TECHNICAL NOTES

U.S. DEPARTMENT OF AGRICULTURE STATE OF OKLAHOMA NATURAL RESOURCES CONSERVATION SERVICE

WOODLAND TECHNICAL NOTE OK-4 (REV) **Jan. 24, 2013**

TO: All Offices

FROM: Steven J. Glasgow
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Re: Basic Forest Measurements and Terminology

The purpose of this technical note is to describe basic terminology used within the field of forestry and to provide various forestry measurement tables which can be used by conservation planners to provide general forestry assistance to landusers.

TERMINOLOGY

Advanced Regeneration	Seedlings or saplings that develop or are present in the understory.
Afforestation	Establishment by seeding or planting of a tree stand or forest in an area that was not previously in forest use.
Agroforestry	Intensive land use management combining trees and/or shrubs with crops and/or livestock to take advantage of economic or ecological interactions among the components. The five key practices of Agroforestry include; Alley Cropping, Forest Farming, Riparian Buffers, Silvopasture and Windbreaks.
All aged Management	Managing a forest by periodically selecting and harvesting individual trees or groups of trees from the stand while preserving its natural appearance. This type of management is common in hardwood forests. See “selection harvest” and “all-aged stand”.
All-aged Forest	A stand of trees with different ages and sizes. All-aged or uneven-aged contrasts with “even-aged”.
Artificial Regeneration	Establishing a new forest by planting or direct seeding.
Basal Area	Of a tree: The cross-sectional area (in square feet) of the tree trunk at breast height (4.5 feet above the ground). For example, the basal area of a tree 14 inches in diameter at breast height is approximately 1 sq. ft. Basal area = 0.005454 times diameter squared. Of an acre of forest: The sum of basal area of the individual trees within one acre of forest. For example, a well stocked pine stand might contain 80 to 120 square feet of basal area per acre.
Board Feet	A unit of measure of the wood in lumber, logs, or trees. It is the amount of wood in a board 1 foot wide, 1 foot long and 1 inch thick before surfacing or other finishing.
Cambium Layer	A thin layer of cells between the inner bark and the woody part of the tree. The cambium layer is responsible for diameter growth of the tree.
Canopy	A layer or multiple layers of branches and foliage at the top or crown of a forest’s trees.

Chain	A unit of measurement used by foresters and surveyors. 1 chain = 66 ft; 10 sq. chains = 1 acre.
Clear-cut Harvest	A harvesting and regeneration method which removes all the trees (regardless of size) on a given area. Clearcutting is most used, with species such as pine which requires full sunlight to reproduce and grow well. Clearcutting produces an even-aged forest stand.
Closed Canopy	Tree spacing such that the branches of the trees touch the branches of neighboring trees.
Codominant Tree	Average to fairly large trees with medium sized crowns that form the forest canopy. These trees receive full light from above but are crowded on the sides.
Commercial Thinning	Any type of thinning that produces merchantable material at least equal to the value of the direct costs of harvesting.
Competition	The struggle among adjacent trees for growth requirements such as sunlight, nutrients, water, and growing space. Competition goes on among both the roots and crowns of trees in the same stand.
Conifer	Trees of the pine family with needlelike or scalelike foliage and cone like fruit. They are usually evergreen and often are called softwoods.
Coppice	A forest stand originating primarily from sprouts of stumps or roots of trees previously cut; the coppice method refers to the way these forests are regenerated. Most hardwood species sprout readily when cut young. Very few conifers will sprout from the stump.
Cord	A stack of round or split firewood containing 128 cubic feet including wood, bark and air space. A standard cord measures 4 feet by 4 feet by 8 feet. A face cord or short cord is 4 feet by 8 feet of any length wood less than 4 feet.
Crop Tree	Those trees in a stand left after thinning and destined to be grown to maturity and form the "final" crop, usually the highest in quality and value of all the trees in a stand.
Crown	The uppermost branches and foliage of a tree.
Crown Class	A tree classification system based on the tree's relative height, foliage density, and ability to intercept light. Crown class measures past growth performance and calls attention to crop trees that could benefit from future thinning and harvest operations. There are four classifications: Dominant Trees, Codominant Trees, Intermediate Trees and Suppressed or Overtopped Trees.
Cruise	A survey of forestland to locate timber and estimate its quantity by species, products, size, quality, or other characteristics. Several different sampling techniques can be used in a cruise.
Cubic Foot	A wood volume measurement containing 1,728 cubic inches, such as a piece of wood measuring 1 foot on each side. A cubic foot of wood contains about 6 to 10 usable board feet of lumber rather than 12 board feet because some wood is lost as sawdust and shavings during processing.
Cull	A tree or log of marketable size that is useless for all but firewood or pulpwood, due to poor form, limbiness, rot, disease, insect infestation or other defects
Cutting Cycle	The planned time interval between major harvesting operations in the same stand, usually in uneven-aged stands. For example, a cutting cycle of 10 years in a hardwood stand means a harvest every 10 years.
Deciduous Tree	A tree which loses all its leaves at some time during the year. These are primarily "hardwoods" such as oak, hickory, maple ash, etc.

Deck	A pile of logs on a landing.
Den Tree	A tree with cavities suitable for birds or mammals to nest in.
Diameter at Breast Height (DBH)	The diameter of a tree measured in inches at breast height – a standard 4.5 feet above the average ground level, on the uphill side of the tree.
Diameter Limit Cutting	A selection method of harvesting whereby all merchantable trees above a specified diameter are harvested. This cutting method is a form of high grading and is not recommended for hardwood stands. It should be used only in certain situations for pine.
Direct Seeding	A method of artificial regeneration whereby tree seeds are sown on the surface of a prepared site from the air or on the ground.
Dominant or Emergent Tree	Larger than average trees having a crown extending above the general level of the canopy and receiving full sunlight from above and partly from the side.
Epicormic Branching	Branches that grow out of the main stem of a tree from buds produced under the bark. Sudden exposure to direct sunlight following a thinning operation can trigger epicormic branching. Severe epicormic branching increases knottiness and reduces lumber quality.
Even-aged Forest	A stand of trees which are about the same age (usually within 10 years). An even-aged forest may be a natural or an artificially regenerated stand.
Even-aged Forest Management	A forest management method in which periodic harvesting of all trees on part of the forest at one time or in several cuttings over a short time to produce stands containing trees all the same or nearly the same age. This type of management is commonly applied to shade intolerant conifers and to some hardwoods.
Feller-Buncher	A self-propelled machine that cuts trees with a saw or shears near the ground level and then stacks the trees in piles to await transport (skidding).
Forestry	The science, art, and practice of managing and using trees, forests, and their associated resources for human benefits.
Girdling	A man-made cut or animal, insect, or disease damage completely encircling the tree trunk, going through the bark and cambium, and penetrating the sapwood. Girdling usually kills the tree by stopping the flow of nutrients between the roots and crown.
Growing Stock	All live trees (except rough and rotten trees) in a forest stand, including sawtimber, pole timber, sapling, and seedlings.
Hardwood	A general term describing trees with broad, flat leaves as opposed to coniferous or needled trees. Wood hardness varies among the hardwood species, and some are actually softer than some softwoods.
Harvesting Methods	See “clear-cut harvest”, “seed tree cut”, “selection harvest”, and “shelterwood cut”.
High Grading	A harvesting technique that removes only the biggest and most valuable trees from a forest stand and provides high returns at the expense of future growth potential. Poor quality culls tend to dominate in these continually high graded sites.
Improvement Cut	A type of intermediate cut with the primary objective of improving the form, quality, health, or wildlife potential of the remaining stand. See “TSI” and “intermediate cut”.
Increment Borer	An auger like tool with a hollow bit used to bore into the tree trunk to remove a wood core which shows the tree’s growth rings to determine age and growth rate.

Intermediate Cut	Removing immature trees from the forest sometime between reproduction and maturity to improve the quality of the remaining forest stand. An intermediate cut may or may not generate income (see “thinning”).
Intermediate Trees	Medium sized trees with small crowns below the general level of the canopy. These trees receive little direct light, are poor crop trees, and should be removed during thinning operations.
“J” Root	An improperly planted seedling that takes a “J” shaped configuration in the planting hole. Such seedlings often die prematurely, grow poorly, and are susceptible to windthrow.
Landing	A cleared working area in the forest where trees and logs are transported (skidded) to be sorted, processed, and loaded on a truck (see “deck”).
Merchantable Height	The stem length, normally measured from the ground to a 10”, 8” or 4” diameter top, above which no other saleable product can be cut.
Merchantable Timber	A stand in which trees are of sufficient size and volume per acre to provide a commercial harvest.
Mid-story	A distinct layer of vegetation within a forest community referring to trees of intermediate height typically growing under dominant and co-dominant trees.
Natural Regeneration	A stand of trees resulting from natural seed fall or sprouting.
Old Growth	Trees 200+ years of age, having large diameters and heights with multi-canopies of understory, mid-story, and over story tree species; also includes large amounts of dead organic matter in the form of downed (fallen) woody debris, standing dead trees (snags), and large amounts of surface litter.
Open Canopy	Tree spacing such that the branches of the trees do not touch the branches of neighboring trees.
Overstory	The portion of the trees forming the uppermost canopy in a forest stand.
Overtopped Trees	See “suppressed trees”.
Partial Cut	A method of harvesting in which a specific portion of a stand may be cut for a specific product or management objective; this usually implies a series of cuttings such as shelterwood cut, selection cut, or seed tree cut.
Patch Cut	A clearcut on a small scale.
Plantation	An artificially forested area established by planting or direct seeding. It is usually made up of a single species in equally spaced rows.
Pole Timber	Trees whose diameters generally range from 5 inches to 10 inches.
Precommercial Thinning	See “thinning”.
Pruning	Removing live or dead branches from standing trees. With forest trees, pruning is generally done along the trunk to remove the side branches (which cause knots in the wood) to produce a higher quality wood (knot free). Some natural self-pruning occurs as lower limbs are shaded out by the forest canopy.

Pulpwood	Wood cut primarily to be converted into wood pulp for the manufacture of paper, fiberboard, or other wood fiber products. Pulpwood sized trees are usually a minimum of 4 inches in diameter.
Reforestation	Re-establishing a forest by planting or seeding an area where forest vegetation has been removed.
Regeneration	The process by which a forest is reseeded and renewed. See “reproduction”.
Regeneration Cut	A cutting strategy to remove the old trees and leave environmental conditions favorable for natural establishment of trees.
Release Cutting	Cutting made to remove overtopping trees that compete with understory or suppressed trees.
Reproduction	(a) Young trees which will grow to become the older trees of the future forest. (b) The process of forest replacement or renewal. This may be done artificially by planting seedlings or seed, or naturally by sprouting or natural seeding.
Residual Stand	Trees left in a stand, after completion of a partial cut, to grow until the next harvest.
Rotation	The number of years required to establish and grow trees to a specified size, product, or condition of maturity. A pine rotation may range from as short as 20 years for pulpwood to more than 60 years for sawtimber.
Salvage Cut	Harvesting dead or damaged trees or those in danger of being killed by insects, disease, flooding, or other factors in order to save their economic value prior to deterioration.
Sanitation Cut	Removal of dead, damaged, or susceptible trees undertaken essentially to prevent the spread of pests or disease pathogens, promoting forest hygiene and to protect the rest of the forest stand.
Sapling	A young tree, usually between 2 and 4 inches in DBH.
Sawlog or Sawtimber	A log or tree large enough to be sawed into lumber, usually at least 10 to 12 inches in diameter. The minimum log length is typically 8 feet.
Sawtimber Stand	A group of trees with individual trees large enough to be sawed into lumber.
Second Growth	Forests that reproduce naturally after removal of the original forest by cutting, fire, or other cause.
Seed Tree Cut	A harvesting method in which a few scattered trees are left in the area to provide seed for a new forest stand. This harvesting method produces an even-aged forest.
Seedling	A tree grown from seed; this usually refers to the stage in a tree’s growth from germination to 1 inch in diameter with a general height of no more than 6 feet.
Selection Harvest	Harvesting individual trees or small groups of trees at periodic intervals (usually 5 to 15 years) based on their physical condition or degree of maturity. This produces an uneven-aged stand.
Shade Tolerance	A tree’s capacity to develop and grow in the shade of, and in competition with, other trees.
Shelterwood Cut	Removing trees on the harvest area in a series of two or more cuttings so new seedlings can become established from the seed of older trees. This method produces an even-aged forest.
Silviculture	The art, science, and practice of managing the establishment, growth, and reproduction of forest stands by manipulating light, water, nutrients and other available resources. It is based

on knowledge of species characteristics and environmental requirements.

Site Index — A numerical expression commonly accepted as an indicator of the quality or timber productivity of a site. It is an expression of the height-age relationship of the tallest trees in normal stands at some designated age, such as 50 years.

Site Preparation — Preparing an area of land for planting, direct seeding, or natural reproduction by clearing, chemical vegetation control, burning, disking, bedding, windrowing, raking, etc.

Skidding — Pulling logs (by machine or animal) from the stump to the skidway, landing, or mill.

Slash — Tree tops, branches, bark, or other woody residue left on the ground after logging, pruning, or other forest operations.

Snag — Standing dead or dying trees; an important forest component that provides habitat for a wide variety of wildlife species.

Softwoods — A tree belonging to the order Coniferales, usually evergreen, cone bearing, and with needles or scalelike leaves such as pine, spruce, fir and cedar.

Sprout — A tree growing from the base, stump, or root of another tree.

Stands, Timber —
(a) Fully stocked - A forest stand with all the growing space effectively occupied but having ample room for the developing crop trees.
(b) Overstocked – Overcrowding in a stand leading to retarded growth.
(c) Understocked – A stand with the growing space not effectively occupied by crop trees.
(d) Moderately stocked – A forest stand density described by crown closure of 40-69%.
(e) Mixed stand – A stand having less than 80 percent of the trees of a single species in the main crown canopy.
(f) Pure stand – A stand with at least 80 percent of the trees of a single species in the main crown canopy.
(g) Residual stand – The stand remaining after cutting.
(h) Old field stand – A stand on land once used for agricultural crops or for pasture.

Stocking — A description of the number of trees, basal area, or volume per acre in a forest stand compared with a desired level for balanced health and growth. Most often used in comparative expressions, such as well-stocked, moderately stocked, poorly stocked, or overstocked.

Stumpage — The value or volume of a tree or group of trees as they stand in the woods uncut (on-the-stump).

Succession — The natural replacement of one plant community by another in the absence of disturbance, until ecological stability (climax forest) is achieved. For example, an abandoned farm, if left to nature, would gradually go through different states of vegetative cover and finally reach the climax forest stage after 100 or more years.

Suppressed Trees — Small trees that grow below the tree canopy and receive no direct sunlight from any direction.

TSI (Timber Stand Improvement) — Improving the quality of a forest stand by removing cull trees, brush, vines, or undesirable species and leaving a stand of good quality trees to enhance forest composition, condition (health), or rate of growth.

Thinning — A tree removal practice that reduces tree density and competition between trees in a stand. Thinning concentrates growth on fewer, high-quality trees to increase the stand's value growth by reducing the number of trees per acre.

Tolerance — See shade tolerance.

Tree Farm	A privately owned forest or woodland in which producing timber crops is a major management goal. Many tree farms are officially recognized by the American Tree Farm System, an organization sponsored by the American Forestry Council.
Tree Height	Height of tree from the ground line to top of the tree.
Tree Injectors	Tools or equipment specially designed to inject chemicals into a tree trunk. Most common injectors can be hand operated by an individual.
Understocked	A stand of trees so widely spaced, that even with full growth potential realized, crown closure will not occur.
Understory	All forest vegetation growing beneath the overstory.
Uneven-aged Forest	A forest with many ages of trees present (technically, more than two age classes) and considerable differences in the ages.
Uneven-aged Management	See all-aged forest management.
Well Stocked	The situation in which a forest stand contains trees spaced widely enough to prevent competition yet closely enough to utilize the entire site.
Windthrow; Windfall	An area or group of trees blown over by high wind.
Wolf Tree	A tree which is taking up more space than its value warrants. It is usually an old, large, low quality tree with a wide spreading crown.

Board Feet in a Log

Doyle log rule: $\frac{(D - 4)^2 \times L}{16}$ = Board feet in the log

(D = Diameter of log inside the bark at the small end; L = Length of log)

Diameter Inside Bark – Small End (Inches)	Length of Log in Feet – Doyle Rule				
	8	10	12	14	16
	Bd. Ft.	Bd. Ft.	Bd. Ft.	Bd. Ft.	Bd. Ft.
6	2	3	3	4	4
7	5	6	7	8	9
8	8	10	12	14	16
9	13	16	19	22	25
10	18	23	27	32	36
11	25	31	37	43	49
12	32	40	48	56	64
13	41	51	61	71	81
14	50	63	75	88	100
15	61	76	91	106	121
16	72	90	108	126	144
17	85	106	127	148	169
18	98	123	147	172	196
19	113	141	169	197	225
20	128	160	192	224	256
21	145	181	217	253	289
22	162	203	243	284	324
23	181	226	271	316	361
24	200	250	300	350	400
25	221	276	331	386	441
26	242	303	363	424	484
27	265	331	397	463	529
28	288	360	432	504	576
29	313	391	469	547	625
30	338	423	507	592	676

Average Distance Between Trees and Number of Trees Per Acre

$$\frac{43{,}560}{\text{L X W of spacing}} = \text{Trees/Acre}$$

(L = Length in feet; W = Width in feet)

Spacing In Feet	Number Trees/Acre	Spacing In Feet	Number Trees/Acre
3 X 3	4,840	12 X 12	302
4 X 4	2,722	14 X 14	222
5 X 5	1,742	16 X 16	170
6 X 6	1,210	18 X 18	135
7 X 7	888	20 X 20	109
8 X 8	680	22 X 22	90
9 X 9	538	24 X 24	76
10 X 10	436	26 X 26	64
11 X 11	360	40 X 40	28

Tree Spacing

6’ X 8’ = 908 Trees per acre

7’ X 8’ = 778 Trees per acre

6’ X 10’ = 726 Trees per acre

8’ X 10’ = 544 Trees per acre