

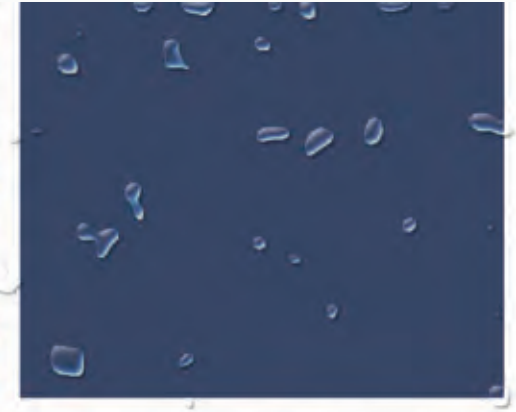

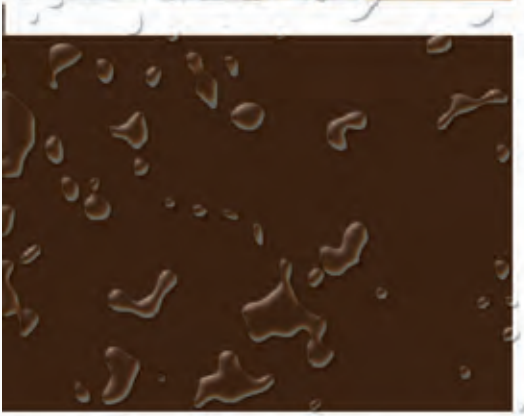




developing water trails in IOWA

practical guidelines and templates for planning, site design, signage, and construction in the state of Iowa

ACKNOWLEDGMENTS

Chapters 1-5 of this manual were written by Mimi Wagner, Iowa State University Department of Landscape Architecture and Nate Hoogeveen, Iowa Department of Natural Resources.

Glenn Harman, Scott Olson, John Wenck, Luke Wright, Emily Haase of Iowa Department of Natural Resources and Stephanie Nelson, Sam Kessel, Megan Corcoran, Kurt Pelzer, Doug Johnston, Carl Rogers of Iowa State University Department of Landscape Architecture assisted with various parts of the text and illustrations.

Special thanks for technical advisement, review and feedback provided by:
Iowa DNR's Water Trails Advisory Committee
Larry Gullet, Jones County Conservation Board
Luther Aadland, Ph.D., Minnesota DNR Stream Restoration Program
E. Sandy Verry, Ellen River Partners
Andrea Chase, Iowa Natural Heritage Foundation Trails Coordinator
Janet Zeller, USDA Forest Service
David Thomson, National Park Service Rivers, Trails and Conservation Assistance Program
Ken Jackson, Iowa DNR engineering bureau
Greg Gelwicks and Bill Kalishek, Iowa DNR fisheries bureau
Erik Wrede, Minnesota DNR water trails program
Mark Edwards, Iowa DNR trails program

Editing and graphic design provided by Brenda Witherspoon, Sam Kessel, Jillian Noble

Initiated, funded, and mandated by the Iowa General Assembly and Governor Chester J. Culver.

REVISION DATE: JUNE 2010

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1 WATER TRAILS IN IOWA

Water trails offer an amazing way to experience remote areas of Iowa. Paddling provides both exercise and relaxation. Beyond directly benefiting people, the thoughtful development and management of water trails offers Iowa a chance to protect fragile ecosystems, as well as to gradually restore low-quality stream reaches and watersheds. Use of water trails, in turn, draws public attention to the state's surface waters and riparian landscapes and can demonstrate the relationship between water quality and land management.

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"... the thoughtful development and management of water trails offers Iowa a chance to protect fragile ecosystems, as well as to gradually restore low-quality stream reaches and watersheds."

INTRODUCTION

The voices of nearly 1,000 Iowans are integrated into the content and strategies included in this development manual. These launch, parking, signage, and stream-management designs represent an updated way of thinking about human interaction and manipulation of streams. An example of this is the recommendation for water trail launches. Rather than suggesting a standard, one-size-fits-all approach to launch construction, water trail developers are coached through decisions about launch locations and construction materials, based on the science of river morphology and engineering.

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. Paddlers and water trail managers strongly supported standardized features for state-designated water trails. These features — such as signage, a menu of adaptable launch types, a statewide system of numbering river miles and related access for navigable streams, and common mapping symbology — increase water trail user satisfaction and expectations. This manual walks each trail project from its earliest planning stages through to streambank stabilization and vegetation choices. Signage design and placement guidelines standardize how drivers are directed to launches, and they help paddlers navigate trails and exit the water safely to avoid hazards.

Successful water trails thrive through strong social relationships between people. Iowa DNR's publication, Getting Started, is a good reference for building these relationships between water trail advocates, local agency staff and outside consultants when needed. The early stages of water trail development include building trust among water trail developers and adjacent stream and riparian landowners. Landowners are critical to trail development because they are often working their land for income and are protective of their property and investments, such as livestock. This trust and understanding, including expectations for how the stream will be used, should be communicated to water trail users at launch sites to foster enduring relationships.

TIMELINE FOR DEVELOPING A WATER TRAIL

The Iowa Water Trails Program supports the responsible development of water trails in all parts of the state. Those trails meeting specific criteria to promote successful experiences are chosen for state designation. Designation, the official recognition that a water trail is part of the state system, occurs after all program requirements have been met and is subject to reversion if conditions are not maintained.

Trail projects seeking state designation are generally new trails developed to meet designation criteria, although existing trails are also encouraged to consider their eligibility by modifying elements as needed. Development of a state-designated water trail generally takes three to five years.

This timeline includes pre-planning, early review, development planning, funding, implementation and, if appropriate, designation (Figure 1-1). Trail implementation is rarely a linear process, instead adapting and re-visioning as opportunities change.Comprehensive plans for water trails are developed before implementation. Funding, however, is generally sought from multiple public and private sources and often arrives in segments rather than all at one time. As such, changes to the original design are sometimes required, including revisions to adapt to design standards or to the amount of funding available. More detail on the development process for water trails is provided in Chapter 2.

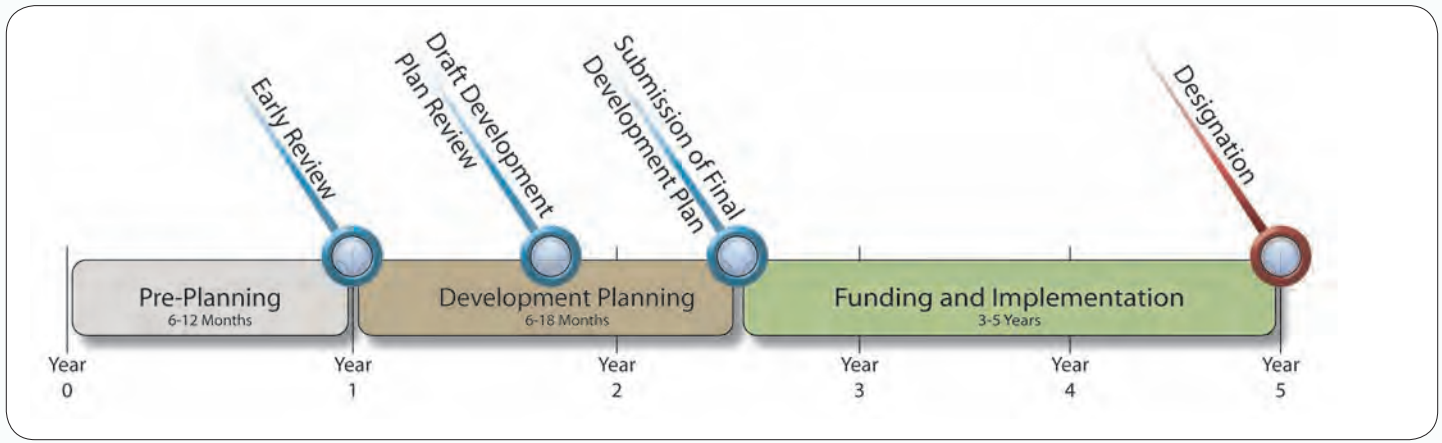

Figure 1-1.
Conceptual Timeline for New Water Trail Development

SUCCESSFUL WATER TRAILS

The state-designation process used in Iowa requires a functional relationship between all those integral to the trail planning, development, use, and management. This relationship is built before applying for state designation. Functional social relationships include community input in trail, launch, and amenity design, as well as considering whether state designation is a critical element of the future trail. Adjacent landowners along a trail route probably have the greatest opportunity to benefit from and also the most concern about water trail development. Water trails are more successful when adjacent landowners support trail use. Likewise, trail sponsors are responsible for developing trust with landowners and ensuring that trail users are informed of trail-use regulations to avoid damaging adjacent property.

Creating water trails that will endure long-term requires significant organization, particularly with multi-county trail routes. Managers of water trail projects are encouraged to foster organization among multiple agencies, such as those responsible for river management, emergency services, and law enforcement, before problems occur.

Water trail sponsorship refers to a relationship among agencies with control over land used for launch sites, trail-maintenance volunteers, and the public. Local paddling groups are a needed part of trail sponsorship, as they often provide important observations about trail use, as well as interest in enhancing water trails. For some construction projects associated with water trails, it is appropriate for paddling group volunteers to raise money and provide construction labor. Volunteers, through both statewide efforts such as Project Aware and local efforts, are the most important source for trash pickup on streams in Iowa. Some management or maintenance exceeds what is possible with volunteers, however. Regular access maintenance, for example, may require equipment or a tractor. For consistent results, a maintenance commitment from a public manager should be obtained for each access along a water trail.

As with all stages of a water trail project, planning and designing the trail and amenities demands both professional expertise and community involvement. Design expertise and knowledge in the early stages of planning can reduce construction and maintenance costs for a project. For example, carefully choosing the appropriate number and spacing of access points on a trail to match the type of trail experience desired will minimize construction expense and maintenance responsibilities post-construction. Understanding the mechanics of how a river flows and its hydraulic properties is valuable for any project requiring dam modification, bank stabilization, or launch siting.

The water in all Iowa rivers is a valuable public resource. Each stream segment holds the possibility for recreational use of some type. To allow the thoughtful development of varied paddling experiences on water, Iowa uses a set of experience designations to help users match river elements with their needs and abilities.

“Successful water trails thrive through strong social relationships between people.”

WATER TRAIL EXPERIENCE TYPES

Paddlers in Iowa told us they wanted to be able to predict the type of experiences they would have on a particular river before deciding where to paddle. Elements of particular interest included the amount of time likely needed for the trip, availability of amenities such as restrooms, appropriateness for use by older paddlers and special-needs populations, and amount of paddling experience necessary. While rivers are inherently unpredictable from day to day in terms of water level and velocity, some river attributes and development decisions provide reasonable predictability. The Iowa Water Trails program goal is to provide the information necessary to allow users to approximate their experiences.

State-designated water trails in Iowa are designed to provide four basic types of experiences: Gateway, Recreational, Challenge, and Wilderness. Each segment of a state-designated trail is assigned one of these experience ratings. This set of experience types reflects the range of conditions available in the state:

- **Gateway experience segments**: At normal flow conditions, these segments provide the most predictable experiences for paddlers. They are good introductory trails for beginners and those wanting shorter trips. Small hazards such as rock riffles or strainers can be easily navigated around. Portage around major hazards is not required. These segments are intended for high use levels. Launch construction includes stable surfaces, such as concrete, often with gentle slopes. Amenities are often available near launch parking areas.
- **Recreational experience segments:** Recreational experiences generally require more skill and experience compared with Gateway segments. At normal flow conditions, some boat maneuvering around hazards may be needed. Short portages are also possible. Launch locations may be more difficult to access from parking areas or may have been constructed with less stable materials such as gravel. Amenities are sometimes present near launch parking areas.
- **Challenge experience segments:** These segments are not for beginners. At normal flow conditions, paddlers will experience a moderate to high number of hazards including logjams, rapids, or other elements such as larger lakes with long open-water crossings and the potential for high waves or limited egress. Multiple short or long portages may be required. Access spacing varies considerably, and amenities are usually not available. Launch areas are usually more difficult to access from parking areas.
- **Wilderness experience segments:** While some contend that Iowa includes no wilderness, the goal of this experience classification is to provide users with what is possible in the state in terms of a paddling experience with minimal human-made distractions and amenities. Launch design and spacing between access points assumes above-average physical condition. Overnight primitive camping facilities may be present, as paddlers on these routes are often looking for multiple-day experiences. Any facilities present are minimal, primitive, and without signage.

LEGISLATION GOVERNING USE OF STREAMS

Water in streams, rivers, and creeks in Iowa is considered public. People are allowed to paddle or navigate on any stream with enough flow to support a small watercraft. Paddlers need some access to land to launch boats and move around channel obstructions, and they often are interested in lunching on sand bars, fishing, wading the length of streams, and exploring land near streams. When property is publicly owned, river users on all streams are allowed to access adjacent land and sand bars, and they are guaranteed on-foot access to channel bottoms. When adjacent land is privately owned, river users have more limited rights beyond floating on streams. These usage rights are based on how a given stream is classified.

Several Iowa rivers were designated "meandered" in original public land surveys for the federal government completed before Iowa received statehood (Figure 1-2). All remaining rivers are designated "non-meandered." The streambeds of meandered rivers, up to the ordinary high-water mark, are considered publicly held property. The stream bed and banks of non-meandered rivers are considered part of the adjacent property. Users of non-meandered rivers have only the right to float on the water surface and wade on the stream bottom. DNR does not advise camping on sandbars on non-meandered navigable streams; on meandered streams, sandbar camping is typically allowed unless specifically prohibited.

In summary, on-foot access to privately owned land beyond the minimum required to launch and navigate include the three following scenarios:

- River users on rivers classified as **meandered** have clear on-foot access rights to the channel bottom and streambanks up to the ordinary high water mark, as those lands are owned by the State of Iowa.
- **Non-meandered** streams with water levels allowing navigation have a tradition of public use and implied rights similar to those of meandered streams, as long as private land within the channel is not used. Water trail developers and users should treat the private ownership of beds and banks with great respect.
- Streams without enough water to allow navigation are classified as "non-navigable" and are not generally considered for water trail development, as they would not be large enough for regular public recreation.

It is important to develop water trails in ways consistent with these criteria and also to communicate these rights to river users with signage at water trail launches.

Landowners with non-meandered streams are allowed to build cross-stream fencing to confine livestock. Conventional conservation practices exclude livestock from entering streams; however, some grazing still exists up to the stream edge. Iowa Code requires that river users must be allowed to navigate through fenced water without injury. River users also have a responsibility to not damage or alter fencing across water. This fencing, where it exists, is often barbed-wire or electric and difficult to maintain against high water.

A number of streams classified as meandered are already state-designated water trails. More miles of non-meandered, navigable streams are suitable for public recreation, and some have already been recognized as state-designated water trails.

Protected Water Areas (PWAs) are important stream segments in Iowa, and they offer interesting opportunities for recreational users. Five scenic rivers across Iowa are designated as PWAs through legislative action (Figure 1-3). Each designation includes management guidelines for adjacent habitats. Water trails developed within PWA corridors require integration of management guidelines, available from the Iowa DNR. In addition, PWA segments often receive additional review in the environmental permitting process. River Programs staff can direct trail developers to appropriate considerations for these valuable stream reaches, including techniques to minimize impact. These considerations may exceed this manual's recommendations for stormwater management, incorporate local ecotypes in vegetative establishment, suggest additional measures for protecting species of greatest conservation need, and incorporate stream restoration principles into access design and construction. The Wilderness experience classification may be appropriate for water trails in PWA corridors, as these regions are typically less developed compared with other landscapes in the state.

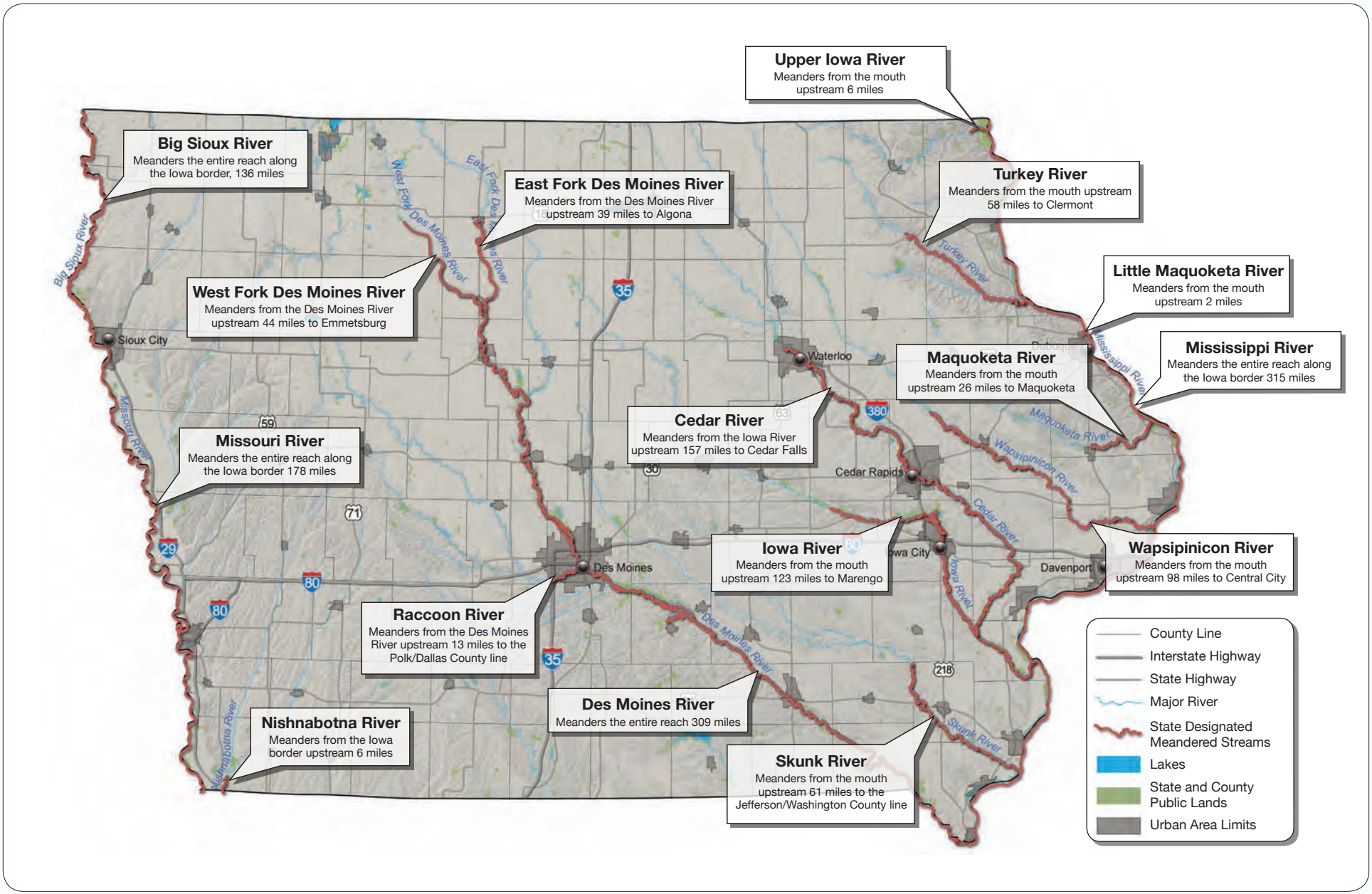

Figure 1-2.
State-Designated Meandered Streams

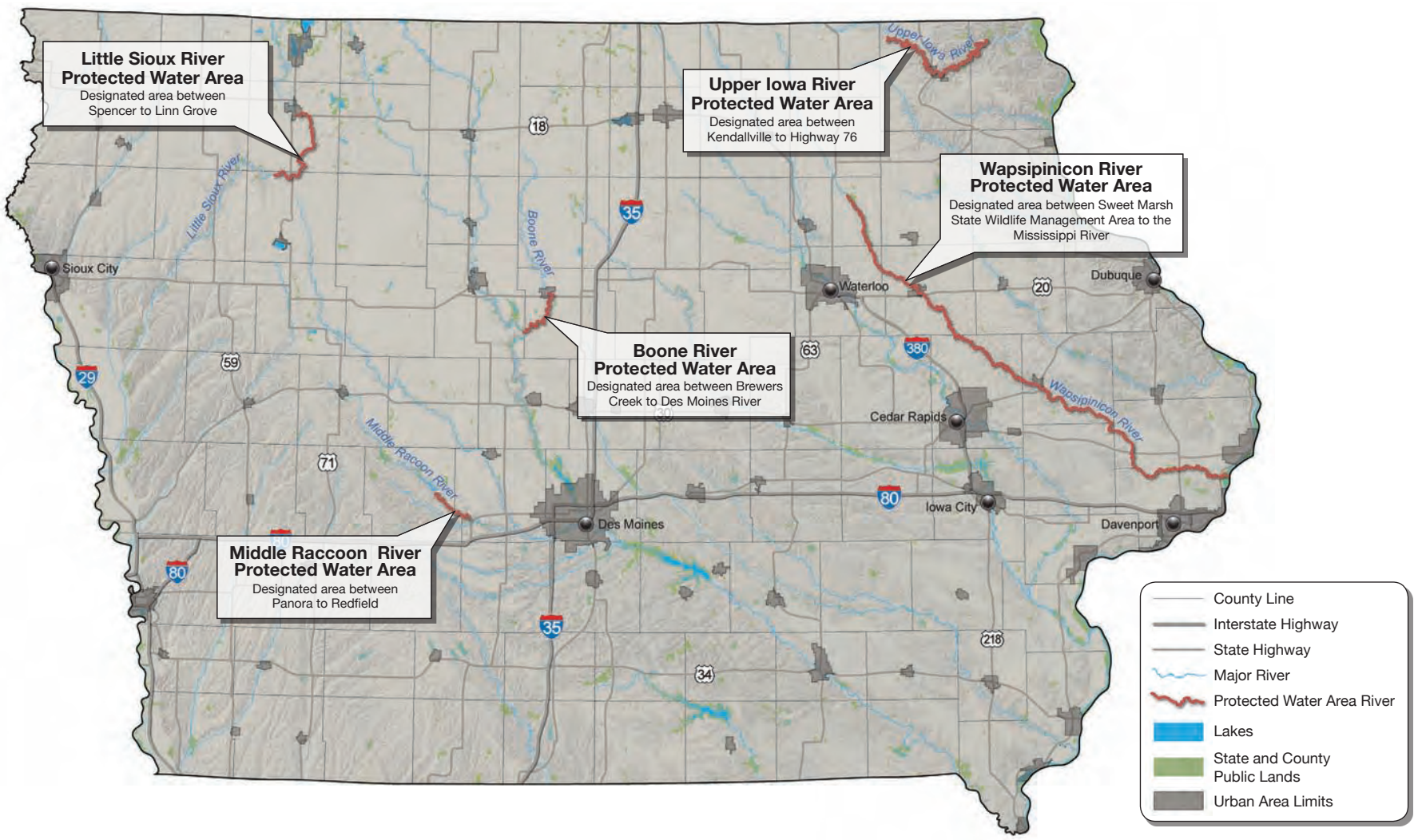

Figure 1-3.
Protected Water Areas

ENVIRONMENTAL PERMITTING

All water trails projects that include moving soil anywhere near a river must file a joint application to Iowa DNR Floodplains, the U.S. Army Corps of Engineers (USACE), and Iowa DNR Sovereign Lands. Projects on streams designated as "meandered" in the State of Iowa must also obtain permission from the Sovereign Lands program. While volunteers can sometimes fill out parts of these applications, the agency in control of the land where the construction will occur is responsible for submitting them. Additional instructions and applications can be found at www.iowadnr.com/other/slands.html.

In some cases, these agencies will issue a response letter stating that a permit is not necessary and, in many cases, the USACE can issue "Nationwide" permits. The Nationwide permit allows a streamlined process when changes or impacts are below a certain threshold. These circumstances include projects that will cause minimal site disturbance and will clearly not result in flood restrictions in the floodplain. Using the following guidelines can reduce turnaround times for permits and response letters. It can also reduce the chance that costs will be incurred for modeling to determine floodplain impacts, wetlands delineation (field surveys conducted by biologists), or mitigation (restoration of wetlands at the site or elsewhere).

Guidelines for a project to be included in the Nationwide permit:

- Use less than 50 cubic yards of net fill. (For example, if you excavate 100 cubic yards of soil and add 150 cubic yards of stone, this can still be permitted.) Certain locations will require zero cubic yards of net fill to be permitted or streamlined.
- Move all extracted material to the upland, or spread excess soil in the floodplain at less than 6 inches in depth.
- Do not discharge soil, water, or other material into an existing wetland.
- Disturb less than 1/10 an acre of wetland.
- Do not place in the water more than 10 cubic yards of material, including riprap, soil, or other materials.
- Do not accumulate debris within a floodplain.
- Do not obstruct the flow of any river.
- Minimize use of bridges or culverts in the floodplain.
- Obtain clearance through the USFWS for Threatened and Endangered Species areas.

Project sites inside a city or county jurisdiction participating in the National Flood Insurance Program may also need local permits before construction. Many cities and unincorporated areas of counties participate. These contacts will be identified by Iowa DNR Floodplains staff as they review application materials.

Additional review during the Floodplains and Sovereign Lands permitting process may apply to project areas along segments of Protected Water Areas.

This information is intended as an aid only. Projects should anticipate at least a 30-day turnaround on permit requests that follow the above guidelines, and some permits for significant channel changes can take as long as a year. Projects exceeding these guidelines may require several months for computations. Please direct specific questions to Iowa DNR Floodplains (515-281-4312), Iowa DNR Sovereign Lands Permitting (515-281-8967), and/or the U.S. Army Corps of Engineers Rock Island District (309-794-5380).

Water trail projects using federal funding are required to develop the projects in compliance with National Environmental Policy Act requirements. Project review by the State Historic Preservation Office is also required. Assistance with these requirements and reviews are usually provided by the funding agency, but project managers should also note that additional time and funds may be necessary. Inventories and reporting, such as archaeological reviews, threatened and endangered species inventory, and other environmental issues may require outside consultants. Specific requirements are variable and based on the scale of the project and the overall project approach.

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2 STATE DESIGNATION OF WATER TRAILS

Experiencing and getting to know a stream often fosters a sense of attachment to the stream as a familiar place. In this way, a new water trail can act as a springboard to motivate residents and landowners to care for and seek enhancements that benefit the stream. Stable, functional watersheds and streams add value to water trail experiences, as well as benefit wildlife and environmental conditions in general. In addition to creating opportunities for recreation, each new water trail allows more sets of eyes on wildlife and stream conditions and can bring public attention to opportunities for local stream and watershed restoration.

2 LIST OF FIGURES AND TABLES

"... each new water trail allows more sets of eyes on wildlife and stream conditions and can bring public attention to opportunities for local stream and watershed restoration."

INTRODUCTION

All water trail projects, whether they seek state designation or not, are encouraged to apply the elements included in this manual. Water trails that become state designated are able to utilize state resources such as technical assistance and review, prioritized DNR-managed funding assistance, listing on the DNR Web site, promotion at various events including the Iowa State Fair, possible future maintenance or enhancement assistance and informational updates. Some developers or managers, however, prefer their water trails not become state-designated for various reasons.

Iowa water trails are developed in ways that match their settings and produce low or no impact on the stream and riparian, or stream-edge, ecosystems. While wildlife viewing is a popular activity from streams in Iowa, some species are sensitive to human presence. Water trail designation includes a review of existing environmental and cultural information to steer launch construction away from locations that may have negative impacts. Launches, new parking areas, and portage trails are designed and built to repair existing damaged landscapes and minimize new impact. Trail developers are encouraged to enhance in-stream habitat and streambank conditions while they are constructing launch sites.

The vision for Iowa's statewide water trail program was developed using the input of nearly 1,000 Iowans from a variety of roles — paddlers, wildlife managers, conservationists, farmers, and environmental educators, to name a few. Trails selected for state designation represent those that provide safe opportunities in a variety of locations, types of landscapes, and stream conditions. Preference is also given to trails able to develop and operate in ways that minimize user impact to the state's sensitive natural resources. Finally, the program strives to present a variety of experience types, responding to diverse boat-handling skills and physical abilities.

State-designated trails are held to a small but consistent set of standards for organization and construction. State designation of water trails does more than point out that recreational opportunities exist. For users, the designation signals that planning has been done to connect experiences users seek (introductory to expert, urban to wilderness) to those they are interested in, and it generates expectations for a certain level of service for a given experience type. That could mean a high degree of infrastructure geared for ease of use and accessibility, or it might mean water experiences in which difficulties and unpredictable conditions (waves for sea

kayakers on a large body of water, rapids, or long stretches of stream with few visual interruptions) may be considered half the fun. Water trail users, especially new paddlers, benefit from positive experiences on streams.

A large part of creating that positive experience at that level is being properly prepared and choosing the right first place to enjoy a river, lake, or wetland. Predictability is more likely on some streams than others. Iowa's program for state-designated trails attempts to provide predictability through consistent signage, launch, and portage trail design, as well as a classification system to help users self-select appropriate water trail segments. Communication via online mapping tools and water trail brochures or web sites will be as important as actual infrastructure improvements. A consistent wayfinding signage system is used to locate access points and also navigate on the river, maintaining consistency when management of accesses changes from one county the next. A system of warning signs directs river users to safely avoid low-head dams and other in-stream hazards.

Each local water trail effort brings a somewhat different mix of goals and existing conditions. For some, the goal is primarily marketing a local resource as part of the mix of local tourism offerings. For others, moving toward solutions to watershed problems or a body of water's health may be a primary motivator. In other cases, local recreational enthusiasts are interested in sharing their activities with a broader audience. For all, benefits of state water trail designation include enhancement funding via the Iowa DNR, marketing assistance from the DNR water trails program, water trail crew assistance, and consistency with neighboring water trails.

The water quality condition or the use classification of a stream or lake can be an important element in determining the quality of recreation. However, water quality condition alone is usually not a factor in determining whether a stream or lake is suitable for state water trail designation. Stream segments or lakes with known long-term impairments affecting human health, such as high bacteria levels, are probably not appropriate for state designation. Temporary impairments can sometimes occur as a result of flooding, drought, or when conditions are right for toxic algae blooms. Warning signage posted at affected access points are used to inform the public of these temporary hazards. These sign designs are included in Chapter 6 of the Iowa Water Trails Development Manual.

A water trail typically begins when an idea catches on among a group of people. Such ideas are shared among local agencies, organizations, and near-stream landowners to develop partnerships. Eventually, one overall sponsoring agency takes leadership and responsibility for the water trail development and future management. Many decisions and plans are required for functional, resilient water trails. The designation process guides each development project through various reviews and design considerations.

A water trail project is eligible for state designation after DNR approval of final design plans and the construction or implementation of amenities included in it, including the installation of all wayfinding and hazard warning signs. Note that continued state designation is subject to maintenance of amenities and trail features, such as signage.

"...the goal is primarily marketing a local resource as part of the mix of local tourism offerings... moving toward solutions to watershed problems or a body of water's health may be a primary motivator. In other cases, local recreational enthusiasts are interested in sharing their activities with a broader audience."

SELECTING A WATER TRAIL EXPERIENCE

Water trail experiences are linked with individual stream settings. Streams typically change as they increase in size, impacting the paddling experience. Narrow, winding stream segments may be challenging in terms of water currents and logjams. Wider, slower-moving streams are often less challenging physically, especially for less-experienced users. Dams may require hazard-avoidance maneuvers in an otherwise easy river. A set of experience types applied to water trail segments between given access points allows users to select stream segment routes meeting their abilities and expectations. The typing system also allows developers to match trail construction and maintenance capabilities with particular stream settings.

Segment length in a water trail refers to the distance between planned access points. Paddlers are looking for segments matching both their ability and the amount of time they have available. Shorter segments are typically paddled more quickly and are considered float trips, while longer segments are considered day or multi-day trips (Table 2-2, see page 2-11). While the Trails Plan 2000 recommended water trail accesses to be spaced every five miles apart, this is no longer encouraged. Frequent access points may seem desirable at first blush, but close access spacing, particularly seven miles or less between access points, is found to often encourage undesirable outcomes such as littering and alcohol consumption.

As mentioned previously in this manual, Iowa's program organizes water trail experiences into four types. Table 2-1 characterizes the experience types. Several examples describe stream segments and locations appropriate for each classification.

Gateway experience example

The Wapsipinicon River from Troy Mills to Pinicon Ridge Park offers a mix of bluff scenery, expansive floodplain woods, wildlife viewing, and several launch options for various lengths of canoe trips, plus a canoe-rental operation run by Linn County Conservation. It is within a 20-minute drive of urban Cedar Rapids. The base of operations is Pinicon Ridge Park at the end of the trip, with landings well upstream of a dam that creates an impoundment. Pinicon Ridge is a full-service tent and RV campground with electricity, drinking water, sanitary pumping, shower houses, playground equipment, and nature trails. Both the river and the park are patrolled by Linn County Conservation rangers. A river segment with a level of management such as this would make an excellent candidate for a Gateway experience water trail for almost any user.

Recreational experience example

The Little Sioux River from Sioux Rapids to the Bluebird Access is an 8.2-mile segment with a pair of access points with adequate parking. Although not required for recreational designation, both also happen to have hard-surface boat ramps that are maintained regularly. The river offers a wooded corridor, wooded hillsides, a rural setting, excellent wildlife viewing, and reasonable fishing opportunities. The Linn Grove Dam is about 400 feet downstream of the Bluebird access, so planned and maintained dam signage would be important for water trail designation. There is no established portage at the Linn Grove Dam, so the water trail would need to end at the access (with signage indicating so) and, if a portage were established, the section downstream of the Bluebird access would be labeled "Challenge," as recreational canoeists or kayakers would not expect to portage.

Challenge experience example

One section of the South Skunk River, from the Anderson Access to Sopers Mill, contains a significant logjam that has caused channel changes, leading in turn to a long set of river-wide obstructions. River users would be required to portage 400 yards around it, through underbrush, with no designated portage trail. Although walking around an obstruction while navigating a stream is not legally considered criminal trespass, practice should not be to encourage a high volume of people to walk on private property. Before an eventual, planned water trail designation, inner-tubers and others have come upon the obstructions unexpectedly. Had they known, most would have chosen a different route. Because of the persistent logjam, an otherwise easy segment should be designated and communicated as a "Challenge" experience trail. Signage at the site may be the most effective way to communicate such a challenge, but DNR data can also be updated to include it.

Wilderness experience example

From Eagle City Access to Pine Ridge Park (near Steamboat Rock) on the Iowa River, Hardin County residents established a greenbelt plan designating the area's overall goal to eventually be a wilderness setting to the greatest degree possible. The plan dates to the 1950s. Over the years, parcels of public land along the river have been accumulated, and significant public ownership of the narrow valley allows a different management approach to the area, focusing on solitude. As the water trail plan was developed with input from the Iowa River Greenbelt Resource Trust, this section was targeted for less amenity development. Overall, the area is managed for wildlife values, a healthy riparian corridor, and low-impact/low-volume recreation. It should be mentioned that "wilderness" in this sense is more of an eventual goal than an existing, pristine pre-condition. That said, the area has the appropriate building blocks, and the goal of the water trail for this segment would reinforce the greenbelt management goals with recommendations to minimize additional development – in particular, construction of new launches where they don't currently exist. Extremely rustic camp sites accessible only by water are not considered detrimental impacts.

Downstream of the Pine Ridge Park is a dam, and a newly established portage around it would make the next segment a "Challenge" experience. Below that, a 6.5-mile scenic segment of stream from Steamboat Rock to Pine Lake State Park with existing amenities could be considered "Gateway," with hard-surfaced/low-slope ramps, and it is already the focus of high-volume recreation with an inner-tubing outfitter available. Restroom facilities are provided at both Pine Lake State Park and the Steamboat Rock launch. Beyond that, the 8-mile segment from Eldora to Bates Park could be considered "Recreational," and the 2-mile segment from the Bates Park launch to the Daisy Long Park landing would currently be a "Challenge" because of a large and persistent logjam.

	Gateway Experience	Recreational Experience	Challenge Experience	Wilderness Experience
User Expectations	— Most predictable, particularly for those with less experience — A paired launch and landing with ramped, hard-surface or well-maintained compacted aggregate slopes generally at 12% or less grade and accommodating widths of 4' or greater — A readily enjoyable setting that will be attractive to new users — Exposure to few hazards relative to other segment types	— Requires some boat control — Intended for users with some experience — Low-head dam hazard signage present, as needed — Varied settings — Basic level of navigational aid (maps, signage)	— User expects to manage risk in hands-on ways — Good boat control necessary — Launch and/or parking may be slightly difficult to very difficult to use — Low-head dam hazard signage present, as needed	— Some degree of solitude, quiet, and viewing of wildlife — Paddling endurance and skill required — Launch and parking areas can be very undeveloped, should strive to be in context with the setting — Wayfinding signage not always present at accesses and on-river — Low-head dam hazard signage present, as needed
Typical Development Goals	— Exposing the greatest number of new users to water trails — Appropriate for extended families and groups of friends — Part-day to full-day trip opportunity — Strong emphasis on building user confidence through signage and ultra-easy launch and parking — Launches, parking, trails designed with Universal Design standards — High degree of environmental educational opportunity	— Offers a typical Iowa water trail experience — Day-trip opportunity — Family and group experiences — Access points may be less developed compared with Gateway experience — Access surfaces may not be stable	— Day- and multi-day-trip opportunity — Low-impact access development may result in more difficult movement from parking to launch: steep slopes, tight turns on trails, or long distances from parking to launch	— Day- and multi-day-trip opportunity — Less development, more restoration and protection of habitats — May include parking in already impacted areas, rustic launches, and rustic remote campsites — Low-impact practices required in all water trails-related construction
Stream Character	— Slow or moderately paced streams to streams with limited riffles — Under normal conditions will have very few, if any, obstacles (although users must still be aware they'll need to avoid common hazards such as snags along banks) — No portages — Often located in or near urban areas	— Vary from narrow and sinuous to wider channel stretches — Some sandbars, rocks, riffles, strainers, or mild rapids under normal conditions — May require short portages — Urban edge or rural setting is typical	— May include faster water and rapids, large lakes, expansive wetland areas — Includes larger lakes with long open-water crossings and power-craft avoidance, potential high waves coupled with areas where steep or rocky shores prevent landing — May include confusing routes that require map-reading skills — May require long or short portages — Moderate to high number of hazards, including logjams, rapids, strainers or others	— Any types of water conditions would be eligible — Setting is remote — Multiple long or short portagespossible — May be "Challenge" elements including unmarked hazards including logjams, rapids, strainers or others

Table 2-1.
Water Trail Experience Classifications

	Gateway Experience	Recreational Experience	Challenge Experience	Wilderness Experience
Access Spacing	≤ 6 miles	≤ 9 miles on average	varies by conditions and development goals	> 9 miles
Maintenance Required	— High level, continual cleanup and repair at launches — Debris removal on stream possible but not likely — Mowing, trash collection, etc. — Regular signage maintenance	— Moderate level of cleanup and repair at launches — Debris removal on stream not likely — Mowing, trash removal possible — Regular signage maintenance	— Low to moderate level of cleanup and repair — Mowing, trash removal possible, but unlikely	— Annual or semi-annual cleanup or repair — Activities geared toward maintaining health riparian corridors, streambanks, and water-quality improvements
Amenities such as restrooms, running water, picnic areas, camping	— Often available at access points — Liveries, shuttle often operating — Wayfinding signage on roadways is more extensive to clearly identify driving route, such as by branching out further to intersections on busier roadways, etc.	— May be available but usually not — Liveries, shuttle desirable	— May be available but usually not — Guided experiences may be encouraged	— Any facilities present, such as remote campsites, are minimal, primitive, and without signage — Guided experiences may be encouraged in place of typical rental businesses
Planning and Management	— Proposed launch sites reviewed for sensitive species by Iowa DNR staff before design or funding request. — A regular maintenance checklist is developed for each segment based on experience classification and adhered to to maintain designation — Law enforcement and emergency response is part of planning process — Possible water-quality monitoring for human threats and water trail posting if threats are present			
	— Launch and landing area designed by engineer or landscape architect according to Universal Design principles included in this manual — Consideration of additional programming for beginners, wildlife watchers, adaptive paddling activities for people with disabilities, etc. — Commitment to conduct regular safety patrols	— A mix of professionally designed projects and staff- or volunteer-constructed projects using design principles included in this manual — Approaches to communicate hazards to users determined before funding requests — Adherence to fairly regular maintenance plan — Commitment to conduct safety patrols as problems arise	— Approaches to communicate hazards to users determined before funding requests — No regular safety patrols but development of a risk-management plan, including maps, rescue plans for higher hazard areas, etc.	— Management targeted to conservation efforts, recreational management and impact mitigation — Requires demonstrated, significant buy-in from owners of the stream bed and banks — Law enforcement and emergency rescue planning focusing on extracting injured people from relatively remote areas with minimum site disturbance

Table 2-1. (Continued)
Water Trail Experience Classifications

WATER TRAIL DEVELOPMENT PROCESS

Water trails developed using a thorough planning process and with the commitment of multiple partners are likely to be successful for many years. The following planning process is adaptable to development of any water trail in Iowa, regardless of whether state designation is a goal. This process is intended to help nonprofit organizations and agencies organize projects and overcome barriers to developing water trails. Note that planning and developing a water trail is not necessarily a linear process. In some instances, planning steps may need to be repeated as funding sources or site conditions change.

Water trail development is better known for thoughtful planning than for speed of the process (Figure 2-1). The first phase, Pre-planning, generally requires six to 12 months to complete. After Early Review approval from DNR, the development of final plans and final approval from DNR generally requires six to 18 months. Construction implementation, including fundraising, often requires two or more years.

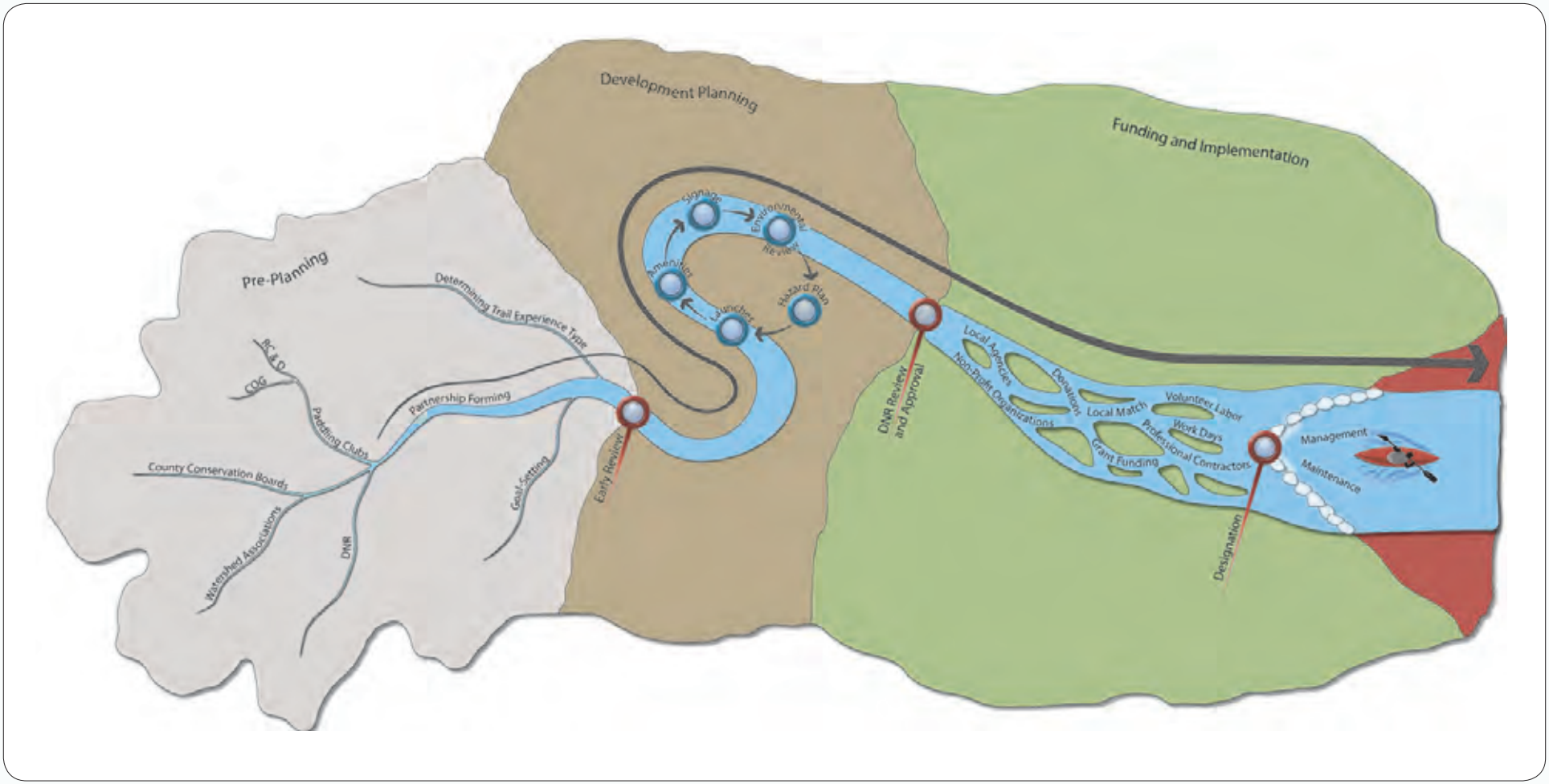


Figure 2-1.
Water Trail Development Process

PRE-PLANNING

This phase of water trail development allows your project the time and space to develop the basics needed for a successful trail. The phase is completed when your pre-planning application is ready for review by Iowa DNR Rivers Section. Refer to Iowa DNR's publication, Getting Started: Launching Water Trails in Iowa, for more detail in the below pre-planning activities. Time spent on these activities is a sound investment in the future water trail. Applications submitted with thoughtful considerations and complete information are likely to progress through Early Review much more quickly than those without.

1. **Express initial interest** to DNR Rivers Programs staff and request an existing access and stream segment inventory form to complete.
2. Form **partnerships** with local agencies, landowners, paddling organizations, community groups, and interested residents. Reaching out to neighboring landowners at this early phase will result in improved relations later. Engage a planner to facilitate the effort using DNR materials. Planners and/or GIS mapping services may be available from a variety of resources; including RC&Ds; regional councils of governments; metropolitan or regional planning authorities; or the National Park Service's Rivers, Trails, and Conservation Assistance Program.

3. Establish **overall goals for the body of water and each segment of the water trail.** Typical goals include consideration of the trail experience appropriate for the setting:

   a. Amount and type of maintenance available, including equipment,
   b. Volume of use expected or desired and the viability for universal access,
   c. Long-term desired outcomes of water trail establishment, including local economic development, education, water-quality enhancement,
   d. Appropriateness of state designation for your stream reach. Some stream reaches, such as those with sensitive species or conditions or where potential parking and access locations are limited, may be better served as water trails without state designation

4. **Consider physical conditions** of the stream stretch and estimate the typical experience it would offer paddlers. Is the stream prone to log and debris dams? Is the current swift or slow? Are portages required to avoid obstacles? Are potential access points readily accessible by vehicles? These and other site inventory questions included in the pre-planning worksheet help focus on reaching your project's goals.

5. Consider a diversity of lengths between launches and landings (Table 2-2) to accommodate different types of activities and abilities — including angling from watercraft and inner-tubing on the shorter end to wilderness adventures on the longer end. Determine whether **special designations** already apply to the stream reach included in the project. Is it included in an Iowa Protected Water Area? Is the segment included on the latest EPA 303d List for Impaired Waters? If so, are there limiting conditions identified in the impairment classification?

6. Complete a pre-planning worksheet and sketch map and submit to IDNR (Figure 2-2). Note the river-mile labeling system used for all water trail projects in Iowa. All communications with DNR during water trail development, as well as on water trail maps for paddlers, use this river-mile labeling system. Stream mile numbers are established for each stream beginning at the mouth of the stream and moving upstream to the state boundary (Figure 2-3).

Short Segments Float Trips	Mid-Length Segments Typical Day Trips	Longer Segments Expedition Trips
Generally 2 to 6 miles, sometimes up to 7 miles depending on river character	Paddling excursions generally 5 to 9 miles, depending upon river character	Paddling excursions greater than 9 miles in length can be either long day trip or include overnight camping
Ideal for angling float trips, if crowding is unlikely to "ruin" fishing	Reduced angling opportunities, as more time is spent paddling	Angling can take a different character, particularly when based from remote camping areas
Potential for high-density use increased by: — Close proximity to urban area or university — Highly scenic setting — Livery with shuttle service	Mid-range use levels reduced by: — A highly visible setting (directly in an urban park, for example) — Challenging river conditions — Challenging access — Unreliable water levels	Longer segments encourage passive users to select other segments. Active users become primary users as additional challenges such as rapids, logjams, and challenging access increase
Focus can become lighthearted social experience, higher potential for alcohol consumption, poor judgment, incidents, and conflicts, with increased law-enforcement or emergency responses	Experiences will range broadly depending upon goals, occasional law-enforcement and emergency response issues should be expected	Solitude, wildlife viewing, and building wilderness skills are focus of experience. Infrequent emergency response focuses on remote rescue situations or difficulties in locating a victim
Fewer health benefits, except in urban setting where before-work and after-work paddling opportunities may be enhanced	More time spent physically paddling can increase health benefits	Maximum health benefits from most time spent physically paddling
Focus on natural resource issues can be incorporated, but other management issues must not be ignored	Focus on natural resources ranges depending on setting, design of infrastructure, and other issues	Experience type is compatible with intensive focus on natural resource management, including protection of wild and rural settings, habitat and species restorations, and public education

Table 2-2.
Management Considerations by Paddling Trip Length

Water Trail Name					
	UTM X	UTM Y	ACCESS NAME	ACCESS # (river mile #)	ACCESS OWNED BY:
Example	436785.79	4598540.84	Commerce Ledges	13b	
Upstream-Most Access					

Figure 2-2.
Preview of Pre-Planning Worksheet.
Full worksheet available at from Iowa DNR

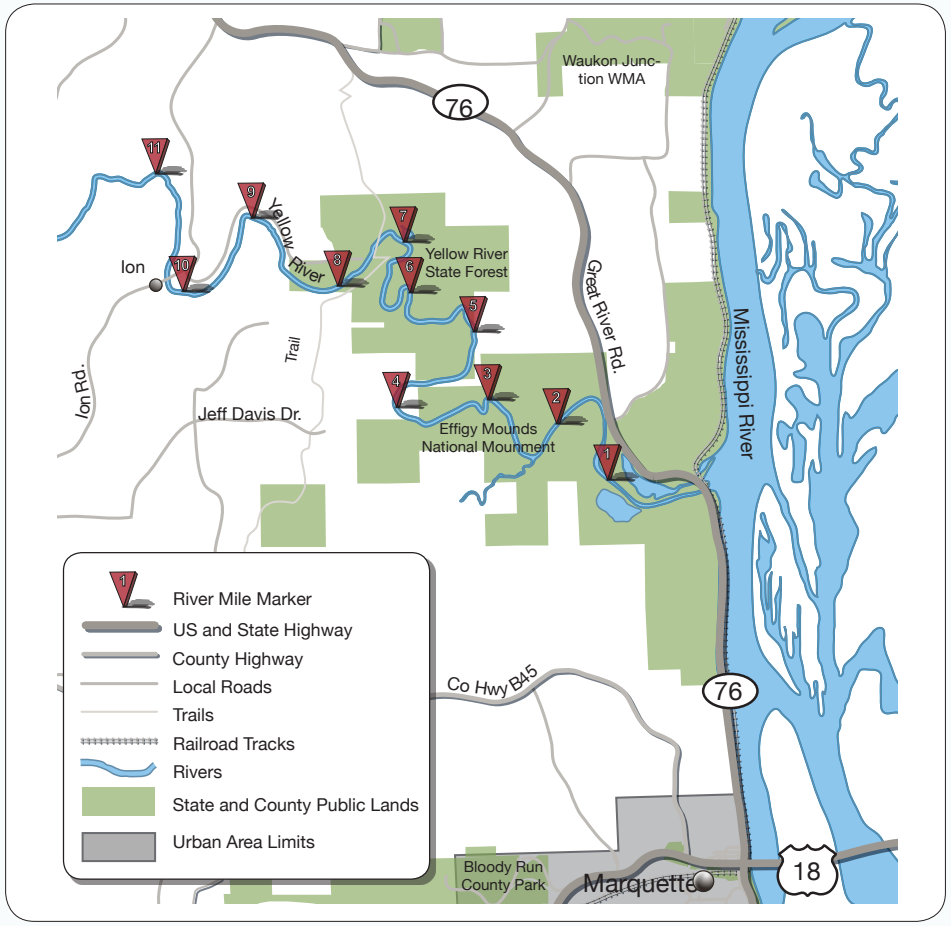


Figure 2-3.
River-Mile Marking

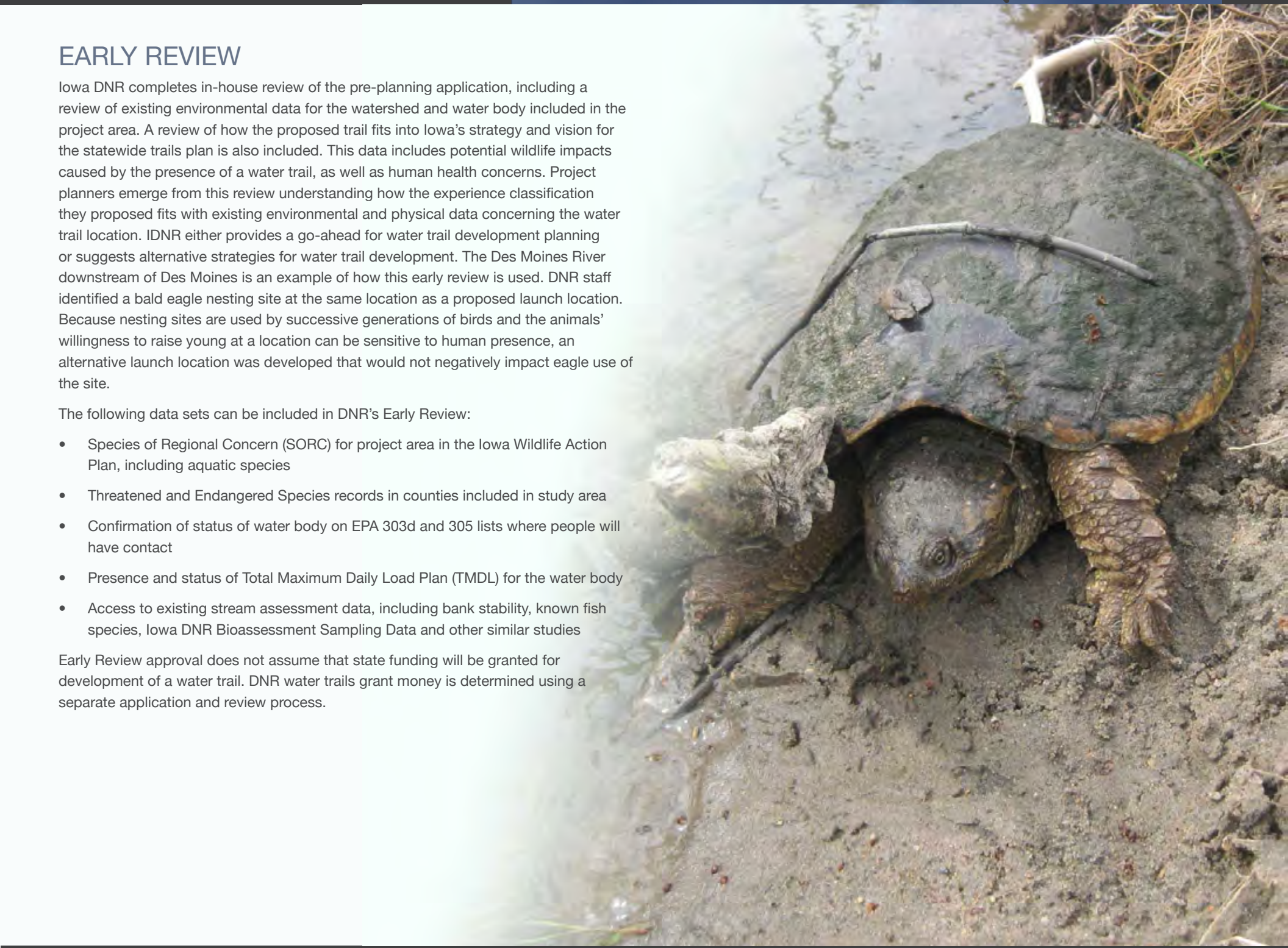
EARLY REVIEW

Iowa DNR completes in-house review of the pre-planning application, including a review of existing environmental data for the watershed and water body included in the project area. A review of how the proposed trail fits into Iowa's strategy and vision for the statewide trails plan is also included. This data includes potential wildlife impacts caused by the presence of a water trail, as well as human health concerns. Project planners emerge from this review understanding how the experience classification they proposed fits with existing environmental and physical data concerning the water trail location. IDNR either provides a go-ahead for water trail development planning or suggests alternative strategies for water trail development. The Des Moines River downstream of Des Moines is an example of how this early review is used. DNR staff identified a bald eagle nesting site at the same location as a proposed launch location. Because nesting sites are used by successive generations of birds and the animals' willingness to raise young at a location can be sensitive to human presence, an alternative launch location was developed that would not negatively impact eagle use of the site.

The following data sets can be included in DNR's Early Review:

- Species of Regional Concern (SORC) for project area in the Iowa Wildlife Action Plan, including aquatic species
- Threatened and Endangered Species records in counties included in study area
- Confirmation of status of water body on EPA 303d and 305 lists where people will have contact
- Presence and status of Total Maximum Daily Load Plan (TMDL) for the water body
- Access to existing stream assessment data, including bank stability, known fish species, Iowa DNR Bioassessment Sampling Data and other similar studies

Early Review approval does not assume that state funding will be granted for development of a water trail. DNR water trails grant money is determined using a separate application and review process.



DEVELOPMENT PLANNING

Development planning is the process of developing detailed plans for amenities associated with a water trail, such as the specific location of access points. This planning phase is complete when final design plans are complete and submitted to the DNR for review. Elements in this process include but are not limited to the following.

1. Site selection of access points based on land available for public use, stream conditions at these locations, and access spacing included in experience classification. Use the “existing access form” filled out previously to identify these. Consider also whether limited (or inappropriate) use, difficulty in maintaining certain facilities because of location, experience type goals, lack of appropriate parking, or other factors may warrant closure of some launches not worthy of sustaining. Refer to Chapter 3 of this manual for more guidance.
2. Designs of launches, parking areas, signage plans, and trails between parking and launch, as well as portage trails. How stormwater is managed at access points has direct impact on the stream and on water trail users’ experiences. Existing gullies and unstable streambanks at proposed launch sites should be mitigated as the sites are developed. Refer to Chapters 3 and 4 of this manual for more information and guidance. Drawings at this point need only be approximately 30 percent complete, realizing a number of elements may change from funding to permitting to final construction.
3. Incorporate Universal Design considerations where possible. Design amenities to accommodate a wide variety of users, including children, the elderly, and people with severe disabilities, without substantially altering the setting.
4. Include habitat-improvement practices in launch or water trail channel design. Partnerships with special-interest groups may lead to funding and volunteer efforts to design and install such enhancements. Examples include angler organizations and foundations or other nonprofit organizations interested in habitat enhancement.
5. Develop proactive strategies for dealing with potential law-enforcement issues (public intoxication, littering, belligerent behavior) with a priority focus on “Gateway” segments. Also, plan access to the water trail in the event of an emergency. This includes working with law enforcement agencies, emergency service providers, and adjacent private property owners to plan how emergency vehicles can reach the stream edge.
6. File any required environmental permits for construction at the completion of development planning.

DRAFT DEVELOPMENT PLAN REVIEW AND SUBMISSION OF FINAL DEVELOPMENT PLAN

Iowa DNR staff reviews draft development plans for each project and may make recommendations based on safety, project stability, stream impacts, capacity for expected use, and/or broader strategies of the water trail system, such as diversity of experiences available statewide, potential access for people with disabilities, and other elements. Some recommendations may point toward legal requirements (these will be clearly stated as such), while others may be suggestions that can be taken into account and ultimately decided at the local level.

The final development plan should be submitted to Iowa DNR, and it will be filed for future use.

FUNDING FOR IMPLEMENTATION

Funds and in-kind donations to construct or enhance water trail components come from multiple sources, including volunteer labor, the Iowa DNR water trails program, the federal recreational trails program, community foundations, and individual donations. It is more common for implementation to occur in parts over two or more construction seasons rather than in one year. Funds for construction of some elements may be more readily available than for others. Developers are encouraged to include all potential funding organizations early in the planning to ensure the project is designed in ways that overlap with potential funders' goals.

At this point, ongoing management and maintenance commitments of various agencies will need to be formalized in agreements that may include memoranda of understanding between the sponsoring agency and other land and access managers or more formal 28E agreements.

IMPLEMENTATION

Implementation includes launch and landing construction, portage trail construction, signage placements, mapping / brochure / web-site development, and execution of management and maintenance plans.

DESIGNATION

State designation of a water trail results in that trail being published as a water trail on the Iowa DNR web site, staff promotion at a variety of events throughout the year, access to water trail enhancement funding, and DNR water trail crew assistance (if available).

To apply for designation:

1. Complete all items on checklist that meets the goals and standards defined in the final development plan. Sign it, and send it to Iowa DNR rivers staff.
2. Schedule a dedication event, usually with some type of celebratory event that includes various projects partners, the main manager of the water trail, elected officials, and users. The designee will be presented with a certificate. More often than not, the event ends with a float down a segment of the stream.
3. Consider designation the beginning of a long-term effort. Developers and land managers are encouraged to develop programming that enhances experiences along the waterway. Maintenance of the water trail, including replacing signs, maintaining access points to the standards outlined by experience type goals, and updating maps in reasonable timeframes will be expected to maintain the state designation.

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3 DESIGN DEVELOPMENT

Iowa's rivers are constantly shifting and changing and can be challenging places to design, construct, and maintain water trails. This section discusses aspects you will immediately encounter when developing a water trail: launches, parking areas, and trails. The intended users and expected use suggest how these amenities are designed and constructed. Water trails intended for extended families, for example, are designed differently from those intended for experienced paddlers on multi-day trips.

3 LIST OF FIGURES AND TABLES

3A WATER TRAIL LAUNCH DESIGN

WATER TRAIL DESIGN DEVELOPMENT

State-designated water trails in Iowa are more than recreation resources. Water trails are developed and managed in ways that protect and enhance Iowa's aquatic and riparian resources. In this way, locating water trail amenities, such as launches, requires consideration beyond user convenience. For example, aquatic resources such as fish can be impacted differently based on how launches are designed and constructed. Likewise, streambank and launch stability is impacted by how drainage from newly created parking areas arrives at the stream. These guidelines reflect what has been learned in Iowa and similar locations about design and management of stream-edge infrastructure, including adaptation of traditional designs.

WATER TRAIL LAUNCH DESIGN

This section describes design options and material choices for water trail launch construction. The goal in choosing among launch designs and construction approaches is to match launch design with the setting. Avoid adding stress or impact to streams and their biologic conditions and, where possible, to enhance conditions for fish and other aquatic species. Always consider the design alternative best matched to the launch site and region. Large, hard-surface launches and extensive earthwork are sometimes necessary on heavily impacted sites and can enhance stream conditions. However, on stable streams, choose launches without concrete or large equipment, as they are less expensive and have a lower impact on the stream.

This manual focuses on locating and designing launches that balance impact with the need to withstand the flashy water-level conditions and the high amounts of sediment often found in Iowa streams. While all launches on Iowa streams require maintenance, good design and construction can help some locations last longer with less maintenance.

Three things are important when designing and constructing a launch: where on the stream the launch is located, the angle of the launch relative to the stream, and the launch construction and materials. Each is important to minimize impact to a given stream and its biologic community. Launches are also the first experiences paddlers will have on Iowa water trails. Well-designed launches minimize stress for users shifting gear from vehicles to the water.

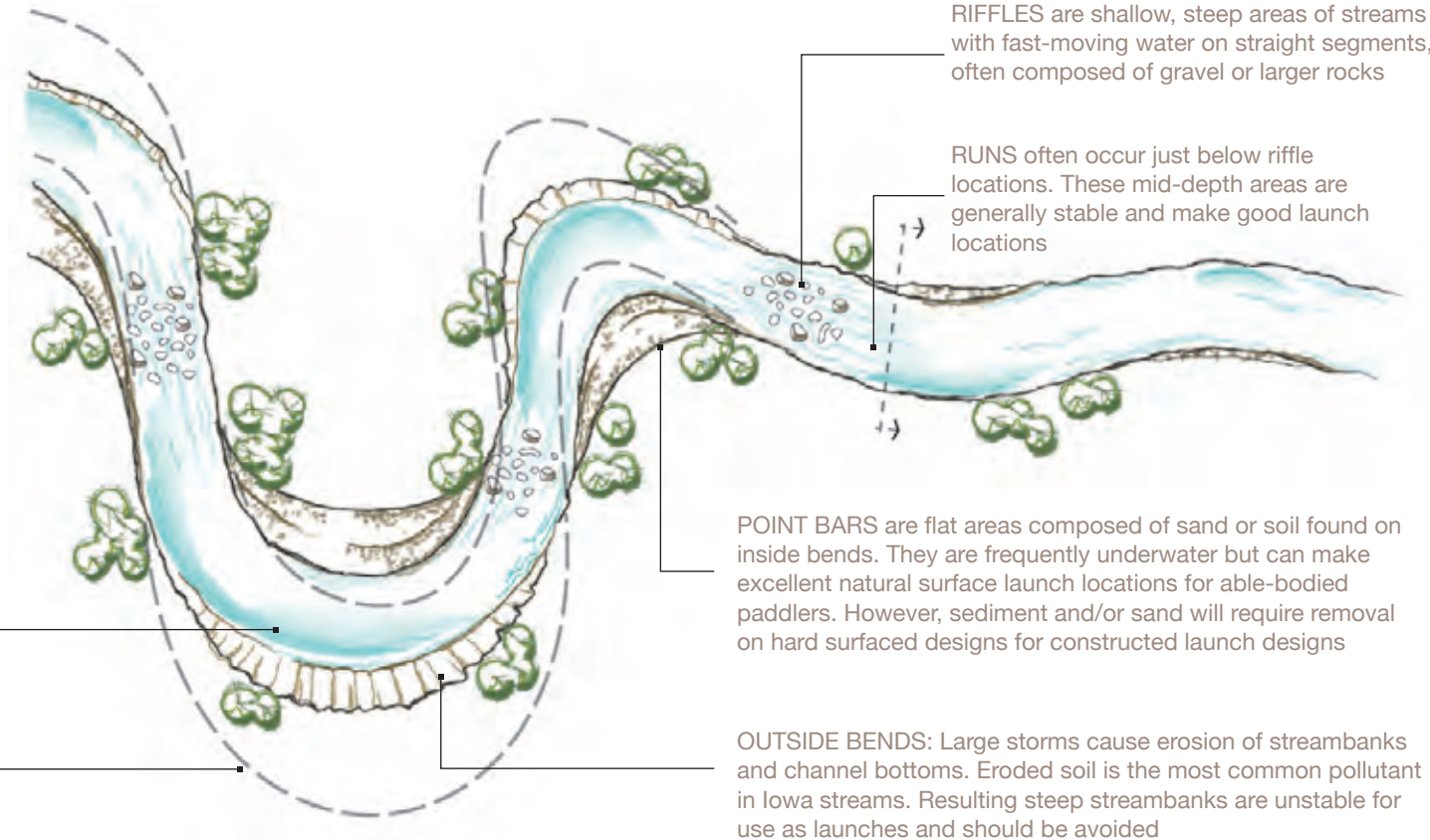
WHERE TO LOCATE LAUNCHES

Consider three key features of streams when evaluating where to locate launches. The first aspect is the route of the stream across the land--whether it is curvy or straight. The second aspect is the shape of the streambanks and bottom. The third consideration in location is how accessible it will be for users and maintenance.

For the first aspect, consider that some sections of Iowa streams are curvy, while others are fairly straight (Figure 3A-1).

Straight stream sections with low streambanks are the most successful launch locations in terms of required maintenance, stream impact, and cost effectiveness. A curving stream section, particularly an outside bend, is the least successful location for a launch. Launches built on curving stream sections or with streambanks sloped more than 12 percent are much more likely to be damaged or washed out as the stream migrates or changes in alignment compared with straight sections.

Figure 3A-1.
Stream Dynamics Related to Successful Launch Locations

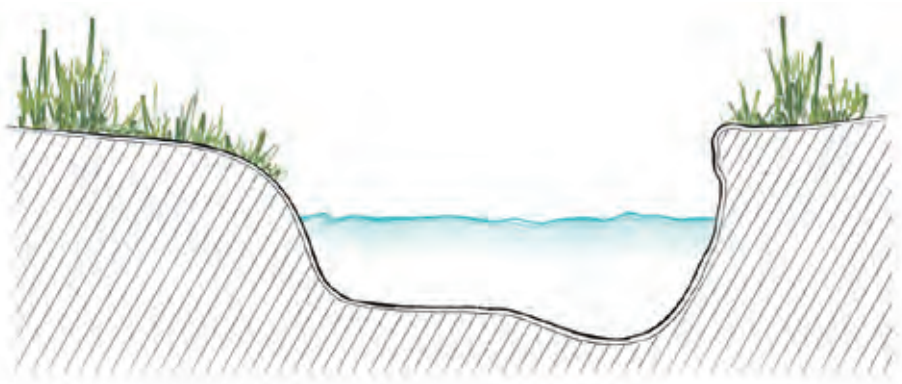


The second aspect is the shape of the streambanks and bottom. If a stream segment has steep banks on both sides with no low terrace (Figure 3A-2), it is unstable and will continue to widen and migrate. Unstable streambanks such as these are not appropriate for launch construction. Stream segments with a low terrace on at least one side (Figure 3A-3) are generally the most stable in terms of minimal launch maintenance and low-impact construction.

Stream depths at launch locations are critical for powerboats and somewhat less so for paddler-only launches. Streams typically include stretches of deep and shallow water. The easiest launches for paddlers are designed so boats can be loaded and launched with minimal wading. These spots are often located just below riffles.

Pool areas greater than 4 feet deep (normal flows) can be desirable concrete boat ramp locations if the banks are not too steep. Be aware that the deepest pools can be valuable fish habitat, especially for over wintering sensitive species such as channel catfish, and should be avoided. Steep drop-offs make poor canoe and kayak access because fluctuating water levels will change the height from the water surface to the top of the bank.

Finally, launch locations require consideration of future users and those maintaining the sites. Consider locations near public roads and near equipment that will be used to maintain the launch area. New launches also require adjacent space for a minimum of five off-road parking spaces. Identify flat areas near streams that do not flood frequently. Locate parking and driveways a minimum of 50 feet from the edge of the water. Sites that minimize tree removal and land reshaping are the most desirable for both launches and parking areas. Refer to Section 3B, Parking Area Design, for more information.



Midwest stream channels have various shapes. Incised segments have steep streambanks, often on both sides. These stream segments are the least suitable for launch construction because they are unstable and eroding.

Figure 3A-2.
Unstable Incised Streams

Some segments are more stable, with the bank on one side more gentle and the other side steeper. These segments offer both shallow and deeper water areas. The shallow side of a stream is often an excellent location for launch construction. Ensure sediment and/or sand deposition is not an issue before constructing launch.

Figure 3A-3.
Stable Streams

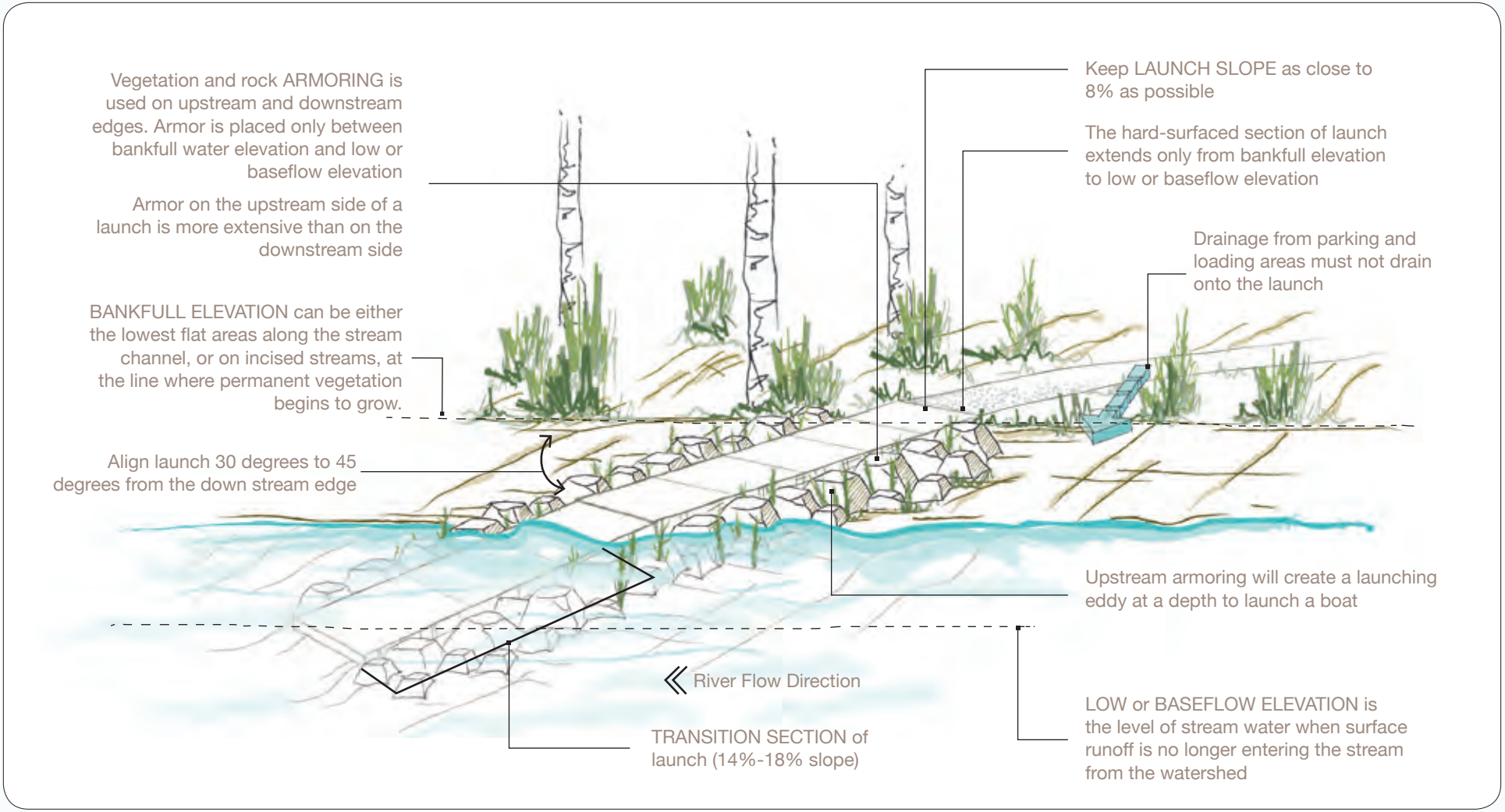


Figure 3A-4.
Typical Launch Design Components

LAUNCH DESIGN SELECTION CRITERIA

The materials and design of a launch correspond with its location. Minimize disturbance to the stream, banks, and surrounding landscape. The most successful launches serve a wide variety of paddlers and physical abilities. Budget expectations for construction and maintenance are also important criteria. Launch materials in Iowa include cast-in-place concrete, pre-cast concrete, stair steps, and natural surfacing.

All launches require attention to five elements, regardless of launch type or location. These elements include armoring, the slope or steepness of the launch ramp, a push-in section, the horizontal alignment of the launch, and the height of the water at the launch location (Figure 3A-4).

- **Armoring:** Launch edges require protection from scour and erosion caused by stream currents and high flows. Vegetation (in the form of root density) is used in conjunction with specific-sized rock as armor to resist erosion and launch failure. (See Chapter 4.) Use the minimum amount of armoring necessary, as excessive rock is expensive and can impact river function and biology. Class D or E riprap is generally used. Specific native grasses, such as prairie cordgrass (Spartina pectinata), are also used above the bankfull elevation for slope stabilization.
- **Channel restoration practices:** If an existing launch fails because of movement of riprap, or if the developer wishes to improve river stability and minimize bank stress, incorporating natural channel design structures such as j-hooks can improve in-stream habitat while reducing the overall amount of rock required. Chapter 4 describes use of these practices in more detail. (See Rosgen 2006.)
- **Slope of launch ramp:** The change in elevation from the top of the launch to the bottom is described by percent of change. Percent slope is calculated by dividing the difference in height by the length of the launch (usually in feet). Water trail launch slopes should be as close to 8 percent as possible, with the exception of the lowest sections, known as push-in sections, which are steeper. The steeper the slope, the more important a roughened surface becomes for traction.

Figure 3A-5.
Launch Selection Criteria

LAUNCH SITE CHARACTERISTICS	Concrete, Pre-Cast concrete, or Cut-Stone Design	Stair-Step Design	Natural-Surface Design
Point bar (sand, gravel) silt, mud point bars NOT recommended, (Figure 3B-1)	Poor	Poor	Good
Bedrock bank or stable slope bank (Figure 3B-3)	Fair	Fair	Good
Unstable, incised stream (Figure 3B-2) See Chapter 4 for suggestions on handling unstable sites	Poor	Fair *Both extreme scour and deposition can be issues: re-shape bank and skew downstream*	Poor
Stable bank, slope <12%	Excellent	Fair	Good
Stable bank, slope <12%-18%	Good	Good	
Stable bank, slope <18%-50%	Fair *Follow contours with bench-cut*	Good *Couple with canoe slide*	
	Excellent	Good	Fair	Poor

- **The push-in section** of the launch is the bottom-most section of the transition zone. It is made of either pre-cast concrete or concrete cast higher on the bank and then pushed into place with mechanical equipment. A push-in section may not be needed if a stream bed is rocky.
- **The transition zone** of a launch is the section transitioning from dry to submerged. The slope is steeper (14 percent to 16 percent, not to exceed 18 percent) for this section than for other parts of the launch.
- **The horizontal alignment** of the launch refers to the angle of the launch compared with the stream edge. For most stream applications, the launch edge should be constructed at a 30 degree to 45 degree downstream angle from the water flow. This alignment minimizes maintenance and creates a reasonable launching eddy. Launch alignment on lake edges can vary from this description as needed.
- **Launch elevation:** Constructing a launch at the proper elevation relative to bankfull elevation is critical to minimize future maintenance. Note that the hardened section of ramps and the armoring extend only between bankfull and baseflow elevations. A simplified way to determine bankfull elevation is to identify the level where permanent vegetation begins to grow. Bankfull is technically defined as the 1.5-year storm-recurrence elevation and can also be mathematically calculated using stream-gage data.

LAUNCH CONSTRUCTION

Note that launch construction most often occurs when stream water level is at low or baseflow elevation—not at bankfull or higher water elevation. This condition most commonly occurs during summer months. A low water level during construction allows the transition zone section of the launch to be poured near or at the low-flow elevation, reducing construction costs. Construction at low-flow elevations may also reduce streambank erosion during construction.

Water trail launch construction, like all construction, includes consideration of federal, state, and local regulations limiting stormwater runoff and erosion during construction. See the Iowa Construction Site Erosion Control Manual (2006) for more information.

LAUNCH DESIGN TYPES

Select launch design based on stream morphology—that is, the slope of the existing streambank and the streambank structure (Figure 3A-5). Hard-surface launches are the most durable and generally require the least intensive maintenance. Hard surfaces are also the most reliable for wheeled vehicles and for people, such as the elderly, with special needs. Drawbacks of hard surfaces include high construction costs, extensive site disturbance to allow mechanical equipment access, increased stormwater runoff and erosion, and undesirable aesthetics in remote settings.

NATURAL-SURFACE LAUNCH DESIGN

Launch construction with natural soil surfaces works best with fine mineral soils, including clays and loams. Natural bedrock outcroppings can also act as highly functional launch sites. Crushed stone is used when subsoils are unstable. Blend launches and trails with existing topography as much as possible to minimize stream impact and construction costs (Figure 3A-6).

This type of launch construction can lend itself to volunteer efforts, increasing the sense of local ownership of the water trail. However, volunteer projects require the same level of design and planning by qualified professionals as other launch designs. Construction without appropriate professional guidance can quickly cause stream and habitat damage. Failed volunteer construction projects can also be problematic in terms of maintaining future interest and investment in the water trail.

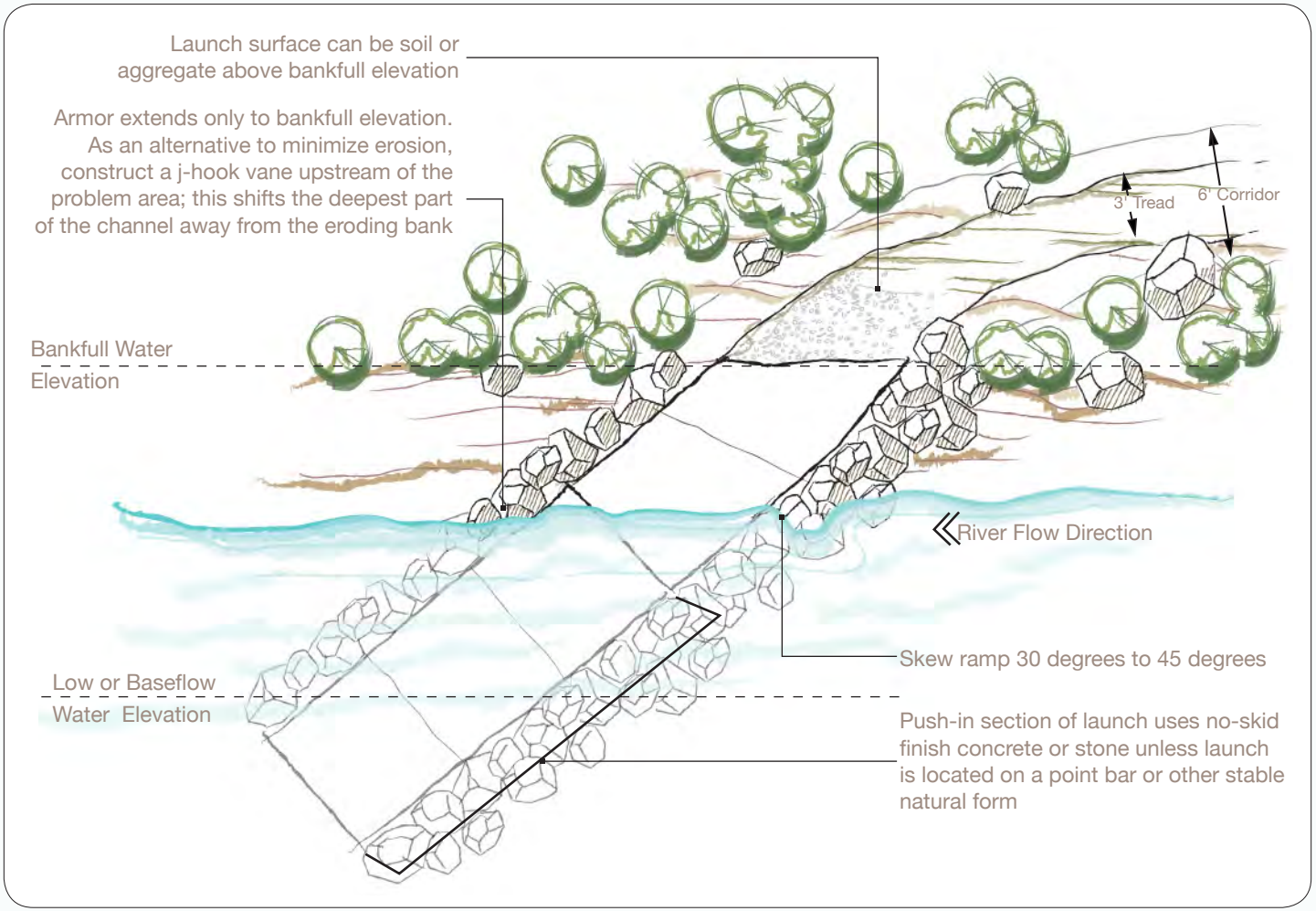


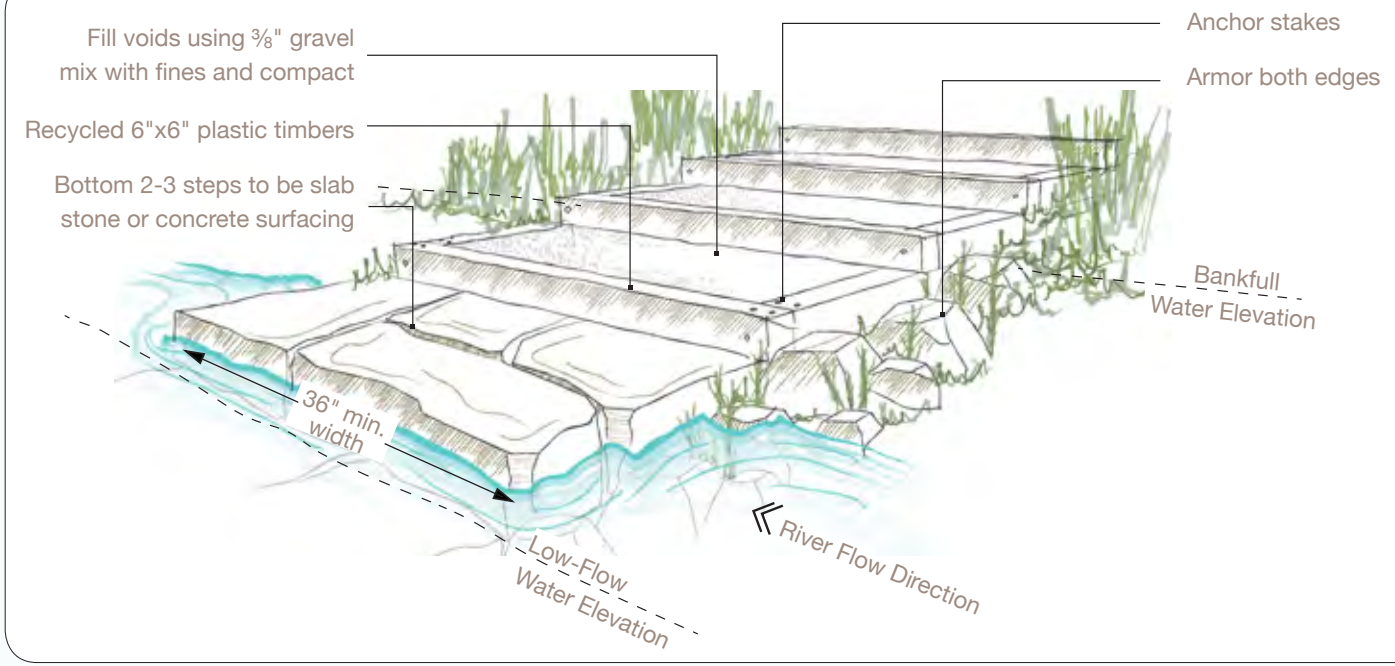
Figure 3A-6.
Natural-Surfacing Launch Design

STAIR-STEP LAUNCH DESIGN

Stair-step design is most commonly used in steep streambank situations. Stair-step design is also a reasonable project for volunteer group construction. This design blends in with the stream setting and can prove durable when constructed on stable streambanks.This design requires users able to manage stairs and steep climbs. Sediment is likely to deposit on stair treads in high-sediment streams, requiring manual removal. This design is easily damaged by water when located on the outside bend of streams, where shear stress is the greatest (Figure 3A-7, Figure 3A-8).

Construct step treads with a 2 percent to 3 percent slope toward the stream to alleviate water ponding on the surface. Step treads should not be steepened to accommodate high streambanks. All stair treads should be the same width and length. Optional handrails benefit users needing support. Canoe slides can be built with two telephone poles or aluminum guardrails along steep slopes.

Figure 3A-7.
Stair-Step Launch Design



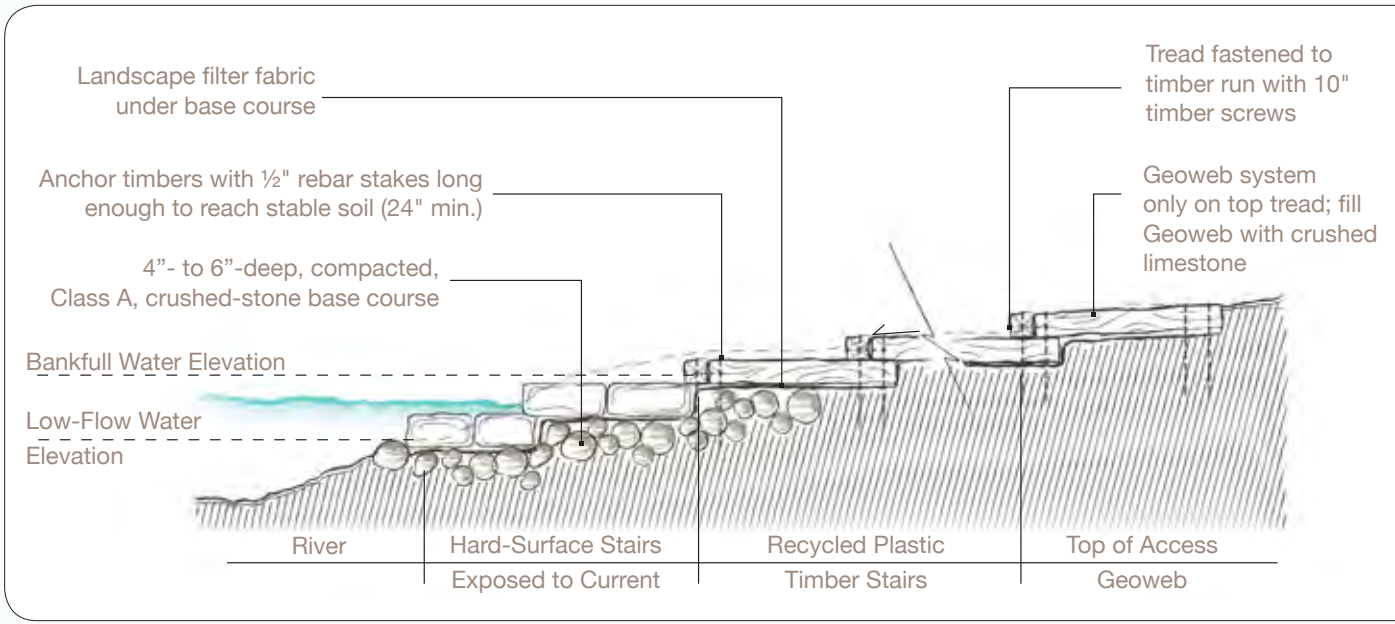


Figure 3A-8.
Stair-Step Launch Cross Section

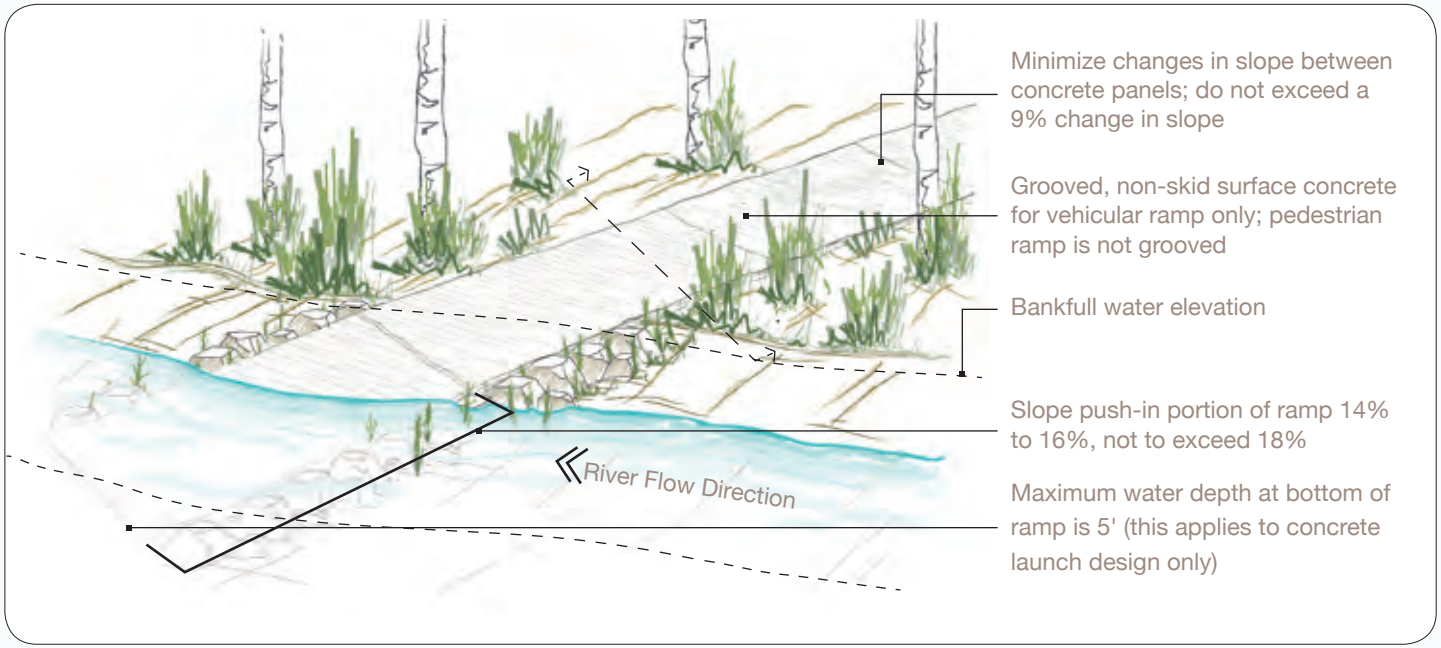
CAST-IN-PLACE CONCRETE LAUNCH DESIGN

Launches formed from concrete poured on site typically cause the most impact and disturbance to near-stream areas because of the equipment needed. Constructing launches that match existing slopes minimizes construction costs, erosion, and the need for slope stabilization (Figure 3A-9). Use launches with a maximum slope of 8 percent whenever possible, with the exception of the push-in sections.

Concrete surfaces are also favored for ease of sediment removal, particularly if mechanical equipment is available. This design is commonly used for access for vehicles with boat trailers (Figure 3A-10). Carry-down trails with heavy use are also good candidates for concrete surfacing (Figure 3C-2 and 3C-5).

Use hardened launch surfacing with caution, however. Hardened surfaces generate the most stormwater runoff and erosion of all launch designs, impacting in-stream habitat and water quality. Concrete launches often are also highly visible from the stream and visually obtrusive. Consider tinting concrete with admixtures or imprinting natural patterns in wet concrete with rubber mats to mitigate visual impact.

Figure 3A-9.
Cast-In-Place Concrete Launch Design



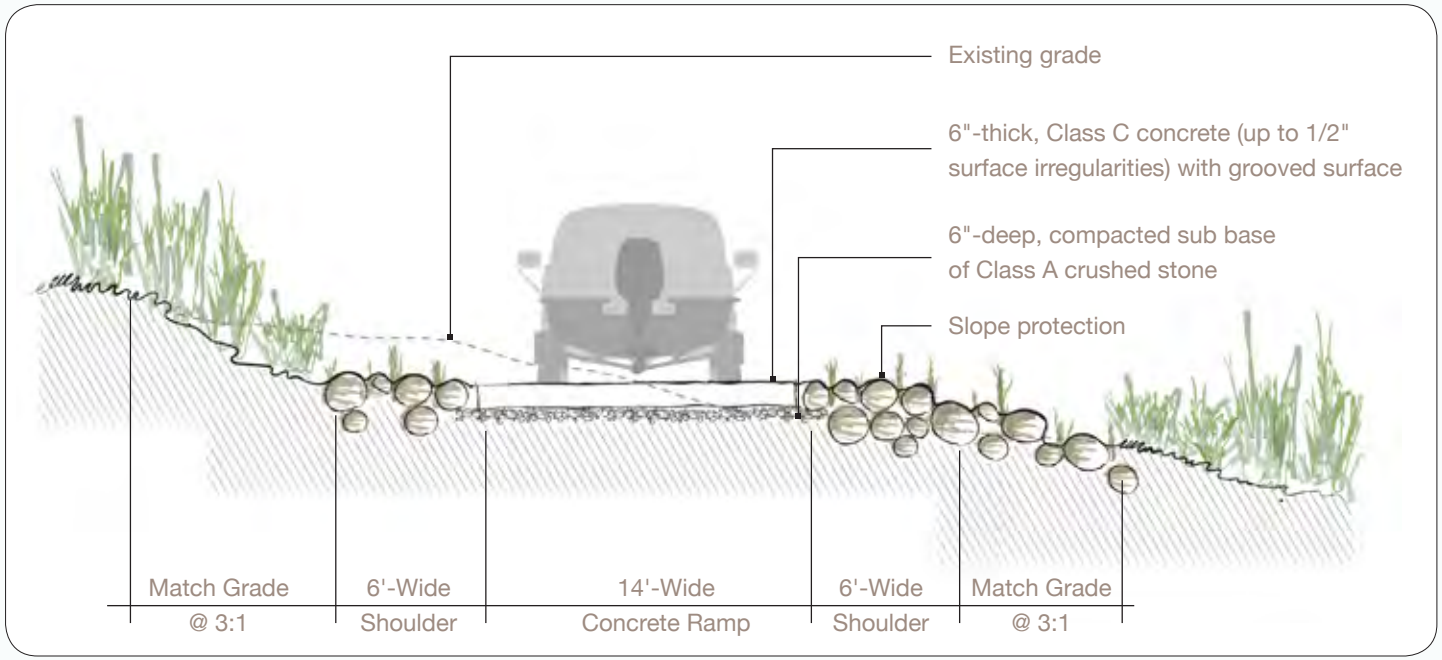


Figure 3A-10.
Cast-In-Place Design for Vehicle Access

PRE-CAST CONCRETE SLAT LAUNCH DESIGN

Pre-cast slats are commonly used in livestock housing and are manufactured in Iowa. Slat units with slight imperfections, available from manufacturers at reduced prices, have been used successfully in Iowa for launch construction. Slat units are a durable alternative for cast-in-place concrete launches when sites are accessible to front-end loaders for placement (Figures 3A-11, 3A-12, 3A-13).

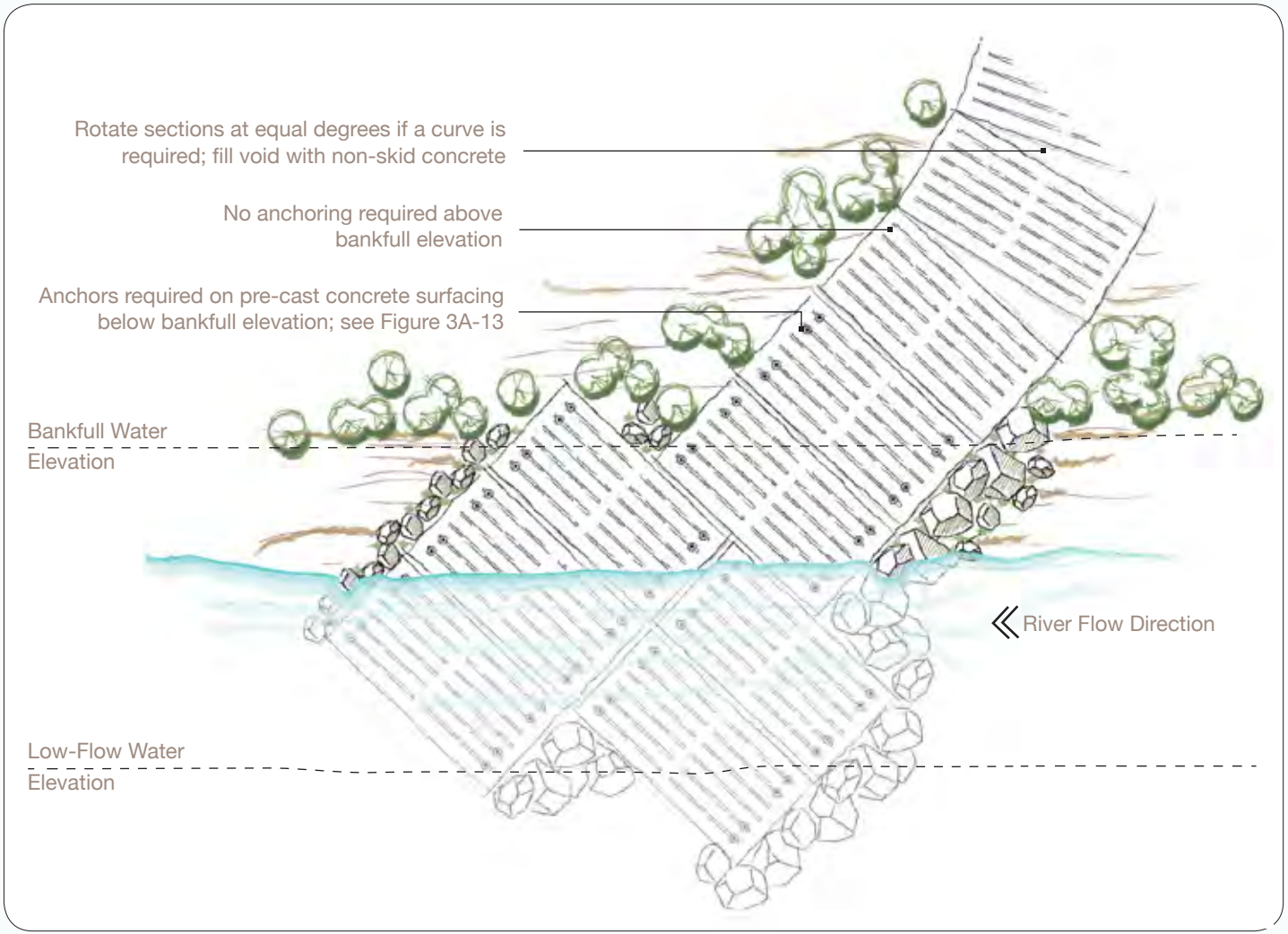


Figure 3A-11.
Pre-cast Concrete Launch Design

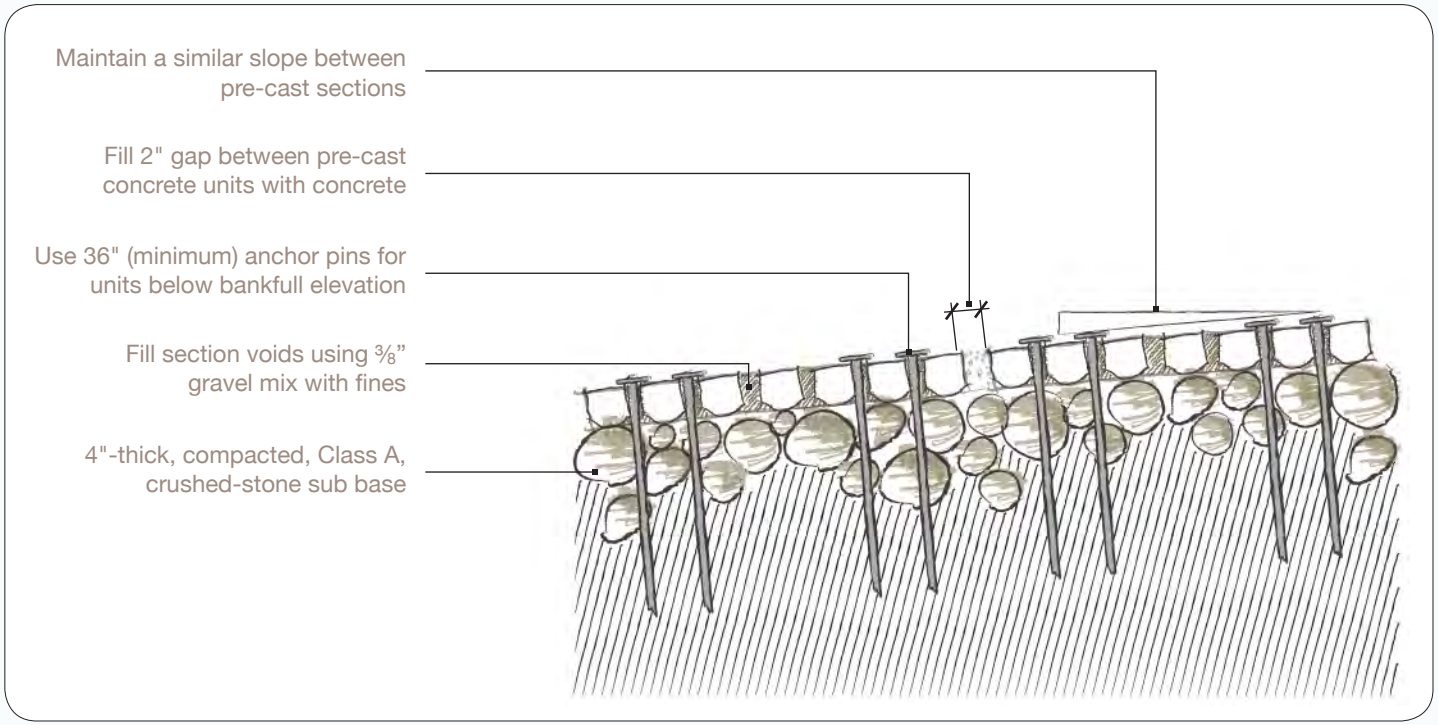


Figure 3A-12.
Pre-cast Concrete Anchoring Below Bankfull Stream Elevation

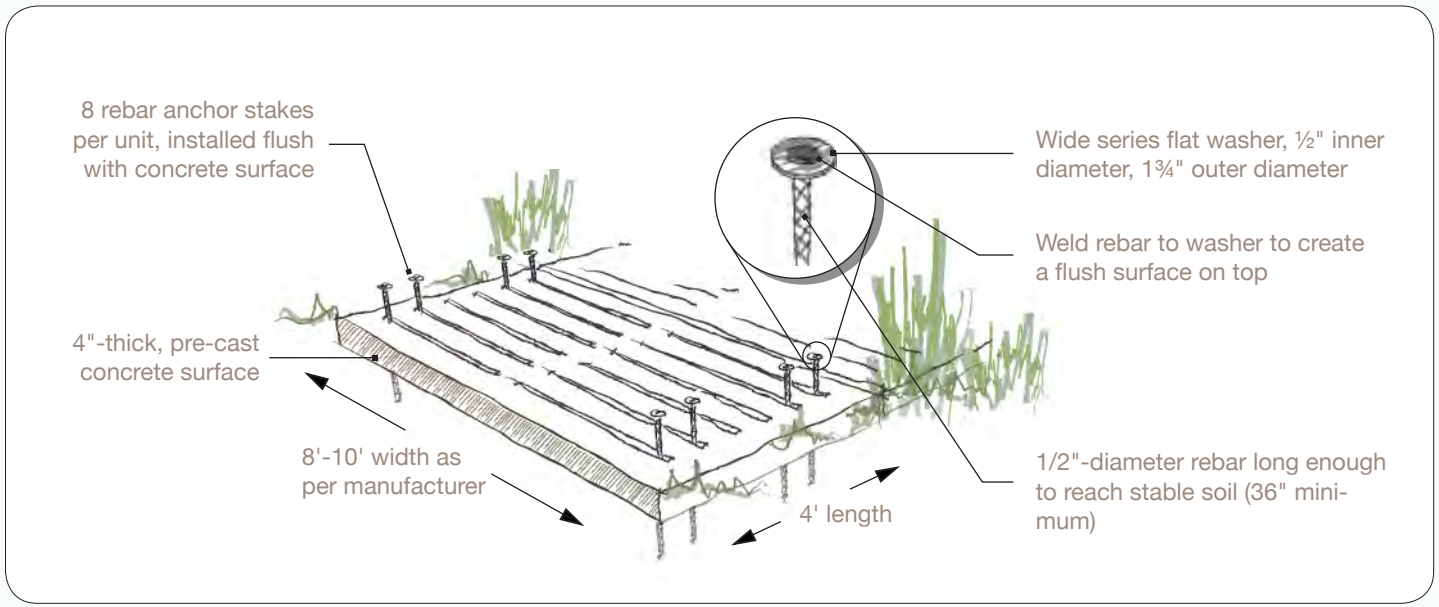


Figure 3A-13.
Pre-cast Concrete Anchoring Detail

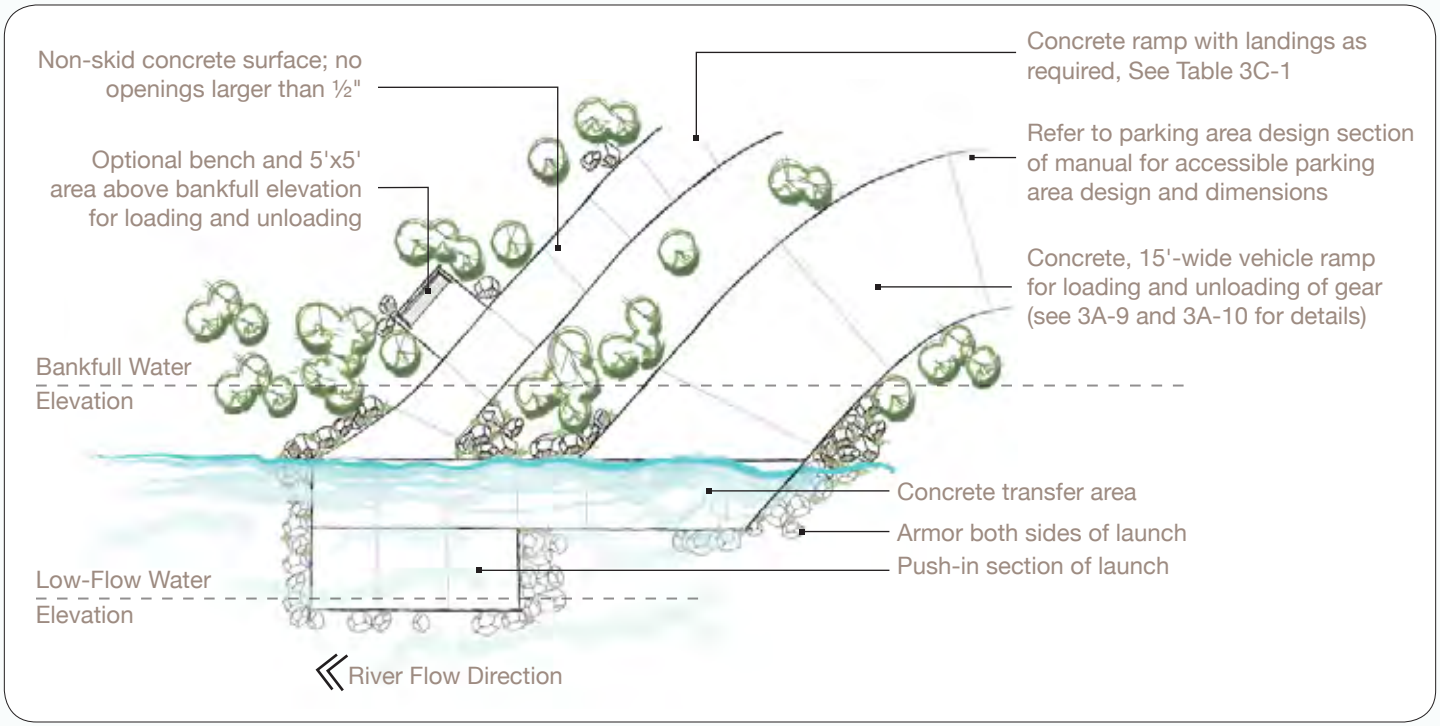
UNIVERSAL LAUNCH DESIGN

Launches providing universal access are based on specifications included in the Americans With Disabilities Act (ADA), a set of Federal civil-rights laws. While Federal ADA standards do not currently exist for boat launch design, universal design principles are applicable and detailed in this section. Universal design practices seek to construct all facilities in ways that integrate users of varying abilities where possible. ADA standards for trail design do exist and are incorporated into universal design. The Iowa DNR encourages the use of these universal design standards when possible.

Universal launch design standards included in this manual recommend two side-by-side ramps, one for pedestrians and another for vehicles (Figure 3A-14). The hard-surfaced vehicle ramp adjacent to the pedestrian ramp allows delivery of boats, gear, and people at stream edges. The vehicle ramp is physically separated from pedestrian ramp, although both extend to meet with the near-level concrete transfer area at the stream edge.

Specifications include surface slope and smoothness, launch width, and near-water transfer areas (Figures 3A-14 and 3A-15).

Figure 3A-14.
Universal Launch Design



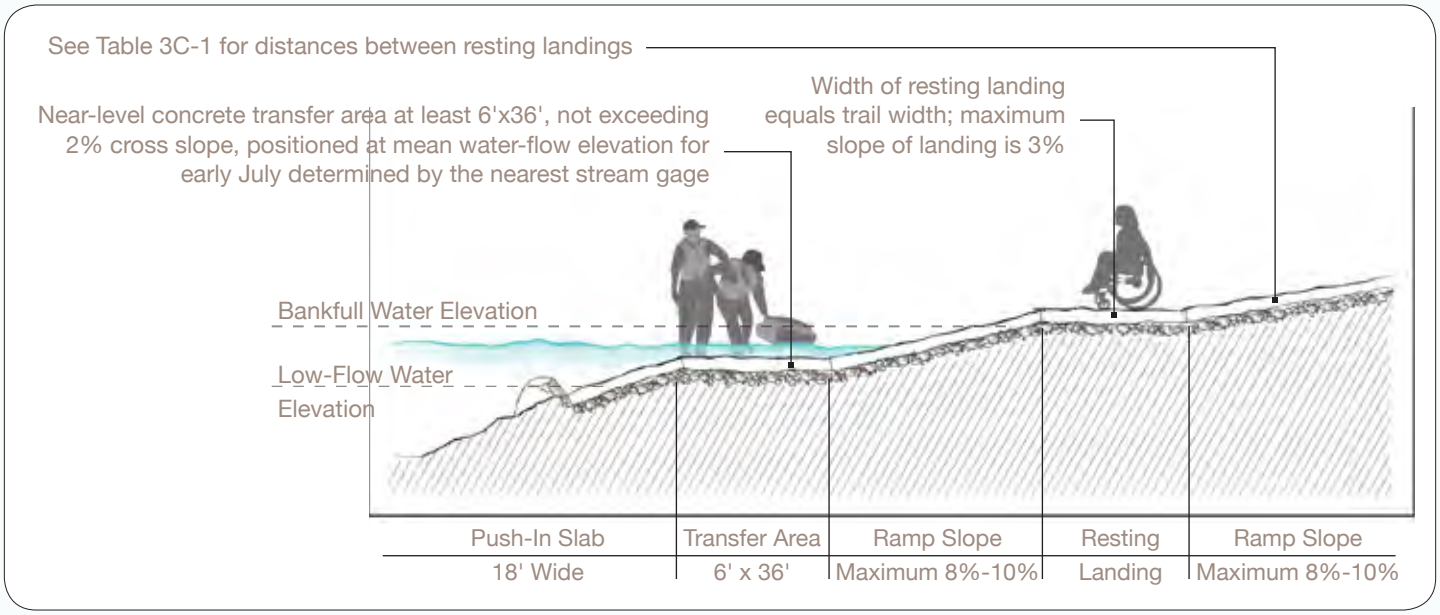


Figure 3A-15.
Universal Launch Cross Section

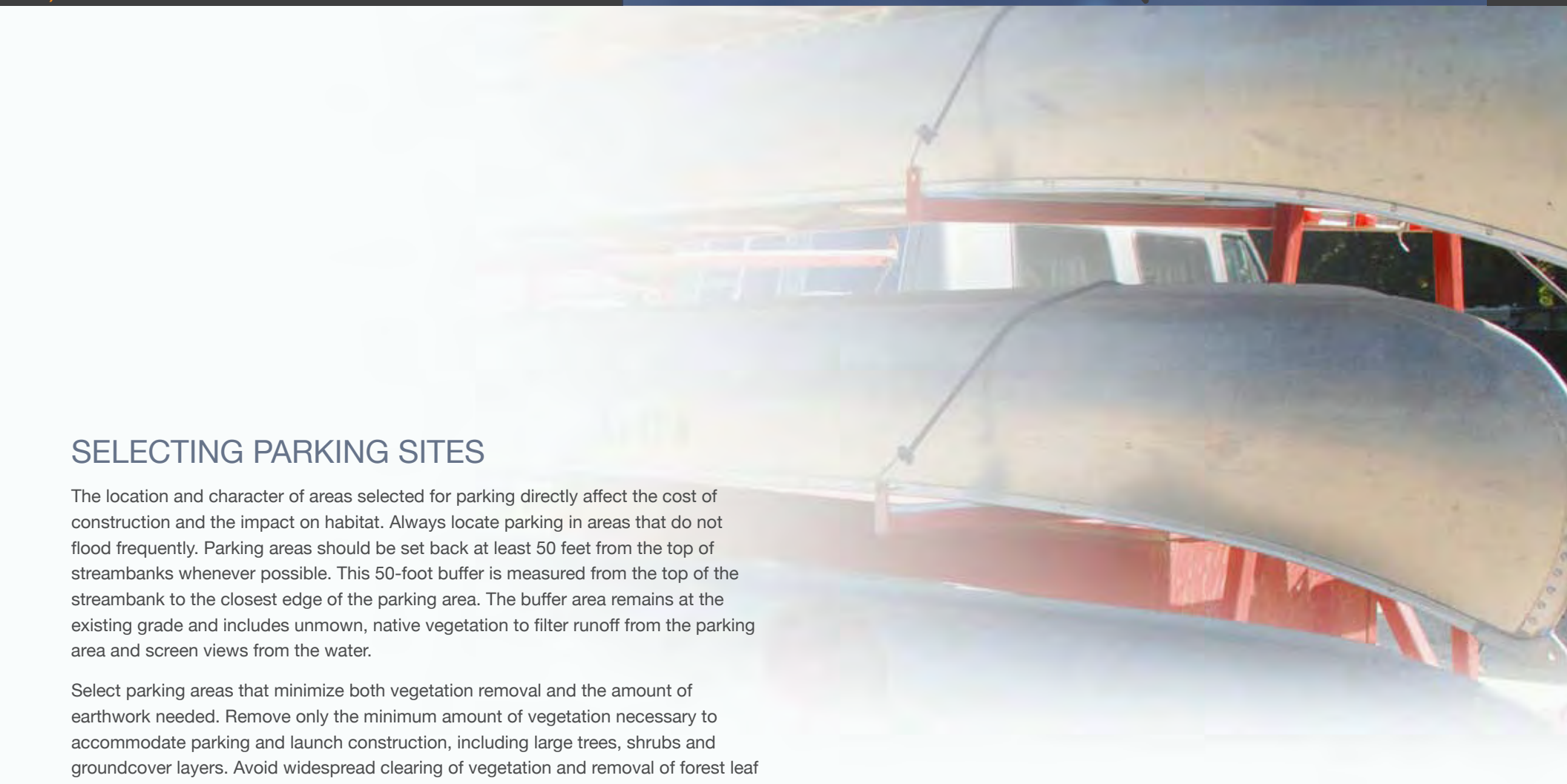
3B PARKING AREA DESIGN

All launch sites for state-designated water trails require designated off-road parking for a minimum of five vehicles. Note that due to safety issues, designated water trails should not encourage parking along roadsides. Iowa DOT will reject sign proposals that do not meet minimum off-road parking requirements. Parking on the road shoulder is unsafe for both water trail users and passers-by. Like other aspects of Iowa's water trail program, parking areas should be designed to minimize landscape disruption and stream impact while accommodating users.

To create paddler-friendly parking areas, designers should:

- Consider including loading lanes.
- Allow generous-sized parking stalls to ease movement between vehicles and water.
- Place staging areas either adjacent to parking or near the water's edge. These areas are used to assemble gear and put on personal flotation devices.
- Route walking trails between parking areas and launches that make it easy to carry gear and boats.

With these general guidelines in mind, this section provides more detail, including how to select parking sites, design guidelines of the parking area, stormwater management guidelines, and construction notes for parking areas.



SELECTING PARKING SITES

The location and character of areas selected for parking directly affect the cost of construction and the impact on habitat. Always locate parking in areas that do not flood frequently. Parking areas should be set back at least 50 feet from the top of streambanks whenever possible. This 50-foot buffer is measured from the top of the streambank to the closest edge of the parking area. The buffer area remains at the existing grade and includes unmown, native vegetation to filter runoff from the parking area and screen views from the water.

Select parking areas that minimize both vegetation removal and the amount of earthwork needed. Remove only the minimum amount of vegetation necessary to accommodate parking and launch construction, including large trees, shrubs and groundcover layers. Avoid widespread clearing of vegetation and removal of forest leaf litter. Parking areas typically have slopes of 2 percent to 5 percent. Select sites with existing slopes in this range to reduce earthwork, cost, and impact.

Wetland areas are critical nodes in the remaining habitat in Iowa and are federally protected by the Clean Water Act. Like any other type of construction, water trail construction that disrupts wetlands requires mitigation if the wetland is more than 1/10 of an acre in size. Disruption includes filling, leveling, draining, or other manipulation that directs stormwater drainage into them. These wetlands along streams and at lake edges in Iowa are not always easy to identify. If wetland areas are common or suspected in the region, obtain a professional wetland determination report for the launch and parking areas before developing construction plans or seeking funding for construction. U.S. Army Corps of Engineers wetland scientists, as well as trained wetland delineation consultants, are available in Iowa.

PARKING DESIGN

Drainage is a special concern in parking and launch areas. Reshape the land surrounding parking and launch areas so water from the rest of the site does not drain across these areas (Figure 3B-1). Also, drainage from the parking area or site in general should not drain into the stream through the launch ramp (Figure 3B-2). Ensure that parking area drainage is treated for water-quality enhancement before it reaches the stream by incorporating stormwater management practices included in this section of the manual.

Develop a plan to reestablish vegetation around the edges of the parking and launch areas disturbed during construction. Native vegetation, rather than lawn grasses, is recommended at launch sites. Information relating to vegetation is provided in Chapter 4 of this manual.

Drivers need clear delineation of the intended limits of parking areas. However, people prefer the visual appearance of rock and wood materials rather than concrete to create edges. Posts and cable are effective and visually non-obtrusive. Also use parking stops and other edging that disperse rather than concentrate stormwater flow.

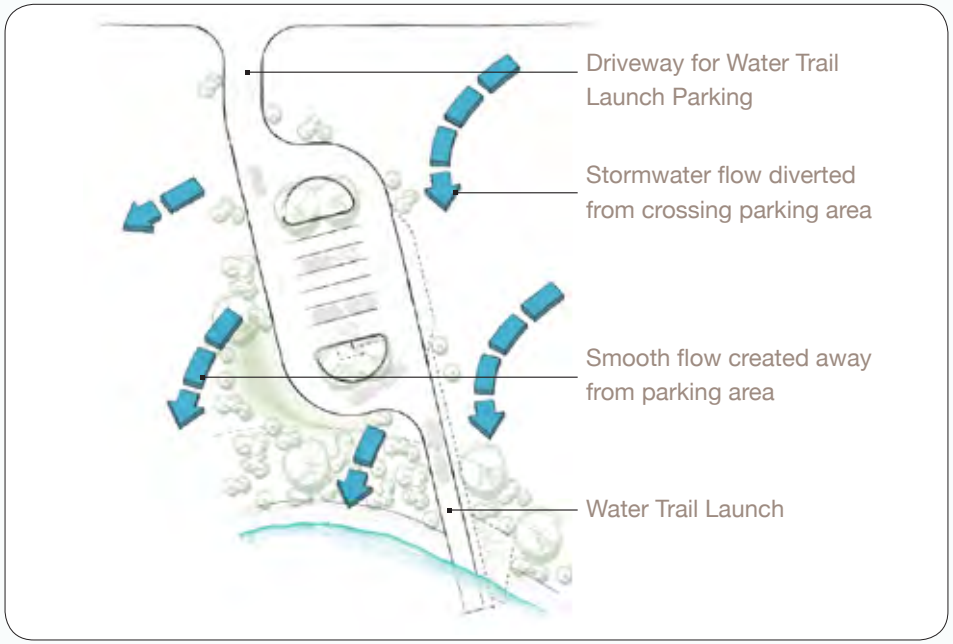


Figure 3B-1.
Stormwater Flow Near Parking Area

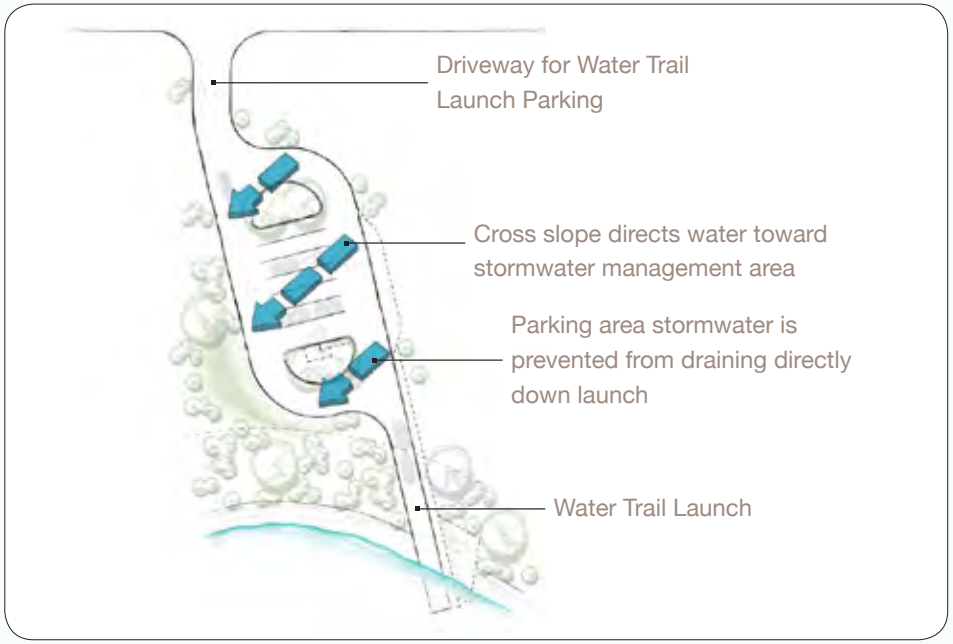


Figure 3B-2.
Stormwater Flow From Parking Area

Create generous-sized parking stalls to accommodate boats, gear, and people. Plan standard parking stalls to be 10 feet wide and 20 feet long. Design details are provided in this manual for carry-down water access, as well as for a traditional, trailered vehicle launch. Templates for 5- to 12-stall designs are included. Templates can easily be expanded to include additional cars based on specific site requirements. All public parking areas require a minimum of one designated, van-accessible parking stall meeting ADA requirements. Stalls meeting van-accessible ADA requirements must be 16 feet wide and 20 feet long. Parking areas serving universal design launches larger than 25 stalls require two or more van accessible stalls (Table 3B-1). Consider use of compacted limestone fines for accessible sections of parking areas not constructed with concrete or asphalt. Materials used successfully for this purpose include a gradation of ¾-inch rock to fines spread, compacted, and wetted in layers.

Total Number of Stalls in Parking Area	Required Minimum Number of Van-Accessible ADA Spaces
1 to 25	1
26 to 50	2
51 to 75	3
76 to 100	4

Table 3B-1.
Determining Parking Stall Counts

A staging area adjacent to either van-accessible ADA parking stalls or a loading lane is required at universal design launch areas (Figure 3C-6). This area accommodates unloading and loading of people, assistive devices, and gear.

Trailers carrying multiple kayaks or canoes are becoming common at state-designated launches. Note that all parking areas include a vehicle turnaround option and accommodate at least one parallel-parking stall for a vehicle with a trailer. The impact and cost of the parking surface added by these elements are minimal when compared with the safety hazards created when they aren't present. If they aren't accommodated within a parking area, trailered vehicles will unload and park on adjacent road shoulders and drive entrances, creating unsafe conditions for other drivers, as well as pedestrians.

MINIMUM PARKING AREA DESIGN WITH BOAT CARRY-DOWN ACCESS

Consider mown grass or aggregate surfacing for parking surface to increase stormwater infiltration rates, particularly in remote and other low-use areas (Figure 3B-3).

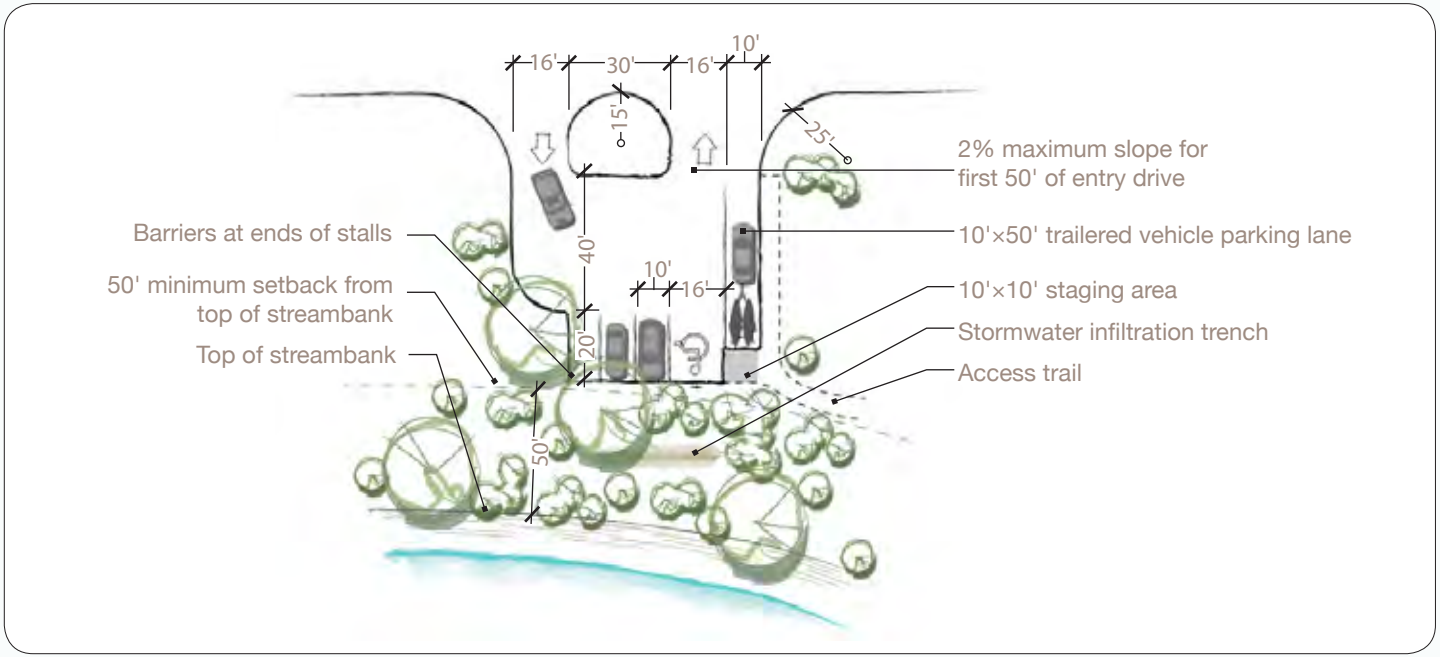
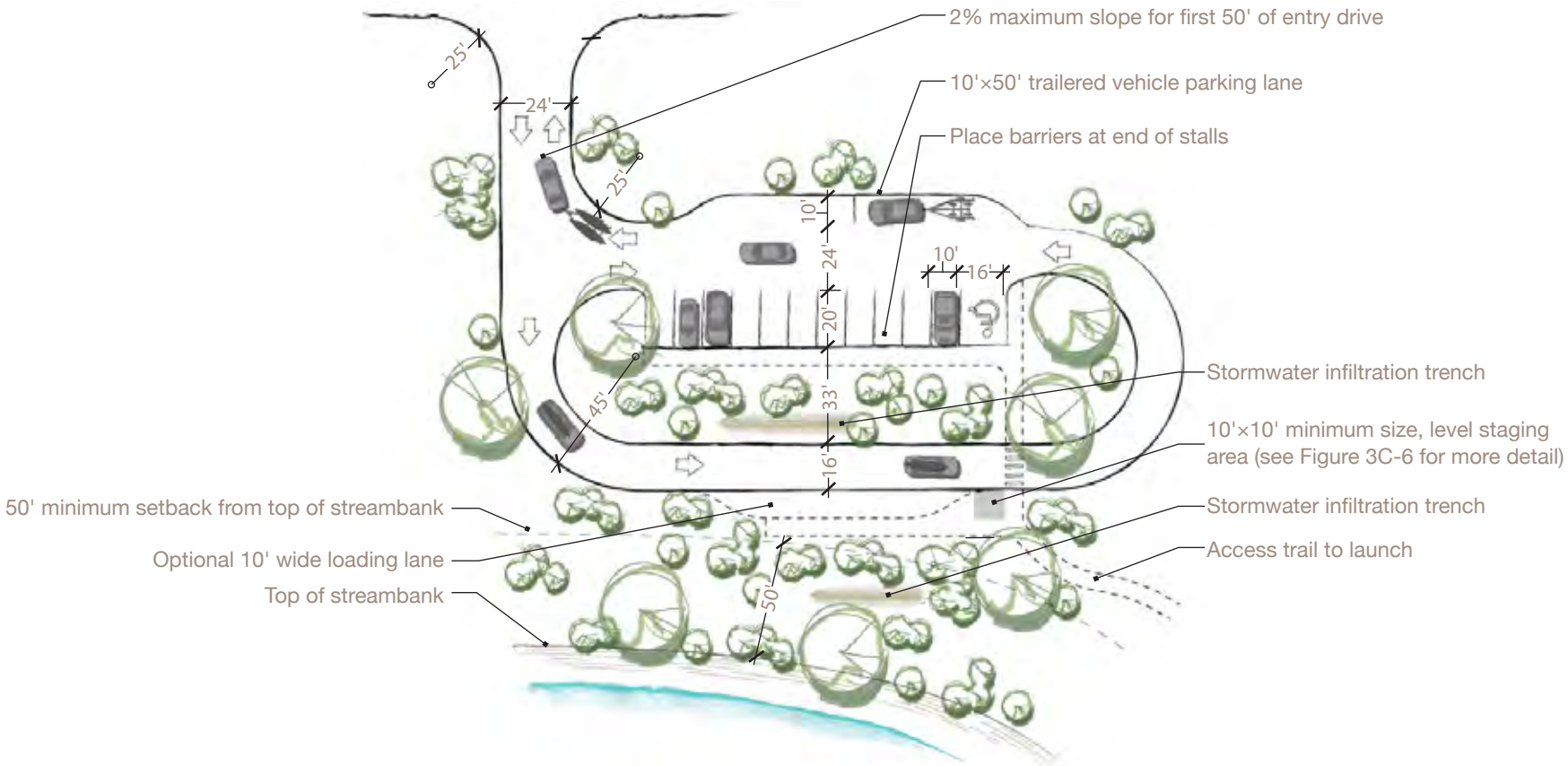


Figure 3B-3.
Minimum Parking Area Design with Boat Carry-Down Access

12-VEHICLE PARKING AREA DESIGN WITH LOADING LANE

Loading lanes allow vehicles to unload gear and people before parking and without blocking traffic. This lane is particularly useful for paddlers when parking cannot be accommodated near the stream. This design is also desirable because it avoids dead-end parking (Figure 3B-4).

Figure 3B-4.
Vehicle Parking Area Design with Loading Lane



7- OR 12-CAR PARKING AREA, VEHICLE LAUNCH DESIGN

This design configuration allows either traditional vehicle parking or boat trailer pull-through parking. An optional tie-down lane is recommended at high-traffic launches. Ensure that drives and parking areas use a minimum 45-foot outside turning radius to accommodate a bus with trailer for drop-off and pickup, as well as emergency vehicles (Figure 3B-5).

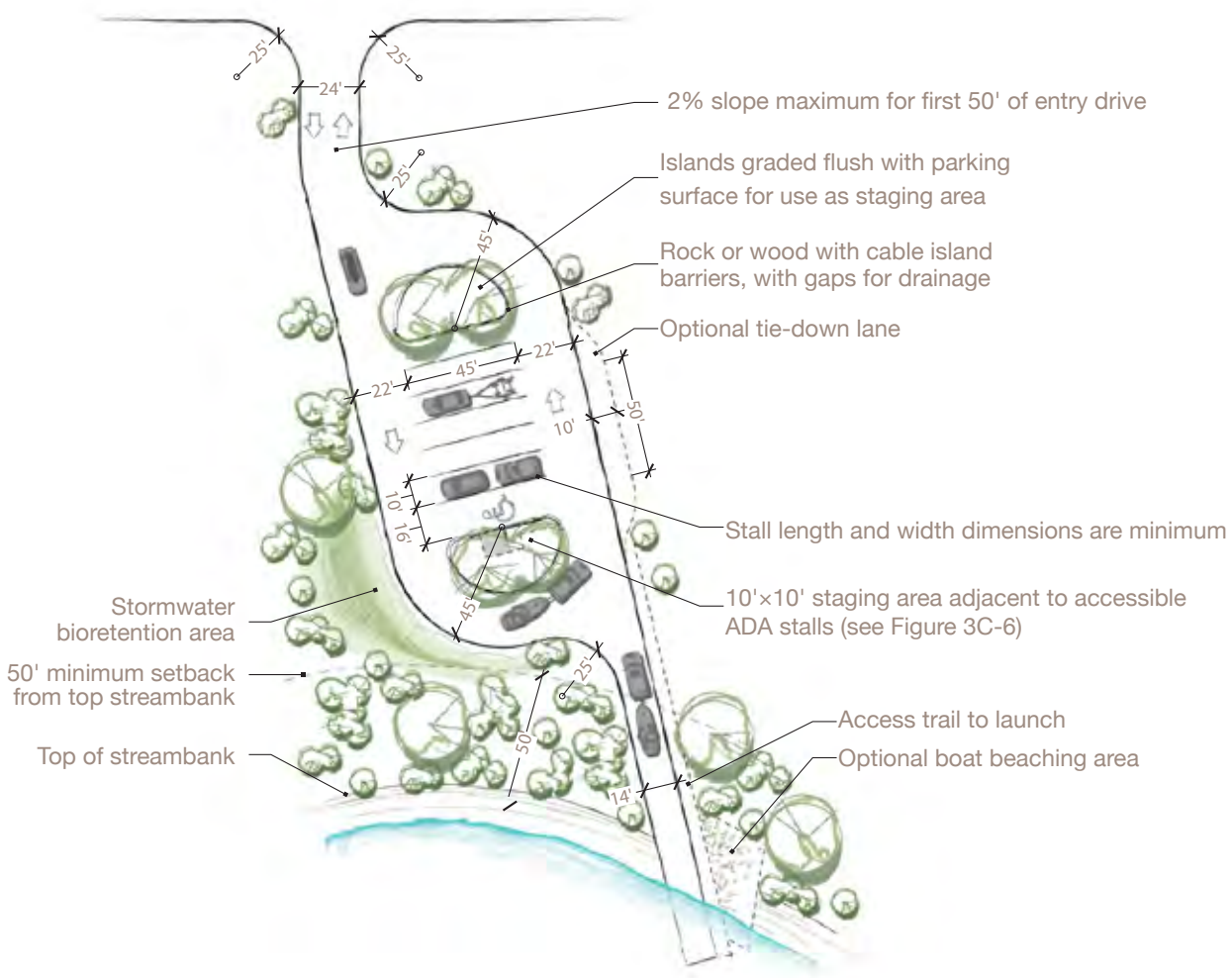


Figure 3B-5.
7- or 12-Car Parking Area, Vehicle Launch Design

STORMWATER MANAGEMENT ON-SITE

The goal of the Iowa Water Trail program is to minimize impact to water resources from construction of amenities serving water trail recreation. Changes in drainage resulting from parking areas, even gravel or mown grass surfaces, impact streambank and channel stability, particularly when located in near-stream areas. The goal is to capture and treat water from parking areas during 1.25-inch storm events before it reaches streams when site conditions permit. This amount of runoff is known as the water-quality volume and in Iowa is the most common type of rain event containing the majority of pollutants from surfaces such as parking. Stormwater management design is based on the Iowa Urban Stormwater Manual engineering standards.

Stormwater can be either infiltrated, where conditions allow, or filtered before reaching adjacent water bodies. Infiltration and filtration areas can be located within the 50-foot buffer between parking and the top of the streambank. Use Table 3B-2 to determine which alternative is most appropriate.

Table 3B-2.
Site Conditions for Stormwater Management

Infiltration is Most Appropriate	Vegetated Filter is Most Appropriate
Seasonal water table is > 4' deep	Seasonal water table is < 4' deep
Does not flood frequently	Floods frequently
Surface and underlying soils are NRCS Hydrologic Group A, B, or C	Surface and underlying soils are NRCS Hydrologic Group D
Slope is < 15%	Slope is > 15%

INFILTRATION DESIGN

Final calculated size and design of infiltration structures use Iowa Stormwater Management Manual formulas and processes. Two infiltration designs are generally applicable to standard water trail launch conditions: infiltration trenches (Figure 3B-6 and Chapter 2E-2 Iowa Stormwater Management Manual) and bioretention areas (Figure 3B-7 and Chapter 2E-4 Iowa Stormwater Management Manual).

An estimate of the size of the area needed to infiltrate the water-quality volume from a parking area can be calculated using the following process:

(Size of parking area in square feet x runoff volume coefficient x designated rain volume storage in inches) / 12 = cubic feet of water storage space needed

The following example assumes a 12,400-square-foot parking area with aggregate surfacing (runoff coefficient of 0.95) and 1.25 inches of rainfall volume:

(12,400 x 0.95 x 1.25) / 12 = 1,227 cubic feet of storage needed to accommodate the water quality volume.

For **underground infiltration trench treatment** (Figure3B-6), convert cubic feet needed to size of area needed using the following process:

Cubic feet of water storage volume needed / (aggregate void space x trench depth in feet) + (infiltration rate in inches/hour x drain time in hours) / 12

The following example uses 1,227 cubic feet in needed storage from above and assumes an 8' deep trench, a 0.35 aggregate void space, a soil infiltration rate of 0.5 inches/hour, and a 72-hour drainage time:

1,227 / [(0.35 x 8) + (0.5 x 72/12)] = 211 sq. ft. (a 10' x 21' area, for example)

For **planted bioretention infiltration treatment** (Figure 3B-7), convert cubic feet of water storage volume to basin size by selecting a basin depth. The following example uses 1,227 cubic feet in needed storage from above and assumes an 8" (0.67 feet) deep basin:

1,227 / 0.67 = 1831 sq. ft. (a 10' x 183' area, for example)

Both forms of infiltration require construction of a stable drainage outflow to accommodate overflow exceeding the design capacity. Drainage would use this outflow when storms exceed the 1.25-inch design.

Native plants suitable for bioretention basins are included in Table 3B-3.

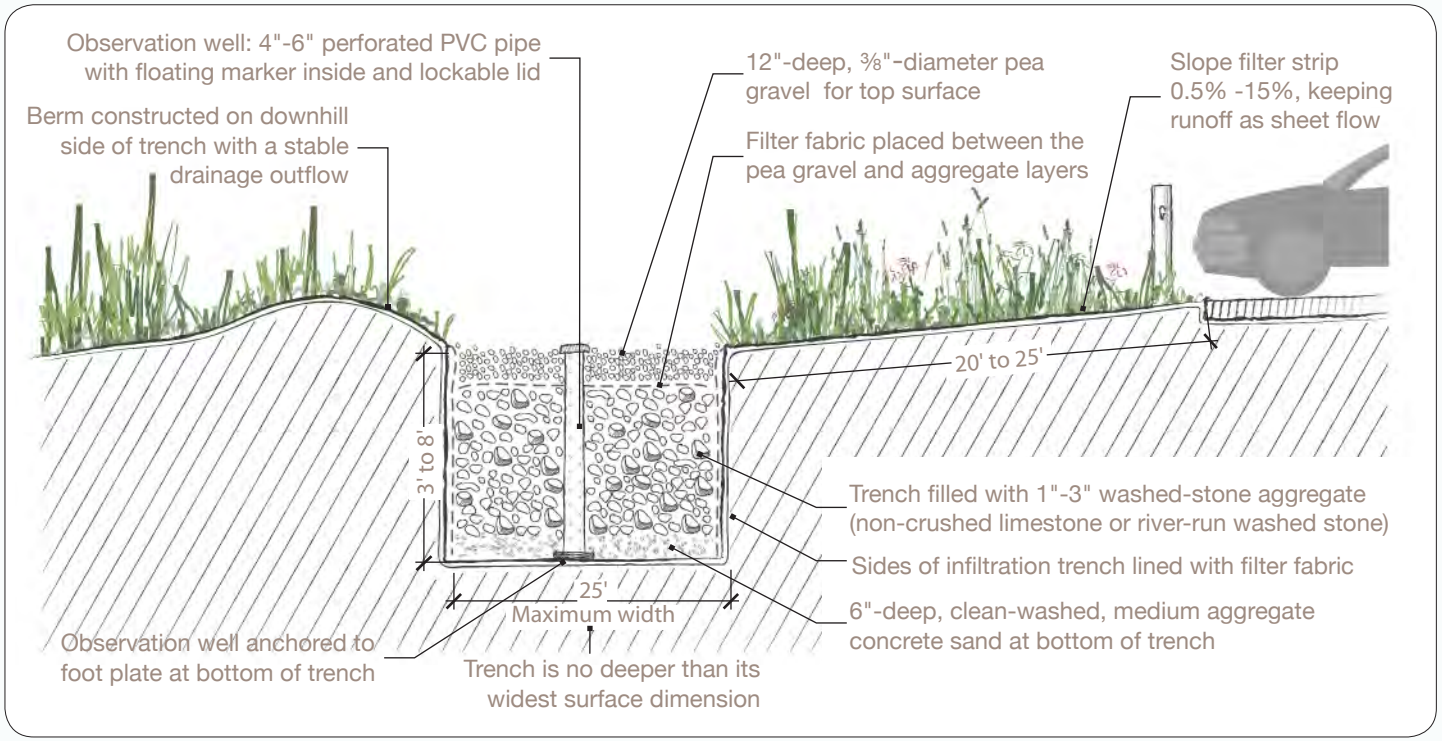


Figure 3B-6.
Infiltration Trenches

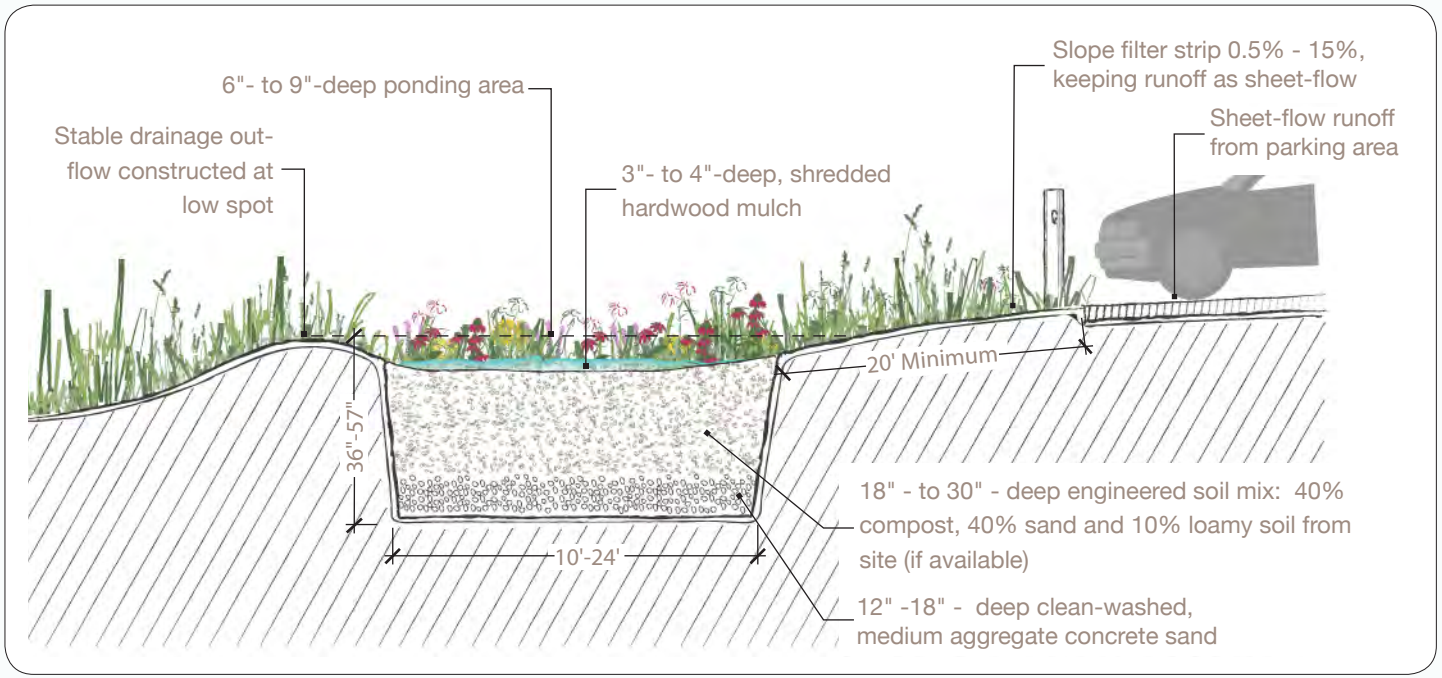


Figure 3B-7.
Bioretention Areas

Plants for Bottom (Low Spot) of Bioretention Basin, Most Wet Soils in Vegetated Filter Strips

Common Name	Botanical Name	Exposure	Height
Buttonbush	Cephalanthus occidentalis	Sun, Part Shade	48" – 72"
Elderberry	Sambucus canadensis	Sun	48" – 72"
Big bluestem	Andropogon gerardii	Sun	48" – 72"
Sweet joe-pye weed	Eupatorium purpureum	Sun, Part Shade, Shade	48" – 72"
Switchgrass	Panicum virgatum	Sun	48" – 72"
Goldenglow	Rudbeckia laciniata (nitida)	Sun, Part Shade	48" – 72"
Indian grass	Sorghastrum nutans	Sun	48" – 72"
Tall purple rue	Thalictrum dasycarpum	Part Shade, Shade	48" – 72"
Swamp milkweed	Asclepias incarnata	Sun, Part Shade	36" – 48"
Blue false indigo	Baptisia australis	Sun, Part Shade	36" – 48"
Ox-eye sunflower	Heliopsis helianthoides	Sun, Part Shade	36" – 48"
Meadow blazing star	Liatris ligulistylis	Sun, Part Shade	36" – 48"
Prairie blazing star	Liatris pycnostachya	Sun	36" – 48"
Bee balm	Monarda didyma	Sun, Part Shade	24" – 48"
Common ironweed	Vernonia fasciculata	Sun, Part Shade	36" – 48"
Lady fern	Athyrium filix-femina	Part Shade, Shade	24" – 36"
Fringed sedge	Carex crinita	Sun, Part Shade, Shade	24" – 36"
Common fox sedge	Carex stipata	Sun, Part Shade, Shade	24" – 36"
Brown fox sedge	Carex vulpinoidea	Sun, Part Shade	24" – 36"
Turtlehead	Chelone glabra	Sun, Part Shade, Shade	24" – 36"
Cardinal flower	Lobelia cardinalis	Part Shade, Shade	24" – 36"
Great blue lobelia	Lobelia siphilitica	Sun, Part Shade	24" – 36"
Bottlebrush sedge	Carex comosa	Sun	12" – 24"
Palm sedge	Carex muskingumensis	Part Shade, Shade	12" – 24"
Broom sedge	Carex scoparia	Sun	12" – 24"
Common rush	Juncus effusus	Sun, Part Shade	12" – 24"
Ohio spiderwort	Tradescantia ohioensis	Sun, Part Shade	12" – 24"
Path rush	Juncus tenuis	Sun	6" – 12"

Table 3B-3.
Native Plants for Bioretention and Filter Strips

Table 3B-3 continued.
Native Plants for Bioretention and Filter Strips

Plants for Bioretention Side Slopes and Combination Wet/Dry Soils in Vegetated Filter Strips

Common Name	Botanical Name	Exposure	Height
American hazelnut	Corylus americana	Sun, Part Shade	10’ – 15’
American cranberrybush	Viburnum opulus var. americanum	Sun, Part Shade	10’ – 15’
Blackhaw viburnum	Viburnum prunifolium	Sun, Part Shade	10’ – 15’
Arrowwood viburnum	Viburnum dentatum	Sun, Part Shade	6’ – 10’
Black chokeberry	Aronia melanocarpa var. elata	Sun, Part Shade	36” – 72”
Big bluestem	Andropogon gerardii	Sun	48” – 72”
White goat’s beard	Aruncusdioicus	Sun, Part Shade	48” – 72”
Sweet joe-pye weed	Eupatorium purpureum	Sun, Part Shade, Shade	48” – 72”
Switchgrass	Panicum virgatum	Sun	48” – 72”
Ninebark	Physocarpus opulifolius	Sun, Part Shade	48" – 72"
Indian grass	Sorghastrum nutans	Sun	48" – 72"
Blue false indigo	Baptisia australis	Sun, Part Shade	36" – 48"
Ox-eye sunflower	Heliopsis helianthoides	Sun, Part Shade	36" – 48"
Prairie blazing star	Liatris pycnostachya	Sun	36" – 48"
Gray-headed prairie coneflower	Ratibida pinnata	Sun, Part Shade	36" – 48"
Purple coneflower	Echinacea purpurea	Sun, Part Shade	24" – 48"
Lady fern	Athyrium filix-femina	Part Shade, Shade	24" – 36"
Brown fox sedge	Carex vulpinoidea	Sun, Part Shade	24" – 36"
Rough blazing star	Liatris aspera	Sun	24" – 36"
Great blue lobelia	Lobelia siphilitica	Sun, Part Shade	24" – 36"
Little bluestem	Schizachyrium scoparium	Sun, Part Shade	24" – 36"
Showy goldenrod	Solidago speciosa	Sun, Part Shade	24" – 36"
Common yarrow	Achillea millefolium	Sun	<6" – 24"
Aromatic aster	Aster oblongifolius	Sun, Part Shade	12" – 24"
Sideoats grama	Bouteloua curtipendula	Sun	12" – 24"
Wild geranium	Geranium maculatum	Part Shade, Shade	<6" – 24"
Goldenrod cultivars	Solidago cultivars	Sun, Part Shade	12" – 24"

Table 3B-3 continued.
Native Plants for Bioretention and Filter Strips

Plants for Top Edge of Bioretention Side Slopes and Driest Soils in Vegetated Filter Strips

Common Name	Botanical Name	Exposure	Height
Black chokeberry	Aronia melanocarpa var. elata	Sun, Part Shade	36” – 72”
Ninebark	Physocarpus opulifolius	Sun, Part Shade	48” – 72”
Boltonia	Boltonia asteroides	Sun	36” – 48”
Purple coneflower	Echinacea purpurea	Sun, Part Shade	24” – 48”
Leadplant	Amorpha canescens	Sun	24” – 36”
Butterfly milkweed	Asclepias tuberosa	Sun, Part Shade	24” – 36”
Narrow-leaved coneflower	Echinacea angustifolia	Sun	24” – 36”
Little bluestem	Schizachyrium scoparium	Sun, Part Shade	24” – 36”
Prairie dropseed	Sporobolus heterolepis	Sun	24” – 36”
Common yarrow	Achillea millefolium	Sun	12” – 24”
American columbine	Aquilegia canadensis	Sun, Part Shade	12” – 24”
Heath aster	Aster ericoides	Sun	12” – 24”
Aromatic aster	Aster oblongifolius	Sun, Part Shade	12” – 24”
Sideoats grama	Bouteloua curtipendula	Sun	12” – 24”
Blue grama	Bouteloua gracilis	Sun	12” – 24”
Purple prairie clover	Dalea purpurea	Sun	12” – 24”
Goldenrod cultivars	Solidago cultivars	Sun, Part Shade	12” – 24”
Wild petunia	Ruellia humilis	Sun, Part Shade	<6” – 12”
Purple poppy mallow	Callirhoe involucrata	Sun	<6”

FILTRATION DESIGN —VEGETATED FILTER STRIP

Filter strips are located on the contour and perpendicular to the direction of flow (Figure 3B-8). Ideally filter strips are located on 2 percent to 6 percent slopes. The entire width of the parking area must be drained evenly across the filter-strip width. A maximum width of 75 feet of parking area can be drained across a properly sized filter strip. Parking area drainage in excess of 75 feet requires multiple filter strips.

The minimum width of filter strips is 20 feet. See Table 3B-4 for required dimensions. The goal for vegetation in the filter strip is to include the densest arrangement of plant stems possible. Native grasses are excellent on sites with full sun exposure. Shady sites require a combination of native tree, shrub, and herbaceous plant species.

Native plants suitable for vegetated filter strips are listed in Table 3B-3.

Table 3B-4.
Vegetated Filter Strip Design Width (adapted from Table 1, Chapter 2I-4, Iowa Stormwater Management Manual).

	Slope of Filter Strip Site		
	< 2%	Between 2% and 6%	>6%
Minimum filter strip width	20’	25’	40’

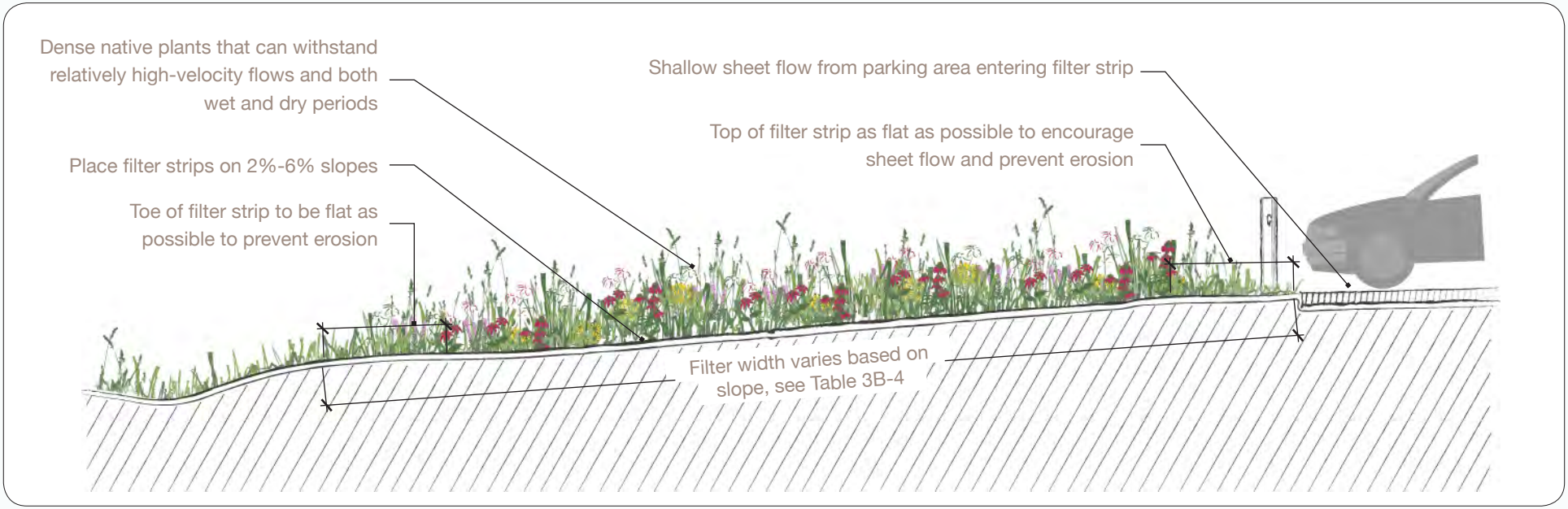


Figure 3B-8.
Vegetated Filter Strip

DRAINAGE SWALES AND OUTFLOW DESIGN

Protect existing drainage patterns in the launch site. Alter swales only to the extent required to slow stormwater runoff and to reduce erosion created by the launch sites. If existing wetlands are identified adjacent to the launch site, ensure that stormwater is separated and not directed into these areas.

Use of piped stormwater conveyance is to be avoided at water trail launch sites, with the exception of culverts at the launch entrance drive. Use open drainage swales, rather than pipes and culverts, to convey drainage across the site toward the water body. Drainage swales are sized using Iowa Statewide Urban Designs and Specifications for open channels. Maximum swale slope is 6 percent. A mixture of warm- and cool-season grasses is recommended for establishment in swales.

Swales at slopes steeper than 6 percent require either V-notched weir, check dams, or drop structures. Willow-wall check dams and slope stabilization with vegetation and rock combination are described in Chapter 4.

PARKING AND LAUNCH CONSTRUCTION

To minimize impact, construction should be completed as quickly as possible once it has begun. Organize construction so the amount of bare ground exposed at any one time is as small as possible and is exposed for the least amount of time. Establish permanent vegetation immediately after construction. All sediment from the construction area must be intercepted and removed before it reaches the stream or lake. Iowa regulations for construction-site erosion control are applicable for all water trail construction, including silt fence and mulching. Refer to Iowa Construction Site Erosion Control Manual for complete information.

CONTACTS AND RESOURCES

Wetland Determination: Obtain a wetland determination report for potential launch sites before applying for funding. This work requires a trained wetland delineator who will determine whether any wetlands are present at or near the construction site. The U.S. Army Corps of Engineers provides this service free of charge and also maintains a list of trained consultants. Contact information:

U.S. Army Corps of Engineers District, Rock Island
Clock Tower Building
P.O. Box 2004
Rock Island, IL 61204-2004
309-794-5376

3C WALKING TRAIL DESIGN

Walking trails are used for circulation between parking and launch areas and as portages, which are land-based alternative routes for water trail segments used to avoid in-stream hazards such as dams. Trail construction includes decisions about trail route, slope, drainage, dimensions or size, and trail surface.

Keep trail flow and shape simple and direct while accommodating existing topography and vegetation. Maintain visual openness along the route, and include gentle curves rather than sharp turns. Curves in standard hiking trails usually create more visual interest and positive emotional perceptions. The same principle can apply to portage and launch-access trails. But remember that trail users will be carrying long boats along the routes, often making multiple trips between points. Avoid constructing trails near and parallel to streams and lakes. Near-water areas are important for bird, amphibian, and mammal habitat.

Trail slope or steepness depends on existing topography. In general, the greater the slope, the more likely it is to cause erosion. Erosion can be significantly reduced by constructing trails that traverse slopes, rather than run down them. Low-slope segments are also friendlier than steep trails for water trail users.

- Parking-to-launch trail maximum slope should be 10 percent to the extent possible
- Portage trail maximum slope should be 12.5 percent to the extent possible
- Maximum trail cross slope should be 2 percent to the extent possible

Most trails, even those with low slopes, change surface drainage and have the potential to cause soil erosion. Eroded soil is one of the most common water pollutants in Iowa. While no trail design eliminates the possibility of introducing erosion, some design characteristics minimize the chance. Avoid using drainage culverts because they concentrate stormwater and form gullies. Use hard-surface crossings for small drainage amounts or small aboveground structures for larger volumes as alternatives. Establishing dense vegetation downslope of trails is advised because it slows and decreases stormwater runoff and increases stormwater infiltration.

Minimize the length of trail that drains to a specific low point, known as a dip (Figure 3C-1).

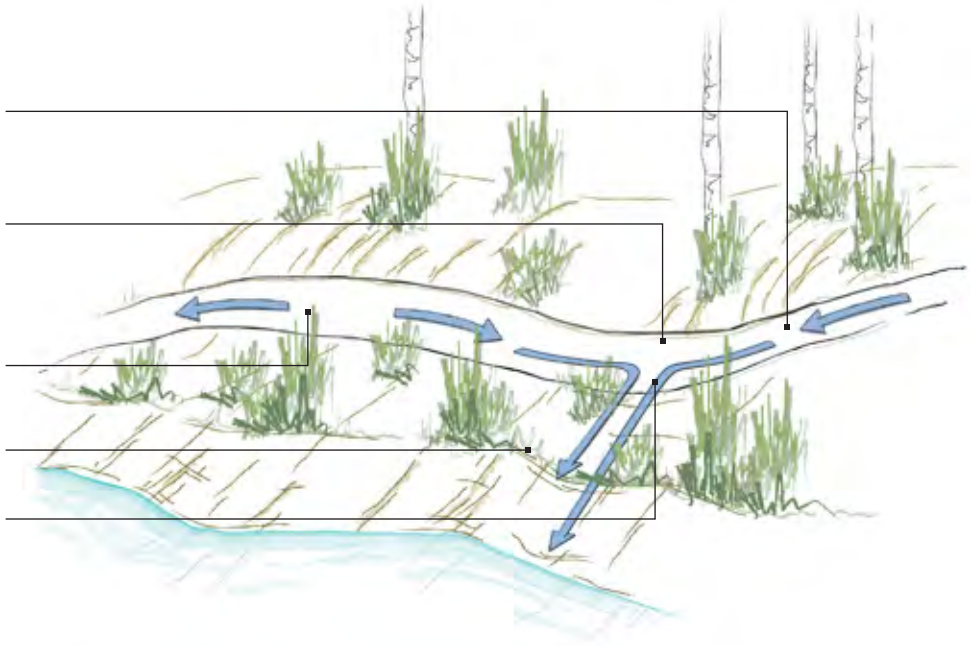


Figure 3C-1.
Trail Dip

Trails must accommodate water trail users carrying gear, boats, and safety devices. A trail width of 3 feet is the minimum needed to accommodate foot traffic in a single direction. A width of 6 feet better accommodates side-by-side passing and walking.

Trail surface material is typically selected based on the type of setting and management of the public land area, existing erosion issues or soil type issues, who will use the launch, the expected volume of use, and the construction budget. Natural-surface and aggregate trails are desirable when site conditions and volume of use are appropriate (Figure 3C-3). Hard-surface trails withstand heavy pedestrian use and are also the most accommodating to elderly and other users with mobility limitations (Figure 3C-2). Hard surfaces are also the most likely of any surface to generate erosion from stormwater runoff and are the most expensive to construct.

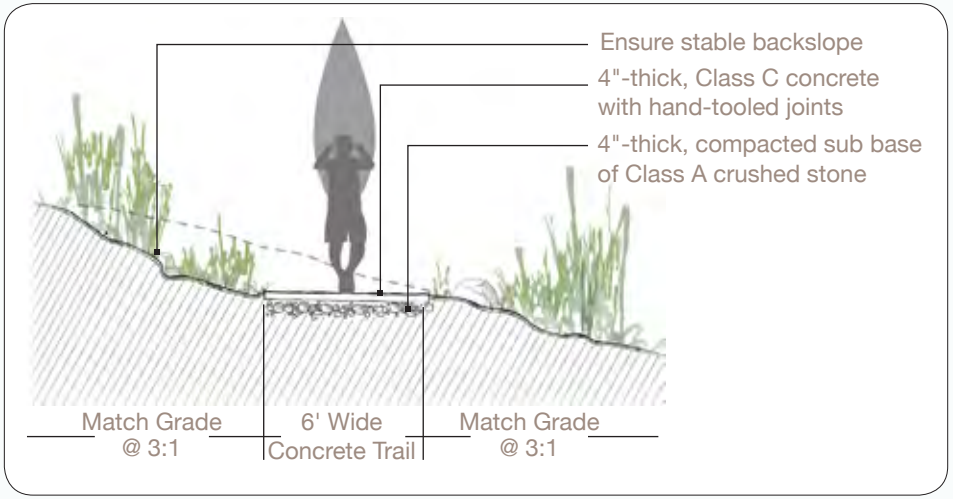
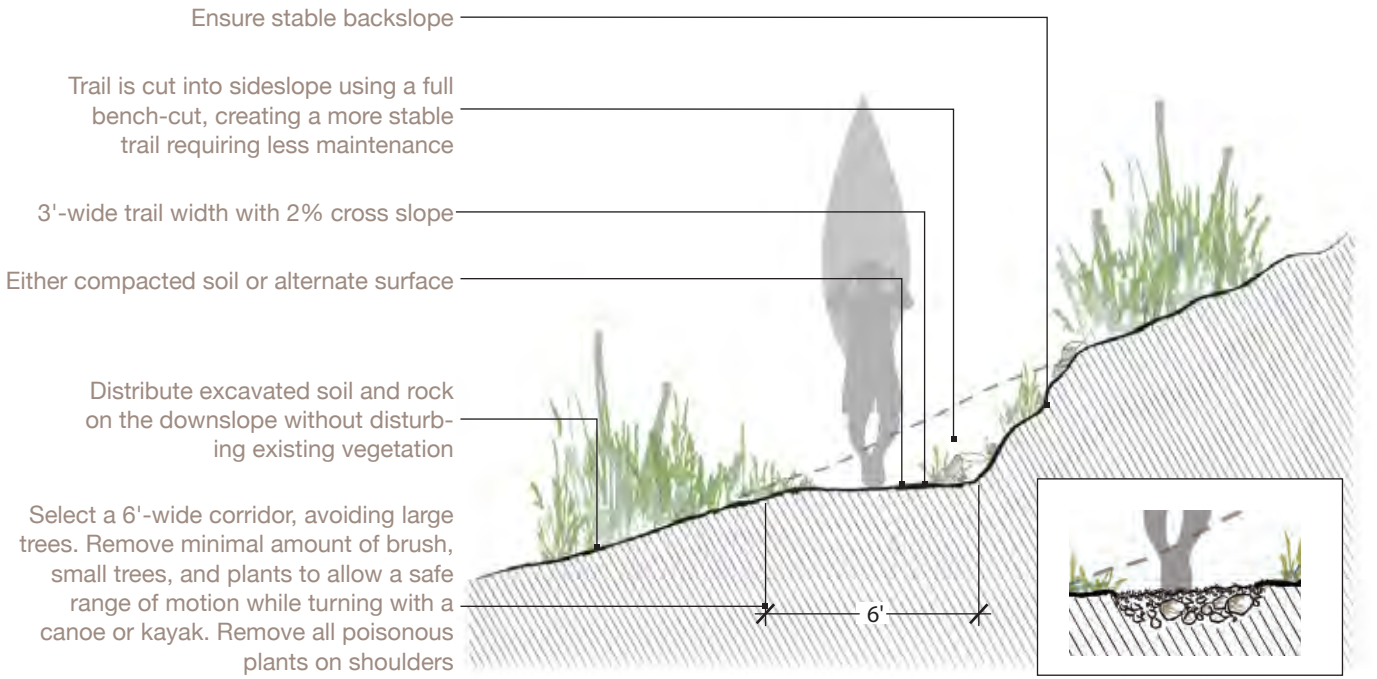


Figure 3C-2.
Typical Cast-In-Place Concrete Trail



Alternate Aggregate Surface:
Compact a 1" layer of 3/8" and finer limestone screenings over a 1" layer of 1" roadstone for tread surface over a 4-6" compacted base of 2-3" diameter roadstone, depending upon soil composition (loose composites needing the most depth)

Figure 3C-3.
Typical Full Bench-Cut Trail, Natural or Aggregate Surface

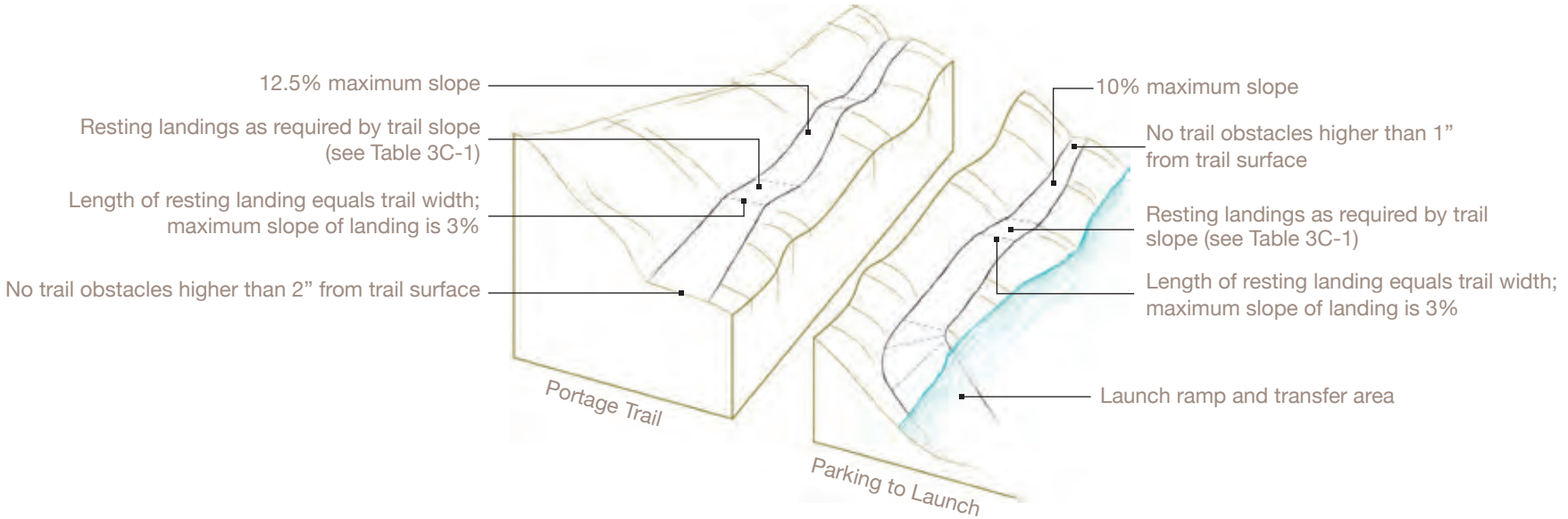


Figure 3C-4.
Accessible ADA Standards for Trail Slope

Water trail developers are encouraged to design and construct trails to meet Accessible ADA standards. Differences between accessible and non-accessible trails include slope, resting intervals, tread width, and height of protrusions. Figures 3C-4 and 3C-5 illustrate trail elements designed to meet ADA standards for accessible design.

Required resting intervals are a notable difference between accessible and non-accessible trails design. Resting intervals are near-level surfaces placed at varying distances based on trail slope (Table 3C-1). On water trail launches designed to meet universal design standards, a hard-surface staging area is required adjacent to either the accessible parking stalls or the loading lane (Figure 3C-6).

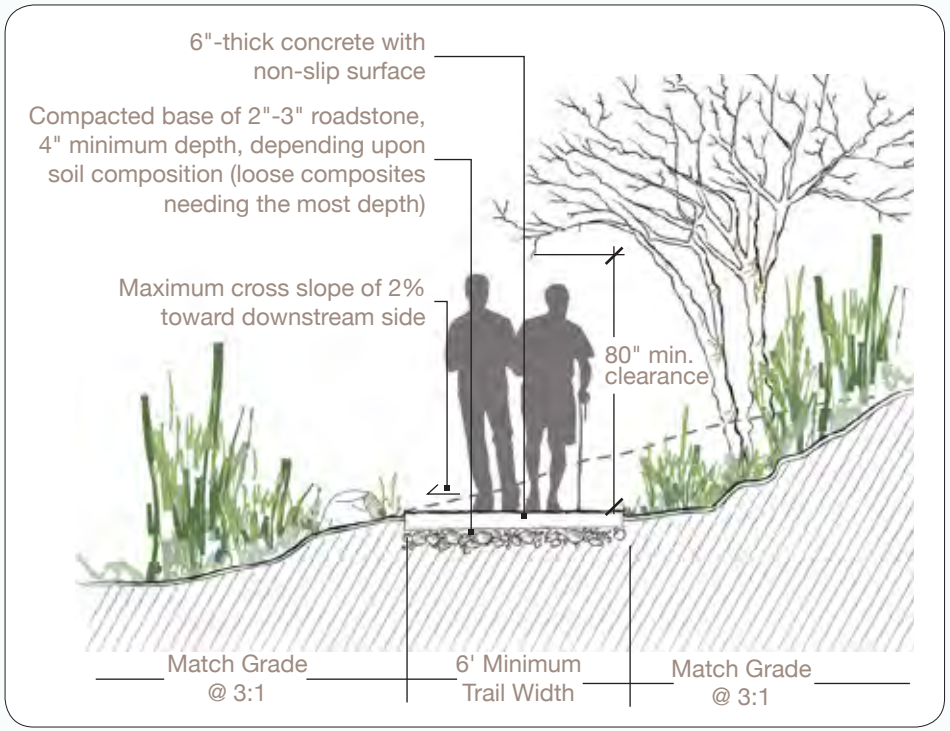


Figure 3C-5.
Typical Accessible ADA Trail

Running Slope of Segment	Trail Types		Maximum Length of Segment Before Resting Interval
	Parking to Launch Trail	Portage Trail	
1%-5%	X	X	No resting intervals required
5%-8%	X	X	50'
8%-10%	X	X	30'
10%-12.5%		X	10'

Table 3C-1.
Trail Resting-Interval Standards for Accessible ADA Design

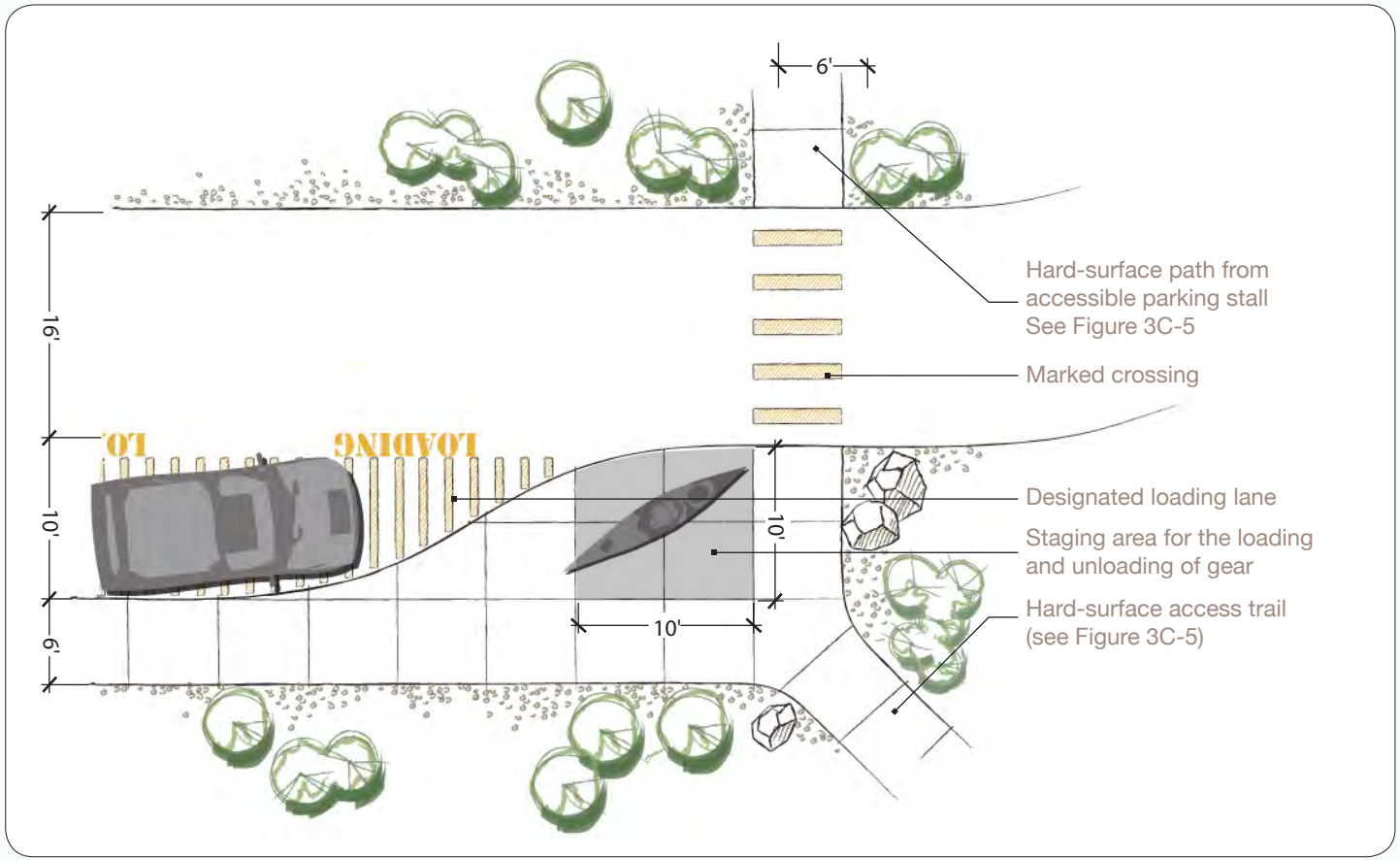


Figure 3C-6.
Staging Area for Universal Design Launch Areas

3D
WATER ACCESS
CAMPSITE GUIDELINES

WATER TRAIL CAMPSITE LOCATIONS

Campsites should only be located in areas that are difficult to reach except by water and not near dwellings, or be within boundaries of an actively managed public recreation area such as a state or county park.

Campsites are to be located ¼ mile or more from all roads, or on opposite side of river to discourage non water trail use.

Traits of desirable sites: a) A short hike up a ridge via a sustainably designed trail can provide a drier site with breezes, fewer insects, and a nice view. b) Low terraces outside of the active floodplain can offer spots for large clusters. c) View and sound of water d) floods infrequently

Amenity level should correspond to desired experience type, although often infrequent maintenance and lack of restroom would put it in the Challenge or Wilderness category.

Use care not to disturb sensitive native species

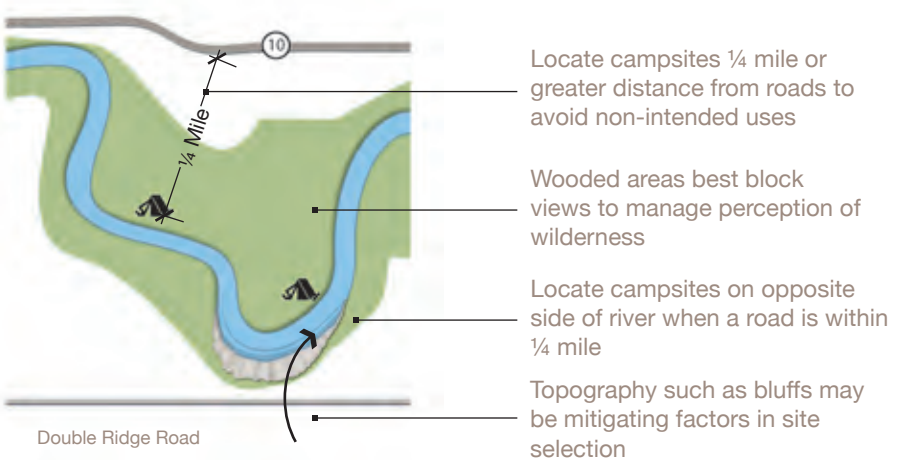


Figure 3D-1.
Water Access Campsites

CLUSTER CAMPSITES

Clusters of shared amenities (fire ring, lantern post, benches, picnic tables, etc.) in a common area have side paths to secluded tent pads. A rolling-dip style trail (3' wide in this case) follows contours and minimal grades from the water's edge to generally flatter area on a ridge, under a wooded canopy, with the sound of rushing water at a riffle below. Campers will not walk through each other's areas to get to their own tents, and the trail does not bring traffic between the tent pads and their views.

Latrines or composting toilets may be considered if use is expected to be more than 200 visitors per season. Must be set back 200 feet from waters edge and out of the 100-year floodplain. Locate them away from common areas or tent pads. Usually, these would be open-air, perhaps with an intentionally planted vegetative screen or privacy fencing, depending upon the setting and experience type goals

Tent pad sites are to be a flat area with sizes between 5'×8' up to 14'×14'. These sites are to be grubbed and initally mulched with woodchips.

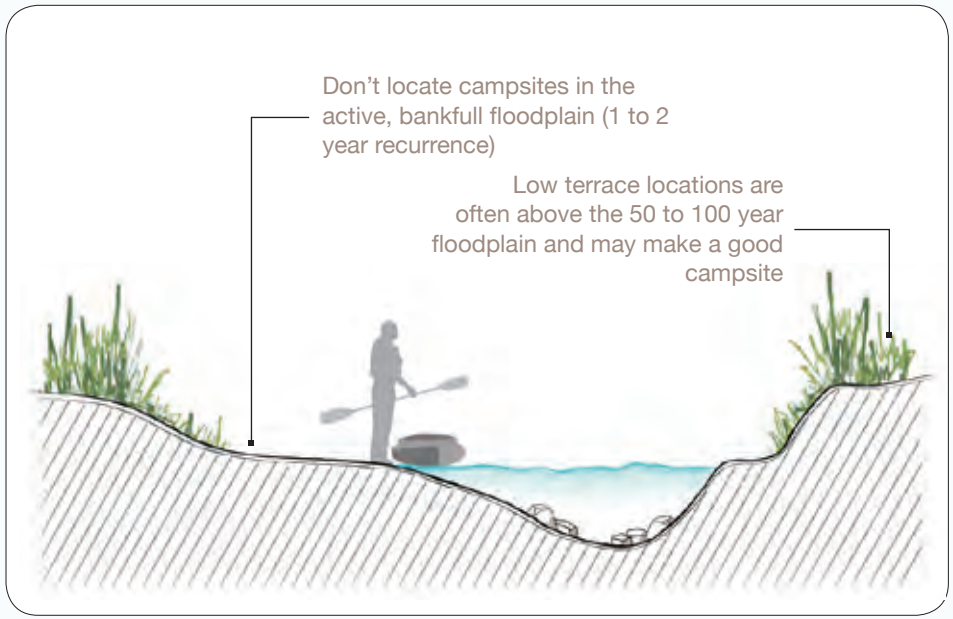


Figure 3D-2.
Campsite Location on Stable Streams

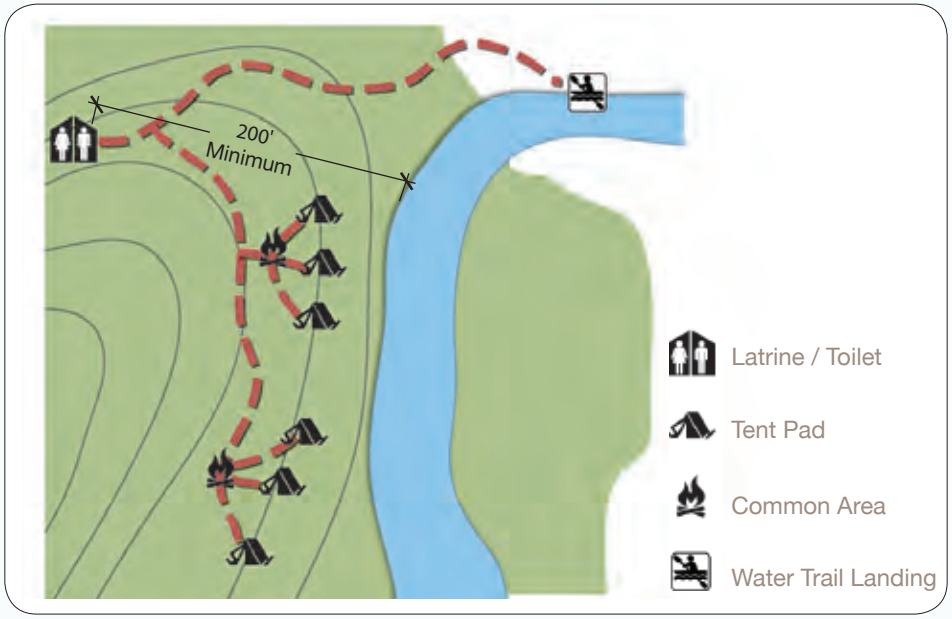


Figure 3D-3.
Cluster Campsites

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4 LAND & STREAM MANAGEMENT

Iowa's rivers are constantly shifting and changing and can be challenging places to design, construct, and maintain water trails. This section discusses aspects you will immediately encounter when developing a water trail: launches, parking areas, and trails. The intended users and expected use suggest how these amenities are designed and constructed. Water trails intended for extended families, for example, are designed differently from those intended for experienced paddlers on multi-day trips.

4 LIST OF FIGURES AND TABLES

INTRODUCTION

Water trail users' most intense experience of land happens near the water. And the land draining into lakes and streams has a tremendous impact on users' water trail experiences. Use and management of that land directly affects the condition of the water body. For example, eroded soil eventually finds its way to the water and acts as a pollutant. Stormwater runoff from parking and mown areas also enters water bodies through drainage culverts and contributes to stream channel and bank degradation. Wildlife habitat can also be impacted by disruption of near-water areas.

Water, soil, and vegetation resources require attention during water trail construction and on a long-term basis. Conservation practices should be used during water trail establishment to repair existing damage at launch sites, as well as to protect the land from later damage from high flows, stormwater runoff, and vegetation removal or change. Habitat improvements in riparian and stream-edge landscapes are also included in water trail design.

After construction, launches and other water trail sites should be inspected at least annually for erosion, invasive species, and other types of impact. Mitigation strategies should be employed as soon as possible after identification of a problem.

Vegetation is a key element in determining the value of a site for wildlife. Appropriately placed vegetation also helps manage stormwater, build soil quality, and add visual interest for people. The best types and species of vegetation to establish at a site or along a stream edge will depend on the conditions of the site and the wildlife species important to protect and promote in the region. The Iowa Wildlife Action Plan, available online on Iowa DNR's web page, describes state and regional goals and needs for habitat. Historic vegetation information about a site, while interesting, is not usually relevant to the altered landscape and stream channel conditions found in Iowa today.

Two categories of management are included in this manual: management practices for near-stream land and those for the streams and streambanks. These practices provide guidelines for habitat establishment that also protect the land from erosion and provide interesting visual corridors for water trail users. These practices are essential for sites disturbed by water trail construction, such as launches, and they are recommended for the entire stretch of the trail.

4A

NEAR-STREAM LAND MANAGEMENT

Land management associated with water trails focuses on areas where water trail users physically move between land and water, including launch sites, portage sites and trails, and other pull-off or camping sites. All riparian landscape areas visually accessible from the water are also critical to the experience of water trail users. Habitat improvements are integrated with recommendations for erosion control and vegetation management. Near-stream land management includes slope protection, gully repair, general vegetation management, and visual access management.

Conservation practices associated with near-stream land can include seeding or introducing live stakes, bare-root or container-grown plants, local boulders and rock, limited amounts of riprap, mulch, or compost. Native species should be used exclusively in water trail projects. Invasive species should be eradicated as much as possible. Specialty products, such as sod blocks and rolls formed with native prairie species, are also commercially available. Stone riprap should be used judiciously; large blankets of riprap on banks can create upstream or downstream erosion problems, visually distract from the natural landscape, and limit vegetative establishment. Broken concrete is not advised for slope or bank stabilization under any circumstance.

SLOPE PROTECTION

Earthwork, or changing the slope of land, is often necessary to construct launches, parking areas and trails. Areas where this is done are susceptible to erosion unless control measures are established during and soon after construction. Both temporary and permanent slope stabilization practices are important. Resulting slopes exceeding 33 percent (or 3:1) require special attention. Steeper slopes, based on local soil characteristics, may require stabilization with a combination of vegetation and rock.

Understanding the site. Successful slope protection requires attention to sun exposure and to soils present on the site. Sites with full sun require different plant species than do full-shade sites. The Iowa Soil Survey provides soil characteristics and behavior under specific conditions. Iowa Soil Survey documents, including maps, can be downloaded online at no cost. Note that soil surveys provide information primarily related to agricultural production, and soil conditions can vary from descriptions in the survey. This is particularly true in urban areas where soil has been modified and near streams where lowering the water table affects the species of plants that would be successful.

After the soil types are determined, amend or aerate the soils as needed to promote plant establishment. Amend soils lacking a topsoil layer, or “A” horizon, with compost mixed into the top 6 inches of existing soil. Soils with compost added absorb more runoff and hold it more effectively for plants to use than non-composted soils. Equipment and foot traffic during construction can compact soil, requiring deep-core aeration or scarification before planting. Scarification is also useful in incorporating compost into the top layer of soil.

In addition to improving soil before planting, landscape fabric or mulch is used anytime seeding or planting occurs on steep slopes. Biodegradable, erosion-control fabrics are made expressly for use with newly seeded slopes. Other landscape fabrics are available to place around tree, shrub, and perennial plantings to control weed invasion. Plastic and other waterproof materials are not used, as they prevent soil and plants from absorbing runoff. A 2–inch-thick mulch layer is an alternative to erosion-control fabric. Mulch materials include chipped or shredded wood, often available from utility companies or municipalities at no cost.

Plant choice. Plant choice is a critical aspect of establishing a successful, stable near-stream site. Native species in combinations of warm and cool season grass and forb species are recommended for areas where non-woody plants are the goal. Establishing native vegetation on a site includes identifying an appropriate plant community, rather than selecting one or two species to establish. In general terms, the greater the variety of species in a seed mix, the broader the adaptability for wildlife, overall resiliency, and long-term success.

Plant communities include groups of native species that evolved to suit specific microclimates and soils. The USDA Natural Resources Conservation Service (NRCS) technical resources web page provides restoration tools for non-woody plant communities. Species lists for 15 native Iowa plant communities are provided. Examples include the Central Midwest Sedge Meadow and the Central Mesic Tallgrass Prairie. The NRCS web page also provides a Plant Community Query, allowing selection of the most suitable plant communities based on soil conditions at a specific site.

Methods for installing plant material at a site include seeding, using dormant cuttings, bare-root planting, and container-grown planting. Selecting plant species for a project site requires regional climate knowledge. Contact local conservation staff to determine appropriateness, as not all species listed are considered native in all areas of the state.

Establishing plants with seed. Seeding is probably most appropriate when an area is large and not steep. Table 4A-1 and 4A-2 list native species commonly established in Iowa. Commercially prepared seed mixes are available from both regional distributors and Iowa-based producers. County conservation boards and county roadside vegetation managers often harvest locally grown seed and make it available for use in the county. Local-ecotype seed species are also available for most species. The additional cost or effort to obtain local-ecotype seed is reasonable if you want to establish regional or state-occurring genetic varieties of native plants. Look for diverse seed mixes adapted specifically to full sun or full shade if your site is one or the other. If not, standard seed mixes usually contain some species adapted to each.

Work 1 to 2 inches of compost into the top layer of soil before seeding. Erosion-control fabrics intended for use over seeded areas greatly increase germination rates and reduce erosion. When these fabrics are used on river banks, though, floods can cause sheer stresses that damage or transport fabrics that aren't secured in redundant manners.

Canada wildrye can be used as a quick-establishing cover grass that survives submergence and dies back over the course of several years. Judiciously seeding it among other seeds, plugs, or live stakes can stabilize soils near the water's edge.

Existing plants can also be transplanted from nearby areas into the desired site. Ensure plants are native to the region and not known to be invasive.

Table 4A-1.
Native Herbaceous Flowering Plants Suitable for Near-Stream Areas[1]. Plants selected for flood-prone areas must be adaptable to wet conditions.

Flowering Plants

Common Name	Botanical Name	Height (ft)	Conditions	Light Requirements
Compass plant	Silphium laciniatum	4'-6'	dry/mesic	full sun – semi-shade
Ironweed	Vernonia fasciculata	4'-6'	mesic/wet	full sun
White wild indigo	Baptisia lactea	3'-6'	mesic	full sun
Meadow rue	Thalictrum dasycarpum	3'-6'	mesic/wet	part shade
Prairie blazing star	Liatris pycnostachya	3'-5'	mesic/wet	full sun
Grayhead coneflower	Ratibida pinnata	3'-5'	dry/mesic	full sun
Stiff goldenrod	Solidago rigida	3'-5'	dry/mesic	full sun
Blue vervain	Verbena hastata	3'-5'	mesic/wet	full sun
Swamp milkweed	Asclepias incarnata	3'-4'	mesic/wet	full sun – semi-shade
Illinois bundleflower	Desmanthus illinoensis	3'-4'		full sun; shade intolerant
Purple coneflower	Echinacea purpurea	3'-4'	mesic	full sun – part shade
Wild bergamot	Monarda fistulosa	3'-4'	dry/mesic/wet	full sun – light shade
Culver's root	Veronicastrum virginicum	3'-4'	mesic	full sun
New England aster	Aster novae-angliae	2'-5'	mesic/wet	full sun – semi-shade
Ox-eye sunflower	Heliopsis helianthoides	2'-5'	dry/mesic	full sun – part shade
Pale purple coneflower	Echinacea pallida	2'-4'	dry/mesic	full sun
Showy goldenrod	Solidago speciosa	2'-4'	dry/mesic	full sun
Spiderwort	Tradescantia ohiensis	2'-4'	dry/mesic/wet	full sun – moderate shade
Prairie sage	Artemisia ludoviciana	2'-3'	dry/mesic	full sun – semi-shade
Butterfly milkweed	Asclepias tuberosa	2'-3'	dry/mesic	full sun – semi-shade
Canada milkvetch	Astragalus canadensis	2'-3'	dry/mesic/wet	full sun
Rattlesnake master	Eryngium yuccifolium	2'-3'	dry/mesic/wet	full sun
Roundheaded bushclover	Lespedeza capitata	2'-3'	dry/mesic	full sun
Foxglove beardtongue	Penstemon digitalis	2'-3'	mesic	full sun – part shade
Hoary vervain	Verbena stricta	2'-3'	dry/mesic	full sun
Smooth blue aster	Aster laevis	1'-5'	dry/mesic	full sun

[1]*List compiled using Iowa DNR (2005).*

Table 4A-1 Continued.

Common Name	Botanical Name	Height (ft)	Conditions	Light Requirements
Stiff coreopsis	Coreopsis palmata	1’-3’	dry/mesic	part shade
Plains coreopsis	Coreopsis tinctoria	1’-3’	mesic	full sun; shade intolerant
White prairie clover	Dalea candida	1’-3’	dry/mesuc	full sun
Purple prairie clover	Dalea purpurea	1’-3’	dry/mesuc	full sun
Flowering spurge	Euphorbia corollata	1’-3’	dry/mesuc	full sun
Yellow gentian	Gentiana alba	1’-3’	mesic	part shade
Golden Alexander	Zizia aurea	1’-3’	mesic/wet	full sun
Black-eyed Susan	Rudbeckia hirta	1’-2’	dry/mesic	full sun – semi-shade
Leadplant	Amorpha canescens	24”-36”	dry/mesic	full sun – part shade
Partridge pea	Chamaecrista fasciculata	24”-36”	dry/mesic	full sun – semi-shade
Canada anemone	Anemone canadensis	12”-24”	mesic/wet	full sun – part shade
Aromatic aster	Aster oblongifolius	12”-24”	dry/mesic	full sun – part shade
Prairie phlox	hlox pilosa	12”-24”	dry/mesic/wet	full sun

Table 4A-2.
Native Grasses and Sedges Suitable for Near-Stream Areas[1]. Plants selected for flood-prone areas must be adaptable to wet conditions.

Grasses and Sedges

Common Name	Botanical Name	Height (ft)	Conditions	Light Requirements
Big bluestem	Andropogon gerardii	3’-9’	dry/mesic	shade intolerant
Indiangrass	Sorghastrum nutans	3’-5’	dry/mesic	full sun
Canada wildrye	Elymus canadensis	3’-4’	dry/mesic/wet	full sun – part shade
Little bluestem	Andropogon scoparius	2’-4’	dry/mesic	full sun – part sun
Prairie dropseed	Sporobolus heterolepis	2’-3’	dry/mesic	full sun
Sideoats grama	Bouteloua curtipendula	15”-30”	dry/mesic	full sun – part shade
Prairie cordgrass[2]	Spartina pectinata	3’-8’	wet	full sun
Baltic rush	Juncus balticus	1’-3’	wet	full sun
Three-square rush	Scirpus americanus	1’-3’	wet	full sun
Dark green bulrush	Scirpus atrovirens	3’-5’	wet	full sun
Wool grass	Scirpus cyperinus	3’-5’	wet	full sun
Bottlebrush sedge	Carex comosa	1’-2’	wet	full sun
Fringed sedge	Carex crinita	2’-5’	wet	full sun – full shade
Hop sedge	Carex lupulina	1’-4’	wet	full sun – part shade
Lurid sedge	Carex lurida	1’-3’	wet	full sun
River wildrye	Elymus riparius	3’-4’	wet	part shade
Virginia wildrye	Elymus virginicus	2’-4’	mesic/wet	part shade

[1] List compiled using information from Iowa DOT (2003), Lown (2001), and Ion Exchange.
[2] Plant establishment is successful using root material from existing plants worked into the soil rather than seed.

ESTABLISHING PLANTS WITH DORMANT CUTTINGS

Cuttings from dormant plants near a project site can be used to establish certain native woody species as an alternative to bare-root or container-grown plants. Cuttings established in this way are known as live stakes, a form of soil bioengineering. Harvesting stakes and fascine materials from a locally successful plant increases the probability that the stakes will grow well in the area. Species used for live stakes include those that establish roots from cuttings of branches or stems fairly rapidly. (See Table 4A-3). Collectively, these species are known as pioneering species because they are the first species to establish when adequate soil moisture is available. Rooting occurs when branches are in contact with soil and soil water and groundwater, and air voids are not present. While pioneering species are functional for near-stream areas, additional woody and herbaceous species should also be present.

Live stakes (Figure 4A-1, following page) are appropriate when construction is coordinated with the dormant cycle of woody plants and when pioneering species are acceptable for the project. Cuttings should be made the day before planting and anytime after leaf drop and before bud break. Cut side branches of trees or shrubs between 1/2 inch and 2 inches in diameter in lengths slightly longer than needed for installation.

Table 4A-3.
Iowa Native Woody Species Adaptable for Use as Dormant Cuttings[1]

Woody Species for Dormant Cuttings

Common Name	Botanical Name	Mature Height (ft)
Eastern cottonwood	Populus deltoides	100’
Black willow	Salix nigra	50’
Sandbar willow	Salix interior	25’
Pussy willow	Salix discolor	20’
Gray dogwood	Cornus racemosa	10’
Ninebark	Physocarpus opulifolius	10’
Redosier dogwood	Cornus sericea	10’
Silky dogwood	Cornus amomum	10’
Buttonbush	Cephalanthus occidentalis	8’
Elderberry	Sambucus nigra ssp.canadensis	8’
Arrowwood viburnum	Viburnum dentatum	7’

Adequate soil moisture and effective drainage are required to establish dormant cuttings. Cuttings up to 4 inches in diameter can be used on sites with medium-textured soils and a high water table. Coarse, sandy soils have the potential to dry out but still fare better than fine-grained, silty soils, which hold moisture and contain less pore space for oxygen. Potentially drier applications, such as in sandy soil or with a low water table, will probably establish more successfully with smaller, 1- to 2-inch diameter material.

Avoid bark damage while preparing live stakes. Soaking cut branches in the stream overnight before planting increases root establishment. Use a water jet/probe or metal stake, such as a rock bar or pipe, to create a hole 2 to 4 feet deep and the same width as the cutting. Insert the cutting into the hole, putting the base of the cutting down. Water well, and fill all voids in the opening with soil to ensure the cutting has contact with soil for its entire length. Trim excess stake material to allow between 1 and 2 inches of stake above the soil level.

Soil bioengineering practices such as live stakes and fascines, discussed in the stream-edge section, have been successfully established by trained volunteer groups in Iowa and offer a low- or no-cost opportunity to re-vegetate slopes and stream edges. An early example of bioengineering techniques developed in Iowa focused on gully reclamation during the Great Depression as a part of the Iowa Engineering Experiment Station at Iowa State College (now Iowa State University). (See Quincy 1935.)

[1]Note that some species listed are only regionally appropriate within the state. Plant species chosen for a project represent those growing close to the project site.

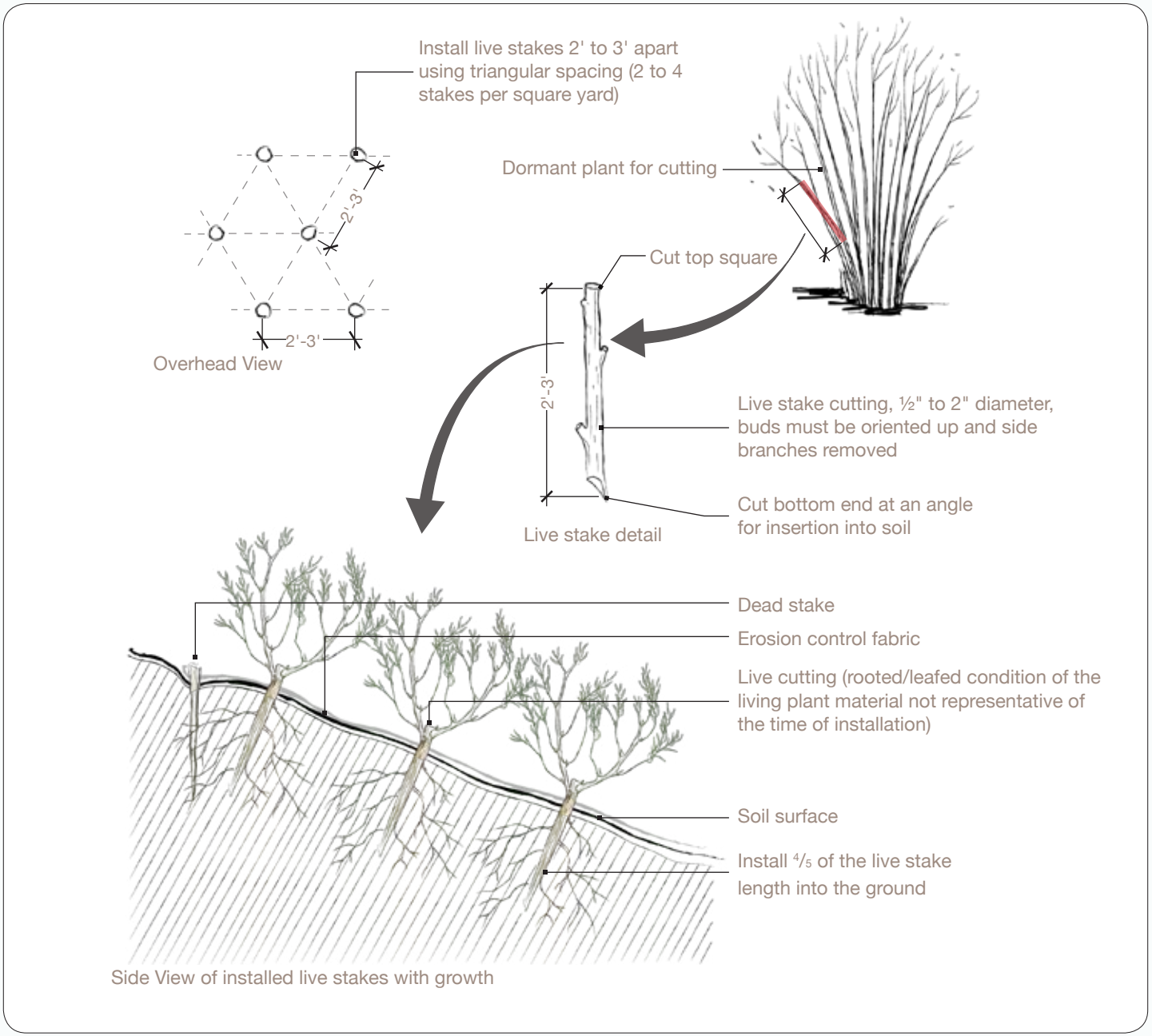


Figure 4A-1.
Live Stakes

ESTABLISHING PLANTS WITH BARE-ROOT OR CONTAINER-GROWN MATERIAL

Bare-root shrubs and trees are both commercially available and economically efficient. Using container-grown plants is also a common way to establish herbaceous plants. Container-grown trees and shrubs are more expensive to purchase compared with bare-root and may be less suitable for large sites. Tables 4A-4 and 4A-5 include native woody species recommended by the DNR that are adaptable and suggested for near-stream areas. Native, herbaceous plants recommended for near-stream areas can be established with small container-grown plants, plant divisions from existing plantings, or seeding. Table 4A-1 and 4A-2 includes recommended herbaceous species. Figure 4A-2 illustrates establishment of vegetation using bare-root and container-grown material. With permission of land managers, some shrubs, such as dogwoods, young willows, buttonbush, and ninebark, may also be uprooted with machinery already mobilized for project construction and transplanted to disturbed zones. Care should be taken to properly identify that invasive shrubs are not used.

Woody species selected for planting are determined by considering field-based knowledge of the project site. New plantings should match those at or near the site. Native range maps, when used to identify what species are found in an area, are often not accurate indicators.

Table 4A-4.
Native Trees and Shrubs Suitable for Near-Stream Areas[1]

Somewhat Wet Soil Conditions

Common Name	Botanical Name	Mature Height (ft)	Growth Rate	Shade Tolerance
Yellow birch	Betula alleghaniensis	100’	medium	intermediate
American basswood	Tilia americana	80’	fast	tolerant
Black walnut	Juglans nigra	80’	fast	intolerant
Paper birch	Betula papyrifera	70’	fast	intolerant
Pecan	Carya illinoensis	70’	slow	intolerant
Red oak	Quercus rubra	70’	medium	intermediate
Black maple	Acer nigrum	60’	medium	very tolerant
Kentucky coffeetree	Gymnocladus dioicus	60’	medium	intolerant
Sugar maple	Acer saccharum	60’	medium	very tolerant
Black cherry	Prunus serotina	50’	medium	intolerant
Ohio buckeye	Aesculus glabra	50’	medium	tolerant
Red maple	Acer rubrum	50’	medium	tolerant
Bigtooth aspen	Populus grandidentata	45’	fast	very intolerant
Shingle oak	Quercus imbricaria	45’	slow	intermediate
Quaking aspen	Populus tremuloides	40’	fast	very intolerant
American hornbeam	Carpinus caroliniana	35’	slow	very tolerant
Downy hawthorn	Crataegus mollis	30’	slow	intermediate
Fleshy hawthorn	Crataegus succulenta	30’	slow	intermediate
Margaret’s hawthorn	Crataegus margaretta	30’	slow	intermediate
Pear hawthorn	Crataegus calpodendron	30’	slow	intermediate
Pin cherry	Prunus pensylvanica	30’	fast	very intolerant
Prairie crabapple	Malus ioensis	22’	medium	intolerant
Chokecherry	Prunus virginiana	20’	medium	very intolerant
Mountain maple	Acer spicatum	20’	slow	tolerant
Pagoda dogwood	Cornus alternifolia	20’	slow	tolerant
Wild plum	Prunus americana	20’	fast	very intolerant
Saskatoon serviceberry	Amelanchier alnifolia	18’	medium	tolerant
American hazelnut	Corylus americana	15’	medium	intermediate
Eastern redbud	Cercis canadensis	15’	slow	tolerant
Eastern wahoo	Euonymus atropurpureus	15’	medium	tolerant
Nannyberry	Viburnum lentago	15’	medium	intermediate
Blackhaw viburnum	Viburnum prunifolium	12’	slow	intermediate
Elderberry	Sambucus canadensis	8’	fast	intermediate
Roundleaf dogwood	Cornus rugosa	8’	medium	tolerant

[1]*List compiled using Iowa DNR (2005).*

Work 1 to 2 inches of compost into the top 6 inches of soil before planting unless soils are already high in organic content. A 4-foot-by-4-foot section of landscape fabric placed around trees and shrubs reduces weed competition during plant establishment and makes plantings identifiable during summer months. Bare-root plants, in particular, greatly benefit from reduced weed competition.

Wet Soil Conditions

Common Name	Botanical Name	Mature Height (ft)	Growth Rate	Shade Tolerance
Silver maple	Acer saccharinum	120’	very fast	tolerant
Cottonwood	Populus deltoides	100’	very fast	very intolerant
Sycamore	Platanus occidentalis	100’	fast	intermediate
River birch	Betula nigra	80’	fast	intolerant
Swamp white oak	Quercus bicolor	70’	slow	intermediate
Hackberry	Celtis occidentalis	60’	slow	intermediate
Pin oak	Quercus palustris	60’	slow	intolerant
Black willow	Salix nigra	50’	fast	very intolerant
Boxelder	Acer negundo	50’	fast	tolerant
Peachleaf willow	Salix amygdaloides	40’	fast	intolerant
Sandbar willow	Salix interior	30’	fast	intolerant
Speckled alder	Alnus incana	30’	medium	intermediate
Bebb willow	Salix bebbiana	25’	fast	intolerant
Coyote willow	Salix exigua	25’	fast	intolerant
Downy serviceberry	Amelanchier arborea	25’	medium	tolerant
Shining willow	Salix lucida	25’	fast	intolerant
Hoptree/water ash	Ptelea trifoliata	15’	slow	intermediate
Pussy willow	Salix discolor	15’	fast	intolerant
Gray dogwood	Cornus racemosa	10’	medium	tolerant
Heart-leaved willow	Salix rigida	10’	fast	very intolerant
Meadow willow	Salix petiolaris	10’	fast	very intolerant
Silky dogwood	Cornus obliqua	10’	medium	tolerant
Witchhazel	Hamamelis virginiana	10’	medium	intermediate
Redosier dogwood	Cornus sericea	8’	fast	tolerant
Rough-leaf dogwood	Cornus drummondii	8’	medium	tolerant

Table 4A-5.
Native Trees and Shrubs Suitable for Near-Stream Areas[1]

[1]*List compiled using Iowa DNR (2005).*

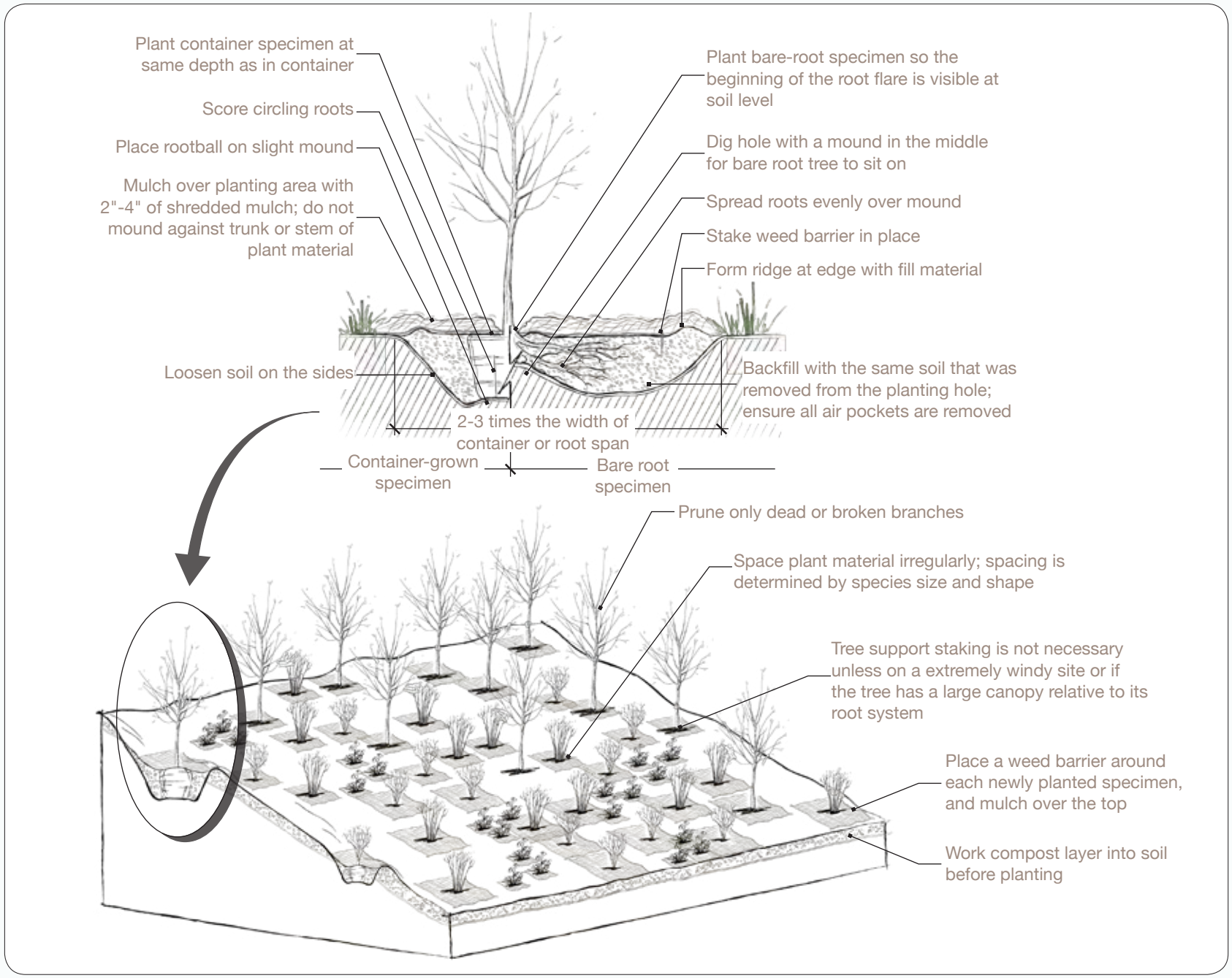


Table 4A-2.
Vegetation Establishment Using Bare-Root or Container-Grown Material

SLOPE PROTECTION WITH VEGETATION – ROCK COMBINATION

Consider including a combination of vegetation and rock when slopes are too steep to be protected by vegetation alone. Slopes greater than 2:1 can have mixed results, especially when soils are unconsolidated. Slopes between 2:1 and 1:1 generally require the addition of rock stabilization. Slopes exceeding 1:1 are too steep for construction. Live stakes can be installed at the time of rock placement or on slopes with existing rock protection (Figure 4A-3). Note that stakes must be installed deep enough to be in contact with underlying soils. Stake orientation should be perpendicular to the rock slope face.

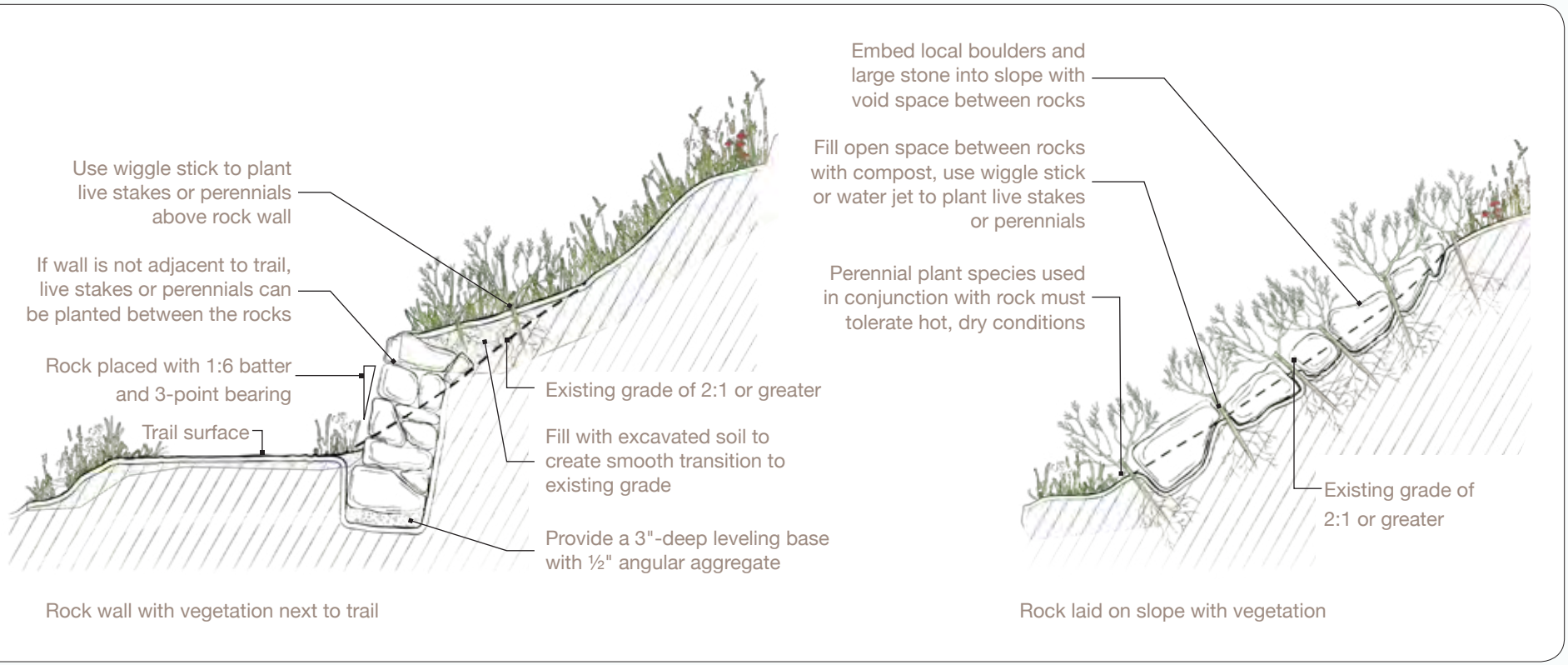


Figure 4A-3.
Slope Protection with Vegetation - Rock Combination

GULLY REPAIR DESIGN

Concentrated stormwater flowing through gullies may contribute some of the highest sediment yields of any source to Iowa streams and lakes. Once a gully is established, runoff widens and deepens the channel, causing more erosion and short-circuiting the filtering intentions of stream-edge vegetative buffers. Existing gullies on a launch site must be repaired and stabilized before additional drainage from parking areas or trails is directed toward them. Gully repair can be accomplished using highly engineered and constructed approaches, as well as with properly designed vegetative practices led by trained volunteers.

If the slope of the gully is greater than 6 percent, gully repair includes some form of check-dam construction. Highly engineered and constructed check dams generally are impermeable. Vegetative check dams are porous, substantially slowing water movement through the gully. All gully repair projects require technical knowledge and oversight, as improperly designed check dams can increase erosion and instability.

Check dams should be configured or spaced to accommodate specific site conditions (Figure 4A-4). Several general recommendations that minimize check-dam failure apply to all designs. Maintain a check-dam height of no greater than 3 feet. Ensure the top and bottom of all check dams in a series have the appropriate vertical relationship to each other. Install a rock splash point at the bottom of each check dam to absorb the energy of the overflow water. Local boulders and large stones, cobble, or shot rock are used when rock is needed to stabilize a waterway.

Check dams called willow walls, built with cuttings from willow trees adjacent to the site, can also be used (Figure 4A-5). Live cuttings installed when dormant, before buds and break and leaves are present, have the added value of sprouting and becoming a living, growing structure.

Swales or waterways with less than 6 percent slope can often be built without check dams and planted with native warm- and cool-season grasses. Refer to the Iowa Stormwater Management Manual for swale sizing calculations.

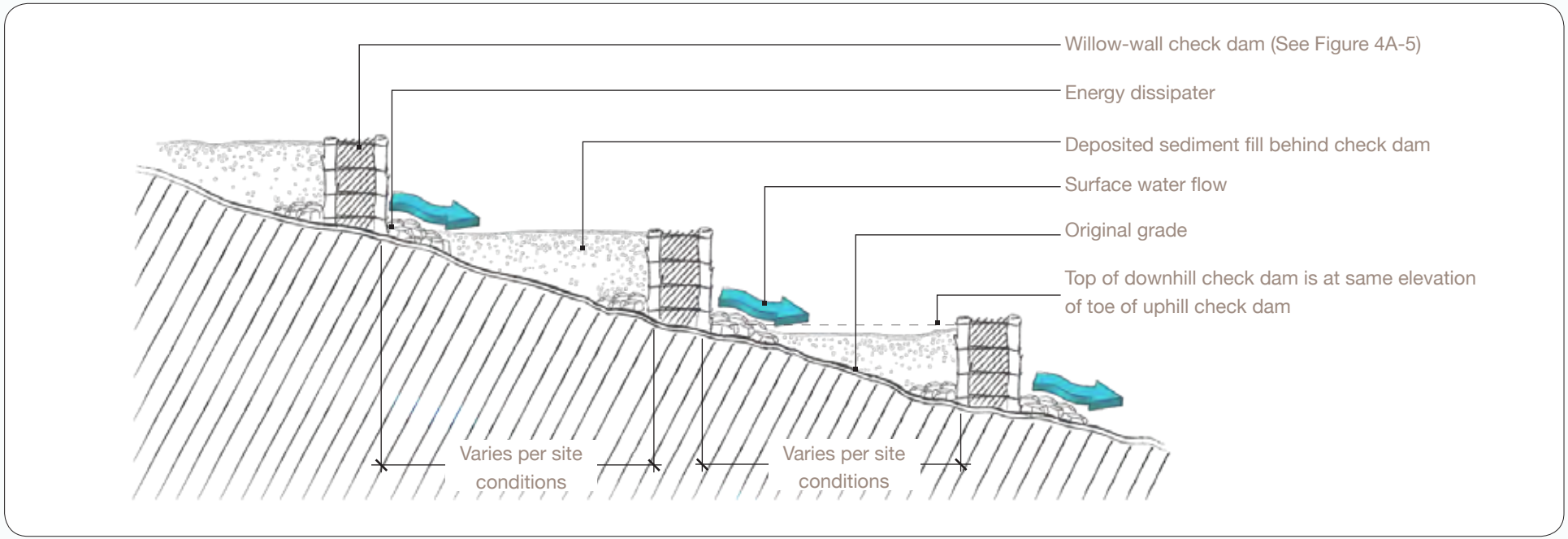


Figure 4A-4.
Check-Dam Alignment

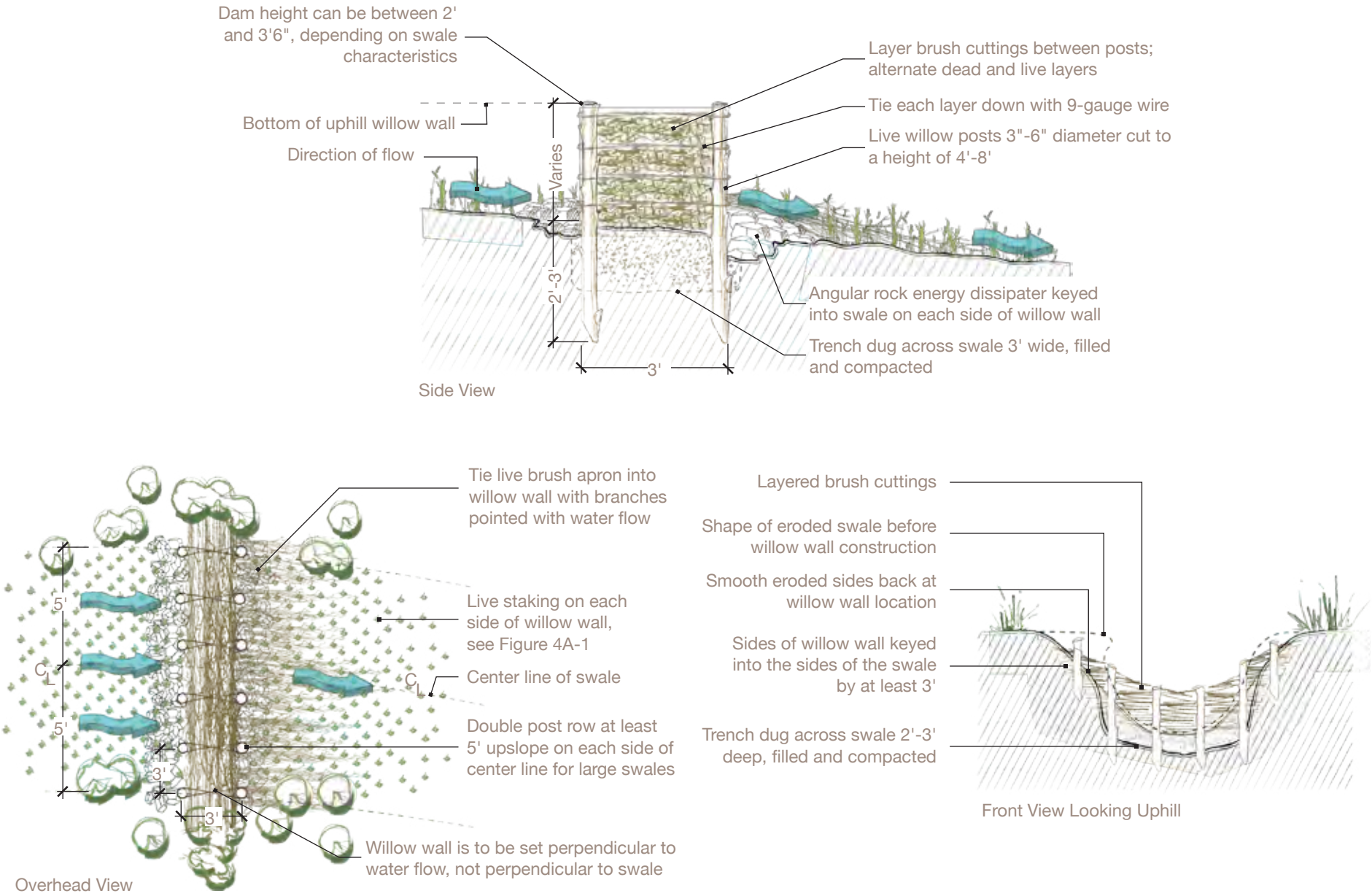


Figure 4A-5.
Willow-Wall Construction Sequence for Reducing Gully Erosion at Construction Sites

VEGETATION MANAGEMENT

Functional wildlife areas require regular observation and occasional maintenance. While leaving woodlands and pastures "to nature" may sound like an earth-friendly and attractive idea, a lack of management in the Iowa landscape unquestionably allows undesirable, invasive plant species to establish and spread. Plants native to Iowa evolved with disturbances such as grazing and fire that eliminate invasive plants. When they are protected from such disturbances, invasive plants that would otherwise be kept in check are able to out-compete the native plants. Some invasive plants, such as honeysuckle, may exacerbate waterway sedimentation. Plants categorized as invasive often resemble native plants to the untrained eye, and some actually are native or hybrids of exotic and native species. However, their dominance crowds out a more diverse plant community. Thirty-seven plants appear on the Iowa State Noxious Weeds List. Iowa has woody, herbaceous, and aquatic forms of invasive plants (Tables 4A-6, 4A-7, 4A-8).

Woody Invasive Plants

Common Name	Botanical Name
Buckthorn	Rhamnus cathartica, Rhamnus frangula
Honeysuckle	Lonicera x bella, Lonicera maackii, Lonicera morrowii, Lonicera tatarica
Multiflora Rose	Rosa multiflora
White Mulberry	Morus alba
Autumn Olive	Elaeagnus umbellata
*Eastern Red Cedar	Juniperus virginiana

*Species invasive in prairie landscapes, especially on dry slopes. Easter red cedars on rocky promontories along streams are in their native setting, were historically protected from fire, and should not be disturbed.

Table 4A-6.
Woody Invasive Plant Species Common in Riparian Areas in Iowa

Herbaceous Invasive Plants

Common Name	Botanical Name
Leafy Spurge	Euphorbia Esula
Reed Canary Grass	Phalaris arundinacea
Garlic Mustard	Alliaria petiolata
Cattail	Typha latifolia, Typha angustifolia
Stinging Nettle	Urtica dioica

Table 4A-7.
Herbaceous Invasive Plant Species to the Prairie Landscape Common in Riparian Areas in Iowa

Aquatic Invasive Plants

Common Name	Botanical Name
Purple Loosestrife	Lythrum salicaria
Eurasian Watermilfoil	Myriophyllum spicatum

Table 4A-8.
Aquatic Invasive Plant Species Common in Riparian Areas in Iowa

Invasive plants can become established in urban, as well as rural, sites, particularly when an existing shade canopy is disrupted or removed. Examples of this include edges of streams or ponds with bare soil, cleared sections of woodland in which desirable species have not been successfully replanted, and areas cleared for overhead utility easements. The additional sunlight reaching the ground surface allows invasive plants to establish. Clearing the land to build a water trail launch and/or parking area presents a similar potential for invasive plants to establish or spread.

Use caution removing any plant cover, including invasives, from stream bank areas. Stream bank areas quickly become unstable when vegetation is removed. Resulting bank failure can be minimized in cleared areas when native plants with a quickly developing root structure are immediately established.

County conservation boards, federal agencies, state agencies, and nonprofit organizations in Iowa frequently enlist volunteer participation to control invasive species. Common practices in Iowa include controlled burning, cutting with herbicide treatment, and physical removal.

Additional information on identifying and managing invasive species is available from state and nonprofit organizations, the Iowa DNR Aquatic Invasive Species program, and the state weed commissioner in the Iowa Department of Agriculture and Land Stewardship. County conservation and soil and water conservation districts may provide localized information.

MANAGEMENT FOR VISUAL ACCESS

People often use water trails to reduce stress and experience landscape areas they perceive as more remote than parks. Visually successful experiences require a balance between providing interesting views with some elements of mystery and helping users understand and make sense of their surroundings. Interesting rock formations, streambank shapes, and unusual trees are examples of enjoyable landmarks that contribute to how people remember water trail corridors. Paddling on water trails creates opportunities to experience a sense of mystery, particularly when channel curves, landforms, and vegetation create temporary visual barriers. Water trail projects build relationships with adjacent landowners early in project development to communicate about stream and stream-edge management and access purpose. While riparian-area management always responds to the objectives of the landowner, state-recognized water trail users enjoy stream segments with minimal disturbance and good stewardship practices.

Litter and other dumped materials can have negative effects on wildlife and plant communities, although it may not be significant enough to impact populations of any given species. However, litter in and along the water's edge significantly disturbs most water trail users. Larger pieces of trash dumped intentionally or moved downstream by high flows are likewise discouraging to users because, similar to erosion, they represent mismanagement and a lack of stewardship. Campaigns to pack out trash are recommended for all water trails. Volunteer cleanup efforts are recommended for each water trail. Cleanups increase the sense of waterway ownership for volunteers and create better experiences for water trail users. It's important to coordinate trash pickup with the entities responsible for removing trash for recycling or disposal.

Traditional riprap bank stabilization and obvious human development, such as housing, are among the least desirable views noted by water trail users. Contemporary designs for bank stabilization, such as those included in this manual, make it possible to avoid constructing entire banks with rock. Not only are the contemporary designs effective at controlling erosion, they also add habitat value to riparian areas and streams and add visual value from the water.

Views of wildlife, spring flower blooms, and fall color are strong motivators for Iowa paddlers to use or select specific water trails. Diverse riparian plant communities, as opposed to landscapes with only a few species, provide the best opportunities for year-round variety. Diverse plant communities also provide a variety of view types—such as closed-forest canopy and openings—which adds visual interest for users.

4B

STREAM RESTORATION
PRACTICES IN WATER TRAIL CONSTRUCTION

Recent estimates suggest streambank erosion contributes 25% to 50% of the annual sediment load in Iowa. Siltation and turbidity are common causes of impairments in Iowa's Section 303(d) list. If left unchecked, erosion of the toe, or bottom of the bank where it makes contact with stream water, leads to mass slope failure and undercut banks. Mass failures often suggest a stream is unstable and attempting to adjust to external changes. Causes could include stormwater delivered to the stream, a channelization project downstream of failing banks, past oversupplies of sediments, or removal of deep-rooted vegetation along the streambank.

Developing water trail launches at vertical cut banks is a common challenge in Iowa. Cut banks, named for their characteristic bare-soil surfaces, are often located on the outside bends of streams. These vertical streambanks, if not densely vegetated with well-established trees, can be extremely unstable during small and large floods. Launch construction is generally discouraged on these types of banks when it can be avoided. In some highly entrenched stream systems, such as certain Western Iowa streams, finding low-slope banks can be difficult. When necessary, a vertical bank can often be modified to provide a somewhat stable launch location or portage landing, using stream restoration or streambank practices.

Stream and streambank restoration practices most commonly associated with water trails include designing natural channels to redirect stream energy and protect streambanks that are clearly in flux at launch points. Streambank protection includes reshaping, minimal streambank armoring, and bioengineering. Both natural channel design and streambank protection reduce erosion and protect the construction investment. Streambank protection on other sections of water trails is also encouraged, particularly when mass slope failure is present. All stabilization practices associated with water trails favor minimal use of rock or hard surfaces.

Incorporating stream restoration principles and practices into designs can:

- enhance the long-term stability of projects
- enhance aesthetics
- provide improved fish habitat at access points where people would tend to fish
- provide cost-effective alternatives to standard riprap revetments, especially for demonstration projects

IDENTIFYING BANKFULL ELEVATION ON A STREAM

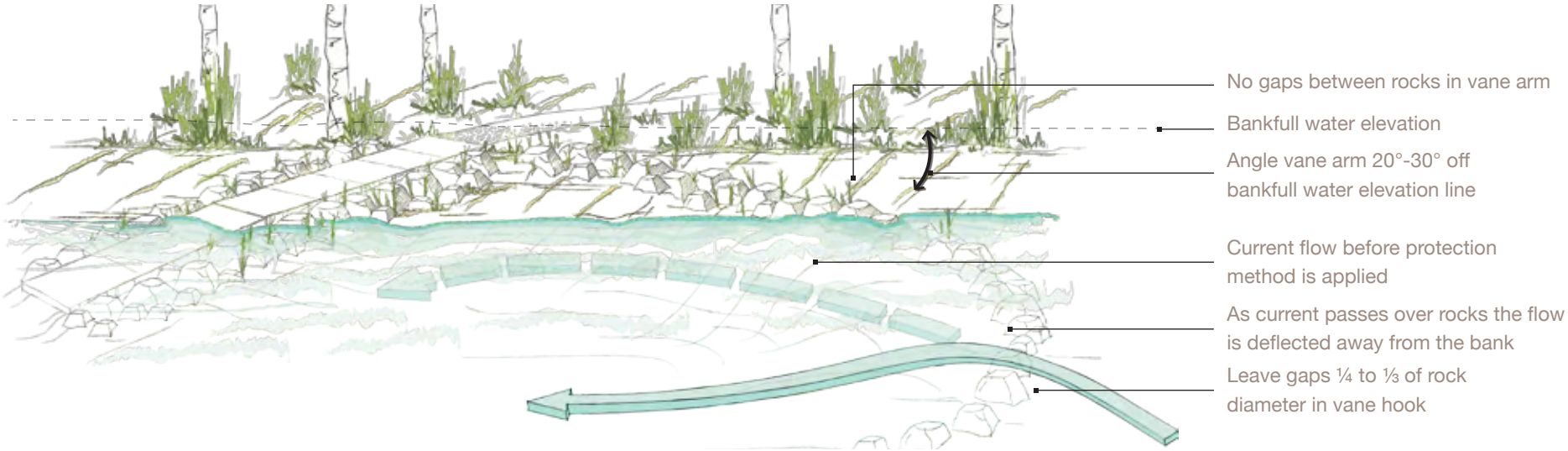
For many rivers and streams, bankfull elevation above a given water surface can be estimated in the field by setting up a laser level and walking at least two meanders with a rod. Record elevations of the lowest flat areas (often, the bankfull floodplain is most obvious on insides of bends), paired with an adjacent water-surface elevation. Subtract the water-surface elevation from each bankfull elevation. Correct readings should not vary more than 0.2 feet. Discard any outliers, and average the remaining readings. At your project area, record the elevation for the same height above the water surface as that average, and establish a benchmark that will allow the construction crew to easily determine the correct elevation for the later project.

Natural channel designs derived from stream restoration include:

- **J-hook vanes or straight vanes:** Rock structures begin on the bank at the bankfull elevation, point upstream at a 20 degree to 30 degree angle of departure from the bank, and disappear beneath the water surface to the stream bottom (Figure 4B-1). This arrangement moves the fastest flow of the water away from banks and directs energy to the channel bottom, creating favorable scour holes for habitat. On many streams, much of the structure can be invisible at normal flows, making it visually more subtle than many “rock wing” structures.
- **Log J-hooks:** On smaller streams, logs can be embedded in banks and used in the same way as j-hooks to move the main flow away from the bank. At bankfull flows, both log and rock j-hooks contribute to sediment equilibrium. Strategically placed j-hooks may also be able to direct scour to a boat ramp downstream to assist with self-cleaning of fine sediments (silt) from ramps.
- **Bankfull bench**: Creation of an active floodplain at the bankfull level in the project area increases roughness on the bench and reduces bank erosion from water scouring the toe of the slope. Excavate a narrow, lower floodplain on a steep or vertical bank, and use a stone toe, bare-root shrub plantings, and/or live stakes (Figure 4B-2). Although technique is not yet common in the Midwest, it is used frequently in other parts of the United States and has been successfully tested in Minnesota. The bankfull bench design, coupled with a concrete walkway, can make an appropriate canoe launch in and of itself.

Minnesota example of a bankfull bench construction
Photo Credits: Luther Aadland

Figure 4B-1.
Streambank Protection at Eroding Launch Site



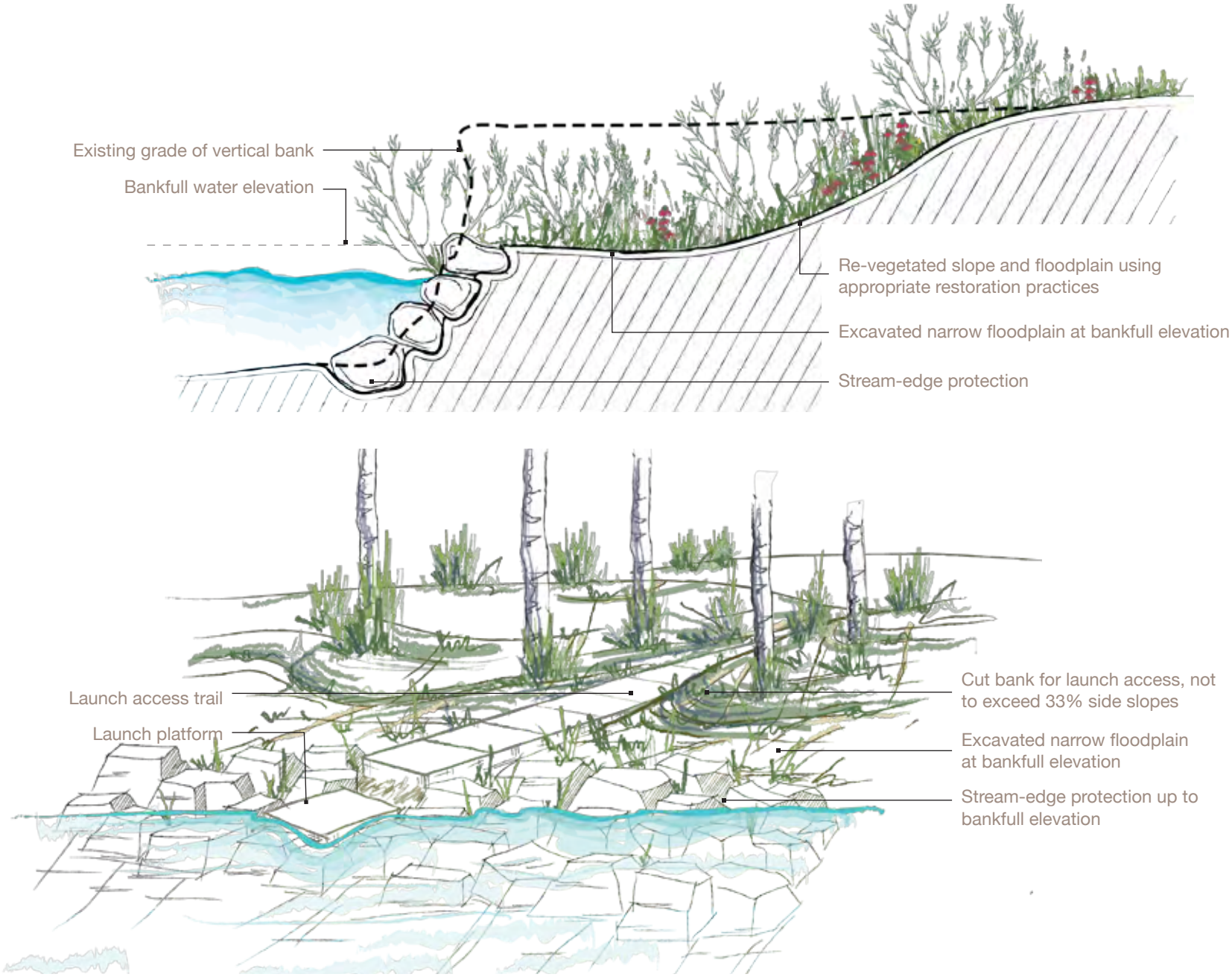


Figure 4B-2.
Bank Reshaping With Narrow Floodplain

STREAMBANK ARMORING THROUGH BIOENGINEERING AND MINIMAL ROCK PLACEMENT

Reactions to landscape changes are most evident near stream edges. Even a seemingly small change, such as reverting a CRP grassland tract back to cropland, increases the volume of stormwater, as well as the amount of sediment leaving the tract and being delivered to the stream. Urban development of cropland, likewise, generally increases stormwater volumes and decreases the amount of sediment. Stream channels react to landscape changes because they manage the volume of water and the amount of sediment delivered to them, as well as accommodate the slope gradient. As the volume of stormwater runoff reaching them increases, the additional channel space required to convey this runoff is configured out of the streambanks. Therefore, continuous changes on the land common in Iowa result in constantly adjusting stream channels. The shape and stability of streambanks are excellent indicators of whether a river is stable or adjusting to change.

When space is available and excess soil can be used in upland areas, the slope of vertical banks can be reduced to between 33 percent and 50 percent, depending on soil type (Figure 4B-3). The toe of the slope, which remains at the same location and elevation as before construction, requires armoring or protection. Newly graded bank slopes also require re-vegetation.

Armor integrating vegetation and rock is useful to cover the height of the bank between low- or base-flow and bankfull elevation. Use rock in armoring judiciously and specifically to prevent undermining of concrete infrastructure or at toes of eroding streambanks. Armoring should not cover the entire height of a streambank except in special circumstances, such as above or below a dam or a water-constricting bridge. Conservation practices associated with streambank armoring include joint planting, live fascines and stakes, and wattles or coconut fiber logs. Additional streambank protection methods are described in Chapter 16, USDA NRCS Engineering Field Manual.

Stabilization with vegetation improves aquatic and terrestrial habitat more than rock stabilization alone. Stream-edge vegetation provides cover for fish, invertebrates, small mammals, and birds. Adding shade over the water usually improves stream water temperatures. Small nooks and gaps between woody and herbaceous stems at the water's edge also act as temporary storage for eroded sediment in the water.

Native, non-invasive plant species are always recommended, particularly those already occurring on other sections of the same stream. Broken concrete is never recommended as armoring material. Bank stabilization practices including vegetation are more susceptible to damage if high flows occur before the plant material becomes established. Vegetation also requires observation, particularly during establishment, to mitigate potential damage from insect pests and excessive eating by rabbits and other small mammals.

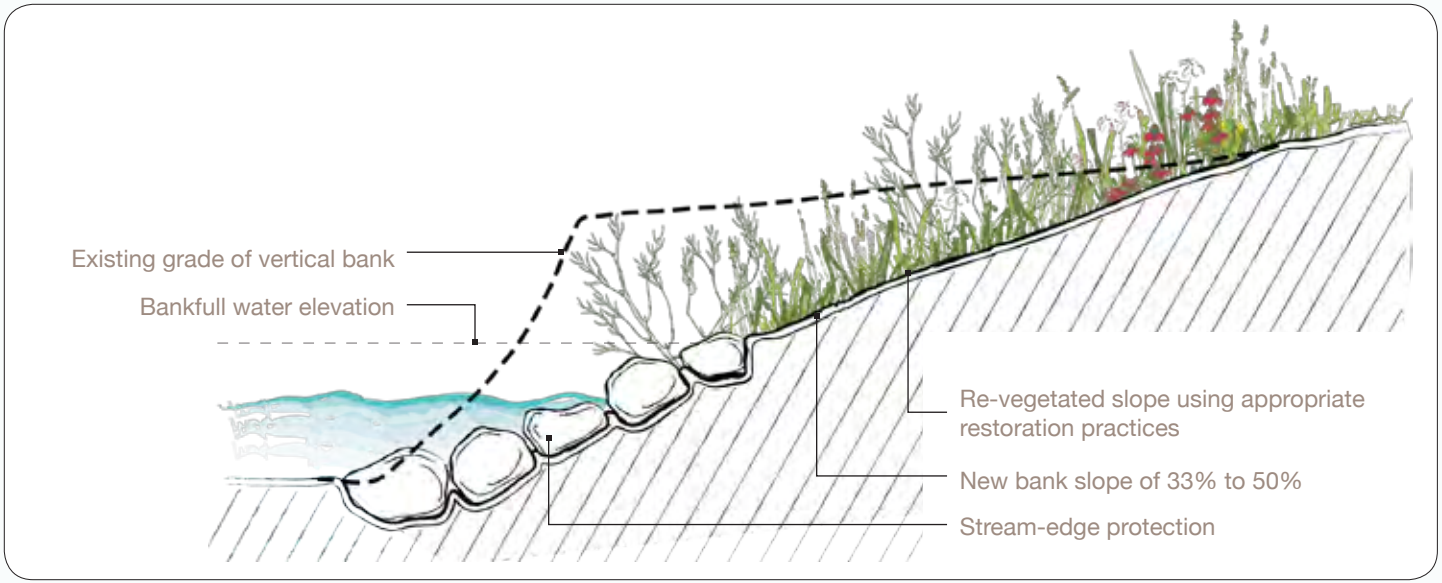


Figure 4B-3.
Reducing Vertical Bank Slopes

Stream-edge protection using rock. Vegetation with rock (Figure 4B-4) stabilizes by combining the immediate physical mass of the rock with development of stabilizing roots of woody cuttings. Local boulders and large stones are sized to withstand typical high flows and are most commonly of 2 feet to 3.5 feet in diameter. Live plant cuttings used for joint planting, such as live stakes, must be cut when dormant. Branch diameter of cut material is between ½ inch and 4 inches, depending on soil wetness. Cuttings between ½ inch and 2 inches in diameter are the most likely to succeed. Soak cuttings overnight in the stream before planting. Create openings between the rocks to plant the cuttings. Water, tamp, and trim as described for the live stakes (Figure 4A-1).

Stream-edge protection using vegetation. Fascines, or bundles of dormant live cuttings, can also be used in combination with a rock toe on slopes not greater than 33 percent (3:1). Seeding, erosion-control fabric, live stakes, and dead stakes are used in conjunction with fascine installation. Fascine bundles are installed slightly exposed in prepared trenches (Figure 4B-5). Trenches are hand-dug and spaced 3 feet to 5 feet upslope from each other, beginning slightly above bankfull elevation. Cut dormant branches less than 2 inches in diameter and 5 feet to 10 feet in length, and immediately soak overnight in the stream. Tightly bind final bundles of 6 inches to 8 inches in diameter with biodegradable twine, and install in trenches as shown. Erosion-control netting is placed under each trench and over the seeded bank above and below the trench.

Other stream-edge protection. Coconut fiber logs can be used as an alternative to live fascines (Figure 4B-6). Coconut fiber rolls are 12 inches in diameter and 20 feet long, and they are usually installed at water's edge then the roll is dry. Native perennial plants and woody cuttings are sprigged into rolls after they become saturated. Rolls degrade much more quickly at the edge of moving water, compared with live fascines. Therefore, fiber rolls are most effective on low-order stream and lake edges.

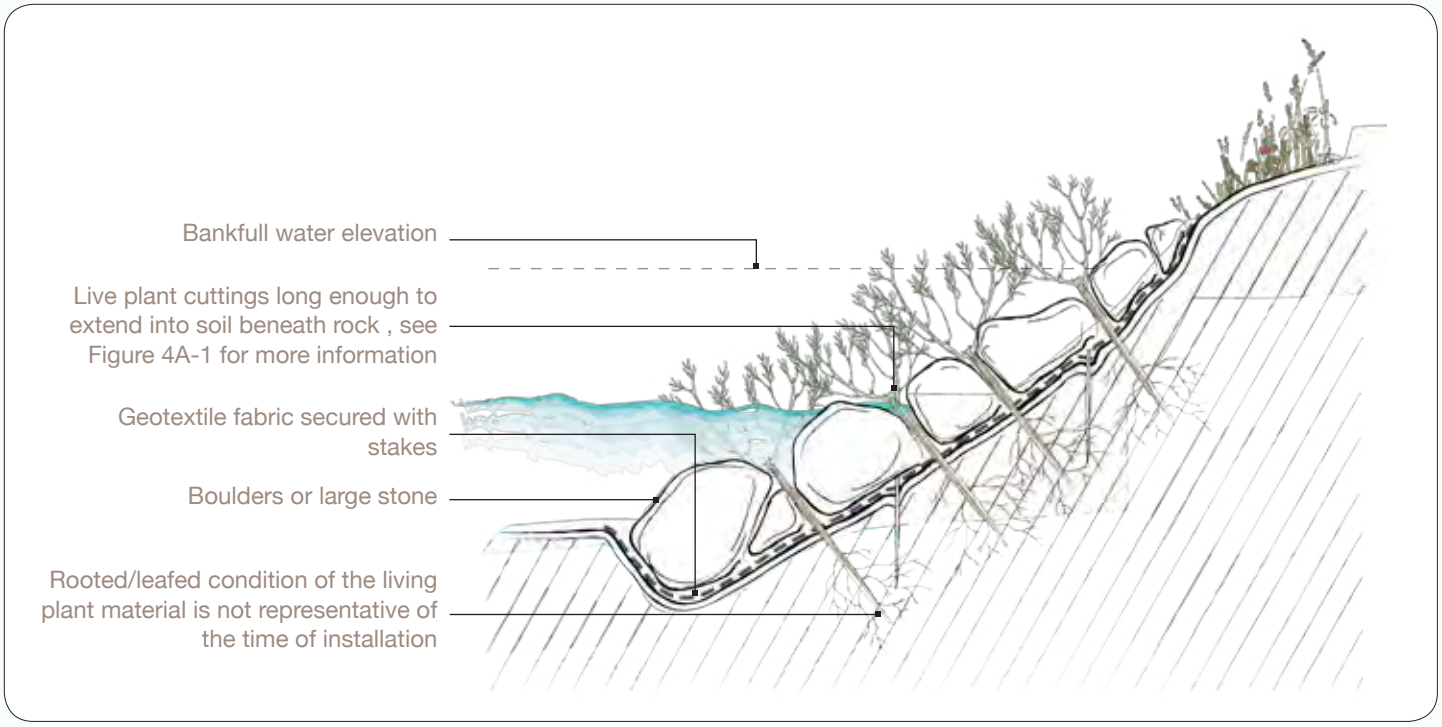


Figure 4B-4.
Stream Edge Protection Using Rock

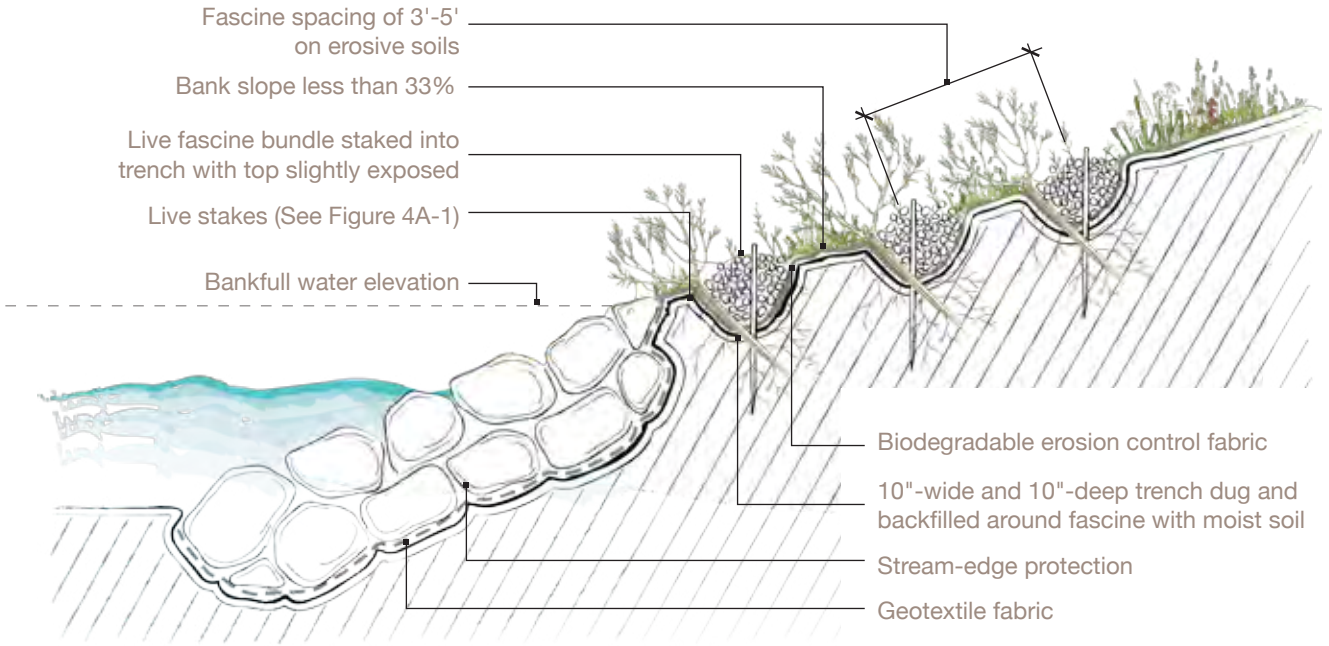


Figure 4B-5.
Stream Edge Protection with Live Fascine

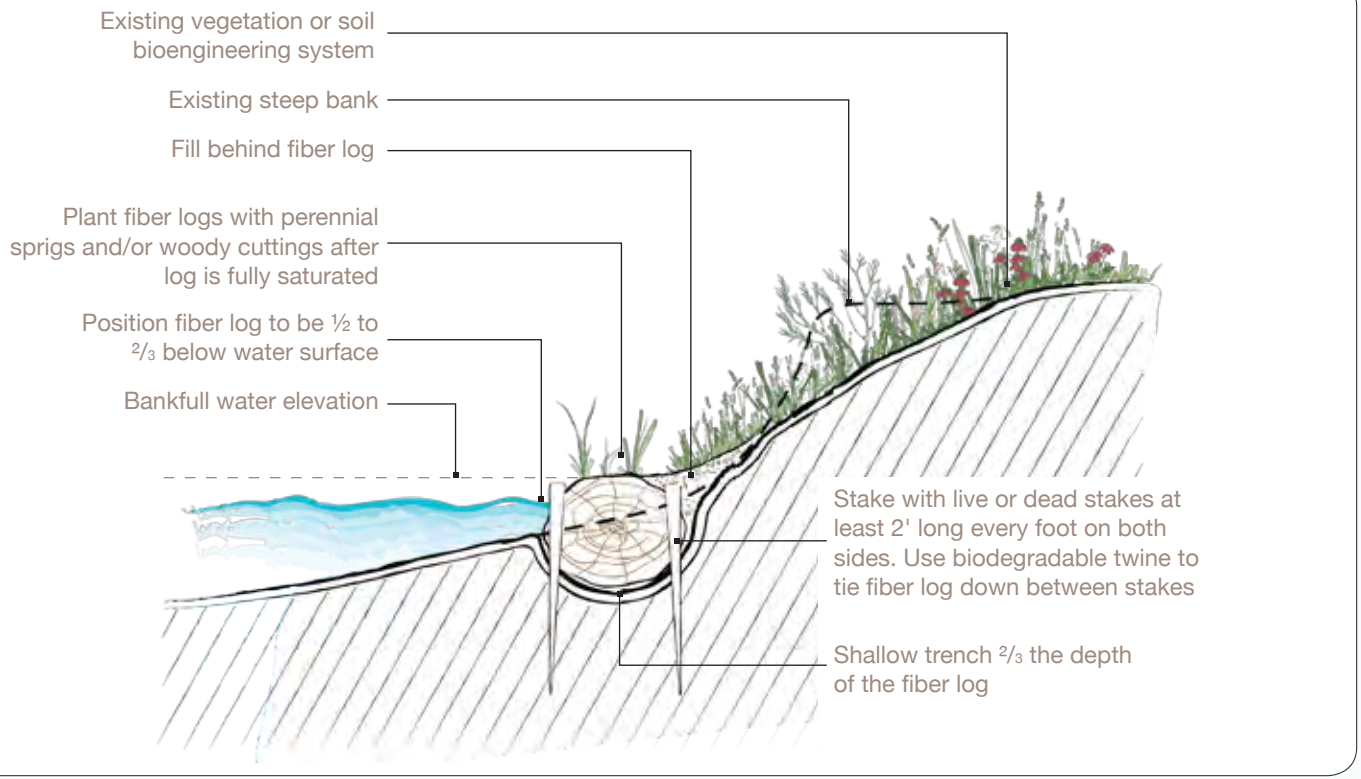


Figure 4B-6.
Stream Edge Protection with Coconut Logs

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5 MANAGING RIVER RECREATION IN IOWA

River management is a regular feature of many states' approaches to rivers. Carefully thought out, it can provide a set of tools maximize experiences for all users while minimizes negative impacts to the river environment.

5 LIST OF FIGURES AND TABLES

INTRODUCTION

River management generally refers to the comprehensive study, protection, and management of river visitors. This chapter focuses on managing recreational experiences for visitors to Iowa's rivers. Stakeholder input makes it clear that Iowans desire a variety of experience types that they can handle with a reasonable degree of safety. General goals include:

- Providing maintenance that matches users' expectations for a given segment.
- Offering education that allows river users to make reasoned decisions, avoid hazards, and minimize risk.
- Developing emergency-response plans.
- Reducing human impact on natural resources.
- Encouraging positive user behaviors, such as Leave No Trace ethics, litter cleanup events, and appreciation of natural resources.
- Reducing behaviors, such as belligerent behavior stemming from to alcohol or drug use, that diminish the experience for others.

This chapter focuses on rivers — as opposed to lakes and wetlands — because 90 percent of water trail development in Iowa is on rivers, a trend that will probably continue. Also, rivers have common issues in that traffic generally flows in the same direction downstream, trips are taken from one access point to another, their surrounding riparian corridors are typically linear, and bends and tree cover usually hides recreational users from plain view. Water trails on lakes and wetlands share some similarities, but each waterway is unique and requires consideration for its peculiarities (i.e. powerboat traffic patterns, bays and open-water crossings, overland portages, confusing back channels, etc.).

PROBLEMS ASSOCIATED WITH RIVER RECREATION

River recreation in Iowa is often viewed as simple: People decide to go fishing, canoeing, or inner-tubing, and they go out on a river. Eventually, they return. Because Iowa rivers are often perceived as safe, problems are considered unlikely. This attitude can lead to a lack of awareness or preparedness by emergency responders, and in some cases users have been unprepared for conditions because their expectations are set too low. Without new approaches, life-threatening incidents can be expected to increase proportionately with increases in recreational river use. Problems include:

- Fatalities at low-head dams. Between 1999 and 2009, 15 drownings were documented at dams in Iowa.
- Victims not wearing life jackets. Of 165 drownings documented in Iowa water bodies from 1998 to 2007, 81 percent of victims were not wearing life jackets. A total of 54 of those drownings, or 33 percent, were on rivers.
- Users unprepared for dynamic conditions. People sometimes do not plan adequately for cold weather, segment length, or potential challenges such as strainers or snags, resulting in deaths, injuries, and need for rescue.

Table 5-1.
Iowa Statewide Drowning Type Statistics, 1998-2007

Iowa Statewide Drowning Type Statistics, 1998-2007

Year	Total Drownings	On Rivers	Dam-Related	Paddlecraft-Related	Swimming-Related	Alcohol Involved	No Life Jacket
1998	15	3			5	7	15
1999	16	10	1	1	5	5	15
2000	17	5		2	4	4	17
2001	6	3	2	1	5	1	6
2002	14	7	1		2	4	14
2003	10	5			3	3	10
2004	11	2				1	11
2005	32	13	1	1	14	5	31
2006	15		2	0			
2007	15		6	0			
Totals	151	48	13	5	38	30	119
% of total		32%	9%	3%	25%	20%	79%

On high-density use segments of rivers, heavy alcohol consumption sometimes leads to casual littering and other problems.

Iowa DNR's Canoe School teaches safety techniques for overturned boats.

In addition, a number of issues appear primarily on short, scenic river segments between accesses with high use, often associated with the presence of one or more canoe, kayak, or inner-tube rental businesses (liveries). Reported problems on some stream segments have included:

- Disorderly behavior (i.e., public intoxication, public urination, nudity, belligerent attitudes, fights, etc.) that sometimes makes families uncomfortable
- Excessive litter
- Vegetative disturbance near heavily used segments of streams because of inadequate facilities for traffic flow, parking, and car and foot traffic
- Poor relationships with neighboring landowners because of trespass and design issues
- Abandoned floatation devices that become litter in stretches of short, commercial "tubing runs" with liveries, as observed by law enforcement officers
- Conflicts among anglers and people floating on streams

If these problems are unchecked, negative experiences increase. Negative first experiences can turn people away from what might have become a lifetime connection with nature through waterways. Landowner conflicts can also lead to backlash against recreational water use.

River management should not unfairly single out specific types of recreation on rivers. Carefully planned recreational river management can keep problems from escalating through strategies that maximize a variety of experiences while reducing negative impacts for people, the river, and its riparian corridor.

As more people enjoy rivers and their corridors, new expectations bring new challenges. This manual encourages holistic management of rivers and considers the multiple functions they can serve, including appropriate levels of recreation, habitat for a diversity of aquatic species, visual-resource (sometimes referred to as "viewshed") management, and coordination with wildlife planning efforts. Finding the right balance can be challenging.

PUBLIC-SAFETY EDUCATION

Iowa DNR offers safety materials and courses for water trail developers and all interested agencies, as well as to canoe, kayak, and inner-tube rental businesses. All water trail users should be made aware of common hazards, as well as taught to avoid obstacles such as logs or low-head dams. These materials should continue to evolve with media, such as hand-held mobile devices.

Encouraging life-jacket use is vital to reducing drownings statewide. Livery operators should be encouraged to see their own self-interest in renting Type III life jackets and requiring visitors to wear them.

Iowa's state-designated water trails are organized by the type of experience the stream segment would typically provide. Four experience types are included: gateway, recreational, challenge, and wilderness. Chapter 2 of this manual describes these experience types in more detail.

The Challenge experience type was developed for two reasons that relate to public-safety education. The first is to alert paddlers to more difficult general conditions than they may encounter on a Gateway or Recreational segment. This will assist users in selecting segments appropriate to their interests and abilities. The second is to warn all users of temporary, known conditions that may be unexpected.

Example #1: A logjam may have accumulated that requires a long portage. Simple, temporary signage from the hazard signage section of this manual should be installed at the next access upstream.

Example #2: A power outage may lead to failure of a wastewater treatment plant, allowing raw sewage to pass into a stream. Simple, temporary signage from the hazard signage section of this manual should be installed at the next access upstream.

Other strategies for public-safety education on water trails will include:

- Participating in “Wear It” campaigns for life-jacket use and similar future programs.
- Providing safety materials that include precautions people can take to reduce human health threats, along with information about common hazards, such as snags and low-head dams.
- Showing action alerts for temporary hazards on web sites and via signage at accesses.
- Continuing to make safety materials available free of charge to water trail developers.

It’s never too early to learn to enjoy canoeing or to become accustomed to wearing a life jacket on the water.

Educating children with a hands-on dam model can help avoid future drownings.

Various styles of display panels and kiosks can interpret a variety of information, but a map and safety information about common hazards should always be included.

RISK MANAGEMENT APPROACHES

One reason for moving to an experience type system is to promote a culture that willfully participates in at-your-own-risk activities. The system helps users select experiences that match their skills, equipment, and expectations. Risk management on water trails can include several strategies. One is to reduce accident potential through clearly communicating that journeys on water have an element of inherent and common risk. Another is to use liability protections established by law in Iowa. A final strategy is to develop an emergency action plan.

Communicating risk at dams and on rivers:
In water trail development, the most important thing may not be to mitigate every possible risk — especially natural obstructions such as snags or rapids. The most important duty is to help people be aware of what hazards they are likely to encounter.

- National Safe Livery System, Introduction to Risk Management for Livery Operators (1994): Describes for livery owners various risk-management and related legal concepts, including duty of care, common versus unforeseeable hazards, defensible waivers, and the importance of communicating to customers via pre-launch briefings. This, along with a more recent DVD (National Paddlesports Safety System) from the Paddlesports Industry Association, is used in training livery operators by Iowa DNR staff.
- Memo from Assistant Attorney General: When is a Dam Owner Liable?: Describes liability exposures related to dam ownership, as well as methods that can be used to save lives and reduce liability risks if they are carefully planned and consistently implemented over time.

Common hazards should be communicated via communications in kiosks, in brochures, and on web sites. More specific hazards on a segment will warrant either a temporary or permanent Challenge designation. Especially for life-threatening temporary hazards, a small sign at an obvious point at the upstream access (along with Water Trail Name sign, for example) may be considered.

For temporary construction projects that create obstructions, notify local engineers during the water trails planning process that DNR river program staff will review construction plans and that permit applicants will be responsible for mitigating hazards. Specific language to mitigate a given hazard will be added to the permit pursuant to Iowa Code Chapter 462A.

Hazard signage for dams can be a life saver for inexperienced paddlers.

Liability exemptions provided under Iowa Code:

During planning, questions about liability often arise. Water trail developers can direct concerned parties and their attorneys to Iowa laws, a body of attorney general opinions and memos, and other documents. Important documents, with synopses of what is relevant in each, are listed below:

- Iowa Code, Chapter 461C, Public Use of Private Lands and Waters: Provides exemption for landowners from liability for recreational users who have not been specifically invited nor paid a fee. Does not provide exemption in cases with willful or malicious failure to guard or warn against a dangerous condition, use, structure, or activity.
- Iowa Code, Chapter 670 4.17, Tort Liability of Governmental Subdivisions: Provides exemption to municipalities (meaning any unit of local government including counties and their various boards) from liability claims for river rafting, canoeing, or kayaking facilities when a person should recognize the inherent risks of those activities when those structures are built according to prevailing standards

It should also be noted that maintenance of dam-warning signage (brush clearing, replacement after damage in a reasonable time) is extremely important for liability reduction. The following excerpt from "When is a Dam Owner Liable" highlights the need for regular maintenance:

> ***Importance of consistent implementation of warnings***
> *If a dam owner, whether governmental or private, adopts a policy or program to provide warnings of a low-head dam hazard to public recreational users, it is very important that the policy or program be implemented and that warnings be maintained. Warnings are not effective unless they are visible from vantage points that allow time for avoidance of the hazard. Warnings should be coupled with safe landing areas above and below dams and portage routes around the hazard. Failure to maintain installed warnings is a path toward greater risk of liability.1 Developing, implementing and maintaining a system of effective warnings, safe landings and portage routes is a reasonable course of action to reduce risk of liability for failure to warn of a concealed hazard and to protect public users of waterways. It will not prevent claims arising when accidents occur. But it should reduce the likelihood that such claims will be successful.*

Developing an Emergency Action Plan

Involving local emergency response professionals, volunteers, and local paddlers in developing an emergency action plan can increase preparedness and lead to more successful rescue efforts in the eventuality of an accident. Brainstorming about what and where the most likely serious accidents might be and developing a plan to locate, reach, treat, and/or transport victims should be considered. The plan should focus primarily on existing resources and should not necessarily result in major equipment investments. A map, with notes on each segment, should be distributed to anyone who would expect to be involved in a rescue. A listing of GPS coordinates for bridge and access locations can be helpful.

The plan also should consider the setting and the goals established for Experience type for a given segment. For example, people committing to a long Wilderness trip should expect and prepare for a longer lag time before a rescue could be mobilized. People in a Challenge trip should expect that self-rescue skills may be needed. New roads or trails should not be cut explicitly to reach remote areas, as participants should be made aware of the local conditions. It should not surprise river users that hazards can also occur on recreational and Gateway segments. However, for heavily used Gateway segments, additional planning such as verbal agreements to cross crop fields or use private lanes in emergencies should be sought.

Hazard reduction through in-channel changes

As described in Chapter 4, obstructions in channels may occasionally cause hazards that need to be addressed. This is most clear-cut in the case of a low-head dam that serves none of its original function, creates a hazardous "roller" or recirculating effect, and has little residual function. In this case, converting the dam into a rapids or removing it would mitigate or eliminate the hazard.

Natural hazards such as logjams present more difficult choices. Wholesale removal of logs from streams is not recommended, as woody debris creates important habitat, such as fish hides and deepwater holes. Most states do not regularly maintain channels to be free from woody debris. Cutting logjams is specialized work that requires an experienced or trained crew to adequately address the problem, and it should not be expected of untrained volunteers. Available resources and priorities dictate whether the Iowa DNR water trails program will have a crew available to assist. This aspect of the program will be considered experimental. In the initial implementation, the crew may be capable of relocating logs downstream by making strategic cuts with chain saws operated from shore or boat or while wading. Restoration techniques may be used to minimize further accumulations of logs and to mitigate aquatic habitat loss. Such steps would be taken under advisement of Iowa DNR River Programs specialists or consulting stream-restoration professionals.

Low-head dam mitigation techniques, as described in the 2010 Dam Mitigation Plan, are sometimes incorporated into water trail planning efforts. More often, warning signage and portages are incorporated, and dam mitigation efforts are separate.

LITTER-REDUCTION STRATEGIES

- Approaches to litter reduction may vary depending on the setting and existing river use. Some areas have few litter problems. On heavily used recreational segments with liveries — a combination often leading to beer cans littering sandbars and the river channel — partnering with livery owners will probably be a critical part of any solution. This could include sending trash bags out with each boat, affixing decal messages to watercraft warning users not to litter, banning repeat offenders from returning, cooperating with law enforcement, etc. If the primary problem is polystyrene bait boxes at access ramps, effective techniques might include local volunteer cleanups, signage listing the current fine for littering, and public outreach to local anglers.
- Enforcement by DNR conservation officers, conservation board rangers, or other local law enforcement may also be an effective part of an overall solution. Proactive law-enforcement contacts with the public can also be helpful, as can volunteer cleanup programs.
- Leave No Trace materials will be distributed, and river users will be encouraged to pack out anything packed in. Particular priority for Leave No Trace programming will target Wilderness water trail segments where maintenance will be minimal. Beverages in reusable bottles will be encouraged, and glass bottles will specifically be discouraged.
- For volunteer cleanup efforts, using the DNR Iowa Streamkeepers volunteer handbook (http://www.iowadnr.gov/riverprograms/streamkeepers.html) and materials can shorten the learning curve in figuring out what to do with the trash, how to plan for disposal costs, and how best to approach neighboring landowners. Registered Streamkeepers volunteers can receive recognition while promoting cleanup events to a statewide audience.
- Because glass bottles easily break and can cause injuries, the Iowa DNR will pursue a statewide ban of glass containers on rivers. If this is not implemented, a listing of segments where this is most important will be developed.

River clean-up events can be an effective way to reduce a legacy of large trash along banks.

River clean-ups can offer camaraderie and develop a culture of respect for waterways, as can programs like Leave No Trace.

TACTICS FOR ADDRESSING DISORDERLY BEHAVIOR

- If public intoxication and disorderly behavior become commonplace on a river segment, it is a critical for agencies, local law enforcement, and liveries to collaborate to reduce the problem with available resources. If typical river users feel intimidated, they are unlikely to return. Reports to public-access managers of negative experiences have increased on several high-use segments on Iowa streams in recent years.
- A number of tactics can be employed. Visits by uniformed and plainclothes officers should be sought. Seasonal water-patrol staff can add visibility by distributing trash bags, encouraging life-jacket use, and writing up violations such as littering.
- Iowa DNR river programs will collaborate with the DNR law enforcement bureau to pursue training materials, specialized staffing, any necessary code or administrative rule changes, and access-management changes to address these issues as they arise.
- Canoe, kayak, and inner-tube rental business (livery) owners can set the stage for positive behavior by including reusable mesh trash bags, limiting the amount of alcohol allowed, requiring life jackets, and providing pre-launch safety briefings. Liveries operating on designated water trails will be required to attend Iowa DNR's annual livery class to better understand their responsibilities.

Law enforcement officers can be part of the solution, whether at the local, county, or state level.

- It needs to be stressed that liveries should not be singled out as a sole cause of problems. Problems have also arisen on segments without liveries. A growing number of canoe, kayak, and innertube liveries perform valuable services across Iowa in introducing people to river recreation. In 2008, livery trips generated $1.14 million in rental and shuttle receipts and $5.14 in directly related spending on camping, hotels, food, and other items. However, liveries will be expected to assist as part of the solution when such issues arise on segments where they operate. Livery cooperation will be critical to developing meaningful solutions.
- Livery owners may choose not to rent to offensive groups again. In addition, a process will be established to require for-profit businesses to cost-share in support of management, maintenance, and law-enforcement at state or county owned public accesses. At state-owned access, the legal mechanism for this is Iowa Code Chapter 461A.4 and county-owned areas will function under local ordinance. Funds will be used be in support of water patrols, education, litter pick-up, access or river channel maintenance, etc.

  Iowa Code, Natural Resources, Chapter 461A.4
  A person, association, or corporation shall not operate a commercial concession in a park, forest, fish and wildlife area, or recreation area under jurisdiction of the department without first entering into a written contract with the department. The contract shall state the consideration and other terms under which the concession may be operated. The department may cancel or, in an emergency, suspend a concession contract for the protection of the public health, safety, morals, or welfare.
- Where a livery is already present during a water trail planning process, or where an entrepreneur may start-up a business because of the water trail effort, the livery should be considered important stakeholders in the planning process. Livery owners and managers should be encouraged to attend Iowa DNR livery classes, and to join other liveries in helping develop an industry code of conduct for the state of Iowa.

PLANNING FOR USE AND DEVELOPMENT LEVELS

Some decisions made during water trail planning directly relate to future management needs. Involving law enforcement and emergency management personnel in this process is critical.

There is no one-size-fits-all solution for all segments in a given water trail. Segments are considered individually in terms of management goals and resources. Some segments in a given water trail vary and lend themselves to particular planning considerations, such as frequency of access spacing, degree of access improvement, and planned new amenities. (See Table 2-1 in the Iowa Water Trails Development Manual Chapter 2.)

Recognizing that user conflicts may develop is important, especially in areas where there has not been a lot of traditional canoe and kayak use. Common conflicts may include high-speed boating on impoundments not mixing well with a burgeoning set of kayakers, or people paddling on what's traditionally been a trout stream. Careful planning of a water trail can reduce some problems, as can encouraging good etiquette among user groups.

Anglers are the dominant existing user group for Iowa's Rivers, according to a recent survey. More anglers also have begun canoeing and kayaking, but can be unaware of the statistical importance of wearing life jackets.

NATIONAL WILD AND SCENIC RIVERS AND OTHER POTENTIAL DESIGNATIONS

A number of special designation types that affect river management are available or may be available in the future for Iowa's streams.

The National Park Service designates rivers by the degree of development in and along the water at the time of designation. From "An Introduction to Wild and Scenic Rivers," the possible designations are:

> *"Wild" river areas — Those rivers or sections of rivers that are free of impoundments and generally inaccessible except by trail, with watersheds or shorelines essentially primitive and waters unpolluted. These represent vestiges of primitive America.*
>
> *"Scenic" river areas — Those rivers or sections of rivers that are free of impoundments, with shorelines or watersheds still largely primitive and shorelines largely undeveloped, but accessible in places by roads.*
>
> *"Recreational" river areas — Those rivers or sections of rivers that are readily accessible by road or railroad, that may have some development along their shorelines, and that may have undergone some impoundment or diversion in the past.*

Currently, no nationally designated recreational, wild, or scenic rivers exist in Iowa. However, the National Wild and Scenic Rivers program has some potential to help manage several rivers in Iowa in the coming decades. The Upper Iowa River was designated for study in 1968. Congress has not yet passed a law designating the Upper Iowa through the program. In addition, segments of seven other rivers are listed on the Nationwide Rivers Inventory (NRI), including the Boone, Cedar, Maquoketa, Middle Raccoon, Turkey, Wapsipinicon, and Yellow rivers. The NRI is a register of stream segments with the potential to qualify as national wild, scenic, or recreational river areas. Segments on the NRI, by presidential directive, require federal agencies to avoid or mitigate adverse impacts when conducting or funding projects and to consult with the National Park Service before any action that could remove it from consideration for wild, scenic, or recreational status.

Additional segments may be added to the NRI via Section 11 of the National Wild and Scenic Rivers Act, which provides technical assistance to states for statewide river assessments and inventories. At the prompting of local entities, Iowa DNR will explore this mechanism with the National Park Service to the degree sensible and possible.

A state program, Protected Water Areas (PWA), is mandated in Iowa Code Chapter 462B. Five segments on the Upper Iowa, Wapsipinicon, Boone, Middle Raccoon, and Little Sioux rivers are currently operating under PWA management plans. These are voluntary programs for adjacent landowners, but they have targeted state matching funds earmarked for public land acquisitions and conservation easements since 1990 under the REAP program. There is some additional permitting review, and occasionally negotiation, during the permitting process for DNR floodplain-development applications. Chapter 462B also explicitly grants the Iowa DNR authority to enter a written cooperative agreement for joint federal-state administration of rivers that may be designated under the National Wild and Scenic Rivers Act.

In addition, a newer Wilderness water trail designation is listed in Iowa Administrative Code 571 - Chapter 30 and is referred to in this manual. A limited number of river segments in Iowa will place local focus on master planning, zoning, and management that protects river segments from further subdivision or development and encourages gradual restoration. Agreements developed with the Iowa DNR water trail program will solidify such approaches for a long time.

In the future, as usage increases, river-use allocation systems could be considered. These systems that cap the number of users through a user-permitting system would probably only be used along with a special designation. Allocation systems fall into three basic types: 1) Full allocation systems account for all commercial trips and trips by individuals; 2) Partial allocation systems usually limit commercial trips only; and 3) Potential allocation systems are developed during planning phases and are only employed if problems arise. Any of these scenarios could be considered but would require management resources not currently available.

PROGRAM DEVELOPMENT

Water trails can be an excellent base for natural-resource-themed outings, including wildlife-watching excursions, skill-building trips, and programs that introduce children to the outdoors. It is recommended that program leaders train with Iowa DNR River Programs staff in a two-day canoe school. It is also recommended that water trail planning incorporate messages that promote stream health and healthier watersheds.

Water trail developers are encouraged to incorporate stewardship into their materials, management and maintenance of areas, and public education. Programs such as the Iowa DNR Streamkeepers adopt-a-stream program and the national Leave No Trace program are examples of stewardship that leads to embracing natural resources.

With careful planning, these general strategies maximize the variety of human experiences while reducing negative impacts for people, rivers, and riparian corridors.

Water trail dedication events often include elected officials.

"Water trails can be an excellent base for natural-resource-themed outings, including wildlife-watching excursions, skill-building trips, and programs that introduce children to the outdoors."

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6 SIGNAGE

Experienced paddlers, as well as new users, say that a successful paddling experience in Iowa includes consistent standards for wayfinding and communication. Therefore, signs used on and for state-designated water trails in Iowa are intentionally consistent in color, size, and graphics. The standards included in this manual apply to all state-designated water trails.

LIST OF TABLES AND FIGURES

ACKNOWLEDGMENTS

This chapter was prepared by :

Iowa Department of Natural Resources: Emily Haase, Nate Hoogeveen, John Wenck

Iowa State University Department of Landscape Architecture: Sam Kessel, Stephanie Nelson, Mimi Wagner

Special thanks for technical review and feedback provided by:

Steve Gents and Kurtis Younkin, Iowa Department of Transportation

Tammy Diesburg and Mark Merfeld, Iowa Prison Industries

Ray McCleary, Des Moines Water Works

Richard Brown, City of Des Moines.

Editing and graphic design provided by Brenda Witherspoon, Sam Kessel, Stephanie Nelson, Jillian Noble

6A WATER TRAILS SIGNAGE

Water trails signage includes all signs associated with wayfinding, navigation, and use information viewed from both on-land and on-water. Users should be able to drive to the water trail launches they seek, as well as understand their locations while on-water.

Iowa's water trails program provides the mechanism and the challenge to create seamless recreational experiences for users across jurisdictions. Locations on state-designated trails, therefore, are identified with river mile numbers, much like the Interstate Highway System. Each launch location references both an access number, representing the river mile where the launch is located, and the launch's formal name, such as Albright's Access. River miles are calculated beginning with 0 (zero) at the mouth of a stream and progressing upstream. Consecutive numbering stops at Iowa state boundary limits.

ON-LAND NAVIGATIONAL SIGNAGE

Wayfinding to launch locations is the first experience users have with Iowa water trails. A straightforward and minimal signage sequence is used to communicate driving directions. Wayfinding signs are consistently used for state-designated trails, regardless of the type of road or road jurisdiction. The Iowa Department of Transportation (DOT) approved these standards to provide identity for the water trails program and to use the fewest signs needed to communicate with drivers looking for launch locations.

All launch entrance-drive locations are consistently signed in both directions using the river mile of the launch as the access number. A minimal sequence of signs is suggested but not required for remaining aspects of launch wayfinding (Figure 6A-1). The series of wayfinding signs is particularly encouraged when multiple turns are required, beginning at the last primary road for both rural and urban routes. Figure 6A-2 illustrates the sequence in a typical rural setting. Wayfinding signage specifications are included in Figure 6A-3.

Sign Locations	Signage at last primary road turn-off to launch (optional)	Signage at all subsequent turns to reach launch (optional)	Signage at launch turn-in (required)
Sign Combinations			
DOT Sign Titles	1. Water Trail Symbol 2. Access Point Identifier 3. Arrow Sign with Miles	1. Water Trail Symbol 2. Arrow Sign	1. Water Trail Symbol 2. Access Point Identifier

Figure 6A-1.
Wayfinding Signage Typical Sequence

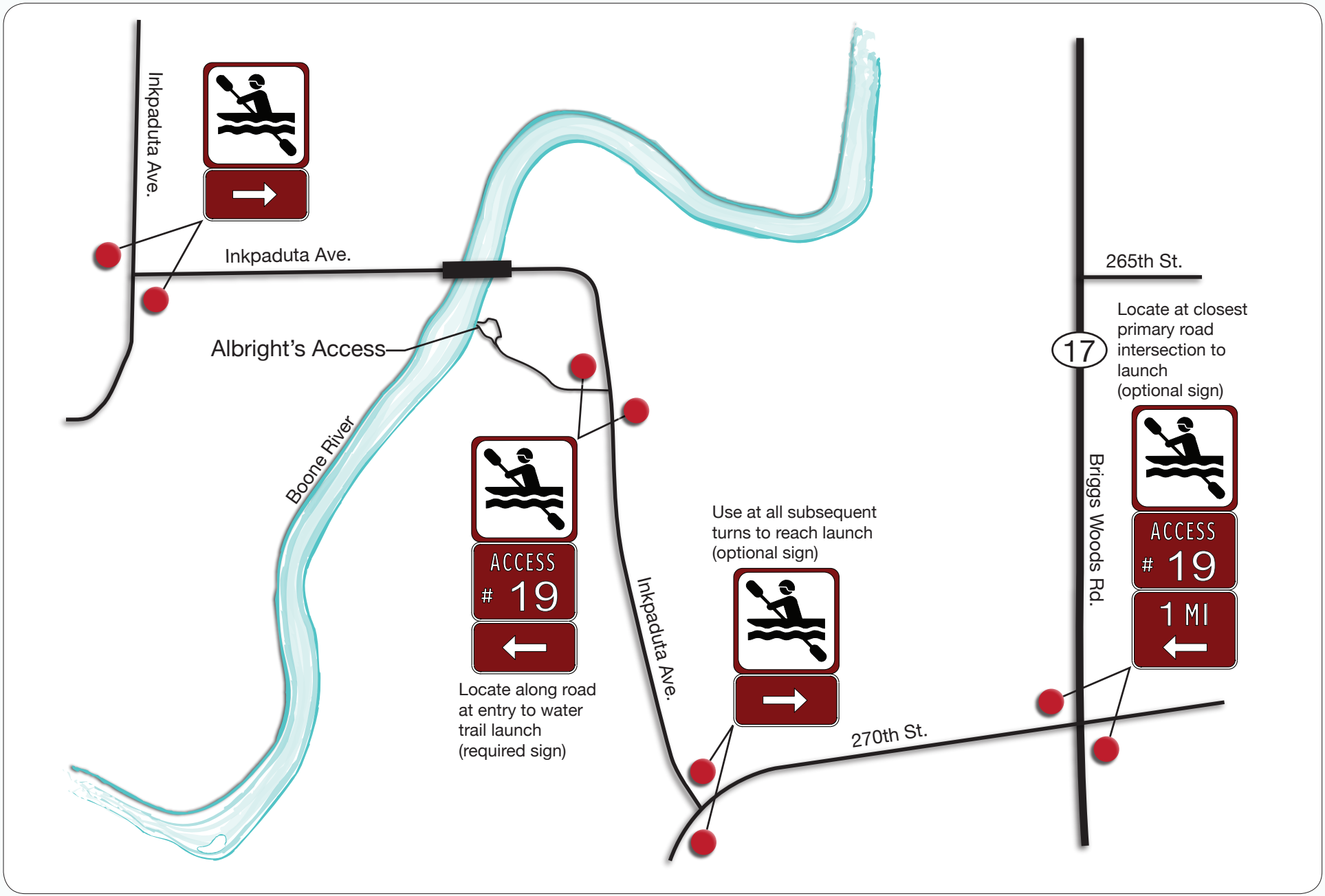
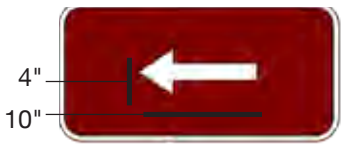


Figure 6A-2.
Wayfinding Signage Location Map (Typical Rural Site)

1. Water Trail Symbol
Iowa Prison Industry Part #: FDNR41524X24EA
Size: 24"x24"
Color: Black on White with Brown Border
Reflective: Yes
Material: Aluminum

2. Access Point Identifier
Iowa Prison Industry Part #: FDNR41924X18EA
Size: 24"x18"
Color: White on Brown
Reflective: Yes
Material: Aluminum
Additional Information:
Specify access number corresponding to river mile

3. Arrow Sign with Miles
Iowa Prison Industry Part #: FDNR420A24X18EA
Size: 24"x18"
Color: White on Brown
Reflective: Yes
Material: Aluminum
Additional Information:
Specify miles to water access and direction of arrow



4. Arrow Sign
Iowa Prison Industry Part #: FDNR420B24X12EA
Size: 24"x12"
Color: White on Brown
Reflective: Yes
Material: Aluminum
Additional Information: Specify direction of arrow

Figure 6A-3.
Wayfinding Sign Specifications

Launch locations are often included inside existing recreation sites. When appropriate river locations are included within existing recreational land parcels, this is often an efficient use of maintenance equipment, surveillance, and shared facilities such as parking. Figure 6A-4, Signage at Access Points Already Signed, illustrates how the standard water trail launch icon and access number are used in conjunction with existing recreational signage.

Existing County Arrowhead Sign
Attach water trail symbol to post

Existing Park Sign within Cities Attach water trail symbol to bottom of sign

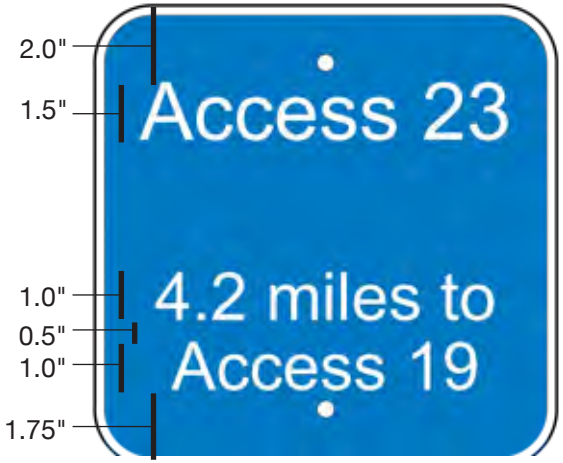
Figure 6A-4.
Signage at Access Points Already Signed

Additional signage at the launch site visible from on-land includes:

- Launch identification at parking area (required), Figure 6A-5, State-Designated Water Trail Logo and Trail Identification
- Identification and distance to next downstream launch (required), Figure 6A-6, Next Downstream Launch Identification and Distance
- Identification of onsite amenities (optional), Figure 6A-7, Onsite Amenity Signage

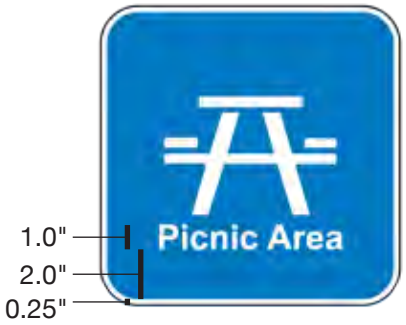
Water Trail Name and Logo
Iowa Prison Industry Part #: FDNR40012X18EA
Size: 12"x18"
Color: Blue, Green, Orange, and Black on White
Reflective: Yes
Material: Aluminum
Additional Information:
Place at head of carry-down trail in launch parking area

Figure 6A-5.
State-Designed Water Trail Logo and Trail Identification

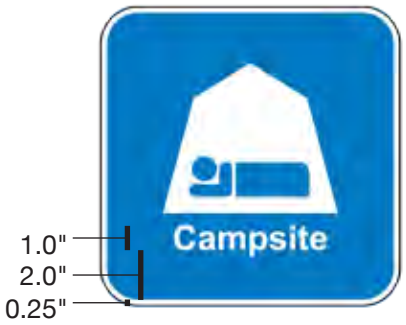


Next Downstream Launch Identification and Distance
Iowa Prison Industry Part #: FDNR40112X12EA
Size: 12"x12"
Color: White on Blue
Reflective: Yes
Material: Aluminum
Additional Information:
Place at head of carry-down trail in launch parking area; can share post with Water Trail Name and Logo sign

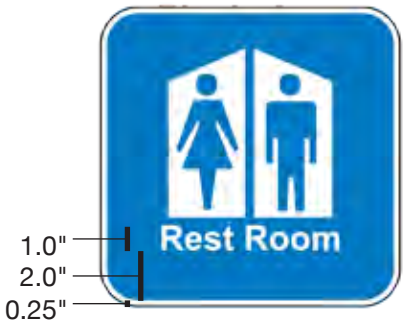
Figure 6A-6.
Next Downstream Launch Identification and Distance



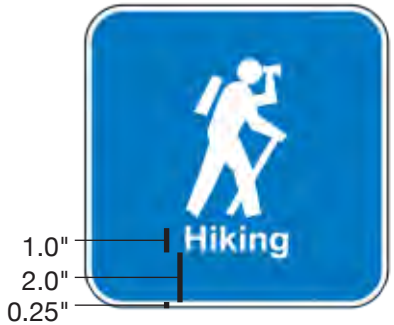
Picnic Area
Iowa Prison Industry Part #: FDNR40512X12EA
Size: 12"x12"
Color: White on Blue
Reflective: Yes
Material: Aluminum
Additional Information:
Place as needed; can share post with Water Trail Name and Logo sign



Camping
Iowa Prison Industry Part #: FDNR40312X12EA
Size: 12"x12"
Color: White on Blue
Reflective: Yes
Material: Aluminum
Additional Information: Place as needed



Rest Room
Iowa Prison Industry Part #: FDNR40712X12EA
Size: 12"x12"
Color: White on Blue
Reflective: Yes
Material: Aluminum
Additional Information: Place as needed;
can share post with Water Trail Name and Logo sign



Hiking Trail
Iowa Prison Industry Part #: FDNR40612X12EA
Size: 12"x12"
Color: White on Blue
Reflective: Yes
Material: Aluminum
Additional Information:
Place at trail heads and along trail as needed

No Camping
Iowa Prison Industry Part #: FDNR40412X12EA
Size: 12"x12"
Color: White, Red on Blue
Reflective: Yes
Material: Aluminum
Additional Information: Place as needed

Figure 6A-7.
Onsite Amenity Signage

ON-WATER NAVIGATIONAL SIGNAGE

Land ownership rights in Iowa allow agricultural producers to graze livestock with free access to water on streams classified as non-meandered. While many producers have excluded livestock from streams and provided off-stream watering devices, water trail users can still encounter both grazing animals and also barbed-wire fencing running across the stream to contain them. Figure 6A-8, Passable High Fence in Deep Water, illustrates a functional approach for this type of fencing. Disruption of fencing and the safety of water trail users passing under it are both valid concerns. Positive relationships between the water trail sponsor and landowners and renters on the water trail route are critical to ensuring that fencing remains functional for livestock and safe for paddlers.

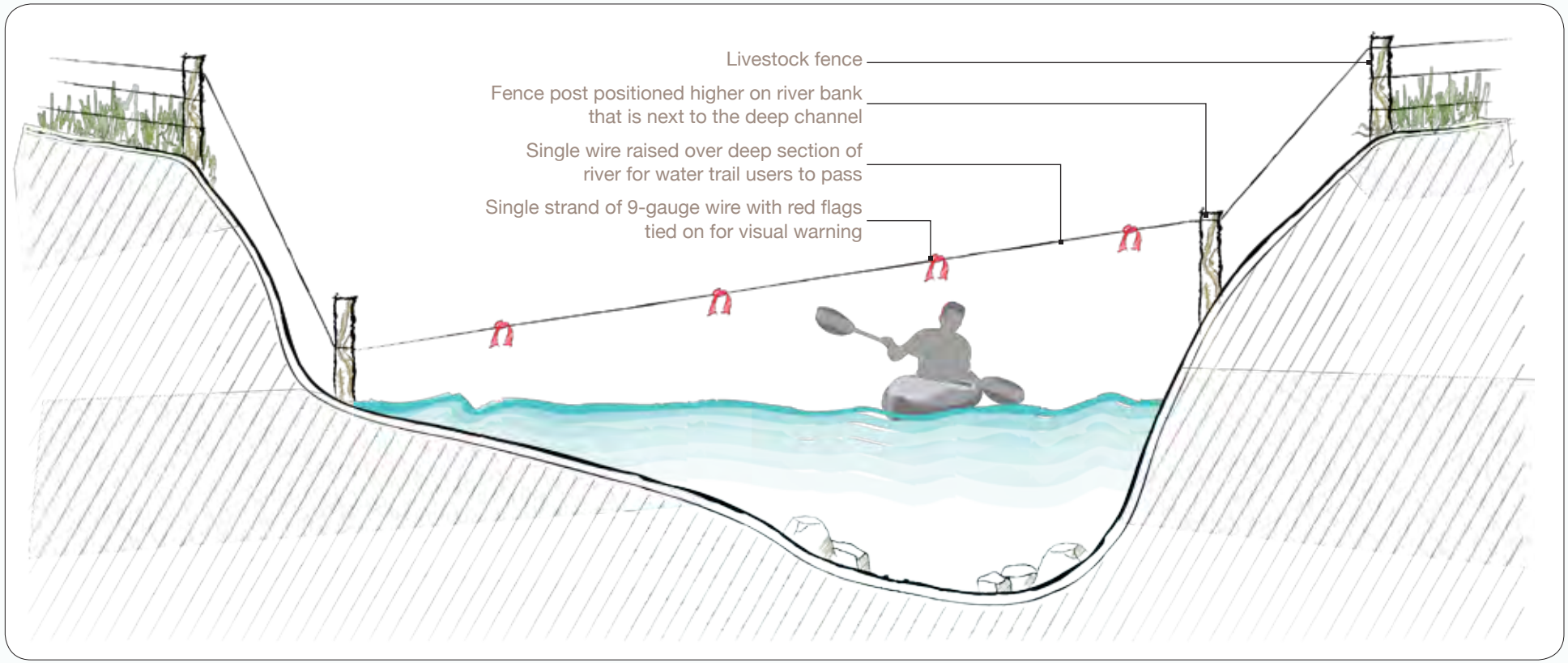
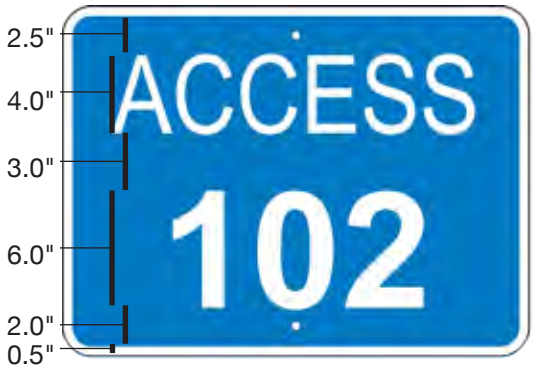


Figure 6A-8.
Passable High Fence in Deep Water

Paddlers unsure of a water trail route and those paddling longer distances indicated they would benefit from location information visible from on-water. Additional signage visible from on-water includes:

- Identification of the next upcoming launch (Figure 6A-9)
- Bridge identification (Figure 6A-10)
- Portage trail wayfinding (Figure 6A-11)
- Boat navigation arrow (Figure 6A-12)
- Water Trail Rules (Figure 6A-13)



On-Water Launch Sign
Iowa Prison Industry Part #: FDNR40224X18EA
Size: 24"x18"
Color: White on Blue
Reflective: Yes
Material: Aluminum

Figure 6A-9.
On-Water Launch Identification

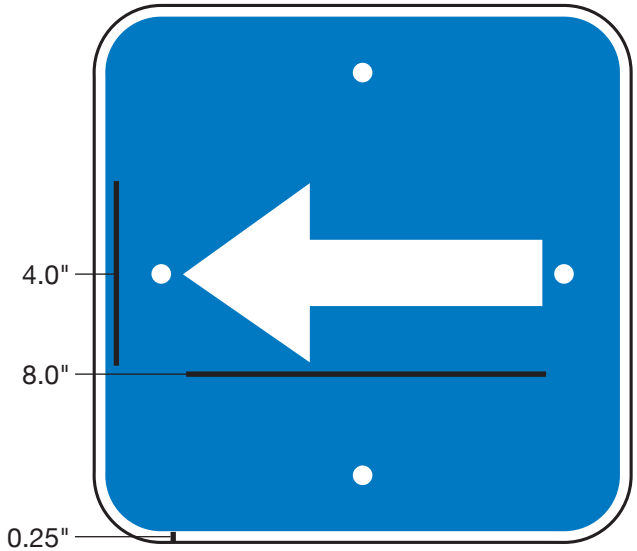
Bridge Signage for Navigation
Iowa Prison Industry Part #: FDNR416BRIDGEEA
Size: 18" height, width varies per text
Color: Black on White
Reflective: Yes
Material: Aluminum
Additional Information: Sign size may be adjusted for amount of text; stencils may be used in lieu of this sign

Figure 6A-10.
Bridge Signage for Navigation

FDNR412R8X8EA **FDNR412L8X8EA** **FDNR412A8X8EA**

Portage Arrows
Size: 8”x8”
Color: White on Blue
Reflective: Yes
Material: Aluminum
Additional Information: Use as an on-water identifier for trailhead to the portage; also use for trail blazes on the portage trail

Figure 6A-11.
Portage Arrows



Boat Navigation Arrow
Iowa Prison Industry Part #: FDNR41712X12EA
Size: 12"x12"
Color: White on Blue
Reflective: Yes
Material: Aluminum
Additional Information:
Place in water or along bank when marking a specific route through a body of water (i.e., navigating a lake or wetland to reduce confusion). Holes punched on all four sides for installation with any orientation.

Figure 6A-12.
Boat Navigation Arrow

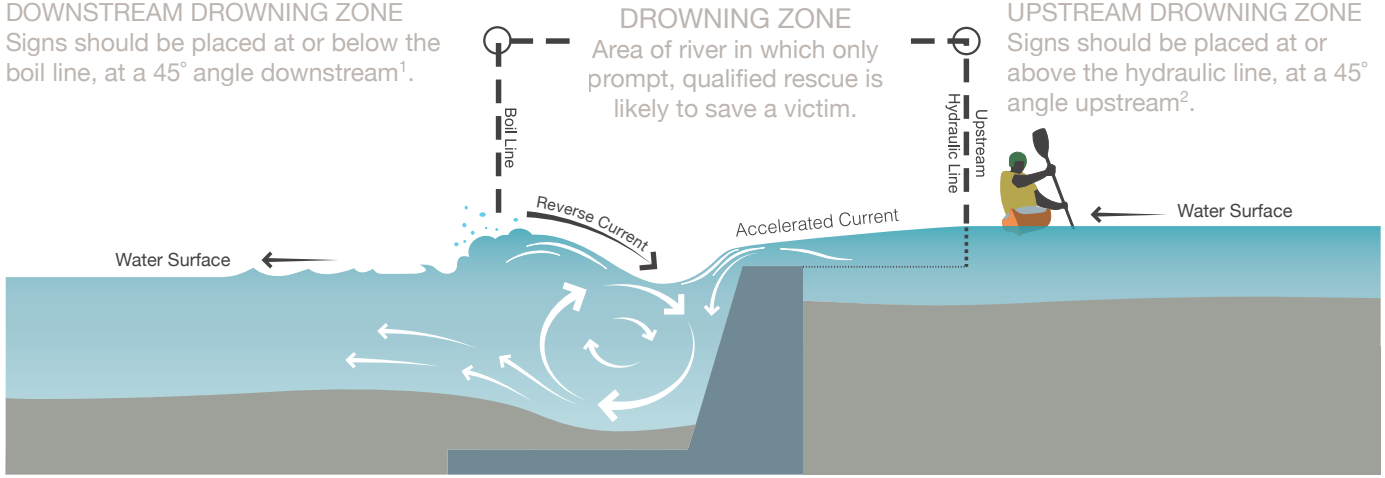
Water Trail Rules
Iowa Prison Industry Part #: FDNR41312X12EA
Size: 12"x12"
Color: White on Blue
Reflective: Yes
Material: Aluminum
Additional Information:
Place at launches, especially where landowner relations are sensitive, or where there have been other problems

Figure 6A-13.
Water Trail Rules

6B
LOW-HEAD DAM SIGNAGE

LOW-HEAD DAM WARNING SIGN
SIZING & PLACEMENT

Figure 6B-1.
Drowning Zone Profile



[1] Typically within 50' downstream of dam
[2] Distance upstream is typically 3 times the vertical head, often within 20' of the dam.

GENERAL LOCATIONS OF HAZARD SIGNS

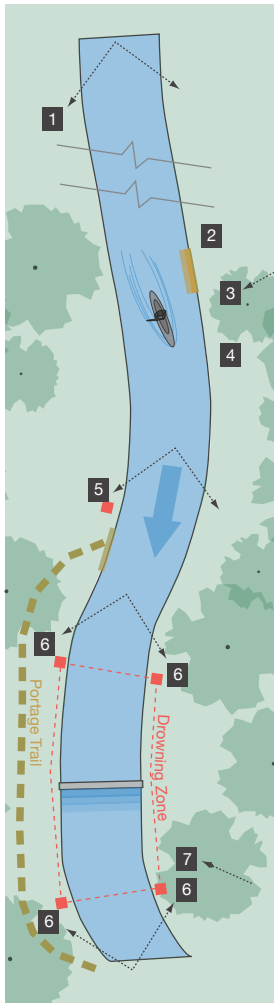
The specific types and sizes of warning signs needed for each hazard on a state-designated water trail are determined individually using a consistent set of criteria. Once the sign design and size is determined, each sign is located adjacent to the hazard based on hydraulic criteria and other local conditions. Low-head dams, for example, include unsafe currents upstream, downstream, and at the site of the dam for boaters and those wading (Figure 6B-1). These high-current areas are known as "drowning zones." Signs identifying drowning zone limits surrounding a hazard must allow a boater to reach shore before being carried by currents over the dam.

All signs viewed from the water are typically sited on the bank at a 45-degree angle facing upstream. The exception to this is the *Drowning Zone* sign placed below a dam facing downstream and offset at a 45-degree angle. Any sign placed on the banks should be as far above the bankfull water elevation as possible. Depending on local conditions, alternative mounting systems such as buoys, overhanging cables, or bridges may be used, in which case the signs may face directly upstream or downstream.

Signs included in this manual can be ordered from vendors, including Iowa Prison Industries (IPI). Note that size, color, and design of all signs corresponds to standards in this manual. Optional features include vandal proof coating using 3M™ Premium Protective Overlay Film Series 1160.

HAZARD SIGN SCENARIOS

River users are minimally provided with two upstream warnings to prepare to leave the stream before reaching a drowning zone and dam. Because rivers often damage signs during flood times and because sign vandalism can be a regular occurrence, some redundancy is programmed into this system to allow time for maintenance responses. River users are directed to a specific side of a stream to reach portage routes or launch locations to avoid the drowning zone. The sequence of signs included for each dam is summarized in Figure 6B-2. Note that differences in sign wording exist based on the course of action available to paddlers as they near hazards. Options include portage trails around the hazards or launches before the drowning zones (which may or may not be the end of the water trail).



SCENARIOS POSSIBLE FOR RIVER USERS TO AVOID A DROWNING ZONE AND DAM	Water Trail Includes Portage Around Dam	Water Trail Launch Available Upstream of Dam to Exit River	Water Trail Launch Available Upstream of Dam to Exit River; Water Trail Ends Here
1 EARLY WARNING SIGN To alert river users to the upcoming dam and cue them to watch for instructions about exiting safely. Required only if landing or egress is located 300 feet or less upstream of a dam, although it may be used optionally to be conservative IPI Part Number: FDNR408EA	Warning Dam Ahead 1,500 Feet	Warning Dam Ahead 1,500 Feet	Warning Dam Ahead 1,500 Feet
2 LAST LANDING ABOVE SIGN To alert river users of the last landing above the dam IPI Part Number: FDNR410EA	Warning Dam Ahead 1.4 Miles Last Landing Portage Ahead Left Bank	Warning Dam Ahead 1.4 Miles Last Boat Landing	Warning Dam Ahead 1.4 Miles Last Landing Water Trail Ends Here
3 LAND-BASED LAST LANDING ABOVE SIGN To alert those staging watercraft or putting in at the launch IPI Part Number: FDNR411EA	Warning Dam Ahead 1.4 Miles Last Landing Portage Ahead Left Bank	Warning Dam Ahead 1.4 Miles Last Boat Landing	Warning Dam Ahead 1.4 Miles Last Boat Landing
4 MOVE LEFT OR RIGHT SIGN To cue river users to move over for last safe exit and/or portage (20/20 vision) IPI Part Number: FDNR414EA	Warning Dam Ahead Move Left For Portage	Warning Dam Ahead Move Left For Safe Exit	Warning Dam Ahead Move Left For Safe Exit
5 LAST SAFE EXIT SIGN To mark the last safe exit and/or portage (20/20 vision) IPI Part Number: FDNR421EA	Danger Dam Ahead Last Safe Portage Here Exit Now! →	Danger Dam Ahead Exit Now! →	Danger Dam Ahead Exit Now! →
6 DROWNING ZONE, UP/DOWNSTREAM LIMITS SIGN To mark the area beyond which no one should enter because of dangerous currents. Exact placement based on field conditions (20/40 Vision) IPI Part Number: FDNR422EA	Dam	Dam	Dam
7 PEDESTRIAN DROWNING ZONE WARNING SIGN Placed at pedestrian approaches to drowning zone areas. Exact placement based on field conditions IPI Part Number: FDNR40918X24EA	Danger! Recirculating Currents Below Dam Trap And Drown Victims	Danger! Recirculating Currents Below Dam Trap And Drown Victims	Danger! Recirculating Currents Below Dam Trap And Drown Victims
8 OTHER HAZARDS SIGN Placed on-land or on-water to alert river users to an upcomming non-dam hazards IPI Part Number:	Warning Rapids Ahead	Warning Rapids Ahead	Warning Rapids Ahead

Figure 6B-2.
General Sign Locations for Use with Dams

SIGN LETTER HEIGHT CALCULATIONS

Criteria used to size all aspects of signs viewed from the water are related to river width at the sign location and includes text height, sign panel size, and text spacing. Text is based on a modified version of the Army Corps of Engineers sign manual standards. The minimum text height for the main message for all water-viewed signs is 4 inches, regardless of river width. The font for all text is Arial.

Begin calculations for text height by determining river width where each sign is to be located. Width can be measured on the Iowa DNR Interactive Mapping Site using aerial photographs (www.iowadnr.gov/mapping/index.html).

The formula for calculating text height is illustrated on the right. Figure 6B-3 and Table 6B-1 are provided to calculate the 20/40 vision viewing distance (V). This value is used to calculate the height of the capital letter text (A) that would be legible from the viewing distance. The sign panel size is then determined based on proportions of the capital letter height and text-spacing requirements.

V (ft) = (M1 - M2) / cos 45°
M1 - M2 = 0.5 river width (ft) (for 45° only)
V (ft) = (0.5 river width (ft)) / 0.707
A (in) = V28

20/40 A (in) x 0.50 = 20/20 A (in)
20/40 A (in) x 0.75 = 20/30 A (in)
(Always round up to nearest inch.)

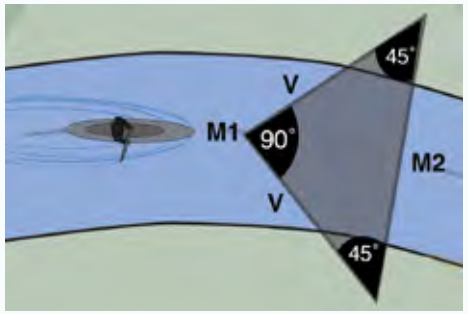


Figure 6B-3.
Calculating Viewing Distance Based on River Width

20/40-VISION CHART FOR DROWNING ZONE SIGNS

River Width (ft)	Capital Letter Height (in)	River Width (ft)	Capital Letter Height (in)	River Width (ft)	Capital Letter Height (in)
0-158	4	791-830	21	1464-1503	38
159-197	5	831-870	22	1504-1543	39
198-236	6	871-909	23	1544-1582	40
237-276	7	910-949	24	1583-1622	41
277-315	8	950-988	25	1623-1661	42
316-355	9	989-1028	26	1662-1701	43
356-395	10	1029-1068	27	1702-1741	44
396-434	11	1069-1107	28	1742-1780	45
435-474	12	1108-1147	29	1781-1820	46
475-513	13	1148-1186	30	1821-1859	47
514-553	14	1187-1226	31	1680-1899	48
554-592	15	1227-1266	32	1900-1939	49
593-632	16	1267-1305	33	1940-1978	50
633-672	17	1306-1345	34	1979-2018	51
673-711	18	1346-1384	35	2019-2057	52
712-751	19	1385-1424	36	2058-2097	53
752-790	20	1425-1463	37	2098-2137	54

Table 6B-1.
Capital Letter Height for 20/40 Vision (Required for all drowning zone signs)

Drowning Zone signs use 20/40 vision standards. In most other locations, 20/20 vision signs are sufficient, as field testing shows they are visible across the river's width. However, larger 20/30 vision signs are recommended in settings where high-speed motorized boat traffic is common, or where local land managers determine a high hazard.

20/30-VISION CHART FOR DROWNING ZONE SIGNS

River Width (ft)	Capital Letter Height (in)	River Width (ft)	Capital Letter Height (in)	River Width (ft)	Capital Letter Height (in)
0-197	4	1029-1107	21	1940-1978	38
198-236	5	1108-1147	22	1979-2057	39
237-315	6	1148-1186	23	2058-2097	40
316-355	7	1187-1266	24	2098-2137	41
356-395	8	1267-1305	25	2138-2216	42
396-474	9	1306-1345	26	2217-2255	43
475-513	10	1346-1424	27	2256-2295	44
514-553	11	1425-1463	28	2296-2374	45
554-632	12	1464-1503	29	2375-2414	46
633-672	13	1504-1582	30	2415-2453	47
673-711	14	1583-1622	31	2454-2492	48
712-790	15	1623-1661	32	2493-2572	49
791-830	16	1662-1741	33	2573-2612	50
831-870	17	1742-1780	34	2613-2651	51
871-949	18	1781-1820	35	2652-2731	52
950-988	19	1821-1899	36	2732-2770	53
989-1028	20	1900-1939	37	2771-2810	54

Table 6B-2.
Capital Letter Height for 20/30 Vision (Optional when greater visibility is desired)

20/20-VISION CHART FOR DROWNING ZONE SIGNS

River Width (ft)	Capital Letter Height (in)	River Width (ft)	Capital Letter Height (in)	River Width (ft)	Capital Letter Height (in)
0-315	4	1583-1661	21	2881-2958	38
316-395	5	1662-1741	22	2959-3036	39
396-475	6	1742-1820	23	3037-3114	40
476-553	7	1821-1899	24	3115-3192	41
554-632	8	1900-1978	25	3193-3271	42
633-711	9	1979-2057	26	3272-3349	43
712-790	10	2058-2137	27	3350-3427	44
791-870	11	2138-2176	28	3428-3505	45
871-949	12	2177-2254	29	3506-3583	46
950-1028	13	2255-2332	30	3584-3662	47
1029-1107	14	2333-2410	31	3663-3740	48
1108-1186	15	2411-2489	32	3741-3818	49
1187-1186	16	2490-2567	33	3819-3896	50
1267-1345	17	2568-2645	34	3897-3974	51
1346-1424	18	2646-2723	35	3975-4053	52
1425-1503	19	2724-2801	36	4054-4131	53
1504-1582	20	2802-2880	337	4132-4209	54

Table 6B-3.
Capital Letter Height for 20/20 Vision (Appropriate for most settings, with the exception of drowning zone signs)

ANNOTATED
SIGN GUIDELINES

EARLY WARNING (ON-WATER) SIGN

Purpose:
To alert river users about an upcoming dam.

Band Color: Orange
Reflective: Yes
Material: Aluminum

This sign is optional. If the last launch is less than 300 feet upstream from the dam, then this sign, along with the **Last Landing Above (On-Water)** sign, is required. It may also be used as an extra precaution where high-speed boat traffic is common, or areas where local land managers determine a high hazard.

Figure 6B-4 describes required dimensions and spacing. “Warning” is in Arial bold font.

Placement is guided by local site conditions. There is no minimum length upstream of dam. The sign may be placed anywhere along the river. More than one sign may be needed, depending on site conditions.

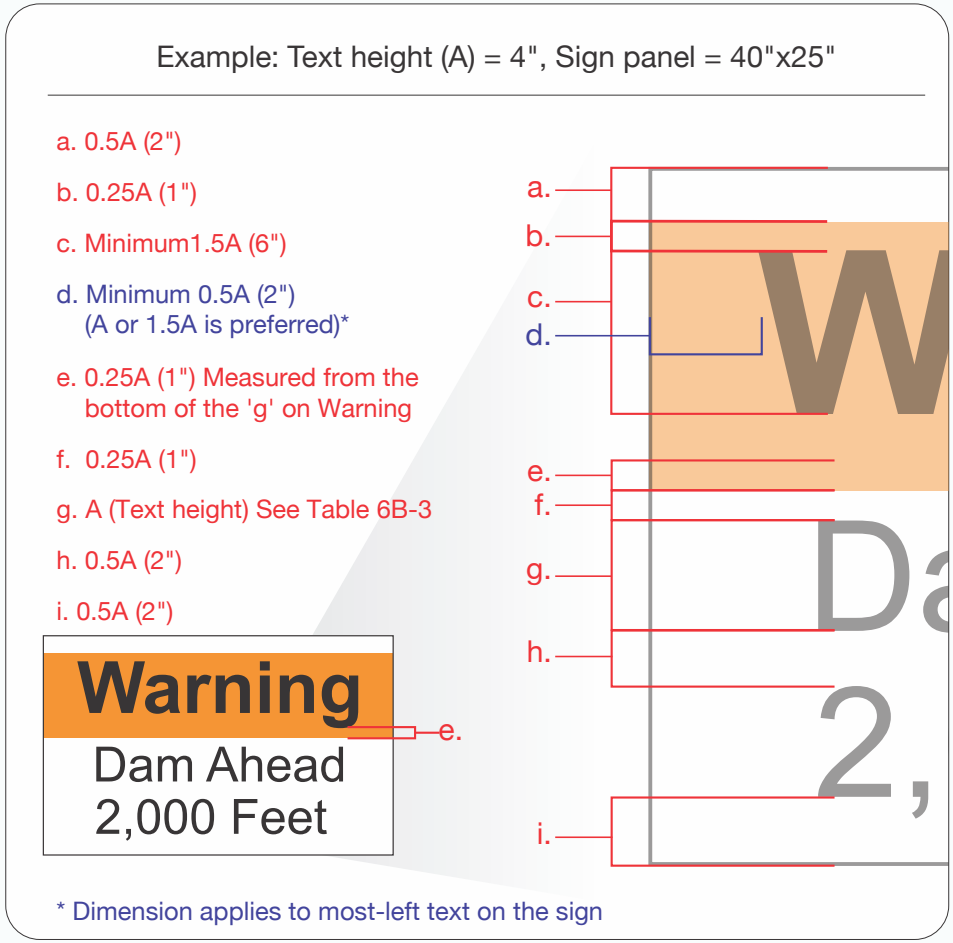


Figure 6B-4.
“Early Warning (On-Water) Sign” Face Dimensions

LAST LANDING ABOVE (ON-WATER) SIGN

Purpose:
To alert river users of the upcoming dam and to cue them to watch for instructions about exiting safely.

Band Color: Orange
Reflective: Yes
Material: Aluminum

This sign is required unless the last launch is more than 300 feet upstream from the dam and the **Last Launch Above (On-Land)** sign is implemented. In this case the sign is optional and could be used as an extra precaution.

Figure 6B-8 describes required dimensions and spacing. “Warning” is in Arial bold font. Three message variations are possible for this sign, depending on the site. Figures 6B-5, 6B-6, and 6B-7 show these alternatives.

Figure 6B-5
Sign Face to Identify End of Designated Water Trail Ahead

Figure 6B-6
Sign Face for Site Without Portage Trail/With Last Landing Ahead

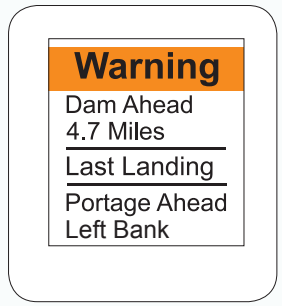
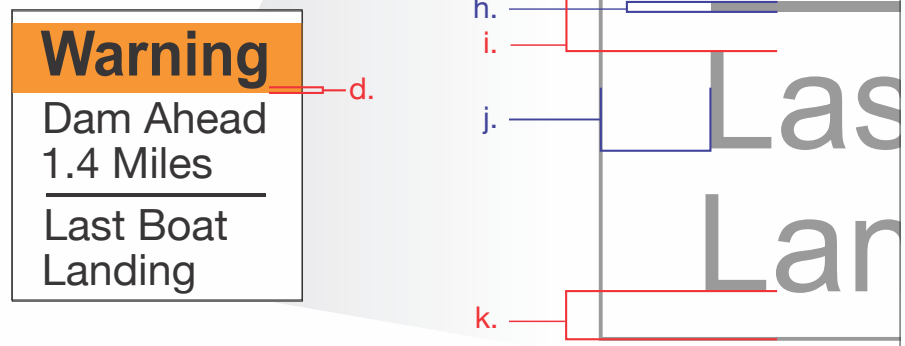


Figure 6B-7
Sign Face for Site with Portage Trail Ahead

Example: Text height (A) = 4", Sign panel = 40"x40"

a. 0.5A (2")
b. 0.25A (1")
c. Minimum 1.5A (6")
d. 0.25A (1") Measured from the bottom of the 'g' on Warning
e. 0.25A (1")
f. 0.5A (2")
g. A (Text height) See Table 6B-3
h. 0.125A (.5")
i. A (4")
j. Minimum 0.5A (2") (A or 1.5A is preferred)*
k. 0.5A (2")



* Dimension applies to most-left text on the sign

Figure 6B-8
“Last Landing Above (On-Water) Sign” Face Dimensions

LAST LANDING ABOVE (ON-LAND) SIGN

Purpose:
To alert river users putting in at the launch about the upcoming dam and to cue them to watch for instructions about exiting safely.

Band Color: Orange
Reflective: Yes
Material: Aluminum

This sign is required and meant to be viewed from land at a launch. The capital text height is 2 inches, regardless of river width.

Figure 6B-11 describes required dimensions and spacing. Two message variations are possible for this sign, depending on the site. Figure 6B-9 and Figure 6B-10 show these options. “Warning” is in Arial bold font.

Proper radii to prevent injury on sign corners is determined by sign manufacturer.

Figure 6B-9
Sign Face for Site Without Portage Trail/ With Last Landing Ahead (On-Land)

Figure 6B-10
Sign Face for Site with Portage Trail Ahead (On-Land)

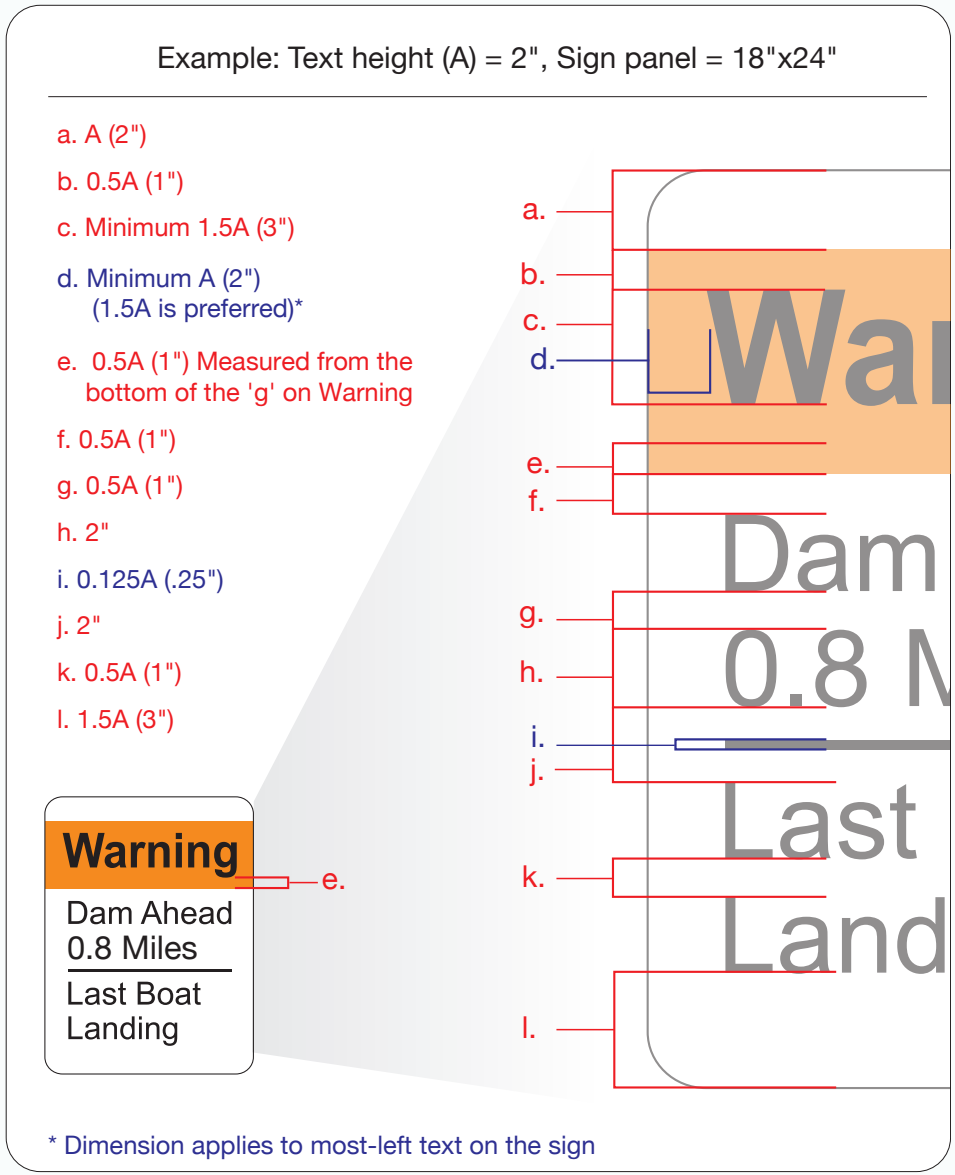


Figure 6B-11
“Last Landing Above (On-Land) Sign” Face Dimensions

MOVE LEFT/RIGHT (ON-WATER) SIGN

Purpose:
To alert users of the upcoming dam and cue them to move to either the left or right side of the river to exit safely.

Band Color: Orange
Reflective: Yes
Material: Aluminum

This sign is required, unless exit is possible on both sides of the river. The sign should be placed a minimum of 3 times the river width upstream from the Last Safe Exit sign so river users have enough reaction time to move over for the portage and/or last safe exit.

Figure 6B-14 describes required dimensions and spacing. Two message variations are possible for this sign, depending on the site. Figure 6B-12 and Figure 6B-13 show these options. “Warning” is in Arial bold font.

Figure 6B-12
Sign Face to Identify Bank for Last Safe Exit

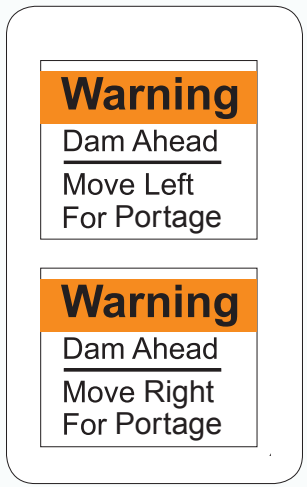


Figure 6B-13
Sign Face to Identify Bank for Portage Trail

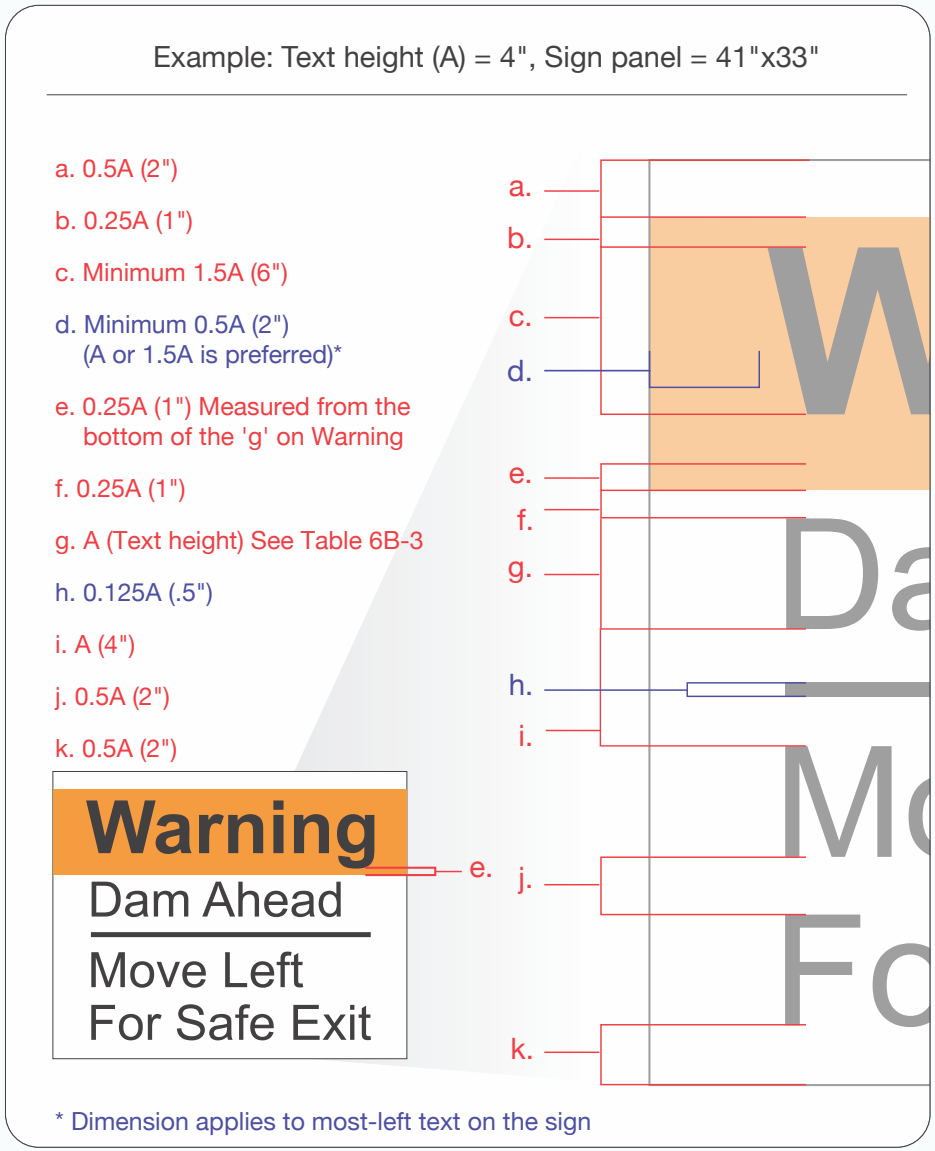
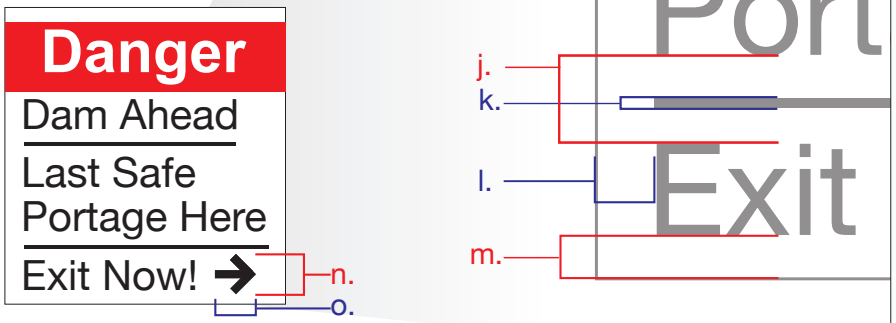
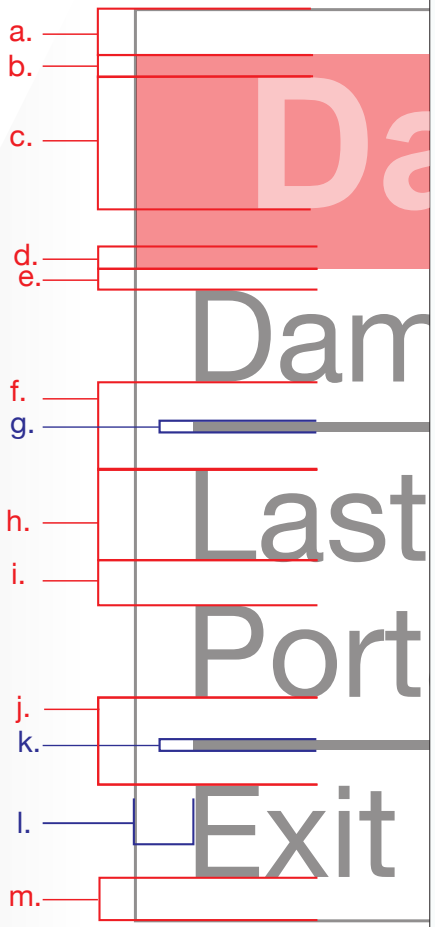


Figure 6B-14
“Move Left/Right (On-Water) Sign” Face Dimensions

Example: Text height (A) = 4", Sign panel = 40"x40"

a. 0.5A (2")
b. 0.25A (1")
c. Minimum 1.5A (6")
d. 0.25A (1") Measured from the bottom of the 'g' on Danger
e. 0.25A (1")
f. A (4")
g. 0.125A (0.5")
h. A (Text height) See Table 6B-3
i. 0.5A (2")
j. A (4")
k. 0.125A (0.5")
l. Minimum 0.5A (A or 1.5A is preferred)*
m. 0.5A (2")
n. 1.4A (5.6")
o. 1.4A (5.6")





* Dimension applies to most-left text on the sign

Figure 6B-17
"Last Safe Exit (On-Water) Sign" Face Dimensions

LAST SAFE EXIT (ON-WATER) SIGN

Purpose:
To mark the last safe exit and/or portage route before the dam.

Band Color: Red
Reflective: Yes
Material: Aluminum

This sign is required. The "Last Safe Portage Here" message should only be used on the side of the river that the portage is on.

Figure 6B-17 describes required dimensions and spacing. Two message variations are possible for this sign, depending on the site. Figure 6B-15 and Figure 6B-16 show these options. "Danger" is in Arial bold font.

Figure 6B-15
Sign Face to Identify Last Safe Exit

Figure 6B-16
Sign Face to Identify Last Safe Portage

DROWNING ZONE, UP/DOWNSTREAM LIMITS (ON-WATER) SIGN

Purpose:
To mark the upstream and downstream limits beyond which no one should enter because of dangerous currents.

Band Color: Red
Reflective: Yes
Material: Aluminum

This sign is required. The diamond shape, as well as the "X" in the center, is a universal symbol of a dangerous hazard.

Figure 6B-18 describes required dimensions and spacing. Sign panel size is determined based on required text height. (See below.) Text is Arial bold font with a black outline.

Sign Size Based on Text Height

A (in.)	Sign Dim.	A (in.)	Sign Dim.
4	17"x17"	13	54"x54"
5	21"x21"	14	58"x58"
6	25"x25"	15	62"x62"
7	29"x29"	16	66"x66"
8	33"x33"	17	70"x70"
9	37"x37"	18	74"x74"
10	41.5"x41.5"	19	78"x78"
11	46"x46"	20	82"x82"
12	50"x50"		

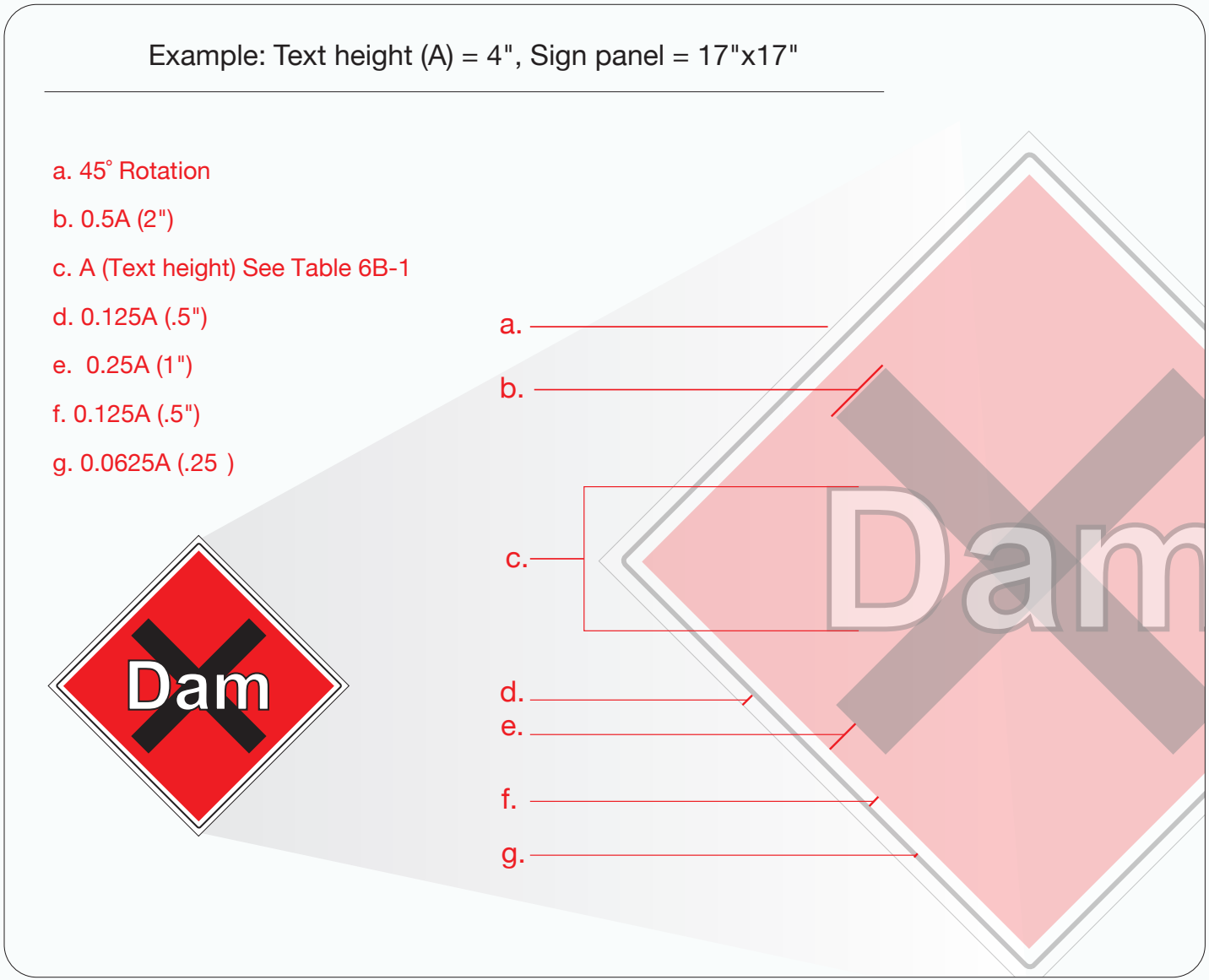


Figure 6B-18.
"Drowning Zone, Up/Downstream Limits (On-Water) Sign" Face Dimensions

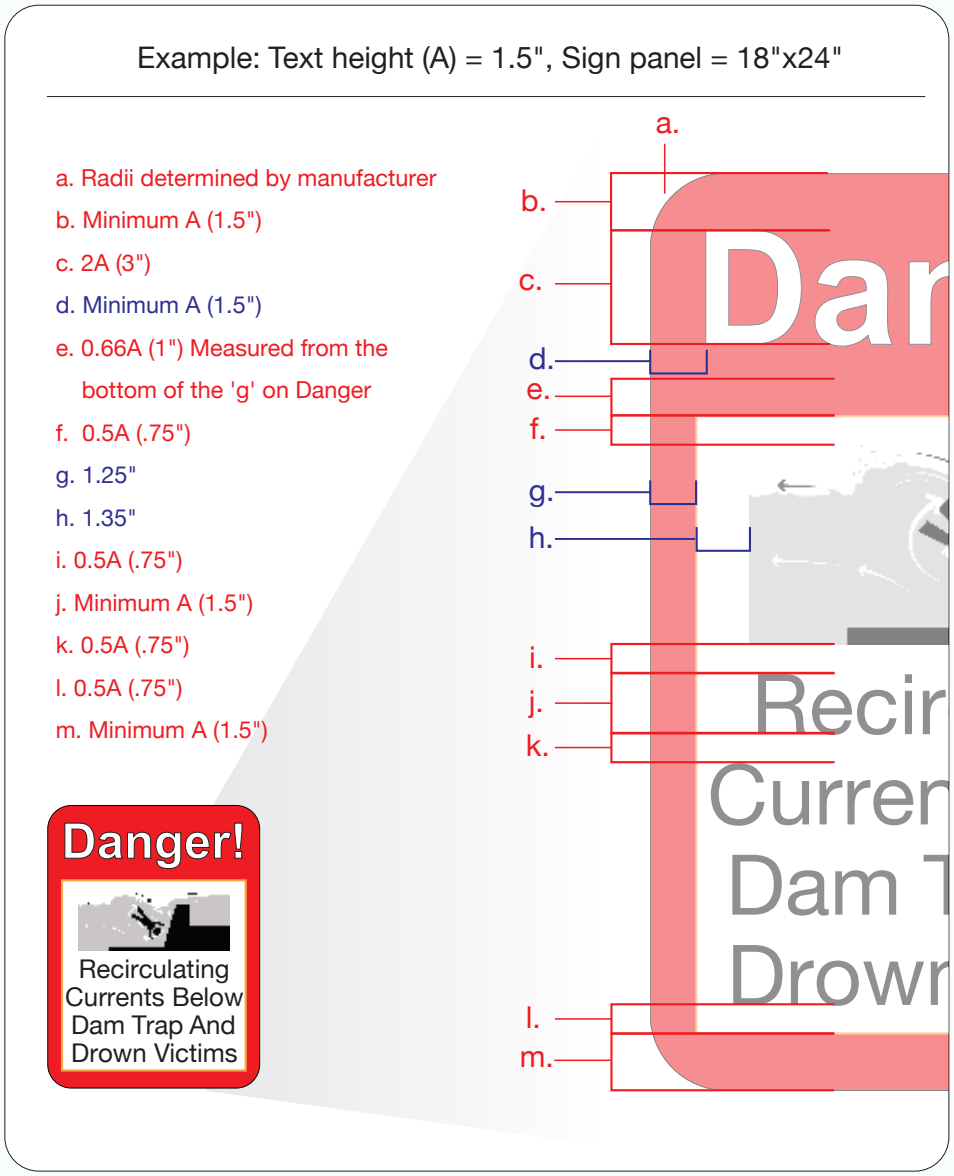


Figure 6B-19
"Pedestrian Drowning Zone Warning (On-Land) Sign"
Face Dimensions

PEDESTRIAN DROWNING ZONE WARNING (ON-LAND) SIGN

Purpose:
To alert people attempting to wade or otherwise access the river about the dangers of the recirculating currents within the drowning zone.

Band Color: Red
Reflective: Yes
Material: Aluminum

These signs are required at all pedestrian approaches above and below the dam and are meant to be viewed from land.

Figure 6B-19 describes required dimensions and spacing. The capital text height is 1.5 inches, regardless of river width. "Danger!" is in Arial bold font with a black outline.

OTHER HAZARDS (ON-WATER OR ON-LAND) SIGN

Purpose:
To alert users to an upcoming non-dam hazard.

Band Color: Orange
Reflective: Yes
Material: Aluminum

This warning sign is optional and can be viewed from land or on water at the last access upstream of the hazard. Refer to Table 6B-3 for the capital text height for on-water signs. For on-land signs the capital text height is 2 inches, regardless of river width. The hazard itself is likely left unmarked except in certain circumstances such as bridge reconstruction.

For land based signs, a proper radii to prevent injury on sign corners is determined by sign manufacturer.

Figure 6B-21 describes required dimensions and spacing. Text describing the hazard may be substituted with “Log-Jam,” “Obstruction” or other hazards as they may apply. Figure 6B-20 shows a few options. “Warning” is in Arial bold font.

Figure 6B-20
Sign Face Examples for Other Hazards

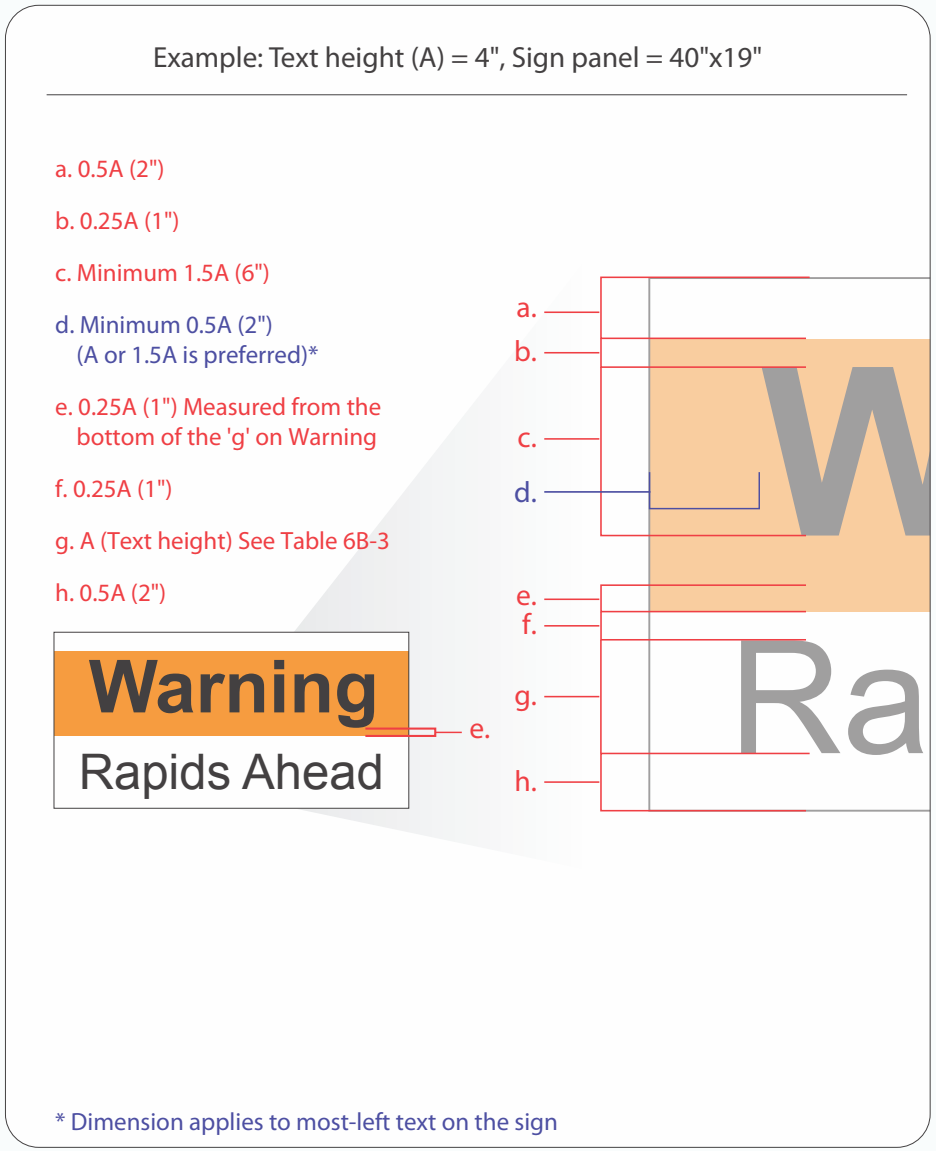


Figure 6B-21
“Other Hazards” Face Dimensions

SITE PLAN EXAMPLES

DES MOINES CASE STUDY:
Water Works Boat Launch On The Raccoon River

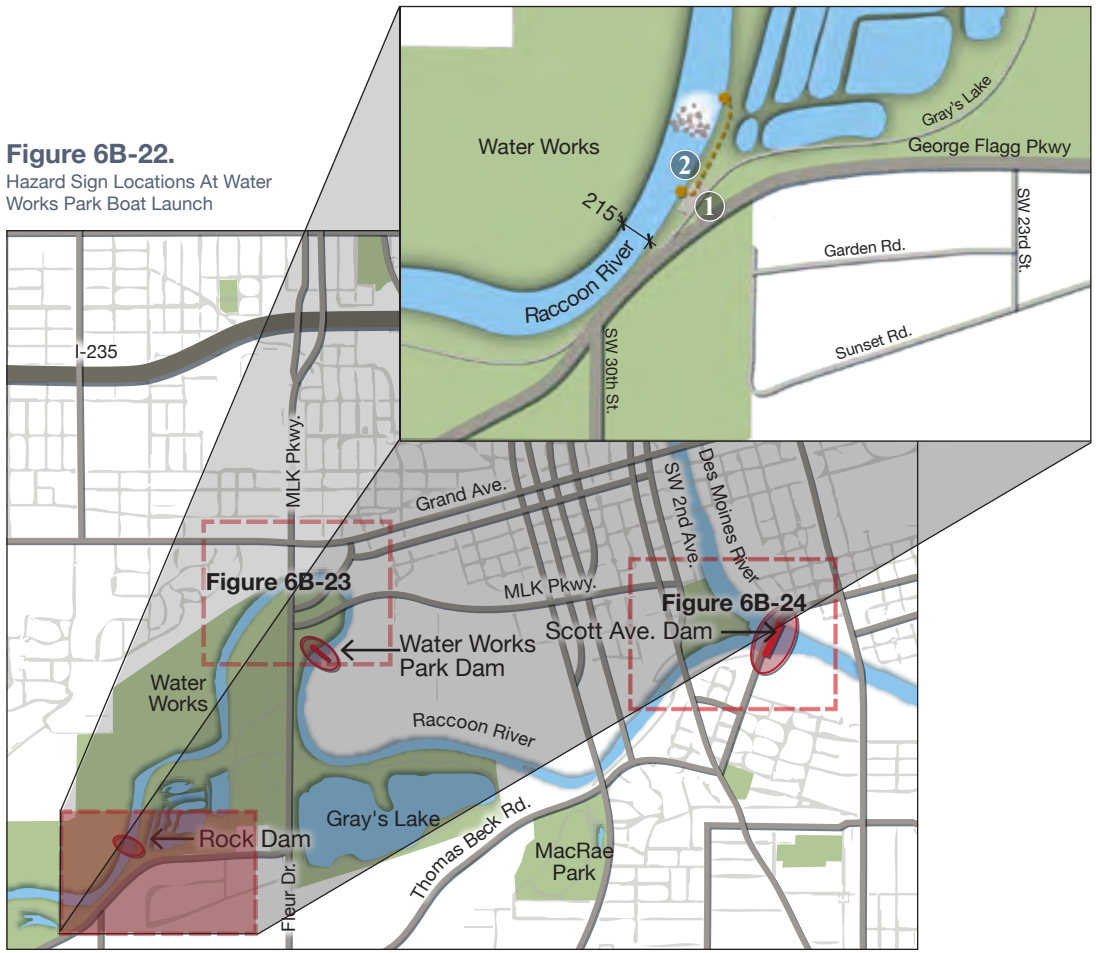


Figure 6B-22.
Hazard Sign Locations At Water Works Park Boat Launch

Table 6B-4.
Signs Used Near Water Works Park Boat Launch

Hazard Signs Near Water Works Park Boat Launch

Sign Type and Location	Example	Sign Size	Text Height
1 LAST LANDING ABOVE (ON-WATER) SIGN Placed at top of boat ramp facing parking lot	Warning Rock Dam 300 Feet Low-Head Dam 1.7 Miles Both Portages On Right Bank	24"×32"	2"
PORTAGE ARROW SIGN (ON-LAND) Placed at top of boat ramp facing parking lot	Portage Trail	8"×8"	.75"
2 LAST LANDING ABOVE (ON-LAND) SIGN Placed immediately downstream of Waterworks boat ramp, visible from upstream.	Warning Rock Dam 300 Feet Low-Head Dam 1.7 Miles Both Portages On Right Bank	60"×66"	5"

NOTES EXPLAINING HOW STANDARD SIGNAGE SEQUENCE WAS MODIFIED AT THIS LOCATION

A number of factors led to customization of signs in the vicinity of the Des Moines Water Works Park boat ramp.

- The rock dam immediately downstream of the boat ramp would not typically be signed; however, Water Works staff wanted to sign it as a low-head dam for liability reasons and to reduce confusion between the rock dam and the low-head dam ahead.
- Sign No. 2 is closely associated with the boat ramp at the top of the bank on its downstream edge; this was the clearest location to direct river users to the landing.

DES MOINES CASE STUDY:
Water Works Park Dam On The Raccoon River

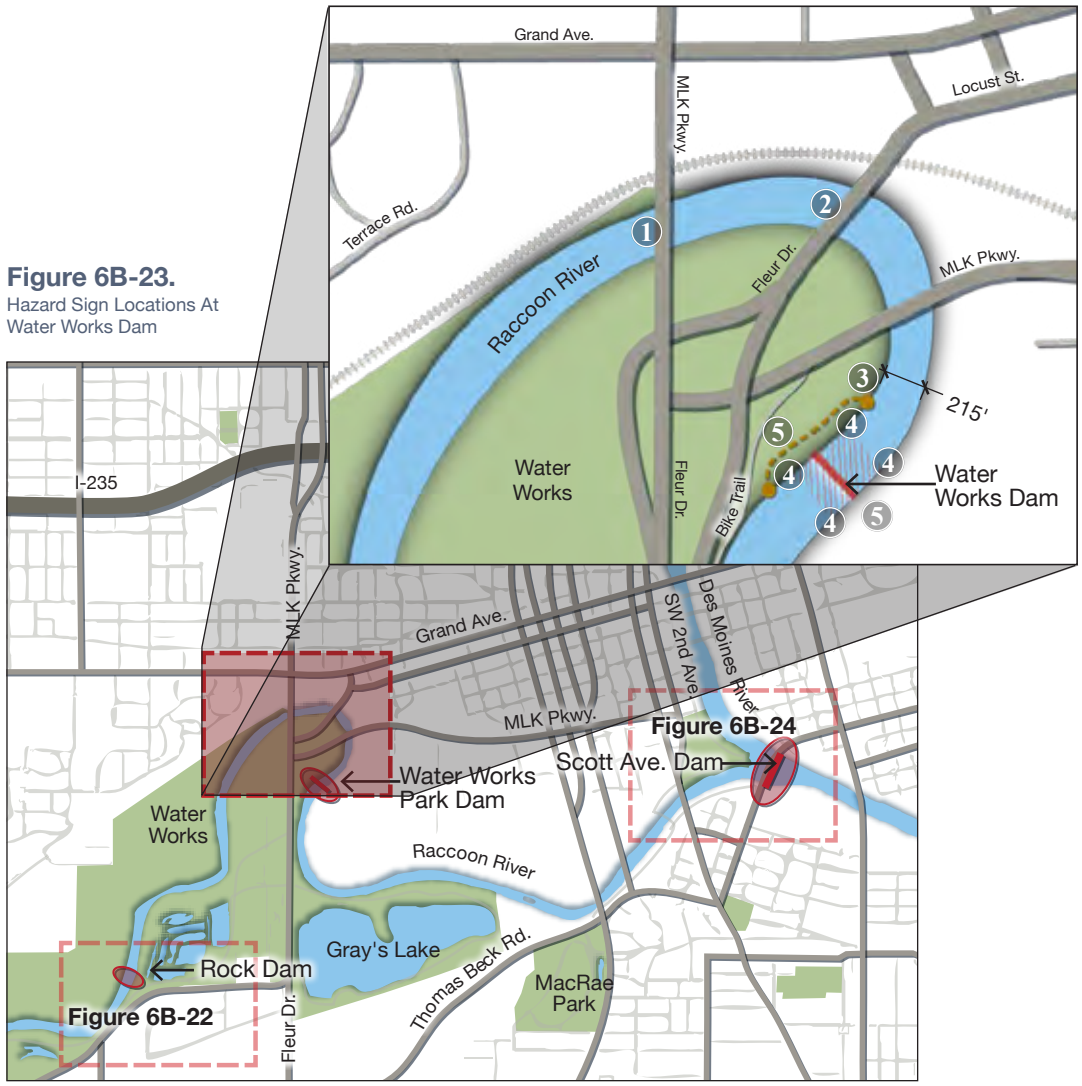


Figure 6B-23.
Hazard Sign Locations At Water Works Dam

Table 6B-5.
Signs Used Near Water Works Park Dam

Hazard Signs Near Water Works Park Dam			
Sign Type and Location	Example	Sign Size	Text Height
1 EARLY WARNING SIGN Placed on MLK Pkwy bridge piers	Warning Dam Ahead 1/2 Mile	48"×30"	5"
2 MOVE RIGHT SIGN Placed on Fleur Dr bridge	Warning Dam Ahead 1,500 Feet Move Right For Portage	48"×50"	5"
3 LAST SAFE EXIT SIGN Placed slightly upstream of portage on bank at 45°	Danger Dam Ahead Last Safe Portage Here Exit Now! →	48"×54"	5"
4 DROWNING ZONE UP/DOWNSTREAM LIMITS SIGN Placed on banks at 45° or on cables upstream and downstream of the dam the river	Dam	25"×25"	
5 PEDESTRIAN DROWNING ZONE WARNING SIGN Placed at pedestrian approach from bike trail and on SE-side levee facing away from dam	Danger! Recirculating Currents Below Dam Trap And Drown Victims	18"×24"	

NOTES EXPLAINING HOW STANDARD SIGNAGE SEQUENCE WAS MODIFIED AT THIS LOCATION

Sign No. 2 includes two messages that would typically be on separate signs. Des Moines Water Works staff wanted a second early warning, and there was a need to advise paddlers to move right for the portage at the same location, so the signs were combined for clarity.

DES MOINES CASE STUDY:
Scott Avenue Dam On The Des Moines River

The Scott Avenue Dam in Des Moines is located at the intersection of the Raccoon River and the Des Moines River.

Figure 6B-24.
Hazard Sign Locations At Scott Avenue Dam

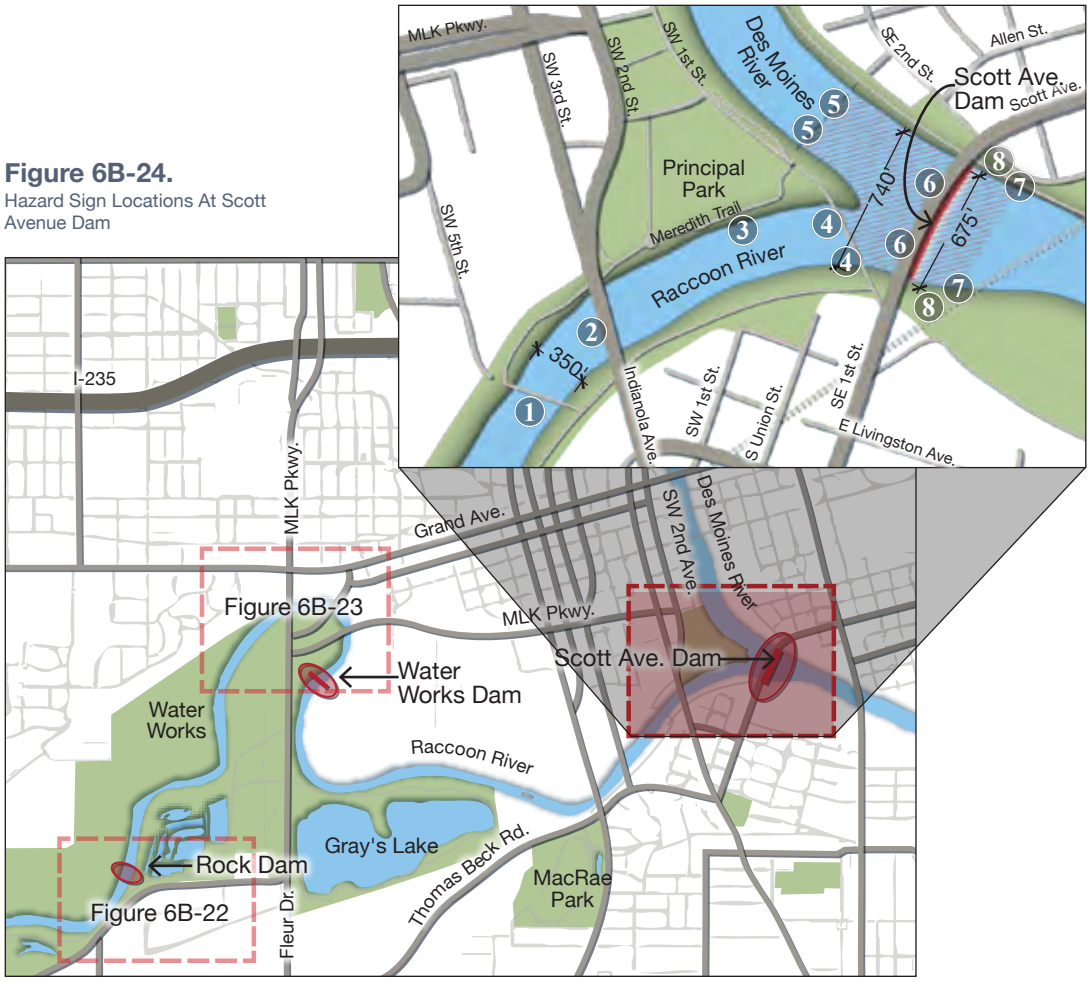


Table 6B-6.
Signs Used Near Scott Avenue Dam

Hazard Signs Near Scott Avenue Dam			
Sign Type and Location	Example	Sign Size	Text Height
1 EARLY WARNING SIGN Placed on trail bridge	Warning / Dam Ahead 2,000 Feet	72"×44"	7"
2 MOVE LEFT SIGN Indianola Ave bridge	Warning / Dam Ahead 1,700 Feet / Move Left For Safe Exit	72"×68"	7"
3 LAST SAFE EXIT SIGN Placed slightly upstream of portage on bank at 45°	Danger / Dam Ahead / Exit Now!	82"×61"	7"
4 DROWNING ZONE UP/DOWNSTREAM LIMITS SIGN Raccoon River trail bridge	Dam	37"×37"	
5 DROWNING ZONE UP/DOWNSTREAM LIMITS SIGN Des Moines River on cables	Dam	46"×46"	
6 DROWNING ZONE UP/DOWNSTREAM LIMITS SIGN Scott Avenue Bridge Piers	Dam	75"×75"	
7 DROWNING ZONE UP/DOWNSTREAM LIMITS SIGN Des Moines River levee tops 70' downstream with sign face @ 45°	Dam	66"×66"	
8 PEDESTRIAN DROWNING ZONE WARNING SIGN Placed at all pedestrian approaches to dam	Danger! / Recirculating Currents Below Dam Trap And Drown Victims	18"×24"	

NOTES EXPLAINING HOW STANDARD SIGNAGE SEQUENCE WAS MODIFIED AT THIS LOCATION

A number of factors led to customization of signs at this location.

- The last boat landing on the Raccoon River is within 300 feet of the dam, and the dam is in an urban area flanked by high-use recreational trails. In this case, the **Last Landing Above (On-Water)** sign was implemented, along with two **Early Warning** signs.
- Sign No. 2 contained two messages that would typically be on separate signs. City of Des Moines staff wanted a second early warning, and there was a need to advise paddlers to move right for the portage at the same location, so the signs were combined for clarity.

DES MOINES CASE STUDY:
Birdland Park Boat Launch On The Des Moines River

Figure 6B-25.
Hazard Sign Locations At
Birdland Park Boat Launch

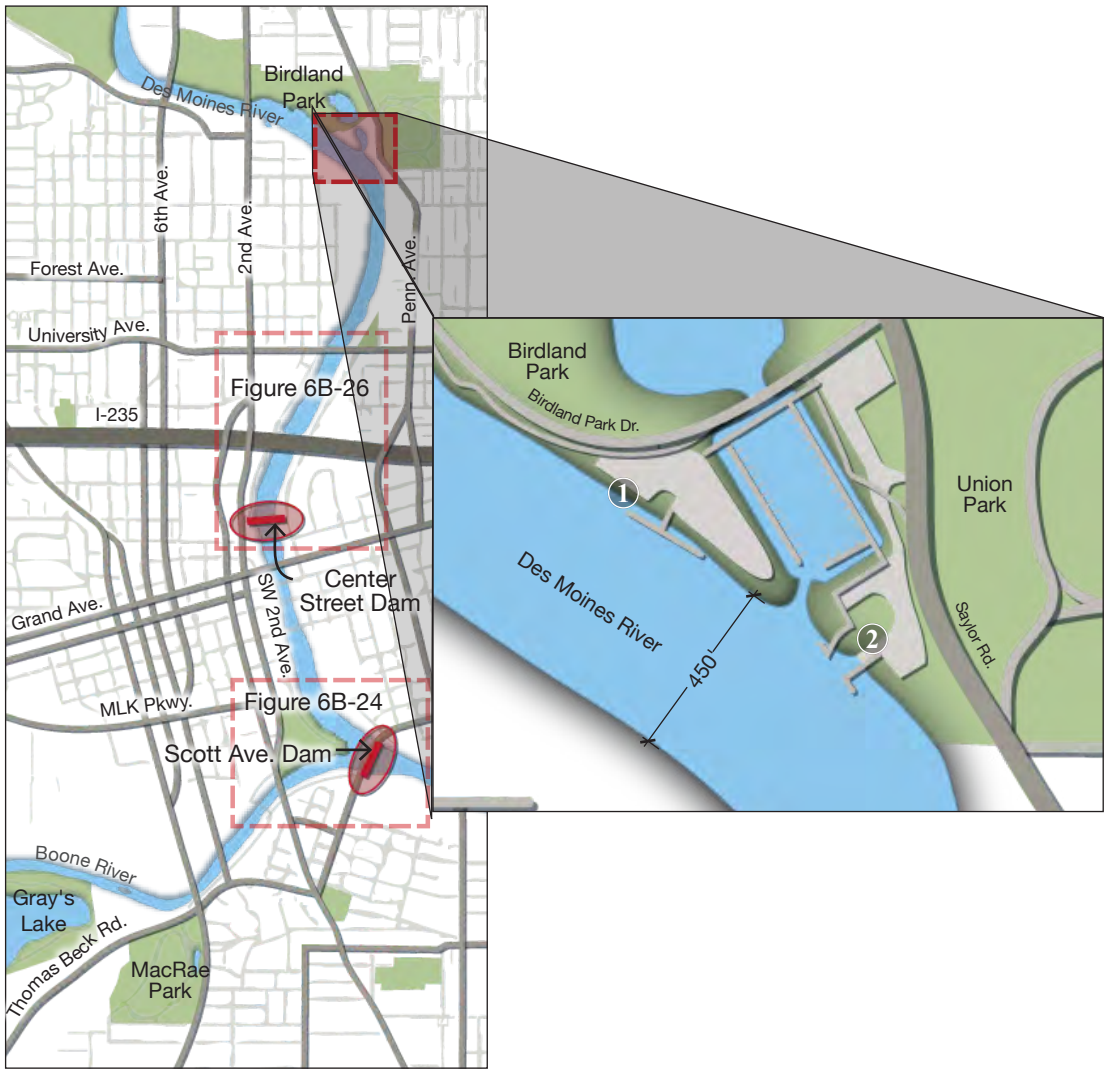


Table 6B-7.
Signs Used Near Birdland Park Boat Launch

Hazard Signs Near Birdland Park Boat Launch			
Sign Type and Location	Example	Sign Size	Text Height
1 LAST LANDING ABOVE (ON-WATER) SIGN Placed on bank upstream of boat launch	Warning / Dam Ahead 1.4 Miles / Last Landing / Water Trail Ends Here	92"×108"	9"
2 LAST LANDING ABOVE (ON-LAND) SIGN Placed at top of boat launch	Warning / Dam Ahead 1.4 Miles / Last Boat Landing	18"×24"	2"

NOTES EXPLAINING HOW STANDARD SIGNAGE SEQUENCE WAS MODIFIED AT THIS LOCATION

The Birdland Marina is in an urban setting with high-speed boat traffic, so the 20/30 vision chart was used to develop appropriate letter heights for sign No.1.

DES MOINES CASE STUDY:
Des Moines River / Center Street Dam

Figure 6B-26.
Hazard Sign Locations At Center Street Dam

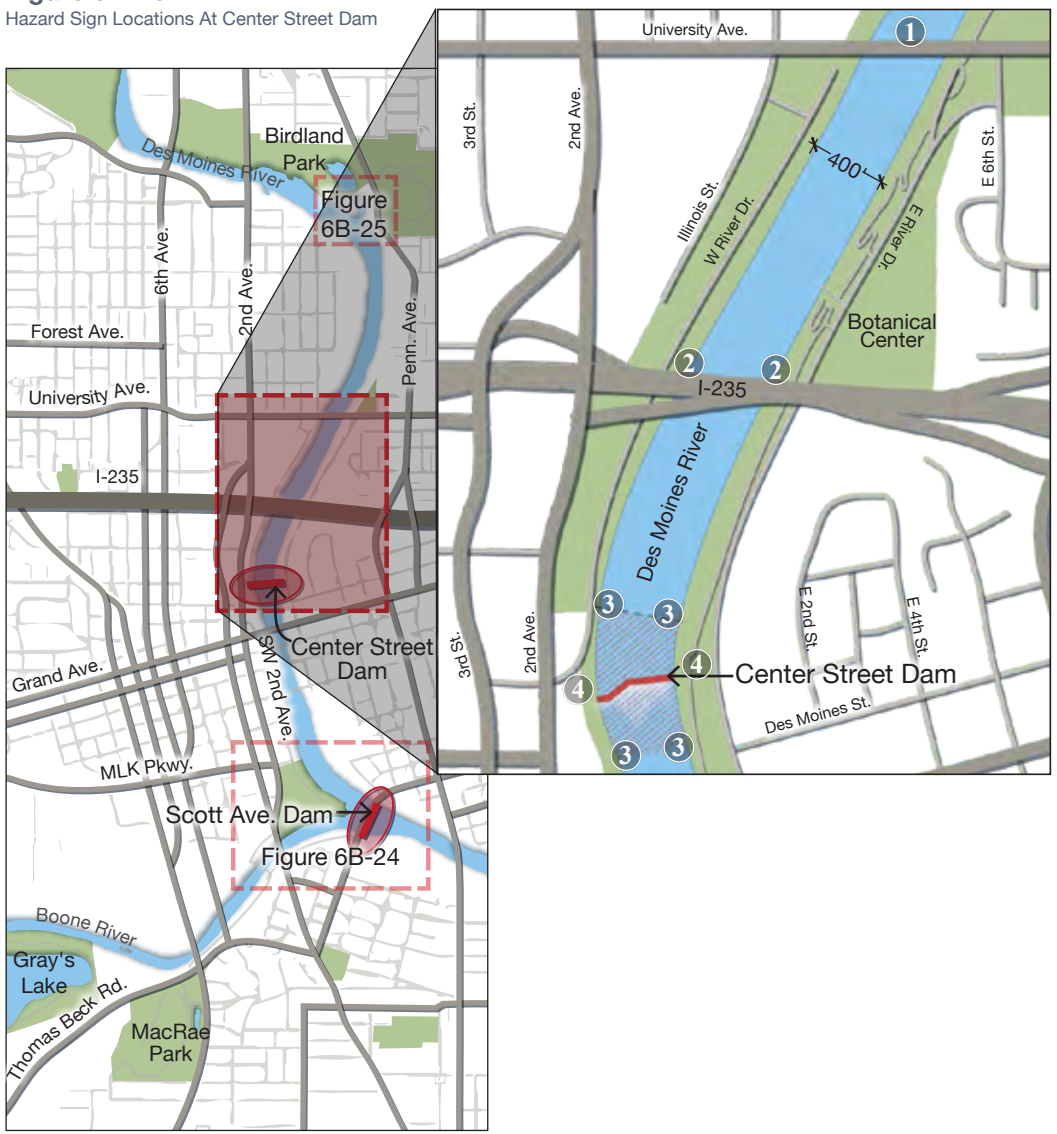


Table 6B-8.
Signs Used Near Center Street Dam

Hazard Signs Near Center Street Dam

	Sign Type and Location	Example	Sign Size	Text Height
1	EARLY WARNING SIGN Placed on University bridge	Warning Dam Ahead 3,500 Feet	66"×44"	7"
2	LAST SAFE EXIT Placed on East and West banks at 45° or on I-235 bridge	Danger Dam Ahead Exit Now!→ Danger Dam Ahead ←Exit Now!	84"×60"	7"
3	DROWNING ZONE UP/DOWNSTREAM LIMITS SIGN Placed upstream on cables over river. Placed 200' downstream of dam on levee tops at 45°	Dam	46"×46"	
4	PEDESTRIAN DROWNING ZONE WARNING SIGN Placed at all pedestrian approaches to dam	Danger! Recirculating Currents Below Dam Trap And Drown Victims	18"×24"	

NOTES EXPLAINING HOW STANDARD SIGNAGE SEQUENCE WAS MODIFIED AT THIS LOCATION

An optional early warning sign (No. 1) was added on the University Avenue Bridge. Well downstream of the end of the water trail, additional emergency egress is delineated in an area where it would be possible for boaters to get out of the river channel if they were in distress.

WINNESHIEK COUNTY CASE STUDY: Upper Dam on the Upper Iowa River

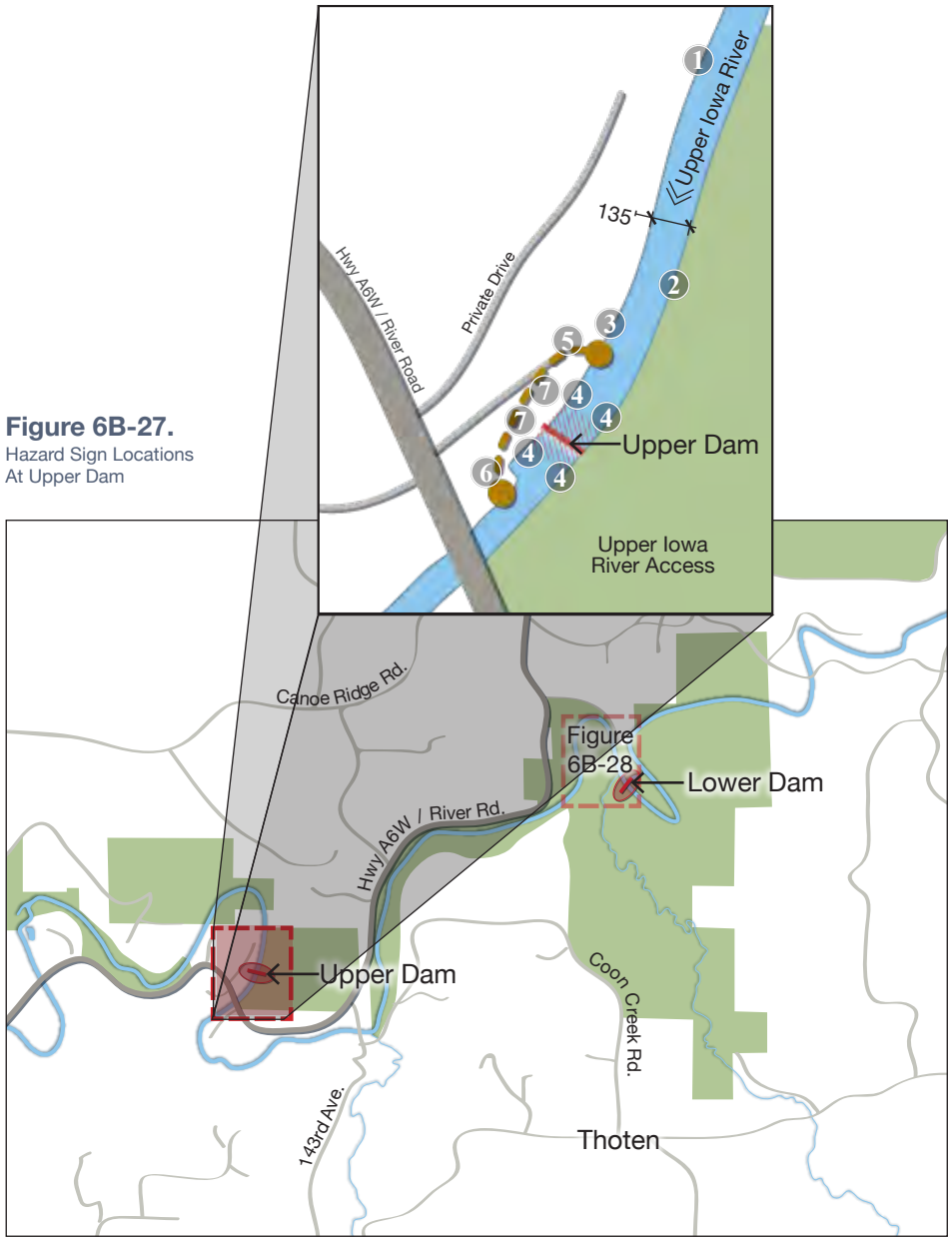


Figure 6B-27.
Hazard Sign Locations At Upper Dam

The two dams shown here on the Upper Iowa River are classic examples of dams on a small river in a rural setting in which 20/20 vision signs are used. This dam is not visible on-water. As such, three upstream warning signs are required, rather than the two typical series of two signs.

The upper dam has boat ramps located downstream of the dam and within 300 feet upstream of the dam. Sign No. 3 in Table 6B-9 performs the function of two signs: **Last Landing Above (On-Water)** and **Last Safe Exit** sign. Combining the messages in this way is encouraged when signs would otherwise be placed at approximately the same location. The red color is used because the sign is near the drowning zone.

The launch located just below the upper dam is also the last launch before the lower dam, 4.7 miles downstream.

Table 6B-9.
Signs Used Near Upper Dam

Hazard Signs Near Upper Dam

	Sign Type and Location	Example	Sign Size	Text Height
1	EARLY WARNING SIGN Placed 1,500' upstream of dam on bank at 45°	Warning Dam Ahead 1,500 Feet	40"×25"	4"
2	MOVE RIGHT SIGN Placed 335' upstream of portage on bank at 45°	Warning Dam Ahead Move Right For Safe Exit	42"×33"	4"
3	LAST SAFE EXIT SIGN Placed slightly upstream of portage on bank at 45°	Danger Dam Ahead 260 Feet Last Boat Landing Exit Now! →	37"×47"	4"
4	DROWNING ZONE UP/DOWNSTREAM LIMITS SIGN Placed upstream and downstream of dam on banks at 45°	Dam	17"×17"	
5	LAST LANDING ABOVE (ON-LAND) SIGN Placed at the top of the upper boat launch facing inland	Warning Dam Ahead 260 Feet Last Boat Launch	18"×24"	2"
6	DROWNING ZONE UP/DOWNSTREAM LIMITS SIGN Placed at the top of the lower boat launch facing inland warning users of the Lower Dam	Warning Dam Ahead 4.7 Miles Portage Ahead On Left Bank	24"×24"	2"
7	PEDESTRIAN DROWNING ZONE WARNING SIGN Placed at all pedestrian approaches to dam	Danger! Recirculating Currents Below Dam Trap And Drown Victims	18"×24"	

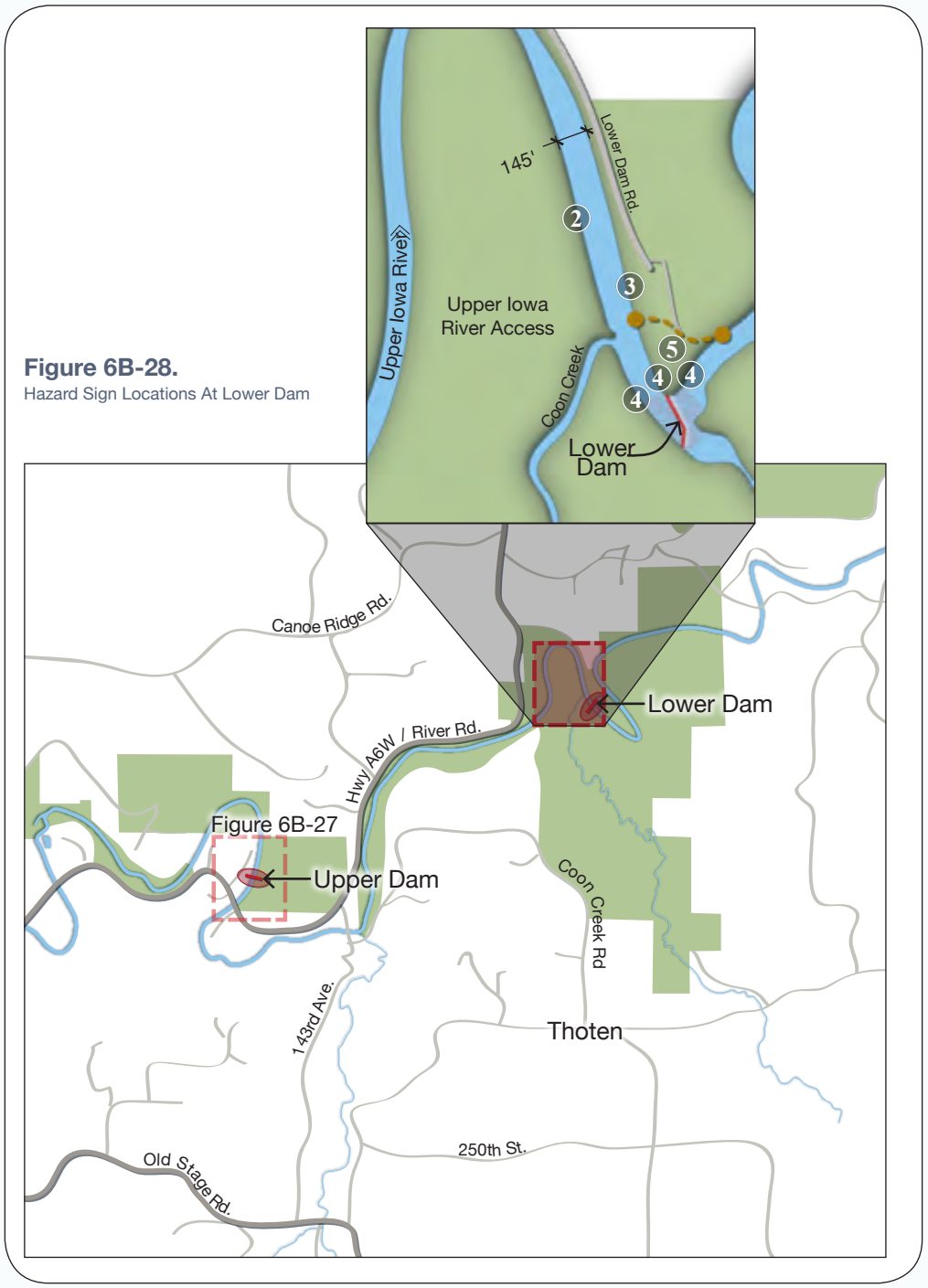


Figure 6B-28.
Hazard Sign Locations At Lower Dam

WINNESHIEK COUNTY CASE STUDY: Lower Dam On The Upper Iowa River

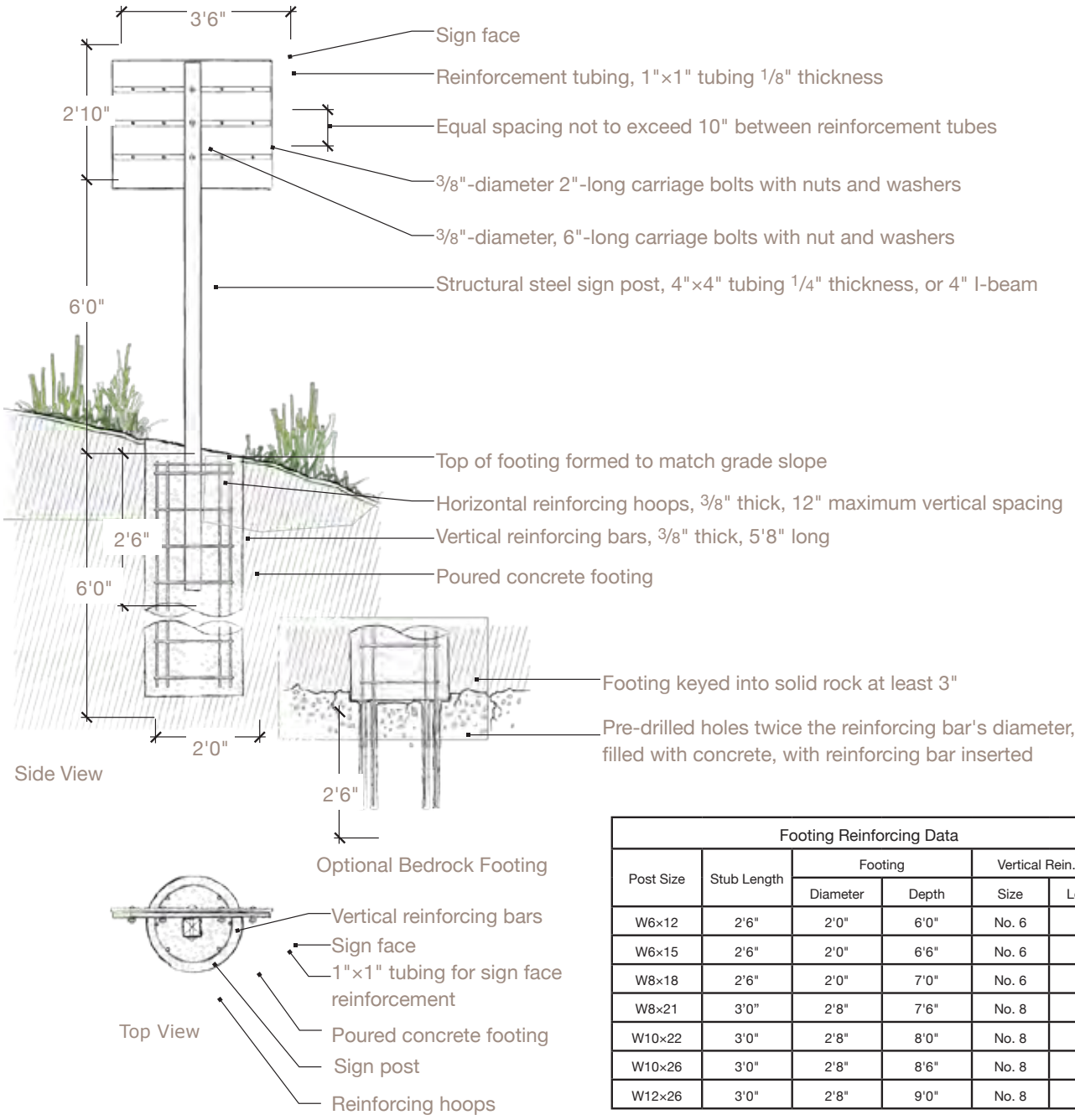
There is only one Drowning Zone Downstream sign located on the north bank downstream of the dam to mark the lower limits of the drowning zone. The existing site conditions on the south bank area below Lower Dam are both highly erosive and depositional during flood events. The lower limit Drowning Zone sign was not implemented on the south bank at this site because of this difficulty. The remote location of this site also makes it unlikely that power boats will approach the dam from downstream.

Table 6B-10.
Signs Used Near Lower Dam

Hazard Signs Near Lower Dam

Sign Type and Location	Example	Sign Size	Text Height
1 EARLY WARNING SIGN Placed 2,100' upstream of dam on bank at 45°	Warning Dam Ahead 2,100 Feet	42"×26"	4"
2 MOVE LEFT SIGN Placed 435' upstream of portage on bank at 45°	Warning Dam Ahead Move Left For Portage	42"×34"	4"
3 LAST SAFE EXIT SIGN Placed slightly upstream of portage on bank at 45°	Danger Dam Ahead Last Safe Portage Here ← Exit Now!	40"×42"	4"
4 DROWNING ZONE UP/DOWNSTREAM LIMITS SIGN Placed upstream and downstream of dam on banks at 45°	Dam	17"×17"	
5 (2) PEDESTRIAN DROWNING ZONE WARNING SIGN Two signs placed inland north of the dam facing away from dam at pedestrian approaches facing inland	Warning Dam Ahead 260 Feet Last Boat Launch	18"×24"	

6C SIGNAGE INSTALLATION



Footing Reinforcing Data					
Post Size	Stub Length	Footing		Vertical Rein. Bar	
		Diameter	Depth	Size	Length
W6×12	2'6"	2'0"	6'0"	No. 6	5'8"
W6×15	2'6"	2'0"	6'6"	No. 6	6'2"
W8×18	2'6"	2'0"	7'0"	No. 6	6'8"
W8×21	3'0"	2'8"	7'6"	No. 8	7'2"
W10×22	3'0"	2'8"	8'0"	No. 8	7'8"
W10×26	3'0"	2'8"	8'6"	No. 8	8'2"
W12×26	3'0"	2'8"	9'0"	No. 8	8'8"

Figure 6C-1
Single or Double Steel Post Installation

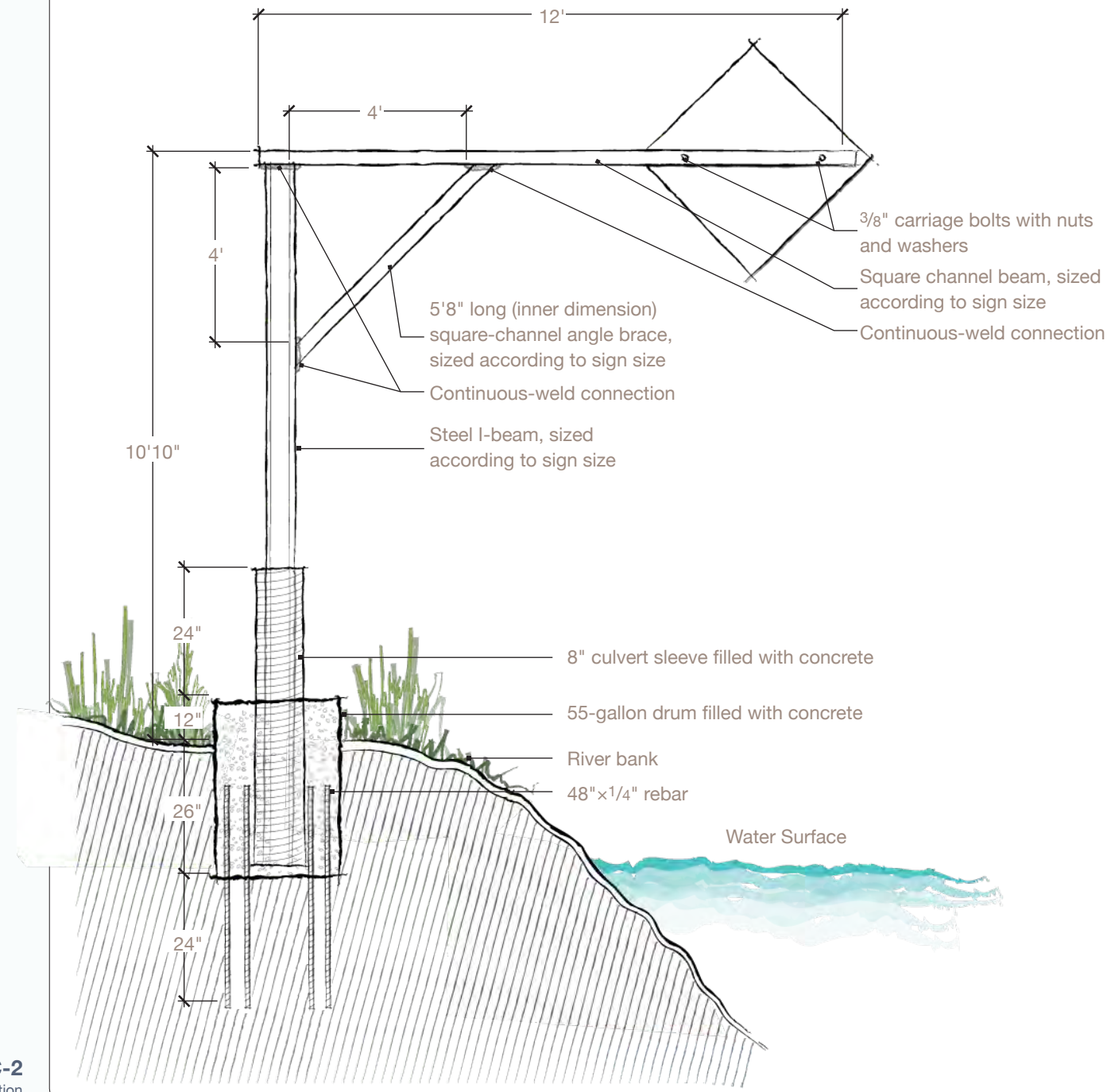


Figure 6C-2
Cantilevered Sign Installation

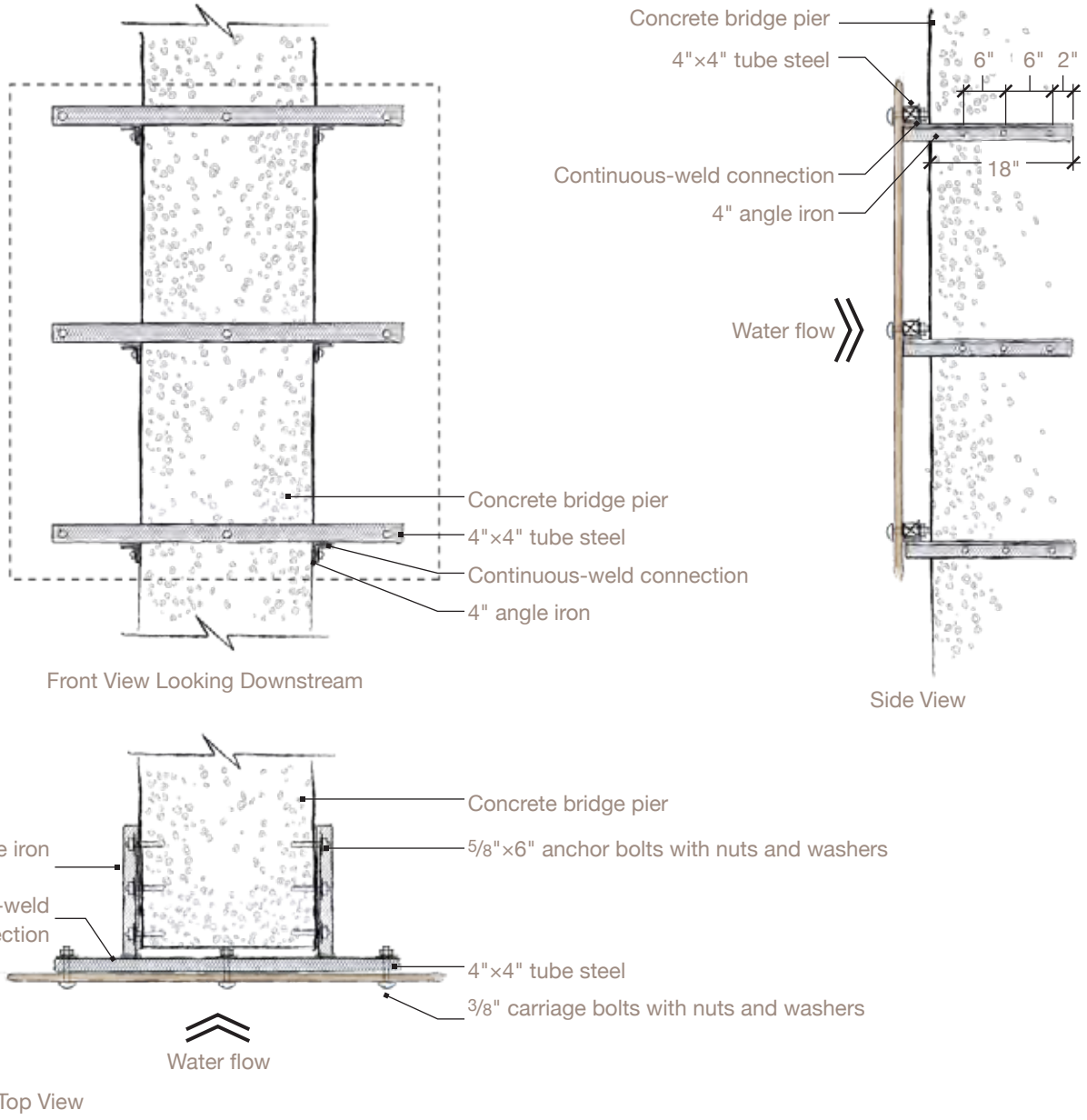


Figure 6C-3
Mounting Signs On Bridge Piers

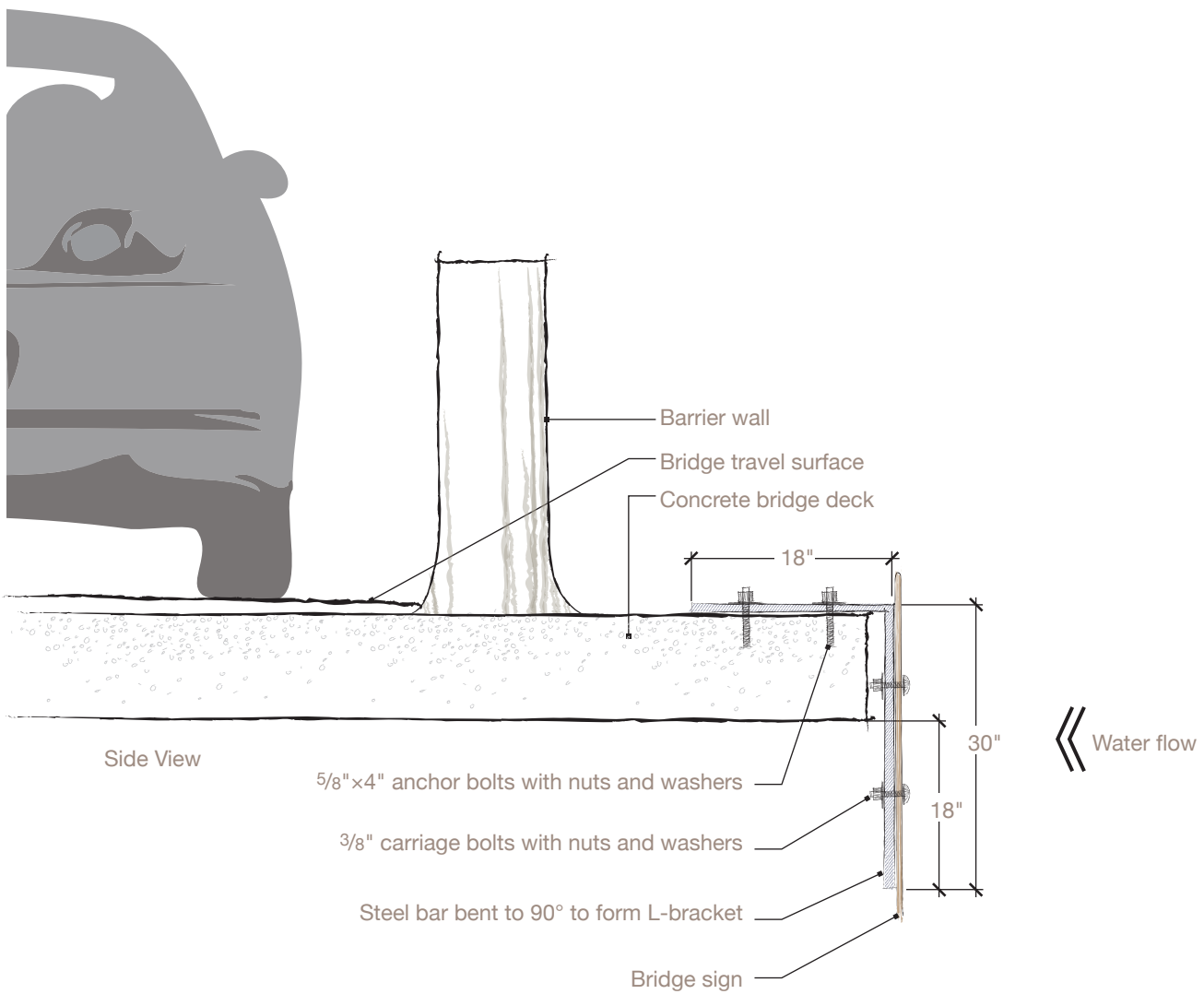


Figure 6C-4
Concrete Bridge Deck Sign Installation

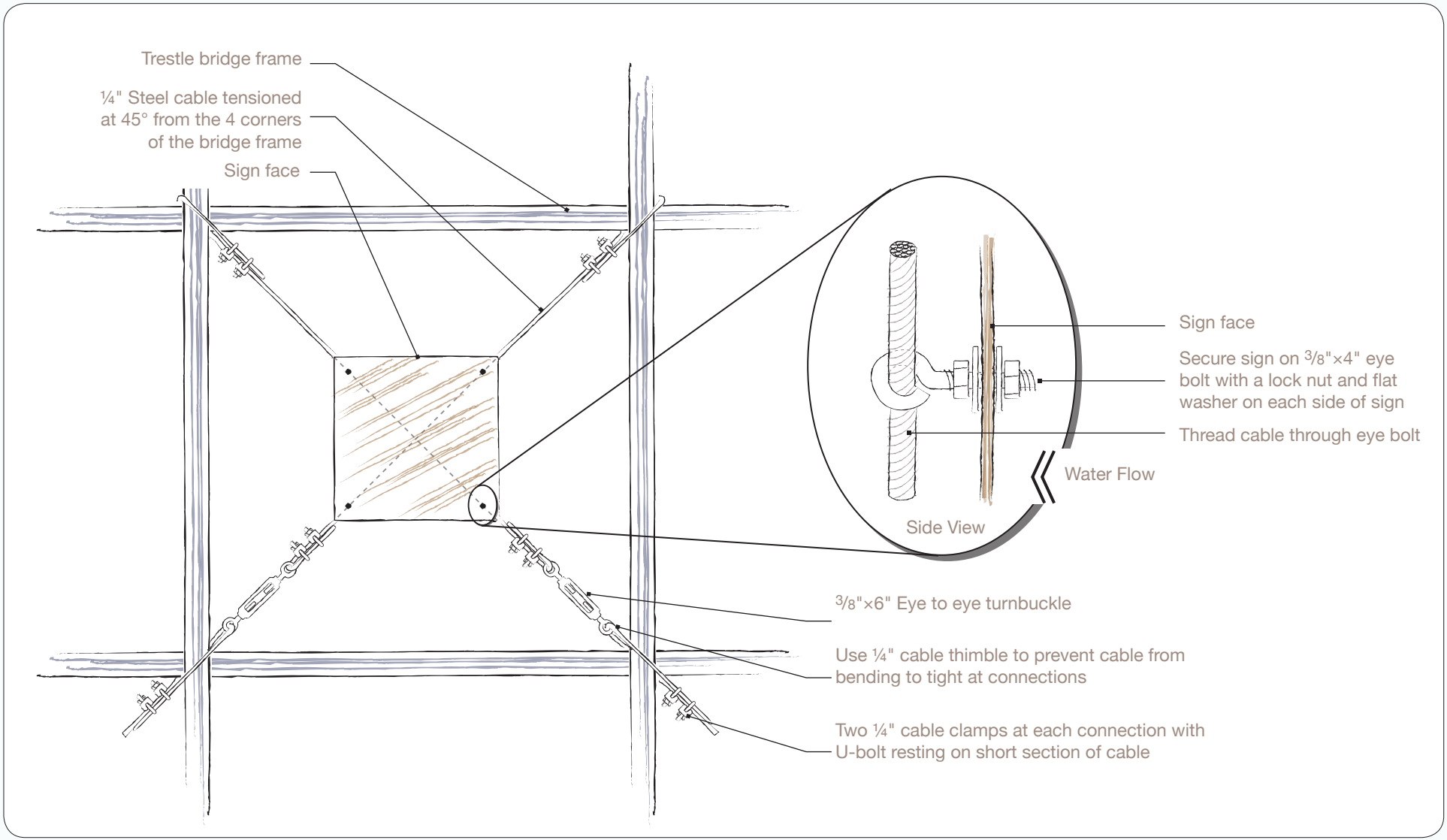


Figure 6C-5
Trestle Bridge Sign Installation

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