



STRATEGY AND PLAN OF ACTION FOR THE WATER TRAILS COMMUNITY

teaching participants about the relationship between land management and stream condition. Understanding and appreciation of current conditions is the first step in conserving and protecting the resources we have left.

This plan lays out multiple strategies for enhancing Iowa's system of state-designated water trails. Some suggest new trail routes. Many strategies simply enhance the use of existing trails for more people while conserving the resources—the soil, water, and vegetation—that make our experience possible. A few strategies recommend new experience types, such as remote, multi-day trips. Most paddlers in Iowa who provided input told us the only reason they don't paddle more frequently is limited time. The water trails program would like to change that by supporting the development of more well-designed trails throughout the state to decrease travel time. We've also developed several standardized features for state-designated water trails in response to paddler and water trail manager support. These features include hazard warning and wayfinding signage as well as access and parking design and will increase water trail user satisfaction and expectations without becoming a burden to water trail developers and managers.



Iowa's water trails bring together people, natural resources and water. And while people are a key component in their success, the water and natural resources make the experience possible. Participants in public strategy development for this water trails plan told us that conserving natural resources and promoting watershed restoration was more important than simply increasing the number of people paddling Iowa streams. This idea began our challenge. We found the best way to meet this challenge was by recommending that water trails be built in ways that match their physical setting. Working with the ways of water when designing a launch, rather than against them, saves money and maintenance time. It also conserves resources. Additional water trail miles promote more eyes on the water, a key element in

Water trails are a unique form of recreation—in its simplest form it consists of floating with minor balance and navigation. However, the ability to reach the water's edge is probably one of the largest obstacles to participation in our state. Federal design standards for parking areas, buildings and access trails exist to broaden the possibility that all people can physically use them. Similar design standards for boat launches on streams don't exist. It is the responsibility of each water trail to consider how to best design access to the water so families and users of all ages and abilities are able to find a way to physically participate. This idea is known as universal design and is incorporated in the design of many things from cookware to urban plazas. Our illustrated manual, *Developing Water Trails in Iowa*, includes design standards for

launches incorporating universal design standards.

As a plan for water trails, much of the discussion in this plan relates to rivers and streams of a large enough size to be navigable. It's important to recognize that the quality and condition of these waterways are a direct reflection of what smaller tributaries and upland parts of the watershed deliver to them. And while water trails consider water and land, we also recognize that successful state designated water trails require functional partnerships between all those integral to the trail planning, development, use and management. Both users and water trail communities benefit from successful trail experiences. Revenues from Iowa's fledgling livery industry generated an estimated \$1.14 million in annual receipts. Revenues from related spending such as fuel, lodging and food bring in an additional \$4 million.



Planning Resources to Consider in Planning New Water Trails

What should be considered in planning new water trails? In addition to visual quality, land use and other traditional data sets, projects are encouraged to consider public data characterizing rivers. Three examples of public data are included here: animal feeding operations, high levels of bacteria in water, and the quality of stream habitat (Figure 11). These three are not intended to be the only information considered. Iowa's expressed interest or concern about each of these when using water trails. Obtaining conceptual-level information concerning each is the first step to understanding your study area. Field work on the stream segment and driving its watershed is also recommended. Additional information for your study area can also sometimes be available from agencies, university researchers, and other organizations.

Understanding what these data sets include, or don't, is more complicated than it seems. Realize that public data bases require frequent updates to be current. Therefore, significant time delays often exist between the time of reported conditions and today. Also realize that changes frequently occur in land use or climate which would impact assessment scoring, if it were repeated at the same location today. Additional information about limitations to these types of public data include:

- **Animal Feeding Operations (AFOs):** AFOs include livestock and poultry feeding operations. The characteristics of each production operation and how manure is managed can vary substantially. Iowa's DNR database is the most complete planning coverage available, but it doesn't include all instances of livestock production. Permits are typically required only for larger animal-size operations.
- **High Levels of Bacteria in Water:** Water quality monitoring assesses the concentration of some common pollutants in Iowa, including bacteria. The amount of data available for planning safe recreational use of water is less than ideal. State water quality monitoring funds are used primarily in areas where pollution is known or suspected to exist. Monitoring records are nearly always by "grab sample"—that is, they collect a single sample of a water body at a specific location and time, rather than a reflection of 24-hour conditions throughout an entire stream reach. Two types of issues related to bacteria terms of human health are discussed:
 - High bacteria counts of fecal bacteria have been linked to urban wastewater treatment plants, livestock production, and under-performing rural home sewage treatment systems
 - Toxins produced by specific forms of cyanobacteria have been linked with nutrient levels in water. Cyanobacteria are also known as blue-green algae (although they are a form of bacteria, not an algae).
- **Quality of Stream Habitat:** Viewing wildlife, particularly birds, reptiles and amphibians, is one of the most frequently mentioned favorite activity of paddlers. Water trail users also seem to appreciate some of the same conditions that fish and other types of wildlife require. Iowa collects data on streams using a method known as the Index of Biotic Integrity (IBI). IBI is a quantitative assessment of the biological health. Qualitative score ranges have been developed from 0 (poor) – 100 (excellent). High IBI scores are correlated with low human impact. Average scores vary between ecoregion.

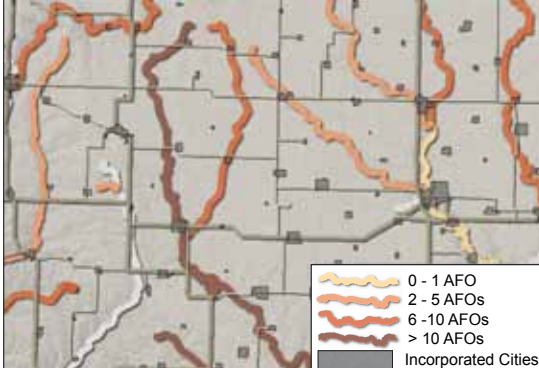
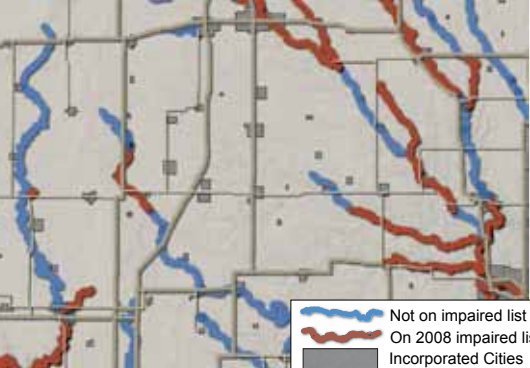
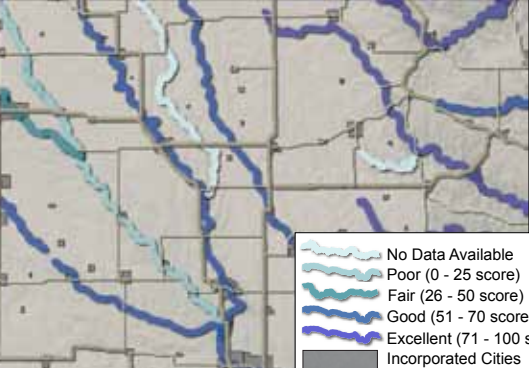
Planning Considerations	Animal Feeding Operations	High Concentration of Bacteria in Water	Quality of In-Stream Habitat
Resource Information Available to the Public	 <p>Example of the number of Animal Feeding Operations (AFOs) permitted within 1,300 feet of stream segments in Iowa</p>	 <p>Example of stream segments included on Iowa's 2008 EPA 303(d) list for impairment due to high concentrations of bacteria</p>	 <p>Example of Index of Biotic Integrity (IBI), Fish Habitat</p>
Why This Matters to Water Trail Experiences	<p>A high density of AFOs near a stream reach has the potential to impact water trail user perceptions and experience.</p> <p>Iowans reported several issues linked to animal production that could potentially negatively impact their experience on a water body:</p> <ul style="list-style-type: none"> *high levels of bacteria present in the water *visual access to the production operation *fish kills resulting from manure spills *if strong odors are present 	<p>One of Iowans most frequently mentioned concerns about using waterways are high levels of bacteria in the water. High fecal bacteria counts can be introduced from urban wastewater treatment plants, livestock production, and under-performing rural home sewage treatment systems. High numbers of organisms per mL can cause sickness, especially among vulnerable populations (elderly, young children, people with auto-immune diseases).</p> <p>Cyanobacteria form dense scums or blooms on the water surface. Some species of cyanobacteria release toxins harmful to people. Toxins have been linked to human health problems from skin contact, ingestion, and respiration of toxins.</p>	<p>Water trail users also seem to appreciate some of the same conditions that fish and other types of wildlife require. These include an intact riparian plant community, clear water, minimal sediment accumulation on top of stream channel rocks and sand, and relatively stable stream banks.</p> <p>Often, what is good for a water trail is also good for fish and other wildlife. More than 70% of wildlife species of regional concern in Iowa require or utilize stream corridors to maintain their population. A successful water trail can be an important momentum-builder to enhance resource conservation in ways that positively impact these species.</p>
Where to Find This Planning Information	<p>Roughly 8,000 AFOs are permitted in Iowa. Iowa's DNR web page provides data on permit locations and details.</p> <ul style="list-style-type: none"> * http://www.iowadnr.gov/afo/index.html <p>Field work in the study stream reach and watershed is the best way to identify all locations of livestock production.</p> <p>Field work on the stream allows a trail planner to determine if AFOs present could possibly negatively impact the visual or air quality experiences of future water trail users.</p>	<p>The Iowa Water Quality Index (IWQI or WQI) includes monthly sampling results for 90 sites in Iowa. Refer to:</p> <ul style="list-style-type: none"> * http://www.igsb.uiowa.edu/wqm/wqi/WqiAllYears.htm * http://www.igsb.uiowa.edu/webapps/iastoret/ <p>Water bodies listed on Iowa's EPA 303d list for impaired waters can be found on Iowa's DNR web page:</p> <ul style="list-style-type: none"> * http://www.igsb.uiowa.edu/wqm/wqa/303d.html <p>Additional information on safe recreational use of water can be found at: http://whqlibdoc.who.int/publications/2003/9241545801.pdf</p> <p>The Iowa Lakes Information System (database of lake sampling and other data):</p> <ul style="list-style-type: none"> * http://limnology.eeob.iastate.edu/lakereport/ 	<p>Not all streams in the state have IBI data available, but a broader variety of study site data are collected when compared with water quality monitoring. Reference (least-impacted sites available) as well as impacted (sites with known problems) have been established in each ecoregion. Assessment results are available from 2004 to 2006 using Iowa's 305(b) reporting:</p> <ul style="list-style-type: none"> * http://www.igsb.uiowa.edu/wqm/wqa/305b.html <p>Relative fish diversity is characterized in navigable stream segments and included in the 2010 Dam Mitigation Plan. This information, in addition to IBI data, provides a strong foundation in understanding a study area.</p>

Figure 11.
Examples of Public Data to Consider in Planning New Water Trails



Planning to Balance Experiences and Geography

Beginning paddlers, in particular, told us they needed the ability to choose a water trail meeting their expectations. The needs of beginners, however, often differ from more experienced paddlers. The goal of the experience classification system Iowa uses is to provide information to approximate the experience paddlers would likely encounter with average flows. Four experience classifications are included: Gateway, Recreational, Challenge, and Wilderness. Planning for water trails requires thought at the river setting scale, the site development scale, and the impact scale.

The purpose of this section of the plan is to recognize potential locations for each of the four experience classification trail types. Not all recommended study areas are expected to develop into state designated water trails, but each holds the potential to develop in a way consistent with the experience classification.

Gateway Experiences

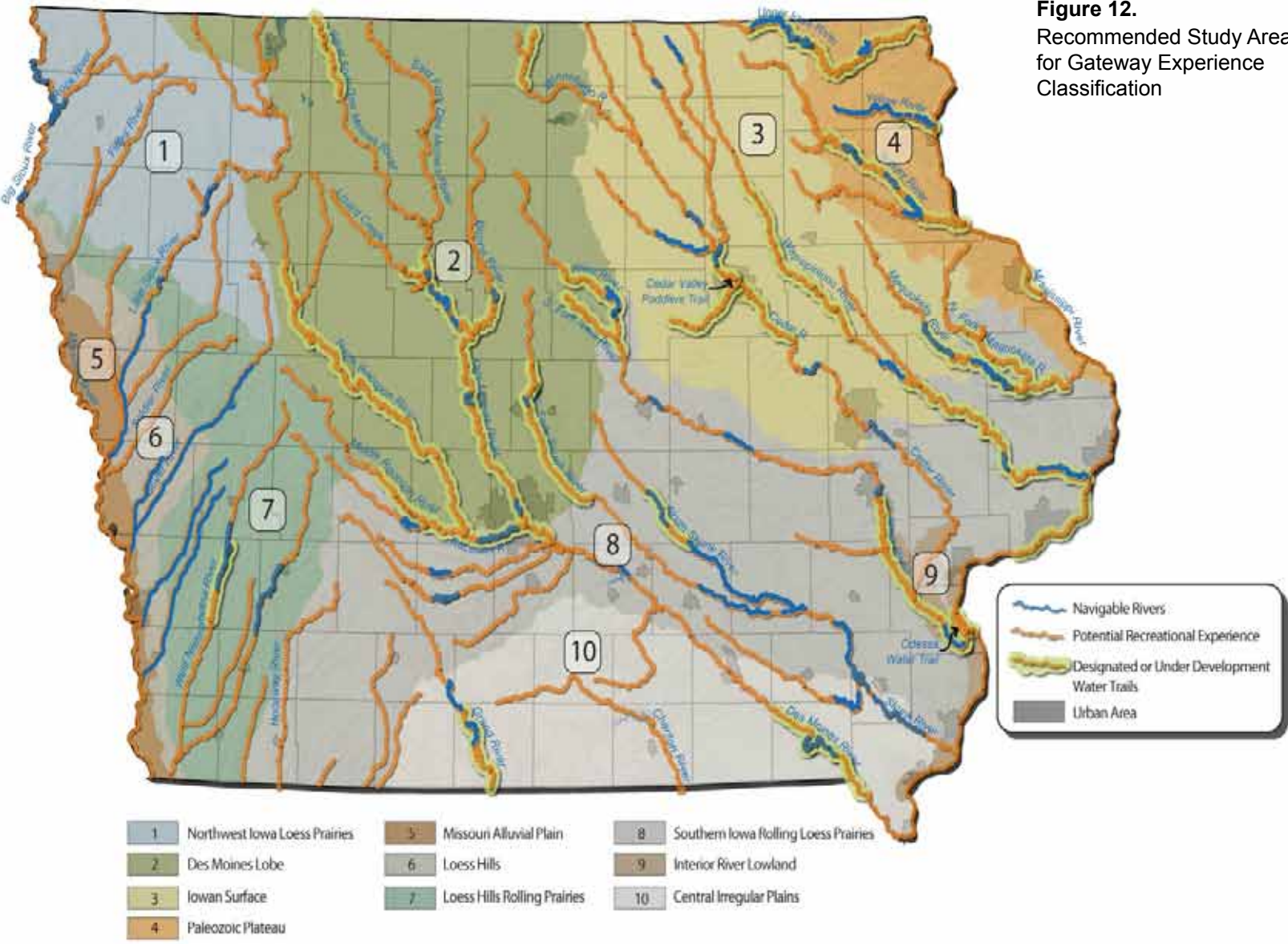
Gateway segments are good introductory trails for beginners and those wanting shorter trips. These segments also typically require a higher level of maintenance due to the amenities present and the high use levels. At the river setting scale, the most critical elements in selecting gateway experiences include segments avoidance of permanent hazards, such as dams, and the length of the segment. Maximum trail segments of 6 or fewer miles seem to work best with this type of user. The channel bottom material is also of some concern. Channels laden with thick deposits of sediment are difficult to navigate at low water levels and usually not recommended for gateway experiences. Ideally, gateway segments of water trails would be located in all regions of the state, close to areas of regional population centers and on rivers already being heavily used for paddling and floating

Figure 12 illustrates river segments with merit as potential gateway water trails. In total, approximately 350 miles

of river are recommended for study. Each ecoregion in the state includes at least one study area. Utilizing existing state park facilities and well-developed county parks for access points is key to the ability to manage a large number of paddlers.

At the site development scale, gateway segment users appreciate access to rental facilities. Actively encourage responsible canoe, kayak, and in some cases inner tube rental businesses. Expect to manage the river and access points in coordination with liveries. Gateway users also appreciate restrooms, hard-surfaced parking and launches, camping and picnic facilities. As these segments are specifically intended for use by families, including older family members, hard-surfaced parking, access trails and access points are critical. Parking areas and access trails designed to meet American's with Disabilities Act (ADA) regulations are encouraged.

Figure 12.
Recommended Study Areas
for Gateway Experience
Classification



Recreational Experiences

Recreational experiences generally require more skill and experience compared with Gateway segments. Parking area and access construction materials may be less stable, such as gravel, and launch locations may be more difficult to access from parking areas.

At the river setting scale, recreational experiences can include some boat maneuvering around hazards and short portages around dams. Recreational experience trail segments are recommended to include 9 or fewer miles—the length of a typical day trip on the water. Recreational trails should be developed with the thought that most lowans have access to a water trails experience relatively close to their home. Interpretation along these water trails would ideally teach users about regional differences such as geology, vegetation, and history. At least minimal amounts of maintenance are expected as these segments are usually heavily used.

Figure 13 illustrates river segments with merit as potential recreational water trails. Appendix B lists these segments. Most ecoregions in the state include multiple study areas. At the site development scale, amenities such as restrooms, changing screens, and developed campsites are sometimes present at access sites.

Challenge Experiences

Challenge experiences are just that – a challenge to paddlers for one or more reasons. Portages around dams, long distances between existing access points, high waves and other risks can be present, requiring advanced boat maneuvering skill. Segments with launches or landings in close proximity to a dam should be reviewed for whether skill would be needed to avoid the hazard. Average paddlers are not encouraged to use these segments so use levels will likely be lower compared to gateway and recreational segments. At the river setting scale, there are few limitations on selecting a challenge route, with the exception of human health. The presence

of challenges or obstacles is more common in designating the length of these segments rather than a maximum length. At the site development scale, challenge segment users require less development in terms of the stability of parking area, trail, and launch materials.

Figure 14 illustrates river segments with merit as potential challenge water trails. Identification of challenge segments is most-appropriately based on local knowledge of a stream, rather than a statewide data analysis. Proposed study areas, therefore, are limited to those on existing water trails recommended by managers or others with paddling experience in the area. In total, 22 segments of river are recommended for study. Appendix C lists these segments.

Wilderness Experiences

People define the concept of wilderness differently. That places untouched by human impact even exist on our planet is debatable. The goal of wilderness water trail segments in Iowa is not to enter this discussion, but rather to provide access to the best places we know of where paddlers can experience

some degree of solitude and separation. Often these segments provide excellent wildlife observation opportunities as well.

Wilderness segment users appreciate remote access points, minimal directional signage and a lack of observable human impact. These trail segments will be most functional when they are long—at least 9 miles and preferably longer. Permanent and temporary hazards are also anticipated. Multi-day experiences are possible when remote camping is available.

Figure 15 illustrates river segments with merit as potential wilderness water trails. In total, approximately 450 miles of river are recommended for study. Appendix D lists these segments. Many ecoregions in the state include at least one study area. Criteria used in identifying these segments, in addition to a remote setting, included an intact forested riparian corridor, minimally developed existing access points, a high percentage of publicly-owned lands bordering the stream, and river intersection with public bird conservation areas.



Figure 13.
Recommended Study Areas
for Recreational Experience
Classification

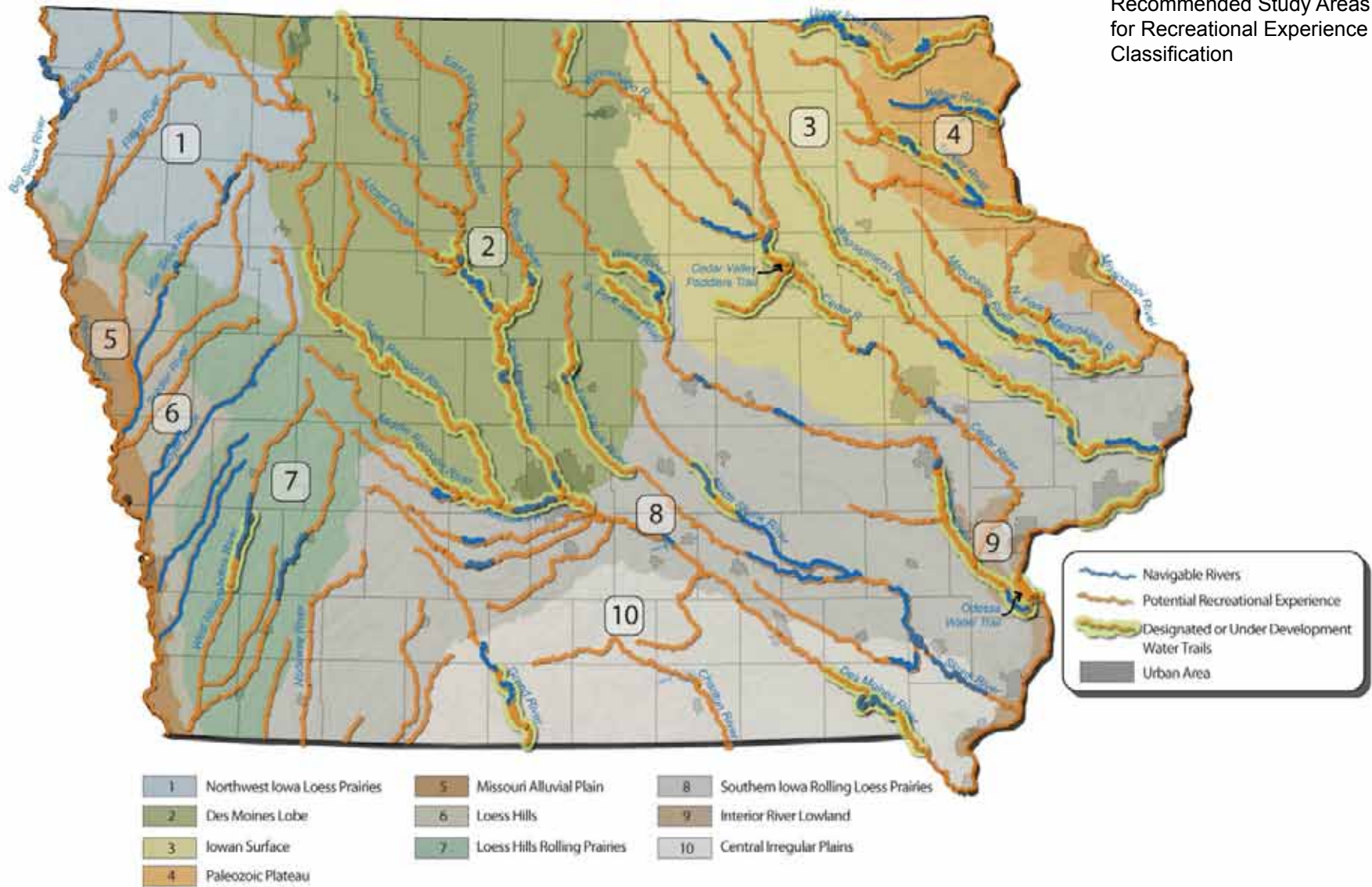


Figure 14.
Recommended Study Areas
for Challenge Experience
Classification

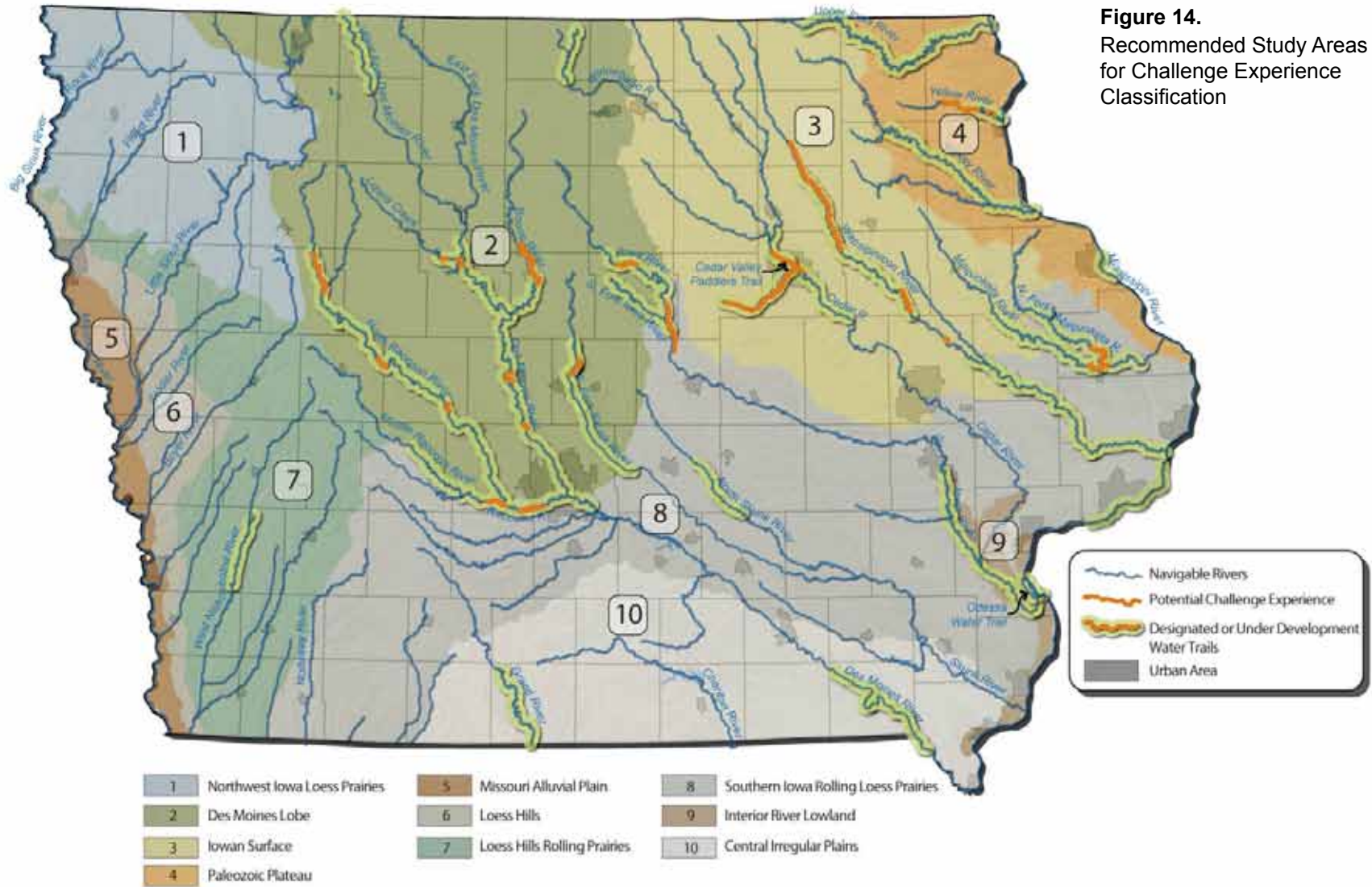
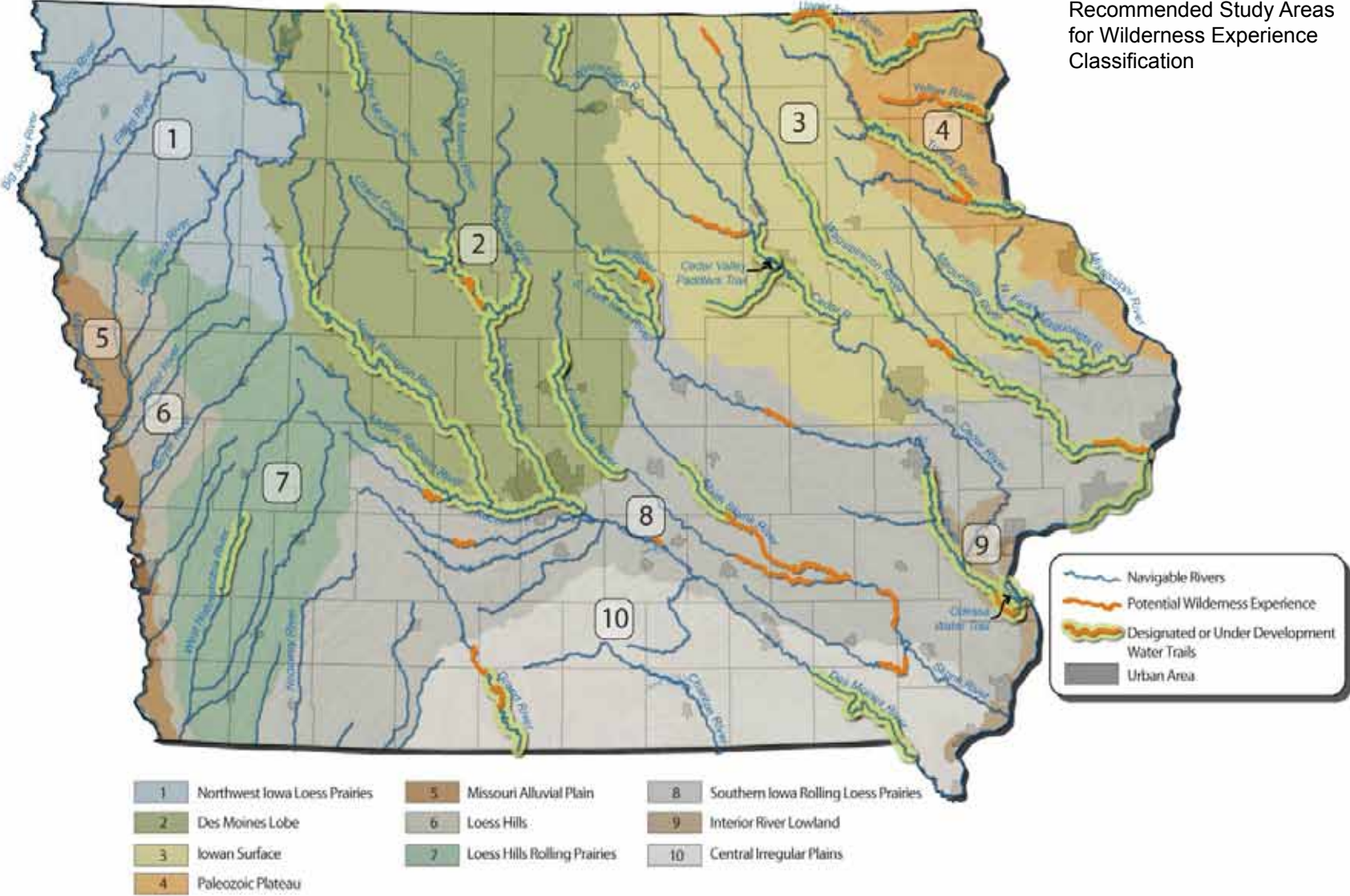


Figure 15.
Recommended Study Areas
for Wilderness Experience
Classification



Water Trails to Promote Specific Interests

Iowans told us their interest in future water trail use can be sparked if trails linked to specific interests existed. The individual identity of trails in the current water trail system is primarily based on the landforms and communities the segment intersects. This new direction is a way for water trails to begin building additional identity and distinguish themselves in the state and region by using the resources present.

This strategy doesn't suggest a change in how experience classifications, signage or other standards of water trail development are implemented. It does suggest that trail experiences can be organized and interpreted to bring new users to the trail or bring new information to people already using it. While new water trails may not be developed solely for these reasons, value can be added to them in terms of public interest using the existing resources and regional differences.

The purpose of this section of the plan is to recognize opportunities for developing and marketing water trails in alternative ways in order to spark interest in using them, help to develop public appreciation for resources and regional differences, and encourage local economies to grow. While people's interests are extremely varied, several consistent themes emerged from our research. These themes included history, local foods, pedal-paddle, and multiple use trail areas.

Human History Tours

It's not a complete surprise that many recognized historic resources in Iowa are aligned closely with rivers, considering how our state developed. When mapped however, the strong overlap in patterns between the two suggests a new collaboration. Rivers with clusters of historic sites visible from on-water or near the water would provide an interesting tour for water trail users, particularly when longer river segments are interspersed with campgrounds and bed and breakfast businesses.

Water trail users with vehicles could follow tour routes with clusters of historic sites within close proximity, but not necessary on the edge of the river.

Iowa includes an abundance of opportunities to learn about history. More than 160 museums are located here. At least one museum is located within 30 miles of every stream segment in our study with several exceptions in Ida, Clayton and Lyon Counties. In addition, nearly 9,000 sites are included in Iowa's National Register of Historic Places. These include bridges, dams, houses, farms, commercial buildings, religious institutions (and a few trees). Approximately 200 bridges in Iowa have been identified by the Iowa Department of Transportation with historic value.

River segments recommended for study for historic interest include the following:

- Des Moines River in southern Van Buren County
- Iowa River downstream of and including Hardin County
- Little Sioux River in Cherokee County
- Rock River near Rock Rapids
- Shell Rock River in Cerro Gordo, Floyd and northern Butler Counties
- Upper Iowa River in Winneshiek County
- Wapsipinicon River

Local Foods Tours

Iowa's connection to agriculture extends far beyond the commodity crops produced on large corporate-owned farms that get the most media and political attention. As our history attests, and the hundreds of farmers markets and community-supported agriculture businesses and community gardens in the state today, Iowa soil and climate conditions are ideal for food production. The local food movement has spread in Iowa over the past 20 years and is based on the notion that food is consumed close to where it was produced. Consumers, institutions and restaurants are examples of those deliberately purchasing these products. Annual crops such as vegetables are common fare. Meat such as lamb, grapes and wine, and orchards and other fruits are also produced and marketed locally in the state. A few farms in the state are also offering visitors on-farm experiences in food production.

Planning to organize water trail segments rich in local food experiences is best conducted at the local and regional scale by groups, organizations and consultants familiar with the industry. Examples of these organizations include Resource Conservation and Development Areas (RC&Ds) and Iowa Councils of Governments (COG's).

Pedal-Paddle Tours

Pedal-paddle participants combine kayaking and bicycling in the same trip. Traditionally, a vehicle is left at the launch location and boats are paddled downstream to the location where a bicycle has been parked. Participants either bike back to the vehicle and drive to pick up the boat, or trailer the boat back to the launch site with their bike. This version of pedal-paddle requires established trails adjacent to river corridors. Corridors recommended for study of traditional pedal-paddle include the following:

- Middle Raccoon River in eastern Guthrie and western Dallas Counties : Raccoon River Valley Trail (16.1 miles of adjacent river and trail)
- South Skunk River in Story County: Skunk River Path and 13th Street Path IV (2 miles of river with intersecting trails)
- West Fork Des Moines River: Three Rivers Trail (10 miles of adjacent river and trail)
- Shell Rock River: Rolling Prairie Trail (8 miles of adjacent river and trail)
- Cedar River in Bremer County: Cedar Valley Lakes Trail and Trolley/218 Trail (34 miles of river and trail in close proximity)
- Des Moines River in Polk County: Neal Smith Trail (6.7 miles of adjacent river and trail)
- Des Moines River in Van Buren County: River Trail (3 miles of adjacent river and trail)
- Black Hawk Creek in Grundy County: Pioneer Trail (11.5 miles of adjacent river and trail)
- Black Hawk Creek in Black Hawk County: Sergeant Road Trail (13.2 miles of adjacent and intersecting river and trails)

An alternative vision of pedal-paddle could allow travel across broad sections of the state on rivers segments, using trail segments to change rivers and continue travel. These tours require multiple days, and adjacent camping facilities. Recommended study areas are listed in Table 6.

North to South Study Area	West Fork Des Moines River (Emmet County)	Intersection with Three Rivers Trail (Humboldt County)
	Three Rivers Trail (Humboldt County)	Boone River (Wright County)
	Boone River (Wright County)	East Fork Des Moines River (Webster County)
	East Fork Des Moines River (Webster County)	Downstream to the state line
Central Study Area	North Raccoon River	Intersection with Raccoon River Valley Trail (Greene County)
	Raccoon River Valley Trail	Intersection with Middle Raccoon River (Dallas County)
	Middle Raccoon River, Raccoon River	(Near) Intersection with Great Western Trail in Des Moines
	Great Western Trail	Intersection with the North River
	North River	Des Moines River
Central to East Study Area	South Skunk River (Story County)	Intersection with Heart of Iowa Nature Trail (Story County)
	Heart of Iowa Nature Trail (trail not complete in this leg)	Iowa River (Marshall County)

Table 6.
Recommended Study Areas
for Pedal-Paddle Tours

Multiple Use Trail Areas

Planners are encouraged to organize water trails with alternative activities and uses to respond to diverse user groups. All members of a group or family may not be interested in water trail use. While some use water trails, others in the group may be interested in fly fishing, hiking, museums, shopping or scenic drives while waiting to provide shuttle support to water trail users in their group. Functional base locations for these groups will be important, particularly those taking advantage of paddling outfitter locations, well-developed parks and environmental learning areas. The following established use types are recommended for integration with state-designated water trail routes where appropriate:

Iowa's state scenic byway system promotes diverse visual experiences. Iowa also includes two national scenic byways, the Loess Hills Scenic Byway and the Great River Road. Web page information provided at <http://www.iowadot.gov/iowasbyways/index.aspx>

Trout fishing in northeast Iowa on cold water streams; Iowa's DNR web page: <http://www.iowadnr.gov/fish/fishing/trout/troutstr.html>

Hundreds of miles of hiking trails exist in Iowa; the Iowa Natural Heritage Foundation provides a database of trails by location and name: <http://www.inhf.org/iowatrails/index.htm>

This planning addressed goals by achieving the following outcomes:

- Developed recommendations for expansion of state designated water trails balancing geography, population, ecologic conditions, and paddling ability
- Developed and implemented a consistent hazard and wayfinding signage system for on-water and on-land viewing
- Developed an experience classification rating system for water trails to help paddlers meet their expectations
- Prepared current design guidelines for parking, trails and launch facilities based on stream characteristics
- Prepared low-impact design guidelines for managing stormwater runoff from access construction
- Prepared stream restoration and stabilization design guidelines to protect launches based on stream restoration methods
- Developed a locally-led planning process for new water trail projects
- Incorporated strategies for incorporating public data in water trail design
- Researched and began to implement existing tools to reduce undesirable behavior on popular rivers

ACTION ITEMS FOR WATER TRAILS

Many goals were met and tasks accomplished in the two-year effort to develop this plan. Important tasks remain, however. The following list prioritizes this work:

Tasks for the Short-Term:

- **Implement hazard warning sign standards** for all dam (2012) and wayfinding signage (2014)
- **Develop and implement a temporary hazard notification system:** temporary hazards to paddlers require communication including health hazards, construction obstructions and flood damage
- **Assess existing slope of walkways and surface types for launches:** It's unclear how many existing launches on state designated and developing water trails provide stable and adequate design and materials to accommodate the elderly and others with special needs. An inventory of amenities will allow future investment in launch enhancement and construction to best serve these users (June 2012)
- **Develop a booklet for paddling enthusiasts, conservationists, and local economic development coordinators :** "*Getting Started: Launching Water Trails in Iowa.*" This booklet will guide citizens groups and interested in organizations in developing and understanding the value of water trails (June 2011)
- **Use volume and activity data:** Collect and organize statewide river use counts and activities based on volunteer field for management and enhancement (June 2012)
- **New online mapping and trail selection system:** The existing online mapping system is unreasonably difficult for the public to use. Changes to roads, launches and dams cannot be updated with the frequency that will be expected by future users (June 2012)

Long-Term Tasks: Use water trail development to strengthen natural resources conservation

- **Continue developing expertise and institutional knowledge in state launch design standards** through monitoring and evaluation. Report results to managers responsible for launches
- **Transition existing and new water trails based on experience classifications and use of the new planning process**
- **Wilderness water trails:** study and develop one or more water trails consistent with this experience classification
- **Training to planners and designers:** to more effectively plan new water trails and develop more efficient budget expectations



Waterways are challenging places to work. A successful water trail system will develop through the efforts of many volunteers, state and federal agency staff, and in some cases professional guidance. Complex settings, such as decisions about whether water trail users should portage around a dam or whether the dam should be modified or removed, often require both social and hydrologic inquiry and attention. Multi-jurisdictional trails are another instance where the skill and experience of a planner or coordinator can pull a vision together into a completed project. Not all water trail designs and plans require professional guidance. But we've learned that having professionals step into a project early in planning can avert unintended consequences.

Iowa has experienced enormous growth in water trails over the past three years. Both participants in this planning and results of research on existing facilities conclude that much understanding of the existing system is still needed. The development of additional water trails should be balanced against better understanding existing trails and their amenities and bringing their standards up to those developed through this planning process.

Resources identified and developed by this planning effort will be refined and streamlined during early phases of implementation. As technologies and social attitudes evolve, this plan provides a solid directions for a burgeoning program to adapt and grow.

Conclusion

*Successful state plans are never the last thing to be written or prepared concerning their subject. The best state plans carve out a new direction. They provide strategies, action guidelines and energy for improvement. **Iowa's Water Trails: Connecting People With Water and Resources** seeks to accomplish this regarding public access to Iowa waterways. While neither lengthy nor complex, it integrates the ideas and needs of many people with resources as they are understood in Iowa.*

Bibliography

- ACA. 2006. Building Community Water Trails. River Rally Workshop 7B. American Canoe Association, Springfield, VA.
- Allan, J.D. 1995. Stream Ecology: Structure and Function of Running Waters. Chapman & Hall, London, UK.
- Allan, J.D. 2004. Landscapes and Riverscapes: The influence of land use on stream ecosystems. Annual Review of Ecology, Evolution and Systematics 35:257-284.
- Altman, N. 2002. Sacred Water: The Spiritual Source of Life. HiddenSpring, Mahwah, NJ.
- Backlund, E.A. & R.D. Bixler. 2006. Place bonding for recreation places: Conceptual and empirical development. Leisure Studies 25:17-41.
- Baylis, K., P. Feather, M. Padgitt, & C. Sandretto. 2002. Water-based recreational benefits of conservation programs: The case of conservation tillage on U.S. cropland. Agricultural Economics 24:384-393.
- Bell, Greene, et al. 2001. Environmental Psychology (5th ed). Harcourt Inc., Orlando, FL.
- Bennett, A.F. 1999. Linkages in the Landscape: The Role of Corridors and Connectivity in Wildlife Conservation. IUCN—The World Conservation Union, Gland, Switzerland.
- Best, L.B., K.E. Freemark, J.J. Dinsmore, & M. Camp. 1995. A review and synthesis of habitat use by breeding birds in agricultural lands in Iowa. The American Midland Naturalist 134(1):1-29.
- Bjerkefors, A., A. Jansson, & A. Thorstensson. 2006. Shoulder muscle strength in paraplegics before and after kayak ergometer training. European Journal of Applied Physiology 97:613-618.
- Breaux, A., S. Farber, & J. Day. 1995. Using natural coastal wetlands systems for wastewater treatment. Journal of Environmental Management 44:285-291.
- Bricker, K.S. & D.L. Kerstetter. 2002. An interpretation of special place meanings whitewater recreationists attach to the South Fork of the American River. Tourism Geographies 4:396-425.
- Caltabiano, M.L. 1994. Measuring the similarity among leisure activities based on a perceived stress-reduction benefit. Leisure Studies 13:17-31.
- CDC. 1996. Surgeon General's Report on Physical Activity and Health. Centers for Disease Control and Prevention, Atlanta, GA.
- Colby, B. & S. Wishart. 2002. Riparian Areas Generate Property Value Premium for Landowners. The University of Arizona, College of Agriculture and Life Sciences, Tucson, AZ. <http://ag.arizona.edu/arec/pubs/riparianreportweb.pdf>. Accessed October, 2009.
- Cottrell, S.P. 2003. Influence of sociodemographics and environmental attitudes on general responsible environmental behavior among recreational boaters. Environment and Behavior 35:347-373. <http://eab.sagepub.com/cgi/content/abstract/35/3/347>. Accessed October, 2009.
- Crane, J.L. Jr. & G.W. Olcott. 1933. Report of the Iowa Twenty-Five Year Conservation Plan. Prepared for the Iowa Board of Conservation and the Iowa Fish and Game Commission.
- Darby, S., & A. Simon. 1999. Nature and Significance of Incised River Channels. In S. Darby & A. Simon (Eds.), Incised River Channels: Processes, Forms, Engineering, and Management. John Wiley & Sons, Inc., Chichester, UK.
- DeSimone, L.A. 2009. Quality of Water from Domestic Wells in Principal Aquifers of the United States, 1991-2004. U.S. Geological Survey Scientific Investigations Report 2008-5227. U.S. Geological Survey, National Water-Quality Assessment Program, Reston, VA.
- Doss, C.R. & S.J. Taff. 1996. The influence of wetland type and wetland proximity on residential property values. Journal of Agricultural and Resource Economics 21:120-129.
- Farrell-Beck, J.A., and R.H. Meints, 1983, "The Role of Technology in the Fresh-Water Pearl Button Industry of Muscatine, Iowa, 1891-1910," Annals of Iowa 47.
- Finkelstein E.A., I.C. Fiebelkorn, & G. Wang. 2004. State-level estimates of annual medical expenditures attributable to obesity. Obesity Research 12(1):18-24. http://www.idph.state.ia.us/iowansfitforlife/common/pdf/obesity_epidemic.pdf. Accessed October, 2009.
- FISRWG. 1998. Stream Corridor Restoration: Principles, Processes, and Practices. Federal Interagency Stream Restoration Working Group, Washington, DC.
- Hageneder, F. 2001. The Spirit of Trees: Science, Symbiosis, and Inspiration. Continuum, New York, NY.
- Hatfield, J.L., L.D. McMullen, & C.S. Jones. 2009. Nitrate-nitrogen patterns in the Raccoon River Basin related to agricultural practices. Journal of Soil and Water Conservation 64(3):190-199.
- HHS, CDC. 2006. Pediatric nutrition surveillance system. 2006 data from the Iowa WIC Program. U.S. Department of Health and Human Services, Centers for Disease Control and Prevention, Atlanta, GA. http://www.idph.state.ia.us/iowansfitforlife/common/pdf/obesity_epidemic.pdf. Accessed October, 2009.
- Hilty, J.A., W.Z. Lidicker Jr., & A.M. Merenlender. 2006. Corridor Ecology: The Science and Practice of Linking Landscapes for Biodiversity Conservation. Island Press, Washington, DC.
- Hoffman, A., K. Garner, M. Krings, D. Ottney, & R. Becker. 2006. Energy expenditure of recreational kayaking. Journal of Undergraduate

- Kinesiology Research, 2:26-31.
- IAN. 1995a. Iowa Wildlife Management (IAN-401). Iowa Association of Naturalists. <http://www.extension.iastate.edu/Publications/IAN401.pdf>. Accessed October, 2009.
- IAN. 1995b. Keeping Iowa Wildlife Wild (IAN-402). Iowa Association of Naturalists. <http://www.extension.iastate.edu/Publications/IAN402.pdf>. Accessed October, 2009.
- IAN. 1995c. Misconceptions About Iowa Wildlife (IAN-403). Iowa Association of Naturalists. <http://www.extension.iastate.edu/Publications/IAN403>. Accessed October, 2009.
- IAN. 1998. Iowa Fish (IAN-605). Iowa Association of Naturalists. <http://www.extension.iastate.edu/Publications/IAN605.pdf>. Accessed October, 2009.
- IDALS. Living on the Edge: Endangered Species in Iowa. Iowa Department of Agriculture and Land Stewardship. <http://www.agriculture.state.ia.us/livingOnTheEdge/endangeredAnimals.asp>. Accessed October, 2009.
- IDALS. 1999. Iowa Wetlands and Riparian Area Conservation Plan. Iowa Department of Agriculture and Land Stewardship, Soil Conservation Division, Des Moines, IA.
- IDPH. 2006. Iowans Fit for Life: Nutrition and Physical Activity. Iowa Department of Public Health, Des Moines, IA. www.state.ia.us/iowansfitforlife/docs/Iowans_Fit_for_Life_overview_powerpoint.ppt. Accessed October, 2009.
- IDPH. 2007. Health of Iowa: Impact of Overweight and Obesity. Iowa Department of Public Health, Des Moines, IA. http://www.idph.state.ia.us/iowansfitforlife/common/pdf/obesity_impact.pdf. Accessed October, 2009.
- IFRCT. 1994. The Floods of 1993: Iowa Flood Disaster Report. Iowa Flood Recovery Coordination Team, Johnston, IA.
- Iowa DNR. 2005. Iowa Wildlife Action Plan (IWAP). Iowa Department of Natural Resources, Wildlife Bureau, Des Moines, IA. <http://www.iowadnr.gov/wildlife/diversity/committee.html>. Accessed October, 2009.
- Iowa DNR. 2006. Iowa State Comprehensive Outdoor Recreation Plan (SCORP). Responsive Management, Iowa Department of Natural Resources, Harrisonburg, IA.
- Iowa DNR. 2007. Iowa Angler Survey. Iowa Department of Natural Resources, Des Moines, IA.
- Iowa DNR. 2009a. Fisheries Management and Research. Iowa Department of Natural Resources, Des Moines, IA. <http://www.iowadnr.gov/fish/programs/mgmt/mgmtmain.html>. Accessed October, 2009.
- Iowa DNR. 2009b. The FINAL 2008 Iowa list of Section 303(d) Impaired Waters. Iowa Department of Natural Resources, Environmental Services Division, Geological and Water Survey, Watershed Monitoring and Assessment Section, Iowa City, IA. <http://www.igsb.uiowa.edu/wqm/WQA/303d/2008/2008FinalListFactSheet.pdf>. Accessed October, 2009.
- Iowa DNR. 2009c. Iowa 303(d) Listing of Impaired Waters. Iowa Department of Natural Resources, Environmental Services Division, Geological and Water Survey, Watershed Monitoring and Assessment Section, Iowa City, IA. <http://programs.iowadnr.gov/adbnw/impairedwaterslist.aspx>. Accessed October, 2009.
- Iowa DNR. 2009d. Unit 1: Iowa's Wildlife Resource Base. Iowa Department of Natural Resources, Des Moines, IA. <http://www.iowadnr.gov/education/wldresbs.html>. Accessed October, 2009.
- Iowa DNR. 2009c. Methodology for Iowa's 2008 Water Quality Assessment, Listing, and Reporting Pursuant to Sections 305(b) and 303(d) of the Federal Clean Water Act. Iowa Department of Natural Resources, Environmental Services Division, Geological and Water Survey, Watershed Monitoring and Assessment Section, Iowa City, IA. <http://www.igsb.uiowa.edu/wqm/WQA/303d/2008/2008IowaMethodology.pdf>. Accessed October, 2009.
- Iowa DNR. 2009d. Unit 2: Aquatic Life. Iowa Department of Natural Resources, Des Moines, IA. <http://www.iowadnr.gov/education/aqlife.html>. Accessed October, 2009.
- Iowa DNR. 2009e. Water Quality Improvement Plans. Iowa Department of Natural Resources, Watershed Improvement, Des Moines, IA. <http://www.iowadnr.gov/water/watershed/tmdl/tmdl.html>. Accessed October, 2009.
- Jahn, L.R. & E.W. Schenck. 1991. What sustainable agriculture means for fish and wildlife. *Journal of Soil and Water Conservation* 46(4):251-254.
- Jensen, C.R. & S.P. Guthrie. 1985. *Outdoor Recreation in America*. Burgess Publishing Co., Minneapolis, MN.
- Jordan, W.R. III. 2003. *The Sunflower Forest: Ecological Restoration and the New Communion with Nature*. University of California Press, Berkeley, CA.
- Kaplan, R., S. Kaplan, & R. Ryan. 1998. *With People in Mind: Design and Management of Everyday Nature*. Island Press, Washington, DC.
- Kaplan, S. 1995. The restorative benefits of nature: Toward an integrative framework. *Journal of Environmental Psychology* 15:169-182.
- Kaplan, S. & R. Kaplan. 1982. *Cognition and the Environment: Functioning in an Uncertain World*. Abbey Publishing, New York, NY.
- Kramer, L. A., M. R. Burkart, D. W. Meek, R. J. Jaquis, & D. E. James. 1999. Field-scale watershed evaluations in deep-loess soils: II. Hydrologic responses to different agricultural land management systems. *Journal of Soil and Water Conservation* 54(4):705-710.
- Larson, R.W., S.A. Gillman, & M.H. Richards. 1997. Divergent experiences of family leisure: Fathers, mothers, and young adolescents. *Journal of Leisure Research* 29:78-97.
- Liao, W., D.S. Bhargava, & J. Das. 1988. Some effects of dams on wildlife. *Environmental Conservation* 15(1):68-70.
- Louv, R. 2006. *Last Child in the Woods: Saving Our Children from Nature-Deficit Disorder*. Algonquin Books of Chapel Hill, Chapel Hill, NC.
- Marsh, J. "First Iowans Settled by Streams" *Annals of Iowa* (1925): 229-230.
- Meyer, J.L. 1997. Stream health: Incorporating the human dimension to advance stream ecology. *Journal of the North American Benthological Society* 16:439-447.
- Molva, E., J.T. Verhoeven, & A.F.M. Meuleman. 1999. Wetlands for wastewater treatment: Opportunities and limitations. *Ecological Engineering* 12:5-12.
- Murphy, S. 2007a. General Information on Nitrogen. Boulder Area Sustainability Information Network, City of Boulder/USGS Water Quality Monitoring. <http://bcn.boulder.co.us/basin/data/BACT/info/NO3+NO2.html>. Accessed July, 2009.
- Murphy, S. 2007b. General Information on Phosphorus. Boulder Area Sustainability Information Network, City of Boulder/USGS Water Quality Monitoring. <http://bcn.boulder.co.us/basin/data/BACT/info/TP.html>. Accessed July, 2009.
- Naiman, R. J., H. Decamps, & M. Pollock. 1993. The role of riparian corridors in maintaining regional biodiversity. *Ecological Applications* 3(2):209-212.
- NPS. 2006. *Water Trails in Northern America Guiding Principles*. River Network Publication 16. National Park Service, River Trails and Conservation Assistance Program (RTCA) & North American Water Trails, Washington, DC.
- NRC. 2002. *Riparian Areas: Functions and Strategies for Management*. National Research Council, Water Science and Technology Board, Committee on Riparian Zone Functioning and Strategies for Management, Washington, DC. National Academy Press, Washington, DC.
- NRCS. 2009. *Iowa Wildlife Habitat Incentive Program Plan (WHIP)*. Natural Resources Conservation Service. ftp://ftp-fc.sc.egov.usda.gov/IA/Programs/Iowa_2009_WHIP_Plan.pdf. Accessed October, 2009.
- Pawelko, K.A. 2004. Illinois Department of Natural Resources Becoming an Outdoors-Woman (BOW) Program: Factors related to outdoor recreation participation. *Proceedings of the 2004 Northeastern Recreation Research Symposium* 362-372.
- Petersen, W.J. 1941. *Iowa: The Rivers of Her Valleys*. Iowa City, IA: The State Historical Society of Iowa.
- Poff, N., LeRoy, J.D. Allan, M.B. Bain, J.R. Karr, K.L. Prestegard, B.D. Richter, R.E. Sparks, & J.C. Stromberg. 1997. The natural flow regime: A paradigm for river conservation and restoration. *Bioscience* 47(11):769-784.
- Pratt, M., C. Macera, & G. Wang. 2000. Higher direct medical costs associated with physical inactivity. *Physician and Sportsmedicine* 28(10):63-70.

- Pulliam, J. 2009, Sept. 23. Algae in Raccoon Prompt Des Moines to Switch Rivers. Des Moines Register, pp. 1.
- Reilly, M. 2009. Ancient Humans Knew Sustainable Fishing. Discovery News. <http://dsc.discovery.com/news/2009/06/01/sustainable-fishing.html>. Accessed October, 2009.
- Robertson, R.A. & J.A. Regula. 1994. Recreational displacement and overall satisfaction: A study of central Iowa's licensed boaters. *Journal of Leisure Research*. 26:174-181.
- RoperASW. 2004. Outdoor Recreation In America 2003: Recreation's Benefits to Society Challenged by Trends. RoperASW (prepared for The Recreation Roundtable), Washington, DC.
- Rosenberg, D.K., B.R. Noon, & E.C. Meslow. 1997. Biological corridors: Form, function, and efficacy. *Bioscience* 47(10):667-687.
- Schilling, K. 2003a. Relationship of increasing baseflow, changing land use and nitrate concentrations in Iowa's streams. Proceedings of the AWRA 2003 Spring Specialty Conference: Agricultural Hydrology and Water Quality. American Water Resources Association, Middleburg, VA.
- Schilling, K. 2003b. Increased baseflow in Iowa over the second half of the 20th century. *JAWRA Journal of the American Water Resources Association* 39(4):851-860.
- Schilling, K. & M. Helmers. 2008. Effects of subsurface drainage tiles on streamflow in Iowa agricultural watersheds: Exploratory hydrograph analysis. <http://www3.interscience.wiley.com/journal/118720581/abstract>.
- Schley, B. 1971. A Century of Fish Conservation (1871-1971). U.S. Fish & Wildlife Service, National Conservation Training Center. <http://training.fws.gov/History/Articles/FisheriesHistory.html>. Accessed October, 2009.
- Schultz, R. Stream Fisheries Assessments above Rathbun Lake. Iowa Department of Natural Resources, Des Moines, IA. <http://www.iowadnr.gov/fish/programs/research/larger/rathbunstreams.pdf>. Accessed October, 2009.
- Schultz, R. Large-scale Watershed Partnerships: The Key to Quality of Water & Recreation. Iowa Department of Natural Resources, Des Moines, IA. <http://www.iowadnr.gov/fish/programs/research/larger/largewatershed.pdf>. Accessed October, 2009.
- Sweeney, B.W., T.L. Bott, J.K. Jackson, L.A. Kaplan, J.D. Newbold, L.J. Standley, W.C. Hession, & R.J. Horwitz. 2004. Riparian deforestation, stream narrowing, and loss of stream ecosystem services. *Proceedings of the National Academy of Sciences* 101(39).
- Swenson, D., L. Eathington, & M. O'Brien. 2008. Economic Impacts of the 2008 Floods in Iowa. Iowa State University Extension, Ames, IA. http://www.econ.iastate.edu/research/webpapers/paper_12954.pdf. Accessed October, 2009.
- TCPD. 2009. Enhancing Water Resources in Tompkins County: Benefits of Riparian Areas and Stream Buffers. Tompkins County Planning Department, Ithaca, NY. <http://www.tompkins-co.org/planning/Water%20Resources/FINAL%20STREAM%20DOC.pdf>. Accessed October, 2009.
- USDA. 2000. Conservation Buffers to Reduce Pesticide Losses. U.S. Department of Agriculture, Natural Resources Conservation Service, Washington, DC. <http://www.in.nrcs.usda.gov/technical/agronomy/newconbuf.pdf>. Accessed October, 2009.
- USDA Forest Service. 2004. Riparian Restoration. Technology and Development Program.
- E. Eubanks?
- USEPA. 2001. National Coastal Condition Report Fact Sheet. National Coastal Condition Report. U.S. Environmental Protection Agency, Washington, DC.
- USEPA. 2009a. Examples of Approved TMDLs. U.S. Environmental Protection Agency, Washington, DC. <http://www.epa.gov/owow/tmdl/examples/>. Accessed October, 2009.
- USEPA. 2009b. An Urgent Call to Action: Report of the State-EPA Nutrient Innovations Task Group. U.S. Environmental Protection Agency, Washington, DC. <http://www.epa.gov/waterscience/criteria/nutrient/nitreport.pdf>. Accessed October, 2009.
- USEPA. 2009c. National Water Quality Inventory Report to Congress. U.S. Environmental Protection Agency, Washington, DC. <http://www.epa.gov/305b/>. Accessed July, 2009.
- USEPA. 2009d. National Water Quality Inventory: Report to Congress, 2004 Reporting Cycle. U.S. Environmental Protection Agency, Washington, DC. <http://www.epa.gov/owow/305b/2004report/>. Accessed July, 2009.
- USEPA. 2009e. The National Water Quality Inventory: Report to Congress for the 2004 Reporting Cycle—A Profile. U.S. Environmental Protection Agency, Washington, DC. <http://www.epa.gov/owow/305b/2004report/factsheet2004305b.pdf>. Accessed October, 2009.
- USEPA. 2009f. Basic Information about E. coli 0157:H7 in Drinking Water. U.S. Environmental Protection Agency, Washington, DC. <http://www.epa.gov/safewater/contaminants/ecoli.html>. Accessed July, 2009.
- USEPA. 2009g. National Pollutant Discharge Elimination System (NPDES): Overview. U.S. Environmental Protection Agency, Washington, DC. <http://cfpub.epa.gov/npdes/>. Accessed July, 2009.
- USEPA. 2009h. NPDES Permit Program Basics. U.S. Environmental Protection Agency, Washington, DC. http://cfpub.epa.gov/npdes/home.cfm?program_id=45. Accessed July, 2009.
- USFWS. 2007. County Distribution of Federally Threatened, Endangered, Proposed and Candidate Species. U.S. Fish and Wildlife Service, Iowa Field Office, Moline, IL. http://www.fws.gov/midwest/endangered/lists/iowa_cty.html. Accessed October, 2009.
- USFWS. 2009. The National Fish Habitat Action Plan. U.S. Fish and Wildlife Service. <http://www.fws.gov/fisheries/fwco/nfhap/>. Accessed October, 2009.
- USGS. 2001. Nitrate and Phosphorus Levels in Eastern Iowa Streams are Among the Highest in the Nation. U.S. Geological Survey, Reston, VA.
- USGS. 2008. Sources of Nutrients Delivered to the Gulf of Mexico. U.S. Geological Survey, Washington, DC. http://water.usgs.gov/nawqa/sparrow/gulf_findings/primary_sources.html. Accessed October, 2009.
- Venolia, C. 1988. Healing Environments: Your Guide to Indoor Well-Being. Celestial Arts, Berkeley, CA.
- Wagner, M.M. and P.H. Gobster. 2006. Interpreting landscape change: Measured biophysical change and surrounding social context. *Landscape and Urban Planning* 81(1-2):67-80.
- Wagner, M.M. 2008. Acceptance by Knowing? The Social Context of Urban Riparian Buffers as a Stormwater Best Management Practice. *Society and Natural Resources* 21(10):908-920.
- Watson, A.E., K.H. Cordell, & L.A. Hartmann. 1989. Characteristics of wilderness users in outdoor recreation assessments. *Recreation and Park Management: Papers from the First National Symposium of Social Science in Resource Management* 1-10.
- Woltemade, C.J. 2000. Ability of restored wetlands to reduce nitrogen and phosphorus concentrations in agricultural drainage water. *Journal of Soil and Water Conservation* 55(3):303-309.