

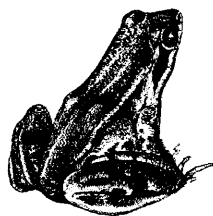


CREATING A TM SCHOOL HABITAT

**A Planning Guide
For Habitat Enhancement on
School Grounds in Texas**



APPENDICES For Southeast Texas Southern Pineywoods and Gulf Coast Prairies & Marshes Ecological Regions



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Additional copies of this manual may be obtained from the offices listed on the next page. Training workshops are offered periodically through the year in association with this manual.

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**Texas Parks & Wildlife
Urban Program
14320 Garrett
Houston, TX 77044
(281) 456-7029**

**U. S. Fish and Wildlife Service
Ecological Services Field Office
17629 El Camino Real,
Suite 211
Houston, TX 77058-3051
(281) 286-8282**

**Native Plant Society of TX
Houston Chapter
P. O. Box 13125
Houston, TX 77219-1254**

Appendix A: Resource Professionals

The following lists in the Appendices are partial lists. Please write in additional local sources as you discover them.

Texas Parks and Wildlife Department
Urban Program
14320 Garrett, Houston, TX 77044
(281) 456-7029

U. S. Fish and Wildlife Service
Ecological Services Field Office
17629 El Camino Real, Suite 211
Houston, TX 77058
(281) 286-8282

Environmental Institute of Houston
University of Houston – Clear Lake Campus
2700 Bay Area Blvd., Box 540
Houston, TX 77058-1098
(281) 283-3950

Urban Harvest
Community Gardens & Orchard Program
1900 Kane, Houston, TX 77007
(713) 880-5540

Texas Natural Resource Conservation Commission
P. O. Box 13087, Austin, TX 78711
(800) 64-TEXAS
(713) 767-3500 local

Texas Agricultural Extension Service
2 Abercrombie Drive, Houston, TX 77084
(281) 855-5600
Texas Forest Service
20525 Tomball Parkway, Houston, TX 77070
(281) 379-6062

Native Plant Society of Texas
Houston Chapter
P. O. Box 131254, Houston, TX 77219-1254

Native Plant Society of Texas
Conroe Chapter, Mercer Arboretum
22306 Aldine Westfield, Humble, TX 77338
(281) 443-8731

Ladybird Johnson Wildflower Research Center
4801 LaCrosse Ave., Austin, TX 78739-1702
(512) 292-4100

Water-Wise Program, City of Houston
Water Conservation Branch
Dept. of Public Works and Engineering
P. O. Box 1562, Houston, TX 77251
(713) 880-2444

Natural Resources Conservation Service
16151 Cairway, Houston, TX 77084
(281) 855-8716

National Wildlife Federation
Gulf States Natural Resources Center
44 East Avenue, Suite 200
Austin, TX 78701
(512) 476-9805

Appendix B: Teacher Training Resources

Project WILD and Aquatic WILD
Texas Parks and Wildlife Department
4200 Smith School Road, Austin, TX 78744
(800) 792-1112, Website – www.tpwd.state.tx.us

School Habitat Workshops
Texas Parks and Wildlife Department, (281) 456-7029
U. S. Fish and Wildlife Service, (281) 286-8282

Adopt-A-Pond and Texas Amphibian Watch
Texas Parks and Wildlife Department
14320 Garrett, Houston, TX 77044 locally
(281) 456-7029

Adopt-A-Wetland Program
Texas A&M University – Corpus Christi Campus
6300 Ocean Drive, NRC 3208,
Corpus Christi, TX 78412, (512) 980-3221

Texas Master Naturalist Program, Gulf Coast Chapter
Texas Agricultural Extension Service, (281) 855-5600
Texas Parks and Wildlife Department, (281) 456-7029

Texas Master Naturalist Program, Statewide
113 Nagle Hall
Texas A&M University System
College Station, TX 77843-2258

Master Gardener Program
Texas Agricultural Extension Service
2 Abercrombie Drive, Houston, TX 77084
(281) 855-5600

Master Composting and Junior Composting Programs,
Texas Natural Resource Conservation Commission,
(800) 64-TEXAS, or (713) 767-3500

Project Learning Tree is offered periodically through the local nature centers in the greater Houston area. Contact them for dates and times.

Project WET training is offered periodically in the Houston area, usually through the local nature centers or the University of Houston – Clear Lake campus. Contact them for dates and times.

Appendix C: Resources for Materials

NOTE: When trying to locate mulch, compost, rocks, and other such materials, be sure to contact possible free sources first. Quite often, cities, utility companies, and tree trimming services have to trim trees. They frequently run the limbs through chipper/shredders and give away the mulch to school projects. In addition, many cities are beginning to operate composting programs and will offer the finished product to the public. Rocks and gravel may be a different story. These materials may have to be purchased from local sand and gravel companies.

This is only a partial list of plant vendors. Other nurseries may carry native species seasonally. Write in additional sources as you discover them.

NATIVE PLANTS:

Anderson Landscape and Nursery (retail)
2222 Pech, Houston, TX 77055, (713) 984-1342

Another Place in Time (retail)
1102 Tulane Street, Houston, TX 77008
(713) 622-6973

Antique Rose Emporium (retail)
Rt. 5 Box 143, Brenham, TX 77833, (409) 836-5548

Buchanan's Native Plants (retail)
611 E. 11th, Houston, TX 77008, (713) 861-5702

Discount Trees of Brenham (retail)
Rt. 4 Box 23, Brenham, TX 77833, (409) 836-7225

Joshua's Native Plants (retail)
111 Heights Blvd., Houston, TX (713) 862-7444

Mark Fox Landscape & Nursery (retail)
4508 13th St., Baycliff, TX 77518
P. O. Box 326, Seabrook, TX 77586
(281) 339-3507

Native American Seed (wildflower, grass seeds)
Mail Order Station, 127 N. 16th Street,
Junction, TX 76849, (800) 728-4043.
www.seedsource.com



RCW Nursery (retail)
15809 Tomball Parkway, Houston, TX 77086
(281) 440-5161

Trees Direct from the Factory (retail)
Sealy, TX, (409) 885-4088

Treeseach Farms (wholesale)
7625 Alabonson, Houston, TX 77088, (713) 937-9811

Vaughan's Nursery & Gardens (retail)
15647 Avenue C, Channelview, TX 77530
(281) 452-7369

Wildseed Farms (wildflower seeds)
425 Wildflower Hills, P. O. Box 3000, Fredricksburg, TX
78624-3000, (800) 848-0078, www.wildseedfarms.com

OTHER MATERIALS:

San Jacinto Stone (rocks, granite gravel, etc.)
195 Yale Street, Houston, TX 77007, (713) 868-3466

GTI Materials (granite gravel)
6505 Homestead, Houston, TX 77028
(713) 631-6700

Living Earth Technologies (mulch, compost, etc.)
5625 Crawford, Houston, TX 77041
(713) 466-7360

USEFUL WEB SITES:

www.nps.gov/plants/alien
Sponsored by the National Park Service, this site contains lists, fact sheets, and information about threats posed by exotic or alien plants to native plant communities.

ADDITIONAL RESOURCES:

Appendix D: Reference Books

Also refer to books listed inside the Reference Boxes located at the end of various chapters.

STUDENT REFERENCES

FIELD GUIDES:

Peterson First Field Guides to:
Butterflies and Moths
Caterpillars
And others....

Texas Monthly Field Guide Series -

Butterflies of Texas by Raymond Neck
Reptiles and Amphibians of Texas by
Garrett and Barker
Snakes of Texas by Alan Tennant

National Geographic Field Guide to Birds of North America

Mammals of Texas by W. B. Davis and D. J. Schmidly,
University of Texas Press

Wildflowers of Texas by Geyata Ajilvsgi, Shearer Publishing

A Guide to Freshwater Ecology by Christine Kolbe and
Mark Luedke, Texas Natural Resource Conservation
Commission,
P. O. Box 13087, Austin, TX 78711-2087

Forest Trees of Texas, How to Know Them, Bulletin 20,
Texas Forest Service

Poisonous Snakes of Texas by Andrew Price, Texas Parks &
Wildlife Press

OTHER BOOKS:

Birding for the Amateur Naturalist by Laura O'Biso Socha,
Acorn Naturalists, (800) 422-8886.

Growing Wild, Inviting Wildlife Into Your Yard, (good for
young children) by Constance Perenyi, Beyond Words
Publishing, 13950 NW Pumpkin Ridge Road, Hillsboro,
OR, 97123.

Habitats, Making Homes for Animals and Plants, by Pamela
Hickman, Acorn Naturalists, (800) 422-8886.

ADDITIONAL RESOURCES:

TEACHER REFERENCES

Texas Wildscapes Gardening for Wildlife by Noreen
Damude and Kelly Conrad Bender, Texas Parks and
Wildlife Press

Native Texas Plants, Landscaping Region by Region
by Sally Wasowski, Gulf Publishing Company

How to Grow Native Plants of Texas and the Southwest
by Jill Nokes, Gulf Publishing Company

Creative Propagation, A Grower's Guide
by Peter Thompson, Timber Press, Portland, Oregon,

Wildflowers of Houston by John and Gloria Tveten,
Rice University Press

A Garden Book for Houston and the Texas Gulf Coast
by The River Oaks Garden Club, Gulf Publishing Company

Texas Trees, A Friendly Guide by Paul Cox and Patty Leslie,
Corona Publishing Company, San Antonio

Attracting Birds to Southern Gardens by Thomas Pope, Neil
Odenwald, and Charles Fryling, Jr., Taylor Publishing
Company, Dallas

Building Birdhouses and Feeders by Ortho Books, Chevron
Chemical Company, San Ramon, California

Schoolyard Sanctuaries, Houston Arboretum and Nature
Center, (713) 681-8433.

Worms Eat My Garbage, by Mary Appelhof, Flower Press,
Kalamazoo, Michigan.

Teaching Kids About Birds (and other booklets), Bird
Watcher's Digest, Pardson Corporation, 1-800-879-2473.

Green Teacher magazine, \$27. per year, P. O. Box 1432,
Lewiston, NY 14092.

Education Goes Outdoors, Addison-Wesley Publishing Co.,
Acorn Naturalists, (800) 422-8886.

Educator's Activity Book About Bats, Bat Conservation
International, (800) 538-BATS.

Beyond the Classroom, Exploration of Schoolground &
Backyard, Acorn Naturalists, (800) 422-8886.

Bottle Biology, Kendall/Hunt Publishing Co., 4050
Westmark Dr., Dubuque, IA 52002. Also available from
Acorn Naturalists,
(800) 422-8886.

Texas Prairies - Relationships, for Grades 4-7,
The Botanical Research Institute of Texas, 509 Pecan St.,
Ft. Worth, TX 76102-4060, (817) 332-4441.

Shinners & Mahler's Illustrated Flora of North Central
Texas, Botanical Research Institute of Texas, 509 Pecan St.,
Ft. Worth, TX 76102-4060, (817) 332-4441.

Appendix E: Ecological Regions

by Noreen Damude, Texas Parks and Wildlife

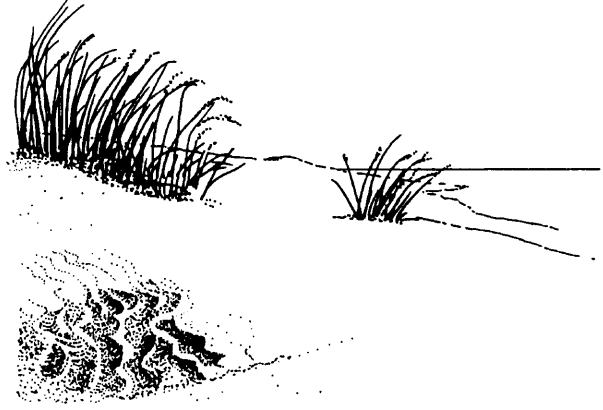
Texas is divided into 10 ecological regions, according to the soil types, rainfall amounts, and vegetation. The greater Houston area lies on the edge of two ecological regions: the East Texas Piney Woods and the Gulf Coast Prairies and Marshes.

EAST TEXAS PINEY WOODS

Mostly deep, dark, and evergreen, the Piney Woods region of East Texas is an extension of the rich pine/hardwood forests of the southeastern United States. Frequent long-term flooding plays an essential role in maintaining these bottomland hardwood communities. The region's 35 to 60 inches of rain each year support pines (loblolly, shortleaf, and longleaf), hardwoods (beech, oaks, elm, and magnolia), and other woodland specialties (sphagnum moss, ferns, pitcher plants, sundews, and orchids). Elevations range from near sea level to almost 500 feet with an average annual temperature of 66 F. The growing season approaches 250 days in the south and 230 days near the Red River in the north. Highly weathered soils are sandy or loamy and very deep. East Texas boasts a rich diversity of wildlife. Bird species, such as the Pine Warbler, Brown-headed Nuthatch, and the endangered Red-cockaded Woodpecker breed in this region. Bald Eagles set up winter roosts in undisturbed woodlands near rivers and lakes. Characteristic mammals of the region include River Otter, Gray Squirrel, Flying Squirrel, and the Louisiana Black Bear.

GULF COAST PRAIRIES AND MARSHES

Following the lip of the Texas coast, and extending inland about 60 miles, are the Gulf Coast Prairies and Marshes. This 9,500,000 acre swath of land traces a broad arc along the coast from the Sabine River to Baffin Bay. Elevations range from near sea level to almost 150 feet, while average annual temperatures range from 74 to 70 degrees Fahrenheit. Soils of the marshy areas include acid sands, sandy loams, and clay. Soils of the Gulf Prairies contain more clay than the marsh areas and are very rich in nutrients. The character of the coastline is shaped by the long and continuous



confrontation with the sea, wind, and rain. Storms shape this place as a sculptor works clay, creating a tapestry of shallow bays, estuaries, salt marshes, dunes, and tidal flats. Because of the proximity to the Gulf of Mexico, many plants are highly salt tolerant or halophytic. Tallgrass and midgrass prairies, as well as spartina marshes, make up a major portion of the coastal vegetation. Much of the upland areas are dissected with numerous sluggish rivers, bayous, creeks, and sloughs. Between rivers, extensive open prairies are dominated by little bluestem, Indiangrass, and various sedges. At one time, the coastal river bottoms were clothed in woodlands of sugarberry, pecan, elms, and coastal live oaks. Few such areas remain today, as most of these prairies are farmed or absorbed into urban areas. Much of the remaining native sod of the coastal prairies has been invaded by exotic species such as MacCartney rose, Chinese tallow, or native woody species including mesquite and prickly pear. Today rich coastal prairie soils are grazed for cattle production or farmed in rice, corn, grain sorghum, and cotton, while the northeastern end of this region are devoted to the oil and petrochemical industries.

Coastal areas are rich in wildlife. Where treeless earth meets endless sky, coastal marshes harbor hundreds of thousands of wintering geese and ducks, as well as providing critical landfall areas for neotropical migratory birds. The area is home to

important wildlife sanctuaries and refuges - notably those protecting the endangered Attwater's Prairie Chicken and the Whooping Crane. In the fall, coastal dunes serve as sentry roost for northward-

bound migrating peregrine falcons, while at any season there are willets, sanderlings, gulls, terns, and black skimmers feeding or loafing near the surf.

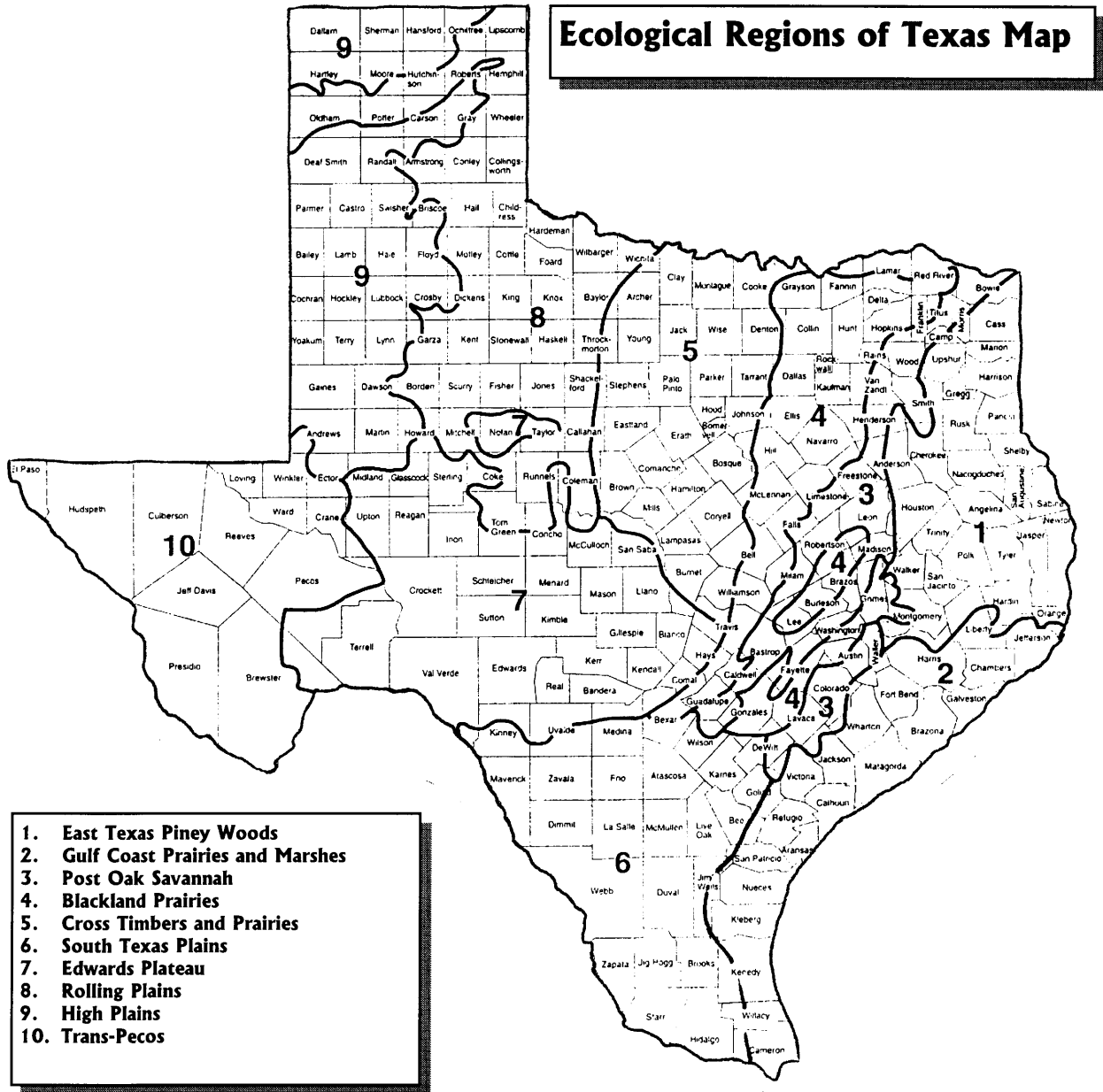


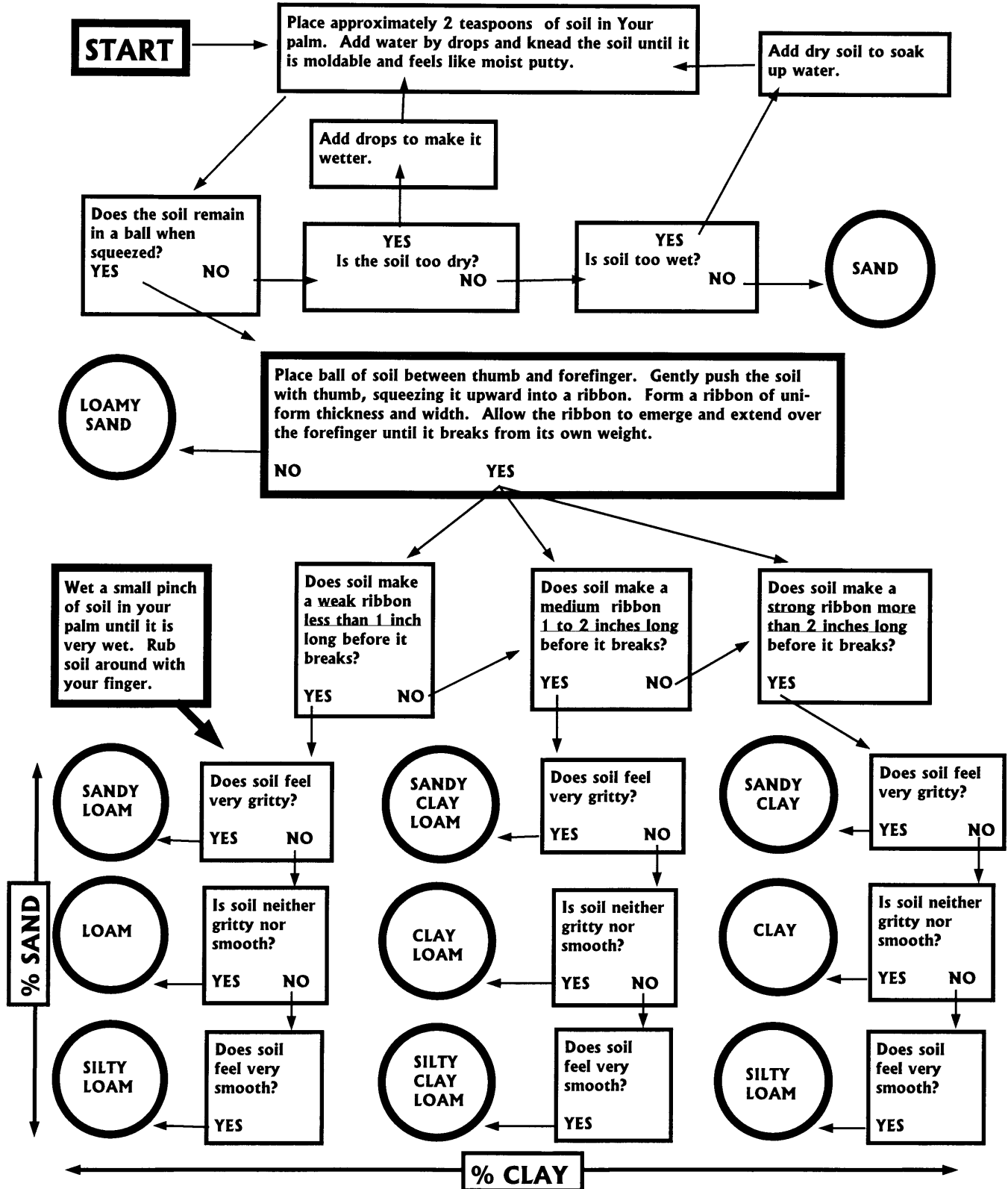
Figure (29). Map of the Ecoregions of Texas. Map adapted from F. W. Gould, G. O. Hoffman and C. A. Rechenhthn, *Vegetational Areas of Texas*, Texas A&M University leaflet 492.

Appendix G: Common Wildlife Foods

	Turkey	Deer	Squirrel	Rabbit	Quail	Bluebirds	Wood Duck	Hawks	Foxes	Beaver	Owls	Shrews	Snakes	Woodpeckers	Raccoons	Bats	River Otter	Turtles	Salamanders	Frogs
Spiders	X				X	X	X							X	X			X		X
Acorns	X	X	X				X							X	X					
Nuts	X		X				X								X					
Mushrooms		X	X																	
Seeds	X	X	X	X	X	X	X		X					X	X					
Fruit	X	X	X	X	X	X	X		X					X	X			X		
Tubers, Roots	X														X					
Greens	X	X			X					X					X			X		
Insects	X				X	X	X	X	X		X	X			X	X		X	X	X
Snails	X				X	X	X								X	X			X	X
Leaves, Twigs	X	X			X					X										
Lichens		X																		
Ferns		X																		
Buds		X	X	X																
Grain	X	X	X	X	X		X								X					
Bark				X						X										
Fish							X	X			X			X	X	X	X	X		
Frogs & Salamanders							X	X										X		X
Snakes								X			X									
Crayfish	X						X	X												
Birds								X			X									
Small Mammals								X			X									
Aquatic Plants									X											
Carrion										X										
Earthworms									X			X								
Eggs													X							
Mussels							X													

Appendix H: “Key to Soil Texture by Feel” Chart

Fig. (31). This key was adapted from a flow chart by Steve Thiem, 1979, source unknown.



Appendix I: Cost Estimate Worksheet, Page 1

PROJECT DESCRIPTION – ITEM	AMOUNT NEEDED	COST PER ITEM	TOTAL COST
POND AREA:			
Backhoe rental with operator			
Pond Liner			
PVC Water Pipe to extend Water Line			
PVC Pipe Fittings			
15 gal. plants			
5 gal. plants			
1 gal. plants			
DECK/ STUDY PLATFORM:			
Boards -			
Boards -			
Boards -			
Nails -			
Concrete -			
PATHWAYS:			
Material -			
Edging -			
Lawn Roller Rental?			

Cost Estimate Worksheet, Page 2

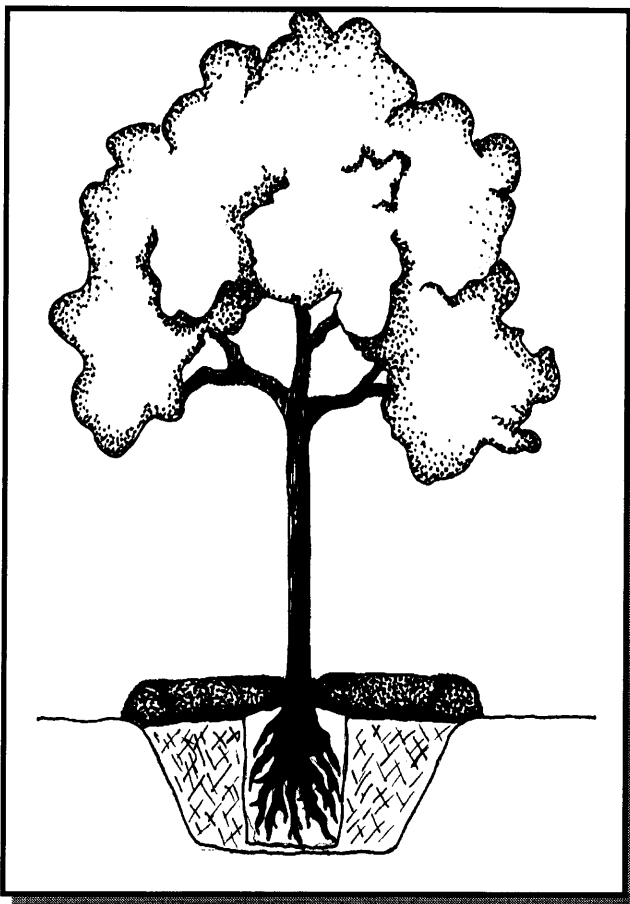
PROJECT DESCRIPTION – ITEM	AMOUNT NEEDED	COST PER ITEM	TOTAL COST
WILDFLOWER / PRAIRIE AREA:			
Tiller Rental			
Herbicide			
Wildflower/ Prairie Seed			
OTHER:			
15 gal. plants			
5 gal. plants			
1 gal. plants			
Plants – other			
Mulch			
Tools –			
Wheelbarrow			
6' X 8' Tool Storage Building			
Chain Link Fencing			
Chain Link Double Gate			
Chain Link Single Gate			

Appendix K: Tips on Planting Trees and Shrubs

from The Houston Area Urban Forestry Council

Trees do wonderful things. They create shade around buildings which decreases summer electric bills. Their cool, green leaves create a peaceful setting, clean and cool the air, buffer wind and noise, protect water quality, prevent soil erosion, screen unsightly areas, and provide food and cover for wildlife. For all the benefits trees provide, it is worth the extra effort to give them a good start.

PROPERLY PLANTED TREE



PLANTING TIME:

Generally, mid-November to late February is the best time to plant trees. Planting in late fall or winter will allow roots to become established before moisture demanding summer sets in. Most shade and ornamental trees sold in the nursery trade are either balled and burlapped or container grown.

6 STEPS TO PLANTING A TREE:

1. PLANTING A CONTAINER GROWN TREE

– Do not remove tree from container until you are ready to place into planting hole. Fine roots dry out rapidly when exposed to air.

2. HOLE SIZE - Loosen the soil in your planting site to a depth of 12 inches using a shovel or tiller. Dig a hole 2 to 3 times wider than the root ball and slightly shallower. The tree should be planted slightly above the original soil level. (This is especially important in heavy clay soils to aid in drainage.) When the hole is ready, gently remove the tree while lightly pressing against the sides of the container. If necessary, cut the container vertically to dislodge the root ball.

3. PLACING THE TREE IN HOLE - Set tree gently into hold, lifting by the root ball. When removing a tree from its container, take care to avoid breaking the root ball. Tree should be centered and level. Hold tree in place while backfilling around the root ball. Tamp soil lightly to eliminate air pockets. Large dirt clods should be broken apart before backfilling.

Figure (32). Properly Planted Tree. Dig the hole at least 2 to 3 times wider than the root ball. Slope sides of the planting hole. Gently place root ball into hole. Backfill with original soil. Build a ring of 3 to 4 inches of mulch around the tree with an indented saucer over root ball. Illustration by Michele G. Foss.

4. MULCHING - Remove any grass or weeds within a 3 foot minimum diameter circle around the tree. Create a slightly indented watering saucer. Cover with 3 – 4 inches of mulch composed of bark, woodchips, compost, or pine needles. Do not use fresh grass clippings. Do not place bark directly against tree bark.

5. WATERING - Adequate water is essential at planting time. Place water hose at base of tree and allow water to slowly trickle until the soil is saturated.

6. CARE OF NEWLY PLANTED TREE -

After watering, add mulch to compensate for any settling. If your tree needs additional support, use two or three six-foot stakes pounded into the ground outside the root ball. Attach the tree to the stakes with wide nylon webbing. The tree should have enough freedom to sway in the wind to develop strength. The stakes should be removed after the first growing season.

PLANTS TO AVOID IN A SCHOOL HABITAT

Non-Natives:	Natives:
Chinese tallow	Trumpet creeper
Purple loosestrife	Mexican hat
Kudzu	Datura
Exotic Privet	Ruellia (katie's ok)
Ligustrum	
Bermuda grass	
Paperbark tree (Melaleuca)	
Torpedograss	
Johnson grass	

The plants listed above should be avoided due to their invasive growth habits or poisonous properties.

For a list of **FEDERALLY PROHIBITED PLANTS** - [Http://www.aphis.usda.gov](http://www.aphis.usda.gov)

TREE PLANTING TIPS

- Loosen the soil far beyond the drip line of the tree.
- Brace the tree only if it will not remain upright in a moderate wind.
- Brace with broad, belt-like material that will not injure the bark. Remove after one growing season.
- Cover root ball with mulch, but keep trunk exposed.
- Keep soil moist, but not water-logged.
- Remove dead, diseased and damaged branches.
- If planting a balled and burlapped tree, check with your local resource professionals for advice on proper methods for your area.

MISTAKES TO AVOID

- Do not plant too deep.
- Do not wrap trees.
- Do not amend the soil, unless the soil is very unhealthy.
- Do not brace the tree so tightly that the tree cannot sway.
- Do not leave the bracing material on for more than one growing season.
- Remind students to remove the container before placing the plant in the ground.



Appendix L: Sample Butterfly & Hummingbird Garden

- GARDEN CHECKLIST:**
- For Hummingbirds**
- _____ Open space for flying
 - _____ Tubular, nectar-rich flowers
 - _____ Twig perches nearby
 - _____ Source of small insects, such as gnats
- For Butterflies:**
- _____ Open spaces in full sun for fluttering
 - _____ Away from strong winds or provide windbreak
 - _____ Masses of color (pink, purple, yellow, orange)
 - _____ Fragrant, nectar-rich flowers
 - _____ Larval food plants
 - _____ Puddling area

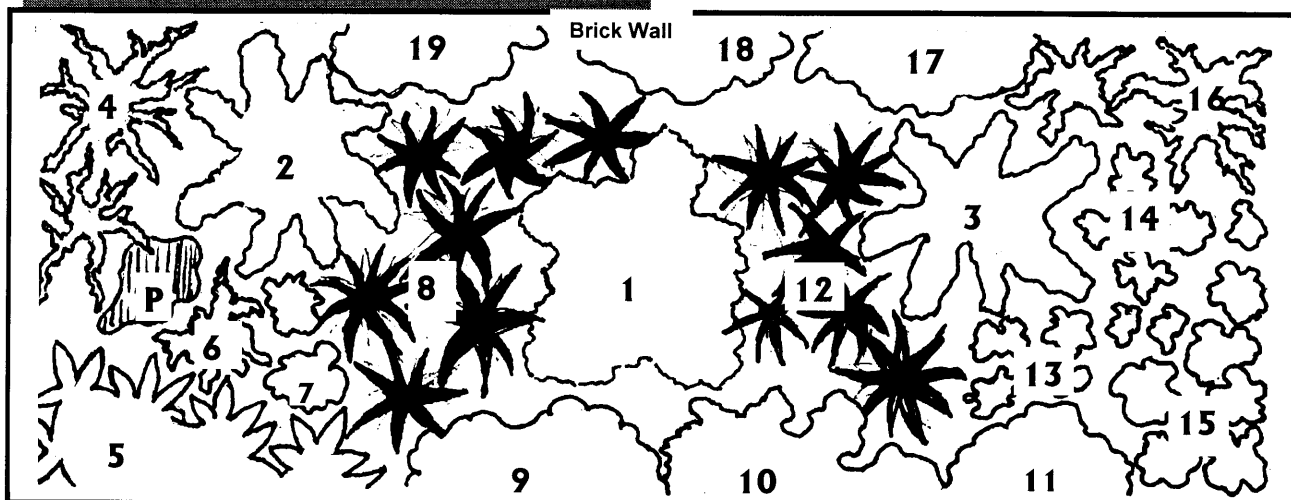


Figure (33). Sample design for a simple 10 foot by 28 foot butterfly and hummingbird garden. The garden is located in full sun against a brick wall. The design includes nectar sources for hummingbirds and butterflies, as well as a few larval host plants for caterpillars. Larger shrubs and vines could be planted nearby. The map scale is 1 inch equals 4 feet. Illustration by Michele G. Foss.

MAP LEGEND:

- | | | |
|------------|-------------------------|-----------------------------------|
| 1 | Hummingbird Bush | (<i>Hamelia patens</i>) |
| 2, 3 | Butterfly Bush | (<i>Buddleia sp.</i>) |
| 4 | Mexican Bush Sage | (<i>Salvia leucantha</i>) |
| 5 | Purple Coneflower | (<i>Echinacea purpurea</i>) |
| 6 | Mealy Blue Sage | (<i>Salvia farinacea</i>) |
| 7 | Dill | (<i>Anethum graveolens</i>) |
| 8, 12 | Milkweed | (<i>Asclepias sp.</i>) |
| 9 | Purple Asters + Winecup | |
| 10 | New Gold Lantana | (<i>Lantana sp.</i>) |
| 11 | Prairie Verbena | (<i>Verbena bipinnatifida</i>) |
| 13 | Fennel | (<i>Foeniculum vulgare</i>) |
| 14 | Gulf coast penstemon | (<i>Penstemon tenuis</i>) |
| 15 | Pentas | (<i>Pentas lanceolata</i>) |
| 16 | Scarlet sage | (<i>Salvia coccinea</i>) |
| 17, 18, 19 | Maximilian Sunflower | (<i>Helianthus maximiliani</i>) |
| P | Puddling area | |

REFERENCE MATERIALS

The Hummingbird Book by Donald and Lillian Stokes, Little, Brown and Company publishers.

The Butterfly Book by Donald and Lillian Stokes, Little, Brown and Company publishers.

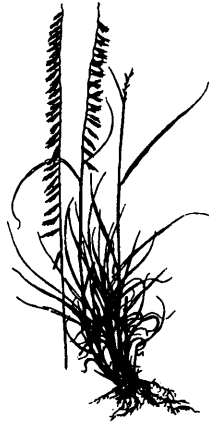
How to Attract Hummingbirds & Butterflies, Ortho Books, Chevron Chemical Company, Consumer Products Division, Box 5047, San Ramon, CA 94583.

Butterfly Gardening for the South by Geyata Ajilvsgi, Taylor Publishing Company.

Butterflies of Houston & Southeast Texas by John and Gloria Tveten, University of Texas Press, Austin.

Appendix M: Establishing a Prairie and Wildflower Area

Your school habitat will likely attract more birds and insects than any other wildlife. Both of these wildlife groups can provide many opportunities for observation. Insects not only attract birds to your habitat, but also offer life cycle observations that can be conducted outdoors or moved into the classroom. Herbaceous vegetation in the form of forbs (i.e., wildflowers) and grasses is more likely to attract insect species, including butterflies, than any other type of vegetation.



Schools often want to plant wildflowers for their aesthetics, and it is often seen as an inexpensive and easy project to do with children. Wildflowers alone do not constitute a habitat type. Mixed with native grasses, these areas will resemble the native prairie (see Appendix E) that once covered much of the Houston area. To maximize your ability to attract insects, it is necessary to provide a mix of forbs and grasses that will provide both food and cover for a wide variety of species. This bit of habitat may also provide food and cover for some bird species.

The establishment, maintenance and sustainability of these areas can be one of the most difficult phases of your school habitat projects. The area may also draw the most comments, both positive and negative.



The establishment of a prairie/wildflower area is divided into 3 phases:

1. Site preparation
2. Planting
3. Maintenance

1. SITE PREPARATION

Site preparation may be the most important aspect of this project. The successful establishment of desired species is directly related to how well you remove and control undesirable competitors, many of which are exotic plant species. Complete elimination of this vegetation should be your goal. There are several techniques available to achieve this goal. Choose a technique or combination of techniques suitable for your site and appropriate for your skill level and available resources.

Methods for Removing Vegetation:

Cultivation

This method includes such techniques as plowing, tilling, rototilling, and scarifying. Cultivation serves to kill undesirable plants and their germinating seeds. This process can be effective but labor intensive and requires the use of machinery. Repetition will probably be required to kill plants that germinate from dormant seeds brought to the surface. Many perennial weeds may not be destroyed by this process, and may, in fact, be spread and increased. This is not an appropriate technique for erosion prone sites. Repeated cultivation may be detrimental to the soil structure.

Herbicide Treatment

If this method is chosen, use a low toxicity, non-persistent herbicide, such as Round-up or Kleenup and follow the manufacturer's instructions carefully. Apply the chemical to green, actively growing vegetation. Wait two weeks and apply again, if necessary.

If your site contains a lot of rank or previous year's growth, it will probably be necessary to mow and rake up the cuttings. After cleaning up, allow the regrowth to reach 6-8 inches tall before applying the herbicide. Tilling done later during seed bed

preparation may bring dormant seed to the surface, resulting in the need for an additional treatment with herbicide or additional tilling for control. This treatment is an effective technique for weed removal and works well on erosion prone sites. Remember that school districts may restrict the use of herbicides or require the spraying be conducted by a licensed applicator.

Solarization Method

Solarization is the process of trapping heat generated by sunlight to kill plants and sterilize the soil. This method involves wetting the soil surface and covering it with clear or black plastic sheeting. Some studies indicate that clear plastic is more effective than the black. The material will have to be anchored down to keep it in place. In our climate, ultraviolet light tends to break the plastic down within one season. To be totally effective, the plastic should remain in place for an entire year to allow for the control of both cool and warm season plant species. While this is a safe process, it can be expensive and impractical for a large area. Some of the tougher plant species may still persist after this treatment.

Your site may require a combination of these methods to achieve the best results. You will find that your efforts will be rewarded by higher survival of your desired species.

Seedbed Preparation

For the most part, seedbed preparation should only consist of lightly tilling or discing of the soil. The goal is to prepare the soil to enable good seed contact with the soil. Tilling or discing should be restricted to the top one or two inches of the soil. By tilling deeper, you encourage undesirable dormant seeds to germinate.

2. PLANTING

The planting process provides another good opportunity to involve students. Students can do everything from selecting the proper plant species for your site to doing the actual installation.

Plant Selection

Select species native to this area. Choose species that match your site conditions. Remember that most of the plants in a prairie

wildflower area prefer full sunlight. Select a mixture with approximately 60% grass species and 40% forbs. You may find that emphasizing perennial species will result in a more successful project. Prepared seed mixes available on the market tend to have a high percentage of annual species. Purchase seeds from a reputable source. [Avoid purchasing seed mixes or “seed mats” that don’t list the flower species on their packaging. These mixes are usually designed for cooler climates and cannot handle our summer heat.] If you collect seeds from the wild, make sure you obtain the permission of the landowner. Never collect more than 50% of the seed available in that wild spot. By leaving half the available seed, this will leave seeds to germinate in the wild next year. Rescuing plants from an area that will be developed, with the landowner’s permission, would be the exception to the collection rule.

Seeding Rates

The seeding rate is the amount of seed applied to a given area, usually shown as lbs./acre or ozs./ 1000 sq. ft.. Seeding rate is based on the PLS (pure live seed) content of your mixture. Seed purchased from a reputable dealer will have the PLS content indicated on the packaging, as well as the recommended seeding rate. You will not know the PLS content for seeds you hand collect from the wild and planting rates may be difficult to calculate. For calculating seeding rates for collected seed, use the rates recommended by seed dealers and then err to the excessive.

Planting Technique

Many of the seeds you will be working with are very small. Several thousand seeds per one ounce is not uncommon. To evenly distribute such tiny seed on your site, it is necessary to dilute them by mixing them with a suitable material, such as dampened sand or sawdust. Use a volume of sand or sawdust equal to or greater than the volume of your seeds.

The more you dilute your seed mixture, the more students you can involve in the planting activity. Divide the mixture in half. Distribute one half of the mixture between the students and have them broadcast it gradually while walking across the site. Distribute the second half of the seed and broadcast it while walking perpendicular to your first path. This process will allow for a more even distribution

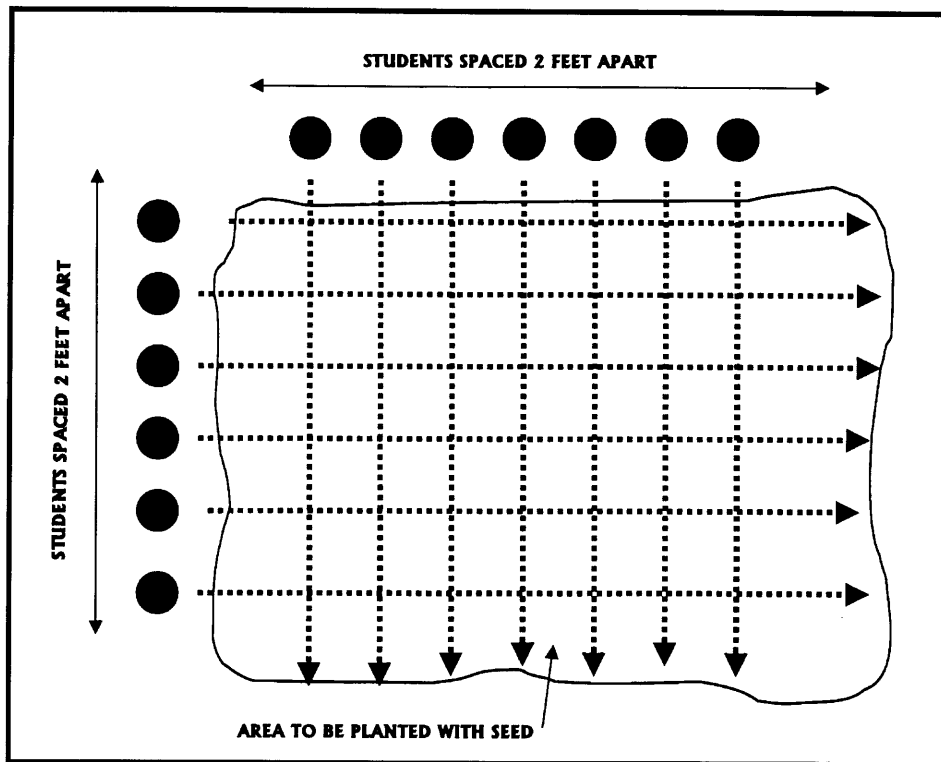


Figure (34). Student Seed Planting Activity. Students line up on two sides of the site to be planted with seed. Students on one side walk in straight lines from their side to the opposite side, gently releasing seed all along their path. Then students from the other side walk in lines perpendicular to the original students' paths. This process results in a fairly even distribution of the seeds.

of the seed mixture. Lightly rake the soil surface. Have the students walk back and forth across the site or rent a lawn roller to gently push the seed mixture into the soil surface. Good soil contact is important for germination success. **Burying the seed is not your goal.** Many of these seeds require light to germinate. Watering after planting may not be necessary and may actually favor the germination of weed seeds. Late summer through fall is the best time to plant warm season grasses and spring or summer blooming wildflowers. Late winter into early spring is the best time to plant fall-blooming wildflowers.

Establishing your habitat with containerized plants rather than from seed will give you quicker results. However, you may find the cost prohibitive and that not as many species are available in containers. An alternative would be to have students raise the plants from seed and transplant them to the habitat. You may choose to use this alternative method for those plant species that are difficult to germinate in the field and then have your students intersperse the seedlings with those that were seeded directly into the ground.

3. Maintenance

Most seeds will germinate the first year. If optimum conditions do not exist the first year, some seeds may lie dormant and then germinate the second year. Many of the grasses concentrate on establishing root systems the first year and as a result, do not produce much top growth. The second year these grasses will produce more top growth and may bloom.

This several year process aids in prairie management. Many unwanted weeds are annuals that will grow taller than your desired prairie species. Therefore, to maintain the prairie, you can cut down the taller annual weeds without damaging your new grass or wildflower seedlings. The goal is to cut the undesirable annuals before they produce and distribute their seed. During the second or third years, you may want to reseed any bare spots or add transplants to increase your plant diversity.

Controlling Invasive Species

You will probably discover that spot applications of herbicide and hand weeding are necessary. If used, a herbicide should be applied to a specific problem plant only, called spot treatment, rather than sprayed widely over the area. Be persistent in controlling invaders, such as bermuda grass and johnson grass. If these tough, invasive grasses persist while your project becomes established, it will be extremely difficult to control them. After these invaders wind their way among your desired plants, spot treatment with herbicide can be almost impossible. Without control, they will eventually outcompete the natives and become the dominate plants in your site.

Prairies benefit from occasionally being burned. In most cases, this is not practical on a school site. An annual mowing in late winter will be your best substitute. However, do not mow your entire site at one time. Instead, mow in small sections at a time, or in a mosaic of strips with unmowed sections in between. As the prairie wildflower area matures, it will provide wintering areas for various insects. Leaving some of it untouched each year assures that some winter cover remains available for wildlife.

ROOT SYSTEMS IN A PRAIRIE

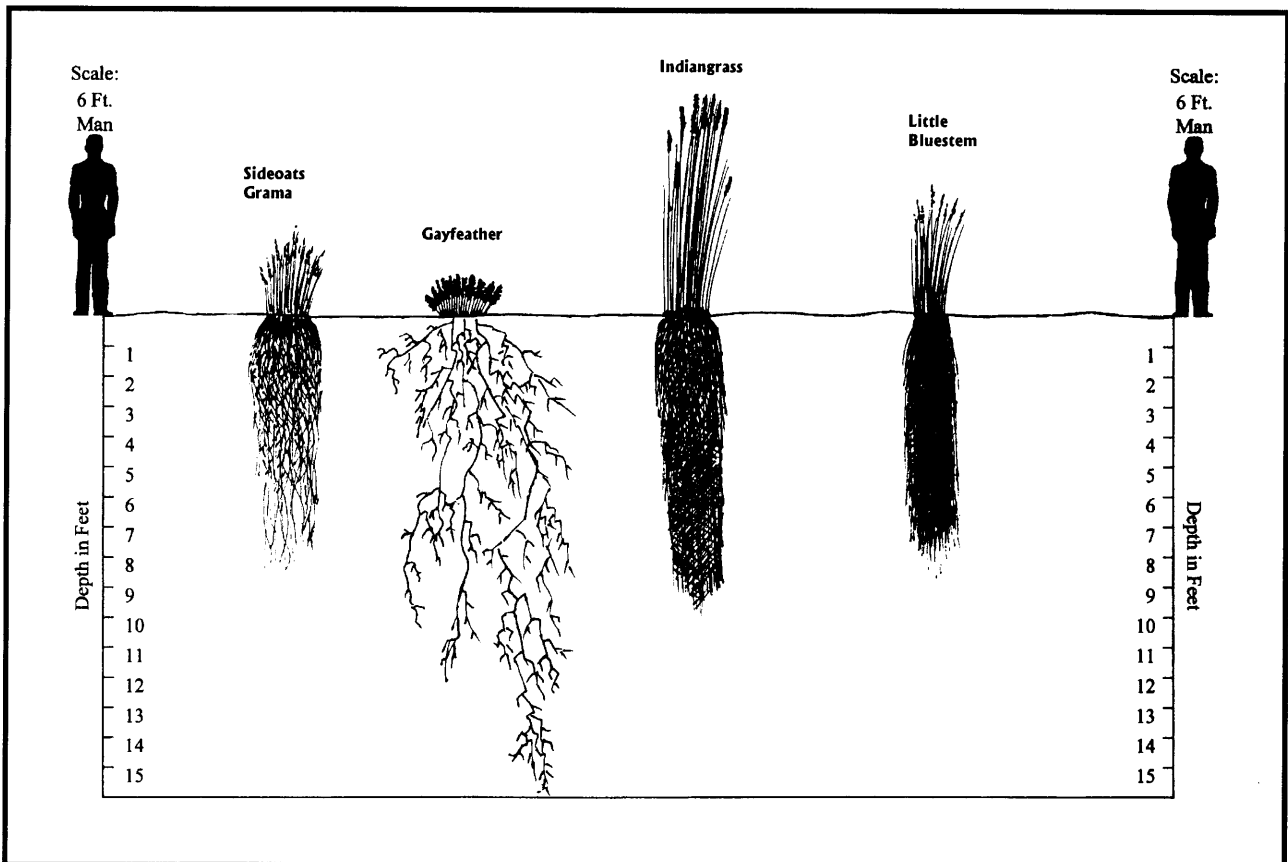
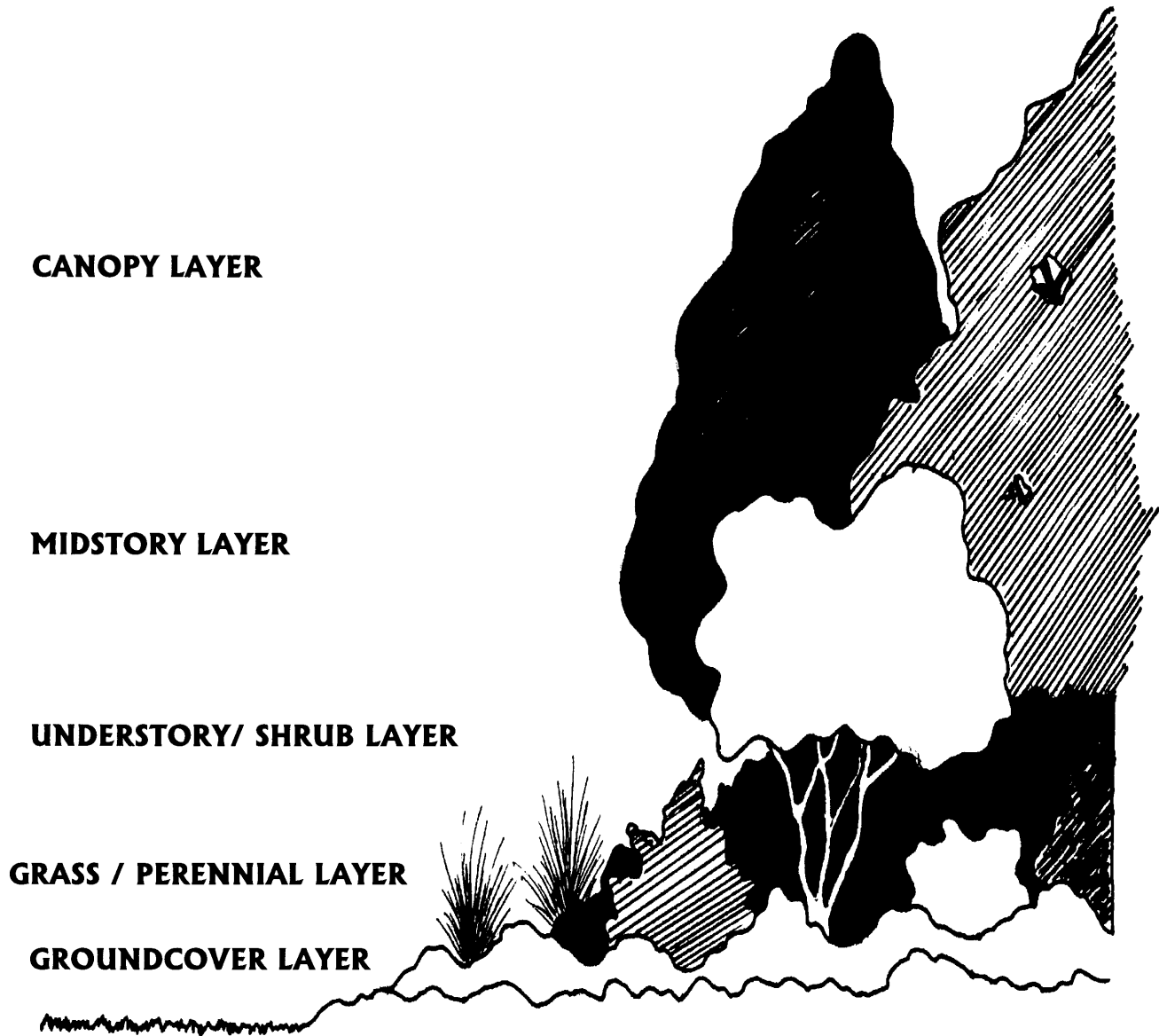


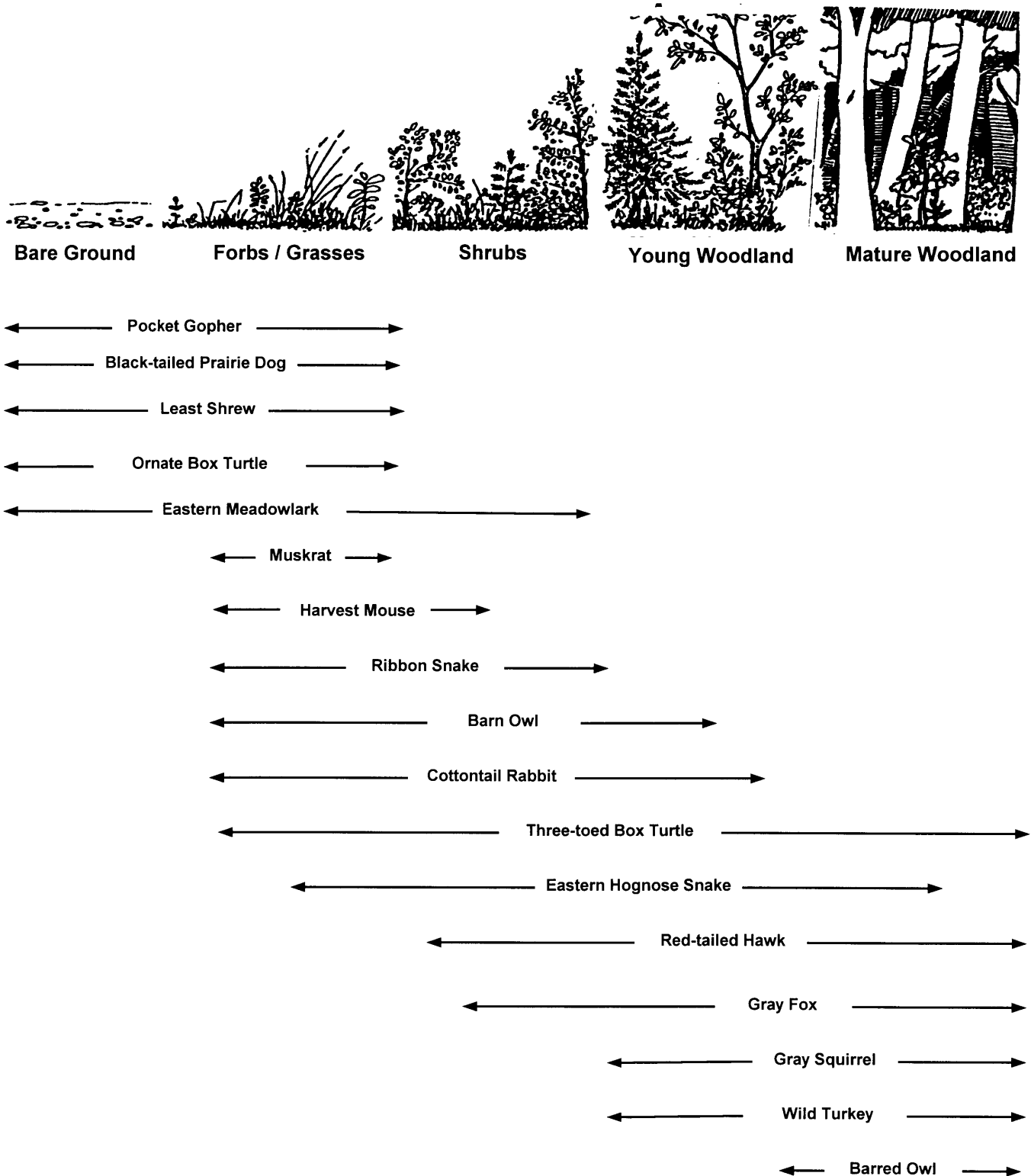
Figure (35). Prairie Root Systems. Extensive root systems are essential for vigorous growth, even during unfavorable weather conditions. The roots hold the plant in place and absorb soil water and nutrients. Perennial plant roots function as surplus food storage centers. Most of the plant root material is concentrated within the top 12 inches of soil; however, as illustrated, many desirable species have deep, vigorous feeding root systems. Illustration by Michele G. Foss.

Appendix N: Vertical Layering in a Habitat



Layers in a habitat. Try to reproduce the many vegetation diversity and layers in a natural habitat in your school habitat. The majority of wildlife species utilize the lower two thirds of a habitat. Illustration by Michele G. Foss.

Appendix O: Stages of Plant Succession and Associated Wildlife Species



Stages of Plant Succession and Associated Wildlife Species. Modified from Homes for Wildlife, published by the New Hampshire Fish and Game Department.

Appendix P: Constructing Raised Beds

If you are constructing raised beds for planting annuals or perennials, delineation and preparation of your beds should be done prior to planting.

1. Kill or remove the grass from the bed area. There are several methods you may choose.

- One method involves using herbicides, such as Roundup, to kill the grass. Remember that most general herbicides kill all plant material they touch, so spray on windless days.
- Another method, called smothering, involves placing black plastic, 3 to 7 layers of newspaper, or cardboard over the grass to deprive it of light. A variation is to place plastic down with a layer of mulch on top. The cover must remain in place for approximately 3 months. When ready to plant, you may remove the cover completely, or simply cut holes through the plastic to plant. The dead grass layer may be left in place to decompose, thus forming a weed barrier and providing nutrients for the soil.
- Another alternative is to dig out the grass layer by hand. Simply tilling the grass, especially Bermuda grass, into the ground without killing it first is a mistake. The grass usually re-seeds or re-sprouts and grows up through your newly planted bed, requiring you to dig it out by hand.

SOIL ESTIMATION FORMULA

$$\text{Volume of Soil (cubic yards)} = \frac{\text{Length of Area (feet)} \times \text{Width of Area (feet)} \times \text{Depth of Area (inches)}}{324}$$

Figure (36). This formula determines the amount of soil, compost, or mulch, in cubic yards, that you will need to order. Pay close attention to the units of measurement when using the formula. Do NOT convert so that all the units are the same.

2. Estimate the amount of soil, mulch, sand, or compost you need. To do this, determine the number of square feet of garden bed you need to fill. Then decide how deep (in inches) you want your soil. Remember that fluffy soil will eventually settle, so plan to add a little extra. Use the Soil Estimation Formula (Figure) to determine the number of cubic yards of soil you need. (Example: Your planting area measures 10 feet long by 12 feet wide. You want the soil in a raised bed 4 inches deep. Multiply 10 feet by 12 feet by 4 inches. Divide by 324. You will need to order 1.5 cubic yards of soil for your area.)

3. Add any soil amendments at this time to correct deficiencies in the soil. (See Soil Health) Till or mix the soil by shovel. Water the soil and allow the area to settle for a week.

4. Use garden hose, rope, string, stakes, lines of flour, or spray paint to temporarily delineate bed edges. Add edging, if desired.

SOIL HEALTH

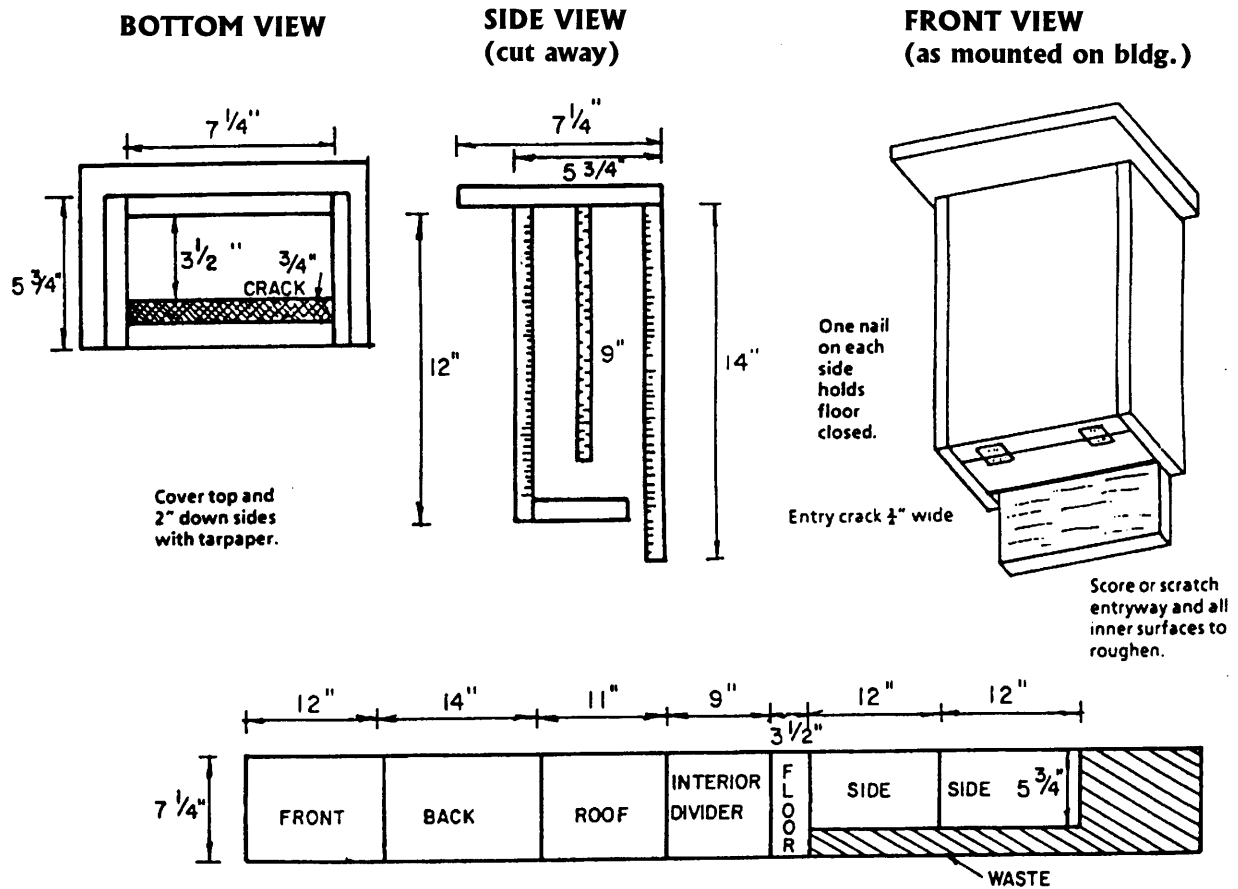
Good soil health insures plant health. Soil should be loose, fluffy, and fairly well-drained. If your soil resembles hard packed cement, then you need to add some ingredients to amend the soil, such as compost, mulch, leaves, or sand. By mixing in the appropriate ingredients, you return needed nutrients to the soil and improve its ability to drain water.

- **Simply add small amounts of compost and dead leaves to the soil and till them in. Over a long period, these additions will gradually improve the soil.**
- **For a quicker solution, order a larger amount of compost or topsoil and add this regularly to your topsoil.**

Appendix Q: Nest Box Specifications

BIRD SPECIES	FLOOR SIZE (Inches)	DEPTH OF CAVITY (Inches)	ENTRANCE HEIGHT ABOVE FLOOR (Inches)	DIAMETER OF ENTRANCE (Inches)	HEIGHT ABOVE GROUND (Feet)
Eastern Bluebird	5 x 5	8	6	1 1/2	5
Chickadee	4 x 4	8 – 10	6 – 8	1 1/8	4 – 15
Carolina Wren	4 x 4	6 – 8	1 – 6	1 1/2	6 – 10
House Wren	4 x 4	8 – 10	1 – 6	1 1/4	6 – 10
Tufted Titmouse	4 x 4	8 – 10	6 – 8	1 1/4	6 – 15
Red-headed Woodpecker	6 x 6	12	10	2	10 – 20
Northern Flicker	7 x 7	16 – 18	14 – 16	2 1/2	6 – 20
Barn Owl	10 x 18	15 – 18	4	6	12 – 18
Screech Owl	8 x 8	12 – 15	9 – 12	3	10 – 30
Wood Duck	10 x 18	10 – 24	12 – 16	4	10 – 20

Appendix R: Bat House Plan (Small)

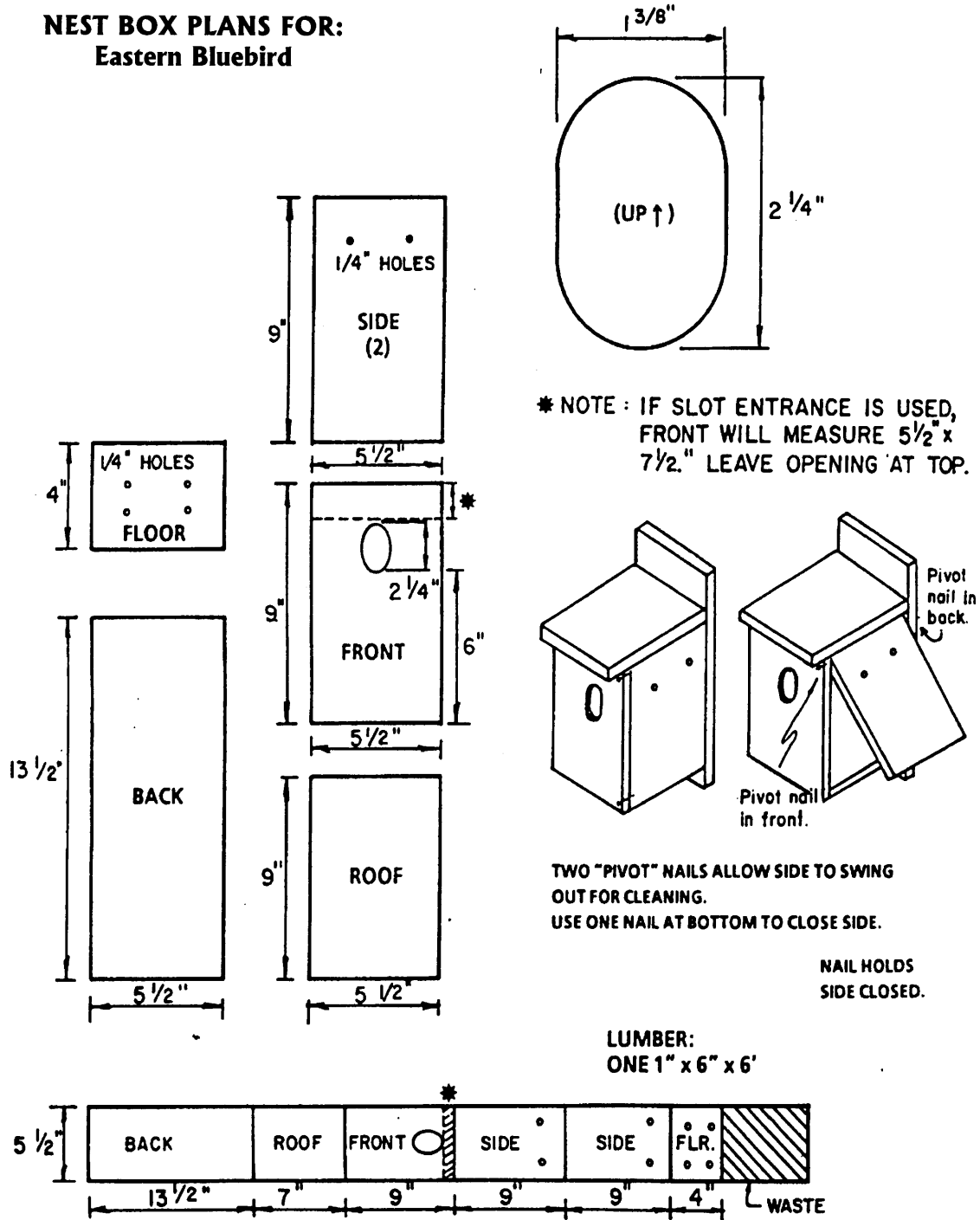


LUMBER: 1 inch X 8 inch X 8 feet

Plans for a small bat house. Reprinted from Woodworking for Wildlife, Minnesota Department of Natural Resources.

Appendix S: Small Nest Box Plan

NEST BOX PLANS FOR: Eastern Bluebird



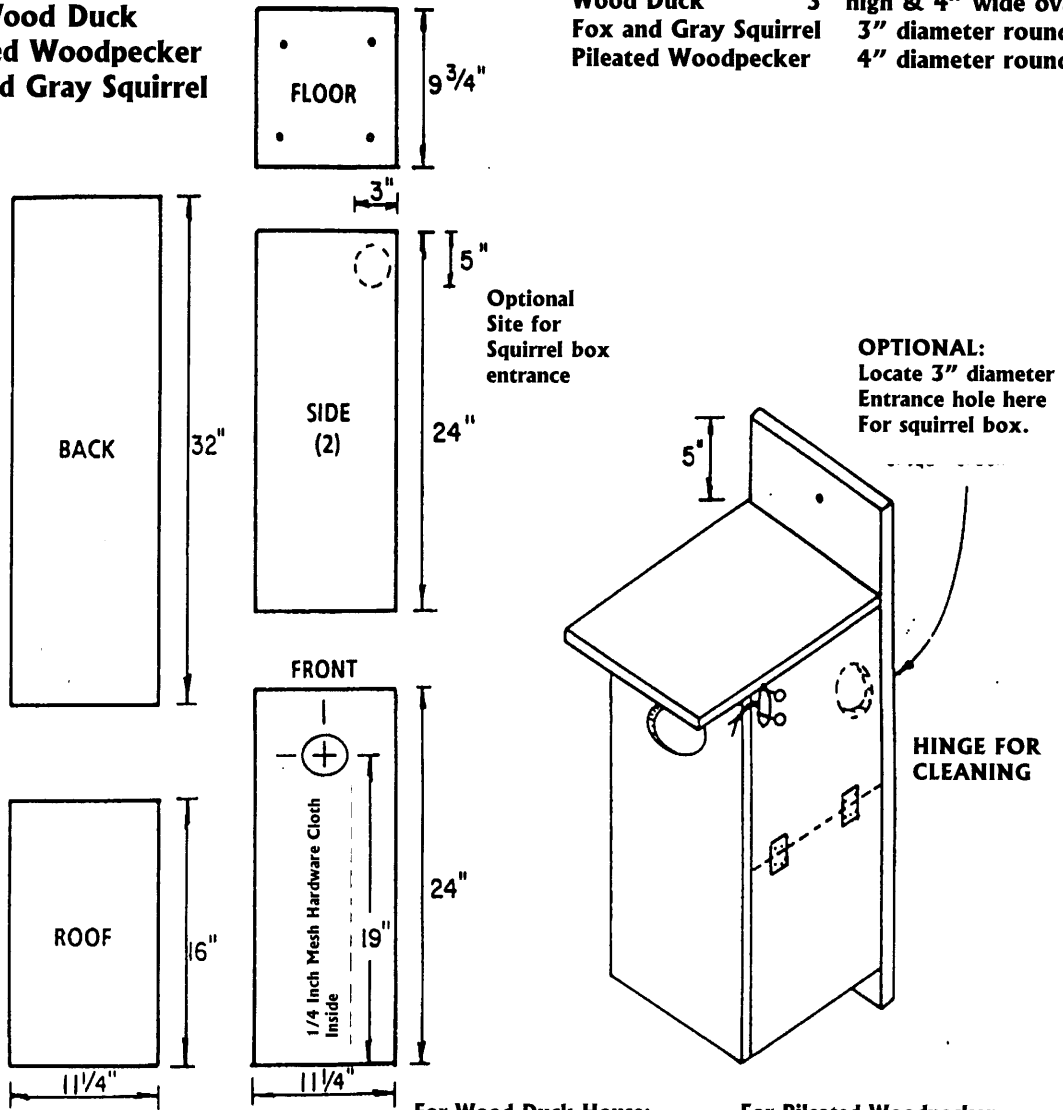
Plans for bluebird nest box. Reprinted from Woodworking for Wildlife, Minnesota Department of Natural Resources.

Appendix T: Large Nest Box Plan

NEST BOX PLANS FOR:

**Wood Duck
Pileated Woodpecker
Fox and Gray Squirrel**

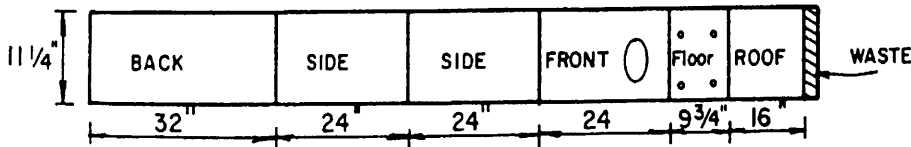
Wood Duck 3" high & 4" wide oval
Fox and Gray Squirrel 3" diameter round
Pileated Woodpecker 4" diameter round



Lumber
One 1 inch X 12 inch X 12 foot

For Wood Duck House:
Place 3 to 4 inches of Wood chips in bottom of box.

For Pileated Woodpecker House: Fill box to top with sawdust.



Note: Pileated Woodpecker box should be constructed from One 2 inch X 12 inch X 12 foot cedar. Floor must be 8 1/4 inches Long instead of 9 3/4 inches.

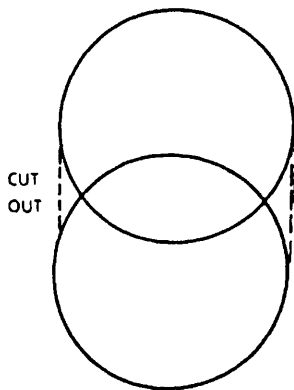
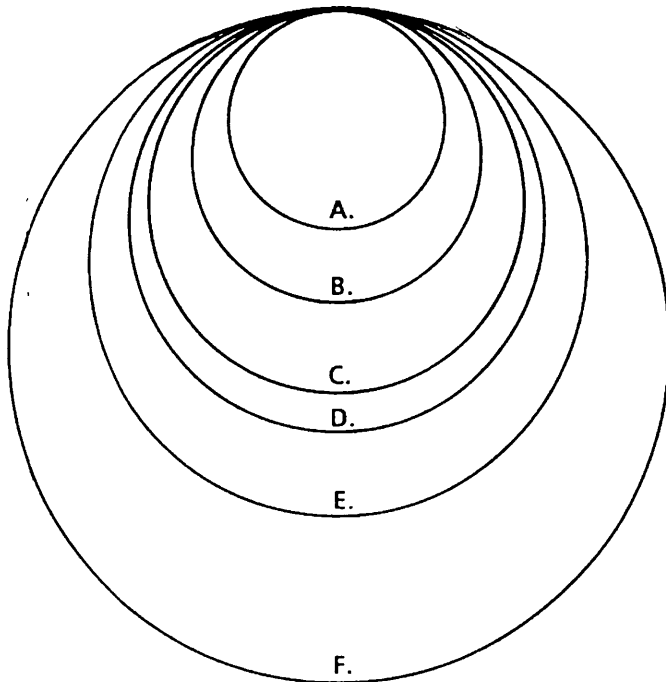
Plans for wood duck, squirrel, pileated woodpecker, and raccoon nest box. Printed from the Woodworking for Wildlife, Minnesota Department of Natural Resources.

Nest Box Entrance Hole Sizes

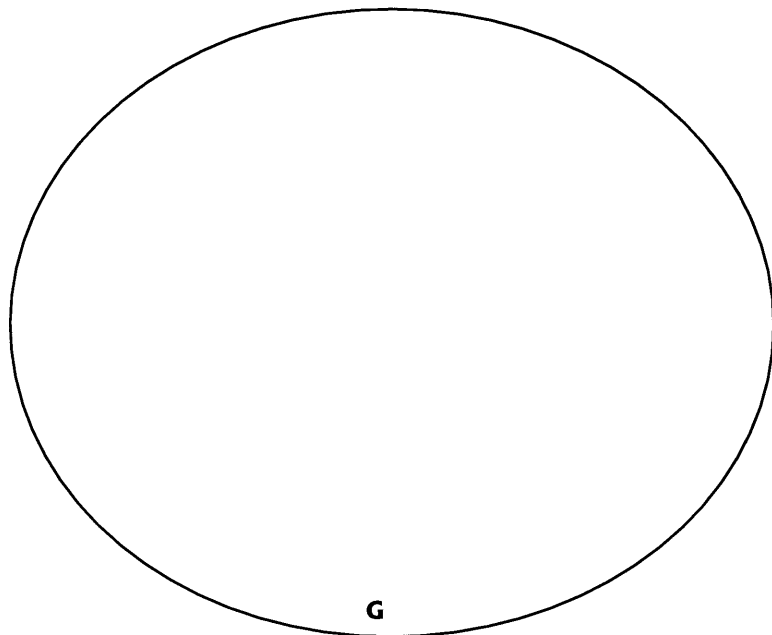
TRACE ONTO WOOD WITH
CARBON PAPER.

ENTRANCE HOLE SIZES FOR SONG-
BIRD, WOODPECKER, AND SQUIRREL
NEST BOXES

- A. House Wren, Chickadee, Titmouse, Prothonotary Warbler
- B. Great Crested Flycatcher
- C. Purple Martin
- D. Common Flicker
- E. Squirrel, Screech Owl, Kestrel
- F. Pileated Woodpecker
- G. Wood Duck



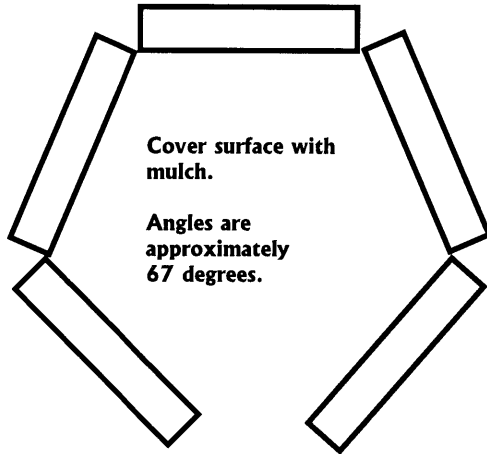
EASTERN BLUEBIRD &
TREE SWALLOW
(DRILL 2 HOLES 1 3/8"
DIAMETER. CENTERED 7/8"
APART.)



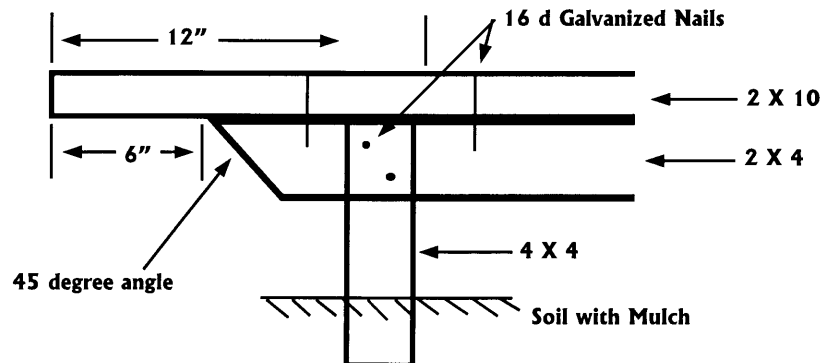
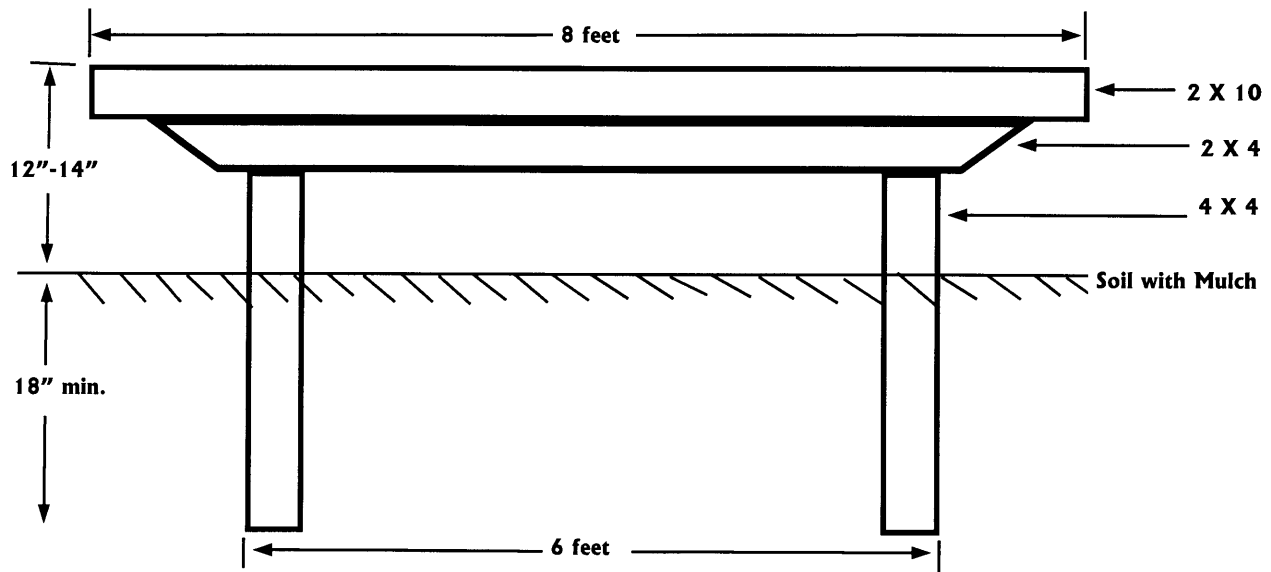
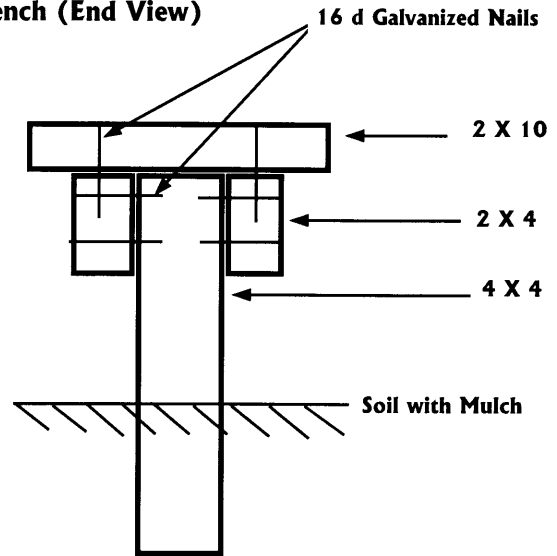
Each species prefers a specific hole size in their in their nest box. Use the illustration above to trace the correct hole shape and size onto the wood.

Appendix U: Sample Bench Design

Bench Configuration



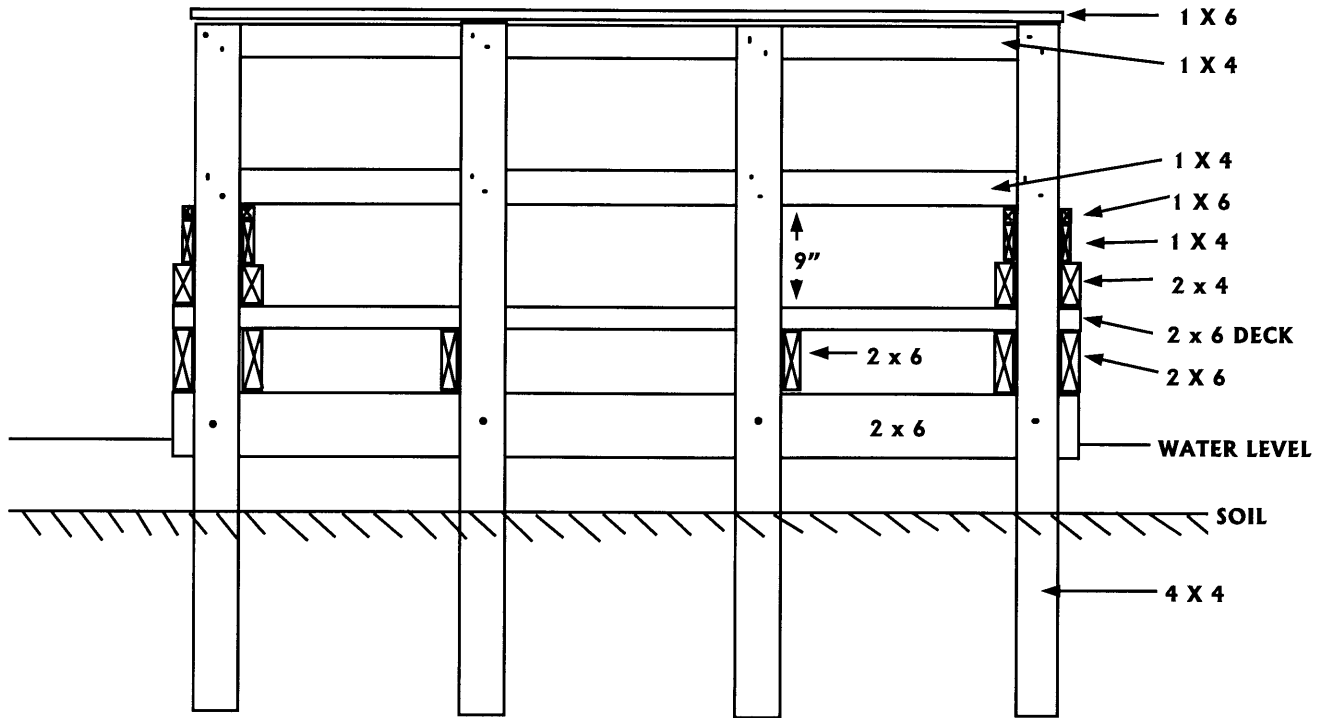
Bench (End View)



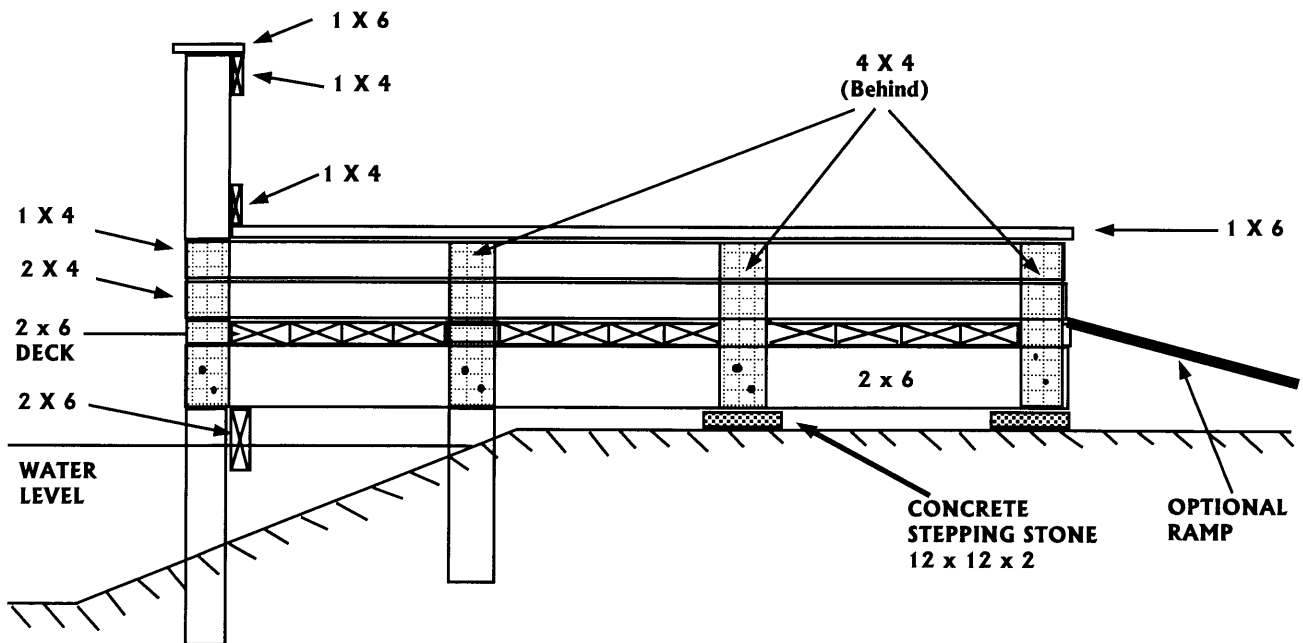
Typical outdoor bench design. Note that all lumber is pressure treated yellow pine. Nails are 16 penny galvanized screw or ring shank. Landscape timbers may be substituted for the 4 X 4 material. Nails are spaced 12 inches apart off center. Design by Ronald K. Jones, U. S. Fish and Wildlife Service.

Appendix V: Sample Study Platform/Deck Design

FRONT POND VIEW

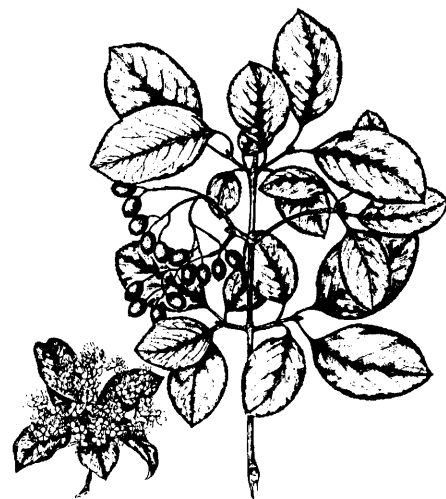
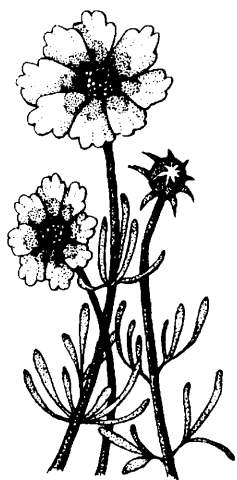
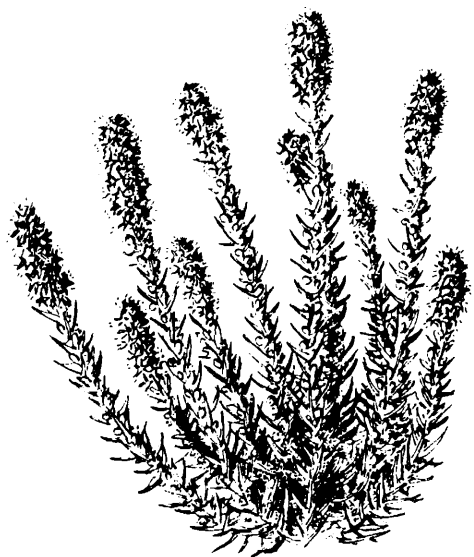


SIDE VIEW



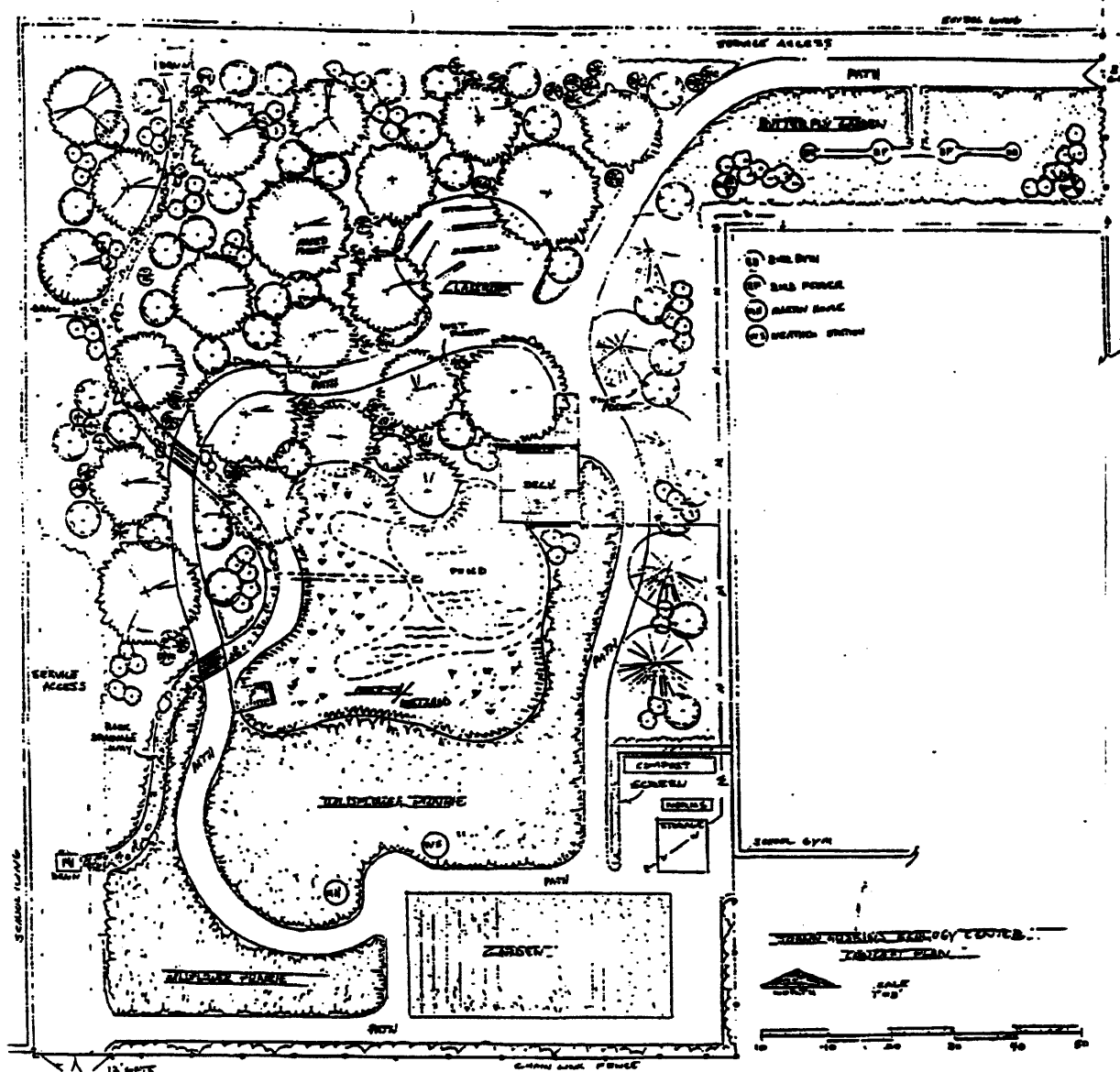
Concept design for Study Platform to provide student access to water features. Style and dimensions of the platform may vary with need, construction techniques, site modifications, etc. Note that all wood is pressure treated. All fasteners are galvanized. Design by Ronald K. Jones, U. S. Fish and Wildlife Service.

Appendix W: Plant Tables



Appendix Y: Concept Drawing

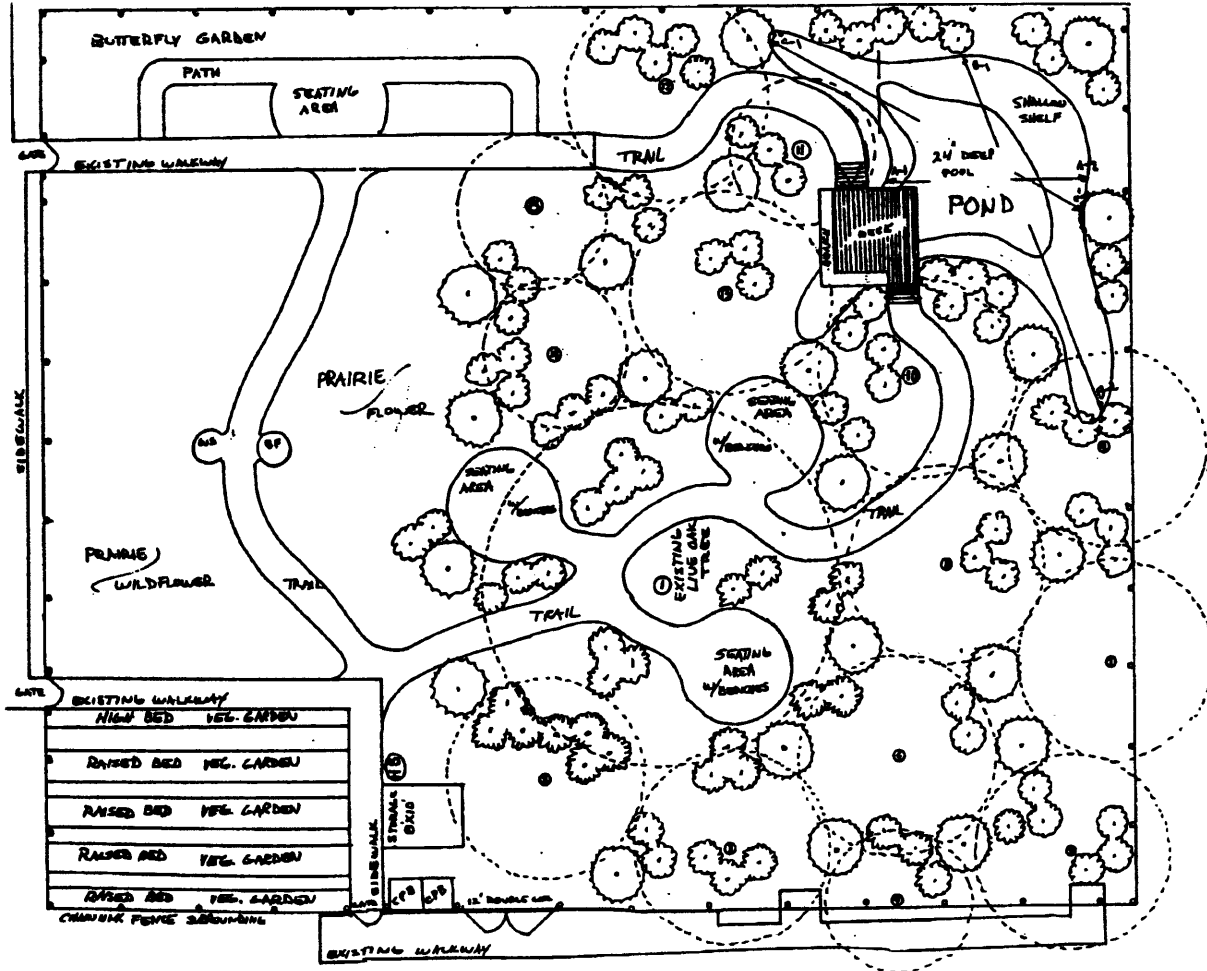
Pearl Hall Elementary, Houston, Texas



Concept design for Pearl Hall Elementary, Pasadena Independent School District. Design by Ronald K. Jones, U. S. Fish and Wildlife Service.

Appendix AA: Concept Drawing

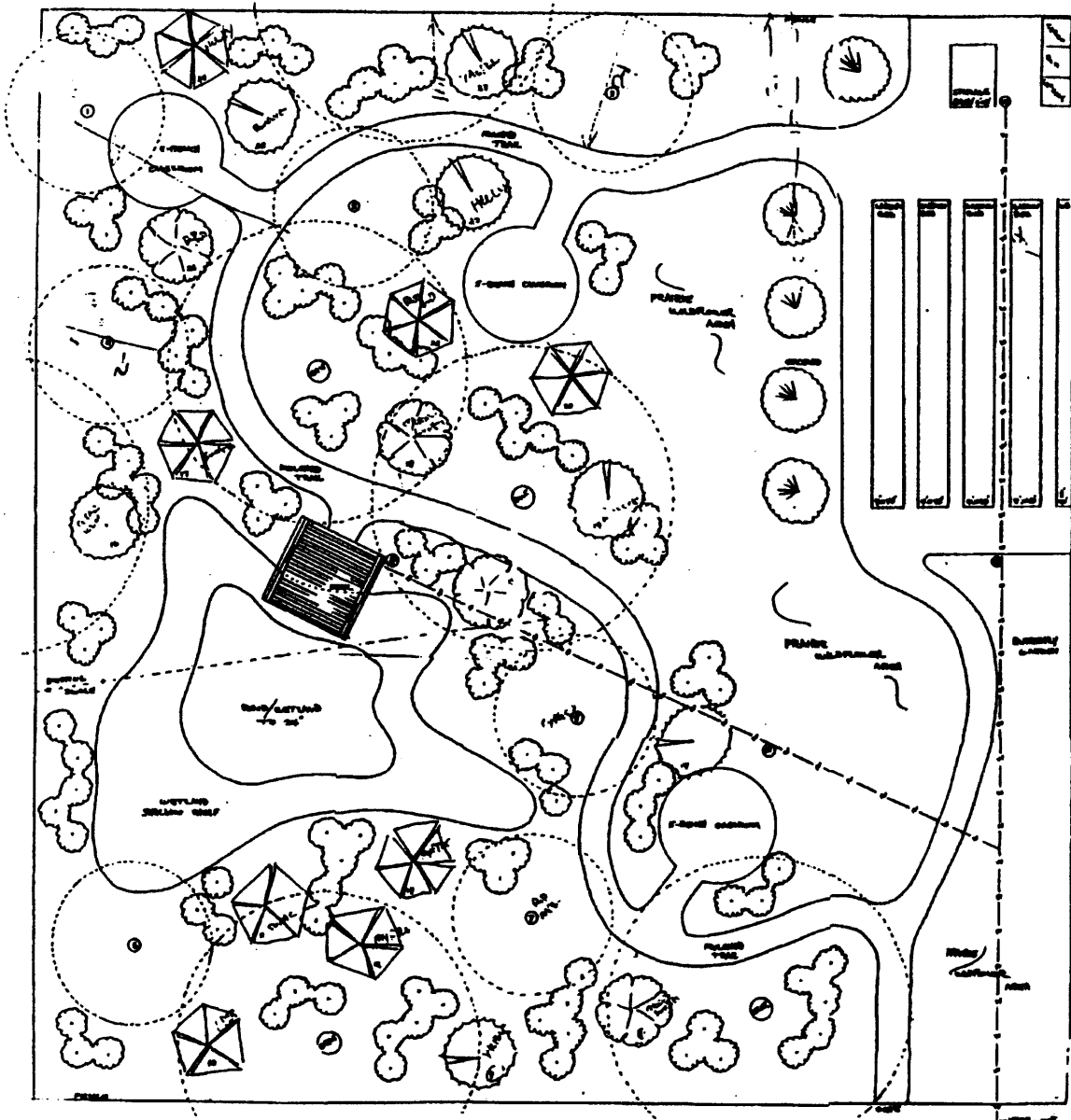
League City Elementary School, League City, Texas



Concept design for League City Elementary, Clear Creek Independent School District. Design by Ronald K. Jones, U. S. Fish and Wildlife Service.

Appendix AB: Concept Drawing

Brannon Elementary School, Lake Jackson, Texas



Concept design for Brannon Elementary School, Brazosport Independent School District. Design by Ronald K. Jones, U. S. Fish and Wildlife Service.