
The Great Trinity Forest
Management Plan
Volume 31
Appendix

Appendix

Supporting Documentation

Volume 31

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Volume 31

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Appendix A

Assumptions

GENERAL ASSUMPTIONS

Acreages

Non-forested: 1,410.1 acres

Forested 4,677.6 acres (1,042.5 of which is under mitigation)

1,000.0 acres of managed forest stands (Management Stands)

235.3 acres within Corps mitigation land (Mitigation Management Stands)

3,442.2 acres of unmanaged forests ("Wilderness")

Forest Inventory and Vegetation Classification

It is assumed that the forest inventory data and vegetation classification is correct.

In 2001 a vegetation classification of the forest was conducted using satellite imagery. Non-vegetated areas such as water were removed from the image initially and then a computer analysis of the image fit the remaining cells into 27 classes. These classes were then analyzed to determine their vegetation composition based on 100 field observation points. A forest inventory was then conducted based on this classification. As new field data was acquired, the classes were altered to better reflect the true vegetative cover. In 2004 the final vegetation map of 12 land-cover classes was complete after an analysis that considered more than 600 samples taken in the field over a period of approximately 3 years. The field data was provided to the planning team already summarized to a per acre basis.

Geographic Data

Soils: Soil maps and descriptions are assumed to be accurate. Soils data was obtained from the Natural Resources Conservation Service (NRCS). The field data used to develop the soil maps and descriptions was originally collected from 1965-1972.

Topography: 2 foot contour data was provided by the City of Dallas. It is assumed to be accurate.

GIS Layers: Geographic Information System (GIS) data was provided by the City of Dallas, including, but not limited to: Great Trinity Forest Boundary, US Army Corps of Engineers Mitigation Land Boundaries, Non management areas, etc. These data are assumed to be accurate.

Additional Literature

The additional literature is provided so the forester or forest manager has the information necessary to develop a healthy forest and to deal with common issues. This information is not meant to be all inclusive and it is important that all activities are implemented with appropriate licenses, permits and safety procedures.

FOREST MANAGEMENT ASSUMPTIONS

Project Initiation Dates

Management activities are assumed to begin in 2010. US Army Corps of Engineers Mitigation Lands are assumed to fall under City of Dallas management and oversight in the year 2025.

Biological Assumptions

All plantings will suffer heavy mortality. For budgeting purposes, it is assumed that although stands are monitored for survival, no stands will need to be replanted.

Stand Site Selection

To select potential planting areas, an overlay analysis was performed on the forest. The analysis considered vegetation, elevation, and soils when rating areas. Therefore, the geographic data and vegetation classes used for the analysis are assumed to be correct.

Herbicide Application

Herbicide application and mixing rates were obtained from the herbicide label. Actual applied per acre rates were estimated based on the forest inventory and photos taken from the field. It is assumed that these estimated rates are correct.

GROWTH AND YIELD ASSUMPTIONS

The following describes the assumptions specific to the forest growth and yield projections that were performed.

General Assumptions when Making Forest Growth Projections

The following list outlines some explanations for discrepancies between observed and predicted yields (Adapted from the WINYIELD Growth Projection, Yield Estimation, and Financial Analysis Program Users Manual).

1. Broken tops, rot, excessive sweep, forking, and other quality defects generally are not accounted for by growth and yield models. When the goal is to estimate merchantable volume yield, users must compensate by adjusting model output before drawing conclusions.
2. A model can only estimate the average stand conditions for a particular combination of input parameters. Users must maintain the perspective that actual stand conditions can vary considerably from the average predicted by the model.
3. A user's estimate of the input parameters is subject to error. This problem is often referred to as garbage in, garbage out. Misinterpretation of the units used also is a common source of misapplication. For example, users sometimes become confused on whether the site index reference age is 25 or 50. This could result in a gross error for estimating volume yield.
4. Stocking in actual stands is not uniform. The model may indirectly account for clumping depending upon the criteria used for locating research plots. Only individual tree distance dependent models possess the necessary spatial resolution to directly account for growth reduction due to clumping.

5. Understory competition may vary considerably from stand to stand depending upon locale, past stand history, and the degree of effectiveness of controls. The model may not be able to accommodate varying levels of understory competition.
6. Expansion of estimates from a per-acre basis to a per-stand basis can lead to over estimation of yield unless areas out of production are excluded from the number of acres in the stand estimate. Often overlooked are areas where there are roads, ditches, powerlines, windrows, rock outcroppings, and other pockets within the stand which are not growing crop trees.
7. Matching actual stand conditions to those assumed by the model is difficult. Geographic locale, past stand history, species composition, soil conditions, incomplete inventory data, or other factors may cause assumptions of the model to be violated. The validity of subsequent projections is difficult to determine. Sensitivity analysis is helpful to examine this effect.
8. The model may be poor. Growth estimates may vary in reliability depending upon the quality of the data (e.g., remeasurement frequency and time interval) used by the researcher to derive the model and according to the "biological reasonableness" exhibited when extrapolating the model. Statistical variation is impossible to quantify in all but the simplest models. Model validation studies attempt to quantify the accuracy and precision of models by comparing predicted values against known values in independent data sets. Also, models implemented through software such as WINYIELD are subject to programming errors or "bugs."

Input Parameter Assumptions

The Forest Vegetation Simulator (FVS) was used to conduct growth projections. FVS is the standard model used by a variety of government, state, educational, and other agencies including private landowners and industry (Dixon 2002). The model has been calibrated for a number of geographic regions and has been widely reviewed. The following outlines the FVS input parameters used in making the projections and the corresponding assumptions.

Stand and Location Data Used to calibrate growth model

- Inventory Year: 2006
- Average Tree Age: 30 years
- Site Index: 60 $_{\text{base age 50}}$ for *Quercus alba* white oak
- Elevation: 400 feet
- Latitude: 32.727°
- Longitude: 96.734°
- Forest Type: 706 Sugarberry (Hackberry)/elm/green ash
- Ecological Unit Code: 255Ce Trinity River Alluvial Valley
- Forest Location Code: Davy Crocket National Forest (Nearest National Forest)
- FVS Variant: Southern

Tree Data

Input tree data was derived from the forest inventory conducted by the City of Dallas. Tree data used for modeling represents the average forest acre within the Great Trinity Forest.

Preexisting species modeled:

- Green ash *Fraxinus pennsylvannica*
- Hackberry species *Ulmus spp.*
- Eastern cottonwood *Populus deltoids*

- Eastern redcedar *Juniperus virginiana*
- Willow species *Salix spp.*
- Elm species *Ulmus spp.*
- Hickory Species (pecan) *Carya spp.*

Operation Assumptions

Planting Operations

All planting operations assumed 60% survival of trees in the first year; which is a conservative survival estimate. It was assumed that planting in mitigation units would primarily occur in openings created by the overstory removal

Table 1. Planted species modeled and their assumed planting densities.

		Per Acre Planting Rates	
Common Name	**Scientific**	**Management Units**	**Mitigation Units**
black walnut	*Juglans nigra*	43	21
bur oak	*Quercus macrocarpa*	108	54
shumard oak	*Quercus shumardii*	86	43
pecan	*Carya illinoinensis*	107	53
common persimmon	*Diospyrus virginiana*	86	43

Natural Regeneration

It was assumed that natural regeneration would only occur in the "Wilderness" area of the forest. Wilderness projections included the following natural regeneration to occur per acre every ten years (Total of 40 trees per acre):

- Green ash 12
- Hackberry 6
- Elm species 6
- Pecan 4
- Willow species 4
- Eastern cottonwood 4
- Eastern redcedar 2
- Bur oak 4 (added every ten years after year 2056)

Overstory Removal by Herbicide Injection

The following assumptions were made to simulate overstory removal operations.

- Simulated herbicide injections were assumed to be 95% effective
- In the mitigation units, it was assumed that large openings would be made to release existing desired species or create areas for planting.
- The injection work would focus on larger trees.
- It was assumed that roughly half the stand would be removed in a mitigation unit overstory removal operation and therefore half the amount of trees would need to be planted per acre.

Snag and Carbon Sub model Assumptions

The Fire and Fuels Extension (FFE) to FVS was used to model snags and carbon sequestration.

Snag Model

The following parameters were used in calculations. Note a snag is a standing dead tree.

- Default FFE algorithms were used to model the fate of snags and their transition from the "hard" to "soft" state.

The following assumptions were made for this model.

- No snags existed in the forest at the time of the inventory.

Carbon Model

The following parameters were used in calculations.

- All carbon reports are shown in imperial tons.
- Biomass was predicted using the predefined FFE algorithms.
- Carbon was modeled on a 10 year cycle. The trend between cycles is assumed to be linear.
- FVS default calculations were used for "Down Dead", "Forest Floor" and "Shrubs/Herbs" carbon.

The following assumptions were made for this model.

- It is assumed that there are no snags ("Standing Dead" and "Belowground Dead") at the beginning of the projection.
- It is assumed that the default values for "Down Dead", "Forest Floor" and "Shrubs/Herbs" are correct.

FINANCIAL ASSUMPTIONS

Equipment costs obtained from the City of Dallas Parks and Recreation Department and from calls to local equipment dealers. Other costs are from the Forestry Suppliers Catalog. Cost data is from 2008.

Personnel costs were increased by the inflation rate, labor cost increases, and fringe benefits.

Inflation Rate: 4.06%

Price Increase for Labor: 0.43%

Fringe Benefits: 33.16%

Appendix B

Glossary

Glossary of Forestry Terminology

-A-

Access Road- a temporary or permanent access route for vehicles into forestland

Acre- a unit of land measurement that contains 43,560 square feet. Sometimes expressed as 10 square chains

Afforestation- the establishment of trees on an area that was not forested before

Uneven-aged stand (all-aged)- a stand of trees with three or more different age classes

Annuals- plants that live or grow for only one year or one growing season

Artificial regeneration- replacing the harvested forest by planting seed or seedlings

-

-B-

Backfire- a burning technique used to reduce the amount of fuel in the forest. The fire is set to burn against the wind or back into the fuel as the wind blows the flames away from the fire

Basal Area- the sum of the cross sectional areas in square feet of the trees on an acre when measured at 4.5 feet above the ground

Bedding- a site preparation method in which special disking equipment is used to concentrate surface soil and forest litter into a ridge or bed elevated six to ten inches (6-10) above the normal soil level on which forest seedlings are to be planted

Best Management Practices (BMPs)- a practice or combination of practices determined to be an effective and practicable (including technological, economical, and institutional considerations) means of preventing or reducing the amount of water pollution generated by non-point sources

Board foot- a piece of wood measuring 1 foot x 1 foot x 1 inch. The term is commonly used to measure the amount of wood in trees, sawlogs, or boards

Bottom Lands- a term often used to define lowlands adjacent to streams and rivers

Browse- leaves and twigs of woody plants, including those from brambles and vines, typically eaten by animals such as white-tailed deer and rabbits.

Browse Lines- a distinct absence of woody plant vegetation from ground-line to a height that browsers like goats and deer can reach. The presence of browse lines is an indication of excessive use of this component of the plant community

Buffer strip- a narrow piece of land bordering an area such as a stream or road with forestry practices that are different from adjacent areas

Bunchgrass- a grass that grows in a well-defined clump, as opposed to sod-forming grass that spreads by stolons or rhizomes

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-C-

Canopy- the layer of covering in a forest made up of tree crowns

Carrying capacity- the maximum number of individuals of a wildlife species an area can support during the most unfavorable time of the year

Chip-n-saw- a mill process that allows small diameter trees 7 to 10 inches, DBH, to be converted into lumber and into chips for pulp and paper manufacturing

Clearcutting- a silvicultural system where all the trees are removed, regardless of size, and all the growing space becomes available for new plants, leading to the establishment of an even-aged stand

Codominant- trees with medium crowns forming the upper level of the crown cover and receiving full light from above and partial light on the sides

Commercial thinning- the removal of marketable trees from maturing young growth to reduce competition and accelerate growth of the remaining trees

Competition- the struggle among trees and other plants for nutrients, water, light, space, and other requirements for existence

Conifer- trees with needles or scales instead of leaves, usually evergreen, and often called softwoods

Consulting forester- a self-employed registered forester who provides landowners with professional forestry advice and services for a fee

Contamination- a general term signifying the introduction into water of micro-organisms, chemicals, organic wastes or sewage, which renders the water unfit for its intended use

Contour- an imaginary line on the surface of the earth connecting points of the same elevation. A line drawn on a map connecting points of the same elevation

Cool-season grasses – grasses that make their active growth during the cooler months of the year, generally September through November and March through May

Coppice- a regeneration method in which the forest stand regenerates primarily from stump and root sprouts

Cord- a stack of round or split wood containing 128 cubic feet of space, including wood, bark, and air space (4' x 4' x 8')

Cost Share Program- a program where a group (usually a government agency) shares in the cost of carrying out forest management practices on private property as an incentive to owners to make a long-term investment in their land

Crop Trees- trees selected to be grown for the final harvest cut

Crown- the branches and foliage of a tree

Crown Ratio- the ratio of the tree crown to the total height of the tree

Cruise- a survey of forest land to estimate species, stocking, volumes, products, size, and quality levels of standing timber

Cubic Foot- a volume measurement containing 1728 cubic inches of material such as a piece of wood measuring 1 foot on each side. A cubic foot of wood contains 12 board feet.

Cull- a tree or log of merchantable size that has no market value because of shape, damage, or species

Culvert- a conduit or pipe through which surface water can flow under roads

Cutting Cycle- the planned time interval between major harvesting operations in the same stand

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-D-

DBH- an abbreviation for tree diameter at breast height (4.5 feet above the ground)

Deciduous Tree- a tree that loses all its leaves at some time during the year

Diameter- the length of a straight line going from one side of a tree trunk to another and passing through the center

Diameter at Breast Height- four and one-half feet above ground-level, the height where a tree's diameter is measured (also known as DBH)

Dibble- also called a planting bar. A tool used for planting bare-root seedlings by hand

Direct Seeding- a method of artificial regeneration in which tree seeds are sown on a prepared site

Dominant- a tree with a crown extending above the general level of the canopy and receiving full sunlight from above and also from the sides

Dormant-season burn- prescribed fire implemented during the dormant season (generally October – March for warm-season plants)

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-E-

Endangered Species- a species where the remaining members may not be sufficient to reproduce enough offspring to ensure survival of the species

Epicormic- Growing from a dormant bud that has been exposed to light and air

Even-aged Management- a system of management leading to the trees in the forest being approximately the same age

Evergreen- a tree that retains some or all of its leaves throughout the year

Exotic species (also **alien** or **nonnative species**)- a species, including its seeds, eggs, spores, or other biological material capable of propagating it, that is not native to a particular ecosystem.

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-F-

Firebreak- a natural or man-made opening used to prevent the spread of fire

Firelane- a permanent barrier to the spread of fire which will be maintained over time for the specific purpose of stopping the spread of fire or for access to an area for the control of a fire

Fireline- a barrier used to stop the spread of fire constructed by removing fuel or rendering fuel inflammable by using water or fire retardants

Flanking fire – a fire set to spread at right angles to the prevailing wind

Forage- leaves, stems, buds and bark that can be eaten for food and energy

Forest- a plant community in which the dominant vegetation is trees and woody plants

Forest Management- the art and science of applying technical forestry principles and practices and business techniques to the management of a forest

Forest Management Plan- usually a written document that includes overall guidelines and recommended management practices to meet a landowner's objectives

Forest Practice- an activity relating to the growing, protecting, harvesting, or processing of forest tree species on forest land and to other forest management aspects such as wildlife, recreation, etc.

Forest Road- an access route for vehicles into forest land

Forest Site- refers to the combination of soil and topography

Forest Stand- a group of trees similar enough to allow treatment as a single unit in a forest management plan

Forestry- the science, art, and practice of managing, and using trees, forests and their associated resources while sustaining these resources for this and future generations

Fungus (pl. fungi)- A nongreen plant with a vegetative body formed of tubular filamentous cells (hyphae). Fungi reproduce by spores

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-G-

Grade- the slope of a road or trail expressed as a percent of change in elevation per unit of distance traveled

Growing-season burn- prescribed fire implemented during the growing season (generally April – September for warm-season plants)

Growing Stock- all live trees in a forest or stand, including saw timber, pole timber, saplings, and seedlings

Gully Erosion- erosion process whereby water accumulates in narrow channels, and over short periods of time removes soil from this narrow area to substantial depths (one foot plus)

-

-H-

Habitat- the natural environment of a specific plant or animal containing all the necessary resources for the plant or animal to live, grow, and reproduce

Hand Planting- the planting of tree seedlings with simple hand tools

Hardpan- a natural or man-made solid clay layer within the soil resulting in poor drainage and poor plant growth

Hardwood- a term describing broadleaf trees such as oaks, maples, ashes, and elms

Harvesting- the felling, loading, and transportation of forest products, roundwood or logs

Haul road- road used to haul wood products. May vary from paved to primitive but are permanent woods (tertiary) roads

Heading fire- a fire set to spread with the prevailing wind, or uphill; generally fast-moving

Herbicides- chemicals used to kill or slow down the growth rate of plants. Herbicides should be applied by qualified applicators and by following label directions

Host- A plant which provides nutrition for an invading parasite.

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-I-

Improvement Cut- a type of intermediate harvest with the primary objective of improving the remaining stand

Intermediate Cut- the removal of trees from the forest sometime between establishment and final harvest with the primary objective of improving the quality of the remaining forest stand

Intermediate Trees- trees shorter than dominant and co-dominant trees but with crowns extending into the crown cover formed by the dominant and co-dominant trees

Intermittent- that part of the drainage network, with a clearly defined stream channel, which provides flow continuously during some seasons of the year, but little or no flow during the remainder of the year

Intolerant- plants that will not grow in the shade of other plants or trees

Inundate- to cover with water (flood)

Invasive species- a species whose dominance causes harm to the economy or the environment. Invasive species can be native or exotic. Native species can become invasive if environmental conditions change substantially and the balance of the ecosystem is disrupted. Exotic species can become invasive when they are freed from the environmental constraints that are unique to their native range

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-J-

J-Root- the growth form of tree roots resulting from improper hand planting where some or all of the roots are bent upward as the tree is placed in the ground

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-L-

Leave Trees- trees left in or immediately adjacent to a harvest area to reseed the area

Litter- represents dead natural fuels on the ground, including leaves, needles, sticks, limbs, grass, etc.

Log- a unit of measure of the trunk portion of a tree equal to 16 feet in length

Logging- the felling and transportation of wood products from the forest to a delivery location

Logging Debris/Slash- the unwanted, or unutilized and generally unmarketable accumulation of woody material such as large limbs, tops, cull logs, and stumps that remain in the forest as residue after logging

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-M-

Mast- refers to the reproductive bodies of plants and is often associated with wildlife food sources. Mast is divided into hard mast and soft mast. Hard mast is the production of hard-shelled seeds, such as acorns and hickory nuts while soft mast is the production of seeds that are covered with fleshy fruit, such as berries.

MBF- an abbreviation meaning one thousand board feet

Mechanical Planting- planting tree seedling with a planting machine that is pulled by a tractor

Merchantable- that part of a tree that can be turned into a product and sold for a profit

Merchantable Timber- a stand where the trees are of sufficient size and volume to provide a commercial cut

Migration- the cyclic or periodic travel of an animal as it returns eventually to its original place of departure. Migration is often annual and is closely linked with the cyclic pattern of the seasons.

Mineral Soil- organic free soil that contains rock less than 2 inches in maximum dimension

Mortality- expressed as trees or percent of growth dying within a certain time frame

Mulch- a natural or artificial layer of plant residue or other materials covering the land surface which conserves moisture, holds soil in place, aids in establishing plant cover, and minimizes temperature fluctuations

Mulching- providing any loose covering for exposed forest soil, using organic residues, such as grass, straw or wood fibers to protect exposed soil and help control erosion

Multiple Use- refers to shared use of managed forests for many benefits, such as wood products, wildlife, watershed benefits, recreation, forage, aesthetics, or clean air

-

-N-

Native species- a species that historically occurred or currently occurs in a particular ecosystem (other than as a result of an introduction). Native species have adapted over thousands of years to their surrounding plant and animal communities and local climate and soil conditions.

Natural Stand- a stand of trees resulting from natural seed fall or sprouting

Non-point Sources- sources of water pollution which are: (1) induced by natural process, including precipitation, seepage, percolation, and runoff; (2) not traceable to any discrete or identifiable point; and (3) best controlled through the utilization of Best Management Practices, including planning and processes techniques

Nutrients- mineral elements in the forest ecosystem such as nitrogen, phosphorus, and potassium usually in soluble compounds that are present naturally or they may be added to the forest environment as forest chemicals, such as fertilizer

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-O-

Old-growth Forest- a forest that has never been changed by management or harvesting

Overtopped- trees within a stand with crown entirely below the crowns of other trees in the stand

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-P-

Palatability- indicated by the preference an animal shows for feeding on a particular plant

Parasite- An organism that lives on or in, and obtains its food from, another organism (host)

Partial Cut- a silvicultural cutting system, which removes at any one time less than the total tree stand

Pathogen- An agent that causes disease

Pedicelled plants- Grass plants that are each setting on a small pedicel of soil. The presence of pedicelled plants is a warning sign of sheet erosion on the site.

Perennial- a plant that produces aboveground parts from the same root system for at least three years or growing seasons

Perennial stream- that part of the drainage network which provides water flow at all times except during extreme drought

Pesticides- a collective term meaning chemicals, including herbicides and insecticides, which are used to kill pests such as weeds, diseases, insects, or unwanted trees

Point Source Pollution- sources of water pollution (generally a man-caused pollutant) which can be traced to a specific place or location (i.e. a pipe)

Pollutant- dredged soil, solid wastes, incinerator residue, sewage, garbage, sewage sludge, chemical wastes, biological materials, radioactive materials, heat, wrecked or discarded equipment, rock sand, cellar dirt, and industrial, municipal, and agricultural waste discharged in the water. (P.L. 92-500 Section 502(6))

Pollution- the presence in a body of water (or soil or air) of substances of such character and in such quantities that the natural quality of the environment is impaired or rendered harmful to health and life or offensive to the senses

Pre-Commercial Thinning- practiced in very young stands to decrease the number of trees and reduce competition for water and nutrients

Prescribed Burning- the controlled use of fire to achieve forest management objectives

Prescription- usually a written recommendation by a forester prescribing present and future management practices for a forest stand

Pruning- the removal of branches from standing trees to produce higher quality knot-free clear wood

Pulpwood- trees cut primarily for conversion into wood pulp for the manufacture of paper, fiberboard, or other wood fiber products

Pure live seed- the percentage of seed that is capable of germinating soon after planting in a suitable environment

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-R-

Reforestation- the regeneration of new trees on an area where the forest has been or will be removed; either naturally by seed fall or artificially by direct seeding or planting seedlings

Regeneration- the practice of replacing old trees either naturally or artificially with new trees

Regeneration Cut- a harvest operation to remove the old trees and leave environmental conditions favorable for the establishment of reproduction

Release Cutting- an operation to release young desirable trees from competition with other trees of the same size or larger and overtopping trees

Residual Stand- trees, often of saw log size, left in a stand after logging to grow until the next harvest

Residual Trees- live trees left standing after the completion of harvesting

Resistance- The ability of a host to slow the development of a disease

Rill Erosion- an erosion process in which numerous small channels only several inches deep are formed; occurs mainly on disturbed and exposed soils

Ring fire- a fire set by igniting the entire perimeter of an area, allowing the fire to converge in the center

Rotation Period- the number of years required to establish and grow trees to a specified size, product or condition of maturity

Runoff- in forest areas, that portion of precipitation that flows from a drainage area on the land surface or in open channels

Ruts- depressions made by the tires of vehicles such as skidders, log trucks, pickups, etc. usually under wet conditions

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-S-

Sanitation Cut- the harvesting or destruction of trees infected or highly susceptible to insects or diseases to protect the rest of the forest stand

Sapling- a small tree usually between 1 and 4 inches DBH

Sawlog- a log large enough to produce a sawn product, usually at least 10 to 12 inches DBH and 8 inches or larger at the small end

Scarify- to break up the forest floor and top soil preparatory to natural or direct seeding (or the planting of seedlings)

Sediment- solid material in suspension, being transported or moved from its original site.

Seed Tree Method- a natural regeneration method where all but a few trees are removed from the harvest area at one time. The remaining trees are carefully selected high quality trees uniformly distributed to provide seed to establish a new forest stand

Seedbank- the collection of seed occurring naturally in the soil

Seedbed- the soil prepared by natural or artificial means to promote the germination of seed and the growth of seedlings

Seedling- usually defined as a tree less than 1 inch DBH, which has grown from seed, either naturally or in a nursery

Selection Method- a natural regeneration method where individual trees or small groups of trees are harvested at periodic intervals based on their physical condition or degree of maturity

Shade Tolerance- a tree's capacity to develop and grow in the shade of and in competition with other trees

Shearing- a site preparation method that involves cutting brush, trees, and other vegetation at the ground level using tractors equipped with angled or v-shaped cutting blades

Sheet Erosion- the removal of a fairly uniform layer of soil removed from the soil surface by water runoff

Sheet Flow- runoff from a rainstorm intense enough to cause direct overland flow of water before entering a receiving stream

Shelterwood Method- a natural regeneration method in which the trees are removed in a series of two or more cuttings to allow the establishment and early growth of the new seedlings under the partial shade and protection of the older trees

Silvics- the study of the life history and general characteristics of forest trees and stands with particular reference to locality factors, as a basis for the practice of silviculture (SAF Interpretation)

Silvicultural Activities- all forest management activities, including intermediate cuttings, harvest, log transport, and forest road construction (EPA interpretation)

Silviculture- generally, the science and art of cultivating (i.e. growing and tending) forest crops, based on a knowledge of silvics; and more particularly, the theory and practice of controlling the establishment, composition, constitution and growth of forests (SAF Interpretation)

Site Index- a measure of site quality based on the height of the dominant and codominant trees of the stand at a specified age (usually 25 or 50 years)

Site Preparation- any treatment of a forest site to get it ready for planting, direct seeding, or natural regeneration such as clearing, chemical vegetation control, burning, disking, bedding, windrowing, or raking

Snags- dead or partially dead standing trees. Snags may be classified as "hard" or "soft." Hard snags are essentially sound wood while soft snags are in an advanced state of decay

Soil- the unconsolidated mineral and organic material on the immediate surface of the earth that serves as a natural medium for the growth of land plants

Soil Conservation- using the soil within the limits of its physical characteristics and protecting it from unalterable limitations of climate and topography

Soil Productivity- the output or productive capability of a forest soil to grow timber crops

Spores- The reproductive unit of fungi. Spores function in the same way that seeds do for higher plants.

Stand- a group of trees occupying a given area and sufficiently uniform in composition, age, and condition so as to distinguish them from adjoining forest areas

Stem- the trunk of the tree

Stocking- the number of trees in a forest stand

Stream- a well-defined natural channel that has a flow anywhere below its headwaters greater than 5 cfs at least 50% of the time (EPA - Army Corp Section 404). A permanently or intermittently flowing body of water that follows a defined course

a. ephemeral stream (or drain) means a stream that flows only during and for short periods following precipitation and flows in low areas that may or may not have a well-defined channel

b. intermittent stream means a stream that flows only during wet periods of the year (30-90% of the time) and flows in a continuous, well-defined channel

c. perennial stream means a stream that flows throughout a majority of the year (greater than 90% of the time) and flows in a well-defined channel

Streambanks- the usual boundaries, not the flood boundaries, of a stream channel. Right and left banks are named facing downstream

Streamside Management Zone (SMZ)- forested area immediately adjacent to stream channels. Managed for forest resources with specific attention given to measures that can be taken to protect both instream and downstream water quality as well as other beneficial uses. The purpose of an SMZ is to reduce the quantity of sediment and logging wastes reaching the streams and to provide shade to prevent water temperature increases

Strip-heading fire- fire set by a series of strips ignited upwind of a firebreak or blackline intended to burn with the wind into the firebreak or backing fire

Succession- the orderly progression through time of changes in community composition, usually described in terms of plant life

Superior seedlings- seedling grown from seed produced by parent trees of high genetic quality

Sustainable Forest Management- the management of forestland to meet the needs of the present without compromising the ability of future generations to meet their own needs

Sustainable Forestry Initiative- an American Forest and Paper Association (AFPA) program started in 1994 and implemented as an industry standard in 1997 with a commitment to sustainable forestry that is open to public monitoring and evaluation

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-T-

Thinning- cutting or removing certain trees to reduce competition and allow the remaining trees to grow faster

Threatened Species- a species where the population is declining to dangerously low numbers but still has enough members to maintain or increase its population

T.S.I. (Timber Stand Improvement)- the performance of practices such as pruning, thinning, and weeding to improve the quality of a forest stand

Tract- a parcel of land considered separately from adjoining land because of differences in ownership, timber type, management objectives, or other characteristics

Tree Crown- a collective term for the limbs, branches, and leaves of a tree

-

-U-

Uneven-aged Management- management of forests in such a way as to get a spread of age classes ranging from small seedlings to mature trees

-

-W-

Warm-season grasses- grasses that make their active growth during late spring and summer

Water Body- an area of standing water with relatively little or slow movement (ponds, lakes, bays)

Water Pollution- contamination or other alteration of the physical, chemical or biological properties of any natural waters of the state, or other such discharge of any liquid, gaseous or solid substance into any waters of the state, as well, or is likely to create a nuisance or render such waters harmful or detrimental or injurious to public health, safety or welfare, or to domestic, commercial, industrial, agricultural, recreational, or other legitimate beneficial uses, or to livestock, wild animals, birds, fish or other aquatic life (EPA definition)

Water Quality- a term used to describe the chemical, physical, and biological characteristics of water, usually in respect to its suitability for a particular purpose

Watershed Area- all land and water within the confines of a drainage divide or a water problem area consisting in whole, or in part, of land needing drainage or irrigation

Wetlands- the U.S. Army Corps of Engineers and the U.S. Environmental Protection Agency jointly define wetlands as *Those areas that are inundated or saturated by surface or ground water at a frequency and duration sufficient to support, and that under normal circumstances do support, a prevalence of vegetation typically adapted for life in saturated soil conditions. Wetlands generally include swamps, marshes, bogs, and similar areas.*

Wildfire Control- actions taken to contain and suppress uncontrolled fires

Wildfires- uncontrolled fires occurring in forestland, brushland, and grassland

Windrow- slash, residue, and debris raked into piles or rows

Wing Ditch- a water turnout or diversion ditch constructed to move and disperse water away from the road and side ditches into adjacent undisturbed areas so that the volume and velocity of water is reduced on slopes

-

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Appendix C

Overview of the Southern Variant of the Forest Vegetation Simulator

United States
Department of
Agriculture

Forest Service

Forest Management
Service Center

Fort Collins, CO

2001

Last Revised:
February 2008

Southern (SN) Variant Overview

Forest Vegetation Simulator

Forest Vegetation Simulator Staff

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QUICK GUIDE TO DEFAULT SETTINGS

Parameter or Attribute	**Default Setting**	
Number of Projection Cycles	1 (10 if using Suppose)	
Projection Cycle Length	10 years	
Location Code (National Forest)	80101 – NF in Alabama – Bankhead Ranger District	
Ecological Classification Code	231Dd (Quartzite and Talladega Slate Ridge)	
Slope	5 percent	
Aspect	0 (no meaningful aspect)	
Elevation (Default location)	7 (700 feet)	
Latitude (Default location)	32.37	
Longitude (Default location)	86.30	
Site Species	63 (white oak)	
Site Index	70 (total age; 50 years)	
Maximum Stand Density Index	Forest Cover Type specific	
Maximum Basal Area	Forest Cover Type specific	
Volume Equations	National Volume Estimator Library	
Pulpwood Volume Specifications:		
Minimum DBH / Top Diameter Inside Bark	**Hardwoods**	**Softwoods**
All location codes	4.0 / 4.0 inches	4.0 / 4.0 inches
Stump Height	1.0 foot	1.0 foot
Sawtimber Volume Specifications:		
Minimum DBH / Top Diameter Inside Bark	**Hardwoods**	**Softwoods**
All location codes	12.0 / 9.0 inches	10.0 / 7.0 inches
Stump Height	1.0 foot	1.0 foot
Sampling Design:		
Large Trees (variable radius plot)	40 BAF	
Small Trees (fixed radius plot)	1/300th Acre	
Breakpoint DBH	5.0 inches	

1.0 INTRODUCTION

The Forest Vegetation Simulator (FVS) is an individual tree, distance independent growth and yield model with linkable modules called extensions, which simulate various insect and pathogen impacts, fire effects, fuel loading, snag dynamics, and development of understory tree vegetation. FVS can simulate a wide variety of forest types, stand structures, and pure or mixed species stands.

New “variants” of the FVS model are created by imbedding new tree growth, mortality, and volume equations for a particular geographic area into the FVS framework. Geographic variants of FVS have been developed for most of the forested lands in the United States.

The Southeast (SE) variant was developed in 1996 using relationships found in the Southeast TWIGS model and applied to Alabama, Georgia, and South Carolina. There was need for a variant that covered more of the forested area in the southeast United States.

Using data from Forest Inventory and Analysis (FIA), the Southern (SN) variant was developed using completely new growth equations and expanded to cover all southern states including the area previously covered by the Southeast TWIGS variant. Development of the SN variant of FVS began in 1998 and was released for production use in 2001. Development of the variant began as a cooperative effort of the Southern Research Station, Southern Regional Office, and the Forest Management Service Center using the FIA data from all 13 states of the Southern Region, Forest Service Research data, and data from the Bureau of Indian Affairs. All model relationships were developed by FMSC staff.

To fully understand how to use this variant, users should also consult the following publications:

Essential FVS: A User’s Guide to the Forest Vegetation Simulator (Dixon 2002)
Keyword Reference guide for the Forest Vegetation Simulator (Van Dyck 2000)

These publications can be downloaded from the Forest Management Service Center (FMSC), Forest Service, U.S. Department of Agriculture website or obtained in hard copy by contacting any FMSC FVS staff member. Other FVS publications may be needed if one is using an extension that simulates the effects of fire, insects, or diseases.

2.0 GEOGRAPHIC RANGE

The SN variant covers forest areas in all of the southeastern states including Florida, Georgia, Alabama, Mississippi, Louisiana, the Carolinas, Virginia, Kentucky, Tennessee, Arkansas, and parts of Texas and Oklahoma. The suggested geographic range of use and corresponding national forests covered in the SN variant are shown in figure 2.0.1.

In addition, the SN variant may be used to simulate the forest types within the Central States (CS) variant range in southern Missouri and southern Illinois.

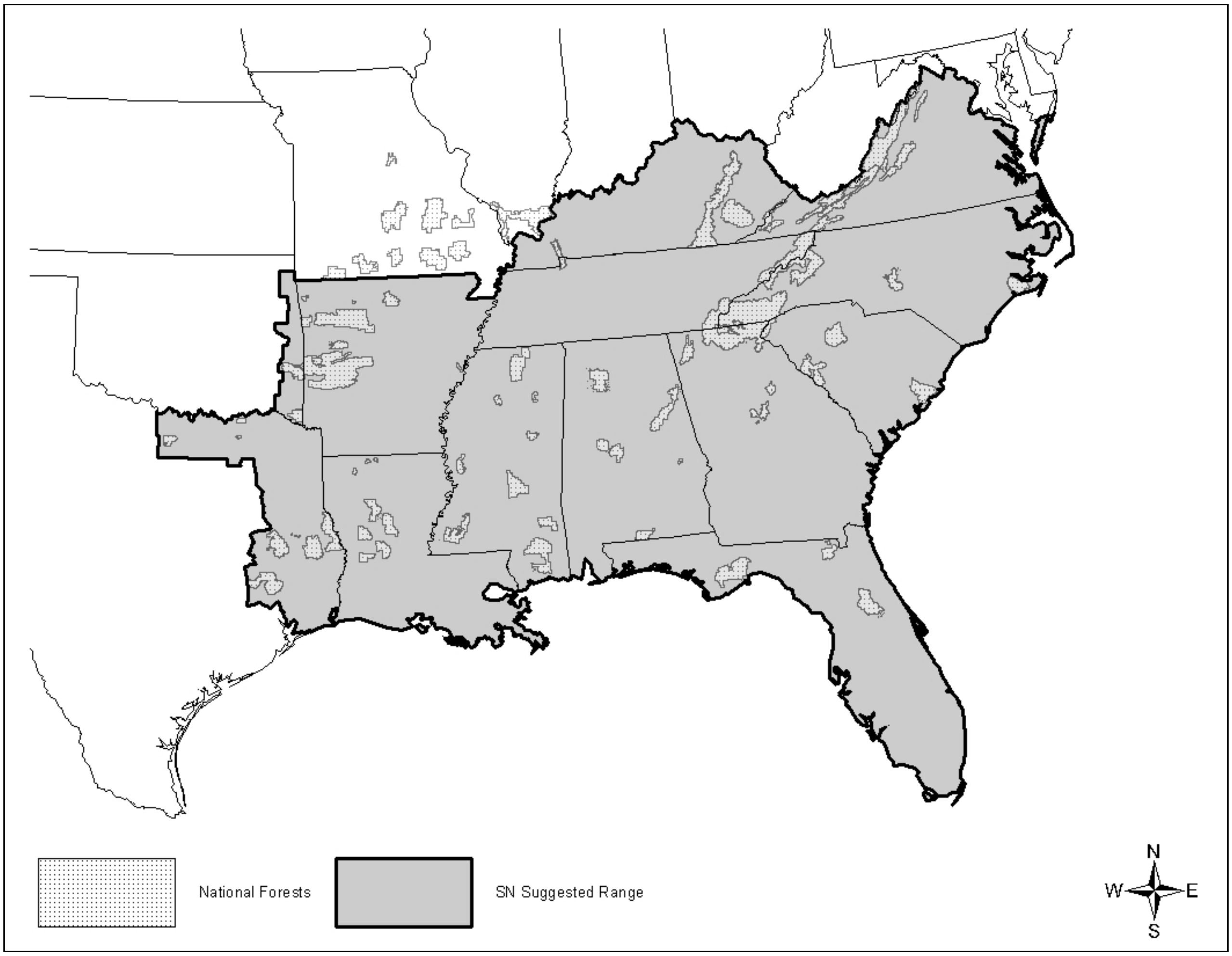

Figure 2.0.1 Suggested geographic range of use for the SN variant.

3.0 CONTROL VARIABLES

FVS users need to specify certain variables used by the SN variant to control a simulation. These are entered in parameter fields on various FVS keywords usually brought into the simulation through the SUPPOSE interface data files or they are read from an auxiliary database using the Database Extension.

3.1 Location Codes

Most location codes in the SN variant use a 5-digit code. The first digit of the code represents the Forest Service Region Number, the second and third digits represent the Forest Number, and the fourth and fifth digits represent the District Number.

If the location code is missing or incorrect in the SN variant, a default forest code of 80101 (National Forests in Alabama, Bankhead Ranger District) will be used. A complete list of location codes recognized in the SN variant, and their associated default latitude, longitude, and elevation are shown in table 3.1.1.

Table 3.1.1 Location codes used in the SN variant.

USFS National Forest	District	Location Code	Latitude	Longitude	Elevation
National Forests in Alabama	Bankhead	80101	32.37	86.30	7 (700 ft)
	Conecuh	80103			
	Oakmulgee	80104			
	Shoal Creek	80105			
	Talledega	80106			
	Tuskegee	80107			
Daniel Boone	Morehead	80211	37.99	84.18	12 (1200 ft)
	Stanton	80212			
	Berea	80213			
	London	80214			
	Somerset	80215			
	Stearns	80216			
	Redbird	80217			
Chattahoochee-Oconee	Armuchee	80301	34.34	83.82	17 (1700 ft)
	Toccoa	80302			
	Brasstown	80304			
	Tallulah	80305			
	Chattooga	80306			
	Cohutta	80307			
	Oconee	80308			
Cherokee	Hiwassee	80401	35.16	84.88	22 (2200 ft)
	Nolichucky	80402			
	Ocoee	80403			
	Tellico	80404			
	Unaka	80405			
	Watuga	80406			
National Forests in Florida	Apalachicola	80501	30.44	84.28	1 (100 ft)
	Lake George	80502			
	Osceola	80504			
	Seminole	80505			
	Wakulla	80506			

USFS National Forest	District	Location Code	Latitude	Longitude	Elevation
Kisatchie	Catahoula	80601	31.32	92.43	2 (200 ft)
	Evangeline/Vernon	80602			
	Kisatchie	80603			
	Winn	80604			
	Caney	80605			
National Forests in Mississippi	Bienville	80701	33.31	89.17	3 (300 ft)
	Desoto	80702			
	Homochitto	80704			
	Chickasawhay	80705			
	Delta	80706			
	Holly Springs	80707			
	Tombigbee	80717			
George Washington/Jefferson NFs	Deerfield	80801	37.27	79.94	21 (2100 ft)
	Dry River	80802			
	James River	80803			
	Lee	80804			
	Pedlar	80805			
	Warm Springs	80806			
	Blacksburg	80811			
	Clinch	80812			
	Glenwood	80813			
	Mt. Rogers	80814			
	New Castle	80815			
	Wythe	80816			
Ouachita	Choctaw	80901	34.50	93.06	9 (900 ft)
	Caddo	80902			
	Cold Springs	80903			
	Fourche	80904			
	Jessieville	80905			
	Kiamichi	80906			
	Mena	80907			
	Oden	80908			
	Poteau	80909			
	Womble	80910			
	Winona	80911			
	Tiak	80912			
Ozark & St. Francis NFs	Sylamore	81001	35.28	93.13	13 (1300 ft)
	Buffalo	81002			
	Bayou	81003			
	Pleasant Hill	81004			
	Boston Mountain	81005			
	Magazine	81006			
	St. Francis	81007			
National Forests in North Carolina	Cheoah	81102	35.60	82.55	25 (2500 ft)
	Croatan	81103			
	Appalachian	81104			
	Grandfather	81105			
	Highlands	81106			
	Pisgah	81107			
	Tusquitee	81109			
	Uwharrie	81110			
	Wayah	81111			
Francis Marion & Sumter NFs	Enoree/Tyger	81201	34.00	81.04	4 (400 ft)
	Andrew Pickens	81202			
	Long cane	81203			

USFS National Forest	District	Location Code	Latitude	Longitude	Elevation
	Wambaw/Witherbee	81205			
National Forests in Texas	Angelina	81301	31.34	94.73	3 (300 ft)
	Davy Crockett	81303			
	Sam Houston	81304			
	Sabine	81307			
	Caddo/LBJ	81308			
Mark Twain	All	905	37.95	91.77	10 (1000 ft)
Shawnee	All	908	37.74	88.54	4 (400 ft)
Savannah River Admin (mapped to 81203)	All	836	34.00	81.04	4 (400 ft)
Savannah River Proclaimed (mapped to 81203)	All	824	34.00	81.04	4 (400 ft)
Land Between the Lakes Admin (mapped to 80216)	All	860	37.99	84.18	12 (1200 ft)
Land Between the Lakes Admin (mapped to 80216)	All	835	37.99	84.18	12 (1200 ft)
Dept. of Defense, Fort Bragg Military Reservation (mapped to 81110)[1]	All	701	35.60	82.55	25 (2500 ft)

3.2 Species Codes

The SN variant recognizes 90 species. You may use FVS species alpha codes, Forest Inventory and Analysis (FIA) species codes, or USDA Natural Resources Conservation Service PLANTS symbols[2] to represent these species in FVS input data. Any valid eastern species code identifying species not recognized by the variant will be mapped to the most similar species in the variant. Any non-valid species code will default to the "other species" category.

Either the FVS sequence number or alpha code must be used to specify a species in FVS keywords and Event Monitor functions. FIA codes or PLANTS symbols are only recognized during data input, and may not be used in FVS keywords. Table 3.2.1 shows the complete list of species codes recognized by the SN variant.

Table 3.2.1 Species codes used in the SN variant.

FVS Number	Alpha Code	Common Name	FIA Code	PLANTS Symbol	Scientific Name
1	FR	fir species	010	ABIES	*Abies sp.*
2	JU	redcedar species	057	JUNIP	*Juniperus sp.*
3	PI	spruce species	090	PICEA	*Picea sp.*
4	PU	sand pine	107	PICL	*Pinus clausa*
5	SP	shortleaf pine	110	PIEC2	*Pinus echinata*
6	SA	slash pine	111	PIEL	*Pinus elliottii*
7	SR	spruce pine	115	PIGL2	*Pinus glabra*
8	LL	longleaf pine	121	PIPA2	*Pinus palustris*
9	TM	table mountain pine	123	PIPU5	*Pinus pungens*
10	PP	pitch pine	126	PIRI	*Pinus rigida*

[1] For some species, users entering a Dept. of Defense, Fort Bragg Military reservation code will use equations not presented in this document.
[2] If using USDA PLANTS symbols in input data entered through text files, users must modify the TREEFMT keyword and change the Species descriptor from A3 to A8, or use the database extension.

FVS Number	Alpha Code	Common Name	FIA Code	PLANTS Symbol	Scientific Name
11	PD	pond pine	128	PISE	*Pinus serotina*
12	WP	eastern white pine	129	PIST	*Pinus strobus*
13	LP	loblolly pine	131	PITA	*Pinus taeda*
14	VP	Virginia pine	132	PIVI2	*Pinus viginiana*
15	BY	baldcypress	221	TADI2	*Taxodium distichum*
16	PC	pondcypress	222	TAAS	*Taxodium ascendens*
17	HM	hemlock species	260	TSUGA	*Tsuga sp.*
18	FM	Florida maple	311	ACBA3	*Acer barbatum*
19	BE	boxelder	313	ACNE2	*Acer negundo*
20	RM	red maple	316	ACRU	*Acer rubrum*
21	SV	silver maple	317	ACSA2	*Acer saccharinum*
22	SM	sugar maple	318	ACSA3	*Acer saccharum*
23	BU	buckeye, horsechesnut species	330	AESCU	*Aesculus sp.*
24	BB	birch species	370	BETUL	*Betula sp.*
25	SB	sweet birch/black birch	372	BELE	*Betula lenta*
26	AH	American hornbeam	391	CACA18	*Carpinus caroliniana*
27	HI	hickory species	400	CARYA	*Carya sp.*
28	CA	Catalpa	450	CATAL	*Catalpa sp.*
29	HB	hackberry species	460	CELTI	*Celtis sp.*
30	RD	eastern redbud	471	CECA4	*Cercis canadensis*
31	DW	flowering dogwood	491	COFL2	*Cornus florida*
32	PS	common persimmon	521	DIVI5	*Diospyros virginiana*
33	AB	American beech	531	FAGR	*Fagus grandifolia*
34	AS	ash species	540	FRAXI	*Fraxinus sp.*
35	WA	white ash	541	FRAM2	*Fraxinus americana*
36	BA	black ash	543	FRNI	*Fraxinus nigra*
37	GA	green ash	544	FRPE	*Fraxinus pennsylvanica*
38	HL	honeylocust	552	GLTR	*Gleditsia triacanthos*
39	LB	loblolly-bay	555	GOLA	*Gordonia lasianthus*
40	HA	silverbell	580	HALES	*Halesia sp.*
41	HY	American holly	591	ILOP	*Ilex opaca*
42	BN	butternut	601	JUCI	*Juglans cinerea*
43	WN	black walnut	602	JUNI	*Juglans nigra*
44	SU	sweetgum	611	LIST2	*Liquidamber styraciflua*
45	YP	yellow-poplar	621	LITU	*Liriodendron tulipifera*
46	MG	magnolia species	650	MAGNO	*Magnolia sp.*
47	CT	cucumbertree	651	MAAC	*Magnolia acuminata*
48	MS	southern magnolia	652	MAGR4	*Magnolia grandiflora*
49	MV	sweetbay	653	MAVI2	*Magnolia virginiana*
50	ML	bigleaf magnolia	654	MAMA2	*Magnolia macrophylla*
51	AP	apple species	660	MALUS	*Malus sp.*
52	MB	mulberry species	680	MORUS	*Morus sp.*
53	WT	water tupelo	691	NYAQ2	*Nyssa aquatica*
54	BG	blackgum, black tupelo	693	NYSY	*Nyssa sylvatica*
55	TS	swamp tupelo	694	NYBI	*Nyssa biflora*
56	HH	eastern hophornbeam,	701	OSVI	*Ostrya virginiana*
57	SD	sourwood	711	OXAR	*Oxydendrum arboreum*
58	RA	redbay	721	PEBO	*Persea borbonia*

FVS Number	Alpha Code	Common Name	FIA Code	PLANTS Symbol	Scientific Name
59	SY	sycamore	731	PLOC	*Platanus occidentalis*
60	CW	cottonwood species	740	POPUL	*Populus sp.*
61	BT	bigtooth aspen	743	POGR4	*Populus grandidentata*
62	BC	black cherry	762	PRSE2	*Prunus serotina*
63	WO	white oak	802	QUAL	*Quercus alba*
64	SO	scarlet oak	806	QUCO2	*Quercus coccinea*
65	SK	southern red oak	812	QUFA	*Quercus falcata*
66	CB	cherrybark oak	813	QUPA5	*Quercus pagoda*
67	TO	turkey oak	819	QULA2	*Quercus laevis*
68	LK	laurel oak	820	QULA3	*Quercus laurifolia*
69	OV	overcup oak	822	QULY	*Quercus lyrata*
70	BJ	blackjack oak	824	QUMA3	*Quercus marilandica*
71	SN	swamp chestnut oak	825	QUMI	*Quercus michauxii*
72	CK	chinkapin oak	826	QUMU	*Quercus muehlenbergii*
73	WK	water oak	827	QUNI	*Quercus nigra*
74	CO	chestnut oak	832	QUPR2	*Quercus prinus*
75	RO	northern red oak	833	QURU	*Quercus rubra*
76	QS	Shumard oak	834	QUSH	*Quercus shumardii*
77	PO	post oak	835	QUST	*Quercus stellata*
78	BO	black oak	837	QUVE	*Quercus velutina*
79	LO	live oak	838	QUVI	*Quercus virginiana*
80	BK	black locust	901	ROPS	*Robinia pseudoacacia*
81	WI	willow species	920	SALIX	*Salix sp.*
82	SS	sassafras	931	SAAL5	*Sassafras albidum*
83	BW	basswood species	950	TILIA	*Tilia sp.*
84	EL	elm species	970	ULMUS	*Ulmus sp.*
85	WE	winged elm	971	ULAL	*Ulmus alata*
86	AE	American elm	972	ULAM	*Ulmus americana*
87	RL	slippery elm	975	ULRU	*Ulmus rubra*
88	OS	other softwood species	298	2TE	
89	OH	other hardwood species	998	2TD	
90	OT	other species	999	2TREE	

3.3 Habitat Type, Plant Association, and Ecological Unit Codes

SN variant users may enter Ecological Unit Codes (EUC) at the Subsection level as a means of distinguishing between major geographic areas within the South (Keys and others 1995). Tree diameter growth models for some species in the SN Variant vary by EUC. A complete list of acceptable EUC codes in the SN variant is shown in Appendix A. If no EUC or an incorrect EUC is entered in the input data, then the default EUC code of 231Dd (Quartzite and Talladega Slate Ridge) is used. Users may enter the plant association code or the plant association FVS sequence number on the STDINFO keyword, when entering stand information from a database, or when using the SETSITE keyword without the PARMS option. If using the PARMS option with the SETSITE keyword, users must use the FVS sequence number for the plant association.

3.4 Site Index

Site index is used in the growth equations for the LS variant. Users should always use that site index curves from Carmean and others (1989) to estimate site index as identified in table 3.4.1. In assigning site index, users should use site curves based on total age at an index age of 50. If site index is available, a single site index for the whole stand can be entered, a site index for each individual species in the stand can be entered, or a combination of these can be entered. If site index is missing or incorrect, the site species is set to white oak with a default site index set to 70.

Site indices for species not assigned a site index are converted from the site species site index using transformation equations outlined in Doolittle (1958) for the Southern Appalachian species and USDA Forest Service site index equivalency tables (USDA Forest Service 1992) for the Southern Piedmont and Mountains species. Species are grouped according to similar growth rates into nine site index groups. Determining each species site index is a four-step process. First, the relative site index of the site species is determined using the minimum and maximum site index values identified in table 3.4.1 and equation {3.4.1}. Second, a site index transformation index is computed using equation {3.4.2} for the site species; coefficients are located in table 3.4.2. Third, the relative site index for each of the site index groups is computed using equation {3.4.3}. Fourth, species site indices are computed using the relative site index for their assigned site index group using equation {3.4.4}. All non-valid site species are assigned a site index based on the relative site index of white oak (site group 9).

{3.4.1} $RSISP = (SI_{site} – SI_{min}) / (SI_{max} – SI_{min})$

{3.4.2} $MGSPIX = A + B * (RSISP * (SIG_{max} – SIG_{min}) + SIG_{min})$

{3.4.3} $MGRSI = ((c + d * MGSPIX) – SIG_{min}) / (SIG_{max} – SIG_{min})$

{3.4.4} $SISP = MGRSI * (SI_{max} – SI_{min}) + SI_{min}$

where:

RSISP	is relative site index of site species
SI_{site}	is site index of site species
SI_{min}	is site index minimum of species
SI_{max}	is site index maximum of species
MGSPIX	is site index transformation index for the site species group
SIG_{min}	is site index minimum of site species group
SIG_{max}	is site index maximum of site species group
A and B	are coefficients of the transformation index shown in table 3.4.2
MGRSI	is relative site index of each site index group
C and D	are coefficients of the site index group shown in table 3.4.2
SISP	is species site index
MGRSI	is relative site index assigned in table 3.4.2

Table 3.4.1 Site index equations and minimum and maximum site index ranges for the SN variant.

FVS Number	Alpha Code	NC-128: Height Growth Equation (FIA species code/page number)	SI_{min}	SI_{max}
1	FR	012/70	15	100
2	JU	068/73	15	70
3	PI	097/88	15	80
4	PU	107/92	35	100
5	SP	110/93	35	105
6	SA	111/99	35	105
7	SR	097/88	45	90
8	LL	107/92	45	125
9	TM	068/73	35	70
10	PP	132/139	25	95
11	PD	128/117	35	105
12	WP	129/119	40	135
13	LP	131/125	40	125
14	VP	132/139	35	95
15	BY	611/36	30	120
16	PC	611/36	30	120
17	HM	261/142	35	90
18	FM	317/19	35	70
19	BE	316/16	35	70
20	RM	316/16	35	85
21	SV	317/19	30	105
22	SM	318/18	35	100
23	BU	318/18	25	90
24	BB	371/21	35	85
25	SB	371/21	35	70
26	AH	068/73	15	40
27	HI	400/25	25	85
28	CA	543/29	30	90
29	HB	068/73	15	90
30	RD	068/73	15	40
31	DW	068/73	15	45
32	PS	068/73	15	70
33	AB	531/26	35	85
34	AS	544/30	35	105
35	WA	541/28	35	95
36	BA	543/29	35	85
37	GA	544/30	35	105
38	HL	901/65	25	120
39	LB	043/72	15	50
40	HA	068/73	15	65
41	HY	531/26	35	70
42	BN	602/31	35	85
43	WN	602/31	35	85
44	SU	611/36	30	125
45	YP	621/39 (Mountain)	30	135
46	MG	621/38 (Piedmont)	35	125
47	CT	694/42	25	115

FVS Number	Alpha Code	NC-128: Height Growth Equation (FIA species code/page number)	SI_{min}	SI_{max}
48	MS	802/52	35	125
49	MV	694/42	15	75
50	ML	694/42	35	125
51	AP	694/42	15	40
52	MB	068/73	15	55
53	WT	068/73	30	105
54	BG	691/41	35	105
55	TS	694/42	35	95
56	HH	694/42	15	40
57	SD	068/73	15	70
58	RA	068/73	15	60
59	SY	068/73	30	120
60	CW	621/39	40	125
61	BT	742/45	30	90
62	BC	743/47	35	105
63	WO	762/50	25	115
64	SO	Upland Oak/52	25	115
65	SK	Upland Oak/52	25	115
66	CB	Upland Oak/52	30	125
67	TO	813/58	25	65
68	LK	068/73	25	65
69	OV	068/73	35	95
70	BJ	828/60	25	65
71	SN	068/73	35	95
72	CK	827/59	35	75
73	WK	802/52	30	115
74	CO	827/59	25	115
75	RO	Upland Oak/52	25	115
76	QS	Upland Oak/52	15	125
77	PO	813/58	25	85
78	BO	068/73	25	115
79	LO	Upland Oak/52	30	65
80	BK	827/59	25	95
81	WI	901/65	15	110
82	SS	901/65	15	80
83	BW	068/73	35	90
84	EL	951/66	35	90
85	WE	972/68	35	90
86	AE	972/68	35	90
87	RL	972/68	35	90
88	OS	972/68	15	55
89	OH	068/73	15	55
90	OT	068/73	15	55

Table 3.4.2 Site index groups, species mapping and coefficients for site index transformations for the SN variant.

Site Index Group	Site Index Species	Mapped Species	Site*	A	B	C	D
1	SP	SP,SA,PD,HM	M	-7.1837	0.1633	44	6.13
			O	-10.000	0.2000	50	5.00
2	SO	SO,WA,CT,RO,BO	M	-8.6809	0.1702	51	5.88
			O	-12.000	0.2000	60	5.00
			S	-16.000	0.2667	60	3.75
3	YP	BY,PC,SU,SY,QS,YP	All	-4.0000	0.1000	40	40.00
4	WP	LL,WP,LP	All	-9.4118	0.1569	60	6.38
5	VP	JU,FR,PI,SR,PU,VP	All	-9.3913	0.1739	54	5.75
6	SK	AS,BT,SK,RL	All	-10.000	0.2000	50	5.00
7	CO	CO	All	-8.6809	0.1702	51	5.88
8	PP	PP	All	-7.1839	0.1633	44	6.13
9	WO	RM,SM,BB,SB,AB,CW,BC, WO,CB,OV,SN,WK,BW	M	-8.7442	0.1860	47	5.38
			O	-10.000	0.2000	50	5.00

*M = Mountain, O = Other, S = species 78(BO)

3.5 Maximum Density

Maximum stand density index (SDI) and stand basal area are important variables in determining density related mortality. Maximum SDI is also an important variable in determining changes in crown ratio. Maximum SDI is set based on the computed forest cover type from the Forest Inventory & Analysis forest cover typing algorithm (Arner, et al. 2001). The default maximum SDI's by forest cover type in the SN variant are located in table 3.5.1.

Table 3.5.1 Default Stand Density Index Maximums by forest cover type in the SN variant.

Forest Cover Type Code	Forest Cover Type Name	*SDI* Maximum
103	Eastern White pine	520
104	White pine/hemlock	535
105	Eastern Hemlock	460
121	Balsam fir	460
124	Red spruce/balsam fir	460
141	Longleaf pine	390
142	Slash pine	435
161	Loblolly pine	505
162	Shortleaf pine	505
163	Virginia pine	495
164	Sand pine	365
165	Table-mountain pine	415
166	Pond pine	475
167	Pitch pine	465
168	Spruce pine	350
181	Eastern redcedar	300
401	Eastern white pine/red oak/white ash	460
402	Eastern redcedar/hardwood	300
403	Longleaf pine/oak	360
404	Shortleaf pine/oak	475

Forest Cover Type Code	Forest Cover Type Name	*SDI* Maximum
405	Virginia pine/southern red oak	480
406	Loblolly pine/hardwood	475
407	Slash pine/hardwood	555
409	Other pine/hardwood	495
501	Post oak/blackjack oak	380
502	Chestnut oak	380
503	White oak/red oak/hickory	415
504	White oak	430
505	Northern red oak	400
506	Yellow-poplar/white oak/red oak	440
507	Sassafras/persimmon	500
508	Sweetgum/Yellow-poplar	440
510	Scarlet oak	360
511	Yellow poplar	455
512	Black walnut	405
513	Black locust	295
514	Southern scrub oak	300
515	Chestnut oak/black oak/scarlet oak	420
519	Red maple/oak	475
520	Mixed upland hardwoods	440
601	Swamp chestnut/cherrybark oak	395
602	Sweetgum-Nuttall-willow oak	460
605	Overcup oak/water hickory	425
606	Atlantic white cedar	300
607	Bald cypress/water tupelo	785
608	Sweetbay/swamp tupelo/red maple	625
701	Black ash/American elm/red maple	415
702	River birch/sycamore	420
703	Cottonwood	450
704	Willow	495
705	Sycamore/pecan/American elm	470
706	Sugarberry(hackberry)/elm/green ash	415
708	Red maple/lowland	445
801	Sugar maple/beech/yellow birch	460
802	Black cherry	325
803	Cherry/ash/yellow-poplar	455
805	Hard maple/basswood	485
807	Elm/ash/locust	415
809	Red maple/upland	555
999	Nonstocked	380

The basal area maximum is set based on the stand SDI maximum set by forest cover type. Equation {3.5.1} is used to set the basal area maximum.

{3.5.1} $BAMAX = SDIMAX * 0.5454154 * SDIU$

where:

SDIMAX is the stand SDI maximum

BAMAX	is stand basal area maximum
SDIU	is the proportion of theoretical maximum density at which the stand reaches actual maximum density (default 0.85, changed with the SDIMAX keyword)

4.0 GROWTH RELATIONSHIPS

This chapter describes the functional relationships used to fill in missing tree data and calculate incremental growth. In FVS, trees are grown in either the small tree sub-model or the large tree sub-model depending on the diameter.

4.1 Height-Diameter Relationships

Height-diameter relationships in FVS are primarily used to estimate tree heights missing in the input data, and occasionally to estimate diameter growth on trees smaller than a given threshold diameter. In the SN variant, the model will dub in heights by one of two methods. By default, the SN variant will use the Curtis-Arney functional form as shown in equation {4.1.1} or equation {4.1.2} (Curtis 1967, Arney 1985). then FVS can switch to a logistic height-diameter equation {4.1.3} (Wykoff, et.al 1982) that may be calibrated to the input data. However, the default in the SN variant is to use equation {4.1.1} or {4.1.2}.

FVS will not automatically use equation {4.1.3} even if you have enough height values in the input data. To override this default, the user must use the NOHTDREG keyword and change field 2 to a 1. Coefficients for the height-diameter equations are given in table 4.1.1.

{4.1.1} Curtis-Arney equation; DBH > 3.0"

$$HT = 4.5 + P_2 * e^{(-P_3 * DBH \wedge P_4)}$$

{4.1.2} Modified Curtis-Arney equation; $DBH \leq 3.0$"

$$HT = ((4.5 + P_2 * e^{(-P_3 * 3 \wedge P_4)} - 4.51) * (DBH - D_{bw}) / (3 - D_{bw})) + 4.51$$

{4.1.3} Wykoff functional form

$$HT = 4.5 + e^{(B_1 + B_2 / (DBH + 1.0))}$$

where:

HT	is tree height
DBH	is tree diameter at breast height
D_{bw}	is bud width diameter at 4.51 feet shown in Table 4.1.1
B_1 - B_2	are species-specific coefficients shown in Table 4.1.1
P_2 - P_4	are species-specific coefficients shown in Table 4.1.1

Table 4.1.1 Default coefficients (P_2 - P_4), (B_1 - B_2), and D_{bw} for the height-diameter relationship equations {4.1.1}, {4.1.2}, and {4.1.3} in the SN variant.

FVS Number	Alpha Code	Curtis-Arney Coefficients				Wykoff Coefficients	
		P_2	P_3	P_4	D_{bw}	B_1	B_2
1	FR	2163.946776	6.26880851	-0.2161439	0.1	4.5084	-6.0116
2	JU	212.7932729	3.47154903	-0.3258523	0.3	4.0374	-4.2964
3	PI	2163.946776	6.26880851	-0.2161439	0.2	4.5084	-6.0116
4	PU	3919.995225	6.87312726	-0.19063343	0.5	4.2899	-4.1019
5	SP	444.0921666	4.11876312	-0.30617043	0.5	4.6271	-6.4095
6	SA	1087.101439	5.10450596	-0.24284896	0.5	4.6561	-6.2258

FVS Number	Alpha Code	Curtis-Arney Coefficients				Wykoff Coefficients	
		P_2	P_3	P_4	D_{bw}	B_1	B_2
7	SR	333.3145742	4.13108244	-0.37092539	0.5	4.7258	-6.7703
8	LL	98.56082813	3.89930709	-0.86730393	0.5	4.5991	-5.9111
9	TM	691.5411919	4.19801014	-0.1856823	0.5	4.2139	-4.5419
10	PP	208.7773185	3.72806565	-0.410875	0.5	4.3898	-5.7183
11	PD	142.7468108	3.97260802	-0.5870983	0.5	4.5457	-6.8000
12	WP	2108.844224	5.65948135	-0.18563136	0.4	4.6090	-6.1896
13	LP	243.860648	4.28460566	-0.47130185	0.5	4.6897	-6.8801
14	VP	926.1802712	4.46209203	-0.20053974	0.5	4.4718	-5.0078
15	BY	119.5749091	4.13535453	-0.79625456	0.2	4.6171	-6.2684
16	PC	162.6505825	3.20796415	-0.47880203	0.2	4.4603	-5.0577
17	HM	266.4562239	3.99313675	-0.38600287	0.1	4.5084	-6.0116
18	FM	603.6736175	3.9896005	-0.21651785	0.2	4.3164	-4.0582
19	BE	287.9445676	3.27674704	-0.26617485	0.2	4.2378	-4.1080
20	RM	268.5564351	3.11432843	-0.29411156	0.2	4.3379	-3.8214
21	SV	80.51179925	26.98331005	-2.02202808	0.2	4.5991	-6.6706
22	SM	209.8555358	2.95281334	-0.36787496	0.2	4.4834	-4.5431
23	BU	630.9504602	4.51086779	-0.26826208	0.3	4.5697	-5.7172
24	BB	170.5253403	2.68833651	-0.40080716	0.1	4.4388	-4.0872
25	SB	68.92234069	43.33832185	-2.44448482	0.1	4.4522	-4.5758
26	AH	628.0209077	3.88103963	-0.15387585	0.2	3.8550	-2.6623
27	HI	337.6684758	3.62726466	-0.32083172	0.3	4.5128	-4.9918
28	CA	190.9797059	3.69278884	-0.52730469	0.3	4.9396	-8.1838
29	HB	484.7529797	3.93933286	-0.25998833	0.1	4.4207	-5.1435
30	RD	103.1767713	2.21695491	-0.3596216	0.2	3.7512	-2.5539
31	DW	863.0501053	4.38560239	-0.14812185	0.1	3.7301	-2.7758
32	PS	488.9349192	4.06503751	-0.27180547	0.2	4.4091	-4.8464
33	AB	526.1392688	3.89232121	-0.22587084	0.1	4.4772	-4.7206
34	AS	251.4042514	3.26919806	-0.35905996	0.2	4.4819	-4.5314
35	WA	91.35276617	6.99605268	-1.22937669	0.2	4.5959	-6.4497
36	BA	178.9307637	4.92861465	-0.63777014	0.2	4.6155	-6.2945
37	GA	404.9692122	3.39019741	-0.255096	0.2	4.6155	-6.2945
38	HL	778.9356784	4.20756452	-0.18734197	0.1	4.3734	-5.3135
39	LB	265.7422693	3.59041788	-0.35232417	0.2	4.4009	-5.0560
40	HA	2620.585492	5.84993689	-0.18030935	0.2	4.4931	-4.6501
41	HY	1467.643523	5.33438509	-0.17395792	0.1	4.0151	-4.3314
42	BN	285.8797853	3.52138815	-0.3193688	0.3	4.5018	-5.6123
43	WN	93.71042027	3.6575094	-0.88246833	0.4	4.5018	-5.6123
44	SU	290.90548	3.6239536	-0.3720123	0.2	4.5920	-5.1719

FVS Number	Alpha Code	Curtis-Arney Coefficients				Wykoff Coefficients	
		P_2	P_3	P_4	D_{bw}	B_1	B_2
45	YP	625.7696614	3.87320571	-0.23349496	0.2	4.6892	-4.9605
46	MG	585.6609078	3.41972033	-0.17661706	0.2	4.4004	-4.7519
47	CT	660.1996521	3.92077102	-0.21124354	0.2	4.6067	-5.2030
48	MS	139.3315132	2.89981329	-0.48514023	0.2	4.4004	-4.7519
49	MV	184.1931837	2.84569124	-0.36952511	0.2	4.3609	-4.1423
50	ML	366.4744742	2.8733336	-0.1819814	0.2	4.4004	-4.7519
51	AP	574.0200612	3.86373895	-0.16318776	0.2	3.9678	-3.2510
52	MB	750.1823388	4.14262749	-0.15940723	0.2	3.9613	-3.1993
53	WT	163.9728054	2.76819717	-0.44098009	0.2	4.4330	-4.5383
54	BG	319.9788466	3.67313408	-0.30651323	0.2	4.3802	-4.7903
55	TS	252.3566527	3.24398683	-0.33343129	0.2	4.4334	-4.5709
56	HH	109.7324294	2.25025802	-0.41297463	0.2	4.0322	-3.0833
57	SD	690.4917743	4.15983216	-0.18613455	0.2	4.1352	-3.7450
58	RA	257.0532628	3.4047448	-0.30291274	0.2	4.0965	-3.9250
59	SY	644.3567687	3.92045786	-0.21444786	0.1	4.6355	-5.2776
60	CW	190.9797059	3.69278884	-0.52730469	0.1	4.9396	-8.1838
61	BT	66.6488871	135.4825559	-2.88622709	0.2	4.9396	-8.1838
62	BC	364.0247807	3.55987361	-0.27263121	0.1	4.3286	-4.0922
63	WO	170.1330787	3.27815866	-0.48744214	0.2	4.5463	-5.2287
64	SO	196.0564703	3.0067167	-0.38499624	0.2	4.5225	-4.9401
65	SK	150.4300023	3.13270999	-0.49925872	0.1	4.5142	-5.2205
66	CB	182.6306309	3.12897883	-0.46391125	0.1	4.7342	-6.2674
67	TO	2137.575644	5.80907868	-0.15590506	0.2	3.9365	-4.4599
68	LK	208.2300233	3.13834277	-0.37158262	0.1	4.4375	-4.6654
69	OV	184.0856396	3.49535241	-0.46211544	0.2	4.5710	-6.0922
70	BJ	157.4828626	3.38919504	-0.39151499	0.2	3.9191	-4.3503
71	SN	281.3413276	3.51695826	-0.3336282	0.2	4.6135	-5.7613
72	CK	72.7907469	3.67065539	-1.09878979	0.1	4.3420	-5.1193
73	WK	470.0617193	3.78892643	-0.25123824	0.1	4.5577	-4.9595
74	CO	94.54465221	3.42034111	-0.818759	0.2	4.4618	-4.8786
75	RO	700.0636452	4.10607389	-0.21392785	0.2	4.5202	-4.8896
76	QS	215.0009406	3.14204012	-0.39067352	0.1	4.6106	-5.4380
77	PO	765.2907525	4.22375114	-0.18974706	0.1	4.2496	-4.8061
78	BO	224.716279	3.11648501	-0.35982064	0.2	4.4747	-4.8698
79	LO	153.9588254	3.11348786	-0.38947124	0.2	4.2959	-5.3332
80	BK	880.2844971	4.59642097	-0.21824277	0.1	4.4299	-4.9920
81	WI	408.2772475	3.81808285	-0.27210505	0.1	4.4911	-5.7928
82	SS	755.1038099	4.39496421	-0.21778831	0.1	4.3383	-4.5018

FVS Number	Alpha Code	Curtis-Arney Coefficients				Wykoff Coefficients	
		P_2	P_3	P_4	D_{bw}	B_1	B_2
83	BW	293.5715132	3.52261899	-0.35122247	0.1	4.582	-5.0903
84	EL	1005.80672	4.6473994	-0.20336143	0.1	4.3744	-4.5257
85	WE	1001.672885	4.57310438	-0.18898217	0.1	4.5992	-7.7428
86	AE	418.5941897	3.17038578	-0.18964025	0.1	4.6008	-7.2732
87	RL	1337.547184	4.48953501	-0.14749529	0.1	4.6238	-7.4847
88	OS	212.7932729	3.47154903	-0.3258523	0.3	4.3898	-5.7183
89	OH	109.7324294	2.25025802	-0.41297463	0.2	3.9392	-3.4279
90	OT	31021.35552	8.3958757	-0.10372075	0.2	3.9089	-3.0149

4.2 Bark Ratio Relationships

Bark ratio estimates are used to convert between diameter outside bark and diameter inside bark in various parts of the model. The equation is shown in equation {4.2.1} and coefficients (b_1 and b_2) for this equation by species are shown in table 4.2.1. Coefficients for the SN variant are based on Clark (1991).

{4.2.1} $DIB = b_1 + b_2 * (DOB)$ $BRATIO = DIB / DOB$

where:

- *BRATIO* is species-specific bark ratio (bounded to $0.80 \leq BRATIO \leq 0.99$)
- *DIB* is tree diameter inside bark at breast height
- *DOB* is tree diameter outside bark at breast height
- b_1, b_2 are species-specific coefficients shown in table 4.2.1

Table 4.2.1 Bark ratio coefficients by species for the SN variant.

FVS Number	Alpha Code	b_1	b_2
1	FR	0.05119	0.89372
2	JU	-0.27012	0.97546
3	PI	-0.17289	0.91572
4	PU	-0.39956	0.95183
5	SP	-0.44121	0.93045
6	SA	-0.55073	0.91887
7	SR	-0.13301	0.93755
8	LL	-0.45903	0.92746
9	TM	0.05119	0.89372
10	PP	-0.58808	0.91852
11	PD	-0.51271	0.90245
12	WP	-0.31608	0.92054
13	LP	-0.48140	0.91413
14	VP	-0.31137	0.95011
15	BY	-0.27012	0.97546
16	PC	-0.94204	0.96735
17	HM	-0.04931	0.92272
18	FM	-0.09800	0.94646
19	BE	-0.09800	0.94646
20	RM	-0.09800	0.94646
21	SV	-0.09800	0.94646

FVS Number	Alpha Code	b_1	b_2
46	MG	-0.21140	0.94461
47	CT	-0.21140	0.94461
48	MS	-0.21140	0.94461
49	MV	-0.17978	0.92381
50	ML	-0.21140	0.94461
51	AP	-0.33014	0.94215
52	MB	-0.33014	0.94215
53	WT	-0.38140	0.97327
54	BG	0.19899	0.88941
55	TS	-0.15231	0.93442
56	HH	-0.42001	0.94264
57	SD	-0.25063	0.94349
58	RA	-0.33014	0.94215
59	SY	-0.09192	0.96411
60	CW	-0.25063	0.94349
61	BT	-0.25063	0.94349
62	BC	-0.12958	0.94152
63	WO	-0.24096	0.93789
64	SO	-0.40860	0.94613
65	SK	-0.42141	0.93008
66	CB	-0.21801	0.93540

FVS Number	Alpha Code	b_1	b_2
22	SM	-0.09800	0.94646
23	BU	-0.35332	0.95955
24	BB	0.21790	0.92290
25	SB	0.21790	0.92290
26	AH	-0.13040	0.97071
27	HI	-0.60912	0.94347
28	CA	-0.33014	0.94215
29	HB	-0.18338	0.95768
30	RD	-0.33014	0.94215
31	DW	-0.33014	0.94215
32	PS	-0.42001	0.94264
33	AB	-0.13040	0.97071
34	AS	-0.34316	0.93964
35	WA	-0.48735	0.93847
36	BA	-0.25063	0.94349
37	GA	-0.34316	0.93964
38	HL	-0.42001	0.94264
39	LB	-0.33014	0.94215
40	HA	-0.33014	0.94215
41	HY	-0.33014	0.94215
42	BN	-0.42001	0.94264
43	WN	-0.42001	0.94264
44	SU	-0.39271	0.95997
45	YP	-0.22976	0.92408

FVS Number	Alpha Code	b_1	b_2
67	TO	-0.61021	0.95803
68	LK	-0.04612	0.93127
69	OV	-0.37973	0.94380
70	BJ	-0.61021	0.95803
71	SN	-0.49699	0.94832
72	CK	-0.34225	0.93494
73	WK	-0.30330	0.95826
74	CO	-0.43197	0.92120
75	RO	-0.52266	0.95215
76	QS	-0.61021	0.95803
77	PO	-0.26493	0.91899
78	BO	-0.70754	0.94821
79	LO	-0.70754	0.94821
80	BK	-0.37166	0.89193
81	WI	-0.25063	0.94349
82	SS	-0.25063	0.94349
83	BW	-0.35979	0.95322
84	EL	-0.42027	0.96305
85	WE	-0.42027	0.96305
86	AE	-0.42027	0.96305
87	RL	-0.42027	0.96305
88	OS	-0.38344	0.91915
89	OH	-0.33014	0.94215
90	OT	-0.25063	0.94349

4.3 Crown Ratio Relationships

Crown ratio equations are used for three purposes in FVS: (1) to estimate tree crown ratios missing in input data for both live and dead trees; (2) to estimate change in crown ratio from cycle to cycle for live trees; and (3) to estimate initial crown ratios for regeneration trees established during a simulation.

In the SN variant, crown ratio missing on dead trees in the input data is dubbed using equation set {4.3.1}.

{4.3.1} $CR = 0.70-0.40/24.0*DBH$ for $DBH \leq 24$.
$CR = 0.30$ for $DBH > 24$

where:

CR is crown ratio expressed as a proportion (bounded to $0.05 \leq CR \leq 0.95$)
DBH is tree diameter at breast height

A Weibull-based crown model developed by Dixon (1985) as described in Dixon (2002) is used to predict crown ratio missing for live trees in the input data and for crown ratio change. To estimate crown ratio using this methodology, the average stand crown ratio is estimated from stand density index using one of following five equations {4.3.2} – {4.3.6}. Next, Weibull parameters are then estimated from the average stand crown ratio using equations in equation set {4.3.7}. Individual tree crown ratio is then set from the Weibull distribution, equation {4.3.7} based on a tree’s relative position in the diameter distribution and multiplied by a scale factor, shown in equation {4.3.9}, which accounts for stand density. Crowns estimated from the Weibull distribution are bounded to be between the 5 and 95 percentile points of the specified Weibull distribution. Equation reference and coefficients for each species are shown in table 4.3.1.

{4.3.2} $ACR = e \wedge [d_0 + (d_1 * \ln(RELSDI)) + (d_2 * RELSDI))]$

{4.3.3} $ACR = e \wedge [d_0 + (d_1 * \ln(RELSDI)]$

{4.3.4} $ACR = d_0 + (d_2 * RELSDI)$

{4.3.5} $ACR = d_0 + (d_1 * \log_{10}(RELSDI))$

{4.3.6} $ACR = RELSDI / ((d_0 * RELSDI) + d_1)$

{4.3.7} Weibull parameters A, B, and C are estimated from average crown ratio

$A = a_0$

$B = b_0 + b_1 * ACR$, *bounded to be greater than 3.0*

$C = c$, bounded to be greater than 2.0

{4.3.8} $ICR = 1\text{-}e^{-((ACR\text{-}A)/B)\wedge c}$

{4.3.9} $SCALE = 1 – 0.00167 * (CCF – 100)$

where:

ACR	is the predicted average crown ratio for the species
RELSDI	is the relative site density index (Stand *SDI* / Maximum *SDI*) and is bounded between 0.5 and 1.5
A, *B*, *C*	are parameters of the Weibull crown ratio distribution
ICR	is crown ratio expressed as a percent
SCALE	is a density dependent scaling factor (bounded to $0.3 \leq SCALE \leq 1.0$)
CCF	is the stand crown competition factor

a_0, b_0, b_1, c_0, c_1, d_0, and d_1 are species-specific coefficients shown in table 4.3.1

Table 4.3.1 Default coefficients for crown ratio change equations {4.3.1} – {4.3.6} in the SN variant.

FVS Number	Alpha Code	*ACR* Equation	d_0	d_1	d_2	a	b_0	b_1	c
1	FR	3	63.51		-0.09	4.0659	-6.8708	1.0510	4.1741
2	JU	3	67.64		-2.25	2.4435	-32.4837	1.6503	2.6518
3	PI	3	63.51		-0.09	4.0659	-6.8708	1.0510	4.1741
4	PU	4	54.0462	-18.2118		4.3780	-5.0254	0.9620	2.4758
5	SP	4	47.7297	-16.352		4.6721	-3.9456	1.0509	3.0228
6	SA	4	42.8255	-15.0135		3.8940	-4.7342	0.9786	2.9082
7	SR	2	4.17	-0.23		5.0000	-10.1125	1.0734	3.3218
8	LL	4	42.84	-5.62		3.9771	14.3941	0.5189	3.7531
9	TM	4	45.8231	-13.8999		3.9190	1.2933	0.7986	2.9202
10	PP	1	4.3546	-0.5034	0.0163	3.9190	1.2933	0.7986	2.9202
11	PD	1	3.8904	-0.3565	0.0478	4.3300	-34.2606	1.7823	3.0554
12	WP	3	51.8		-0.8	4.6496	-11.4277	1.1343	2.9405
13	LP	1	3.8284	-0.2234	0.0172	4.9701	-14.6680	1.3196	2.8517

FVS Number	Alpha Code	*ACR* Equation	d_0	d_1	d_2	a	b_0	b_1	c
14	VP	1	4.1136	-0.331	0.007	5.0000	-10.2832	1.1019	2.4693
15	BY	4	48.2413	-10.1014		5.0000	-9.8322	1.1062	2.8512
16	PC	4	36.0855	-5.4737		4.9986	-9.6939	1.0740	2.3667
17	HM	3	63.51		-0.09	4.0659	-6.8708	1.0510	4.1741
18	FM	4	53.1867	-9.4122		5.0000	-18.6340	1.2622	3.6407
19	BE	4	61.9643	-22.3363		5.0000	-18.6340	1.2622	3.6407
20	RM	4	46.1653	-6.088		4.7322	-24.2740	1.4587	2.9951
21	SV	3	42.98		0.55	5.0000	-18.6340	1.2622	3.6407
22	SM	3	48.2		-0.01	4.6903	-19.5613	1.2928	3.3715
23	BU	3	42.13		-0.1	5.0000	-18.6340	1.2622	3.6407
24	BB	1	3.7275	-0.1124	0.0282	4.1939	1.2500	0.8795	3.1500
25	SB	1	3.8785	-0.1749	0.0171	4.1939	1.2500	0.8795	3.1500
26	AH	1	3.9904	-0.1496	0.0171	4.5640	0.9693	0.9093	3.0540
27	HI	1	3.9939	-0.2117	0.0238	5.0000	-29.1096	1.5626	3.5310
28	CA	4	48.03	-13.21		4.8371	-14.3180	1.2060	3.7345
29	HB	4	50.8266	-14.5261		4.5671	-49.1736	2.1311	2.9883
30	RD	4	44.5839	-14.0874		5.0000	15.0407	0.6546	3.0344
31	DW	4	51.8467	-14.1876		4.7093	-9.6999	1.1020	2.7391
32	PS	1	3.8415	-0.2879	0.0297	4.7093	-9.6999	1.1020	2.7391
33	AB	4	59.09	-4.99		4.6965	-14.3809	1.2016	3.5571
34	AS	3	38.26		-0.77	4.0098	-12.7054	1.2224	2.7400
35	WA	1	3.7881	-0.0634	-0.0055	4.8776	-11.6617	1.1668	3.8475
36	BA	3	35.49			4.0098	-12.7054	1.2224	2.7400
37	GA	3	35.49			4.5987	-16.9647	1.3925	3.3601
38	HL	2	3.82	-0.1		4.9245	-13.3135	1.2765	2.8455
39	LB	3	37.83		-0.15	4.1992	-16.8789	1.2949	2.7697
40	HA	1	4.4653	-0.834	0.107	4.7093	-9.6999	1.1020	2.7391
41	HY	3	52.05		-0.11	4.6965	-14.3809	1.2016	3.5571
42	BN	2	3.91	-0.12		4.2967	-17.7977	1.3186	3.0386
43	WN	2	3.91	-0.12		4.2967	-17.7977	1.3186	3.0386
44	SU	1	3.8153	-0.0964	0.0055	4.6350	-39.7348	1.9132	3.0574
45	YP	2	3.87	-0.07		4.9948	-11.1090	1.1089	3.8822
46	MG	3	44.71		0.4	5.0000	9.2520	0.7899	3.2166
47	CT	3	42.15		-0.11	4.9829	-5.2479	0.9552	3.8219
48	MS	3	44.71		0.4	5.0000	9.2520	0.7899	3.2166
49	MV	3	36.5		-0.23	4.2299	-32.4970	1.7316	2.7902
50	ML	3	44.71		0.4	5.0000	9.2520	0.7899	3.2166
51	AP	3	55.48		-2.38	4.2932	-7.1512	1.0504	2.7738
52	MB	3	42.32		-1.08	4.8677	-22.5591	1.4240	2.8686
53	WT	3	36.02		-0.3	5.0000	-15.1643	1.2524	3.1645
54	BG	3	41.01		-0.21	4.6134	-42.6970	1.9983	3.0081
55	TS	3	41.379		-0.8012	4.8257	-7.1092	1.0128	2.7232
56	HH	4	52.7207	-11.484		5.0000	15.0407	0.6546	3.0344
57	SD	3	38.71		-0.1	4.8677	-22.5591	1.4240	2.8686
58	RA	3	38.03		-0.09	3.5122	22.2798	0.3081	2.7868
59	SY	1	3.9839	-0.0462	-0.0248	4.5640	-30.7592	1.6192	3.2836
60	CW	4	48.03	-13.21		4.8371	-14.3180	1.2060	3.7345
61	BT	4	48.03	-13.21		4.8371	-14.3180	1.2060	3.7345
62	BC	3	45.06		-0.96	4.2932	-7.1512	1.0504	2.7738

FVS Number	Alpha Code	*ACR* Equation	d_0	d_1	d_2	a	b_0	b_1	c
63	WO	2	4.05	-0.12		5.0000	-16.0927	1.2319	3.5016
64	SO	4	51.7	-9.65		5.0000	-4.6551	0.9593	3.8340
65	SK	2	3.92	-0.09		5.0000	-26.7842	1.6030	3.5160
66	CB	1	3.9112	-0.1697	0.0147	5.0000	-4.2993	1.0761	3.5922
67	TO	2	3.95	-0.02		4.1406	13.6950	0.6895	3.0427
68	LK	4	54.36	-11.3181		4.6329	-1.2977	0.9438	3.2263
69	OV	4	57.82	-18.45		5.0000	11.2401	0.7081	3.5258
70	BJ	4	56.42	-14.13		4.1406	13.6950	0.6895	3.0427
71	SN	1	3.9344	-0.0845	0.0043	4.4764	-18.7445	1.3539	3.8384
72	CK	1	4.1233	-0.1279	-0.0142	5.0000	-7.5332	1.0257	3.1662
73	WK	1	3.9116	-0.2657	0.0509	5.0000	-50.1177	2.1127	3.5148
74	CO	4	54.53	-14.7		5.0000	-9.7922	1.0728	3.6340
75	RO	2	3.9	-0.07		5.0000	-12.4107	1.1363	3.6430
76	QS	3	46.72		-0.85	5.0000	5.0414	0.8032	3.6764
77	PO	4	44.34	-5.23		4.7585	-83.4596	3.0817	3.4788
78	BO	2	4.17	-0.18		5.0000	-6.5883	1.0266	3.5587
79	LO	3	49.27		-0.72	5.0000	11.2401	0.7081	3.5258
80	BK	4	49.022	-22.5732		3.5643	-10.5101	1.2176	2.2033
81	WI	3	44.5295		-1.0053	4.8547	-17.1135	1.3108	3.2431
82	SS	3	38.85		-0.99	4.9082	-11.2413	1.1519	2.4971
83	BW	5	0.0283	-0.012		4.2656	-26.6773	1.5580	4.4024
84	EL	2	3.68	-0.02		5.0000	1.1421	0.9141	3.0621
85	WE	4	43.64	-10.03		4.9367	7.6678	0.9105	3.0303
86	AE	1	3.7366	-0.0896	0.0151	5.0000	1.1421	0.9141	3.0621
87	RL	1	3.8487	-0.2005	0.0276	4.7375	-21.8810	1.5340	3.3558
88	OS	3	67.64		-2.25	2.4435	-32.4837	1.6503	2.6518
89	OH	1	3.78	-0.02	-0.02	4.1374	17.2956	0.4987	2.2670
90	OT	2	3.93	-0.15		4.9041	-2.5097	0.9225	2.7628

Crown ratio change is estimated at the end of the projection cycle. Since this occurs after diameter growth and mortality are estimated, FVS will already know the stand SDI at the end of the projection cycle. Accordingly, crown ratio at the end of the projection cycle can be estimated using the Weibull distribution and the SDI at the end of the cycle. Crown ratio change is the difference between the crown ratio at the beginning of the cycle and the predicted crown ratio at the end of the cycle. Crown change is checked to make sure it doesn't exceed the change possible if all height growth produces new crown. Crown change is further bounded to 1% per year for the length of the cycle to avoid drastic changes in crown ratio.

4.3.1 Crown Ratio for Newly Established Trees

Crown ratios for newly established trees during regeneration are estimated using equation {4.3.1.1}. A random component is added in equation {4.3.1.1} to ensure that not all newly established trees are assigned exactly the same crown ratio.

{4.3.1.1} $CR = 0.89722 - 0.0000461 * PCCF + RAN$

where:

CR	is crown ratio expressed as a proportion (bounded to $0.2 \leq CR \leq 0.9$)
PCCF	is crown competition factor on the inventory point where the tree is established
RAN	is a small random component

4.4 Crown Width Relationships

The SN variant calculates the maximum crown width for each individual tree based on individual tree and stand attributes. Crown width for each tree is reported in the tree list output table and used for percent canopy cover (*PCC*) and crown competition factor (CCF) calculations in the model. When available, forest-grown maximum crown width equations are used to compute *PCC* and open-grown maximum crown width equations are used to compute *CCF*, see equations {4.4.1} through {4.4.5}. Species equation assignment and coefficients are shown in tables 4.4.1 and 4.4.2 for forest- and open-grown equations, respectively. Equations are numbered via the FIA species code and equation number, i.e. the forest grown equation from Bechtold (2003) assigned to fir has the number: 01201.

{4.4.1} Bechtold (2003); Equation 01

$FCW = a_1 + (a_2 * DBH) + (a_3 * DBH^2) + (a_4 * CR) + (a_5 * HI)$ $\quad DBH \geq MinD$

$FCW = [a_1 + (a_2 * DBH) + (a_3 * DBH^2) + (a_4 * CR) + (a_5 * HI)] * (DBH / MinD)$ $\quad DBH < MinD$

{4.4.2} Bragg (2001); Equation 02

$FCW = a_1 + (a_2 * DBH^{a_3})$

{4.4.3} Ek (1974); Equation 03

$OCW = a_1 + (a_2 * DBH^{a_3})$ $\quad DBH \geq MinD$

$OCW = [a_1 + (a_2 * MinD^{a_3})] * (DBH / MinD)$ $\quad DBH < MinD$

{4.4.4} Krajicek and others (1961); Equation 04

$OCW = a_1 + (a_2 * DBH)$ $\quad DBH \geq MinD$

$OCW = [a_1 + (a_2 * MinD)] * (DBH / MinD)$ $\quad DBH < MinD$

{4.4.5} Smith and others (1992); Equation 05

$OCW = a_1 + (a_2 * DBH * 2.54) + (a_3 * (DBH * 2.54)^2) * 3.28084$ $\quad DBH \geq MinD$

$OCW = [a_1 + (a_2 * MinD * 2.54) + (a_3 * (MinD * 2.54)^2) * 3.28084] * (DBH / MinD)$ $\quad DBH < MinD$

where:

FCW	is crown width of forest grown trees (used in *PCC* calculations)
OCW	is crown width of open-grown trees (used in *CCF* calculations))
DBH	is tree diameter at breast height, if bounded
CR	is crown ratio expressed as a percent
MinD	is the minimum diameter
HI	is the Hopkins Index

$HI = (ELEVATION - 887) / 100) * 1.0 + (LATITUDE – 39.54) * 4.0 + (-82.52 - LONGITUDE) * 1.25$

$a_1 - a_5$	are the coefficients shown in tables 4.4.1 and 4.4.2

Table 4.4.1. Crown width equation assignment and coefficients for forest-grown trees in the SN variant.

FVS Number	Alpha Code	Equation Number	a_1	a_2	a_3	a_4	a_5	Upper limit of DBH	Max CW
1	FR	01201	0.6564	0.8403		0.0792			34
2	JU	06801	1.2359	1.2962		0.0545			33
3	PI	09401	0.3789	0.8658		0.0878			30
4	PU	13201	-0.1211	1.2319		0.1212			34
5	SP	11001	-2.2564	1.3004		0.1031	0.0562		34
6	SA	11101	-6.9659	2.1192	0.0333	0.0587	0.0959	30	
7	SR	11001	-2.2564	1.3004		0.1031	0.0562		34
8	LL	12101	-12.2105	1.3376		0.1237	0.2759		50
9	TM	12601	-0.9442	1.4531		0.0543	0.1144		34
10	PP	12601	-0.9442	1.4531		0.0543	0.1144		34
11	PD	12801	-8.7711	3.7252	0.1063				34
12	WP	12901	0.3914	0.9923		0.1080			45
13	LP	13101	-0.8277	1.3946		0.0768			55
14	VP	13201	-0.1211	1.2319		0.1212			34
15	BY	22101	-1.0183	0.8856		0.1162			37
16	PC	22101	-1.0183	0.8856		0.1162			37
17	HM	26101	6.1924	1.4491	0.0178		0.0341	40	
18	FM	31801	4.9399	1.0727		0.1096	0.0493		54
19	BE	31301	6.4741	1.0778		0.0719	0.0637		57
20	RM	31601	2.7563	1.4212	0.0143	0.0993		50	
21	SV	31701	3.3576	1.1312		0.1011	0.1730		45
22	SM	31801	4.9399	1.0727		0.1096	0.0493		54
23	BU	40701	4.5453	1.3721		0.0430			54
24	BB	37301	11.6634	1.0028					68
25	SB	37201	4.6725	1.2968		0.0787			54
26	AH	39101	0.9219	1.6303		0.1150	0.1113		42
27	HI	40701	4.5453	1.3721		0.0430			54
28	CA	93101	4.6311	1.0108		0.0564			29
29	HB	46201	7.1043	1.3041		0.0456			51
30	RD	49101	2.9646	1.9917		0.0707			36
31	DW	49101	2.9646	1.9917		0.0707			36
32	PS	52101	3.5393	1.3939		0.0625			36
33	AB	53101	3.9361	1.1500		0.1237	0.0691		80
34	AS	54401	2.9672	1.3066		0.0585			61
35	WA	54101	1.7625	1.3413		0.0957			62
36	BA	54301	5.2824	1.1184					34
37	GA	54401	2.9672	1.3066		0.0585			61
38	HL	55201	4.1971	1.5567		0.0880			46
39	LB	65301	8.2119	0.9708					41
40	HA	49101	2.9646	1.9917		0.0707			36
41	HY	59101	4.5803	1.0747		0.0661			31
42	BN	60201	3.6031	1.1472		0.1224			37
43	WN	60201	3.6031	1.1472		0.1224			37
44	SU	61101	1.8853	1.1625		0.0656			50
45	YP	62101	3.3543	1.1627		0.0857			61
46	MG	65301	8.2119	0.9708					41
47	CT	65101	4.1711	1.6275					39
48	MS	65301	8.2119	0.9708					41
49	MV	65301	8.2119	0.9708					41
50	ML	65301	8.2119	0.9708					41
51	AP	76102	4.102718	1.396006					52

FVS Number	Alpha Code	Equation Number	a_1	a_2	a_3	a_4	a_5	Upper limit of DBH	Max CW
52	MB	68201	13.3255	1.0735					46
53	WT	69101	5.3409	0.7499		0.1047			37
54	BG	69301	5.5037	1.0567		0.0880	0.0610		50
55	TS	69401	1.3564	1.0991		0.1243			41
56	HH	70101	7.8084	0.8129		0.0941	0.0817		39
57	SD	71101	7.975	0.8303		0.0423	0.0706		36
58	RA	72101	4.2756	1.0773		0.1526	0.1650		25
59	SY	73101	-1.3973	1.3756		0.1835			66
60	CW	74201	3.4375	1.4092					80
61	BT	74301	0.6847	1.1050		0.1420	0.0265		43
62	BC	76201	3.0237	1.1119		0.1112	0.0493		52
63	WO	80201	3.2375	1.5234		0.0455	0.0324		69
64	SO	80601	0.5656	1.6766		0.0739			66
65	SK	81201	2.1517	1.6064		0.0609			56
66	CB	81201	2.1517	1.6064		0.0609			56
67	TO	81901	5.8858	1.4935					29
68	LK	82001	6.3149	1.6455					54
69	OV	82301	1.7827	1.6549		0.0343			61
70	BJ	82401	0.5443	1.4882		0.0565			37
71	SN	83201	2.148	1.6928	0.0176	0.0569		50	
72	CK	82601	0.5189	1.4134		0.1365	0.0806		45
73	WK	82701	1.6349	1.5443		0.0637	0.0764		57
74	CO	83201	2.148	1.6928	0.0176	0.0569		50	
75	RO	83301	2.8908	1.4077		0.0643			82
76	QS	81201	2.1517	1.6064		0.0609			56
77	PO	83501	1.6125	1.6669		0.0536			45
78	BO	83701	2.8974	1.3697		0.0671			52
79	LO	83801	5.6694	1.6402					66
80	BK	90101	3.0012	0.8165		0.1395			48
81	WI	97201	1.7296	2.0732		0.0590	0.0869		50
82	SS	93101	4.6311	1.0108		0.0564			29
83	BW	95101	1.6871	1.2110		0.1194	0.0264		61
84	EL	97201	1.7296	2.0732		0.0590	0.0869		50
85	WE	97101	4.3649	1.6612		0.0643			40
86	AE	97201	1.7296	2.0732		0.0590	0.0869		50
87	RL	97501	9.0023	1.3933			0.0785		49
88	OS	06801	1.2359	1.2962		0.0545			33
89	OH	93101	4.6311	1.0108		0.0564			29
90	OT	31601	2.7563	1.4212	0.0143	0.0993		50	

Table 4.4.2. Crown width equation assignment and coefficients for open-grown trees for the SN variant.

FVS Number	Alpha Code	Equation Number	a_1	a_2	a_3	a_4	a_5	Upper limit of DBH[3]	Max CW
1	FR	01203	0.3270	5.1160					34
2	JU	06801	1.2359	1.2962		0.0545			33
3	PI	09403	3.5940	1.9630					37
4	PU	13201	-0.1211	1.2319		0.1212			34
5	SP	11005	0.5830	0.2450	0.0009				45
6	SA	11101	-6.9659	2.1192	0.0333	0.0587	0.0959	30	
7	SR	11005	0.5830	0.2450	0.0009				45
8	LL	12105	0.1130	0.2590					50
9	TM	12601	-0.9442	1.4531		0.0543	0.1144		34
10	PP	12601	-0.9442	1.4531		0.0543	0.1144		34
11	PD	12801	-8.7711	3.7252	0.1063				34
12	WP	12903	1.6200	3.1970					58
13	LP	13105	0.7380	0.2450	0.0008				66
14	VP	13201	-0.1211	1.2319		0.1212			34
15	BY	22101	-1.0183	0.8856		0.1162			37
16	PC	22101	-1.0183	0.8856		0.1162			37
17	HM	26101	6.1924	1.4491	0.0178		0.0341	40	
18	FM	31803	0.8680	4.1500					54
19	BE	31301	6.4741	1.0778		0.0719	0.0637		57
20	RM	31603	0.0000	4.7760					55
21	SV	31701	3.3576	1.1312		0.1011	0.1730		45
22	SM	31803	0.8680	4.1500					54
23	BU	40703	2.3600	3.5480					54
24	BB	37301	11.6634	1.0028					68
25	SB	37201	4.6725	1.2968		0.0787			54
26	AH	39101	0.9219	1.6303		0.1150	0.1113		42
27	HI	40703	2.3600	3.5480					54
28	CA	93101	4.6311	1.0108		0.0564			29
29	HB	46201	7.1043	1.3041		0.0456			51
30	RD	49101	2.9646	1.9917		0.0707			36
31	DW	49101	2.9646	1.9917		0.0707			36
32	PS	52101	3.5393	1.3939		0.0625			36
33	AB	53101	3.9361	1.1500		0.1237	0.0691		80
34	AS	54403	0.0000	4.7550					61
35	WA	54101	1.7625	1.3413		0.0957			62
36	BA	54301	5.2824	1.1184					34
37	GA	54403	0.0000	4.7550					61
38	HL	55201	4.1971	1.5567		0.0880			46
39	LB	65301	8.2119	0.9708					41
40	HA	49101	2.9646	1.9917		0.0707			36
41	HY	59101	4.5803	1.0747		0.0661			31
42	BN	60201	3.6031	1.1472		0.1224			37
43	WN	60201	3.6031	1.1472		0.1224			37
44	SU	61101	1.8853	1.1625		0.0656	0.0300		50
45	YP	62101	3.3543	1.1627		0.0857			61
46	MG	65301	8.2119	0.9708					41
47	CT	65101	4.1711	1.6275					39
48	MS	65301	8.2119	0.9708					41

[3] Maximum crown widths and DBH have been assigned to prevent poor behavior beyond the source data. In addition, *CR* has been set to 90% for species using equation 01, Bechtold (2003).

FVS Number	Alpha Code	Equation Number	a_1	a_2	a_3	a_4	a_5	Upper limit of DBH[3]	Max CW
49	MV	65301	8.2119	0.9708					41
50	ML	65301	8.2119	0.9708					41
51	AP	76102	4.1027	1.3960					52
52	MB	68201	13.3255	1.0735					46
53	WT	69101	5.3409	0.7499		0.1047			37
54	BG	69301	5.5037	1.0567		0.0880	0.0610		50
55	TS	69401	1.3564	1.0991		0.1243			41
56	HH	70101	7.8084	0.8129		0.0941	0.0817		39
57	SD	71101	7.9750	0.8303		0.0423	0.0706		36
58	RA	72101	4.2756	1.0773		0.1526	0.1650		25
59	SY	73101	-1.3973	1.3756		0.1835			66
60	CW	74203	2.9340						80
61	BT	74301	0.6847	1.1050		0.1420	0.0265		43
62	BC	76203	0.6210	7.0590					52
63	WO	80204	1.8000	1.8830					69
64	SO	80601	0.5656	1.6766		0.0739			66
65	SK	81201	2.1517	1.6064		0.0609			56
66	CB	81201	2.1517	1.6064		0.0609			56
67	TO	81901	5.8858	1.4935					29
68	LK	82001	6.3149	1.6455					54
69	OV	82303	0.9420	3.5390					78
70	BJ	82401	0.5443	1.4882		0.0565			37
71	SN	83201	2.1480	1.6928	0.0176	0.0569		50	
72	CK	82601	0.5189	1.4134		0.1365	0.0806		45
73	WK	82701	1.6349	1.5443		0.0637	0.0764		57
74	CO	83201	2.1480	1.6928	0.0176	0.0569		50	
75	RO	83303	2.8500	3.7820					82
76	QS	81201	2.1517	1.6064		0.0609			56
77	PO	83501	1.6125	1.6669		0.0536			45
78	BO	83704	4.5100	1.6700					52
79	LO	83801	5.6694	1.6402					66
80	BK	90101	3.0012	0.8165		0.1395			48
81	WI	97203	2.8290	3.4560					72
82	SS	93101	4.6311	1.0108		0.0564			29
83	BW	95101	1.6871	1.2110		0.1194	0.0264		61
84	EL	97203	2.8290	3.4560					72
85	WE	97101	4.3649	1.6612		0.0643			40
86	AE	97203	2.8290	3.4560					72
87	RL	97501	9.0023	1.3933			0.0785		49
88	OS	06801	1.2359	1.2962		0.0545			33
89	OH	93101	4.6311	1.0108		0.0564			29
90	OT	31603	0.0000	4.7760					55

4.5 Crown Competition Factor

The SN variant uses crown competition factor (*CCF*) as a predictor variable in some growth relationships. Crown competition factor (Krajicek and others 1961) is a relative measurement of stand density that is based on tree diameters. Individual tree CCF_t values estimate the percentage of an acre that would be covered by the tree's crown if the tree were open-grown. Stand *CCF* is the summation of individual tree (CCF_t) values. A stand *CCF* value of 100 theoretically indicates that tree crowns will just touch in an unthinned, evenly spaced stand. Crown competition factor for an individual tree is calculated using equations {4.5.1} and {4.5.2 and is based off of open-grown crown width equations.

{4.5.1} $CCF_t = 0.001803 * OCW^2$ $\qquad$ $DBH \geq 1.0$”

{4.5.2} $CCF_t = 0.001$ $\qquad$ $DBH < 0.1$”

where:

- CCF_t is crown competition factor for an individual tree
- OCW_t is open-grown crown width for an individual tree
- *DBH* is tree diameter at breast height

4.6 Small Tree Growth Relationships

Trees are considered “small trees” for FVS modeling purposes when they are smaller than some threshold diameter. This threshold diameter is set to 3.0” for all species in the SN variant.

The small tree model is height growth driven, meaning height growth is estimated first and diameter growth is estimated from height growth. These relationships are discussed in the following sections.

4.6.1 Small Tree Height Growth

The small-tree height growth model predicts periodic potential height growth (POTHTG) from height growth curves using the Chapman-Richards nonlinear functional form for a particular species, see GTR-NC-128 (Carmean and others 1989). A linear function fills in the height growth curves from 0 at age 0 to the lower end of the height growth curve. Height growth is computed by subtracting the current predicted height from the predicted height 5 years in the future, as depicted in equation {4.6.1.1}. Coefficients for each species are located in table 4.6.1.1.

{4.6.1.1} $POTHT = c_1 * SI^{c_2} * [1.0 - e^{(c_3 * AGET)}]^{(c_4 * (SI \wedge c_5))}$

where:

- *POTHT* is predicted tree height, used for current and future height growth.
- *SI* is species site index
- *AGET* is tree age
  $AGET = (1 / c_3) * \ln[1 - (HT / (c_1 * SI^{c_2}))]^{((1 / c_4) * (SI \wedge c_5))}$
- $c_1 - c_5$ are species-specific coefficients

Table 4.6.1.1 Height growth curve coefficients from GTR-NC-128 (Carmean and others 1989) for the SN variant.

FVS Number	Alpha Code	NC-128 Height Growth Equation (FIA code / page number)	c_1	c_2	c_3	c_4	c_5
1	FR	012/70	2.077	0.9303	-0.0285	2.8937	-0.1414
2	JU	068/73	0.9276	1.0591	-0.0424	0.3529	0.3114
3	PI	097/88	1.3307	1.0442	-0.0496	3.5829	0.0945
4	PU	107/92	1.266	1.0034	-0.0365	1.5515	-0.0221
5	SP	110/93	1.4232	0.9989	-0.0285	1.2156	0.0088
6	SA	111/99	1.1557	1.0031	-0.0408	0.9807	0.0314
7	SR	097/88	1.3307	1.0442	-0.0496	3.5829	0.0945

FVS Number	Alpha Code	NC-128 Height Growth Equation (FIA code / page number)	c_1	c_2	c_3	c_4	c_5
8	LL	107/92	1.421	0.9947	-0.0269	1.1344	-0.0109
9	TM	068/73	0.9276	1.0591	-0.0424	0.3529	0.3114
10	PP	132/139	1.1204	0.9984	-0.0597	2.4448	-0.0284
11	PD	128/117	1.1266	1.0051	-0.0367	0.678	0.0404
12	WP	129/119	3.2425	0.798	-0.0435	52.0549	-0.7064
13	LP	131/125	1.1421	1.0042	-0.0374	0.7632	0.0358
14	VP	132/139	1.1204	0.9984	-0.0597	2.4448	-0.0284
15	BY	611/36	1.0902	1.0298	-0.0354	0.7011	0.1178
16	PC	611/36	1.0902	1.0298	-0.0354	0.7011	0.1178
17	HM	261/142	2.1493	0.9979	-0.0175	1.4086	-0.0008
18	FM	317/19	1.0645	0.9918	-0.0812	1.5754	-0.0272
19	BE	316/16	2.9435	0.9132	-0.0141	1.658	-0.1095
20	RM	316/16	2.9435	0.9132	-0.0141	1.658	-0.1095
21	SV	317/19	1.0645	0.9918	-0.0812	1.5754	-0.0272
22	SM	318/18	6.1308	0.6904	-0.0195	10.1563	-0.5330
23	BU	318/18	6.1308	0.6904	-0.0195	10.1563	-0.5330
24	BB	371/21	6.0522	0.6768	-0.0217	15.4232	-0.6354
25	SB	371/21	6.0522	0.6768	-0.0217	15.4232	-0.6354
26	AH	068/73	0.9276	1.0591	-0.0424	0.3529	0.3114
27	HI	400/25	1.8326	1.0015	-0.0207	1.408	-0.0005
28	CA	543/29	4.2286	0.7857	-0.0178	4.6219	-0.3591
29	HB	068/73	0.9276	1.0591	-0.0424	0.3529	0.3114
30	RD	068/73	0.9276	1.0591	-0.0424	0.3529	0.3114
31	DW	068/73	0.9276	1.0591	-0.0424	0.3529	0.3114
32	PS	068/73	0.9276	1.0591	-0.0424	0.3529	0.3114
33	AB	531/26	29.73	0.3631	-0.0127	16.7616	-0.6804
34	AS	544/30	1.6505	0.9096	-0.0644	125.7045	-0.8908
35	WA	541/28	4.1492	0.7531	-0.0269	14.5384	-0.5811
36	BA	543/29	4.2286	0.7857	-0.0178	4.6219	-0.3591
37	GA	544/30	1.6505	0.9096	-0.0644	125.7045	-0.8908
38	HL	901/65	0.968	1.0301	-0.0468	0.1639	0.4127
39	LB	043/72	1.5341	1.0013	-0.0208	0.9986	-0.0012
40	HA	068/73	0.9276	1.0591	-0.0424	0.3529	0.3114
41	HY	531/26	29.73	0.3631	-0.0127	16.7616	-0.6804
42	BN	602/31	1.2898	0.9982	-0.0289	0.8546	0.0171
43	WN	602/31	1.2898	0.9982	-0.0289	0.8546	0.0171
44	SU	611/36	1.0902	1.0298	-0.0354	0.7011	0.1178
45	YP	621/39 (Mountain)	1.2673	1.0	-0.0331	1.1149	0.0001
45	YP	621/38 (Piedmont)	1.1798	1.0	-0.0339	0.8117	-0.0001
46	MG	694/42	1.3213	0.9995	-0.0254	0.8549	-0.0016
47	CT	802/52	1.2866	0.9962	-0.0355	1.4485	-0.0316
48	MS	694/42	1.3213	0.9995	-0.0254	0.8549	-0.0016
49	MV	694/42	1.3213	0.9995	-0.0254	0.8549	-0.0016
50	ML	694/42	1.3213	0.9995	-0.0254	0.8549	-0.0016
51	AP	068/73	0.9276	1.0591	-0.0424	0.3529	0.3114
52	MB	068/73	0.9276	1.0591	-0.0424	0.3529	0.3114
53	WT	691/41	1.2721	0.9995	-0.0256	0.7447	-0.0019
54	BG	694/42	1.3213	0.9995	-0.0254	0.8549	-0.0016
55	TS	694/42	1.3213	0.9995	-0.0254	0.8549	-0.0016
56	HH	068/73	0.9276	1.0591	-0.0424	0.3529	0.3114
57	SD	068/73	0.9276	1.0591	-0.0424	0.3529	0.3114
58	RA	068/73	0.9276	1.0591	-0.0424	0.3529	0.3114
59	SY	621/39	1.2673	1.0	-0.0331	1.1149	0.0001
60	CW	742/45	1.2834	0.9571	-0.068	100.0	-0.9223

FVS Number	Alpha Code	NC-128 Height Growth Equation (FIA code / page number)	c_1	c_2	c_3	c_4	c_5
61	BT	743/47	5.2188	0.6855	-0.0301	50.0071	-0.8695
62	BC	762/50	7.1846	0.6781	-0.0222	13.9186	-0.5268
63	WO	Upland Oak/52	1.2866	0.9962	-0.0355	1.4485	-0.0316
64	SO	Upland Oak/52	1.2866	0.9962	-0.0355	1.4485	-0.0316
65	SK	Upland Oak/52	1.2866	0.9962	-0.0355	1.4485	-0.0316
66	CB	813/58	1.0945	0.9938	-0.0755	2.5601	0.0114
67	TO	068/73	0.9276	1.0591	-0.0424	0.3529	0.3114
68	LK	068/73	0.9276	1.0591	-0.0424	0.3529	0.3114
69	OV	828/60	1.3295	0.9565	-0.0668	16.0085	-0.4157
70	BJ	068/73	0.9276	1.0591	-0.0424	0.3529	0.3114
71	SN	827/59	1.3466	0.959	-0.0574	8.9538	-0.3454
72	CK	802/52	1.2866	0.9962	-0.0355	1.4485	-0.0316
73	WK	827/59	1.3466	0.959	-0.0574	8.9538	-0.3454
74	CO	Upland Oak/52	1.2866	0.9962	-0.0355	1.4485	-0.0316
75	RO	Upland Oak/52	1.2866	0.9962	-0.0355	1.4485	-0.0316
76	QS	813/58	1.0945	0.9938	-0.0755	2.5601	0.0114
77	PO	068/73	0.9276	1.0591	-0.0424	0.3529	0.3114
78	BO	Upland Oak/52	1.2866	0.9962	-0.0355	1.4485	-0.0316
79	LO	827/59	1.3466	0.959	-0.0574	8.9538	-0.3454
80	BK	901/65	0.968	1.0301	-0.0468	0.1639	0.4127
81	WI	901/65	0.968	1.0301	-0.0468	0.1639	0.4127
82	SS	068/73	0.9276	1.0591	-0.0424	0.3529	0.3114
83	BW	951/66	4.7633	0.7576	-0.0194	6.511	-0.4156
84	EL	972/68	6.4362	0.6827	-0.0194	10.9767	-0.5477
85	WE	972/68	6.4362	0.6827	-0.0194	10.9767	-0.5477
86	AE	972/68	6.4362	0.6827	-0.0194	10.9767	-0.5477
87	RL	972/68	6.4362	0.6827	-0.0194	10.9767	-0.5477
88	OS	068/73	0.9276	1.0591	-0.0424	0.3529	0.3114
89	OH	068/73	0.9276	1.0591	-0.0424	0.3529	0.3114
90	OT	068/73	0.9276	1.0591	-0.0424	0.3529	0.3114

For all species, a small random error is then added to the height growth estimate. The estimated height growth is then adjusted to account for cycle length, user defined small-tree height growth adjustments, and adjustments due to small tree height increment calibration from input data.

Height growth estimates from the small-tree model are weighted with the height growth estimates from the large tree model over a range of diameters (X_{min} and X_{max}) in order to smooth the transition between the two models. For example, the closer a tree's *DBH* value is to the minimum diameter (X_{min}), the more the growth estimate will be weighted towards the small-tree growth model. The closer a tree's *DBH* value is to the maximum diameter (X_{max}), the more the growth estimate will be weighted towards the large-tree growth model. If a tree's *DBH* value falls outside of the range given by X_{min} and X_{max}, then the model will use only the small-tree or large-tree growth model in the growth estimate. The weight applied to the growth estimate is calculated using equation {4.6.1.2}, and applied as shown in equation {4.6.1.3}. The range of diameters for each species is shown in table 4.6.1.3.

{4.6.1.2}
$$XWT = 0 \qquad DBH \leq X_{min}$$
$$XWT = (DBH - X_{min}) / (X_{max} - X_{min}) \qquad X_{min} < DBH < X_{max}$$
$$XWT = 1 \qquad DBH \geq X_{max}$$

{4.6.1.3} Estimated growth = [(1 - *XWT*) * *STGE*] + [*XWT* * *LTGE*]

where:

XWT	is the weight applied to the growth estimates
DBH	is tree diameter at breast height
X_{max}	is the maximum *DBH* is the diameter range, set to 1.0”
X_{min}	is the minimum *DBH* in the diameter range, set to 3.0”
STGE	is the growth estimate obtained using the small-tree growth model
LTGE	is the growth estimate obtained using the large-tree growth model

4.6.2 Small Tree Diameter Growth

As stated previously, for trees being projected with the small tree equations, height growth is predicted first, and then diameter growth. So both height at the beginning of the cycle and height at the end of the cycle are known when predicting diameter growth. Small tree diameter growth for trees over 4.5 feet tall is calculated as the difference of predicted diameter at the start of the projection period and the predicted diameter at the end of the projection period, adjusted for bark ratio. These two predicted diameters are estimated using the species-specific height-diameter relationships discussed in section 4.1. By definition, diameter growth is zero for trees less than 4.5 feet tall.

4.7 Large Tree Growth Relationships

Trees are considered “large trees” for FVS modeling purposes when they are equal to, or larger than, some threshold diameter. This threshold diameter is set to 3.0” for all species in the SN variant.

The large-tree model is driven by diameter growth meaning diameter growth is estimated first, and then height growth is estimated from diameter growth and other variables. These relationships are discussed in the following sections.

4.7.1 Large Tree Diameter Growth

The large tree diameter growth model used in most FVS variants is described in section 7.2.1 in Dixon (2002). For most variants, instead of predicting diameter increment directly, the natural log of the periodic change in squared inside-bark diameter (ln(*DDS*)) is predicted (Dixon 2002; Wykoff 1990; Stage 1973; and Cole and Stage 1972). For variants predicting diameter increment directly, diameter increment is converted to the *DDS* scale to keep the FVS system consistent across all variants.

The SN variant predictes diameter growth using equation {4.7.1.1}. Coefficients for this equation are shown in tables 4.7.1.1 and 4.7.1.5. For longleaf pine and loblolly pine on the Fort Bragg Military Reservation, a different equation developed by John Shaw, Rocky Mountain Research Station.

{4.7.1.1} $\ln(DDS) = \beta_1 + (\beta_2 * \ln(DBH)) + (\beta_3 * DBH^2) + (\beta_4 * \ln(CR)) + (\beta_5 * RELHT) + (\beta_6 * SI) + (\beta_7 * PBA) + (\beta_8 * PBAL) + (\beta_9 * \tan(SLOPE)) + (\beta_{10} * \cos(ASP) * SLOPE) + (\beta_{11} * \sin(ASP) * SLOPE) + (\beta_{12} * FORTYPE) + (\beta_{13} * ECOUNIT) + (\beta_{14} * PLANT)$

where:

DDS	is the predicted periodic change in squared inside-bark diameter
DBH	is tree diameter at breast height
CR	is crown ratio expressed as a percent
HREL	is relative height of subject tree to the Top Height of the stand
SI	is site index of the species
PBA	is the plot basal area per acre
PBAL	is the plot basal area in larger trees
SLOPE	is the stand slope
ASPECT	is the stand aspect
FORTYPE	is a categorical variable for the current forest type group of the stand
ECOUNIT	is a categorical variable for the ecological unit province code
PLANT	is a categorical variable for managed stands of sand pine, slash pine, longleaf pine, eastern white pine and loblolly pine
β_1 - β_{11}	are species-specific coefficients shown in tables 4.7.1.1
β_{12}	is a coefficient based on the current forest type group shown in table 4.7.1.2
β_{13}	is a coefficient based on the ecological unit province code shown in table 4.7.1.3
β_{14}	is a coefficient in managed stands of PU, SA, LL, WP, and LP shown in table 4.7.1.4

During data analysis and regression fitting for the large-tree diameter growth model, it became apparent that data for most species were concentrated in small to medium large trees and were lacking in the very large size classes. Since this could lead to overestimation of diameter growth in larger trees, a bounding function was established to decrease the growth rates for very large trees.

The bounding function is applied using the following concepts. For a tree with projected diameter less than the lower diameter-bounding limit, diameter growth is not modified. For a tree with a projected diameter greater than the lower diameter-bounding limit and less than the upper diameter-bounding limit, diameter growth is modified using equation {4.7.1.2}. For a tree with a projected diameter greater than the upper diameter-bounding limit, diameter growth is multiplied by 0.1. The lower and upper diameter limits were determined from data used to fit the diameter growth models and from literature for mature and maximum tree sizes (Harlow and Harrar 1968, Burns and Honkala 1990). The bounding limits for the diameter growth bounding function are located in Table 4.7.1.5.

{4.7.1.2} $DGBMOD = 1.0 – 0.9 * ((DBH - DBH_{LOW}) / DBH_{HI} – DBH_{LOW}))$

where:

DGBMOD is diameter growth bounding modifier

DBH	is the predicted diameter at breast height
DBH_{LOW}	is the lower diameter-bounding limit
DBH_{HI}	is the upper diameter-bounding limit

Table 4.7.1.1 Default coefficients (β_1 - β_{11}) for the non-categorical variables of the diameter increment model by species for the SN variant.

FVS number	Alpha Code	Model Coefficients					
		β_1	β_2	β_3	β_4	β_5	β_6
1	FR	-2.267851	1.442529	-0.000548	0.568468	-0.001151	-0.241408
2	JU	-1.864431	1.403065	-0.001237	0.273616	-0.000374	-0.231988
3	PI	-2.267851	1.442529	-0.000548	0.568468	-0.001151	-0.241408
4	PU	-3.791466	1.796179	-0.005109	0.902185	-0.002009	0.501409
5	SP	-0.008942	1.23817	-0.00117	0.053076	0.004723	-0.704687
6	SA	-1.641698	1.461093	-0.00253	0.265872	0.006851	-0.018479
7	SR	-2.431165	1.691731	-0.000945	0.588558	0.000109	-0.324278
8	LL	-1.331052	1.098112	-0.001834	0.184512	0.008774	0.225213
9	TM	-2.600803	1.525435	-0.003519	0.615731	0.001033	-0.217771
10	PP	-3.639059	1.397394	-0.00167	0.739443	0.008731	-0.317178
11	PD	-2.353114	1.425614	-0.001694	0.455833	0.007876	0.685018
12	WP	-3.497764	1.339503	-0.000961	0.75906	0.004214	-0.372738
13	LP	0.222214	1.16304	-0.000863	0.028483	0.005018	-0.759347
14	VP	-2.600803	1.525435	-0.003519	0.615731	0.001033	-0.217771
15	BY	-1.735969	1.505649	-0.000054	0.132441	0.003996	-0.560585
16	PC	-4.224977	1.831739	-0.000595	0.446234	0.005975	2.356739
17	HM	-2.267851	1.442529	-0.000548	0.568468	-0.001151	-0.241408
18	FM	-1.685778	1.454506	-0.000818	0.242436	0.00436	-0.339807
19	BE	-0.871047	1.217898	-0.000105	0.240101	-0.000022	-0.613177
20	RM	-2.260482	1.449834	-0.000931	0.361311	0.003444	-0.097604
21	SV	-2.260482	1.449834	-0.000931	0.361311	0.003444	-0.097604
22	SM	-2.313444	1.350084	-0.000816	0.394806	-0.000542	-0.032482
23	BU	-1.876225	1.197048	-0.000778	0.183857	0.010254	-0.178079
24	BB	-1.092055	1.024946	-0.000653	0.20677	0.002354	-0.192793
25	SB	-1.092055	1.024946	-0.000653	0.20677	0.002354	-0.192793
26	AH	-1.281144	1.335625	0	0.111128	0.005347	-0.224489
27	HI	-2.728289	1.548449	-0.000761	0.203837	0.004399	-0.245761
28	CA	-1.06898	1.164191	0	0.084279	0.0097	0.075733
29	HB	-0.833167	1.190567	0	0.193368	-0.000056	-0.179044
30	RD	-1.062539	1.17405	0	0.239942	-0.005893	-0.391784
31	DW	-2.540719	1.293125	-0.000856	0.368481	0.004257	-0.282662
32	PS	-2.524455	1.479865	-0.001512	0.289171	0.003369	-0.327799
33	AB	-1.251887	1.349337	-0.000447	0.193148	-0.000287	-0.3804
34	AS	-2.954457	1.461691	0	0.377819	0.007104	-0.619659
35	WA	-1.315283	1.216264	-0.00008	0.087907	0.003424	0.018297
36	BA	-0.897707	1.243091	0	0.090158	-0.000465	-0.158064
37	GA	-0.897707	1.243091	0	0.090158	-0.000465	-0.158064
38	HL	-0.314922	0.927191	0	0.103234	0.003038	-0.107755
39	LB	-2.514589	1.459672	-0.001317	0.654209	-0.003582	-3.469125
40	HA	-2.352258	1.746852	0	0.291502	0.003239	0.335703
41	HY	-1.981934	1.456263	-0.002061	0.215249	0.00424	-0.303627
42	BN	-2.35419	1.050171	-0.000154	0.425328	0.001348	0.133415
43	WN	-2.35419	1.050171	-0.000154	0.425328	0.001348	0.133415
44	SU	-1.324147	1.395884	-0.00049	0.145539	0.001993	-0.502977
45	YP	-2.513351	1.495351	-0.000756	0.530123	0.000746	-0.321777
46	MG	-2.516823	1.454173	-0.000925	0.252335	0.007223	-0.025555
47	CT	-1.239592	1.06336	-0.000092	0.243097	-0.003084	-0.308453
48	MS	-1.477929	1.126474	-0.000267	0.134257	0.005884	0.405735
49	MV	-2.516823	1.454173	-0.000925	0.252335	0.007223	-0.025555
50	ML	-1.477929	1.126474	-0.000267	0.134257	0.005884	0.405735
51	AP	-1.746231	1.234133	-0.000017	0.285511	0.002596	-0.872861
52	MB	-1.746231	1.234133	-0.000017	0.285511	0.002596	-0.872861

FVS number	Alpha Code	Model Coefficients					
		β_1	β_2	β_3	β_4	β_5	β_6
53	WT	-2.721782	1.599221	-0.000162	0.351271	0.001783	-0.023349
54	BG	-1.508549	1.306362	-0.000576	0.112403	0.003356	-0.296628
55	TS	-2.55572	1.303035	0	0.319301	0.006498	-0.130105
56	HH	-1.431973	1.452294	-0.001475	0.061077	0.004856	-0.422675
57	SD	-3.18004	1.35579	-0.000784	0.532236	0.00517	-0.29268
58	RA	-2.096616	1.254708	0	0.344067	0.002656	-1.762191
59	SY	-1.012995	1.272885	-0.000238	0.23453	0.000406	-0.092471
60	CW	-1.06898	1.164191	0	0.084279	0.0097	0.075733
61	BT	-1.06898	1.164191	0	0.084279	0.0097	0.075733
62	BC	-2.610023	1.22031	-0.000234	0.520739	0.003897	-0.071719
63	WO	-1.608339	1.468589	-0.000778	0.139456	0.00453	-0.223273
64	SO	-2.284302	1.569893	-0.000632	0.272422	0.005065	-0.204324
65	SK	-0.783581	1.432483	-0.000412	0.04446	0.003012	-0.312121
66	CB	-0.295485	1.239946	-0.000163	0.020622	0.00383	-0.105862
67	TO	-2.69813	1.622081	-0.001703	0.354924	0.000682	-1.084846
68	LK	-1.561284	1.335456	-0.000412	0.246163	0.004714	-0.704548
69	OV	-0.947174	1.37635	-0.000482	0.099697	0.00128	-0.666854
70	BJ	-1.948938	1.611438	-0.000844	0.135696	0.00274	-0.071837
71	SN	-1.321662	1.640507	-0.000285	0.038193	0.005844	-1.251051
72	CK	-2.223515	0.937359	0.000212	0.286311	0.008621	-0.065269
73	WK	-0.845477	1.488444	-0.000286	0.053292	0.00533	-0.151128
74	CO	-2.900655	1.34735	-0.000533	0.300133	0.008415	-0.133852
75	RO	-2.732646	1.49945	-0.000729	0.344764	0.004632	-0.174932
76	QS	-0.328678	1.282494	-0.000351	0.071625	-0.001173	-0.692617
77	PO	-1.430321	1.293728	-0.000452	0.047937	0.005466	-0.408878
78	BO	-2.345845	1.45033	-0.000674	0.251441	0.005921	-0.307814
79	LO	-3.64066	1.448503	-0.00021	0.549199	0.009377	-0.099727
80	BK	-1.307911	0.963269	0	0.268621	0.003713	-0.335364
81	WI	-1.109398	1.187096	0	0.202056	0.006303	-0.135482
82	SS	-1.745126	1.31334	-0.000179	0.201048	0.004206	-0.01334
83	BW	-1.848106	1.424209	-0.001488	0.289244	0.003499	-0.580068
84	EL	-2.356235	1.479429	-0.000517	0.425367	0.002767	-1.000956
85	WE	-0.790138	0.949707	0	0.100266	0.00436	-0.439374
86	AE	-0.510736	1.164789	0	0.127893	0.00045	-0.446461
87	RL	-0.229212	1.060275	0	0.116801	-0.001806	0.158824
88	OS	-1.864431	1.403065	-0.001237	0.273616	-0.000374	-0.231988
89	OH	-1.431973	1.452294	-0.001475	0.061077	0.004856	-0.422675
90	OT	-1.645961	1.447657	-0.002158	0.241038	-0.00325	-1.080004

FVS number	Alpha Code	Model Coefficients				
		β_7	β_8	β_9	β_{10}	β_{11}
1	FR	0.066508	0.086959	-0.403762	-0.000824	-0.002503
2	JU	0.077542	-0.025792	0.177408	-0.00362	-0.00189
3	PI	0.066508	0.086959	-0.403762	-0.000824	-0.002503
4	PU	-1.788107	-1.231519	0	-0.005287	-0.003203
5	SP	0.127667	0.028391	0.040334	-0.004394	-0.003271
6	SA	-0.193157	-0.251016	0.069104	-0.002939	-0.004873
7	SR	0.526867	0.009866	-0.326169	-0.001847	-0.001394
8	LL	0.086883	0.107445	0.388018	-0.002182	-0.002898
9	TM	0.018819	-0.052142	0.059646	-0.002304	-0.002716
10	PP	0.083538	0.150686	-0.193198	-0.002257	-0.002188
11	PD	-2.907934	1.683401	-0.198222	-0.003001	-0.00451
12	WP	-0.085193	-0.035582	0.605201	-0.000865	-0.004065

FVS number	Alpha Code	Model Coefficients				
		β_7	β_8	β_9	β_{10}	β_{11}
13	LP	0.18536	-0.072842	0.006935	-0.003408	-0.004184
14	VP	0.018819	-0.052142	0.059646	-0.002304	-0.002716
15	BY	-0.42814	-0.739509	-0.119572	-0.000502	-0.000768
16	PC	-8.639114	5.615465	-0.125847	-0.000191	-0.0006
17	HM	0.066508	0.086959	-0.403762	-0.000824	-0.002503
18	FM	-0.204878	-0.14711	-0.140837	-0.003268	-0.001923
19	BE	0.315909	-0.237088	0.071213	-0.001242	-0.000826
20	RM	-0.069753	0.094162	0.282436	-0.002133	-0.001383
21	SV	-0.069753	0.094162	0.282436	-0.002133	-0.001383
22	SM	-0.009543	0.005581	0.631803	-0.001413	-0.001527
23	BU	0.187157	-0.108544	0.547747	-0.004219	-0.000586
24	BB	-0.112449	0.113349	0.489441	-0.002005	-0.001848
25	SB	-0.112449	0.113349	0.489441	-0.002005	-0.001848
26	AH	0.031993	-0.160702	-0.244632	-0.003852	-0.000644
27	HI	0.055798	0.080648	0.570012	-0.003339	-0.001029
28	CA	-0.601088	-0.757088	0.501307	-0.001041	-0.001349
29	HB	0.039673	-0.071628	0.508738	-0.001846	-0.001776
30	RD	0.039121	-0.03835	0.411945	-0.001141	-0.002822
31	DW	-0.084011	0.104748	-0.611245	-0.003144	-0.001235
32	PS	-0.200696	-0.145939	0.243575	-0.001319	-0.002784
33	AB	0.160386	-0.088382	0.279322	-0.002547	-0.001176
34	AS	0.020132	-0.020785	0.185353	-0.002027	-0.000779
35	WA	-0.001091	-0.021565	0.487191	-0.000807	-0.001262
36	BA	-0.138225	-0.081197	0.496594	-0.000001	-0.00145
37	GA	-0.138225	-0.081197	0.496594	-0.000001	-0.00145
38	HL	0.958763	0.823135	0.538379	-0.001181	-0.002489
39	LB	-10.149549	1.404412	0.106808	-0.000311	-0.002192
40	HA	-0.657751	0.585839	-1.771604	0	-0.00077
41	HY	0.210525	-0.159362	-0.414064	-0.003096	-0.000394
42	BN	-0.209729	0.014948	0.616257	-0.000564	-0.000588
43	WN	-0.209729	0.014948	0.616257	-0.000564	-0.000588
44	SU	0.141477	0.003549	0.256765	-0.002978	-0.00194
45	YP	-0.001645	0.064815	0.161718	-0.001839	-0.002217
46	MG	0.149606	0.032438	0.243666	-0.001259	-0.001111
47	CT	-0.071496	0.265688	0.533202	0.00068	-0.001643
48	MS	-0.063579	0.017095	0.539	-0.00274	-0.000886
49	MV	0.149606	0.032438	0.243666	-0.001259	-0.001111
50	ML	-0.063579	0.017095	0.539	-0.00274	-0.000886
51	AP	-0.078948	-0.023609	0.180572	-0.001709	-0.000099
52	MB	-0.078948	-0.023609	0.180572	-0.001709	-0.000099
53	WT	2.073647	-2.213173	0.133939	-0.00037	-0.000262
54	BG	-0.131968	-0.031596	0.121169	-0.002482	-0.001013
55	TS	-0.053688	0.149549	-0.109064	-0.001087	-0.001185
56	HH	-0.236535	0.201149	-0.208915	-0.003145	0
57	SD	0.050523	-0.008687	0.077021	-0.002389	-0.000797
58	RA	1.202555	0.383865	0.176829	-0.002625	-0.000811
59	SY	0.494599	-0.367667	0.332494	-0.000252	-0.001608
60	CW	-0.601088	-0.757088	0.501307	-0.001041	-0.001349
61	BT	-0.601088	-0.757088	0.501307	-0.001041	-0.001349
62	BC	-0.028196	-0.180664	0.181418	-0.002494	-0.001904
63	WO	0.008526	-0.032889	0.358369	-0.002807	-0.002269
64	SO	-0.004871	0.048758	0.206868	-0.001157	-0.001315
65	SK	0.051221	0.109366	0.241383	-0.003263	-0.001913
66	CB	0.191286	-0.324254	0.431515	-0.002257	-0.001826

FVS number	Alpha Code	Model Coefficients				
		β_7	β_8	β_9	β_{10}	β_{11}
67	TO	-0.196932	0.51463	-0.033854	-0.002773	-0.002901
68	LK	0.421803	0.296509	0.381808	-0.001526	-0.002253
69	OV	-0.977891	-0.311322	0.427943	-0.001416	-0.002636
70	BJ	-0.147407	0.241882	0.056739	-0.003558	-0.001825
71	SN	-0.342161	0.077775	0.086499	-0.004171	-0.001962
72	CK	-0.008808	0.471906	0.733279	-0.000299	-0.001711
73	WK	0.073469	-0.165679	0.130856	-0.003479	-0.001641
74	CO	-0.05605	0.003947	0.597032	-0.001112	-0.001536
75	RO	-0.042528	0.110336	0.466082	-0.000908	-0.001131
76	QS	0.176391	0.069174	0.4556	-0.000482	-0.002125
77	PO	0.009165	0.054469	0.514612	-0.003306	-0.001375
78	BO	-0.033568	0.054762	0.527504	-0.002235	-0.000862
79	LO	-0.1742	-0.102828	0.073672	-0.003217	-0.000779
80	BK	-0.084806	0.127896	0.396699	-0.001858	-0.001674
81	WI	-0.083002	0.059529	0.093966	0	-0.001075
82	SS	-0.021681	-0.069965	0.542693	-0.002593	-0.000345
83	BW	0.235707	-0.055862	0.253525	-0.001236	-0.002875
84	EL	-0.064524	-0.146557	-0.083383	-0.003132	-0.001352
85	WE	0.272172	0.248287	0.348136	-0.002975	-0.00103
86	AE	0.228712	0.069806	0.516517	-0.003114	-0.001524
87	RL	-0.216082	0.037837	0.430393	-0.00133	-0.002098
88	OS	0.077542	-0.025792	0.177408	-0.00362	-0.00189
89	OH	-0.236535	0.201149	-0.208915	-0.003145	0
90	OT	0.112883	0.158354	0.719652	0	-0.002468

Table 4.7.1.2 Default coefficients for the *FORTYPE* (β_{12}) categorical variable of the diameter increment model by species for the SN variant.

FVS Number	Alpha Code	Base *FORTYPE*	Forest Type Group Codes*						
			FTLOHD	FTNOHD	FTOKPN	FTSFHP	FTUPHD	FTUPOK	FTYLPN
1	FR	FTUPOK	0	-0.023264	0.294886	-0.271743	-0.004304	0	0.039012
2	JU	FTUPOK	0.128828	-0.020186	0.054362	0	0.079239	0	0.144288
3	PI	FTUPOK	0	-0.023264	0.294886	-0.271743	-0.004304	0	0.039012
4	PU	FTYLPN	1.214007	0	0.751229	0	1.139953	0.23948	0
5	SP	FTYLPN	0.106418	0.45502	0.017518	0	0.066811	-0.040181	0
6	SA	FTYLPN	0.325861	0	0.116235	0	0.16202	0.410684	0
7	SR	FTLOHD	0	0	-0.09895	0	0.072308	-0.055071	-0.236871
8	LL	FTYLPN	0.048216	0	0.088872	0	0.08672	0.106061	0
9	TM	FTYLPN	-0.059007	0.325781	0.04537	0.091999	-0.004333	-0.067779	0
10	PP	FTUPHD	0	-0.110161	-0.010394	0.043707	0	-0.315855	0.116814
11	PD	FTYLPN	0.187724	0	0.044416	0	0.482241	0.296549	0
12	WP	FTUPHD	-0.585211	-0.062163	-0.073668	-0.198969	0	0.022013	0.046063
13	LP	FTYLPN	0.126441	-0.122163	0.050835	0	0.063669	-0.016885	0
14	VP	FTYLPN	-0.059007	0.325781	0.04537	0.091999	-0.004333	-0.067779	0
15	BY	FTLOHD	0	-0.050765	-0.201498	0	0.19488	0.081554	-0.324291
16	PC	FTLOHD	0	0	-0.196837	0	0	0	-0.24176
17	HM	FTUPOK	0	-0.023264	0.294886	-0.271743	-0.004304	0	0.039012
18	FM	FTLOHD	0	-0.581137	-0.049388	0	-0.021913	-0.323458	0.304165
19	BE	FTLOHD	0	0.197314	-0.002307	-0.361488	0.213336	-0.003385	-0.252234
20	RM	FTLOHD	0	-0.008575	-0.091712	-0.2265	-0.115718	-0.233899	-0.000042
21	SV	FTLOHD	0	-0.008575	-0.091712	-0.2265	-0.115718	-0.233899	-0.000042
22	SM	FTUPOK	0.177698	0.081088	-0.00783	0.268289	0.018085	0	-0.969059

FVS Number	Alpha Code	Base *FORTYPE*	Forest Type Group Codes*						
			FTLOHD	FTNOHD	FTOKPN	FTSFHP	FTUPHD	FTUPOK	FTYLPN
23	BU	FTNOHD	0.276485	0	0	0	-0.158379	-0.066001	0
24	BB	FTLOHD	0	-0.090106	-0.211483	-0.11285	-0.150287	-0.229603	-0.122245
25	SB	FTLOHD	0	-0.090106	-0.211483	-0.11285	-0.150287	-0.229603	-0.122245
26	AH	FTLOHD	0	0.107053	-0.184779	0	-0.144979	-0.125931	-0.023984
27	HI	FTUPOK	0.307092	0.127121	0.075082	0.163686	0.145813	0	0.091028
28	CA	FTLOHD	0	0	-0.122639	0	-0.227215	0.428371	-0.127654
29	HB	FTLOHD	0	-0.020917	-0.227013	0	-0.0466	-0.142184	-0.37316
30	RD	FTUPHD	-0.131762	-0.159125	0.081533	0	0	-0.091293	0.005318
31	DW	FTUPOK	0.193678	0.080191	0.22776	-0.207255	0.123444	0	0.395749
32	PS	FTYLPN	0.140335	0.008246	-0.030083	0	0.064726	-0.063738	0
33	AB	FTUPOK	0.139891	0.094979	0.112394	0.191476	0.098473	0	0.301892
34	AS	FTLOHD	0	0.065051	-0.006241	0.243386	0.009788	-0.041769	-0.049053
35	WA	FTUPOK	0.112081	0.244086	-0.042491	0	0.199271	0	0.256243
36	BA	FTLOHD	0	0.003456	-0.108803	0	-0.01864	-0.08551	-0.27944
37	GA	FTLOHD	0	0.003456	-0.108803	0	-0.01864	-0.08551	-0.27944
38	HL	FTLOHD	0	0	-0.228299	0	-0.170453	-0.17868	-0.343244
39	LB	FTLOHD	0	0	-0.063217	0	-0.297261	0	0.065035
40	HA	FTUPOK	0	-0.063207	0	0	-0.111645	0	0
41	HY	FTLOHD	0	-0.003095	-0.007689	0	-0.082245	-0.187742	-0.008297
42	BN	FTUPHD	0.163749	-0.176854	-0.164651	-0.557302	0	-0.156488	-0.23263
43	WN	FTUPHD	0.163749	-0.176854	-0.164651	-0.557302	0	-0.156488	-0.23263
44	SU	FTLOHD	0	0.057604	-0.090836	0.491153	-0.155894	-0.168272	0.058458
45	YP	FTUPHD	0.083904	0.057388	-0.055234	-0.499954	0	-0.090655	0.053935
46	MG	FTLOHD	0	-0.326815	-0.017682	0	-0.029526	-0.096994	-0.031043
47	CT	FTUPOK	-0.295834	0.049636	-0.353219	0	0.008351	0	-0.627226
48	MS	FTLOHD	0	-0.153348	0.183663	-0.024673	0.055907	0.109578	0.052422
49	MV	FTLOHD	0	-0.326815	-0.017682	0	-0.029526	-0.096994	-0.031043
50	ML	FTLOHD	0	-0.153348	0.183663	-0.024673	0.055907	0.109578	0.052422
51	AP	FTLOHD	0	-0.357484	0.01002	0	-0.023979	-0.02495	0.272524
52	MB	FTLOHD	0	-0.357484	0.01002	0	-0.023979	-0.02495	0.272524
53	WT	FTLOHD	0	0	-0.203627	0	0.066993	0.696768	0.045531
54	BG	FTUPOK	0.114656	0.063092	0.076702	-0.447981	0.111483	0	0.22918
55	TS	FTLOHD	0	0.580807	-0.116496	0	-0.11074	-0.195302	0.006188
56	HH	FTLOHD	0	-0.154634	-0.087145	0	-0.071133	-0.204189	0.120468
57	SD	FTUPOK	0.076657	0.352409	0.079881	-0.131538	-0.023003	0	0.300435
58	RA	FTLOHD	0	-1.199357	-0.022774	0	0.060206	0.390875	-0.045807
59	SY	FTLOHD	0	-0.019656	-0.262507	0	-0.150643	-0.161551	-0.239422
60	CW	FTLOHD	0	0	-0.122639	0	-0.227215	0.428371	-0.127654
61	BT	FTLOHD	0	0	-0.122639	0	-0.227215	0.428371	-0.127654
62	BC	FTUPOK	0.181563	0.303382	0.162524	0	0.146052	0	0.203538
63	WO	FTUPOK	0.214921	0.196181	0.106951	0.210088	0.100081	0	0.154886
64	SO	FTUPOK	0.081994	0.17408	0.073767	-0.126888	0.089055	0	0.015718
65	SK	FTUPOK	0.148989	0.201455	0.055742	0	0.06846	0	0.047989
66	CB	FTLOHD	0	0.130043	-0.065943	0	-0.066026	-0.114309	-0.023093
67	TO	FTUPOK	-0.049627	0	0.167384	0	0.09929	0	0.184647
68	LK	FTLOHD	0	-0.127737	0.029504	0	-0.053091	0.012219	0.03069
69	OV	FTLOHD	0	-0.924265	-0.183514	0	-0.083244	-0.057771	-0.076588
70	BJ	FTUPOK	-0.123167	0	0.000279	0	0.170335	0	-0.096186

FVS Number	Alpha Code	Base *FORTYPE*	Forest Type Group Codes*						
			FTLOHD	FTNOHD	FTOKPN	FTSFHP	FTUPHD	FTUPOK	FTYLPN
71	SN	FTLOHD	0	-0.28634	0.07676	0	0.037457	0.010126	0.088233
72	CK	FTUPOK	0.086112	0.035396	0.021275	0	0.111528	0	-0.518898
73	WK	FTLOHD	0	0.044529	-0.042926	0	-0.088049	-0.08591	-0.068603
74	CO	FTUPOK	0.237228	0.136033	0.030761	-0.23819	0.096751	0	0.053589
75	RO	FTUPOK	0.103731	0.207951	0.010721	-0.023986	0.138142	0	0.052338
76	QS	FTUPOK	0.139953	0.207603	0.009285	0	0.13252	0	0.219845
77	PO	FTUPOK	0.268975	0.482744	0.042786	0	0.090618	0	0.056597
78	BO	FTUPOK	0.049693	0.272007	0.034224	-0.104624	0.071804	0	-0.044373
79	LO	FTLOHD	0	0	0.074099	0	0.061718	0.229807	-0.043042
80	BK	FTUPHD	0.138241	0.117354	-0.097572	0	0	-0.083039	-0.046524
81	WI	FTLOHD	0	0	0.001536	0	0.019648	0.165022	-0.001371
82	SS	FTUPHD	-0.058475	0.013995	-0.139506	0.414214	0	-0.166983	-0.018172
83	BW	FTNOHD	0.067203	0	0.008236	0	-0.033491	0.012197	0.14852
84	EL	FTLOHD	0	-0.005493	-0.263842	0	-0.054579	-0.202033	0.071996
85	WE	FTUPOK	0.211919	0.11261	0.174149	0	0.168458	0	0.364012
86	AE	FTLOHD	0	-0.221068	-0.019557	0	-0.210607	-0.237209	0.137175
87	RL	FTLOHD	0	-0.23243	-0.086137	0	-0.073558	-0.242294	0.177563
88	OS	FTUPOK	0.128828	-0.020186	0.054362	0	0.079239	0	0.144288
89	OH	FTLOHD	0	-0.154634	-0.087145	0	-0.071133	-0.204189	0.120468
90	OT	NONE	0	0	0	0	0	0	0

* Forest Type Group Code definitions are as follows:

FTLOHD = Lowland Hardwoods, forest cover types: 168, 508, 601, 602, 605, 606, 607, 608, 702, 703, 704, 705, 706, 708
FTNOHD = Northern Hardwoods, forest cover types: 701, 801, 805
FTOKPN = Oak – Pine, forest cover types:165, 403, 404, 405, 406, 407, 409
FTSFHP = Spruce – Fir – Hemlock – Pine, forest cover types: 104, 105, 121, 124
FTUPHD = Upland Hardwoods, forest cover types: 103, 167, 181, 401, 402, 506, 511, 512, 513, 519, 520, 802, 807, 809
FTUPOK = Upland Oak, forest cover types: 501, 502, 503, 504, 505, 510, 514, 515
FTYLPN = Yellow Pine, forest cover types: 141, 142, 161, 162, 163, 164, 166

Table 4.7.1.3 Default coefficients for the *ECOUNIT* (β_{13}) categorical variable of the diameter increment model by species for the SN variant.

FVS number	Alpha Code	Base ECOUNIT	Model Coefficients					
			M221	M222	M231	221	222	231A
1	FR	M221	0	0	0	-0.121082	0	0.022498
2	JU	P231A	0.131771	0.217904	0.436986	0.083896	-0.005539	0
3	PI	M221	0	0	0	-0.121082	0	0.022498
4	PU	P232	0	0	0	0	0	0
5	SP	P231B	-0.569409	-0.252741	-0.265699	-0.694484	-0.285112	-0.504565
6	SA	P232	0	0	0	0	0	-0.025549
7	SR	P232	0	0	0	0	0	0
8	LL	P232	0	0	0	0	0	-0.175073
9	TM	P231A	-0.157516	0	0	-0.107642	-0.034553	0
10	PP	M221	0	0	0	0.020105	-0.297952	0.236656
11	PD	P232	0	0	0	0	0	0
12	WP	M221	0	0	0	-0.06563	-0.450665	0.102041
13	LP	P232	-0.069716	0.581967	0.790149	-0.584818	-0.364073	-0.183317
14	VP	P231A	-0.157516	0	0	-0.107642	-0.034553	0
15	BY	P232	0	0	0	0	0.230225	0.457755
16	PC	P232	0	0	0	0	0	0
17	HM	M221	0	0	0	-0.121082	0	0.022498

FVS number	Alpha Code	Base ECOUNIT	Model Coefficients					
			M221	M222	M231	221	222	231A
18	FM	P231A	0	0.044974	-0.121719	0	0.289979	0
19	BE	P234	-0.202911	-0.354429	0.37115	-0.282925	-0.250799	-0.351211
20	RM	P232	-0.010003	-0.15782	-0.04678	0.171661	0.170429	-0.031739
21	SV	P232	-0.010003	-0.15782	-0.04678	0.171661	0.170429	-0.031739
22	SM	P222	-0.074887	-0.21626	0	0.064792	0	-0.207182
23	BU	M221	0	0	0	0.168179	0.024888	0.029753
24	BB	M221	0	0.379877	-0.528365	0.30676	0.167634	0.178981
25	SB	M221	0	0.379877	-0.528365	0.30676	0.167634	0.178981
26	AH	P232	-0.260665	-0.170424	-0.314804	-0.11468	0.04355	-0.090864
27	HI	P231A	0.03407	-0.221662	-0.17272	0.04251	-0.012725	0
28	CA	P234	0	0	0	0	-0.010636	-0.380297
29	HB	P234	-0.435211	-0.117993	-0.495339	-0.347813	-0.336521	-0.32578
30	RD	P231A	0.147356	0.184427	-0.070292	0.281057	0.322736	0
31	DW	P231A	0.101205	0.352912	0.166296	0.233779	0.104553	0
32	PS	P232	0.111933	-0.023333	0.289483	0.480859	0.215139	-0.049742
33	AB	P232	-0.191377	-0.370162	-0.181571	-0.105676	0.093229	0.006941
34	AS	P232	0.424837	0	0	-0.181787	0	0.073246
35	WA	P222	-0.082465	-0.149061	-0.241677	-0.146698	0	-0.208643
36	BA	P234	0.1469	-0.443396	-0.448423	-0.133024	-0.079056	-0.119819
37	GA	P234	0.1469	-0.443396	-0.448423	-0.133024	-0.079056	-0.119819
38	HL	P234	-0.256637	-0.149473	0.04739	-0.34169	-0.215198	-0.396963
39	LB	P232	0	0	0	0	0	0
40	HA	M221	0	0	0	0	0	-0.211742
41	HY	P232	-0.126229	0	0	-0.278119	-0.179796	0.019636
42	BN	P222	-0.071073	0.374367	-0.05879	-0.072556	0	-0.015672
43	WN	P222	-0.071073	0.374367	-0.05879	-0.072556	0	-0.015672
44	SU	P232	0.214847	-0.027123	-0.098745	0.311384	0.203471	-0.034773
45	YP	P231A	-0.035012	0	0	0.114831	0.255257	0
46	MG	P232	-1.72121	0	0	-0.438669	0	-0.316872
47	CT	M221	0	-0.333954	0	0.326227	-0.158005	-0.089037
48	MS	P232	-0.184013	-0.708021	0	-0.947356	0	-0.256347
49	MV	P232	-1.72121	0	0	-0.438669	0	-0.316872
50	ML	P232	-0.184013	-0.708021	0	-0.947356	0	-0.256347
51	AP	P231B	0.352576	0.128982	0.243569	0.26906	0.000219	-0.25349
52	MB	P231B	0.352576	0.128982	0.243569	0.26906	0.000219	-0.25349
53	WT	P232	0	0	0	0	0.18624	-1.048379
54	BG	P232	-0.014903	-0.266804	-0.251634	-0.000477	0.058798	-0.116789
55	TS	P232	0	0	0	0	0	0.01815
56	HH	P232	-0.041534	0.13042	0.212883	0.110701	-0.130543	-0.02585
57	SD	P231A	0.012432	0	0	0.160384	0.079502	0
58	RA	P232	0	0	0	0	0	0
59	SY	P234	-0.308437	-0.468897	-0.573635	-0.163987	-0.291934	-0.312825
60	CW	P234	0	0	0	0	-0.010636	-0.380297
61	BT	P234	0	0	0	0	-0.010636	-0.380297
62	BC	P231A	0.290593	0.163528	-0.111387	0.060201	0.089278	0
63	WO	P231A	-0.191164	-0.155148	-0.154994	-0.063321	-0.031876	0
64	SO	P231A	-0.258781	0	0	-0.063421	-0.023554	0
65	SK	P231B	-0.294531	-0.267829	-0.113549	-0.146202	-0.078697	-0.142921
66	CB	P231B	-0.303022	-0.568197	-0.001804	-0.301395	-0.106435	-0.139157
67	TO	P232	0	0	0	0	0	-0.141504
68	LK	P232	0	0	0	0	0	-0.18474
69	OV	P234	0	0	-0.506825	0	0.074902	-0.083491
70	BJ	P232	-0.172582	0.107373	-0.084775	0.127193	-0.066699	-0.052485
71	SN	P232	-0.25241	0	-0.27847	-0.201638	0.222377	-0.053375

FVS number	Alpha Code	Base ECOUNIT	Model Coefficients					
			M221	M222	M231	221	222	231A
72	CK	P222	-0.039862	-0.110433	-0.170239	0.024645	0	0.126865
73	WK	P232	0.197053	0.108061	-0.061415	-0.343207	-0.056293	-0.113493
74	CO	M221	0	0	0	0.15138	0.200026	0.204279
75	RO	M221	0	0.023769	0.058308	0.043448	0.036206	0.132129
76	QS	P231B	-0.854641	-0.590369	-0.160338	-0.190715	-0.329148	-0.237106
77	PO	P231B	-0.042633	-0.25256	-0.243734	-0.162999	-0.160463	-0.048463
78	BO	P222	-0.122266	-0.144853	-0.16313	0.021869	0	-0.048649
79	LO	P232	0	0	0	0	0	0
80	BK	M221	0	-0.174431	0.170467	0.016664	0.035772	0.047888
81	WI	P234	-0.316154	0	0	-0.36058	0.031358	0.151013
82	SS	P222	-0.109616	0.068664	-0.981901	-0.066394	0	-0.153195
83	BW	M221	0	0.022312	0.378775	0.195305	0.106462	-0.145798
84	EL	P231A	0.340206	-0.330585	0.261703	0.431384	-0.107188	0
85	WE	P231B	0.11777	-0.235842	-0.43592	-0.036156	-0.229106	0.125704
86	AE	P234	-0.312702	-0.097041	-0.361568	-0.127373	-0.293653	-0.413743
87	RL	P231B	-0.167102	-0.292978	0.084842	-0.229308	-0.287173	-0.014656
88	OS	P231A	0.131771	0.217904	0.436986	0.083896	-0.005539	0
89	OH	P232	-0.041534	0.13042	0.212883	0.110701	-0.130543	-0.02585
90	OT	NONE	0	0	0	0	0	0

* Provincial code 231A includes sections A, C, and D. Provincial code 231B includes sections B, E, F, and G.

FVS number	Alpha Code	Base ECOUNIT	Model Coefficients				
			231B	232	234	255	411
1	FR	M221	-0.097721	0	0	0	0
2	JU	P231A	0.49074	0.399497	0.938548	1.088152	0
3	PI	M221	-0.097721	0	0	0	0
4	PU	P232	0	0	0	0	0
5	SP	P231B	0	-0.113258	0.114097	0.092458	0
6	SA	P232	0.324111	0	0.306793	0	-0.342293
7	SR	P232	-0.155764	0	-0.112223	0	0
8	LL	P232	-0.067793	0	0.123262	0	0
9	TM	P231A	0.025073	-0.150946	0	0	0
10	PP	M221	0	0	0	0	0
11	PD	P232	0	0	0	0	-0.205608
12	WP	M221	0	0	0	0	0
13	LP	P232	0.256273	0	0.28179	0.274618	0
14	VP	P231A	0.025073	-0.150946	0	0	0
15	BY	P232	0.154525	0	0.021935	0.288209	-0.033047
16	PC	P232	0	0	0	0	0.156623
17	HM	M221	-0.097721	0	0	0	0
18	FM	P231A	0.416909	0.163106	0.451765	0	0
19	BE	P234	-0.15656	-0.233523	0	-0.011673	0
20	RM	P232	0.111637	0	0.283893	0	-0.340066
21	SV	P232	0.111637	0	0.283893	0	-0.340066
22	SM	P222	-0.145892	0.70785	0.28978	0	0
23	BU	M221	0	0	0	0	0
24	BB	M221	0.365419	0.236959	0.417591	1.151813	0
25	SB	M221	0.365419	0.236959	0.417591	1.151813	0
26	AH	P232	0.087924	0	0.215406	0	0
27	HI	P231A	0.116846	0.113816	0.183886	0.441744	0
28	CA	P234	-0.091346	-0.145951	0	-0.227224	0
29	HB	P234	-0.130359	-0.212093	0	-0.208957	0
30	RD	P231A	0.452072	0.552309	0.255957	0.576422	0
31	DW	P231A	0.359721	0.093627	0.488202	0	0

FVS number	Alpha Code	Base ECOUNIT	Model Coefficients				
			231B	232	234	255	411
32	PS	P232	0.24935	0	0.363787	0.31787	0
33	AB	P232	-0.003611	0	-0.031277	0	0
34	AS	P232	0	0	0	0	-0.795646
35	WA	P222	-0.015617	-0.004213	0.151449	-0.056292	0
36	BA	P234	-0.116966	-0.075746	0	-0.003469	0
37	GA	P234	-0.116966	-0.075746	0	-0.003469	0
38	HL	P234	0.095929	-0.078848	0	0.115297	0
39	LB	P232	0	0	0	0	0
40	HA	M221	0	0	0	0	0
41	HY	P232	0.163182	0	-0.283774	0.941544	0
42	BN	P222	0.349608	0.255119	0.259162	0.352483	0
43	WN	P222	0.349608	0.255119	0.259162	0.352483	0
44	SU	P232	0.115389	0	0.129382	0.492438	0
45	YP	P231A	0.095383	0.113058	0.11154	0	0
46	MG	P232	0.014928	0	0.161649	0	0
47	CT	M221	0.587498	0.575938	0.572974	0	0
48	MS	P232	-0.181586	0	0.493509	0	0
49	MV	P232	0.014928	0	0.161649	0	0
50	ML	P232	-0.181586	0	0.493509	0	0
51	AP	P231B	0	-0.119399	0.032415	0.498573	0
52	MB	P231B	0	-0.119399	0.032415	0.498573	0
53	WT	P232	0.031801	0	-0.054588	0	0
54	BG	P232	0.138867	0	-0.031436	0.37582	0
55	TS	P232	0.688179	0	0.202859	0	0
56	HH	P232	0.087497	0	0.018385	0.255056	0
57	SD	P231A	0.295282	0.057285	0.424776	0	0
58	RA	P232	0.712083	0	0.489307	0	-0.1476
59	SY	P234	-0.20443	-0.167438	0	0.12295	0
60	CW	P234	-0.091346	-0.145951	0	-0.227224	0
61	BT	P234	-0.091346	-0.145951	0	-0.227224	0
62	BC	P231A	0.23992	0.12589	0.264833	1.90134	0
63	WO	P231A	0.16471	0.031862	0.089972	0.448682	0
64	SO	P231A	0.067643	0.087098	0	0	0
65	SK	P231B	0	-0.137069	0.044499	0.189435	0
66	CB	P231B	0	0.000058	-0.035715	-0.198361	0
67	TO	P232	0.987526	0	1.109686	1.446041	0
68	LK	P232	0.183278	0	0.238162	0.768121	-1.32854
69	OV	P234	0.045341	0.062981	0	-0.065887	0
70	BJ	P232	0.178459	0	-0.037201	0.380348	-0.741911
71	SN	P232	0.006612	0	0.0076	0	0
72	CK	P222	-0.010615	0.755389	0.471921	0.606309	0
73	WK	P232	0.076125	0	0.122936	0.249718	-0.26175
74	CO	M221	0.295079	0.085617	0.080911	0.585065	0
75	RO	M221	0.163239	0.205401	0.433254	0	0
76	QS	P231B	0	-0.089086	-0.19085	-0.03683	0
77	PO	P231B	0	-0.081158	0.159575	0.171401	0
78	BO	P222	0.151382	0.084829	0.369759	-0.051983	0
79	LO	P232	0	0	0.268416	0	-0.639461
80	BK	M221	0.371885	0.171124	0.240479	0.444606	0
81	WI	P234	-0.120265	-0.059706	0	-0.203095	0
82	SS	P222	0.075592	-0.040417	0.333962	0.393517	0
83	BW	M221	-0.155027	-0.071987	0.920288	0.644926	0
84	EL	P231A	0.045265	0.036098	-0.31894	0.270984	0
85	WE	P231B	0	0.070072	-0.022479	0.23536	0

FVS number	Alpha Code	Base ECOUNIT	Model Coefficients				
			231B	232	234	255	411
86	AE	P234	-0.127535	-0.043112	0	0.11986	0
87	RL	P231B	0	-0.029868	0.210046	-0.360256	0
88	OS	P231A	0.49074	0.399497	0.938548	1.088152	0
89	OH	P232	0.087497	0	0.018385	0.255056	0
90	OT	NONE	0	0	0	0	0

Table 4.7.1.4 Default coefficients for the *PLANT* (β_{14}) categorical variable of the diameter increment model by species for the SN variant.

FVS Number	Alpha Code	β_{14}
4	PU	0.173758
6	SA	0.227572
8	LL	0.110751
12	WP	0.098090
13	LP	0.245669

Table 4.7.1.5 Default DBH_{LOW} and DBH_{HI} values by species in the SN variant.

FVS Number	Alpha Code	DBH_{LOW}	DBH_{HI}
1	FR	12.0	26.0
2	JU	11.9	24.1
3	PI	12.0	38.0
4	PU	12.5	18.9
5	SP	15.3	27.9
6	SA	14.0	27.4
7	SR	20.7	32.6
8	LL	15.9	24.4
9	TM	13.7	18.7
10	PP	15.8	24.2
11	PD	15.3	28.7
12	WP	20.6	32.9
13	LP	17.1	37.2
14	VP	12.3	20.0
15	BY	26.0	79.8
16	PC	15.1	45.4
17	HM	20.5	39.3
18	FM	13.5	26.1
19	BE	15.7	26.7
20	RM	14.5	35.9
21	SV	24.1	44.2
22	SM	17.8	35.2
23	BU	20.5	35.3
24	BB	18.8	38.4
25	SB	13.3	24.9
26	AH	8.5	17.3
27	HI	17.2	38.6
28	CA	30.7	46.5
29	HB	18.8	32.9
30	RD	6.4	11.3
31	DW	5.2	9.7
32	PS	10.2	22.4
33	AB	25.5	42.8
34	AS	15.2	30.7

FVS Number	Alpha Code	DBH_{LOW}	DBH_{HI}
46	MG	14.4	32.5
47	CT	17.7	27.0
48	MS	19.8	36.5
49	MV	14.4	32.5
50	ML	19.8	36.5
51	AP	9.0	21.2
52	MB	13.0	23.6
53	WT	21.4	63.8
54	BG	16.2	30.8
55	TS	15.9	33.0
56	HH	8.8	18.6
57	SD	8.1	16.7
58	RA	7.4	19.2
59	SY	23.6	56.6
60	CW	30.7	46.5
61	BT	24.0	48.0
62	BC	12.3	26.9
63	WO	18.9	42.8
64	SO	17.7	34.5
65	SK	19.2	42.3
66	CB	25.5	46.2
67	TO	8.6	17.2
68	LK	22.1	48.1
69	OV	26.7	48.0
70	BJ	13.0	22.7
71	SN	25.1	47.2
72	CK	19.5	37.2
73	WK	22.9	47.6
74	CO	20.4	38.4
75	RO	21.3	41.1
76	QS	23.1	40.6
77	PO	17.6	38.9
78	BO	19.3	40.2
79	LO	31.4	58.8

FVS Number	Alpha Code	***DBH$_{LOW}$***	***DBH$_{HI}$***
35	WA	18.2	33.4
36	BA	18.0	36.0
37	GA	20.6	37.0
38	HL	18.4	33.2
39	LB	12.5	28.1
40	HA	14.8	20.5
41	HY	7.4	17.1
42	BN	12.0	30.0
43	WN	16.7	32.9
44	SU	16.3	39.6
45	YP	19.5	40.4

FVS Number	Alpha Code	***DBH$_{LOW}$***	***DBH$_{HI}$***
80	BK	17.2	30.8
81	WI	23.8	38.8
82	SS	11.8	25.6
83	BW	19.0	32.1
84	EL	15.4	31.4
85	WE	13.4	23.9
86	AE	19.6	46.7
87	RL	17.8	35.8
88	OS	11.9	24.1
89	OH	12.3	33.3
90	OT	9.8	20.5

4.7.2 Large Tree Height Growth

In the SN variant, the large-tree height growth model follows the approach of Wensel and others (1987) where the potential height growth is calculated for every tree and modified based on individual tree crown ratio and relative height in the stand using equation {4.7.2.1}. Potential height growth is calculated using the methodology described in the small-tree height increment model.

The crown ratio modifying function uses Hoerl’s Special Function (HSF) form (Cuthbert and Wood 1971, p. 23) identified in equation {4.7.2.2} with a range of 0.0 to 1.0. The a-c parameters are chosen so that height growth is maximized for crown ratios between 45 and 75%.

{4.7.2.1} $HTG = POTHTG * (0.25 * HGMDCR + 0.75 * HGMDRH)$

{4.7.2.2} $HGMDCR = CR^{3.0} * e^{-5.0*CR}$

where:

HTG is periodic height growth
POTHTG is the potential periodic height growth, see section 4.6.1.
HGMDCR is the crown ratio modifier (bounded to *HGMDCR* < 1.0)
HGMDRH is the relative height modifier
CR is crown ratio expressed as a proportion

The relative height modifying function (*HGMDRH*) is based on the height of the tree record compared to the top height of the stand, adjusted for shade tolerance. The modifying function is based on the Generalized Chapman-Richards function (Donnelly and Betters 1991, Donnelly and others 1992, and Pienaar and Turnbull 1973), whose parameters are set to attenuate height growth based on relative height and shade tolerance, see equation {4.7.2.3} – {4.7.2.7}. Coefficients for these equations are shown in tables 4.7.2.1 and 4.7.2.2. The modifier value (*HGMDRH*) decreases with decreasing relative height and species intolerance with a range between 0.0 and 1.0. Height growth reaches an upper asymptote of 1.0 at a relative height of 1.0 for intolerant species and 0.7 for tolerant species.

{4.7.2.3} $FCTRKX = ((RHK / RHYXS)^{(RHM - 1)}) - 1$

{4.7.2.4} $FCTRRB = (-1.0 * RHR) / (1 - RHB)$

{4.7.2.5} $FCTRXB = RELHT^{(1 - \mathrm{RHB})} - \mathrm{RHXS}^{(1 - \mathrm{RHB})}$

{4.7.2.6} $FCTRM = 1 / (1 - \mathrm{RHM})$

{4.7.2.7} $HGMDRH = \mathrm{RHK} * (1 + FCTRKX * e^{FCTRRB*FCTRXB})^{FCTRM}$

where:

RELHT is the subject tree's height relative to the 40 tallest trees in the stand
HGMDRH is the relative height modifier used in equation {4.7.2.1} above
RH… are coefficients based on shade tolerance of a species shown in table 4.7.2.1

Table 4.7.2.1 Shade tolerance coefficients for equations {4.7.2.3} – {4.7.2.7} the SN variant.

Shade Tolerance	RHR	RHYXS	RHM	RHB	RHXS	RHK
Very Tolerant	20	0.20	1.1	-1.10	0	1
Tolerant	16	0.15	1.1	-1.20	0	1
Intermediate	15	0.10	1.1	-1.45	0	1
Intolerant	13	0.05	1.1	-1.60	0	1
Very Intolerant	12	0.01	1.1	-1.60	0	1

Table 4.7.2.2 Shade tolerance by species in the SN variant.

FVS Number	Alpha Code	Shade Tolerance	FVS Number	Alpha Code	Shade Tolerance	FVS Number	Alpha Code	Shade Tolerance
1	FR	Very Tolerant	31	DW	Very Tolerant	61	BT	Very Intolerant
2	JU	Intolerant	32	PS	Very Tolerant	62	BC	Intolerant
3	PI	Tolerant	33	AB	Very Tolerant	63	WO	Intermediate
4	PU	Intolerant	34	AS	Tolerant	64	SO	Very Intolerant
5	SP	Intolerant	35	WA	Intolerant	65	SK	Intermediate
6	SA	Intolerant	36	BA	Intolerant	66	CB	Intolerant
7	SR	Very Tolerant	37	GA	Tolerant	67	TO	Intolerant
8	LL	Intolerant	38	HL	Intolerant	68	LK	Tolerant
9	TM	Intolerant	39	LB	Tolerant	69	OV	Intermediate
10	PP	Intolerant	40	HA	Tolerant	70	BJ	Intolerant
11	PD	Intolerant	41	HY	Very Tolerant	71	SN	Intolerant
12	WP	Intermediate	42	BN	Intolerant	72	CK	Intolerant
13	LP	Intolerant	43	WN	Intolerant	73	WK	Intolerant
14	VP	Intolerant	44	SU	Intolerant	74	CO	Intermediate
15	BY	Intermediate	45	YP	Intolerant	75	RO	Intermediate
16	PC	Intermediate	46	MG	Tolerant	76	QS	Intolerant
17	HM	Very Tolerant	47	CT	Intermediate	77	PO	Intolerant
18	FM	Tolerant	48	MS	Tolerant	78	BO	Intermediate
19	BE	Tolerant	49	MV	Intermediate	79	LO	Intermediate
20	RM	Tolerant	50	ML	Tolerant	80	BK	Very Intolerant
21	SV	Tolerant	51	AP	Intolerant	81	WI	Very Intolerant
22	SM	Very Tolerant	52	MB	Tolerant	82	SS	Intolerant
23	BU	Tolerant	53	WT	Intolerant	83	BW	Tolerant
24	BB	Intolerant	54	BG	Tolerant	84	EL	Intermediate
25	SB	Intolerant	55	TS	Intolerant	85	WE	Tolerant
26	AH	Very Tolerant	56	HH	Tolerant	86	AE	Intermediate
27	HI	Intermediate	57	SD	Tolerant	87	RL	Tolerant
28	CA	Intolerant	58	RA	Tolerant	88	OS	Intermediate
29	HB	Intermediate	59	SY	Intermediate	89	OH	Intermediate
30	RD	Tolerant	60	CW	Very Intolerant	90	OT	Intermediate

5.0 MORTALITY MODEL

In the SN variant there are two types of mortality. The first is background mortality which accounts for occasional tree mortality in stands when the stand density is below a specified level. The second is density related mortality which determines mortality rates for individual trees based on their relationship with the stand's maximum density. Maximum density values are described in section 3.5. A detailed description of the mortality equations and how they are applied to individual trees can be found in section 7.3.2 of the Essential FVS guide (Dixon 2002).

5.1 Background Mortality

The equation used to calculate background mortality for all species is shown in equation {5.1.1}. This annual rate is adjusted to the length of the cycle by using a compound interest formula as shown in equation {5.1.2}.

{5.1.1} $RI = [1 / (1 + e^{(b_1 + b_2 * DBH)})] * 0.5$

{5.1.2} $RIP = 1 – (1 – RI)^{Y}$

where:

RI	is the proportion of the tree record attributed to mortality
RIP	is the final mortality rate adjusted to the length of the cycle
DBH	is tree diameter at breast height
Y	is length of the current projection cycle in years
b_1, b_2	are species-specific coefficients shown in table 5.1.1

Table 5.1.1 Default coefficients used in the background mortality equation {5.1.1} in the SN variant.

FVS Number	Alpha Code	b_1	b_2
1	FR	5.1676998	-0.0077681
2	JU	9.6942997	-0.0127328
3	PI	5.1676998	-0.0077681
4	PU	5.5876999	-0.0053480
5	SP	5.5876999	-0.0053480
6	SA	5.5876999	-0.0053480
7	SR	5.1676998	-0.0077681
8	LL	5.5876999	-0.0053480
9	TM	5.5876999	-0.0053480
10	PP	5.5876999	-0.0053480
11	PD	5.5876999	-0.0053480
12	WP	5.5876999	-0.0053480
13	LP	5.5876999	-0.0053480
14	VP	5.5876999	-0.0053480
15	BY	5.5876999	-0.0053480
16	PC	5.5876999	-0.0053480
17	HM	5.1676998	-0.0077681
18	FM	5.1676998	-0.0077681
19	BE	5.1676998	-0.0077681
20	RM	5.1676998	-0.0077681
21	SV	5.1676998	-0.0077681
22	SM	5.1676998	-0.0077681
46	MG	5.1676998	-0.0077681
47	CT	5.9617000	-0.0340128
48	MS	5.1676998	-0.0077681
49	MV	5.9617000	-0.0340128
50	ML	5.1676998	-0.0077681
51	AP	5.9617000	-0.0340128
52	MB	5.1676998	-0.0077681
53	WT	5.9617000	-0.0340128
54	BG	5.1676998	-0.0077681
55	TS	5.9617000	-0.0340128
56	HH	5.1676998	-0.0077681
57	SD	5.1676998	-0.0077681
58	RA	5.1676998	-0.0077681
59	SY	5.9617000	-0.0340128
60	CW	5.9617000	-0.0340128
61	BT	5.9617000	-0.0340128
62	BC	5.9617000	-0.0340128
63	WO	5.9617000	-0.0340128
64	SO	5.9617000	-0.0340128
65	SK	5.9617000	-0.0340128
66	CB	5.9617000	-0.0340128
67	TO	5.9617000	-0.0340128

23	BU	5.1676998	-0.0077681
24	BB	5.9617000	-0.0340128
25	SB	5.1676998	-0.0077681
26	AH	5.1676998	-0.0077681
27	HI	5.9617000	-0.0340128
28	CA	5.9617000	-0.0340128
29	HB	5.9617000	-0.0340128
30	RD	5.1676998	-0.0077681
31	DW	5.1676998	-0.0077681
32	PS	5.1676998	-0.0077681
33	AB	5.1676998	-0.0077681
34	AS	5.1676998	-0.0077681
35	WA	5.9617000	-0.0340128
36	BA	5.9617000	-0.0340128
37	GA	5.1676998	-0.0077681
38	HL	5.9617000	-0.0340128
39	LB	5.1676998	-0.0077681
40	HA	5.1676998	-0.0077681
41	HY	5.1676998	-0.0077681
42	BN	5.9617000	-0.0340128
43	WN	5.9617000	-0.0340128
44	SU	5.9617000	-0.0340128
45	YP	5.9617000	-0.0340128
68	LK	5.1676998	-0.0077681
69	OV	5.9617000	-0.0340128
70	BJ	5.9617000	-0.0340128
71	SN	5.9617000	-0.0340128
72	CK	5.9617000	-0.0340128
73	WK	5.9617000	-0.0340128
74	CO	5.9617000	-0.0340128
75	RO	5.9617000	-0.0340128
76	QS	5.9617000	-0.0340128
77	PO	5.9617000	-0.0340128
78	BO	5.9617000	-0.0340128
79	LO	5.9617000	-0.0340128
80	BK	5.1676998	-0.0077681
81	WI	5.1676998	-0.0077681
82	SS	5.1676998	-0.0077681
83	BW	5.1676998	-0.0077681
84	EL	5.1676998	-0.0077681
85	WE	5.1676998	-0.0077681
86	AE	5.1676998	-0.0077681
87	RL	5.1676998	-0.0077681
88	OS	5.5876999	-0.0053480
89	OH	5.9617000	-0.0340128
90	OT	5.9617000	-0.0340128

5.2 Density-Related Mortality

When density-related mortality is in effect, mortality is determined based on the trajectory developed from the relationship between stand SDI and the maximum SDI for the stand. In the SN variant, mortality is dispersed to individual tree records in relation to a tree's percentile in the basal area distribution (*PCT*) using equation {5.2.1}. This value is then adjusted by a species-specific mortality modifier (representing the species' shade tolerance) to obtain a final mortality rate as shown in equation {5.2.2}.

The mortality model makes multiple passes through the tree records multiplying a record's trees-per-acre value times the final mortality rate (*MORT*), accumulating the results, and reducing the trees-per-acre representation until the desired mortality level has been reached.

{5.2.1} $MR = 0.84525 - (0.01074 * PCT) + (0.0000002 * PCT^3)$

{5.2.2} $MORT = MR * MWT * 0.1$

where:

MR	is the proportion of the tree record attributed to mortality (bounded: $0.01 \leq MR \leq 1$)
PCT	is the subject tree's percentile in the basal area distribution of the stand
RELHT	is tree height divided by average height of the 40 largest diameter trees in the stand
MORT	is the final mortality rate of the tree record
MWT	is a mortality weight value based on a species' tolerance shown in table 5.2.1

Table 5.2.1 Default *MWT* values for the mortality equation {5.2.2} in the SN variant.

FVS Number	Alpha Code	MWT	FVS Number	Alpha Code	MWT	FVS Number	Alpha Code	MWT
1	FR	0.1	31	DW	0.1	61	BT	0.9
2	JU	0.7	32	PS	0.1	62	BC	0.7
3	PI	0.3	33	AB	0.1	63	WO	0.5
4	PU	0.7	34	AS	0.3	64	SO	0.9
5	SP	0.7	35	WA	0.7	65	SK	0.5
6	SA	0.7	36	BA	0.7	66	CB	0.7
7	SR	0.1	37	GA	0.3	67	TO	0.7
8	LL	0.7	38	HL	0.7	68	LK	0.3
9	TM	0.7	39	LB	0.3	69	OV	0.5
10	PP	0.7	40	HA	0.3	70	BJ	0.7
11	PD	0.7	41	HY	0.1	71	SN	0.7
12	WP	0.5	42	BN	0.7	72	CK	0.7
13	LP	0.7	43	WN	0.7	73	WK	0.7
14	VP	0.7	44	SU	0.7	74	CO	0.5
15	BY	0.5	45	YP	0.7	75	RO	0.5
16	PC	0.5	46	MG	0.3	76	QS	0.7
17	HM	0.1	47	CT	0.5	77	PO	0.7
18	FM	0.3	48	MS	0.3	78	BO	0.5
19	BE	0.3	49	MV	0.5	79	LO	0.5
20	RM	0.3	50	ML	0.3	80	BK	0.9
21	SV	0.3	51	AP	0.7	81	WI	0.9
22	SM	0.1	52	MB	0.3	82	SS	0.7
23	BU	0.3	53	WT	0.7	83	BW	0.3
24	BB	0.7	54	BG	0.3	84	EL	0.5
25	SB	0.7	55	TS	0.7	85	WE	0.3
26	AH	0.1	56	HH	0.3	86	AE	0.5
27	HI	0.5	57	SD	0.3	87	RL	0.3
28	CA	0.7	58	RA	0.3	88	OS	0.5
29	HB	0.5	59	SY	0.5	89	OH	0.5
30	RD	0.3	60	CW	0.9	90	OT	0.5

6.0 REGENERATION

The SN variant contains a partial establishment model which may be used to input regeneration and ingrowth into simulations. A more detailed description of how the partial establishment model works can be found in section 5.4.5 of the Essential FVS Guide (Dixon 2002).

The regeneration model is used to simulate stand establishment from bare ground, or to bring seedlings and sprouts into a simulation with existing trees. Sprouts are automatically added to the simulation following harvest or burning of known sprouting species (see table 6.0.1 for sprouting species). Users wanting to modify or turn off automatic sprouting can do so with the SPROUT or NOSPROUT keywords, respectively. Sprouts are not subject to maximum and minimum tree heights found in table 6.0.1 and do not need to be grown to the end of the cycle because estimated heights and diameters are end of cycle values.

Regeneration of seedlings must be specified by the user with the partial establishment model by using the PLANT or NATURAL keywords. Height of the seedlings is estimated in two steps. First, the height is estimated when a tree is 5 years old (or the end of the cycle – whichever comes first) by using the small-tree height growth equations found in section 4.6.1. Users may override this value by entering a height in field 6 of the PLANT or NATURAL keyword; however the height entered in field 6 is not subject to minimum height restrictions and seedlings as small as 0.05 feet may be established. The second step also uses the equations in section 4.6.1, which grow the trees in height from the point five years after establishment to the end of the cycle.

Seedlings and sprouts are passed to the main FVS model at the end of the growth cycle in which regeneration is established. Unless noted above, seedlings being passed are subject to minimum and maximum height constraints and a minimum budwidth constraint shown in Table 6.0.1. After seedling height is estimated, diameter growth is estimated using equations described in section 4.6.2. Crown ratios on newly established trees are estimated as described in section 4.3.1.

Regenerated trees and sprouts can be identified in the treelist output file with tree identification numbers beginning with the letters “ES”.

Table 6.0.1 Default regeneration parameters by species in the SN variant.

FVS Number	Alpha Code	Sprouting Species?	Minimum Bud Width (in)	Minimum Tree Height (ft)	Maximum Tree Height (ft)
1	FR	No	0.1	0.50	23
2	JU	No	0.3	2.08	27
3	PI	No	0.2	0.50	21
4	PU	No	0.5	1.00	21
5	SP	No	0.5	1.32	22
6	SA	No	0.5	2.51	20
7	SR	No	0.5	0.50	24
8	LL	No	0.5	2.53	18
9	TM	No	0.5	2.75	18
10	PP	No	0.5	0.50	17
11	PD	No	0.5	5.05	22
12	WP	No	0.4	0.50	20
13	LP	No	0.5	4.70	20
14	VP	No	0.5	0.50	20

FVS Number	Alpha Code	Sprouting Species?	Minimum Bud Width (in)	Minimum Tree Height (ft)	Maximum Tree Height (ft)
15	BY	Yes	0.2	1.33	20
16	PC	Yes	0.2	1.33	20
17	HM	No	0.1	0.66	20
18	FM	Yes	0.2	2.40	20
19	BE	Yes	0.2	1.35	20
20	RM	Yes	0.2	1.35	20
21	SV	Yes	0.2	2.03	20
22	SM	Yes	0.2	0.50	20
23	BU	No	0.3	0.50	20
24	BB	No	0.1	0.50	20
25	SB	No	0.1	0.50	20
26	AH	No	0.2	2.08	20
27	HI	Yes	0.3	0.51	20
28	CA	No	0.3	0.63	20
29	HB	No	0.1	2.08	20
30	RD	No	0.2	2.08	20
31	DW	Yes	0.1	2.08	20
32	PS	No	0.2	2.08	20
33	AB	No	0.1	0.50	20
34	AS	Yes	0.2	0.50	20
35	WA	Yes	0.2	0.50	20
36	BA	Yes	0.2	0.92	20
37	GA	Yes	0.2	0.50	20
38	HL	Yes	0.1	5.98	20
39	LB	Yes	0.2	0.94	20
40	HA	No	0.2	2.08	20
41	HY	Yes	0.1	0.50	20
42	BN	Yes	0.3	3.28	20
43	WN	Yes	0.4	3.28	20
44	SU	Yes	0.2	1.33	20
45	YP	Yes	0.2	0.89	20
46	MG	Yes	0.2	1.53	20
47	CT	Yes	0.2	1.38	20
48	MS	Yes	0.2	3.59	20
49	MV	Yes	0.2	3.59	20
50	ML	Yes	0.2	3.59	20
51	AP	Yes	0.2	2.08	20
52	MB	No	0.2	2.08	20
53	WT	Yes	0.2	4.15	20
54	BG	Yes	0.2	3.59	20
55	TS	Yes	0.2	3.59	20
56	HH	Yes	0.2	2.08	20
57	SD	Yes	0.2	2.08	20
58	RA	No	0.2	2.08	20
59	SY	Yes	0.1	0.89	20
60	CW	Yes	0.1	0.50	20
61	BT	Yes	0.2	0.50	20
62	BC	Yes	0.1	0.50	20
63	WO	Yes	0.2	1.38	20
64	SO	Yes	0.2	1.38	20
65	SK	Yes	0.1	1.38	20
66	CB	Yes	0.1	0.50	20
67	TO	Yes	0.2	2.75	20
68	LK	Yes	0.1	2.75	20

FVS Number	Alpha Code	Sprouting Species?	Minimum Bud Width (in)	Minimum Tree Height (ft)	Maximum Tree Height (ft)
69	OV	Yes	0.2	0.50	20
70	BJ	Yes	0.2	2.75	20
71	SN	Yes	0.2	0.50	20
72	CK	Yes	0.1	1.38	20
73	WK	Yes	0.1	0.50	20
74	CO	Yes	0.2	1.38	20
75	RO	Yes	0.2	1.38	20
76	QS	Yes	0.1	0.50	20
77	PO	Yes	0.1	2.75	20
78	BO	Yes	0.2	1.38	20
79	LO	Yes	0.2	0.50	20
80	BK	Yes	0.1	5.98	20
81	WI	Yes	0.1	4.70	20
82	SS	Yes	0.1	2.08	20
83	BW	Yes	0.1	0.55	20
84	EL	Yes	0.1	0.50	20
85	WE	Yes	0.1	0.50	20
86	AE	Yes	0.1	0.50	20
87	RL	Yes	0.1	0.50	20
88	OS	No	0.3	2.08	20
89	OH	No	0.2	2.08	20
90	OT	No	0.2	2.08	20

7.0 VOLUME

Volume estimation method is based on the volume equations contained in the National Volume Estimator Library and is maintained by the Forest Products Measurements group in the Forest Management Service Center. For information on the equation numbers used by each species, please contact the Forest Products Measurements group at wo_ftcol_measurement@fs.fed.us.

Volume is calculated for three merchantability standards: merchantable stem cubic feet pulpwood, merchantable stem cubic feet sawtimber, and merchantable stem board feet sawtimber. The default merchantability standards for the SN variant are shown in table 7.0.1.

Table 7.0.1 Volume merchantability standards for the SN variant.

Pulpwood Volume Specifications:		
Minimum DBH / Top Diameter Inside Bark	**Hardwoods**	**Softwoods**
All location codes	4.0 / 4.0 inches	4.0 / 4.0 inches
Stump Height	1.0 foot	1.0 foot
Sawtimber Volume Specifications:		
Minimum DBH / Top Diameter Inside Bark	**Hardwoods**	**Softwoods**
All location codes	12.0 / 9.0 inches	10.0 / 7.0 inches
Stump Height	1.0 foot	1.0 foot

8.0 FIRE AND FUELS EXTENSION (FFE)

The Fire and Fuels Extension (FFE) to FVS (Reinhardt and Crookston 2003) integrates FVS with models of fire behavior, fire effects, and fuel and snag dynamics. This allows users to simulate various management scenarios and compare their effect on potential fire hazard, surface fuel loading, snag levels, and stored carbon over time. Users can also simulate prescribed burns and wildfires and get estimates of the associated fire effects such as tree mortality, fuel consumption, and smoke production, as well as see their effect on future stand characteristics. FFE, like FVS, is run on individual stands, but it can be used to provide estimates of stand characteristics such as canopy base height and canopy bulk density when needed for landscape-level fire models.

For more information on the Fire and Fuels Extension and how it is calibrated for the SN variant, see the Fire and Fuels Extension to the Forest Vegetation Simulator (Reinhardt and Crookston 2003) and the Fire and Fuels Extension Addendum (http://www.fs.fed.us/fmsc/ftp/fvs/docs/gtr/FFEaddendum.pdf).

9.0 INSECT AND DISEASE EXTENSIONS

FVS Insect and Disease models have been developed through the participation and contribution of various organizations led by Forest Health Protection. The models are maintained by the Forest Health Technology Enterprise Team (FHTET) and regional Forest Health Protection specialists. There are no insect and disease models currently available for the SN variant. However, FVS addfiles that simulate the effects of known agents within the SN variant may be found at the FHTET website (http://www.fs.fed.us/foresthealth/technology/).

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11.0 APPENDICES

Appendix A. Ecological Unit Codes (EUC) Codes

Table 11.0.1 EUC codes recognized in the SN variant.

FVS Sequence Number = EUC	Subsection Name
1 = 221Db	Piedmont Upland
2 = 221Eb	Teays Plateau
3 = 221Ha	Rugged Eastern Hills
4 = 221Hc	Southwestern Escarpment
5 = 221Hd	Sequatchie Valley
6 = 221He	Low Hills Belt
7 = 221Ja	Rolling Limestone Hills
8 = 221Jb	Sandstone Hills
9 = 221Jc	Holston Valley
10 = 222Ab	Central Plateau
11 = 222Ag	White River Hills
12 = 222Ah	Elk River Hills
13 = 222Al	Black River Ozark Border
14 = 222Am	Springfield Plain
15 = 222An	Springfield Plateau
16 = 222Cb	Northern Deep Loess Hills and Bluffs
17 = 222Cc	Deep Loess Hills and Bluffs
18 = 222Cd	Clay Hills
19 = 222Ce	Northern Loessial Hills
20 = 222Cf	Northern Pontotoc Ridge
21 = 222Cg	Upper Loam Hills
22 = 222Ch	Ohio and Cache River Alluvial Plain
23 = 222Da	Interior Western Coalfields
24 = 222Db	Lower Ohio-Cache-Wabash Alluvial plains
25 = 222Dc	Outer Western Coalfields
26 = 222Dd	Marion Hills
27 = 222De	Crawford Uplands
28 = 222Dg	Southern Dripping Springs
29 = 222Di	Lesser Shawnee Hills
30 = 222Dj	Northern Dripping Springs
31 = 222Ea	Eastern Highland Rim
32 = 222Eb	Eastern Karst Plain
33 = 222Ec	Outer Nashville Basin
34 = 222Ed	Inner Nashville Basin
35 = 222Ee	Highland Rim-Hilly and Rolling
36 = 222Ef	Tennessee-Gasper Valley
37 = 222Eg	Western Pennyroyal Karst Plain
38 = 222Eh	Penneroyal Karst Plain
39 = 222Ei	Western Knobs
40 = 222Ej	Eastern Knobs Transition

FVS Sequence Number = EUC	Subsection Name
114 = 232Bf	Florida Central Highlands
115 = 232Bg	South Coastal Plains
116 = 232Bh	Gulf Southern Loam Hills
117 = 232Bi	The Plains
118 = 232Bj	Southern Loam Hills
119 = 232Bk	Southern Clay Hills
120 = 232Bl	Lower Loam and Clay Hills
121 = 232Bm	Lower Clay Hills
122 = 232Bn	Lower Loam Hills
123 = 232Bo	Border Sand Hills
124 = 232Bp	Wiregrass Plains
125 = 232Bq	Sand Hills
126 = 232Br	Atlantic Southern Loam Hills
127 = 232Bs	Floodplains and Terraces
128 = 232Bu	Southwestern Loam Hills
129 = 232Bv	Northern Loam Plains
130 = 232Ca	Upper Terraces
131 = 232Cb	Lower Terraces
132 = 232Cc	Okefenokee Uplands
133 = 232Cd	Okefenokee Swamp
134 = 232Ce	Coastal Marsh and Island
135 = 232Cf	Bacon Terraces
136 = 232Cg	Flatwoods Floodplains and Terraces
137 = 232Ch	Tidal Area
138 = 232Ci	Pamlico and Albemarle Sounds and Barrier Islands
139 = 232Cj	Chesapeake Bay
140 = 232Da	Immokalee Rise
141 = 232Db	Gulf Coastal Lowlands
142 = 232Dc	Gulf Coast Flatwoods-Bays and Barrier Islands
143 = 232Dd	Mobile Bay, Sounds and Islands
144 = 232De	Florida Gulf Coastal Bays and Islands
145 = 232Ea	Gulf Coast Prairies
146 = 232Eb	Gulf Coast Marshes and Inland Bays
147 = 232Ec	Lake Ponchartrain
148 = 232Ed	Gulf Coast Bays and Islands
149 = 232Ee	Lake Borgne, Sounds and Islands
150 = 232Fa	Southern Loam Hills
151 = 232Fb	Southwest Flatwoods
152 = 232Fc	Sabine Alluvial Valley
153 = 232Fd	Neches Alluvial Valley

FVS Sequence Number = EUC	Subsection Name
41 = 222Ek	Mitchell Karst Plains
42 = 222En	Kinniconick and Licking Knobs
43 = 222Eo	The Cliffs
44 = 222Fa	Outer Bluegrass
45 = 222Fb	Inner Bluegrass
46 = 222Fc	Western Bluegrass
47 = 222Fd	Northern Bluegrass
48 = 222Ff	Scottsburg Lowland
49 = 231Aa	Midland Plateau Central Uplands
50 = 231Ab	Piedmont Ridge
51 = 231Ac	Schist Plains
52 = 231Ad	Lower Foot Hills
53 = 231Ae	Charlotte Belt
54 = 231Af	Carolina Slate
55 = 231Ag	Schist Hills
56 = 231Ah	Granite Hills
57 = 231Ai	Opelika Plateau
58 = 231Aj	Mica Rich Plateau
59 = 231Ak	Lynchburg Belt
60 = 231Al	Northern Piedmont
61 = 231Am	Triassic Uplands
62 = 231An	Western Coastal Plain-Piedmont Transition
63 = 231Ao	Southern Triassic Uplands
64 = 231Ap	Triassic Basins
65 = 231Ba	Black Belt
66 = 231Bb	Interior Flatwoods
67 = 231Bc	Upper Clay Hills
68 = 231Bd	Upper Loam Hills
69 = 231Be	Transition Loam Hills
70 = 231Bf	Floodplains and Terraces
71 = 231Bg	Northern Loessial Hills
72 = 231Bh	Deep Loess Hills and Bluffs
73 = 231Bi	Deep Loess Plains
74 = 231Bj	Jackson Hills
75 = 231Bk	Southern Pontotoc Ridge
76 = 231Bl	Jackson Prairie
77 = 231Ca	Shale Hills and Mountain
78 = 231Cb	Sandstone Plateau
79 = 231Cc	Table Plateau
80 = 231Cd	Sandstone Mountain
81 = 231Ce	Moulton Valley
82 = 231Cf	Southern Cumberland Valleys
83 = 231Cg	Sequatchie Valley
84 = 231Da	Chert Valley
85 = 231Db	Sandstone-Shale and Chert Ridge
86 = 231Dc	Sandstone Ridge

FVS Sequence Number = EUC	Subsection Name
154 = 232Fe	Piney Woods Transition
155 = 232Ga	Eastern Beach and Lagoons
156 = 232Gb	Eastern Beach and Dunes
157 = 232Gc	Okeechobee Plain
158 = 232Gd	Kissimmee River
159 = 234Aa	Southern Mississippi River Alluvial Plain
160 = 234Ab	Crowleys Ridge
161 = 234Ac	White and Black Rivers Alluvial Plain
162 = 234Ad	Baton Rouge Terrace
163 = 234Ae	Arkansas Grand Prairie
164 = 234Af	Atchafalaya Alluvial Plain
165 = 234Ag	Arkansas Alluvial Plain
166 = 234Ah	Macon Ridge
167 = 234Ai	Red River Alluvial Plain
168 = 234Aj	Bastrop Ridge
169 = 234Ak	Opelousas Ridge
170 = 234Al	Teche Terrace
171 = 234Am	St. Francis River Alluvial Plain
172 = 234An	North Mississippi River Alluvial Plain
173 = 251Ea	Scarped Osage Plains
174 = 251Ec	Central Tallgrass
175 = 251Ed	Elk Prairie
176 = 251Fb	Eastern Flint Hills
177 = 251Fc	Southern Flint Hills
178 = 255Aa	Cross Timbers-Cherokee Prairies
179 = 255Ab	Central Oklahoma Cross Timbers
180 = 255Ac	Central Red Rolling Prairies
181 = 255Ad	Southern Oklahoma Grand Prairies
182 = 255Ae	Cross Timbers and Central Rolling Red Prairies
183 = 255Af	Cross Timbers - Southern Oklahoma
184 = 255Ag	Red River Alluvial Plain
185 = 255Ah	Texas Eastern Cross Timbers
186 = 255Ai	Texas Grand Prairie
187 = 255Aj	Texas Western Cross Timbers
188 = 255Ak	Southwestern Timbers
189 = 255Ba	Blackland Prairie
190 = 255Ca	Texas Claypan Savannah
191 = 255Cc	Interior Savannah
192 = 255Cd	Interior Blackland Prairie
193 = 255Ce	Trinity Alluvial Valley
194 = 255Cf	Blackland Prairie
195 = 255Cg	Southern Texas Claypan Savannah
196 = 255Da	Texas Coastal Prairies
197 = 255Db	Brazos and Brazonia Alluvial Valley
198 = 255Dc	Marshes-Inlands Bays-and Barrier Islands
199 = 255Dd	Southern Texas Coastal Prairies and Savannah

FVS Sequence Number = EUC	Subsection Name
87 = 231Dd	Quartzite and Talladega Slate Ridge
88 = 231De	Shaley Limestone Valley
89 = 231Ea	South Central Arkansas
90 = 231Eb	Southwestern Arkansas
91 = 231Ec	Ouachita Alluvial Valleys
92 = 231Ed	Sabine Alluvial Valley
93 = 231Ee	Southern Oklahoma Subsection
94 = 231Ef	Piney Woods Transition
95 = 231Eg	Sand Hills
96 = 231Eh	Southern Loam Hills
97 = 231Ei	Southwest Flatwoods
98 = 231Ej	South Central Arkansas Flatwoods
99 = 231Ek	Southwestern Arkansas Blackland Prairies
100 = 231El	Trinity Alluvial Valley
101 = 231Em	Red River Alluvial Plain
102 = 231En	East Texas Timberlands-Cross Timbers
103 = 231Fa	Gulf Coast Praries
104 = 231Fb	Marshes and Inland Bays
105 = 231Ga	Eastern Arkansas Valley and Ridges
106 = 231Gb	Mount Magazine
107 = 231Gc	Western Arkansas Valley and Ridges
108 = 232Ad	Western Chesapeake Uplands
109 = 232Ba	Fragipan Loam Hills
110 = 232Bb	Southern Loessial Plains
111 = 232Bc	Cintronelle Plains
112 = 232Bd	Southern Deep Loess Hills and Bluffs
113 = 232Be	Florida Northern Highlands

FVS Sequence Number = EUC	Subsection Name
200 = 411Aa	Lake Okeechobee
201 = 411Ab	Everglades
202 = 411Ac	Southern Slope
203 = 411Ad	Atlantic Coastal Ridge
204 = 411Ae	Coastal Lowlands-Tidal Marshes and Bays
205 = 411Af	Big Cypress Spur
206 = 411Ag	Florida Keys and Biscayne Bay
207 = M221Aa	Ridge and Valley
208 = M221Ab	Great Valley of Virginia
209 = M221Ba	Northern High Allegheny Mountains
210 = M221Bd	Eastern Allegheny Mountain and Valley
211 = M221Be	West Allegheny Mountain and Valley
212 = M221Ca	Western Coal Fields
213 = M221Cb	Eastern Coal Fields
214 = M221Cc	Black Mountains
215 = M221Cd	Southern Cumberland Mountains
216 = M221Ce	Pine and (The) Cumberland Mountain
217 = M221Da	Northern Blue Ridge Mountains
218 = M221Db	Central Blue Ridge Mountains
219 = M221Dc	Southern Blue Ridge Mountains
220 = M221Dd	Mestasedimentary Mountains
221 = M222Aa	The Boston Mountain
222 = M222Ab	Boston Hills
223 = M231Aa	Fourche Mountains
224 = M231Ab	West Central Ouachita Mountains
225 = M231Ac	East Central Ouachita Mountains
226 = M231Ad	Athens Piedmont Plateau

Appendix D

Sources and Contacts

Great Trinity Forest Management Plan

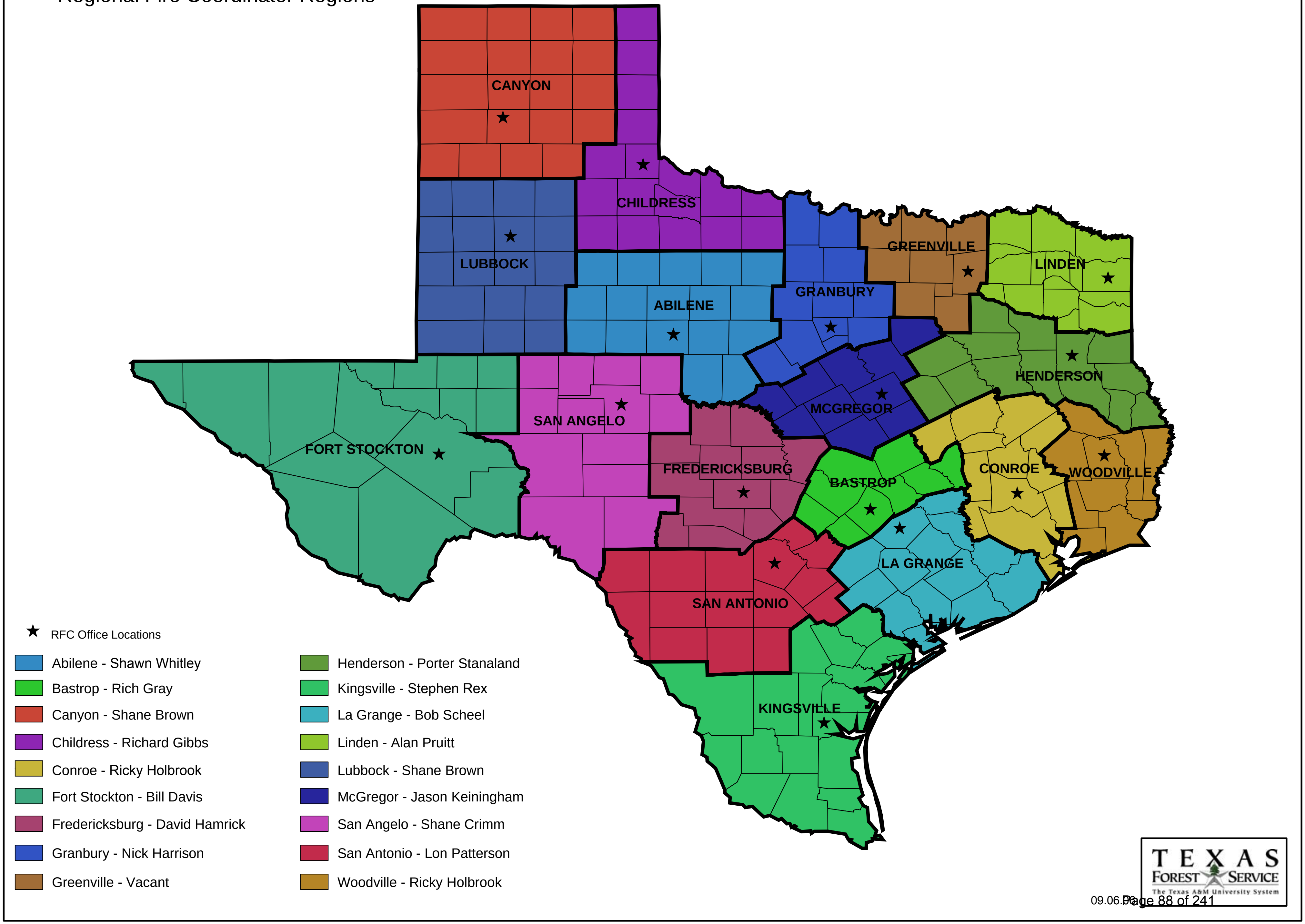
Sources and Contacts

Texas Forest Service Contacts

&

Regional Location Map

Regional Fire Coordinator Regions



09.06.08

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Texas Regional Fire Coordinators:

Region	Coordinator	Office Phone	Cell Phone
Abilene	Shawn Whitley	(325) 676 5827	(936) 545 7184
Bastrop	Rich Gray	(512) 321 2467	(979) 218 2406
Canyon	Shane Brown	(806) 651 3473	(979) 220 1540
Childress	Richard Gibbs	(940) 937 2286	(979) 220 0577
Conroe	Ricky Holbrook	(936) 327 4832	(936) 546 3094
Fort Stockton	Bill Davis	(915) 336 7290	(979) 218 2300
Fredericksburg	David Hamrick	(830) 997 5426	(979) 220 0756
Granbury	Nick Harrison	(817) 579 5772	(979) 218 2408
Greenville	vacant		
Henderson	Porter Stanaland	(936) 564 9276	(936) 546 1968
Kingsville	Stephen Rex	(361) 595 5118	(979) 324 0912
La Grange	Bob Scheel	(979) 968 5555	(979) 248 2407
Linden	Alan Pruitt	(903) 734 3504	(936) 546 1915
Lubbock	Shane Brown	(806) 651 3473	(979) 220 1540
McGregor	Jason Keiningham	(254) 840 9086	(979) 218 3108
San Angelo	Shane Crimm	(325) 944 0065	(979) 218 2405
San Antonio	Lon Patterson	(210) 532 5536	(979) 220 0522
Woodville	Ricky Holbrook	(936) 327 4832	(936) 546 3094
West Texas	Paul Hannemann, Chief	(830) 997 5426 (979) 458 7344	(979) 218 2401
West Texas	Les Rogers, Asst. Chief	(325) 676 5827	(979) 218 2403
Central Texas	Marty Martinez, Asst. Chief	(361) 595 5118	(979) 218 2404
East Texas	Bill Rose, Chief	(936) 875 4400 (903) 586 7545	(936) 546 1768

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UWI STAFF

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Rich Gray, Regional Fire Coordination / State UWI Coordinator **Bastrop Office** Office: (512) 321 2467 Pager: 1 800 299 4099, ID # 9536 Cell: (979) 218 2406 e-mail: rgray@tfs.tamu.edu	**Traci Weaver, UWI Specialist / Public Information Officer** **Granbury Office** Office: (817) 579 1847 Pager: 1 800 299 4099, ID # 3843 Cell: (979) 218 3035 e-mail: tweaver@tfs.tamu.edu
Robbie Curles, Mitigation / Suppression Specialist **Bastrop Office** Office: (512) 321 2467 Pager: 1 800 299 4099, ID # 4416 Cell: (979) 268 3770 e-mail: rcurles@tfs.tamu.edu	**Jan Fulkerson, UWI Specialist (Neighborhood and Community Planning)** **Wimberly Office** Office: (512) 847 7387 Pager: 1 800 299 4099, ID # 5971 Cell: (979) 200 1010 e-mail: jfulkerson@tfs.tamu.edu
Karen Kilgore, UWI Specialist (GIS and UWI Assessment) **Bastrop Office** Office: (512) 321 2467 Cell: (979) 218 3036 e-mail: kallender@tfs.tamu.edu	**Mary Leathers, UWI Mitigation Exhibit Specialist** **McGregor Office** Office: (254) 840 9086 Pager: 1 800 299 4099, ID # 4925 Cell: (979) 218 3030 e-mail: mleathers@tfs.tamu.edu
Lexi Maxwell, UWI Specialist (Information and Education) **Bastrop Office** Office: (512) 321 2467 Pager: 1 800 299 4099, ID # 0256 Cell: (979) 220 0787 e-mail: lmaxwell@tfs.tamu.edu	**P.J. Pearson, UWI Specialist (Firewise Communities / USA)** **Fredricksburg Office** Office: (830) 997 5426 Pager: 1 800 299 4099, ID # 4419 Cell: (979) 220 1217 e-mail: ppearson@tfs.tamu.edu
Justice Jones, East Texas UWI Coordinator **Conroe Office** Office: (936) 273 2261 Pager: 1 800 299 4099, ID # 1086 Cell: (936) 546 8042 e-mail: jjjones@tfs.tamu.edu	**Lee McNeely, Regional UWI Coordinator** **Linden Office** Office: (903) 665 7400 Pager: 1 800 299 4099, ID # 0064 Cell: (936) 546 315614 e-mail: lmcneely@tfs.tamu.edu

Karen Stafford, Regional UWI Coordinator **Woodville Office** Office: (409) 331 9030 Pager: 1 800 299 4099, ID # 1371 Cell: (936) 545 6991 e-mail: kstafford@tfs.tamu.edu		**Jeff Lester, Regional UWI Coordinator** **Conroe Office** Office: (936) 273 2261 Pager: 1 800 299 4099, ID # 4562 Cell: (936) 544 0964 e-mail: jlester@tfs.tamu.edu
Jan Amen, Public Information Officer **Lufkin Office** Office: (936) 639 8105 Cell: (936) 546 1004 e-mail: jamen@tfs.tamu.edu		**Mahlon Hammetter, Public Information Officer** **Lufkin Office** Office: (936) 639 8162 Cell: (936) 546 1895 e-mail: mhammetter@tfs.tamu.edu

Great Trinity Forest Management Plan

Sources and Contacts

Forest Services Vendor Database:

Herbicide Application Vendors

Herbicide Application Vendors

Company	Contact	Address	City	State	Zip	WorkPhone	HomePhone	Fax
Acorn Outdoor Services	Justin Penick	P. O. Box 151537	Lufkin	TX	75915-1537	(936) 875-5400		(936) 875-5401
Advanced Forestry Services	Scotty or Karen Ward	P. O. Box 1327	Jasper	TX	75951	(409) 384-5209		(409) 384-8147
AgRotors, Inc.	Jay Allison	508 Airport Road	Natchitoches	LA	71457-3158	(318) 352-3691		(717) 334-0854
Bonner Reforestation	Bubba Bonner	3198 Bethlehem Road	Lufkin	TX	75904	(936) 875-3016		
Coastal Spray Company	Jose Chavez	P. O. Box 3227	Pasadena	TX	77501	(713) 473-1191	(713) 664-3382	(713) 920-1143
Don Taylor	Don Taylor	Route 1 Box 4580	Nacogdoches	TX	75961	(936) 569-7734		
George Whatley, Jr.	George Whatley, Jr.	558 County Road 4231	Atlanta	TX	75551	(903) 796-5564		(903) 796-5564
Glasscock Enterprises	James Glasscock	22904 Hwy 69 N	Mineola	TX	75773	(903) 882-3532		
Hagler Forestry		830 CR 1092	Center	TX	75935	(936) 598-4805	(936) 598-4805	(936) 590-4843
IBF	Matthew L. Buchanan	P. O. Box 165	Carthage	TX	75633	(903) 693-4929		(903) 693-3161
Jimmy Glasscock Construction	Jimmy Glasscock	P. O. Box 561	Lindale	TX	75771	(903) 882-6021	(903) 882-6021	(903) 882-6021
McDonald Bro. Farms	Mitchell McDonald	510 E. Bell	Crockett	TX	75835	(936) 546-5444	(936) 544-8823	
McIlvain Enterprises Inc.		2510 Mc Bride Devillier	Winnie	TX	77665	(409) 296-4531	(409) 296-6985	(409) 296-3530
Nelms Equipment & Reforestation	Jason Nelms	P. O. Box 5	Pennington	TX	75856	(936) 638-2072		(936) 638-2093
Northstar Helicopter Inc	Mike Godwin	P. O. Box 2033	Jasper	TX	75951	(409) 384-5315		(409) 384-3002
Parker Forestry Consultants	Keelin Parker	Route 2 Box 3225	Woodville	TX	75979	(409) 283-5413		(409) 837-2524
Red River Specialties	Mike Cage	7545 Haygood Road	Shreveport	LA	71107	(800) 256-3344	(318) 965-9944	(318) 426-6562
Silva-Tech/South, Ltd.	Buddy Stalnaker	P. O. Box 633262	Nacogdoches	TX	75963	(936) 568-9031		(936) 568-9031
Superior Forestry Service (Tree Planting)	Jerry Arter	P. O. Box 25	Tilly	AR	72679	(870) 496-2442		
Superior Forestry Services (Herbicide Appl)	Mark Harnage	P. O. Box 25	Tilly	AR	72679	(800) 541-1060		(870) 496-2388
Timberland Silvicultural Services	Edward Taylor	1101 South Main	Demopolis	AL	36732	(318) 352-7476		
Tommy Kessler	Tommy Kessler	Box 816	Linden	TX	75563	(903) 756-7001		
Troy Jones	Troy R. Jones	754 County Road 2164	Shelbyville	TX	75973	(936) 275-1159		
UAP Distribution, Inc.	Cobbie Callaway	1101 South Memory Lane	Marshall	TX	75670	(903) 926-5358		
Van Duson Timber Corp.	Gary Van Dusen	4015 Valley Ranch Rd.	Longview	TX	75602	(903) 236-7696		
Vegetation Control	Randy Ward	123 Longhorn Dr.	Palestine	TX	75801	(903) 723-1866	(903) 723-1866	

Herbicide Application Vendors continued

Company	MobilePhone	Email	Helicopter	Skidder	Tractor	FourWheeler	HandMethods	Broadcast	BandSpray	MinimumAcres
Acorn Outdoor Services	(936) 438-2499	aosinc@consolidated.net	No	Yes	Yes	Yes	Yes	Yes	Yes	1
Advanced Forestry Services		www.advancedforestryserv.com	No	No	No	Yes	Yes	No	Yes	1
AgRotors, Inc.	(717) 818-5139	jcallison@agrotors.com	Yes	No	No	No	No	Yes	No	1
Bonner Reforestation	(936) 635-8450		No	No	Yes	No	No	No	Yes	1
Coastal Spray Company	(713) 825-9233	josechavez@coastalspray.com	No	Yes	Yes	Yes	Yes	Yes	Yes	1
Don Taylor			No	No	No	No	No	No	No	1
George Whatley, Jr.			No	No	Yes	No	No	Yes	Yes	1
Glasscock Enterprises		jackieglasscock@yahoo.com	No	No	Yes	Yes	No	No	Yes	10
Hagler Forestry		tara1@qzip.net	No	Yes	No	Yes	Yes	Yes	Yes	25
IBF	(903) 692-2406	IBFTree@gmail.com	Yes	Yes	Yes	Yes	Yes	Yes	Yes	1
Jimmy Glasscock Construction	(903) 520-3302		No	No	Yes	No	No	Yes	No	1
McDonald Bro. Farms			No	No	Yes	Yes	No	Yes	Yes	10
McIlvain Enterprises Inc.		lmcilv@aol.com	No	No	No	Yes	Yes	No	Yes	1
Nelms Equipment & Reforestation	(936) 546-8061	Nelms1@yahoo.com	No	No	Yes	Yes	No	Yes	Yes	1
Northstar Helicopter Inc		nshi@inu.net	Yes	No	No	No	No	Yes	No	1
Parker Forestry Consultants		pfc@parkerforestry.com	No	No	Yes	Yes	Yes	Yes	Yes	1
Red River Specialties		mcagejr@hotmail.com	Yes	No	No	No	No	Yes	No	20
Silva-Tech/South, Ltd.	(936) 552-4807	buddy@silvatechsouth.com	Yes	Yes	No	Yes	No	No	No	1
Superior Forestry Service (Tree Planting)		sfs@superiorforestry.com	No	No	No	No	No	No	No	1
Superior Forestry Services (Herbicide Appl)	(501) 258-8649	Superior.forestry@worldnet.att.net	No	No	No	No	Yes	Yes	Yes	1
Timberland Silvicultural Services	(936) 635-4429		Yes	Yes	No	Yes	Yes	Yes	Yes	40
Tommy Kessler			No	No	Yes	No	No	Yes	Yes	1
Troy Jones			No	No	No	No	No	No	Yes	1
UAP Distribution, Inc.	(903) 926-5358	cobbie.callaway@uap.com	Yes	Yes	Yes	Yes	Yes	Yes	Yes	1
Van Duson Timber Corp.		jv1053@aol.com	No	Yes	No	Yes	Yes	Yes	Yes	1
Vegetation Control		rajhal@hotmail.com	No	No	No	Yes	No	No	Yes	1

Great Trinity Forest Management Plan

Sources and Contacts

Forest Services Vendor Database:

Mechanical Site Prep Vendors

Mechanical Site Prep Vendors

Company	Contact	Address	City	State	Zip	WorkPhone	HomePhone
Acorn Outdoor Services	Justin Penick	P. O. Box 151537	Lufkin	TX	75915-1537	(936) 875-5400	
Advantage Forestry, Inc	Vic Cooper	1099 Fm 3172	Shelbyville	TX	75973	(936) 368-2839	
Austin Land Service		3875 W. Whitestone	Cedar Park	TX	78613	(512) 260-1576	
Beaver Dozer Service	Allen Reed	11828 FM 138	Center	TX	75935-5718	(936) 591-2247	(936) 254-3146
Bonner Reforestation	Bubba Bonner	3198 Bethlehem Road	Lufkin	TX	75904	(936) 875-3016	
Brewer Construction	Billy Brewer	10305 US Hwy 69 N	Pollock	TX	75969	(936) 853-4859	
Bugs Dozer Service	Richard Weeks	2775 Hwy 190 E	Woodville	TX	75979	(409) 429-4041	(409) 283-2373
Burrous Dozer & Dirt Service	Robert Burrous	3167 Martin Cochran Rd.	Huntington	TX	75949	(936) 422-3878	
C. T. Construction	Chris Tyre	3393 FM 417 East	Shelbyville	TX	75973	(936) 590-0271	
Cass County Crushing	Burt Clem	P. O. Box 1125	Atlanta	TX	75551	(903) 796-7911	
Circle H Environmental	Paul Harrell	Route 3 Box 2020	Livingston	TX	77351		(936) 563-4530
D & C Dozer Co.	Chris Collins & Stan Fleming	388 County Road 2565	Center	TX	75935	(936) 590-4531	(936) 598-2201
Double O Contractors	Larry O'Rear	Route 1 Box 1686	Shelbyville	TX	75973	(936) 368-2359	(936) 368-2359
Dover Dozer and Trucking	Steve Dover	Route 1, Box 66b	Rusk	TX	75785	(903) 683-5491	
East Texas Brush Busters	Robert M. Smith	P. O. Box 880	Canton	TX	75103-0880	(903) 479-3900	
Environmental Tree Shredding, L.P.	Kris Knackstedt	P. O. Box 1042	Kilgore	TX	75663	(903) 262-0909	
George Harrell Construction		Route 3 Box 2300	Livingston	TX	77351	(936) 563-4733	(936) 563-4733
Glasscock Enterprises	James Glasscock	22904 Hwy 69 N	Mineola	TX	75773	(903) 882-3532	
Hagler Forestry		830 CR 1092	Center	TX	75935	(936) 598-4805	(936) 598-4805
Haley Dozer Contractor	Chad Haley	P. O. Box 12	Center	TX	75935	(936) 598-9167	
Hans Schipmann	Hans Schipmann	14723 Tanglewood	Dallas	TX	75234	(972) 243-5843	
Holland Dozer Sevice	Nathan Holland	147 N Peachtree	Jasper	TX	75951	(409) 384-0232	(409) 383-0504
Holland Equipment	Willard Holland	P. O. Box 151	Pennington	TX	75856	(409) 638-4455	(409) 638-4455
IBF	Matthew L. Buchanan	P. O. Box 165	Carthage	TX	75633	(903) 693-4929	
James Bond Custom Land Clearing	James or Desirae Bond	26050 Brushy Creek Drive	Hockley	TX	77447	(936) 931-9372	
Jimmy Glasscock Construction	Jimmy Glasscock	P. O. Box 561	Lindale	TX	75771	(903) 882-6021	(903) 882-6021
Kellco Construction	Charles Kelley	P. O. Box 1606	Cleveland	TX	77327		(281) 592-7647
Mayo Dozer Service	Martin Stanaland	669 Cr 264	Nacogdoches	TX	75965	(936) 552-7285	
Moore Dozing	Herman Moore	Route 2 Box 181-A	Crockett	TX	75835	(936) 624-6791	(936) 624-6791
Nelms Equipment & Reforestation	Jason Nelms	P. O. Box 5	Pennington	TX	75856	(936) 638-2072	
Pope Dozer Inc.	Paul Pope	8708 W. Fox	Orange	TX	77632	(409) 781-3530	(409) 745-1045
Providence Land Services	Mark James	P. O. Box 329	Mt. Enterprise	TX	75681	(903) 822-4139	
Quality Custom Dozer Service	Reno Garcia	P. O. Box 713	Buffalo	TX	75831	(903) 322-3080	
Robert Lange, Inc.	Robert Lange	P. O. Box 1076	Brenham	TX	77834-1076	(979) 836-5633	(979) 836-3362
Rockin M Agri Services		Rt 2 Box 197 C	Shelbyville	TX	75973	(936) 275-2721	(936) 275-2721
Silva-Tech/South, Ltd.	Buddy Stalnaker	P. O. Box 633262	Nacogdoches	TX	75963	(936) 568-9031	
Smith & Smith Forest Management, Inc.	David C. Smith	211 N. Main Street	Gladewater	TX	75647	(903) 844-9240	
Southwest Silviculture	Mike Wagstaff	P. O. Box 719	Warren	TX	77664	(409) 381-1423	(409) 547-0027
Strahan Dozer Service	Robbie Strahan	652 CR 4714	Timpson	TX	75975	(936) 254-3238	(936) 254-3238
Tebbetts Dozer Service	Peter Tebbetts	1476 Hwy 111	Leesville	LA	71446	(337) 238-4392	
Texas Land Clearing Company	Tim Burgess	6010 Almelo Drive	Round Rock	TX	78681	(512) 217-8845	
Texas Land Clearing, Inc.	Ike Jackson	24042 Stanart Rd.	Porter	TX	77365	(281) 354-5108	(281) 354-5808
Thomas Dozer & Construction	Derrell Thomas	300 Trimble	Palestine	TX	75803-7088	(903) 723-3999	(903) 723-2822
Timber Heights Forestry		P. O. Box 2412	Jasper	TX	75951	(409) 383-1090	
Timberland Silvicultural Services	Edward Taylor	1101 South Main	Demopolis	AL	36732	(318) 352-7476	
Tommy Kessler	Tommy Kessler	Box 816	Linden	TX	75563	(903) 756-7001	
Van Duson Timber Corp.	Gary Van Dusen	4015 Valley Ranch Rd.	Longview	TX	75602	(903) 236-7696	

Company	Fax	MobilePhone	Email	Shear	Rake	Bed	CombinationPlow	Subsoil/Rip	Scalp
Acorn Outdoor Services	(936) 875-5401	(936) 438-2499	aosinc@consolidated.net	Yes	Yes	Yes	Yes	Yes	Yes
Advantage Forestry, Inc	(936) 368-2839	(936) 591-4099		Yes	Yes	Yes	Yes	Yes	No
Austin Land Service	(512) 259-6482		info@austinwoodrecylcing.com	No	No	No	No	No	No
Beaver Dozer Service	(936) 254-3460			Yes	Yes	Yes	Yes	Yes	Yes
Bonner Reforestation		(936) 635-8450		No	Yes	No	No	No	No
Brewer Construction	(936) 853-4869			Yes	Yes	Yes	No	Yes	No
Bugs Dozer Service				Yes	Yes	No	Yes	No	No
Burrous Dozer & Dirt Service				No	Yes	Yes	No	No	No
C. T. Construction		(936) 590-9961		Yes	Yes	No	No	Yes	No
Cass County Crushing	(903) 796-7911			Yes	No	No	No	Yes	No
Circle H Environmental				Yes	Yes	No	No	No	No
D & C Dozer Co.	(936) 590-4531	(936) 590-0941	ddnfleming@aol.com	Yes	Yes	Yes	No	No	No
Double O Contractors				Yes	Yes	No	No	Yes	No
Dover Dozer and Trucking	(903) 683-5033	(903) 727-7005		Yes	Yes	No	No	No	No
East Texas Brush Busters	(903) 479-3638	(214) 215-1369	www.EastTexasBrushBusters.com	No	No	No	No	No	No
Environmental Tree Shredding, L.P.	(903) 984-0850		texastreeshredding@earthlink.net	Yes	Yes	Yes	No	Yes	No
George Harrell Construction	(936) 563-2044			Yes	Yes	No	No	No	No
Glasscock Enterprises			jackieglasscock@yahoo.com	Yes	Yes	No	No	Yes	No
Hagler Forestry	(936) 590-4843		tara1@qzip.net	Yes	Yes	No	No	No	No
Haley Dozer Contractor		(936) 590-0646		Yes	Yes	No	No	No	No
Hans Schipmann				No	No	No	No	No	No
Holland Dozer Sevice	(409) 489-0465	(409) 489-6153	holland@inu.net	Yes	Yes	Yes	Yes	Yes	No
Holland Equipment	(409) 638-4334		cholland@txucom.net	Yes	Yes	No	Yes	No	No
IBF	(903) 693-3161	(903) 692-2406	IBFTree@gmail.com	Yes	Yes	Yes	Yes	Yes	Yes
James Bond Custom Land Clearing	(936) 931-3724	(713) 206-1427	riverrat@ev1.net	No	No	No	No	No	No
Jimmy Glasscock Construction	(903) 882-6021	(903) 520-3302		Yes	Yes	Yes	Yes	Yes	No
Kellco Construction				Yes	Yes	No	No	No	No
Mayo Dozer Service		(936) 552-1392		No	Yes	No	No	No	No
Moore Dozing	(936) 624-6791			Yes	Yes	Yes	Yes	Yes	No
Nelms Equipment & Reforestation	(936) 638-2093	(936) 546-8061	Nelms1@yahoo.com	Yes	Yes	Yes	Yes	Yes	No
Pope Dozer Inc.	(409) 489-1031			Yes	Yes	No	Yes	Yes	No
Providence Land Services		(903) 649-1729		No	No	No	No	No	No
Quality Custom Dozer Service	(903) 322-4743	(903) 388-8585		Yes	Yes	Yes	Yes	Yes	Yes
Robert Lange, Inc.	(979) 836-5634		robertlange@msn.com	Yes	Yes	No	No	No	No
Rockin M Agri Services	(936) 275-2721			Yes	Yes	No	Yes	No	No
Silva-Tech/South, Ltd.	(936) 568-9031	(936) 552-4807	buddy@silvatechsouth.com	No	No	No	No	No	No
Smith & Smith Forest Management, Inc.	(903) 844-9278			Yes	Yes	No	No	No	No
Southwest Silviculture	(936) 967-4230		macstaff@pernet.net	Yes	Yes	Yes	Yes	No	Yes
Strahan Dozer Service	(936) 248-4630			Yes	Yes	No	No	No	No
Tebbetts Dozer Service		(337) 526-4599	ptebbett@bellsouth.net	Yes	Yes	Yes	No	Yes	No
Texas Land Clearing Company		(512) 217-8845	tpburgess@austin.rr.com	Yes	No	No	No	Yes	No
Texas Land Clearing, Inc.	(281) 354-3474			Yes	Yes	No	No	No	No
Thomas Dozer & Construction	(903) 727-8643	(903) 724-3363	dttt@flash.net	Yes	Yes	No	No	Yes	No
Timber Heights Forestry	(409) 383-1090			No	Yes	No	No	No	No
Timberland Silvicultural Services		(936) 635-4429		Yes	No	Yes	Yes	Yes	No
Tommy Kessler				No	Yes	No	No	No	No
Van Duson Timber Corp.			jv1053@aol.com	Yes	Yes	No	Yes	No	No

Mechanical Site Prep Vendors continued

Company	DrumChop	Disk	Mow	Firebreaks	MinimumAcres
Acorn Outdoor Services	Yes	Yes	Yes	Yes	1
Advantage Forestry, Inc	No	Yes	No	Yes	1
Austin Land Service	Yes	No	No	No	10
Beaver Dozer Service	Yes	No	No	Yes	25
Bonner Reforestation	No	No	No	Yes	1
Brewer Construction	Yes	No	Yes	Yes	1
Bugs Dozer Service	Yes	No	No	Yes	1
Burrous Dozer & Dirt Service	No	No	Yes	No	1
C. T. Construction	Yes	No	Yes	Yes	1
Cass County Crushing	No	No	No	No	20
Circle H Environmental	Yes	No	No	Yes	25
D & C Dozer Co.	No	No	No	Yes	30
Double O Contractors	Yes	No	No	Yes	1
Dover Dozer and Trucking	No	No	No	Yes	1
East Texas Brush Busters	No	No	No	Yes	1
Environmental Tree Shredding, L.P.	Yes	Yes	Yes	Yes	1
George Harrell Construction	No	No	No	No	1
Glasscock Enterprises	No	No	No	No	10
Hagler Forestry	No	No	No	Yes	25
Haley Dozer Contractor	No	No	No	Yes	1
Hans Schipmann	No	No	No	Yes	1
Holland Dozer Sevice	Yes	No	No	Yes	25
Holland Equipment	Yes	No	No	Yes	40
IBF	Yes	Yes	Yes	Yes	1
James Bond Custom Land Clearing	No	No	Yes	Yes	1
Jimmy Glasscock Construction	Yes	Yes	Yes	No	30
Kellco Construction	No	No	No	No	100
Mayo Dozer Service	No	Yes	Yes	Yes	1
Moore Dozing	Yes	No	No	Yes	1
Nelms Equipment & Reforestation	Yes	Yes	Yes	Yes	1
Pope Dozer Inc.	Yes	No	No	Yes	100
Providence Land Services	No	No	No	Yes	1
Quality Custom Dozer Service	Yes	Yes	Yes	Yes	
Robert Lange, Inc.	No	No	No	No	1
Rockin M Agri Services	No	No	No	Yes	20
Silva-Tech/South, Ltd.	No	No	No	No	1
Smith & Smith Forest Management, Inc.	Yes	No	No	Yes	75
Southwest Silviculture	No	No	Yes	Yes	1
Strahan Dozer Service	No	No	No	No	1
Tebbetts Dozer Service	Yes	No	No	No	1
Texas Land Clearing Company	No	No	Yes	Yes	1
Texas Land Clearing, Inc.	No	No	No	No	20
Thomas Dozer & Construction	No	No	No	No	1
Timber Heights Forestry	Yes	No	No	No	1
Timberland Silvicultural Services	No	No	No	Yes	10
Tommy Kessler	Yes	No	No	Yes	1
Van Duson Timber Corp.	No	No	No	No	1

<u>Great Trinity Forest Management Plan</u>

Sources and Contacts

Forest Services Vendor Database:

Prescribed Fire Vendors

Prescribed Fire Vendors

Company	Contact	Address	City	State	Zip	WorkPhone	HomePhone	Fax
Acorn Outdoor Services	Justin Penick	P. O. Box 151537	Lufkin	TX	75915-1537	(936) 875-5400		(936) 875-5401
Beaver Dozer Service	Allen Reed	11828 FM 138	Center	TX	75935-5718	(936) 591-2247	(936) 254-3146	(936) 254-3460
Bird Forestry Services, Inc.	Mark W. Brian	2557 SH 7 East	Center	TX	75935	(800) 259-3053		
Environmental Tree Shredding, L.P.	Kris Knackstedt	P. O. Box 1042	Kilgore	TX	75663	(903) 262-0909		(903) 984-0850
Hagler Forestry		830 CR 1092	Center	TX	75935	(936) 598-4805	(936) 598-4805	(936) 590-4843
IBF	Matthew L. Buchanan	P. O. Box 165	Carthage	TX	75633	(903) 693-4929		(903) 693-3161
Keith Axelson	Keith Axelson	Route 4 Box 265	Crockett	Texas	75835		(936) 544-3034	
Kellco Construction	Charles Kelley	P. O. Box 1606	Cleveland	TX	77327		(281) 592-7647	
Nelms Equipment & Reforestation	Jason Nelms	P. O. Box 5	Pennington	TX	75856	(936) 638-2072		(936) 638-2093
Raven Enviromental Services Inc.		P. O. Box 6482	Huntsville	Texas	77342	(936) 291-0946	(936) 436-1654	(936) 291-0960
Smith & Smith Forest Management, Inc.	David C. Smith	211 N. Main Street	Gladewater	TX	75647	(903) 844-9240		(903) 844-9278
Southwest Silviculture	Mike Wagstaff	P. O. Box 719	Warren	TX	77664	(409) 381-1423	(409) 547-0027	(936) 967-4230
Zavala Forestry Services	Juan A. Zavala	P. O. Box 3222	Longview	TX	75606	(903) 399-8618		

Prescribed Fire Vendors continued

Company	MobilePhone	Email	SitePrepBurn	UnderstoryBurn	Winter	Spring	Summer	Fall
Acorn Outdoor Services	(936) 438-2499	aosinc@consolidated.net	Yes	Yes	Yes	Yes	Yes	Yes
Beaver Dozer Service			Yes	Yes	Yes	Yes	Yes	Yes
Bird Forestry Services, Inc.	(936) 560-2931	www.bfsinc.com	No	Yes	Yes	Yes	Yes	Yes
Environmental Tree Shredding, L.P.		texastreeshredding@earthlink.net	Yes	No	Yes	Yes	Yes	Yes
Hagler Forestry		tara1@qzip.net	Yes	No	No	Yes	Yes	Yes
IBF	(903) 692-2406	IBFTree@gmail.com	Yes	Yes	Yes	Yes	Yes	Yes
Keith Axelson			Yes	Yes	Yes	Yes	Yes	Yes
Kellco Construction			Yes	Yes	Yes	Yes	Yes	Yes
Nelms Equipment & Reforestation	(936) 546-8061	Nelms1@yahoo.com	Yes	Yes	Yes	Yes	Yes	Yes
Raven Enviromental Services Inc.			Yes	Yes	Yes	Yes	Yes	Yes
Smith & Smith Forest Management, Inc.			Yes	Yes	Yes	Yes	Yes	Yes
Southwest Silviculture		macstaff@pernet.net	Yes	Yes	Yes	Yes	Yes	Yes
Zavala Forestry Services	(903) 295-9446		Yes	Yes	No	No	No	No

Prescribed Fire Vendors continued

Company	FireFighterRedCarded	BrushTruck	Dozer	FirePlow	MinimumAcres
Acorn Outdoor Services	Yes	Yes	Yes	Yes	1
Beaver Dozer Service	No	No	Yes	Yes	25
Bird Forestry Services, Inc.	No	No	Yes	Yes	1
Environmental Tree Shredding, L.P.	No	No	Yes	No	1
Hagler Forestry	No	No	Yes	No	35
IBF	No	No	Yes	Yes	1
Keith Axelson	No	No	Yes	Yes	35
Kellco Construction	No	No	Yes	No	100
Nelms Equipment & Reforestation	No	No	No	No	1
Raven Enviromental Services Inc.	Yes	No	Yes	Yes	50
Smith & Smith Forest Management, Inc.	No	No	Yes	No	50
Southwest Silviculture	Yes	No	Yes	Yes	1
Zavala Forestry Services	No	No	Yes	No	1

Great Trinity Forest Management Plan

Sources and Contacts

Forest Services Vendor Database:

Tree Planting Vendors

Tree Planting Vendors

Company	Contact	Address	City	State	Zip	WorkPhone	Fax
Abel Sanchez Forestry Service	Abel Sanchez	P. O. Box 1571	Jasper	TX	75951	(409) 384-7834	
All Regions Forestry, Inc.	Lorenzo or Diana Tunek	P. O. Box 8435	Bossier City	LA	71113	(318) 549-1767	(318) 746-1556
D & W Regeneration, Inc.		P. O. Box 1231	Center	TX	75935	(936) 591-2535	
Doug Meadows	Doug Meadows	4827 FM 561	Simms	TX	75574	(903) 543-2943	
Doug Wilder	Doug Wilder	Route 1 Box 198	Corrigan	TX	75939	(936) 398-2224	
Eller & Sons Trees, Inc.	Jerry Eller	500 Loblolly Lane	Franklin	GA	30217	(706) 675-6471	
Gary Hess Contracting, Inc.	Gary Hess	P. O. Box 65	Garvin	OK	74736	(580) 286-2961	
George Whatley, Jr.	George Whatley, Jr.	558 County Road 4231	Atlanta	TX	75551	(903) 796-5564	(903) 796-5564
Glasscock Enterprises	James Glasscock	22904 Hwy 69 N	Mineola	TX	75773	(903) 882-3532	
IBF	Matthew L. Buchanan	P. O. Box 165	Carthage	TX	75633	(903) 693-4929	(903) 693-3161
John Lee Lewis	John Lee Lewis	610 FM 1725	Willis	TX	77378	(936) 767-4537	
Kimbo Farms, Inc.	Kimberly Thurman	P. O. Box 30	Joaquin	TX	75954		
Magro Arriaga	Magro Arriaga	498 Dorgan Dr.	Jasper	TX	75951		
Manuel Mijares	Manuel Mijares	406 E. Morris Street	Jasper	TX	75951		
Mark Langford	Mark Langford	338 County Road 421	Carthage	TX	75633	(903) 235-5836	
Parker Forestry Consultants	Keelin Parker	Route 2 Box 3225	Woodville	TX	75979	(409) 283-5413	(409) 837-2524
Pineywoods Reforestation		P. O. Box 508	Marshall	AR	72675	(870) 448-6150	(903) 721-2591
R V Forestry Co.	Ruben J. Valencia	P. O. Box 1754	Silsbee	TX	77656		
RAAD Agricultural, Inc.	Michael S. Gay	1012 County Road 2552	Shelbyville	TX	75973		
Silva-Tech/South, Ltd.	Buddy Stalnaker	P. O. Box 633262	Nacogdoches	TX	75963	(936) 568-9031	(936) 568-9031
Spivey Tree Planting Service	Fred Spivey	P. O. Box 349	Mt. Enterprise	TX	75681	(903) 822-3267	
Star Forestry Co.	Luis Garcia	P. O. Box 473	Timpson	TX	75975	(936) 254-3652	
Superior Forestry Service (Tree Planting)	Jerry Arter	P. O. Box 25	Tilly	AR	72679	(870) 496-2442	
Tommy Kessler	Tommy Kessler	Box 816	Linden	TX	75563	(903) 756-7001	
Tree Tech Forest Farm, Inc.	David Riley	Box 278 CR 4720	Silsbee	TX	77656	(409) 429-5180	
Van Duson Timber Corp.	Gary Van Dusen	4015 Valley Ranch Rd.	Longview	TX	75602	(903) 236-7696	

Tree Planting Vendors continued

Company	MobilePhone	Email	MachineOpenLand	MachineWildLand	Dibble	Hoedad	Shovel	MinimumAcres
Abel Sanchez Forestry Service			Yes	Yes	Yes	No	No	1
All Regions Forestry, Inc.		allregionsinc@aol.com	No	No	Yes	Yes	No	1
D & W Regeneration, Inc.		kurtdenney@yahoo.com	No	No	Yes	No	No	1
Doug Meadows	(903) 826-4262		Yes	No	No	No	No	1
Doug Wilder		dwilder2001@yahoo.com	Yes	Yes	Yes	No	No	1
Eller & Sons Trees, Inc.		info@ellerandsons.com	No	No	Yes	Yes	No	1
Gary Hess Contracting, Inc.		garyhess@arbuckleonline.com	No	No	No	No	Yes	1
George Whatley, Jr.			Yes	No	No	No	No	1
Glasscock Enterprises		jackieglasscock@yahoo.com	Yes	Yes	No	No	No	1
IBF	(903) 692-2406	IBFTree@gmail.com	Yes	Yes	Yes	No	Yes	1
John Lee Lewis			Yes	No	No	No	No	1
Kimbo Farms, Inc.			No	No	Yes	No	No	1
Magro Arriaga			Yes	Yes	Yes	No	No	1
Manuel Mijares			No	No	Yes	No	No	1
Mark Langford			Yes	No	No	No	No	1
Parker Forestry Consultants		pfc@parkerforestry.com	Yes	Yes	Yes	No	No	1
Pineywoods Reforestation	(903) 721-2592		No	No	No	Yes	No	1
R V Forestry Co.	(409) 782-0162		Yes	No	Yes	No	No	1
RAAD Agricultural, Inc.	(936) 591-1960		Yes	Yes	Yes	No	No	1
Silva-Tech/South, Ltd.	(936) 552-4807	buddy@silvatechsouth.com	Yes	No	No	No	No	1
Spivey Tree Planting Service		spiveystakecompany@hotmail.com	Yes	Yes	Yes	No	No	1
Star Forestry Co.	(936) 556-2087	starforestry@yahoo.com	No	No	Yes	No	No	1
Superior Forestry Service (Tree Planting)		sfs@superiorforestry.com	No	No	Yes	Yes	No	1
Tommy Kessler			Yes	Yes	No	No	No	1
Tree Tech Forest Farm, Inc.	(936) 329-0890		No	No	Yes	No	No	1
Van Duson Timber Corp.		jv1053@aol.com	Yes	Yes	No	No	No	1

TEXAS FOREST SERVICE

Best Management Practices

Product and Vendor Guide

March, 1999

This guide consolidates information needed to obtain materials for road and stream crossing construction. The price information in this guide is approximated and may vary with distance from distributors.

More detailed information of each product is available from the BMP Project. If you need specific information about a product, call Burl Carraway or Hughes Simpson at (936) 639-8180 or e-mail us at hsimpson@tfs.tamu.edu.

If you know of additional sources from which materials may be obtained, please let us know.

The Texas Forest Service does not endorse the use of specific products or vendors listed in the contents of this guide.

All prices are subject to change.

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GEOTEXTILE FABRICS

Application: Geotextiles, often called construction fabric, are the most widely used geosynthetic. They are constructed from long lasting synthetic fibers that are bonded together to form a fabric held together by weaving, heat bonding, or other means. They are primarily used for separation or reinforcement over wet, unstable soils. Geotextile fabrics are typically used in conjunction with geoweb or geogrid.

Note: Geotextiles are photodegradable; they must be stored out of the sunlight.

Manufacturers:

Company	Phone	Product
Contech	(409) 296-4098	C-200 Woven Fabric or C-38 Non-woven fabric
Nicolon/Mirafi Group	(800) 234-0484	140N
Linq Industries	(800) 543-9966	130EX

Price Range: $00.32 to $1.50 per square yard for nonwoven geotextiles.
$00.50 to $2.00 per square yard for woven geotextiles.

Quantities: Sold by the roll. One roll will cover 475 to 600 square yards (150ft. of road) and will weigh 120 to 150 pounds.

Distributors:

CONTECH Construction Products, Inc.
Greg Nester, Sales Representative
14505 Torrey Chase Blvd., Suite 108
Houston, TX 77014
Phone: (281) 893-6012
Fax: (281) 893-6026

Seabreeze Culvert, Inc.
Mason Breaux, Sales Representative
P.O. Box 6
Stowell, TX 77661
Phone: (409) 296-4098 or (409) 267-5274
Fax: (409) 296-4099

GEOGRIDS

Application: Geogrids are made from polyethylene sheeting that is formed into open grid-like configurations. Geogrids are good for reinforcement because they have high tensile strengths, and coarse aggregate can interlock into the grid structure.

Manufacturers:

Company	Phone	Product
Nicolon/Mirafi Group	(800) 234-0484	Miragrid 5T
Tensar	(800) 836-7271	BX 1100
Tenax	(800) 356-8495	MS330
Huesker	(800) 942-9418	Fortrac 35/20-20

Price Range: $1.60 to $5.00 per square yard (the higher cost products are made from coated polyester).

Quantities: Typically sold by the roll (13.1' X 164'). May be ordered in specific dimensions. One standard roll weighs 75 to 100 pounds.

Distributors:

CONTECH Construction Products, Inc.
Greg Nester, Sales Representative
14505 Torrey Chase Blvd., Suite 108
Houston, TX 77014
Phone: (281) 893-6012
Fax: (281) 893-6026

Seabreeze Culvert, Inc.
Mason Breaux, Sales Representative
P.O. Box 6
Stowell, TX 77661
Phone: (409) 296-4098 or (409) 267-5274
Fax: (409) 296-4099

Construction Materials
18909 Highland Road
Baton Rouge, LA 70821
Phone: (504) 751-4000

Tensar
David Poe
825 Fort View Road, Ste. 112F
Austin, TX 78704
Phone: (512) 440-0898
Fax: (512) 440-0899

GEOCELLS

Application: Geocells are made from polyethylene strips from 2 to 8 inches high that are bonded to form a honeycomb structure. The product is shipped in a collapsed and compact form. Geocells may be used as a low-water crossing or as a wet-area crossing. It works best in areas with flat approaches to the crossing and with a fairly firm base. Used in perennial and intermittent streams, water may flow over the geocells, which prevents lateral movement of the fill material and provides for a stable base for traffic. It is recommended that a geotextile fabric be installed under the geocells. Type of fill materials will be influenced by expected stream velocities.

Manufacturers:

Company	Phone	Product
Presto	(920) 738-1211	Geoweb
AGH	(713) 552-1749	Envirogrid
WEBTEC	(800) 438-0027	TerraCell

Price Range: $150 - $400 per unit.

Quantities: Typically sold by the sheet (8’ X 20’). Four inch sheets are adequate for light traffic (pick-up trucks and small tractors), while eight inch sheets are recommended for heavy traffic (large tractors and logging traffic.)

Distributors:

CONTECH Construction Products, Inc.
Greg Nester, Sales Representative
14505 Torrey Chase Blvd., Suite 108
Houston, TX 77014
Phone: (281) 893-6012
Fax: (281) 893-6026

Seabreeze Culvert, Inc.
Mason Breaux, Sales Representative
P.O. Box 6
Stowell, TX 77661
Phone: (409) 296-4098 or (409) 267-5274
Fax: (409) 296-4099

Big “R” Manufacturing & Distributing, Inc.
Dave Wilke, Sales Rep.
P.O. Box 1290
Greeley, CO 80632-1290
Phone: (970) 356-9600 or (800) 234-0734
Fax: (970) 356-9621

RENO MATTRESS

Application: A reno mattress is comparable to a box spring mattress from a bed. It differs in that it is made from a product similar to chain-link fencing. The mattress is place in the stream when it is filled up with fist-size rock and the top is wired shut. This product serves to hold rock in place for a low water crossing. It differs from Geoweb in that it does not necessarily need to be installed flush with the bottom of the stream channel. The open characteristics of the wire will allow for water to flow through the mattress as well as over the top. This product comes as galvanized wire or can be coated with PVC to extend the life of the product.

Manufactures:

Company	Phone	Product
MacCaferri Gabions	(972) 346-2974	Reno mattress
***Price range:**	Galvanized	PVC
12'X6'X6"	$68.00	$98.75
12'X6'X12"	$78.20	$117.85

Distributors:

MacCaferri Gabions
1120S. Texas St., Suite F
Lewisville, Texas 75057-4833
Phone: (972) 346-2974
FAX: (972) 219-1639

The Texas Forest Service does not endorse the use of specific products or vendors listed.

CULVERTS

Application: Almost everybody knows when culverts are appropriate to install. What also needs to be understood is the tremendous variation in culvert sizes and types. Three “main types that seem to emerge by their use in forestry operations are galvanized steel, aluminum, and polymer-coated galvanized steel. Aluminized, asphalt coated, plastic, and fiberglass are less common types but may also be appropriate.

Specifications:

Types	Description	Life Span
Galvanized Steel	Most common	15 years (pH <7, >7)
Aluminum	Very light but easily crushed	50 years
Polymer-coated Galvanized	Relatively heavy, and must handle w/care	30-50 years
Asphalt-coated	Being phased out (environmental concerns)	N/A
Plastic	Relatively light, and gaining popularity	30 years
Aluminized	Relatively light	30 years
Fiberglass	Very heavy, but inexpensive	50 years

*Note that Life Spans are not definite – they vary with soil type, water acidity, and manufacturer’s claims.

Size/Price*:

Types	24 inch	36 inch	48 inch	60 inch
Galvanized Steel	$12.42	$18.55	$24.65	$38.06
Aluminum	$17.93	$30.30	$39.81	$62.28
Polymer-coated Galvanized	$14.67	$21.15	$30.15	$47.62
Aluminized	$13.55	$20.00	$26.40	$40.20
Fiberglass	$10.00	$12.50	$15.00	$20.00

*Prices are for standard 16 gauge per linear foot. Heavier gauges obviously cost more.

Arched Culverts: Culverts vary by shape as well. Arched culverts are "short" and egg-shaped, and work well where sufficient head or fill height is of concern. They may also require use of a heavier gauge to facilitate the arching process, thereby increasing the cost. The cost of arched culverts may generally be calculated by adding 7% to the initial culvert cost.

Culvert Sizing: It cannot be emphasized enough the importance of properly sizing culverts! Cheaper is not always better, and a 6" rain will sure prove it. Refer to the chart below when sizing culverts.

ACRES DRAINED	**Light Soils** (Sands)			**Medium Soils**			**Heavy Soils** (Clays)		
	Flat	Mod.	Steep	Flat	Mod.	Steep	Flat	Mod.	Steep
	Culvert Diameter in Inches								
5	18	18	18	18	18	21	21	21	24
10	18	18	18	21	24	27	27	27	36
20	18	18	18	24	27	36	36	36	42
30	18	18	18	27	30	36	36	42	48
40	18	18	18	27	36	42	42	48	
50	18	18	18	30	36	48	48	48	
75	18	21	21	36	42				
100	21	21	24	36	48				
150	21	24	24	42					
200	24	30	30	48					
250	27	30	30						
300	30	36	36						
350	30	36	42						
400	36	36	42						

Flat: 0% - 5% Slope
Moderate (Mod.): 5% - 10%
Steep: 15%+

Distributors:

CONTECH Construction Products, Inc.
Greg Nester, Sales Representative
14505 Torrey Chase Blvd., Suite 108
Houston, TX 77014
Phone: (281) 893-6012
Fax: (281) 893-6026

Seabreeze Culvert, Inc.
Mason Breaux, Sales Representative
P.O. Box 6
Stowell, TX 77661
Phone: (409) 296-4098 or (409) 267-5274
Fax: (409) 296-4099

Texas Steel Culvert Company
Susan Cole, Sales Representative
2020 W. Division
Arlington, TX 76012
Phone: (817) 265-2255
Fax: (817) 265-2250
Galvanized and Polymer-coated only

STEEL PIPE

Product: Steel Pipe

18” X 40’	$10.95/ft.
22” X 40’	$12.95/ft.
24” X 40’(Truckload of 15 joints)	$550/joint
48”	$2,250/30 ft. joint; 3 joints/$4,150

Distributor:

Price Co. (Steel Pipe)
Rt. 2, Box 42K
Kumby, TX 75433
Phone: (800) 443-1145

TEMPORARY CROSSING MATS FOR HARVESTING OPERATIONS

Application: Temporary crossing mats are used to cross small streams and/or wet areas. They are easily moved from one location to another by a large tractor or skidder. They are relatively inexpensive and they prevent the need for fill material associated with culverted crossings.

Product: Drag-Line Mats (Heavy Duty)

Specifications: Mats are constructed of untreated, mixed American hardwoods.

Size/Price/Weight:

Eight Inch (4 X 8):

Sixteen Feet	$295 each	$885/set of 3	2,800 lbs. per mat
Eighteen Feet	$330 each	$990/set of 3	3,200 lbs. per mat
Twenty Feet	$385 each	$1,155/set of 3	3,500 lbs. per mat
Twenty-four Feet	$480 each	$1,440/set of 3	4,200 lbs. per mat

Twelve Inch (4 x 8):

Twenty Feet	$575 each	$1,725/set of 3	5,280 lbs. per mat
Twenty-four Feet	$700 each	$2,100/set of 3	6,300 lbs. per mat
Twenty-eight Feet	$875 each	$2,625/set of 3	7,400 lbs. per mat
Thirty Feet	$970 each	$2,910/set of 3	7,900 lbs. per mat
Thirty-two Feet	$1175 each	$3,525/set of 3	8,400 lbs. per mat

Manufacturer/Distributor:

Quality Mat Company
John Penland, Sales Representative
6550 Tram Road
Beaumont, TX 77713
Phone: (409) 722-4594 or (800) 227-8159

Product: Laminated Drag-Line Mats
"Board Road"

Specifications: Mats are constructed of untreated, mixed American hardwood. Mats are designed for light traffic, or heavy traffic in wet-areas with no span. Life span is about five years.

Size/Price/Weight:

12' X 8' X 6" (oak)	$295 per mat	2600 pounds
16' X 8' X 6" (oak)	$415 per mat	3400 pounds
16' X 8' X 6" (mixed hdwd.)	$395 per mat	3250 pounds

Manufacturer/Distributor:

Quality Mat Company
John Penland, Sales Representative
6550 Tram Road
Beaumont, TX 77713
Phone: (409) 722-4594 or (800) 227-8159

Product: "Panel-Lam" Skidder Mats

Specifications: Constructed from 4" X 8" creosote treated timbers. Life span is approximately 5 years.

Size/Price/Weight:

5' X 24' X 8"	$2350 - $2500 per mat	4600 pounds

Manufacturer:

Wheeler Lumber Operations
3340 Republic Avenue
P.O. Box 26100
St. Louis Park, MN 55426
Phone: (800) 328-3986

Distributor:

Big "R" Manufacturing & Distributing, Inc.
David Wilke, Sales Representative
P.O. Box 1290
Greeley, CO 80632-1290
Phone: (970) 356-9600 or (800) 234-0734
Fax: (970) 356-9621

RAILCARS

Product: Tank Cars

Specifications: Tank cars with the ends cut out. Wall thickness from 1/2 inch to 7/8 inch. Life span is 30-50 years. Appropriate in larger creeks where conventional sized culverts are too small.

Price/Size*:

Diameter	Length	Cost
6'6" – 7'11"	32' – 40'	$85/foot ($3,750/car)
8'0" – 8'11"	32' – 50'	$90/foot ($3,750/120 ft.)
9'0" – 9'4"	32' – 50'	$95/foot
9'5" – 10'	40' – 60'	$105/foot

*Price is per linear foot.

Distributors:

Diversified Railcar
Terry Smith, Owner
143 Ouachita 504
Camden, AR 71701
Phone: (870) 231-9782 or (870) 664-2196

Price Company
Rt. 2, Box 42K
Kumby, TX 75433
Phone: (800) 443-1145

Product: Flat Cars

Specifications: Appropriate for spanning larger streams. Very inexpensive relative to constructing a bridge.

Size/Price*/Weight:

Size	Price*	Weight
10' X 40'	$3,500	20,000 pounds
10' X 50'	$4,000	25,000 pounds
10' X 60'	$4,800	38,000 pounds
8' X 89'	$9,500	44,000 pounds

Distributors:

Diversified Railcar
Terry Smith, Owner
143 Ouachita 504
Camden, AR 71701
Phone: (870) 231-9782 or (870) 664-2196

Product: Box Car Beds

Specifications: Appropriate for spanning larger streams. Very inexpensive relative to constructing a bridge. Box car beds are box cars with the top cut off. They are lighter than the flat cars.

Size/Price*/Weight:

10' X 50'	$4,000	27,000 pounds

*Price includes delivery to most of East Texas.

Distributor:

Diversified Railcar
Terry Smith, Owner
143 Ouachita 504
Camden, AR 71701
Phone: (870) 231-9782 or (870) 664-2196

GABION BASKETS

Application: Gabion baskets look like chain link fencing material. They are made from both zinc-coated wire and zinc-coated with a PVC sleeve. The baskets are primarily used as retaining structures, and may be appropriate for use in stream crossings. Baskets are typically filled with 6" or larger stones (no fines). One drawback is that rock must be placed by hand.

GABION BASKETS SIZES AND PRICES						
Length (feet)	Width (feet)	Height (feet)	Number of Cells	Capacity (cubic yards)	Price Galvanized	Price PVC-Coated
6	3	3	2	2.0	$47.15	$62.67
9	3	3	3	3.0	$67.27	$89.92
12	3	3	4	4.0	$85.50	$114.87
6	3	1.5	2	1.0	$33.27	$43.70
9	3	1.5	3	1.5	$47.47	$62.67
12	3	1.5	4	2.0	$70.17	$80.82
6	3	1	2	0.66	$29.82	$38.95
9	3	1	3	1.0	$41.25	$54.67
12	3	1	4	1.33	$52.15	$71.02
4.5	3	3	1	1.5	$40.70	$48.70

*Some units may be purchased at costs up to $275.

Manufacturers:

Lane Metal Products Division
State Rt. 1030
Dublin, VA 24084
Phone: (540) 674-4645

MacCaferri Gabions, Inc.
1120 S. Texas St., Ste. F
Lewisville, TX 75057-4833
Phone: (972) 436-2974
FAX: (972) 219-1639
email: magaec@aol.com

Distributors:

Big "R" Manufacturing & Distributing, Inc.
Dave Wilke, Sales Representative
P.O. Box 1290
Greeley, Co 80632-1290
Phone: (970) 356-9600 or (800) 234-0734
Fax: (970) 356-9621

CONTECH Construction Products, Inc.
Greg Nester, Sales Representative
14505 Torrey Chase Blvd., Suite 108
Houston, TX 77014
Phone: (281) 893-6012
Fax: (281) 893-6026

MISCELLANEOUS PRODUCTS

Product: Silt Fencing

Application: Appropriate for use as an erosion barrier.

Price/Size: Standard roll (3' X 100') costs $30.00 and weighs 55.0 lbs.
Silt fencing backed with wire for $90.00 for a roll (3' X 100')
Both rolls come with pre-attached posts for installation.

Distributors:

CONTECH Construction Products, Inc.
Greg Nester, Sales Representative
14505 Torrey Chase Blvd., Suite 108
Houston, TX 77014
Phone: (281) 893-6012
Fax: (281) 893-6026

Seabreeze Culvert, Inc.
Mason Breaux, Sales Representative
P.O. Box 6
Stowell, TX 77661
Phone: (409) 296-4098 or (409) 296-5274
Fax: (409) 296-4099

Product: Erosion Control Fabrics

Application: Appropriate for use on exposed soils to prevent erosion. The products are so widely varied in specifications and prices that it is impractical to list specific products. However, below is a list of distributors that carry many different types of fabrics. Fabrics range from polymer synthetics to natural materials.

Distributors:

Synthetic Industries
Geosynthetic Products Division
4019 Industry Drive
Chattanooga, TN 37416
Phone: (800) 621-0444 or (423) 899-0444
Fax: (423) 899-7619

North American Green
14649 Highway 41 North
Evansville, IN 47711
Phone: (800) 772-2040 or (812) 867-6632
Fax: (812) 867-0247

BonTerra America
355 W. Chestnut Street
Genesee, Idaho 83832
Phone: (800) 882-9489
e-mail: **bonterra@moscow.com**

American Excelsior Company
http://www.amerexcel.com
Phone: (800) 777-SOIL (777-7645)
Fax: (817) 649-7816

Product: Hydromulch

Application: Slope rehabilitation and stabilization. The products are often used for revegetation after large forest fires as well as stabilizing large road cuts. Probably limited in forestry practices; however, information is available if the need arises.

Quantities: 40 bales per ton

Rates: Average application rates vary but average 800 lbs. of fiber per acre.

Prices: Average price is $250 per ton.

Distributors:

Dyna Turf Fibers
Rose Niemi
1125 Muscat Avenue
Sanger, CA 93657
Phone: (888) Buy Turf or (559) 875-0493
Fax: (559) 875-0667

Wood Recycling, Inc.
Woburn, MA 01801
(800) 850-9752
*Free video available.

Spittle Enterprises, Inc. (Product is called Terramulch)
Kevin Spittle
P.O. Box 1918
Huntersville, NC 28070
Phone: (800) 726-6414 or (704) 822-6511
Fax: (704) 827-9398

Product: Hydroseeders

Application: Use in applying hydromulches.

Prices: Prices range from $7,500 for 300 gallon seeders to $40,000 for 2,000 gallon seeders.

Distributor:

Finn Corporation
9281 LeSaint Drive
Fairfield, OH 45014
Phone: (800) 543-7166 or (513) 874-2818
Fax: (513) 874-2914

FILL MATERIALS

Southeast Texas:

Distributor	Phone	Product
Wayne Hooks – Grisham Construction	(409) 661-0717	Slag
Smith & Company	(409) 756-6960	Crushed Limestone
WM. Acreman	(409) 756-3634	Fill Dirt Crushed Limestone
Deanco	(281) 356-8417	Crushed Limestone
Nathan Hoagland Construction	(409) 264-3322	Crushed Sandstone Crushed Concrete Fill Dirt Crushed Asphalt

Northeast Texas:

Distributor	Phone	Product
Lee's Gravel	(903) 756-5387	Iron Ore Crushed Limestone
Transit Mix Concrete & Materials Co.	(409) 569-9571	Crushed Concrete Crushed Limestone
East Texas Asphalt	(409) 639-2216	Crushed Limestone Filtered Limestone

Product	**Cost Per Ton***
Crushed Limestone	$20.00 - $32.00
Slag	$6.50
Fill Dirt	$6.00 - $7.50
Crushed Concrete	$5.00
Crushed Sandstone	Price based on distance. Please call for quote.
Crushed Asphalt	Price based on distance. Please call for quote.
Iron Ore	Price based on distance. Please call for quote.

*Note that one ton is equal to approximately 1.35 cubic yard. Price does not include hauling fee. Some businesses charge flat rates per mile and some charge hourly fees.

Sources and Contacts

Native Grass Seed Suppliers

Native Grass Seed Suppliers

The following is a partial list of some of the larger native grass seed suppliers in Texas provided by Native Prairies Association of Texas <http://texasprairie.org/>.

Native American Seed http://www.seedsource.com

Bamert Seed Co. of Muleshoe 800-262-9892

Bob Turner Seed Co. of Breckenridge 817-559-2065

Curtis and Curtis in New Mexico has seed for west Texas.

Douglass King's Seed Co. of San Antonio 210-661-4191

Foster-Rambie Grass Seed of Uvalde 512-278-2711

George Warner Seed Co. of Hereford 806-364-4470

Harpool Seed Inc of Dallas 214-421-7181

High Plains Native Grass, Inc of Maple 806-927-5545

Sharp Brothers Seed Co. of Amarillo 806-352-2781

An up-to-date list of grass and wildflower seed suppliers and nurseries can be obtained from the Lady Bird Johnson Wildflower Center 4801 Lacrosse Avenue in Austin, 78739-1702 (512-292-4200). Or go to the Texas NRCS website, then click on plant materials information. It provides a list of many species native and exotic and suppliers.

United States
Department of
Agriculture

Forest Service

Southern Region

State and Private
Forestry

Cooperative
Forestry

Miscellaneous ReportR8-MR 33

COMMERCIAL SUPPLIERS

OF

TREE AND SHRUB SEED

IN THE

UNITED STATES

DECEMBER 1995

Introduction

The purpose of this directory is to provide a list of possible vendors of tree and shrub seed for those persons involved in the regeneration and maintenance of plant communities.

The information in this directory was compiled from data furnished by the vendors who responded to a letter sent to all commercial dealers of which the Forest Service of the U.S. Department of Agriculture and the State Foresters had a record. Endorsement of a dealer or the dealer's product is not intended and must not be inferred. Any vendor who was not included in this volume should contact the address below to be included in the next revision.

National Tree Seed Laboratory
5675 Riggins Mill Road
Dry Branch, Georgia 31020-9696
Telephone: 478-751-3551
Fax: 478-751-4135

To Use This Directory, follow this chart.

If you need to:	**Use:**	**To Find:**
Learn what is important to know when buying seed.	Section 1	o Information on seed origin. o Information on seed quality.
Contact a specific seed vendor.	Section 2	o Names o Mailing addresses o Telephone Numbers o Fax Numbers
Find a vendor to provide a specific service.	Section 3	o Information on the services provided by each vendor.
Find a supplier of a kind of seed.	Section 4	o An alphabetic list of all species of tree and shrub seed sold in the U.S. The list is cross referenced to section 1.
Find a scientific name using a common name.	Section 5	o An alphabetic list of common names of some trees and shrubs.

Section 1. Suggested Guidelines for Purchasing Seed

- Geographic Origin of Seeds
- Seed Testing
- What Tests Should be Performed
- Where Can Seed be Tested

Geographic Origin of Seed

Most sellers of seed in this directory will, upon request, furnish data on the origin of the seed they sell. Some vendors certify seed. Seed certified in regard to geographic origin or genetic identity is defined as having used a third party to make inspection of the seed production process in order to provide verification of genetic identity. The third party in the United States is a state Crop Improvement Agency or a state Department of Agriculture. A crop improvement agency is an independent agency created by the state government to be the official agency for certifying seed within the state.

Research in this country and other countries has proved the general superiority of tree and shrub plantings made with planting stock from seed of local origin. Seed of local origin is seed from an area subject to similar climatic influence, usually within 100 miles of the planting site and differing in elevation by less than 1,000 feet in elevation.

If seed of local origin is not available, the best second choice is seed from a region having environmental factors comparable to those at the planned planting site. Such factors include length of growing season, day length, maximum and minimum growing season temperatures, and rainfall amount and distribution.

Source identified seed is labeled with yellow tags in seed certification programs. A yellow tag will tell if the seed was collected in wild stands and would be useful in identifying local sources. The tag will be attached to the seed container in a tamper-evident manner.

In some intensive forms of cultivation such as short rotation wood production, urban or ornamental plantings, or Christmas tree production, seed has been successfully moved great distances beyond local boundaries. This should, however, only be practiced after obtaining all available information on the risks and benefits of the move. Also, occasionally, in these intensive forms of cultivation higher levels of genetic selection are certified. These higher levels are essentially of two types, phenotypically selected, and proven genetic superiority. Different colored tags are used for each level of genetic selection.

Seed Testing

Seed testing refers to the testing of the purity, moisture content, weight, and viability of the seed. Knowing the values of these quality variables is very important in establishing the dollar value of seed and its suitability for different types of regeneration. The most accurate and reliable way to test the seed is to have a sample drawn from the seed lot by an independent third party who submits it for testing to a testing laboratory skilled in testing the kind of seed in question. The least reliable is to take the word of the vendor who cut a few seeds with a pocket knife to estimate the quality. An accurate testing procedure could cost $20 to $100 per seed lot, but the use of poor quality seed could result in partial or complete failure resulting in millions of dollars in loses. There is rarely a good excuse for not having a laboratory test seed before paying for it.

Viability can be estimated in several ways. The best procedure is to have a germination test. This test is usually more objective because you can actually see the seedlings and their characteristics. For difficult to germinate species, estimates of viability are sometimes best made with procedures that excise the embryo from the seed and germinate just the embryo (this is called an excised embryo test) or procedures that use vital stains that stain the seed in a way that allow the living tissue to be differentiated from the nonliving. The use of x-ray is a third alternative to quickly estimate viability. An x-ray test is simply a picture of the tissues that make up the seed. This test alone may not be as accurate as an excised embryo or a chemical stain.

Moisture content is very important because it so closely regulates the viability of the seed. Most temperate species of seed will live only a brief period if they are above 10% in moisture content. A few such as oaks, silver maple, and walnuts must be kept moist to preserve viability. It is important to know the characteristics of the seed you work with. The moisture content will also determine how much water you pay for and how much seed you pay for.

Purity is an estimate of the percentage by weight of the amount of pure seed in a seed lot. The maximum purity is 100. The higher the purity, the more pure seed is in the seed lot.

Seed weight is the number of seeds per pound (or per kilogram) of pure seed. The larger the seeds the fewer seeds there are per unit weight (pound or kilogram).

Pure live seed per pound is the product of purity, seed weight and viability. It tells how many potential seedlings there are in a unit weight of seed as it is offered for sale. In general, the higher this value, the higher is the seed quality.

What test should be done on the seed I buy?

As a minimum, the moisture content and the viability of the seed should be known. The viability must be known because dead or low viability seed is of little value. Even if the vendor refunds your money, you have not obtained the plants that were desired. For general nursery usage, a viability of 80% is often required as a minimum. The higher the quality standards are for seedlings, the higher must be the quality of the seed. Many more modern nursery procedures require germination of 90% or higher for efficient operation. High viability may be difficult to acquire for some species because they are mechanically fragile or deteriorate rapidly.

Where can seed be tested?

There are both private and public laboratories in the U.S. that can test tree and shrub seed. It is good to know the qualifications of the laboratory to conduct tests. For instance, is the laboratory a member of the Association of Official Seed Analysts? Is the laboratory familiar with the species to be tested? What other training might the analyst have? The vendor should know the location of a good laboratory. If the vendor does not know, then you can contact your state's forestry agency or the National Tree Seed Laboratory at the address given in the introduction.

Section 2. Contacting a Specific Seed Vendor.

The list in this section provides the information needed to contact seed vendors by mail service, telephone or fax. The vendors are listed alphabetically. The number to the left of the vendor's name is the reference number used in Section 3, Vendor Services and Section 4, the Species Master List.

The information provided here was accurate at the time of printing. You may contact the National Tree Seed Laboratory at the address given in the introduction to receive new information, or to provide updated or additional information. Changes may occur. You may contact the National Tree Seed Laboratory at the address given in the introduction. The NTSL may have received new information, or you may assist us in updating our list. Information is always welcome about changes to this list or about vendors not included.

COMMERCIAL SEED DEALERS AND CODE NUMBERS

COMMERCIAL SEED DEALERS AND CODE NUMBERS			
1	Better Forest Tree Seeds P.O. Box 709 Petersburg PA 16696 814-667-5088 814-667-5089 Fax	8	Clyde Robin Seed Co., Inc. 3670 Enterprise Ave Hayward CA 94545 510-785-0425 510-785-6463 Fax
2	Blue Ridge Evergreen Nursery Rt. 4, Box 599 Boone NC 28607	9	Comstock Seed 8520 West 4th St Reno NV 89523 702-746-3681
3	Brown Seed Company P0 Box 1792 Vancouver WA 98668 206-892-4111 206-892-1781 Fax	10	Container Corporation of America P0 Box 626 Callahan FL 32011 904-879-3051 904-879-1537 Fax
4	Callahan Seeds 6054 Foley Lane Central Point OR 97502 541-855-1164	11	Dean Swift Seed Company P0 Box B Jaroso CO 81138 719-672-3739 719-672-3865
5	Carter Seeds 475 Mar Vista Rd Vista CA 92083 619-724-5931 619-724-8832 Fax	12	OUT OF BUSINESS Dow Seeds Hawaii Ltd.
6	Cascade Forest Nursery Rt. 2 Cascade IA 52033 319-852-3042	13	Early Bird Nursery 2875 Salem Rd Parrottsville TN 37843 615-625-1362
7	Charles Inouye & Sons Box 937 Gunnison UT 84634 801-528-7863	14	F.W. Schumacher Co., Inc. 36 Spring Hill Rd Sandwich MA 02563 508-888-0659 508-833-0322 Fax

15	Federal Paper Board Co., Inc. P0 Box 1007 Lumberton, NC 28359 919-621-1551 919-739-1302 Fax	22	Inter Ag Seed Company 3720 64th St Holland MI 49423 616-857-1209
16	Forest Seeds of California 1100 Indian Hill Rd Placerville CA 95667 916-621-1551 916-626-6926 Fax	23	Intermountain Seed Company 445 South 1st E., Box 62 Ephraim UT 84627 801-283-4383 801-283-4388 Fax
17	Granite Seed Company P0 Box 177 Lehi UT 84043 801-531-1456 801-768-3697 Fax	24	International Forest Seed Co. P0 Box 490, Simpson Rd Odenville AL 35120 205-629-6461 205-629-6671 Fax
18	Great Northern Seed Company 1002 Hamilton St Wausau WI 54401 715-845-7752	25	K & S Jeane Seed Inc. P0 Box 21 Quitman LA 71268 318-259-2088 318-259-2088 Fax
19	OUT OF BUSINESS Herbst Tree Seed Inc	26	Lafara Tree Seed Company Rt 3, Box 172-1 Cloverdale IN 46120 317-528-2732
20	Hicks Seed Company 2747 State Road 76 Willow Springs MI 65793 417-469-3181 417-469-1239 Fax	27	Land of the Sky Nurseries 108 Lakewood Dr Asheville NC 28803 704-252-5962
21	Indiana Propagation Company #3 Lyon Block Salem IN 47167 812-358-5262	28	Lawyer Nursery, Inc. 950 Highway 200 West Plains MT 59859 406-826-3881 406-826-5700 Fax

29	Louisiana Forest Seed Co., Inc. 303 Forestry Rd Lecompte LA 71346 318-443-5026 318-487-0316 Fax	36	Northwest Seed Company 38050 Highway 228 Brownsville OR 97327 503-367-5767 503-367-6587 Fax
30	Lovelace Seeds, Inc. Browns Mill Rd Elsberry MO 63343 314-898-2103 314-898-2855 Fax	37	Pacific Forest Seeds 1075 Meridian Brownsboro Rd Eagle Point OR 97524 503-826-6900 503-826-6900 Fax
31	Maple Leaf Industries, Inc. Box 9-6, 480 South 50 East Ephraim UT 84627 801-283-4701 801-283-6872	38	Pakulak Seed and Nursery Co. 4293 West Hansen Rd Ludington MI 49431 616-845-6375 616-845-1887 Fax
32	Mistletoe Sales 780 North Glen Annie Rd Goleta CA 93117 805-968-4818 805-968-2242 Fax	39	Pecoff Brothers Nursery & Seed 20220 Elfin Forest Rd Escondido CA 92029 619-744-3120 619-744-8614 Fax
33	Mortensen Landscaping, Inc. N 7512 Bruce Rd Spokane WA 99207 509-924-2414	40	Plants of the Southwest Rt 6, Box 11-A Santa Fe NM 87501 505-438-8888
34	NORTHPLAN/Mountain Seed P0 Box 9107 Moscow ID 83843 208-882-8040 208-882-7446 Fax	41	Resource Mgmt Service, Inc. P0 Box 43388 Birmingham AL 35243 205-991-9516 205-991-2807 Fax
35	Native Seed Foundation Star Route Moyie Springs ID 83845 208-267-7938 208-267-3265 Fax	42	5 & R Seed Dealers, Inc. P0 Box 1087 Cass Lake MN 56633 218-335-2363

43	Sheffield1s Seed Co., Inc. 273 Auburn Rd Rt. 34 Locke NY 13092 315-497-1058 315-497-1059 Fax	50	Tree Improvement Enterprises, Inc. P0 Box 630 Cottage Grove OR 97424 503-942-4066 503-942-0110 Fax
44	Silvaseed Company P0 Box 118 Roy WA 98580 206-843-2246 206-843-2239 Fax	51	Vans Pines Inc. 7550 144th Ave West Olive MI 49460 616-399-1620 616-399-1652 Fax
45	Smith Nursery Co. P0 Box 515 Charles City IA 50616 515-228-3239	52	Wapumne Native Plant Nursery Co. 3807 Mt. Pleasant Rd Lincoln CA 95648 916-645-9737
46	Southern Seed Company P0 Box 340 Baldwin GA 30511 706-778-4542 706-776-2736 Fax	53	West Tennessee Forest Seed Co. 720 Nancy Dr Brownsville TN 38012 901-548-4043 901-772-7795 Fax
47	Stevenson Intermountain Seed P0 Box 2 Ephraim UT 84627 801-283-6639 801-283-4155 Fax	54	Western Native Seed P0 Box 1463 Salida CO 81201 719-539-1071 719-539-6755 Fax
48	Syverson Seed P0 Box 520 Ridgefield WA 98642 206-887-4094 206-887-4094 Fax	55	Weyerhauser Company 33405 8th Ave., South Federal Way WA 98003 206-924-3292 206-924-3453 Fax
49	Timberline Tree Seed 9100 Abbey Rd Pueblo CO 81004 719-564-6120 719-564-6120 Fax	56	Wild Seed Inc. P.O. Box 27751 Tempe AZ 85285 602-276-3536 602-276-3524 fax
57	Williams Tree Seeds Rt 4, Box 275-B Bemidji MN 566Ol 218-751-7957	58	Wind River Seed Rt 1, Box 97 Manderson WY 82432 307-568-3325 307-568-3325 Fax

Section 3. Vendor Services.

Vendors included in this directory were asked to answer the following questions. Their answers are listed on the following three pages.

o Does your company have a catalog?

o Can you supply source information on the seed?

o Can you formally certify the seed source?

o Do you maintain an inventory of seed?

o Can you supply seed test data on your seed?

  o Were tests performed in accordance with Association of Official Seed Analysts Rules for Testing Seeds?

o Do you make special collections?

o Do you have a minimum order?

  o What is your minimum order?

SEED DEALERS BACKGROUND INFORMATION

COMPANY NUMBER	CATALOG	SOURCE	CERTIF-ICATION	INVENTORY	TESTS	COLLECTION	MINIMUM
1	Yes	Yes					
2	No	Yes	Yes	Yes	Yes-AOSA	No	Yes 1 lb.
3	Yes	Yes	Yes	Yes	Yes	Yes	Yes 1 lb.
4	Yes	Yes	Yes	Yes	Yes-AOSA	Yes	Yes
5	Yes	Yes	No	Yes	Yes	Yes	Yes
6	Yes	Yes	Yes	Yes	No	Yes	Yes-$20.00
7	Yes	Yes	Yes	Yes	Yes	Yes	No
8	Yes	Yes	No	Yes	Yes	Yes	No
9	Yes	Yes	Yes	Yes	Yes	Yes	No
10	No	Yes	No	Yes	Yes	Yes	No
11	Yes	Yes	No	Yes	Yes	Yes	Yes 1 lb.
12	Yes	Yes	No	Yes	Yes	Yes	No
13	Yes	Yes	No	No	No	No	No
14	Yes	Yes	Yes	Yes	Yes	Yes	No
15	No	Yes	Yes	Yes	Yes	Yes	No
16	Yes	Yes	Yes	Yes	Yes	Yes	Yes 1 oz.
17	Yes	Yes	Yes	Yes	Yes	Yes	Yes $50.00
18	Yes	Yes	Yes	Yes	Yes	Yes	No
19	Yes	Yes	Yes	Yes	Yes	Yes	Yes $50.00
20	Yes	Yes	Yes	No	Yes	Yes	No
21	Yes	Yes	No	No	No	Yes	No
22	Yes	Yes	Yes	Yes	Yes	Yes	Yes 1 lb.
23	Yes	Yes	Yes	Yes	Yes	Yes	Yes
24	Yes	Yes	Yes	Yes	Yes	Yes	No

Seed Dealers Background Information

Company Number	Catalog	Source	Certif-ication	Inventory	Tests	Collection	Minimum
25	Yes	Yes	Yes	Yes	Yes	Yes	Yes
26	Yes	Yes	No	No	No	Yes	No
27	Yes	Yes	Yes	Yes	Yes	Yes	Yes $25.00
28	Yes	Yes	Yes	Yes	Yes	Yes	Yes $50.00
29	Yes	Yes	Yes	Yes	Yes	Yes	Yes 1 lb.
30	Yes	Yes	Yes	Yes	Yes	Yes	No
31	Yes	Yes	Yes	Yes	Yes	Yes	Yes $100.00
32	Yes	Yes	Yes	Yes	Yes	Yes	Yes $25.00
33	Yes	Yes	No	No	No	Yes	No
34	Yes	Yes	No	Yes	Yes	Yes	No
35	Yes	Yes	No	No	Yes-AOSA	Yes	Yes $25.00
36	No	Yes	Yes	Yes	Yes-AOSA	Yes	Yes $50.00
37	Yes	Yes	No	Yes	Yes	Yes	Yes 1 lb.
38	Yes	Yes	No	Yes	Yes	Yes	Yes 1 lb.
39	Yes	Yes	Yes	Yes	Yes	No	Yes $25.00
40	Yes	Yes	Yes	Yes	Yes	Yes	No
41	No	Yes	No	Yes	Yes	Yes	No
42	Yes	Yes	No	Yes	Yes	Yes	No
43	Yes	Yes	Yes	Yes	Yes	Yes	Yes 2 gr.
44	Yes	Yes	Yes	Yes	Yes-AOSA	Yes	Yes 1 lb.
45	Yes	No	No	No	No	No	No
46	Yes	Yes	Yes	Yes	Yes	Yes	Yes 10 lbs.
47	Yes	Yes	Yes	Yes	Yes	Yes	Yes
48	No	Yes	Yes	Yes	Yes	Yes	Yes 1 lb.

Seed Dealers Background Information

Company Number	Catalog	Source	Certif-ication	Inventory	Tests	Collection	Minimum
49	Yes	Yes	Yes	Yes	Yes	Yes	No
50	Yes	Yes	Yes	Yes	Yes	Yes	Yes $25.00
51	Yes	Yes	No	Yes	Yes	Yes	Yes
52	No	Yes	No	Yes	Yes	Yes	No
53	Yes	Yes	Yes	Yes	Yes	Yes	No
54	Yes	Yes		Yes	Yes	Yes	No
55	Yes	Yes	Yes	Yes	Yes	Yes	Yes $100.00
56	Yes	Yes	No	Yes	Yes	Yes	Yes $50.00
57	Yes	Yes	Yes	Yes	Yes-AOSA	Yes	No
58	Yes	Yes	No	Yes	Yes	Yes	Yes $50.00

Section 4. Species Master List with Company Numbers.

There are over 2000 species of tree and shrub seed offered for sale in the United States. Both native and exotic species are listed. They are listed alphabetically by scientific name. The common name is given to the right of the scientific name. If you do not know a species scientific name, consult Section 5, the Index of Common Plant Names. The numbers below the species name are the company numbers listed on the left of the company names in Section 2.

This list is a guide. It is designed to allow the seed buyer to quickly determine which vendor(s) sell seed of each species. When a vendor(s) number appears below the species name, that company has stated that they can supply that species. The buyer should be aware however that seed crops vary from year to year. In certain years a species may have a poor seed crop due to environmental conditions. A species genetics can also influence its seed crop. For these reasons some of the dealers listed below a species may not be able to provide seed of that species every year. The seed buyer should plan to contact seed vendors well in advance of the time they want to plant any seed.

In addition, many of the companies in this directory sell species of herbaceous plants (wildflowers, grasses) that are not listed in this directory.

SCIENTIFIC NAME	COMMON NAME
Abies alba 12, 14, 28, 43, 55	Fir, Silver
Abies amabilis 4, 14, 36, 43, 44	Fir, Pacific Silver
Abies balsamea 2, 3, 4, 8, 12, 14, 19, 28, 42, 43, 44, 51, 55, 57	Fir, Balsam
Abies bornmuelleriana 3, 4, 14, 43	Fir, Turkish
Abies bracteata 4, 5, 12, 32, 43	Fir, Bristlecone
Abies cephalonica 4, 12, 14, 28, 43	Fir, Greek
Abies cilicica 43	
Abies concolor 1, 3, 4, 5, 8, 12, 14, 18, 19, 28, 32, 34, 36, 38, 40, 43, 49, 54, 55	Fir, White
Abies concolor var. *glauca* 11, 44	Fir, Rocky Mtn. White
Abies concolor var. *lowiana* 4, 14, 16, 44	Fir, California White
Abies ernesti 43	
Abies firma 5, 14, 43	Fir, Momi
Abies fraseri 1, 2, 3, 5, 12, 14, 19, 27, 28, 43, 44, 51, 55	Fir, Fraser
Abies grandis 1, 3, 4, 5, 12, 14, 16, 28, 34, 36, 43, 44, 48, 49, 54, 55	Fir, Grand
Abies holophylla 28, 43	Fir, Needle
Abies homolepsis 12, 14, 43	Fir, Nikko
Abies koreana 3, 8, 12, 14, 28, 43	Fir, Korean
Abies lasiocarpa var. *arizonica* 4, 5, 11, 14, 28, 32, 43, 44, 49, 54	Fir, Corkbark
Abies lasiocarpa var. *lasiocarpa* 4, 5, 11, 14, 28, 32, 34, 43, 44, 49, 54	Fir, Subalpine
Abies magnifica var. *magnifica* 1, 3, 4, 5, 8, 12, 14, 16, 28, 32, 36, 37, 43	Fir, California Red
Abies magnifica var. *shastensis* 3, 4, 14, 16, 28, 36, 37, 43, 44, 50, 55	Fir, Shasta Red

SCIENTIFIC NAME	COMMON NAME
Abies mariesii 43	
Abies nephrolepis 28, 43	Fir, Manchurian
Abies nordmanniana 3, 12, 14, 23, 28, 43, 44, 55	Fir, Nordmann
Abies numidica 43	Fir, Algerian
Abies pindrow 4, 12, 14, 28, 43	Fir, West Himalayan
Abies pinsapo 4, 12, 14, 43	Fir, Spanish
Abies procera 3, 4, 5, 14, 28, 36, 43, 44, 48, 50	Fir, Noble
Abies religiosa 4	
Abies sachalinensis 14, 43	Fir, Sakhalin
Abies sibirica 14, 22, 28, 43	Fir, Siberian
Abies veitchii 14, 43	Fir, Veitch
Acacia species 4, 5, 8, 12, 14, 17, 28, 32, 39, 43, 56	
Acalypha hispida 12	Chenille Plant
Acer x *leucoderme* 43	
Acer argutum 43	
Acer barbatum 43	Maple, Florida
Acer buergeranum 12, 14, 28, 43	Maple, Trident
Acer campestre 12, 14, 28, 30, 34, 43	Maple, Hedge
Acer capillipes 12, 43	
Acer cappadocicum 12, 43	
Acer carpinifolium 43	Maple, Hornbeam

SCIENTIFIC NAME	COMMON NAME
Acer circinatum 4, 14, 28, 34, 43	Maple, Vine
Acer cissifolium 43	
Acer davidii 4, 12, 14, 28, 43	
Acer diabolicum 43	
Acer ginnala 5, 8, 12, 14, 18, 19, 20, 28, 30, 33, 43, 45, 51	Maple, Amur
Acer glabrum 4, 17, 23, 34, 35, 43, 47, 54	Maple, Rocky Mountain
Acer glabrum sbsp. *douglasii* 4, 14, 28	Maple, Rocky Mountain
Acer grandidentatum 4, 23, 28, 43, 47	Maple, Canyon
Acer griseum 4, 14, 20, 28, 43	Maple, Paperbark
Acer grosseri var. *hersii* 4, 12, 14, 43	
Acer heldreichii 43	Maple, Balkan
Acer japonicum 12, 28, 43	Maple, Japanese
Acer macrophyllum 4, 8, 12, 14, 16, 28, 43	Maple, Big-leaf
Acer mandshuricum 43	
Acer maximowiczianum 43	Maple, Nikko
Acer miyabei 33, 43	Maple, Miyabei
Acer mono 28, 43	
Acer monspessulanum 43	Maple, Montpellier
Acer negundo 12, 14, 19, 28, 43, 54	Boxelder
Acer negundo sbsp. *californicum* 1	Boxelder
Acer nigrum 28, 43, 45	Maple, Black

SCIENTIFIC NAME — COMMON NAME

SCIENTIFIC NAME	COMMON NAME
Acer oblongum	
12, 14, 43	
Acer orientale	
43	
Acer palmatum	Maple, Japanese
3, 5, 8, 12, 14, 19, 28, 32, 43	
Acer palmatum var. *atropurpeum*	Maple, Japanese
5, 8, 12, 14, 20, 32, 43	
Acer pensylvanicum	Maple, Striped
18, 19, 43	
Acer pentaphyllum	
43	
Acer platanoides	Maple, Norway
5, 12, 14, 19, 26, 28, 30, 33, 43, 45	
Acer platanoides var. *schwedleri*	Maple, Schwedler
12, 14, 28, 33, 43, 45	
Acer pseudoplatanus	Maple, Sycamore
12, 14, 28, 33, 43	
Acer rubrum	Maple, Red
5, 12, 14, 18, 19, 20, 25, 26, 28, 29, 30, 32, 43, 51, 53, 57	
Acer rubrum var. *drummondii*	Maple, Drummond Red
25, 29, 43	
Acer rufinerve	Maple, Snake Bark
12, 28, 43	
Acer saccharinum	Maple, Silver
5, 12, 14, 18, 20, 21, 26, 28, 30, 32, 43, 51, 53	
Acer saccharum	Maple, Sugar
5, 8, 12, 14, 18, 19, 21, 26, 28, 30, 43, 45, 51, 53	
Acer sieboldianum	
43	
Acer spicatum	Maple, Mountain
18, 43	
Acer tataricum	Maple, Tatarian
12, 14, 28, 43	
Acer triflorum	Maple, Three Flowered
12, 14, 28, 43	
Acer truncatum	Maple, Shantung
12, 14, 28, 43	
Acer truncatum var. *mono*	Maple, Painted
14	
Actinidia deliciosa	Chinese Gooseberry
12	

SCIENTIFIC NAME	COMMON NAME
Adansonia digitata	Baobab, Monkey-bread
12	
Adenium obesum	Desert Rose
12	
Adenostoma fasciculatum	Chamise - Greasewood
39	
Adenostoma sparsifolium	Ribbonwood - Redshanks
39	
Aesculus x *carnea*	Horse Chestnut, Red
43	
Aesculus californica	Buckeye, California
4, 16, 43	
Aesculus chinensis	
43	
Aesculus glabra var. *glabra*	Buckeye, Ohio
18, 20, 21, 43	
Aesculus hippocastanum	Horsechestnut
12, 14, 18, 20, 28, 33, 43	
Aesculus indica	
43	
Aesculus octandra	Buckeye, Yellow
43	
Aesculus parviflora	Buckeye, Bottlebrush
20, 43	
Aesculus pavia	Buckeye, Red
20, 25, 28, 43	
Aesculus sylvatica	
43	
Aesculus turbinata	Horse Chestnut, Japanese
43	
Aesculus wilsonii	
43	
Aesculus woerlitzensis	
43	
Agathis australis	Kaori Pine
12	
Agathosma ovata	
12	
Agave americana	Century Plant
40	
Agave attenuata	
12, 32	

SCIENTIFIC NAME	COMMON NAME
Agave parryi 40, 56	Mescal
Agonis flexuosa 5, 12, 32	Peppermint Tree
Agonis marginata 12	Willow Myrtle
Ailanthus altissima 5, 12, 14, 28, 43	Tree-of-Heaven
Akebia quinata 12, 43	Akebia, Five-leaf
Akebia trifoliata 12, 43	Akebia, Three-leaf
Alberta magna 12, 28	Alberta
Albizia adianthifolia 28	Gummifera
Albizia julibrissin 4, 5, 14, 19, 25, 28, 29, 32, 43	Mimosa
Albizia lebbeck 5, 12, 28, 39, 43	Woman's Tongue Tree
Albizia lophantha 5, 32, 39	Albizia, Plume
Albizia lucidior 12	
Albizia odoratissima 12	Ceylon Rosewood
Albizia procera 12, 39	
Alectryon excelsus 12	Titoki
Allamanda species 12	Allamanda
Allophylus dregeanus 12	
Alnus cordata 5, 12, 14, 28, 32, 43	Alder, Italian
Alnus firma 43	
Alnus formosana 12	
Alnus glutinosa 5, 12, 14, 19, 20, 28, 43	Alder, European

SCIENTIFIC NAME	COMMON NAME
Alnus hirsuta 43	Alder, Manchurian
Alnus incana 12, 14 ,28, 34, 43	Alder, White
Alnus jorullensis 43	
Alnus nepalensis 5, 12, 43	
Alnus nitida 12	
Alnus rhombifolia 4, 5, 12 ,32, 34	Alder, White
Alnus rubra 3, 4, 5, 14, 28, 34, 36, 43, 44	Alder, Red
Alnus rugosa 18, 43	Alder, Speckled
Alnus serrulata 19	Alder, Hazel
Alnus sinuata 4, 34, 43	
Alnus tenuifolia 4, 43	Alder, Mountain
Alnus viridis 12, 28, 43	Alder, European Green
Alphitonia excelsa 12	
Alstonia scholaris 12	Devil Tree
Ambrosia dumosa 9, 17, 56	Burr Sage
Amelanchier alnifolia 9, 12, 14, 17, 23, 28, 31, 34, 35, 40, 43, 45, 47, 54, 58	Serviceberry, Saskatoon
Amelanchier arborea 12, 14, 43	
Amelanchier canadensis 14, 18, 26, 28, 30, 43, 45	Juneberry
Amelanchier grandiflora 30	
Amelanchier laevis 18, 28, 43, 45, 51	
Amelanchier lamarkii 14, 28, 43	

SCIENTIFIC NAME	COMMON NAME
Amelanchier ovalis 18, 28	
Amelanchier sanguinea 18, 30	Serviceberry, Roundleaf
Amelanchier spicata 43	
Amelanchier stolonifera 43	
Amelanchier utahensis 9, 17 , 23, 47	Serviceberry, Desert
Amorpha californica 4	False Indigo, California
Amorpha canescens 43, 54	Lead Plant
Amorpha fruticosa 4, 12, 14, 28, 40, 43, 45, 54	Indigo Bush
Ampelopsis brevipedunculata 43	
Anacardium occidentale 12	Cashew
Annona cherimola 12	Cherimoya
Annona reticulata 12	Bullock's-heart
Antigonon leptopus 5, 32, 39	Coral Vine
Aralia chinensis 12	Chinese Angelica
Aralia elata 28, 43	Japanese Angelica
Aralia spinosa 25, 43	Devils-walkingstick
Araucaria angustifolia 12, 43	Parana Pine
Araucaria araucana 4, 12, 28, 43	Monkey-puzzle
Araucaria bidwillii 5, 12, 43	Bunya-bunya
Araucaria columnaris 12	New Caledonia Pine
Araucaria heterophylla 5, 12, 14, 28, 32, 43	Norfolk Island Pine

SCIENTIFIC NAME	COMMON NAME
Araujia sericifera 12	Bladder-flower
Arbutus arizonica 4	
Arbutus glandulosa 4	
Arbutus menziesii 4, 5	Madrona
Arbutus unedo 4, 5, 12, 32, 43	Strawberry Tree
Arbutus xalapensis 4, 40	
Archontophoenix alexandrae 12, 28	Palm, Alexandra
Archontophoenix cunninghamiana 5, 12, 32	Palm, Piccabeen
Arcocarpus fraxinifolius 12	Shingle Tree
Arctostaphylos species 4, 28, 34, 39, 43 ,54	Manzanita
Arctostaphylos uva-ursi 4, 12, 14, 28, 34, 35, 40, 43, 54	Bearberry
Ardisia crenata 12, 32	Coralberry
Ardisia humilis 12	
Ardisia macrocarpa 12	
Areca triandra 12	
Arecastrum romanzoffianum 5, 12, 32, 39	Palm, Queen
Arenga pinnata 12	Sugar Palm
Aristolochia californica 4	Birthwort
Aristolochia durior 14, 43	Dutchman's Pipe
Aristolochia elegans 12	Calico Flower
Aristotelia serrata 12	

SCIENTIFIC NAME	COMMON NAME
Aronia x *prunifolia* 12	
Aronia arbutifolia 14, 43	Chokeberry, Red
Aronia brilliantissima 14, 30, 43	Chokeberry
Aronia melanocarpa 14, 18, 28, 43	Chokeberry, Black
Artemisia californica 8, 39	Sagebrush, California
Artemisia cana 9, 17, 23, 28, 31, 34, 47, 58	Sagebrush, Silver
Artemisia filifolia 9, 23, 31, 40	Sagebrush, Sand
Artemisia frigida 9, 17, 23, 28, 31, 40, 47, 54, 58	Sagebrush, Fringed
Artemisia ludoviciana 9, 17, 32, 40, 47, 55, 58	Sagebrush, Prairie
Artemisia nova 9, 17, 23, 31, 47, 54, 58	Sagebrush, Black
Artemisia pycnocephala 8, 12	Wormwood, Sandhill
Artemisia tridentata var. *tridentata* 8, 9, 12, 17, 23, 28, 31, 34, 47, 54, 58	Sagebrush, Basin
Artemisia tridentata var. *vaseyana* 9, 17, 23, 28, 31, 34, 40, 47, 58	Sagebrush, Mountain Big
Artemisia tridentata var. *wyomingensis* 9, 17, 23, 28, 31, 34, 47, 58	Sagebrush, Wyoming Big
Artemisia vulgaris 43	Mugwort
Asimina parviflora 25	Pawpaw, Small Flower
Asimina triloba 12, 14, 20, 25, 28, 43, 51	Pawpaw
Asparagus falcatus 12	Sickle Thorn
Atalaya hemiglauca 12	
Athrotaxis cupressoides 4	Pencil Pine
Athrotaxis selaginoides 4	King Billy Pine

SCIENTIFIC NAME	COMMON NAME
Atriplex canescens	Saltbrush, Fourwing
5, 8, 9, 12, 17, 23, 28, 31, 32, 34, 40, 43, 47, 54, 56,58	
Atriplex confertifolia	Shadscale
8, 9, 12, 17, 23, 28, 31, 34, 39, 49, 43, 47, 54, 58	
Atriplex corrugata	Saltbrush, Mat
8, 17, 23, 31, 47, 58	
Atriplex cuneata	Saltbrush, Castle Valley
17, 23, 39, 47, 58	
Atriplex gardneri	Saltbrush, Gardner
9, 17, 23, 31, 47, 58	
Atriplex glauca	Saltbush, Blue
8, 12, 39	
Atriplex halimus	Sea Orach
12	
Atriplex hymenelytra	Saltbush, Desert-holly
9, 56	
Atriplex lentiformis	Quail Bush
5, 8, 9, 12, 17, 32, 39, 47, 56	
Atriplex muelleri	Saltbush, Mueller's
12	
Atriplex nummularia	Saltbush, Old-man
8, 12, 39	
Atriplex nuttallii	Saltbrush, Nuttalii
12, 28, 43	
Atriplex polycarpa	Saltbush, Desert
5, 8, 9, 12, 17, 47, 56, 58	
Atriplex rhagodioides	
39	
Atriplex semibaccata	Saltbush, Australian
5, 8, 12, 17, 28, 32	
Atriplex tridentata	Saltbush, Trident
9, 17, 23, 47, 58	
Atriplex undulata	
39	
Aucuba japonica	Japanese Aucuba
12	
Averrhoa carambola	Carambola
12	
Azadirachta indica	Neem
12	
Baccharis pilularis	Coyote Bush
5, 8	

SCIENTIFIC NAME	COMMON NAME
Baccharis sarothroides 8, 17, 40	Rosin Brush
Banksia species 12	
Barringtonia acutangula 12	Indian Oak
Bauhinia acuminata 12	Bauhinia, Dwarf White
Bauhinia galpinii 12, 28, 32	Bauhinia, Red
Bauhinia monandra 12, 32	Butterfly Flower
Bauhinia natalensis 12	
Bauhinia purpurea 5, 14, 28, 32, 43, 56	Orchid Tree, Butterfly
Bauhinia racemosa 12	
Bauhinia vahlii 12	Malu Creeper
Bauhinia variegata var.. *candida* 5, 12, 28, 32, 43	Orchid Tree
Beaucarnea recurvata 5, 12, 32	Elephant-foot Tree
Beaumontia grandiflora 12	Easter-lily-vine
Beilschmiedia tawa 12	
Berberis amurensis 43	
Berberis aristata 12	
Berberis canadensis 43	Barberry, American
Berberis chinensis 43	
Berberis koreana 43	
Berberis oblonga 43	
Berberis thunbergii 5, 12, 14, 19, 28, 30, 32, 43	Barberry, Japanese

SCIENTIFIC NAME	COMMON NAME
Berberis wilsoniae 43	
Berzelia species 12	
Betula alba-sinensis 12, 14, 28, 43	Birch, Chinese Paper
Betula alleghaniensis 12, 14, 18, 19, 28, 43, 45	Birch, Yellow
Betula apoiensis 43	
Betula costata 28, 43	Birch, Costata
Betula davurica 14, 28, 43	Birch, Dahurian
Betula ermanii 12, 14, 28, 43	Birch, Gold
Betula grossa 43	Birch, Japanese Cherry
Betula jacquemontii 12, 14, 43	
Betula lenta 14, 18, 28, 43	Birch, Sweet
Betula maximowicziana 12, 14, 28 ,43	Birch, Monarch
Betula nana 39	Birch, Dwarf
Betula nigra 5, 12, 14, 19, 20, 25, 28, 29, 30, 32 ,43, 45, 51, 53, 54	Birch, River
Betula occidentalis 4, 12, 34	Birch, Water
Betula papyrifera 5, 12, 14, 18, 19, 28, 34, 35, 43, 46, 51, 57	Birch, Paper
Betula papyrifera var. *subcordata* 4	Birch, Northwest Paper
Betula pendula 5, 12, 14, 19, 28, 30, 32, 43, 45, 51	Birch, European White
Betula platyphylla var. *japonica* 12, 14, 19, 28, 43	Birch, Japanese White
Betula populifolia 12, 14, 18, 19, 28, 43, 45	Birch, Gray
Betula pubescens 12, 28, 43	Birch, White

SCIENTIFIC NAME	COMMON NAME
Betula pumila 43	Birch, Low
Betula schmidtii 43	
Betula tianschanica 14, 28	Birch, Tian Shan Mtn.
Betula uber 43	
Betula utilis 12, 14, 28, 43	Birch, Himalayan
Billardiera longiflora 12	
Bischofia trifoliata 12	
Bismarckia nobilis 12	
Bolusanthus speciosus 12	Rhodesian Wisteria
Borassus flabellifer 12	Palm, Tala
Boronia species 12	
Boscia albitrunca 12, 28	Shepherds Tree
Brachychiton acerifolius 5, 12, 28, 32	Bottle Tree, Flame
Brachychiton discolor 5, 28, 32	Bottle Tree, Scrub
Brachychiton gregorii 12	Desert Kurrajong
Brachychiton populneus 5, 12, 28, 32	Kurrajong
Brachychiton rupestris 12	Narrow-leaved Bottle Tree
Brachyglottis repanda 12	
Brahea armata 12, 32	Palm, Blue Hesper
Brahea edulis 12	Guadeloupe Palm
Brassaia actinophylla 12	Australian Umbrella Tree

SCIENTIFIC NAME	COMMON NAME
Broussonetia papyrifera 12	Paper Mulberry
Brunfelsia pauciflora 12, 32	Morning-Noon-and-Night
Buddleia asiatica 12	
Buddleia davidii 12, 14, 28, 43	Summer Lilac
Bumelia lanuginosa 43	Chittamwood
Butia capitata 5, 12, 14, 28, 32	Palm, Jelly
Buxus sempervirens 28, 43	Boxwood
Buxus sinica 28	Boxwood, Chinese
Caesalpinia decapetala 12	Mysore Thorn
Caesalpinia gilliesii 4, 12, 32, 56	Bird-of-Paradise
Caesalpinia mexicana 4, 12, 56	Poinciana, Mexican
Caesalpinia pulcherrima 4, 12, 32, 40, 56	Barbados-Pride
Caesalpinia spinosa 39	Tara
Cajanus cajan 12	Cajan, Pigeon-pea
Calliandra eriophylla 4, 56	Fairy-duster
Callicarpa americana 12, 25	Beautyberry
Callicarpa dichotoma 14, 43	
Callicarpa japonica 43	
Callicarpa mollis 43	
Callistemon acuminatus 12	

SCIENTIFIC NAME	COMMON NAME
Callistemon brachyandrus 12	
Callistemon citrinus 5, 12, 28, 32	Bottlebrush, Crimson
Callistemon citrinus var. *splendens* 12, 28	Bottlebrush, Crimson
Callistemon linearifolius 5, 12, 32	
Callistemon macropunctatus 12	
Callistemon pachyphyllus 12	
Callistemon pallidus 12	
Callistemon paludosus 12	
Callistemon phoeniceus 12	
Callistemon pinifolius 12	
Callistemon rigidus 5, 12, 32	
Callistemon salignus 5, 12, 32	
Callistemon sieberi 12	
Callistemon teretifolius 12	
Callistemon viminalis 5, 12, 28, 32	Bottlebrush, Weeping
Callitris species 4, 12	Cypress Pine
Calluna vulgaris 12, 14, 28, 43	Heather
Calocedrus decurrens 3, 4, 5, 12, 14, 16, 28, 32, 36, 37, 43, 44, 55	Incense-cedar
Calocedrus formosana 4	Incense Cedar, Formosa
Calocedrus macrolepis 4	Incense Cedar, Chinese
Calodendrum capense 12	Cape Chestnut

SCIENTIFIC NAME	COMMON NAME
Calothamnus species	Netbush
12	
Calotropis procera	Madar - Mudar
39	
Calycanthus floridus	Sweet Shrub
5, 12, 14, 19, 43	
Calycanthus occidentalis	Western Spicebush
4	
Camellia japonica	Camellia
14, 43	
Camellia oleifera	Tea-oil Plant
43	
Camellia sasanqua	Camellia, Sasanqua
12, 14, 43	
Camellia sinensis	Tea
12	
Campsis radicans	Trumpet Creeper
5, 12, 14, 19, 20, 28, 34, 43	
Camptotheca acuminata	Camptotheca
12, 14, 28	
Capparis spinosa	Caper Bush
14, 43	
Caragana arborescens	Peashrub, Siberian
9, 12, 14, 19, 28, 34, 43, 45, 54, 57, 58	
Caragana boisii	
12	
Caragana microphylla	Caragana, Littleleaf
12, 28, 43	
Caragana zahlbruckneri var. *pekinensis*	Tupelo, Ogeechee Lime
43	
Carica papaya	Papaya
5, 12, 28, 32	
Carissa grandiflora	Natal Plum
5, 12, 14, 32	
Carludovica palmata	Panama-Hat Plant
12, 32	
Carmichaelia species	
12	
Carnegia gigantea	Saguaro
56	
Carpentaria acuminata	
12	

SCIENTIFIC NAME	COMMON NAME
Carpenteria californica 4, 5, 12	Tree Anemone
Carpinus betulus 5, 12, 14, 19, 28, 43	Hornbeam, European
Carpinus caroliniana 14, 18, 19, 28, 43	Hornbeam, American
Carpinus cordata 43	
Carpinus japonica 43	
Carpinus laxiflora 14, 43	
Carpinus orientalis 28, 43	Hornbeam, Oriental
Carpinus tschonoskii 43	
Carpinus turczaninovii 43	
Carpodetus serratus 12	
Carya aquatica 25, 29, 43	Hickory, Water
Carya cordiformis 20, 25, 43	Hickory, Bitternut
Carya glabra 20, 21, 25, 43, 45, 53	Hickory, Pignut
Carya illinoensis 12, 14, 20, 25, 28, 29, 30, 43, 45, 51	Pecan
Carya laciniosa 12, 14, 20, 21, 28, 30, 43, 45, 51, 53	Hickory, Shellbark
Carya myristicaeformis 25, 29, 43	Hickory, Nutmeg
Carya ovata 5, 12, 14, 20, 21, 25, 28, 29, 30, 43, 45, 51, 53	Hickory, Shagbark
Carya pallida 43	Hickory, Sand
Carya texana 43	Hickory, Black
Carya tomentosa 20, 21, 25, 29, 43, 45, 53	Hickory, Mockernut
Caryota species 12	Palm, Fishtail

SCIENTIFIC NAME	COMMON NAME
Cassia armata 39	
Cassia artemisioides 5, 12, 32, 39, 56	Senna, Wormwood
Cassia australis 12	
Cassia circinnata 12	
Cassia eremophila 5, 12, 32, 56	Cassia, Desert
Cassia fistula 5, 12	Golden-shower
Cassia grandis 12	Pink-shower
Cassia hebecarpa 43	Senna, Wild
Cassia javanica 12	Cassia, Apple-blossom
Cassia leptophylla 5, 32	
Cassia oligophylla 12	
Cassia renigera 12	
Cassia siamea 5, 12, 28	Kassod Tree
Cassia sturtii 5, 12, 32, 56	
Cassia tomentosa 5, 12, 32	
Castanea dentata 4, 43	Chestnut, American
Castanea mollisima 14, 19, 20, 28, 30, 43, 51	Chestnut, Chinese
Castanea pumila 19, 25	Chinquapin
Castanea sativa 43	Chestnut, Spanish
Castanopsis chrysophylla 16, 43	Chinquapin, Giant
Castanopsis sempervirens 9	Chinquapin, Sierra

SCIENTIFIC NAME	COMMON NAME
Castanospermum australe 12	Australian Chestnut
Casuarina cristata 12	
Casuarina cunninghamiana 5, 12, 14, 28, 32, 43	Beefwood
Casuarina equisetifolia 5, 12, 28, 32, 39, 43	Beefwood, Horsetail, Tree
Casuarina fraseriana 12	
Casuarina glauca 12	
Casuarina littoralis 12	
Casuarina stricta 12	
Casuarina torulosa 12	
Catalpa bignonioides 12, 14, 25, 28, 39, 43	Catalpa, Southern
Catalpa ovata 12, 28, 43	Catalpa, Chinese
Catalpa speciosa 5, 12, 14, 19, 28, 43, 51	Catalpa, Northern
Ceanothus americanus 43	New Jersey Tea
Ceanothus arboreus 4	Ceanothus, Feltleaf
Ceanothus cordulatus 4, 8, 9, 39	Buckbrush, Snowbush
Ceanothus cuneatus 4, 8, 9, 12 ,34	Buckbrush
Ceanothus cyaneus 4, 39	Ceanothus, San Diego
Ceanothus impressus 4, 5, 8, 12	Ceanothus, Santa Barbara
Ceanothus incanus 4	Whitethorn, Coast
Ceanothus integerrimus 4, 5, 8, 9, 12, 14, 28, 34	Buckbrush, Deerbrush
Ceanothus jepsonii 4	Jepsons Hollybush

SCIENTIFIC NAME	COMMON NAME
Ceanothus lemmonii 4, 34	Ceanothus, Lemmon's
Ceanothus leucodermis 4	Whitethorn, Chaparral
Ceanothus megacarpus 4, 12	Ceanothus, Big-pod
Ceanothus palmeri 4	Ceanothus, Palmer
Ceanothus papillosus 4	Ceanothus, Wart Leaf
Ceanothus parryi 4	Ceanothus, Parry
Ceanothus prostratus 4, 5, 8, 9, 12, 14, 28, 34	Buckbrush, Mahala-mat
Ceanothus pumilus 4	Siskiyou-mat
Ceanothus sanguineus 4, 8, 9, 14, 17, 28, 34, 35, 58	Buckbrush, Wild Lilac
Ceanothus sorediatus 4, 9	Jim Bush
Ceanothus spinosus 4, 9	Ceanothus, Green-bark
Ceanothus thyrsiflorus 4, 9	Blueblossom
Ceanothus tomentosus 4, 8, 9	Ceanothus, Woolly
Ceanothus velutinus 4, 9, 17, 28, 34, 35, 54, 58	Buckbrush
Ceanothus velutinus var. *laevigatus* 4	
Cecropia palmata 12	Snakewood Tree
Cedrela sinensis 43	
Cedrela toona 12, 28	Toon Tree
Cedrus atlantica 4, 5, 12, 14, 28, 32, 43	Cedar, Atlas
Cedrus deodara 3, 4, 5, 12, 14, 16, 19, 28, 32, 43, 55	Cedar, Deodar
Cedrus libani 5, 14, 32, 43	Cedar-of-Lebanon

SCIENTIFIC NAME	COMMON NAME
Celastrus orbiculatus 12, 14, 28, 43	Bittersweet, Oriental
Celastrus paniculatus 12	
Celastrus scandens 5, 12, 14, 19, 20, 28, 30, 43, 45, 51	Bittersweet, American
Celtis africana 12	
Celtis australis 5, 12, 28, 32, 43	Hackberry, Mediterranean
Celtis bungeana 28	
Celtis laevigata 25, 29, 30, 43	Sugarberry
Celtis occidentalis 5, 12, 14, 18, 19, 20, 21, 28, 34, 43, 45	Hackberry
Celtis pallida 56	Hackberry, Desert
Celtis reticulata 4, 34, 54, 56	Hackberry, Net-leaved
Celtis sinensis 5, 12, 28, 32, 43	Hackberry, Japanese
Cephalanthus occidentalis 4, 14, 20, 25, 28, 30, 43	Buttonbrush
Cephalotaxus fortunei 14, 28, 43	
Cephalotaxus harringtonia var. *drupacea* 12, 43	
Ceratoides lanata 9, 17, 23, 28, 31, 34, 40, 47, 58	Winterfat
Ceratonia siliqua 5, 12, 14, 28, 32, 43	Carob
Ceratopetalum gummiferum 12	
Cercidiphyllum japonicum 14, 28, 43	Katsura Tree
Cercidium floridum 4, 5, 12, 17, 32, 39 ,56	Palo Verde, Blue
Cercidium microphyllum 4, 5, 12, 17, 32, 39, 56	Palo Verde, Foothills
Cercidium praecox 56	Brea, Palo

SCIENTIFIC NAME	COMMON NAME
Cercis canadensis	Redbud, Eastern
5, 12, 14, 19, 20, 21, 25, 28, 29, 30, 32, 34, 43, 45, 51	
Cercis canadensis var. *alba*	Whitebud
20, 43	
Cercis chinensis	Redbud, Chinese
5, 14, 19, 28, 32, 43	
Cercis occidentalis	Redbud, California
4, 5, 8 , 12, 14, 16, 28, 34, 37, 43	
Cercis siliquastrum	Judas Tree
5, 12, 14, 39, 43	
Cercocarpus betuloides	
4, 5, 39, 43	
Cercocarpus intricatus	
43	
Cercocarpus ledifolius	Curlleaf Mahogany
4, 9, 17, 23, 28, 31, 34, 40, 47, 54, 58	
Cercocarpus montanus	Mountain Mahogany
9, 17, 28, 31, 34, 40, 43, 47, 54, 58	
Cestrum nocturnum	Jessamine, Night
5, 12, 32	
Chaenomeles cathayensis	
43	
Chaenomeles japonica	Flowering Quince, Lesser
14, 28, 43	
Chaenomeles speciosa	Quince, Japanese
12, 43	
Chamaebatiaria millefolium	Fernbush
40	
Chamaecyparis funebris	Mourning Cypress
4, 12, 28	
Chamaecyparis lawsoniana	Port Orford-cedar
3, 4, 12, 14, 16, 28, 36, 43, 44, 55	
Chamaecyparis nootkatensis	Alaska-cedar
4, 43, 44, 55	
Chamaecyparis obtusa	False Cypress, Japanese
14, 28, 43	
Chamaecyparis pisifera	Sawara Cypress
12, 14, 28, 43	
Chamaecyparis thyoides	Atlantic White-cedar
14, 18, 43	
Chamaedorea elegans	Palm, Parlor
5, 32	

SCIENTIFIC NAME	COMMON NAME
Chamaerops humilis 5, 12, 14, 28, 32	Palm, European Fan
Chamelaucium uncinatum 12	Waxflower, Geraldton
Chilopsis linearis 4, 5, 40, 43, 56	Desert Willow
Chimaphila umbellata 34	Wintergreen
Chimonanthus praecox 5, 12, 14, 28, 43	Wintersweet
Chionanthus retusus 14, 28, 43	Fringe Tree, Chinese
Chionanthus virginicus 5, 12, 14, 18, 19, 20, 25, 28, 29, 30, 32, 43, 45	Fringetree
Chordospartium stevensonii 12	
Chorisia speciosa 5, 12, 32	Floss-Silk Tree
Chorizema dicksonii 12	Yellow-eyed Flame-pea
Chrysalidocarpus cabadae 12	
Chrysalidocarpus lutescens 12	Yellow Butterfly Palm
Chrysalidocarpus madagascariensis 12	
Chrysalidocarpus species 12	Palm
Chrysobalanus icaco 12	Icaco, Coco-plum
Chrysothamnus greenei 31	Rabbitbrush, Green
Chrysothamnus nauseosus 5, 9, 17, 23, 28, 31, 34, 39, 40, 47, 54, 58	Rabbitbrush, Rubber
Chrysothamnus viscidiflorus 9, 17 ,23, 28, 31, 47, 58	Rabbitbrush, Mt. Little
Chukrasia tabularis 12	
Cibotium species 12	Tree Fern
Cinnamomum camphora 5, 12, 14, 28, 32, 43	Camphor Tree

SCIENTIFIC NAME	COMMON NAME
Cissus species 5, 12, 32, 39	Treebine
Cistus albidus 12	
Cistus ladanifer 12, 28, 32, 39	Laudanum
Cistus salviifolius 12, 32	
Cistus villosus var. *corsicus* 5, 8, 12, 32, 39	Rock Rose, Mauve
Citrus macrophylla 12	Alemow
Cladrastis lutea 14, 20, 28, 38	Yellowwood
Clematis columbiana 34	Clematis, Blue
Clematis heracleifolia 43	
Clematis ligusticifolia 23, 28, 34, 43	Western Virginsbower
Clematis microphylla 12	
Clematis montana 12	
Clematis tangutica 12, 14, 28, 43	Clematis
Clematis virginiana 43	Woodbine
Clematis vitalba 12, 28, 43	Traveller's Vine
Clematis viticella 12, 14, 28, 43	Clematis, Italian
Cleome isomeris 4, 8, 9	Bladderpod
Clerodendrum tomentosum 12	
Clerodendrum trichotomum 14, 43	Glory-bower
Clethera species 14, 43	White Alder
Cleyera japonica 12, 14, 25 ,43	

SCIENTIFIC NAME	COMMON NAME
Cliftonia monophylla 43	Buckwheat Tree
Coccoloba uvifera 12	Sea Grape, Platterleaf
Coccothrinax argentea 12	Palm, Broom
Cochlospermum gillivraei 12	
Coffea arabica 5, 12, 32	Coffee
Coleonema pulchrum 12	
Colutea arborescens 12, 14, 28, 43	Bladder Senna
Comarostaphylis diversifolia 4	Summer Holly
Comarostaphylis diversifolia var. *planif* 4	
Conocarpus erectus 12	Buttonwood
Coprosma species 5, 12, 32	
Cordia sebestena 12	Geiger Tree
Cordyline australis 5, 12, 32	Dracaena, Giant
Cordyline australis var. *atropurpurea* 32	Dracaena, Giant
Cordyline banksii 12	
Cordyline baverii 12	
Cordyline indivisa 12, 14, 32	Dracaena, Blue
Cordyline stricta 12	
Cordyline terminalis 12, 32	Hawaiian Good-Luck Plant
Cornus alba 12, 14, 28, 46	Dogwood, Tartarian
Cornus alba var. *siberica* 14, 28, 30, 43	Dogwood, Siberian

SCIENTIFIC NAME	COMMON NAME
Cornus alternifolia 5, 12, 14, 18, 19, 28, 30, 43, 45	Dodwood, Pagoda
Cornus amomum 12, 14, 18, 19, 28, 30, 43, 45, 51	Dogwood, Silky
Cornus australis 28, 43	
Cornus canadensis 8, 14, 19, 28, 34, 35, 43	Dogwood, Bunchberry
Cornus capitata 8, 12, 14, 28, 43	Dogwood, Himalayan
Cornus controversa 12, 14, 28, 43	Dogwood, Pacific
Cornus drummondii 25, 28, 30, 43	Dogwood, Roughleaf
Cornus florida 3, 5, 12, 14, 19, 20, 21, 25, 26, 28, 29, 30, 32, 34, 43, 51	Dogwood, Flowering
Cornus glabrata 4, 43	Dogwood, Brown
Cornus kousa 3, 8, 12, 14, 19, 28, 30, 43, 51	Dogwood, Kousa
Cornus mas 4, 12, 14, 28, 30, 43	Cornelian Cherry
Cornus nuttalli 3, 4, 5, 8, 12, 14, 16, 28, 34, 43	Dogwood, Pacific
Cornus occidentalis 4	Dogwood Western
Cornus officinalis 12, 14, 30, 43	Japanese Cornelian Cherry
Cornus racemosa 5, 12, 14, 18, 19, 28, 30, 43, 45, 51	Dogwood, Gray
Cornus rugosa 43	Dogwood, Round-leaved
Cornus sanguinea 12, 14, 28, 30, 43	Dogwood, Blood-twig
Cornus sericea 5, 9, 12, 14, 17, 18 ,19, 23, 28, 30, 34, 35, 40, 43, 51, 54, 55, 58	Dogwood, Red-osier
Cornus sessilis 4, 43	Dogwood, Pacific
Cornus walteri 43	
Corokia species 12	

SCIENTIFIC NAME	COMMON NAME
Coronilla emerus 12	Scorpion-senna
Corylopsis species 43	Winter Hazel
Corylus americana 5, 14, 18, 19, 20, 28, 30, 43, 45, 51	Hazel, American
Corylus avellena 12, 14, 28, 43	Hazelnut, European
Corylus colurna 12, 14, 28, 43	Hazel, Turkish
Corylus cornuta 43	Hazel, Beaked
Corylus cornuta var. *californica* 4, 28	Hazelnut, Western
Corylus heterophylla 28	
Corynocarpus laevigata 12	
Cotinus coggygria 5, 14, 28, 30, 43	Smoketree
Cotinus coggygria var. *atropurpea* 20, 30, 43	Smoketree, Purple Leaf
Cotinus obovatus 20, 43	Smoketree, American
Cotoneaster acutifolia 11, 12, 14, 23, 28, 31, 43, 45	Cotoneaster, Peking
Cotoneaster adpressus 12, 14, 28, 43	
Cotoneaster apiculatus 5, 12, 14, 43	Cotoneaster, Cranberry
Cotoneaster bullatus 12, 14, 28, 43	Cotoneaster, Vilmorin
Cotoneaster dammeri 39, 43	
Cotoneaster dielsianus 12, 14, 28, 43	Cotoneaster, Diel's
Cotoneaster divaricatus 12, 14, 28, 43	Cotoneaster, Spreading
Cotoneaster franchetii 12, 14, 28, 43	
Cotoneaster glaucophyllus 12	

SCIENTIFIC NAME	COMMON NAME
Cotoneaster horizontalis 5, 12, 14, 28, 32, 43	Cotoneaster, Rock
Cotoneaster integerrimus 28	
Cotoneaster lacteus 12, 14, 28, 32 ,43	
Cotoneaster lucidus 28, 43	Cotoneaster, Hedge
Cotoneaster microphyllus 14, 28, 43	
Cotoneaster multiflorus 12, 14, 28, 43	
Cotoneaster pannosus 12	
Cotoneaster salicifolius 12, 14, 28, 43	
Cotoneaster simonsii 12, 43	
Couroupita guianensis 12	Cannonball Tree
Cowania mexicana 9, 17, 31, 40, 58	Cowania
Cowania mexicana var. *stansburiana* 4, 12, 23, 28, 34, 47, 54	
Crataegus aestivalis 43	
Crataegus arnoldiana 28	Hawthorn, Arnold
Crataegus azarolus 43	Azarole
Crataegus brachyacantha 25, 43	Hawthorn, Blueberry
Crataegus coccinea 28	Hawthorn, Fireberry
Crataegus columbiana 4, 28, 34	Hawthorn, Red
Crataegus crus-galli 5, 12, 14, 18, 28, 30, 43, 45	Hawthorn, Cockspur
Crataegus douglasii 4, 18, 28, 34	Hawthorn, Black
Crataegus erythropoda 28	Hawthorn, Chocolate

SCIENTIFIC NAME — COMMON NAME

Crataegus intricata
14, 43

Crataegus intricata var. *neobushii*
28
Hawthorn, Monteer

Crataegus laevigata
12, 14, 28, 43
Hawthorn, English

Crataegus marshallii
25, 28, 43
Hawthorn, Parsley

Crataegus mollis
5, 14, 28, 43, 45
Hawthorn, Downy

Crataegus monogyna
12, 14, 43

Crataegus opaca
25, 29
Hawthorn, Riverflat

Crataegus phaenopyrum
5, 12, 14, 18, 19, 20, 26, 28, 30, 43, 51
Hawthorn, Washington

Crataegus pinnatifida
28

Crataegus pubescens
28
Hawthorn, Mexican

Crataegus punctata
12, 14, 28
Hawthorn, Dotted

Crataegus submollis
28

Crataegus succulenta
28
Hawthorn, Fleshy

Crataegus viridis
28, 30, 43

Cryptomeria japonica
4, 12, 14, 28, 43
Japanese Cedar

Cryptomeria japonica var. *sinensis*
4, 28
Cryptomeria, Chinese

Cryptostegia grandiflora
12
Rubber Vine

Cunninghamia konishii
4, 43
China Fir

Cunninghamia lanceolata
4, 28, 43
China Fir

Cunonia capensis
12

Cupaniopsis anacardiopsis
5, 12, 32

SCIENTIFIC NAME	COMMON NAME
Cupressus arizonica 4, 5, 8, 11, 14, 16, 28, 32, 43, 44, 54, 55, 56	Cypress, Arizona
Cupressus bakeri 4, 12	Cypress, Modoc
Cupressus cashmeriana 4	Cypress, Kashmir
Cupressus duclouxiana 4	Cypress, Yunnan
Cupressus glabra 4	Cypress, Smoothbark Ariz.
Cupressus goveniana 4, 34	Cypress, Gowan
Cupressus goveniana var. *pigmaea* 12, 16	Cypress, Mendocina
Cupressus guadalupensis 4	Cypress, Guadalupe
Cupressus lusitanica 4, 28, 41, 43	Cypress, Mexican
Cupressus lusitanica cv. *benthamii* 4	Cypress, East Mexican
Cupressus macnabiana 4, 12, 43	Cypress, MacNab
Cupressus macrocarpa 4, 5, 12, 14, 28, 32, 43	Cypress, Monterey
Cupressus nevadensis 4	Cypress, Piute
Cupressus sargentii 4, 12, 43	Cypress, Sargent
Cupressus sempervirens 4, 5, 14, 28, 32, 43	Cypress, Italian
Cupressus sempervirens var. *atlantica* 4	Cypress, Moroccan
Cupressus stephensonii 4	Cypress, Cuyamaca
Cupressus torulosa 4, 28, 43	Cypress, Bhutan
Cussonia paniculata 12	Cabbage Tree
Cussonia spicata 12	Cabbage Tree
Cycas species 28	Palm, Sago

SCIENTIFIC NAME COMMON NAME

Cydonia oblonga Quince, Common
28
Cydonia sinensis Quince, Chinese
28, 43
Cyphomandra betacea Tomato Tree
12
Cyphomandra fragans
12
Cyrilla racemiflora Leatherwood, Titi
43
Cytisus species Broom
12, 14, 28, 39, 43
Dacrydium cupressinum Rimu
12
Dacrydium franklinii Huon Pine
4
Dais cotinifolia
12
Dalbergia sissoo Sissoo
12
Dalea frutescens Dalea, Black
40
Dalea spinosa Smoke Tree
56
Daphne species
12
Darwinia citriodora
12
Dasylirion wheeleri Desert Spoon
56
Davidia involucrata Dove Tree
12, 14, 28, 43
Daviesia species
12
Decaisnea fargesii
43
Delonix regia Poinciana, Royal
4, 5, 12, 14, 28, 39
Dendromecon rigida Tree Poppy, Yellow
4, 8
Derris robusta Jewel Vine
28

SCIENTIFIC NAME	COMMON NAME
Dicksonia species 12	Tree Fern
Dillwynia juniperiana 12	
Diospyros kaki 5, 12, 14, 28, 43	Persimmon, Kaki
Diospyros lotus 5, 12, 14, 28, 43	Date Plum
Diospyros texana 4	Persimmon, Black
Diospyros virginiana 4, 5, 12, 14, 20, 21, 25, 28, 29, 30, 43, 51, 53	Persimmon
Dirca palustris 20, 43	Leatherwood
Disanthus cercidifolius 14, 43	
Distylium racemosum 43	Isu Tree
Dizygotheca elegantissima 12, 32	False Aralia
Dodonaea cuneata 12	Hopbush
Dodonaea truncatialis 12	
Dodonaea viscosa 5, 12, 32, 56	
Dodonaea viscosa var. *purpurea* 4, 5, 12, 32, 39	Hopbush, Purple
Dombeya burgessiae 12	
Dracaena draco 5, 12, 32	Dragon Tree
Dracaena umbraculifera 12	
Dracophyllum species 12	
Dryandra species 12	
Duranta repens 12	Golden-dewdrop, Skyflower
Durio zibethinus 12	Durian

SCIENTIFIC NAME	COMMON NAME
Dyssodia acerosa	Dog Fir
17	
Echinocereus coccineus	Cactus, Claret Cup
40	
Echium fastuosum	Viper's Bugloss
5, 32, 39	
Ehretia dicksonii	
28	
Ekebergia capensis	
12	
Elaeagnus angustifolia	Russian-olive
4, 5, 12, 14, 17, 19, 23, 28, 30, 31, 34, 35, 40, 43, 45, 47, 51, 58	
Elaeagnus commutata	Silverberry
14, 18, 28, 34, 43, 54	
Elaeagnus multiflora	Elaeagnus, Cherry
12, 43	
Elaeagnus umbellata	Autumn Olive
12, 14, 19, 20, 25, 28, 30, 34, 43, 51	
Elaeis guineensis	Palm, Oil
12	
Elaeocarpus species	
12	
Eleutherococcus senticosus	Siberian Ginseng
28	
Embothrium coccineum	Chilean Fire Tree
12	
Encelia californica	Encelia, California
5, 8, 39	
Encelia farinosa	Brittlebrush
5, 8, 17, 39, 56	
Encelia frutescens	Brittlebush, Green
56	
Enkianthus campanulatus	
14, 43	
Enkianthus perulatus	
43	
Entelea arborescens	
12	
Enterolobium cyclocarpum	Elephant's-ear
12	
Ephedra nevadensis	Mormon Tea, Nevada
9, 17, 23, 28, 31, 34, 40, 43, 47, 58	

SCIENTIFIC NAME	COMMON NAME
Ephedra viridis 9, 17, 23, 31, 34, 43, 47, 58	Mormon Tea, Green
Eremophila glabra 12	
Eremophila maculata 12	
Erica species 12	Heath
Eriobotrya deflexa 5, 12, 32	
Eriobotrya japonica 5, 12, 28, 32	Loquat
Eriocephalus species 12	
Eriogonum species 23	
Eriogonum arborescens 8, 32	Buckwheat, Santa Cruz Isl
Eriogonum cinereum 8, 12	Buckwheat, Ashyleaf
Eriogonum fasciculatum 5, 8, 12, 17, 34, 39, 47	Buckwheat, California
Eriogonum giganteum 5, 8, 32, 39	Buckwheat, Giant
Eriogonum parvifolium 8	Buckwheat, Coastal
Eriogonum umbellatum 8, 31, 47, 54, 58	Buckwheat, Sulphur Flower
Eriophyllum species 8, 39	
Erythrina caffra 5, 12, 28, 32, 39	Coral Tree
Erythrina corallodendrum 12	
Erythrina crista-galli 5, 12, 14, 32	Coral Tree, Cockspur
Erythrina flabelliformis 4, 56	Coral Tree, Southwestern
Erythrina lysistemon 12	
Erythrina suberosa 12	

SCIENTIFIC NAME	COMMON NAME
Erythrina vespertilio 12	Gray Corkwood
Eucalyptus species 4, 5, 8, 12, 14, 16, 28, 32, 39, 43	
Eucommia ulmoides 12, 14, 28, 43	Hardy Rubber Tree
Eugenia myrtifolia 12	
Eugenia uniflora 12, 32	Surinam Cherry
Euonymus alata 12, 14, 20, 28, 30, 43	Euonymus, Winged
Euonymus atropurpea 14, 20, 28	Wahoo
Euonymus bungeana 28, 30, 43	Euonymus
Euonymus europaea 12, 14, 28, 43	Spindle Tree, European
Euonymus fortunei 14, 43	
Euonymus hamiltoniana var. *maackii* 28, 43	
Euonymus japonica 43	Spindle Tree
Euonymus latifolia 28, 43	
Euonymus occidentalis 4	Wahoo, Western
Euonymus verrucosa 28	Spindle Tree, Warty
Euphorbia leucocephala 12	Pascuita
Euphorbia virosa 12	
Euscaphis japonica 43	
Euterpe edulis 12	Palm, Assai
Evodia danielii 12, 14, 20, 28, 43	Evodia, Korean
Evodia hupehensis 12, 28, 43	Evodia, Hupeh

SCIENTIFIC NAME	COMMON NAME
Exochorda racemosa	Pearlbush
14, 43	
Fagraea bertereana	
12	
Fagus crenata	Beech, Japanese
43	
Fagus grandifolia	Beech, American
14, 18, 19, 25, 28, 29, 43	
Fagus orientalis	
14, 28, 43	
Fagus sylvatica	Beech, European
3, 5, 12, 14, 19, 28, 43	
Fallugia paradoxa	Apache-plume
4, 9, 12, 17, 23, 34, 40, 47, 54, 58	
Fatsia japonica	Paper Plant
12, 14, 32	
Feijoa sellowiana	Feijoa
5, 12, 14, 32	
Fendlera rupicola	Fendlerbush, Cliff
14, 40	
Ficus species	Ficus, Fig
5, 12, 28	
Firmiana simplex	Chinese Parasol Tree
5, 12, 14, 28, 43	
Fokienia hodginsii	
4	
Forestiera acuminata	Swamp Privet
4	
Forestiera neomexicana	Desert Olive
40	
Forestiera segregata	
12	
Fothergilla gardenii	Witch Alder
43	
Fothergilla major	
43	
Fouquieria burragei	
12	
Fouquieria diguetii	
12	
Fouquieria splendens	Ocotillo
12, 56	

SCIENTIFIC NAME	COMMON NAME
Franklinia alatamaha	Franklin Tree
12, 14, 43	
Fraxinus americana	Ash, White
5, 12, 14, 18, 19, 20, 21, 25, 28, 30, 43, 45, 51, 53	
Fraxinus angustifolia	
28, 43	
Fraxinus caroliniana	Ash, Carolina
25	
Fraxinus cuspidata	Ash, Fragrant
40	
Fraxinus dipetala	Ash, Flowering
4	
Frraxinus excelsoir	Ash, European
12, 14, 28, 43	
Fraxinus latifolia	Ash, Oregon
4, 28	
Fraxinus nigra	Ash, Black
18, 43	
Fraxinus ornus	Ash, Flowering
12, 14, 28	
Fraxinus oxycarpa	
12	
Fraxinus pennsylvanica	Ash, Green
5, 12, 14, 18, 19, 20, 21, 25, 28, 29, 30, 33, 34, 51, 53	
Fraxinus profunda	Ash, Pumpkin
25, 43	
Fraxinus quadrangulata	Ash, Blue
21	
Fraxinus uhdei	Ash, Evergreen
5, 12, 32	
Fraxinus velutina	Ash, Velvet
5, 28, 32, 40, 43, 56	
Fremontodendron californicum	Fremontia, California
4, 5, 8, 12, 32, 43	
Fremontodendron mexicanum	Fremontia
4, 5, 32	
Fuchsia procumbens	
12	
Galphimia glauca	
12	
Galvezia speciosa	
39	

SCIENTIFIC NAME	COMMON NAME
Garcinia mangostana 12	Mangosteen
Gardenia species 12	
Garrya species 4, 12	Silk-tassel
Gaultheria antipoda 12	
Gaultheria procumbens 14, 43	Wintergreen
Gaultheria shallon 14, 28, 32, 34, 43	Salal
Geijera parviflora 5, 12, 32	
Genista species 12	Broom
Geonoma schottiana 12	
Ginkgo biloba 4, 5, 12, 14, 19, 28, 30, 32, 43	Ginkgo
Gleditsia aquatica 43	Waterlocust
Gleditsia caspica 12, 14, 28, 43	
Gleditsia triacanthos 5, 12, 14, 23, 28, 34, 43	Honeylocust
Gleditsia triacanthos var. *inermis* 12, 14, 18, 19, 28, 30, 32, 33, 43, 45	Honeylocust
Gliricidia sepium 12	Nicaraguan Cocoa-shade
Glyptostrobus lineatus 4	Chinese Water Pine
Gmelina arborea 12, 28	
Gordonia lasianthus 43	Bay, Loblolly
Grayia brandegei 23	Hopsage, Spineless
Grayia spinosa 9, 17, 23, 28, 47, 58	Hopsage, Spiny
Grevillea banksii 12	

SCIENTIFIC NAME	COMMON NAME
Grevillea robusta 5, 12, 14, 28, 32	Silk Oak
Grevillea synaphae 12	
Grewia species 12	
Greyia radlkoferi 12	Natal Bottlebrush
Grindelia stricta 8	Gumweed
Griselinia littoralis 12	
Gymnocladus dioicus 4, 12, 14, 18, 19, 20, 21, 28, 30, 43	Kentucky Coffeetree
Gypsophila paniculata 28	Baby's Breath
Hakea species 5, 12, 28, 32	Pincushion Tree
Halesia carolina var. *carolina* 5, 12, 14, 19, 20, 28, 30, 43, 45	Carolina Silverbell
Halesia diptera 12, 25, 43	Silverbell, Two-winged
Halesia monticola 12, 14, 43	Silverbell Tree
Haloxylon species 28	
Hamamelis japonica 12, 14, 28, 43	Witch-hazel, Japanese
Hamamelis mollis 12, 14, 28, 43, 51	Witch-hazel, Chinese
Hamamelis vernalis 14, 20, 43	Witch-hazel, Ozark
Hamamelis virginiana 5, 12, 14, 18, 19, 20, 25, 28, 30, 38, 43, 44, 45, 51	Witch-hazel
Hamelia patens 12	Scarlet Bush, Firebush
Hardenbergia comptoniana 12	
Hardenbergia violacea 12	Vine-lilac, Coral-pea

SCIENTIFIC NAME	COMMON NAME
Harpephyllum caffrum	Kaffir Plum
5, 12, 32	
Harpullia pendula	
12	
Hebe species	
12	
Hedera helix	English Ivy
12, 28	
Hedeycarya arborea	
12	
Helicteres isora	
12	
Heteromeles arbutifolia	Toyon
4, 8, 32, 39	
Hibbertia scandens	Snake Vine
12	
Hibiscus ludwigii	
12	
Hibiscus mutabilis	Confederate Rose
12	
Hibiscus schizopetalus	Hibiscus, Japanese
12	
Hibiscus syriacus	Althea-shrub
12, 14, 19, 28, 43	
Hibiscus tiliaceus	Mahoe
12, 32	
Hippohae rhamnoides	Sea Buckthorn
4, 12, 14, 28, 43	
Holacantha emoryi	Crucifixion Thorn
12	
Holodiscus discolor	Ocean Spray
14, 28, 34, 35, 54	
Holodiscus dumosus	Cliff Spirea
40	
Holoptelea integrifolia	
12	
Homalanthus populifolius	Queensland Poplar
12	
Hovea species	
12	
Hovenea dulcis	Japanese Raisin Tree
12, 14, 28, 43	

SCIENTIFIC NAME	COMMON NAME
Howea species 12	Palm, Sentry
Hoya carnosa 12	Wax Plant
Hydrangea anomala 12, 14, 43	Hydrangea, Climbing
Hydrangea quercifolia 14, 43	
Hydriastele wendlandiana 12	
Hymenosporum flavum 5, 32	
Hypericum calycinum 5, 12, 32, 43	Rose-of-Sharon
Hypericum patulum 12, 43	
Hypericum revolutum 12	
Hyptis emoryi 56	Desert Lavender
Idesia polycarpa 12, 28, 43	Iigiri Tree
Idria columnaris 56	Boojum
Ilex aquifolium 5, 12, 14, 28, 43	Holly, English
Ilex cassine 12	Dahoon, Cassina
Ilex cornuta 5, 12, 14, 28, 43	Holly, Chinese
Ilex decidua 12, 14, 20, 25, 43	Holly, Deciduous
Ilex glabra 14, 43	Gallberry
Ilex latifolia 28	Holly, Luster-leaf
Ilex opaca 12, 14, 19, 20, 25, 29, 34, 43	Holly, American
Ilex pedunculosa 43	
Ilex serrata 14, 43	Winterberry, Japanese

SCIENTIFIC NAME	COMMON NAME
Ilex verticillata 12, 14, 18, 28, 34, 43, 51	Winterberry
Ilex vomitoria 14, 25, 28, 29, 43	Yaupon
Illicium verum 28	Star Anise
Indigofera species 12	
Isopognon species 12	
Itea virginica 25	Sweetspire
Ixora coccinea 12	Flame-of-the-woods
Jacaranda mimosifolia 5, 12, 28, 32, 39	Jacaranda
Jacquinia pungens 12	
Jamesia americana 43	
Jasminum humile cv. *revolutum* 12	Jasmine
Jasminum officinale 12	Jasmine, Poet's
Jatropha curcas 28	Barbados Nut
Jatropha podagrica 12	Tartogo
Juglans ailantifolia 43	Walnut, Japanese
Juglans californica 4	Walnut, California
Juglans cinerea 14, 18, 20, 28, 30, 43, 45, 51	Butternut
Juglans hindsii 4, 28	Walnut, Hinds
Juglans major 4, 43	Walnut, Arizona
Juglans mandshurica 14, 28, 43	Walnut, Manchurian
Juglans microcarpa 4, 28	Walnut, Little

SCIENTIFIC NAME	COMMON NAME
Juglans nigra	Walnut, Black
5, 6, 14, 20, 25, 28, 29, 30, 33, 43, 45, 51	
Juglans regia	Walnut, English
5, 14, 43, 51	
Juglans regia var. *carpathian*	Walnut, Carpathian Engl.
28, 30, 43, 51	
Juniperus ashei	Juniper, Ashe
4	
Juniperus californica	
4, 43	
Juniperus chinensis	Juniper, Chinese
4, 12, 14, 28, 43	
Juniperus communis	Juniper, Common
4, 5, 12, 14, 28, 43	
Juniperus deppeana	Juniper, Alligator
4, 14, 56	
Juniperus formosana	
14, 28	
Juniperus horizontalis	Juniper, Creeping
4, 28, 43	
Juniperus monosperma	Juniper, Cherrystone
4, 14, 40, 43, 54	
Juniperus occidentalis	Juniper, Western
4, 16, 43	
Juniperus osteosperma	Juniper, Utah
4, 12, 23, 47	
Juniperus pinchotii	Juniper, Red-berry
4, 43	
Juniperus rigida	Juniper, Needle
43	
Juniperus scopulorum	Juniper, Rocky Mountain
4, 11, 12, 14, 23, 28, 34, 35, 40, 43, 47, 54, 58	
Juniperus silicicola	Southern Red Cedar
4, 12, 14, 43	
Juniperus virginiana	Eastern Red Cedar
4, 5, 12, 14, 18, 19, 20, 25, 28, 29, 30, 34, 43, 44, 45, 47, 51, 57	
Kalmia latifolia	Laurel, Mountain
12, 14, 19, 43	
Kalopanax pictus	Castor Aralia
12, 28, 43	
Kennedia species	Coral Pea
5, 12, 32	

SCIENTIFIC NAME	COMMON NAME
Kerria japonica 12, 14, 28, 43	Japanese Rose
Keteleeria davidiana 4	
Khaya nyasica 12	Nyasaland Mahogany
Khaya senegalensis 12	Senegal Mahogany
Kiggelaria africana 12	
Knightia excelsa 12	
Kochia prostrata 9, 17, 23, 31, 47, 58	Kochia
Koelreuteria bipinnata 5, 12, 25, 32, 43	Goldenrain tree
Koelreuteria paniculata 5, 12, 14, 19, 20, 25, 28, 30, 32, 33, 43	Varnishtree
Kolkwitzia amabilis 12, 14, 28, 43	Beauty Bush
Kraussia floribunda 12	
Kunzea species 12	
Laburnum alpinum 5, 12, 14, 28, 43	Laburnum, Scotch
Laburnum anagyroides 5, 14, 19, 28, 30, 43	Chaintree
Lagerstroemia floribunda 12	
Lagerstroemia indica 5, 12, 14, 28	Crape Myrtle
Lagunaria patersonii 12, 28	Primrose Tree
Lansium domesticum 12	
Lapageria rosea 43	Chilean Bellflower
Larix x *eurolepsis* 28, 43	Larch, Dunkeld
Larix decidua 14, 18, 19, 28, 43, 51	Larch, European

SCIENTIFIC NAME	COMMON NAME
Larix gmelinii 14, 28, 43	Larch, Dahurian
Larix gmelinii var. *olgensis* 28	Larch, Olga Bay
Larix gmelinii var. *principis-rupprechti* 28	Larch, Prince Rupprecht
Larix kaempferi 12, 28, 43	Larch, Japanese
Larix laricina 14, 18, 19, 28, 43, 57	Tamarack
Larix lyallii 4, 43	
Larix occidentalis 3, 4, 12, 14, 28, 34, 43, 44	Larch, Western
Larix sibirica 14, 28, 43	Larch, Siberian
Larrea divaricata 17, 39	Creosotebush
Larrea tridentata 40, 56	Creosotebush
Latania loddigesii 5, 12, 32	Palm, Latan
Laurelia novae-zealandiae 12	
Laurus nobilis 5, 12, 14, 32, 43	Sweet Bay
Lavatera assurgentiflora 8	Tree Mallow, California
Leea coccinea 5, 12, 32	West Indian Holly
Lepidozamia peroffskyana 12	
Leptospermum species 5, 12, 28, 32	
Lespedeza bicolor 12, 14, 28, 30, 43	Clover Bush
Leucaena leucocephala 12, 32	Lead Tree
Leucaena retusa 4	Leucaena, Little-leaf

SCIENTIFIC NAME	COMMON NAME
Leucospermum species 12	Pincushion
Leucothoe fontanesiana 12, 19, 43	Leucothoe, Drooping
Leycesteria formosa 43	Himalaya Honeysuckle
Licuala species 12	
Ligustrum japonicum 5, 12, 14, 25, 28, 32, 43	Privet, Japanese
Ligustrum lucidum 14, 25, 28, 32, 43	Privet
Ligustrum obtusifolium 43	Privet, Regel's
Ligustrum ovalifolium 12	Privet, California
Ligustrum sinense 12	
Ligustrum vulgare 28, 43	Privet, Common
Lindera benzoin 14, 20, 21, 28, 43	Spicebush
Liquidambar formosana 14, 28, 43	Formosan Gum
Liquidambar orientalis 43	Sweet Gum, Oriental
Liquidambar styraciflua 5, 12, 14, 19, 20, 21, 24, 25, 28, 29, 30, 32, 39, 43, 46, 53	Sweet Gum
Liriodendron chinensis 14, 28	Tulip Tree, Chinese
Liriodendron tulipifera 5, 12, 14, 19, 28, 32, 43, 46, 51, 53	Tulip Tree, Yellow-poplar
Lithocarpus densiflorus 4, 5, 28, 43	Tanbark Oak
Livistona species 5, 12, 14, 28, 32	Palm, Fan
Lonicera alpigena 43	Honeysuckle
Lonicera ciliosa 34	Honeysuckle, Trumpet
Lonicera involucrata 34	Twinberry

SCIENTIFIC NAME	COMMON NAME
Lonicera japonica 12, 14, 28, 43	Honeysuckle, Japanese
Lonicera maackii 14, 28, 30, 43	Honeysuckle, Amur
Lonicera quinquelocularis 43	
Lonicera tatarica 12, 14, 28, 30, 43, 51	Honeysuckle, Tatarian
Lonicera utahensis 34	Honeysuckle, Utah
Lonicera xylosteum 28, 39, 43	Honeysuckle, European Fly
Luculia gratissima 12	
Lupinus arboreus 12, 28, 39	Lupine, Tree
Lyonothamnus floribundus sbsp. *asplenifolius* 5, 32	Catalina Ironwood
Lysiloma microphyllum 12	
Lysiloma sabicu 12	Sabicu
Lysiloma thornberi 56	Desert Fern
Maackii amurensis 14, 28, 43, 45	
Macadamia integrifolia 5, 12, 32	Macadamia Nut
Macfadyena unguis-cati 12, 32, 56	Cat's-Claw Creeper
Mackaya bella 12	
Maclura pomifera 4, 12, 14, 19, 28, 30, 43	Osage-orange
Macropiper excelsum 12	Pepper Tree, Kawa-Kawa
Magnolia x *loebneri* 43	
Magnolia x *soulangeana* 43	Magnolia, Chinese Saucer
Magnolia x *soulangeana* var. *lennei* 12	

SCIENTIFIC NAME	COMMON NAME
Magnolia acuminata 14, 18, 19, 20, 28, 43	Cucumber Tree
Magnolia ashei 43	Magnolia, Ashe
Magnolia fraseri 19, 43	Magnolia, Fraser
Magnolia grandiflora 5, 12, 14, 19, 20, 21, 25, 28, 32, 43	Magnolia, Southern
Magnolia heptapeta 12, 28, 43	Magnolia, Yulan
Magnolia kobus 12, 14, 43	
Magnolia macrophylla 4, 12, 25, 28, 43	Magnolia, Bigleaf
Magnolia sieboldii 28, 43	
Magnolia stellata 14, 20, 43	Magnolia, Star
Magnolia tripetala 21, 43	Magnolia, Umbrella
Magnolia virginiana 12, 19, 25, 28, 43	Magnolia, Sweetbay
Mahonia aquifolium 3, 4, 5, 8, 12, 14, 25, 28, 32, 33, 34, 35, 39, 43	Oregon Grape
Mahonia bealei 5, 12, 32	
Mahonia californica 4	
Mahonia dictyota 4	
Mahonia fremontii 4	
Mahonia haematocarpa 4, 40, 56	Mahonia, Red
Mahonia higginsiae 4	
Mahonia lomariifolia 5, 12, 32	
Mahonia nervosa 3, 5, 14, 28, 34, 43	Oregon Grape
Mahonia nevinii 4	

SCIENTIFIC NAME | COMMON NAME

Mahonia pinnata
4

Mahonia piperana
4

Mahonia pumila
4

Mahonia repens — Dwarf Oregon Grape
3, 4, 5, 11, 12, 14, 17, 23, 28, 31, 32, 33, 34, 35, 39, 40, 43, 54

Mahonia trifoliolata
4, 40

Malus x *micromalus*
28

Malus x *zumi* — Crab Apple, Zumi
28, 43

Malus baccata — Crab Apple, Siberian
5, 14, 28, 34, 43, 51

Malus baccata var. *mandshurica* — Crab Apple, Siberian
14, 28, 30, 43

Malus brevipes — Crab Apple, Oriental
34

Malus floribunda — Crab Apple, Showy
5, 12, 14, 43

Malus fusca — Crab Apple, Oregon
4

Malus hupehensis — Crab Apple, Tea
14, 28, 43

Malus ioensis — Crab Apple, Prairie
28, 43

Malus prunifolia — Apple, Plum-leaved
12, 28, 43

Malus pumila — Apple, Common
12, 14, 19, 28, 43

Malus sargenti — Crab Apple, Sargent
5, 14, 28, 30, 43, 51

Malus sieboldii — Crab Apple, Toringo
14, 28, 43

Malus sylvestris — Apple, Wild
12, 14, 28, 43

Malus toringoides
12, 14, 28, 43

Malus transitoria
28

SCIENTIFIC NAME	COMMON NAME
Malus yunnanensis 43	
Manilkara roxburghiana 12	
Manilkara zapota 12	Sapodilla
Maytenus boaria 5, 12, 32	Mayten
Medinilla magnifica 32	
Melaleuca species 5, 12, 28, 32	Honey Myrtle
Melia azedarach 5, 12, 14, 25, 28, 39	Chinaberry
Melia toosendan 28	
Melia ternata 12	
Melicytus species 12	
Meryta sinclairii 12	Puka
Mespilus germanica 12, 14, 28	Medlar
Mesua ferrea 12	Gau-gau
Metasequoia glyptostroboides 4, 5, 12, 14, 28, 32, 43, 51	Dawn Redwood
Metrosideros excelsus 12, 28, 32	New Zealand Christmas Tree
Michelia champaca 12	Champaca
Microcoleum weddellianum 12	Palm, Weddel
Millettia dura 12	
Mimosa polycarpa 12	
Mimosa pudica 5, 14, 32	Touch-Me-Not Plant
Mimosa scabrella 12	Bracaatinga

SCIENTIFIC NAME	COMMON NAME
Mimulus species 5, 8, 39	Monkey Flower
Mimusops elengi 12, 28	Spanish Cherry
Mitchella repens 43	Partridgeberry
Morinda citrifolia 12	Indian Mulberry, Awl Tree
Moringa pterygosperma 12	Horseradish Tree
Morus alba 5, 14, 28, 34, 43	Mulberry, White
Morus alba var. *tartarica* 14, l9, 28, 32, 43, 45	Mulberry, Russian
Morus nigra 5, 14, 28, 43	Mulberry, Black
Morus rubra 14, 19, 43	Mulberry, Red
Mucuna deeringiana 28	Velvet Bean
Murraya paniculata 5, 12, 32	Orange Jasmine
Myoporum species 12	
Myrciaria jaboticaba 12	
Myrica californica 4, 16, 39	Bayberry, Pacific
Myrica cerifera 5, 12, 19, 25, 32, 43	Wax-myrtle
Myrica pennsylvanica 12, 14, 18, 19, 20, 21, 43	Bayberry, Northern
Myroxylon balsamum 12	
Myrsine africana 12	Cape Myrtle, Afr. Boxwood
Myrtus communis 5, 12, 28, 32	Myrtle
Nandina domestica 5, 12, 14, 19, 25, 28, 29, 32, 43	Heavenly Bamboo
Nannorrhops ritchiana 12	Palm, Mazari

SCIENTIFIC NAME	COMMON NAME
Neodypsis species	
12	
Nerium oleander	Oleander
5, 12, 32	
Nicotiana glauca	Tree Tobacco
12, 39	
Noronhia emarginata	
12	
Nothofagus species	
12, 43	
Nuxia floribunda	
12	
Nyctanthes arbor-tristis	Tree-of-sadness
12	
Nymania capensis	
12	
Nypa fruticans	Palm, Nypa
12	
Nyssa aqautica	Tupelo, Water
12, 14, 25, 28, 29, 43	
Nyssa sylvatica var. *sylvatica*	Blackgum
5, 12, 14, 18, 19, 20, 21, 25, 28, 29, 30, 32, 43, 51	
Ochna serrulata	Mickey-Mouse Plant
5, 12, 32	
Oemleria cerasiformis	Indian Plum
4, 12	
Olea europaea	Olive, Common
5, 12, 14, 28, 43	
Olearia species	Tree Aster
12	
Orania sylvicola	
12	
Orixa japonica	
43	
Orphium frutescens	
12	
Ostrya carpinifolia	Hop Hornbeam, European
12, 14, 28, 43	
Ostrya virginiana	Hop Hornbeam
14, 18, 19, 25, 28, 43	
Oxydendrum arboreum	Sourwood
12, 14, 19, 43	

SCIENTIFIC NAME	COMMON NAME
Pachira aquatica 12	Guiana Chestnut
Paeonia suffruticosa 14, 43	Peony, Tree
Paliurus spina-christi 12	Christ's Thorn
Pandanus species 5, 12, 32	Screw Pine
Pandorea pandorana 12	Wonga-wonga Vine
Paranomus reflexus 12	
Parkinsonia aculeata 4, 5, 12, 14, 28, 32, 39, 43, 56	Jerusalem Thorn
Parmentiera cereifera 12	Candle Tree
Parrotia persica 14, 28, 43	Parrotia, Persian
Parrotiopsis jacquemontiana 43	
Parthenocissus quinquefolia 5, 12, 14, 19, 20, 25, 28, 32, 43, 45	Virginia Creeper
Parthenocissus tricuspidata 5, 12, 14, 19, 28, 32, 43	Japanese Creeper
Passiflora edulis 5, 12, 14, 32	Passion Fruit
Paulownia tomentosa 5, 12, 13, 14, 19, 20, 28, 43	Princess Tree
Peltophorum dubium 12	
Peltophorum pterocarpum 12, 28	Yellow-flame Poinciana
Pentachondra pumila 12	
Peraphyllum ramosissimum 23, 47, 54	Squawapple
Persea borbonia 25, 43	Redbay
Petteria ramentacea 43	
Phellodendron amurense 5, 12, 14, 18, 20, 28, 30, 43	Amur Corktree

SCIENTIFIC NAME	COMMON NAME
Phellodendron chinense 43	Cork Tree
Phellodendron japonicum 43	
Phellodendron sachalinense 43	
Philadelphus coronarius 43	Mock Orange
Philadelphus lewisii 28, 34, 35	Mock Orange, Lewis
Phoenix species 5, 12, 14, 28, 32	Palm, Date
Photinia serrulata 5, 12, 28, 32	Chinese Hawthorn
Photinia villosa 28, 43	
Phyllanthus emblica 12	Emblic, Myrobalan
Phyllodoce empetriformis 34	Mountain Heather, Red
Physocarpus capitatus 4	
Physocarpus opulifolius 12, 14, 18, 28, 43	Ninebark
Phytolacca dioica 12	
Picea abies 3, 4, 12, 14, 19, 22, 28, 38, 43, 51, 55	Spruce, Norway
Picea asperata 4, 28, 43	
Picea breweriana 4, 14, 28, 37, 43, 44	Spruce, Brewer
Picea engelmannii 1, 3, 4, 5, 8, 11, 12, 14, 18, 28, 34, 36, 43, 44, 49	Spruce, Engelmann
Picea glauca 1, 4, 8, 12, 14, 18, 19, 28, 38, 42, 43, 44, 51, 55, 57	Spruce, White
Picea glauca var. *albertiana* 12, 14, 28, 43, 44	Spruce, Western White
Picea glauca var. *densata* 1, 3, 5, 11, 12, 14, 18, 28, 43, 45, 49, 51, 55	Spruce, Black Hills
Picea glehnii 12	Spruce, Sakhalin

SCIENTIFIC NAME	COMMON NAME
Picea jezoensis 4, 14, 28, 43, 51	Spruce, Yeddo
Picea koyamai 28, 43, 51	Spruce, Koyama
Picea mariana 4, 14, 18, 19, 28, 42, 43, 51, 57	Spruce, Black
Picea meyeri 4, 14, 28, 43	
Picea obovata 14, 22, 28, 43	Spruce, Siberian
Picea omorika 3, 12, 14, 19, 22, 28, 43, 51, 55	Spruce, Serbian
Picea orientalis 12, 14, 28, 43	
Picea polita 43	Spruce, Tiger-tail
Picea pungens 4, 8, 11, 18, 32, 34, 55	Spruce, Colorado Blue
Picea pungens var. *glauca* 1, 3, 5, 12, 14, 16, 17, 19, 28, 40, 43, 44, 49, 51, 54	Spruce, Blue
Picea rubens 12, 14, 19, 28, 43	Spruce, Red
Picea schrenkiana 28, 43	Spruce, Schrenkiana
Picea sitchensis 3, 4, 8, 12, 14, 16, 28, 36, 43, 44, 55	Spruce, Sitka
Picea smithiana 12	Spruce, Himalayan
Picea tiashanica 4	
Picea wilsonii 4, 28	Spruce, Wilson's
Pickeringia montana 4	Chaparral Pea
Pieris floribunda 12, 14, 19, 28, 43	Fetterbush
Pieris japonica 5, 12, 14, 19, 43	Lily-of-the-Valley Bush
Pigafetta filaris 12	
Pimenta dioica 12	Allspice, Pimento

SCIENTIFIC NAME	COMMON NAME
Pinckneya pubens 43	Fever Tree
Pinus albicaulis 4, 14, 34, 43	Pine, White-bark
Pinus aristata 3, 4, 5, 8, 11, 12, 14, 17, 28, 32, 43, 49, 51, 54	Pine, Bristlecone
Pinus armandii 4, 14, 28, 43	Pine, Armand
Pinus attenuata 3, 4, 5, 14, 16, 28, 32, 37, 43, 50	Pine, Knobcone
Pinus attenuata x *Pinus radiata* 50	Pine, Knobcone x Monterey
Pinus ayacahuite 4, 43	Pine, Mexican White
Pinus balfouriana 4	Pine, Foxtail
Pinus banksiana 4, 5, 12, 14, 18, 19, 28, 38, 42, 43, 51, 57	Pine, Jack
Pinus brutia var. *eldarica* 4, 5, 14, 16, 28, 32, 43	Pine, Afghan
Pinus bungeana 4, 14, 28, 43, 51	Pine, Lace-bark
Pinus canariensis 5, 8, 12, 14, 28, 32, 43	Pine, Canary Island
Pinus caribaea 5, 12, 14, 28, 41, 43, 46	Pine, Caribbean
Pinus cembra 4, 5, 8, 12, 14, 28, 43	Pine, Swiss Stone
Pinus cembroides 4, 8, 28, 43	Pine, Mexican Pinyon
Pinus chiapensis 4	Pine, Chiapas White
Pinus clausa 12, 24, 43	Pine, Sand
Pinus contorta 4, 5, 8, 12, 32, 34, 55	Pine, Lodgepole
Pinus contorta var. *contorta* 3, 14, 16, 28, 36, 43, 44	Pine, Lodgepole
Pinus contorta var. *latifolia* 4, 5, 8, 11, 14, 17, 28, 43, 44, 49, 54	Pine, Rcky. Mtn. Lodgepol
Pinus contorta var. *murrayana* 3, 4, 14, 16, 28, 36, 43, 44	Pine, Sierra Lodgepole

SCIENTIFIC NAME	COMMON NAME
Pinus coulteri 4, 5, 8, 12, 14, 16, 28, 32, 43	Pine, Coulter
Pinus densiflora 5, 12, 14, 28, 32, 43, 51, 55	Pine, Japanese Red
Pinus echinata 4, 12, 14, 24, 28, 29, 43	Pine, Shortleaf
Pinus edulis 4, 5, 11, 12, 14, 16, 23, 28, 32, 40, 47, 49, 54	Pine, Pinyon
Pinus elliottii var. *elliottii* 4, 5, 11, 12, 14, 19, 24, 25, 28, 29, 32, 41, 43, 46	Pine, Slash
Pinus engelmanii 4, 28	Pine, Apache
Pinus flexilis 4, 5, 11, 12, 14, 17, 28, 43, 51, 54	Pine, Limber
Pinus gerardiana 4, 43	Pine, Nepal Nut
Pinus glabra 14, 25, 29, 43	Pine, Spruce
Pinus greggii 12	
Pinus halepensis 3, 4, 5, 8, 12, 14, 16, 28, 32, 39, 43	Pine, Aleppo
Pinus insularis 43	Pine, Benguet
Pinus jefferyi 3, 4, 5, 8, 12, 14, 16, 28, 32, 36, 37, 43, 44	Pine, Jeffrey
Pinus kesiya 28	Pine, Kesiya
Pinus koraiensis 3, 4, 5, 14, 28, 43	Pine, Korean
Pinus lambertiana 3, 4, 5, 8, 12, 14, 16, 28, 32, 36, 37, 43, 44	Pine, Sugar
Pinus leucodermis 3, 14, 28, 43	Pine, Heldreich
Pinus massoniana 4, 28, 43	Pine, Masson's
Pinus maximartinezii 12	
Pinus merkusii 4	Pine, Tennaserim
Pinus monophylla 4, 5, 11, 14, 16, 43	Pine, Singleleaf Pinyon

SCIENTIFIC NAME	COMMON NAME
Pinus montezumae	Pine, Rough-barked Mexica
4, 5, 12, 14, 28	
Pinus monticola	Pine, Western White
3, 4, 8, 12, 14, 28, 34, 36, 43, 44, 50, 55	
Pinus mugo	Pine, Swiss Mountain
14, 28, 32	
Pinus mugo var. *mugo*	Pine, Mugo
3, 5, 8, 14, 19, 28, 43	
Pinus mugo var. *pumilo*	Pine, Dwarf Mugo
3, 5, 12, 14, 19, 28, 32, 43	
Pinus muricata	Pine, Bishop
3, 4, 5, 12, 14, 16, 32, 36, 43	
Pinus nigra	Pine, Austrian
1, 3, 5, 12, 14, 16, 19, 22, 28, 32, 43, 51, 55	
Pinus oocarpa	Pine, Oocarpa
4, 28, 41, 43, 51	
Pinus palustris	Pine, Longleaf
4, 5, 10, 12, 14, 15, 19, 24, 25, 28, 29, 32, 41, 43, 46	
Pinus parviflora	Pine, Japanese White
5, 8, 12, 14, 32, 43	
Pinus patula	Pine, Mexican Yellow
4, 5, 12, 14, 28, 32, 43	
Pinus peuce	Pine, Macedonian
4, 12, 14, 28, 43	
Pinus pinaster	Pine, Cluster
4, 5, 14, 28, 43	
Pinus pinceana	
4	
Pinus pinea	Pine, Italian Stone
4, 5, 8, 12, 14, 16, 28, 32, 51	
Pinus ponderosa	Pine, Ponderosa
1, 3, 4, 5, 8, 11, 12, 14, 16, 17, 18, 28, 32, 34, 36, 37, 40, 43, 44, 49, 51, 54, 55	
Pinus pseudostrobus	
4, 12, 43	
Pinus pumila	Pine, Dwarf Siberian
4, 5, 14, 43, 51	
Pinus pungens	Pine, Table Mountain
43	
Pinus quadrifolia	Pine, Parry Pinyon
4	
Pinus radiata	Pine, Monterey
4, 5, 8, 12, 14, 16, 28, 32, 36, 43, 44	

SCIENTIFIC NAME	COMMON NAME
Pinus radiata var. *binata*	
4	
Pinus resinosa	Pine, Red
1, 4, 12, 14, 18, 19, 28, 38, 42, 43, 51, 55, 57	
Pinus rigida	Pine, Pitch
12, 14, 19, 24, 28, 43	
Pinus roxburghii	Pine, Chir
5, 12, 14, 16, 28, 32, 43	
Pinus rudis	
4	
Pinus sabiniana	Pine, Digger
4, 5, 8, 12, 14, 16, 28, 32, 36, 37, 43	
Pinus serotina	Pine, Pond
4, 12, 14, 43	
Pinus strobiformis	Pine, Southwest White
1, 4, 11, 28, 43, 49, 54	
Pinus strobus	Pine, Eastern White
1, 3, 5, 12, 14, 18, 19, 24, 27, 28, 29, 38, 42, 43, 44, 46, 51, 55, 57	
Pinus sylvestris	Pine, Scotch
1, 3, 5, 8, 12, 14, 16, 19, 22, 28, 32, 34, 43, 44, 51, 55	
Pinus tabuliformis var. *yunnanensis*	Pine, Yunnan
28, 43	
Pinus taeda	Pine, Loblolly
4, 5, 10, 12, 14, 15, 19, 24, 25, 28, 29, 32, 41, 43, 46, 55	
Pinus taiwanensis	Pine, Formosa
4, 28	
Pinus teocote	Pine, Twisted-leaf
4	
Pinus thunbergiana	Pine, Japanese Black
3, 4, 5, 12, 14, 19, 28, 32, 43, 55	
Pinus torreyana	Pine, Torrey
4, 5, 12, 14, 28, 32	
Pinus virginiana	Pine, Virginia
4, 5, 12, 14, 19, 24, 28, 29, 32, 46	
Pinus wallichiana	Pine, Himalayan White
3, 4, 12, 28, 43, 55	
Piper nigrum	Pepper Plant
12	
Pistacia atlantica	Mt. Atlas Mastic Tree
5, 12, 28	

SCIENTIFIC NAME	COMMON NAME
Pistacia chinensis 5, 12, 14, 25, 28, 32, 43	
Pistacia terebinthus 12, 32	Cyprus-Turpentine
Pistacia texana 43	Pistachio, American
Pistacia vera 28, 43	Pistacia, Nut
Pithecellobium dulce 12, 28	Manila Tamarind
Pittosporum crassifolium 5, 12, 28, 32	Karo
Pittosporum dallii 12	
Pittosporum eugenioides 5, 12, 32	Tarata
Pittosporum phillyraeoides 5, 12, 32	Pittosporum, Willow
Pittosporum ralphill 12	
Pittosporum rhombifolium 5, 32	Pittosporum, Queensland
Pittosporum tenuifolium 5, 12, 32	Tawhiwhi - Kohuhu
Pittosporum tobira 5, 12, 14, 28, 32, 43	Pittosporum, Japanese
Pittosporum undulatum 5, 12, 28, 32	Victorian Box
Pittosporum viridiflorum 5, 28, 32	Pittosporum, Cape
Platanus x *acerifolia* 5, 12, 32	Planetree, London
Platanus occidentalis 5, 12, 14, 19, 20, 24, 25, 28, 29, 30, 43	Sycamore
Platanus orientalis 5, 12, 14, 28, 43	Planetree, Oriental
Platanus racemosa 5, 12, 28, 32	Sycamore, California
Platanus wrightii 12, 40, 56	Sycamore, Arizona
Platycladus orientalis 4, 5, 12, 14, 28, 34, 43	Arborvitae, Oriental

SCIENTIFIC NAME	COMMON NAME
Platylobium formosum 12	
Podalyria calyptrata 12, 28	Sweet Pea Bush
Podocarpus darydioides 12	Kahika, White Pine
Podocarpus gracilior 5, 12, 32	African Fern Pine
Podocarpus henkelii 5, 12, 32	
Podocarpus macrophyllus 5, 12, 32	Japanese Yew
Podocarpus macrophyllus var. *maki* 5, 14, 32	Japanese Yew
Podocarpus totara 12	Totara Pine
Podranea brycei 12	Queen-of-Sheba Vine
Podranea ricasoliana 12	Pink Trumpet Vine
Poliothyrsis sinensis 43	
Polyalthia species 12	
Polyscias fruticosa 12	Ming Aralia
Pomaderris kumeraho 12	
Poncirus trifoliata 12, 43	Trifoliate Orange
Pongamia pinnata 12	Karum Tree, Poonga-Oil Tr
Populus tremuloides 18, 28, 34, 35, 55	Aspen, Quacking
Porlieria augustifolium 4	
Potentilla fruticosa 40	Cinquefoil, Shrubby
Prinsepia sinensis 14, 28, 43, 45	Prinsepia, Cherry
Pritchardia pacifica 12	Palm, Fiji Fan

SCIENTIFIC NAME	COMMON NAME
Pritchardia thurstonii	
12	
Prosopis chilensis	Algarrobo
5, 28, 32, 56	
Prosopis juliflora	Mesquite
5, 9, 12, 17, 28, 43, 56	
Prosopis pubescens	Screw-Bean
4, 5, 56	
Protea species	
12	
Prunus americana	Plum, American
9, 14, 17, 18, 19, 28, 30, 34, 40, 43, 45, 47, 51, 54, 58	
Prunus andersonii	Desert Peach
4, 9	
Prunus angustifolia	Plum, Chickasaw
25, 43, 53	
Prunus armeniaca	Apricot
14, 28, 43	
Prunus avium	Cherry, Mazzard
14, 28, 43	
Prunus besseyi	Cherry, Sand
5, 9, 11, 14, 28, 30, 34, 40, 43, 45, 54	
Prunus campanulata	Cherry, Taiwan
43	
Prunus caroliniana	Cherry Laurel
12, 14, 25, 28, 29, 32	
Prunus cerasifera	Plum, Myrobalan
14, 28, 43	
Prunus cerasus	Cherry, Sour
28, 43	
Prunus davidiana	Peach, David's
14, 28, 43	
Prunus domestica	Plum, Common European
28, 43	
Prunus domestica sbsp. *insititia*	Plum, Damson
28	
Prunus dulcis var. *amara*	Almond, Bitter
14, 28, 43	
Prunus emarginata	Cherry, Bitter
4, 34	
Prunus fasciculata	Almond, Desert
4, 23, 34, 47	

SCIENTIFIC NAME	COMMON NAME
Prunus fremontii 4	Apricot, Desert
Prunus fruticosa 28, 43	Cherry, European Dwarf
Prunus glandulosa 28, 43	Almond, Flowering
Prunus ilicifolia 4, 5, 32	Cherry, Holly-leaved
Prunus laurocerasus 4, 43	Cherry-laurel
Prunus lusitanica 4	Portugese Cherry-laurel
Prunus lyonii 4, 5, 32	Cherry, Catalina
Prunus maackii 14, 28, 43	Cherry, Maackii
Prunus mahaleb 5, 14, 28, 43	Cherry, Mahaleb
Prunus maritima 14, 43	Plum, Beach
Prunus mexicana 5, 25	Plum, Mexican
Prunus mume 14, 28, 43	Apricot, Japanese
Prunus nigra 43	Plum, Canada
Prunus padus 14, 28, 43	Cherry, European Bird
Prunus pennsylvanica 14, 18, 28, 43	Cherry, Pin
Prunus persica 5, 14, 28	Peach
Prunus salicina 14, 28, 43	Plum, Japanese
Prunus sargentii 14, 43	Cherry, Sargent
Prunus serotina 14, 18, 19, 20, 21, 25, 28, 30, 43, 45, 51	Cherry, Black
Prunus serotina sbsp. *capuli* 12	Capuli
Prunus serrulata 14, 28, 43	Cherry, Oriental

SCIENTIFIC NAME	COMMON NAME
Prunus spinosa	Blackthorn
28, 43	
Prunus subcordata	Plum, Sierra
4, 43	
Prunus subhirtella	Cherry, Rosebud
14, 43	
Prunus tenella	Almond, Dwarf Russian
5, 14, 28, 43	
Prunus tomentosa	Cherry, Nanking
5, 14, 28, 30, 34, 43, 51	
Prunus triloba	Almond, Flowering
28, 43	
Prunus umbellata	Plum, Sloe
25, 29	
Prunus virginiana	Chokecherry
9, 17, 18, 19, 28, 30, 31, 34, 35, 40, 43, 45, 47, 54, 58	
Prunus virginiana var. *demissa*	
4	
Prunus virginiana var. *melanocarpa*	Chokecherry, Black
4, 14, 23	
Prunus yedoensis	Cherry, Yoshino
14, 43	
Pseudolarix kaempferi	Golden Larch
4, 12, 14, 28, 43	
Pseudopanax arboreus	Five-fingers
12	
Pseudopanax lessonii	
12	
Pseudotsuga macrocarpa	Douglas Fir, Big Cone
4, 5, 28, 43	
Pseudotsuga menziesii	Douglas Fir
1, 3, 4, 5, 8, 12, 14, 16, 17, 18, 28, 32, 34, 36, 37, 43, 44, 48, 49, 50, 54, 55	
Pseudotsuga menziesii var. *glauca*	Douglas Fir, Rocky Mounta
4, 5, 11, 12, 19, 28, 32, 44	
Psidium littorale	Guava, Yellow Strawberry
5, 12, 32	
Psophocarpus tetragonolobus	Asparagus Pea
43	
Psychotria species	Wild Coffee
12	
Ptelea trifoliata	Common Hoptree
12, 14, 18, 20, 28, 40, 43, 54	

SCIENTIFIC NAME	COMMON NAME
Pterocarya species 28, 43	Wingnut
Pteroceltis tartarinowii 43	
Pterospermum acerifolium 12	
Pterostyrax species 43	Epaulette Tree
Ptychosperma elegans 5, 12, 32	Palm, Alexander
Punica granatum 5, 12, 28, 32	Pomegranate
Purshia glandulosa 17, 23, 31, 47	Bitterbrush, Desert
Purshia tridentata 8, 12, 17, 23, 28, 31, 34, 39, 40, 47, 54, 58	Bitterbrush, Antelope
Putterlickia pyracantha 12	
Pyracantha coccinea 5, 12, 14, 28, 43	Firethorn
Pyracantha crenulata 12	Firethorn, Nepal
Pyracantha rogersiana 12	
Pyrus betulifolia 12, 14, 28, 43	Pear, Betulifolia
Pyrus calleryana 5, 12, 14, 19, 20, 25, 28, 30, 32, 43	Pear, Calleryana
Pyrus communis 5, 12, 14, 19, 28, 43	Pear, Common
Pyrus pyrifolia 12, 14, 28, 43	Pear, Sand
Pyrus serrulata 28, 43	
Pyrus ussuriensis 12, 14, 28, 43	Pear, Chinese
Quercus x *heterophylla* 43	Oak, Bartram
Quercus acutissima 14, 20, 25, 28, 29, 30, 43, 45, 53	Oak, Sawtooth
Quercus agrifolia 4, 5, 32, 43	Oak, California Live

SCIENTIFIC NAME	COMMON NAME
Quercus alba 14, 18, 20, 21, 25, 26, 28, 29, 30, 43, 51, 53	Oak, White
Quercus bicolor 18, 20, 21, 26, 28, 30, 43	Oak, Swamp White
Quercus cerris 28, 30	Oak, Turkey
Quercus chrysolepis 4, 5, 12, 16, 28, 43	Oak, Canyon Live
Quercus coccinea 5, 20, 21, 26, 28, 30, 32, 43	Oak, Scarlett
Quercus dentata 43	Oak, Daimyo
Quercus douglasii 4, 5, 16, 28, 32, 43	Oak, Blue
Quercus dumosa 4, 5, 28, 43	Oak, California Scrub
Quercus durata 4	Oak, Leather
Quercus ellipsoidalis 43, 45	Oak, Jack - Northern Pin
Quercus emoryi 4	Oak, Emory
Quercus engelmannii 4, 5	Oak, Engelmann
Quercus falcata var. *falcata* 21, 25, 28, 29, 30, 43, 53	Oak, Southern Red
Quercus falcata var. *pagodaifolia* 20, 21, 25, 28, 29, 30, 43, 53	Oak, Cherrybark
Quercus frainetto 43	Oak, Italian
Quercus gambelii 4, 28, 31, 43, 54	Oak, Gambel
Quercus garryana 4, 5, 28, 43	Oak, Oregon
Quercus ilex 5, 32, 43	Oak, Holly
Quercus ilicifolia 43	Oak, Scrub
Quercus imbricaria 20, 21, 28, 30, 43	Oak, Shingle
Quercus incana 25, 43	Oak, Bluejack

SCIENTIFIC NAME	COMMON NAME
Quercus kelloggii	Oak, Black
4, 5, 16, 28, 32, 43	
Quercus laevis	Oak, Turkey
43	
Quercus laurifolia	Oak, Laurel
5, 25, 32, 43	
Quercus laurifolia var. *obtusa*	Oak, Obtusa
25, 43	
Quercus lobata	Oak, Valley
4, 5, 16, 28, 32, 43	
Quercus lyrata	Oak, Overcup
14, 21, 25, 28, 29, 43	
Quercus macrocarpa	Oak, Bur
5, 14, 18, 20, 21, 25, 26, 28, 29, 30, 43, 45, 51, 57	
Quercus marilandica	Oak, Blackjack
20, 25, 43, 45	
Quercus meuhlenbergii	Oak, Chinkapin
20, 21, 30, 43, 45	
Quercus michauxii	Oak, Swamp Chestnut
20, 21, 25, 29, 43, 53	
Quercus myrsinifolia	
43	
Quercus nigra	Oak, Water
25, 28, 29, 43, 53	
Quercus nuttallii	Oak, Nuttall
20, 25, 28, 29, 43, 53	
Quercus palustris	Oak, Pin
5, 14, 20, 21, 26, 28, 30, 32, 43, 51, 53	
Quercus petraea	Oak, Durmast
43	
Quercus phellos	Oak, Willow
5, 14, 20, 25, 28, 29, 30, 32, 43, 53	
Quercus prinoides	Oak, Chinquapin
43	
Quercus prinus	Oak, Chestnut
21, 28, 43	
Quercus robur	Oak, English
14, 28, 33, 43, 51	
Quercus rubra	Oak, Northern Red
5, 14, 18, 19, 20, 21, 26, 28, 30, 32, 33, 43, 51, 57	
Quercus sadlerana	Oak, Deer
4, 43	

SCIENTIFIC NAME	COMMON NAME
Quercus shumardii 5, 20, 21, 25, 28, 29, 30, 32, 43, 45, 51, 53	Oak, Shumard
Quercus stellata 20, 21, 25, 28, 29, 43	Oak, Post
Quercus suber 5, 32, 43	Oak, Cork
Quercus turbinella 43, 54	Oak, Desert Scrub
Quercus vacciniifolia 4	Oak, Huckleberry
Quercus velutina 14, 20, 21, 25, 28, 43, 51, 53	Oak, Black
Quercus virginiana 5, 25, 29, 32, 43	Oak, Live
Quercus wislizeni 4, 5, 16, 32	Oak, Interior Live
Radermachera sinica 5, 12, 32	
Raphiolepis x *delacourii* 12	
Raphiolepis indica 5, 12, 32	Indian Hawthorn
Raphiolepis umbellata 12, 32	Yedda Hawthorn
Rauvolfia serpentina 12	Serpentine Wood
Ravenala madagascariensis 12	Traveler's Tree
Ravenea rivularis 12	
Reinhardtia gracilis 12	
Rhamnella franguloides 43	
Rhamnus californica 4, 5, 8, 12, 16, 32	Coffeeberry
Rhamnus californica sbsp. *crassifolia* 4	Coffeeberry, Velvet-leaf
Rhamnus californica sbsp. *occidentalis* 4	Coffeeberry, Northern
Rhamnus californica sbsp. *tomentella* 4	Coffeeberry, Chaparral

SCIENTIFIC NAME	COMMON NAME
Rhamnus caroliniana 14, 20, 25	Buckthorn, Carolina
Rhamnus cathartica 12, 14, 18, 19, 28, 43	Buckthorn, European
Rhamnus crocea sbsp. *ilicifolia* 4	Redberry
Rhamnus frangula 12, 14, 18, 28, 30, 43	Buckthorn, Alder
Rhamnus koraiensis 43	
Rhamnus purshiana 4, 34	Cascara Sagrada
Rhamnus rubra 4	Coffeeberry, Red-stem
Rhapis excelsa 5, 28	Lady Palm
Rhigozum obovatum 12	
Rhododendron species 12, 14, 19, 43	
Rhodotypos scandens 14, 43	Jetbead
Rhopalostylis species 12	Palm, Nikau
Rhus aromatica 5, 12, 14, 20, 28, 30, 43	Sumac, Fragrant
Rhus copallina 12, 14, 19, 20, 25, 28, 30, 43	Sumac, Shining
Rhus glabra 4, 5, 12, 14, 17, 18, 19, 25, 28, 30, 31, 34, 35, 40, 43, 45, 47	Sumac, Smooth
Rhus integrifolia 4, 58, 32, 39	Lemonade Berry
Rhus lancea 5, 12, 32, 39, 56	
Rhus laurina 5, 8, 12, 32, 39	Sumac, Laurel
Rhus ovata 4, 5, 8, 32	Sugarbush
Rhus punjabensis 43	
Rhus trilobata 9, 14, 17, 23, 28, 31, 34, 40, 43, 47, 54, 56, 58	Skunkbush

SCIENTIFIC NAME	COMMON NAME
Rhus typhina	Sumac, Staghorn
5, 12, 14, 18, 19, 28, 30, 43, 57	
Rhynchosia senna var. *texana*	Rosary Bean Vine
56	
Ribes alpinum	Currant, Mountain
28, 43	
Ribes aureum	Currant, Golden
17, 23, 28, 31, 34, 35, 40, 47, 54, 58	
Ribes cereum	Currant, Wax
9, 17, 23, 34, 47, 54	
Ribes fasciculatum var. *chinense*	Currant
43	
Ribes inerme	
43	
Ribes nigrum	Currant, Black
28	
Robinia fertilis	Locust, Bristly
14, 19, 28, 30, 43	
Robinia neomexicanus	Locust, New Mexico
4, 9, 17, 40, 43, 47	
Robinia pseudoacacia	Locust, Black
5, 12, 14, 18, 19, 21, 23, 28, 32, 33, 34, 43, 45, 51	
Romneya coulteri	California Tree Poppy
4, 5, 32	
Rosa arkansana	
43, 54	
Rosa blanda	Rose, Meadow
28, 43, 45	
Rosa canina	Rose, Dog
12, 14, 28, 34, 43, 54	
Rosa carolina	Rose, Pasture
12, 28, 43	
Rosa chinensis	Rose, China
12	
Rosa davidii	Rose, David's
28, 43	
Rosa davurica	
12	
Rosa eglanteria	Sweetbrier - Eglantine
12, 14, 43	

SCIENTIFIC NAME	COMMON NAME
Rosa gymnocarpa	Rosa, Wood
34	
Rosa hugonis	
12, 14, 28, 43	
Rosa laevigata	Rose, Cherokee
28	
Rosa moyesii	Rose, Moyes
12, 28, 43	
Rosa multiflora	Rose, Multiflora
5, 12, 14, 28, 43, 51	
Rosa nutkana	Rose, Nootka
28, 34, 35, 43, 54	
Rosa palustris	Rose, Swamp
43	
Rosa rubrifolia	Rose, Red-leaf
12, 14, 28, 43	
Rosa rugosa	Rose, Japanese
5, 12, 14, 28, 30, 43, 45, 51	
Rosa setigera	Rose, Prairie
43	
Rosa spinosissima	Rose, Scotch
12, 28, 43	
Rosa virginiana	Rose, Virginia
28, 43	
Rosa wichuraiana	Rose, Memorial
12, 14, 28	
Rosa woodsii	Rose, Woods
12, 14, 17, 23, 28, 31, 34, 35, 40, 43, 47, 54, 58	
Rosa xanthina	Rose, China
28, 43	
Rothmannia species	
12	
Roystonea species	Palm, Royal
12	
Rubus species	Blackberry, Raspberry
34, 43	
Ruspolia hypocraterifromis	
12	
Sabal species	Palmetto
12	
Salix species	Willow
9	

SCIENTIFIC NAME	COMMON NAME
Salvia species 5, 8, 9, 12, 39	Sage
Sambucus caerulea 4, 9, 17, 23, 28, 31, 34, 35, 43, 47, 54, 58	Elderberry, Blue
Sambucus canadensis 18, 20, 25, 43	Elderberry, American
Sambucus nigra 12, 14, 28	Elderberry, European Black
Sambucus pubens 43, 54	Elderberry, American Red
Sambucus racemosa 4, 12, 14, 17, 23, 28, 31, 34, 35, 43, 47, 58	Elderberry, European Red
Sambucus racemosa sbsp. *pubens* v. *mlncrp* 35	Elderberry, Black
Santalum album 12	Sandalwood, White
Sapindus drummondii 4, 12, 43	Soapberry
Sapindus mukorossi 28	Soapberry, Chinese
Sapium sebiferum 5, 14, 25, 28, 32, 43	Chinese Tallowtree
Sarcobatus vermiculatus 9, 17, 23, 31, 47, 58	Greasewood
Sarcococca species 5, 28, 32, 43	Sweet Box
Sassafras albidum 19, 20, 21, 25, 30, 43, 51	Sassafras
Schefflera species 12, 32	Umbrella Tree
Schima wallichii 28	
Schinus species 5, 12, 14, 28, 32, 39	Pepper Tree
Schisandra species 12, 28	Magnolia Vine
Schismus barbatus 39	
Schizolobium parahybum 12	
Schizophragma hydrangeoides 43	Japanese Hydrangea

SCIENTIFIC NAME	COMMON NAME
Schotia species 12	Tree Fuschia
Sciadopitys verticillata 3, 12, 14, 28, 43	Japanese Umbrella Pine
Securidaca longipedunculata 12	
Securinega suffruticosa 43	
Senna species 39	
Sequoia sempervirens 3, 4, 5, 8, 12, 14, 16, 28, 32, 36, 43, 44, 55	Redwood
Sequoiadendron giganteum 3, 4, 5, 8, 12, 14, 16, 28, 32, 34, 36, 37, 43, 44, 55	Giant Sequoia
Serenoa repens 12	Palmetto, Saw
Serruria florida 12	Blushing-bride
Sesbania species 12	
Shepherdia argentea 4, 9, 12, 14, 17, 18, 28, 34, 35, 40, 43, 47, 54, 58	Buffaloberry, Silver
Shepherdia canadensis 17, 23, 28, 34, 35, 43, 54	Buffaloberry
Shepherdia rotundifolia 4, 17, 31	Buffaloberry, Roundleaf
Simmondsia chinensis 4, 5, 12, 28, 32, 40, 43, 56	Goat Nut - Jojoba
Sinowilsonia henryi 43	
Solanum aviculare 12	Kangaroo Apple
Solanum capiscastrum 12	False Jerusalem Cherry
Solanum dulcamara 43	Nightshade, Poisonous
Sollya heterophylla 5, 12, 32	Bluebell Creeper
Sophora affinis 4	
Sophora chrysophylla 12	Mamane

SCIENTIFIC NAME	COMMON NAME
Sophora japonica 5, 12, 14, 19, 20, 28, 30, 32, 43	Japanese Pagoda Tree
Sophora macrocarpa 39	
Sophora microphylla 12	
Sophora secundiflora 4, 5, 12, 32, 40, 43, 56	Mescal Bean
Sophora tetraptera 12	Kowhai
Sophora tomentosa 12	Siverbush
Sorbaria sorbifolia 43	False Spiraea
Sorbus alnifolia 28, 43	Mountain-ash, Korean
Sorbus americana 12, 14, 19, 28, 43, 51, 57	Mountain-ash, American
Sorbus aria 14, 43	White Beam
Sorbus aucuparia 12, 14, 18, 28, 30, 43, 51	Mountain-ash, European
Sorbus decora 28, 35, 43	
Sorbus discolor 28, 43	Mountain-ash, Snowberry
Sorbus domestica 12, 14, 43	Service Tree
Sorbus intermedia 12, 14, 43	
Sorbus latifolia 43	
Sorbus mougeotii 43	
Sorbus pohuashanensis 28, 43	Mountain Ash, Chinese
Sorbus scopulina 3, 12, 14, 23, 28, 34, 35, 43	Mountain Ash
Sorbus sitchensis 28, 34	Mountain Ash, Sitka
Sorbus torminalis 12, 14, 28, 43	Wild Service Tree

SCIENTIFIC NAME	COMMON NAME
Sparmannia africana 12	African Hemp
Spartium junceum 5, 12, 14, 28, 32, 39, 43	Spanish Broom
Spathodea species 12	
Sphaeralcea ambigua 39	
Spiraea species 34	
Staphylea bumalda 43	Bladdernut
Staphylea pinnata 43	Bladdernut, European
Staphylea trifolia 18, 20, 43	Bladdernut, American
Stenocarpus sinuatus 5, 12, 32	Firewheel Tree
Stephanotis florabunda 12, 32	Madagascar Jasmine
Sterculia foetida 12	Indian Almond
Stewartia species 14, 43	
Stictocardia beravensis 12	
Strelitzia nicolai 5, 12, 32	Bird-of-Paradise Tree
Strelitzia reginae 5, 12, 14, 28, 32, 43	Bird of Paradise
Strongylodon macrobotrys 12	Jade Vine
Strophanthus speciosus 12	
Styrax americanus 14, 25, 43	Snowbell
Styrax japonicus 12, 14, 28, 43	Snowbell, Japanese
Styrax obassia 14, 28, 43	Snowbell, Fragrant
Styrax officinalis var. *californicus* 4, 43	Snowdrop Bush

SCIENTIFIC NAME	COMMON NAME
Sutherlandia frutescens	Cancerbush
12	
Swietenia macrophylla	Mahogany, Honduran
12	
Swietenia mahagony	Mahogany, West Indian
12	
Symphoricarpos albus	Snowberry
9, 14, 17, 28, 34, 35, 43, 47, 54, 58	
Symphoricarpos mollis	Snowberry, Creeping
34	
Symphoricarpos occidentalis	Wolfberry
28, 34, 43, 54, 58	
Symphoricarpos orbiculatus	Indian Currant
12, 14, 20, 28, 30, 43	
Symphoricarpos oreophilus	Snowberry, Mountain
9, 17, 23, 31, 34, 47, 58	
Symplocos paniculata	Sweetleaf, Asiatic
43	
Symplocos tinctoria	Sweetleaf
25, 43	
Syringa x *prestoniae*	
12	
Syringa emodii	Lilac, Himalayan
12	
Syringa josikaea	Lilac, Hungarian
12, 14, 43	
Syringa oblata	Lilac
14, 28, 43	
Syringa pekinensis	Lilac, Chinese
14, 28, 43, 45	
Syringa reflexa	
12	
Syringa reticulata	Lilac, Japanese Tree
14, 20, 28, 43, 45	
Syringa villosa	Lilac, Late
5, 12, 14, 28, 43, 45	
Syringa vulgaris	Lilac, Common
5, 12, 14, 19, 28, 30, 43, 45	
Syzygium paniculatum	Australian Brush Cherry
12, 32	
Tabebuia chrysotricha	Trumpet Tree
5, 12, 32	

SCIENTIFIC NAME	COMMON NAME
Tabebuia pallida 12	Trumpet Tree, Cuban Pink
Tabebuia rosea 12	Trumpet Tree, Rosy
Taiwania cryptomeroides 4	
Tamarix aphylla 39	Athel
Tamarix gallica 12	Tamarisk
Taxodium distichum 4, 5, 12, 14, 19, 20, 25, 28, 29, 30, 32, 43	Bald Cypress
Taxodium mucronatum 4, 5, 14	Montezuma Cypress
Taxus x *media* 12	
Taxus baccata 5, 12, 14, 28, 43	Yew, English
Taxus brevifolia 4, 16, 28, 34, 37, 43, 50	Yew, Pacific
Taxus canadensis 18	Yew, Canadian
Taxus cuspidata 12, 14, 19, 28, 43	Yew, Japanese
Tecoma stans 5, 12, 28, 32, 56	Yellowbells
Tecomaria capensis 12, 32	Cape Honeysuckle
Telopea species 12	Waratah
Tephrosia species 12	
Terminalia species 12, 28	
Tetradymia spinescens 9	Tetradymia
Tetrapanax papyriferus 12, 32	Rice-Paper Plant
Theobroma cacao 12	Cacao
Thespesia populnea 12, 32	Portia Tree

SCIENTIFIC NAME	COMMON NAME
Thevetia peruviana 12, 32	Be-Still Tree
Thrinax species 12	Palm, Thatch
Thuja occidentalis 1, 4, 5, 14, 18, 19, 28, 38, 43, 44, 45, 51, 57	Northern White-cedar
Thuja plicata 3, 4, 5, 12, 14, 28, 34, 36, 43, 44, 48, 55	Redcedar, Western
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Appendix E

Dallas Urban Forest Advisory Committee Great Trinity Forest Management Plan Recommendations

Dallas Urban Forest Advisory Committee

Great Trinity River Forest Management Plan Recommendations

The Trinity River corridor contains complex ecosystems that have been impacted by many changes over the years. The Great Trinity Forest is the largest urban hardwood forest in America and it is a crown jewel as far as natural assets. Bottomland hardwood forest contains the most diverse habitat in Texas, which, unfortunately, is also the most endangered. As a result, the proper care and management of the Trinity Forest is of critical importance. A properly managed forest will increase populations of wildlife and their habitat; improve air, water and soil quality; increase aesthetic appeal; plus offer recreational opportunities. Proactive management of this precious resource will help to produce a world class park as a treasured and highly valued asset. A healthy and sustainable forest is indeed a worthy gift for present and future generations to enjoy.

Forest management is the practical application of scientific, social, and economic principals to the administration, operation, and maintenance of a forest. Proper forest management includes the proper care and control of a forested ecosystem to maintain and improve the health, vigor, flow of resources including wildlife and its habitat, recreational opportunities, air and water quality as well as aesthetic enhancement. The primary goal of a management plan for the Great Trinity Forest is to protect and enhance the ecosystems and to restore, manage, and preserve the forest, as well as to increase its value to society. The plan is an administrative document that offers guidance for all future management related affairs.

Regarding the future management of the Great Trinity Forest, the Dallas Urban Forest Advisory Committee offers the following recommendations:

General:

- Ensure that surrounding neighborhoods as well as all potential stakeholders are included as a part of the development process. Encourage input from all public and private entities interested in the various aspects of the project.
- Due to the limited access to the forest, carefully plan ideal access points and coordinate the planning with affected neighborhood groups. Access points can generate business development associated with the influx of people. Accurate access maps should be provided to the public that also specify significant features in the area, including local business locations.
- Produce a sound marketing campaign to promote the many recreational opportunities and encourage the public to experience the forest.
- Hold city functions and encourage other functions that bring the public into the forest.
- Urge transit authorities to include stops at or near access points for buses or the rail system. Continue to develop the area trail system to route as many trails as possible to access points for the forest. This will allow access without the need for a vehicle and encourage more usage of the available facilities.

- Any of the concepts expressed in these recommendations need to be conveyed to the public by utilizing educational graphics in various locations that are suitable. The addition of graphics that explain the ecological value of snags, brush piles or leaf litter, helps the public to understand why they are important. Graphics can be placed at specific locations that contain components of importance that allow for an illustration. “Edge Effect” is a concept in ecology which states that wildlife diversity will be greatest where various types of habitat meet and should be included in the theme for educational signage development. In the interior of the forest, we find only forest dwellers. In the interior of the grassland, we find only grassland dwellers. Where the habitat types meet, we find both types *plus* species which can use either.
- Consider calculating the amount of carbon sequestration by the forest as well as any other potential environmental benefits provided by the forest that may be quantified by sound science or research.

Forest Management:

- Carefully consider all aspects of forest ecosystem protection, management and usage, as well as the short and long term impacts of each action. The Trinity forest of the future should contain many different types of natural areas consisting of a wide diversity of plant and animal habitat.
- Work toward a healthy, future climax forest ecosystem with a very diverse number of shade and ornamental trees, shrubs, as well as understory plants. One of the goals should be to produce a forest containing trees of many various ages which allows for some resistance to pests or pathogens and produces better habitat, which ultimately creates a more sustainable forest.
- We highly recommend that the City of Dallas establish a Department of Urban Forestry to ensure that adequate resources and expertise are provided for the Trinity Forest. At present, there are at least five (5) separate city departments that deal with tree issues but no one authority that has the proper training, skills and education to adequately manage the forest. Most all progressive communities have a Department of Urban Forestry which provides one authority that is responsible for most, if not all, tree/forest related affairs. Since the Park Department manages the recreation within the forest there is no need to establish another authority to manage activities in the forest.
- Conserve pockets of species diversity. Where the forest ecosystem appears to be recovering and able to re-establish on its own accord, leave these areas alone and avoid upsetting the balance of nature.
- It is important that the removal, cutting, transplanting or pruning of trees require an approval from the city Urban Forester.
- Formulate specific objectives and plans for each year covered by the forest management plan, including each of the various intended uses.
- Manage each forest stand as its own ecosystem. Consider a more detailed analysis of all plants in each forest stand to include flora and fauna or what types of understory plants exist, such as any herbs, forbs, prairie plants or noxious weeds.
- As all aspects of the forest ecosystem are connected, we recommend that forest management plans also be integrated with management plans for soil, water and wildlife, but not cause a loss of floodplain storage capacity or topsoil.
- We highly recommend that the forest management plan encompass the entire Great Trinity Forest, including property inside and outside of the flood plain. Forested areas outside the flood plain are often a higher quality forest that will require some degree of

maintenance in order to increase the health of the forest stand and to minimize the effect of invasive or problematic plants, insects and pathogens.

- Take into account the potential risk of flood damage or drought to the management plan goals and objectives in any given year.
- Consider studying and mapping any landmark or historic resource that may exist to support future planning efforts. Identify any natural resources that warrant protection.
- Explore the possibility of marketing any resource that must be removed from the forested areas.
- Carefully consider access to the forest. Access equals ownership. Diverse groups need to be able to benefit from the forest, thereby building support for management objectives. Trails, trailheads, sufficient parking, roads, boat ramps and other access points should be carefully planned with public input as well as adequately budgeted. Wheelchair accessibility should also be considered.
- It should be required that the removal or planting of trees as well as any landscaping or public improvement projects within the Trinity Forest fully comply with city codes governing these affairs such as the Dallas tree ordinance, landscape ordinance, escarpment ordinance or any other applicable local, state or federal regulations.

Forest Regeneration:

- Due to a lack of species diversity in certain areas, consider the removal of all trees in small plots (or blocks) and replanting with species from the Dallas Urban Forest Advisory Committee's recommended species list for the Trinity Forest. The plots should be planted with a diversity of species that support the objectives of the forest management plan. Replanting in areas less prone to flooding and higher in elevation should include mast, as well as fruit and seed producing species to encourage the spread of future populations of ideal species. Planting large numbers of small seedlings (500-1000 per acre) will take into account expected future losses. Larger plant material may also be required in some plots. Some plots may also require the judicious use of chemicals to allow for some plants to establish. Sources for saplings may limit species availability and diversity; therefore, resources may include all western gulf region states. Due to the potential for flooding, consider planting trees in higher elevations first. Specific areas should be planted each year until management objectives are complete for species regeneration.
- Tree plots and rows being planted should contain a diversity of species and include some understory species as well.
- Seeding of some areas may also be an option.
- Consider establishing a city greenhouse/nursery that grows plants and trees from a local seed source or negotiate a contract with a local grower or nonprofit such as the Texas Trees Foundation, to produce plant stock from local plant seed that is grown specifically for the Trinity forest.
- Species being utilized should have some tolerance for drought or flooding.

Wildlife:

- Consider establishing a comprehensive wildlife management plan that surveys for threatened or endangered animals or plants (HEP standards) and includes habitat stabilization/improvement.

- Complete an inventory of all existing wildlife species (and throughout the year) as well as their life cycle, habitat requirements and travel corridors.
- All due consideration should be provided for the hundreds of species of birds that reside or migrate through the forest. As one example, there is currently a Black-capped Vireo habitat restoration project underway in the Cedar Ridge Preserve.
- Wetlands will encourage waterfowl but must be properly established and maintained in perpetuity to effectively provide a benefit.
- One main objective is to increase the diversity of food producing plants in the area. Berries, seeds, nuts, nectar and vegetation are all important food sources for wildlife. It is also important to have these food sources available throughout all seasons of the year.
- Another main objective is to increase the structural diversity of the area or restore and supplement any layers of vegetation that are sparse or missing altogether. Wildlife habitat supports the greatest number of species when all the vegetation layers are present. The canopy layer (tall, mature shade trees) is needed to support canopy-dwelling birds and mammals such as the Tufted Titmouse, Northern Cardinal, woodpeckers, nuthatches, and squirrels. The midstory layer (smaller ornamental trees such as Texas Redbud and Mexican Plum) is important for those animals that spend significant amounts of time in the midstory such as Mourning Doves and Indigo Buntings. This layer also provides protection when animals move vertically between the canopy and the ground. The understory (shrubs, grasses, etc.) is important because it provides food and shelter for ground-dwelling and ground-feeding animals such as Northern Flickers, Kentucky Warblers, roadrunners, rabbits, and other small mammals.
- Specific suggestions for vegetative layers include the following (A complete recommended species list is attached):

Short understory plants

Inland Seaoats (*Chasmathium latifolium*), Virginia Wildrye (*Elymus virginicus*), Sideoats Grama (*Bouteloua curtipendula*), Wild Columbine (*Aquilegia canadensis*), Butterfly Weed (*Asclepias tuberosa*), Winecup (*Callirhoe involucrata*), Purple Coneflower (*Echinacea purpurea*), Mealy Blue Sage (*Salvia farinacea*), Scarlet Sage (*Salvia coccinea*), Brown-Eyed Susan (*Rudbeckia hirta*).

Understory shrubs

Turk's Cap (*Malvaviscus arboreus* var. *drummondii*), Coralberry (*Symphoricarpos orbiculata*), American Beautyberry (*Callicarpa americana*), Texas Elbow-bush (*Forestiera pubescens*).

Small Trees

Mexican Plum (*Prunus mexicana*), Rusty Blackhaw Viburnum (*Viburnum rufidulum*), Redbud (*Cercis canadensis*), Aromatic Sumac (*Rhus aromatica*), Carolina Buckthorn (*Rhamnus caroliniana*), Red Buckeye (*Aesculus pavia*).

Vines

Passionflower (*Passiflora incarnata*)

- Open and sunny area should be enhanced by introducing many of our native bunch grasses and wildflowers. Wildlife species that are attracted to open, grassy areas are different than those attracted to wooded areas. Grassland plots can attract flycatchers and kingbirds.
- Recommended species for attracting Butterflies include many open and sunny area plants such as:
  Brown-Eyed Susan (*Rudbeckia hirta*), Butterfly Weed (*Asclepias tuberosa*), Purple Coneflower (*Echinacea purpurea*), Mealy Blue Sage (*Salvia farinacea*), Scarlet Sage (*Salvia coccinea*), Plains Coreopsis (*Coreopsis tinctoria*), Lemon Mint (*Monarda citriodora*), and Indian Blanket (*Gaillardia pulchella*).
- Snags are usually cut down and hauled off because they are considered useless. However, this is not the case. Snags are as valuable to wildlife as living trees. Snags are often hollow which provides homes for squirrels, raccoons, opossums, and even bats. Woodpeckers often excavate their homes in snags. Once the woodpeckers have excavated a cavity and moved on, other species such as chickadees, bluebirds, and the tufted titmouse will move in and continue to use the cavity for seasons to come. Leave dead trees in areas of limited public use for animal habitat, when appropriate.
- When limbs or trees fall to the ground, they are called “downed wood”. Downed wood is often removed because it too is considered useless. Once again, this is not the case. Downed wood provides homes for ground dwelling animals. Small mammals will use hollow logs to escape predators and inclement weather. Lizards, toads, and all types of invertebrates rely on the cool, moist microhabitat beneath the downed wood to survive. In addition to the wildlife benefits of downed wood, it also benefits the soil and surrounding vegetation. As the wood decays, nutrients locked inside are released into the soil and made available once again to the living vegetation. Removing the downed wood would remove a great source of nutrients critical to the continued health of the remaining vegetation.
- Brushpiles are similar to downed wood in their value to wildlife, except they serve slightly different clientele. Downed wood serves small mammals, reptiles, amphibians, and invertebrates. Brushpiles serve small mammals and reptiles to some extent, but they are especially valuable to songbirds. Songbirds will use the cover of brushpiles frequently while feeding. This is especially true in winter.
- Management plans should consider establishing habitat for any species of indigenous wildlife that is considered to be threatened or endangered currently or at any point in the future.
- It is important that management plans include protecting forest trees and plants as well as restoration project work sites from wildlife that may cause damage such as feral hogs, deer, beaver or others. Plans should fully address future threats to the ecological balance by the existence and or over population of damaging wildlife species. In some cases, managing populations of wildlife is preferred as opposed to eradication of a species.
- Leaf litter (the ground layer of fallen leaves) is much like downed wood in that it provides habitat for invertebrates and small lizards. The insects that are found in this layer are food for other animals and thus form much of the foundation of the food web. Skinks, for example, are specialized lizards that live their entire life cycle in the layer of leaves on the forest floor. They rummage beneath the leaves searching for the invertebrates that thrive there. Skinks, in turn, are food for roadrunners. Roadrunners could then be eaten by bobcats, and so on. In addition to its wildlife value, as leaf litter decays, it returns valuable nutrients to the soil. It also acts as a mulch which insulates the

soil keeping it cooler in the summer and warmer in the winter. Having a layer of leaf litter on the ground helps the soil hold moisture and shields it from the erosive effects of the rain and wind. Because of these benefits, we recommend that leaf litter be allowed to accumulate wherever possible.

- Encourage and plan for areas with thick, dense cover or "Edge Habitat".

Significant Trees:

- Consider a registry of significant trees listing G.P.S. coordinates, as well as other details, and consider adding the information to the Texas Tree Trails website (www.texastreetrails.org) to encourage ecotourism. Develop tree trail maps to significant trees that include GPS coordinates, similar to the Arboretum or Fort Worth Botanic Garden trails noted on the Texas Tree Trails website.

Recreation:

- Due to the fact that any recreational activity that occurs in the forest has the potential to affect the health of existing trees and forest stands, the Dallas Urban Forester and the Dallas Urban Forest Advisory Committee, should play a role in the planning of activities or development of any type that could affect trees.
- In general, the objective should be a balanced and inclusive approach to planning recreation related development and activities that include something for all possible interested parties. As a result, a plan for future activity and development must enjoy public support.
- Low impact trails and observation points should be a part of the future plans and any concrete required should be permeable to allow water absorption and reduce the heat island effect. Any concrete trails should be located on the exterior of the flood plain due to the potential for frequent flooding and high maintenance costs, if at all possible.
- It is important that management plans clearly state all future goals regarding the recreational use of the forest. Lower impact uses of the forest such as hike and bike trails, interpretive trails or birding trails are ideal due to the minimal impact on the existing ecosystems. River trails can be low impact if they do not involve the installation of a hard surface. However, access would need to be regulated as well as the type of traffic allowed on all trails. More active uses such as motorized vehicle trails or equestrian trails should be located outside the forested areas or important habitat areas as much as possible. These types of activities that are required within any important ecosystem should be carefully planned, executed, managed and policed, in an effort to minimize the impacts. There are areas that should have limited human intervention in order to conserve relatively undisturbed habitat or unique ecosystems.
- It is important that any development for recreation carefully consider the natural features of specific areas and every effort should be made to minimize the impacts of any development or activity on the natural features.

Public Safety:

- Consider public safety and security in the development of forest management and development plans. Security can become a concern due to the potential size of the park. Preventing crime could be a problem. Locating or rescuing an injured person may also become a concern.

- Note to the public that there is safety in numbers and going alone into the forest involves some inherent risk.

Hazard Trees:

- Consider public safety by encouraging the establishment of a hazard tree policy for areas open to the general public. Although this will require funds to remove hazardous trees, the potential liability to the public more than warrants the expense in planning future budgets.

Fire:

- Consider the potential for fire to affect the property and develop potential plans/methods of prevention, control, and management, including associated expenditures. Any plans should be developed in coordination with the Dallas Fire and Rescue Department.
- In order to suppress invasive plant species and encourage native plant regeneration, expert supervised and controlled burning could be considered.

Illegal Activities:

- All due consideration should be provided for any physical damage to trees, including the illicit removal of trees, plants, timber or important components of any existing ecosystem. Any planning should address the current problem with illegal dumping. Prevention is one part of the equation but clean up costs should also be calculated and considered as a part of the management plan.

Invasives:

- Consider establishing a sound management plan to fight invasive plants and sometimes non-native plants due to the potential to suppress beneficial plant species and alter wildlife habitat. The list of invasive plants may change over time but must include Chinese Privet (*Ligustrum sinense*), Japanese Ligustrum (*Ligustrum japonicum*) and Chinese Tallow (*Sapium sebiferum*).
- Ragweed, Johnsongrass, Bamboo, and Poison Ivy are also undesirable species for one reason or another. Ragweed is a native annual species that is to blame for the seasonal allergies that many of us have. Its presence is indicative of some type of disturbance to the soil. Anywhere the soil is plowed, scraped, or tilled, will soon become home to ragweed. Although ragweed is beneficial to wildlife (doves, northern Cardinals, Red Wing Blackbirds, finches, sparrows, etc. feed on the seeds), we recommend controlling it because of its affects on humans when it is possible. Because of its annual habits, ragweed can be knocked back by selectively cutting it in late August before it has a chance to flower and set seed. Cutting it sooner will allow it time to recover. Doing this for several seasons should significantly reduce the population (provided no future areas are disturbed). The judicious use of herbicide should only be considered as a last resort and many factors should be carefully considered.
- Poison ivy is also a native species that is valuable to wildlife (chickadees, Northern Mockingbirds, thrushes, woodpeckers, etc. feed on the seeds). However, we recommend keeping it cut away from any trail because of its affect on some people. The ideal method of control is cutting it back to the ground and digging out the roots. Due to the

value to wildlife, the objective should be to manage poison ivy as opposed to the complete eradication of it.

- Any bamboo that is found on city property has little value to wildlife other than providing dense cover, plus it is an exotic plant. We recommend controlling or removing bamboo by cutting back the top growth and physical removal of the root system, where it is practical and not damaging to nearby trees. Chemical control has not been effective and management of the problem can be an ongoing effort.
- Johnsongrass is an exotic grass that was originally introduced in the U.S. from Africa as a pasture grass. It has since become a tremendous problem for those of us who prefer our native grasses. Johnsongrass will eventually take over an area and out-compete the natives. Although we prefer not to use herbicides, we have no cost effective method as an alternative. As a result selective use of glyphosphate (Roundup) may be required as a control measure. However, Roundup and other herbicides will also kill desirable plants; therefore, we recommend that herbicides be used carefully and as a last resort.

Financial:

- It is very important that the city provide adequate funding that is commensurate with the task of managing the largest urban hardwood forest in America. Any and all outside sources of potential funding should be pursued. Consider offering the ability to "adopt" a particular feature such as a stand of trees, a campground or others in lieu of a substantial donation that provides for the future care and maintenance of the feature or the forest as a whole. A management plan for the forest without a substantial financial commitment from the city is of little use.
- Calculate a financial analysis and annual budget for each action proposed in the plan, along with a detailed annual time line.
- It is important that future budgets take into consideration potential inflation and changes regarding labor/material costs.
- Consider listing options for funding future management objectives, including the establishment of an endowment. Without a significant financial commitment from the public and the city, the benefits of the plan will be compromised.
- Establish a substantial budget specifically for a marketing campaign which promotes the forest as an international habitat center. Without exposing the public to the significant opportunities and resources that exist in the forest, public acceptance and support for future initiatives will be difficult. Public ownership of the forest will be required to advance many future goals and objectives.

Respectfully submitted on behalf of the City of Dallas Urban Forest Advisory Committee,

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Appendix F

Dallas Urban Forest Advisory Committee Great Trinity Forest Recommended Plant Species

Dallas Urban Forest Advisory Committee

Great Trinity Forest

Recommended Species List

All of the species below will require a source for seeds, saplings or small container grown or field grown plants. Preference should be given to a local source for the plant materials and seeds; however, expansion of the plant resources may include the greater southwest area, if required. Some of the species are listed as a reference for use in public areas and some may not be suitable for use in a forested area. A number of the species listed are not considered to be native but all of them have the potential to become viable species given the right conditions. Due to the limited number of species that currently exist in the Trinity forest, many of the following are recommended in an effort to diversify the composition of species in the forest. A more diverse forest will attract a more diverse group of wildlife and will be more sustainable than a forest with a limited number of plant and tree species.

Shade Trees:

- ✓ Pecan, *Carya illinoensis*
- ✓ Ginkgo, *Ginkgo biloba*
- ✓ Live Oak, *Quercus virginiana*, *Quercus fusiformis*
- ✓ Bur Oak, *Quercus macrocarpa*
- ✓ Chinquapin Oak, *Quercus muhlenbergii*
- ✓ American Elm, *Ulmus americana*
- ✓ Cedar Elm, *Ulmus crassifolia*
- ✓ White Ash, *Fraxinus americana*
- ✓ Texas Ash, *Fraxinus texensis*
- ✓ Bald Cypress, *Taxodium distichum*
- ✓ Arizona Cypress, *Cupressus arizonica*
- ✓ Eastern Red Cedar, *Juniperus virginiana*
- ✓ Black Jack Oak, *Quercus marilandica*
- ✓ Shumard Red Oak, *Quercus shumardii*
- ✓ Post Oak, *Quercus stellata*
- ✓ Osage Orange, *Maclura pomifera*
- ✓ Red Mulberry, *Morus rubra*
- ✓ Gum Bumelia, *Bumelia lanuginosa*
- ✓ Eastern Persimmon, *Diospyros virginiana*
- ✓ Thornless Honey Locust, *Gleditsia triacanthos* var. *inermis*
- ✓ Eve's Necklace, *Sophora affinis*
- ✓ Black Walnut, *Juglans nigra*
- ✓ Texas Walnut, *Juglans microcarpa*

- ✓ Western Soapberry, *Sapindus drummondii*
- ✓ Bigtooth Maple, *Acer grandidentatum*
- ✓ Caddo Maple, variant of *Acer saccharum* Marsh, from trees native to SW Oklahoma

Ornamental Trees:

- ✓ Desert Willow, *Chilopsis linearis*
- ✓ Red Buckeye, *Aesculus pavia*
- ✓ Texas Pistache, *Pistacia texana*
- ✓ Eastern Redbud, *Cercis canadensis*
- ✓ Texas Redbud, *Cercis canadensis* var. *texensis*
- ✓ Saucer Magnolia, *Magnolia soulangeana*
- ✓ Smooth Sumac, *Rhus glabra*
- ✓ Prairie Flameleaf Sumac, *Rhus lanceolata*
- ✓ Common Prickly Ash (Hercules Club), *Zanthoxylum clava-herculis*
- ✓ Texas Mountain Laurel, *Sophora secundiflora*
- ✓ Carolina Cherry Laurel, *Prunus caroliniana*
- ✓ Mexican Plum, *Prunus mexicana*
- ✓ Rusty Blackhaw Viburnum, *Viburnum rufidulum*
- ✓ Havard Shin Oak, *Quercus havardii*
- ✓ White Shin Oak, *Quercus sinuata* var. *breviloba*
- ✓ Durand Oak, *Quercus durandii*
- ✓ Lacy Oak, *Quercus laceyi*
- ✓ Vasey Oak, *Quercus pungens*, var. *vaseyana*
- ✓ Texas Hawthorne, *Crataegus texana*
- ✓ Wild Goose Plum, *Prunus munsoniana*
- ✓ Possumhaw Holly, *Ilex decidua*
- ✓ Carolina Buckthorn, *Rhamnus caroliniana*
- ✓ Texas Persimmon, *Diosypros texana*
- ✓ Catclaw Acacia, *Acacia wrightii*
- ✓ Golden Ball Lead Tree, *Leucaena retusa*
- ✓ Mexican Buckeye, *Ungnadia speciosa*
- ✓ Texas Buckeye, *Aesculus arguta*
- ✓ Reverchon Hawthorne, *Crataegus reverchonii*
- ✓ Green Hawthorne, *Crataegus spp*.

Shrubs and Forbs:

- ✓ American Beautyberry, *Callicarpa americana*
- ✓ Illinois Bundleflower, *Desmanthus illinoensis*
- ✓ American Elderberry, *Sambucus canadensis*
- ✓ Partridge Pea, *Casia fasciculata*
- ✓ Obedient Plant, *Physostegia intermedia*
- ✓ Pink Evening Primrose, *Oenothera speciosa*
- ✓ Clasping Coneflower, *Dracopis amplexicaulis*
- ✓ Common Sunflower, *Helianthus annuus*
- ✓ Scarlet Sage, *Salvia coccinea*
- ✓ Wood violet, *Viola missouriensis*
- ✓ Spiderwort, *Tradescantia occidentalis*
- ✓ Buttonbush, *Cephalanthus occidentalis*
- ✓ Texas Elbow-bush, *Forestiera pubescens*

- ✓ Cardinal flower, *Lobelia cardinalis*
- ✓ Winecup, *Callirhoe involucrata*
- ✓ Turk's Cap, *Malvaviscus drummondii*
- ✓ White Boneset, *Eupatorium serotinum*
- ✓ Texas Gold Columbine, *Aquilegia hinklei*
- ✓ Wild Columbine, *Aquilegia canadensis*
- ✓ Passionflower vine, *Passiflora incarnata*
- ✓ Coral Honeysuckle (climbing vine), *Lonicera sempervirens*
- ✓ Frostweed, *Verbesina virginica*
- ✓ Pigeonberry, *Rivina humilis*
- ✓ Frogfruit , *Lippia nodiflora*
- ✓ Purple Coneflower, *Echinacea purpurea* (well drained soil)
- ✓ Cutleaf Daisy, *Engelmannia pinnatifida*
- ✓ Brown-eyed Susan, *Rudbeckia hirta*
- ✓ Texas Bluebells, *Eustoma grandiflora*
- ✓ Coralberry, *Symphoricarpos orbiculatus*
- ✓ False Indigo, *Amorpha fruticose*
- ✓ Wood Ferns, *Dryopteris spp*.
- ✓ Trout Lily, *Erythronium albidum*
- ✓ Plains Coreopsis, *Coreopsis tinctoria*
- ✓ Dwarf Palmetto, *Sabal minor*
- ✓ Wild Petunia, *Ruellia nudiflora*
- ✓ Rain-lily, *Cooperia drummondii*
- ✓ Horseherb, *Calyptocarpus vialis*
- ✓ White honeysuckle, *Lonicera albiflora*

Grasses:

- ✓ Eastern Gamagrass, *Tripsacum dactyliodes,* blackland eco-type
- ✓ Texas Cupgrass, *Eriochloa sericea*
- ✓ Upland Switchgrass, *Panicum virgatum*
- ✓ Switchgrass, *Panicum virgatum*
- ✓ Sideoats grama, *Bouteloua curtipendula*
- ✓ Texas Wintergrass, *Nassella leucotricha*
- ✓ Inland Sea Oats, *Chasmanthium latifolium*
- ✓ Little Bluestem, *Schizachyrium scoparium*
- ✓ Prairie Wildrye, *Elymus canadensis*
- ✓ Sand Lovegrass, *Eragrostis trichodes*
- ✓ Indiangrass or Waco Indiangrass, *Sorghastrum nutans*
- ✓ Big Bluestem, *Andropogon gerardii*
- ✓ Green Sprangletop, *Leptochloa dubia*
- ✓ Lindheimer's Muhly, *Muhlenbergia lindheimeri*

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