for inclusion in a future park.
Black Swamp Conservancy, Ohio. Photo: Black Swamp Conservancy
http://www.blackswamp.org/news/Blade%20article%2010-06-2003.htm

Land trust members can help draft and propose wetland ordinances to local governments or work with local government staff to draft such regulations. Members can then lobby local legislators and the public to adopt the regulations. Members can help administer regulations by providing comments and testimony on permit applications. They can help enforce the regulations by monitoring the wetlands and reporting violations.

Buy and Hold Land for Other Conservation Entities

Many land trusts purchase land when it is available for later transfer to governmental entities or not-for-profits. For example, the Black Swamp Conservancy in Ohio purchased 80-acres in Paulding County for $330,000 with the goal for transferring it to the Pauling County Park District which was in the process of being formed.

Construct and Operate Visitor Centers

An increasing number of land trusts are constructing ad operating visitor centers. Some of these like the Jackson Bottom Wetlands Preserve in Oregon focus on wetlands. See photos.

Make Wetlands Accessible to the Public—Boardwalks, Trails

Increasingly, land trusts are also constructing wetland trails and boardwalks. For example, the Massachusetts Audubon Society has established boardwalks and trails at several of their sanctuaries. These include the boardwalk at the Stony Brook Wildlife Sanctuary, which follows the edge of Teal Marsh. Another boardwalk enters the salt marsh at the Wellfleet Sanctuary. See http://www.massaudubon.org/Nature_Connection/Sanctuaries/Stony_Brook/index.php.

The Nature Conservancy has constructed a boardwalk and visitor center at the heart of the 4,000-acre Great Salt Lake Shorelands Preserve. The visitor's center has more than 34 educational exhibits.

Jackson Bottom Wetlands Education Center, Oregon. Photos: Jackson Bottom Wetlands Education Center, http://www.jacksonbottom.org/educationcenter.htm

Boardwalk at Stony Brook |Wildlife Sanctuary, Massachusetts. Photo: http://www.massaudubon.org/Nature_Connection/Sanctuaries/Stony_Brook/index.php

Weather Monitoring at Jackson Bottom Wetlands Preserve, Oregon. Photo: http://www.jacksonbottom.org/wetlandsmonitoring.htm

Hart Wetland, Wetland Restoration by the Wetland Conservancy, Oregon. Photo: http://www.wetlandsconservancy.org/preserves/hart.html

Delta Land Trust Restoration in Mississippi. Photo: http://www.deltalandtrust.org/wetlands_restoration.html

Monitor Wetlands

Some land trusts are monitoring changes in wetlands. For example, the Jackson Bottom Wetlands Preserve has implemented an environmental monitoring program to collect real-time information on weather, water quality, habitat and wildlife from the preserve. The system includes a weather station, remote water quality station, and remote video camera system.

Restore Wetlands

Hundreds of land trusts are restoring wetlands. For example:

- Wetland Conservancy. The Wetland Conservancy has protected many wetlands in Oregon and restored some. See http://www.wetlandsconservancy.org/preserves.html. For example, a culvert was removed in Hart Wetland and ponds excavated to "daylight" a stream.

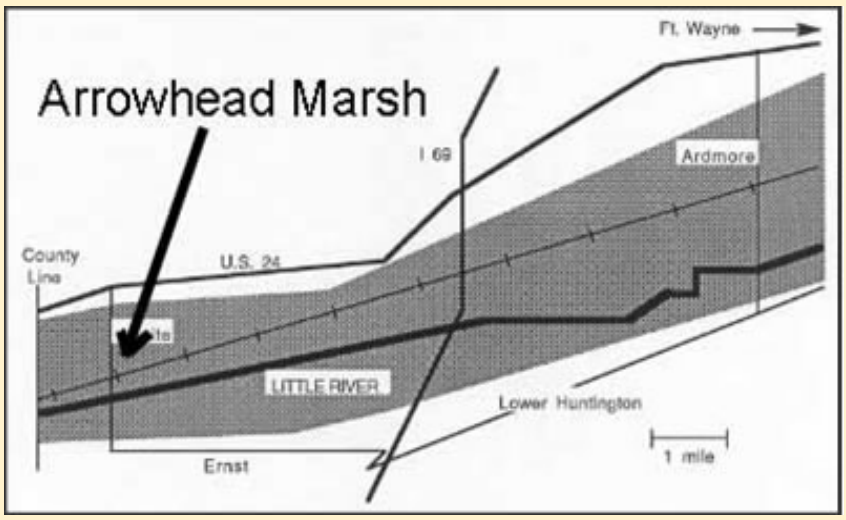
- Galveston Bay Foundation. Texas. This Foundation has a goal of restoring 24,000-acres of Galveston Bay Habitat (not limited to wetlands) by 2010. Since 1999 the Foundation has operated a "Marsh Mania" programs with over 2,400 volunteers who have helped create new habitat. (http://www.galvbay.org/5-1.cfm)

- Delta Land Trust. This trust creates and manages wetland restoration sites in Arkansas, Louisiana, and Mississippi. Restoration sties are established on economically marginal farmland and replanted with a variety of flood forest and bottomland hardwood species. Each restoration site is protected by a conservation easement. See http://www.deltalandtrust.org/wetlands_restoration.html. A Partners in Perpetuity Program established in 1990 has accepted 53 conservation easements covering over 18,000-acres.

- The Huntington Beach Wetland Conservancy was established in 1985 to preserve the few remaining wetlands in Huntington Beach and throughout Orange County, California. It has undertaken a 25-acre restoration project for Talbert Marsh. It has also assisted in the restoration of a 46-acre San Joaquin Marsh in Irvine. The Conservancy has constructed a Wetlands and Wildlife Care Center. See Huntington Beach Coastal Conservancy. See http://www.hbwc.org/.

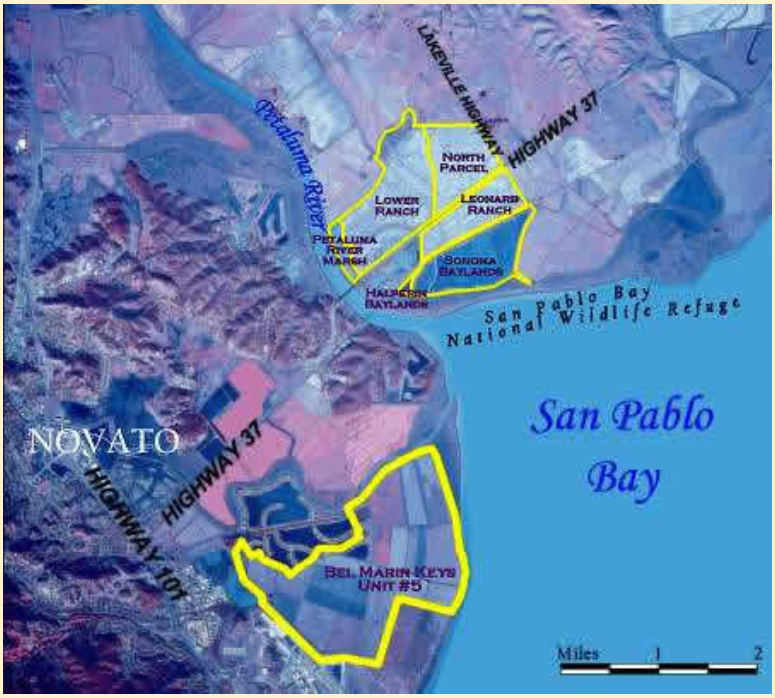
- The Little River Wetland Project in Indiana goal is to facilitate the restoration of wetlands in the historical Little River watershed and to provide educational opportunities. See http://www.lrwp.org/.

- Since 1976 the Sonoma California Land Trust has protected and restored more than 15,000-acres of land. These efforts have included the protection and restoration of many wetlands. See photos below. Sonoma Land Trust Bel Marin Keys Unit V project in Marin County involving management and enhancement of seasonal and tidal wetlands on a 1,613-acre property. See (http://www.sonomalandtrust.org); http://www.sonomalandtrust.org/area29a.htm



A project of the Little River Wetland Project, Indiana.
Photo: http://www.lrwp.org/arrowhead.html

Wetland enhancement project of the Sonoma Land Trust, California
http://www.sonomalandtrust.org/addwater.htm



Restoration areas of the Sonoma Land Trust, California
http://www.sonomalandtrust.org/area29a.htm

Sonoma Land Trust in California, Sonoma Baylands wetland restoration project. A 431-acre former diked farmland was restored to tidal action. Dredged materials were used to raise the elevation of subsided properties. Photo: http://www.sonomalandtrust.org/area29.htm#prm.

Volunteers establish coit logs on Paradise Creek. Restoration led by the Palouse-Clearwater Environmental Institute, Idaho. Photo: http://www.landandwater.com/features/vol47no2/vol47no2_1.html

Organize and Manage Mitigation Banks and Other Mitigation Projects

A number of land trusts are becoming involved with the organization and management of mitigation banks and other landowner initiated mitigation projects. For an excellent and thoughtful report exploring the full range of issues concerning the potential role of land trusts in mitigation see "Mitigation Program of the Solano Land Trust". This report does not focus exclusively on wetlands but wetlands are addressed. See http://www.solanolandtrust.org/documents/SLT_Mitg_Pgm_09-04.pdf

Paradise Creek in Idaho, Restoration site. Photo: http://www.landandwater.com/features/vol47no2/vol47no2_1.html

Most wetland mitigation banks are wetland restoration or creation projects. Some also involve preservation. For example, the Georgia Land Trust has negotiated easements on two large tracts in Camden and Piece countries as mitigation banks. (See http://www.galandtrust.org/Coastal_Programs.htm.) While attractive in protecting some of the most sensitive systems, preservation alone results in net loss of wetland resources and is best combined with restoration or creation.

Mitigation banks have several advantages over site-specific and case-by-case mitigation. Because they are constructed upfront, there is less chance of project failure. There is also less chance of failure because the expertise of mitigation bankers is usually greater than for case-by-case mitigation. They allow the creation and restoration of larger wetlands with greater habitat diversity. The fees from mitigation banks can help fund land trust wetland acquisition, restoration, and monitoring/research programs. Such fees may be substantial.

On the other hand, mitigation banks are controversial and have a number of disadvantages. Benefits and costs are shifted from one segment of landowners, the public, and the ecosystem to another. Such shifting of benefits does not solve the flooding, pollution, or habitat loss problems caused by wetland destruction in original community and may result in liability.

Examples or land trust involvement with mitigation banks include:

- The Brewster Wetland Mitigation Bank in northeastern Ohio is operated by the Wilderness Center, Inc. a nonprofit corporation, regional nature center and land trust. It has been approved for 46.8 wetland preservation credits. The Center's missions include nature education, wildlife and land conservation, natural history research and community service. The Center has a very active public education program. The wetland is a high quality category 3-forested wetland. See http://www.wildernesscenter.org/wetland_mit.html.

Brewster, Ohio, Wetland in Winter. Photo: http://www.wildernesscenter.org/wetland_mit.html

Old Fort Bayou Mitigation Bank, The Nature Conservancy, Mississippi
http://www.nature.org/wherewework/northamerica/states/mississippi/work/art13093.html

- In 1996 the Mississippi chapter of The Nature Conservancy acquired 1,700-acres of wetlands and uplands in Jackson County Mississippi to establish the Old Fort Bayou Mitigation bank. Expansion to a much larger area of bottomland hardwoods is pending. The Conservancy acquired this site because of the wetland functions, ease of restoration, and ease of management. The Conservancy has discretionary authority to sell credits to developers. The Conservancy has developed a management plan for the area to provide goals, objectives, and management strategies for the area. Restoration will include filling ditches and canals, monitoring and acquisition and protection outside of the bank area. See http://www.olemiss.edu/orgs/SGLC/mitiga.htm.

- The Center for Natural Lands Management in California has been formed to help protect biological resources through the long-term stewardship of mitigation and conservation lands. This includes management of mitigation banks. See http://www.cnlm.org/soq.html.

Orchestrate Wetland Protection and Restoration Projects

Many land trusts are helping to orchestrate protection and management efforts by a broad range of local, state, and federal agencies. An example is the effort of the Sycamore Land Trust to protect and restore the Bean Bottoms Complex in Indiana.

Bean Blossom Bottoms Complex, Indiana. Photo: http://www.bloomington.in.us/~sycamore/bbbnp.html

Conduct Research

Some land trusts are conducting management-oriented wetland research on their lands. Many others are encouraging colleges and schools to carry out wetland research on trust-owned wetlands. In some instances this research is "basic" such as understanding wetland hydrology. More often the research relates to the management needs of wetlands owned and managed by the trust such as the use of fire in wetland management and the habitat requirement of rare and endangered species. The Nature Conservancy has a particularly large and extensive research program with many research projects at The Nature Conservancy wetland sites.

The Elkhorn Slough Foundation in California is assisting the Elkhorn Slough National Estuarine Research in assembling a chronological sequence of historical maps and air photos to trace the history of the Slough. It is also studying tidal erosion, changes in creek morphology, and loss of vegetated salt marsh.

For many examples of research on Nature Conservancy sites in Texas through its Conservation by Design Research Program see http://nature.org/whereweork/northamerica/states/texas/science/art7804.html.

Elkhorn Slough, California
http://www.elkhornslough.org/research.htm

Raise Funds

Fund raising is not a wetland protection or restoration technique per se. But it is a necessary step in implement of the techniques described above. Funds are needed to acquire lands and conservation easements (when they are not gifts or willed). Funds are needed for staffing and for special projects such as restoration and boardwalks.

Land trusts are using a variety of techniques to raise money to restore and protect wetlands:

- Work one-on-one with landowners, governmental units to persuade them to donate lands and funds as charitable gifts or as estates.
- Hold dinners, auctions, bake sales, benefits, yard sales, concerts and other activities to raise money. For example, Ducks Unlimited holds more than 5,000 dinners and banquets every year. Ducks Unlimited provides guidance concerning the holding of a Ducks Unlimited banquet. See http://www.ducks.org/about/faq/faq_events.asp#top.
- Conduct land trust membership drives for special wetland acquisition projects or protection and restoration efforts more generally. Much of the funding for land acquisition often comes from tax-deductible gifts (money or property) from land trust members.
- Seek grants from foundations. Many land trusts have successfully sought funding from foundations.
- Seek grants from public agencies. Many land trusts have also successfully sought funding from government agencies including the FWS's Partners for Fish and Wildlife grant program, USDA Natural Resources Conservation Service Wetland Reserve and Wildlife Habitat Incentive Programs, EPA Five Star Restoration Program, North American Wetlands Conservation Act grants, and NOAA's Community Based Restoration Projects grants.
- Carry out special events such as Wetland and Birding Festivals. See examples above.

CHAPTER THREE: MAPPING

The following chapter is designed to help land trusts inventory and map wetlands and riparian areas. Chapter four considers wetland assessment in greater depth.

Why Map?

Land trusts map wetlands to serve a number of goals:

- Help land trusts determine which of their lands are wetland. General wetland maps (e.g., National Wetland Inventory Maps) may be used to indicate how much wetland exists, the wetland types, and the spatial relationships between individual wetlands and other wetlands, uplands, and aquatic ecosystems. More specialized wetland maps may indicate endangered or threatened species, invasive species, potential restoration sites, and other more specific information.
- Help land trusts understand their ecosystems. Wetlands are important components of aquatic ecosystems. They also play important support roles for adjacent upland ecosystems. Maps can help land trusts understand these relationships.
- Identify wetland areas in a community in need of land trust acquisition or conservation easements,
- Help prioritize land trust acquisition and restoration efforts,
- Provide the basis for and aid land trust land active land and water management programs including efforts to control or irradiate exotic species,
- Assist local, state, and federal government land use regulatory efforts by providing accurate and large scale wetland maps, and
- Help landowners identify wetland and related areas needing protection or restoration.
- Provide an important first step in more detailed assessment of wetlands for management, restoration, interpretation, scientific research and other purposes. See discussion in Chapter 4.

Types of Information Needed

Land trusts may need a variety of types of information to guide their acquisition and land management efforts. Three principal types of information ("parameters") are typically used to map wetland areas—hydrology, vegetation, and soils. Each of these parameters will be briefly discussed. Other types of commonly needed information will be discussed in greater depth in Chapter 3.

Areas often dry may, nonetheless, be wetlands. Photo: Jon Kusler, ASWM

"Parameters" for Mapping

Three principal characteristics or "parameters" of wetlands used to define, map, and delineate wetlands include:

- **Hydrology.** Hydrology determines whether an area is or is not a wetland and, to a lesser or greater extent, wetland characteristics. Relevant hydrology includes water depth, extent of inundation, period of inundation, frequency of inundation, and water quality. Hydrology is not easily assessed. For example, water may be observed at the surface of the ground for only part of the year in many forested and shrub wetlands but such wetlands may be dry the rest of the year. Therefore, hydrology must be "implied" through vegetation, flood records and flood maps, debris lines, flooding marks on trees and other vegetation, evidence of scour, and soils.

- **Vegetation.** The types of plants that can live in wetlands and riparian areas are determined by the depth and duration of flooding and saturation. Vegetation is the most common parameter used in defining, mapping, and delineating wetlands and, to a lesser extent, riparian areas because it can be identified on air photos and observed in the field. However, indication of wetland plant species is difficult in some instances because there are over 7,000 plants which grow in wetlands in the U.S. A much smaller number, about 26%, are "obligate". Obligate species grow only in wetlands. "Facultative" plants grow in both wetlands and uplands and are a less good indicator but are useful when combined with soils and hydrologic information.

- **Soils.** Wetland soils often contain large amounts of organic matter because saturation prevents oxidation of plant materials. Soils reflect long term hydrology and are, therefore, useful in identifying wetlands even where hydrology and plants have been disturbed or during periods of drought. Soil maps are often used as one of several sources of information in preparing wetland maps.

Field delineation

Wetland Definitions in Common Use

A land trust must decide what "definition" of wetland it wishes to use for mapping, assessment and management. Two wetland definitions utilizing hydrology, vegetation and soil parameters are in broad use for mapping, planning, and regulation at national, state, and local levels. These include:

(1) The U.S. Fish and Wildlife Service (FWS) wetland definition. This scientific definition was developed by Lewis Cowardin et al for FWS in 1979. The USDA Natural Resources Conservation Service (NRCS) also uses the Cowardin definition in its National Resources Inventory and the 1987 National Food Security Act manual in administering the Swampbuster program. The FWS definition broadly provides:

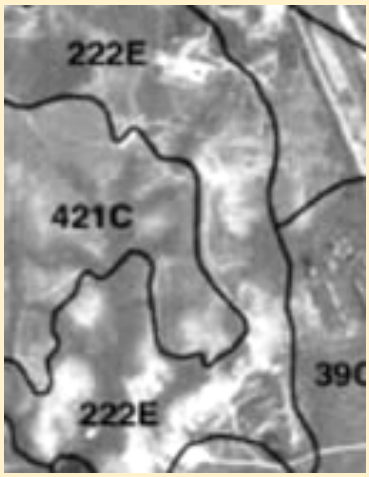
> "Wetlands are lands transitional between terrestrial and aquatic systems where the water table is usually at or near the surface or the land is covered by shallow water. For purposes of this classification wetlands must have one or more of the following three attributes: (1) at least periodically the land supports predominantly hydrophytes; (2) the substrate is predominantly undrained hydric soil; and (3) the substrate is nonsoil and is saturated with water or covered by shallow water at some time during the growing season of each year."

(2) The second commonly used definition was developed by the U.S. Army Corps of Engineers (Corps) in 1977 for the Section 404 permit program. This definition provides:

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

The major difference between the FWS definition used for the purposes of the National Wetland Inventory (NWI) and the Corps definition used for Section 404 regulatory purposes is that the FWS definition requires only one major parameter while the Corps definition requires hydrology and vegetation. This means that the NWI definition is more inclusive. This is particularly true for infrequently flooded or saturated wetlands such as flats, plays, riparian zones, and some depressions which lack wetland vegetation some of the time. Characteristic soils may also be lacking.

Many states and local governments have adopted their own wetland definitions. However, these definitions are usually similar to the FWS or Corps definition although there are exceptions. For example, Connecticut uses soil maps to define wetlands and Massachusetts uses the 100 floodplain to define wetlands for certain purposes.



Connecticut uses soils to define wetlands. Photo: USDA NRCS, Planning, http://www.mt.nrcs.usda.gov/technical/ecs/plants/xeriscp/plan.html

Riparian areas are not broadly encompassed by either definition.

A land trust should use the Fish and Wildlife Service definition if the trust wishes to utilize National Wetland Inventory maps or NWI digital data because these Service products utilize this definition. The NWI definition also encompasses more of the water-related ecosystem than the Corps of Engineers definition.

Wetlands and Riparian Areas

Climate, of course, varies from one region to another. Rainfall varies in the U.S. from over 120 inches a year in some areas of the Northwest to less than 7 inches per year in New Mexico. Many floodplain/riparian areas in the West serve functions similar to those for wetter systems in the East such as erosion control, flood storage, flood conveyance, pollution control, and bird, mammal, amphibian, and fish and reptile habitat. See National Research Council. 2002. Riparian Areas: Functions and Strategies for Management. National Academy Press. Washington, D.C. These systems are "wetter" than the surrounding landscape but less wet than Eastern wetlands. Plants and animals found in such areas do not reflect saturated conditions. For these reasons, riparian zones are not generally considered wetlands. Nevertheless, they need protection and restoration. Land trusts should consider preparation of riparian as well as wetland maps to help protect these areas through fee acquisition, easements, or other approaches.

Options in Mapping

Land trusts wishing to map their wetlands have a number of options:

- Utilize existing maps.
- Prepare new wetland maps.
- Create or utilize GIS systems to store and manipulate data (and to produce maps as needed).

We will briefly consider each.

1. Utilize existing maps. Land trusts may use existing wetlands maps prepared by the U.S. Fish and Wildlife Service, National Wetland Inventory or state and local wetland programs. NWI maps show wetlands at the scale of l/24,000. They are available for about 90% of the lower 48 states including the most populated areas. Some wetland maps have also been prepared by NOAA and other agencies. These maps may be used in their existing form or updated.

NWI maps are a good starting point for more detailed mapping efforts. However, NWI maps are at too small a scale for most management planning and display only a portion of the information needed to establish acquisition, management or other priorities. To supplement and update maps, land trusts may use air photos and USGS topographic maps, FEMA flood maps, NRCS soil maps and field investigations.

A number of states have prepared their own wetland maps for wetland regulatory and management purposes such as New York, Massachusetts, and Wisconsin. However, other states are using NWI maps or a state version of these maps. Some local governments have also prepared their own wetland maps or have incorporated a NWI maps into their GIS systems. See Chapter 1.

2. Prepare new maps. Land trusts may also prepare new maps for management and restoration purposes. New maps are needed where no maps now exist. They are also needed at larger scale and with additional types of information to guide management. See Chapter 4. Large scale and accurate maps are particularly needed for wetlands or riparian areas on trust lands which need active management such as control of invasive species.

Typical steps in preparing new maps include:

- **Select base map.** Land trusts wishing to prepare their own wetland maps often use USGS orthophotos as base maps. They may also use topographic maps.

- **Draw draft wetland/riparian boundaries on base map.** Land trust staff next draw draft wetland/riparian boundaries upon the base maps based upon existing sources of information and air photo interpretation (black and white, color, color infra red). Existing sources of information which may be used include National Wetland Inventory maps, NRCS soil maps, and USGS topographic maps. Other sources of information may also be used such as FEMA flood maps.

- **Field check wetland/riparian boundaries.** Staff next checks boundaries in the field. They may also gather a variety of additional data at the same time including GPS coordinates, evidence of rare or endangered species, vegetation information, soils, etc.

- **Correct maps.** Staff corrects the draft boundaries based upon the field observations and other information.

- **Digitize boundaries and other information (where wanted).** In some instances staff digitize the wetland maps for use in GIS systems. See below.

- **Periodically update maps.** Maps typically need updating as wetland vegetation and hydrology change.

3. Prepare Digital Inventories/Maps. The third major alternative for land trusts is to collect wetland information in digital, geo-referenced form or to digitize existing information for use in geoinformation systems. Digital inventories facilitate analysis and the preparation of maps at various scales. However, digitizing detailed data may be time consuming and expensive.

The National Wetland Inventory makes digital wetland data available for about 40% of the nation. The FWS is making available on line a less technical version of their NWI maps for much of the nation.

Some states such as New York are also digitizing their wetland maps. A number of states have established state geoinformation systems with wetland maps from state or federal sources as one component. Examples include Wisconsin, Minnesota, New York, Texas, and California.

NWI Map. Photo: U.S Fish and Wildlife Service

CHAPTER FOUR: WETLAND ASSESSMENT

This chapter addresses wetland assessment. We use the term wetland "assessment" to refer to the gathering and analysis of information needed for land trust wetland decision-making for protection and restoration purposes. Assessment includes but goes beyond general mapping which was discussed in Chapter three.

Field Assessment. Photo: Massachusetts Office of Coastal Zone Management, http://www.mass.gov/czm/wetlandassessment.htm

Why Assess Wetlands?

Land trusts assess wetlands for a variety of reasons:

- Identify the wetlands on their properties or in a locality most in need of fee or easement acquisition.
- Determine management needs and practices for wetlands.
- Determine the content and scope of proposed conservation easements.
- Help plan and construct trails, boardwalks, interpretive centers.
- Plan and implement wetland and related ecosystem restoration projects.
- Develop educational and scientific research programs.
- Create and/or manage wetland mitigation banks or other resource protection banks.
- Help communities, states and federal agencies evaluate the impact of development proposals on wetlands.

Types of Information Needed

The specific types, scales, and degrees of accuracy of wetland information needed by land trust decision-makers vary, depending upon management needs and threats or stressors to wetlands. For example, invasive species are a problem in some areas and not in others. And the types of invasive species vary in the semi-arid West from the temperate East. Needed information also depends upon the activities the land trust may wish to carry out. See, for example, discussion below of restoration and construction of boardwalks and trails.

General categories of information desired by land trusts for prioritizing acquisition and management purposes often includes:

- Wetland boundaries, types (see discussion of mapping in Chapter 3),
- Flora and fauna including threatened or endangered species,
- Biological diversity,
- Relative scarcity of the wetland type in the region,
- Relationship of wetlands to other wetlands, riparian areas, aquatic systems,
- Presence or absence of wetland upland buffers,
- Invasive species which may be present including type, density, etc.
- Natural hazards such as flooding and soil stability if trails, boardwalks, or interpretive centers are to be established,
- Land ownership, and
- Functions and values of specific wetlands based upon not only natural resource characteristics but accessibility to the public, use by various groups (e.g. bird watchers).

Assessment information may be displayed as maps, computer images, written reports, graphs or charts. In an ideal world, wetland decision-makers would gather all of the biological and other types of information for all of the wetlands on their lands or within the community or region as a whole.

However, because the costs of detailed and accurate information gathering and analysis are great and the time and expertise available often limited, land trusts must typically prioritize the geographic scope of the information gathering, the types of information gathered, and the scales and degrees of accuracy. Data gathering may take place at different scales for different wetlands. For example, more detailed and accurate information is needed for wetlands which are to be actively managed to control nuisance species. Less detail is needed for wetlands which will not be actively managed.

Steps in Wetland Assessment

The following general steps may be useful in assessing wetlands for a variety of purposes:

- **Determine information needs and goals for assessment.**
- **Map** wetlands. See Chapter 3 for a discussion of mapping.
- **Carry out more detailed issue-specific surveys as needed.** The types of information gathered will depend upon the types of information identified such as rare or endangered species, invasive species, functions and values for specific wetlands.
- **Analyze information.** Information may be analyzed manually or through the use of computer models and/or GIS systems.
- **Format results (**e.g., charts, graphs, maps, etc.)**.**
- **Present information to decision makers.**

Land alteration affects regional hydrology. Photo: http://ccma.nos.noaa.gov/ccma_resource.html

Sources of Information

Four overall sources of information may be used by land trusts for acquisition, planning, land management, restoration and other purposes.

- **Existing data.** Land trusts may make use of a variety of existing wetland maps, topographic maps, air photos, soil maps, land ownership information, surveys of rare or endangered species, and a broad range of other existing maps, memos, reports, papers, GIS data bases.
- **Field Surveys.** Field surveys are usually critical to supplement existing information such as the possible presence of rare or endangered species. Real, on the ground observation of vegetation, wildlife, hydrology, soils and are features is needed to supplement and validate more general analyses.
- **Air Photos.** Air photos are often useful for not only general mapping but the conduct of more detailed surveys such as surveys of invasive plants.
- **Digital Remote Sensing.** Digital aerial surveys and satellite imagery have proven useful for wetland mapping and delineation and for “overview” evaluation of overall ecological and hydrologic characteristics. But, there are limits upon what can be assessed from an air photo or satellite image. Remote sensing approaches also typically provide only a “one shot” view of resources unless time series images are used.

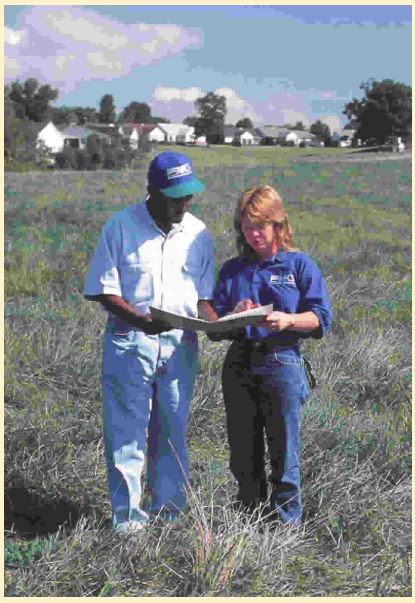
Analytical Approaches

A variety of approaches may also be used to analyze information:

- **Manual Analysis of Data.** Manual analysis and storage of data is sufficient to meet site-specific decision needs for specific wetlands. However, GIS and other computer models are helpful for broader scale analyses.

- **Use of Issue-Specific Computer Models for Quantitative Assessment of Functions.** A variety of computer models may be used by land trusts to help them assess specific wetland characteristics including functions and values. For example, a land trust may use Corps of Engineers HEC (Hydrologic Engineering Center) models to determine flood conveyance and flood storage.

  Because it is difficult to develop "real" (ratio) numbers in assessing wetlands, some rapid wetland assessment procedures utilize nonratio numbers to help assess wetland functions or condition (e.g., rating a wetland on a 1-10 nominal scale for a particular function or condition). Nonratio numbers can help suggest the overall importance of a particular function or feature. However, such numbers cannot ordinarily be validly added or subtracted (as is often attempted). They must be used with care.



People count. Photo: Bob Nichols, USDA NRCS

- **Wetland "Rapid" Assessment Techniques.** Over the last two decades more than 50 wetland rapid "assessment" techniques have been developed at federal or state levels and by the academic community. Most of these efforts have been aimed at evaluating wetland "functions" or a combination of functions and "values" for regulatory purposes. Unfortunately none of these techniques have been broadly used in the field. None meet more than a portion of the full range of land trust information needs. Different wetland assessment techniques also do different things. Costs, levels of expertise, understandability, and accuracy also differ. For example, WETHINGS (an assessment model developed by the Univ. of Massachusetts for the Northeast) evaluates capability of a wetland to serve as habitat for particular animal species. HEC (a hydrologic assessment model developed by the Army Corps of Engineers) can be used to analyze hydrology. WET (a rapid wetland assessment model developed by the Army Corps and other agencies) provides a way of evaluating capacity, opportunity, and social significance although this model is subject to many limitations. HGM (a more detailed, referenced-based approach to assessment developed by the Army Corps and other agencies) provides a more satisfactory evaluation of overall ecological capacity than many other techniques but is also costly and time consuming.

- **Use of Geoinformation Systems (GIS) for Landscape Analysis.** Some land trusts have "overlaid" wetland, floodplain, public water, natural hazard, existing use information, land ownership information, public infrastructure information and other types of information through the use of GIS systems to produce land and water use plans and maps which allocate lands throughout a community to their most "suitable" or "appropriate uses". Multiobjective, landscape level analysis through the use of GIS system is useful in planning and regulation because alternative development and preservation scenarios may be provided.

Bioassessments, Indices of Biological Integrity

Much of the information needed by land trusts for wetland protection and restoration is botanical and biological in character such as presence or absence of rare and endangered species in a wetland, invasive species, or overall biodiversity. Assessment methods which only evaluate general wetland vegetative features but fail to evaluate actual plant and animal species and assemblages of species provide only a partial picture of ecosystem functioning.

The Environmental Protection Agency, U.S. Fish and Wildlife Service, National Research and Conservation Service have cooperatively developed a number of bioassessment techniques and "indices of biological integrity" for evaluating wetlands. These generally assess basic hydrology and geomorphic as well as observable plant and animal species to determine the suitability of wetlands as habitat. Most techniques developed in the last decade involve the establishment of "reference" wetlands or reference conditions against which other wetlands may be compared.

Efforts to assess wetland plant and animal species are complicated by the broad range of hydrologic and ecological niches in wetlands related to the depth of water, saturation, flooding, and soils. And, these niches shift somewhat throughout the year and over a period of years as water levels change. This prevents simple characterization of a wetland as a whole and requires analysis of more specific subzones within a wetland over time. A single visit to a wetland site will often provide only limited information concerning the plant or animal species which may be found at a site over time because of seasonal and longer term variations in water levels and temperature and resulting variations in plant and animal species. Time-series information is needed. Volunteers such as bird watchers may play important roles in gathering such information.

Volunteers from Minnesota towns being trained to assess the biological integrity of wetlands. Photo: USEPA, Wetlands, Dakota County, http://www.epa.gov/owow/wetlands/bawwg/case/mn2.html

Many states are now developing wetland bioassessment methods similar to those used for rivers and streams. These hold considerable promise for providing improved evaluation of biological condition, impacts on that condition, and the success of mitigation and compensation measures.

Hydrogeomorphic Method

The Hydrogeomorphic Method (HGM) for assessing wetland functions was cooperatively proposed by the Corps of Engineers, EPA and other agencies in 1996. This method classifies wetlands by hydrogeologic setting. It separates wetland functions and values for evaluation purposes. It uses "reference" to compare wetlands with least altered wetlands of a particular type. Field data is gathered to evaluate individual functions. However, the HGM technique has not been broadly used for regulatory and other purposes despite the development of many HGM models. It is subject to important limitations from a land trust perspective. It develops only a small portion of the information needed by land trusts for land management. It is quite costly and time-consuming (at least through development stages) to apply. It evaluates ecological condition and overall characteristics but does not provide species-specific information (fish, birds, wildlife) needed by wetland planners and regulators for a variety of purposes (e.g., compliance with the Endangered Species Act). It does not directly evaluate "functions" as the term has been broadly used in regulations and the literature such as flood storage and conveyance but only the underlying processes. And assessment of underlying processes does not necessarily produce accurate assessment of "goods and services" and values. It does not evaluate "opportunity" or "social significance" including who benefits and who pays from changes in conditions and there is little opportunity for public input. It does not consider or assess "values" such as archaeological, cultural, heritage, health and safety, or other values.

Despite limitations, the HGM method and HGM models may be useful to land trusts interested in a ecological evaluation of their wetlands or restoration. HGM may also be modified to meet the land trusts evaluation needs.

Establishment and Use of Reference Sites

Both HGM and Indices of Biological Integrity utilize "reference". The use of reference and of reference sites may serve a variety of land trust purposes. Reference sites can be used to guide land trust wetland restoration efforts by suggesting appropriate water level elevations and vegetation types. They can be used to evaluate the comparative success of protection and restoration efforts. They can be used for wetland research and education. The least altered wetlands on trust lands are good candidates for reference sites.

Comparing Wetlands With Other Wetlands

For certain purposes, such as determining land acquisition priorities and establishing protection or management needs, land trusts may usefully compare wetlands with one another. Early wetland assessment approaches were, in fact, developed to prioritize acquisition and management efforts based upon differences between wetlands.

However, efforts to compare wetlands with other wetlands for land and water use planning and regulatory purposes often fail to provide much of the information needed to determine whether activities should occur at a wetland versus an upland site—the typical planning and regulatory situation. Comparison of ecosystem context, natural hazards, land ownership, public trust values, the costs of public services and many other factors is needed.

Comparison of wetlands only with other wetlands may suggest that certain "low value" wetlands should be developed. However, when compared with uplands, wetlands with even limited natural functions and values are often less desirable for development than upland sites.

Hydrologic and Ecosystem Context

Use of wetlands by many animal species such as fish and amphibians depends upon adjacent ecosystems and connections between wetlands and other upland and aquatic areas. Habitat value, ecological integrity, and restoration potential require consideration of hydrologic and ecosystem context. It often makes no sense to carry out detailed, onsite, quantitative assessment of wetlands alone functions and values depend upon this broader context.

Waterfowl often use wetlands for short periods complicating assessment. Photo: Tim McCabe, USDA NRCS

Anthropomorphic Changes in Hydrology

In urbanizing areas and other areas with rapidly changing hydrology due to human activities, future conditions must be reasonably anticipated in evaluating restoration potential. This is not easy, but failure to anticipate future hydrology is a major reason for failure of restoration projects.

Calculating Compensation Ratios

For land trusts establishing or managing wetland mitigation banks, it is not enough to only assess relative ecological "condition" or "capacity" in calculating compensation ratios. Many other factors are relevant to calculation of compensation ratios including the length of time it takes to bring a project to a functioning condition, the hydrology, sedimentation rates, the expertise of the project sponsor, whether mid-course correction capability is provided, whether monitoring and management will be provided over time, threats to a site, and a host of other factors.

"Who" benefits and who will suffer costs from wetland losses is also relevant. For example, restoration or creation of a wetland in a rural area with few potential "users" in the area will not adequately compensate (from a public interest perspective) for destruction of a wetland with similar acreage ecological capacity in an urban area serving thousands of individuals including minorities for recreation, education, and other purposes. The "public interest" involves social justice and social equity issues as well as scientific considerations.

The establishment of local, state, or regional wetland reference sites as has been done in Pennsylvania could aid the development and calibration of more specific wetland assessment approaches and models. Reference site systems can be used for long term monitoring, research, interpretation, and education.

Compensation ratios need to reflect ecological condition and many other factors. Photo: USDA NRCS, http://www.ga.nrcs.usda.gov/programs/fishwildlife.html

CHAPTER FIVE: WETLAND RESTORATION

Forested wetlands are rare in some areas of the nation. Photo: Jon Kusler, ASWM

Many land trusts may now own or will acquire wetlands which have been damaged by filling, drainage, pollution, exotic species, and changes in watershed hydrology.

This chapter addresses wetland restoration. The chapter draws upon a series of research projects carried out by the Association of State Wetland Managers including the preparation of a report: Kusler, J. and M. Kentula (eds.) 1990. Wetland Restoration and Creation: Status of the Science, Island Press. It reflects speaker presentations and conclusions and recommendations from wetland restoration national symposia and training workshops in Vicksburg, Mississippi; St. Paul, Minnesota; Fairlee, Vermont; Albuquerque, New Mexico; Plymouth, Massachusetts; Baton Rouge, Louisiana; and Annapolis, Maryland.

Why Restore Wetlands and Related Ecosystems?

Wetland restoration may serve a variety of land trust goals:

- Provide enhanced bird-watching and other recreational opportunities for land trust members, members of the public
- Restore biodiversity,
- Restore or provide rare and endangered species habitat,
- Provide wetland types and ecosystem niches which are rare in the area,
- Restore wetland functions needed to address specific problems or issues in the area such as flood storage and pollution control, and
- Create wetland banks to compensate for additional wetland losses (e.g., mitigation banks).

Techniques

Land trusts have available to them a number of techniques to restore, create, and enhance wetlands in specific circumstances. Examples include:

- Fill drainage ditches,
- Excavate fill,
- Breach dikes and levees,
- Restore stream flows and other hydrologic regimes by removing dams, levees,
- Control sedimentation and other pollutants; restoring water quality,
- Control exotic species,
- Replant,
- Reintroduce fish, beavers, other wildlife,
- Provide bird nesting boxes,
- Control predators,
- Restore buffers, and
- Restore connections between wetlands and adjacent waters, wetlands, and uplands (e.g. removing structure, dams, fills).

Factors Determining Appropriate Techniques

The most appropriate technique or techniques in a specific circumstance will depend, in part, upon the type of activity causing the wetland damage. For example, restoration of a partially drained agricultural wetland may be accomplished by filling the ditch or crushing the drainage tile. Restoration of a filled wetland will require removing the fill. The techniques required will also often depend upon the type of wetland. For example, restoration of riverine wetland will often require restoring the river contours through grading and stabilization of banks through bioengineering. In contrast, restoration of a depressional wetland will often require removal of fill or installation of water control structures.

Steps

The steps needed for wetland restoration differ somewhat, depending upon the technique, the stressors which have damaged the wetland and other factors. However, general steps include:

- Identify stressors,
- Determine restoration goals for the specific wetland,
- Develop an implementation plan,
- Implement the plan,
- Monitor the wetland, and
- Manage; make “in course” adjustments.

Identification of Potential Restoration Sites

A variety of natural and cultural factors are relevant to the identification and prioritization of potential wetland restoration sites. Some natural resource characteristics include:

- Evidence of past drainage. Wetland areas which have been partially drained but not filled and contain original soils are often good potential restoration sites. Soil maps, air photos, topographic maps, agricultural maps, and onsite inspections can be used to indicate areas subject to past drainage.
- Organic soils. Organic soils often indicate historical wetlands and areas with high restoration potential. Soil maps can be used to identify areas with organic soils including drained areas.
- Low-lying topography. Topographic maps can be used to identify valley bottoms, depressions, and other low-lying areas and drainage paths which may have been historical wetlands and may constitute good restoration and creation sites.
- Tidal inundation. Tide maps and a combination of topographic maps and tidal elevations can be used to suggest good potential coastal and estuarine wetland restoration, creation, or enhancement sites.
- Proximity to other wetlands, water bodies, parks, wildlife areas, and adjacent upland buffers. Air photos, topographic maps, satellite imagery, and land use maps can be used to identify areas which would be, if restored or created, be near to or connected with wetlands or water bodies. These areas may also be high priority restoration sites.
- Low velocity waters. Topographic maps, air photos, and flood maps including post flood damage surveys can suggest coastal, riverine, isolated wetland, and lakeshore areas with low velocity waters. Low energy sites often make the best restoration and creation sites because wetland vegetation may be destroyed by high energy waves or high velocity flows.
- Low sedimentation rates. Flood maps, topographic maps, erosion surveys can be used to identify areas subject to low sedimentation rates from runoff. Such areas often make preferred restoration and creation sites because high rates of sedimentation will quickly destroy a wetland.

A variety of natural resource and cultural factors are also relevant to the identification and prioritization of potential restoration sites.

Prioritization of Potential Restoration Sites

A land trust may prioritize wetland restoration sites to guide restoration, acquisition, conservation easement, and land management activities. A number of factors are relevant to such prioritization including the factors relevant to the identification of restoration sites (see above) and:

- The need for specific wetland types and functions at particular sites such as flood storage, biodiversity, and rare and endangered species habitat,
- The probability of restoration success. Areas subject to severe pollution, flooding, or erosion or other problems make high risk restoration sites. On the other hand, lands subject to problems which can be ameliorated through wetland restoration may also be a priority sites.
- Cost. Sites with lower land costs are sometimes but not always preferred candidates for restoration.
- Land ownership. Potential restoration sites in public or land trust ownership are often a priority because of the reduced costs and the possibility of providing upland buffers and long term management.
- Landowner attitudes. Sites owned by individuals wanting to restore their lands are a priority.

Costs, Available Funds

Costs per acre vary greatly, depending upon land values, the technique or techniques used, the amount of expertise required, and other factors. Some agricultural wetlands may be restored for less than $1000 an acre by filling drainage ditches or crushing tiles. In contrast, complex restoration or creation projects in urban areas involving extensive excavation, replanting, and exotic weed control may cost more than $300,000 an acre.

Use of volunteers for restoration. Photo: Samantha Christie, Friends of Ballona Wetlands, http://www.ballonafriends.org/volunteer_restoration.htm

Cost-Saving Approaches

Some examples of cost-saving approaches for land trust restoration efforts include:

- Use volunteers to carry out the manual aspects of restoration or creation.
- Don't replant but rather let natural reseeding occur (not always possible or wise).
- Undertake restoration "opportunistically" such as restoration of riverine wetlands after a flood disaster when funds and political will may support such efforts.

Keys to Success

Keys to success in restoration, creation, and enhancement projects vary somewhat, depending upon the type of wetland and context. Keys to success include:

- Project goals need to be clearly defined and realistic,
- Adequate hydrology is needed,
- Project design must be competent,
- Implementation (e.g., grading elevations) must be carefully supervised,
- Mid course correction capability should be built into many projects (e.g., control of exotics), and
- Long term protection, monitoring and management is needed (in many cases)

Avoiding Project Failures

Project failures are particularly common for restoration "mitigation" projects proposed by private or public developers to compensate for wetland losses. Land trusts may be asked to be long term care-takers of such projects. The private or private individual proposing such losses often wants to carry out as little mitigation as possible and to "walk away" from the mitigation project as soon as possible. Reasons for failures include:

- Projects are not constructed consistent with plans,
- Plans lack clear goals and designs related to those goals,
- Project designers lack adequate expertise,
- Inadequate understanding and replication of hydrology occurs (too dry, too wet, wrong water depths),
- Project supervision in implementation is lacking or inadequate,
- Vegetation or substrate are destroyed after construction by floods, erosion, fires, grazing and predation (e.g., geese),
- Exotic species invade the site,
- Threats from adjacent lands occur such as sediment or toxic laden runoff, and
- Project monitoring and mid-course corrections are not undertaken.

Design of Self-Sustaining Systems

The design of restoration projects as self-sustaining systems without outside intervention is a useful land trust goal. Self-sustaining systems are particularly important for "mitigation" wetlands where the project proponent wishes to complete the project, donate it to a land trust, and quickly move on. However, totally self-sustaining systems may not be possible where sediment rates or nutrient levels are high, watershed hydrology continues to be altered (e.g. urbanizing conditions), or there are threats from exotic species or predators. In such situations, continued management or maintenance over a period of years is essential. This may include water level manipulation, replanting, control of exotics, protection of the wetland from cattle, grazing, or off the road vehicles, and other measures. In such circumstances, land trusts need to seek not only donation of restored wetlands but long term funding for maintenance and management.

Required Expertise

The type and amount of expertise needed for wetland restoration depends upon the type of wetland, stressors and type of interference with natural functions, size of the project and other factors. Expertise requirements also depend upon the phase of project implementation. For example, project design often requires considerable expertise. However, much of the project implementation work including grading work and replanting may be carried out by relatively unskilled labor with adequate supervision (Boy Scouts, Job Corps, etc.).

The amount of expertise required also depends upon the type of wetland and the causes of degradation. Considerable multidisciplinary expertise is needed to restore the meanders and slopes for an unstable stream or to restore the topography for a forested wetland. On the other hand, less expertise is needed where the cause of wetland damage or destruction is a drainage ditch and the remedy of filling the ditch is obvious. It is also possible to restore a partially drained wetland in an agricultural field by filling a drainage ditch or crushing drainage tiles with a backhoe or bulldozer with limited expertise. No replanting or special management may be needed. Similarly, it may be possible to restore or create a marsh adjacent to an existing marsh by excavating fills or uplands with modest expertise if the elevations of the existing nearby marsh are used as a template. Much more expertise is needed to restore forested wetlands with highly sensitive hydrologic requirements or wetlands created in high energy zones of lakes, rivers, and coastal areas.

Wetland Creation and Enhancement

To restore wetland functions, land trusts may undertake not only wetland "restoration", but "creation" or "enhancement" in some instances. The term wetland "restoration" is generally used to refer to the return of a wetland to a former condition. "Creation" is used to refer to establishment of a wetland in a location where it did not previously exist. "Enhancement" is used to refer to activities which increase particular functions of a wetland.

Total "restoration" or "creation" of a wetland in a manner that totally duplicates all aspects of a naturally occurring wetland including soils is impossible in a short period of time. Natural, undisturbed wetlands are characterized by organic soils developed over thousands of years and subtle relationships of hydrology, soils, nutrients, vegetation, and animal life. Soils are particularly important to some pollution control, carbon storage and habitat functions. However, many wetlands characteristics including functions and values such as flood storage and conveyance, erosion control, pollution control, fisheries, and many other habitat functions may be partially restored or created.

Wetland creation is particularly difficult. It is possible to create an area which looks like a natural wetland. But, it is not possible to quickly create mature wetland soils and the biota which inhabit such soils. Created wetlands are also often more unstable in the landscape than natural wetlands and fill with sediment. Attempts to create wetlands often fail because it is difficult to "get the hydrology" right. The exception is where an upland adjacent to an existing wetland or water body is excavated, using the existing wetland or nearby wetlands as a guide for bottom elevations, topography, and vegetation. This helps "get the hydrology" right, insures a source of water, and provides seed stocks.

"Enhancement" of wetlands may also be used to restore lost functions. The U.S. Fish and Wildlife Service uses dikes, dams, and other water control techniques to manipulate water levels for the purpose of enhancing wetlands for waterfowl habitat including maintenance of open water areas, maintaining preferred vegetation, and controlling exotic vegetation. Other types of management such as deepening portions of a wetland, animal control (e.g., muskrats), and planting of particular species can, in some instances, be used to increase (enhance) specific wetland functions. While it is often possible to enhance a particular function or suit of functions, this may come at the expense of other functions. For example, cutting trees and other dense vegetation in a wetland adjacent to a river may enhance wetland flood conveyance capacity, but it may reduce pollution control, habitat, scenic and other functions and values.

Success Varies by Wetland Type

A relatively high degree of success has been achieved in restoring coastal, estuarine, and freshwater marshes adjacent to lakes and streams and tidal waters due to the presence of adjacent water bodies which provide a source of water and relatively predictable elevation requirements. Adjacent wetlands can also often be used as a guide ("reference") for restoration or creation efforts. Less success has been achieved for marshes with elevation-sensitive plant species such as *Spartina patens* and for shrub wetlands. Even less success has been achieved with sea grasses and forested wetlands which have precise hydrologic requirements. Certain heritage or archaeological functions such as a unique shell mound may be impossible to restore.

It is also more difficult to restore some wetland functions than others. It is relatively easy to restore flood conveyance and flood storage which depend primarily upon topographic contours and, to a lesser extent, upon vegetation. Erosion control functions may also be restored by bioengineering stream banks and riverine wetlands and replanting native plants. Similarly, certain pollution prevention and control functions may be restored through natural revegetation and replanting. Water recreation and aesthetic functions may be restored by reestablishing original hydrology regime, recontouring and replanting. Forestry and other natural crop functions may be restored by natural revegetation or replanting. But, habitat functions which depend upon very specific hydrologic regimes and water quality such as habitat for many endangered plant and animal species are very difficult to restore. Such restoration is particularly difficult if invasive species are present.

Location of Restoration

Does restoration need to take place at the site of original damage? Onsite and in-kind restoration are not always possible or practical. In addition it may be desirable in some instances from an ecosystem perspective to restore or recreate a wetland at another site and "out of kind". For example, it may be desirable to replace a marsh with a forested wetland if marshes are common and forested wetlands rare.

But, scientists often favor onsite and in-kind restoration because the restored area may play a similar role in the local ecosystem. Restoration, creation, or enhancement at a new site can sometimes restore or create new functions and values at that site such as water quality protection, erosion control, and flood storage which are equal or exceed, overall, to those at an original site. But, this does not mean that the original, contextual functions are replicated at the new site and there may be significant loss of function in the overall ecosystem, depending upon the situation.

Wetland functions and values depend upon not only the size, shape, type, and other characteristics of a wetland but upon proximity and connections with other waters, water quality, adjacent upland buffers, threats, and a broad range of other factors. Creation or restoration of wetland characteristics alone will not insure replication of functions and values, particularly those which depend upon landscape and watershed context. And, at a minimum, different individuals or ecosystems will usually enjoy the benefits of those functions even if the created or restored wetland is in the same watershed. For example, it may be possible to create or restore a marsh on one lake to compensate for the destruction of a lakeshore marsh on a second lake. But, there may be a significant decline in Northern Pike populations on the second lake with resulting impacts on riparian homeowners and the public. Similarly, restoration or creation of a wetland at one site on a river or stream may to some extent compensate for loss of flood storage or conveyance or erosion control at another site. But, landowners damaged by flood or erosion near the first site will receive little comfort from the compensation at the other site and may, in fact, sue other landowners or governmental units for such damage. In other instances a shift in location will not be so important.

Length of Time Needed

How long will it take for a restored or recreated system to approximate the original system?

The answer depends upon the type of wetland, the wetland functions, and the target plants and animals. It may be possible to restore or recreate a marsh with a lush stand of marsh vegetation in three or four years. Restoration of a red maple swamp may take thirty years or more. And wetland functions dependent upon mature soils may take hundreds or thousands of years. Although these recreated or restored systems may visually resemble the originals quite quickly, restoration of soils with pollution control capabilities and suitability of habitat for certain amphibians may be quite different.

Northern Pike. Photo: NOAA, Great Lakes Environmental Research Laboratory

The speed at which restoration of particular functions can occur varies. Flood storage and flood conveyance capability may be quickly recreated since these functions depend almost entirely upon topography which may be manipulated. Waterfowl habitat capability which depends upon open water and marsh vegetation may also be restored quite quickly. But, amphibian habitat which depends upon wetland soils may take much longer.

"Getting the Hydrology Right"

Hydrology is so important because primary wetland characteristics including soils, vegetation, and animal life depend upon the depth of water, the area of inundation, the hydroperiod, and other hydrologic features. Functions and values also, therefore, depend upon hydrology. Inadequate hydrology is the most common cause of failure of restoration and creation projects.

Replanting

Is it necessary to replant a wetland as part of restoration, creation, or enhancement? Yes, and no, depending upon the circumstances. Often natural seed stocks from the soil or adjacent wetlands will reestablish vegetation in a restored or created wetland without replanting, particularly if the restored or created wetland is adjacent to natural wetland or is flooded with water from a lake, stream, or an ocean which carries seeds. However, there are exceptions. Replanting is desirable for high energy areas where erosion may occur. Replanting is needed where exotics may quickly invade a site and planting may give particular species a competitive advantage. Replanting is needed where habitat must be quickly recreated (e.g., new habitat for an endangered species which has been disturbed).

Selection of Wetland Assessment Method or Methods for Restoration

There is strong disagreement among scientists concerning the use of wetland assessment methods to evaluate proposed sites of wetland destruction or damage, potential restoration sites, and restoration sites after construction. This is particularly true where wetland restoration, creation, or enhancement at one site is proposed to compensate for destruction at another.

None of the rapid wetland assessment methods have proven both accurate and "rapid" to quantitatively evaluate the functions and values of the original wetland (to be damaged or destroyed) or projecting the functions and values of a restored, created, or enhanced wetland. The Hydrogeomorphic Method (HGM) has proven useful in analyzing wetland processes but it provides no information concerning wetland values and little information concerning many other critical parameters. Specific, detailed assessment methods have proven more useful for evaluating particular functions, issues, and problems such as the use of hydrological models for evaluating flood storage and conveyance.

Use of Reference Wetlands

Reference sites have proven useful for reestablishment of elevations, hydrology, and plants in wetland restoration, creation, and enhancement projects and to provide comparative monitoring over time. A naturally occurring "reference" wetland in the vicinity of a proposed restoration, creation, or enhancement can be used to help determine appropriate water depths, wetland configuration, vegetation, and other factors. The HGM wetland assessment method utilizes wetland reference sites; so do various biocriteria approaches.

Reference sites may also be a source of wetland seeds and plants. Reference sites can be used, over time, to help measure the success or failure of a project.

Adaptive Management

The overall goals of restoration, creation and enhancement projects is to "get the hydrology right" in the beginning and to create self maintaining systems. Unfortunately, wetland hydrology is often difficult to predict, particularly where watershed conditions are changing. Many unforeseen threats may develop to wetland systems such as the growth of exotic plant species. And, active management such as control of cattle grazing may be needed over time. Therefore, many if not most larger restoration, creation, or enhancement projects need to involve monitoring during and after construction to determine whether "adjustments" are needed in design or in management.

The degree or type of monitoring, mid course correction, and adaptive management capability needed for a restoration or creation project will depend upon a variety of both onsite and offsite project factors. More monitoring, mid course correction, and adaptive management capacity are needed for high risk projects involving difficult to create wetland types (such as some forested wetlands), uncertain hydrology, changing hydrology, and threats such as invasion of exotics.

Purple loosestrife. Photo: Alberta Invasive Plants Council, http://www.invasiveplants.ab.ca/gallery_OR.htm

Perhaps the most common adaptive wetland management measure in project design is the installation of small dams in a project which will allow the adjustment of water levels over time to achieve desired vegetation. The use of small dams is common with marsh management projects. Such water level adjustments may be necessary because initial evaluation of hydrology was incorrect or because watershed hydrology changes over time. Adjustments may also be necessary to help control exotic plants.

Other adaptive management measures may include control of exotic plant species such as purple loosestrife or indigenous plants such as cattail which tend toward a monoculture.

Creating or Managing Mitigation Banks

Increasingly land trusts are being asked by developers or government agencies to create or manage wetland "mitigation banks". A mitigation bank is a wetland which has been restored, created, or enhanced to help compensate for future wetland losses. Individuals wishing to destroy or damage a wetland may buy credits in the bank to compensate for such destruction or damage.

Mitigation banks have a number of advantages over small onsite and in-kind projects to compensate for wetland losses. They can often be more carefully planned with greater expertise than such smaller projects. They can often be more advantageously located than smaller projects. They can also be better managed over time. Substantial funding may be available to a land trust for creating or managing a mitigation bank.

But, there are important disadvantages as well. Creating or managing a mitigation bank may be expensive and costs may exceed original estimates. Most importantly, banks do not replace lost functions and values in the original setting. For example, providing flood storage many miles from the destruction of a wetland may benefit some adjacent landowners but it will not prevent flooding at the original location. See discussion above.

Land trusts considering the establishment or management of a mitigation bank should do so with great care. They should consider long term costs and not simply short term funding.

Establishing Compensation Ratios for Mitigation Banks

A number of factors are relevant to the calculation of wetland restoration "ratios" to "compensate" for wetland damage or losses which may be caused by proposed development. Some of these factors include:

- The type of wetland and the degree of difficulty in restoring that type,
- The types of functions/values including difficulty likely to be encountered in restoring or creating particular functions/values and length of time it will take to restore or create the functions/values,
- The soils, topography, existing condition, and other features of the site,
- The adequacy of the project design,
- Degrees of threat to the proposed project such as sedimentation, water quality, predation,
- The extent to which the "public" and original landowners will benefit from the restored or created wetland,
- The experience and expertise of the individual or organization proposing to carry out the restoration, and
- Whether the project incorporates mid-course correction and long term maintenance capability.

Wetland Restoration
Photo: Jeanne Christie, ASWM

States and federal agencies have adopted a variety of standards for mitigation ratios. Ratios usually operate on a sliding scale depending upon the type of wetland and problems which may be encountered with restoration.

CHAPTER SIX: CONSTRUCTING WETLAND BOARDWALKS AND TRAILS

This chapter is based upon a series of studies and workshops conducted by the Association of State Wetland Managers (ASWM) including a survey of approximately 100 wetland interpretive sites in preparing the publication J. Kusler et. al (1993) Wetland Interpretation and Ecotourism, Association of State Wetland Managers. Most of these sites involved the construction of a boardwalk and trail. This guide is also based upon three ecotourism workshops conducted by the ASWM and inputs from individuals who have constructed wetland boardwalks and trails over the last decade.

Land trusts are increasingly constructing boardwalks and trails into wetlands on land trust property. Boardwalks into wetlands and trails adjacent to wetlands allow the public, students, teachers, and others to see the "hidden" world of wetlands. Wetlands are of great interest to students, scientists, and the general public, but few individuals venture into them due to the dense vegetation, standing water and deep organic soils. A few enter with canoes or waders. But alternative and more convenient means of access—boardwalks and trails—are needed by the rest.

Particularly well known boardwalks and trails include the Anhinga Trail in the Everglades, Corkscrew Swamp trail in Florida, Huntley Meadows boardwalk in Alexandria, Virginia and the boardwalks in Plum Island National Wildlife Refuge, Massachusetts.

Boardwalks and trails are usually combined. Trails are often designed as loops around wetlands or to provide visual access to portions of larger wetlands. Boardwalks are typically parts of such broader trail systems although boardwalks and trails may also be "stand alone" efforts.

Why Construct Boardwalks and Trails?

Land trusts may construct boardwalks and trails to:

- Help educate the public concerning the beauty and functions of wetlands,
- Help build support for protection and restoration of wetlands and related resources,
- Facilitate bird watching,
- Facilitate science education at all academic levels, and
- Facilitate scientific research.

Constructing boardwalks and trails can also be a partnership-building exercise. Projects like this can bring land trusts, conservation commissions, and other locals together with tangible end products.

Young bird watcher.
Photo: Jon Kusler, ASWM

Elements of a Boardwalk/Trail Project

Elements of a boardwalk/wetland project typically include:

- Parking area (often but not always needed),
- Access trail,
- Kiosk with map and explanatory materials at the parking lot or along the access road,
- The boardwalk and/or trail,
- A signing system for marking the trail and points of interest, and
- Informational brochures.

An interpretative center may also be constructed but this requires much greater commitment of funds and staffing.

Where Boardwalks and Trails Are Needed

Boardwalks and trails are not needed for every wetland. But even a single boardwalk and/or wetland trail in a community can "open up" wetland education and public understanding for wetlands within the community. Trails rather than boardwalks may suffice to provide visual access to a wetland (e.g., birding) if there is raised ground around the wetland or adjacent to the wetland (e.g., many depressional wetlands, riverine wetlands). However, boardwalks are often needed where adjacent lands are flat and the wetland manager wishes to provide access to the wetland for bird watching, other nature watching, public education, or research. Not all efforts to construct boardwalks need also involve construction of trails or vice versa. However, longer wetland-related trails typically utilize at least raised walkways (planks, logs, rocks) or short boardwalks to cross low lying areas.

Overall Steps

Steps for construction of a trail and/or boardwalk often include:

- Form a working group,
- Identify objectives,
- Inventory the wetland and adjacent lands to determine possible locations for the boardwalk and trail,
- Design the boardwalk and/or trail,
- Obtain necessary permits (if any needed),
- Raise necessary monies,
- Construct the trail and boardwalk,
- Put up signs and interpretative materials, and
- Maintain the trail and boardwalk.

Railings are important.
Photo: Jon Kusler, ASWM

Each of these steps will now be examined in greater depth.

Forming a Working Group

Often a single enthusiastic individual such as a land trust member, member of a local conservation commission, member of a "friends of…." or simply an interested bird watcher or member of the public may take the lead in organizing a working group. The group can be part of or drawn from other groups--a conservation commission, a group of bird watchers, a group of land trust members, the staff of a park, or local teachers and students. What is important is identifying and gaining the support of motivated individuals who are willing to work on the trail or boardwalk. A working group typically provides the expertise and volunteer labor force needed to construct and maintain a boardwalk and/or trail.

The types of expertise desirable for such a working group include:

- An engineer or architect (help with boardwalk, trail design, acquiring materials),
- A biologist or botanist (inventory of the wetland, layout of the boardwalk or trail, development of signs, brochure),
- A carpenter or similar construction expert (get materials, supervise construction),
- A teacher (signs, brochure), and
- Other volunteers to construct the boardwalk and trail.

Not all of these types of expertise will always be available. However, at least one individual with expertise in wetland plants and animals is needed to help inventory the wetland and assist with layout and design, signing, and preparation of interpretive materials. A construction advisor with knowledge of building construction practices including any design codes is also important, particularly for larger boardwalks. Such an expert can help address a variety design considerations as well supervise procurement of materials and actual construction.

Establishing Objectives

The working group needs to decide upon the intended audience and goals for the trail and boardwalk. What is the boardwalk and/or trail to achieve? Who is the intended audience? Bird watchers? Student researchers? The broader public? How many will use the boardwalk at one time? Is the boardwalk and/or trail to be handicapped accessible? If so, somewhat different designs will be needed for both a boardwalk and a trail.

It is helpful for the working group to visit one or more existing wetland boardwalks in the area to help establish objectives and to secure design ideas and tips before design and construction of their own boardwalk.

Plum Island. Photo: Jeanne Christie, ASWM

Inventorying the Wetland and Adjacent Lands

In deciding where to place a boardwalk in a wetland or trail adjacent to a wetland and in designing the boardwalk, the working group should inventory and prepare notes on the following sorts of features. A detailed air photo, topographic map, or wetland map may be used as base map. Important features observed with a field visit can be sketched directly on the base maps and notes can be placed on the map or attached. Multiple copies of the base map are helpful if more than one person is carrying out the evaluation.

The group or individual undertaking the inventory may be able to carry out a portion of the inventory from the upland immediately adjacent to the wetland. But, he or she will also need to get out into the wetland in waders or a canoe or boat to carry out some portions of the inventory. If in a northern climate, he or she may be able to walk around the wetland on the ice in the winter. Depth of water and soils can also be measured through holes in the ice. Of course, birds, animals, and most plant species will not be visible this time of the year.

Features needing to be inventoried include:

1. Features along the possible route of the boardwalk:
    a. Depth of water?
    b. Vegetation along the route?
    c. Wildlife observed or anticipated along the route?
    d. Are there connections to existing paths, greenways, roads, and parking lots for the boardwalk or trail?
    e. Are the high areas within the wetland or adjacent area? It often easiest to construct a boardwalk or trail linking high points in a wetland although this may also not be the best location to observe other wetland features.

2. Features which may/should be visible from the boardwalk and trail:
    a. What type of vegetation is found within the wetland? Where? What is marsh? Shrub? Forested?
    b. What types of birds, fish, other animals are found within the wetland or adjacent area? Where are they best observed?
    c. Where are the most beautiful areas and most beautiful vistas within the wetland and adjacent area? Where?
    d. Where is the open water? How deep is it? What can be seen looking down into the water?
    e. Are there shell mounds, other cultural features? Where?

3. Limitations upon boardwalk and trail construction:

    a. Where are endangered and sensitive plant and animal species (if any) or other species needing special protection located?
    b. How deep and how consolidated are the organic soils? Deep, unconsolidated soils pose problems for boardwalk construction except for floating structures.
    c. Is the area subject to flooding including possible wave, ice action? How high will the water get? How much velocity?
    d. Are there distractions such as utility lines, roads, houses, litter visible from particular areas?

Designing the Boardwalk/Trail

Overall Design

The location, length, width, height of the boardwalk and whether there will be observation platforms and towers, and other design features should reflect a variety of considerations.

- The design must, of course, reflect available funds. With little or no money, a small, narrow boardwalk may only be possible; with more money, a longer and wider boardwalk may be possible; with even more, an observation tower and blind may be added.
- The boardwalk should bring users into contact with key features of the wetland (see objectives) while, simultaneously avoiding impacts to sensitive plants and animals.
- The boardwalk should be located to show varied habitats and biodiversity. For example, if possible, the boardwalk should show shrub, marsh, forested wetland and open water.
- The boardwalk should be wide enough to comfortably allow (at the absolute minimum) the passage of two large adults (perhaps with baby carriages)—a minimum of forty-eight inches.
- The boardwalk must be strong enough to support anticipated loads with a safety feature. Risk factors will of course vary. Risks may be low for a boardwalk only six inches above a marsh with no or little open water. Risks may be great for a boardwalk over deep, open water (with, perhaps, a few alligators). Architectural and engineering design manuals should be used to provide guidance. For example, a single four-foot wide and eight-foot long span should, in general (there are exceptions) be able to support a minimum of 2,000 pounds (10 two hundred pound adults).

Architectural design.
Photo: Jon Kusler, ASWM

- The boardwalk may include additional features such as viewing blinds or observation platforms and towers to provide panoramic views of the wetland, facilitate bird watching, or facilitate other nature watching. The boardwalk should use construction materials that will resist rot and other deterioration.
- The boardwalk must be designed to withstand reasonably anticipated flooding, wave action, and ice (in the North).
- The boardwalks must, in most instances, have railings or fencing. This is particularly true where small children may use the boardwalk.
- The boardwalk should be architecturally interesting. Curves are more interesting than long straight areas but also require more expertise and funds.

Railings

Some boardwalks are constructed without railings where there is little danger if children or adults fall from the boardwalk into the wetland. There is often little danger for boardwalks in forested, freshwater marshes or for salt marsh wetlands with only a few inches of water and little drop from the deck to the wetland (e.g. less than a foot). However, even here a small two by four "rim" along the edge of the decking is desirable if the boardwalk is to be used by wheelchairs.

More substantial railings are needed if the boardwalk crosses deep water or attains considerable height (e.g., two-feet or more). Someone may then be injured by falling into the wetland or may drown in the water. This is particularly a problem if a boardwalk is to be used by children.

It is very difficult to construct a railing system which will totally protect children. Some railings are designed with three or more horizontal rails (near the deck, half way up, and at the top of the railing supports) to obtain this result. But even than, a determined child may be able to squeeze between the railings. Some boardwalks utilize wire mesh to prevent this.

Calculating Load Bearing Needs

An architect or engineer can provide a working group with information concerning anticipated load bearing needs based upon the width of the deck, section length, and other features. We strongly suggest you seek such expert help for a large boardwalk, particularly if a tower or other elevated area is to be constructed. You need to design with a considerable safety factor and assume a worst-case scenario. For example, as suggested above, it might be assumed that as many as ten people weighing 200 pounds each might crowd onto a four-foot wide by eight-foot section looking at a snake or rare bird in the wetland. The section would, therefore, need to support at least 2000 lbs of weight.

We also suggest you consult an architect or engineer concerning load bearing capacities of various materials including pressure treated wood and plastic composites.

Architectural design, Plum Island
Photo: Jon Kusler, ASWM

Including Observation Blinds, Platforms and Observation Towers

Observation blinds, platforms, and observation towers can facilitate bird-watching and provide spectacular views (often). Simple blinds are easy to construct and relatively inexpensive. Observation towers are more expensive but also provide panoramic views.

Selecting Boardwalk Materials

Most boardwalks are constructed of pressure treated four by four's or six by sixes (pilings) with two by six or two by eight cross members and two by six or two by eight deck material. However, some boardwalks also use two by tens for decking and cross members for longer spans or heavy use.

There has been some concern that chemicals from pressure treated wood may pollute nearby waters although there is apparently little empirical evidence to support this. Increasingly, plastic composites are used for boardwalk construction as an alternative to wood. However, they are quite expensive. In addition, some of the composites are brittle in freezing conditions and easily split when under even modest tension.

Most boardwalks use galvanized nails or screws to secure the decking. Bolts (stainless steel preferred but expensive) are usually used to secure cross members to the pilings. Screws and bolts are preferable to nails because nails can work themselves out with the flexing of the boardwalk. But nails are, of course, cheaper.

Reducing Potential Flood Damages

Water level fluctuations of 10-feet or more are common for 100-year flood events for many riverine, coastal, and estuarine wetlands. Boardwalks constructed of wood typically float if not firmly attached. If firmly attached to pilings they may survive submergence for a period of hours or a few days. But, few can survive prolonged wave action and flowing water. Flowing water combined with upward buoyancy forces often tear sections of a boardwalk from their pilings.

Fluctuating water levels pose a dilemma in boardwalk construction. In an ideal world, the deck of a boardwalk would be raised above reasonably anticipated flood elevations (e.g., a 100 year flood). But, this may be unsightly and impractical. On the other hand, few not for profits or local governments have funds to repeatedly rebuild a boardwalk destroyed or damaged by flooding.

Several strategies are available to address flood and erosion problems. They can often be combined.

- The first is to elevate the boardwalk enough to deal with yearly flooding (e.g., a foot or two of flooding) and then to rebuild or repair any damage after a major flood. This may be a cost effective strategy, particularly where a continued source of funds and maintenance staff are available and major floods are infrequent. Rebuilding and repair costs may be reduced through the use of additional strategies (see below).
- A second strategy is to securely bolt each section of the boardwalk to deep-seated pilings with the hope that the boardwalk will stay in place when flooding occurs and not be damaged. This works fairly well where flooding is of short duration, there is no wave action or velocity in the water, and the pilings can be sunk deep into the soil.
- A third strategy is to tether each section or span of a boardwalk with a cable or nylon rope to its pilings. The boardwalk is designed so that sections rest on their pilings but the sections are not firmly attached to them. With this design, each section floats off of its piling during a flood, but is kept near the pilings by the tether. After floodwaters fall, the sections are placed by hand again on the pilings. This may work for small sections of relatively narrow and lightweight boardwalks.

Reducing the Impact of Boardwalks Upon Vegetation, Wildlife, Scenic Beauty

A variety of measures may be used for reducing impacts:

- Trails and boardwalks should be located in less sensitive areas of a wetland and adjacent lands, away from rare or endangered vegetation and wildlife. Trails and boardwalks often can be routed around large trees so that large trees do not need to be cut.
- Care should be taken to maintain natural wetland hydrology including fluctuations of water levels important to wildlife in any construction.
- Natural materials should be used (e.g. wood for boardwalks, woodchips for trails).
- Designs and colors should be used which blend with natural scenery (e.g., natural wood colors).
- Construction may be able to take place in the winter which reduces impacts on nesting or feeding wildlife.
- Once a boardwalk or trail is constructed, limitations can be placed on the months and hours of access to minimize impacts upon nesting birds and other wildlife (where this is necessary).
- Litter containers can be provided at convenient locations to reduce littering.

Designing Trails

Suggestions for trail development adjacent to a wetland include:

- A trail, like a boardwalk, should not be constructed in highly sensitive upland areas with rare or endangered plants or animals or other highly limiting factors.
- The trail should parallel the shore of a wetland as closely as possible to provide vistas of the wetland. However, a balance must be struck between maximum view of the wetland and construction and maintenance problems. A trail located along the immediate shore of a wetland is often flooded or muddy a portion of the year.

- If possible, the trail should avoid organic soil areas. This is not always possible, however. Boardwalks, small bridges, rock pathways, and other techniques should be used to bridge such areas.
- The trail should have an interesting, curvilinear design where possible.
- The trail should avoid steep gradient areas where erosion is likely.
- In many instances, use of mountain bikes and any motor vehicles should be prohibited on the trail since trails adjacent to wetlands tend to be wet a portion of the time and often muddy. Vehicles will quickly exacerbate these problems.
- Natural materials such as wood chips are often desirable for trail covering. However, wood chips float when flooding occurs and are simply washed away. Crushed stone is therefore desirable in some of these areas.
- If possible and practical, the trail or a portion of the trail should be designed for handicapped access. This is not always possible for all trails adjacent to wetlands, however, because of the wet soils and mud which is common during certain times of the year and the rapid (albeit only a few feet) climbs and drops common on many wetland-related trails.

Developing Signs

Two types of signs are typically needed for boardwalks and trails:

- General informational signs. These signs provide the name and description of the wetland and boardwalk/trail, provide use information (e.g., hours of operation), and mark the trail on the ground (e.g., blazes on trees).
- Plant and animal descriptive signs. These signs mark areas of the wetland and plants/animals of special interest. Many boardwalks and trails have numbered markers at trees and other vegetation of significance. A trail brochure, then, provides more information concerning these trees or other features.

Trail Sign, Cape Cod, Maine.
Photo: Jon Kusler, ASWM

Vandalism of signs is often a problem. Vandalism, however, can be reduced by placing signs or markers some distance from the boardwalk in the wetland (e.g., 3 feet). Few vandals find it worthwhile to actually walk out into the wetland.

Tips for use of signs include:

- Keep them simple.
- Use weather resistant materials.
- Place them in visible areas but at least three-feet out into the wetland from the boardwalk or trail to reduce vandalism.

Brochures

A brochure should, at a minimum:

- Briefly describe the wetland including its history and why it is important.
- Provide rules of conduct and advice on use of the area (e.g., stay on the trails, watch out for poison ivy).
- Include a boardwalk/trail map showing number points of interest.
- Include a brief description of each numbered points of interest.
- Provide contacts for more information.
- Request the user to return the brochure to the kiosk or trail/boardwalk or entrance point.

Implementing the Plan

Costs

Costs for a boardwalk and trail will, of course, depend upon the width, height, and construction materials used. Costs will also depend upon the railing system (if any) and whether there will be blinds, observation decks, or towers. Costs will depend upon whether volunteer or expert, professional labor is used or what combination of the two.

Per lineal foot costs may be lower than $30 if volunteer labor is used for a four foot wide, pressure treated boardwalk with eight foot sections utilizing four-by-four pilings, two by eight rafters, and two by eight decking with a two rail (top and middle) railing.

On the other hand, per lineal foot costs may be as high as $100 or more a lineal foot for a six-foot wide boardwalk using composite materials utilizing eight-foot section with six-by-six pilings, two by ten rafters, and two by eight or two by 10 decking and a three rail (bottom, middle, top) railing and with the use of professional architects and carpenters.

Reducing Costs

Costs can be reduced by:

- Reducing the size and length of the boardwalk. In some instances this may be possible by increasing trail areas and decreasing boardwalk length. Trail construction (providing there is no surfacing and few bridges) in lands immediately adjacent to the wetland is often relatively inexpensive; boardwalk construction often quite expensive.
- Using volunteers for construction, maintenance, etc.
- Soliciting lumberyards or other suppliers to donate materials or to provide materials at cost.
- Constructing a portion of a boardwalk during the winter for open-water areas which are iced-over. It is often much easier and less time consuming to sink pilings through holes in the ice than to maneuver them into place during the summer.
- Placing numbering signs on poles or trees in the wetland where they are less susceptible to vandalism.
- Using low cost materials for the brochure and recycling brochures.

Seeking Regulatory Permits

Permits from regulatory authorities may be needed depending, upon the federal, state, and local regulations in effect, the size of the boardwalk, whether fills will be placed in the wetland, the type of wetland and other factors. We suggest you check with your local zoning administrator with regard to any local zoning or building code permits which may be needed and the regulatory requirements. The zoning administrator may also be aware of state permitting requirements. A state permit is often needed if the wetland is part of a broader lake or coastal water with the bed owned by the state. A federal Section 404 (Clean Water Act) permit may also be needed from the U.S. Army Corps of Engineers in some instances. In general, a Section 404 permit will not be needed for a boardwalk in an "isolated" wetland. In addition, a small boardwalk for a non-isolated wetland but involving no fill or dredging may qualify for a "programmatic" permit. Larger structures or those involving substantial fills will require a permit.

Wetland Boardwalk
Traverse City. Photo: Jeanne Christie, ASWM

Reducing Difficulties in Working in Water and Mud

Constructing a boardwalk in water and deep organic mud (often encountered in a wetland) is a challenge. Waders help in shallow water and boats and canoes can be used where there is enough water depth. It is also sometimes possible to finish one section of a boardwalk before starting the next and to thereby provide a continuous "build out" although some time in the water is required to set pilings. The next set of pilings are sunk using the last finished section as a construction platform. But, sinking all pilings at once before construction of the platforms also has advantages.

Other suggestions include:

- Sections of decking can be assembled in upland areas and carried or floated to pilings. This works, particularly, for small, lightweight sections.
- For areas with prolonged freezing temperatures, holes can be cut in the ice with an ice augur. Pilings can then be driven through the hole in the ice and into the soil. Snowmobiles and sleds may be used to move materials into place.
- Wide, light, flat-bottomed boats such as Jon boats may be used to move materials in and out of shallow water and to place pilings.

Upgrading an Existing Boardwalk.
Photo: Jon Kusler, ASWM

Developing and Implementing Interpretative Programs

Many land trusts with trails and boardwalks also provide interpretive programs. However, programs often offered in cooperation with schools, local land trusts, public resource agencies (e.g., state fish and game departments) include:

- School visits to the wetland/boardwalk to observe the wetland, wildlife, plants, or to carry out research.
- Wetland and birding festivals.
- Ecotours conducted by local guides, travel agencies (e.g. tours into the Everglades).
- Scheduled nature walks, lectures for the general public.

CHAPTER 7: WETLAND FESTIVALS

This chapter is designed for land trust and local government interested in carrying out a "Wetland Fest". A selected bibliography and list of websites provide the reader with more information concerning specific subjects. It was written based upon materials developed, in part, by Ralph Tiner of the U.S. Fish and Wildlife Service.

The chapter draws upon two wetland festivals conducted by the Association of State Wetland Managers, Inc. (ASWM) in 2002 and 2004, two Wetland Festivals conducted by Ralph Tiner of the U.S. Fish and Wildlife Service in Amherst Massachusetts in 2001 and 2002, and a variety of conferences, workshops, training sessions and other activities conducted by ASWM over a period of years. It also draws upon other publications and websites. See bibliography and list of websites.

Why Conduct a Wetland Fest?

Reasons why a land trust should conduct a wetland festival include:

- Educate the public and build support for the protection and restoration of wetlands and related ecosystems.
- Interest children and teachers in wetlands and other natural systems.
- Build camaraderie among federal, state, local government, academic and other groups working with wetlands.
- Provide an opportunity for agencies and organizations to highlight their efforts related to wetland conservation.
- Provide a "hands-on" community activity which draws together individuals interested in protecting the environment and focuses them on wetlands and related ecosystems (including greenways, floodplains, wetlands, streams).
- Provide a wetland/nature activity (the Fest itself) which provides economic benefits (food, lodging, gasoline sales) to local businesses and encourages them to protect wetlands.
- Support local wetland artists and photographers and encourage them to select wetland and birding topics in their artwork.

Steps Needed

Steps needed to organize and conduct a wetland fest will depend, somewhat, upon the size of the fest although most of the steps suggested below will be needed for almost any fest. The scale of activities will also, of course, differ. For example, a large fest will require a formal advisory committee and more formal organization. Suggested steps include:

Hands-on activities are particularly popular. Photo: Ralph Tiner, U.S. FWS, 2001

- Identify groups and individuals who may be interested in cooperating in a fest.
- Organize a preliminary meeting of the interested individuals. At the meeting, identify other groups and individuals who may be interested. Contact them.
- Establish a Fest advisory committee with at least one representative from each of the cooperating parties. Firm up their roles as cooperating and sponsoring parties.
- Appoint a chairman and vice-chairman for the advisory committee (useful for larger fests, not needed for smaller fests).
- Hold a meeting of the whole advisory group. Set goals. Pick a tentative date for the Fest. Pick a tentative location.

- Check out possible facilities. Confirm date and location with facilities and with advisory group.
- Solicit, with the help of the advisory group, exhibits for the Fest from among cooperating and sponsoring parties, others. Solicit individuals willing to conduct wetland walks, bird walks, and demonstrations.
- Publicize the Fest. Create a website, produce a brochure. Notify newspapers.
- Conduct the actual Fest.
- Follow up with thank you letters.

Selected steps are discussed in greater depth below.

Defining Goals for the Fest

Possible goals for your Fest have been listed above. It is important for your advisory committee to agree upon goals because the goals will, in turn, define the intended audience and the Fest activities. The primary goals and primary audience for a Fest may differ somewhat from year to year. For example, the first Fest we conducted was designed to educate the general public. The second fest focused more on educating birders.

Primary and Secondary Audiences

Your goals will determine your audiences. Primary and secondary audiences of a Fest may include:

- Members of the general public, children,
- Teachers,
- Birders, land trust members,
- Fishermen, sportsmen,
- Local, federal, state government officials,
- Landowners, and
- Local artists.

Your advisory committee can help you define the primary and secondary audiences.

Children are often a primary audience for a fest.
Photo: Ralph Tiner, U.S.FWS, 2001

Individuals and Groups Who May Be Interested in Helping With the Fest

We have found that a broad range of parties are interested in helping with a Fest. These include:

- Local offices of national not-for-profit organizations. For example, Audubon Society, Sierra Club, National Wildlife Federation, Ducks Unlimited, Trout Unlimited, and the Nature Conservancy,
- Other local land trusts,
- Academic institutions including local grade schools, middle schools, high schools, and university and colleges,
- Federal agencies with wetland missions such as U.S. Environmental Protection Agency (EPA), U.S. Fish and Wildlife Service (FWS), National Oceanic Atmospheric Administration (NOAA), USDA Natural Resources Conservation Service (NRCS), U.S. Army Corps of Engineers (Corps), and the U.S. Forest Service (USFS),
- State agencies such as the state pollution control and wildlife agencies. State natural heritage staff,
- Local governments,
- Graphic artists, photographers, batik makers, and other artists, and
- Local native plant nurseries (particularly those growing wetland plants).

Advisory group

We recommend that your advisory group include at least one representative from each of the cooperating parties and organizations. You should seek active participants on the advisory group who would be willing to assume responsibility for some portion of the Fest such as publicity, setting up tents, providing financial support, etc. See discussion below.

Issues to be Addressed By the Advisory Group

We recommend that you put together a list of questions you wish your advisory group to address and send or e-mail a copy to each member. Follow this up with a telephone call or e-mail to solicit their individual opinions. We then suggest that you collate the comments and recommendations and share this summary with the larger group through e-mail and an advisory group meeting or conference call.

Sample questions include:

- What should be the goals for the Fest?
- What should be the principal audience for the Fest? Secondary audiences?
- What groups and organizations (or individuals) other than the ones already contacted should be approached as possible cooperating/sponsoring parties?
- Where should the Fest be held?
- When should the Fest be held? What dates should be avoided?
- Who should be approached as exhibitors for the Fest?
- If funds are needed, how much and for what (e.g. rental of tents, tables)? What are possible sources of funds?
- Who will volunteer to do what? See more detail below.

Where Should the Advisory Meeting Be Held?

We suggest that you hold the advisory meeting at the facility you have chosen for your Fest or nearby (if, for example, a town common is to be used). This familiarizes the group with the facility including its strengths and limitations. Meeting face to face also helps coalesce a group and peak the interests of individual members. We suggest that you hold the meeting on an evening or weekend if your advisory group is primarily volunteers since many of the individuals you want for your advisory group may work during the day. If your main cooperators are from government agencies, a meeting during the day is preferable. The meeting can be quite informal. But, we like to go around the table to solicit responses from each advisory member on each issue.

Good Dates for a Fest?

Spring and fall weekends are particularly good times for a Fest although the winter may also be fine in the South. Three of the four Fests we have been associated with have been in May—Wetlands Month. May is a good pick for many areas of the country because it is not too hot or cold and there is great interest in the out-of-doors. Many spring festivals, tulip festivals, and other meetings are held in May. However, April or June or the early fall (September or October) are good picks as well. Coinciding a Fest with fall or spring migration of birds is also a good idea.

We associated the second of the two festivals we conducted with a Fall Fest at an environmental education center which typically attracted 2000 plus individuals to the Fall Fest. Building on an existing fall or spring festival or a birding or other nature festival has several advantages including a guaranteed audience of substantial size and shared responsibility for identifying and locating exhibitors.

Fest Location

If possible locate the Fest in a beautiful location at or near a wetland if possible so that wetland walks and wetland bird watching are possible. Locating a Fest at or near a wetland can also help with the ambiance of the Fest and public appreciation of wetland functions and values. Walking tours can be an important part of a Fest located at or near a wetland. We located our first Fest at the Emma Treadwell Thacher

Nature Center on Thompson's Lake, New York near Albany. There was a forested wetland several hundred yards from the Center and other wetlands available for walking tours. We located out second Fest at the Five Rivers Environmental Center in Delmar, New York. Several wetlands were nearby. Wetland and birding walks were designed to visit these wetlands.

Location near an urban area will help draw crowds into the meeting. For example, the U.S. Fish and Wildlife Service held two Fests on the Amherst Common in Amherst, Massachusetts. The Common is in the center of Amherst and drew many passersby to the Fest. This location also provided food and beverages nearby and was a benefit to local merchants.

Ample, free parking will also help. Location at a facility with sufficient space for exhibits, displays, parking and other needs of the Fest is also essential. Sufficient space to move indoors in case of inclement weather is helpful. Other relevant questions include: Is the location easy to get to from population centers? Is the facility well known with locals and easily reached? This helps with attendance.

Activities

Some of the activities which may be included in the Fest include:

- Federal, state, and local agency wetland, stream, lake, floodplain program exhibits (materials, videos, local experts)
- Not-for-profit, land trust, academic institution, other wetland, stream, lake, floodplain exhibits
- Demonstrations of chair-caning and basket weaving with wetland plant materials
- Display of wetland plants including medicinal and poisonous wetland plants
- Wetland photographic exhibits
- Wetland oil, water color, pastels, etching, other art displays
- Native wetland plants nurseries displays
- Wildlife rehabilitators and wildlife exhibitors with an emphasis on wetland species (e.g., birds, beavers, muskrats, fish, wildflowers)
- Wetland videos concerning wetland functions and values, restoration, many other related topics
- Music (great if you can find a group or group that performs "environmental" songs)
- Fish tanks
- Distribution of free wetland, streams, floodplain, riparian, educational materials
- Fly tying exhibits
- Fly and reel casting
- Wetland and birding walks
- Self guiding wetland field trip
- Lectures and PowerPoint presentations (e.g., wetlands and birding 101, wetland restoration)
- "Ask the expert" table exhibits and panels
- Wetlands activities for children (e.g., wetland bingo)

Activities for Children

We have found that Fests are popular with children and a major portion of our activities have focused on children. Such activities may include:

- Wetland bingo
- Salamander tunnel (plastic culvert pipe)
- Frog calling contest
- Frog-hop sack races
- Wetland coloring books
- Face painting
- Fly tying

Adults as well as children enjoy the exhibits.
Photo: Ralph Tiner, U.S.FWS, 2001

- Bead stringing (dried wetland berries)
- Wetland flower pressing
- Wetland art contests (need to be set up in advance with schools)

We have found that the publication Wow, the Wonders of Wetlands from Environmental Concern an excellent source of wetland games and activities for children.

Costs

Cost, of course, depends upon what you do. Fests conducted over a many day period with rented facilities may be quite expensive and require $3,000 to $10,000 or more.

On the other hand, one-day wetland fests at free public or not for profit facilities may be put together at a very low cost and entirely with volunteer labor. The first Fest we conducted had no funding and was conducted entirely with voluntary labor. The second one had support from EPA which certainly made things easier. With a little funding we were able to:

- Rent tents for outside exhibits
- Rent display tables
- Purchase apples and candy to be given away to children
- Prepare free CD's and educational materials

Funding

Where can you find funding support for your Fest? We were able to fund the second fest we conducted with government agency (EPA) support. It may be possible to raise money to pay for your Fest in a number of different ways.

- Applying for a grant from a foundation or from a government agency such as a wetland or wildlife agency.
- Soliciting donations of funds or services from local businesses (e.g., seedlings from local plant nurseries).
- Soliciting donations from cooperating not-for- profits.
- Soliciting donations from individuals interested in wetlands, birding.
- Selling food at the Fest (e.g., hot dogs, popcorn, cookies, and cake).
- Selling wetland t-shirts, mugs.
- Conducting a book sale.
- Conducting a silent auction.

Reducing the Costs of a Fest

We have found the following to be useful in reducing costs (perhaps stating the obvious):

- Utilize free host facility,
- Utilize the services of cooperating organizations to help organize, publicize, and conduct the Fest,
- Use volunteers extensively at the Fest, and
- Make the Fest part of an existing annual Fall Fest or Spring Fest.

Publicizing the Fest

We have used a variety of techniques to publicize our Fests:

- Creation of a web page and posting to the Internet,
- Creation of a Fest brochure and poster and posting in food stores, gasoline stations, general stores, schools, other locations throughout the region,
- Notification of local newspapers (often public service announcements are free),
- Contacting science teachers at schools,

- Contacting radio stations, TV stations, cable television stations for free public service announcements, and
- Direct mail to schools; inclusion in school newsletters that go home to parents.

Some Major "Do's and Don'ts" in Designing and Carrying Out a Fest

Some do's include:

- Keep it simple. Too much complexity in scheduling or any other aspect often leads to problems.
- Keep the crowd together as much as possible (don't disperse the exhibits too much).
- Pick a high visibility date and good location.
- Make the event a joint activity with cooperating organizations, share responsibilities.
- Make the festival fun for both the audience and exhibitors.
- Have plenty of child-oriented activities.
- Prepare for rain (unless you are in the desert).
- Acquire event liability insurance if the host organization does not have such insurance.

Some don'ts include:

- Don't make it too complex.
- Don't make it too academic.
- Don't incorporate any element which will be unsafe for the public.

Where to Get Assistance

Often there are individuals in the community who have had experience in conducting festivals who may be able to help with the organization or your meeting.

Federal, state, and local government wetland agency technical staff may be able to help with locating exhibitors and publicizing the Fest.

Wetland festival exhibits may take many forms.
Photo: Ralph Tiner, U.S. FWS, 2001

CHAPTER EIGHT: HELPING LAND TRUSTS

How can local governments, states, and federal agencies help land trusts protect and restore wetlands? Recommendations for such help include:

Provide technical assistance. Land trust staff and members often have the motivation to protect and manage wetlands but lack the expertise in wetland assessment and management. This is particularly true for smaller land trusts. Land trusts can be encouraged and assisted in protecting and restoring wetlands by providing them with technical assistance:

- Local government assistance. Local government planning and zoning staff can help land trusts by providing wetland maps, flood maps, and copies of zoning and other regulations. They can provide copies of community land and water use plans. Local engineering staff (e.g., public works departments) may help land trusts address stormwater and floodplain management issues.
- State wetland agency assistance. These agencies may also supply wetland maps and education materials. They may assist land trusts in restoring wetlands and developing management plans.
- Federal agency assistance. Federal agencies may also supply maps, technical information such as information concerning endangered species and hydrology. Technical assistance is available from the FWS, NRCS, EPA, NOAA and other agencies.
- Teacher assistance. Many primary, secondary and college level schoolteachers have expertise in wetland plants and animals and can help design trails and educational materials. They also may take school children on field trips into wetlands. Contact local schools and colleges.
- Consultant assistance. Some states such as Michigan has compiled lists of wetland consultants which are available online. Some are willing to donate some time to land trusts.

Many land trusts need technical help in wildlife management. Photo: Dennis Larson, USDA NRCS

Form coordinating and support organizations. Land trusts may be assisted in a state or region through the formation of coordinating and support organizations. For example, the Texas Land Trust Council (see http://www.texaslandtrusts.org/) was formed to promote and sustain the conservation efforts of Texas's land trusts. It acts as a clearinghouse, publishes a newsletter, publishes a land trust directory, published a conservation easement handbook, conducts an annual inventory of protected lands in Texas and distributes a conservation "package, which can be tailored to individual land trust needs.

The Maine Land Trust Network serves a similar communications and coordination function. It was formed in 1995 to formalize relationships between the states largest land trust—the Maine Coast Heritage Trust—and the states 88 local land trusts. It acts as a clearinghouse for communication and coordination, provides technical assistance concerning land conservation techniques, and fosters leadership with regard to issues of interest to Maine's land trusts. See http://www.mltn.org/.

The Compact of Cape Cod Conservation Trusts, Inc. (http://www.compact.cape.com/) was formed in 1986 to help coordinate and provide technical assistance to six land trusts on Cape Cod. It now works with 25 local and regional land trusts and watershed associations to acquire and manage important natural areas as open space. It also advises its members on non-profit administration, legal, and tax questions. This is important because most local land trusts are managed by volunteers without expertise in these matters. The Compact also conducts research and carries out projects such as mapping and prioritization of natural areas on the Cape including wetlands.

Provide financial assistance. Land trust wetland protection and restoration efforts may be strengthened through increased funding from Congress, state legislatures, local government councils and private landowners. Land trusts need money for staff and administration and to purchase lands and conservation easements. Most operating money is collected by land trusts from member fees and donations. Many trusts continue to operate on shoestring budgets with a volunteer staff and donated office space. For this reason even small sums of money (e.g. the EPA Five Star Grant Program) can be helpful in assisting land trusts with specific wetland protection and restoration projects. State, federal, and local governments now provide a variety of grants in aid to land trusts. These could be increased. Examples of existing grants include:

- Grants for restoration of wetlands from EPA (e.g., Five Star Wetland Restoration Grant Program), NRCS (Wetland Reserve, Other Programs), US Fish and Wildlife Service (Partners for Wildlife) and other agencies.
- Grants for acquisition of wetlands from the Land and Water Conservation Fund, and other state and federal programs. Funds are also available for land trust acquisition of wetlands from many state open space funds.

Land trusts receive most lands donation of fee or easements. Photo: Don Poggensee, USDA NRCS

Provide continued and strengthened tax incentives for wetland protection at all levels—income tax, estate tax, gift tax, real estate tax. Tax incentives are absolutely critical to land trust protection and restoration activities. The federal government (Congress, the Administration) needs to continue to provide income, gift and estate tax incentives to landowners who donate their wetlands or other lands to land trusts. Some states also provide income tax incentives and real estate tax incentives for wetlands and other open space lands in some states. Congress and state legislatures could assist land trust protection and restoration efforts by enhancing tax incentives.

Provide detailed, accurate, and up to date wetland maps. Land trusts need accurate wetland maps to help them identify wetlands and prioritize acquisition and protection priorities. Accurate maps can also help them with planning and the management of wetlands once acquired. National Wetland Inventory maps are available on-line and in hard copy for most of the U.S. These are useful but have inaccuracies. Cooperative, more detailed mapping for a particular local government unit or area are needed. Other federal agencies such as NOAA and state wetland agencies have also assisted some land trusts map wetlands.

Provide practical and accurate wetland assessment models. EPA, the FWS, the U.S. Army Corps of Engineers and other federal agencies have developed biologically-oriented wetland assessment models such as HGM and IBI models. They could help land trusts by continuing to develop and test these models in cooperation with trusts. They could also help trusts develop other, broader GIS based models reflecting biodiversity, relative scarcity of particular wetland types, ecosystem context, fragmentation, restoration potential, land ownership, threats such as water pollution, and other features relevant to acquisition and management.

Provide data and maps suggesting location of wetland-related endangered species, areas of special biodiversity, natural hazards and other information needed for acquiring and managing lands. Land trusts increasingly desire such data in GIS form in addition to old-fashion maps. For example, the Wells National Estauarine Research Reserve has provided conservation maps for the Kittery Land Trust and the Scarbough Land Trust. See www.wellsreserve.org/cmp/update_2000-12.htm.

Provide training. Federal, state, and local agencies could help land trusts by providing more targeted training for land trust staff, members, and landowners in mapping wetland, assessment of wetlands, management planning, restoring wetlands, creating mitigation banks, addressing exotic species and other management topics.

Provide "how to" manuals. Many land trusts need practical, step-by-step help pertaining to boardwalk construction, control of exotic species, use of fire and other management, and a variety of other topics (see training above) since staff and members lack expertise in many aspects of protection and restoration.

Provide case studies of wetland protection and restoration. Land trusts are particularly interested in the success and failures of other land trusts. Detailed case study examples illustrating particular protection and restoration techniques would be useful.

Conduct joint, management-oriented research. The USGS, EPA and other agencies could help fund and conduct management-oriented research with land trusts. Some priority research topics may include control of exotic species, use of fire in management, restoration techniques, assessment techniques, and the use of GIS.

Help land trusts establish mitigation banks. Land trusts may be able to raise moneys for wetland protection and restoration through operation of mitigation banks. Federal agencies, states, and local governments could help trusts establish banks and provide guidance as to when the use of such banks may be appropriate.

Provide land trusts with educational materials for landowners such as how the protection and restoration of wetlands and related ecosystems can benefit landowners as well as society. Material should be broadly available on the web.

Many trusts are interested in protecting and restoring wetlands but need technical assistance, maps, training and funding help. Photo: Don Poggensee, USDA NRCS

APPENDIX A: "VULNERABLE" WETLANDS

All wetlands in the U.S. are vulnerable (to a greater or lesser extent) to threats such as diking, fills, drainage, climate change, acid rain and air pollution, and changing watershed hydrologic regimes due to watershed development.

Wetlands are partially protected by the Clean Water Act Section 404 program as well as state and local regulations in some states. They are also partly protected by public land management policies and by nonregulatory protection programs such as the Swampbuster program and conservation easements under the Wetland Reserve program.

However, certain types of wetlands continue to be very vulnerable. These include:

- "Isolated" wetlands not clearly connected to other waters—playas, bogs, etc. These are not regulated by the federal Section 404 and Section 10 programs. They are also not regulated at the state or local levels in many states.

- Smaller wetlands not identified on wetland maps. Many smaller wetlands are not located on National Wetland Inventory or state or local wetland maps. Typically state and local regulations only apply to mapped wetlands.

- Wetlands dry much of the time such as vernal pools. Some do not meet strict wetland criteria (e.g., riparian areas in the West). Others do not appear on wetland maps because they were dry in the seasons or years when the air photos used for mapping were taken. Landowners also often do not recognize areas as wetlands, which are dry much of the time to be wetlands.

- Wetlands in urbanizing and other watersheds with changes in water quantity and quality due to development, stormwater management, and other activities. Particularly vulnerable are wetlands located in watersheds with high rates of sedimentation and pollution. Also vulnerable are wetlands located in areas with competing high demands for water (i.e., agricultural water diversions, municipal and industrial water diversion, groundwater pumping).

The help of land trusts, local governments and landowners is needed to protect these wetlands.

APPENDIX B: READINGS, WEBSITES

Chapters One: About Land Trusts: Suggested Readings

Byers, E. and K. Marchetti, 1988. The Conservation Easement Handbook. Land Trust Alliance

Diehl, J. and T. Barrett. 1988. The Conservation Easement Handbook: Managing Land Conservation and Historic Preservation Easement Programs. Trust for Public Land, San Francisco

Gustanski, J. and R. Squires. 2000. Protecting the Land: Conservation Easements Past, Present, and Future. Island Press

Hopper and Cook. 2004. The Conservation Finance Handbook: How Communities are Paying for Parks and Land Conservation

Land Trust Alliance. 1990. Starting a Land Trust, A Guide to Forming a Land Conservation Organization. Land Trust Alliance

Lind, B. 1991. The Conservation Easement Stewardship Guide, Designing, Monitoring, and Enforcing Easements. Land Trust Alliance and Trust for Public Lands

McQueen, M. and E. McMahon. 2003. Land Conservation Financing. The Conservation Fund, Island Press

Mitch, W. & J. Gosslink, 2nd Ed., 1993. Wetlands. Van Nostrand Reinhold, New York

Chapters One: About Land Trusts: Suggested Websites

http://www.lta.org/
Land Trust Alliance. Many links. Excellent collection of publications for sale.

www.epa.gov/owow/nps/ordinance/
U.S. Environmental Protection Agency. Collection of model ordinances to protect local resources

http://www.jacksonbottom.org/
Jackson Bottoms Wetland Preserve

http://www.nrcs.usda.gov/technical/stream_restoration/
Federal Interagency Stream Restoration Working Group, Stream Corridor Restoration: Principles, Processes, and Practices.

www.smartgrowth.org/Default.asp?res=1024
Smart Growth Online.

http://aswm.org/wbn/current.htm
ASWM, Wetlands Breaking News

Chapter Two: Overview of Protection and Restoration Techniques: Suggested Readings

See readings listed for Chapters 3-7.

Chapter Two: Overview of Protection and Restoration Techniques: Suggested Websites

http://www.wetlandsconservancy.org/index.shtml
The Wetlands Conservancy – Oregon.

http://www.wetlandsconservancy.org/heroic_tales.html
Heroic Tales of Wetland Restoration (Book). Oregon Wetland Conservancy.

http://www.sonomalandtrust.org/index.htm
Sonoma Land Trust wetland restoration project.

http://www.elkhornslough.org/esf.htm
Elkhorn Slough Foundation wetland restoration projects.

http://www.uri.edu/ce/wq/mtp/html/pawshort.html
Project to identify wetland restoration sites between the Nature Conservancy and the University of Rhode Island.

http://www.tpl.org/tier2_kad.cfm?folder_id=2554#cs8
Trust for Public Lands watershed case studies.

http://www.tpl.org/index.cfm?folder_id=2105
Trust for Public Lands.

http://www.ballona.org/f-about.asp
The Ballona Wetlands Land Trust formed to protect the Ballona wetlands ecosystem.

http://www.bolsachica.org/
Bolsa Chica Conservancy.

http://landtrust.org/
Little Traverse Conservancy (MI) has acquired many properties containing wetlands.

http://www.audubon.org/local/sanctuary/corkscrew/Visit/Visit_Us.html
Audubon Society's Corkscrew Swamp Sanctuary.

http://www.massaudubon.org/Nature_Connection/Sanctuaries/Wellfleet/index.php
Massachusetts Audubon's Wellfleet Bay Sanctuary. Wetlands and boardwalks.

http://www.compact.cape.com/
The compact of Cape Cod land trusts formed to aid land trusts in protecting open space including wetlands.

Chapter Three: Mapping: Suggested Readings

U.S. Fish and Wildlife Service National Wetlands Inventory.

Tiner, R. 1999. Wetland Indicators: A Guide to Wetland Identification, Delineation, Classification, and Mapping. Lewis Publishers, Washington, D.C.

Tiner, R. 1997. "Piloting a More Descriptive NWI." National Wetlands Newsletter. Volume 19, No. 5. Environmental Law Institute, Washington, D.

Chapter Three: Mapping: Suggested Websites

wetlands.fws.gov

Chapter Four: Wetland Assessment: Suggested Readings

Adamus, P. 1996. Bioindicators for Assessing Ecological Integrity of Prairie Wetlands. EPA/600/R-96/082. U.S. Environmental Protection Agency, National Health and Environmental Effects Research Laboratory, Western Ecology Division, Corvallis, OR.

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Adamus, P., E. Clairain, R. Smith, and R. Young. 1987. "Wetland Evaluation Technique (WET); Vol. II: Methodology". Operation Draft Technical Report Y-87. U.S. Army Corps of Engineers Waterways Experiment Station, Vicksburg, Mississippi.

Agency of Environmental Conservation. 1982. Vermont Wetlands: Identifying Values and Determining Boundaries. Montpelier, Vermont.

Ainslie, W.B., Smith, R.D., Pruitt, B.A., Roberts, T.H., Sparks, E.J., West, L., Godshalk, G.L., and Miller, M.V. (1999). "A Regional Guidebook for Assessing the Functions of Low Gradient, Riverine Wetlands in Western Kentucky," WRP-DE-17, U.S. Army Engineer Waterways Experiment Station, Vicksburg. View on-line or download part1.exe & part2.exe.

Ammann, A., and A. Stone. 1991. Method for the Comparative Evaluation of Nontidal Wetlands in New Hampshire. NHDES-WRD-1991-3. New Hampshire Department of Environmental Service, Concord, New Hampshire.

Bartoldus, C. 1999. A Comprehensive Review of Wetland Assessment Procedures: A Guide for Wetland Practitioners. Environmental Concern, Inc., St. Michaels, MD.

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Bartoldus, C., E. Garbisch, and M. Kraus. 1994. Evaluation for Planned Wetlands (EPW). Environmental Concern, Inc., St. Michaels, Maryland.

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Fennessy, S., Jacobs and M. Kentula. 2004. Review of Rapid Methods for Assessing Wetland Condition, U.S. Environmental Protection Agency, Corvallis, Oregon.

Greeson, P.E., J.R. Clark, and J.E. Clark. (eds.). 1979. Wetland Functions and Values: The State of Our Understanding. American Water Resources Association, Minneapolis, MN.

Hayes, D. F., Olin, T. J., Fischenich, J. C., and Palermo, M. R. (2000). “Wetlands Engineering Handbook,’ ERDC/EL TR-WRP-RE-21, U. S. Army Engineer Research and Development Center, Vicksburg. View on-line or download wrpre21.exe.

Hollands, G. and D. Magee. 1995. A Hydrogeomorphic Procedure for Assessing the Functional Capacity of Wetlands. Normandeau Associates, Bedford, NH.

Hruby, T. 1998. “The HGM Dialogue: What is Science and What is Belief?” Society of Wetland Scientists Bulletin. Vol. 15, No. 2. Lawrence, KS. pp. 7-8.

Hruby, T., T. Granger, and E. Teachout. 1999. Methods for Assessing Wetland Functions. Vol. I: Riverine and Depressional Wetlands in the Lowlands of Western Washington. Part 2: Procedures for Collecting Data. Washington State Department of Ecology Publication No. 99-116, Olympia, WA.

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U.S. Environmental Protection Agency. 2002. Methods for Evaluating Wetland Condition (17 Parts). Washington, D.C.

U.S. Environmental Protection Agency, Region IV. 1993. High Risk Geographic Areas Targeted for Wetlands Advance Identification. Wetlands Planning Unit, Atlanta, Georgia.

Washington Department of Ecology. 1991. Washington State Wetlands Rating System for Western Washington. Olympia, Washington.

Chapter Four: Wetland Assessment: Suggested Websites

http://ceres.ca.gov/wetlands/geo_info/cal_wetland_riparian.html
California Wetlands Information System. California Central Valley Wetlands and Riparian Geographic Information Systems Project. Map Site. GIS based wetland and riparian maps for the California Central Valley

www.epa.gov/region01/eco/wetland/contact.html
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Florida Ecological Restoration Inventory. Use of GIS to store information concerning wetland restoration sites in Florida.

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Florida's Wetland Web GIS and Geo-Database. Use of a wetland GIS system to characterize wetlands in Florida, track restoration.

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Kusler, J. 2004. Assessing Functions and Values. Association of State Wetland Managers, Inc., Berne, New York.

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Kusler J. 2004. Wetland Assessment in the Courts. Association of State Wetland Managers, Inc., Berne, New York

http://www.epa.gov/owow/wetlands/bawwg/case.html
U.S. Environmental Protection Agency. Wetlands. Wetland Bioassessment Case Studies. website describing a variety of wetland bioassesment projects for Montana, King County Washington, Oregon, Penn State, North Dakota, Wisconsin, Michigan (and Great Lakes), Ohio, Vermont, Massachusetts, Mid Atlantic (Maryland), Florida, Montana.

www.state.me.us/dep/blwq/monitoring.htm
Maine's Department of Environmental Protection, Bureau of Land & Water. Monitoring & Assessment web page for biological monitoring.

www.4sos.org/wssupport/ws_rest/decid2.html
Monitoring Wetlands: Deciding What to Measure by Tom Danielson.

http://www.soils.usda.gov/
USDA Natural Resources Conservation Service. "Helping People Understand Soils." Access to hydric soils list.

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www.pwrc.usgs.gov/wli/wetassm.htm.
Wetland Science Institute. Wetland Assessment.

http://plants.usda.gov/
USDA Natural Resources Conservation Service. Plants database.

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www.on.ec.gc.ca/wildlife/factsheets/fs_wetlands-e.html
Putting an Economic Value on Wetlands - Concepts, Methods and Considerations. Environment Canada.

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http://www.nal.usda.gov/wqic/Constructed_Wetlands_all/index.html
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http://www.nal.usda.gov/wqic/Bibliographies/conwet2.html
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http://www.nmfs.noaa.gov/habitat/habitatprotection/pdf/Wet%20Res%20Guidance_FINAL.pdf
Interagency Workgroup on Wetland Restoration. 2003. An Introduction and User's Guide to Wetland Restoration, Creation, and Enhancement. National Oceanic and Atmospheric Administration. Washington, D.C.

http://www.csc.noaa.gov/lcr/swamp/text/p661.htm
NOAA SWAMP model. See examples of applications for the SWAMP Model.

http://www.vims.edu/ccrm/cci/adv_id/funcassess.pdf
Virginia Institute of Marine Sciences identification of potential restoration sites to serve specific functions.

http://www.mass.gov/czm/wrp/projects_pages/projects_overview.htm
Massachusetts Office of Coastal Zone Management. Wetlands Restoration Program. Massachusetts restoration projects are described.

http://www.coastalamerica.gov/text/projects/projects.html
Coastal America. Regional Conservation Projects. Restoration projects (listed regionally). Several hundred projects described.

http://www.coastalamerica.gov/text/cwrpprojdesc.html
Corporate Wetlands Restoration Partnership. Brief description of many projects.

http://www.gulfofmaine.org/library/habitat/restoration2.htm
Gulf of Maine Council on the Marine Environment. Gulf of Maine Projects. List of 355 restoration sites or sites with restoration potential.

http://www.gulfofmaine.org/library/habitat/restoration2.htm
EPA's five star restoration program. Brief profiles are provided on 300 projects.

http://www.savelawetlands.org/site/alphabet.html
Louisiana Department of Natural Resource. Coastal Restoration Division. This site has descriptions and links to more than 200 Louisiana coastal restoration projects (many of them wetlands).

http://www.evergladesplan.org/utilities/search.cfm
Listing and description of many separate Everglade's restoration projects. Most are wetlands.

http://www.saj.usace.army.mil/projects/index.html
U.S. Army Corps of Engineers restoration projects in the Everglades

http://www.nrcs.usda.gov/programs/wrp/photo_gallery/Gallery.html
State-by-state photo gallery of NRCS Wetlands Reserve projects.

http://www.photolib.noaa.gov/habrest/bar.htm
NOAA Restoration Center Image Catalog. Brief descriptions and hundreds of photos of NOAA restoration projects.

http://www.dep.state.pa.us/dep/deputate/watermgt/wc/subjects/wwec/general/wetlands/Wetlands.htm
Pennsylvania Department of Environmental Protection. Waterways, Wetlands, and Erosion Control. Description of state wetland restoration projects in Pennsylvania with many before and after pictures. Examination of 69 mitigation sites.

http://www.suscon.org/pir/watersheds/elkhorn.asp
Case study restoration examples from Sustainable Conservation (a not for profit organization).

http://www.nrcs.usda.gov/programs/wrp/states/success.html
USDA Natural Resources Conservation Service, Wetlands Reserve Program Success Stories (17 quite detailed profiles).

http://www.nh.nrcs.usda.gov/technical/Ecosystem_Restoration/Salt_marsh_projects.html#Stuart%20Farm
USDA Natural Resources Conservation Service. New Hampshire Cooperative Salt Marsh Projects. Description of 17 salt marsh cooperative restoration sites in New Hampshire.

http://feri.dep.state.fl.us/
Florida Ecological Restoration Inventory. Florida restoration case studies.

http://www.epa.gov/owow/wetlands/restore/links
Wetlands Restoration Links by State. U.S. Environmental Protection Agency

http://www.srs.fs.usda.gov/charleston/
USDA Forest Service, Southern Research Station. Center for Forested Wetlands Research.

http://www.nrcs.usda.gov/technical/stream_restoration/
Federal Interagency Stream Restoration Working Group, Stream Corridor Restoration: Principles, Processes, and Practices.

http://search.nap.edu/books/0309074320/html/
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http://www.soils.usda.gov/use/hydric/
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http://plants.usda.gov/
USDA Natural Resources Conservation Service, National Plant Database

http://www.nwrc.usgs.gov/
U.S. Geological Survey's National Wetlands Research Center online publications.

Chapter Six: Constructing Wetland Boardwalks and Trails: Suggested Readings

Kusler, J. 1994. Guidebook for Creating Wetland Interpretation Sites Including Wetlands and Ecotourism. Association of State Wetland Managers.

Kusler, J. 2004. Common Questions. Wetlands and Ecotourism. ASWM, Berne, New York.

Sinnot, T. 1999. Assessment of the Risks to Aquatic Life From the Use of Pressure-Treated Wood in Water. New York Department of Environmental Conservation.

Chapter Six: Constructing Wetland Boardwalks and Trails: Suggested Websites

http://handbooks.btcv.org.uk/handbooks/content/section/2341
BTCV Handbook Online. Guidelines for boardwalk construction. Useful.

http://www.appalachianenvironment.com/villagegreen.htm
Photos and brief description of Village Green boardwalk.

www.audubon.org/local/sanctuary/corkscrew/Visit/BoardwalkTour.html
Boardwalk Tour - Corkscrew Swamp Sanctuary. This site contains a boardwalk tour at Corkscrew Swamp (excellent).

www.sfrc.ufl.edu/Extension/pubtxt/for5d.htm
Bridges, Boardwalks and Other Wetland Crossings. Design suggestions for boardwalks in wetlands (good).

www.uvm.edu/~kcook3/?Page=cbogd.html&MM=natural_menu.html
Colcester Bog Boardwalk (University of Vermont). Plastic floats and native woods were primarily used.

www.meadowlands.state.nj.us/ec
Meadowlands Environment Center. The Center has several boardwalks.

www.sfrc.ufl.edu/Extension/pubtxt/for5c.htm
Trail Construction. Recommendations for trail construction (good).

http://www.fhwa.dot.gov/environment/fspubs/01232833/found05.htm
Recommendations for wetland trail and boardwalk design.

www.sackville.com/visit/waterfowl/index.html
Waterfowl Park – Sackville. Description of Sackville wetland site.

www.rice.edu/wetlands/PR_Materials/pr02.html
West Eugene Wetlands Self Guided Tour. Rice University.

www.deq.state.mi.us/documents/deq-swq-nps-wec.pdf
Wetland Crossings. Design specifications for wetland crossings in Minnesota.

www.epchc.org/docks_and_boardwalks.htm
Specifications for docks and boardwalks in wetlands (Hillsborough County, Florida)

http://www.ecsu.edu/ECSU/AcadDept/Geology/dismal_swamp.htm
Dismal Swamp wetland boardwalk project.

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Millar, Nancy S. How to Organize a Birding or Nature Festival. American Birding Association. http://www.americanbirding.org/programs/consfestlr.pdf

American Birding Association. List of birding trails in the 50 states. Excellent. http://americanbirding.org/resources/birdingtrails.html

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http://www.birdingamerica.com/links.htm
Birding Links. Excellent site with many links.

http://www.fws.gov/partners/
U.S. Fish and Wildlife Service. Partners for Fish and Wildlife Program. Working Together to Restore Habitat.

http://www.audubon.org/campaign/wetland/map.html
Nation Audubon Society Wetlands Campaign. Audubon at Work on Wetlands. A great resource for any wetlands advocate.

http://www.americanbirding.org
American Birding Association. Much excellent material and many excellent links.

http://www.savingcranes.org/
International Crane Foundation.

http://www.audubon.org/bird/iba/index.html
Audubon. Important Bird Areas Program: A Global Currency for Bird Conservation.

http://www.npwrc.usgs.gov/resource/othrdata/chekbird/bigtoc.htm
U.S. Geological Survey. Northern Prairie Wildlife Research Center. Bird Checklists of the United States. Excellent site.

http://www.geocities.com/ntgreencitizen/birdsandwetlands.html Birds and Wetlands. If You Care About Birds, You Care About Wetlands

http://www.tpwd.state.tx.us/nature/birding/festivals/
Texas Parks and Wildlife. Birding and Nature Festivals of Texas

http://www.horiconmarshbirdclub.com/birdfest/events.cfm Horicon Marsh Bird Festival
http://www.gunflint-trail.com/planner/birding.html
Gunflint Trail Vacation Planner – Birding

http://www.twingroves.district96.k12.il.us/Wetlands/Swamp/SwampFest.html
Kildeer Countryside Virtual Wetlands Preserve. Swamp Tour: Swamp Fest

http://www.crestonwildlife.ca/visit/vosprey/ospreyfest.html
Creston Valley Wildlife Management Area. 2005 Osprey Festival

http://northeast.fws.gov/wetlandfest/
U.S. Fish and Wildlife Service. The Wetland Education and Nature Arts Festival, Amherst, Massachusetts.

http://www.fb-net.org/fb-links.htm
Farm Bill Network. Links to Farm Bill Programs

http://www.epa.gov/owow/birds/help.html
U.S. Environmental Protection Agency. Bird Conservation. What You Can Do?