

**COMMON QUESTIONS:
CONSTRUCTING
WETLAND
BOARDWALKS
AND
TRAILS**



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PREFACE

This guide was prepared for land trusts, watershed councils, federal, state, and local land management agencies, landowners and others interested in wetland education, ecotourism or related subjects. The summary 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 a publication J. Kusler et. 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 many individuals who have constructed wetland boardwalks and trails over the last decade.

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Photos by Jon Kusler, Association of State Wetland Managers, Inc., Berne, New York

COMMON QUESTIONS: CONSTRUCTING WETLAND BOARDWALKS AND TRAILS

What purposes may wetland boardwalks and wetland trails serve?

A. 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.

Across the Nation, hundreds of federal and state government natural resource agencies, land trusts, and local governments have constructed boardwalks in wetlands and trails adjacent to and paralleling wetland boundaries in adjacent uplands. 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.

Boardwalks and trails may be used to:

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

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.

What are the key elements of a boardwalk or trail?

A. Key elements include:

- Access trail or road to wetland boardwalk or trail, parking area (often needed), and open kiosk with map and explanatory materials,
- The boardwalk and/or trail,
- A signing system for marking the trail and points of interest including kiosk at the beginning of the trail, and
- Informational brochures.

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



Young bird watcher

In what circumstances are boardwalks needed? How many?

A. 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 all of the 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 utilize at least raised walkways (planks, logs, rocks) or short boardwalks to cross low lying areas.

What overall steps should be followed in constructing a boardwalk and/or trail system?

A. Useful steps for a state, local, or federal wetland owner, land trust, other environmental organization, corporation, or private landowner include:

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

How do you form a working group?



Railings are important

A. 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 can 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.

Federal and state natural resource management agencies (park, wildlife refuge) with staff, expertise, and funding have constructed boardwalks and trails without an external working group. Instead, they rely on an internal team of workers. A working group is a particularly important step for construction of boardwalks and trails on private lands or lands owned by local governments and land trusts where unpaid volunteers must play an essential role.

What sorts of expertise is desirable in such a working group?

A. 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.

What factors should a working group consider in establishing objectives?

A. The working group needs to decide upon the intended audience and goals for the trail and boardwalk. What is the group to achieve with the boardwalk and/or trail? 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.

“...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...”

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.

What should the working group inventory in the wetland and adjacent area?

A. 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 often 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 some 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 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?

What overall considerations should guide design of a boardwalk?

A. 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).
- 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.



Architectural design

- The boardwalk should use construction materials that will resist rot and other deterioration.
- The boardwalk must be designed to withstand 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.

How much will a boardwalk cost per lineal foot?

A. Costs 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 \$20 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.

How can we reduce costs?

A. 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.

Are regulatory permits needed for a boardwalk?

A. They may be, depending upon state and local regulations, 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 fills will require a permit.

Are railings needed for the boardwalk, observation areas? If so, how extensive should they be?

A. Some boardwalks are constructed with no railings where there is little danger if children or adults fall from the boardwalk into the wetland. These are particularly common for 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 then, a determined child may be able to squeeze between the railings. Some boardwalks utilize wire mesh to prevent this, but wire mesh is also not attractive.

What sort of materials should be used for boardwalk construction?

A. 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.

How can boardwalks be constructed to reduce potential flood damages?

A. Flooding is a particular concern in boardwalk construction for wetlands adjacent to major lakes, rivers, or estuaries since many boardwalks in these locations suffer flood damage. Water levels in many wetlands typically fluctuate two to five feet during spring runoff or rainy periods for many inland wetlands. 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 will 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 anticipated flood elevations. But, this may be unsightly and impractical. On the other hand, few not for profits or local governments have sufficient funds to repeatedly rebuild a boardwalk each year.

Several strategies are available to address potential 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 works particularly well for small sections of relatively narrow and lightweight boardwalks.

How are load bearing needs and the capacities of various materials to be calculated?

A. 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.

How can the difficulties with working in water and mud be reduced?

A. 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 continuously “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

How can the impacts of boardwalks and trails upon vegetation and wildlife be reduced?

A. 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.



Observation tower

What purposes may observation blinds, platforms and observation towers serve?

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

What factors should be considered in design and construction of a trail adjacent to a wetland?

A. 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 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.

What sort of signs should be provided for the boardwalk and/or trail?

A. 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.

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.

What tips can be provided for signs?

A. 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.

What sorts of boardwalk/wetland brochures are needed?

A. 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 contact for more information.
- Request the user to return the brochure to the kiosk or trail/boardwalk or entrance point.



Trail Sign, Cape Cod, Maine

What sorts of interpretative programs are appropriate for boardwalks/trails?

A. This will depend, in part, upon the type of the wetland, location, and the needs for the area. However, programs offered by schools, local land trusts, public resource agencies (e.g., state fish and game departments) often 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.

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.

SUGGESTED WEB SITES

<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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An electronic version of this brochure is available in PDF at:

<http://www.aswm.org/brochure/boardwalks.pdf>