


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.

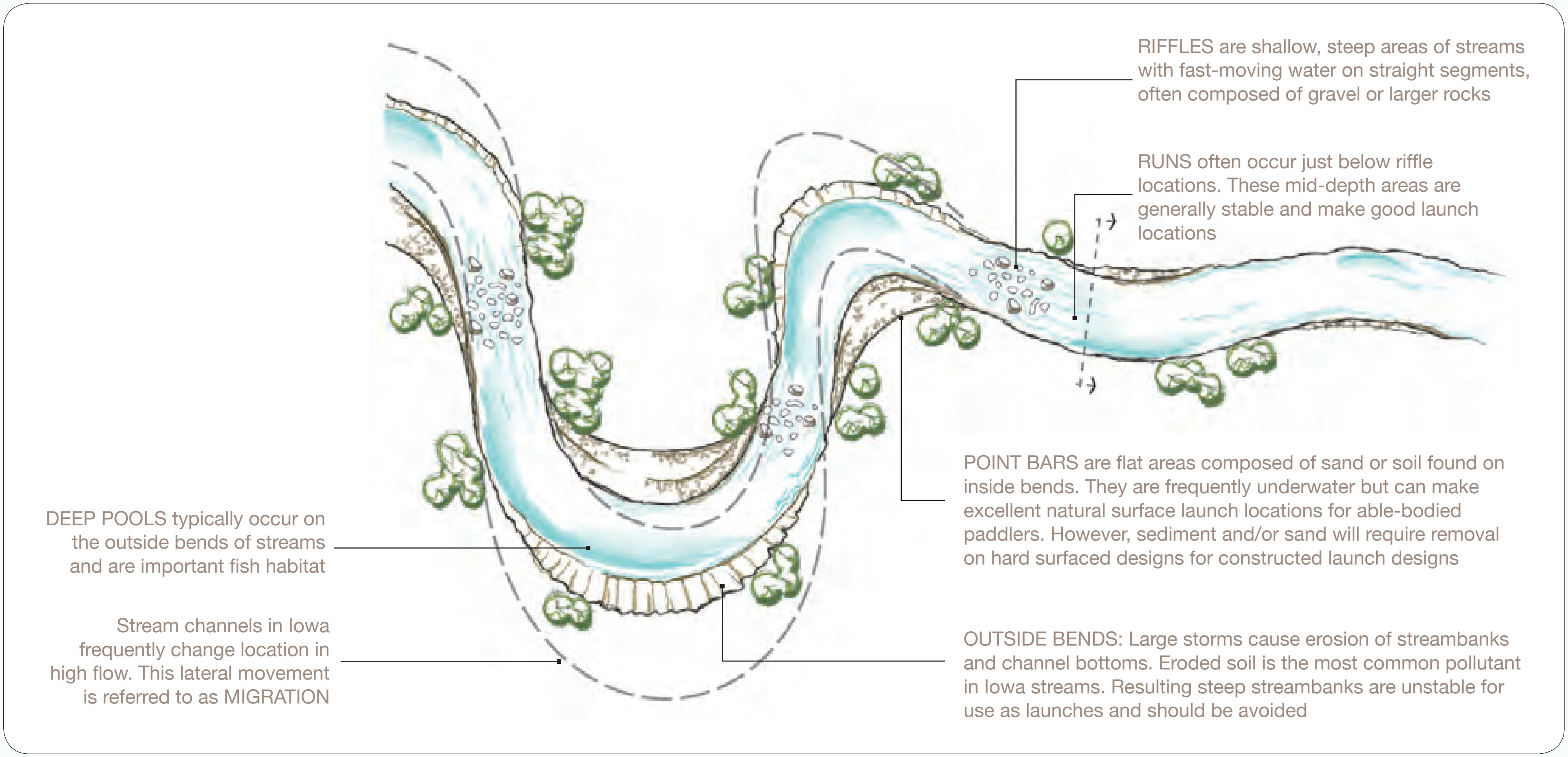
WHERE TO LOCATE LAUNCHES

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

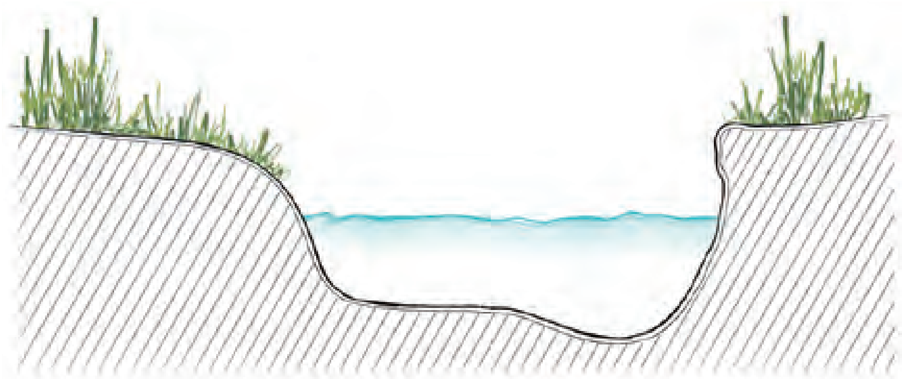


The second aspect is the shape of the streambanks and bottom. If a stream segment has steep banks on both sides with no low terrace (Figure 3A-2), it is unstable and will continue to widen and migrate. Unstable streambanks such as these are not appropriate for launch construction. Stream segments with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

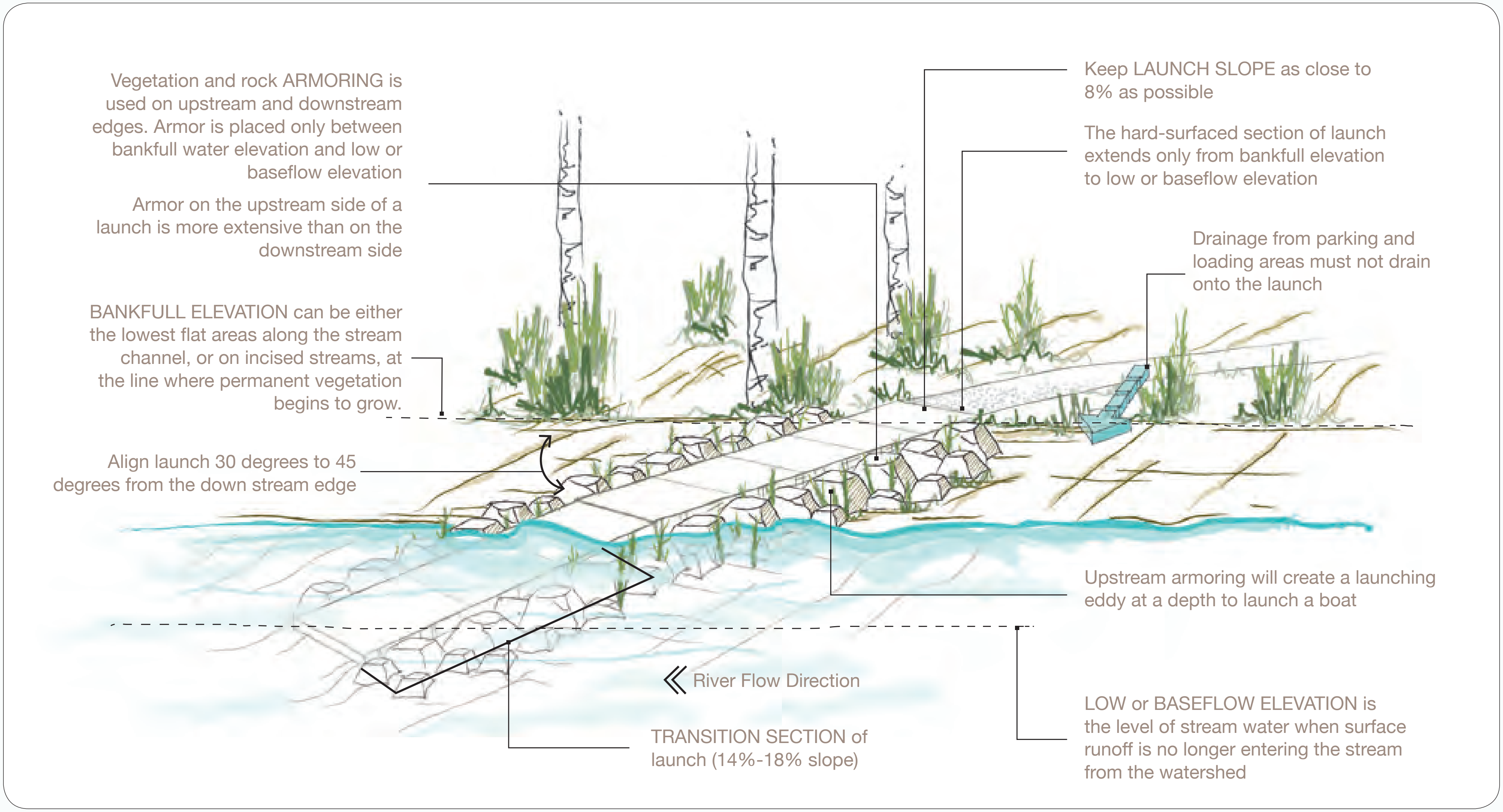


Figure 3A-4.
Typical Launch Design Components

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.

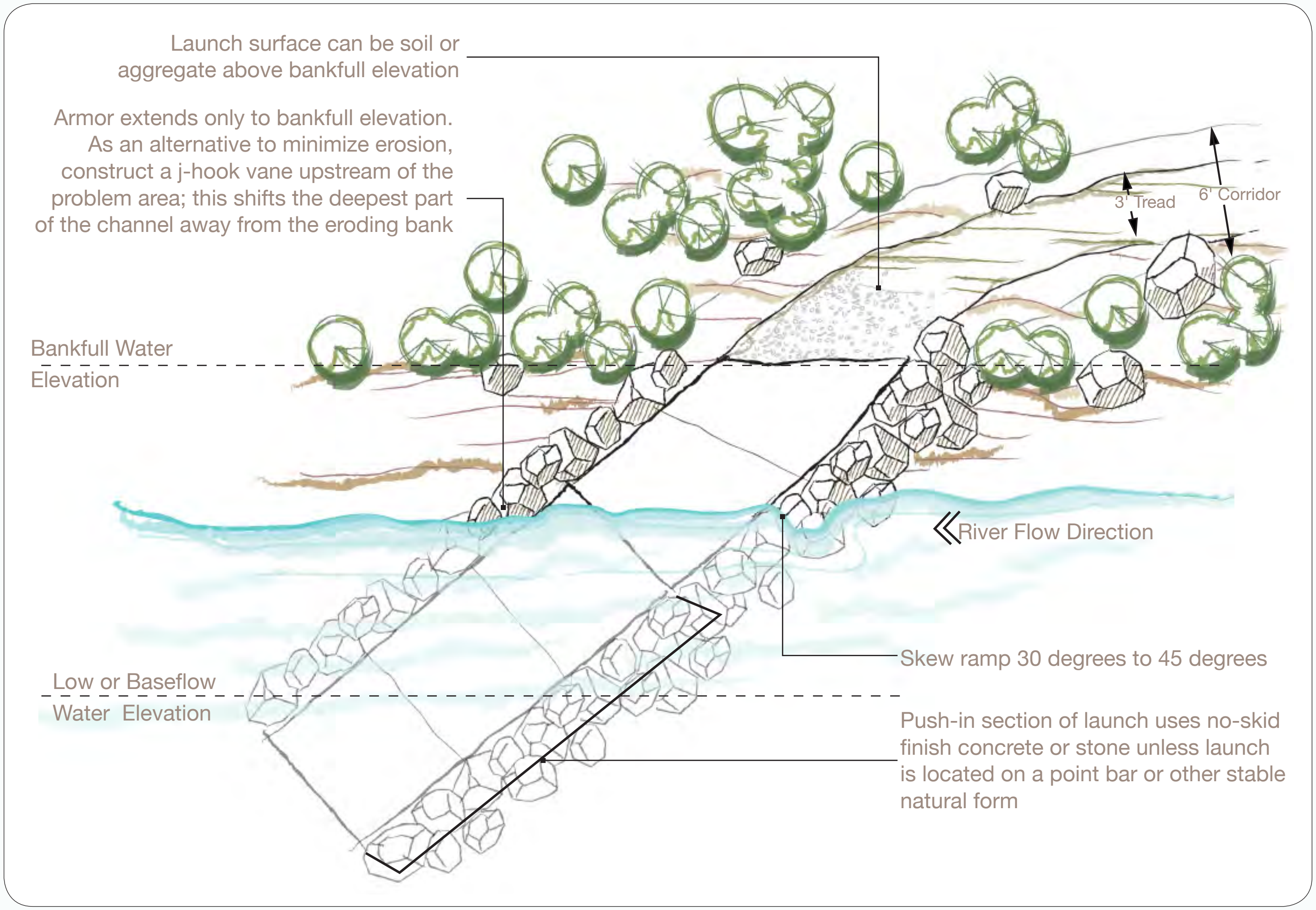


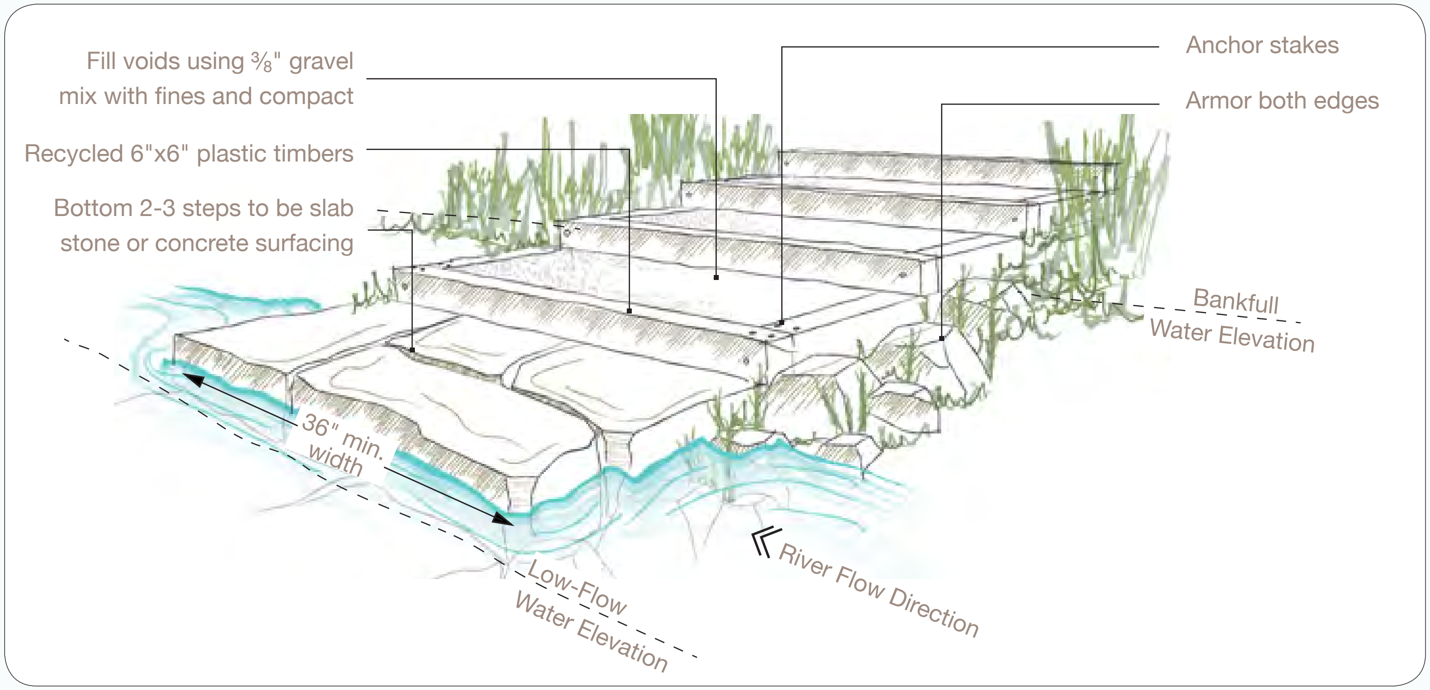
Figure 3A-6.
Natural-Surfacing Launch Design

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



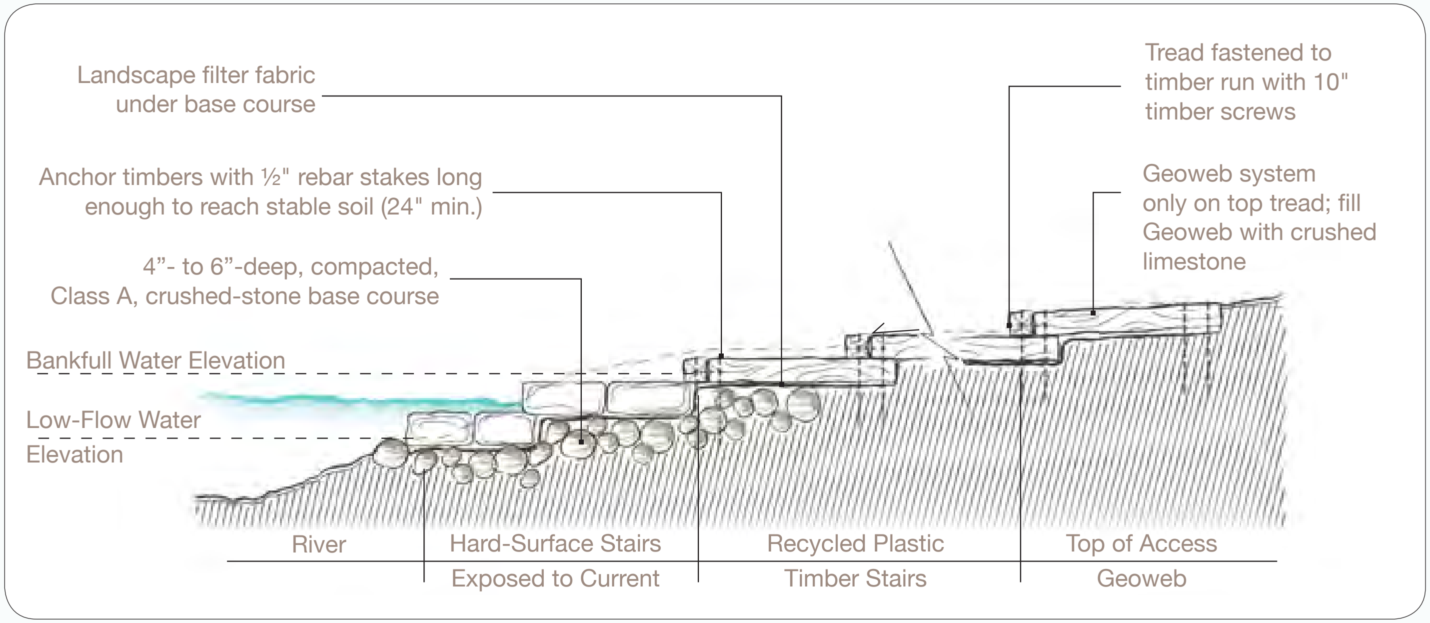


Figure 3A-8.
Stair-Step Launch Cross Section

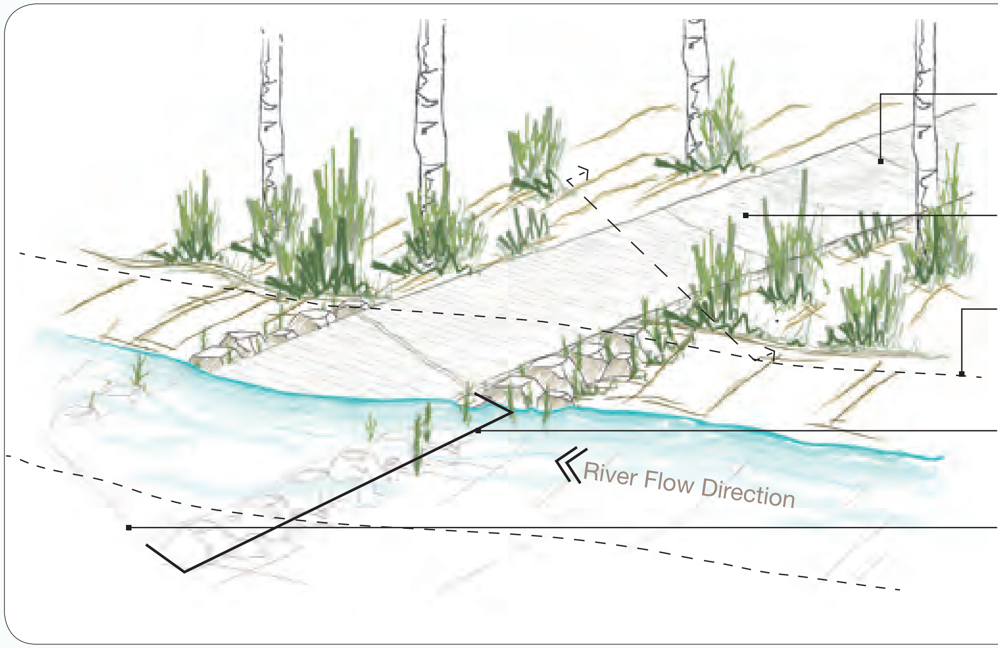
CAST-IN-PLACE CONCRETE LAUNCH DESIGN

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



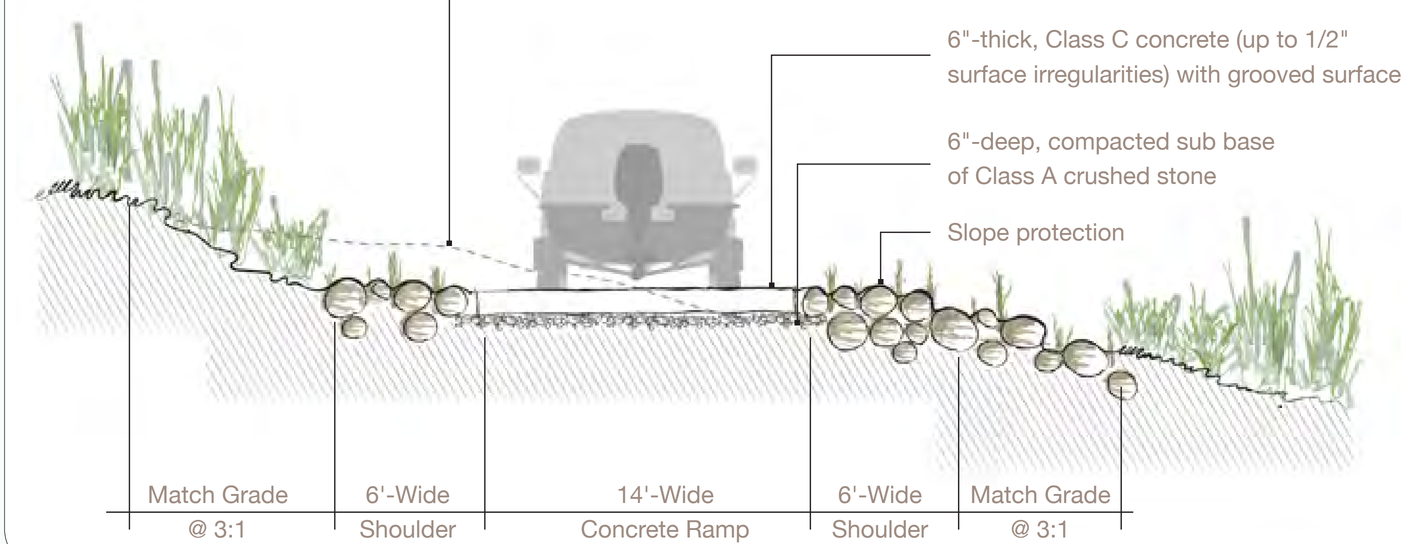


Figure 3A-10.
Cast-In-Place Design for Vehicle Access

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).

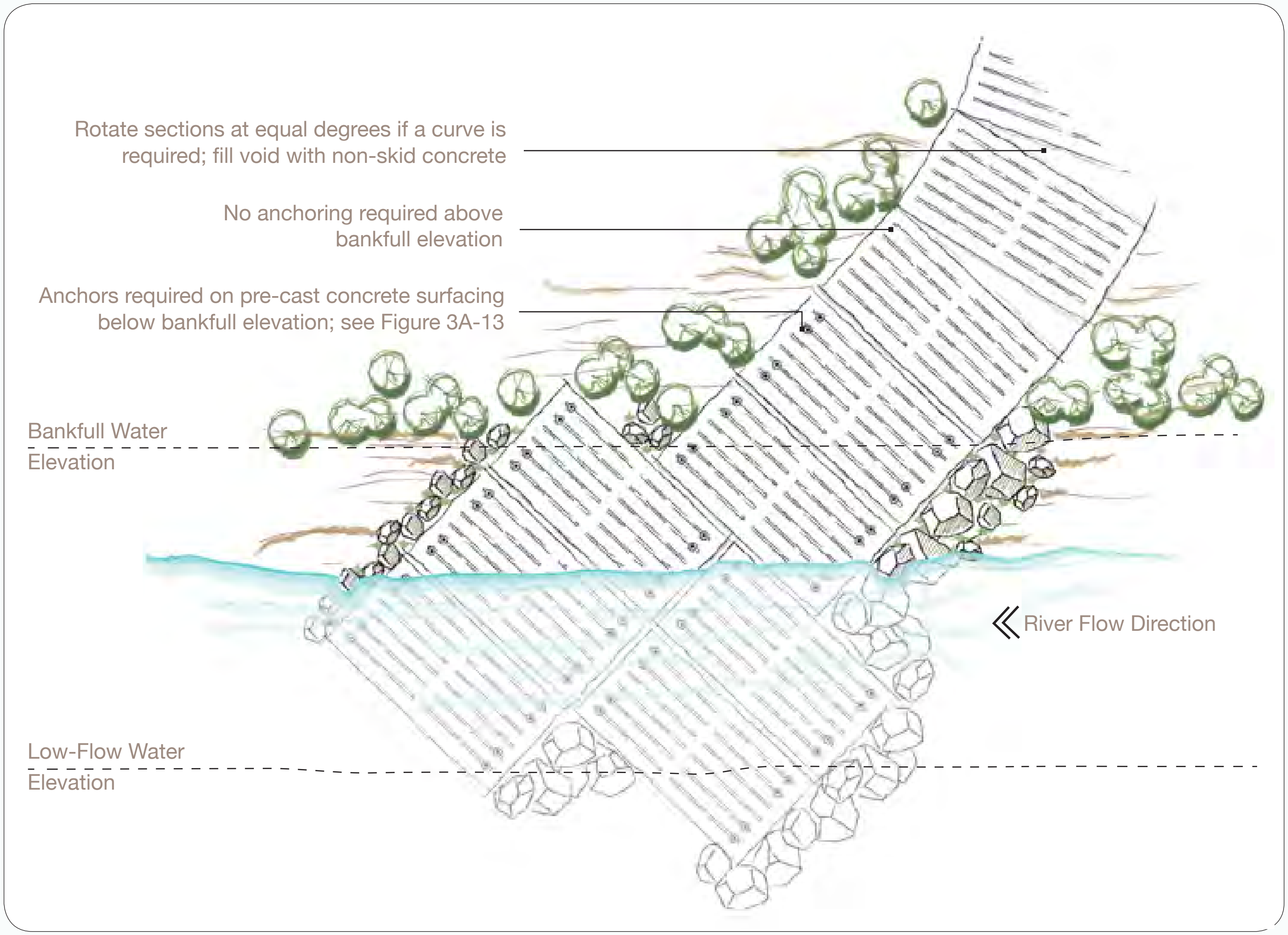


Figure 3A-11.
Pre-cast Concrete Launch Design

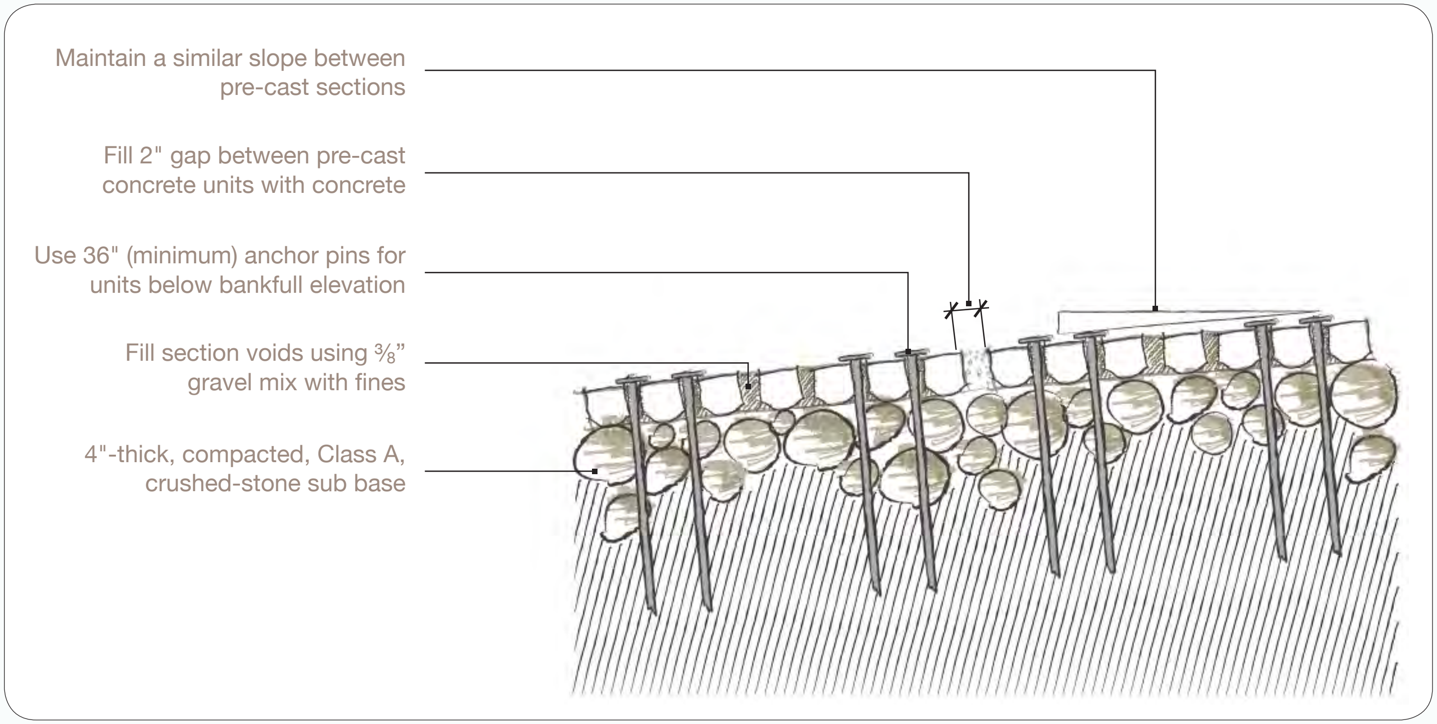


Figure 3A-12.
Pre-cast Concrete Anchoring Below Bankfull Stream Elevation

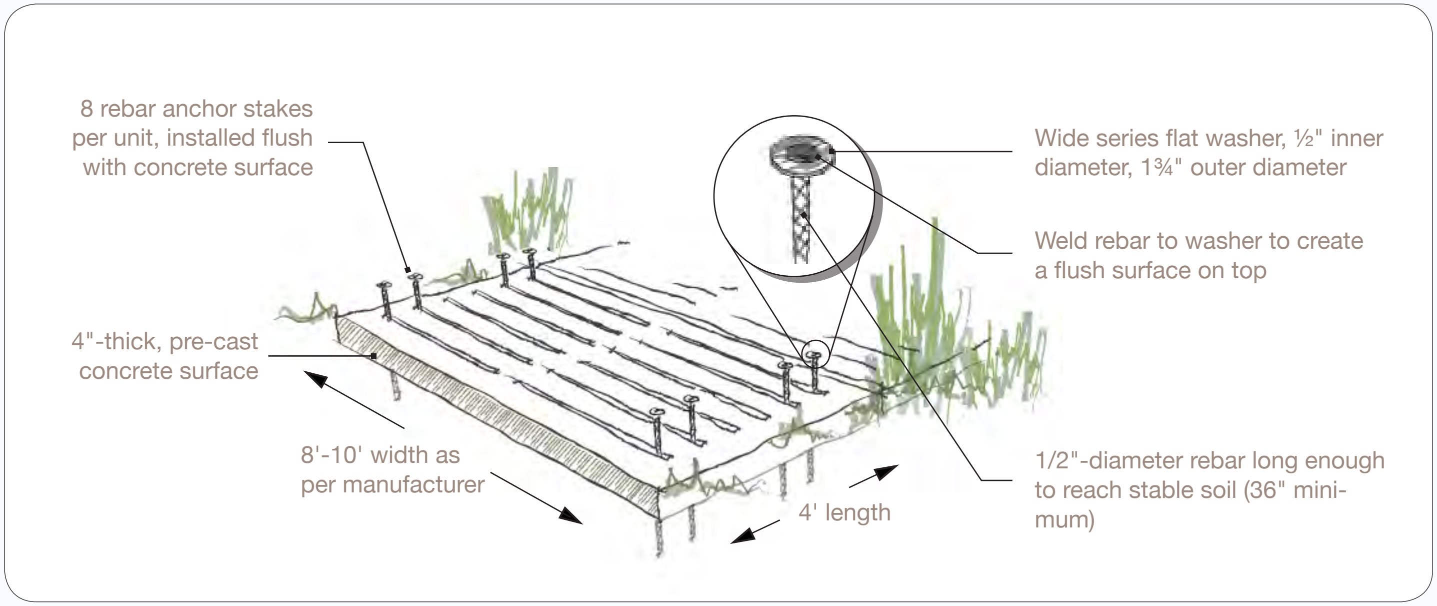


Figure 3A-13.
Pre-cast Concrete Anchoring Detail

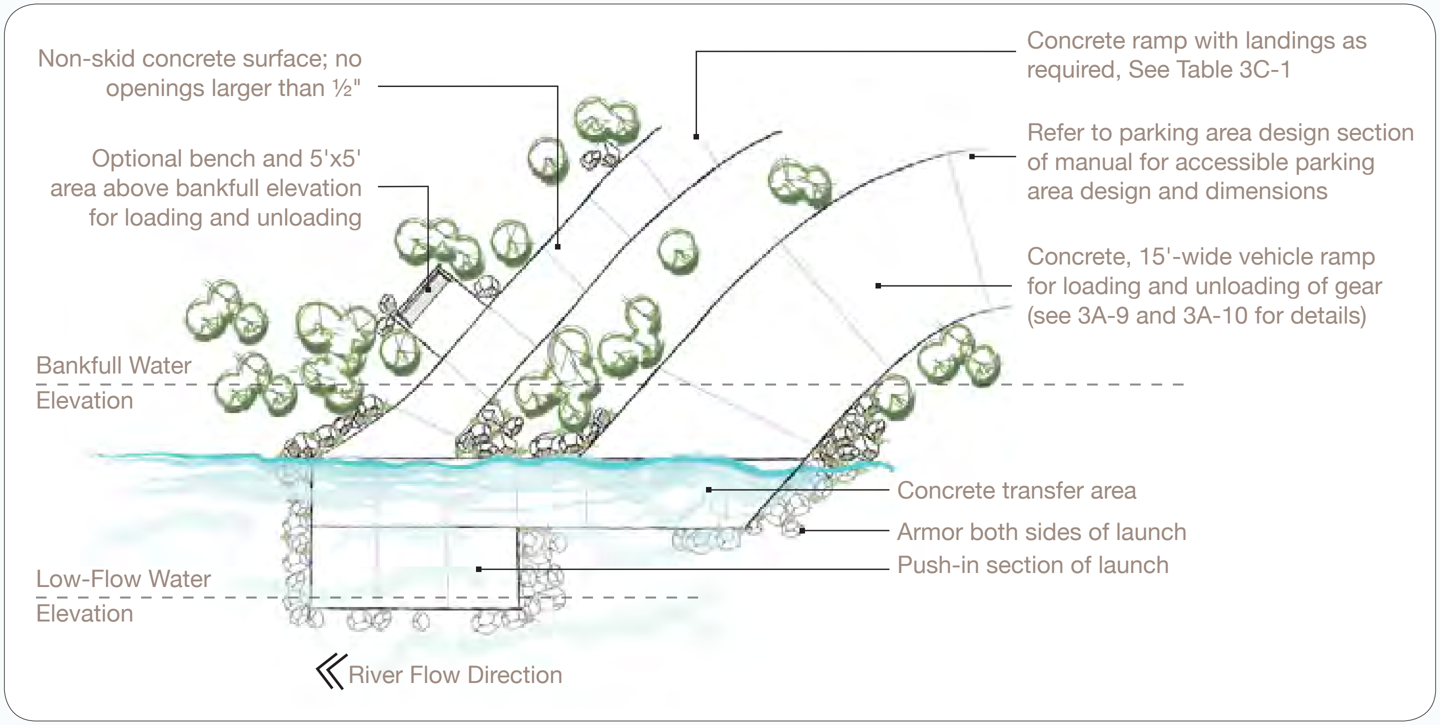
UNIVERSAL LAUNCH DESIGN

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



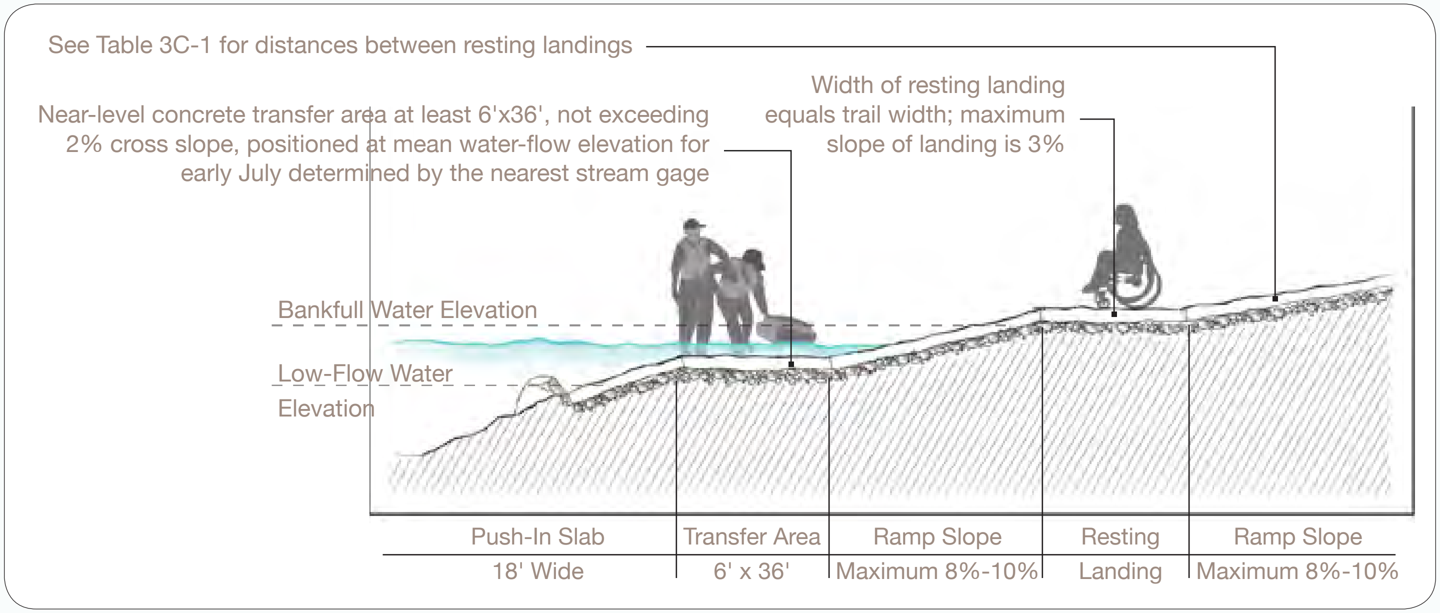


Figure 3A-15.
Universal Launch Cross Section

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.

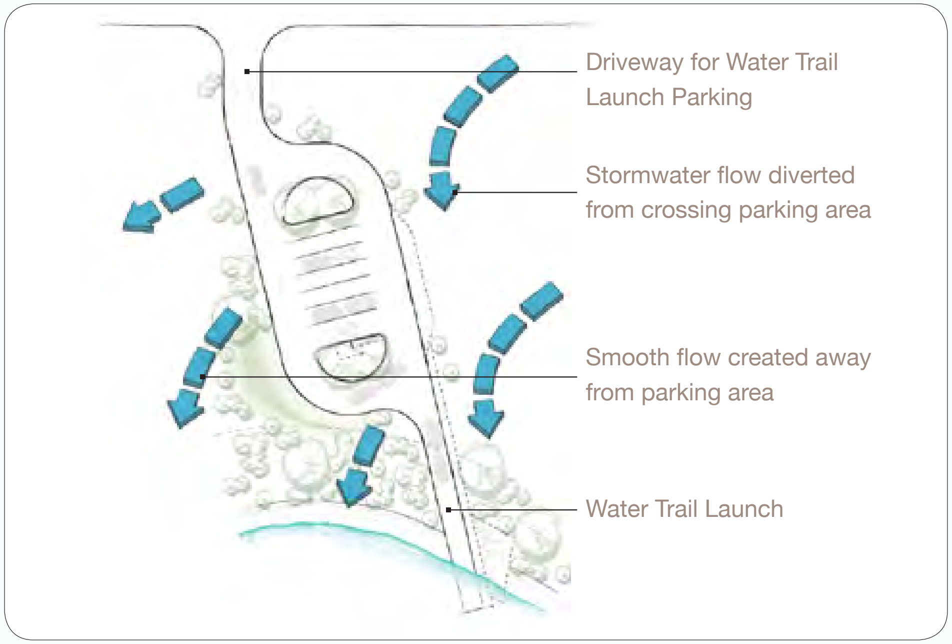


Figure 3B-1.
Stormwater Flow Near Parking Area

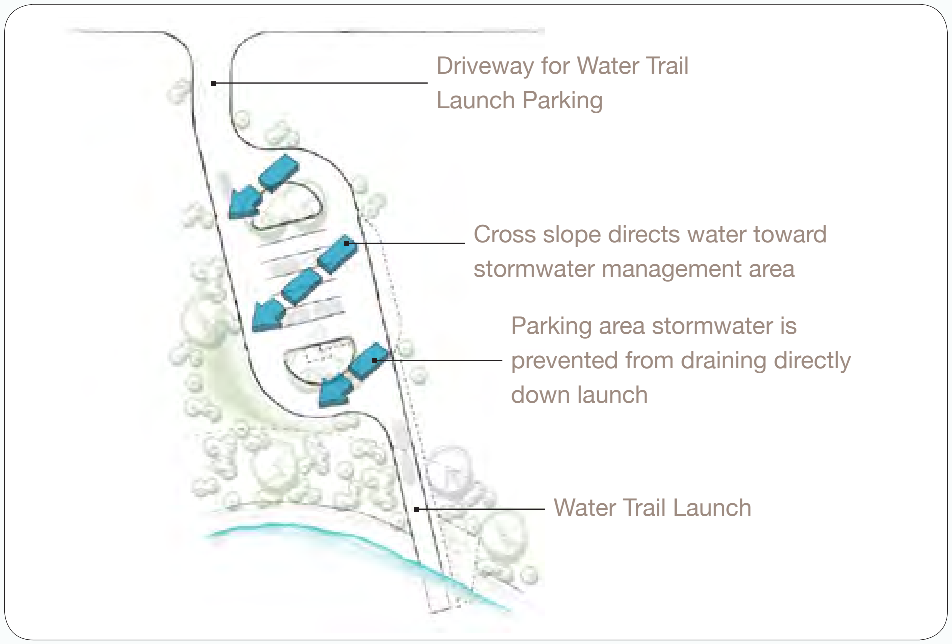


Figure 3B-2.
Stormwater Flow From Parking Area

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).

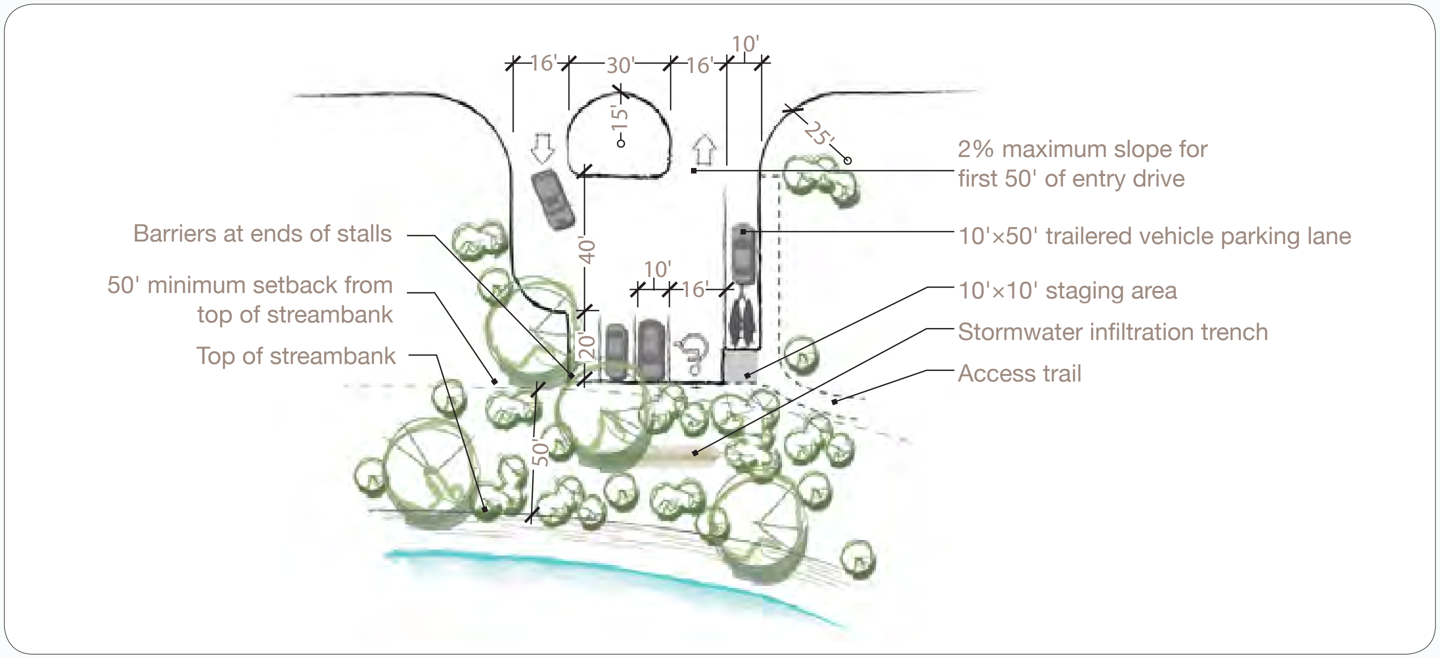
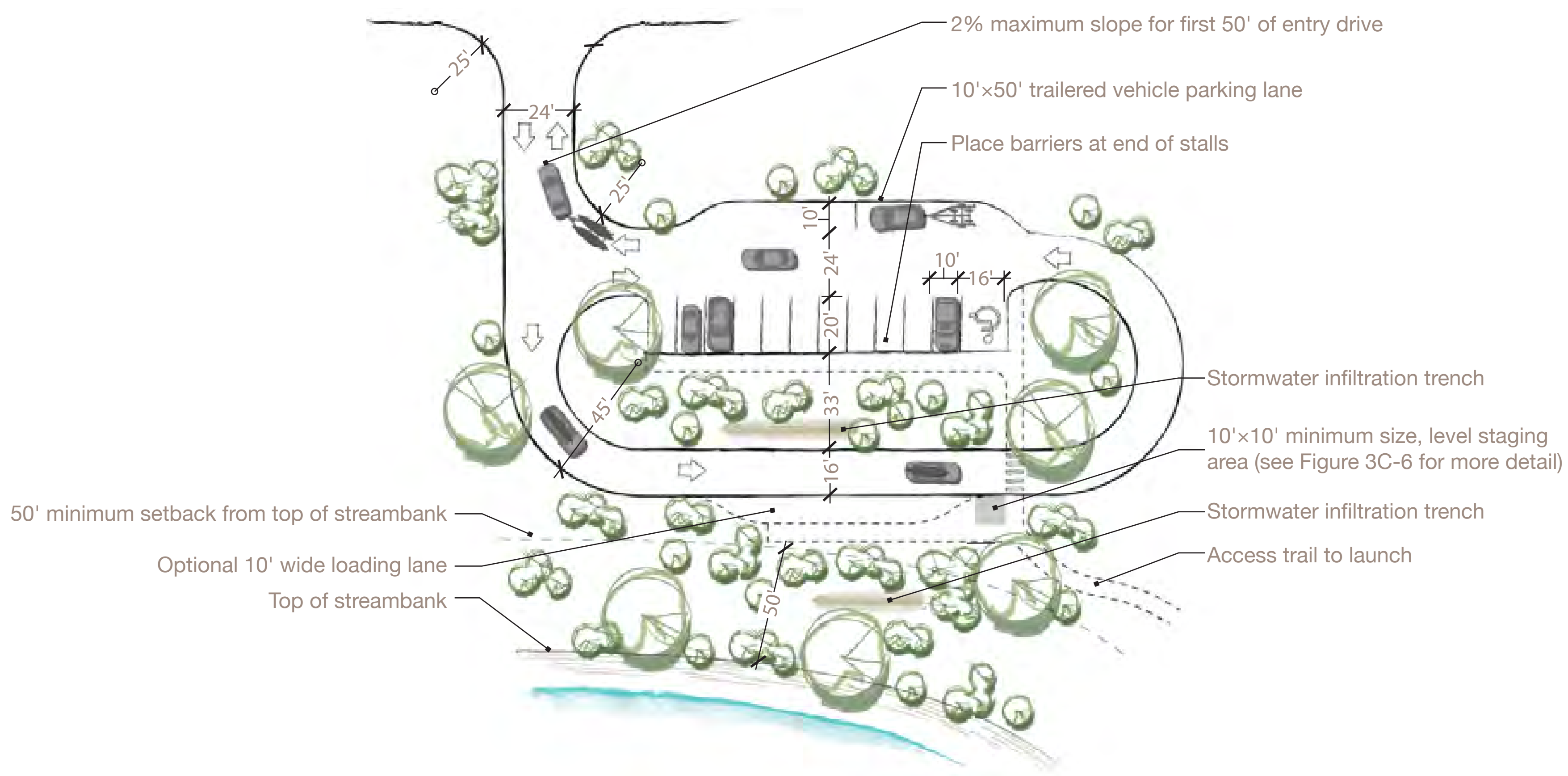


Figure 3B-3.
Minimum Parking Area Design with Boat Carry-Down Access

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).

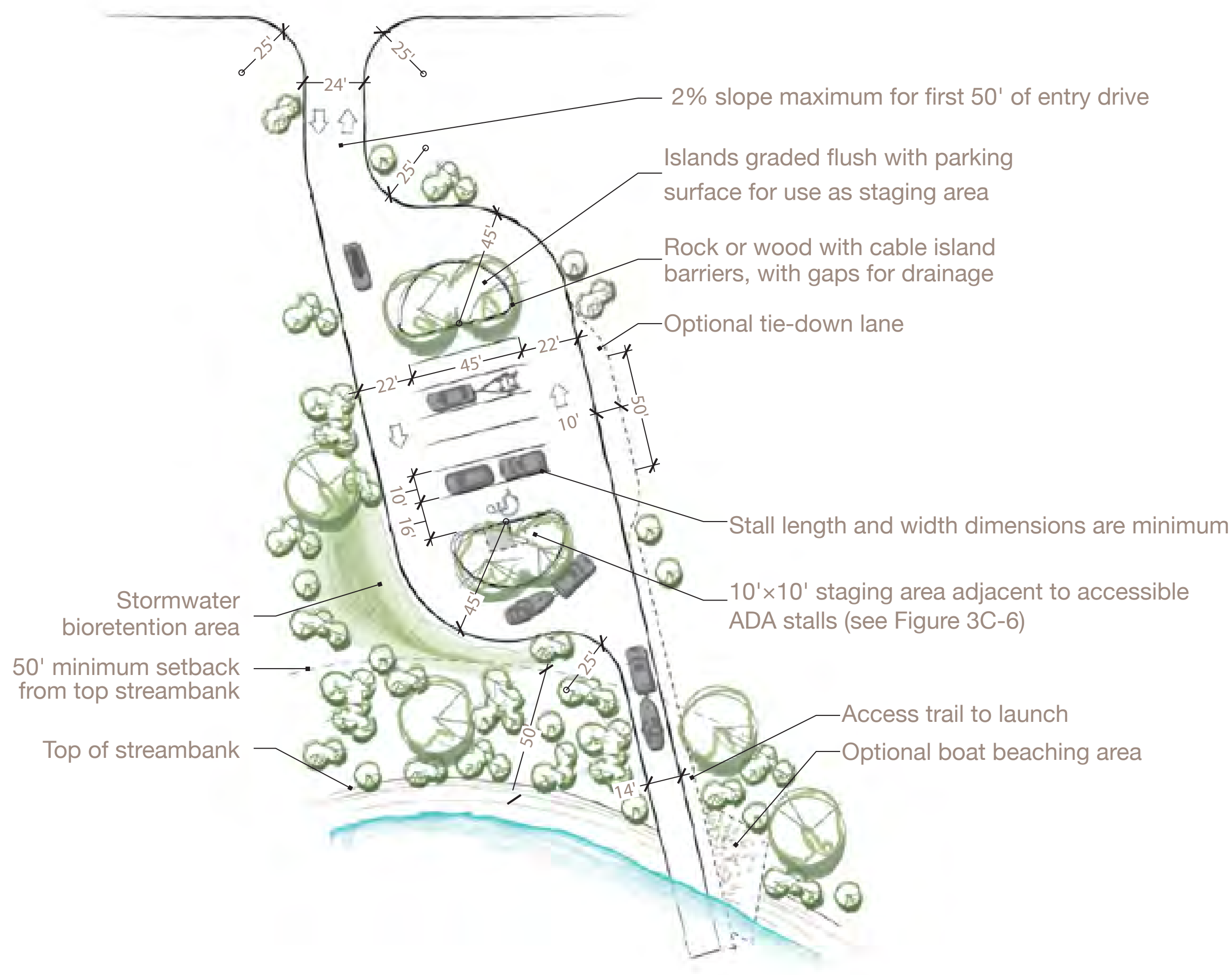


Figure 3B-5.
7- or 12-Car Parking Area, Vehicle Launch Design

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 run-off 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.

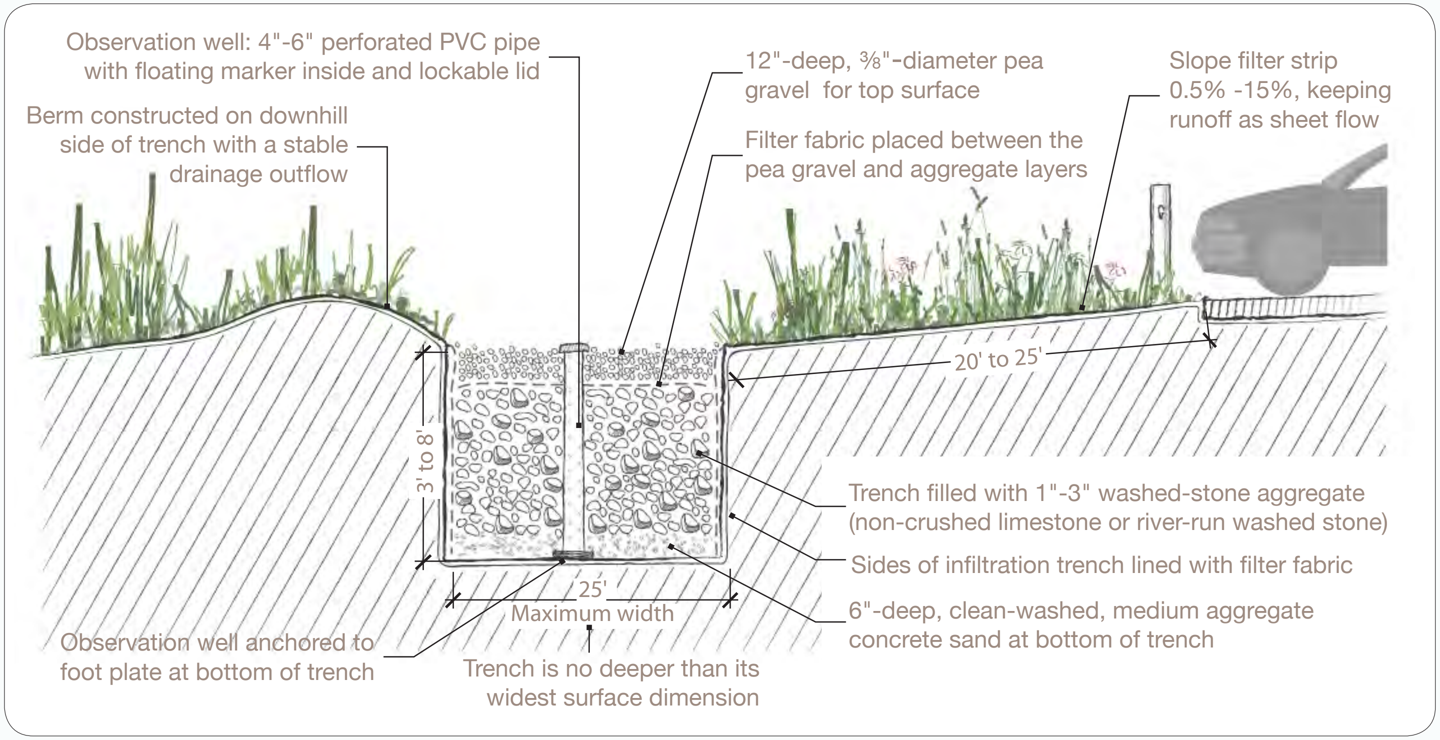


Figure 3B-6.
Infiltration Trenches

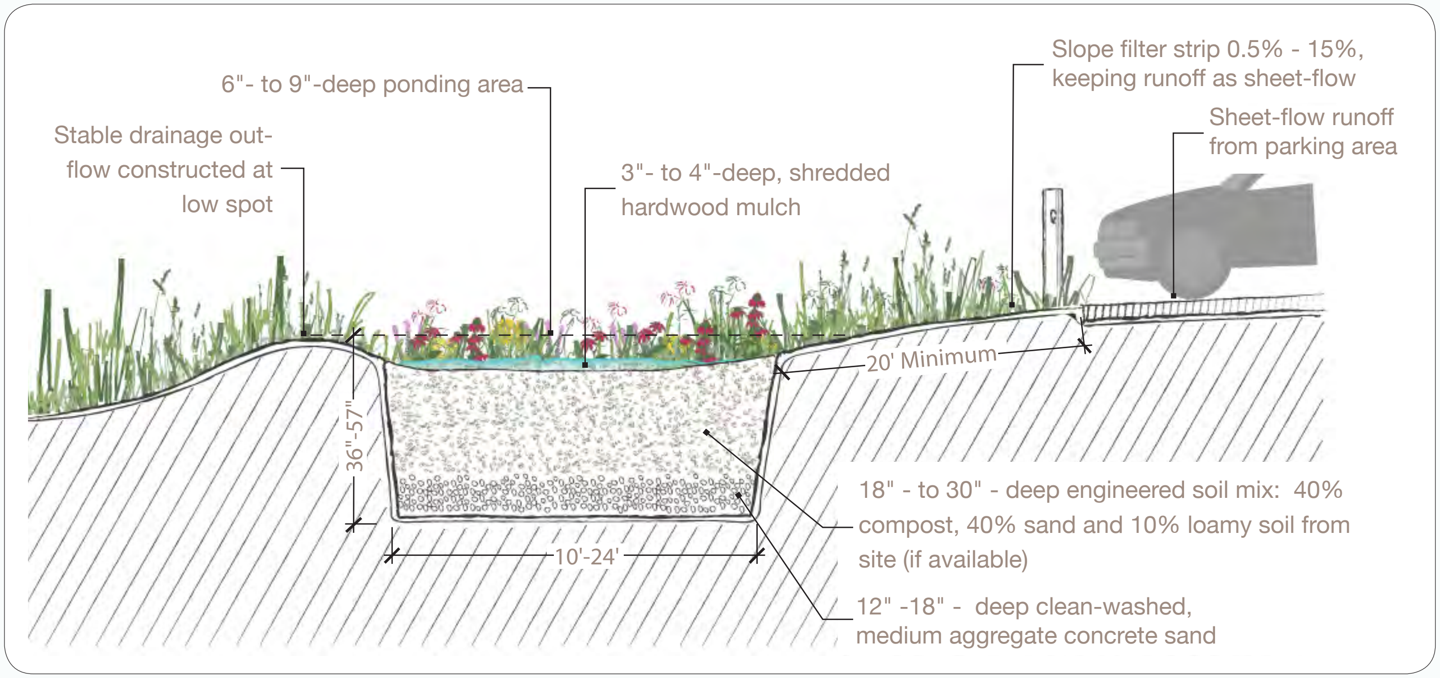


Figure 3B-7.
Bioretention Areas

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

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 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’

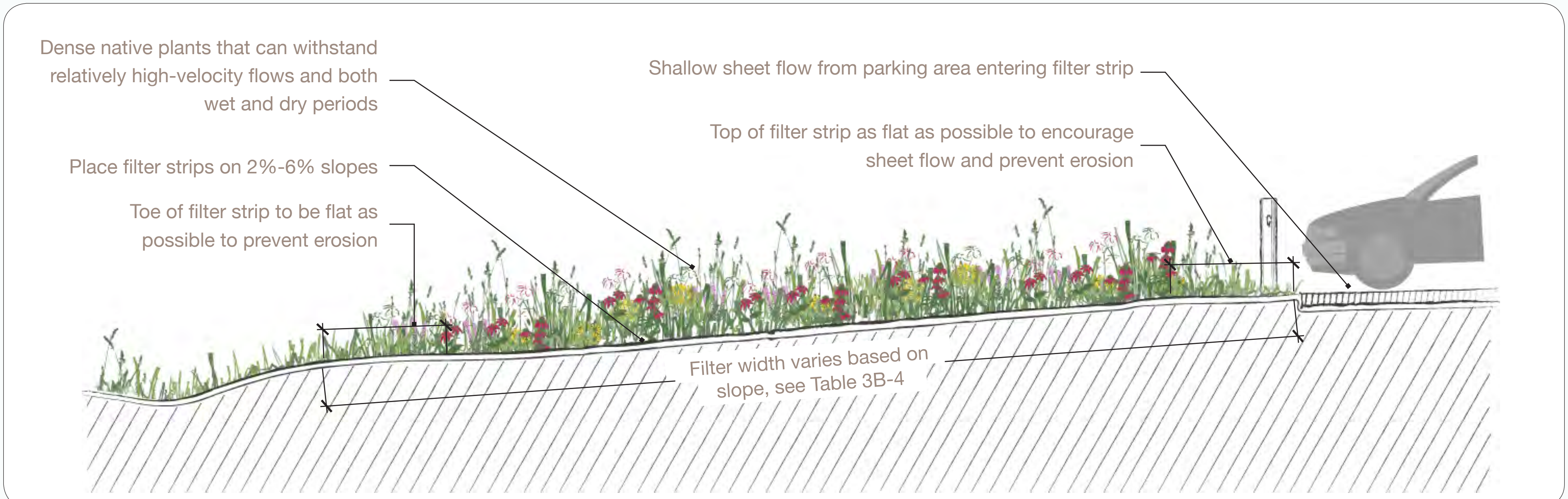


Figure 3B-8.
Vegetated Filter Strip

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).

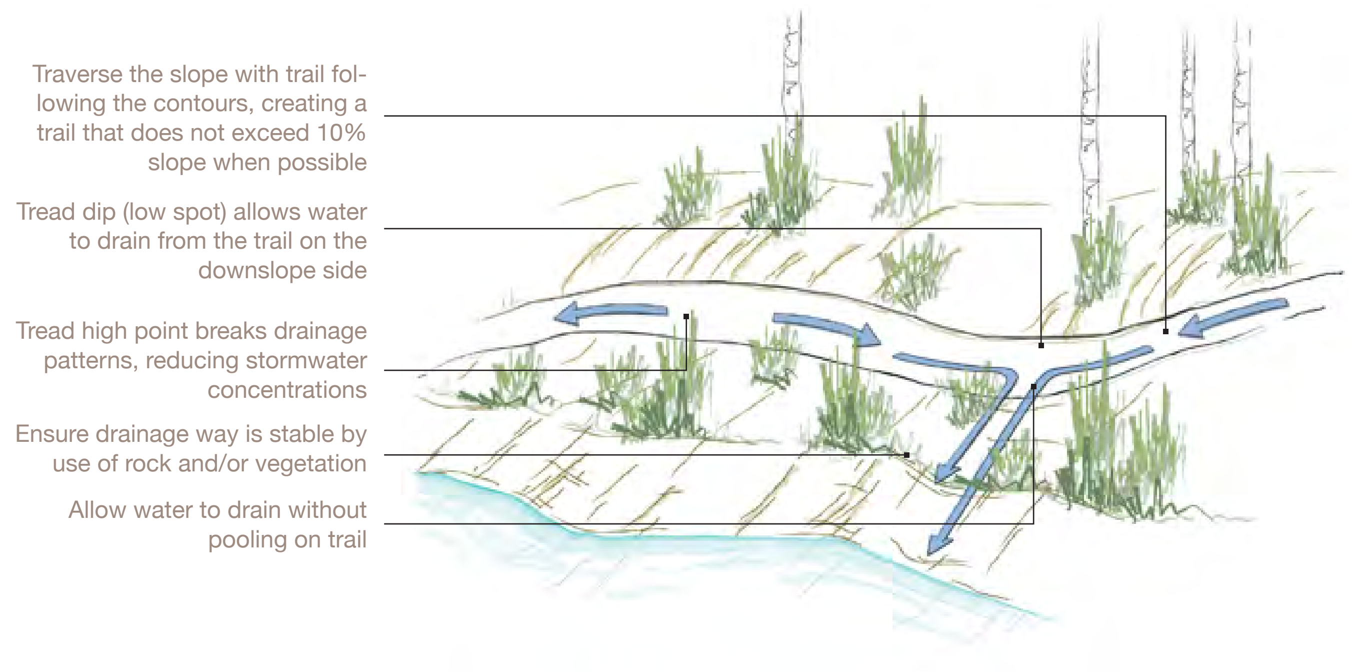


Figure 3C-1.
Trail Dip

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.

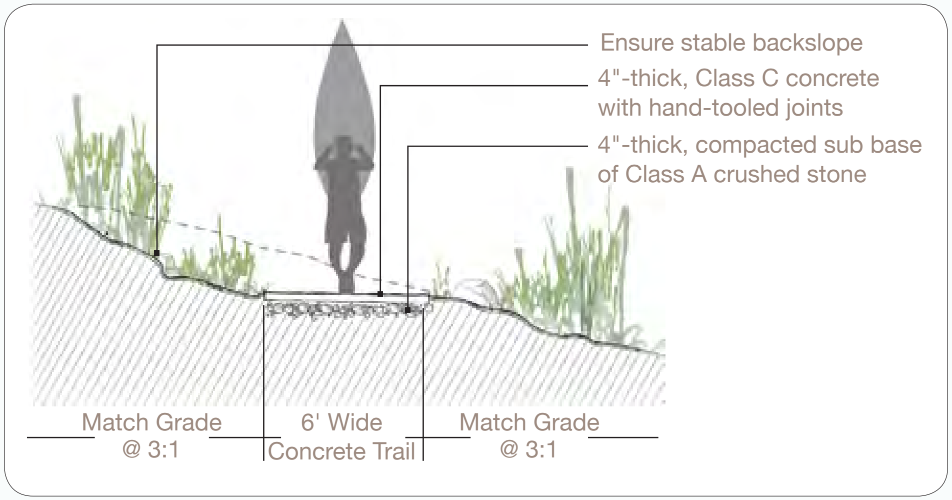


Figure 3C-2.
Typical Cast-In-Place Concrete Trail

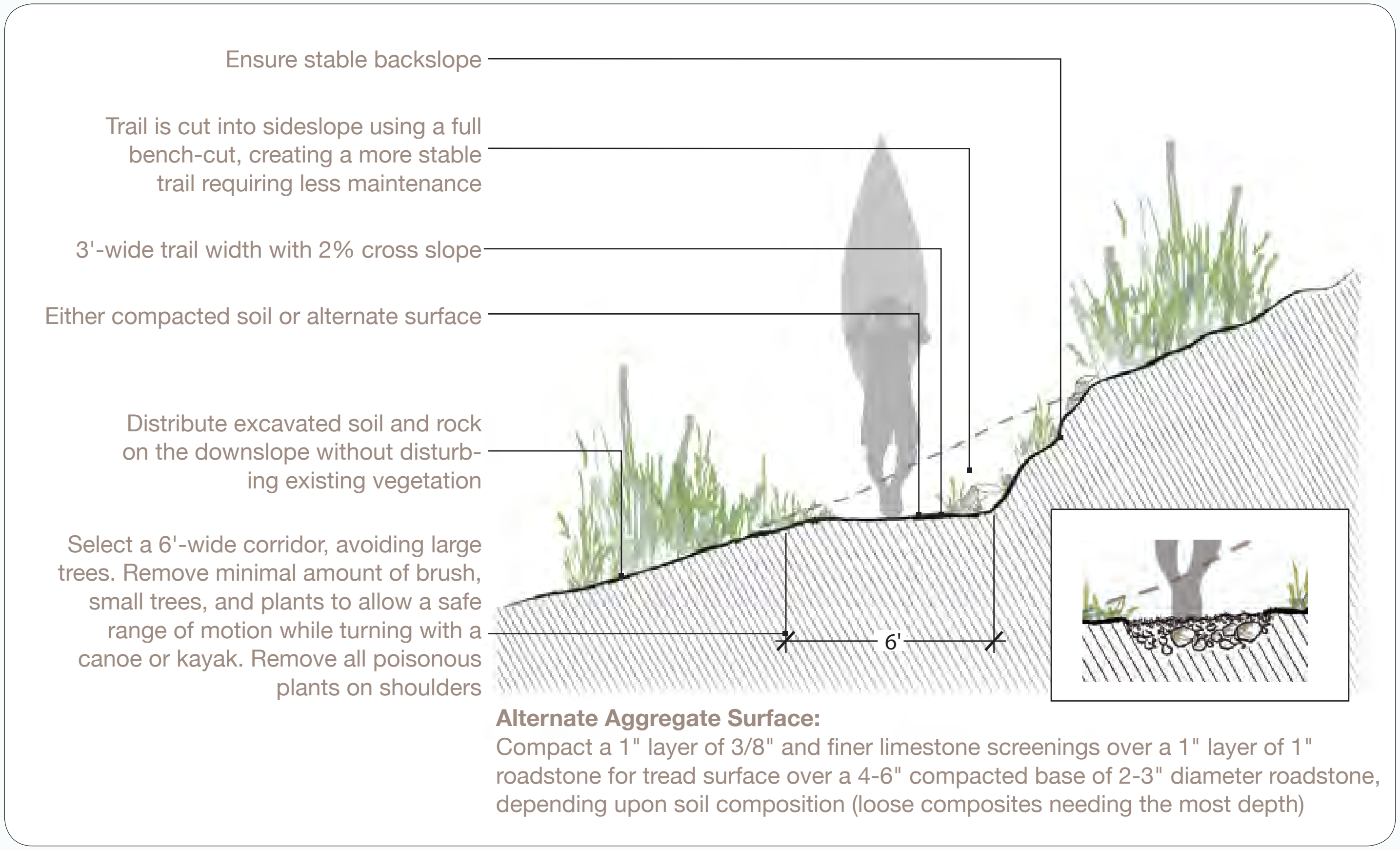


Figure 3C-3.
Typical Full Bench-Cut Trail, Natural or Aggregate Surface

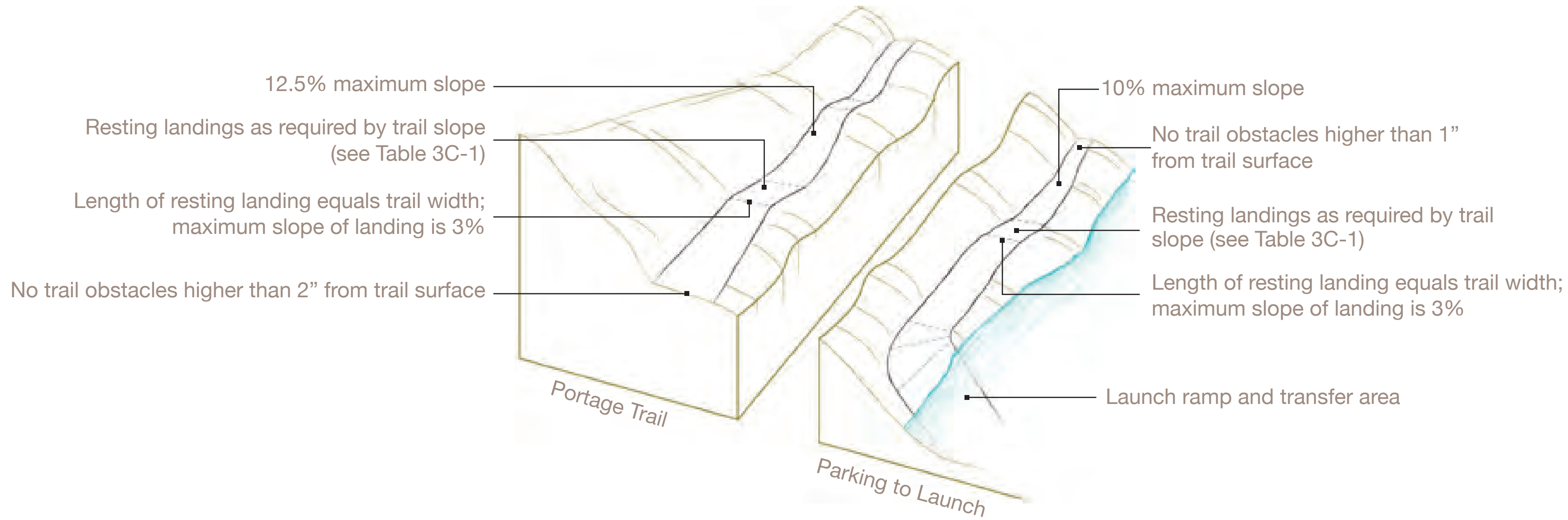


Figure 3C-4.
Accessible ADA Standards for Trail Slope

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).

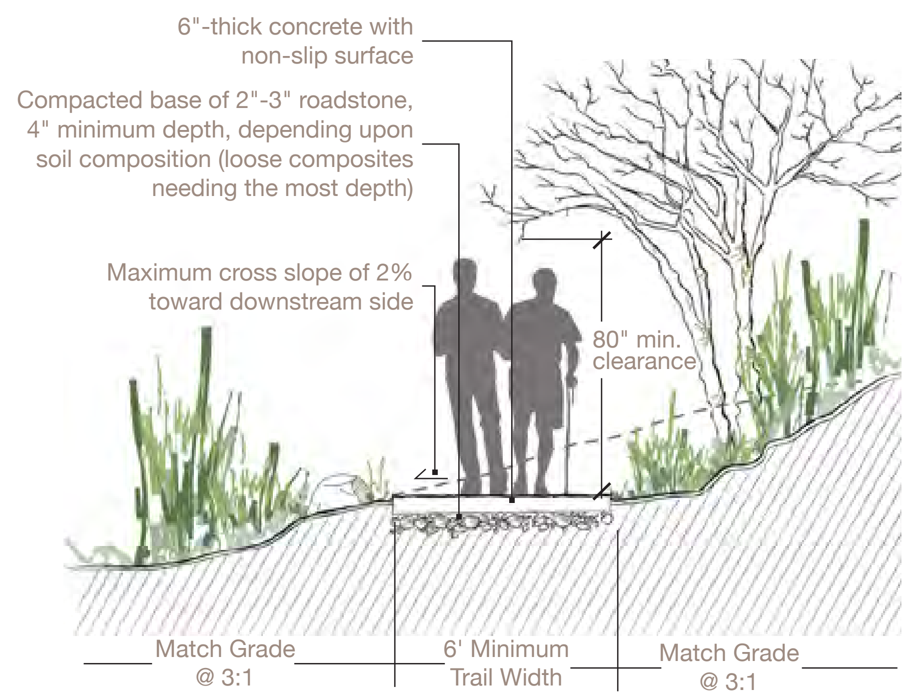


Figure 3C-5.
Typical Accessible ADA Trail

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

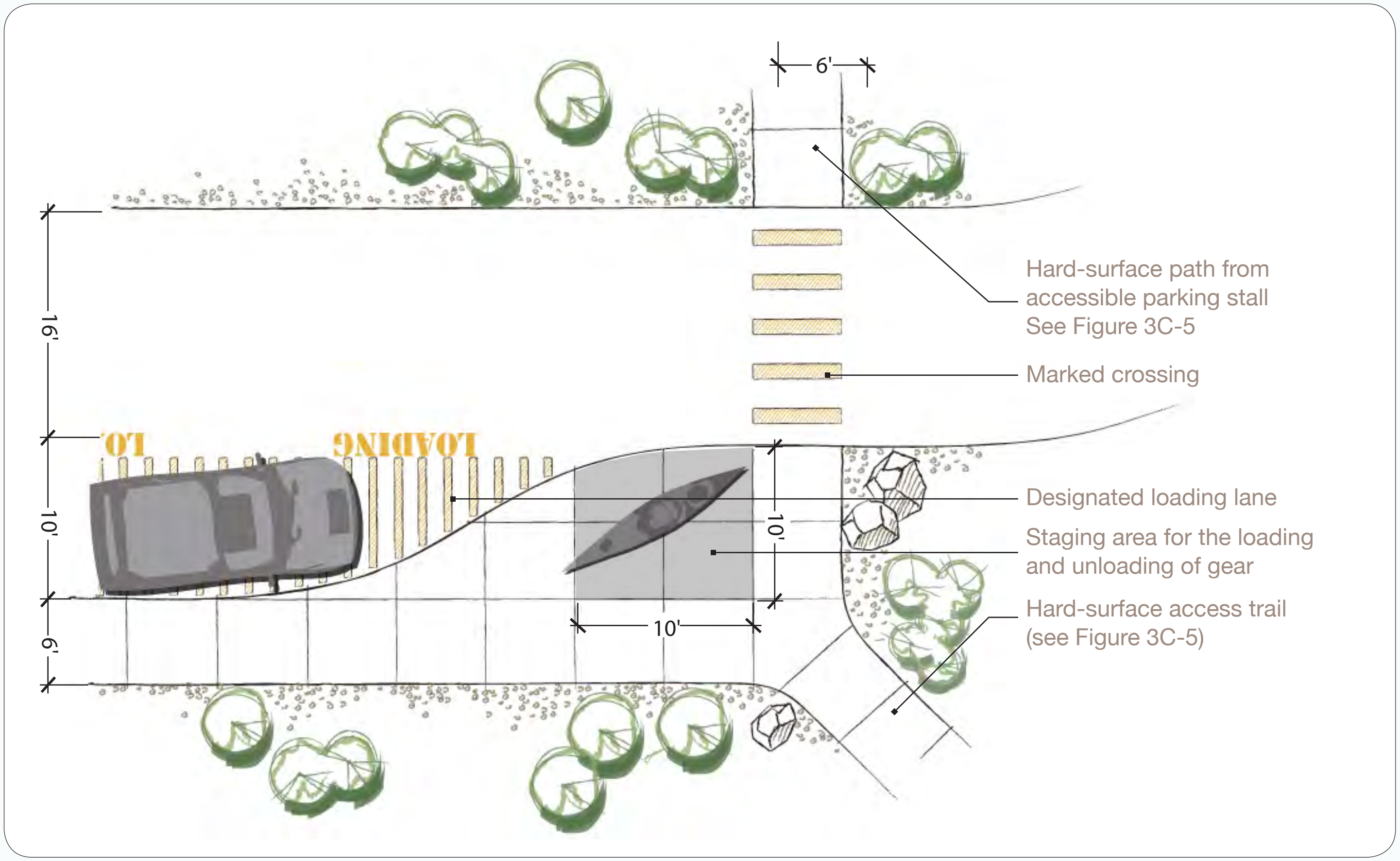


Figure 3C-6.
Staging Area for Universal Design Launch Areas

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

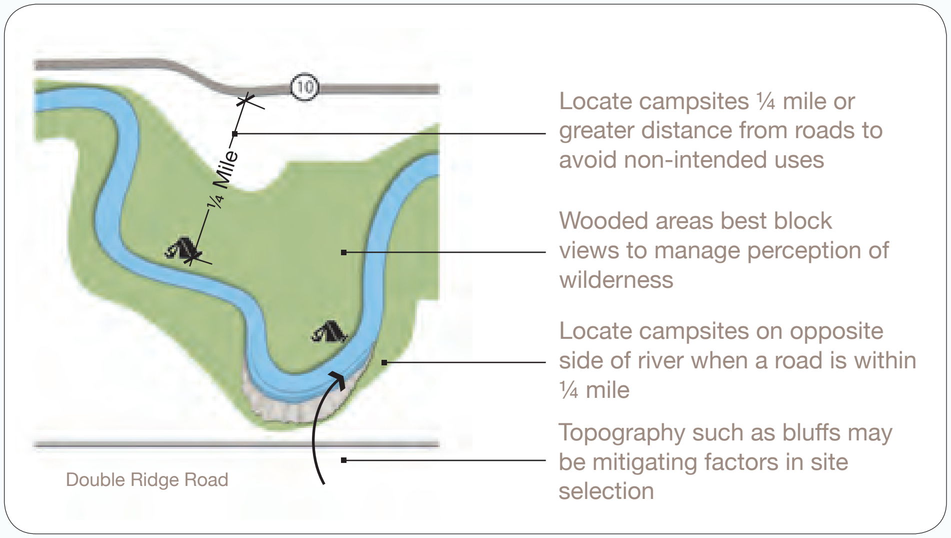


Figure 3D-1.
Water Access Campsites

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.

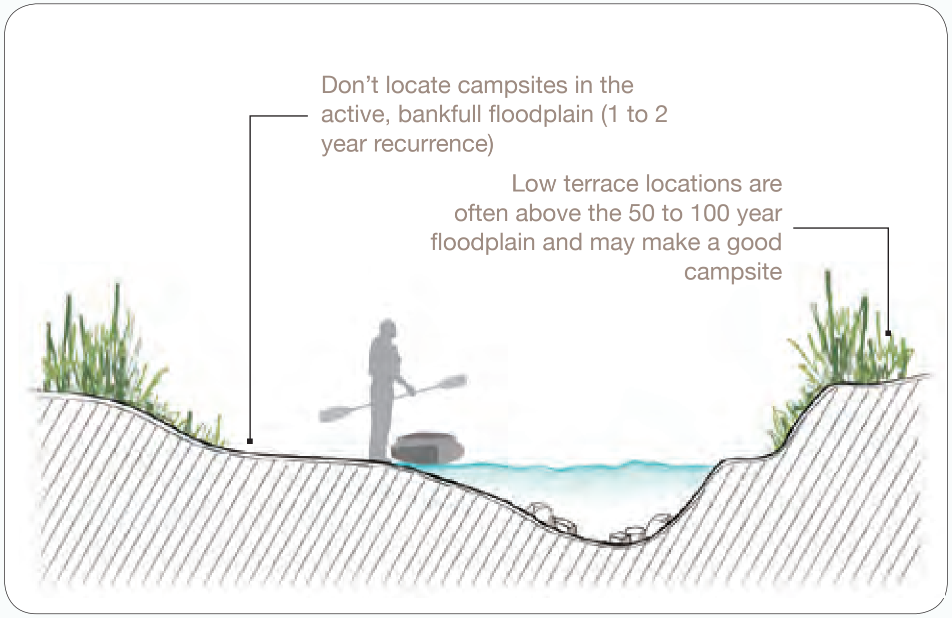


Figure 3D-2.
Campsite Location on Stable Streams

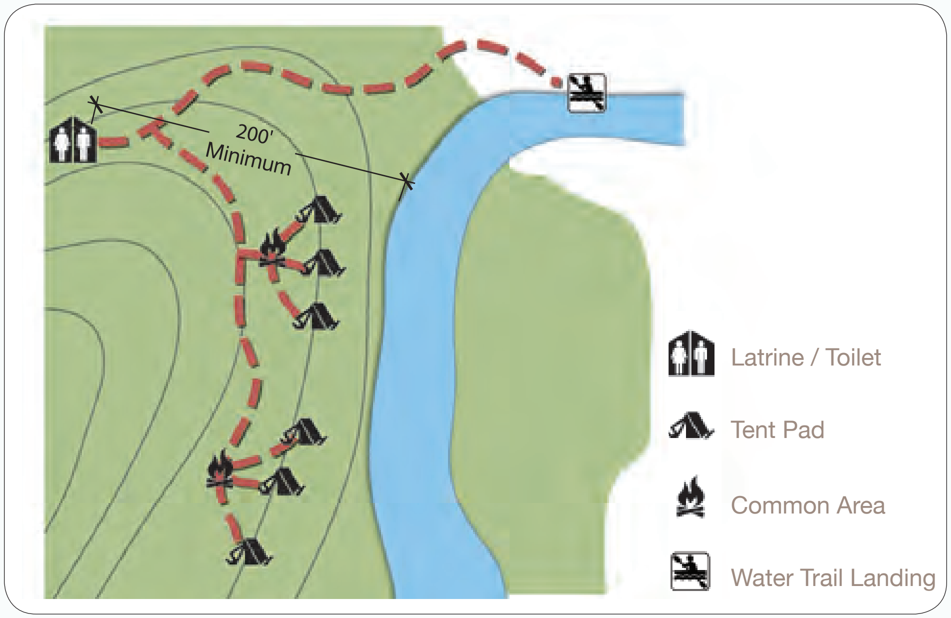


Figure 3D-3.
Cluster Campsites

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