Practice Specification
Tree/Shrub Establishment (Code 612)

SCOPE:

This work will consist of establishing adapted and compatible native and introduced trees and shrubs for forest products, wildlife habitat, erosion control and water quality, treating waste, storing carbon, energy conservation, improving or restoring natural diversity, and enhancing aesthetics.

GENERAL SPECIFICATIONS APPLICABLE TO ALL PURPOSES

Planting Plan

The planting plan will be recorded on the approved VT NRCS 612 Job Sheet or other acceptable format and will include the natural community type if applicable, species and sizes, numbers to be planted, spacing, locations and specifications for protection if applicable.

Locally developed, native Vermont plant materials or seeds should be considered for planting. Do not order or plant species developed outside of Vermont which are uncommon or rare in the State. This will maintain the genetic integrity of these species.

Plant Material Descriptions

Bare-root Stock – woody plant seedlings lifted from the nursery soil and delivered with their roots bare of soil. Readily available and commonly planted throughout Vermont. Various sizes.

Tubelings – woody plant seedling grown in plastic “plug” containers with small amount of soil. While a type of ‘container grown’ plant material they are unique enough to be treated separately.

Container Grown/Balled-Burlapped - woody plant seedlings and saplings grown and delivered in soil; either plastic container or wrapped in burlap. Generally larger sizes.

Live stakes - living woody plant cuttings capable of quickly rooting in moist soils; generally ½ - 2 inches in diameter and 1-3 feet long and large enough to be tamped-in as stakes. Typically used for bioengineering but may be used in other moist soil conditions.

Whips – living woody plant cuttings capable of rooting in moist soils and usually assembled into

bundles called wattles or fascines; generally ¼ - 1 inch diameter and 3-4 feet in length. Typically used for bioengineering but may be used in other moist soil conditions.

Wattles - bundles of whip cuttings bound together into sausage-like structures capable of rooting in moist soils; generally wattles are at least 3-4 feet long. Typically used for bioengineering by placing in trenches and securing with live stakes.

Fascines - bundles of whip cuttings bound together into sausage-like structures capable of rooting in moist soils; generally fascines are 5-20 feet long. Typically used for bioengineering by placing in trenches and securing with live stakes.

Site Preparation/Weed Control for Establishment

Determine the level of preparation and weed control based upon the site conditions and plant materials. In prior crop fields it is unlikely that weed control or mats will be necessary but in prior hayfield it may be necessary due to the tall grass; particularly if planting small bare root stock. If planting tall trees (4 feet or more) weed mats are likely unnecessary.

- Eliminate all competing vegetation in all seedbed areas to be direct seeded prior to planting.
- If fabric weed barriers are used, the following shall apply:
  - Barrier must be a minimum of 9 sq.ft/plant.
  - Barrier must be permeable to water and be guaranteed by manufacturer to last a minimum of 3 years when exposed to sunlight.
  - Barrier shall be capable of inhibiting all underlying plant growth.

    - Barrier must be pinned and otherwise installed according to manufacturer's specifications.
- If tillage is used for weed control, care must be taken not to damage plant stems. Keep tillage depths shallow to avoid root damage.
- Mowing or cutting of weeds or grass is not an acceptable means of weed control around woody plantings.
- Herbicide may be used and applied according to label instructions.

Planting Dates

- Bare-rooted stock and tubelings shall be planted during the dormant season in the spring after the ground thaws until May 30 as soil moisture and local weather conditions permit. Care should be taken to plant leafed-out tubelings in May after danger of frost has passed. Fall planting may be done after October 1 until the ground freezes when soil moisture is adequate. Fall planting of barerooted stock will not be done on soils subject to frost-heave action (clays, clay loam, silty clay loams, silts, silt loams, and loams).
- Balled and burlapped or container-grown stock shall be planted October 1 to May 30 as local soil moisture and weather conditions permit. Fall planting may be done after October 1 until the ground freezes when soil moisture is adequate. Stock may be planted later in summer if it will be watered on a regular basis.
- Cuttings, including live stakes, wattles and fascines, shall be planted during the dormant season; generally from October 15th through April 30th. This is intended to capture the time period from after the first hard frost and leaf drop in late fall before the ground freezes to before bud swell in early spring. Cuttings may be planted as soon as the ground thaws. The spring planting date may be extended to the end of May if cuttings have been in cold storage.
- Direct seeding shall be completed from October 1 through April 30 depending on local soil moisture, target species dispersal date and as weather conditions permit. Spring seeding of some heavy seeded species may reduce rodent and insect damage. Fall seeding may eliminate the need for seed stratification and seed storage but may increase loss to rodents and other pests.

Minimum Planting Stock Size

Bare root stock should be 12 inches or more in total length. Generally this will be size '1-0' size which is one year old. Seedlings are often described as 1-0, 2-0 and 3-0. The first number refers to the number of years grown in a nursery seedling bed and the second to the number of years in a transplant nursery bed. Transplants are commonly designated as 2-1, 2-2, and 3-2. The total age of the plant is the sum of the two numbers. For example, 1-0 refers to a 1-year-old seedling and 2-2 to a 4-year-old transplant.

Cuttings:

- "Whips" for wattles and fascines should be ¼ to 1 inch diameter and 3-4 feet in length.
- Live stake size should be ½ to 2 inch diameter and 12-24 inch length. Use longer lengths to increase chance of success.

Storage, Care and Handling of Woody Planting Stock

- Planting stock roots will be protected from dessication (drying) during temporary storage and handling prior to and during planting. Stock will be kept in a cool environment out of direct sunlight and wind.
- Keep seedlings in shipping container and place in cold storage at 35 degrees to 45 degrees F. If cold storage is not feasible, heel in planting stock (see figure 1) for a period not to exceed 2 weeks. Follow supplier's direction which may include "sweating" or forcing some species out of dormancy and into bud break before planting.
- Roots of bare-rooted stock shall be kept moist and protected from freezing during planting operations by placing in a water-soil (mud) slurry, peat moss, sphagnum moss, superabsorbent (e.g., polyacrylamide) slurry or other equivalent material. (Note: Do not soak trees in water for more than 8 hours.).
- Rooting medium of containerized and balled and burlapped stock shall be protected from

excessive heat and freezing and kept moist at all times by periodic watering.

- Whips and live stakes can be sprayed with water to help keep them moist prior to bagging for storage. Bags should be made of fairly rugged plastic. Addition of moist peat moss to the bag prior to tying the top is desirable. Cuttings should fit comfortably inside the bags. Bags should be heavy enough to prevent punctures which tend to occur when handling bagged cuttings. Bags should be able to retain moisture around the cuttings. Cuttings can be stored in the dark, at temperatures approximately 33-40 F for 3-4 months without any significant reduction in establishment success. Whether cuttings are kept in a cooler, root cellar, or snowbank, make sure the storage area is dark, moist and cool at all times.

Plant Material Collection - Cuttings

Landowner permission shall be obtained prior to plant material harvest. Only one third to half of available plant material from a natural site should be harvested. It may be beneficial to identify potential harvest sites during the growing season to aid with plant identification

Cuttings - Live Stakes and Whips

The best cuttings are those which are fairly straight and have few branches which necessitates trimming. The best wood is 2-7 year old with smooth bark that is not split or furrowed. Use sharp hand tools to make clean cuts and limit damage to bark. Side branches should be removed. Live stake tops should be cut square so they can be tamped or pushed into the soil. Live stake basal ends (lower portion cut from tree or shrub) should be cut angled to allow for easy insertion in soil. Cutting the live stakes in this fashion will eliminate confusion as to which end is up for planting.

Emphasis should be placed on obtaining quality materials with no obvious insect or disease problems. Plant material should be cut from shrub willows, red osier and silky dogwood, black willow, cottonwood or balsam poplar. See VT Forestry Technical Note 2 – VT Trees and Shrubs for Conservation for more information.

Cuttings should be collected in the dormant season. The dormant season is after the first hard frost and leaf drop in fall and before bud swell in spring (roughly October 15th through April 30th). Keep the cuttings cool and moist until planting (see storage and handling section above). To minimize storage time, harvest cuttings in late winter to early spring and plant immediately when possible.

Length and Thickness of Cuttings: Basal diameter for whips should be a minimum of ¼ - 1 inch in diameter and 3-4 feet in length. Basal diameter for live stakes should be ½ -2 inch diameter and 12-24 inches long. Generally, larger diameter cuttings are better as they ensure a large supply of stored energy in the stem which improves establishment success. Also, longer cuttings (~4 feet) usually experience greater rooting success then shorter (2 foot) cuttings. The longer length allows cuttings to be planted deeper and into the mid-summer moisture zone. Cuttings planted into soil which dries out below the cutting and its developing roots have poor survival rates. Plant materials center trials have shown that large poles from 3-8 inch diameter have been very successful.

Planting Requirements for Woody Planting Stock

- Stock shall not be planted when the soil is frozen or dry. Rooted stock will be planted in a vertical position with the root collars approximately level with or slightly below (0.5 inch or less) the existing ground line. Planting depth should mimic the depth grown at the nursery.
- **Seedlings:** The planting trench or hole must be deep and wide enough to permit roots to spread out and down without doubling, J-rooting or Lrooting. If the roots are too long for the planting equipment, minimal pruning of small end roots may be needed. Do not prune back into the main root system or more than 25% of the total root length. Prune out any diseased root branches. Pack soil around each plant firmly to eliminate air pockets after planting.
- **Cuttings (Whips and Live Stakes):** Using cuttings of willow and other woody shrubs and trees that root from the stem is a successful and inexpensive treatment in moist soil conditions. Planting of hardwood cuttings will be limited to shrub and black willow, red osier and silky dogwood, cottonwood and balsam poplar. See VT Forestry Technical Note 2 – VT Trees and Shrubs for

Conservation for more information. Willow and dogwood are the typical species planted and available in Vermont. Plant cuttings within 2 days of collection or shipping arrival in the spring through April 30th. Planting may be done as late as the end of May if cuttings have been in cold storage.

- **Containerized trees**: Dig a hole slightly larger than the container diameter. Gently remove plants from containers before placing in the ground and firmly pack soil around roots to eliminate air pockets. Before planting, loosen any spiraling or compacted roots. Water should be applied generously.
- **Balled and burlapped trees:** When handling stock, never lift a tree at the stems or trunk. Handle stock at the root ball. Dig a hole 1 1/2 times as wide as the root ball and about the same depth as the root ball. Remove any rope, wire, or plastic twine from the tree. Pull back burlap around trunk and fold down once in the hole. Carefully place the tree in the hole and firmly pack soil around roots to eliminate air pockets. Water should be applied generously.

Planting Techniques

Small Seedlings

The two primary methods of planting smaller seedlings and bare root stock are slit method and side-hole method. These techniques are suitable when the root system is small enough so that it is not doubled over in the hole created by the tools. Figure 2 (below) shows some tree planting tools such as planting/dibble bars and shovels.

Slit Method: This method (See Figure 3) consists of making a slit in the ground with a planting bar, shovel or other suitable tool. This technique is much more rapid than side-hole method. After planting the tree in the slit, the bar is re-inserted several inches away, rocked away from the plant to kick in the soil at the bottom of the roots, and then rocked toward the plant to compress the soil around the base of the plant. The planter will then firm the soil around the plant with their feet.

Side-Hole Method: This method consists of digging a hole with a mattock or grub hoe deep enough to hold the roots of the tree (see Figure 4). This approach can work on larger seedlings and most bare root stock. Drive the tool into the ground and rock it to create a wedge-shaped hole and place the plant at the proper depth. Be sure to hold the plant at the proper depth when backfilling and compacting the soil so as to prevent plant settling below the root collar. If the roots are too long then deepen the hole rather than bending roots into a “J” shape. Firm the soil around the plant with the feet.

Large Seedlings/Small Saplings

The primary methods of planting large seedlings and small saplings are with planting tools such as a tile spade or light mechanical equipment such as a gas powered auger or light excavation equipment. These techniques are used when the plant material is too large for smaller planting equipment and a larger hole is necessary to accommodate large root systems. Follow the guidelines under the previous section *Planting Requirements for Woody Planting Stock*. Cultural resource review is required when digging below the plow zone (8-12 inches).

Cuttings – Whips and Live Stakes

It is strongly recommended to soak cuttings in water for 1-2 days before planting. Soaking has been shown to significantly increase the survival rate of the cuttings. They should also be kept cool and moist in water during the planting operation. Cuttings will be hand planted under optimum moisture conditions. Live stakes will be planted vertically with the buds pointing upward.

Live stakes will be inserted into the soil (angled basal end down) for approximately 75% of the stake length (a 24 inch stake should be in the ground 18 inches). Depending upon the soil, stakes may be pushed, inserted in hole/slit or pounded into the ground. Use of a pilot hole is recommended using rebar, soil auger, planting shovel or other (see figure 5). When using a pilot hole it is important to ensure adequate soil/stake contact and to eliminate air by firming soil around stake. If the top of the stake is damaged (split) from pounding it should be pruned downed to an undamaged area on the stake or replaced; ideally, two buds and/or bud scars should be above the ground after planting.

Space the individual willow cuttings about 3-5 feet apart for shrubs and about 6-12 feet apart for trees. In those areas where erosive action is expected, plant the larger plant materials (3-8 inch diameter) at least 3-4 feet in the ground with a more dense spacing.

Wattles and Fascines

Assembly: To assemble wattles/fascines use whips from desired species. Typically this will be shrubs. Orient the basal ends of branches in opposite directions to create a wattle or fascine with a uniform diameter (See figure 6). Tie wattles with twine at both ends and every 2-3 feet for longer fascines. Finished bundle should be compressed to 4-8 inch diameter.

Installation: Dig a shallow trench slightly wider than the size of the wattle or fascine. The depth of the trench should be approximately 75% of the diameter of the bundle. Lay the bundle flat in the trench and cover with soil being sure to pack soil in to eliminate air pockets. Do not cover the entire bundle. The top part of the bundle and stems must be visible for the length of the bundle.

Where flowing water and erosion is a concern, overlapping multiple wattles/fascines (~12 inches) and staking may be necessary. Live stakes or wooden stakes may be driven through the bundle and into the soil for 75% of the stakes length. Install stakes every 4 feet at alternating angles on each side of and through the bundle. Stakes should be a minimum of 12 inches or greater. Follow the specifications in Chapter 16 of the Engineering Field Handbook if the intent of installation is stream bank protection. The above specifications are for moist soil vegetative establishment.

Protection

Tree shelters can help with the establishment of trees in many situations. They physically protect the plant from browsing by deer and girdling by rodents. They have also been shown to increase growth rates by creating a favorable microclimate with increased moisture and CO2. Finally, managing competing vegetation will be much easier with the plant protected by the shelter (e.g. herbicide, etc). The use of shelters is probably the most important protective measure a landowner can use to help with planting. To provide these benefits, correct installation is critical.

Because of the relative absence of moisture stress, sheltered seedlings can grow later into the season, making them susceptible to die-back in cold winters. This is a temporary effect; re-growth in the following year will usually harden off properly.

In areas where high deer numbers may lead to substantial browsing, four foot tree tubes will be used. Two to three foot tubes will be used where rodents or rabbits are a cause of concern but deer browse is not.

The base of a tree shelter must be placed at least an inch into the soil to avoid a chimney effect, which increases moisture loss and also allows entry by rodents. Tree shelters are then secured to a rotresistant stake. Tree shelters will be assembled and installed according to manufacturer instructions.

Most tree shelters do not decompose and should be removed 2 to 3 years after plants emerge from them or when the trunk diameter grows beyond 2 inches. When the bark begins to grow against the shelter, the tree can develop cankers and fungus that threaten the health of the tree.

Evaluate the appropriateness of the site for tree shelters. Frequently flooded riparian areas may lead to maintenance problems with the shelter and or contribute to plant damage.

Beaver Protection

If beaver are damaging an excessive amount of plant materials, tree seedlings can be protected with wire fencing with a nine-inch or smaller mesh, installed around the tree to a height of 3 feet. This fencing should be anchored at the bottom to keep the beaver from working its way under the fence. Another method to prevent beaver gnawing is to paint the lower bark of the tree seedlings with a mixture of latex paint and mason sand. The ratio is approximately 5 ounces of sand to one quart of paint. The mixture results in an unappetizing cover for the beaver to gnaw through.

Natural Regeneration

Natural regeneration can be a cost effective way to allow tree and shrub establishment and plant succession to occur on site. Most natural plant communities in Vermont are dominated by trees and or shrubs. However, natural regeneration may not provide desired or uniform stem density as would be afforded through planting.

Determine if natural regeneration can successfully meet objectives. Where closed canopy conditions on the land unit are desired in a short period of time; natural regeneration may not be the best choice.

Once some woody stems have been established it should lead to further regeneration through changes in the site condition (shading favoring trees and shrubs), seed dispersal by birds and mammals and root suckering.

When considering potential establishment through natural regeneration, consider the site conditions and potential for establishment. Dense sod in old hayfields will likely need to be harrowed while idle crop fields or pastures may be well suited. Often pastures have some woody component that has been suppressed by browsing.

Consider the surrounding forest areas for seed sources. Natural regeneration is not a good option if the land unit is surrounded by agricultural land with no favorable seed sources or potential for vegetative reproduction. Where there are perches for birds (e.g. fence posts, trees on site, etc.) there is a better likelihood of colonization for some woody species; in particular, shrubs whose fruits are fed upon by birds will be seeded into these areas.

When planning for natural regeneration to occur, consider mode of dispersal, distance between seed source and target area, seed source strength (number and size of mature seed bearing specimens) and seed size. Generally, heavy seeded species can disperse short distances of 150 feet or less while wind and bird dispersed seeds may travel 450 feet or less. Obviously all seeds can travel greater distances depending on the site and seed dispersers present but the probabilities become increasingly smaller. See Table 1.

Wind and bird dispersed seeds will be most likely to colonize a site with some stems present. Where there are no perching sites on the land unit, wind dispersed seeds will be the primary form of regeneration. Heavy seeded species such as oak and hickory will take longer to naturally establish; particularly over longer distances. Consider planting species such as oak and hickory in regenerating areas to aid in establishment where they are a component of the targeted natural community.

Areas that are not planted may persist in an early successional state for decades. This may provide good habitat for certain species of concern in the Northeast (e.g. scrub shrub birds) but it can also provide favorable conditions for invasive plants such as buckthorn and honeysuckle. Monitoring is important to prevent their initial establishment.

TABLE 1 (from Hewitt and Kellman 2003)

Species	Dispersal[1]	Seed Size[2]
Ash (white and green)	Wind	2
Basswood	Unspec.	2
Beech	Bird	2
Birches	Wind	1
Cherry	Bird	2
Dogwoods	Bird	2
Elms (American and slippery)	Wind	2
Hickory (bitternut and shagbark)	Rodent	3
Ironwood (Ostrya virginiana)	Unspec.	2
Maples (boxelder, red, silver and sugar)	Wind	2
Musclewood (Carpinus caroliniana)	Unspec.	2
Oaks (black, white, red)	Bird/Rodent	3
Oak, Bur	Rodent	4
Poplar (cottonwood, bigtooth and trembling aspen)	Wind	1
Serviceberry	Bird	2
Walnut/Butternut	Rodent	4

[1]-Dispersal is primary mechanism – 'unspec.' (unspecialized) Lacks adaptations for wind or animal dispersal. [2]-Seed size 1=<0.01gram, 2=0.01-0.99g, 3=1-5g and 4=>5g

Direct Seeding Guidelines

General Guidelines

- Direct seeding may be used as an alternative to planting cuttings or rooted woody plants. Direct seeding may be less likely to establish woody plants than planting seedlings because seed germination and survival is less predictable and seed loss from rodents, insects and other predators can be high.
- Seed may be obtained from commercial seed sources or collected from wild plants. If purchased seed is to be used, acquire locally adapted seeds and plan shipping of seed to coincide with planting.
- Site preparation generally requires greater control of grass and forbs.
- Seeds should be inspected for damage prior to planting.
- Acorns of most species in the white oak group have little or no dormancy and should be planted as soon as possible after collection in the fall.
- If possible, seed should be planted immediately after collection. Spring seedings (before April 30) will be less susceptible to rodent damage than fall seedings (after October 1) but may need stratification and dormancy period depending on species (see Silvics of North America below).
- Techniques and specifications for Vermont have not been established and tested. This is a viable alternative to tree planting and should be experimented with where possible. Direct seeding is a well established process in the south and Midwest and there are many useful resources with extensive information available. Resources:
  - Michigan and Illinois Tree and Shrub Establishment Standard/Specification 612.
  - Illinois Direct Seeding Handbook – A Reforestation Guide, 2003. http://www.il.nrcs.usda.gov/technical/for estry/dshndbk.html
  - Silvics of North America Manual http://www.na.fs.fed.us/spfo/pubs/silvic s_manual/table_of_contents.htm
  - Numerous USFS General Technical Reports.

ADDITIONAL SPECIFICATIONS APPLICABLE TO IMPROVING WILDLIFE HABITAT

In general, there is no set species mix, planting density or configuration for improving wildlife habitat due to the varied needs of different wildlife. The wildlife habitat plan will specify the target species or group and the desired future habitat condition that will be met with this practice. The plan will outline species, density and configuration of the tree and shrub establishment. As a general rule, native species and species with high wildlife value will be planted. See VT Forestry Technical Note 2 – VT Trees and Shrubs for Conservation for species specific values for wildlife.

ADDITIONAL SPECIFICATIONS APPLICABLE FOR EROSION CONTROL/STREAMBANK PROTECTION

See the NRCS Engineering Field Handbook, Chapter 16 for specifications, layout and installation of live stakes and fascines for streambank protection and erosion control.

ADDITIONAL SPECIFICATIONS APPLICABLE FOR WATER QUALITY

- Select species that have rapid growth characteristics and extensive root systems where excess nutrients are a concern.
- Where high stream temperatures are a concern, select species with rapid growth and large canopy cover.
- Refer to the Riparian Forest Buffer (#391) Conservation Practice Standard and Specification Sheet for additional criteria and specifications.

ADDITONAL SPECIFICATIONS APPLICABLE FOR NATURAL COMMUNITY/FOREST

RESTORATION

Natural community restoration will be designed to meet the intended purpose of the practice. Generally, when reforesting a site it is most effective to mimic natural communities native to the site and soils. The specific species that make up the natural community are the most likely to thrive under those site conditions.

The primary reference for determining natural community and species composition is Wetland Woodland Wildland – A Guide to the Natural Communities of Vermont. The companion reference is the Vermont NRCS Soil Series of Vermont and their associated Natural Communities found within section IIA of the electronic Field Office Technical Guide (eFOTG).

Steps: For a given site, the planner may determine the soil series from the County Soil Survey or onsite review. Next, refer to the Soil Series Natural Community guide and find the soil series; read across the table to find the natural community typical of that soil series. Refer to the *Wetlands Woodlands Wildland* publication for more information about the natural communities including tree and shrub species.

It is also important for the planner to evaluate nearby plant communities on similar site conditions to determine what is appropriate or typical for the specific site. Finally, the planting plan will also need to account for the availability of plant materials. Some species are difficult to grow locally and may be better established through natural regeneration on site.

Note: Be aware of potential pathogens or pests known to be associated with plant materials that may be ordered from outside Vermont. For example, hemlock should generally not be imported due to wooly adelgid concerns.

REFERENCES:

Bio-engineering Specification Wattles/Fascines and Live Stakes. USFWS Partners for Fish and Wildlife. Lake Champlain Office.

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Silvics of North America: 1. Conifers; 2. Hardwoods. 1990. Burns, Russell M., and Barbara H. Honkala, tech. coords. Agriculture Handbook 654. U.S. Department of Agriculture, Forest Service, Washington, DC. vol.2, 877 p.

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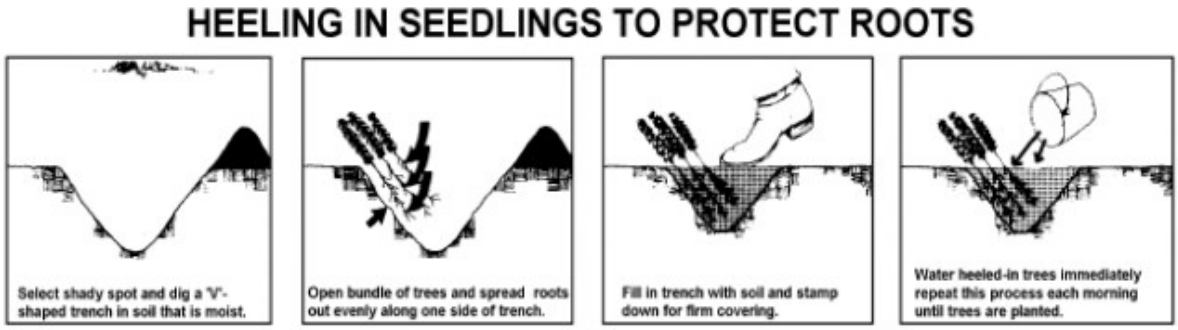

Figure 1. Heeling In Method. (Source: Tree Planting Notes, Minnesota Department of Natural Resources, Division of Forestry.)

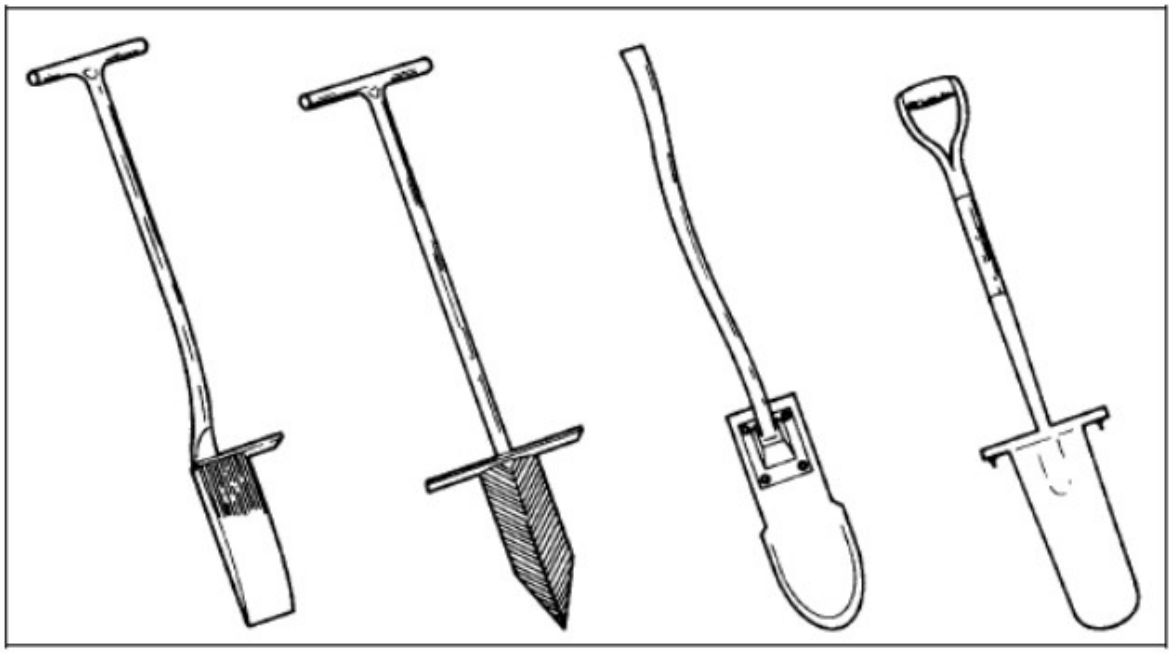

Figure 2. Four tree-planting tools (left to right): planting bar, a pointed planting bar useful in stony soils, the Rindi grub-hoe (L-shaped) for making straight-sided planting holes, and a tile spade planting shovel for digging deep holes for large planting stock. (Source: The Practice of Silviculture, Smith, 1986.)

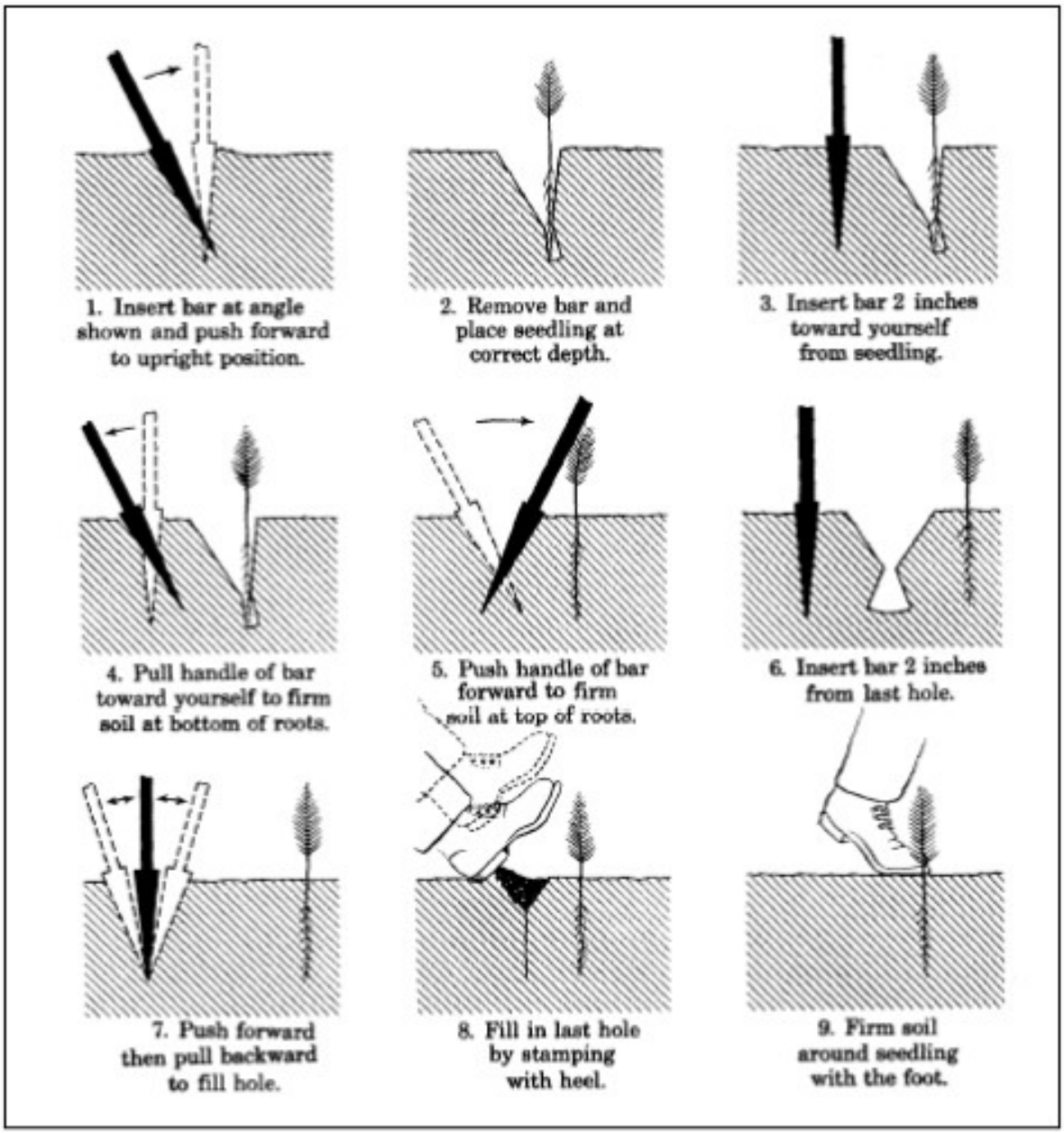

Figure 3. Slit Method. Steps in the use of the slit method of planting seedlings. (Sketch by U.S. Forest Service.)

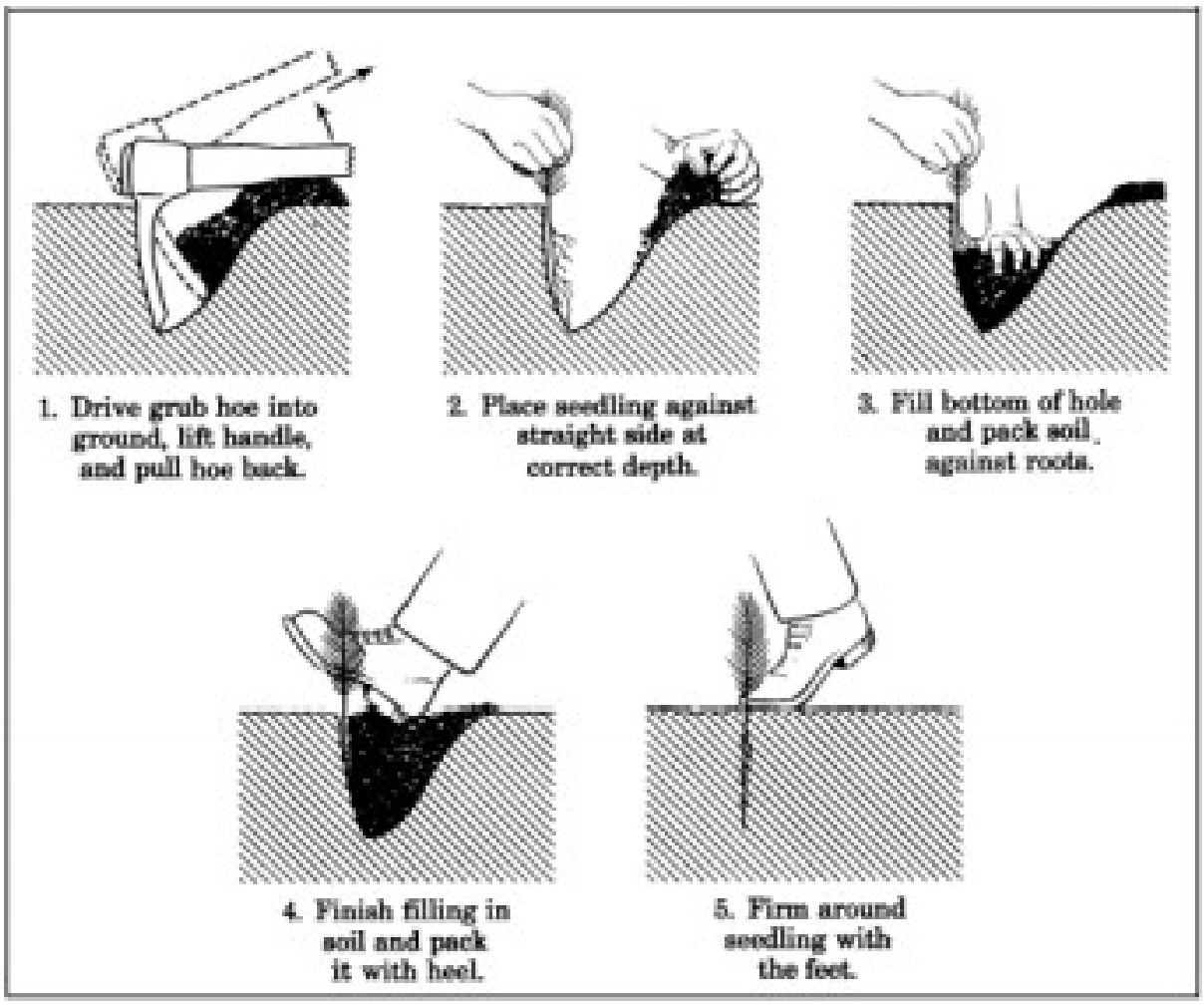

Figure 4. The Side-Hole Method of Planting. (Sketch adapted from U.S. Forest Service and The Practice of Silviculture, Smith, 1986.)

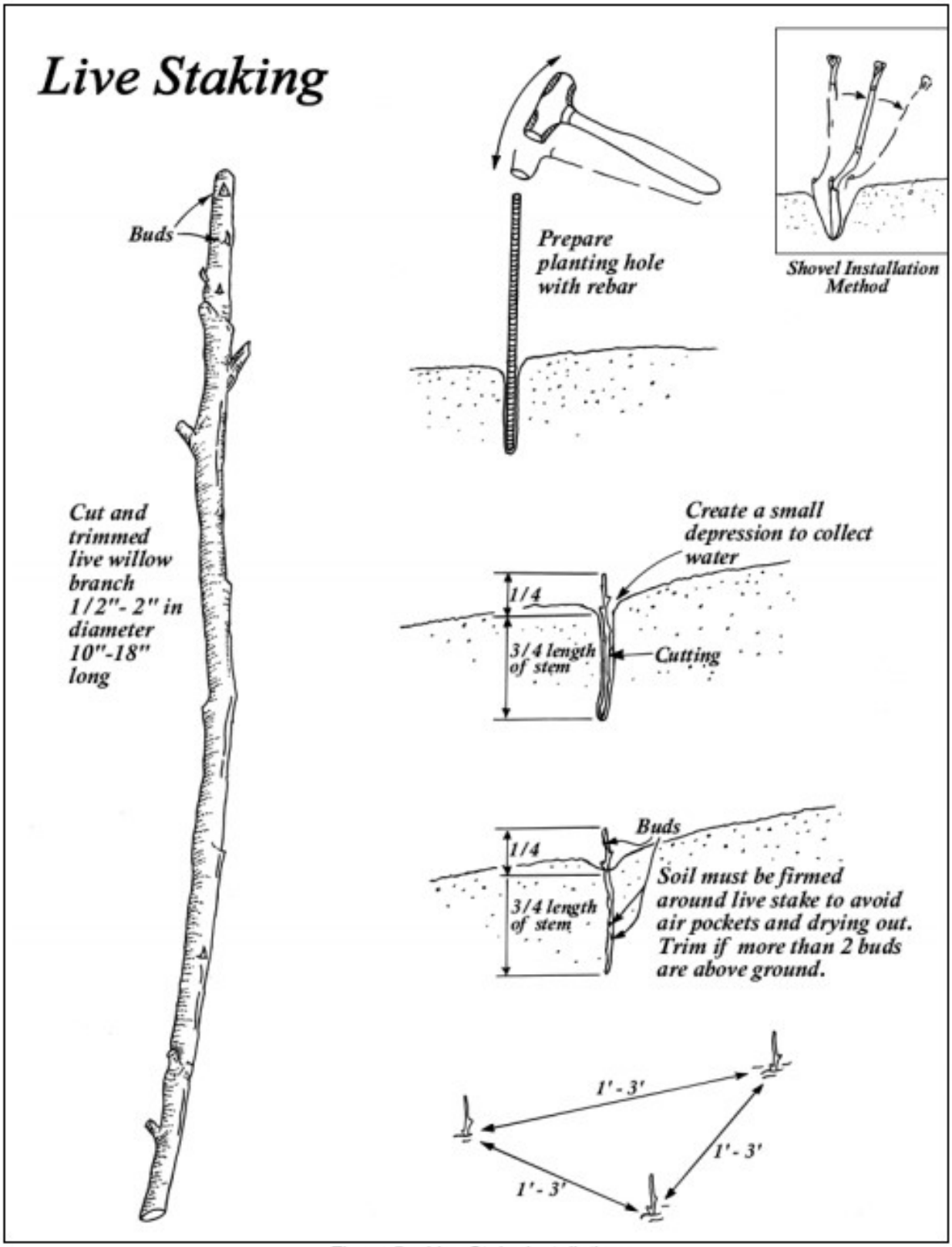

Figure 5 – Live Stake Installation

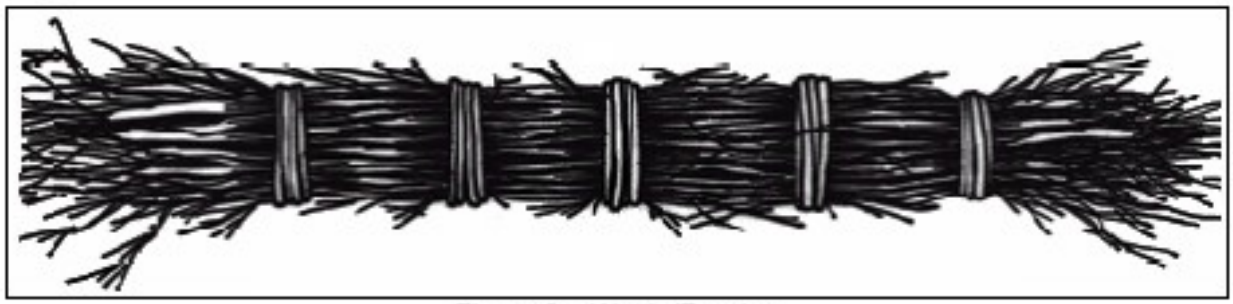

Figure 6 – Wattle/Fascine

Specific Site Requirements