Wildlife 5-Year Management Plan

Eagle Point Ranch, Llano County

prepared January 2024

LAND STEWARD

TEXAS MANAGEMENT PLANS

EAGLE POINT RANCH WILDLIFE MANAGEMENT PLAN
FOR 2024-2029

LANDOWNER GOAL AND OBJECTIVES

Enhance the property's native habitat biodiversity and water sources to support a sustainable population of White-tailed Deer for hunting and native bird species for passive recreational enjoyment. Achieve this by managing debt to increase quality and antler size, increasing the bottomland pond stability and diversity, breaking up dense cover to enhance wildlife movement and biodiversity, sinking overland flows to reduce erosion and increase soil health, seeding and planting native grasses, forbs, and riparian trees, retaining cavities and adding nest boxes, adding an upland water source, and integrating low-intensity cattle grazing.

TARGETED NATIVE WILDLFIE

Target species will include White-tailed Deer, Rio Grande Wild Turkey, Painted Bunting, Eastern Screech Owl, Golden-fronted Woodpecker and Ladder-back Woodpecker. Focusing on these species will increase the property's long-term habitat diversity and ecological function.

WILDLIFE VALUATION MAINTENANCE

The landowner will perform and document at least three management activities outlined in this plan each year. Documentation will include photographs, videos, receipts, log sheets, counts, and a property map that indicates where activities occurred. Submit annual reports to the Llano County tax appraisal office.

PLAN PREPARATION

Prepared by Elizabeth McGreevy with Land Steward Management Plans with the input of Chris Mostyn, Texas Parks & Wildlife biologist. The site visit to gather information occurred December 5-6, 2023.

WILDLIFE PRACTICES TO INCLUDE

1. Habitat Control
- Grazing Management
- Range Management
- Brush Management
- Forest Management
- Riparian Management

2. Erosion Control
- Pond Construction and Repair
- Pond Revegetation
- Establish Water Diversion

3. Predator Management
- Feral Hog Control

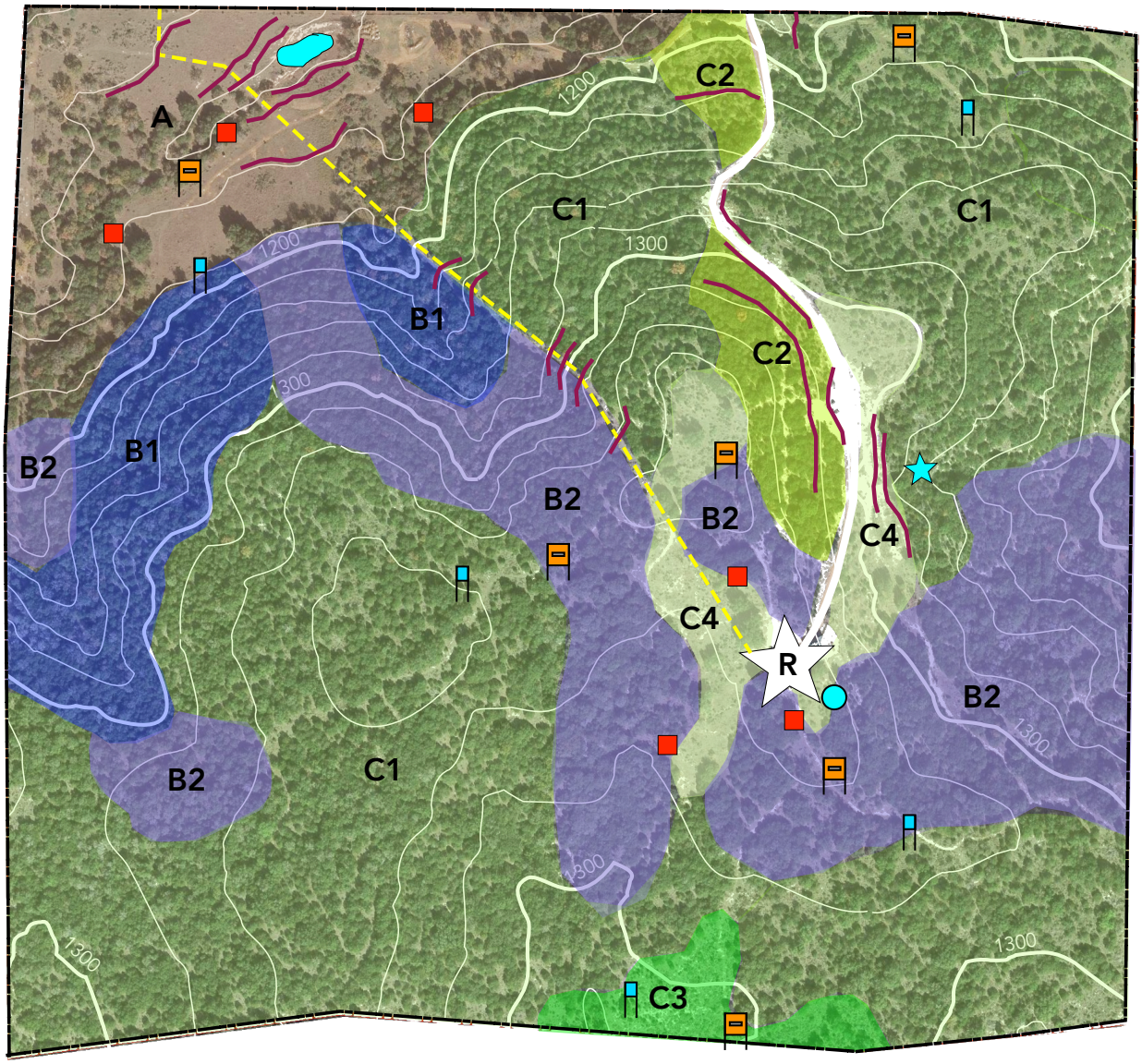
4. Provide Supplemental Water
- Marsh-Wetland Development
- Wildlife Watering Facility

5. Provide Supplemental Shelter
- Nest Boxes
- Natural Cavities and Snags

6. Census Counts
- Standardized Incidental Observations
- Harvest Data Collection
- Census of Non-game Wildlife

PROPERTY PLAN

showing habitats, amenities, and isolated activity locations



BOTTOMLAND PRAIRIE (20 acres)
[A] Riparian Corridor

UPLAND FOREST (52 acres)
[B1] Old-growth Forest
[B2] Regenerating Forest

UPLAND MIXED WOODLAND/SCRUB (93 acres)
[C1] Juniper-Oak Woodland/Scrub
[C2] Degraded Scrub
[C3] Scrub Cactus
[C4] Clearing

RESIDENTIAL (1 acre)
[R]

N

AMENITIES
Deer Blind
Deer Feeder
Pond
Hillside Gravity Spring

PLANNED ACTIVITIES
Contour Brakes
Nest Boxes
Water Trough

HABITAT DESCRIPTIONS

The +/- 166 acre property consists of three primary habitat types: bottomland riparian prairie (20 acres), upland forest (52 acres), and upland mixed woodland/scrub (943 acres). Residential land use totals one acre.

The bottomland soils are characterized as Luckenbach clay loam with more than 80 inches depth to paralithic bedrock and water table. The upland soils are characterized as Eckrant-Rock Outcrop complex with only 8 to 20 depth to paralithic bedrock and more than 80 inches to the water table.

Bottomland Riparian Prairie [A]

Situated in the northwest corner of the property, most of this area has been regularly grazed and supports 100-150+ old Post Oak-Cedar Elm woodlands, dense thickets with good diversity, large open areas, and a scattering understory of Texas Persimmon, Prickly Pear, Cholla, juvenile Ashe Juniper trees, and a few Bee bush. At the base of the slope the soil tends to be more rocky and degraded and supports more bushy Ashe Junipers, Prickly Pear, Cholla, and Agarita. The dense thickets are dispersed throughout and dominated by Texas Persimmon. An exceptional, well-utilized thicket is situated east of the pond and extends to the central ravine. It contains Cedar Elm, Gum Bumelia, and numerous Green Condalia. Northern Cardinal, Titmouse were observed and low cedar elms showed signs of being browsed.

The open areas appear to be dominated by Bermuda Grass and KR Bluestem, however, since the area had been recently cleared, it was difficult to determine the extent of the cover and presence of greater diversity. A large number of small brush piles are scattered throughout. This area would be ideal for future native prairie restoration.

The soil consists mostly of sandy loam and is relatively healthy. A pond was added less than two years ago within the intermittent stream bed, but has experienced significant silting in due to a lack of significant pond bank and buffer vegetation establishment above and around the pond. Several signs of hog wallowing, turkey tracks, and numerous other wildlife tracks were observed near and around the pond. Upstream the vegetation is well-established but has low diversity, consisting of mostly canopy Cedar Elm and Ashe Juniper along with several stands of regenerating tree junipers.

Observed vegetation
Post Oak, Cedar Elm, Ashe Juniper, Honey Mesquite, and Plateau Live Oak canopy. Texas Persimmon, Gum Bumelia, Beebush, Bushy Ashe Juniper, Agarita, Juvenile Ashe Juniper Tree, Cholla Pencil Cactus, Prickly Pear, and Green Condalia mid-story. Bermuda (exotic), KR Bluestem (exotic), Wood Sorrel, Cowpen Daisy, Hooded Windmill Grass, Sand Lovegrass, Lindheimer Senna, Nightshade, Vetch, Croton, Side Oats Grama, Sleep Daisy, Threeawn, and Slim Tridens.

Upland Forest [B]

The Upland Forest runs through the middle of the property from east to west. The extent of this area was determined on-site and by using Google Earth historical aerials that show this area had not been cleared from 1985 to the present. The forest canopy is dominated by heartwood Ashe juniper trees and/or Plateau Live Oak trees.

The **Upland Forest—Old-growth Forest [B1]** contains numerous, large Ashe juniper trees (150-300 years old), Durand Oaks, Texas Persimmon, Cedar Elms, and an incredible array and variety of rock outcroppings, overhangs, cavities, snags, and fallen trees, thick leaf debris, and rich, dark soil covered with clovers and Pleurochaete ground moss. A few small grassy meadows are interspersed throughout and large, axe-chopped juniper stumps were seen. Less than 20% of this area consists of bushy Ashe Juniper covering more degraded, rocky ground. Besides these areas, there are no signs of erosion. Mossy groundcover indicated potential shallow seeps, but no dripping or standing water was visible. It would be beneficial to supplement the vegetation with vines and additional groundcovers. Potential signs of a mountain lion den detected under one overhang as well as small to medium ground burrows.

Upland Forest—Regenerating Forest [B2] appears to have been cleared and/or burned in the last 100 years prior to 1985. Most of the canopy consist of Plateau Live Oak and Ashe Juniper (100-200+ years old). However, it is regenerating and contains many pockets of juvenile Ashe Juniper trees mixed with Cedar Elm saplings, and several patches of bushy Ashe Junipers that will require minor management to enhance wildlife access and use. B2 has noticeably less groundcover, understory, and leaf debris than B1. It's likely much of its seedbank washed away due to historical clearings.

Observed vegetation
Ashe Juniper, Cedar Elm, Durand Oak, Gum Bumelia, and Plateau Live Oak canopy. Texas Persimmon, Cedar Elm, Bushy Ashe Juniper, Agarita, Gum Bumelia, Juvenile Ashe Juniper trees, and Prickly Pear mid-story. Wood Sorrel, Cedar Sedge, Side Oats Grama, Square Pleuruchaete Moss, Indian Mallow, Mexican Hat, Plains Bristlegrass, and Lindheimer Senna groundcover.

Upland Mixed Woodland/Scrub [C]

The Upland Mixed Woodland/scrub cover the bulk of the upland area. It is dominated by bushy Ashe Junipers, canopy Plateau Live Oaks, and a few larger Ashe Juniper trees. Google Earth revealed much of this area was cleared prior to 1985. Excessive clearing can damage this limestone area since it has shallow soils. This is especially true on the slopes.

Juniper-oak Woodland/Scrub [C1] dominates this area. It consists of larger bushy Ashe Junipers (30-40 years old), well-developed woody thickets, prickly pear patches, Cholla, Bee Bush, grassy meadows, large rock outcroppings, overhangs. Although the diversity and soils are mostly good, wildlife movement is restricted by the dense growth of the junipers. The groundcover is dominated by clovers and early succession native grasses, however reduced grazing should allow more grasses (such as Side Oats Grama) and forbs to flourish. Pockets of Thompson Yucca and rock ferns were found growing, especially along the lower slopes. One hillside spring was found (blue star on map). It was not flowing, but the presence of ferns (Alabama Lip Fern and Cliffbrake Fern) and mosses indicate the potential for spring enhancement. Upland rill erosion indicate that overland flows are now bypassing the area that could help recharge the spring to increase flows for wildlife use.

Degraded Scrub [C2] is infrequent, encompassing less than 10 acres. Most of it occurs along the slope that runs just west of the driveway. The area is dominated by younger bushy Ashe junipers (10-30 years old). Plant diversity is low and erosion is common.

Scrub Cactus [C3] covers less than five acres. It is located midway along the south fence line. The clearing reveals what happens if too much bushy Ashe Juniper is cleared before the junipers have successfully improved the soil and/or without following up with soil protection measures. However, the the low thicket nature of the habitat does provide forage and food for turkey and deer. However, the overall density and extreme rockiness can restrict wildlife movement.

Clearing [C4] contains recently cleared areas. These areas possess little to no rock out droppings. Clearing that's west of the residence contains more healthy soils and would be prime for grassy native prairie establishment. The area currently contains a number of scattered, dense thickets that serve as excellent cover and food for wildlife and would need to be managed to accommodate more grass-for growth. Clearing that runs along the driveway is very rocky and degraded and shows signs of sheet and rill erosion.

Observed vegetation
Ashe Juniper, Cedar Elm, Durand Oak, and Plateau Live Oak canopy. Texas Persimmon, Prickly Pear, Beebush, Agarita, Green Condalia, Thompson Yucca, Cedar Elm, Bushy Ashe Juniper, Juvenile Ashe Juniper Tree, Honey Mesquite, Gum Bumelia, Baccharis, and Cholla Pencil Cactus mid-story. Lindheimer Senna, Sideoats Gramma, Threeawn, Lace Cactus, Cliffbrake Fern, Texas Bluebonnet, Golden Aster, Alabama Lip Fern, Plateau Milk Vine, Twistleaf Yucca, Horseherb, Zexmenia, Indian Mallow, Nightshade, Mexican Hat, Prairie Verbena, and Slim Tridens groundcover.

HABITAT NEEDS OF TARGETED WILDLFIE

White-tailed Deer, *Odocoileus virginianus*

White-tailed deer are highly adaptable species that can live in any mixed habitat with forest, brush lands, grassy prairie, and meadows with a nearby water source. Generally, they prefer taller established wooded areas with small grassy openings or areas adjacent to larger openings with taller, dense grass. They also need low vegetation for escape, low and mid levels for food, and high vegetation for protection from heat and cold extremes. Their primary food consists of browse and forbs, lichens, mushrooms, fruit, acorns (especially those lower in tannic acid), and nuts. Ashe Juniper trees, especially fruiting female trees, comprise up to 34% of White-tailed Deer diets.

Rio Grande Wild Turkey, *Meleagris gallopavo intermedia*

Grasses, insects, and forbs are all critical components of the Rio Grande Wild Turkey's diet. Insects are a highly preferred food source and readily consumed when available, which is primarily in the summer and fall. Grasses, such as Indian Grass, Switchgrass, Tall Dropseed, and Side Oats Grama, are the most utilized source of nutrition for Rio Grande Wild Turkeys and make up the bulk of the subspecies diet in the winter, spring, and fall. They also consume mast, mesquite beans, fruits, and herbaceous forbs. Turkey distribution is often associated with the abundance of water via the presence of streams, drainages, wind mills, and stock tanks. Studies have indicated that most turkeys nest within one mile of standing water and commonly within 0.25 miles. Turkeys roost in tall trees, especially those with pronounced horizontal branches, to avoid predation. Rio Grande Wild Turkey roosting sites are often made up of trees located close to streams, rivers, and drainage sites. Roost trees are surrounded by cover at least 18 inches tall to protect turkeys while coming to and from their roost. Turkeys are a ground nesting species . Nesting and brood rearing cover is a vital component of turkey habitat and should also be made up of low brush (2 to 8' high), dense grass (at least 18 inches tall), and low tree branches.

Painted Bunting, *Passerina ciris*

Painted Buntings nest in a large portion of the United States and winter in Mexico. The primary food source for buntings is grass (such as Texas Cup Grass, Switchgrass, and Indian Grass), sedge, and small seeds, fleshy fruits, and insects. Painted buntings inhabit dense scrub, riparian thickets, and other woodland habitats adjacent to open grassy areas with moving shallow water. Nests are built in dense brush or small trees 2 to 6 feet above the ground.

Eastern Screech Owl, *Megascops asio*

Eastern Screech-Owls breed in well-established woodlands and forest with longleaf pine, mixed pine-hardwood, deciduous oak-hickory, live oak-juniper, live oak-mesquite, cottonwood-willow, elm-sugarberry, or ebony-tepeguaje near water, wetlands, and grassy prairies. They prefer forests with relatively open understory and nest in tree cavities or nest boxes 10 to 30 feet above the ground. Natural tree cavities formed by wind damage, rotting, and squirrel gnawing are usual nest sites, and large woodpecker holes are used. They mostly eat large insects and small rodents

Golden-fronted Woodpecker, *Melanerpes aurifrons*

The golden-front occupies a variety of habitats including semi-open mixed oak-juniper-mesquite woodlands and brush as well as riparian woodlands of cottonwood, willow, cypress, juniper, and oak. They need tall trees and snags located along woodland/forest edges to accommodate nesting cavities 6 to 20 feet above the ground. Golden-fronted Woodpeckers are omnivorous. They forage at all levels in trees and on the ground where they search for insects. They also consume acorns, pecans, and wild fruits. Golden-fronts are not shy and commonly visit human habitations.

Ladder-backed Woodpecker, *Picoides scalaris*

The nesting season extends from April to early July. These birds are usually seen as individuals or pairs, but may form small flocks after the breeding season. The Ladder- backed Woodpecker is found in desert scrub, riparian woodlands, in juniper-oak woodlands, thorny thickets with mesquite, cottonwood, willow, walnut, hackberry, juniper, and oak. The nests are excavated in dead limbs, stumps, fence posts, yuccas, agaves and large cacti, typically 4 to 20 feet off the ground.

Turkey tracks

Orb Weaver spider in Prickly Pear—Cholla Pencil Cactus cluster

Deer tracks in intermittent stream bed

Red Harvester Ant mound

PLANNED ACTIVITIES

1. HABITAT CONTROL

Objective: Actively manage the land to create or promote an environment that benefits native wildlife on the land.

Grazing Management

Currently, annual cattle grazing summer through fall is preventing grass and forbs from reaching maturity and producing seed/fruit to benefit wildlife. It is recommended that grazing be deferred to every 2 years or longer instead of once a year to benefit and enhance native vegetation/seed production. The other option is to only graze winter through spring.

Range Management

The bottomland contains native and exotic pasture grasses. Each year treat one acre (recommend starting 2026). For each acre, mow existing cover to the ground. Create four to five 5-8' wide strips following the contour. Add seed using the drill method (see Appendix), then spray with liquid manure compost (use Green Cow Compost out of Dublin) or spread manure compost 1/8-1/4 inches deep. Take care to not disturb Red Harvester Ant (*Pogonomyrmex barbatus*) mounds. Contact Native American Seed for seeding instructions and quantities.

Recommended Seed Mix (mix ratio: 60% grass : 40% forbs):

**Green Sprangletop*	*Plains Lovegrass*	*Lemon Mint*
**Cane Bluestem*	*Cowpen Daisy*	**Indian Blanket*
Side Oats Grama	*Black-eyed Susan*	*Plains Coreopsis*
Texas Cupgrass	*Mealy Blue Sage*	

*these native species are fast spreaders—so at least 50% of these seeds should be included in the mix.

Brush Management

Do not remove brush during spring to minimize disturbance to nesting wildlife. Remove woody brush using a chainsaw and/or a skid steer with hydraulic shears or hydro-axe head. The hydro-axe head attachment is recommended for more extensive clearing and requires no follow-up brush work. Repurpose cut woody brush to form brush windrows on-contour (see Erosion Control). If the brush gets shredded, make sure woody debris is spread no deeper than 2 inches. If the landowner wishes to burn the piles, use the top-down burn pile method to reduce fire hazards, smoke, and soil damage (see Appendix). Burn in fall or winter when winds are low and humidity is high. Shredded woody debris can be left on the ground where it falls.

The Bottomland contains several large, woody thickets that serve as important sources of shelter, escape, and food for the targeted species. It is important to retain these. Smaller to single woody shrubs can be removed as needed to maintain open areas, especially around the deer feeder and blind.

The Upland Mixed Woodland/Scrub, Juniper-Oak Woodland/Scrub **[C1]** contains an abundance of larger, dense woody brush (mostly bushy Ashe Junipers and Texas Persimmon). Although such cover is beneficial to wildlife and maintains limestone karst function and soil health, the density is obstructing the mobility of larger wildlife and limits seed dispersal. To remedy this, use GPS to mark existing grassy openings. Then link them

by moving the skid steer from point A to B to create wildlife corridors. Follow contours whenever possible to mitigate for erosion. Make these corridors 1 to 2x the width of the skid steer. Enlarge grassy openings as needed, but no more than 20' wide and 40' long on contour. There are several areas with large rock outcroppings—allow these to remain covered with shrubs.

BRUSH ACTIVITIES SUMMARY

Bottomland:
Remove isolated brush and prickly pear in open areas every 5 years summer-winter.

Upland:
[C1] Add 3-5 corridors per acre per year summer-winter.

[C1] [C3] Reduce up to 50% of Prickly Pear per acre and spread seed mix on exposed soil every 3 years fall/winter.

[C4] Reduce 1 acre of woody thickets by 75% per year + spread seed fall/winter.

Prickly Pear is common in the Upland Mixed Woodland/Scrub—Juniper-Oak Woodland/Scrub **[C1]** and abundant in Upland Mixed Woodland/Scrub—Scrub Cactus **[C3]**. Prickly Pear is more abundant where soils are degraded and rocky, but also because there are no Javelinas on the property to help keep the plant's numbers in check. Although a hindrance to most livestock, Prickly Pear benefits targeted wildlife. Also, the Prickly Pear helps regenerate poor soils, so removal without follow-up strategies will allow soils to further degrade. So the plan is to reduce Prickly Pear, not eradicate it. As with woody brush, where it grows thick, remove to create corridors to facilitate movement of larger wildlife such as deer and turkey. In late fall or winter, attach a rock rake bucket to a skid steer or other small tractor. Use to pull individual Prickly Pear plants from the ground and shade out soil. Manually hand rake any fragments pads that fell during removal. Stockpile pulled plants and pads, then leave as is, burn, or grind into mush with a mulcher head. Spread a seed mix into exposed soil. For areas of exposed soil larger than 10' x 10', cover the bare soil and seeds with coconut erosion blanket. Contact Native American Seed for seeding instructions and quantities to order.

Recommended Seed Mix:

Green Sprangletop	*Little Bluestem*	*Lemon Mint*
Cane Bluestem	*Mexican Hat*	*Indian Blanket*
Side Oats Grama	*Texas Cupgrass*	*Bush Sunflower*

A last resort to reduce Prickly Pear can be to carefully spray individual plants with toxic herbicides. Only use herbicides containing the active chemical Fluroxpyr (not Picloram) since Picloram can remain active for several years. Be careful to not allow the herbicide to drip to the soil since it can kill soil biota. Do not use herbicide within 100 feet of the bottomland pond.

Upland Mixed Woodland/Scrub—Clearing **[C4]** west of the house can numerous woody thickets. Reduce by 75% in the central portion of this area to allow for more prairie grass growth. Spread or drill seed (see Appendix) in cleared areas and protect with coconut erosion blankets. Treat one acre per year.

Recommended Seed Mix:

Texas Grama	*Little Bluestem*	*Indian Blanket*
Cane Bluestem	*Texas Cupgrass*	*Texas Bluebonnets*
Side Oats Grama	*Lemon Mint*	*Curly Mesquite*

Rock rake being used to scoop up and remove Prickly Pear.

Forest Management
Conduct forest management June through February to minimize wildlife disturbance. The primary goal for the first 5 years is to manage the juvenile Ashe Juniper trees and open up portions of the understory to increase wildlife movement without reducing the overhead tree canopy.

Dense stands of juvenile Ashe Juniper trees (dog hair regrowth) can be thinned to facilitate more rapid tree regeneration and open the understory. Remove no more than 25% of trees and not more often than every 7 years. Remove juvenile junipers within 5 feet of an existing canopy tree and poorly formed trees (such as forked low). Retain junipers that surround emerging plants such as Cedar Elm and Plateau Live Oak since they will protect those plants from deer browsing. Also, create corridors tall and wide enough for a person to walk through easily to allow wildlife to more easily access the area. This can be done any removing juvenile junipers and/or knocking off lower branches from taller trees.

For reach area treated, spread seeds in 20 patches to enhance biodiversity. Patches should be about 5'x5' and located along the corridors just created or in small openings. Pull back the leaf debris, spread seeds, then push leaf debris back over. Do this in late fall to early winter. Treat one acre each year.

Recommended Seed Mix:

Prairie Wildrye	*Blue Curls*	*American Beauty Berry*
Virginia Wildrye	*Frostweed*	*Snailseed Vine*
Plains Bristlegrass	*Turk's Cap*	

Riparian Management
Install a cattle fence around the pond and lower riparian to exclude cattle and facilitate riparian revegetation. Set back at least 20 feet from the upper riparian banks. Do this first. Refer to Erosion—Riparian Revegetation for follow-up work.

Healthy stand of Juvenile Ashe Juniper trees in the Upland Forest. Dog-hair regrowth is more dense and thicket-like. Doghair can be thinned and pruned to look like the ones in this photo.

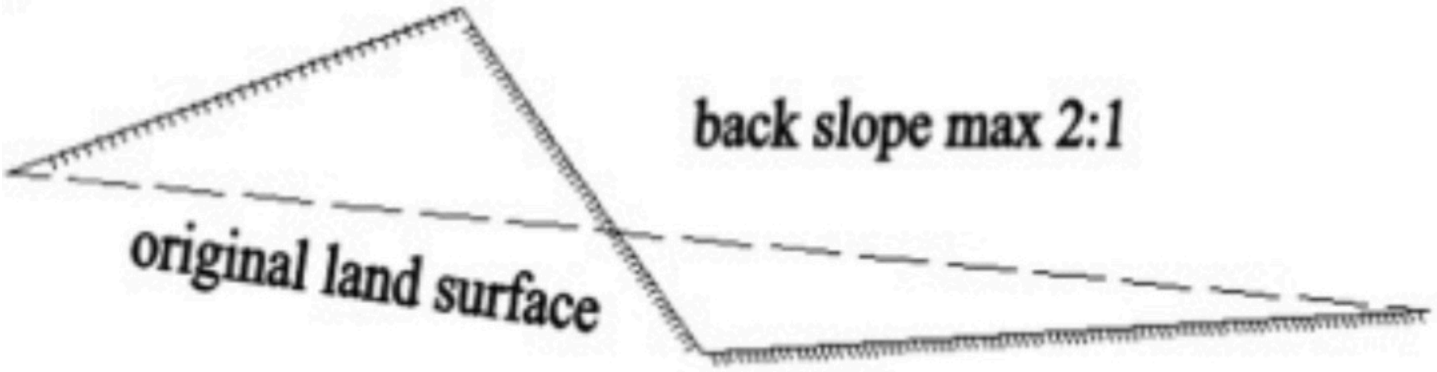
2. EROSION CONTROL

Objective: Attempt to reduce or keep soil erosion to a minimum will benefit native wildlife. When falling rain hits exposed soil, it dislodges soil particles. The more degraded the soil, the more particles that will dislodge. Heavy rains will then wash away dislodged particles.

NOTE: Do Gully Shaping and Water Diversion around pond FIRST—then start revegetation

Pond Construction and Repair

The newly constructed pond located in the bottomland has experienced highly than normal siltation loads. An analysis of the upslope intermittent stream bank revealed no significant source of erosion. However, the area around the pond and the dirt road that cuts through the stream just west of the pond are contributing to the siltation. The plan strongly recommends constructing one terraces halfway up pond bank to slow surface runoff. Back slope the terrace a maximum of 2:1. Recommend bringing in pond shaping specialist Van Dyck Earthworks for a consultation (www.droughtprooftx.com)



Establish Water Diversion

Diversion strategies encourage more stormwaters to soak into the ground instead of running overland. Sinking more stormwater flows decreases erosion, pond silting, and soil dehydration, and helps to increase groundwater supplies. The most basic strategy involves creating brakes on the same contour to slow down the vertical movement of surface flows (see plan for recommended locations). See the Appendices for simple ways to mark out contours on-site.

A simple, cost-effective strategy utilizes cut brush. Rearrange cut brush to form linear brush piles (brush windrows), about 3' wide and 1-2' tall, following contours as shown on the plan. Small rocks can also be formed into rock gabions on areas with less erosion (not shown on plan). Another option is to lay larger logs following contours (not shown on plan). A more expensive but proven, effective solution is to install contour bioswales (contact Van Dyck Earthworks). After installing contour bioswales, spread seed and cover with coconut erosion blankets. After install brush windrows, spread seed along the edge of the brush. Add 1-2 longer or 3-4 shorter contour brakes per year.

Recommended Seed Mix:

Green Sprangletop
Cane Bluestem
Little Bluestem
Indian Grass
Indian Blanket
Side Oats Grama
Texas Cupgrass
Lemonmint
Cereal Rye Grain
Bush Sunflower

Along the western edge of the eastern-most area of habitat [C1] there is an hillside gravity spring (see blue start on habitat map). It is currently intermittent but geological and vegetation indicate it historically flowed more continuously. The flow likely decreased due to the loss of upslope soil and decreased limestone porosity in habitat [C4] just upslope of the spring. Allowing this area of [C4] to revegetate and installing contour brakes could help revitalize this spring and create more sustained flows.

The Upland Mixed Woodland/scrub—Degraded Scrub [C2] consists of younger bushy Ashe junipers (10-30 years old). The ground around each shrub is very degraded. Do not clear brush from this area except for clearings made along proposed contour brakes (see plan) installed to enhance rainwater infiltration to boost soil regeneration. After five years, assess soil infiltration to determine next steps to take.

Example of a contour bioswale.

Pond Revegetation

After adding the fence, pond bank terrace, and bottomland contour brakes, add seed, live roots, and live stakes. Insert live stakes perpendicular to the slope every 12-36" along the pond bank terrace slope (see Appendix). Measure perimeter of the terrace and multiply by 8' to obtain approximate square feet for live stakes. Plant live roots below the terrace slope. Multiple the perimeter by 6' to obtain the square to calculate the number of live roots needed. Spread seed on and above the terrace and cover with coconut erosion control blanket. Multiple the perimeter by 12-14' to obtain square feet. Contact Native American Seed for assistance. For wildlife credit, plant live stakes one year, roots the next, and seed the third.

Obtain live stakes from local resources or purchase from:
Black Willow (Salix nigra) and Eastern Cottonwood live stakes should be at least 24" long
Collect locally or order from the following online nurseries:
Mid Atlantic Native Plant Farm Inc. (www.midatlanticnatives.com)
Hillis Nursery Company (www.https://www.hillisnursery.com)
Wholesale Nursery Company (www.wholesalenurseryco.com)

Live Roots:
Switch Grass
Indian Grass
Maximilian Sunflower

Seed:

Green Sprangletop
Cane Bluestem
Indian Grass
Texas Cupgrass
Little Bluestem
Plains Bristlegrass
Prairie Wildrye
Tall Dropseed
Eastern Gamagrass
Sand Lovegrass
Indian Blanket
Black-eyed Susan
Green Milkweed
American Basketflower
Side Oats Grama
Sand Dropseed
Sand Lovegrass
Cowpen Daisy
Partridge Pea
Hooded Windmill Grass
Slim Tridens
Sleepy Daisy
Texas Bluegrass

3. PREDATOR MANAGEMENT

Objective: Conduct activity intended to manage the population of predators to benefit the property owner's target wildlife population. When managing for wildlife it is important to not spray pesticides as this will impact food sources.

Feral Hog Control

The presence of feral hogs increases mast competition among deer and turkey. Reducing hogs could benefit Javelina populations should they expand or be reintroduced to the property in the future. The landowners will convert the back portion of the existing cattle corral to capture and hold nonnative feral hogs for local processing. Best time for trapping is December through February.

4. SUPPLEMENTAL WATER

Objective: Provide supplemental water inhabitants where water is limited or redesigning water sources to increase availability to wildlife.

Marsh/Wetland Development

Construct about a 15 feet long shelf on one side of the bottomland pond just below normal pond level to add shallow wading area for smaller wildlife and the establishment of emergent vegetation. One time activity.

Wildlife Watering Facility

Add an upland water trough. Feed water into the trough from rainwater collected from the existing home metal roof. Recommend a 500-gallon tank minimum to extend water source through summer. Locate trough in open area that gets afternoon shade and has nearby brush cover (see plan for recommended location). Troughs can be purchased online from companies such as rainmakerwildlife.com or constructed on-site (see Appendix for ideas). It is important to include a ramp to allow smaller wildlife to access and escape the water. Include a bubbler to add movement to the water surface to attract more wildlife such as painted buntings, woodpeckers and turkey. Surround with cattle fence if needed to reduce use by cattle. Provide monthly maintenance and cleaning as needed.

5. PROVIDE SHELTER

Objective: Supplement shelter for native wildlife by actively adding and maintaining shelters that provide shelter, escape, and breeding sites.

Nest Boxes

Where snags are lacking, install Eastern Screech Owl nest boxes. Add at least one per 10 acres of suitable habitat, but no closer than 200' apart (see plan for recommended locations). Locate boxes 15 to 20' up a tall tree or pole located at a woodland or forest edge near a water source. Attach boxes so they face southeast or south and near a branch to allow young to climb out and perch. Add 2-3" of dry leaves inside the box. Recommended source for boxes: Veteranhealing (in Georgetown, Texas) on Etsy. Install 3 boxes in the bottomland one year; install 3 boxes in the upland a second year.

Natural Cavities and Snags

Standing and fallen dead trees provide important food and shelter for native wildlife, including the target species: Eastern Screech Owl, Golden-fronted Woodpecker, and Ladder-backed Woodpecker. Retain these snags whenever possible.

6. CENSUS COUNTS

Objective: Provide periodic surveys and inventories to assess the number, composition, or other relevant information to determine if the current wildlife management practices are serving targeted species.

Standardized Incidental Observations

Keep a record of wildlife viewed at the upland water trough using a motion-activated wildlife camera. Write down date, species seen, and number.

Harvest Data Collection

Harvested records of White-tailed Deer should include sex, weight, condition, age, antler growth, and date of harvest, and blind number/name. Monitoring blind will help track movement and use. Dressed weights of adult, lactating in particular indicates herd health. After 5 years, review patterns to determine if blinds should be enhanced, relocated, or eliminated.

Census of Nongame Wildlife

Record use of nest boxes by Eastern Screech Owls each spring. Obtain bird census counts in spring to determine the abundance and presence of targeted bird species (contact the Llano Estacado Audubon Society for volunteers). Make sure to keep track of cowbird populations since they commonly parasitize painted bunting nests.

Perfect snag near the driveway in [C1] habitat. It is located at the edge of a dense woodland and near the pond.

5-YEAR MANAGEMENT MATRIX

TREATMENT	TIMING	2024	2025	2026	2027	2028
HABITAT CONTROL						
Grazing Management	Nov-Apr		X		X	
Range Management	Oct-Dec			X	X	X
Brush Management	Jun-Feb	X	X	X	X	
Forest Management	Jun-Feb		X	X	X	X
Riparian Management	asap	X				
EROSION CONTROL						
Pond Construction and Repair	summer or winter	X	X			
Pond Revegetation	Oct-Feb	X	X	X		
Establish Water Diversion	summer or winter	X	X	X	X	X
PREDATOR MANAGEMENT						
Feral Hog Control	Dec-Feb	X	X	X	X	X
PROVIDE SUPPLEMENTAL WATER						
Marsh/Wetland Development	Oct-Mar	X	X			
Wildlife Watering Facility	year round	X	X	X	X	X
PROVIDE SUPPLEMENTAL SHELTER						
Nest Boxes	Sep-Feb		X			
Natural Cavities and Snags	year round	X	X	X	X	X
CENSUS COUNTS						
Standardized Incidental Observations	year round	X	X	X	X	X
Harvest Data Collection	Oct-Mar	X	X	X	X	X
Census of Nongame Wildlife	Apr-May	X	X	X	X	X

APPENDICES

Property Soils
EcC—Eckrant-Rock outcrop
LuB—Luckenbach clay loam

Harvesting Rainwater for Wildlife

Live-staking

Seeding Methods

Simple Way to Locate Contour Lines On-site

Top-down Burn Pile Method

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B-6182
02/06

Harvesting Rainwater *for* Wildlife

Harvesting Rainwater *for* Wildlife

James C. Cathey[1], Russell A. Persyn[2], Dana O. Porter[3], Monty C. Dozier[4], Mike Mecke[5] and Billy Kniffen[6]

People are intrigued by wildlife and enjoy watching different species interact. Many Texans have been introduced to the outdoors through hunting and fishing, activities that have contributed an estimated $3.3 billion annually to the state's economy.

Wildlife viewing, including bird-watching, is gaining in popularity among outdoor enthusiasts. For example, the number of bird-watchers nationwide has increased from 21 million in 1983 to 68 million in 2000.

With increased enthusiasm for wildlife comes a growing economic potential for landowners to offer nature-based tourism. To attract wildlife—and in turn, people—to their properties, land managers have worked to improve the habitat on their properties by using management techniques such as shallow disking, prescribed burning and livestock grazing.

One underused method for attracting wildlife is the installation of watering devices to provide a supplemental source of water for animals. Land managers are also harvesting rainwater to better distribute water on the landscape, thus increasing the amount of usable space for wildlife.

Rainwater can be captured using several kinds of devices and management techniques. To make the best choice for a specific property, land managers should consider many factors, including the sources of water used by animals, the number and diversity of wildlife on the land, differences in mobility for various species, rainfall patterns in the area and options available for harvesting, storing and conveying rainwater.

[1]Assistant Professor and Extension Wildlife Specialist, [2]Assistant Professor and Extension Specialist, [3]Associate Professor and Extension Agricultural Engineering Specialist—Water Management, [4]Assistant Professor and Extension Water Resources Specialist, [5]Extension Program Specialist—Water Management, [6]County Extension Agent—Menard County, All of The Texas A&M University System

Wildlife water sources

Just as for humans, water is essential for all animals, including wildlife. Animals obtain water in three basic forms:

- **Free water** (drinking water), which is surface water taken from ponds, creeks, water troughs, bird baths and other similar sources.
- **Metabolic water,** which is derived from breaking foods down (digestion) into their chemical components.
- **Preformed water,** which is bound within a food itself. For instance, prickly pear cactus contains about 85 percent water (preformed water) and 15 percent solid material. Prickly pear cactus comprises a large part of the diet of the javelina (collard peccary). Javelinas are often found in southwestern Texas, where free water is sparse. Consequently, javelinas rely on the water contained in cactus pads. Some songbirds get much of their water not from bird baths and other free-water sources, but from the water held within worms, grubs, insects and various plants.

Wildlife management considerations

When making decisions about modifying your land to attract wildlife, it is important to consider the factors that contribute to the attractiveness of a habitat for animals, including wildlife diversity, home-range size and animal mobility.

Wildlife diversity: Although management efforts often are tailored toward attracting the species that are economically important and aesthetically pleasing, all animals play important roles in nature. Diversity is an indicator of ecosystem health. Therefore, the success of watering devices may be measured in part by the numbers and different kinds of animals using them.

Home-range size and animal mobility: Different kinds of animals use free water at different rates. They also require varying amounts of energy to crawl, walk or fly to a water source (Table 1). When considering where and how many watering points to provide, think about how an animal might move over a square mile (640 acres). Then break this acreage into smaller blocks (such as 320, 160 and 80 acres) for animals that can move far and for those that are more sedentary.

In livestock management, it is generally recommended to place watering points about 1 mile from each other, the idea being that a cow located at the midpoint would need to travel only 1/2 mile to acquire water. Such placement lessens the chances of cattle "walking off" weight gains. It also minimizes the habitat damage resulting from prolonged use, as some animals will not forage far from a water source.

These livestock management considerations are good starting points for wildlife management plans. Large mammals can easily travel 1/2 to 1 mile to obtain water; medium-sized mammals would benefit from closer water point spacing (such as one per 320 acres); and smaller mammals are better served by water points distributed one per 80 to 160 acres.

Similarly, wild turkey and mourning dove can travel farther than can other birds, so water distribution for these two birds should be one water point per mile (640 acres). Conversely, the home ranges of bobwhite and scaled quail are much smaller, and water points placed at one per 80 to 160 acres would be more suitable. This density of water sources is also appropriate for most Texas songbirds.

Rainfall

In some parts of Texas, rainwater is an important source of free water for wildlife. The supply of rainwater available depends on three key factors: the amount of rainfall, the type of surface on which rainfall lands (runoff coefficient) and the size of the area that catches rainwater (catchment area).

The amount of rainfall in Texas varies dramatically from east to west (Fig. 1). The East Texas Pineywoods region averages more than

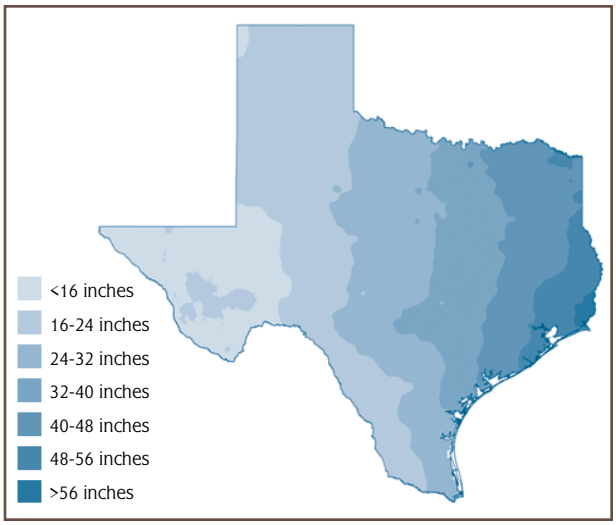


Figure 1. Long-term average rainfall in Texas.

Table 1. Recommended water distribution according to animal group.

Animal group	Recommended water-point spacing
Large mammals (white-tailed and mule deer, coyotes and bobcats)	1/2 to 1 mile (1 per 320-640 acres)
Medium-sized mammals (javelinas, foxes, skunks and raccoons)	1 per 320 acres
Smaller mammals (ring-tailed cats, armadillos, squirrels and rabbits)	1 per 80 to 160 acres
Wild turkey and mourning dove	1 per 320-640 acres
Bobwhite and scaled quail and most songbirds	1 per 80 acres

48 inches of rainfall annually, while the Post Oak Savannah of Central Texas averages 32 to 48 inches a year. The High, Rolling and South Texas plains generally receive 16 to 32 inches of rain, and the Trans-Pecos region gets only 8 to 16 inches of rain each year.

Table 2 shows the long-term average-annual rainfall amounts for various Texas cities. Please note, however, that annual and seasonal rainfall can deviate significantly from these long-term averages.

Because of rainfall distribution patterns across Texas, wildlife watering devices will have greater impact in the western half of the state (west of Interstate Highway 35) than in the eastern half.

Rainfall across Texas varies by season as well. For example, El Paso typically receives its peak rainfall in July, August and September (mid to late summer), while San Antonio has two rainfall "peaks," in May and June (early summer) and in September and October (early autumn) (Fig. 2).

Catchment area and runoff coefficients

The amount of a particular surface that is available to capture rainfall is called the catchment area. Some of the rain in an area will soak into the ground and the rest will leave as runoff. The fraction of the total rainfall that will run off (and be available to be harvested) from a particular surface is known as the runoff coefficient (Table 3).

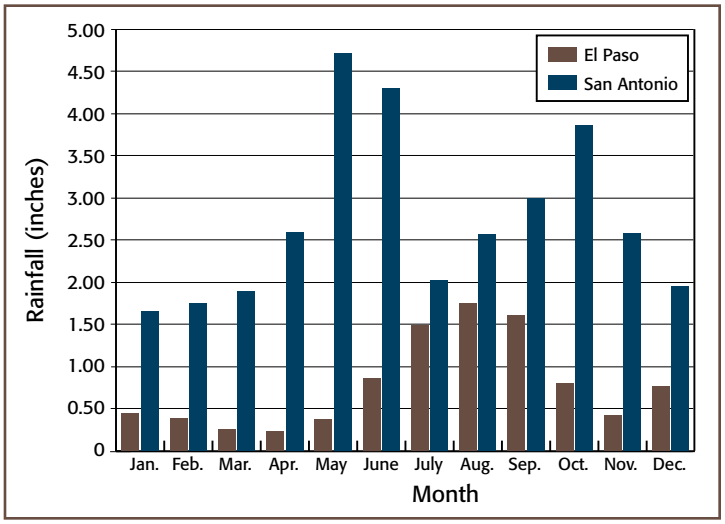


Figure 2. Long-term average seasonal rainfall distribution.

Table 2. Long-term average monthly rainfall (inches) for Texas cities.*

Cities**	Jan	Feb	Mar	Apr	May	June	July	Aug	Sep	Oct	Nov	Dec	Annual
Abilene	0.97	1.13	1.41	1.67	2.83	3.06	1.69	2.63	2.91	2.90	1.30	1.27	23.77
Amarillo	0.63	0.55	1.13	1.33	2.50	3.28	2.68	2.94	1.88	1.50	0.68	0.61	19.71
Austin	2.21	2.02	2.36	2.63	5.12	3.42	2.03	2.51	2.88	3.99	3.02	2.53	34.72
Brownsville	1.36	1.18	0.93	1.96	2.48	2.93	1.77	2.99	5.31	3.78	1.75	1.11	27.55
College Station	3.32	2.38	2.84	3.20	5.05	3.79	1.92	2.63	3.91	4.22	3.18	3.23	39.67
Corpus Christi	1.75	1.62	1.84	1.73	2.05	3.48	3.53	2.00	3.54	5.03	3.94	1.74	32.25
Dallas/Fort Worth	1.90	2.37	3.06	3.20	5.15	3.23	2.12	2.03	2.42	4.11	2.57	2.57	34.73
Del Rio	0.57	0.96	0.96	1.71	2.31	2.34	2.02	2.16	2.06	2.00	0.96	0.75	18.80
El Paso	0.45	0.39	0.26	0.23	0.38	0.87	1.49	1.75	1.61	0.81	0.42	0.77	9.43
Galveston	4.08	2.61	2.76	2.56	3.70	4.04	3.45	4.22	5.76	3.49	3.64	3.53	43.84
Houston	3.68	2.98	3.36	3.60	5.15	5.35	3.18	3.83	4.33	4.50	4.19	3.69	47.84
Lubbock	0.50	0.71	0.76	1.29	2.31	2.98	2.13	2.35	2.57	1.70	0.71	0.67	18.68
Midland	0.53	0.58	0.42	0.73	1.79	1.71	1.89	1.77	2.31	1.77	0.65	0.65	14.80
Port Arthur	5.69	3.35	3.75	3.84	5.83	6.58	5.23	4.85	6.10	4.67	4.75	5.25	59.89
San Angelo	0.81	1.18	0.99	1.60	3.09	2.52	1.10	2.05	2.95	2.57	1.10	0.94	20.90
San Antonio	1.66	1.75	1.89	2.60	4.72	4.30	2.03	2.57	3.00	3.86	2.58	1.96	32.92
Victoria	2.44	2.04	2.25	2.97	5.12	4.96	2.90	3.05	5.00	4.26	2.64	2.47	40.10
Wichita Falls	1.12	1.57	2.27	2.62	3.92	3.69	1.58	2.38	3.19	3.11	1.68	1.68	28.81

*Data obtained from the Office of the State Climatologist (http://climate.tamu.edu).
**Average rainfall for locations near those listed or for specific time periods may vary from the averages shown here.

Table 3. Runoff coefficients for various surfaces.*

Type of surface	High	Low
Roof		
Metal, gravel, asphalt shingle	0.95	0.75
Paving		
Concrete, asphalt	0.95	0.70
Brick	0.85	0.70
Gravel	0.70	0.25
Soil		
Flat (2% or less), bare	0.75	0.20
Flat (2% or less), with vegetation	0.60	0.10
Lawns, sandy soil		
Flat (2% or less)	0.10	0.05
Average (2% to 7%)	0.15	0.10
Lawns, heavy soil		
Flat (2% or less)	0.17	0.13
Average (2% to 7%)	0.22	0.18

*Data obtained from: Haan, C.T., B.J. Barfield and J.C. Hayes, 1994, Design Hydrology and Sedimentology for Small Catchments, Academic Press; and Waterfall, P.H., 1998, Harvesting Rainwater for Landscape Use, Arizona Department of Water Resources.

The amount of rainwater that runs off an area depends partly on the type of surface there. Take for example a 10-foot by 10-foot surface. If that surface is a metal roof, it could be expected to yield as runoff about 95 percent (0.95) of the rainfall it intercepts. If the surface is flat, bare soil, it would be expected to yield as runoff no more than 75 percent of the water intercepted.

To calculate the rainwater supply (in gallons) for your area, use the following equation:

Supply (gallons)	=	Rainfall (inches)	×	Catchment area (square feet)	×	Conversion factor 0.623

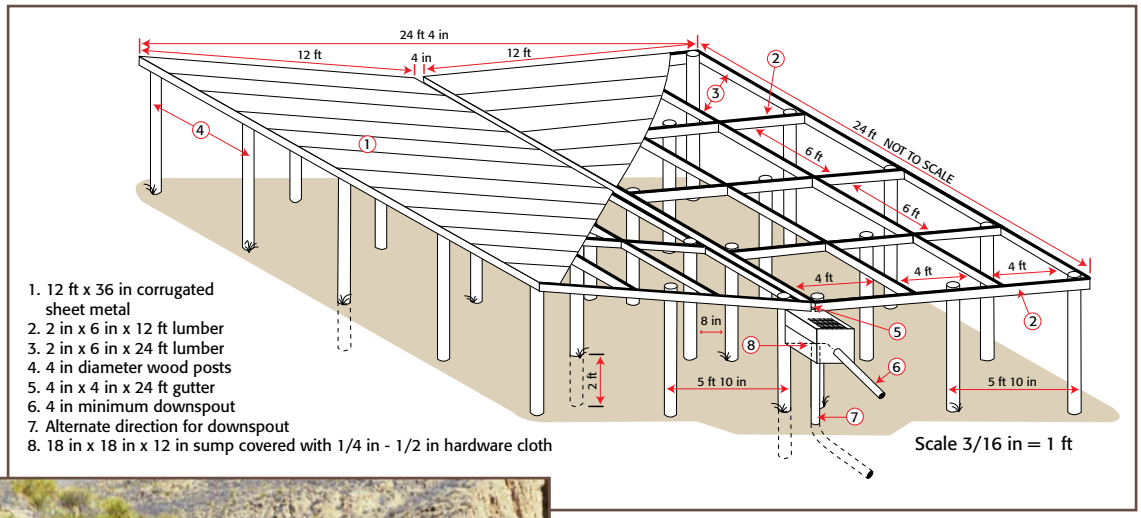
Wildlife tax valuation and supplemental water

Changing trends in land ownership have contributed to a growing number of absentee landowners and small-acreage properties in Texas. Land fragmentation has affected property tax valuations as well as the feasibility of conventional production agriculture.

Before 1995, land that was used to manage wildlife did not qualify for the same tax valuation as did similar properties managed for agricultural purposes. However, that has since changed. The state has altered Article VIII, Section 1-d-1 of the Texas Constitution to include wildlife management and its subcomponents as options for agricultural land use. According to the new tax law, land changed from traditional agricultural use to wildlife use now carries the same property tax assessment.

For land to qualify for wildlife valuation, it must have been entered previously into the agricultural appraisal process under Section 1-d-1. The land must be able to sustain breeding populations of indigenous, migrating or wintering wild animals. Also, the property must have a wildlife management plan detailing strategic goals and practices aimed at improving wildlife habitat there.

Providing supplemental supplies of water is one of seven components accepted in a wildlife management plan. Three devices that can be used to provide supplemental water to improve wildlife habitat are the Black Gap Guzzler, the Elephant Mountain Guzzler and a concrete rainwater catchment (Texas Parks and Wildlife Department). Also available for consideration are other catchments, wildlife watering facilities and modified livestock trough methods.



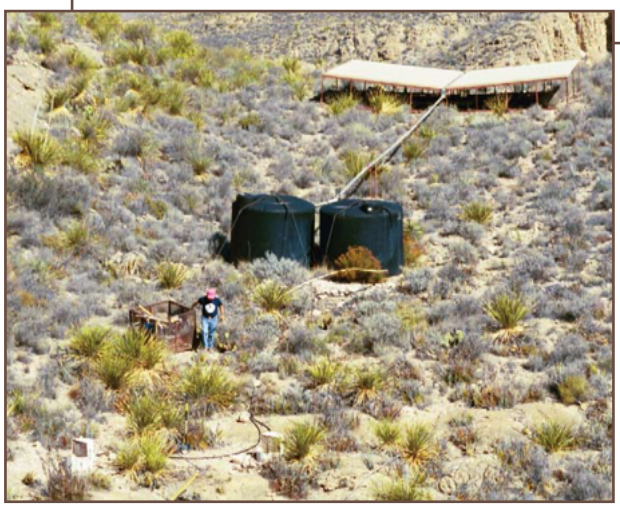


Figure 3. A Black Gap Guzzler rainwater catchment.

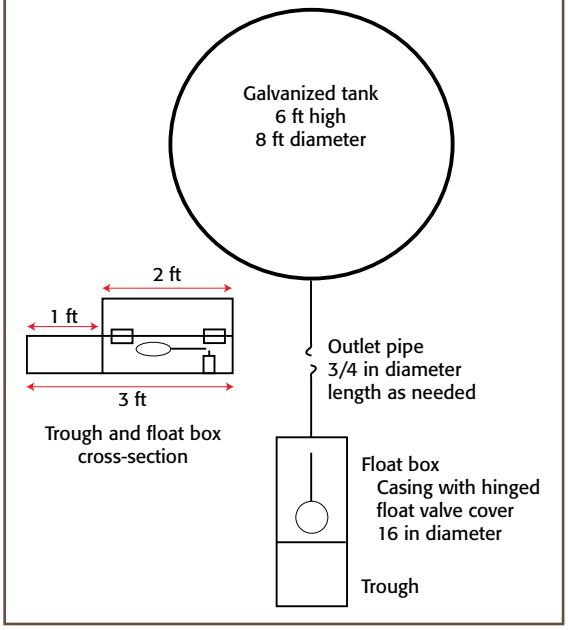


Figure 4. Black Gap Guzzler storage tank and trough detail.

Black Gap Guzzler

The Black Gap Guzzler is a well-designed catchment that requires minimal maintenance. This system works in areas with a minimum of 8 inches of rainfall per year. It requires few construction materials and little maintenance after the system is built.

Materials needed:

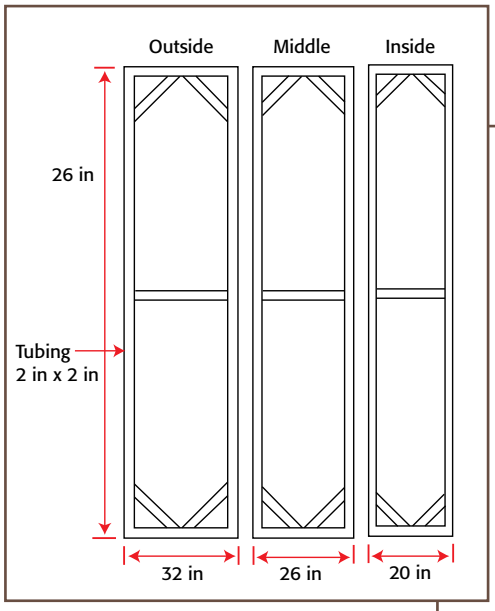
- 12 ft x 36 in corrugated sheet metal
- 2 in x 6 in x 12 ft lumber
- 2 in x 6 in x 24 ft lumber
- 4 in diameter wood posts
- 4 in minimum downspout
- 18 in x 18 in x 12 in sump covered with 1/4 in - 1/2 in hardware cloth
- 2,250 gallon storage tank
- Plastic/aluminum pipe, 4-inch diameter (length to be determined from sump box to storage tank)
- Galvanized pipe 3/4-inch diameter (length as needed from storage tank to trough)
- Float and valve
- Cement for posts
- #12 x 3/4 self-drilling galvanized tex screws – about 450
- Steel casing 16 inches in diameter, 3 feet long for trough, with sheet metal welded on the ends and hinges for float cover

The Elephant Mountain Guzzler

The Elephant Mountain Guzzler is designed for areas not accessible by land vehicles. The prefabricated parts can be air-lifted by helicopter, then set up once they are on location.

Materials needed include

- Outside support panels:
  - 6 pieces – 2 in square tubing, 32 in long
  - 8 pieces – 2 in square tubing, 13 ft long
  - 8 pieces – 2 in square tubing, 18 in long
  - 12 pieces – 2 in x 2 in angle iron, 2 in long
- Middle support panels:
  - 6 pieces – 2 in square tubing, 26 in long
  - 8 pieces – 2 in square tubing, 13 ft long
  - 8 pieces – 2 in square tubing, 16 in long
  - 24 pieces – 2 in x 2 in angle iron, 2 in long
- Inside support panels:
  - 6 pieces – 2 in square tubing, 20 in long
  - 8 pieces – 2 in square tubing, 13 ft long
  - 8 pieces – 2 in square tubing, 10 in long
  - 12 pieces – 2 in x 2 in angle iron, 2 in long
- 12 pieces – 2 in square tubing, 66 in long
- 12 pieces – 2 in square tubing, 66 1/4 in long
- 12 pieces – 1 in x 1 in angle iron, 71 11/16 in long
- 8 pieces – 2 in x 2 in angle iron, 153 in long
- 6 pieces – 2 in x 2 in angle iron, 12 in long
- 16 pieces – 2 in x 2 in angle iron, 2 in long
- 18 pieces – 36 in coverage galvanized "U" panel
- #12 x 3/4 self-drilling galvanized Tex screws (~600)
- Ridge roll – 26 ft
- 29 gauge sump box with dimensions 18 in x 18 in x 12 in with 4 in collar
- Plastic/aluminum pipe, 4 in diameter (length to be determined from sump box to storage tank)
- Galvanized pipe 3/4 in diameter (length as needed from storage tank to trough)
- Float and valve
- 76 pieces – bolts 5/16 x 2 1/2
- Hail screen to cover sump box
- 36 pieces – 1 in round rod, 36 in long (used to anchor)
- 2,250 gallon storage tank
- Steel casing 16 in diameter, 36 in long with sheet metal welded on ends and hinges for float cover



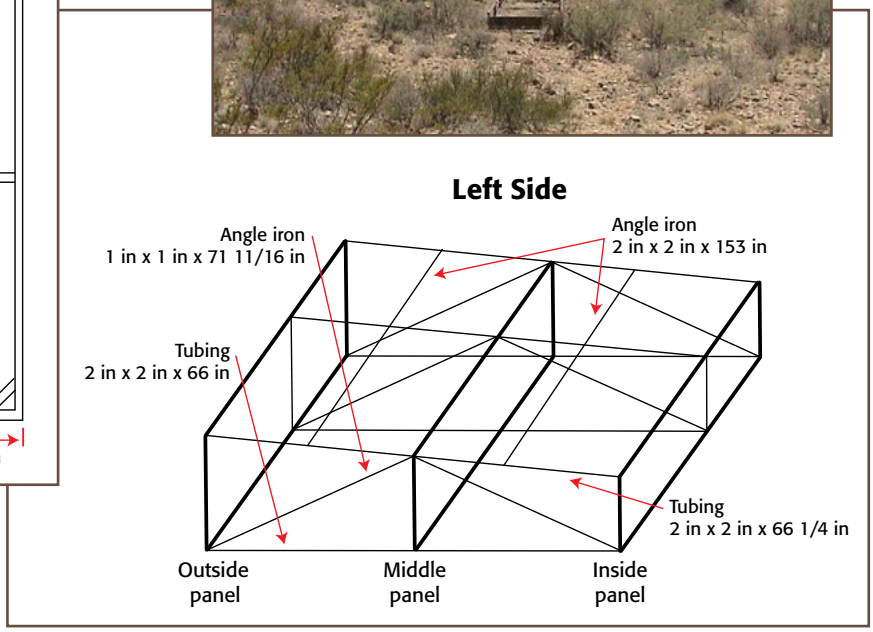


Figure 5. Prefabricated panels (above) and completed support section (right).

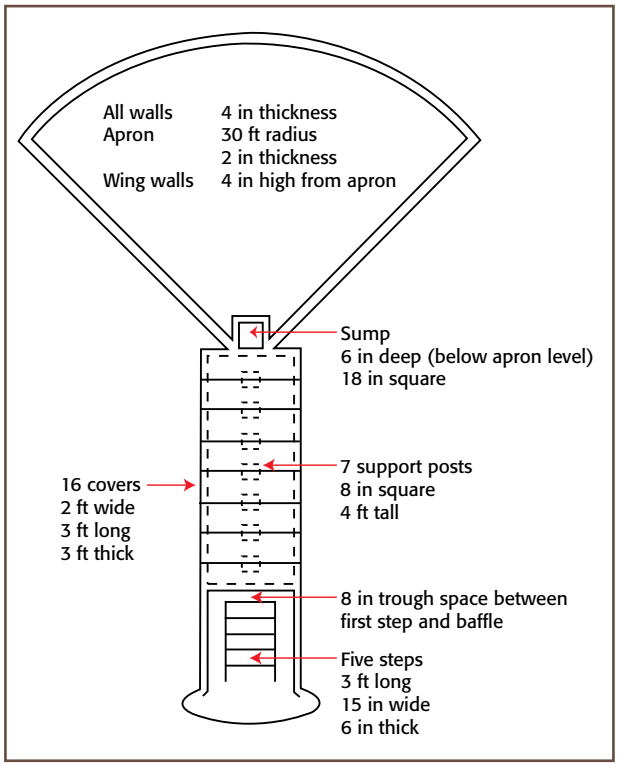


Figure 6. Top view of a concrete rainwater catchment.

Concrete rainwater catchment

A concrete rainwater catchment system is permanent and requires very little maintenance.

Materials needed:

- Concrete – about 14 yards
- Rock, 3/4-in – 23,000 lbs
- Sand – 21,000 lbs
- Water – 490 gallons
- Reinforcing steel and mesh, to reinforce sides, bottom and collecting apron
- Hail screen to cover sump box
- Framing materials
- Plywood, 1/2-in for wall framing
- Lumber, 2-in x 4-in
- Lumber, 1-in x 1-in
- Nails

Other systems

The drawings and diagrams on the following pages provide additional rainfall harvesting, storage and conveyance ideas for landowners.

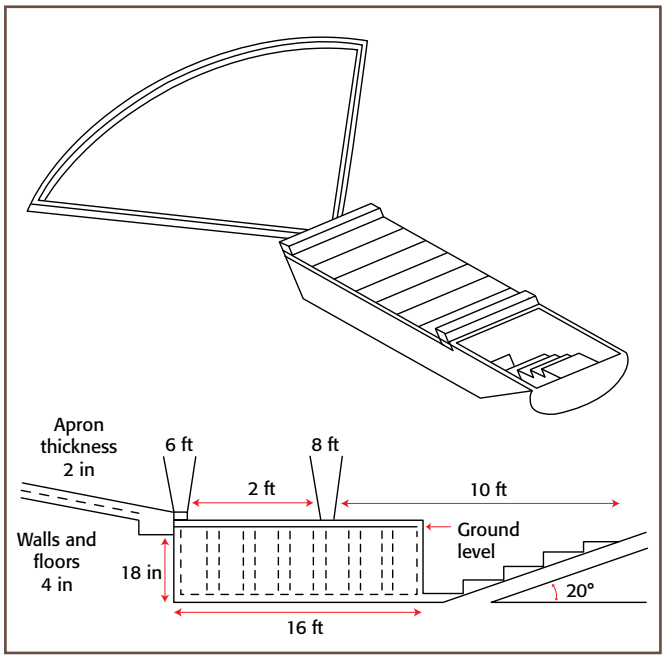


Figure 7. Isometric and side view of a concrete rainwater catchment.

Figure 8. Underground storage tank (above) and trough (below) for concrete catchment.

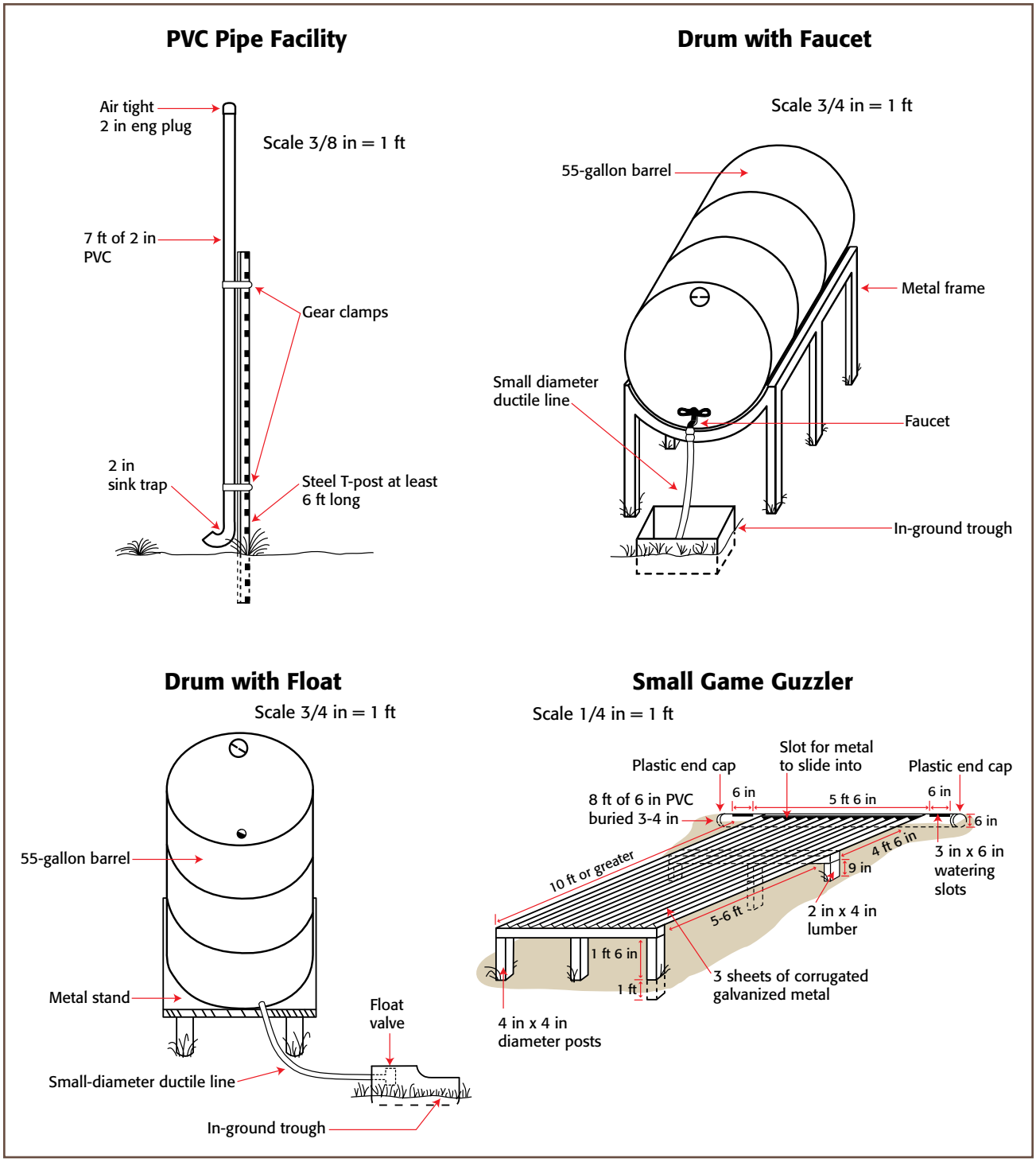


Figure 9. Wildlife watering devices.

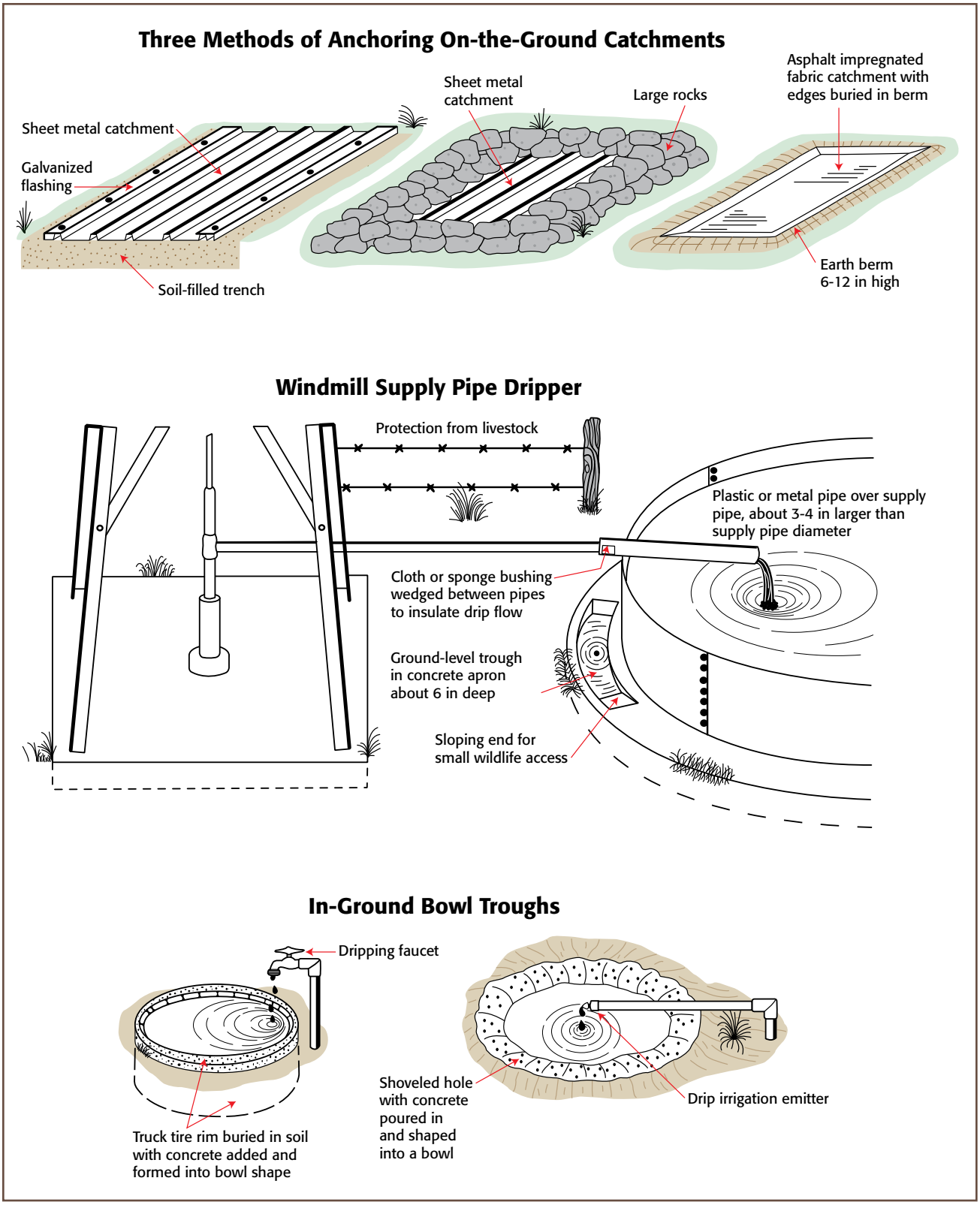


Figure 10. Methods of anchoring and types of troughs.

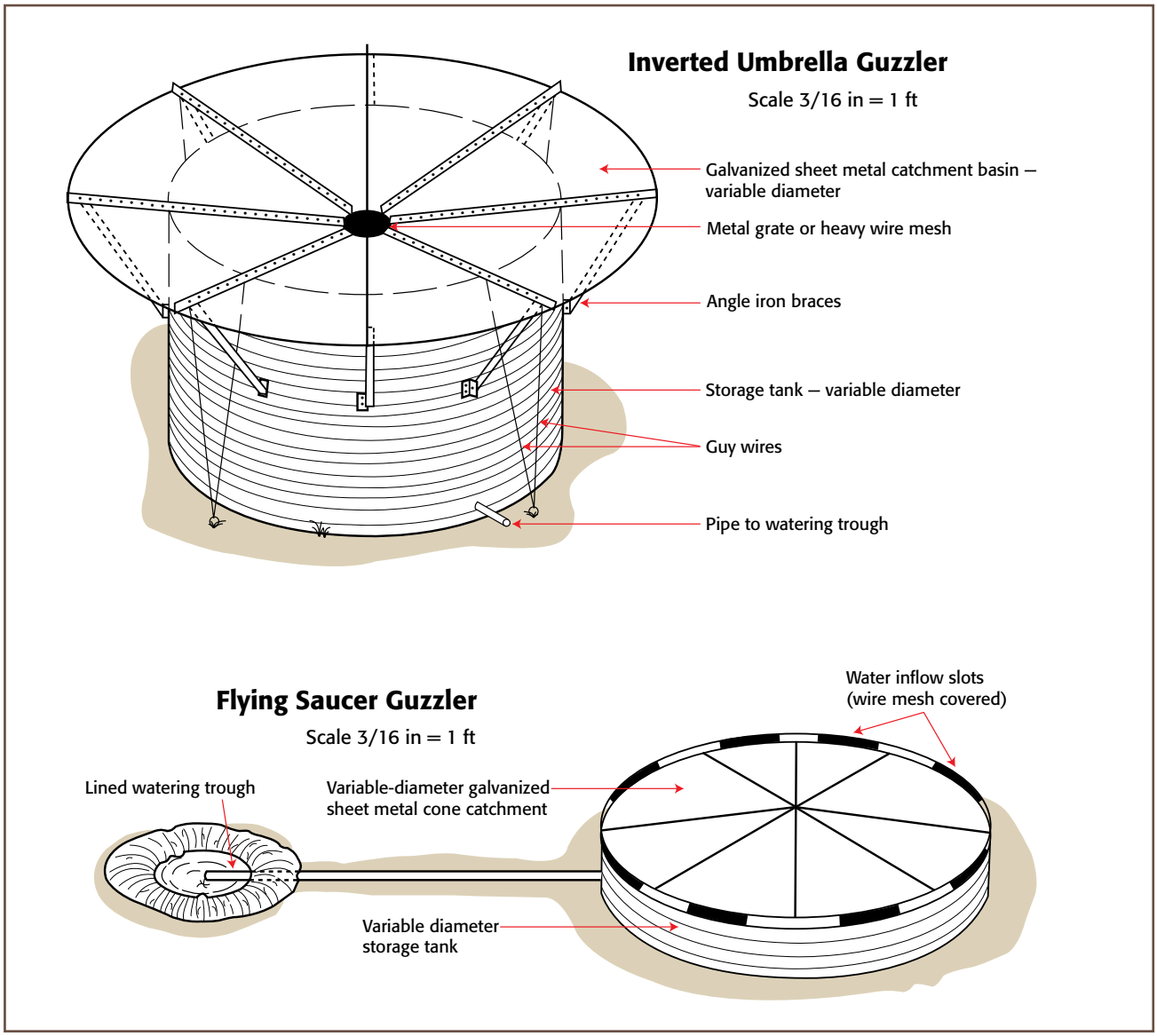


Figure 11. Rainwater catchments.

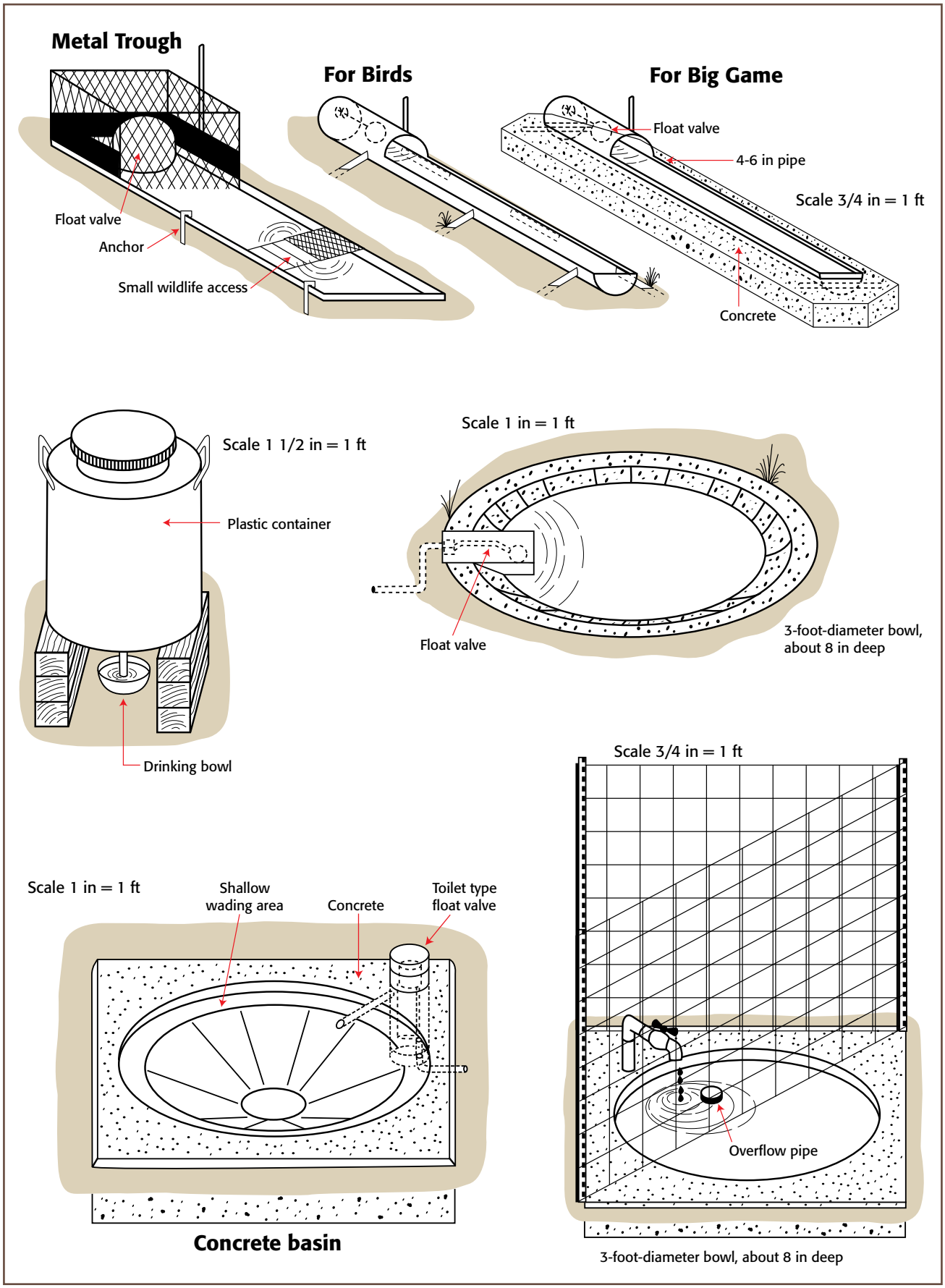


Figure 12. Rainwater conveyance devices.

Other considerations for water-supply systems

Consider these tips on providing water for wildlife:

- In areas with seasonal cold temperatures, be sure to build and protect your system properly. This can be accomplished by burying or insulating water pipes susceptible to freezing.
- Cut costs by modifying existing water structures such as windmills and water troughs. The concrete aprons around livestock water troughs can be modified to hold overflow water. A shallow groove (about 3 inches deep and 6 inches wide) in concrete will catch and retain overflow water.
- Provide water at ground level for birds and small mammals because their size limits their ability to reach water. Seeps from stock tanks or dripping windmill pipes can provide additional ground-level water for wildlife.
- Eliminate drowning hazards.
- Make sure that all water-delivery mechanisms slope gently from shallow to deep.
- Place ramps made of expanded metal on the outside and inside of water troughs to allow access and exit.
- Pile rocks or use floats or mats at the edges of water troughs to allow escape.
- Use infrared-triggered cameras placed near watering points to monitor use by wildlife species.

For more information

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Quail photo courtesy of David L. Alford.
Bighorn sheep and guzzler photos courtesy of Justin Foster,
Texas Parks and Wildlife Department, and the Texas Bighorn Society.

Line drawings were adapted from
Water for West Texas Wildlife,
Texas Parks and Wildlife Department,
and *Wildlife Watering Facilities,*
Natural Resource Conservation Service,
United States Department of Agriculture.

This publication was funded by the Rio Grande Basin Initiative administered by the Texas Water Resources Institute of Texas Cooperative Extension, with funds provided through a grant from the Cooperative State Research, Education, and Extension Service, U.S. Department of Agriculture, under Agreement No. 2005-45049-03209.

Produced by Agricultural Communications, The Texas A&M University System
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Issued in furtherance of Cooperative Extension Work in Agriculture and Home Economics, Acts of Congress of May 8, 1914, as amended, and June 30, 1914, in cooperation with the United States Department of Agriculture. Edward G. Smith, Director, Texas Cooperative Extension, The Texas A&M University System.
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LIVE STAKING

~ Stabilizing the Banks of Streams, Rivers, and Lakes ~

Portland Water District

Purpose: Live stakes are woody shrub cuttings that root quickly once planted in moist to wet soils along the banks of streams and lakes. Live stakes make a good, low-cost source of plant materials for stabilizing banks and restoring shoreland (riparian) vegetation. Healthy vegetation in shoreland areas provides shade, pollution filtering, food for aquatic organisms, and bank stability. Live staking is most suitable for areas with low to moderate slopes. Since it may take two or more growing seasons for the plantings to become well established, live stakes should be installed in conjunction with temporary erosion control measures such as seeding and mulching.

Materials: Some of the best native species to use for live stakes are Redosier Dogwood, Grey Dogwood, and Pussy Willow [see table/images below]. These shrubs have strong root systems to stabilize banks, are naturally found along lakes and streams, and can grow from cuttings. Live stakes, like other plants, should be planted in areas with suitable soils, moisture and sunlight. For more information on plant identification visit the website plants.USDA.gov.

Common Name	Scientific Name	Sun	Height	Soil Moisture
Redosier Dogwood	*Cornus sericea*	Full Sun, Partial Sun, Shade	6-9'	Wet, Flood Tolerant
Grey Dogwood	*Cornus racemosa*	Full sun, Partial Shade	15'	Moist
Pussy Willow	*Salix discolor*	Full Sun	10-15'	Wet, Flood Tolerant

Redosier Dogwood

Grey Dogwood

Pussy Willow

Collection:
Live stakes can be collected from established/mature plants. This is a very cost effective option, but make sure that ***permission is granted by property owners*** before gathering cuttings off a healthy parent plant. For best results, live stakes should be *harvested and planted* while the parent plant is *dormant* in late October until the ground is frozen, or in the spring before plants start to leaf-out. The northern part of the state should aim for spring plantings because the frost heaves plants that are not established. When gathering live stakes, make sure part of the thick end of the branches are at least ½ inch in diameter (the larger the diameter the better).

Make a straight cut at the narrow end of the branch (toward the tip of the branch). At the thicker end (toward the trunk) cut the branch at an angle, so that it makes a point. This way you will know which end is up and it will also be easier to drive the stakes into the ground. If the wrong end of the branch is put in the ground the stake will die.

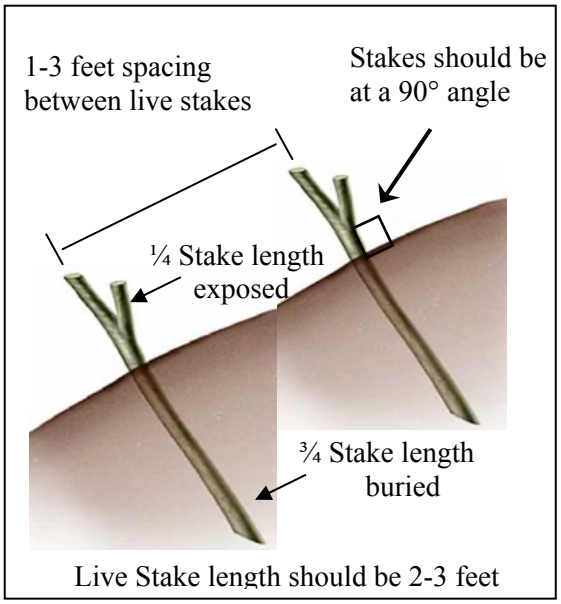
Live stakes should be between two and three feet long.

Once a cut has been made, remove all side branches and leaves. This will help prevent the stakes from drying. Keep these slender side branches, or whips, intact. These whips can be used in the installation process.

To increase the survival rate of the stakes, it is best to plant within 24 hours of collection. Until the planting, keep the stakes damp by wrapping them in wet burlap sacks or soaking them in buckets of water. If the stakes are being planted on a hot day, make sure to store them in the shade.

Purchase:
Local nurseries may carry live stakes. Alternately, call your county Soil and Water Conservation District or Maine DEP for suppliers of live stakes or try an online search. When purchasing live stakes, ensure that the plant species are native to Maine.

Installation:
The site should be prepared before planting the live stakes. Invasive and competing vegetation should be cut back avoiding the use of herbicides to protect water quality. Information on invasive species can be found at www.mainenaturalareas.org/docs/program_activities. In conjunction with live staking, cover bare soil with erosion control mulch (refer to ECM fact sheet from this series) or annual grasses and hay mulch to hold the soil and help prevent weed establishment until the stakes are established.



Push (or use a rubber mallet) to carefully drive the pointed end of each live stake into the stream bank. If the stake doesn't go into the ground easily, use a metal rod to first create a hole the length of the stake.

Stakes should be planted at a 90° angle with ¼ of the stake (including a few buds) sticking out of the ground.

When planting, leave 1-3 feet spacing between the individual stakes.

If the stake will be shaded by surrounding vegetation, use longer stakes and leave one foot sticking above the ground. If a willow stake, in particular, gets too much shade, it will drop its new leaves and die.

The side branches, or whips, that were snipped off during the collection process will grow nicely if they are planted in very moist areas at the edges of streams and wetlands. Push them into the ground as far as they will go without breaking.

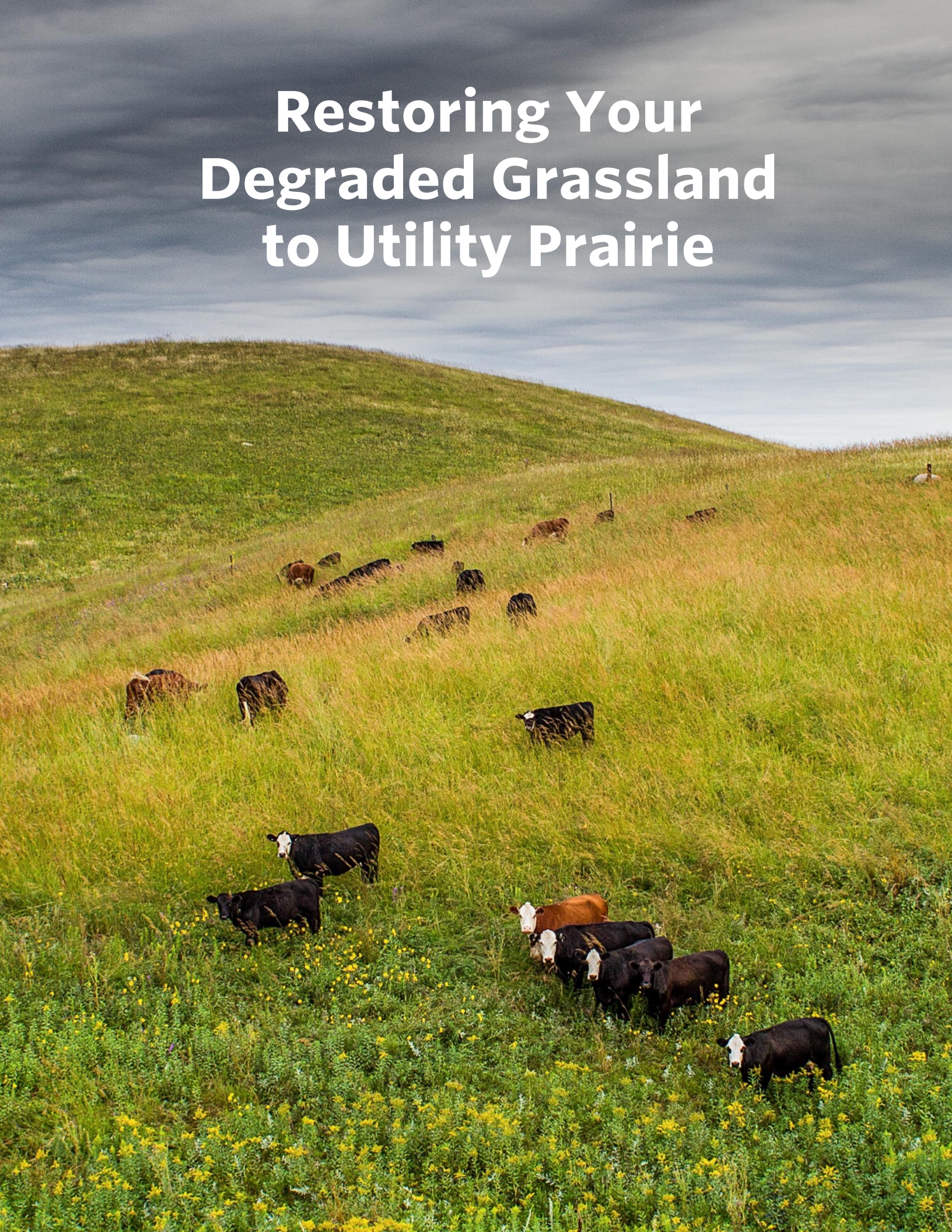
Maintenance: If live stakes are planted while dormant, shoots (leaves and small branches) should be seen in spring. If live stakes are planted during the growing season, it may take a full year or two to see results. If two or three growing seasons pass without signs of growth, remove the dead stakes and replace with live stakes. Also, be prepared to replant if the area is affected by high water, drought, or ice damage before the stakes are fully established. To increase survival, the live stakes could be watered once a week during their first growing season.

If a bank is severely eroded or steep it will need more stabilization than live staking. Contact your county Soil and Water Conservation District or the Maine DEP for more information and guidance.

Part of the ***Conservation Practices for Homeowners*** Fact sheet Series, available at:
Maine DEP (800.452.1942); http://www.maine.gov/dep/blwq/docwatershed/materials.htm
Portland Water District (207.774.5961); http://www.pwd.org/news/publications.php

April 2007 DEPLW-0840

Restoring Your Degraded Grassland to Utility Prairie



The author of this Restoration Guide is Laura Phillips-Mao, University of Minnesota. Steve Chaplin, MN/ND/SD Chapter of The Nature Conservancy, administered the project and helped with production. Marybeth Block, Minnesota Department of Natural Resources, provided review and editorial comments. Susan Galatowitsch, University of Minnesota, contributed to an earlier version of this guide.

Funding for the development of this restoration guide was provided by the Minnesota Environment and Natural Resources Trust Fund as recommended by the Legislative-Citizen Commission on Minnesota Resources (LCCMR) through grant LCCMR092C. The Trust Fund is a permanent fund constitutionally established by the citizens of Minnesota to assist in the protection, conservation, preservation, and

net Minnesota State Lottery proceeds are dedicated to building the Trust Fund and ensuring future benefits for Minn

Additional funding for the update and redesign of the guide was provided by a Working Lands Initiative grant from the Minnesota Department of Natural Resources.

Cover photo taken at Sheepberry Fen Preserve by Alison Mickelson, Greater Good Photography.

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ENVIRONMENT AND NATURAL RESOURCES TRUST FUND

DEPARTMENT OF NATURAL RESOURCES

Restoring Your Degraded Grassland to

In this guide, you will learn the basic steps to restoring a degraded grassland of native and invasive species to a utility prairie. The precise restoration actions will depend on the particular features of your site as well as your budget, preferences and project goals.

When planning your restoration, we recommend that you consult with restoration professionals to evaluat characteristics. Please visit http://www.nature.org/ourinitiatives/regions/northamerica/unitedstates/minnesota/explore/prairie-restoration-guides.xml for more information on who to contact or other publications that cover site assessment protocols.

What is utility prairie?

Utility prairie is designed to maximize production and palatability for forage, while still supporting basic conservation goals. It is distinguished from conventional hay fields and pasture by its emphasis on native species and greater diversity.

Compatible land uses include:

- Conservation grazing using cattle or bison
- Hay production
- Commercial seed harvest
- Recreational activities (e.g. hunting).

Conservation benefits include improved water quality, soil stabilization, and habitat for birds, animals and insects. Utility prairie can also serve as a buffer for other high-quality native prairies and increase the habitat area for wildlife species that depend on large contiguous areas of grassland.

Why restore degraded grasslands?

Grasslands that have a combination of both desired native species and invasive perennial weeds may be restored to reduce the coverage of invasive species and promote the health of the native prairie community. These sites include:

- Degraded prairie remnants that have never been plowed and have original prairie vegetation
- Low-diversity prairie plantings that have become invaded
- Prairies that were over-seeded with exotic perennials for pasture

The challenge of restoring these sites is to reduce the cover of invasive species while retaining the existing native species and increasing their abundance and diversity.

Selective vegetation control measures are used to reduce the cover of invasive species while avoiding damage to the natives present. This is particularly important on prairie remnants, where preserving original prairie vegetation is of paramount importance.

To enhance existing vegetation and increase native cover and diversity, prairie species are sown into the existing vegetation as opposed to into a prepared seedbed. This planting strategy

made to species selection to avoid harming existing natives.

As a general guideline, consider using selective vegetation control measures on sites that have 25-75% of native prairie species and 25-75% invasive perennials and other undesired species. If any rare or threatened species are present on a site, selective measures should be used to preserve them. If the existing native species have been planted, are of particularly poor quality, or are of questionable origin (e.g. cultivars, or southern ecotypes), the site may be treated as an invasive-dominated prairie and

non-selective methods of control may be more effective[1].

This guide assumes that your site has moderate to dry soil moisture and has not been drained. Wet sites in particular are often invaded by reed canary grass, which can be particularly difficult to control. It often requires multiple years of repeated treatments. Relatively wet fields that have been drained via drainage tiles or ditches are better suited for restoring to wet meadow. This may require additional steps to restore the hydrology[2]. If invasive trees and shrubs are present on site, additional removal strategies may be required[3].

What will it involve?

Prairie restoration typically includes these basic steps:

Site Assessment Identify the site characteristics and define goals for the restoration.

Vegetation Removal Remove existing weeds and undesired vegetation from the site to prevent aggressive weedy species from out-competing native prairie plants.

Seedbed Preparation Prepare a seedbed to ensure good seed-soil contact and promote germination of planted seeds.

Seeding/Planting Select seed mixes and seeding methods that are well suited to the site and project goals. Or, in the case of small sites of less than half an acre, consider hand-planting plugs for quicker results[4].

Establishment & Aftercare Control weeds and promote the establishment and growth of prairie plants through the first few years after seeding.

Long-term Management Maintain the health and diversity of native prairie into the future.

How long will it take?

Restoring a prairie invaded by exotic perennial weeds requires at least one full growing season of invasive species removal prior to interseeding. The more you invest in weed control up front, the less time and effort you will need to spend controlling weeds in the long term. , expect to spend at least three years on aftercare to ensure good establishment of the utility prairie. This period is referred to as the establishment phase of restoration.

After establishment, often around year 4, the long-term management phase begins. Management actions are typically less frequent and intensive than during the establishment phase, but are critical for maintaining the health and diversity of the prairie into the future.

Cattle on a utility prairie near Glacial Lakes State Park © TNC\Steve Chaplin

[1] -D on removing invasive species with non-selective control measures.

[2] n.

[3] - controlling invasive trees and shrubs.

[4] Plugs are young plants sold in 4- or 6-packs. Plugs cost substantially more than seed, but they establish rapidly and can produce a resilient and visually appealing meadow more quickly than seeding, so it is often a preferred option for smaller sites.

What will it cost?

The cost of the restoration will be influenced by:

- Management level required to control weeds
- Species and number of species selected for the seed mix
- Cost of seed, which fluctuates from year to year
- Labor and equipment available for the project

The cost estimate in this document will give you a baseline for what you can expect to spend through the initial establishment phase of your restoration (i.e. through three years after seeding). It may be tempting to cut costs by reducing the number of species planted or the frequency of weed control activities. Be aware that these investments on the front end can actually save costs in the long run. A healthy and diverse prairie will be more resilient to disturbance, invasion by exotic species, and extreme weather events such as drought.

Degraded prairie with brome and Kentucky bluegrass invasion near Bluestem Prairie © TNC\ Steve Chaplin

Degraded Grassland to Utility Prairie Restoration Guidelines

Site assessment

A successful prairie restoration is highly dependent on specific characteristics of a site. Important considerations when planning a restoration include:

Has the site had herbicide treatments that would prohibit seed from germinating?

Is there a risk of herbicide drift from neighboring cropfields?

Are the soils dry, moderate or wet?

Are there steep slopes that may be vulnerable to erosion?

What types of vegetation are currently present on the site?

If you are new to prairie restoration, we strongly encourage enlisting someone who has restoration experience to help you assess the characteristics of the site and develop a

features and your project goals.

Vegetation removal

When restoring degraded grasslands, the primary challenge of vegetation removal is to control aggressive invasive perennials with minimal harm to the existing native vegetation. If the native vegetation includes only a few very competitive native species, it may also be important to reduce these species to allow new species to grow
diversity. Activities prior to seeding typically include a fall burn or mowing and selective vegetation removal to allow interseeded natives to establish.

Recommended protocol:

Burn the entire site in the spring or fall, or mow/hay in the summer to remove thatch.

When regrowth of invasive perennials reaches 4-6 in. height, selectively treat with appropriate herbicide such as glyphosate.

- To minimize damage to natives,

  larger patches using ATV-mounted sprayers, applied to smaller patches with backpack sprayers, or applied with a wicking device to individual plants.
- When possible, dormant-season applications of herbicide can be applied to cool-season exotics without damaging warm-season native grasses. Caution is advised if native cool-season grasses and sedges are present on site.
- See Smith 2010 (Chapter 4) and Packard and Mutel 2007 (Chapter 16) for lists of recommended herbicides.

Repeat selective herbicide application when invasive perennial vegetation regrowth again reaches 4-6 in. height.

Wait at least 2 weeks following last herbicide application to seed.

Spraying weeds with a backpack sprayer
©Minnesota BWSR

Native seed mixes should be planted with equipment designed to handle different-sized seeds ©Justin Meissen.

If invasive woody species are present, saplings < ½ in. diameter can be herbicide-treated along with invasive perennials, but larger trees will require mechanical removal[5].

If reed canary grass is present, apply glyphosate in September for maximum effect.[6]

Cropping is not recommended for degraded grasslands, and native remnants (unplowed prairie) should not be cropped or disked.

Seedbed preparations

Minimal seedbed preparation is recommended when interseeding into existing vegetation. This helps avoid disturbing the native species on site and bringing additional weed seeds and rhizomes to the soil surface. If invasive species are minimal and the site is dominated by a few highly competitive native species, selective disking or tilling (for example, in patches or strips covering 25-50% of the site) is sometimes used to reduce competition from existing natives and create openings for seedling establishment. However, if a diversity of native species are present, we recommend avoiding soil disturbance and instead drilling seeds into newly burned ground after a spring or fall burn. Native remnants (unplowed prairie) should never be tilled or disked.

Recommended protocol:

Forgo seedbed preparations to minimize soil disturbance and reinvasion.

Burn, mow or hay prior to seeding to remove thatch (see vegetation removal).

Seeding

The key to establishing a successful prairie is to maximize seed to soil contact during planting.

If planting with a no-till drill, use a seed drill designed specifically to plant prairie grasses and flowers. Drilling into an untilled site can be hard on the drill. If the site is very rough, rocky or has numerous gopher mounds, broadcast seeding may be a better alternative. If broadcasting seed, native-seed broadcasters such as a Vicon seeder should be used. They are designed to spread mixes with different sized seeds.

[5] Refer to the restoration guide "Restoring your Woody-invaded Prairie to Utility Prairi
invasive trees and shrubs.

[6] -Dominated Grassland to Utility Meadow for more detailed information on controlling reed canary grass.

If the site is remnant (unplowed) prairie, seeding should be undertaken with caution to avoid negatively impacting remnant vegetation, soil communities and wildlife. Seed mixes should exclude aggressive species that may outcompete existing vegetation, and species already present on site should not be planted unless the seed is harvested on site. Whenever possible, locally-harvested seed should be used, and species selection should be based on historical records and/or reference sites.

Recommended protocol:

How to seed:

- Drill seeds into existing vegetation with no-till drill such as a Truax following a burn or mowing/haying to remove thatch.
- An alternative seeding method is to broadcast seeds and incorporate them into the soil with a light drag, such as a piece of chain link fence or a packer pulled behind the tractor/ATV while broadcasting seed.

When to seed:

- Planting dates will vary depending on the weather and location within the state. Consult with native seed suppliers or restoration specialists to determine the best planting dates for the year.
- Growing season plantings should occur May 1 to July 1 OR when the soil temperature is at least 60 degrees F[7]. Spring/early summer seeding promotes warm season grasses.
- Dormant seeding should occur Dec. 1 to April 30 OR after soil temperatures fall below 50 degrees F for a consistent period of time[8]. When possible, timing the seeding before a snowfall may help prevent loss of seed that is consumed by wildlife over the winter months. Dormant seeding in late fall, also known as frost seeding, can be done with a seed drill or until the ground is frozen. Seed can also be broadcast over snow in winter/early spring, although results of snow seeding are more variable and dependent on weather conditions. Dormant seeding promotes cool season grasses and flowering plants.

Seed mixes will vary but should take into account:

- Consider soil moisture conditions of the site.
- Choose palatable species that can tolerate grazing or haying.
- Select a mix of both warm- and cool-season species to ensure availability of forage throughout the season[9].
- Avoid adding species that are already dominant on the site as they may out-compete other less common native species and lower diversity.
- Cover/nurse crops are not recommended for interseeding.

Design:

- Seed the mix evenly across the site unless soil moisture is highly variable.
- If there are wet to wet-mesic soils on the site, select a separate seed mix for wet conditions for these seeding zones[10].

[7] Summer seeding after July 1 leads to poor seedling survival and is not recommended for prairies.
[8] Early fall seeding is not recommended for prairies, because seed may germinate too early and not survive over winter.
[9] See nature.org/MNPrairieRestorationGuides for more information on seed mix design and an example utility prairie seed mix.
[10] See nature.org/MNPrairieRestorationGuides for examples of utility meadow seed mixes appropriate for wetter soils.

Prescribed fire is an important tool in maintaining a utility prairie ©Chris Helzer/TNC

Seed rate:

- Plant at a minimum of 40 seeds/sq. foot to reduce risk of weed invasion.
- If there is minimal weed pressure and excellent site preparation, the rate can be reduced to 30 seeds/sq. foot.
- Increase rate to 50 seeds/sq. foot on steep slopes (3:1 grade).
- Seeding rates may need to be increased by 25% for dormant seedings to account for lower germination rates and loss of seed to wildlife.

Post-seeding aftercare and long-term management

Utility prairie establishment generally takes 3 to 5 years but will vary depending on soil moisture and climate conditions. Early management (aftercare) is critical to preventing re-invading weeds and woody species from out-competing and displacing establishing natives.

Maintaining control of invasive perennials is the primary management concern in interseeded prairie restorations. However, existing native vegetation should also be carefully managed to promote rapid establishment of planted natives.

Post-seeding aftercare goals include discouraging weeds and encouraging rapid and robust establishment of native species that can sustain grazing, haying and other uses. Management strategies during the establishment phase include:

Mowing or haying to reduce competition

Selective use of herbicide to control invasive perennials

Prescribed fire to promote native prairie species and discourage further invasion

Monitoring vegetation to evaluate establishment of prairie seedlings

Throughout the establishment phase and beyond, adjust management plans as necessary, including the option to reseed, to achieve the desired species composition and diversity.

Recommended management protocol:

Year 1:

Mow vegetation to a height of 4-6 inches when it reaches a height of 12-18 inches to reduce competition from established natives and minimize thatch build-up. Most newly planted prairie plants will not reach this height in first year and will not be damaged by a mower. The frequency of mowing will depend on the height and density of weeds, and how much they are competing with the prairie seedlings for light and moisture.

OR hay the site two to three times, removing mowed material to prevent thatch build-up. Expect low yields.

Locate and spot-treat invasive perennials using appropriate herbicides and application methods that minimize damage to natives, such as dormant season application or spot-treatment with backpack sprayer or wick applicator. Avoid applying on windy days to prevent drift.

Year 2:

Mow/hay field to 12-inch height twice. Once in late spring and again in mid-summer.

Locate and spot-treat invasive perennials using appropriate herbicides and application methods that minimize damage to natives.

Year 3:

Begin prescribed burns after three growing seasons or as soon as biomass accumulation is sufficient to carry a burn.

Begin grazing or haying after three growing seasons, or when native grasses have achieved dominance.

Mowing should no longer be needed. Spot-treat weeds as necessary using dormant season applications and/or back-pack sprayer/wick applicator to minimize damage to native species.

Conduct stand evaluation to assess seedling establishment outcomes. If native plant density is less than 1 plant per square foot, interseed to increase cover and diversity.

Year 4 & beyond (long-term management phase):

Burn at a frequency of every 3-5 years to stimulate productivity of native prairie plants and prevent invasion of perennial weeds and woody trees and shrubs.

Burn and hay in rotations, disturbing no more than one half of a field at a given time, to maintain diversity and a local refuge for wildlife. Suggested interval is to burn one-third of the field annually, so that each patch has a 3 year rotation.

Graze at low to moderate intensities, or at stocking rates prescribed by a grazing management plan written to meet the objectives of the utility prairie. Avoid grazing in saturated conditions.

Time burning, haying and grazing to allow sufficient biomass accumulation for each activity. For example, an alternating biennial rotation of grazing and haying within a 3-4 year burn rotation.

Hay in late July or August to promote diversity and avoid grassland bird nesting season. Leave 6-8 inch stubble and regrowth for winter cover/spring nesting habitat.

Adjust timing and intensity of burning, grazing and haying to maximize diversity and adjust species composition.

- Grazing in late spring or early summer will favor warm season grasses.
- Mid-late summer grazing will favor cool season grasses.

Every 1 to 3 years, monitor vegetation composition and diversity.

- Interseed as needed to increase native cover and diversity if native species are declining.
- Adjust management plan, such as frequency and intensity of burning, haying, or grazing, if:

  cover of native species is declining

  desired composition is not being maintained

cover of invasive species or undesired woody species is increasing

- Spot-treat weeds as needed by hand-pulling, back-pack sprayer, wick-applicator or dormant-season application.
- Temporarily increase burn frequency, such as annual burns for 2 years, if woody invasions increase in cover. Note that sustained burn intervals of less than 3 years will negatively impact cool-season natives and wildlife.

Restored dry prairie at Glacial Ridge
© Gail Gilliland

Cost estimate

The estimated cost to restore degraded grassland to utility prairie is $1,306 per acre, based on 2013 prices. Costs associated with site assessment and project planning are excluded from this estimate. This cost estimate assumes vegetation removal includes two selective herbicide applications and one controlled burn (whole site), and the site is seeded with a no-till drill.

Post-seeding management costs include aftercare activities through year 3, specifically: ten mowing treatments, two selective herbicide treatments (spot-spray), and two controlled burns (burning no more than one half of the site per season). Actual project costs will be lower if a less-frequent mowing schedule is required. Long-term management costs are not included in this cost estimate but can be quite variable depending on site needs. Costs assume services and seed are purchased from restoration contractors and native seed nurseries.

Lead plant, white and purple prairie clovers, yarrow, and blue vervain on a restored prairie © TNC\Sue Chaplin

Useful references

Going Native: A prairie restoration handbook for MN Landowners MN Dept. of Natural Resources
http://files.dnr.state.mn.us/assistance/backyard/prairierestoration/goingnative.pdf

Guidelines for inter-seeding to restore or enhance native species diversity Minnesota Board of Water and Soil Resources
www.bwsr.state.mn.us/native_vegetation/inter-seeding.pdf

Invasive Plant Species Management & Identification MN Dept. of Natural Resources
www.dnr.state.mn.us/invasives/terrestrialplants

Minnesota Noxious Weeds MN Dept. of Transportation
www.dot.state.mn.us/roadsides/vegetation/pdf/noxiousweeds.pdf

Native Vegetation / Seed Mixes MN Board of Water & Soil Resources
www.bwsr.state.mn.us/native_vegetation

Prairie Seedling and Seeding Evaluation. Bockenstedt, P. 2006. Bonestroo Rosene Anderlik & Associates.

The Tallgrass Prairie Center Guide to Prairie Restoration in the Upper Midwest. Smith, D. 2010. University of Iowa Press, Iowa City, IA.

The Tallgrass Restoration Handbook for Prairies, Savannas, and Woodlands. S. Packard and C. F. Mutel, editors. 2007. Island Press, Washington, D.C.

MN Board of Water & Soil Resources
www.bwsr.state.mn.us/practices/whats_working-invasivespecies

Module 5: Implementation **Technical Annex**

Methods of Marking Contour Lines

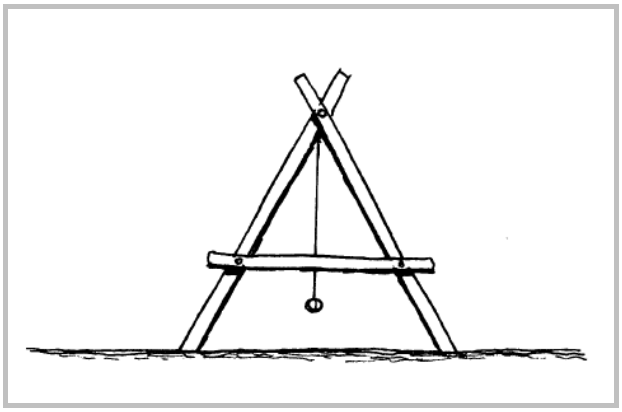
Contour lines may be marked out using an A-frame, a hose-level, or a plank-level. The hose level is the most precise of the three methods, but care must be taken to avoid water spillage. The main advantage of the plank-level is that the procedure can be accomplished by one person.

A. The A-Frame

Construction

Three straight pieces of wood 1.5 m long and about 4 cm wide and 1.5 cm thick are used. Mount them using the following steps:

- Join two of the three pieces of wood by crossing them at one end and binding them together strongly to form two sides of the letter “A.” The distance between the two open ends should be exactly 2 m. Make sure they are bound tightly and will not move.
- Then join the third piece of wood to form the cross piece of the letter “A” at about two thirds of the way down from the apex.
- At the apex of the “A” tie a length of string to which a small stone has been attached to act as a plumb line as shown in the figure below.



Calibration

- Place the A-frame on flat ground and mark the position of the two legs on the ground, then lightly mark the point at which the plumb line crosses the horizontal bar.
- Pivot the A-frame through 180° placing the legs exactly on the spots previously marked, and lightly mark the position where the plumb line crosses the horizontal bar.
- The reference point that shows where the A-frame is level lies in the middle of these two marks, and should be permanently marked on the horizontal bar.

Note: If the A-frame is dismantled, it must be recalibrated before using again.

Note: If wind is a problem that frequently disturbs the plumb line, replace the horizontal bar by two horizontal planks of wood, with the plumb line hanging between them to reduce the swinging motion of the string.

Use to Mark out Contour Lines

- To mark out contour lines, start at the highest point where a contour line is required, place one leg of the A-frame adjacent to a stake, then move the other leg up and down slope until the plumb line coincides with the reference mark on the horizontal bar.
- Mark the position of the second leg with a stake, by making a depression in the ground, or by making a small cut in the soil surface with a hoe or pick-axe, then move the A-frame positioning the first leg at the marked position, and adjust the second leg until the plumb line again coincides with the reference mark on the horizontal bar, and mark the position of the second leg in the same way.
- Repeat the process marking the positions of the legs of the A-frame when the plumb lime coincides with the reference mark on the horizontal bar.
- Check the alignment of the stakes or surface markings, correcting the contour line by eye, and marking it either with stakes or by cutting a shallow trench into the ground.

B. The Hose-Level

Construction

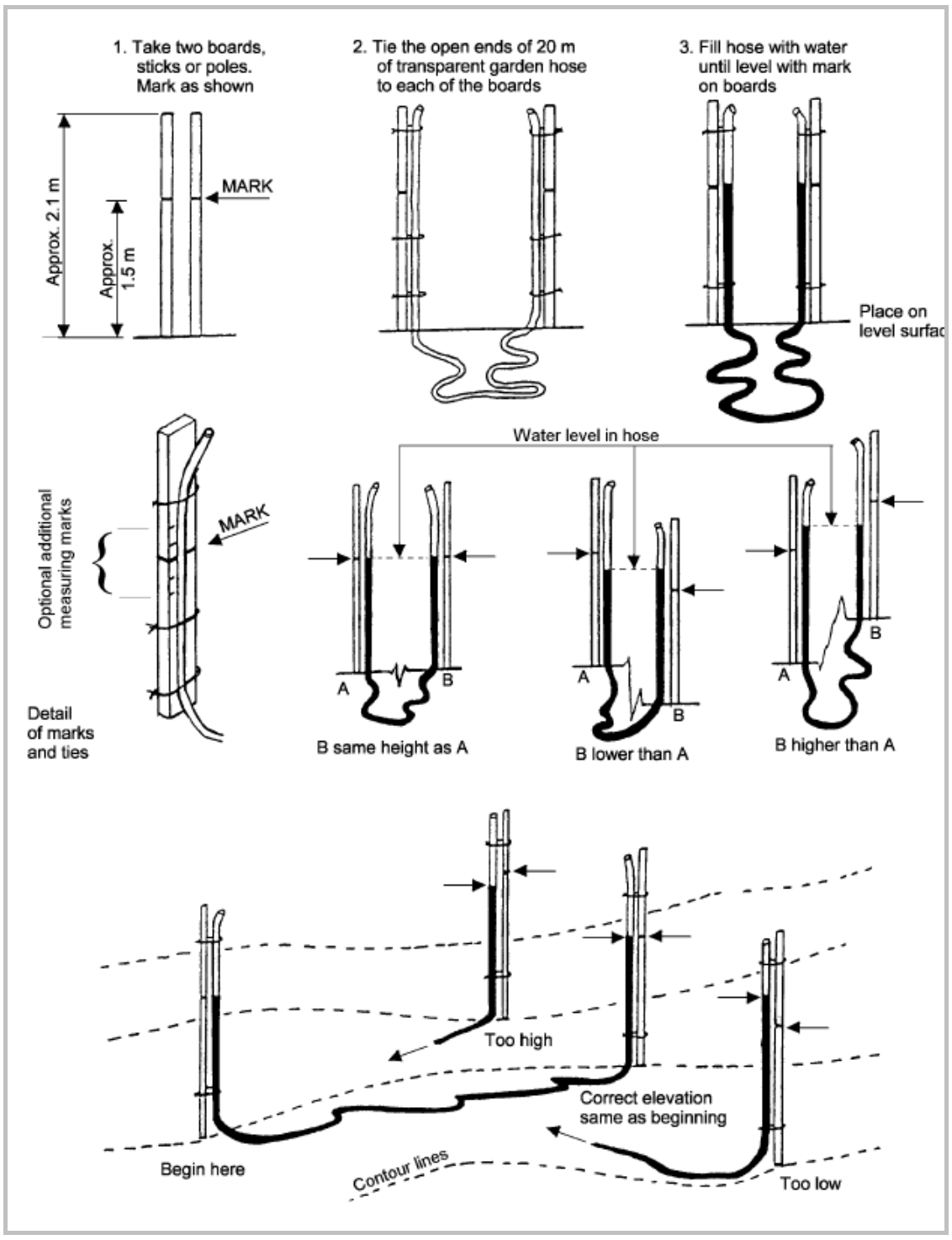
- The hose-level is constructed from two poles of 2 m length, and a clear plastic hose of 10 to 25 m length of about 1 cm in diameter.
- The hose is securely attached at both ends to the two poles with the ends of the hose protruding 10 to 20 cm beyond the top of the poles.
- Carefully fill the hose with water ensuring that no air bubbles are trapped inside.
- Hold the poles side by side and adjust until the water level settles at exactly the same height on each pole. Mark this height on both poles which should be about 1.5 metres above ground (see figure below).

Use to Mark out Contour Lines

This requires two people.

- The first person should hold one pole upright at the starting position, which is marked with a stake.
- The second person moves the other pole to another position estimated to be along the contour.
- Each time a pole is moved the water levels must be allowed to settle. If the water level settles above the mark on the second pole, move the pole up the slope; if it settles below the mark move the pole down the slope. When the water level coincides with the marks on both poles, insert a stake, or mark the ground surface with a depression or a small cut at the position of the second pole.
- Repeat the process marking the positions of the poles of the hose-level when the water level coincides with the reference marks on both poles.
- Check the alignment of the stakes or surface markings, correcting the contour line by eye, and marking it either with stakes or by cutting a shallow trench into the ground.

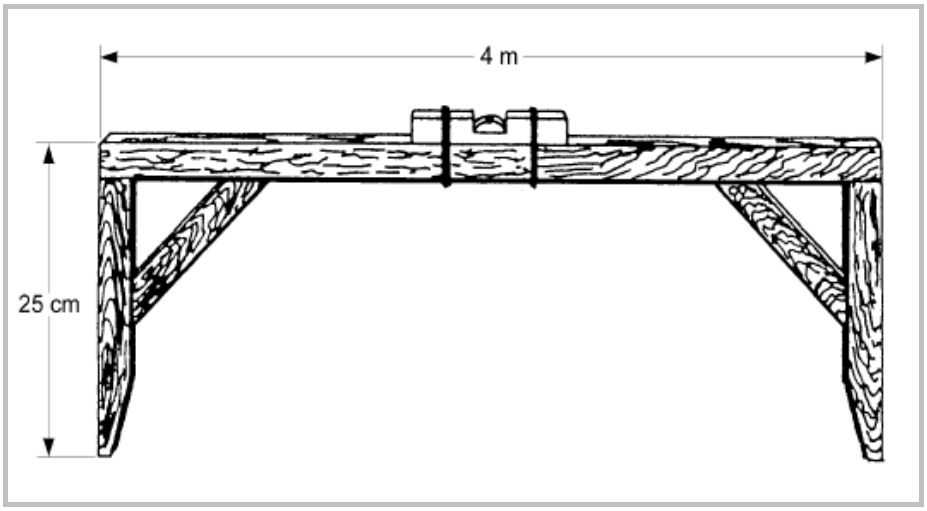
Note: When moving the poles you should block the end of the tubes with your thumb to avoid any spillage of water.



C. The Plank-Level

Construction

The plank-level consists of a plank of wood 4 m in length supported by two legs at either end of 25 cm height. A carpenter's spirit level is placed on top of the horizontal plank (see figure below).



Use to Mark out Contour Lines

- Place one of the legs of the plank-level on the starting point of the contour line and mark the position on the ground.
- Move the other leg up and down the slope until the spirit level shows the plank to be level, and mark the position of the leg.
- Pivot the plank-level around it and repeat the process, marking the positions of the legs when the spirit level shows the plank-level to be level.
- Check the alignment of the stakes or surface markings, correcting the contour line by eye, and marking it either with stakes or by cutting a shallow trench into the ground.

References and Sources for Further Reading

[1] FAO 2000: Lessons Learned and Farmer-to Farmer Transfer of Technologies. Soils Bulletin. No. 76. ftp://ftp.fao.org/agl/agll/docs/sb76e.pdf

TOP-down Burn Pile Method

Using this method turns wood slash into charcoal. It produces a safer fire with less smokes and it doesn't get hot enough to destroy soil biota the way bottom burning does.

Ignite the top middle of the pile. Create a bird's nest on top if needed. Stand by as it burns down. The flame at the top of the burn pile turns the top layer of brush into charcoal. That layer then heats the layer below, driving off gases that burn in the flame. Just underneath the flame, there is no oxygen, so the charcoal layer is protected. As the pile burns down, some of the charcoal on the edges will burn, but much of it will not start burning until the pile has settled down into a heap of glowing coals.

Push brush from the outside with a rake, to the middle as it burns, until you have a clean burn (no flames, mostly coals which break apart easy).

Scatter the remaining charcoal across the ground to benefit the soil and plants, or soak in a manure compost tea for 3 days or longer, then incorporate the pieces into your garden bed soil or compost.

LAND STEWARD

TEXAS MANAGEMENT PLANS

Contact Information for Land Steward

Elizabeth McGreevy
elizabeth@landsteward.net
512.657.9675