Nongame Wildlife Habitat Guide:

Complementary Opportunities for Stream Restoration Projects

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Introduction

The Driftless Area, located in the heart of the Upper Mississippi River basin, is a geographically distinct 24,000 square-mile area primarily in southwestern Wisconsin, and includes areas of southeastern Minnesota, northeastern Iowa and extreme northwestern Illinois (see Figure 1). This area is interlaced with more than 1,200 streams (more than 4,000 river miles) that spring from the underlying limestone-bedrock. The area includes very steep topography with elevations ranging from 603 to 1,719 feet. The peculiar terrain is due to its having escaped glaciation during the last glacial period (approximately 10,000 years ago).

The streams and riparian habitats of the Driftless Area suffer from a history of human disturbances. Land use practices have led to extensive erosion and subsequent sedimentation of the watersheds in this region. The steep topography of the region has exacerbated these human influences. Across the region, hundreds of miles of spring creeks have been inundated with soils and fine sediment, resulting in degraded water quality, increased stream temperatures, damage to aquatic habitat, and altered watershed hydrology. For over fifty years conservationist and conservation organizations have been working to improve Driftless Area streams by stabilizing streambanks and incorporating habitat for trout. Each year federal, state and county conservation agencies spend millions of dollars to stabilize streambanks and create habitat for trout. However, past stream restoration projects in the upper Midwest have often failed to incorporate habitat for non-game species such as amphibians, birds, invertebrates, mammals and reptiles, primarily because of a lack of knowledge about those species' habitat needs. Developing habitat for other non-game species at the same time that construction equipment is being used for stream restoration projects is efficient and cost-effective. Failure to combine habitat for these species is a missed opportunity.

Having a better understanding of what kinds of non-game wildlife live in your project area and a basic understanding of their life history will help you create a better project. A good way to start gathering information on which non-game species would benefit from additional or improved habitats is by reviewing your state's Wildlife Action Plan. All of the states in the Midwest have developed Wildlife Action Plans identifying natural communities and their associated *Species of Greatest Conservation Need* (SGCN) (low and/or declining populations that are in need of conservation action). From this you can generate a target species list for your region. We have provided a generalized target species list in this guide for the Driftless region to help you refine your species list (see page 20). It will be helpful to then obtain a more precise list of

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Figure 1. Driftless Area map

© Bob Hay

Painted turtle

© Jeff Hastings

Degraded Stream in need of restoration.

© Bob Hansis

Wetland scrapes along the East Branch of the Pecatonica, WI

© Bob Hay

Juvenile wood frog

species that are likely to exist in your more immediate area by contacting local species experts in your area, such as biology departments at local colleges and universities and Department of Natural Resources staff. These folks may also be able to put you in touch with local non-agency species experts as well.

NOTE: *Your target species list should also include common wetland, riparian or aquatic non-game species and species that are likely to use restored upland habitats.*

This guide provides information about the habitat needs of a variety of upland, riparian and wetland/aquatic non-game species and describes a number of specific habitat features that can benefit them. By integrating some of these features into your project, where appropriate, you may be able to make a positive contribution toward increasing the carrying capacity of instream, wetland, riparian and upland habitats for non-game birds, herptiles, invertebrates, mammals and possibly non-game fish.

The second edition of this Habitat Guide includes modifications to help project planners better determine whether a particular habitat feature is likely to accomplish its intended purpose within the immediate habitats and within the surrounding landscapes. The previous guide simply provided a suite of habitat features that could benefit non-game species. A Habitat Feature Landscape Decision Matrix is provided on pages 18 -19 of this guide to help planners and agency reviewers determine which habitat features are most likely to benefit species on your target list. For example, adding wetland scrapes within an intact riparian corridor is likely to benefit populations of common amphibian species in your area and may also improve populations of SGCN species like the northern cricket frog and the pickerel frog. On the other hand, adding wetland scrapes within an active pasture is likely to have more limited benefits for amphibians. Wetland scrapes in a pasture may be even less likely to succeed if the surrounding landscape is comprised primarily of row crops. This improvement to the guide will help project proponents develop plans that only incorporate habitat features that are likely to succeed at accomplishing their intended purposes. The Matrix should also allow project reviewers to make better informed decisions within their review and approval process.

Keep in mind that any proposed disturbances within existing wetlands, floodplains or waterways are likely to require county, state and/or federal approval before the plans can be implemented. Be sure to check with your state's wetland/water regulations program to determine if and what permits and approvals will be required. It is best to get this information well up front and in writing.

Nongame Wildlife Life History Consideration

Amphibians (Class Amphibia)

Amphibians, such as frogs and salamanders are cold-blooded animals, most of which metamorphose from a larval form to an adult form. A majority of them require access to both aquatic and terrestrial habitats. Most amphibians lay their eggs in standing water but have varied habitat preferences on land, ranging from open canopy grasslands to dense forests. Suitable breeding habitat is critical to their long-term survival. Amphibians in this region generally breed during three peak phenology windows, although overlaps often occur between these windows *(see Amphibians Breeding Phenology Calendar- Figure 2)*. These breeding windows may vary annually due to climate. The early spring breeding frogs mostly rely on ephemeral wetlands or ponds that do not support predatory fish. Successful recruitment for most amphibians requires surface water for at least 3-5 months during spring and summer, although there are some exceptions where that time period may be shorter. Most of the Driftless Area's terrestrial salamanders breed in water in April and their larvae transform from mid-July through early September. They require longer water persistence than the early breeding frogs. The middle phenology breeders require water presence well into August. These breeding frogs, like the early breeders, reproduce most successfully in fishless environments. The third phenology involves three frogs that breed from late May through early-August. Of these, two species have overwintering larvae (American bullfrog and northern green frog tadpoles) and require permanent waters. The third species, the endangered northern cricket frog, breeds in semi-permanent and permanent water but the larvae transforms in the same season. All three of these species have developed chemical or behavioral means by which to reduce predation rates by fish.

Frogs and salamanders have thin, semi-permeable skin that needs to remain moist. Therefore, upland habitats must provide microhabitats that allow them to avoid damaging water loss. Downed woody debris, healthy duff layers and areas of shade often supply these microhabitats. Adult salamanders often live underground or under large woody debris on land when not breeding.

© Bob Hay

Blue-Spotted Salamanders

© Bob Hay

Northern Leopoard Frog

Vernal pools and ponds were not historically abundant in the Driftless Area due to steep topography and narrow valleys. The impacts of over-grazing and early agricultural practices have significantly altered most stream drainages in this area, often resulting in broader floodplains. These floodplains provide managers

Amphibian Breeding Phenology Calendar

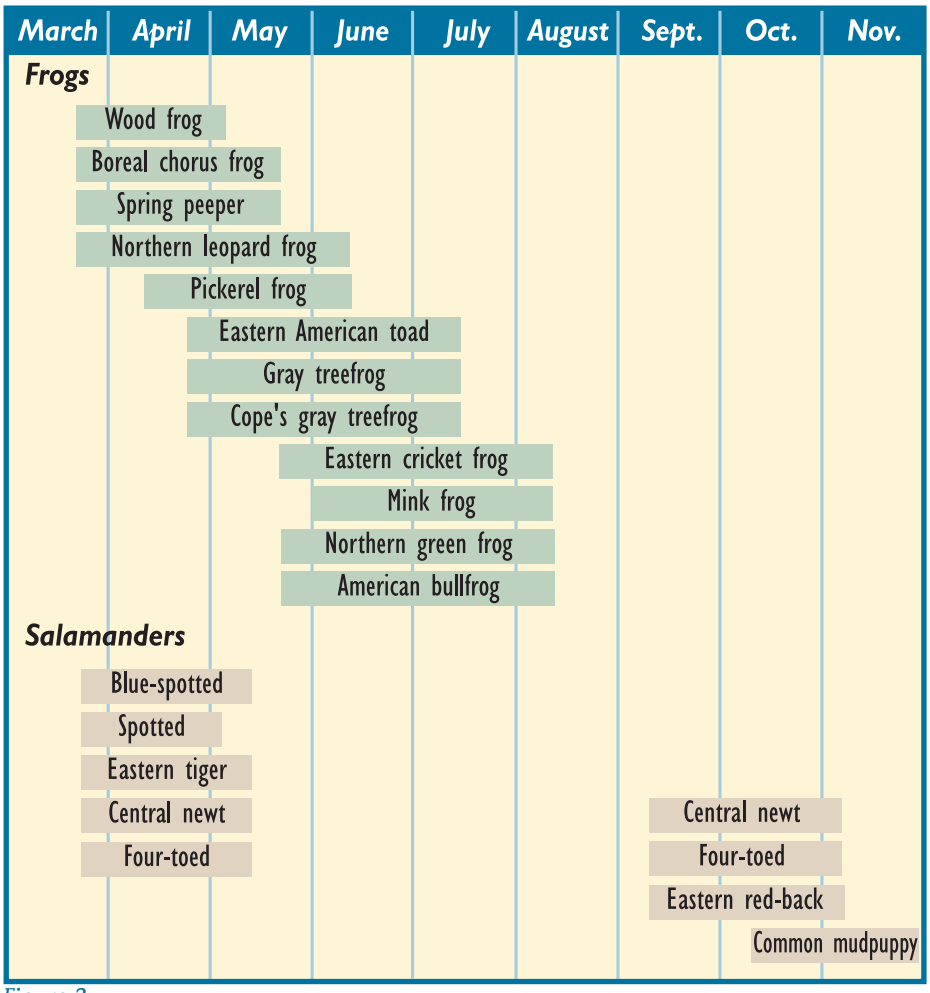

Figure 2


© Jeff Hastings

Vernal pool

with the opportunity to create and restore wetlands adjacent to these streams. Consult with your county and state's wetland/water regulations program during the project planning phase to obtain approvals and permits as may be required.

Amphibians spend the winter in a variety of ways. Some overwinter underwater to avoid freezing while others burrow below the frost line to avoid freezing. The endangered northern cricket frog is unique in its overwintering requirements. They cannot withstand freezing nor can they withstand being underwater for more than a few hours. Because they cannot effectively burrow to escape freezing, they require specialized microhabitats where they can avoid freezing, yet still retain moisture. Crayfish burrows, cracks in damp unfrozen soils near the shoreline or near seeps, and other microhabitats are essential to this species' persistence. Research is needed to determine how to best create, manage and maintain these critical microhabitats. The lack or loss of these microhabitats is a major limiting factor for cricket frogs.

Reptiles (Class Reptilia)

Reptiles, for purposes of this guide, include snakes and turtles. They are cold-blooded animals with scales covering most or all of their skin as opposed to having smooth moist skin like amphibians. Terrestrial and most aquatic reptiles lack the ability to internally regulate their body temperatures but instead rely on external influences to achieve their preferred body temperatures. As such, they rely on ambient air and ground temperatures, as well as sun and shade, to regulate their body temperatures. Varied habitat structure that offers a range of canopy conditions and that favors open canopy conditions is very important for reptiles. Reptiles also require overwintering microhabitats underground or underwater to avoid freezing during the winter.

Reptiles, especially turtles, are slow to mature and are often long-lived species. As a result, extremely low annual adult mortality is essential to population maintenance. Therefore, it is important to avoid their overwintering period (typically from mid-September through mid-April) when doing project installations in or adjacent to streams.

Aquatic and semi-aquatic turtles require basking surfaces to increase their body temperatures. This helps them digest food, acquire Vitamin D and maintain shell health. Gravid females bask in spring to elevate their temperatures in order to allow for timely egg develop. Many turtles will commonly emerge from overwintering habitats as soon as the ice melts. Turtles that overwinter in riverine settings often migrate in early spring to adjacent wetlands and shallow ponds. These habitats warm up more quickly in spring, providing better conditions for foraging on invertebrates and aquatic vegetation. Shallow standing water helps turtles complete their annual life cycle.


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Common Gartersnake


© D. Nedrelo

Blanding's turtle

Snakes are primarily terrestrial animals. They have relatively high thermal preferences and prefer open canopy habitats. The most commonly encountered snakes along streams in the Driftless Area include the common gartersnake and the common watersnake. These snakes feed on a combination of amphibians, crayfish, worms and fish. Several other snake species are found in streamside communities in this area but are less dependent on it. Many of these snakes are communal denning, meaning that they congregate to overwinter. In areas where natural den sites are limited or absent, artificial structures can be created to meet their overwintering needs. (See page 46)


© A. Badje

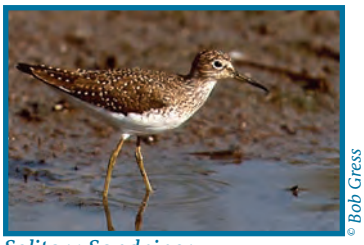
Northern cricket Frog in soil crack, one of its overwinter microhabitats


© Bob Hay

Wood Turtle

Birds(Class Aves)

Birds are warm-blooded species that maintain stable internal body temperatures regardless of external influences. Because winters in the Midwest impact food availability for many birds, they migrate south to take advantage of warmer climates where access to food resources is not limited by cold temperatures, ice or frozen soils. This includes many of the riverine and wetland- associated birds. Most water-associated non-game bird species fall into the categories of insectivores (which eat invertebrates including insects), piscivores (which eat primarily fish), or omnivores (more general predators, which eat a wide variety of prey including insects, fish, amphibians, reptiles and small mammals, along with wetland/aquatic vegetation and seeds). A wide variety of birds can be found along stream corridors, but are not dependent on these habitats alone.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Solitary Sandpiper


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Yellow Warbler


© Bob Hay

Great Blue Heron


© J. Hastings

Not all trees are removed, only the invasive/shallow rooted trees

Shallow wetlands, low gradient shorelines of ponds, mud flats and backwater areas along streams provide excellent foraging areas for wading birds. Perches over the water are important for a variety of insect eating birds such as eastern kingbirds and for fish eaters like the belted kingfisher. Dead trees provide perching areas for hawks and other birds and can provide structure for nesting and foraging. Vertical banks can be important nesting habitats for bank swallows and kingfishers. Varied habitat structure (trees, brush and grasslands) in riparian habitats can provide a variety of nesting opportunities.

Invertebrates (protozoa, annelids, mollusks, arthropods, crustaceans, arachnids and insects)

This exceedingly diverse group of species is the backbone or base of the animal food chain and as a result is perhaps the most important. Providing for the life cycles of such a broad range of species may be best accomplished by replicating many of the macro and microhabitats that occur within an intact natural riparian community in the watershed or region where you are working. Providing standing and flowing water habitats with varied depths, temperatures, substrates and structures may be the best way to maximize aquatic invertebrate diversity. Some of these microhabitat features are likely to be naturally provided over time. Riparian and upland habitats should have varied vegetative structure and be planted with a diverse mix of species (forbs and grasses). In order to achieve this, we are suggesting seed mixes that contain both native and exotic species (grasses and forbs) that have the greatest likelihood of achieving a varied herbaceous vegetation layer once established. We are purposefully including some exotic plant species, such as Kentucky bluegrass, because it provides a low-canopy structure that is valuable to a variety of non-game species from a thermoregulatory perspective. We include this species because we recognize that most of these properties will not receive management after they are initially planted. The establishment and maintenance of a diverse native planting typically requires significant management, especially in the early years, if a diverse plant community


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Black Swallowtail

with variable habitat structure is to be achieved. Where a project is attempting to improve conditions for one or more of the SGCN target invertebrates, such as a butterfly, seed mixes can include host plant seeds as appropriate. Having knowledge about these species and their specific habitat requirements, including host

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Dragonfly

plants and soil types, is essential to determine if you can accommodate these species within your project area. Other terrestrial microhabitat structures for invertebrates include flat rocks on the surface, imbedded rocks and varying types and sizes of downed woody debris.

© Bob Hay

Meadow Fritillary

Note. *The use of exotics in your seeding mixture may be in direct conflict with the program funding that you are receiving for your project and may in fact harm native/ rare remnant plant communities already established. Consult with your regulatory agency and program administer before using exotics. Furthermore, there may be grants, cost share and other incentive programs to aid native plant restorations on public and private lands.*

Mammals (Class Mammalia)

Mammals are warm-blooded animals with varying degrees of cold temperature tolerance. Mammals of the Midwest do not migrate seasonally. Many remain active year-round by growing a denser coat of fur, while others hibernate underground or in protective structures (e.g. hollow trees). A few mammals, such as muskrats, beaver, otter, mink and short-tailed weasels, are highly associated with riverine environments. Many other mammals, from shrews to bears, also utilize riverine habitats.

North American beavers are unique among all of the animals found in riverine communities because they create aquatic habitat in order to improve access to their food supply. Beavers provide extremely valuable shallow water habitats for a wide variety of amphibians, birds, invertebrates, mammals and reptiles. However, beavers also create problems for streams by impounding water that warms the stream; can block upstream migration of fish; and can impact instream habitats. These created habitats are relatively short lived. However, because these changes to the stream can impact cool/cold water fish species and impact instream habitat beneficial to trout, they are often controlled on cool and cold-water streams. However, stream restoration specialists can create habitats that provide similar conditions for the many non-game species that benefit from shallow impoundments and they can do this without having negative impacts on the stream itself. These alternative habitats can help stabilize and improve local biodiversity and add to the carrying capacity of the area.

Donated

North American beaver

Instream Habitat Features that benefit Nongame Wildlife

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Backwater hook on Gordon Creek, Iowa Co. WI

Backwater Hook: Construct point bars that allowed for the deposition of sediment, creating shallow flats of mud or sand. (See Habitat Designs page 25). These shallow sediments typically support low and sparse vegetation and are ideal for a number of aquatic invertebrates and frogs. This habitat feature is particularly important for Wisconsin's only endangered amphibian, the northern cricket frog.

Basking Logs/Escape Log: Basking helps snakes and turtles regulate their body temperature and aids in digestion. Vitamin D from the sun is important for the uptake of calcium from their food and is important for shell development and maintenance. Basking allows the shell to dry, inhibiting bacterial and fungal growth and assists some species with the shedding of scutes (the keratin plates overlaying the shell bones) (Christoffel et al. 2002). Creating permanent basking logs, or escape logs, is a simple task with an excavator. (See Habitat Designs page 29). Logs can be anchored into the bank and placed so that they sit just above the water surface during normal flows where they would not significantly obstruct water flow. Because basking logs are only partially submerged rot will occur at the water interface. To increase longevity, hardwoods such as oak and elm should be used when possible.

Backwater Refuge: These shallow structures placed adjacent to the stream create idea habitat for reptiles and amphibians. (See Habitat Designs page 26-27). Utilize short grass mixtures were possible.

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Basking log, West Fork Kickapoo, Vernon Co. WI

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Backwater refuge, Big Spring Creek, Iowa Co. WI


© Jeff Hastings

Brush anchored with rocks are stable and provide valuable habitat, Hay Creek, MN

LUNKERS: are wooden "cribs" designed to provide permanent overhead cover for trout. (See Habitat Designs page 35-37). They consist of two-inch boards, log spacers and reinforcing rod. When installed they not only help stabilize badly eroded stream banks but also provide 8-10 inches of clearance underneath. They work best in streams with a hard bottom and water depths between 2-3 feet. Beyond three feet, there is adequate cover in the water depth alone to provide cover for trout. LUNKERS are typically faced with rock; however they can also be faced with a quarter logs.

Brush Bundles: Brush bundles installed immediately behind rock deflectors, or in conjunction with rock, will quickly gather sand and silt during high water events. These areas can provide multiple benefits for basking, burrowing, and foraging.

Cross Channel Logs: Cross channel logs can also be used to create deep plunge pools. (See Habitat Designs page 30-31). Care must be taken to keep water from undermining the log and losing the plunging effect. Packing rock of different sizes on the upstream side of the log will help reduce the chance of undermining. Cross channel logs will last indefinitely if they are completely submerged. They also can be used to direct flow into other in stream structures such as LUNKERS and Skyhooks.


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Cross channel log placed on angle to direct water flow into overhead structure.

Cross Channel Rock Weirs: Cross channel rock weirs can go directly across the stream and create a scouring affect, like a vortex weir, or placed on an angle to direct water flow into a structure. (See Habitat Designs page 32-33). Rocks are often used in place of logs because they are readily available and undermining is less likely to occur.


© Gary Sabota

Cross channel rock weir directs water flow into skyhooks on Pine Creek, Winona, MN

Log Deflectors: A single log deflector should be a minimum of 24 inches DBH or five logs of 16 inches or larger with roots on each log. (See Habitat Designs page 34). You will want to be careful in that you don't create erosion on the opposite bank. The vast majority of the log should be below the ordinary high water mark OHWM and all but 15% of the log submerged so that the log won't rot.


© Joe Schmelz

Log deflectors installed on Six Mile Branch, Iowa Co. WI

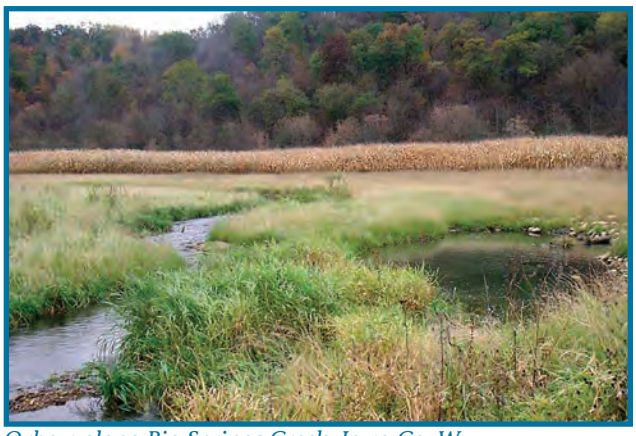
Minnesota Skyhook: The Minnesota Skyhook was originally designed to be used just below rock weirs on outside bends that are considered to be pool areas. (See Habitat Designs page 44-45). The advantage of using a (Dornack) Minnesota Skyhook structure is in how it is supported by a fulcrum that is 3 feet back from the stream edge of the structure, which means it is almost impossible to undercut the structure and have it tip in towards the middle of the stream. The dimensions for the

Minnesota Skyhook structure is 8' wide by 8' long making it perfect for narrowing degraded streams where the channel dimensions are overly wide. The structure can be used under any circumstance in any area of the stream where other types of bank hide structures are typically used as well. *-Tom Dornack*

Oxbows: Connecting and even enlarging old oxbows to the stream will support a variety of invertebrates, tadpoles, frogs, turtles and forage fish. An oxbow lake is a U-shaped lake water body formed when a wide **meander** from the **mainstem** of a **river** is cut off, creating a lake. Coldwater predatory fish will usually avoid these refuge areas because of the higher temperatures created by their shallow water and little or no flow.

Random Boulder Placement: Another practice often used to create additional habitat for trout is placing large boulders in flowing deep water on straight stretches of stream. (See Habitat Designs page 39). These boulders should be placed in tight groupings of four to five rather single boulders spaced far apart. Care must be taken to prevent the boulders from deflecting current around and into an unprotected bank. Eddies behind the large boulders in the center of the channel will also provide microhabitats for over wintering turtles.

Rock Deflectors: Rock deflectors typically installed to kick water flow from one bank to the other, in-time will also provide shallow sediment flats on the downstream side. (See Habitat Designs page 40). These provide habitat for burrowing invertebrates, quieter water for tadpoles and frogs and foraging habitats for small wading birds. Adding rocks to riffles that sit just above normal stream flow can serve as insect foraging sites for birds like the Louisiana Waterthrush *Parkesia motacilla.*



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Oxbow along Big Springs Creek, Iowa Co. W.

© Jeff Hastings

Oxbow

© Jeff Hastings

Cover rocks placed for additional habitat

Side Channels: Creating side channels that connect to the stream but are slightly warmer in temperature will also provide additional microhabitats for frogs, forage fish and invertebrates, which in turn provide foraging habitat for streamside community snakes, turtles and wading birds.

© WDNR

Foraging rock are used by a number of species, Bad Axe, Vernon Co. WI La Crosse Fisheries

© Tom Dornack

Side channels provide critical habitat for a variety of species, Pine Creek, Winona Co. MN

© Joe Schmelz

Turtle Hibernaculum ready to be installed

Turtle Hibernaculum: Natural hibernacula in streams are often created by tree falls along the streambank that leads to either deep bank undercutting or that creates slack water immediately downstream of the tree up against the bank. These areas eventually fill in with fine sediments in which turtles will opportunistically bury in during winter. Unfortunately, some of the worst streambank erosion occurs adjacent to these unstable trees and roots. As discussed earlier, an unanchored tree may be good for a year or more but eventually moves downstream during flood events. A more permanent artificial overwintering structure has been developed to create a similar sediment trap. These structures are strategically placed under the bank immediately downstream of flow deflectors placed on the upper inside end of bends. They are specifically designed for snapping turtles but may occasionally be used by other turtles. The turtle hibernaculum, made of a hard wood, will be virtually rot resistant once it is placed fully submerged. The current design uses 2 inch thick rough oak, 8 feet long, which is what we typically use for building other habitat structures. See Habitat Designs for specifications on pages *48-51*.

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Vortex Weirs: Vortex weirs are installed to create permanent pools in streams. A weir is constructed by placing large rocks in the shape of a "V", with the point of the "V" facing upstream. (See Habitat Designs page 52-53). As water flows over the rock it is directed to the center of the stream scouring out a deep pool below. When possible, weirs should be constructed at the lower ends of riffles. This better utilizes increased riffle velocities and will reduce upstream pooling. Although weirs can be used in all sized streams with a variety of gradients, waters with a medium or higher flow (20-30 cubic feet/second [cfs]) will generate larger pools.

Vortex Weirs with Pool Boulders or Woody Debris: Weirs can also be used to direct flow into other habitat structures such as LUNKERS and Skyhooks. Placing multiple boulders or root wads in the plunge pool below the weir increases microhabitat and creates current free zones. (See Habitat Designs page 43). These boulders should be placed in a tight group of four or five rather than widely spaced apart.

In order to maximize the likelihood of success of these additional habitat features, it will be important to eliminate or strictly restrict access to ponds and streams by livestock. Where approved, stabilize bottom substrates for cattle crossings to reduce erosion and turbidity. These areas can also serve as fish redds.

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Vortex weir, West Fork, Vernon Co. WI

© Jeff Hastings

Vortex Weir Bishops Branch, Vernon Co. WI

The instream, riparian and upland nongame wildlife habitat features in this guide were developed for the Driftless Area. However, many of these practices would be beneficial outside of the Driftless Area. Cool and warm water streams typically support a broader diversity of instream species, so the practices in this guide would likely be especially beneficial in and along those waters.

Riparian and Upland Area Habitat Feature that Benefit Nongame Wildlife

© Joe Schmelz

Recently constructed scrape Big Springs Branch project, Iowa Co. WI Nohr Chapter

The following habitat features are designed to improve conditions for amphibians, reptiles, birds, invertebrates and mammals.

Creating wetland scrapes and ponds: Create where soils have low permeability or where the water table is close to the surface. (See Habitat Designs page 54). Note. Placement in an existing wetland must be pre-approved by your state's natural resources agency. These are typically only approved where the wetland is dominated by monotypic exotic vegetation or where other disturbances have grossly simplified wetland functions.

- Ephemeral ponds and scrapes should hold water for at least 4-5 months (early spring through mid-summer) and be less than 30 inches deep.
- Permanent ponds should have varying depths. Ponds should be 6 feet in the deepest part to allow for overwintering by amphibians, invertebrates and turtles. Note. These ponds could support fish populations.
- Design scrapes and ponds with irregular shorelines to increase shoreline to area ratios (not bowl shaped) (*see Design Feature page 54)*
- Scrapes and ponds should have varied but generally low gradient slopes (6-8 to 1).
- Add brush and large woody debris to ponds for egg deposition, basking and cover. Basking logs should extend at least 5 feet out from shore to minimize ambush by terrestrial predators. Include trees with branches above the water for birds. Logs should be a minimum of 6 inches in diameter and should be anchored into the bank to help secure them during floods or high water levels. Where available, use logs that have been dead for at least one year as green logs are heavy and tend to sink.
- If more than one pond is constructed, vary their distance to the stream. Ephemeral scrapes are best placed where they will flood only during high water events or from surface water runoff.
- Isolate ponds from unwanted sources of pollution such as runoff from paved roads or sloped pastures.

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Wetland scrape, Bad Axe, Vernon Co. WI


© Jeff Hastings

Wetland adjacent to Pine Creek, Winona Co. MN

Maintaining/Restoring Connectivity: Connect riparian habitats and buffer strips to suitable upland habitats to improve/restore habitat connectivity.

Bird perches: Because bird perches near the normal water level can serve as debris traps during flood stages, make a conscious decision to leave a few bank-grown native tree species that are near or that overhang the water but that will not impeded flows or result in debris entrapment during flood conditions.


© Bob Hay

Pickerel Frog

Terrestrial Cover Objects: Place large woody debris and large rocks (where permitted) adjacent to ponds and along travel corridors for cover and as elevated basking sites. Over time, large woody debris often supports abundant invertebrate life that is valuable to a wide variety of species.

Plantings: Plant mixes of short grasses and low growing forbs around ponds and scrapes and in riparian habitats as buffer strips (minimum of 60 meters) to improve thermal conditions for herptiles while providing habitat for a variety of other nongame wildlife and their prey and to protect water quality.


© Gary Sobota

West Indian Creek in Wabasha Co. MN


Craig Erickson

Partially buried upland brush/log pile for wildlife.

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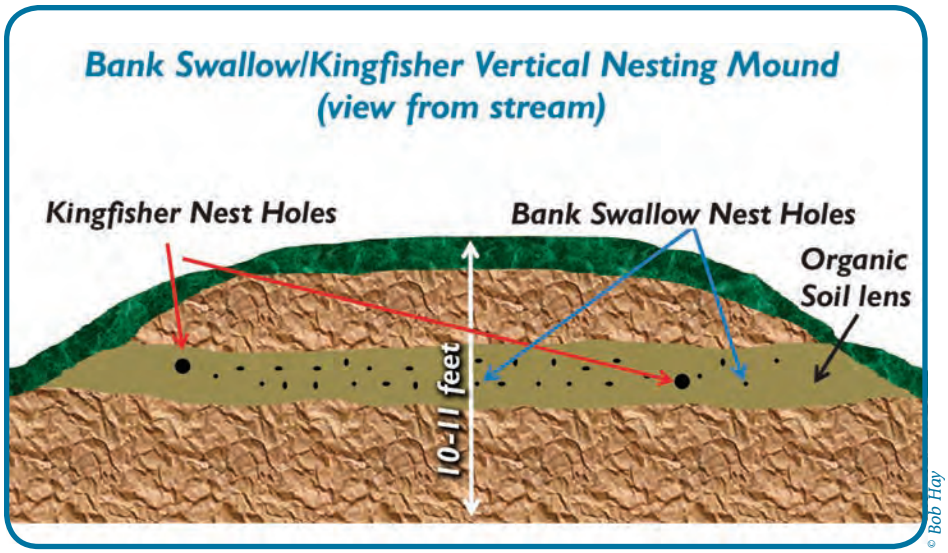

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Vertical Bird Nesting Banks:
Construct vertical nesting banks for swallows and kingfishers away from the streambank but in close proximity to it. This is done by creating soil mounds that have a vertical face on the streamward side. Stabilize the rest of the mound with short-canopy cool and warm season grasses. The vertical face should be tall enough to prevent terrestrial predation from below or above. To help stabilize the vertical bank the lower half of the mound should be constructed of compacted heavier soils containing clay. Overlay the heavier soils with a lighter organic soils about 2-3 feet thick. The lighter soil lens provides suitable soils for birds to excavate nest chambers. Finish the mound by overlaying the lighter soils with a layer of heavier soils. The overall height of the mound should be 10-11 feet.

NOTE. *To avoid destroying nests during construction place netting over eroding banks where bank nesting is known or is expected to occur* ***prior to the nesting season*** *in the year that the stream restoration will occur.*

Trees:
Leave some trees for bird use along the riparian corridor, but not at the immediate shoreline. Where trees only occur at the shoreline and must be removed due to threats to streambank stabilization, replant native trees back from the bank to restore nesting and perching sites.

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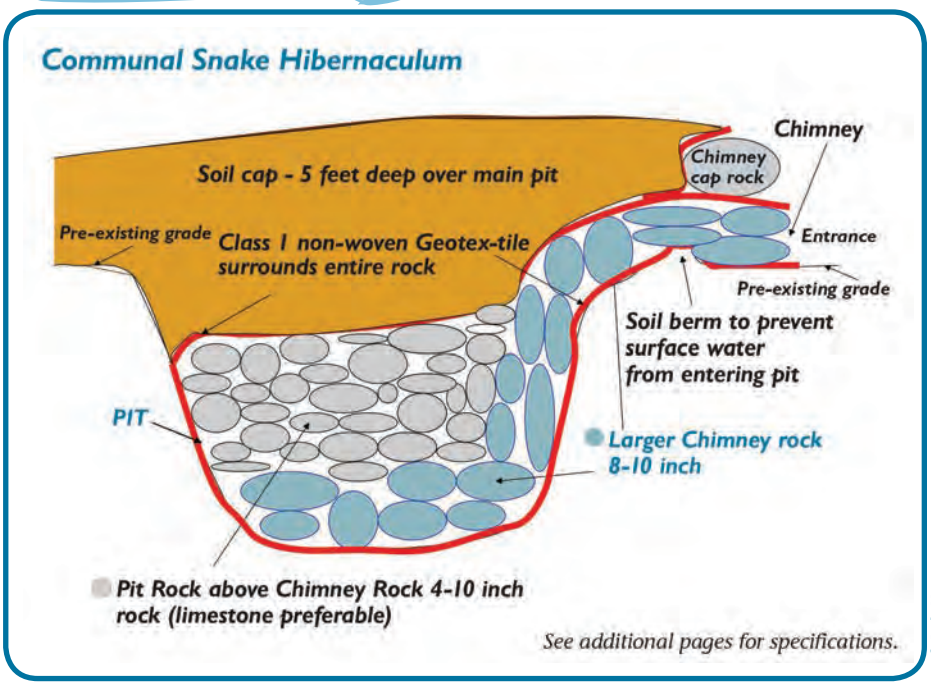
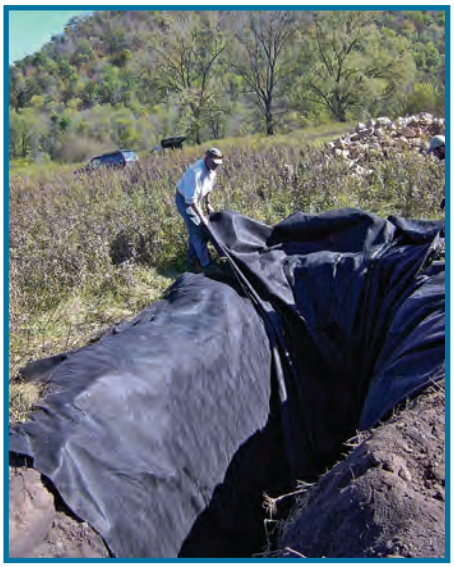
Swallow/Belted Kingfisher mound on Rush Creek, Winona, MN

© Jeff Hastings



© Bob Hay



© Jeff Hastings

© Jeff Hastings

Excavate below water table one to two feet.

Snake Hibernaculum: Several species of snakes in the Driftless Area overwinter communally. These include the bullsnake, common gartersnake, common watersnake, Decay's brownsnake, eastern milksnake, gray ratsnake, northern red-bellied snake, prairie ring-necked snake, timber rattlesnake and the western foxsnake. These species may overwinter together, in some combination, or separately as a species depending on the surrounding habitats and the availability of suitable hibernacula. Some species are known to migrate up to two miles from their summer range to their hibernation site, but migration distances are often shorter. Snakes also have different overwintering microhabitat preferences even within the same hibernaculum, so designing a one-size-fits-all hibernaculum is easier said than done. The use of varying sizes of rock (3-12 inch diameters) will help create different micro-sites within the hibernaculum that can provide for the needs of various species and snake sizes. Two key elements are critical for snakes to overwinter successfully; conditions that prevent snakes from freezing and sufficient moisture levels to prevent damaging water loss during the long period they remain underground. A number of studies have shown the lack of adequate hibernacula to be a limiting factor for some snake populations (Christoffel et al. 2002). The hibernaculum design and specifications below were developed by gaining experience with the design of several old and abandoned dug wells that support several of the communal denning snakes. (See Hiberenaculum specifications on page 46.

© Paul Krahn

Add smaller mixed rock on top of the 8 to 10 inch bottom rock.

© Jeff Hastings

© Jeff Hastings

Creating the hibernaculum opening.

- ***Pit placement –*** Must be placed outside the 100-year floodplain in uplands where the water table is normally 5 to 7 feet below the existing ground surface during late summer or fall (when water tables tend to be low). Place on flat or south facing slopes.
- The excavated pit must be slightly longer at the top than it is deep. This meets the Wisconsin definition of a pond. It is therefore not a well – Wisconsin DNR Regulations.
- The pit should be excavated with the north end of the pit being vertical and the south end being sloped. The excavation equipment should operate from the south end of the pit to facilitate a sloped southern end. Excavate the pit to a depth of 1 to 2 feet ***below*** the normal late summer or fall water table. The bottom of the pit should be about 5 feet in length. This sloped southern end of the pit is where the chimney (entrance) is to be constructed. (See schematic previous page).
- Pit width should ***not exceed*** 40 inches, 30 to 36 inches is preferred.
- Create a 6 inch high berm of compacted soil across the width of the Chimney entrance, about 2 feet away from the southern pit edge. This is required to prevent surface water from flowing directly into the pit. The chimney is where snakes enter the hibernaculum.
- Line the entire pit, including the chimney and the 6 inch berm, with heavy Class 1 non-woven geotextile fabric with enough extra fabric to allow all of the rock to be enclosed after all of the rock has been placed in the pit and chimney.
- Fill the bottom and chimney (entrance) of the pit with 8 to 10 inch rock that is two layers deep (16-20 inches deep). The larger rock allows for entry by larger snakes. The chimney rock should extend about 3 feet horizontally past the top edge of the pit on top of the existing grade.
- Add a mix of 4-10 inch rock on top of the larger rock at the bottom of the pit until the total rock depth in the pit is about 4 to 5 feet in depth. It is best to have an even mix of smaller and larger rocks for this. Add occasional shovels of damp soil as the rock is being placed in the pit. Add soil in moderation to avoid filling in all the voids between the rocks. The soils hold valuable moisture that is essential to hibernating snakes.
- Wrap the rocks completely with the fabric, including over the entire chimney except for the vertical face of the hibernaculum entrance.
- Place 10-12 inch rocks directly above the chimney entrance ***on top of the chimney fabric and rocks***. These rocks are to serve as a retaining wall for the soils that will be added to cap the hibernaculum. Place an additional piece of the geotextile fabric over the back half and backside of the retaining wall rocks to help prevent soils from spilling over into the chimney entrance.
- After ensuring that all the rock in the pit and chimney are enclosed in fabric, add soils on top of the fabric to fill in the pit and cover the chimney. The soils should be a minimum of 5 feet deep over the pit proper and 1 to 2 feet deep over the chimney.
- Seed and mulch the entire cap with a perennial grass mix.

© Bob Hay

Western Foxsnake

© Jeff Hastings

Hibernaculum entrance after vegetation establishment.

Habitat Features Decision Matrix

Projects that include one or more of the nongame habitat features listed in this guide are not guaranteed to produce success. All of these features are known to of benefit to some nongame species. However, understanding the limitations of a project site to support various nongame wildlife is important. For example, most amphibians require both aquatic and terrestrial habitats to complete their life cycles. Because most frogs and salamanders have small home ranges, their breeding ponds or wetlands must be close to and connected with their upland habitats. Creating a breeding wetland for amphibians where the adjacent uplands are primarily unsuitable (e.g. active pasture or row crop fields), the created wetland is likely to be of limited value to these species. The following matrix is designed to help determine under what conditions the major nongame habitat features in this guide are most likely to provide benefits for various nongame species. The success of these features is closely linked to the surrounding habitats, land uses and the landscape context of your project area.

To evaluate each of the following habitat features, determine the features value based on the planned outcome of your project within the riparian area, the immediately adjacent uplands and within the surrounding landscape. The following scale of values is defined as:

- ***No or very low value***
- ***Low to moderate value***
- ***Moderate to good value***
- ***Good to excellent value***

Pond or Wetland Scrape

Riparian Conditions ***(minimum 66-foot easement post project)***	***Immediate Adjacent Landuse*** ***(edge of easement to 300 meters past stream on both sides- post project)***	***Landscape Context*** ***(outer edge of 300 meter habitat to .5 miles from stream on both sides)***
Row cropped- No value- do not consider this feature	Row crop- little value	100% Agricultural- little value
Active pasture	> 60% Active pasture	>70% Ag & <30% fallow
>50 % undisturbed riparian <50% row crop/active pasture	< 60% Active pasture	~50% Ag ~50% fallow
Revegetated and undisturbed riparian habitat	Established old field (not to be pastured)	<30% Ag & >70 % fallow
	Planted natural community	Mostly undisturbed habitat

Bob Hansis

Wetland scrapes along East Branch of the Pecatonica River

You must score at least ***moderate to good*** under the Riparian Conditions and ***low to moderate*** in the Immediate Adjacent Landuse to consider placement of a scrape or pond in your project. The more ***green*** you will have, the better the likelihood for success.

Snake Hibernaculum

Riparian Conditions (minimum 66-foot easement post project)	Immediate Adjacent Landuse (edge of easement to 300 meters past stream on both sides- post project)	Landscape Context (outer edge of 300 meter habitat to .5 miles from stream on both sides)
Row cropped- No value- do not consider this feature	> 70% row crop or active pasture	100% row crop and active pasture
Active pasture or forested habitat	<70% row crop or active pasture >30% undisturbed open canopy	>70% Ag & <30% fallow
>70% of one side of stream is undisturbed open canopy	< 50% row crop or active pasture >50% undisturbed open canopy	<50% Ag >50% fallow
Revegetated and undisturbed open canopy habitat on both sides of stream	Established old field or planted natural community (not to be pastured)	<30% Ag >70 % fallow/planted natural community

© Bob Hay

You must score at least moderate to good under the Riparian Conditions and at least low to moderate in the Immediate Adjacent Landuse to potentially benefit streamside community snakes. Having green in all three habitat categories will improve your potential to benefit a broader snake community.

Swallow Nesting Bank

Riparian Conditions or Immediate Adjacent Landuse - post project	Landscape Context (habitat out to .5 miles from stream on both sides)
Row cropped to shoreline or forested- No value-	Primarily closed canopy
Active pasture or row crops adjacent to riparian area	Primarily open canopy
Southerly exposed slope in undisturbed open canopy habitat adjacent to stream with base of slope above the 100 years flood level	

© Jeff Hastings

Only install where open canopy conditions prevail. Do not install in agricultural settings where livestock or farm equipment may compromise vertical bank stability.

Turtle Hibernaculum

Stream Type	Riparian Habitat
Small, stable rock/cobble, cold headwater stream	Primarily closed canopy
Medium sized cool to cold water stream*	Primarily open canopy
Medium sized cool to warm water stream/river	
Larger warm water rivers	

© Bob Hay

The turtle hibernaculum is designed primarily for overwintering snapping turtles. Other instream features such as lunker structures and boulders in deep pools may provide overwintering structures for other turtle species.

**Turtle hibernacula on cold water streams should be located within .3 miles of a confluence with a cool or warm water river/stream.*

Vertebrate Species of Driftless Area Streams and Riparian Habitats

Amphibians


© Bob Hay

Spring Peeper

Salamanders

Blue-spotted salamander
*Central newt
Common mudpuppy
*Eastern tiger salamander
*Four-toed salamander

Frogs

*American bullfrog
*Boreal chorus frog
*Cope's gray treefrog
*Eastern America toad
*Gray treefrog
*Northern cricket frog
*Northern green frog
*Northern leopard frog
*Pickerel frog
*Spring peeper
*Wood frog

Riparian/Wetland Reptiles

Snakes

*Common gartersnake
*Common watersnake
*Decay's brownsnake
Eastern hog-nosed snake
*Northern red-bellied snake
Western foxsnake

Turtles

Blanding's turtle
*Eastern snapping turtle
*Painted turtle
Spiny softshell turtle
Wood turtle


© Bob Hay

Blanding's Turtle

Riparian/Wetland Mammals

*Beaver
Coyote
Deer mouse
Eastern chipmunk
Gray fox
Meadow jumping mouse
Masked shrew
*Mink
*Muskrat
*Otter
Prairie vole
*Raccoon
Red fox
*Short-tailed weasel


Donated

Striped skunk
Thirteen-lined ground squirrel
Woodchuck

Riparian/Wetland Birds

American redstart
*Bank swallow
* Belted kingfisher
*Common yellowthroat
*Eastern kingbird
Eastern phoebe
Great blue heron
*Green-backed heron
Hooded merganser
Killdeer
*Mallard duck
Northern rough-winged swallow
*Red-winged blackbird
Sanderling
Sandhill crane
*Spotted sandpiper
Tree swallow
Wood duck


Donated

Belted Kingfisher


© Bob Hay

Common Watersnake

** Species often dependent on riparian/ wetland habitats along cool/cold water streams in the Driftless Area.*

Monitoring Section

The Wild & Rare Committee has compiled a suite of monitoring protocols to assess nongame wildlife on larger projects that incorporate several to many of the habitat features listed in this guide. The purpose of monitoring is to determine if the added nongame habitat features accomplish their intended purpose of improving nongame diversity and relative abundances. In order for monitoring to have value, pre and post monitoring is necessary. Pre-monitoring provides a baseline of species and relative abundances that can be compared to post-project results. Monitoring for pre and post construction must be done by following the same methods and levels of effort. While this will not provide definitive results for all species, it will help managers and funding agencies make decisions about what habitat features are most beneficial. Over time, monitoring results should help identify which practices to continue promoting and which to exclude. We strongly encourage you to monitor your projects to determine if adding these nongame habitat features is producing the desired results.

© Bob Hay

Pickerel Frog Eggs

Measurable Objectives

1. Species presence
2. Age class structure
3. Evidence of onsite reproduction
4. Successful recruitment
5. Habitat comparisons (pre and post)

Recommended Approaches

Pre-monitoring

Conduct pre-restoration inventories to acquire a reasonable baseline for nongame species using the protocols listed below. Wherever possible, pre-monitoring is recommended for two seasons prior to construction to obtain a more robust pre-construction inventory. For restoration projects where construction will be initiated after mid August, pre-monitoring can occur within the same season. For projects where construction must begin prior to mid August, pre-restoration monitoring should be conducted prior to the year that construction is initiated (e.g. If restoration is to begin in June 2015, pre-monitoring should to occur in 2013 and/or 2014, depending on whether one or two years of monitoring is planned.)

Conduct a thorough habitat assessment prior to or during pre-monitoring activities to identify all habitat types, land use within the restoration area and land use immediately adjacent to the restoration area, and the percent of each habitat type within the restoration area. Hand map the habitat types on aerial photos. This will be used along with the project plan map to help determine where to set up monitoring activities.

Post-monitoring

Post-monitoring should begin ***no sooner than two years after project completion.*** This will allow time for vegetation to become established and for the species to find and begin using the restored habitats. Long-term monitoring (year 5 and 7 post construction) is suggested for large projects sites (>.5 mi.) where two years of pre-construction monitoring occurred.

© Bob Hay

Calling frog American Toad

Monitoring Methods and Protocols

Clearly identify the monitoring area (length and width of riparian corridor). GPS and flag the upstream and downstream project limits and lateral perimeters. Pre-existing habitat types and projected post-project habitat types should be used to determine where to conduct the various monitoring efforts. Monitoring activities, pre and post, should be conducted where the highest capture/detection rates are likely, based on habitat conditions. Some locations, such as bird point counts, will be the same for both pre- and post-monitoring. The placement of traps, cover boards, drift fences, bird point counts and frog survey locations should be GPS'd for both monitoring efforts to provide consistency within each of the pre- and post-monitoring periods.

Pre- and post-monitoring efforts should also utilize the identical arrays of monitoring types (e.g. no. of traps, number of transects, number of bird count points, etc.) in order to have comparable levels of effort for each sampling type.

© J. Kapfer

Drift Fence Array for sampling amphibians, terrestrial invertebrates, mammals and small reptiles.

Amphibians

- Calling Surveys: 2 surveys during each of the three calling periods (April 8-30; May 20-June 6; July 1-15) for a total of 6 surveys* (See Wisconsin Frog and Toad Surveys Methods at: **http://wiatri.net/inventory/frogtoadsurvey/Volunteer/manual.cfm**
- In-pond larval salamander funnel trapping: Place 5 screen or wire funnel traps in each wetland/pond for 5 consecutive days between July 5 and July 20). Check traps daily and remove all of the entrapped contents once every 24 hours. Keep all larvae and invertebrates alive in pond water and get to a herps and invertebrate specialist for identification.
- Time/Area-constrained searches: Search along pond edges and streams using visual encounter, dip net, and hand collection.
- Drift Fencing: Place two Y-shaped arrays (3- 15M legs) per site using funnel and pitfall traps. Arrays should be run three times per year, mid-April to early May, mid May through June and late July through August. Fences should be checked for 3-5 days during each fence trapping period.

** Restoration sites longer than .5 miles will need more than one listening point. Listening points must be a minimum of .5 miles apart.*

Reptiles

- Hoop Net Trapping- in riparian wetlands and stream- trap for eight nights between May 15-June 30- 1 to 2 traps per wetland depending on size plus instream/backwaters (minimum of 6 traps and 48 trap nights).
- Cover Board Sampling (32" x 48" ¾ inch plywood- do not use OSB or other particle board types)- Boards are to be placed every 33 M along the length of the riparian corridor on both sides of the stream. Boards are to be laid where soils are normally dry. Boards should be checked on ten (10) non-consecutive days when air temperatures exceed 65 degrees and sunny conditions have occurred for at least 4 hours the day the boards are checked. Boards are to be checked no sooner than ***3 hours prior to sunset*** between May 15-July 15.
- Time-constrained searches- during suitable conditions (10- 1.5 hrs periods- conduct on days of other surveys when suitable conditions permit).
- Drift Fencing- (See amphibian section for details)

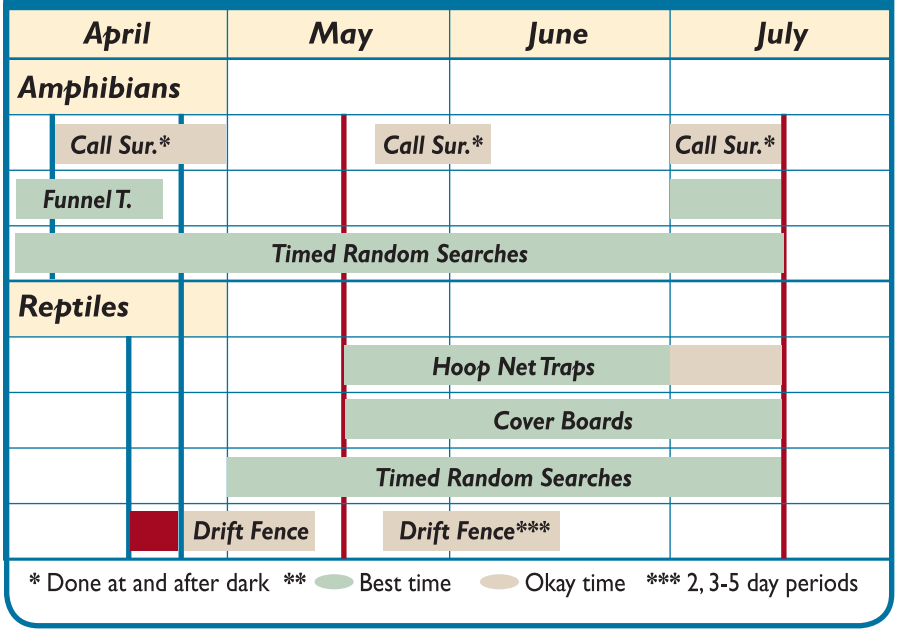
Birds

- Point counts: Conduct point counts along the length of the project area at GPS'd locations that are spaced at 200 meter intervals along the stream. Conduct additional point counts at 200 meter intervals in habitats that will or have been restored beyond 250 meters from the stream. Point counts should be done once in mid-late April to detect early breeding birds, again between Memorial Day and July 4 for summer breeders and in late July to early August to detect late breeders (e.g American goldfinch) and second nesters. Point counts are done for 5 minutes at each GPS'd location. Use the identical GPS points for pre and post restoration. Record all birds seen or heard. Also record any evidence of breeding or nesting while on site of all surveys. Point counts are conducted from sunrise to 9:30 am, during suitable weather conditions (good visibility, little or no precipitation, light winds).
- Record miscellaneous observations. (R. Hoffman, WDNR, pers. comm.)

Mammals

- Live trapping: Use Sherman and rain-protected pitfall traps in a transect. Place Sherman traps and pitfall traps alternately at 10 meter intervals along a 190 meter transect. Place one transect along each side of the stream for every 500 meters of stream and include as many habitat types as possible in each transect. GPS trap locations for both the pre- and post-monitoring efforts as the locations are likely to be different. Conduct trapping for four (4) full trap nights during July and August when rodent populations are at their highest. Check traps

Amphibian and Reptile Survey Phenology



© Neal Mundahl

Cover board

shortly after sunrise and again just before sunset each day. Remove and record all vertebrates captured and remove all other entrapped contents each time the traps are checked.

- Cover board surveys (combine with reptile surveys)
- Auditory and visual observations are to be made during other surveys
- Track surveys: Use North American mammal track guide to verify all tracks observed
- Drift fencing: (see Amphibian section for details)
- Bat Surveys: Conduct 2 night surveys during non-rainy and mild weather during the summer using electronic bat detectors and a laptop computer (Optional- dependent on having proper bat detection equipment).


© J. Kapfer

Mouse in drift fence funnel trap

Nongame Fish

Electro-shocking surveys: The following protocol are to be followed for evaluating the entire fish community.

1. Electrofish in an upstream direction during daylight hours when water levels are not substantially above baseline flows.
2. Conduct electrofishing sometime between May 20 and 10 September.
3. Each station should be 35 times the average width of the stream (i.e., if the stream site averages 7 m wide, the site should be 245 m long), with a minimum length of 100 m for streams less than ~3 m wide and a maximum of 400 m in length for streams greater than ~11.5 m wide.
4. Sites should start and stop at least 10 stream widths from a bridge, dam, tributary, or other feature that changes the hydrological character of the stream, and where possible the site should stop and start at a riffle; sometimes the station will have to be lengthened or shortened a few m to meet these criteria. The exact length sampled (and the average width) should be noted but isn't critical as long as it's ***never*** less than 100 m.
5. Equipment type- In streams less than ~2 m wide, a pulsed-DC backpack shocker should be used, but in larger streams a DC stream shocker with two or three anodes (3 whenever possible, but 2 OK in streams ~2-5 m wide).
6. During shocking every effort should be made to pick up all individuals or all species (i.e., don't focus on just larger fish or on gamefish), and all captured fish should be identified to species.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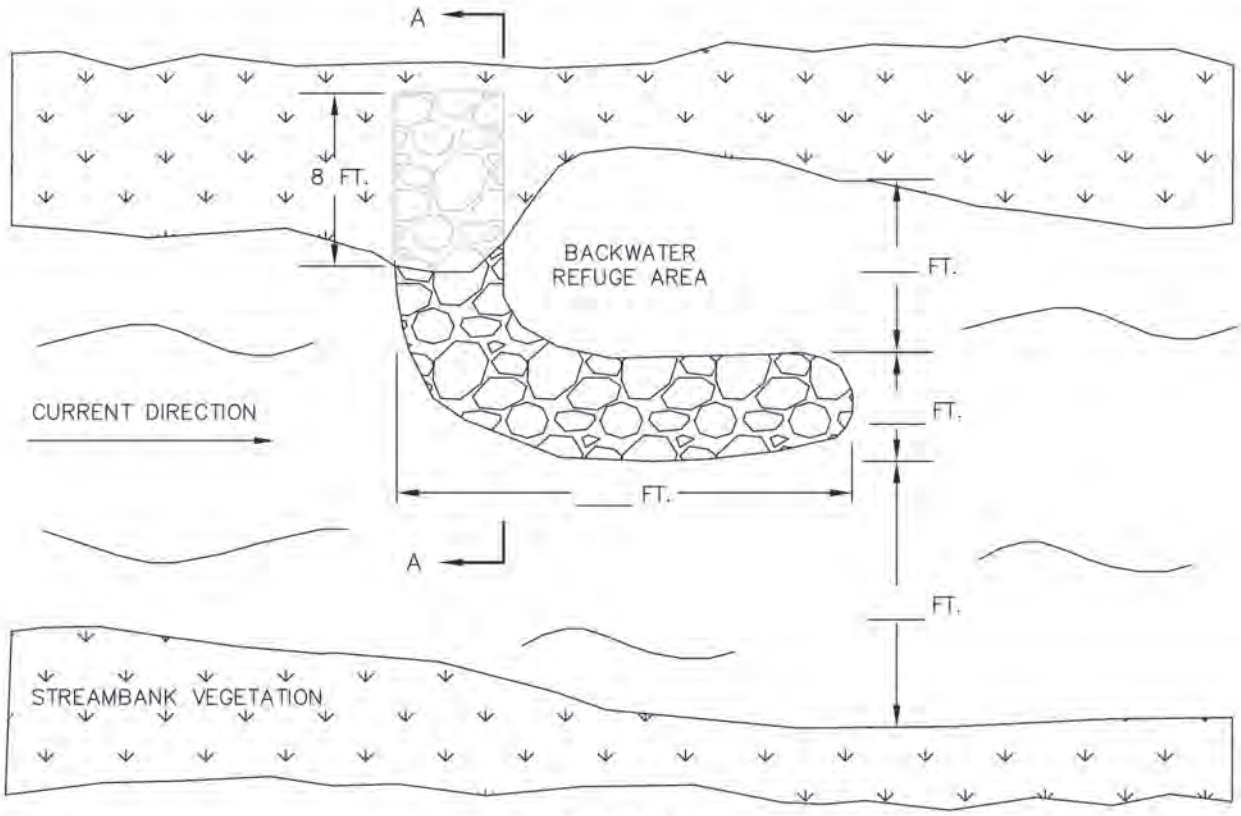
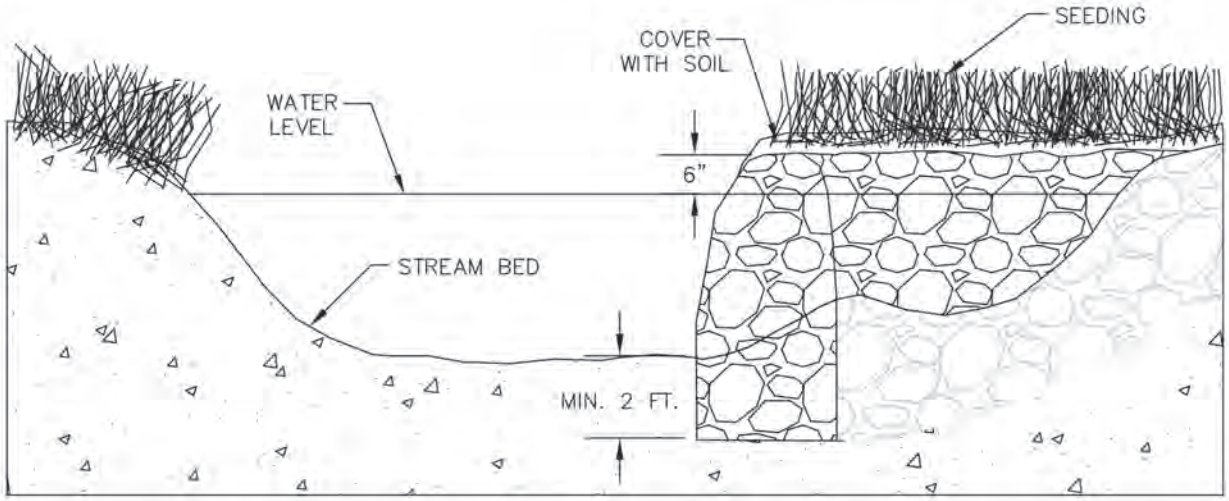
Habitat Designs

Wood turtle hatchling

Index



PLAN VIEW



SECTION A–A

NOTE: CARE SHALL BE TAKEN DURING PLACEMENT TO AVOID STREAM BANK EROSION ON OPPOSITE BANK.

ROCK GRADATION	
PERCENT PASSING BY WEIGHT	SIZE IN INCHES
100	
60–85	
25–50	
5–20	
0–5	

QUANTITIES	
ROCK RIPRAP FOR HOOK (W.C.S.* 9)	CU. YD.

*W.C.S. = WIS. CONSTRUCTION SPECIFICATION
*ESTIMATED TO THE NEAT LINES AND GRADE

NRCS
Natural Resources Conservation Service
United States Department of Agriculture

BACKWATER HOOK

CLIENT: _____
COUNTY: _____

Date
Designed _____
Drawn _____
Checked _____
Approved _____

Drawing Name
WI–931A

Date
12/2010

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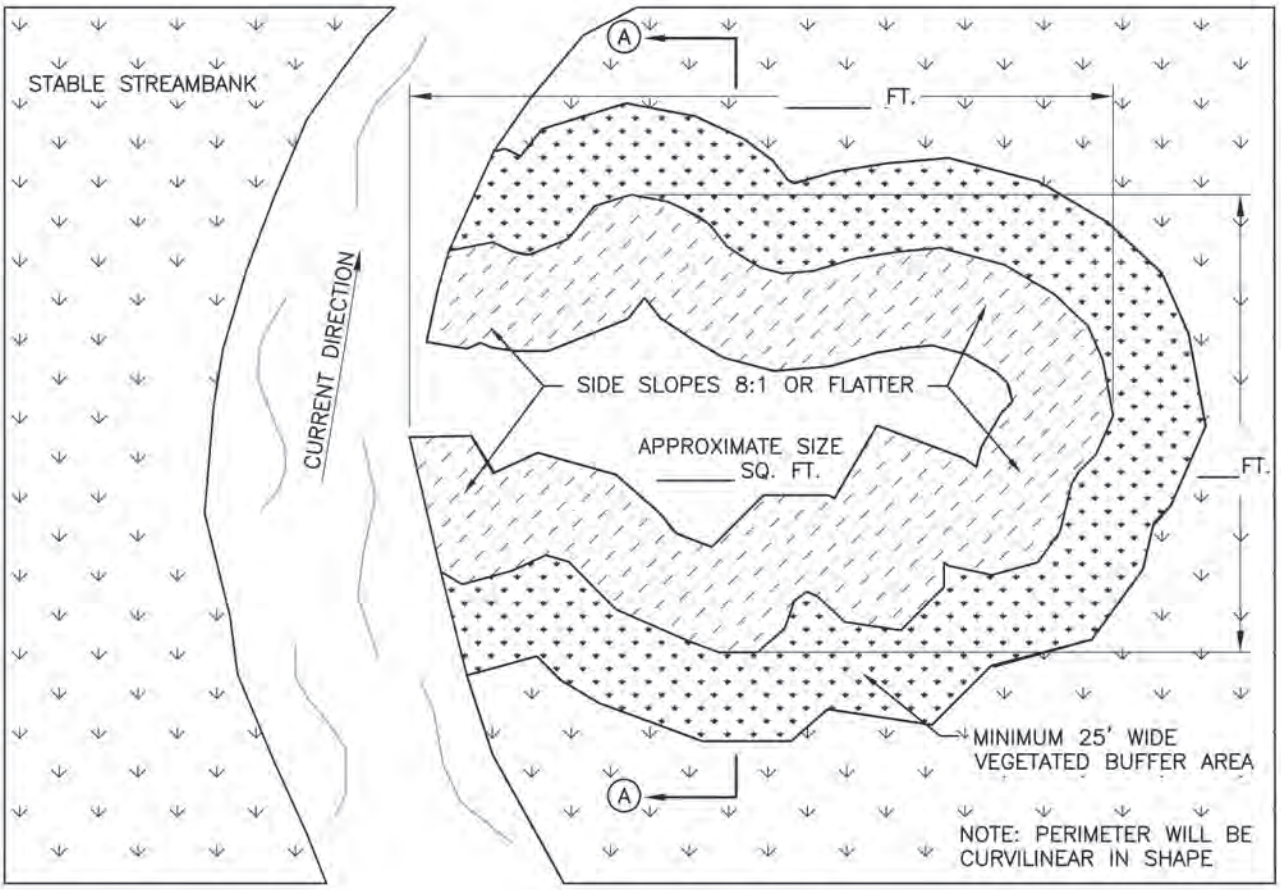

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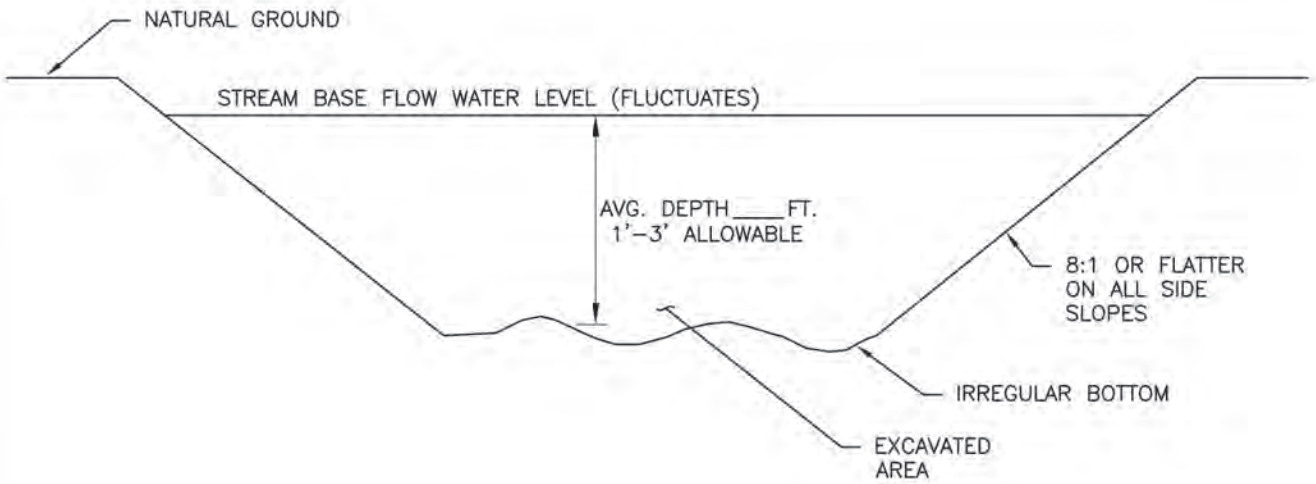


TYPICAL CROSS SECTION A–A

NRCS Natural Resources Conservation Service United States Department of Agriculture	BACKWATER REFUGE CLIENT: _____ COUNTY: _____	Date Designed _____ Drawn _____ Checked _____ Approved _____	DWG Name/Date WI-931 / 7-10 Page 1 of 2 Sheet of

CONSTRUCTION NOTES FOR BACKWATER REFUGE

1. BACKWATER REFUGES ARE TO BE IRREGULAR IN SHAPE WHEN COMPLETED. WHEEL RUTS ARE ALLOWED AND DESIRED. THE REFUGE NEEDS TO BE CONSTRUCTED TO THE APPROXIMATE SURFACE AREA, DEPTH AND RREGULARITY AS WHAT IS FLAGGED BY NRCS STAFF.

2. ALL EXCAVATION SHALL BE IN ACCORDANCE WITH WISCONSIN CONSTRUCTION SPECIFICATION #2.

3. RE-TOPSOILING MAY BE NEEDED. IF NEEDED A MINIMUM OF 6" OF TOPSOIL WILL BE REMOVED FROM REFUGE SITE AND STOCKPILED FOR RE-SPREADING. BEFORE TOPSOIL IS RE-SPREAD THE DEPTH AND SLOPES MUST BE CHECKED. SEEDING SHOULD BE COMPLETED PER DRAWING WI-710 FOR INTRODUCED SPECIES OR DRAWING WI-711 FOR NATIVE SPECIES.

4. THE FINSIHED SIDE SLOPES ARE TO BE 8:1 OR FLATTER.

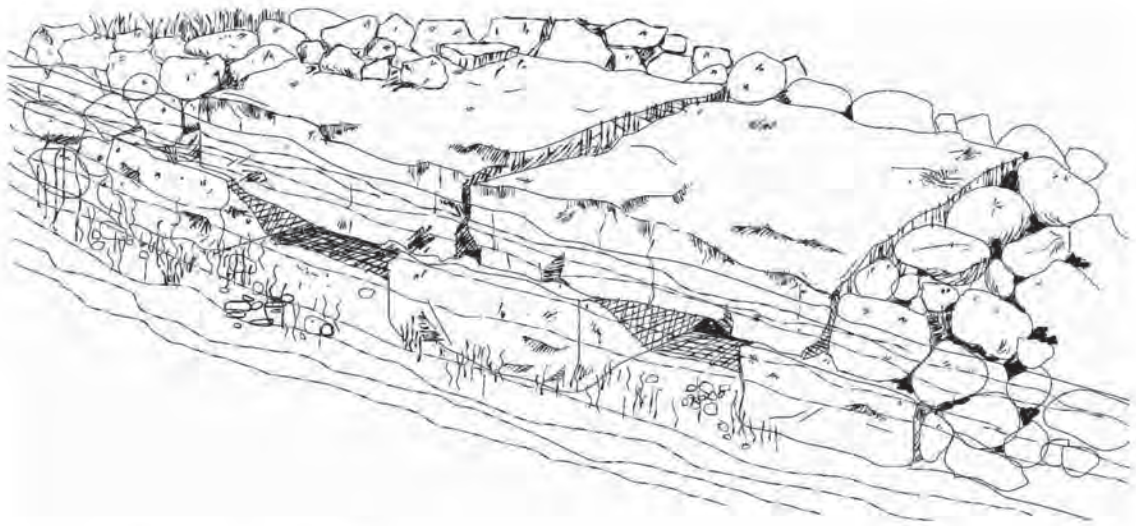
5. EXCAVATED SPOIL FROM THE REFUGE SHALL BE:
   a. REMOVED FROM THE REFUGE/FLOODPLAIN AREAS AND PLACED AS INDICATED ON THE PLAN VIEW.
   b. PLACED BELOW THE PLANNED NORMAL WATER ELEVATION OF THE POOL FOR REFUGE MICROTOPOGRAPHY.
   c. SPREAD ABOVE THE PLANNED NORMAL WATER ELEVATION IN A LAYER AVERAGING NO MORE THAN 3-6 INCHES THICK. SPREAD IN THE LOCATIONS INDICATED ON THE PLAN VIEW FOR THIS PROJECT. NO FILL SHALL BE PLACED IN AN EXISTING WETLAND.

6. BASKING AREAS MAY BE ADDED AS APPROVED BY NRCS STAFF. THESE AREAS CAN CONSIST OF LOGS/WOODY DEBRIS OR PILES OF STONE ADDED TO THE REFUGE. THESE ADDITIONS SHOULD BE PLACED A MINIMUM OF 3-4 FEET FROM THE EDGE OF THE REFUGE TO ACT AS A BASKING AREA AND BE FAR ENOUGH INTO REFUGE TO MINIMIZE PREDATION.

7. BUFFER SEED MIXES SHOULD BE STRONGER IN FORB AND SHORT GRASS COMPONENTS. THIS WILL CREATE MORE INTERSTITIAL SPACE, AIDING IN REPTILE/AMPIBIAN MOVEMENT AND BASKING PER WI-710 OR WI-711.

WI-931

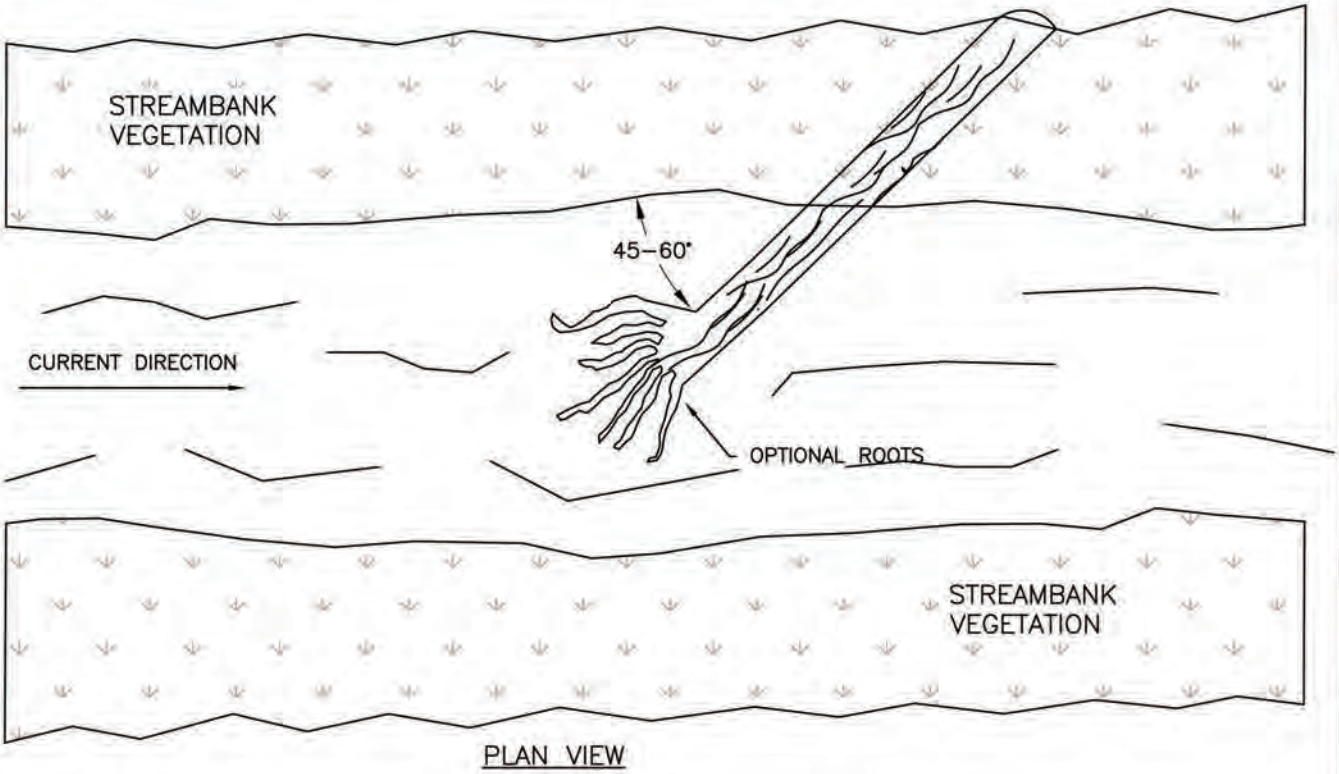
BARNIE RUBBLE
TROUT HABITAT STRUCTURE
ORIGINAL DESIGN BY TOM DORNACK



MATERIAL LIST

A BUNCH OF LIMESTONE
ROCKS AND A SKILLED
BACKHOE OPERATOR

ORIGINAL DESIGN BY TOM DORNACK
ILLUSTRATED BY: TOM LANE - JULY '09
FOR USE BY: TROUT UNLIMITED & DNR



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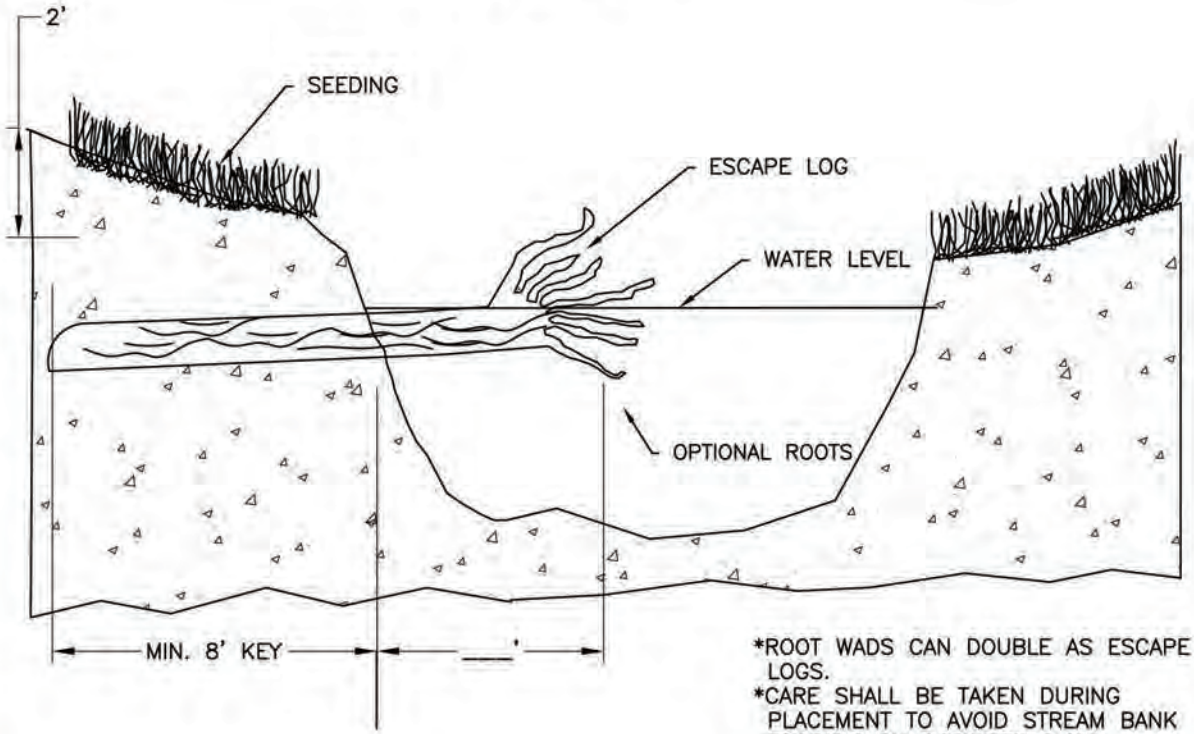


CROSS SECTION

*ROOT WADS CAN DOUBLE AS ESCAPE LOGS.
*CARE SHALL BE TAKEN DURING PLACEMENT TO AVOID STREAM BANK EROSION ON OPPOSITE BANK.
*THE LOG SHOULD EMERGE MIN. 3'–4' FROM EDGE OF STREAM BANK.
*ROOTS/LIMBS SHALL BE TRIMMED SO AS TO BE BELOW THE ORDINARY HIGH WATER MARK.

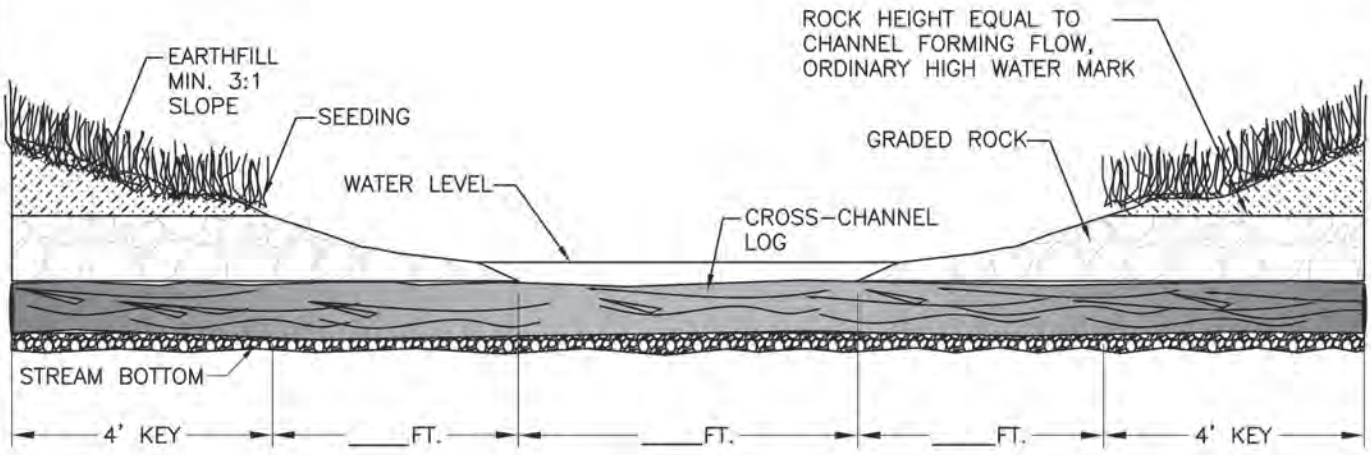
NRCS
Natural Resources Conservation Service
United States Department of Agriculture

ESCAPE LOG

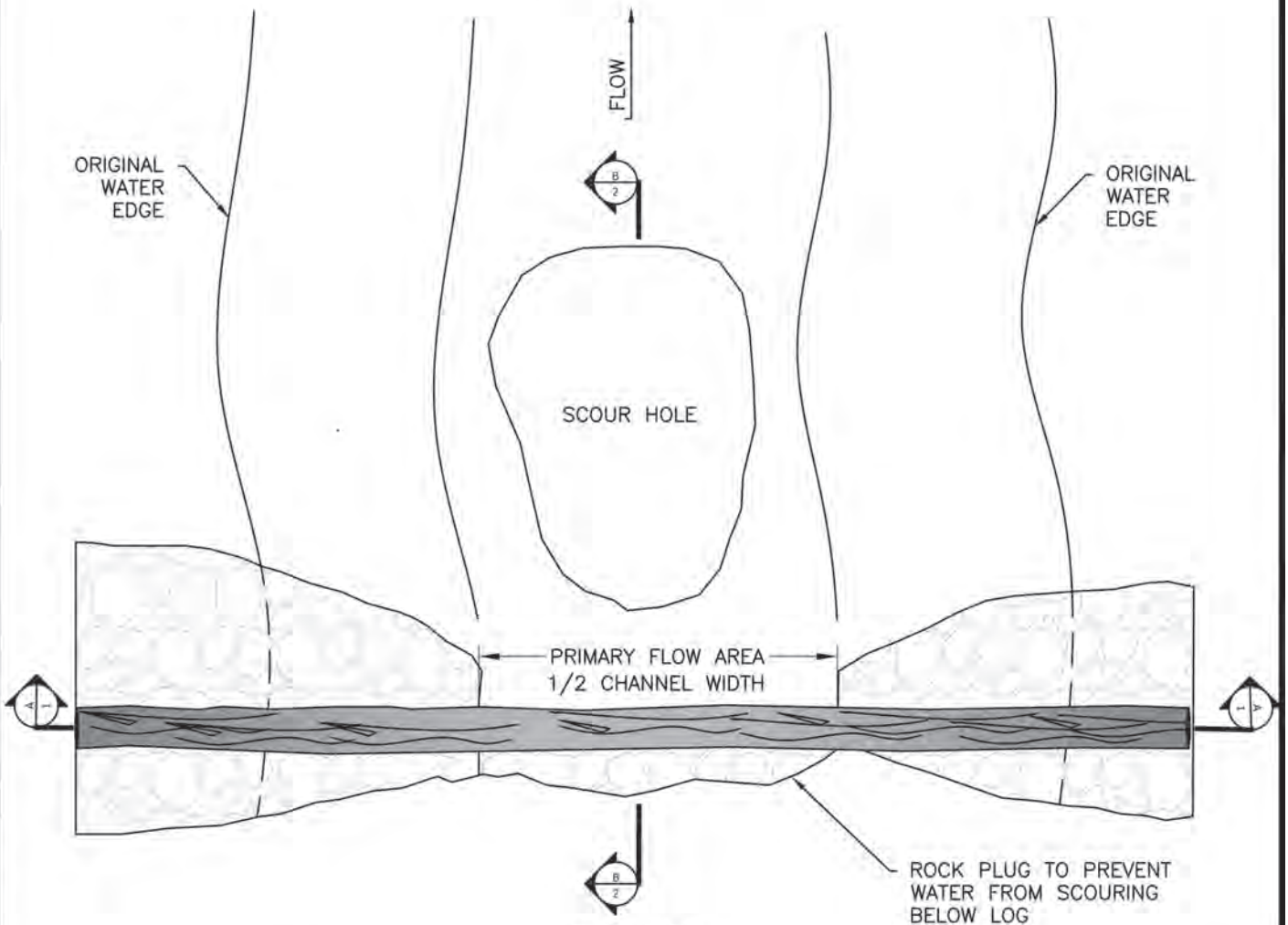
CLIENT: _____

COUNTY: _____

	Date	Drawing Name
Designed		WI–942
Drawn		Date 12/2010
Checked		
Approved		Sheet of

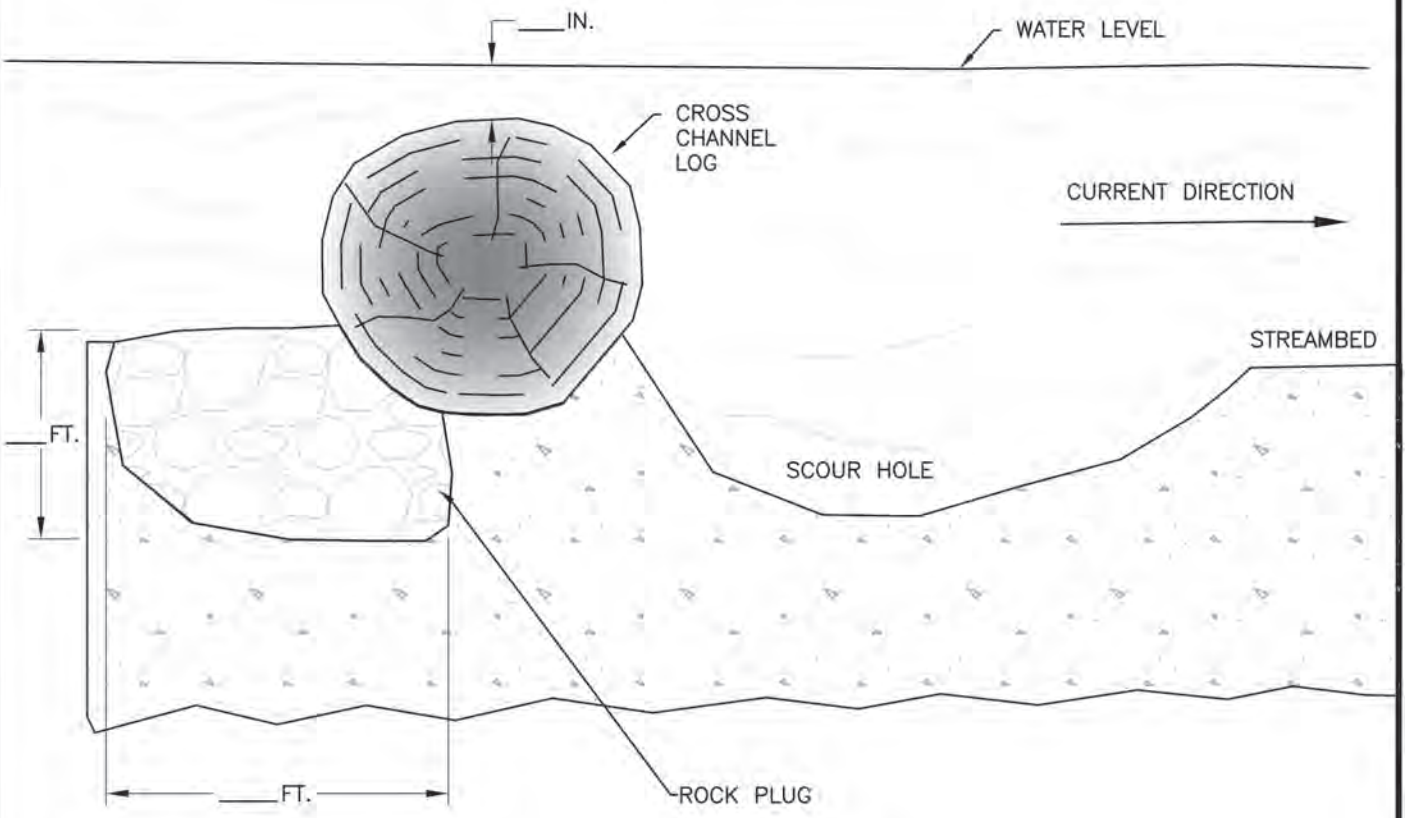


CROSS SECTION A–A



PLAN VIEW

NRCS Natural Resources Conservation Service United States Department of Agriculture	CROSS CHANNEL LOG CLIENT: _____ COUNTY: _____	Date Designed _____ Drawn _____ Checked _____ Approved _____	DWG Name/Date WI-935/12-11 Page 1 of 2 Sheet of



CROSS–SECTION B–B

NOTE: ROOT WADS, BOULDER RETARDS OR ESCAPE LOGS CAN BE ADDED TO SCOUR HOLE FOR ADDED HABITAT ENHANCEMENT

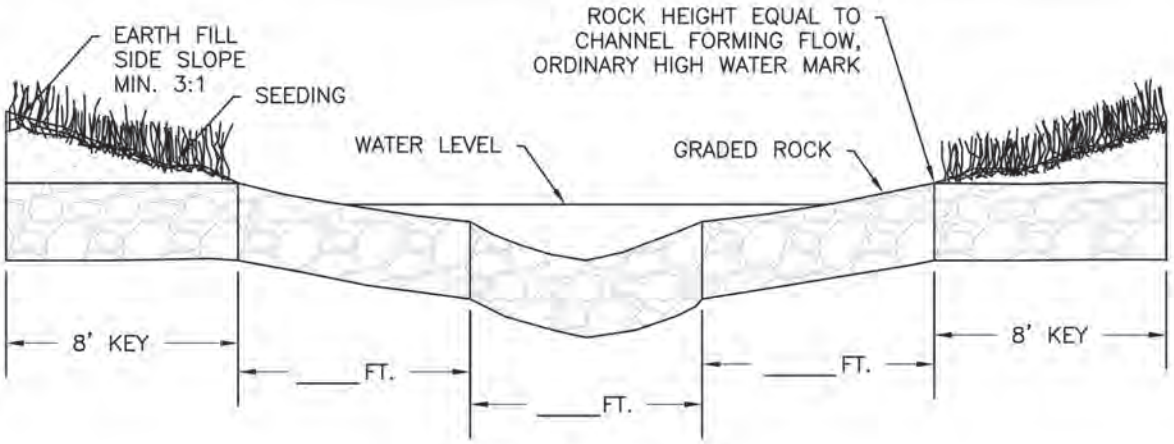
ROCK GRADATION	
PERCENT PASSING BY WEIGHT	SIZE IN INCHES
100	
60–85	
25–50	
5–20	
0–5	

QUANTITIES	
ROCK RIPRAP FOR ROCK PLUG (W.C.S.* 9)	CU. YD.

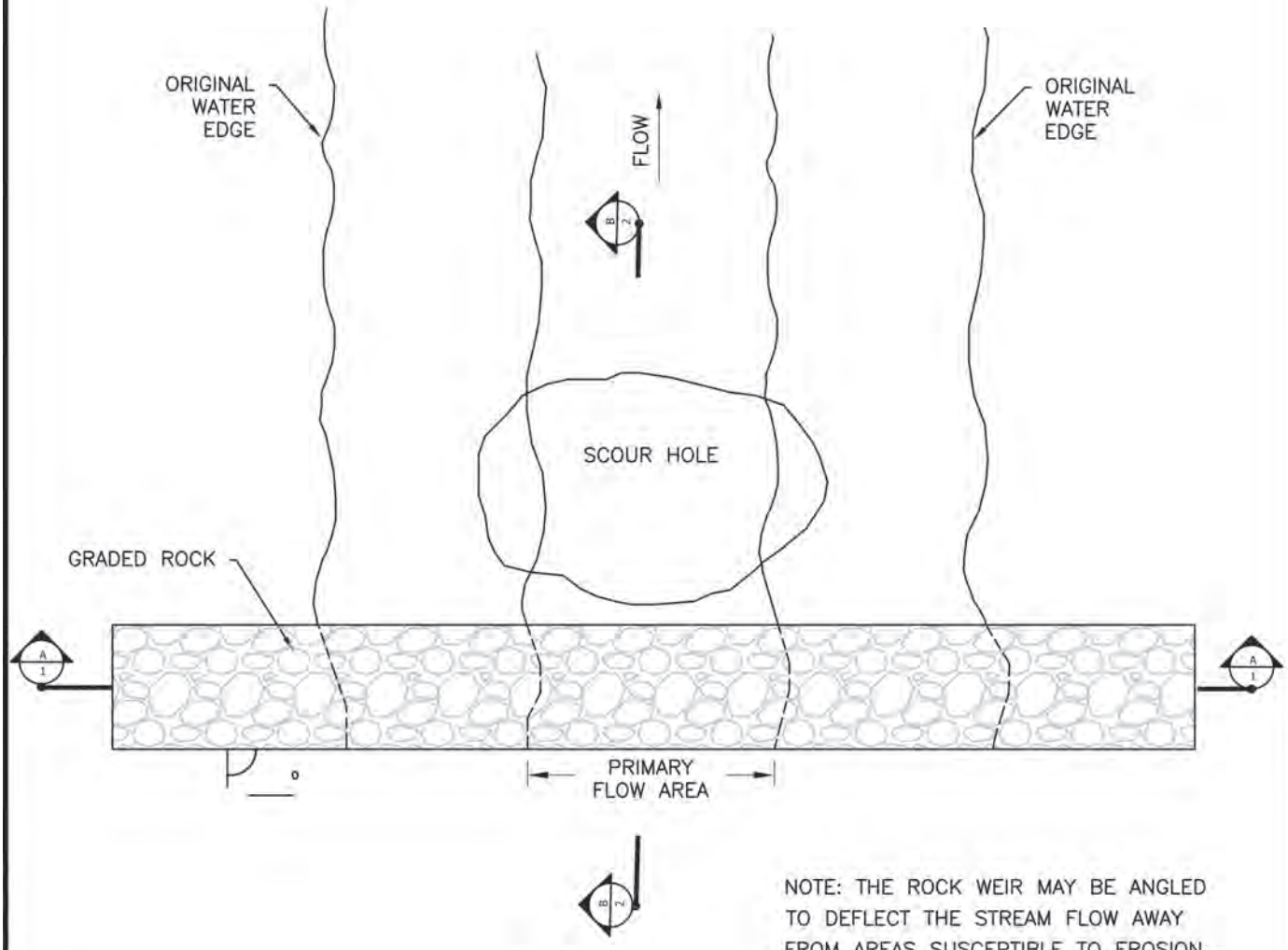
*W.C.S. = WIS. CONSTRUCTION SPECIFICATION

*ESTIMATED TO THE NEAT LINES AND GRADE

WI–935



CROSS SECTION A–A



NOTE: THE ROCK WEIR MAY BE ANGLED TO DEFLECT THE STREAM FLOW AWAY FROM AREAS SUSCEPTIBLE TO EROSION.

PLAN VIEW

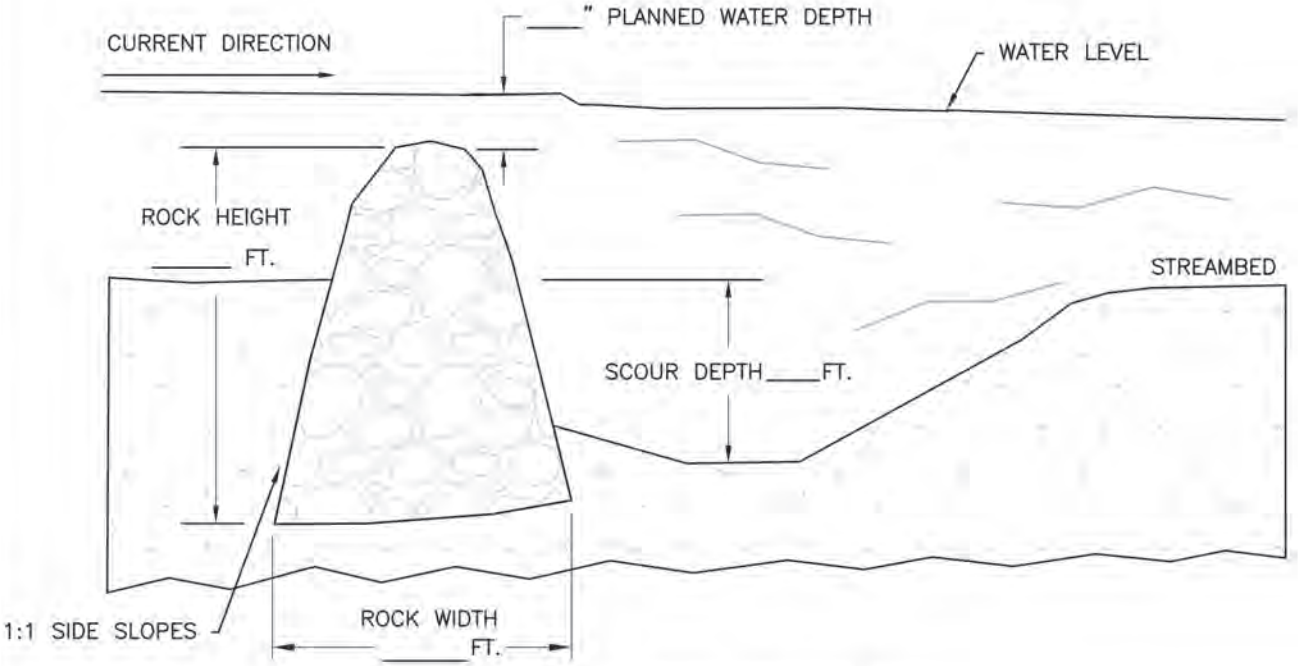
NRCS
Natural Resources Conservation Service
United States Department of Agriculture

CROSS CHANNEL ROCK WEIR

CLIENT: _____

COUNTY: _____

	Date	DWG Name/Date
Designed		WI–935A/12–11
Drawn		Page 1 of 2
Checked		
Approved		Sheet of



CROSS–SECTION B–B

NOTES:
1. ROCK DEPTH BELOW STREAMBED MUST BE GREATER THAN THE ANTICIPATED DEPTH OF HE SCOUR HOLE.

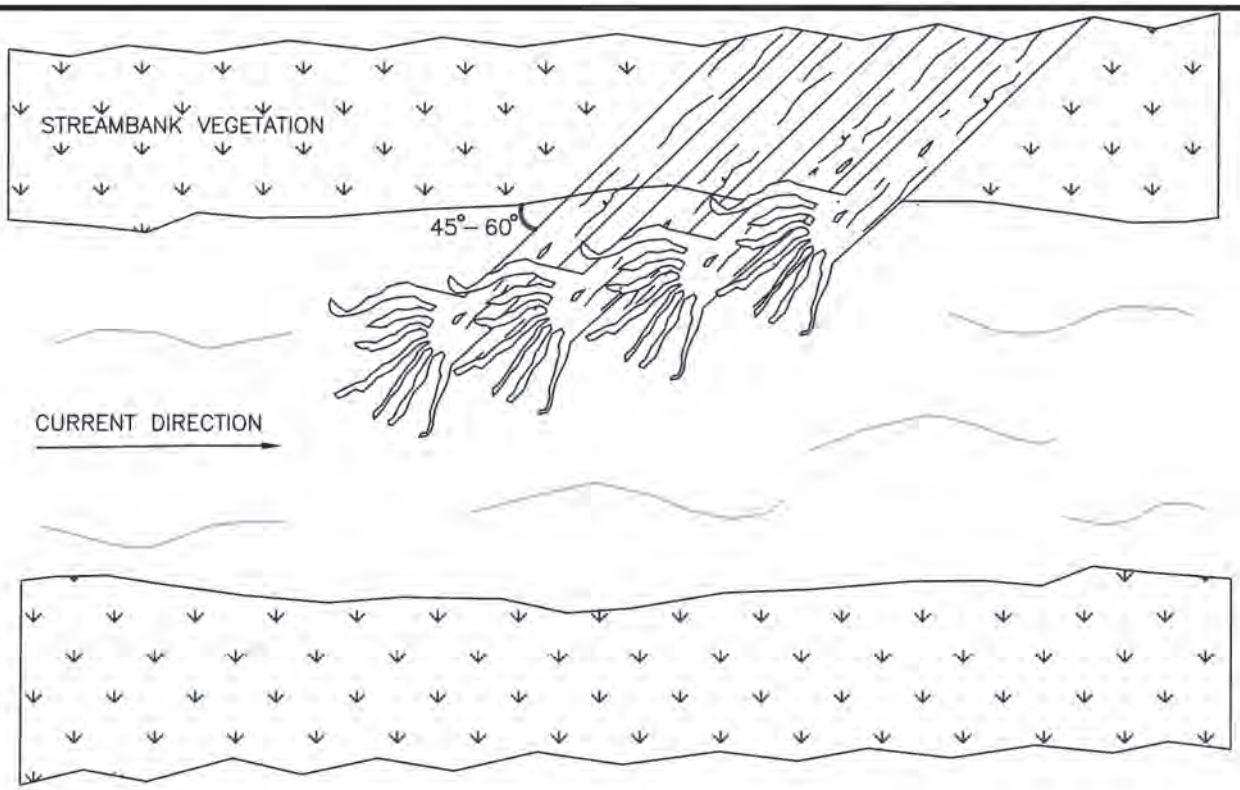
2. ROOT WADS, BOULDER RETARDS, ESCAPE LOGS, ETC. CAN BE ADDED TO SCOUR HOLE FOR HABITAT ENHANCEMENT.

ROCK GRADATION	
PERCENT PASSING BY WEIGHT	SIZE IN INCHES
100	
60–85	
25–50	
5–20	
0–5	

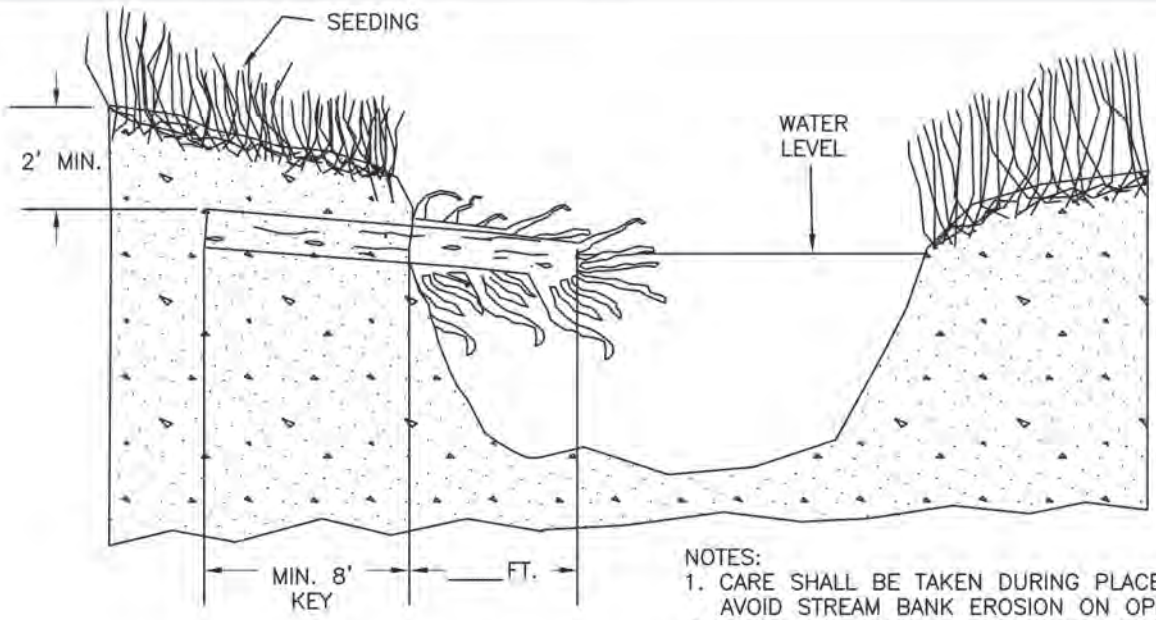
QUANTITIES	
ROCK RIPRAP FOR ROCK WEIR (W.C.S.* 9)	CU. YD.

*W.C.S. = WIS. CONSTRUCTION SPECIFICATION
*ESTIMATED TO THE NEAT LINES AND GRADE

WI–935A



PLAN



CROSS SECTION

NOTES:
1. CARE SHALL BE TAKEN DURING PLACEMENT TO AVOID STREAM BANK EROSION ON OPPOSITE BANK.
2. ROOT WADS MUST BE PRESENT ON EACH LOG.
3. THE LOG DEFLECTOR SHALL CONSIST OF THREE LOGS AT A MIN 24" DBH OR FIVE LOGS OF APPROX. 16" DBH.
4. THE MAJORITY OF THE LOG SHALL BE SUBMERGED WITH APPROX. 15% OF THE LOG EMERGED. CARE SHALL BE TAKEN TO KEEP THE LOG BELOW THE OHWM.

NRCS
Natural Resources Conservation Service
United States Department of Agriculture

LOG DEFLECTOR

CLIENT: _____

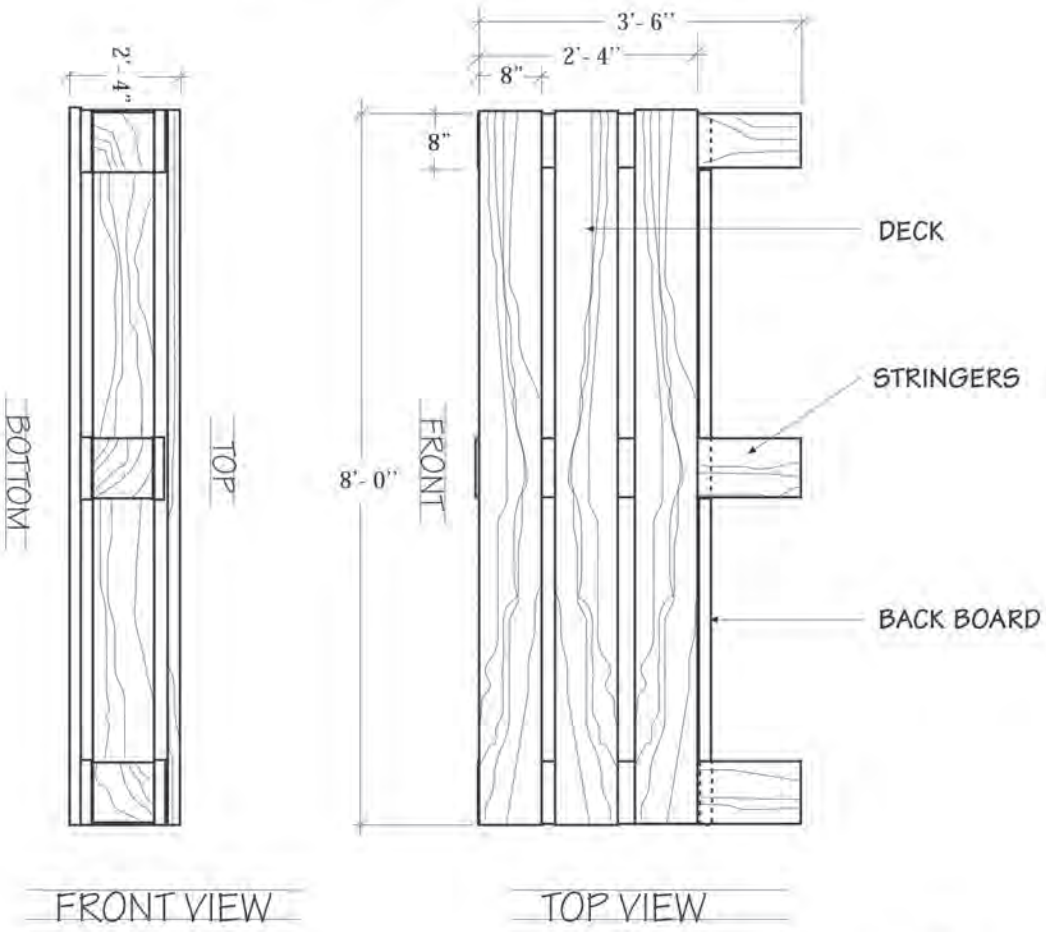
COUNTY: _____

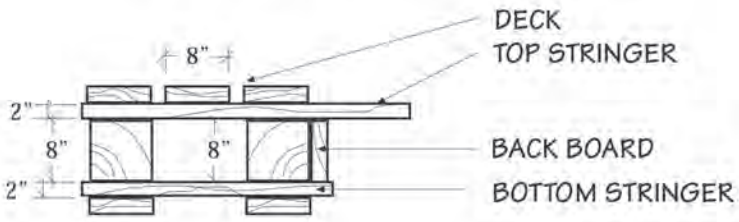
	Date	Drawing Name
Designed		WI–934
Drawn		Date
Checked		7/10
Approved		Sheet of

THE LUNKER

42" TROUT HABITAT STRUCTURE

ORIGINAL DESIGN BY DAVE VITRANO





MATERIAL LIST

6 - 2" X 8" X 8'
3 - 2" X 8" X 3' -6"
3 - 2" X 8" X 2' -4" STRINGERS
6 - 8" X 8" X 8" BLOCKS

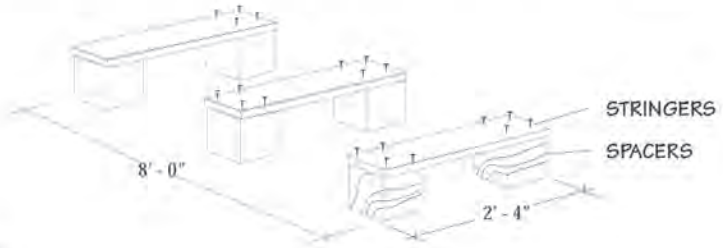
The structures are made of solid oak rough-cut materials and are designed to be held in place by flat limestone rock weighing over 1200 lbs. The structures are laid in place, end to end, 3-5 at a time with the limestone overlapping and tieing the structures in place. This series of structures is place just below the water line with cover rock and dirt completely covering the structures. The area is then reseeded with a mixture of oats and wild prairie plants which will reestablish a heavy grass matt to tie back in with the natural setting of the stream.

ORIGINAL DESIGN BY DAVE VITRANO
ILLUSTRATED BY: TOM LANE - MAR '10
FOR USE BY: TROUT UNLIMITED & DNR

42" LUNKER
ASSEMBLY INSTRUCTIONS

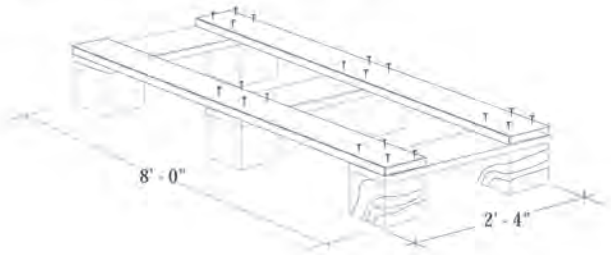
STEP 1

CUT SIX SPACERS, 8"X 8"X 8" AND PLACE THEM ON THE GROUND IN PAIRS WITH THE OUTSIDE EDGES 2' -4" APART AS ILLUSTRATED BELOW. NAIL A 2"X 8" X 2'-4" OAK STRINGER BOARD TO THE TOP OF THE SPACERS.



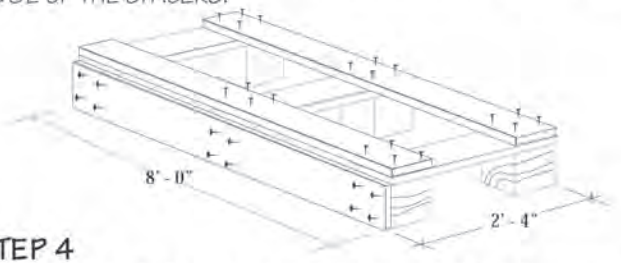
STEP 2

PLACE 2 - 2" X 8" X 8' LONG BOARDS ACROSS THE 2' -4" STRINGERS AND NAIL IN PLACE TO TIE THE PAIRS TOGETHER.



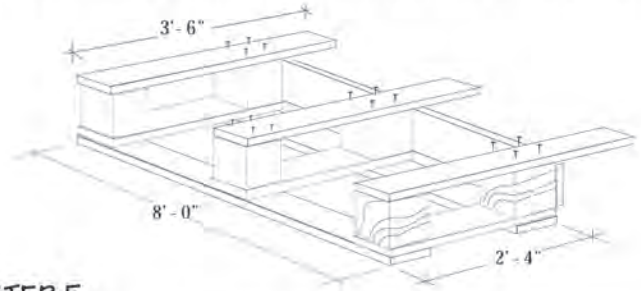
STEP 3

NAIL A 2" X 8" X 8' BACKING BOARD ON THE BACK OF THE REAR SET OF SPACERS. MAKE SURE THE BACKING BOARD IS LINED UP WITH THE BOTTOM EDGE OF THE SPACERS.



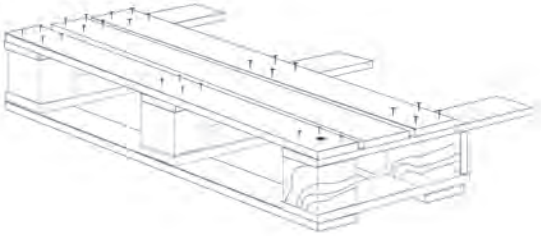
STEP 4

FLIP THE STRUCTURE OVER AND ATTACH 3 - 2" X 8" X 3' -6" LONG STRINGER BOARDS TO THE TOP OF THE 8" X 8" SPACERS, MAKING SURE THE TOP STRINGERS ARE RUNNING IN THE SAME DIRECTION AS THE SHORTER STRINGERS. THE LONGER STRINGERS WILL OVER LAP THE BACKING BOARD.



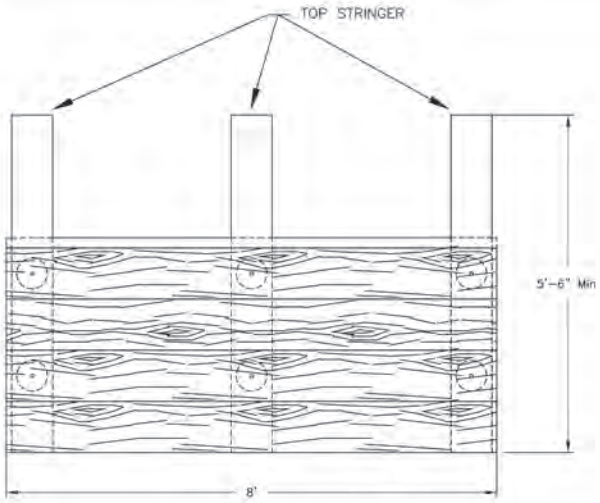
STEP 5

ADD 3 - 2" X 8" X 8' BOARDS 2" APART, TO CREATE A PLATFORM ON THE TOP FRONT OF THE STRUCTURE.

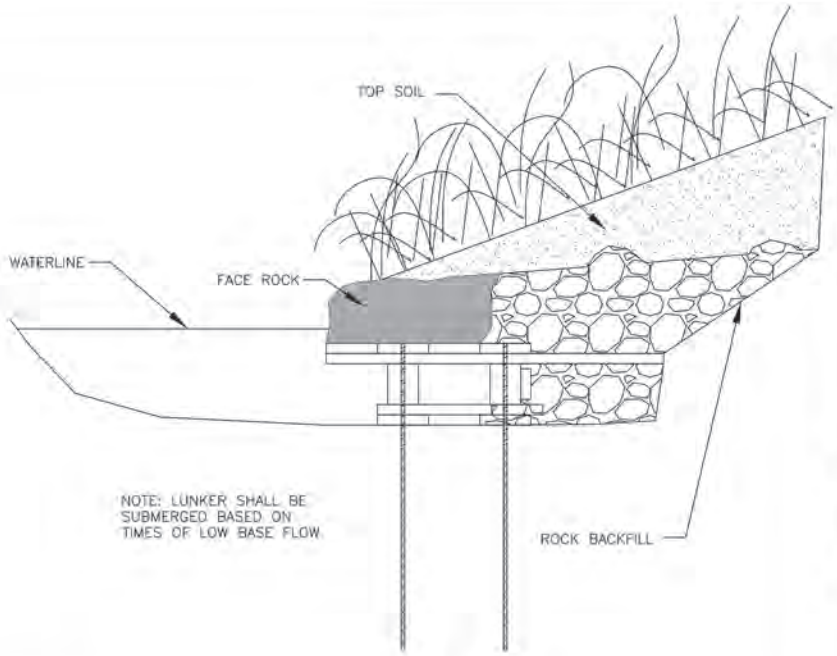


ORIGINAL DESIGN BY DAVE VITRANO
ILLUSTRATED BY: TOM LANE - MAR '10
FOR USE BY: TROUT UNLIMITED & DNR

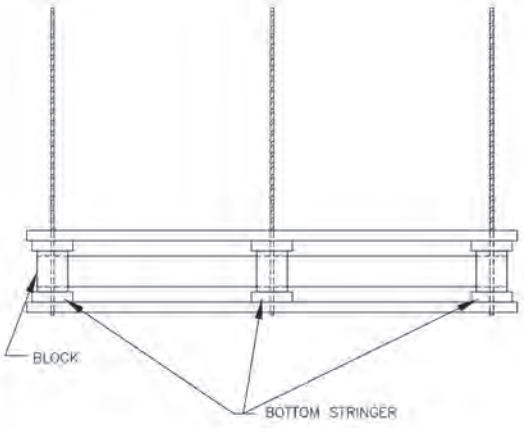
Edited: 3/8/10



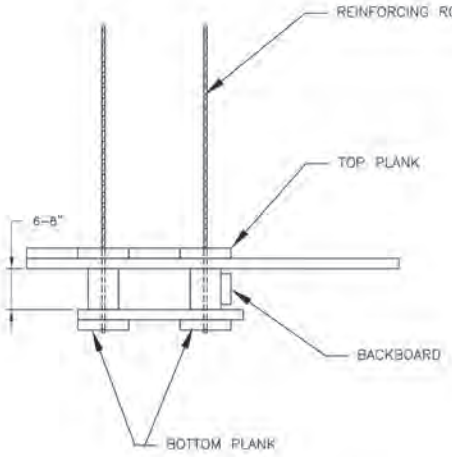
TOP VIEW



CONSTRUCTED SIDE VIEW



FRONT VIEW



SIDE VIEW

BILL OF MATERIALS
LUNKER STRUCTURE

ITEM	SIZE	QUANTITY
TOP PLANK	2" X 8" X 8' OAK BOARD	4
TOP STRINGER	2" X 8" X 4' Min OAK BOARD	3
BLOCK	6" DIA. X 8" OAK BLOCK	6
BOTTOM STRINGER	2" X 8" X 30" BOARD	3
BOTTOM PLANK	2" X 8" X 8' OAK BOARD	2
BACKBOARD	2" X 6"(or 8") X 8' OAK BOARD	1
#5 REINFORCING ROD	5/8" X 5' DEFORMED STEEL	6
NAILS	20D GALVANIZED	60

9 Total Boards 2" X 8" X 8 Feet Long

Date
Designed
Drawn
Checked
Approved

LUNKER STRUCTURE DETAIL

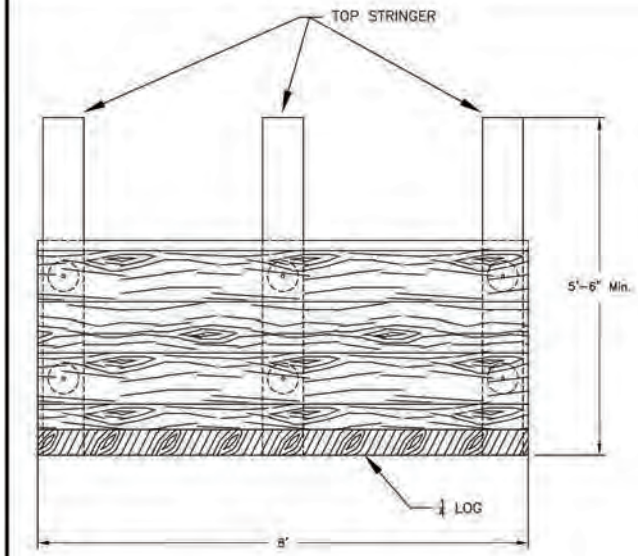
OWNER:
COUNTY:

NRCS
Natural Resources Conservation Service
United States Department of Agriculture

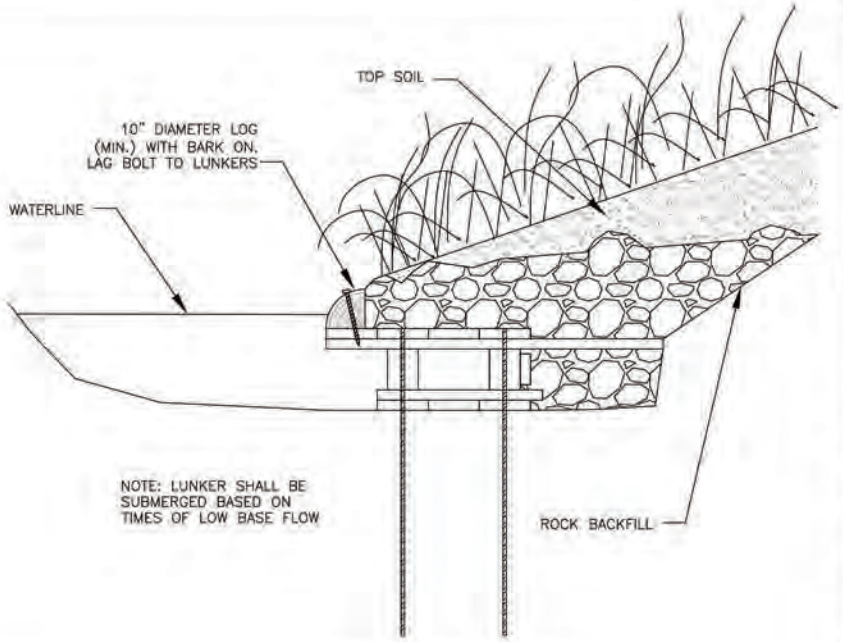
Drawing Name
WI-930

Date
7/10

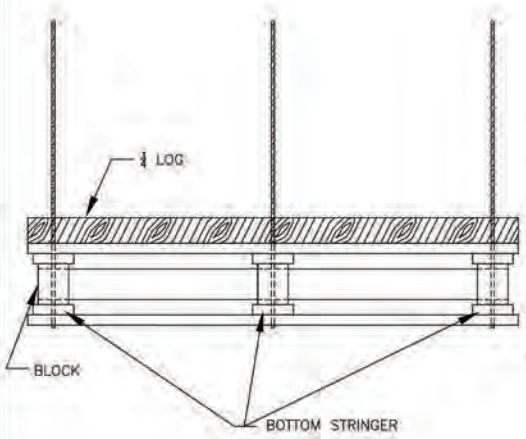
Sheet of



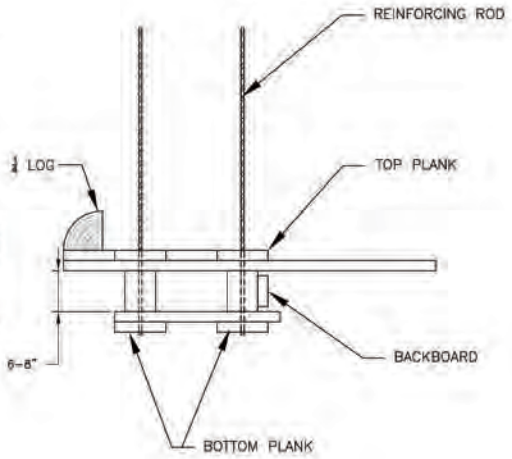
TOP VIEW



CONSTRUCTED SIDE VIEW



FRONT VIEW



SIDE VIEW

BILL OF MATERIALS LUNKER STRUCTURE		
ITEM	SIZE	QUANTITY
TOP PLANK	2" X 8" X 8' OAK BOARD	4
TOP STRINGER	2" X 8" X 5'-6" Min OAK BOARD	3
BLOCK	6" DIA. X 8" OAK BLOCK	6
BOTTOM STRINGER	2" X 8" X 30" BOARD	3
BOTTOM PLANK	2" X 8" X 8' OAK BOARD	2
BACKBOARD	2" X 6" X 8' OAK BOARD	1
#5 REINFORCING ROD	⅝" X 5' DEFORMED STEEL	6
NAILS	20D GALVANIZED	60
LAG BOLTS	¾" X 8" GALVANIZED	4
¼ LOG	8-9 FEET LONG	1

10 Total Boards 2" X 8" X 8-9 Feet Long

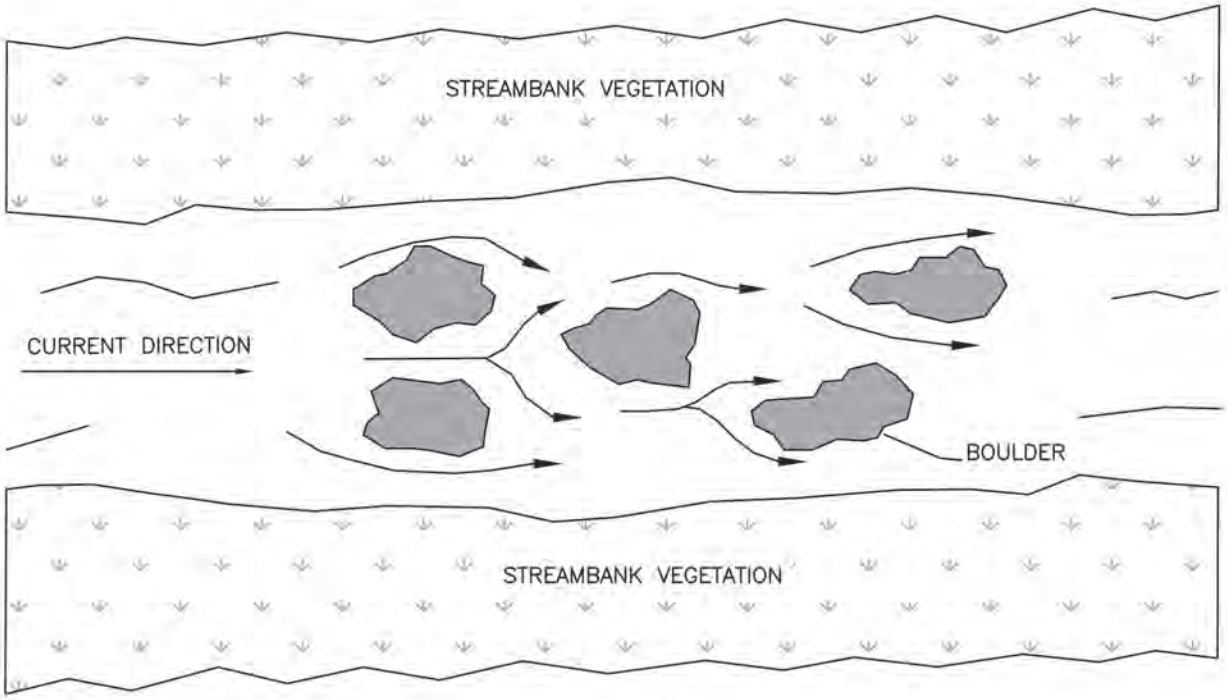
Date
Designed
Drawn
Checked
Approved

LUNKER STRUCTURE DETAIL WITH 1/4 LOG

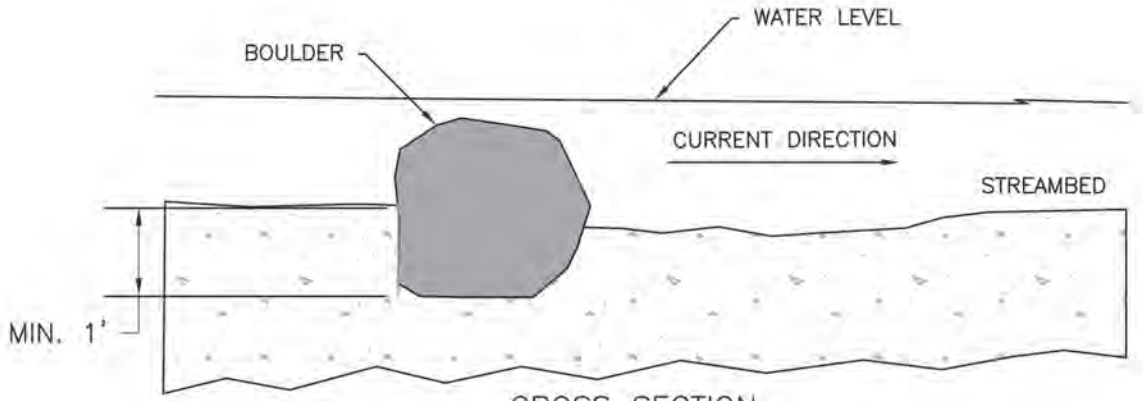
OWNER:
COUNTY:

NRCS
Natural Resources Conservation Service
United States Department of Agriculture

Drawing Name
WI-930 A
Date
7/10
Sheet of



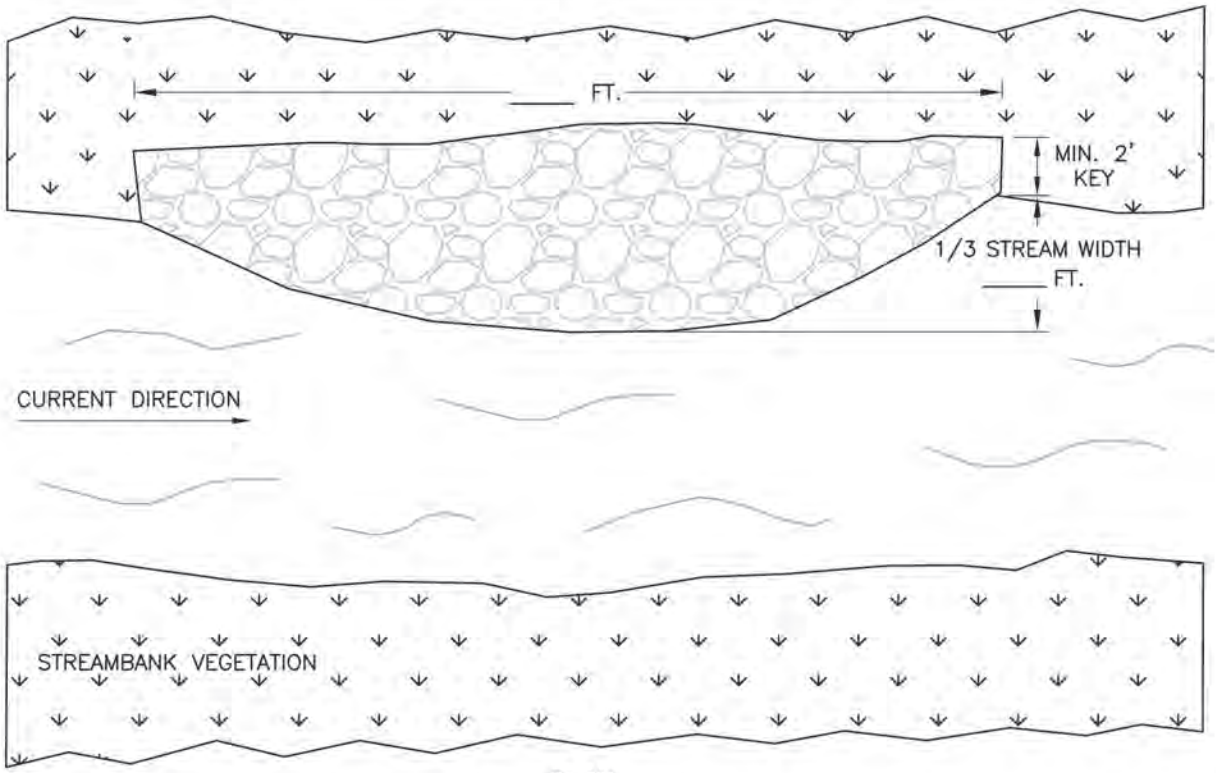
PLAN VIEW



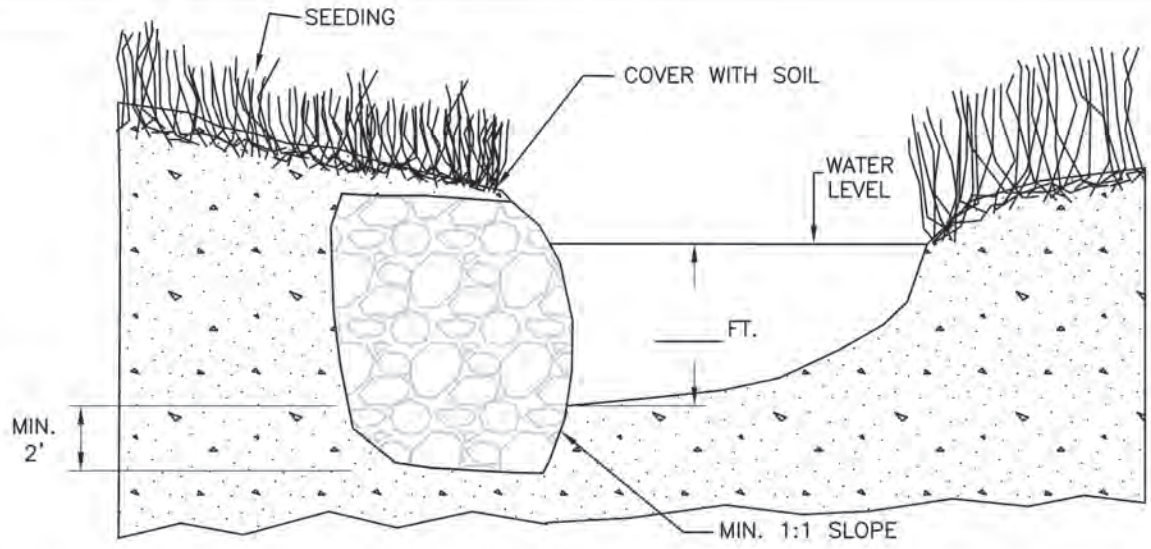
CROSS SECTION

- AVERAGE ROCK SIZE– 1.5'–3.5' DIA.–ROCK, SIZE IS SITE DEPENDENT.
- A MINIMUM OF ONE BOULDER PER SET OF BOULDERS SHOULD PROTRUDE FROM WATER SURFACE DURING TIMES OF ORDINARY FLOW TO ACT AS MID–STREAM PERCHING/LOAFING SITES.
- USE BOULDERS WITH IRREGULARITIES OR MULITPLE BOULDERS TOGETHER TO PROVIDE SLIGHT OVERHANGING COVER.
- PLACE BOULDERS SO CURRENT WILL NOT BE DEFLECTED INTO UNPROTECTED STREAM BANKS.

NRCS Natural Resources Conservation Service United States Department of Agriculture	RANDOM BOULDER PLACEMENT CLIENT: _____ COUNTY: _____	Date Designed _____ Drawn _____ Checked _____ Approved _____	Drawing Name WI–937 Date 12/2010 Sheet of



PLAN



CROSS SECTION

NOTE: CARE SHALL BE TAKEN DURING PLACEMENT TO AVOID STREAMBANK EROSION ON OPPOSITE BANK.

ROCK GRADATION	
PERCENT PASSING BY WEIGHT	SIZE IN INCHES
100	
60–85	
25–50	
5–20	
0–5	

QUANTITIES	
ROCK RIPRAP FOR ROCK DEF. (W.C.S.* 9)	CU. YD.

*W.C.S. = WIS. CONSTRUCTION SPECIFICATION

*ESTIMATED TO THE NEAT LINES AND GRADE

NRCS
Natural Resources Conservation Service
United States Department of Agriculture

ROCK DEFLECTOR

CLIENT: _____

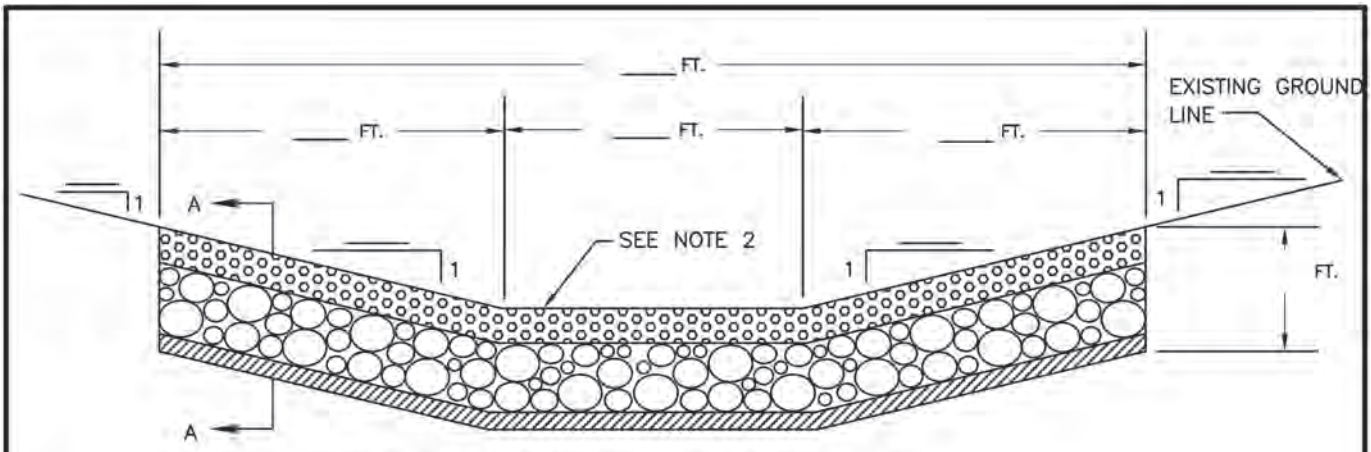
COUNTY: _____

	Date
Designed	
Drawn	
Checked	
Approved	

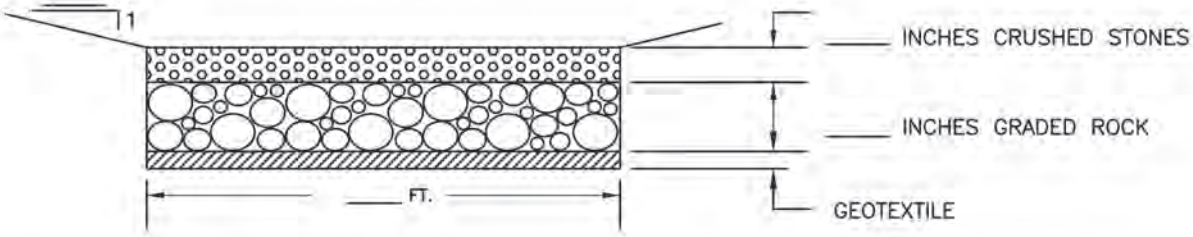
Drawing Name: WI-933

Date: 7/10

Sheet of



PROFILE ALONG CENTERLINE OF CROSSING



SECTION A–A

QUANTITY ESTIMATE*	
EXCAVATION	CU. YD.
GEOTEXTILE WOVEN/NON WOVEN CLASS	SQ. YDS.
CRUSHED STONE	CU. YD.
CRUSHED STONES CONSISTS OF 100% PASSING 3/4" SIEVE AND 10% MAXIMUM PASSING THE #200 SIEVE.	
GRADED ROCK	CU. YD.
GRADED ROCK: 100% PASSING THE BASE COURSE THICKNESS DIMENSION WITH A MAX. OF 10% PASSING THE 3/4" SIEVE. ALL SIZES BETWEEN THE LIMITS ARE TO BE REPRESENTED.	
HOOF CONTACT MATERIAL	CU. YD.
SEEDING	ACRES

SEE REVERSE SIDE FOR ADDITIONAL INFORMATION

*ESTIMATED TO THE NEAT LINES AND GRADES

NOTES:

1. COMPACT SURFACING MATERIAL BY EQUIPMENT TRAVEL.
2. CROSSINGS SHALL HAVE THE TOP–MOST SURFACE LAYER AT THE SAME LEVEL AS THE NATURAL STREAMBED IMMEDIATELY UPSTREAM AND DOWNSTREAM FROM THE CROSSING.

SITE OR STATION _____

THIS STANDARDIZED DESIGN MUST BE ADAPTED TO THE SPECIFIC SITE.

NRCS
Natural Resources Conservation Service
United States Department of Agriculture

ROCK CROSSING
(GEOTEXTILE BASE)

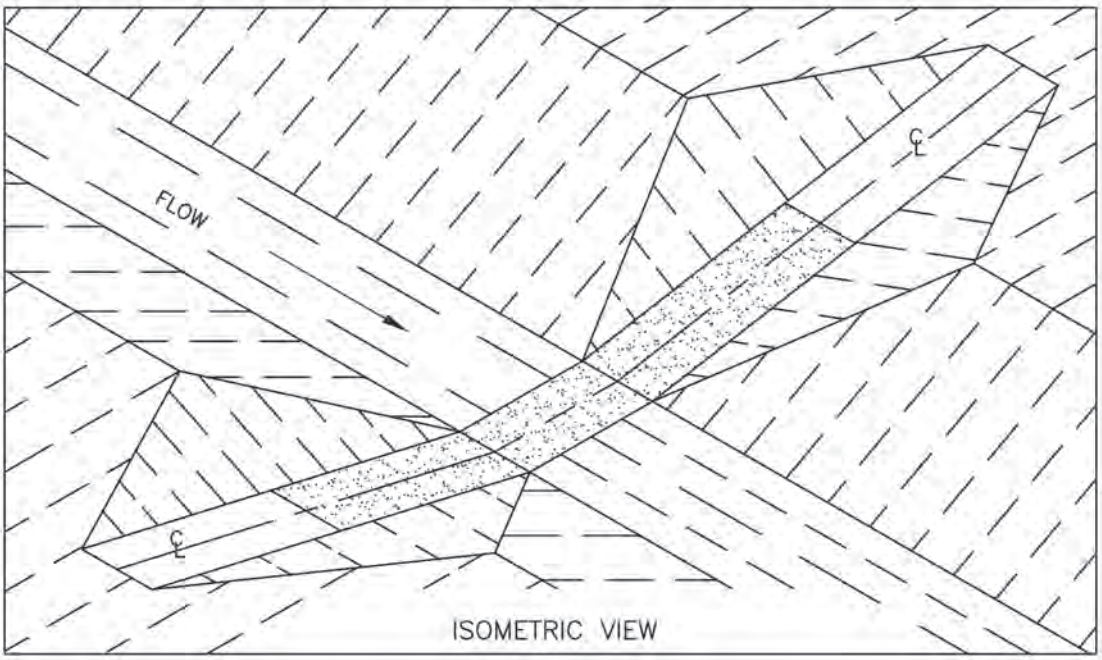
CLIENT: _____
COUNTY: _____

Date
Designed _____
Drawn _____
Checked _____
Approved _____

File Name Date
WI–405D 9/11

Page 1 of 2

Sheet of

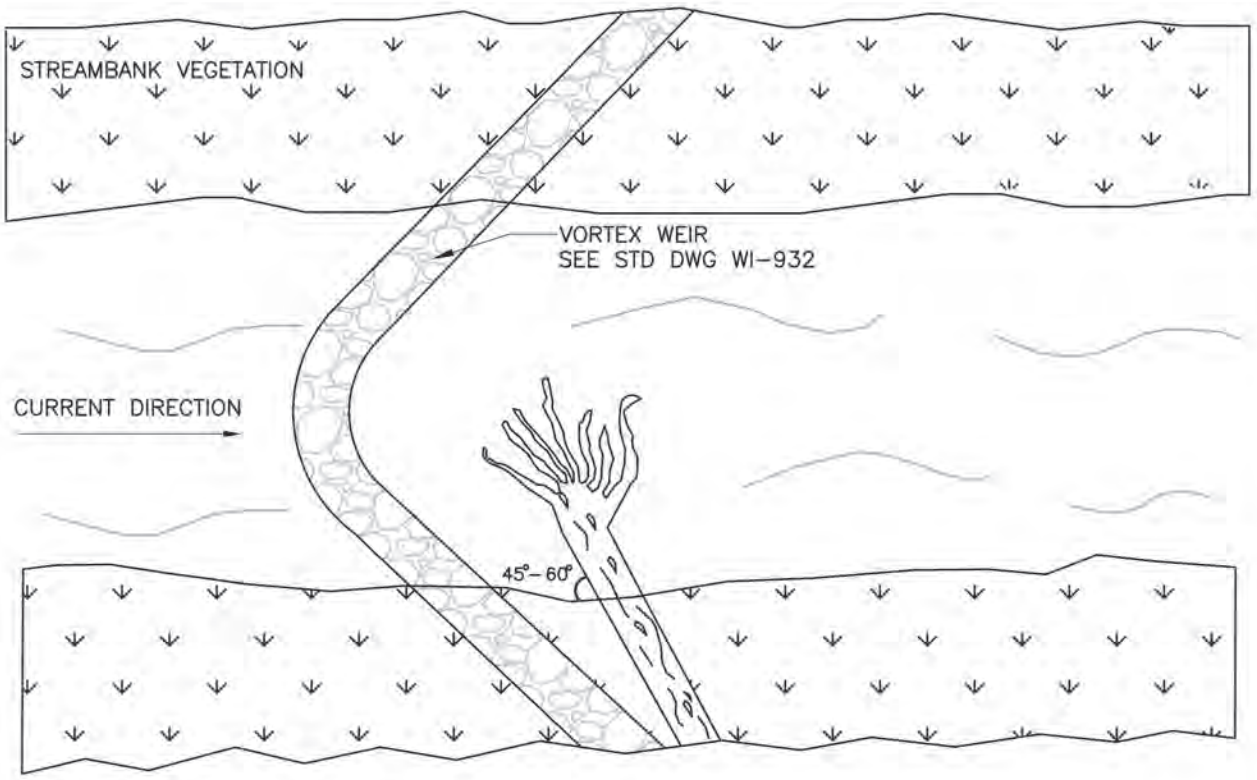


ISOMETRIC VIEW

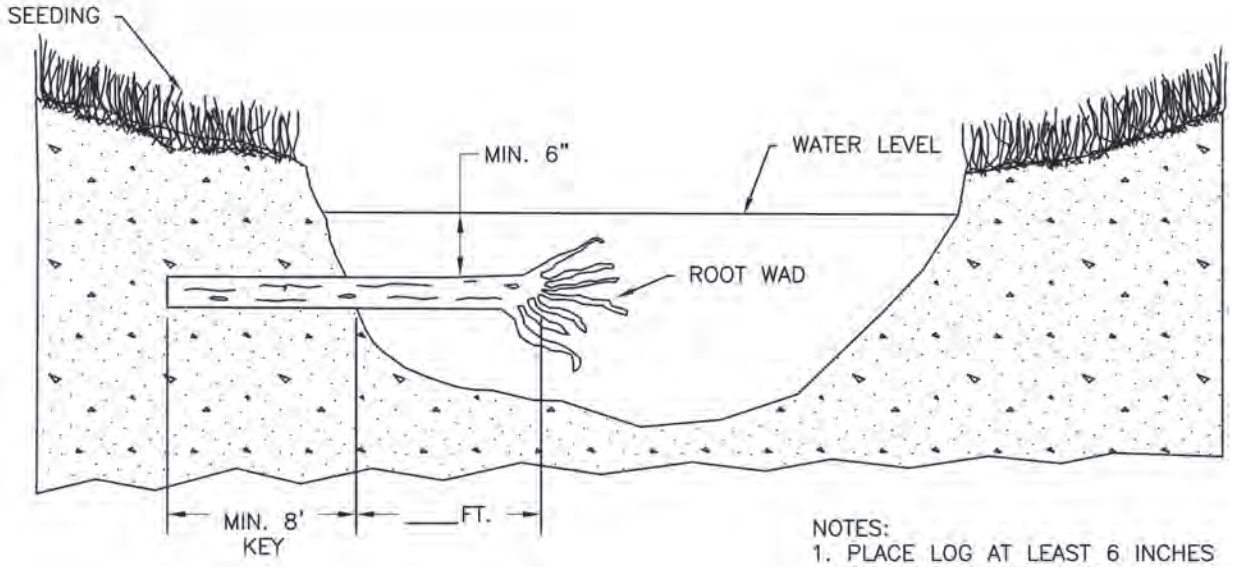
GRADED ROCK MATERIAL GRADATION

PERCENT PASSING BY WEIGHT	SIZE (INCHES)
100	_____
60–85	_____
25–50	_____
5–20	_____
0–5	_____

WI-405D



PLAN



CROSS SECTION

NOTES:
1. PLACE LOG AT LEAST 6 INCHES BELOW THE WATERLINE.
2. PLACE LOG AT A 45–60 DEGREE ANGLE UPSTREAM FROM BANK.
3. REFERENCE WI STD DWG 932 FOR DETAILS ON VORTEX WEIR CONSTRUCTION.

NRCS
Natural Resources Conservation Service
United States Department of Agriculture

ROOT WAD

CLIENT: _____

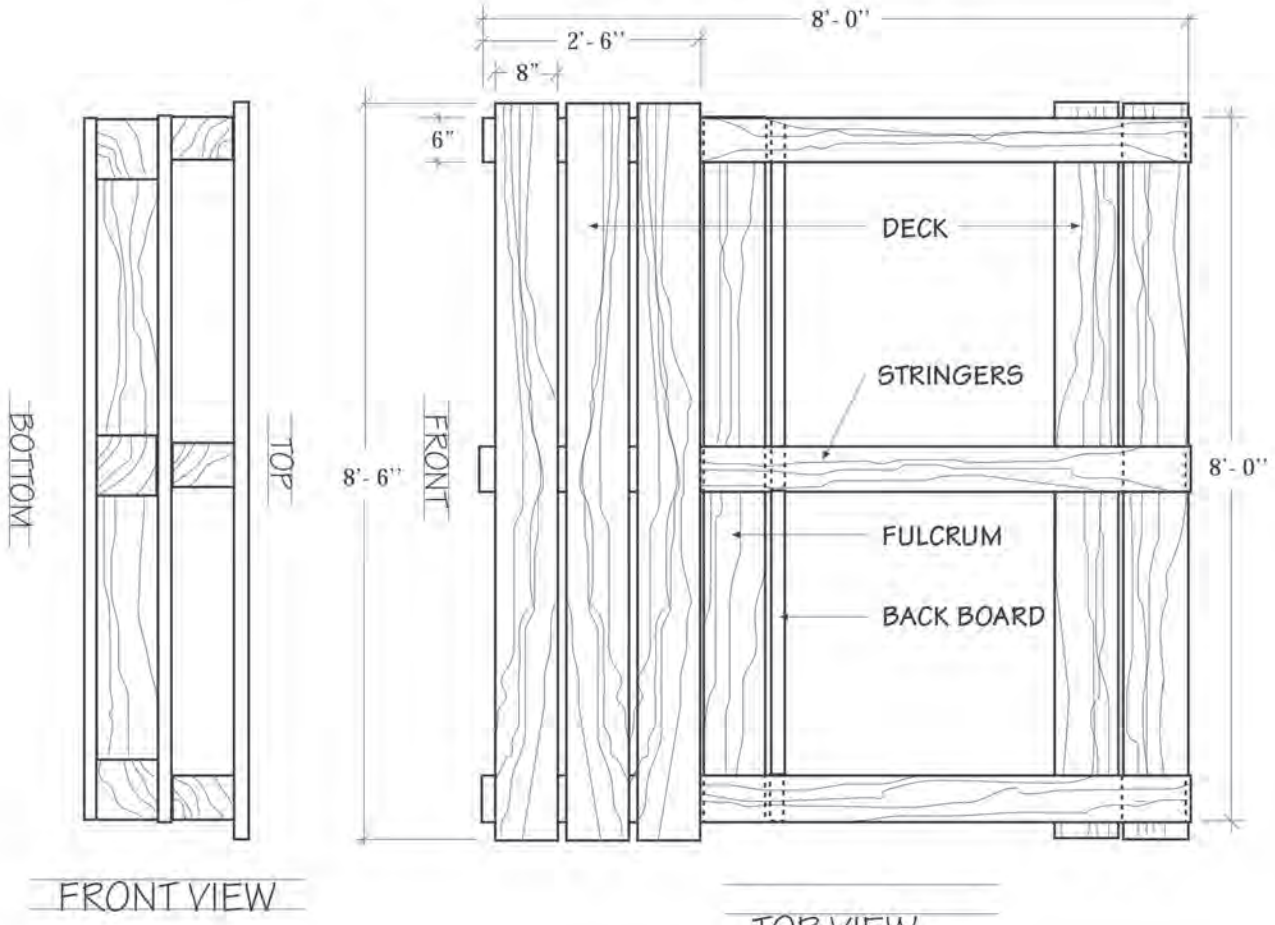
COUNTY: _____

	Date	Drawing Name
Designed		WI-936
Drawn		Date 7/10
Checked		
Approved		Sheet of

THE SKYHOOK

STREAM OVERHANG STRUCTURE

ORIGINAL DESIGN BY TOM DORNACK



MATERIAL LIST

3 - 6" X 8" X 8'	BEAMS
7 - 2" X 8" X 8'-6"	BOARDS
1 - 1" X 8" X 8'-6"	BACKING BOARD
3 - 8" X 8" X 8"	FULCRUM BLOCKS

FIGURE APPROX. 170-200
NAILS: B&C EAGLE - PLASTIC STRIP
3.25"X .131 SMOOTH 22°
(314 X 131 / 22)

6" HOT DIPPED GALVENIZED
SS R/S POLEBARN NAILS OR
5" TRUSSLOK SCREWS

The structures are made of solid oak rough-cut materials and are designed to be held in place by flat limestone rock weighing over 1200 lbs. The structures are laid in place, end to end, 3-5 at a time with the limestone overlapping and tieing the structures in place. This series of structures is place just below the water line with cover rock and dirt completely covering the structures. The area is then reseeded with a mixture of oats and wild prairie plants which will reestablish a heavy grass matt to tie back in with the natural setting of the stream.

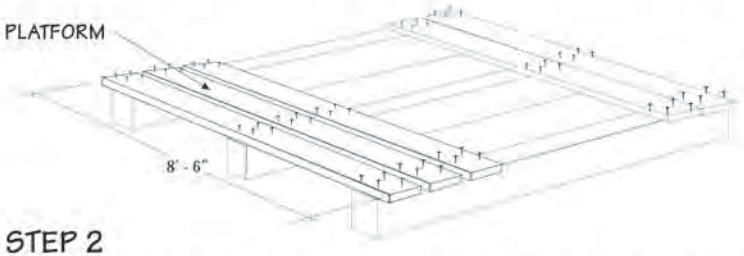
ORIGINAL DESIGN BY TOM DORNACK
ILLUSTRATED BY: TOM LANE - MARCH 2012 / 7-12
FOR USE BY: TROUT UNLIMITED & DNR

THE SKYHOOK
ASSEMBLY INSTRUCTIONS

Cover Grasses:
Non-native Timothy
For cool weather: Canada rye, Slender wheat grass,
Fowl bluegrass
For warm weather: Switch grass, Indian grass,
Big Bluestem, Little Bluestem

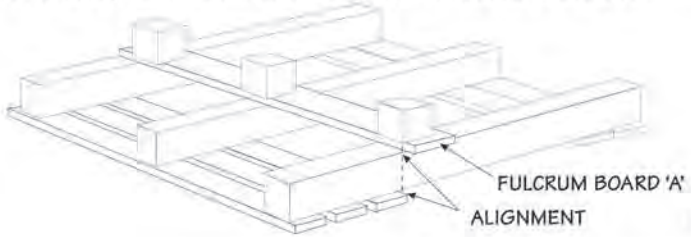
STEP 1

PLACE 3 - 6" X 8" X 8' LONG TIMBERS ON THE GROUND, WITH THE 6" WIDTH ON THE GROUND. PLACE TWO OF THE TIMBERS 8' APART. CENTER THE THIRD TIMBER BETWEEN THEM.
NAIL 3 - 2" X 8" X 8'-6" LONG BOARDS TO THE FRONT END OF THE TIMBERS.
ADD 2 - 2" X 8" X 8'-6"LONG BOARDS TO THE OTHER END OF THE STRUCTURE.



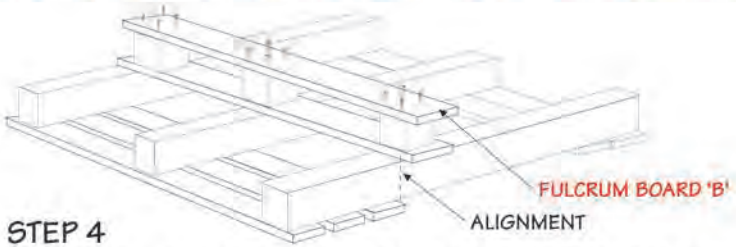
STEP 2

FLIP STRUCTURE OVER AND PLACE 1 - 2" X 8" X 8'-6" BOARD (FULCRUM BOARE 'A') ON THE BOTTOM OF THE STRUCTURE, ALIGNING THE FRONT EDGE OF THE BOARD WITH THE BACK EDGE OF THE 3 BOARD PLATFORM.
DO NOT NAIL IN PLACE.
CUT THREE FULCRUM BLOCKS, 8"X 8"X 10" AND PLACE THE THREE BLOCKS ON FULCRUM BOARD 'A' , OFF SETTING THE BLOCKS SO THE BOARD CAN BE TOE NAILED TO THE STRINGERS. ALLIGN THE FRONT EDGE OF THE BLOCKS WITH THE FRONT EDGE OF FULCRUM BOARD 'A'.



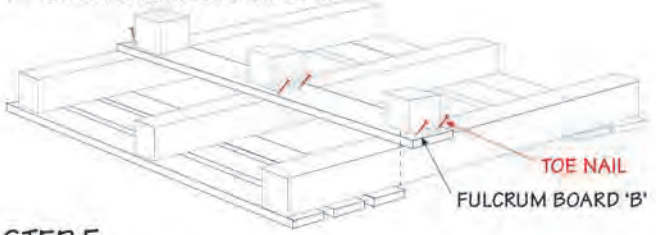
STEP 3

PLACE 1 - 2" x8" x 8'-6" BOARD ON TOP OF THE BLOCKS, FULCRUM BOARD 'B' AND NAIL IN PLACE MAKING SURE TO ALIGN THE FRONT EDGE OF THE BOARD WITH THE FRONT EDGE OF THE BLOCKS.IMPORTANTS: USE THE PNEUMATIC NAILER ON THIS BOARD. THIS IS THE WEAKEST POINT.



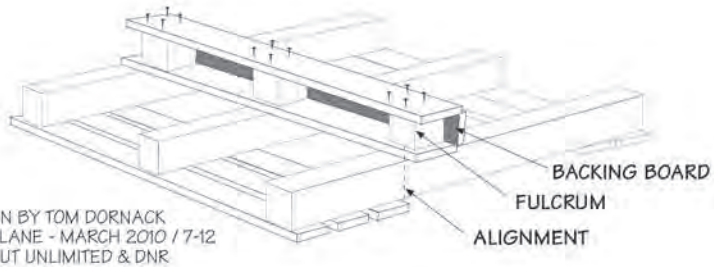
STEP 4

FLIP FULCRUM STRUCTURE OVER SO THE ALIGNED EDGE IS TO THE BACK. REMOVE FULCRUM BOARD 'A' AND TOE NAIL FULCRUM BOARD 'B' TO STRINGERS USING THE PNEUMATIC NAILER. USE GALV. SS R/S POLEBARN NAILS OR SRUSSLOK SCREWS

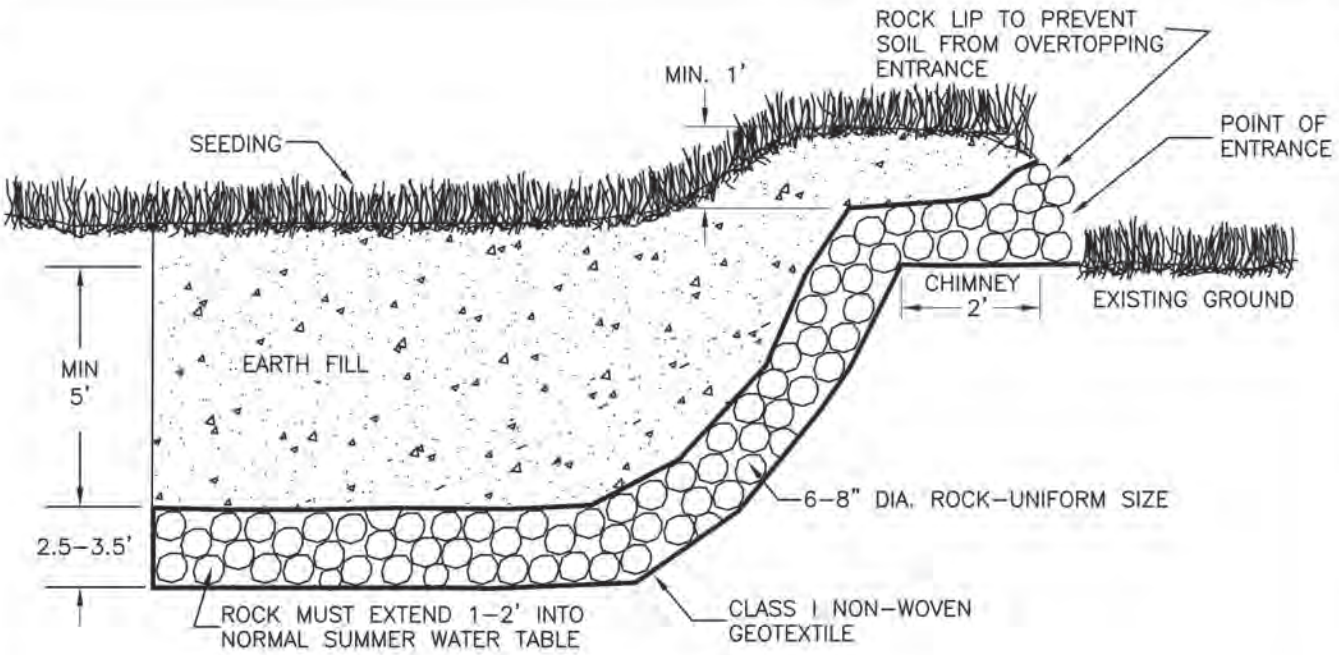


STEP 5

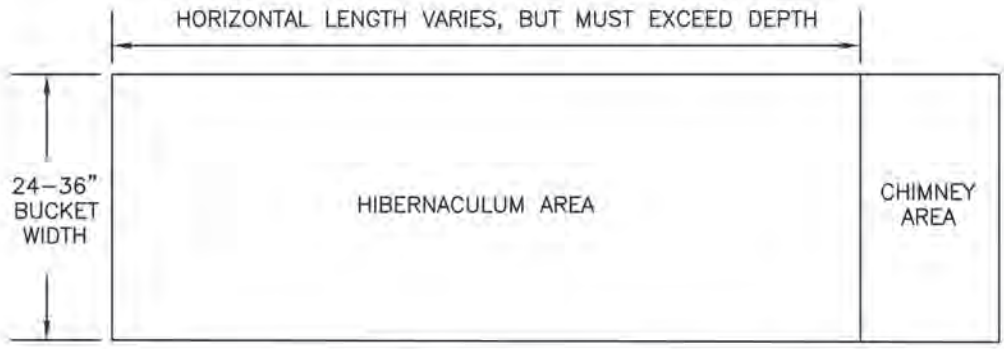
NAIL FULCRUM BOARD 'A' ON THE TOP OF THE FULCRUM, ALIGNING THE BACK EDGE OF THE BOARD TO THE BLOCKS.
ATTACH A 2"x 8"x 8'-6" BOARD TO THE BLOCKS ON THE BACK SIDE OF THE FULCRUM TO ACT AS A BACKING BOARD.



ORIGINAL DESIGN BY TOM DORNACK
ILLUSTRATED BY: TOM LANE - MARCH 2010 / 7-12
FOR USE BY: TROUT UNLIMITED & DNR



PROFILE VIEW



PLAN VIEW

NOTES:
1. STRUCTURE PROVIDES SNAKE OVER-WINTERING HABITAT.
2. HIBERNACULUM SHOULD BE PLACED OUT OF THE PRIMARY FLOODPLAIN WITH A SOUTHERN OR WESTERN EXPOSURE FOR THE POINT OF ENTRANCE.
3. A MININMUM OF 5 FEET OF EARTH FILL SHALL COVER THE ROCK. THIS ACTS AS A BUFFER TO MAINTAIN A HIBERNACULUM TEMPERATURE OF AT LEAST 51 DEGREES FAHRENHEIT.
4. A SOIL BERM MAY BE REQUIRED TO ISOLATE THE HIBERNACULUM FROM THE RIVER BANK. THIS IS TO BE FLAGGED BY THE TECHNICIAN IN THE FIELD.
5. ONE BACKHOE BUCKET OF SOIL SHALL BE SPRINKLED ON TOP OF PLACED ROCK BEFORE COVERING WITH GEOTEXTILE AND EARTHFILL.

QUANTITIES	
ROCK RIPRAP (W.C.S.* 9)	CU. YD.
GEOTEXTILE-CLASS I NON-WOVEN (W.C.S. 13)	SQ. YD.

*W.C.S. = WIS. CONSTRUCTION SPECIFICATION
*ESTIMATED TO THE NEAT LINES AND GRADE

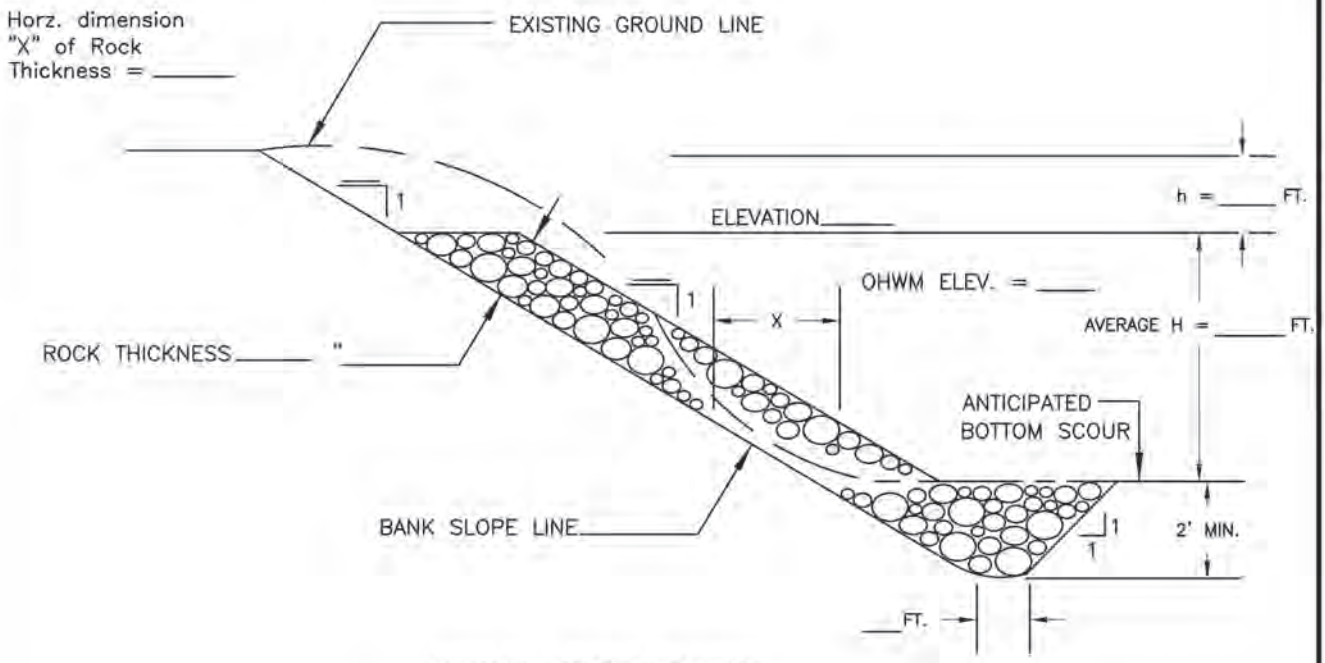
NRCS
Natural Resources Conservation Service
United States Department of Agriculture

SNAKE HIBERNACULUM

CLIENT: _____
COUNTY: _____

Date
Designed _____
Drawn _____
Checked _____
Approved _____

Drawing Name WI-941
Date 7/10
Sheet of



TYPICAL CROSS SECTION

GRADATION OF ROCK

PERCENT PASSING BY WEIGHT	SIZE (INCHES)
100	
60–85	
25–50	
5–20	
0–5	

QUANTITY ESTIMATE*

BANK SLOPING FOR RIPRAP	_____	LIN. FT.
BANK SLOPING (SEEDING ONLY)	_____	LIN. FT.
ROCK FOR RIPRAP (WI CONST. SPEC. 9)	_____	CU. YD.
SEEDING	_____	ACRES

*ESTIMATED TO THE NEAT LINES AND GRADE

NOTES:

1. DOUBLE THE ROCK THICKNESS FOR A DISTANCE OF _____ FEET AT THE UPSTREAM AND DOWNSTREAM ENDS OF THE RIPRAP. BLEND THE ROCK SURFACE TO MATCH THE EXISTING STABLE BANK SURFACE.

THIS STANDARDIZED DESIGN MUST BE ADAPTED TO THE SPECIFIC SITE.

EXCAVATED KEYWAY

SITE _____

NRCS
Natural Resources Conservation Service
United States Department of Agriculture

STREAMBANK PROTECTION NO FILTER OR GEOTEXTILE (PARTIAL BANK HEIGHT)

CLIENT: _____

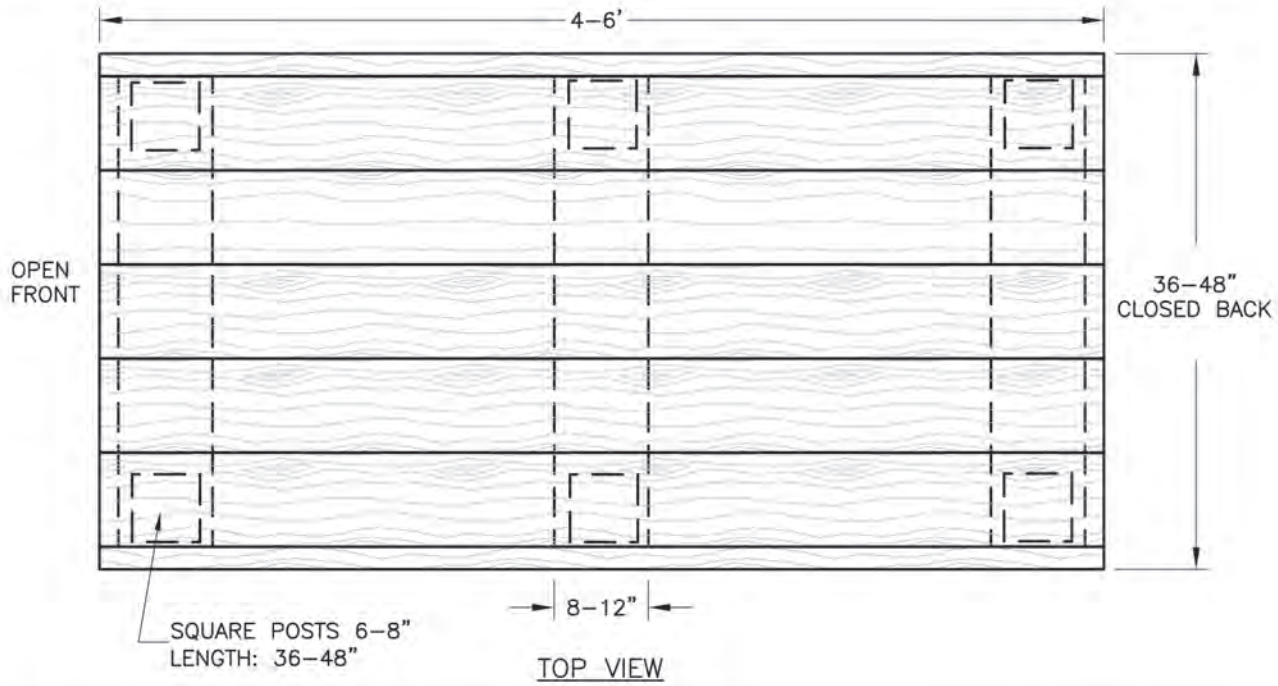
COUNTY: _____

	Date
Designed	
Drawn	
Checked	
Approved	

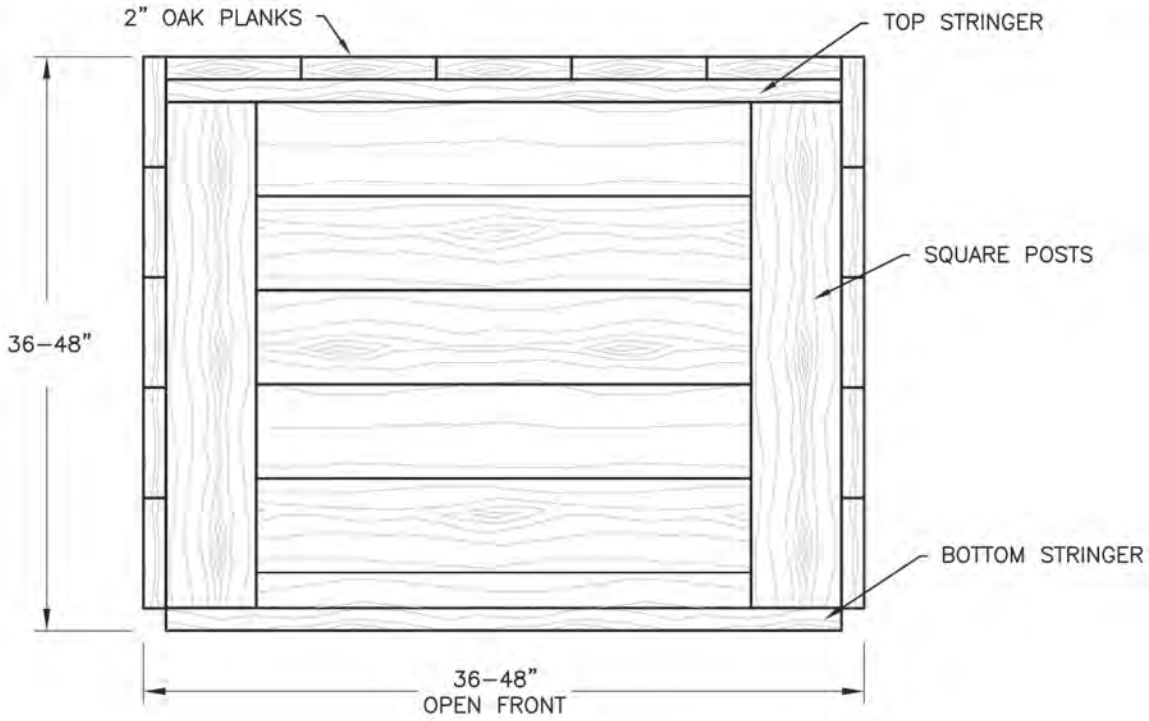
File Name WI–404E

Date 6/07

Sheet of



TOP VIEW

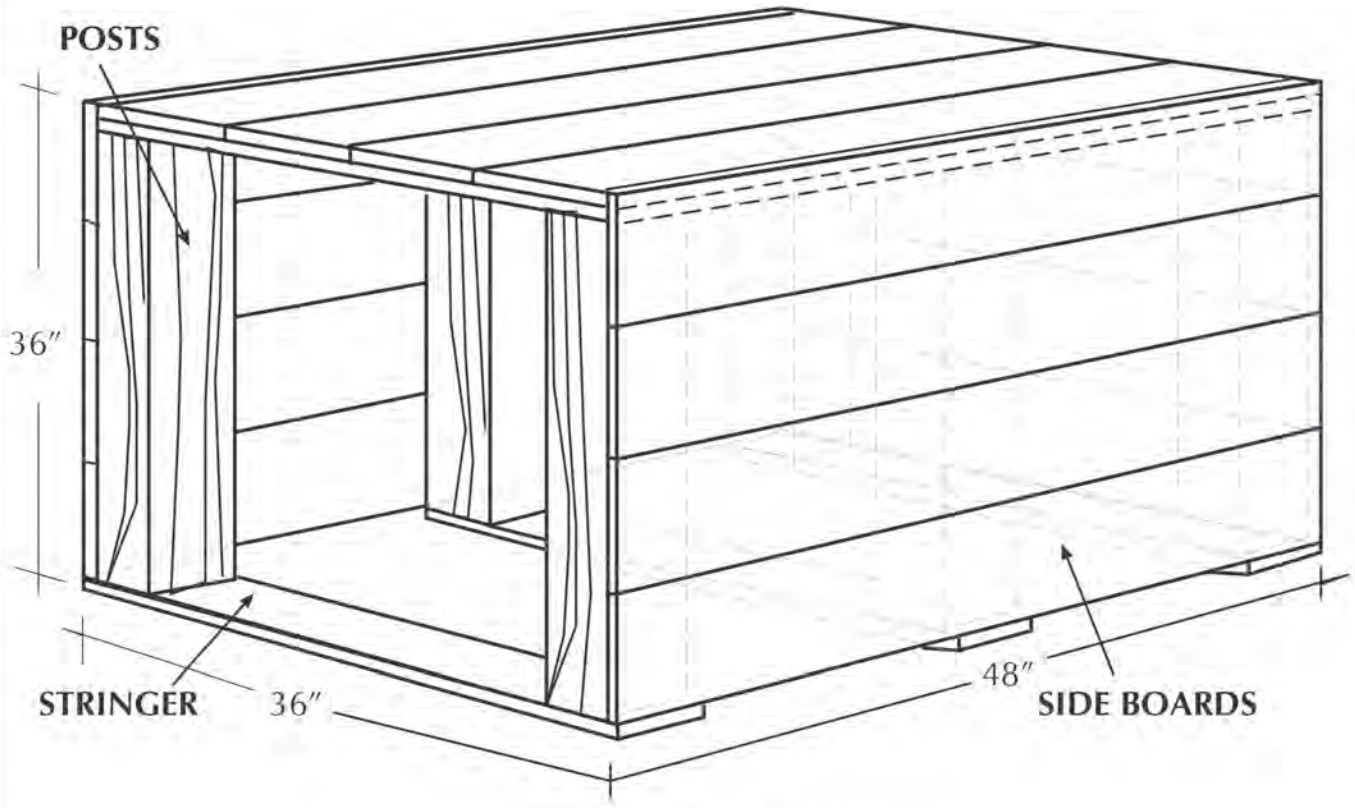


FRONT VIEW

NOTES:
1. STRUCTURES ARE BUILT USING OAK PLANKS 2" THICK BY 8–12" WIDE.
2. STRUCTURES ARE NAILED TOGETHER WITH 20D RING SHANK NAILS.

NRCS Natural Resources Conservation Service United States Department of Agriculture	TURTLE HIBERNACULUM CLIENT: _____ COUNTY: _____	Date Designed _____ Drawn _____ Checked _____ Approved _____	DWG Name/Date WI–940/ 7/10 Page 1 of 3 Sheet of

TURTLE HIBERNACULUM

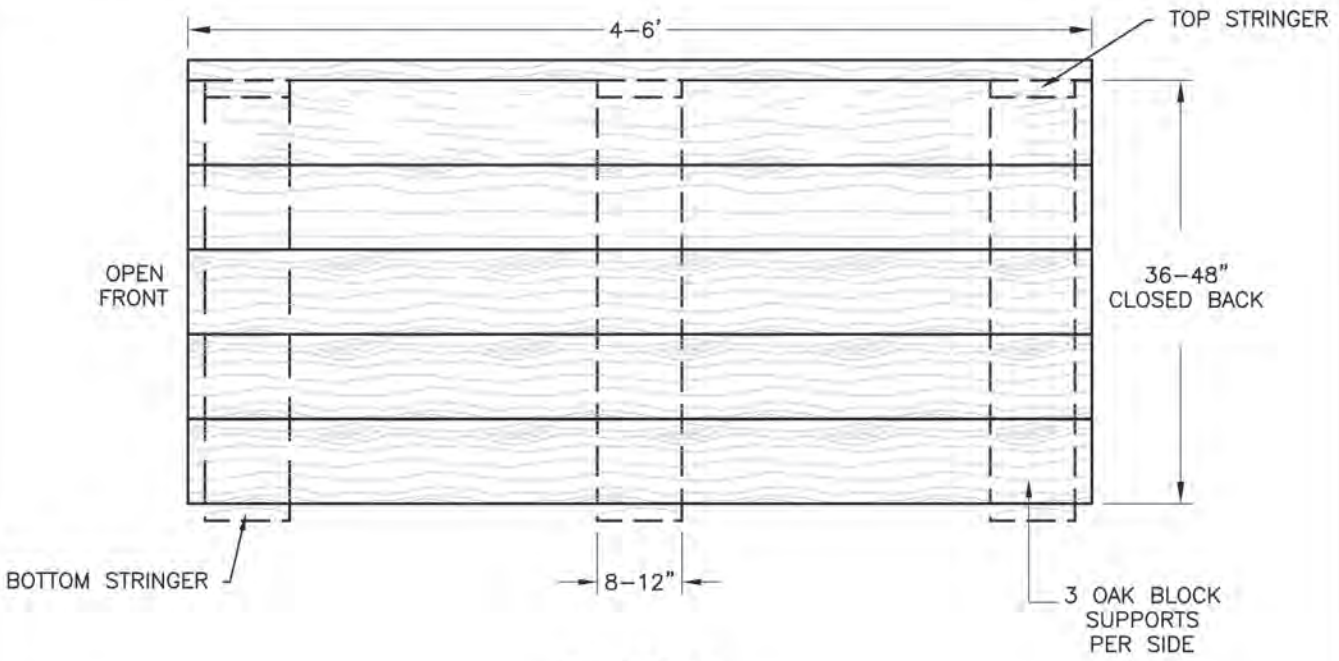


TURTLE HIBERNACULUM
36″ X 36″ X48″

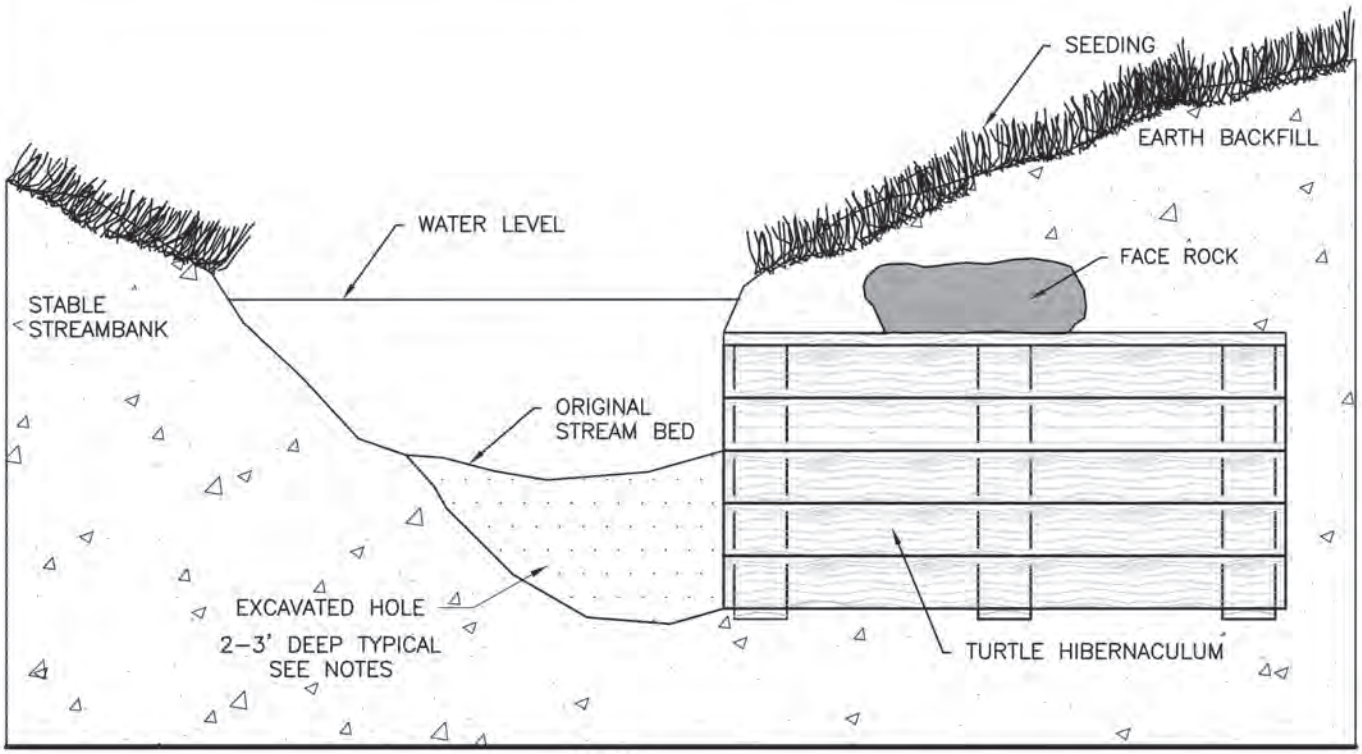
MATERIALS - ROUGH CUT OAK

6 -	6″ X 8″ X 28″	POSTS
6 -	2″ X 8″ X 32″	STRINGERS
12 -	2″ X 8″ X 48″	BOARDS
4 -	2″ X 8″ X 32″	BACK BOARDS

BUILD 3 POST & STRINGER STRUCTURES
ADD SIDE AND TOP BOARDS
ADD BOARDS TO THE BACK OF STRUCTURE



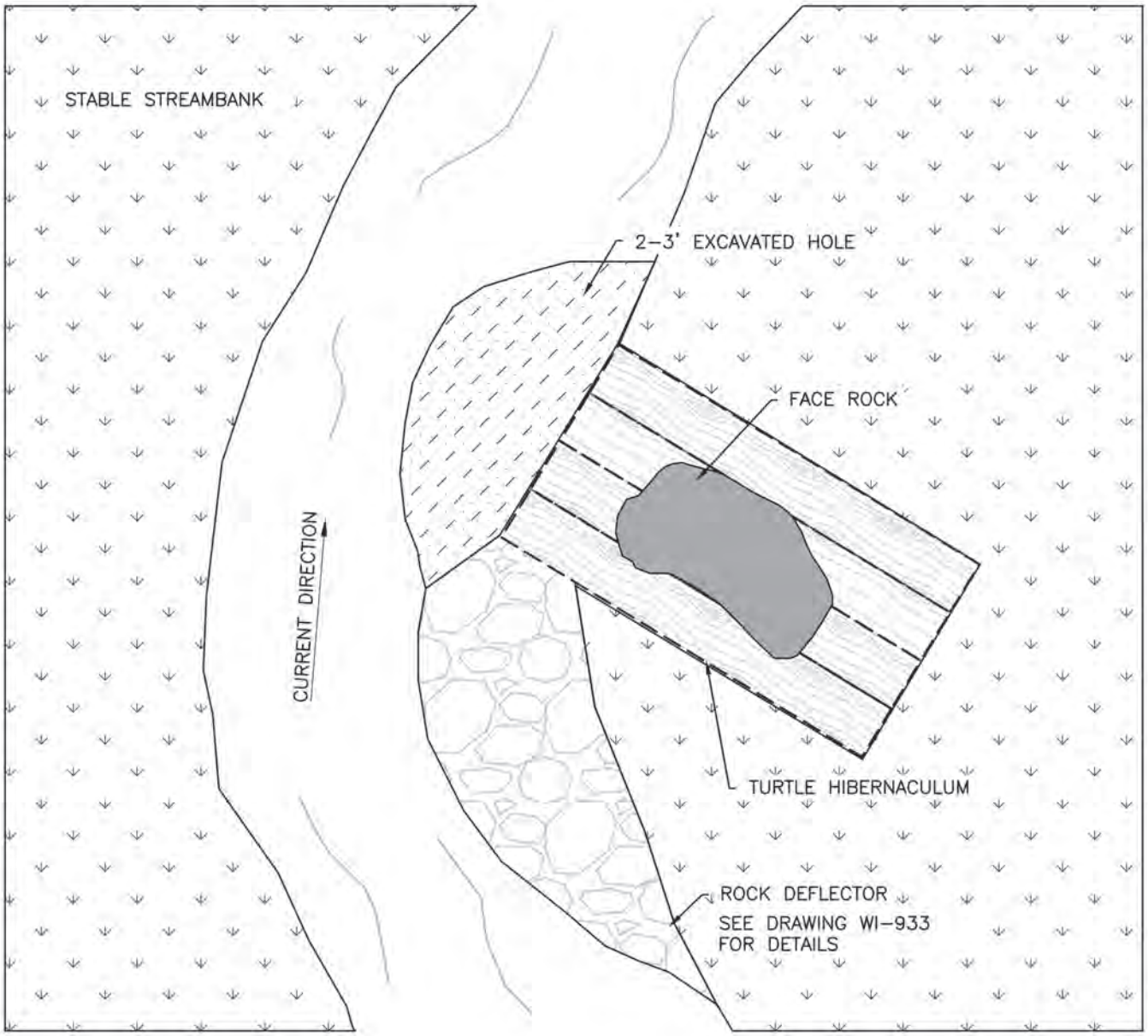
SIDE VIEW



CONSTRUCTED SIDE VIEW

NOTES:
1. THE STRUCTURE MUST BE FULLY SUBMERGED TO PREVENT THE LUMBER FROM ROTTING. DEPTH OF EXCAVATED HOLE MAY BE INCREASED TO ENSURE FULL SUBMERSION.
2. THE BOTTOM OF THE HIBERNACULUM SHOULD BE A MINIMUM OF 2 FEET BELOW THE EXISTING STREAM BED TO HELP ACCUMULATE A DEPTH OF AT LEAST 2 FEET OF FINE SEDIMENTS WITHIN THE STRUCTURE.
3. A ROCK DEFLECTOR WILL BE INSTALLED TO FURTHER ENCOURAGE SEDIMENT ACCUMULATION. SEE PAGE 3 FOR DETAILS.
4. TURTLE HIBERNACULUM SHOULD SET INTO THE BANK 4–6 FEET.

WI–940



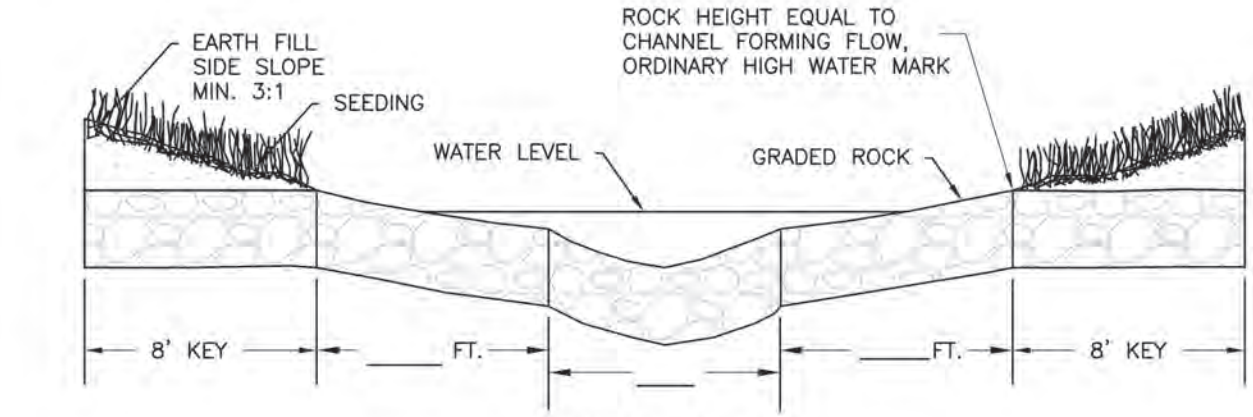
PLAN VIEW

NOTE: THE HIBERNACULUM SHOULD BE PLACED DIRECTLY BEHIND A STRUCTURE WHICH DEFLECTS THE FLOW OF THE STREAM AND CREATES A BACK EDDY, CAUSING SEDIMENT ACCUMULATION. THIS BACK EDDY WILL BE ACCENTUATED BY THE EXCAVATED HOLE IN FRONT OF THE HIBERNACULUM. THE FILLING OF FINE SEDIMENT MAKES IT SUITABLE HABITAT FOR TURTLES TO BURROW INTO.

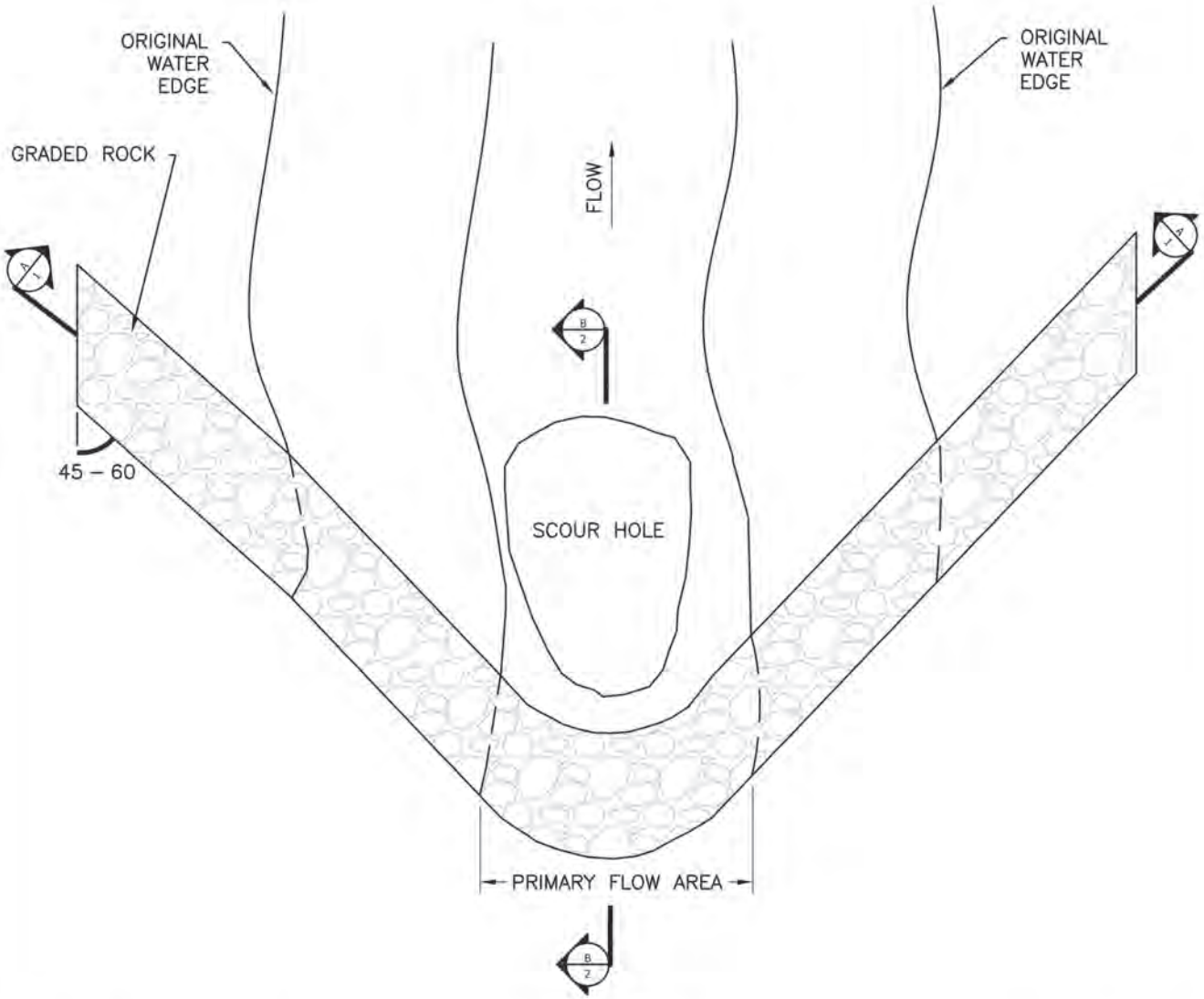
QUANTITIES	
2" OAK PLANK–8" WIDTH, 4–6' LENGTH (15–18/UNIT)	EACH
6–8" SQUARE POSTS, 36–48" LENGTH (6/UNIT)	EACH
2" OAK PLANK–8" WIDTH, 36–48" LENGTH (6/UNIT)	EACH
2" OAK PLANK–8" WIDTH, 36–48" LENGTH (5–6/UNIT)	EACH
20D RING SHANK NAILS	AS NEEDED

*ESTIMATED TO THE NEAT LINES AND GRADE

WI–940

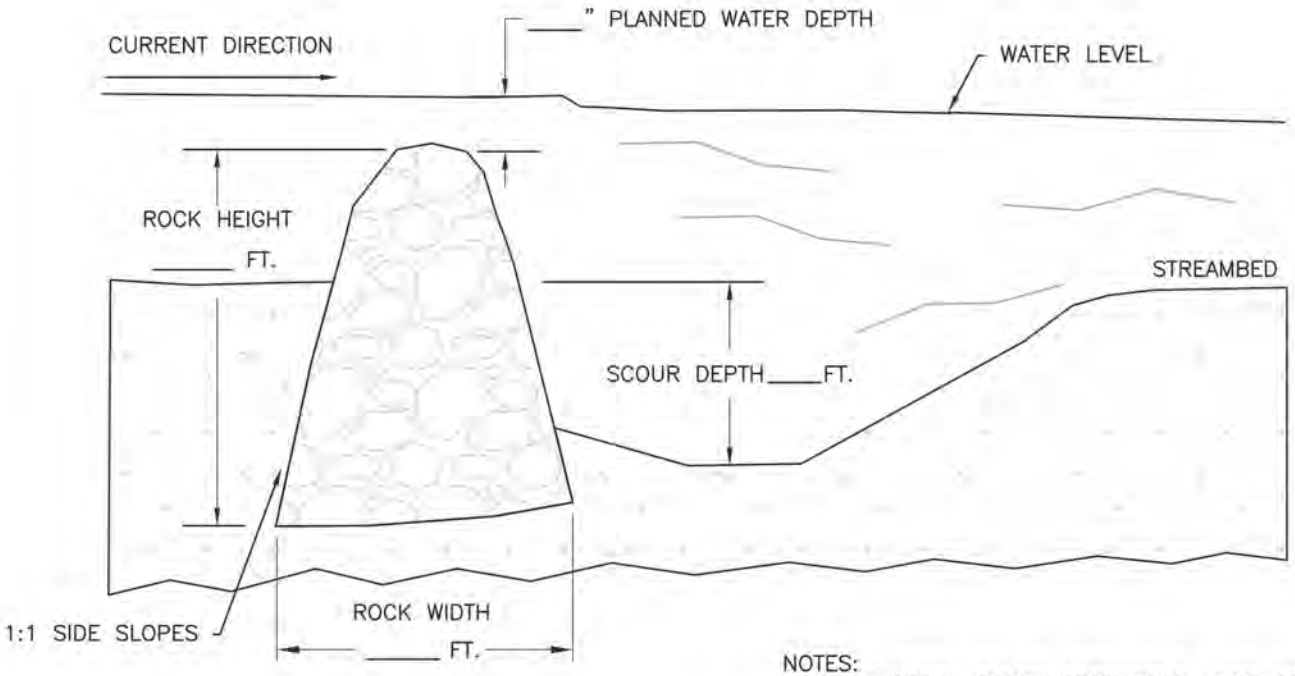


CROSS SECTION A–A



PLAN VIEW

NRCS Natural Resources Conservation Service United States Department of Agriculture	VORTEX WEIR CLIENT: _____ COUNTY: _____	Date Designed _____ Drawn _____ Checked _____ Approved _____	DWG Name/Date WI–932 /12–11 Page 1 of 2 Sheet of



NOTES:
1. ROCK DEPTH BELOW STREAMBED MUST BE GREATER THAN THE ANTICIPATED DEPTH OF THE SCOUR HOLE
2. ROOT WADS, BOULDER RETARDS ESCAPE LOGS, ETC. CAN BE ADDED TO SCOUR HOLE FOR ADDED HABITAT ENHANCEMENT.

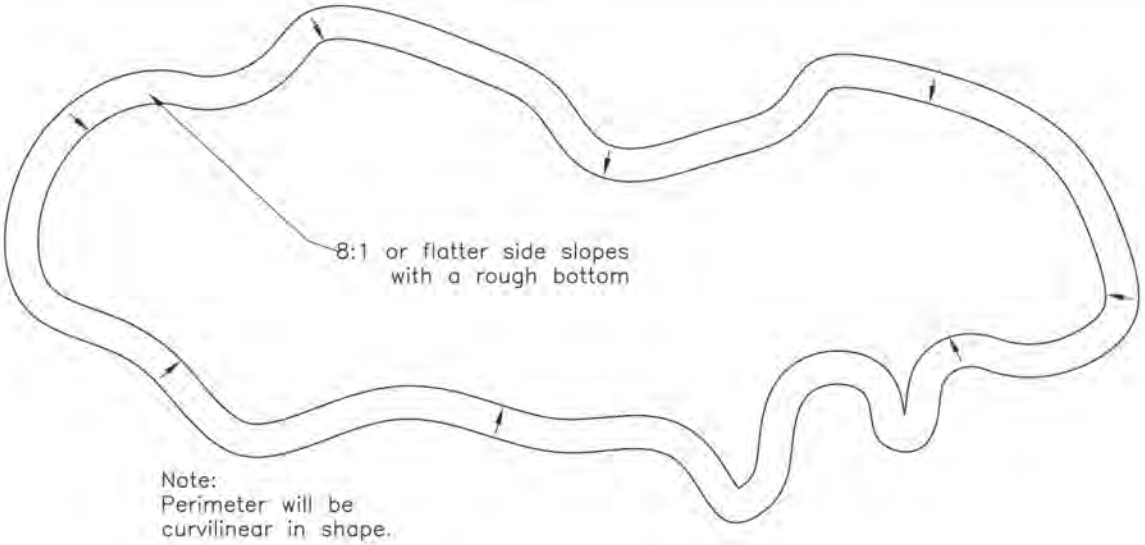
CROSS–SECTION B–B

ROCK GRADATION	
PERCENT PASSING BY WEIGHT	SIZE IN INCHES
100	
60–85	
25–50	
5–20	
0–5	

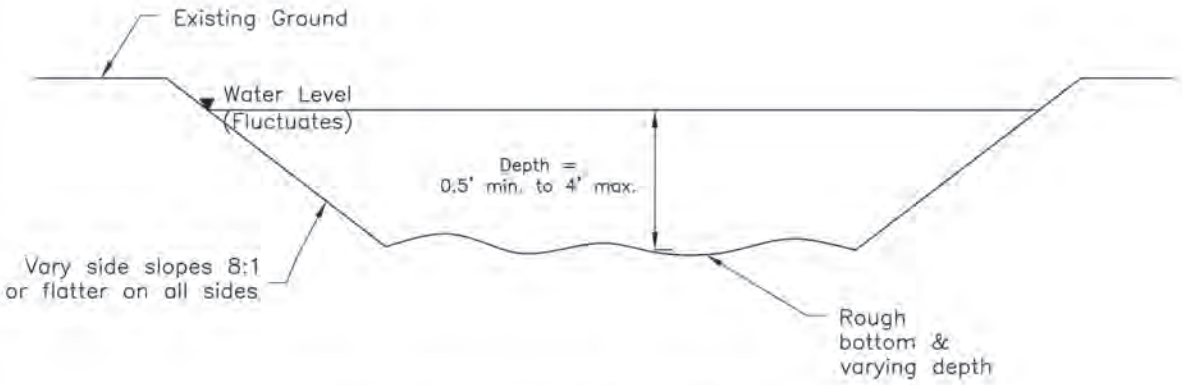
QUANTITIES	
ROCK RIPRAP FOR VORTEX WEIR (W.C.S.* 9)	CU. YD.

*W.C.S. = WIS. CONSTRUCTION SPECIFICATION
*ESTIMATED TO THE NEAT LINES AND GRADE

WI–932



WETLAND SCRAPE PLAN VIEW



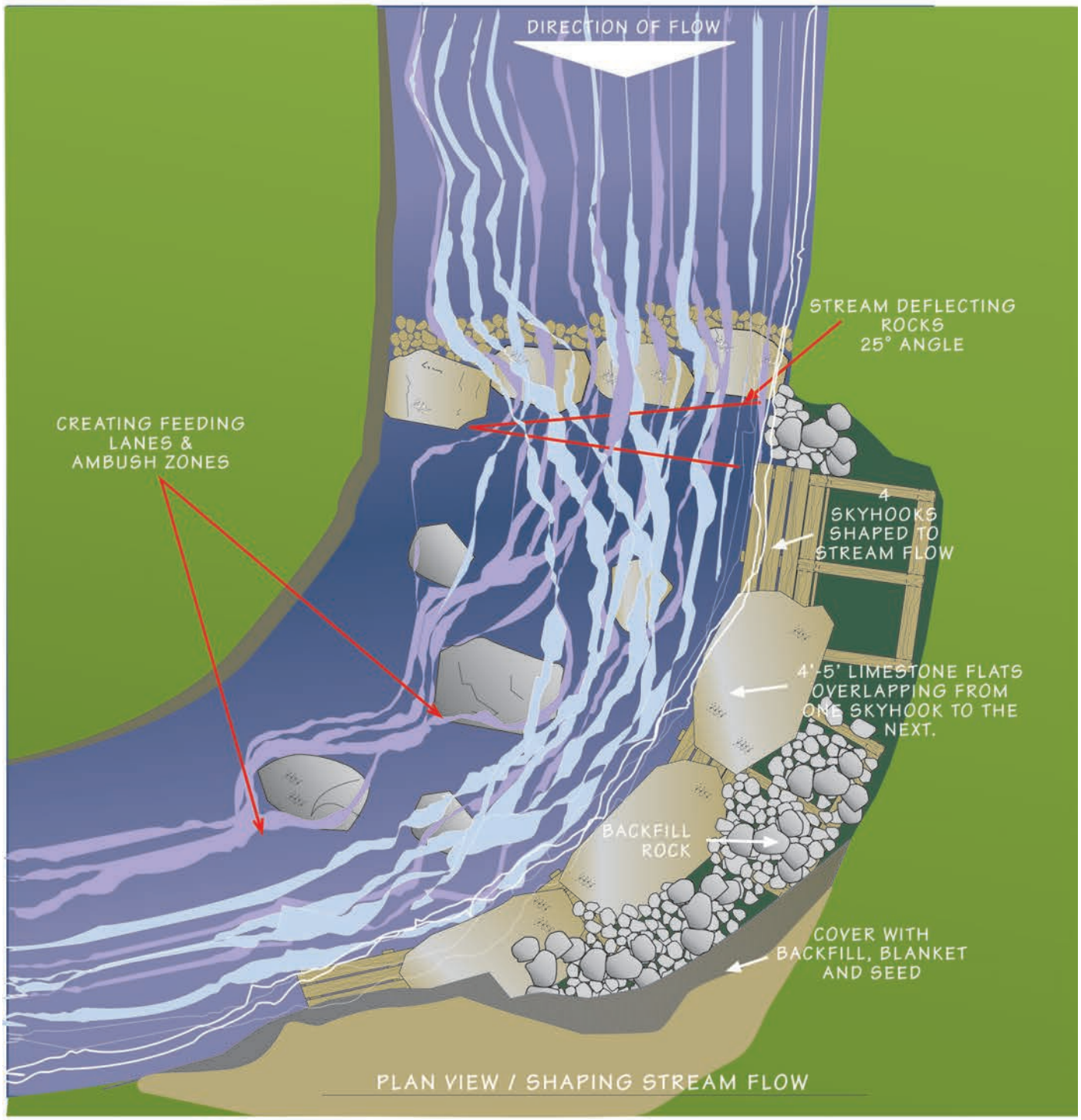
TYPICAL WETLAND SCRAPE CROSS SECTION

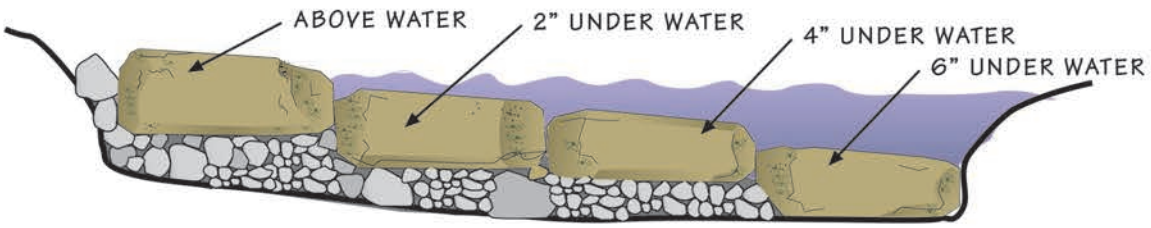
See Sheet_____for the location of the scrapes

Notes:

1. Scrapes/borrow areas will be constructed at locations and as flagged by the technician.
2. Scrapes are to be irregular in shape when completed. Wheel ruts are allowed and desired.
3. Wisconsin Construction Specification 2, Excavation, shall be followed.
4. Strip minimum 6" of topsoil and stockpile it for spreading, if needed, after the excavation is completed.
5. Before topsoil is spread, the depth and slopes must be checked by the technician. Seeding shall be done as per Job Sheet 134 for Introduced Species or Job Sheet 135 for Native Species or WI Drawings WI-710 or WI-711.
6. Spoil shall be disposed of at locations approved by the technician.

NRCS Natural Resources Conservation Service United States Department of Agriculture	Wetland Scrape/Borrow Areas CLIENT: _____ COUNTY: _____	Date Designed _____ Drawn _____ Checked _____ Approved _____	Drawing Name WI-950 A Date 1/09 Sheet of





STREAM LEVEL / FOR STREAM DEFLECTION

ILLUSTRATED BY: TOM LANE