7. Appendices

Appendix 7.1. Methods used for assessments

7.1.1. Assessing changes in overall canopy levels within the City from 1952 to 2003.

Phytosphere used 1998 aerial photographs supplied by the City of Rocklin to delimit the approximate boundaries of the developed portions of the City. These boundaries were digitized in a geographic information system (GIS) covering Rocklin. The delimited area covered about 13 square miles, or approximately two-thirds of the current City area. Phytosphere also contacted the County of Placer to find historical aerial photo coverage of the Rocklin area. Information provided by George Nunes of the Placer County Public Works Department and an image of the index sheet located in the U.C. Davis Library were used to add the approximate boundaries of the available historical aerial images to the GIS. Stratified random sampling was used to identify sample points that were within the delimited developed area and for which historical aerial coverage was available.

Sample points were located on prints of the historical (1952) aerial photographs at the Placer County offices in January 2004 by Phytosphere. The area around each sample point was photographed at a fixed magnification using a 4 megapixel digital camera. Digital images of these sample areas were subsequently matched to the degree possible with the most recent (August 2003) aerial images provided by the City of Rocklin. Once both digital images were aligned and adjusted to the same magnification, a grid was superimposed over both images that served as the actual sample plot. If necessary, the grid was shifted to ensure than adjacent sample areas did not overlap. Because the 1952 aerial photos were not orthocorrected (i.e., they were not corrected to show a direct overhead perspective), the sample plots (Figure 3.1-4) vary slightly in area and shape.

Phytosphere assessed whether canopy cover was present or absent at each of a minimum of 575 dots randomly superimposed over the sample area on the image. Land uses (% developed, % residential, % commercial/industrial) within each sample area were visually estimated with the aid of a superimposed grid. Canopy measurements were made on 23 sample plots. The size of the sample plots averaged 159 acres (about 0.25 square mile). A total of 3,364 acres (5.26 square miles) were sampled for both photo dates, using a minimum of 13,800 individual dots for each year counted.

7.1.2. Oak woodland evaluation methods

In consultation with City staff, Phytosphere identified 11 locations with oak woodlands to be included in the evaluation. All areas were either currently owned by the City of Rocklin, or in the case of the Greenbrae Road site, was to be transferred to the City as a condition of project approval (Table 3.2-1, Figure 3.2-1). At the China Garden Rd. site, only the south portion of the parcel was surveyed; this is beyond the area being considered for development.

Stratified random sampling was used to establish the position of permanent survey plots in these woodlands. Using May 1993 aerial imagery, wooded areas within the designated City-owned parcels were located. Wooded areas were subdivided into subunits no larger than about 6 acres. Random coordinates from within each subunit were generated and uploaded to

a GPS receiver that was used to locate the coordinates in the field. The coordinates were used to establish the center of each survey plot. Survey plots were 52.5 feet (16 m) radius circular plots (0.2 acres) for most open woodlands, but in dense riparian woodlands, the plot radius was reduced to 26.25 feet (8 m) (area=0.05 acres). Data in survey plots was collected in August 2003, using the attached datasheet. Plot coordinates are given in Table 7-1 below.

Two to three trees closest to the plot center were tagged with 1 inch diameter round aluminum tree tags secured with aluminum nails. Tags face the plot center and are placed at a height of about 6 to 8 feet to reduce vandalism. Phytosphere's tag numbers range from 784 to 842. In many of the locations other types of aluminum tags are present on some trees due to previous tree surveys.

Data were collected on both tagged trees and non-tagged trees within the plots. Data on other plot characteristics were also recorded, as shown in the attached datasheet. In addition to data collected within plots, additional observations were made on the overall composition and condition of the woodlands within each surveyed location.

Table 7.1-1. Coordinates of oak survey plots.

Plot	Latitude	Longitude	Location
1	38.78930167	-121.24708833	Johnson-Springview Pk
2	38.79136071	-121.24660707	Johnson-Springview Pk
3	38.79280860	-121.24680472	Johnson-Springview Pk
4	38.79442940	-121.24895727	Johnson-Springview Pk
5	38.79130019	-121.24945734	Johnson-Springview Pk
6	38.78792538	-121.23558621	City Hall area
7	38.79528210	-121.22383830	Sierra Meadows Park
8	38.78225662	-121.25259569	Sunset East Pk
9	38.78553500	-121.25251500	Sunset East Pk
10	38.78142379	-121.25303951	Sunset East Pk
11	38.78844221	-121.25101226	Antelope Creek Pk
12	38.77968295	-121.22753288	Greenbrae Rd
13	38.77806818	-121.22781375	Greenbrae Rd
14	38.77562251	-121.23709780	China Garden Rd
15	38.77489538	-121.23972310	China Garden Rd
16	38.80418024	-121.26555797	Pebble Creek Pk
17	38.80526167	-121.26940073	Pebble Creek Pk Park Rd
18	38.80635199	-121.26604496	Pebble Creek Pk Park Rd
19	38.80676170	-121.26455340	Pebble Creek Pk Park Rd
20	38.83304165	-121.24919968	Pebble Beach Dr
21	38.83714677	-121.24574566	Pleasant Grove Creek

Oak woodland datasheets, definitions, and protocols

The following three pages show copies of the datasheets and the data definitions and protocols used in the oak woodlands evaluations.

Oak Woodland Datasheet: Date: Location:

Plot number	UTM X	UTM Y	waypt
To / From		dist m	azm °
Plot slope %	plot aspect °	stumps	
Plot canopy cover 0-6:	Shrub cover 0-6:	herb cover 0-6:	Bare 0-6:
10 yr gap - yes no	in stand / stand edge	road/ trail / fence /	in plot /within m
disturbance/mgmt			

TAGGED TREES

Tag number:			
species	Qd Qw QL Ac Ps	Qd Qw QL Ac Ps	Qd Qw QL Ac Ps
Origin / Number of stems	seed / sprout	seed / sprout	seed / sprout
Distance to plot center	m	m	m
Azimuth tree to plot center	□ from center °	□ from center °	□ from center °
DBH stems>3cm			
Decline	yes no	yes no	yes no
sky exposed canopy %: 0-6			
thinning: 0-2			
epicormics 0-2			
canopy dieback: 0-6			
decay impact: 0-3			
canker rot (CR) / fungi			

☐☞**Circle sp. name if in overstory** PLOT TREES OTHER THAN TAGGED TREES

Coding: count/ status/m if mult stems(if >1)/ u if understory: decline 3 stem = Cm; live 1 stem understory = Lu

Live deCline - Xdead	3-10 cm	10-30 cm	30-60 cm	>60 cm	adv reg1 s0	regen s1&2	sapl regen s3
Q douglasii							
Q lobata							
Q wislizeni							
P sabiniana							
Buckeye							

UNDERSTORY SPP

Poison oak	Honeysuckle	Toyon	Coffeeberry	Wild rose
Rhamnus ilicifolia	Ceanothus cuneatus	Manzanita		Rubus
Yellow Starthistle				
Nassella				

browse impact 0-3	Inonotus / Phellinus / Ganoderma / Laetiporus / canker rot / root disease/ rodents /deer /cattle
photos	

0-6 SCALE
0: not seen
1:< 2.5%
2: 2.5 <20%
3: 20 < 50%
4: 50 < 80%
5: 80 < 97.5%
6: > 97.5%

0-2 SCALE
0 - trace or not seen
1 - slight / few
2 - definite / many

0-3 Decay Impact Scale
0- no impact
1-low impact
2- moderate impact
3 high impact

Understory = sky exp ≤ 2
regen count to 10, then to nearest 10
s0: <1 cm basal
s1-2: >1 cm basal, up to 1 cm dbh
s3: 1-3 cm dbh

Oak Woodland Datasheet (page 2 of 2)
Plot number Date: Woodland type_____

Other species in vicinity

Dominant	Common	Uncommon

Human use: low moderate heavy
access -
use types/impacts:

Management issues:
exotics

human use

regeneration

other

Oak Woodland Datasheet definitions and protocols

DBH – diameter at 4.5 feet (137 cm) above grade, measured at center ground elevation for trees on slopes

Oak regeneration size classes:
S0 – less than 1 cm basal diameter
S1-2 – at least 1 cm basal diameter, less than 1 cm DBH
S3 – 1 to 3 cm DBH
Saplings with at least 1 stem 3 cm DBH or larger are counted in tree size classes

Multistem: 2 or more stems originate at or within 30 cm of soil surface; two stems may be appressed to a height greater than 30 cm, but if origin is clearly below this level, they are scored as multiple stems

Multistem non-tally trees - count multistemmed tree as one tree; overstory if any stem in overstory. Count stems separated by 1 m or more as separate trees even if they have originated from the same ancestral stump.

Decline: Trees in severe decline, i.e., overall tree condition is poor enough that tree death within 10 years is likely.

Dead: Dead trees are scored only if they appear to have died within the past 10 years. Trees with entirely dead top but with live basal sprouts are rated as dead.

Sky exposed canopy: percent of tree canopy projection that is exposed to overhead light, i.e., percent that would be visible in an overhead aerial photo.

Overstory/understory designation: Overstory- trees with intermediate to dominant canopy position (overhead sun) = sky exposed canopy of 2 - 6; understory if overtopped = sky exposed canopy of 0 or 1 (<2.5%)

Shrub species are classified under shrubs even if greater than 3 cm in DBH

7.1.3. Methods for assessing City park trees

Based on discussions with Parks Division of the Department of Community Services and Facilities staff (Don Jorgenson, Shawn Darling), Phytosphere included details that focused on long- and short-term management issues associated with tree care in the City park tree survey. Because surveying was more intensive and time consuming than the other urban tree assessments conducted in this project, the number of parks sampled was limited.

Stratified random sampling was used to select eight parks for the survey that were distributed throughout the City and represented a range of ages since construction. Phytosphere surveyed the developed portions of the selected parks, not including adjoining oak woodland areas or oaks in riparian corridors. A GPS receiver was used to delineate the surveyed portions of each park. Only the southwestern portion of Twin Oaks Park was included in the survey for that location. The surveyed area of Twin Oaks Park included an open turf area and a playground.

Data collected on trees in the sampled areas included:

Species or species group Tree species was noted for the most common and conspicuous species. Less common species were identified only to genus (e.g., pines, maples) or in general groups (e.g., miscellaneous hardwoods).

Condition class: Trees were placed into one of three condition classes.

Healthy - Trees in fair or better condition

Decline - Trees in poor condition; generally such trees are not likely to show significant growth or survive more than 10 years

Dead - Dead trees.

Age class: Age class was rated as the percent of the final canopy size that the tree is likely to achieve at maturity at the site, which may be less than the reported maximum size. For example, though coast redwood can grow to great size in its native range, the maximum size that these trees typically reach in the Sacramento Valley is much more modest. This provides an estimate of how much additional canopy cover the trees are likely to provide as they mature. The age classes used were:

(1) Less than 25% of size at maturity

(2) 25 to less than 75% of size at maturity

(3) 75% or more of size at maturity

Empty planting spaces. Stumps of removed trees or obvious blank areas in planting beds were counted as empty planting spaces. Surveyors did not attempt to estimate how many additional trees could be added to the sites.

Management concerns: The most obvious short and long-term tree management concerns that applied to the rated trees were noted as shown in Table 7.1-2. These ratings are based on only a quick evaluation, and may not include all maintenance and management items. The concerns were coded by species. For analysis, categories A and C were combined.

Table 7.1-2. Management concern categories rated for trees in the assessment of City park trees.

Category	Type	Notes
A	Structure / Pruning	Tree structure is poor and/or pruning is needed to improve structure or remove dead wood.
B	Current or potential hazard (with target)	Tree or part likely to fail in the future due to current or projected conditions and could damage property or cause injury.
C	Clearance	Trees needing pruning for clearance
D	Tree placement / excessive density	Poor tree placement (e.g., under existing mature canopy) and/or excessive tree density
E	Diseases / pests	Includes canker rot and other decay fungi in oaks, other problems including sunburn and borer invasion in other species
F	Rootzone problems (conserved trees primarily)	Past or current fill, grading, compaction, paving, and/or irrigation of an existing tree's rootzone having an adverse effect on tree health and survival
G	Excessive surface roots	Surface roots are were numerous enough and large enough to be damaged by mowers or otherwise subject to injury and/or constitute a tripping hazard
H	Mechanical damage	Most commonly damage to lower trunk from mowers

7.1.4. Methods for assessing City-maintained trees along streets and parkways

Stratified random sampling was used to establish the location of survey plots along streets for which the City currently maintains shoulder and/or median tree plantings. Ron Patten of Public Works provided Phytosphere with a map showing street segments that included City-maintained trees. Sampling points within the City were selected by first superimposing random geographic coordinates on the map and then finding the intersection of City-maintained streets that was closest to each random point. These intersections were used as the starting points of survey plots. Each plot proceeded along the selected street in a randomly-selected direction from the starting point for a distance of about 0.15 mile (250 m). GPS readings were taken at both endpoints of the street segment to estimate the total distance of each surveyed street section.

Only City-maintained trees along the street segment were included in this survey. These included both median and shoulder plantings where applicable.

Data collected on trees in the sampled areas included:

Species or species group: Tree species was noted for the most common and conspicuous species. Less common species were identified only to genus (e.g., pines, maples) or in general groups (e.g., miscellaneous hardwoods).

Condition class: Trees were placed into one of three condition classes.

Healthy - Trees in fair or better condition

Decline - Trees in poor condition; generally such trees are not likely to show significant growth or survive more than 10 years

Dead - Dead trees.

Age class: Age class was rated as the percent of the final canopy size that the tree is likely to achieve at maturity at the site, which may be less than the reported maximum size. For example, though coast redwood can grow to great size in its native range, the maximum

size that these trees typically reach in the Sacramento Valley is much more modest. This provides an estimate of how much additional canopy cover the trees are likely to provide as they mature. The age classes used were

(1) Less than 25% of size at maturity

(2) 25 to less than 75% of size at maturity

(3) 75% or more of size at maturity

Empty planting spaces: The count of empty planting spaces was based on gaps in the regular planting patterns and the presence of stumps from removed trees.

7.1.5. Methods for assessing privately maintained trees along residential streets

Phytosphere used stratified random sampling to establish the location of survey plots in single-family residential neighborhoods throughout the City. First, random geographic coordinates were generated for locations within the City. If these coordinates fell within residential neighborhoods, a 0.1 mile long sample plot was established along the street section. At the site, one end of the sample area was identified from a map showing the starting coordinates and a car odometer was used to establish the other end about 0.1 mile away. GPS readings were taken at both endpoints of the street segment to provide an estimate the total distance of each surveyed street segment.

Data were collected from both sides of the sampled street segments by an evaluator walking along the segment. Data were recorded for all trees in front yards in the segment. In areas where the side of the lot was along the street, back or side yard trees were included in the survey if they were within the average front yard setback distance.

Data collected on trees in the sampled areas included:

Species or species group: Tree species was noted for the most common and conspicuous species. Less common species were identified only to genus (e.g., pines, maples) or in general groups (e.g., miscellaneous hardwoods).

Condition class: Trees were placed into one of three condition classes.

Healthy - Trees in fair or better condition

Decline - Trees in poor condition; generally such trees are not likely to show significant growth or survive more than 10 years

Dead - Dead trees.

Age class: Age class was rated as the percent of the final canopy size that the tree is likely to achieve at maturity at the site, which may be less than the reported maximum size. For example, though coast redwood can grow to great size in its native range, the maximum size that these trees typically reach in the Sacramento Valley is much more modest. This provides an estimate of how much additional canopy cover the trees are likely to provide as they mature. The age classes used were:

(1) Less than 25% of size at maturity

(2) 25 to less than 75% of size at maturity

(3) 75% or more of size at maturity

Canopy at edge of pavement: Midday shading of streets requires that tree canopies extend over the pavement. Evaluators noted, by species, the number of trees whose canopies (1) currently extended past the edge of pavement (beyond the street edge of the curb) or (2)

could extend beyond the edge of pavement at maturity. Evaluators also estimated the overall level (percent) of canopy cover at the edge of pavement for the entire surveyed street section.

Empty planting spaces: For residential lots, empty planting spaces were designated by conservatively estimating that each front yard (or equivalent length of street frontage for other yards along streets) would support one tree. In actuality, many sites not rated as empty could support additional tree plantings.

7.1.6. Methods for assessing trees in commercial parking lots

Simple random sampling was used to select parking lots to be surveyed. Sampled parking lots were those in the commercially zoned parcel closest to each of 10 random geographic coordinates within the City. The sample included large parking lots associated with large retail centers, business professional complexes, a small stand-alone lot for a bank, and a hotel/restaurant site. Portions of 10 commercial parking lots were included in the sample.

Within parking lots, a random number table was used to select rows of parking spaces for sampling. For double rows of parking spaces, both sides of the row were surveyed. The line of each selected row was projected to the end of the parking lot (street or buildings) so that parking spaces in rows oriented at right angles to the main rows would be represented in the sample. Hence, trees included in the survey included those located in parking lot islands as well as those in beds on the edges of the lot along streets or near buildings.

A minimum of three rows or 80 parking spaces was surveyed in each selected parking lot. For the one small lot included in the sample (lot 2), the entire parking lot was surveyed. GPS readings were taken at the endpoints of surveyed rows.

Data collected on trees in the sampled areas included:

Species or species group: Tree species was noted for the most common and conspicuous species. Less common species were identified only to genus (e.g., pines, maples) or in general groups (e.g., miscellaneous hardwoods).

Condition class: Trees were placed into one of three condition classes.

Healthy - Trees in fair or better condition

Decline - Trees in poor condition; generally such trees are not likely to show significant growth or survive more than 10 years

Dead - Dead trees.

Age class: Age class was rated as the percent of the final canopy size that the tree is likely to achieve at maturity at the site, which may be less than the reported maximum size. For example, though coast redwood can grow to great size in its native range, the maximum size that these trees typically reach in the Sacramento Valley is much more modest. This provides an estimate of how much additional canopy cover the trees are likely to provide as they mature. The age classes used were:

(1) Less than 25% of size at maturity

(2) 25 to less than 75% of size at maturity

(3) 75% or more of size at maturity

Pavement shading: By species, evaluators counted the number of trees that were currently providing some direct overhead (midday) shading of pavement, i.e., the canopy extended beyond the planter bed over pavement. Evaluators also noted whether tree canopy would extend over parking lot pavement when the tree reached mature size.

Empty planting spaces: Treeless planters were considered to have an empty planting space if they were large enough to hold a tree that could shade pavement. Generally these were sites that clearly contained trees in the past, but in some cases, the original design might have only included shrubs or other landscaping.

Parking spaces with shade. Within the sampled portion of each parking lot, evaluators counted the number of parking spaces and placed them into categories based on the amount of direct overhead tree canopy cover. The categories used were:

(1) 1 to 25% shade canopy cover

(2) 25 to less than 50% shade canopy cover

(3) 50% or more shade canopy cover

In general, a parking space with at least 50% canopy cover would be considered reasonably well shaded. Spaces with 25 to 50% shade would be considered marginally shaded, and lower levels of shading would generally be inadequate.

Although the shade evaluations provided a rapid means for assessing relative shading, they do not account for shade provided by trees when the sun is at lower angles, such as in the late afternoon. This effect is most pronounced for tall trees.

Appendix 7.2. Past and current maintenance practices for City of Rocklin public trees

City of Rocklin Public Works and Parks Division of the Department of Community Services and Facilities staff provided the following summaries of historical and current maintenance practices for public trees along streets and parkways and in developed parks.

Streetscape Tree Maintenance Practices

Prepared by Michael Rock, Public Works Operations Manager and Ron Patten, Public Works Landscape Maintenance Supervisor. Dated June 24, 2004.

Following is a brief chronological narrative of the past and present maintenance practices for the City of Rocklin's streetscape trees. The information was obtained from employees who have worked for the Public Works Landscape Maintenance Division from 1991 to 2004.

Soil Conditions

Soils within the Rocklin area are generally of poor quality; no areas have been identified as having prime soils.

- Prominent soil conditions
    1. Granite
    2. Decomposed granite
    3. Lava cap
    4. Lava cap mixed with cobble
    5. Hardpan/Clay

Tree Care Practices: Past

1991-1994: During this period the City was developing its maintenance standards and had just begun some basic training for staff on tree maintenance.

- Tree Replacement: None
    1. Filled tree well with soil
- Pruning: Respond to complaints only
    1. No pruning standards were in place at this time
    2. Trimmed over sidewalks
    3. Removed downed branches
- Equipment:
    1. Manual pruning pole saws
    2. Lopping shears
    3. 1 small 12" chain saw
    4. Any available truck
- Fertilizer: None
- Insecticide: None
- Irrigation: Overhead spray

1995-1998: During this period the City began specialized training for staff in tree care and irrigation maintenance.

- Tree Replacement: Occasional/sporadic
    1. Replaced a few dead trees with 5 gallon size trees
    2. Transplanted volunteer trees from Stanford Ranch area to the redevelopment area
    3. Staked downed trees back in place
- Pruning:
    1. Pruning standards were starting to be used, in house training only
    2. Responded to complaints
    3. Trimmed over sidewalks
    4. Removed downed branches
    5. Removed dangerous limbs
    6. Started a Fall/Winter "Pruning Program"
- Equipment:
    1. Manual pruning pole saws
    2. Lopping shears
    3. Chain saws
    4. Any available truck
- Fertilize:
    1. Fertilizer tablets were dug into the soil at the base of some trees.
- Insecticide:
    1. Merit (liquid pesticide) was injected into the soil at the base of Crape Myrtle trees to control aphids.
- Irrigation: Over head spray

Tree Care Practices: Present

1999-2004: During this period the City continues to refine its training for staff and has sent some staff to specialized training in irrigation technology and practical pruning for arborists.

- A Tree Replacement Program is now in place:
    1. Trees are replaced as a result of automobile accidents, and storm/wind damage.
    2. Replacement costs, due to auto accidents, are recovered by insurance.
    3. Accident related replacement of trees is contracted out.
    4. Accident related trees are replaced with large 24" box trees.
    5. Trees lost in previous years are being routinely replaced.
    6. A list of replacement trees is kept for the year; trees are then replaced in the fall.
- Pruning:
    1. Regular fall/winter, and early spring pruning is done by the City of Rocklin Landscape Maintenance Staff, and by landscape maintenance contractors under contract with the City of Rocklin.
    2. Landscape Maintenance Staff are trained to prune to the International Society of Arboriculture pruning standards. Training is received at the University of California Davis. Contractors are required to meet this same standard.
    3. Respond to resident complaints
    4. Trim over sidewalks to 8 feet
    5. Trim over streets to 14 feet

6. Remove downed branches
7. Remove dangerous limbs
8. Remove public and private tree limb's that obscure traffic signals
9. Remove problem or undesirable trees

- Equipment:
  1. Pneumatic pruning shears
  2. Extended power pole chain saws
  3. A variety of chain saw size selections 12" to 24"
  4. Chipper
  5. Urban Forest truck for chipped material. Vehicle is outfitted with a hydraulic system for pneumatic pruning tools.
- Fertilizer:
  1. Fertilizer is generally a 15-15-15 slow release product
  2. Groups of trees are chosen each season, on a rotating base, to be fertilized in the fall when the rain starts, and again in the spring before the rain stops.
- Insecticide:
  1. Imicide (liquid pesticide is injected into targeted trees). There are immediate results controlling scale, aphids, and white flies.
  2. The injections are done on an as needed basis, and on every second tree, so as not to kill off desirable insects.
- Irrigation:
  1. Existing irrigation is being changed from overhead spray to a Netafim drip line grid at the base of each tree.
  2. New irrigation installed by developers is required to be Netafim subterranean drip for shrubs and groundcover, and bubbler heads at trees.

Many of the "Urban Forest" problems that the City of Rocklin is experiencing today are the result of past practices that are no longer part of the City's maintenance program. Trees that are planted within the City's right-of-way by developers, contractors, and the City are now inspected for problems that started in the nursery. The trees are either accepted, or rejected due to obvious defects. The trees are now properly pruned to International Society of Arboriculture pruning standards, fertilized, and irrigated. These current practices will show the rewards in the long term, with a more vigorous and healthier "Urban Forest".

Parks Tree Maintenance Practices

Prepared by Shawn Darling, Parks Maintenance Supervisor. Dated October 25, 2004.

Following is a brief chronological narrative of the past and present maintenance practices for the City of Rocklin's park trees. The information was obtained from employees who have worked for the Parks Division of the Department of Community Services and Facilities from 1989 to 2004.

Soil Conditions

Soils within the Rocklin area are generally of poor quality; no areas have been identified as having prime soils.

- Prominent soil conditions

1. Granite
2. Decomposed granite
3. Lava cap
4. Lava cap mixed with cobble
5. Hardpan/Clay

Tree Care Practices: Past

1989-1994: During this period the Park Division was developing its maintenance standards and had just begun some basic training for staff on tree maintenance.

- Tree Replacement: Dead trees were replaced unless location was poor or the tree was undesirable.
- Pruning: Basic tree pruning practices varied based on skills of staff.
    1. Trimmed for safety
    2. Trimmed over sidewalks
    3. Removed downed branches
    4. Trimmed to allow for mowing equipment to pass under trees.
- Equipment:
    1. Manual pruning pole saws
    2. Lopping shears
    3. 1 small 12" chain saw
    4. Any available truck
- Fertilizer: Trees in turf area received fertilization only.
- Insecticide: None
- Irrigation: Overhead spray

1995-1998: During this period the Park Division began specialized training for staff in tree care and irrigation maintenance.

- Tree Replacement: Continual
    1. Replaced dead trees unless the location was in a poor drainage area or the tree was undesirable.
    2. Staked trees to maintain upright position.
- Pruning:
    1. Pruning standards were starting to be used, in house training only
    2. Responded to complaints
    3. Trimmed over sidewalks
    4. Removed downed branches
    5. Removed dangerous limbs
    6. Started a Fall/Winter "Pruning Program"
- Equipment:
    1. Manual pruning pole saws
    2. Lopping shears
    3. Chain saws
    4. Any available truck
- Fertilize:

1. Fertilizer tablets were installed to some existing trees that appeared to be lacking in nutrition. All newly planted trees received fertilizer tabs.

- Insecticide: None
- Irrigation: Over head spray

Tree Care Practices: Present

1999-2004: During this period the City continues to refine its training for staff and has sent some staff to specialized training in irrigation technology and practical pruning for arborists.

- Tree Replacement: Continual
  1. Replaced dead trees unless the location was in a poor drainage area or the tree was undesirable.
  2. Trees in bad locations were replaced and moved to a desirable planting location.
  3. A list of replacement trees is kept for the year; trees are then replaced in the fall.

- Tree Planting Projects: In-house and volunteer.
  1. Oak restoration projects were completed in Breen Park and Ruhkala Park.
  2. Wesley Park received 40 additional trees in the undeveloped area above the original park landscape.
- Pruning:
  1. Regular fall/winter, and early spring pruning is done by the City of Rocklin Parks Maintenance Staff.
  2. Parks Maintenance Staff are trained to prune to the International Society of Arboriculture pruning standards. Training is received at the University of California Davis. Contractors are required to meet this same standard.
  3. Respond to resident complaints
  4. Trim over sidewalks to 8 feet
  5. Remove downed branches
  6. Remove dangerous limbs
  7. Remove problem or undesirable trees
- Equipment:
  1. Pneumatic pruning shears
  2. Extended power pole chain saws
  3. A variety of chain saw size selections 12” to 24”
  4. Chipper
  5. Urban Forest truck for chipped material. Vehicle is outfitted with a hydraulic system for pneumatic pruning tools.
- Fertilizer:
  1. Fertilizer tablets were installed to some existing trees that appeared to be lacking in nutrition. All newly planted trees received fertilizer tabs.
- Insecticide:
  1. Imicide (liquid pesticide is injected into targeted trees). There are immediate results controlling scale, aphids, and white flies.
  2. The injections are done on an as needed basis, and on every second tree, so as not to kill off desirable insects.
- Irrigation: Overhead spray

Many of the “Urban Forest” problems that the City of Rocklin is experiencing today are the result of improper installation, poor tree selection and maintenance practices that are no longer part of the City’s pruning program. Since quality tree selection is the beginning of the process, we are continuing to be proactive in the inspection of trees once they have arrived from the nursery. The trees are now properly pruned to International Society of Arboriculture pruning standards, fertilized, and irrigated. These current practices will show the rewards in the long term, with a more vigorous and healthier “Urban Forest”.

Appendix 7.3 Notes from the Rocklin Urban Forest Community Meeting, July 15, 2004

On July 15, 2004, an open community meeting was held in the Rocklin City Council Chambers at City Hall to discuss the draft urban forest plan. The meeting was attended by about 15 Rocklin residents and a number of City staff members. Introductory remarks were made by City Council Member Ken Yorde and Senior Planner David Mohlenbrok. Consultant Ted Swiecki of Phytosphere Research presented overviews of urban forest benefits and the urban forest planning process and then discussed the results of the assessments of Rocklin's urban forest. Covered topics included the evaluations of tree canopy cover change (Section 3.1), native oak woodlands on City-owned lands (Section 3.2), park trees (Section 3.3), City-maintained trees along streets (Section 3.4, residential front yard trees (Section 3.5), and trees in commercial parking lots (Section 3.6).

Following the formal presentation, an extended question-answer and public comment session was held to obtain input from City residents. The comments and questions from the meeting are summarized below. Summarized responses by the consultant or City staff are shown in italics.

- Lack of planting strip between street and sidewalk in the City of Rocklin contributes to the lack of a street canopy.
- Smaller lots are resulting in the need to have to plant smaller trees and why many trees don't grow to their full size.
- Newly developing areas are prone to inferior planting practices by developers (on private property) which results in the need to replace trees in the short term. Particularly, planting holes that are dug for new trees not large enough to prepare sufficient soil for future tree growth. Possible solutions to address this situation would be to make sure that the planting standards are enforceable and measurable, and to have increased inspection requirements.
- Will the consultant be making specific recommendations to the City? For example, has the consultant identified areas in the City that need new plantings? *The urban forest plan contains a variety of recommendations, but specific planting plans by area are not included.*
- Invasive species – will the consultant be recommending the removal of invasive species? Cottonwoods that are regenerating are of particular concern for some because of their "messiness". *A possible solution would be to develop creek management plans for various creek sections. These plans would set objectives for managing vegetation within the riparian zone in a fashion that is compatible with adjacent land uses, flood and erosion control needs, habitat values, etc. The plan would provide guidance on vegetation composition and management and other creek bed maintenance issues. Plans may be subject to review by state and/or federal agencies. .*
- Tree density – is there a priority for oaks specifically, and can the oak tree mitigation fund monies be used to help regenerate oaks, acquire new oak woodland areas, and/or help maintain existing oaks? Recognize that public safety is a priority where oaks are near publicly accessible areas and require limb removal/trimming.

- Noticed many public areas are planted with non-oak trees such as flowering pear trees. Would rather see oaks planted instead of non-oaks in public areas.
- Is the disc golf course a problem to existing oaks? *This activity was not addressed in consultant's analysis.*
- Is the ground squirrel population a problem? *Too many squirrels usually indicate some type of ecological imbalance in the landscape. High ground squirrel populations can result in the loss of seeds (acorns) and young oak seedlings.*
- Some jurisdictions have programs where incentives are given to encourage the growing and/or planting of trees – does Rocklin have a similar program? Aren't there other tree planting programs sponsored by national groups or entities such as PG&E? *The Plan will include a listing of outside sources of funds for tree planting / tree care projects.*
- Comment that at least one local school had been growing local oaks in containers that could be made available for planting by others.
- Observation was made that it's expensive for landowners to remove and replace trees when they die, so financial assistance of some sort would be welcome.
- The City needs to get other agencies (PG&E, SPMUD, etc) to get involved in (oak) tree programs. There needs to be assistance given to Homeowner Associations (HOAs) on planting and maintenance.
- How limiting are the soils in Rocklin with regard to certain species of trees? *Plan will include discussion of soil factors that limit tree growth in Rocklin.*
- Near the Stanford Ranch Road/Park Drive area, there is a large wildlife/wetlands area that has lots of water but very little vegetation – can trees, especially oaks, be planted there?
- It is a great idea to be thinking ahead about the City's trees because money can be saved in the long run, which is ideal. The urban forest plan will help with recommendations and guidelines, but it needs to be made easy and understandable for the public. As an example, the City of Sacramento has a pamphlet of trees that discusses different species, where to plant, where to see mature examples, etc. It would be nice to have something like that here in Rocklin.
- The gap between the City and the general public needs to be bridged. Suggested methods for "getting the word out" were pamphlets, website, and eventually having a City tree department and City arborist.
- Many plants sold at local nurseries aren't adapted to the area or were grown in nurseries outside of the Sacramento region and therefore have a difficult time acclimating to the area.
- Nurseries need to be educated and they need to provide education to their customers about the trees that they are buying. Big box stores (e.g., Home Depot, Lowe's) should provide education/information like they do for other products they sell (how-to classes), or the City should see about having some educational literature available locally to give guidance.
- Kudos to the City on the planting at Taylor /Pacific Street and Sunset.
- The recreation guide (as an ad or class), billing inserts, and other publications are other opportunities to help "get the word out". The City could partner with nurseries where a discount could be offered by the City for planting the "right tree in the right place".

- Suggestion made that fruit trees do well in Rocklin and can provide shade as well as produce. *However, due to fruit drop and other issues, large fruit trees are not good options for many urban planting situations. Another option is to consider community orchards, similar to community gardens that exist, to provide options for residents to grow/harvest tree fruit that might not be possible in yard situations.*

Post meeting communications with City of Rocklin Planning Department:

- Would like to see Front Street tree-lined or enhanced with trees and plants, from Rocklin Road to Farron Street. It may be that railroad ownership of that property would present some complications, but it would certainly beautify that part of the City. Another location would be the screening of the tank farm at the corner of Sunset and Pacific. Some nice conifers or pines around the site might make it look less ghastly.
- I attended the Rocklin tree planning meeting Thursday evening. I'm glad to see the City of Rocklin is taking a proactive approach with this subject. I am a resident in the City and an I.S.A. certified Arborist with a few years of experience in the field. If I can be of any help, I would be happy to do some volunteer work.

Appendix 7.4. Recommended changes to Oak Tree Preservation Guidelines

Based on our review of Rocklin's current Oak Tree Preservation Guidelines (dated January 1997) Phytosphere suggests the following revisions to address technical issues.

General comment – the term oak is used thoughout to refer to oaks native to Rocklin, but this is not explicitly stated. Because non-native oaks are widely planted in Rocklin, it would avoid confusion to note that oak refers only to oaks native to Rocklin unless otherwise noted.

Section II.D.1 – Consider allowing direct seeding of local acorns and protection/recruitment of existing natural oak seedlings or saplings as an alternative to planting.

Section III.B.1. – Because the condition and size of trees can change over time, language should be inserted to indicate how recent the arborist's survey and report should be. Reports greater than two years old should at least be updated to note any changes from the original survey.

Section III.B.1.a, last paragraph – When a sampling method is used to assess impacts, it should be coupled with an analysis of aerial imagery to evaluate the potential amount of total canopy cover loss associated with the project.

Section III.C.2, first and fourth bullets – Because roots can extend out 2 to 3 time the canopy spread (dripline distance), protection to the vicinity of the dripline is often inadequate for long-term tree health. The "dripline + 1 foot" standards should not be viewed as an ideal standard. A more flexible and superior alternative would be this "2-2/3 standard": require protection of a continuous zone including at least 2/3 of the area equal to twice the diameter of the canopy spread, while not allowing any encroachment any closer than 2/3 of the distance between the trunk and dripline. This has the potential to protect a greater fraction of the rootzone while still providing flexibility for site design purposes. In situations where root distribution is likely to be non-uniform, an arborist should provide direction as to the likely location of the bulk of the root system.

Section III.D.1, last paragraph – Add caveat that mitigation would be required if the death of tree or its dying/diseased status was the result of intentional actions by the owner. In other words, it should be clear that intentionally killing trees in advance of development to avoid mitigation is not an option.

Section III.D.3. – Presumably, this formula provides an incentive to avoid removing more than 20% of the oaks on a property, but it is not immediately clear from the text itself. In particular, because the term "discount diameter" is used in connection with removal in excess of 20%, it almost seems like it is better (i.e., you get a discount) to remove more than 20% of the trees. Changes in the text would clarify the intent of this section for those who encounter it for the first time. It might also help to note the minimum replacement ratio of 2:1 and a reference to the Appendix C in this section as well as in section 4.

Appendix A. – Remove *Quercus agrifolia* (Coast live oak) from the list of native oaks. It is not native to the Rocklin area. The *Q. agrifolia* hybrids can also be removed from the list as such hybrids are not likely to occur naturally in the Rocklin area.

Appendix D.1. – The diagram is a bit more geared toward trees in areas with summer rainfall. In dry areas like Rocklin, root density in the upper 6-8 inches of the soil profile is typically low. Also, the rule of thumb that root spread is typically 2 to 3 times the dripline

diameter is probably more applicable than the height-based estimate. Also, it is not clear why the diagram shows few roots to the left side of the tree. This would not be typical for any tree.

Appendix D.2. Root zone – For most trees, the number of roots beyond the dripline is much greater that that within the dripline. For Rocklin's oaks, the root spread is likely to be in the 2-3+ times dripline range (for 2X, only 25% of the rootzone is within the dripline). The source of the 1.67 times dripline figure is not stated, but it is more likely to be typical of trees growing in wetter regions than Rocklin.

Appendix D.3.B.1. – A better standard for protection around the trunk would be to have no excavation within 1/2 to 2/3 of the distance from the trunk to the dripline. This standard would also apply to Section 3.B.3.a

Appendix D.3.B.3. – The dry well diagram shown is not an acceptable method for protecting oak trees and should be deleted. Fill of up to a foot depth should be considered the same as rootzone destruction and should be subject to the limits discussed earlier.

Appendix D.3.D.4. – The concept of "balancing" root removal with corresponding top removal is not supported by research and may be more detrimental than beneficial. The pruning recommendation should be removed from this section.

Appendix D.3.E.1. – Change fence placement to the designated protected root zone area + 3 feet rather than dripline +3 feet.

Appendix D.5.A.2.a.iii. – Delete sentence about spraying. Most of these insects produce only 1 generation per year and by the time damage is obvious, spraying is usually too late to provide any benefit.

Appendix D.5.A.2.c. – Mushrooms are infrequently seen in trees with *Armillaria.* Damage to the roots, especially fill, coupled with summer irrigation are main factors that allow *Armillaria* to decay the roots and root crowns of oaks.

Appendix D.5.A.2.d. – Replace with following:

Canker rot and other decay fungi. A number of wood decay fungi attack living oaks, most commonly infecting through wounds. They can result in branch dieback and the slow decline of affected oaks. Extensive wood decay may also cause branches or the entire trunk to break. An arborist should be consulted to evaluate whether levels of decay are cause for concern and whether pruning can be used to reduce potential hazards.

Appendix D.5.A.2.f. – Spanish moss poses no threat to oaks.

Appendix D.5.B.2. – Change references to more current guidelines noted in this document.

Appendix D.5.B.3. – Delete this recommendation.

Appendix D.5.B.4,5. – Large branch removals should preferentially be done in the summer for all oaks as noted in this report. Also, oaks should never be "heavily" pruned.

Appendix D.5.C.3. – In general, oaks do not benefit from fertilization and excess fertilization can be associated with various problems. Phytosphere recommends deleting this section, other than adding the foregoing sentence.

Appendix D.6. – This section includes several questionable recommendations. Phytosphere recommends that the section be replaced with information they have developed based on various studies and practical experience. See http://phytosphere.com/oakplanting/oakplanting.htm

Appendix 7.4. Recommended changes to Oak Tree Preservation Guidelines

Appendix D. Exhibit 1. – There are more recent and extensive lists available. (e.g., Bruce W. Hagen, Barrie D. Coate, Keith Oldham, 1991. **Compatible Plants Under and Around Oaks.** California Oak Foundation)

Appendix 7.5. Regional survey on the performance of common tree species in urban settings

Methods

Phytosphere surveyed both the Sacramento Valley Regional Urban Forest Council (SVUFC) members and City of Rocklin Public Works and Parks staff by email in November 2003. The objective of the survey was to get opinions on trees that perform especially well or especially poorly in an urban setting in the lower Sierra foothills area. Respondents were asked to note species that perform either especially well or poorly in typical **street tree** settings (median and shoulder planting beds, parking lots) and **yard/park** settings (in or around turf, large landscaping beds typical of developed parks or residential yards). The survey instrument was designed to help identify trees that, based on local experience, are especially good or bad trees in these situations.

A list of the most common tree species found in Rocklin's parks, front yards, parking lots, and street plantings was provided as a species list in the survey. Though limited, this list contained many of the most common trees found in the area. Respondents were asked to place an x in the appropriate column for species they felt were especially good or bad trees for yard/park or street settings. Columns were left blank if the respondent had no strong opinions one way or the other about a given tree, so the number of responses per tree varied.

Respondents were also asked to add species to the list that were likely to be especially good for use in the area. For these additional species, respondents were asked to indicate whether their opinion was based on long term observations of local trees or other information. Phytosphere received and tabulated results from 8 SVUFC member surveys. Phytosphere also received a compiled response from City of Rocklin staff that included data from at least 6 respondents.

The ratings were tabulated by concatenating the responses directly from the surveys. Some respondents used both capital and lower case x's, which are reproduced in the results table. Presumably the capital X's are used for emphasis (very good or bad). Additional notes provided by some respondents are also reproduced in the table. Different responses are separated by semicolons. Responses from City of Rocklin staff are shown in separate columns from those of the SVUFC members.

Results

A review of the Table 7.5-1 shows that some trees were universally panned and others were universally liked. However, many of the trees had both proponents and detractors for various uses. Presumably, at least some of this variation reflects differences in tree performance in different areas and situations. In general, species with mixed reviews should probably get special scrutiny during the process of matching a tree to a site.

One comment is in order for coast live oak, which generally got good reviews. Although this species may have horticultural uses in inland areas, there are good ecological reasons not to use this species in areas where it is close to native interior live oak. These two species can hybridize, and introducing coast live oak genes into native populations of interior live oak is potentially deleterious to the population genetics of the latter species. For the protection of native oak forest genetic resources, Phytosphere strongly recommends that coast

live oak not be used within about 2 miles of native stands of interior live oak or riparian corridors and generally advises against its use in Rocklin altogether.

Tables 7.5-2 and 7.5-3 include species that are not on the main list but that respondents felt were especially good for use in the area. Table 7.5-2 includes species for which respondents had good long term observations, i.e., tree are performing well after being in place at least 30 years or so. Table 7.5-3 includes species deemed likely to perform well that had not been observed over a long enough time period yet. Some species are listed in both tables, presumably reflecting different periods that species have been used in different areas.

Table 7.5-1. Compiled tree survey responses from Sacramento Valley Regional Urban Forest Council members (SVUFC) and City of Rocklin Public Works and Parks staff (Rocklin).

Common name (Scientific name)	Good yard/ park (SVUFC)	Bad yard/ park (SVUFC)	Good street (SVUFC)	Good street (Rocklin)	Bad street (SVUFC)	Bad street (Rocklin)	Comments
alder, Italian (*Alnus cordata*)	xX	xxx	x	xx	xxX	xxx	Short lived, codominant trunks;
alder, white (*Alnus rhombifolia*	x	xxxxx		xx	xXxxX	xxx	Short lived (15-20 years), invasive roots; Short lived, borers; Alder borer;
ash, modesto (*Fraxinus velutina* 'Modesto')		xxxxxx		x	xxXxxX	xxxx	Pests and disease ; Dangerous structure,; Do not use; Mistletoe, anthracnose, poor structure; Structural problems, anthracnose, mistletoe;
ash, raywood (*Fraxinus oxycarpa* 'Raywood')	x	xxxx	x	xxxx	Xxxx	xx	Weak crotches, ash lilac borer, but seems to do pretty well in Roseville; Do not use; Borers, poor structure; Structural problems, serious canker disease;
birch (*Betula* spp.)	?xxxx	x		xxxx	XxxX	x	White struggles with borers , try B. nigra for more heat tolerance; Ok in cooler neighborhoods; Water demanding, borers; Bore disease in direct sun;
catalpa (*Catalpa* spp.)	xXx	xx	x	x	xxX	xxxxx	Struggles in hot weather; Litter, poor structure, root invasive; Messy, seed pods;
cedar, deodar (*Cedrus deodara)*	xxXxxx		xxxx	xxx	x	x	Doesn't canopy over street; For large spaces; Generally performs quite well; With room for street;
cedar, Incense (*Calocedrus decurrens)*	xXxxx	x	xxx	xxx	xX	xxx	Cannot take poor drainage, needs additional irrigation at elevations lower than normal range (1500'); For large spaces; Not good in turf or poorly drained areas; Marginal in heat;
cherry, flowering (*Prunus serrulata)*	Xx	xx	x	xx	xx	xx	Beautiful, but hard to grow. Drainage, sunburn, borers, gummosis…; Not drought tolerant, borers; Marginal in heat;

Appendix 7.5 Regional survey on the performance of common tree species in urban settings

Common name	Good yard/ park (SVUFC)	Bad yard/ park (SVUFC)	Good street (SVUFC)	Good street (Rocklin)	Bad street (SVUFC)	Bad street (Rocklin)	Comments
Chinese pistache (*Pistacia chinensis)*	xxxXxx x		xxXxxX	xxxxx			Some concern from CNPS about re-seeding into wild lands, cannot take poor drainage; Common; Verticillium can be a problem;
Chinese tallow (*Sapium sebiferum)*	xxx	xxxx			xxxxxx	xxxxx	Re-seeds abundantly, invasive roots; Bad roots; Use with caution-roots/seedlings-invasive; Easy to grow, but surface rooting and invasive in wetlands; Weedy;
chitalpa (*X Chitalpa tash-kentensis)*	xx	xx		x	xxX	xxxx	Sparse canopy and aphids; Use with only best site conditions;
crab apple (*Malus* X)	xxxxx		xxX			xxxx	Newer varieties more disease resistant, good sizes for today's smaller yards; messy;
crape myrtle (*Lager-stroemia indica)*	xXxxxx		xXxxX	xxxxx			If tree-sized cultivar is chosen; Fauriei x indica hybrids for small shade; Generally good performer, small size ; overused;
cypress, Arizona (*Cupressus arizonica var. arizonica or C. glabra)*	xxx	xx	x	xxx	xx	xx	Interesting accent; Pest problems,; Caution with only drier conditions; Underused; Fire prone, cultivars can be attractive;
cypress, Italian (*Cupressus semper-virens*)	xxx	x	X	xx	xxx	xxx	Why bother, ugly, only use as screen; Windbreak only-not accent; Accent tree; Fastigiate growth form, Limited use;
elm, Chinese (*Ulmus parvifolia)*	?xxxxx		?Xxx	x	r	xxxx	DED found in Sacramento as per Dan Psykowski; OK: Requires early training; Caution on roots and brittle branches;
eucalyptus, red ironbark (*Eucalyptus sideroxylon*)	?	xxxx		x	xxxxX	xxxxx	High maintenance, needs frequent pruning to avoid branch breakage; Until lerp psylids controlled; Branch failure, pavement damage;
ginko (*Ginkgo biloba)*	xxxxxx x		xxxxx	xxx		xxx	Slow to start, trouble free; Needs to grow faster to survive many spots; Male only; GOOD drainage; Well behaved tree!;
hackberry (*Celtis* spp.*)*	xxxxxx		xXxxx	xxx		xx	European ok, others now get woolly aphids; Over-used; Aphid problem Bio control may reduce impact ; European only; had problems with diseases
hawthorne (*Crataegus phaeno-pyrum)*	xxxxx	x	xXX	xxx	xx	xx	Fireblight, hard to find quality stock due to early heading; Lavelle hawthorn useful, thorns, much pruning;

Appendix 7.5 Regional survey on the performance of common tree species in urban settings

Common name (Scientific name)	Good yard/ park (SVUFC)	Bad yard/ park (SVUFC)	Good street (SVUFC)	Good street (Rocklin)	Bad street (SVUFC)	Bad street (Rocklin)	Comments
honey-locust (*Gleditsia triacanthos inermis*)	?x	xxx		x	xxxx	xxxx	Tangled growth makes it costly to prune, often has dieback in Roseville; Toss up. Sparse canopies due to midges; Subject to sunburn damage, poor performance, pests; Brittle branches;
liquidambar (*Liquidambar styraciflua)*	xxxx	xx		x	xxXxxx	xxxx	Ok in non-lawn areas which are irrigated, large root system and "sputnik deathballs" limits usefulness; Dangerous structure, Pest problems,; Rooting concerns but very versatile; Parks only, too much root intrusion; Root/pavement damage, much space needed; Shallow roots, brittle limbs;
locust (*Robinia* spp.)	?	xxxxx	?		XxxX	xxxx	Purple Robe weak crotches and suckers, according to Bruce Hagen it is sensitive to armillaria; Robinia? Poor structure, early limb failure; Purple robe' structural problems, poor in lawns ;
magnolia (*Magnolia* spp.)	xXxxxx	x	xxxx	xxxxx	x		Evergreen or deciduous? Consider species and variety since they vary greatly; Evergreen and deciduous;
maple, red (*Acer rubrum*)	xxXxxx		xXxX	xxx	x		Good if there is enough room; Cultivars only; Water demanding;
mulberry, fruitless (*Morus alba*)	xXx	xxxx			xXxxx	xxxxx	Large roots; Dry conditions; Too big and invasive for most yards, but great for parks with lots of room; Pollen/allergies, pavement damage, otherwise ok;
oak, blue (*Quercus douglasii*)	xxxxx	x	Xxx	xxxxx	x		Attractive in dry location; Dry conditions; Too hard to grow, intolerant of most cultivated conditions; Slow, not in turf; Well behaved for dry soils;
oak, coast live (*Quercus agrifolia)*	Xxxxx		XxxX	xxxxxx			Does surprisingly well on the east side of the Sac. Valley; Messy, poor in turf; [Note: not recommended for Rocklin due to ecological issues related to native oak populations; see Section 6.2.1 and Table 6.2]
oak, holly (*Quercus ilex*)	xxxxx	x	xXX	xxx	xx	xx	Not for waterlogged soil; Pavement damage, poor in turf;
oak, interior live (*Quercus wislizeni*)	xXxxxx		xxxX	xxxxx		x	Fast growing, but rots young; Dry conditions; Messy, poor in turf;
oak, pin (*Quercus palustris*)	xxxxxx		xXxxX	xxxxx			Holds leaves in winter; Holds foliage in winter;

Appendix 7.5 Regional survey on the performance of common tree species in urban settings

Common name (Scientific name)	Good yard/ park (SVUFC)	Bad yard/ park (SVUFC)	Good street (SVUFC)	Good street (Rocklin)	Bad street (SVUFC)	Bad street (Rocklin)	Comments
oak, scarlet (*Quercus coccinea*)	xXxxxx		xxxxX	xxxxx		x	Holds foliage in winter;
oak, valley (*Quercus lobata*)	xxXxxx		XxxX	xxxx		xx	Ok if soil dries between irrigations; Messy, poor in turf;
olive (*Olea europaea*)	xXxxx	x	xX	xx	xxx	xxxx	Olives are high allergy and messy; Fruiting concerns/pollen; fruit; Messy, pollen;
palm, date (*Phoenix dactylifera*)	xX	xx	x		xX	xxxxxx	Pest problems; Take them back to socal; High maintenance;
pear, flowering (*Pyrus calleryana*)	xxxxx	x	xXx	xxxxxx	xx		Common-overused; Keep on top of the pruning; Overused, some varieties prone to mistletoe limbs break;
pecan (*Carya illinoi-nensis*)	xxx	xXx	xx	x	xxx	xxxx	Often have poor structure, nuts are messy; Dangerous structure,; Messy, pavement damage; Reseed;
pine, canary island (*Pinus canariensis*)	xxXxx	x	xX	xxxxxx	Xx		
pine, foothill (*Pinus sabiniana*)	xx	xXxx		xxxx	xxXxxX	x	Heavy cones can be a hazard; Digger Pine (Dangerous structure),; Too large; Hazardous with age; Structure, large cones;
pine, Italian stone (*Pinus pinea*)	xxx	xxx	xx		xxXX	xxxxxx	Poor structure; Too large;
plane, London (*Platanus acerifolia*)	xxxxx		xXxxX	x		xxx	Common-overused, high allergy, anthracnose and mildew common; Too widely planted at this time,; Varietal considerations; Overused, not encouraged for now; The right cultivar, e.g., 'Columbia'; *personally don't like*
plum, purple leaf (*Prunus cerasifera* varieties, including *Prunus* X *blireiana*)	xxx	xx	x	xxxxx	xX		Fruiting; We encourage high branched stock; short lived, pests;
poplar, lombardy (*Populus nigra 'Italica'*)		xxxxx		x	xxxX	xxx	Invasive roots, short lifespan; Limited use as windbreak/screen; Water demanding, canker disease;
redbud (*Cercis* spp.)	xxxxxx		XxX	xxxxxx	x		Well drained soils/dry for Western; Good size for most yards, keep out of lawn areas; Eastern? Poor performance;

Appendix 7.5 Regional survey on the performance of common tree species in urban settings

Common name (Scientific name)	Good yard/ park (SVUFC)	Bad yard/ park (SVUFC)	Good street (SVUFC)	Good street (Rocklin)	Bad street (SVUFC)	Bad street (Rocklin)	Comments
redwood, coast (*Sequoia semper-virens*)	xXx	xxx	xx	xxxxxx	xXx		If large enough space exists; Too widely planted at this time,; Not suited to foothills due to water needs at maturity; Needs space; High water needs, overused;
silk oak (*Grevillea robusta*)	x	xxxx		x	xxxX	xxx	Weak wood, frost sensitive; Dangerous structure,; Cold sensitive; Frost tender; Size, water-demanding;
silk tree (*Albizzia julibrissen*)	x	xxxxx			XxxX	xxxxx	Really messy flowers, re-seeds prolifically; Invasive/messy; Albizzia? Very messy, short-lived;
spruce, Colorado blue (*Picea pungens*)	xxx	x	x	xxxx	xX	x	generally poor performance;
tulip tree (*Liriodendron tulipifera*)	xxxxx	x	xXx	xxxxx	xxX		Sensitive to root disturbance and herbicide damage; Pest problems,; Needs lots of water to look good; Needs space/aphid problems; Needs space; Big time aphids, water-demanding, ok in deep, moist soils;
willow, weeping (*Salix babylonica*)	x	xxxxx			xxXxxx	xxxxxx	Brittle wood; Limited use with adequate space, wet conditions; Short lived; Short-lived, high maintenance, hazards; Large moist areas only;
zelkova (*Zelkova serrata*)	xxxxxx X		xXxX	x	x	xxxxx	Check newer cultivars;

Table 7.5-2. Other species of note based on long-term (30 years+) performance compiled from Sacramento Valley Regional Urban Forest Council member (SVUFC) responses.

Botanical and common name	Good yard/park	Bad yard/park	Good street	Bad street	Comments
Acer burgeranum, (trident maple)	xXx		XXx		Great flexible tree!; No address in foothills. All added trees grow very well in area; Good maple for smaller area
Acer campestre (Hedge maple)	x		X		
Acer ginnala (Amur maple)	x		X		
Acer truncatum (Shantung Maple)	x				
Arbutus unedo (Strawberry tree)	x				Fruit messy, hummingbirds love flowers, can take xeriscape to moderate water
Cercis (eastern or western redbud)	x		X		
Koelreuteria paniculata, (Goldenrain tree)	xx		Xx		Fast growth and strong wood, pods somewhat messy, good for solar gain as it drops it's leaves early and gets them late
Tilia (Linden)	X		X		
Magnolia x soulangiana (saucer magnolia)	x				Will not stay as a standard, great blooms
Nyssa sylvatica (tupelo, blackgum)	xX		XX		In moist places; Great color, females fruit
Quercus suber (cork oak)	x				Great accent

Table 7.5-3. Other species of note without good long term data yet compiled from Sacramento Valley Regional Urban Forest Council member (SVUFC) responses.

Botanical and common name	Good yard/park	Bad yard/park	Good street	Bad street	Comments
Betula nigra (river birch)	X				
Chionanthus retusus (Chinese fringe tree)	x		x		Grows mod-fast, beautiful flowers, females fruit
Ulmus spp (new Dutch Elm Disease-resistant elms)	x		x		Check with Schmidt Nurseries for some nice varieties
Platanus racemosa (California sycamore)	x		x		California native
Quercus castaneaefolia, (chestnut leaf oak)	x		x		Grows fast, can take lawn irrigation
Quercus rubra (red oak)	x		X		
Quercus macrocarpa (bur oak)	X				
Quercus phellos (willow oak)	Xx		Xx		Grows fast, can take lawn irrigation, good fall color
Quercus shumardii (Shumard oak)	x		X		
Tilia americana (American linden)	X		X		
Tilia cordata (Littleleaf Linden)	x		X		
Nyssa aquatica (water tupelo)	x		x		

Appendix 7.6. Selected trees from the California Invasive Plant Council inventory.

The California Invasive Plant Council (Cal-IPC) maintains an inventory of invasive plant species that can adversely impact native ecosystems in California. The most recent version of the Cal-IPC inventory of invasive plants (Cal-IPC. 2006. California Invasive Plant Inventory. Cal-IPC Publication 2006-02. California Invasive Plant Council: Berkeley, CA.) is available online as a printable document and as an interactive database at http://www.cal-ipc.org. The table below lists a number of tree species found in the 2006 Cal-IPC inventory that may be invasive in or around the Rocklin area.

Scientific name	Common name	Rating of threat[1]	Areas invaded and notes
Ailanthus altissima	tree of heaven	Moderate	Riparian areas, grasslands, oak woodland. Impacts highest in riparian areas.
Crataegus monogyna	hawthorn	Moderate	Riparian habitats, woodland. Limited distribution. Impacts appear to be minor.
Elaeagnus angustifolia	Russian olive	Moderate	Interior riparian. Impacts more severe in other western states. Current distribution limited in CA.
Eucalyptus globulus	Tasmanian blue gum	Moderate	Riparian areas, coastal grasslands, scrub. Impacts can be much higher in coastal areas.
Ficus carica	edible fig	Moderate	Riparian woodland. Can spread rapidly. Abiotic impacts unknown. Can be locally very problematic.
Myoporum laetum	myoporum	Moderate	Coastal habitats, riparian areas. Mostly along the southern coast. Abiotic impacts unknown.
Olea europaea	olive	Limited	Rarely escapes in CA but is a concern due to the possibility of spread into riparian areas.
Robinia pseudoacacia	black locust	Limited	Riparian areas, canyons. Severe impacts in southern states. Impacts minor in CA.
Sapium sebiferum	Chinese tallow tree	Moderate	Significant potential for invading new ecosystems. Riparian areas. Impacts severe in southeast US. Limited distribution, but spreading rapidly regionally.
Schinus molle	Peruvian peppertree	Limited	Riparian. Limited distribution. Impacts largely unknown in CA.
Schinus terebinthifolius	Brazilian peppertree	Limited	Riparian. Very invasive in tropics. Abiotic impacts unknown, but appear significant locally.
Sesbania punicea	scarlet wisteria tree	High	Significant potential for invading new ecosystems. Riparian areas

[1] Level of threat is based on a combination of the invasiveness, ecological impacts, and distribution of the plant.

Appendix 7.7. Tree planting and care informational handouts for Rocklin homeowners and businesses

Where to plant your new tree

Position your new tree to maximize benefits and minimize potential problems

You can't rearrange trees in your yard like you can move your furniture, so it pays to carefully consider a number of factors before you decide where to plant your new tree(s).

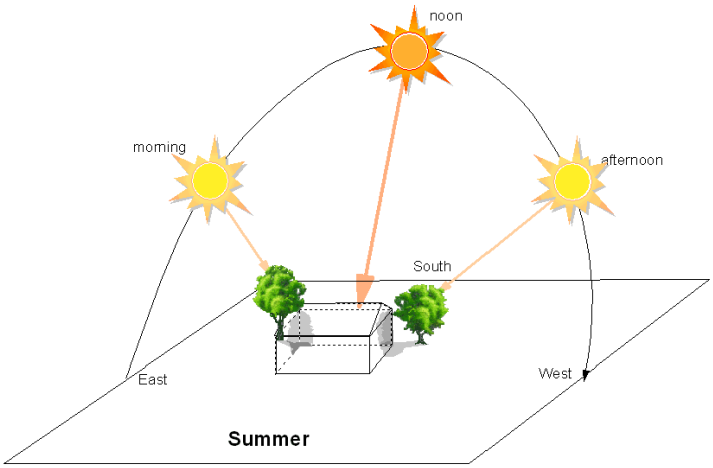
Give your tree enough space for its mature size.

Don't be fooled by the size of the tree at planting.

- Where possible, plant trees 10 ft away from underground utilities including water, sewer, and gas pipes as well as underground electric, phone, and cable lines, and 20 ft from light standards.
- Plant only small trees such as crape myrtle under high voltage power lines. The mature height of the tree should be at least 10 ft less than the height of high voltage wires directly overhead.
- Plant trees far enough from buildings, sidewalks, driveways, and foundations to avoid problems. Trees that will be large at maturity (such as London plane) will need more room than small trees (such as crape myrtle) and should be planted farther from underground and aboveground utility lines and structures.

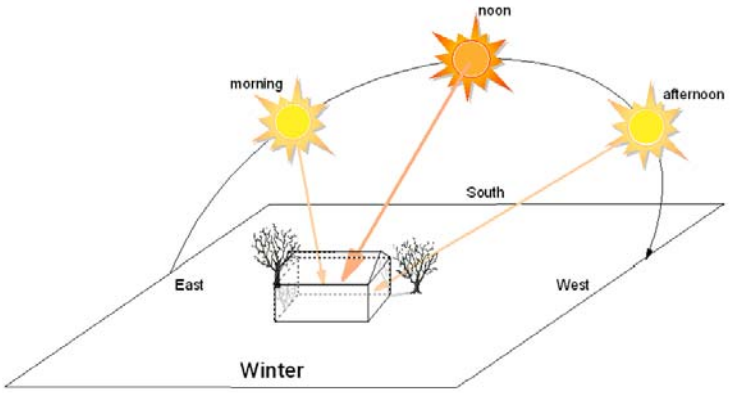
Maximize your energy savings.

Walls shaded by trees are generally 15 degrees cooler than unshaded walls. Shade on a window prevents heat buildup inside more effectively than curtains or blinds.



- Walls facing east and west receive maximum exposure to sun during the middle of summer and are the most important parts of your house to shade. At midday in midsummer, the sun is very nearly directly overhead, so it is difficult to shade south-facing walls at that time of the year.
- You can cool your local area by using trees to shade sidewalks, patios, and pavement to reduce the amount of heat that is reflected from and stored in these surfaces.
- Shading your air conditioner in the summer will improve its efficiency and save energy.
- Use deciduous trees to provide summer shade on your house. They will lose their leaves in fall, allowing winter sun to warm the house to reduce your heating costs.

- Evergreen trees produce shade in winter too, so plant them toward the north side of your property if possible, to decrease the amount of shade your house receives in the winter.



Other things to consider...

- Appropriately placed trees can provide visual screening and privacy, but don't place evergreen trees where they will block lines of sight needed for safety (such as near intersections and driveway entrances).
- Virtually all trees will drop leaves, twigs, seeds, or other materials at some point during the year. Avoid placing trees where falling debris will cause major maintenance problems.

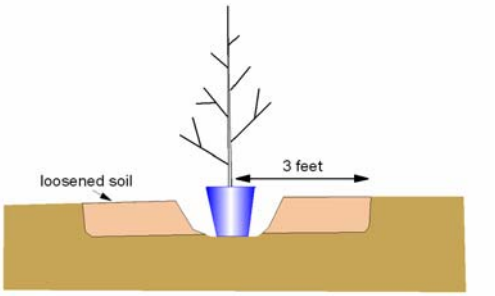
How to plant a new container-grown tree

When to plant - Fall and winter are the best seasons to plant in our area. Planting during this period allows more time for tree roots to become established so that they can meet the water needs of the leaves in hot weather. Trees can be successfully planted in spring and summer, but proper watering is especially critical for trees planted during hot weather.

Picking good planting stock - In general, the smaller the tree, the easier it will be to establish successfully. Larger trees take longer to become established. Ideally, the top should have a single main stem with branches distributed along it. Avoid trees whose main stem has been cut back or which have been excessively pruned up ("lollipop" style) or have large, unhealed pruning wounds on the trunk. A properly-grown tree will be thicker at the base and taper gradually toward the top. Avoid any tree that shows large circling roots near the trunk. Such roots will never straighten out. Also avoid trees with decayed or mushy roots.

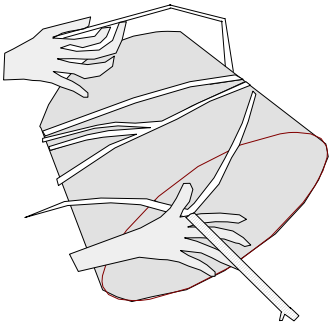
Preparing a site and planting your tree - Investing a little time and effort at planting will pay off in terms of faster tree establishment and better growth and vigor. A good quality tree may still perform poorly if it is not properly planted in a well-prepared site.

1. Prepare the soil at the planting site. Soils in subdivisions are highly compacted during construction, and tree roots cannot grow in such highly compacted soil. Most tree roots grow in the upper 1.5 to 2 feet of soil and spread far beyond the tree's canopy. Your tree will perform best if you can loosen the soil in the rootzone to a depth of at least 1 ft and a distance of at least 3 ft from the trunk in all directions. You can do this by spading and turning over the soil with a shovel in the same manner that one prepares the soil in a garden. You can also use power equipment to do the job. Soil augers, trenchers, or backhoes are the most effective for big jobs. Most rototillers do not till deep enough.

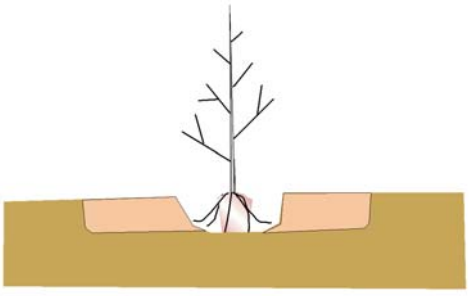


2. Dig the hole. Once you have turned over the soil at the planting site, digging the actual planting hole will be fairly easy. The hole should be no deeper than the depth of the tree's root ball. The tree root ball should rest on firm soil at the center of the hole so that the tree will not settle excessively. Make the planting hole about twice as wide as the pot to allow for spreading of roots away from the rootball.

3. Unpot the tree. Carefully remove the tree from the pot to avoid breaking off roots. Unwind all circling roots. Circling roots will not straighten themselves out and can eventually strangle the tree as they expand. Kinked, circled, or knotted roots that cannot be straightened out should be cut off cleanly with sharp pruning shears. Because roots are critical for tree survival and establishment, try to minimize the amount of root removal and damage.

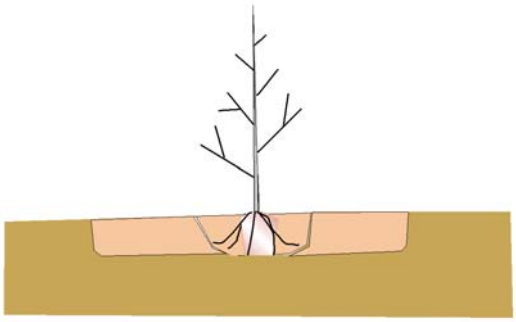


4. Set the tree. Gently place the tree in the planting hole, laying roots out so they radiate away from the trunk. Don't allow roots to kink or double back at the edge of the hole - expand the hole so that roots can spread out if necessary. Make sure that when the tree is set in the hole, the top of the root ball is slightly above the final grade of the soil. The root crown (where the first roots emerge from the trunk) should be set a bit higher than the surrounding soil so that water doesn't pool next to the trunk.

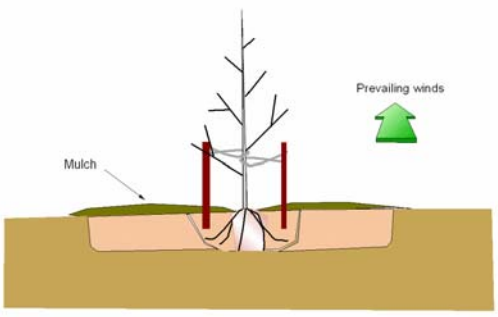


How to plant a new container-grown tree

5. Backfill the hole. Add soil to the planting hole and firm it down moderately with your hand to remove large air gaps. Avoid creating a sharp boundary between the container soil and the surrounding soil by gently breaking up the container soil as you refill the hole. Be sure that the tree is set at the proper height as you fill the hole. After the soil settles, the soil line of the tree in the pot should be the same as the final planted soil line. Once the hole is filled, water the rootball area with a low flow from a hose to settle the soil. If the top of the root ball sinks below grade after watering, gently pull it back up to level.

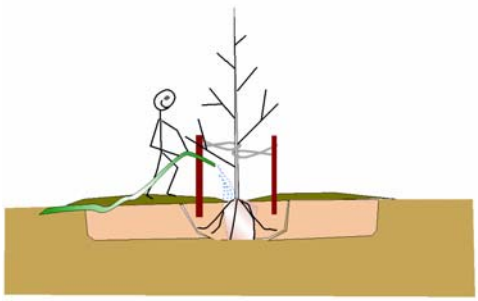


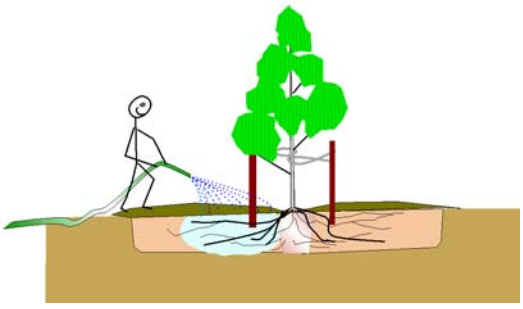
6. Stake only if necessary. Remove the pot stake, if any, that came with the tree. If the tree appears stable, staking is not needed (this is more likely to be the case for smaller trees). If staking is necessary, hold the trunk with one hand to find the height at which the unsupported top can stand up on its own and will spring back to a vertical position if lightly flexed. Position flexible support ties (no wires) about 6 inches above that point. A loose fitting figure 8 cushions the tree from rubbing against the stake and allows for some movement that stimulates the tree to develop taper. Use 2 stakes, placed in a line perpendicular to the prevailing wind direction. Place stakes beyond the container root ball, and cut stakes off about 2 inches above the ties to keep the trunk and branches from rubbing on the stakes. Remove support ties and stakes as soon as the tree becomes established, normally within one year of planting. Additional stakes or fencing may be needed around the tree to provide protection from people, pets, and equipment.



7. Mulch your tree. Use 3 to 4 inches of an organic mulch, such as bark or wood chips, to cover the soil surface at the planting site, but keep the mulch depth to 1 inch or less next to the trunk. Mulch should extend at least 2 to 3 ft away from the trunk on all sides. Mulch will help your tree get established by moderating soil temperatures, suppressing weed growth, and conserving soil moisture. If planting in a lawn, turf should be kept at least 2 to 3 ft from the trunk of newly planted trees because it suppresses tree growth.

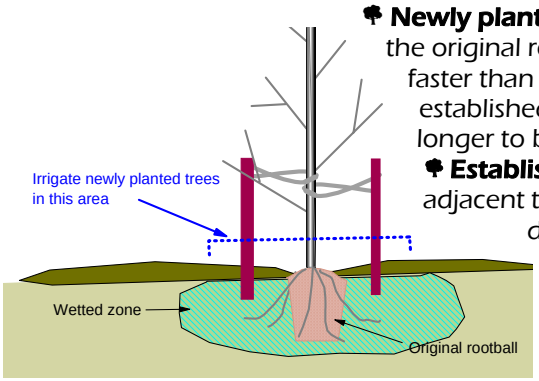
8. Water your tree. Until new roots grow into the soil of the planting site, your tree will be dependent on the water that is held in the original root ball area. Especially if you are planting in late spring or summer it is critical that this root ball area does not dry out. In areas with clay soils, the surrounding soil will pull moisture out of the porous soil mix the tree is potted in, so your tree may dry out much more quickly than you expect. Check and, if needed, water your new tree right at the root ball every few days for the first several weeks during the growing season. The soil around the rootball should remain moist though not saturated. Within several months, when sufficient numbers of roots have grown into the loosened, mulched soil surrounding the rootball, you can direct your irrigation to that area. If you plant in fall or winter, you will probably need to water your new tree every two to four weeks during its first summer, more often in especially hot periods. If your tree is planted in spring or later, you may need to water at least once a week throughout the first summer. When irrigating, apply enough water to thoroughly wet the root zone to a depth of at least a foot, but don't water so often that the soil stays waterlogged.





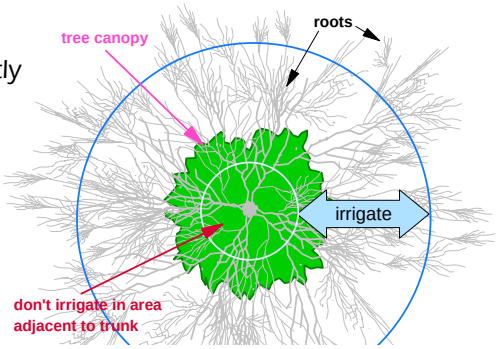
Watering your tree

Where to irrigate



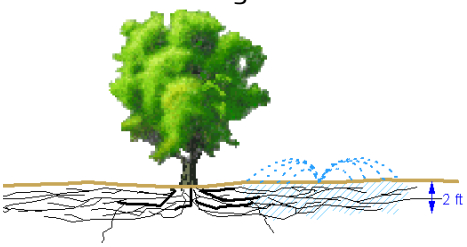
Newly planted trees: Until new roots grow into the soil of the planting site, water the original root ball area and just beyond this area. The root ball area may dry out faster than the surrounding soil. A newly planted tree may take 1-2 years to become established. Larger container stock trees may take longer to become established than smaller stock.

Established trees: Don't irrigate the area directly adjacent to the trunk - this can increase the risk of disease. Roots extend far beyond the edge of canopy or drip line. Water in the outer half of the area under the canopy and beyond the edge of the canopy. ⇨



How to irrigate

You can apply water effectively using sprinklers, drip irrigation, or a hose running on the soil surface. Regardless of how you apply the water, follow these basic rules.



Water deeply rather than frequently. Because most tree roots are found in the upper 18 - 24 inches of the soil, this is the zone that should be wetted up in each irrigation cycle. Each deep irrigation will meet a tree's water needs for between 10 days to 4 weeks during the hottest part of the summer, depending on the tree species and soil type.

Stop watering when runoff starts. Water infiltration into compacted soils and soils high in clay can be very slow - as little as 1/4 inch per hour. If water starts to pool or run off, stop irrigating, let the water soak in, and start watering again. Repeat on/off cycles until you apply enough water to wet the soil to 18-24 inches. This may take a number of cycles over several consecutive days.

Don't saturate the soil for long periods. Water displaces air in the soil, so long periods of soil saturation can suffocate growing roots. Take a long enough break between irrigation cycles to allow the free water to be absorbed. If in doubt, probe or dig to make sure that the soil isn't soggy below the surface.

How much water does my tree need?

Tree irrigation needs change over time. The amount of irrigation your tree will need can be affected by:

Tree age - A newly planted tree will need more frequent irrigation than an established tree because its root system is more limited.

Root damage - An established tree that suffers root loss or damage (for instance, due to trenching within the root zone) may need additional irrigation until new roots grow to replace those that are destroyed.

Time of the year - The need for irrigation is greatest in mid to late summer, when temperatures are the highest and most of the moisture stored in the soil over the winter has been depleted.

Weather conditions - In drought years, soil moisture is used up earlier in the season, so the period of peak water need is longer. Some trees that do not normally need irrigation may benefit from irrigation in drought years. In very wet years, irrigation may not be needed until early summer.

Soil conditions - Water used by trees is stored in the soil. Soil type, depth, and condition influence how much water can be stored in the soil, and consequently how often you may need to water. Soils that have more clay hold more water and can be irrigated less frequently. Sandy soils hold relatively little water and need more frequent irrigation.

Species - Some tree species require no additional irrigation once established, whereas others will do poorly without consistent irrigation throughout the summer.

Typical irrigation requirements (inches of applied water per month) for high, medium and low water use tree species in Rocklin under average weather conditions.

Tree water use	March	April	May	June	July	August	September	October	Total
High	1.5	3.5	6	8.2	9.2	8.2	5.9	2.8	45.4
Medium	0.3	1.8	3.7	5.4	6.2	5.5	3.9	1. 5	28.2
Low	0	0.1	1.3	2.7	3.1	2.8	1. 9	0.1	11.8

One inch of applied water (= 1 inch water depth) equals 62.3 gallons per 100 square feet (a 10 ft by 10 ft area).

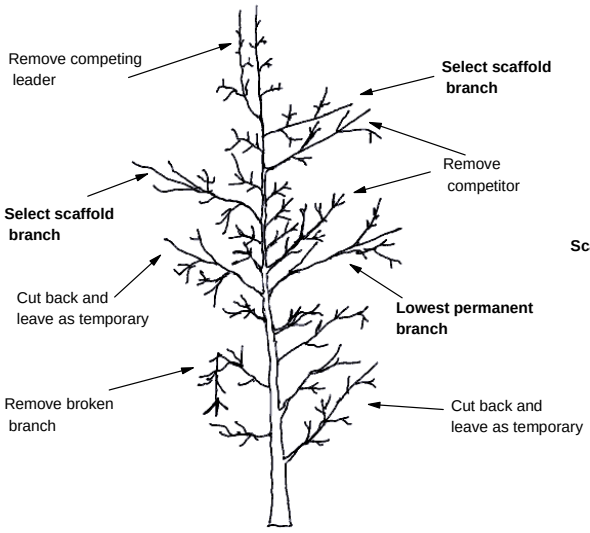
Pruning guidelines

Why should you train young trees?

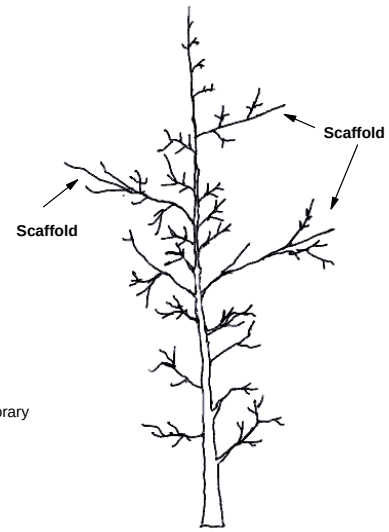
1. **Improve structural strength**: remove branches that will be more prone to breakage as tree grows
2. **Reduce future maintenance**: good branch distribution and structure will reduce need for future maintenance and will make any needed maintenance easier.
3. **Increase tree longevity**: properly trained trees are less likely to suffer branch breakage that can shorten tree life

Five steps for training young trees

Step	What	When	How
1.	Remove broken, diseased, dying, or dead branches	Start at planting and repeat as necessary	◔ Remove only as much as needed to correct the problem
2.	Select a central leader and remove competing leaders	Start at planting and repeat as necessary	◔ Generally the strongest and most vertical stem should be selected as the leader
3.	Select the lowest permanent branch	By the fourth or fifth year after planting; need to wait until tree is tall enough	◔ Height is based on necessary clearance: typically 8 ft over sidewalks ◔ You can use string to mark the branch for future reference
4.	Select main (scaffold) branches and remove or cut back competing branches	After lowest permanent branch is selected	◔ Distribute main branches around the trunk evenly on all sides ◔ Space main branches 12 to 18 inches apart up and down the trunk - use larger spacing for trees that have greater mature height ◔ Main branches should be no more than half the size of the trunk at the attachment point and should not contain **included bark** (bark that becomes pinched between branches that diverge at a narrow angle) ◔ Lateral branches along the main branches should not be closer than 2 feet from the trunk
5.	Select and maintain temporary branches below the lowest permanent branch	Starting at planting	◔ Remove temporary branches that: - become 1½ inches in diameter - are 1/3 the size of the main stem at the point of attachment - are within about 4 inches of selected scaffolds ◔ Shorten temporary branches to suppress them



Before pruning



After pruning

◔ Don't remove any more branches than are needed to accomplish steps 1-5.

◔ Don't remove more than about 1/4 of the tree canopy in a single year. Commonly, no more than 5% to 10% of the canopy needs to be removed in a given year during training.

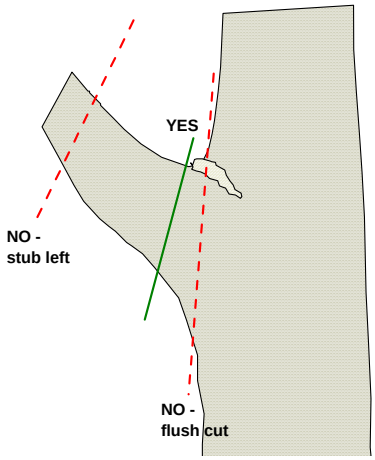
Pruning guidelines

When should I prune?

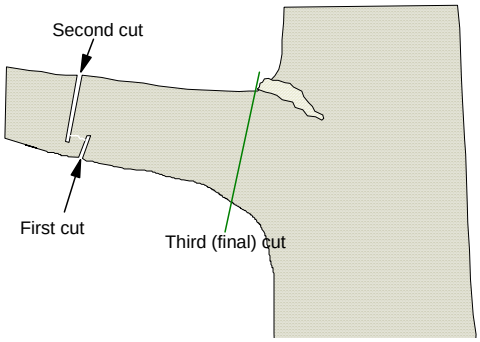
- The best time to prune can vary somewhat by species. It is best to prune most trees during the dormant season (December to February), or as close to the dormant season as possible. For mature native oaks, pruning during the dry season (late spring to late summer) is preferred to reduce the chance that decay fungi will invade new pruning wounds. Light pruning and removal of dead wood can usually be done anytime. Avoid pruning during the spring growth flush.

Proper pruning cuts

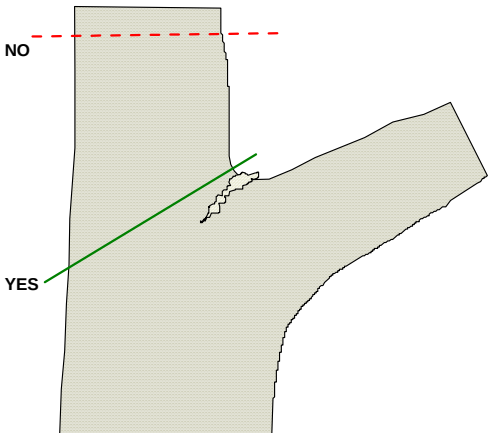
- When removing a branch, cut all the way back to the main stem without leaving a stub, but don't try to cut flush to the main stem. A small collar of tissue is often present around the base of the stem - cut to the outer edge of that collar.



- When removing a branch with a saw, first cut part way into the branch on the underside about a foot from the area where the final cut will be made. Then cut through the branch from the top. This will remove most of the branch without tearing the bark beyond the cut. Finally, cut the remaining stub off cleanly near the main stem, supporting the stub if necessary to avoid tearing the bark when the cut is made. Pruning in this fashion will result in the smallest possible pruning wound.



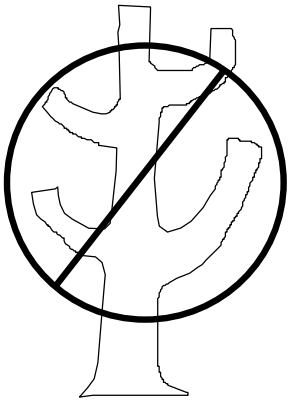
- When reducing the length of a branch, place the cut next to a side branch that is at least 1/2 the diameter of the removed stem.



Don't top your tree!!

Topping (cutting large branches back to stubs) is bad for both you and your tree.

- Topping typically removes 50 - 100% of the leaf-bearing crown of the tree. This seriously weakens the tree, and can lead to branch decay and possibly tree death.



- After topping, trees respond by producing excessive numbers of fast growing shoots from latent buds. These sprouts are poorly attached to the stubbed branches and develop into branches that are prone to break off, especially in high winds.
- Topped trees require more maintenance than properly-pruned trees. Corrective pruning is required to make topped trees less hazardous, but can never really restore the tree to its previous form.

How do I choose an arborist or tree care service?

Recommendations from the International Society of Arboriculture (http://www.isa-arbor.com)

What to look for in an arborist or tree care firm:

- Membership in professional organizations such the International Society of Arboriculture (ISA) or the American Society of Consulting Arborists (ASCA).
- Certification through the ISA Certified Arborist program.
- California State Contractors license (for jobs over $500.00) and proof of insurance.
- A list of references (Don't hesitate to check.)
- Avoid using any tree company that advertises topping or recommends that a tree be topped or uses tree climbing spikes to climb trees that are being pruned. Knowledgeable arborists know that topping is harmful to trees and is not an accepted practice. Climbing spikes can damage trees, and their use should be limited to trees that are being removed.

Appendix 7.8. Guideline Specifications for Nursery Tree Quality

These guidelines were produced by a committee comprised of municipal arborists, urban foresters, nurserymen, U.C. Cooperative Extension horticultural advisors, landscape architects, non-profit tree groups, horticultural consultants, and others. They are available online at http://urbantree.org/specs.asp.

Guideline Specifications for Nursery Tree Quality

Selecting Quality Nursery Stock

A committee comprised of municipal arborists, urban foresters, nurserymen, U.C. Cooperative Extension horticultural advisors, landscape architects, non–profit tree groups, horticultural consultants, etc., developed the attached specifications to ensure high quality landscape trees. After more than a year of work, they succeeded in drafting a document entitled Specification Guidelines for Container–grown Trees for California. This document will be published and the guidelines promoted throughout the nursery and landscape industry. Its intent is to help landscape professionals develop their own comprehensive and detailed specifications to ensure that they obtain high quality container–grown nursery trees. The document is also intended to help nursery professionals in their efforts to improve the quality of trees grown in California. These specifications can be modified for specific simulations.

The following people worked on the **Guideline Specifications for Nursery Tree Quality:**

David Burger	UC Davis, Department of Environmental Horticulture, Davis
Barrie Coate	Consulting Arborist, Los Gatos
Larry Costello	UC Cooperative Extension, Half Moon Bay
Robert Crudup	Valley Crest Tree Company, Sunol
Jim Geiger	Center for Urban Forest Research UC Davis, Davis
Bruce Hagen	California Dept. of Forestry & Fire Protection, Santa Rosa
Richard Harris	UC Davis Department of Environmental Horticulture, Davis
Brian Kempf	Urban Tree Foundation, Visalia
Jerry Koch	City of Berkeley Division of Urban Forestry, Berkeley
Bob Ludekens	L. E. Cooke Company, Visalia
Greg McPherson	Center for Urban Forest Research, UC Davis, Davis
Martha Ozonoff	California ReLeaf, Sacramento
Ed Perry	UC Cooperative Extension, Stanislaus County
Markio Roberts	Caltrans, LDA Maintenance Division, Oakland

Illustrations:

Front page, c) temporary branches C. Trunk Taper Illustration by Edward F. Gilman, Professor, Environmental Horticulture Department, IFAS, University of Florida.
All other Illustrations adapted from Integrated Management of Landscape Trees, Shrubs and Vines, Fourth Edition, 2003, Harris, Clark, Matheny
Photos: Brian Kempf
For more information contact Brian Kempf 559–713–0631 or brian@urbantree.org

Guideline Specifications for Nursery Tree Quality

I. PROPER IDENTIFICATION

All trees shall be true to name as ordered or shown on the planting plans and shall be labeled individually or in groups by species and cultivar (*where appropriate*).

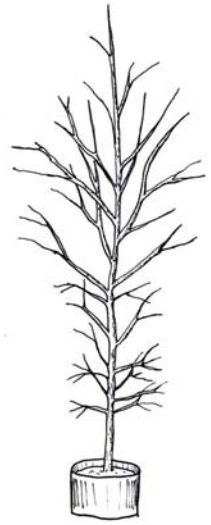


Illustration by Edward F. Gilman, Professor, Environmental Horticulture Department, IFAS, University of Florida.

II. COMPLIANCE

All trees shall comply with federal and state laws and regulations requiring inspection for plant disease, pests and weeds. Inspection certificates required by law shall accompany each shipment of plants. Clearance from the County Agricultural Commissioner, if required, shall be obtained before planting trees originating outside the county in which they are to be planted. Even though trees may conform to county, state, and federal laws, the buyer may impose additional requirements.

III. TREE CHARACTERISTICS AT THE TIME OF SALE OR DELIVERY

A. TREE HEALTH

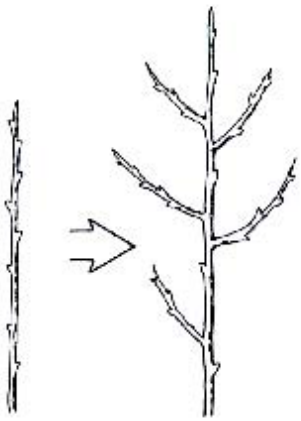
As typical for the species/cultivar, trees shall be healthy and vigorous, as indicated by an inspection for the following:

1. Trees shall be relatively free of pests (*insects, pathogens, nematodes or other injurious organisms*).
2. An inspection of the crown, trunk, and roots shall find the following characteristics:

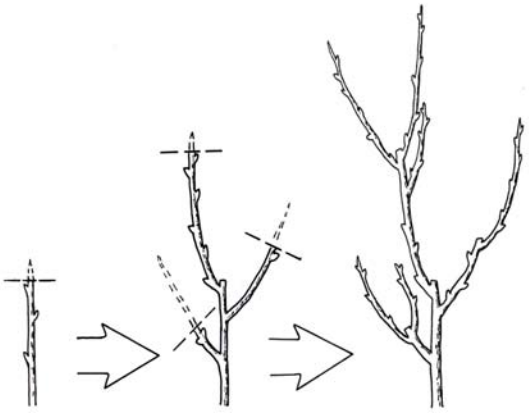
a. Crown Form: The form or shape of the crown is typical for a young specimen of the species/cultivar. The crown is not significantly deformed by wind, pruning practices, pests or other factors.
b. Leaves: The size, color and appearance of leaves are typical for the time of year and stage of growth of the species/cultivar. Leaves are not stunted, misshapen, tattered, discolored (*chlorotic or necrotic*) or otherwise atypical.
c. Branches: Shoot growth (*length and diameter*) throughout the crown is typical for the age/size of the species/cultivar. Trees do not have dead, diseased, broken, distorted or other serious branch injuries.
d. Trunk: The tree trunk should be fairly straight, vertical and free of wounds (*except properly–made pruning cuts*), sunburned areas, conks (*fungal fruiting bodies*), wood cracks, bleeding areas, signs of boring insects, galls, cankers/lesions and girdling ties.
e. Tree height and trunk diameter are typical for the age, species/cultivar and container size.
f. Roots: The root system is free of injury from biotic (*insects, pathogens, etc.*) and abiotic agents (*herbicide toxicity, salt injury, excess irrigation, etc.*). Root distribution is uniform throughout the soil mix or growth media and growth is typical for the species/cultivar.

B. CROWN

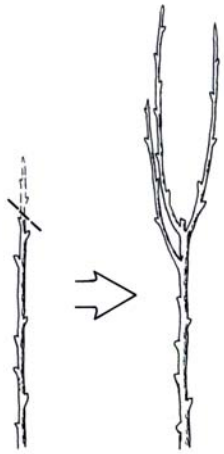
1. **Central Leader**: Trees shall have a single, relatively straight central leader and tapered trunk, free of codominant stems and vigorous, upright branches that compete with the central leader. If the original leader has been headed, a new leader at least ½ (*one–half*) the diameter of the original leader shall be present.



Maintaining a single, centeral leader is preferable.



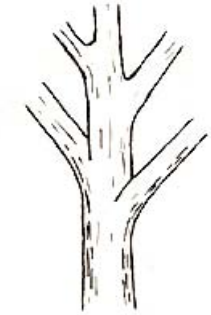
Heading and retaining a leader is acceptable.



Heading without retaining a leader is unacceptable.

2. **Main Branches** (*scaffolds*): Branches should be distributed radially around and vertically along the trunk, forming a generally symmetrical crown typical for the species.

a) **Main branches**, for the most part, shall be well spaced.



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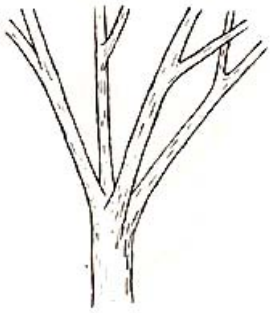

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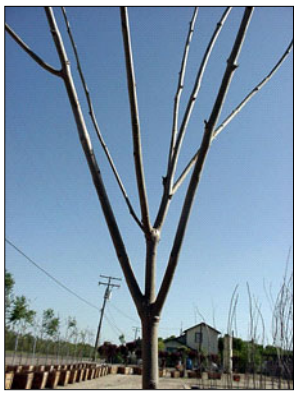


unacceptable

b) **Branch diameter** shall be no greater than 2/3 (*two thirds*) the diameter of the trunk, measured 1" (*one inch*) above the branch.

preferable

unacceptable

preferable

unacceptable

c) The attachment of scaffold branches shall be free of **included bark**.

preferable

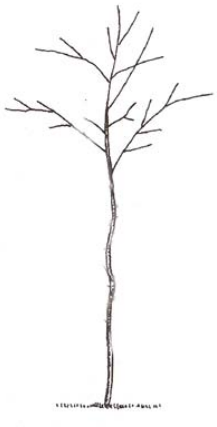
unacceptable

preferable

unacceptable

3. **Temporary branches:** Temporary branches should be present along the lower trunk, particularly for trees less than 1–1/2" (*one and one–half inches*) in trunk diameter. They should be no greater than 3/8" (*three–eighths inch*) in diameter. Heading of temporary branches is often necessary to limit their growth.

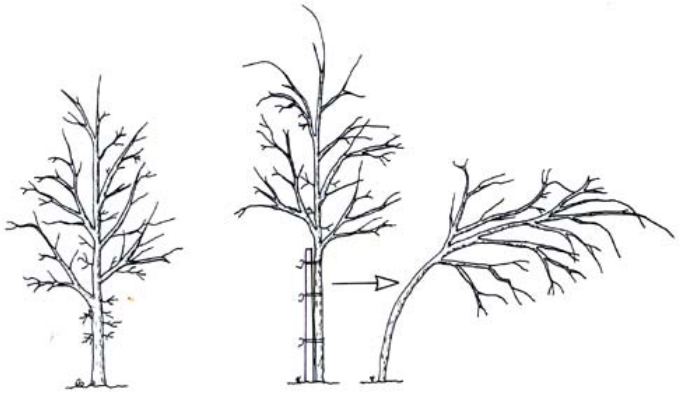

Good

Not as Good

C. TRUNK

1. **Trunk diameter and taper** shall be sufficient so that the tree will remain vertical without the support of a nursery stake.



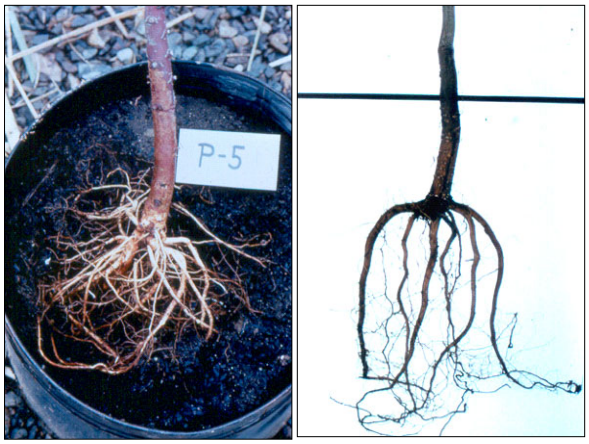
2. The **trunk shall be free of wounds** (*except properly–made pruning cuts*), sunburned areas, conks (*fungal fruiting–bodies*), wood cracks, bleeding areas, signs of boring insects, galls, cankers and/or lesions.

3. **Trunk diameter** at 6" (*six inches*) above the soil surface shall be within the diameter range shown for each container size below:

Container Size	Trunk Diameter (*inches*)
# 5 (gallon)	0.5" to 0.75"
# 15 (gallon)	0.75" to 1.5"
24 inch box	1.5" to 2.5"

D. ROOTS

1. The trunk, **root collar** (*root crown*) and large roots shall be free of circling and/or kinked roots. Soil removal near the root collar may be necessary to inspect for circling and/or kinked roots.



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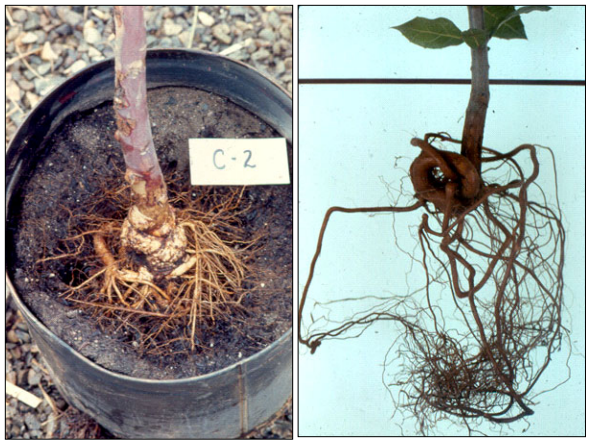


unacceptable

2. The tree shall be **well rooted** in the soil mix. When the container is removed, the rootball shall remain intact. When the trunk is carefully lifted both the trunk and root system shall move as one.

preferable

unacceptable

3. The **upper–most roots** or root collar shall be within 1" (*one inch*) above or below the soil surface.

preferable

unacceptable

4. The **rootball periphery** should be free of large circling and bottom–matted roots. The acceptable diameter of circling peripheral roots depends on species and size of rootball. The maximum acceptable size should be indicated for the species (*if necessary*).

preferable

unacceptable

E. MOISTURE STATUS

At time of inspection and delivery, the rootball shall be moist throughout. The crown shall show no signs of moisture stress as indicated by wilted, shriveled or dead leaves or branch dieback. The roots shall show no signs of excess soil moisture conditions as indicated by poor root growth, root discoloration, distortion, death or foul odor.

V. INSPECTION

The buyer reserves the right to reject trees that do not meet specifications as set forth in these guidelines or as specified by the buyer. If a particular defect or substandard element or characteristic can be easily corrected, appropriate remedies shall be required. If destructive inspection of a rootball(s) is to be done, the buyer and seller should have a prior agreement as to the time and place of inspection, minimum number of trees or percentage of a species or cultivar to be inspected and financial responsibility for the inspected trees.

DELIVERY

The buyer should stipulate how many days prior to delivery that notification is needed.

GLOSSARY:

Codominant – Two or more vigorous and upright branches of relatively equal size that originate from a common point, usually where the leader has been lost or removed.

Crown – The aboveground part of the tree including the trunk.

Cultivar – A named plant selection from which identical or nearly identical plants can be produced, usually by vegetative propagation or cloning.

Girdling root – A root that partially or entirely encircles the trunk and/or buttress roots, which could restrict growth and downward movement of photosynthate and/or water and nutrients up.

Included bark – Bark embedded within the crotch between a branch and the trunk or between two or more stems that prevents the formation of a normal branch bark ridge. This often occurs in branches with narrow-angled attachments or branches resulting from the loss of the leader. Such attachments are weakly attached and subject to splitting out.

Kinked root – A primary root(s), which is sharply bent, causing a restriction to water, nutrient, and photosynthate movement. Kinked roots may compromise the structural stability of root systems.

Leader – The dominant stem which usually develops into the main trunk.

Photosynthate – Pertains to sugar and other carbohydrates that are produced by the foliage during photosynthesis, an energy trapping process.

Root collar – The flared area at the base of a tree where the roots and trunk merge. Also referred to as the "root crown" or "root flare".

Shall – Used to denote a practice that is mandatory.

Should – Used to denote a practice that is recommended.

Scaffold branches – Large, main branches that form the main structure of the tree.

Temporary branch – A small branch that is retained temporarily along the lower trunk of young trees. Temporary branches provide photosynthate to increase trunk caliper and taper and help protect it from sunburn damage and mechanical injury. Such branches should be kept small and gradually removed as the trunk develops.

Trunk – The main stem or axis of a tree that is supported and nourished by the roots and to which branches are attached.

Appendix 7.9. How to Prune Trees (USDA Forest Service Publication NA-FR-01-95)

This guide to pruning was produced by the Northeastern Region of the USDA Forest Service is also available online at http://www.na.fs.fed.us/spfo/pubs/howtos/ht_prune/prun001.htm. It contains much of the same information found in the copyright-protected ANSI A300 pruning standards, but can be freely reproduced for distribution.

NA-FR-01-95

USDA Forest Service

Northeastern Area State and Private Forestry

HOW to Prune Trees

Peter J. Bedker, Joseph G. O'Brien, and Manfred M. Mielke
Illustrations by Julie Martinez, Afton, MN

Introduction

The objective of pruning is to produce strong, healthy, attractive plants. By understanding how, when and why to prune, and by following a few simple principles, this objective can be achieved.

Why Prune

The main reasons for pruning ornamental and shade trees include safety, health, and aesthetics. In addition, pruning can be used to stimulate fruit production and increase the value of timber. Pruning for *safety* (Fig. 1A) involves removing branches that could fall and cause injury or property damage, trimming branches that interfere with lines of sight on streets or driveways, and removing branches that grow into utility lines. Safety pruning can be largely avoided by carefully choosing species that will not grow beyond the space available to them, and have strength and form characteristics that are suited to the site.

Pruning for *health* (Fig. 1B) involves removing diseased or insect-infested wood, thinning the crown to increase airflow and reduce some pest problems, and removing

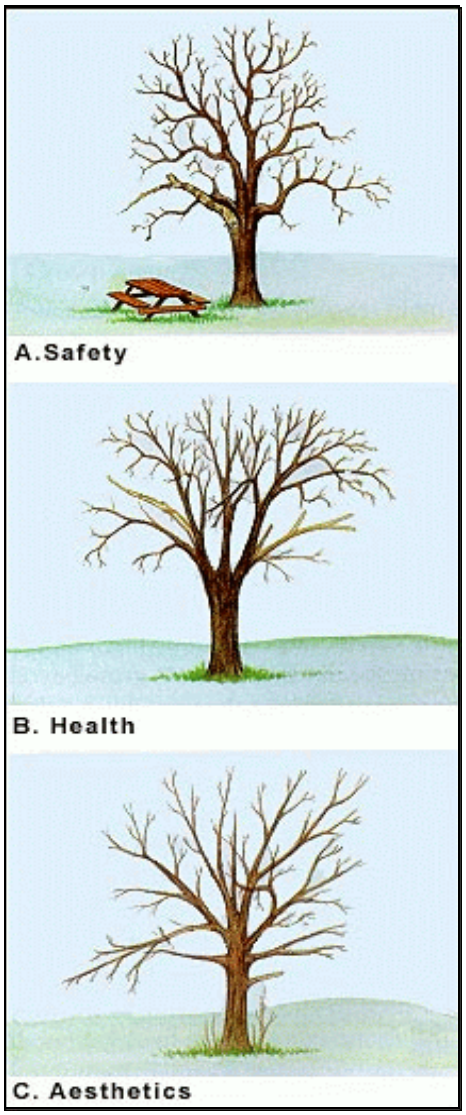


Figure 1. Reasons for pruning.

crossing and rubbing branches. Pruning can best be used to encourage trees to develop a strong structure and reduce the likelihood of damage during severe weather. Removing broken or damaged limbs encourage wound closure.

Pruning for *aesthetics* (Fig. 1C) involves enhancing the natural form and character of trees or stimulating flower production. Pruning for form can be especially important on open-grown trees that do very little self-pruning.

All woody plants shed branches in response to shading and competition. Branches that do not produce enough carbohydrates from photosynthesis to sustain themselves die and are eventually shed; the resulting wounds are sealed by **woundwood** (callus). Branches that are poorly attached may be broken off by wind and accumulation of snow and ice. Branches removed by such natural forces often result in large, ragged wounds that rarely seal. Pruning as a cultural practice can be used to supplement or replace these natural processes and increase the strength and longevity of plants.

Trees have many forms, but the most common types are pyramidal **(excurrent)** or spherical (**decurrent)**. Trees with pyramidal crowns, e.g., most conifers, have a strong central stem and lateral branches that are more or less horizontal and do not compete with the central stem for dominance. Trees with spherical crowns, e.g., most hardwoods, have many lateral branches that may compete for dominance.

To reduce the need for pruning it is best to consider a tree's natural form. It is very difficult to impose an unnatural form on a tree without a commitment to constant maintenance.

Pollarding and **topiary** are extreme examples of pruning to create a desired, unnatural effect. Pollarding is the practice of pruning trees annually to remove all new growth. The following year, a profusion of new branches is produced at the ends of the branches. Topiary involves pruning trees and shrubs into geometric or animal shapes. Both pollarding and topiary are specialized applications that involve pruning to change the natural form of trees. As topiary demonstrates, given enough care and attention plants can be pruned into nearly any form. Yet just as proper pruning can enhance the form or character of plants, improper pruning can destroy it.

Pruning Approaches

Producing strong structure should be the emphasis when pruning young trees. As trees mature, the aim of pruning will shift to maintaining tree structure, form, health and appearance.

Proper pruning cuts are made at a node, the point at which one branch or twig attaches to another. In the spring of the year growth begins at buds, and twigs grow until a new node is formed. The length of a branch between nodes is called an internode.

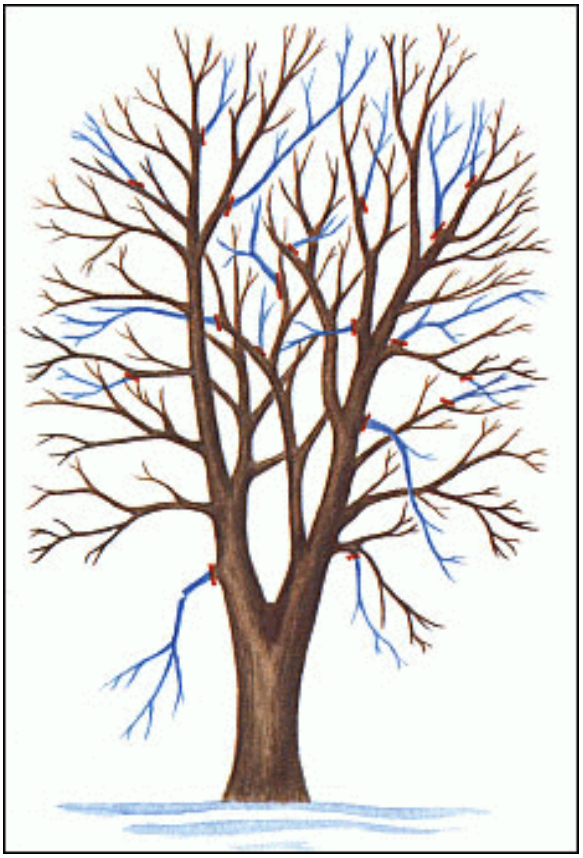


Figure 2. Crown thinning - branches to be removed are shaded in blue; pruning cuts should be made at the red lines. No more than one-fourth of the living branches should be removed at one time.

The most common types of pruning are:

1. *Crown Thinning* (Fig. 2)

Crown thinning, primarily for hardwoods, is the selective removal of branches to increase light penetration and air movement throughout the crown of a tree. The intent is to maintain or develop a tree's structure and form. To avoid unnecessary stress and prevent excessive production of epicormic sprouts, no more than one-quarter of the living crown should be removed at a time. If it is necessary to remove more, it should be done over successive years.

Figure 3. Types of branch unions.

Branches with strong U-shaped angles of attachment should be retained (Fig 3A). Branches with narrow, V-shaped angles of attachment often form **included bark** and should be removed (Fig. 3B). Included bark forms when two branches grow at sharply acute angles to one another, producing a wedge of inward-rolled bark between them. Included bark prevents strong attachment of branches, often causing a crack at the point below where the branches meet. Codominant stems that are approximately the same size and arise from the same position often form included bark. Removing some of the lateral branches from a codominant stem can reduce its growth enough to allow the other stem to become dominant.

Lateral branches should be no more than one-half to three-quarters of the diameter of the stem at the point of attachment. Avoid producing "lion's tails," tufts of branches and foliage at the ends of branches, caused by removing all inner lateral branches and foliage. Lion's tails can result in sunscalding, abundant **epicormic sprouts**, and weak branch structure and breakage. Branches that rub or cross

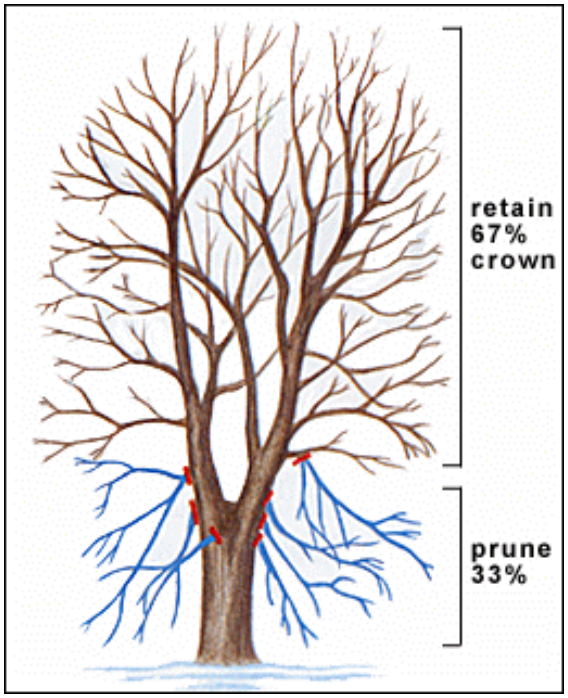


Figure 4. Crown raising - branches to be removed are shaded in blue; pruning cuts should be made where indicated with red lines. The ratio of live crown to total tree height should be at least two-thirds.

another branch should be removed.

Conifers that have branches in whorls and pyramidal crowns rarely need crown thinning except to restore a dominant leader. Occasionally, the leader of a tree may be damaged and multiple branches may become codominant. Select the strongest leader and remove competing branches to prevent the development of codominant stems.

2. *Crown Raising* (Fig. 4)

Crown raising is the practice of removing branches from the bottom of the crown of a tree to provide clearance for pedestrians, vehicles, buildings, lines of site, or to develop a clear stem for timber production. Also, removing lower branches on white pines can prevent blister rust. For street trees the minimum clearance is often specified by municipal ordinance. After pruning, the ratio of the living crown to total tree height should be at least two-thirds (e.g., a 12 m tree should have living branches on at least the upper 8 m).

On young trees "temporary" branches may be retained along the stem to encourage taper and protect trees from vandalism and sun scald. Less vigorous shoots should be selected as temporary branches and should be about 10 to 15 cm apart along the stem. They should be pruned annually to slow their growth and should be removed eventually.

3. *Crown Reduction* (Fig. 5)

Crown reduction pruning is most often used when a tree has grown too large for its permitted space. This method, sometimes called **drop crotch pruning**, is preferred to topping because it results in a more natural appearance, increases the time before pruning is needed again, and minimizes stress (see drop crotch cuts in the next section).

Crown reduction pruning, a method of last resort, often results in large pruning wounds to stems that may lead to decay. This method should never be used on a tree with a pyramidal growth form. A better long term solution is to remove the tree and replace it

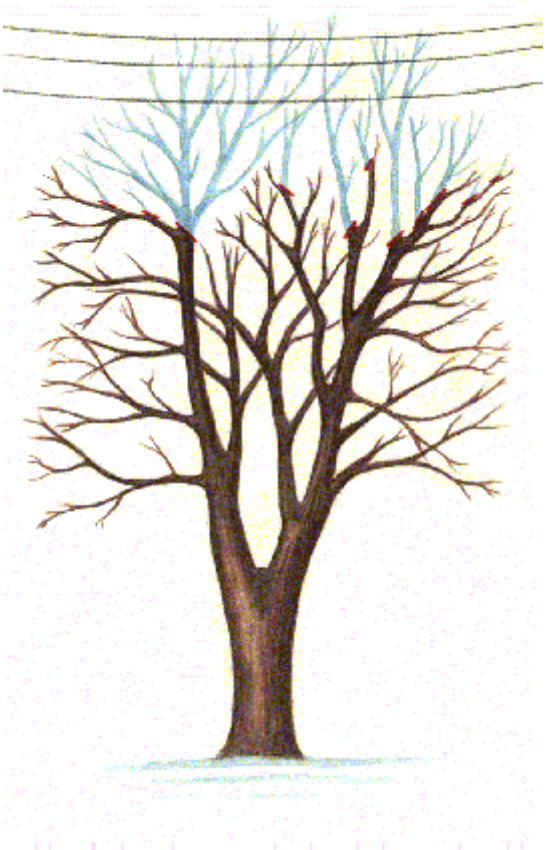


Figure 5. Crown reduction - branches to be removed are shaded in blue; pruning cuts should be made where indicated with red lines. To prevent branch dieback, cuts should be made at lateral branches that are at least one-third the diameter of the stem at their union.

with a tree that will not grow beyond the available space.

Pruning Cuts

Pruning cuts should be made so that only branch tissue is removed and stem tissue is not damaged. At the point where the branch attaches to the stem, branch and stem tissues remain separate, but are contiguous. If only branch tissues are cut when pruning, the stem tissues of the tree will probably not become decayed, and the wound will seal more effectively.

1. *Pruning living branches* (Fig. 6)

To find the proper place to cut a branch, look for the **branch collar** that grows from the stem tissue at the underside of the base of the branch (Fig. 6A). On the upper surface, there is usually a **branch bark ridge** that runs (more or less) parallel to the branch angle, along the stem of the tree. A proper pruning cut does not damage either the branch bark ridge or the branch collar.

A proper cut begins just outside the branch bark ridge and angles down away from the stem of the tree, avoiding injury to the branch collar (Fig. 6B). Make the cut as close as possible to the stem in the **branch axil**, but outside the branch bark ridge, so that stem tissue is not injured and the wound can seal in the shortest time possible. If the cut is too far from the stem, leaving a branch stub, the branch tissue usually dies and woundwood forms from the stem tissue. Wound closure is delayed because the woundwood must seal over the stub that was left.

The quality of pruning cuts can be evaluated by examining pruning wounds after one growing season. A concentric ring of woundwood will form from proper pruning cuts (Fig. 6B). **Flush cuts** made inside the branch bark ridge or branch collar, result in pronounced development of woundwood on the sides of the pruning wounds with very little woundwood forming on the top or bottom (Fig. 7D). As described above, stub cuts result in the death of the remaining branch and woundwood forms around the base from stem tissues.
When pruning small branches with hand pruners, make sure the tools are sharp enough

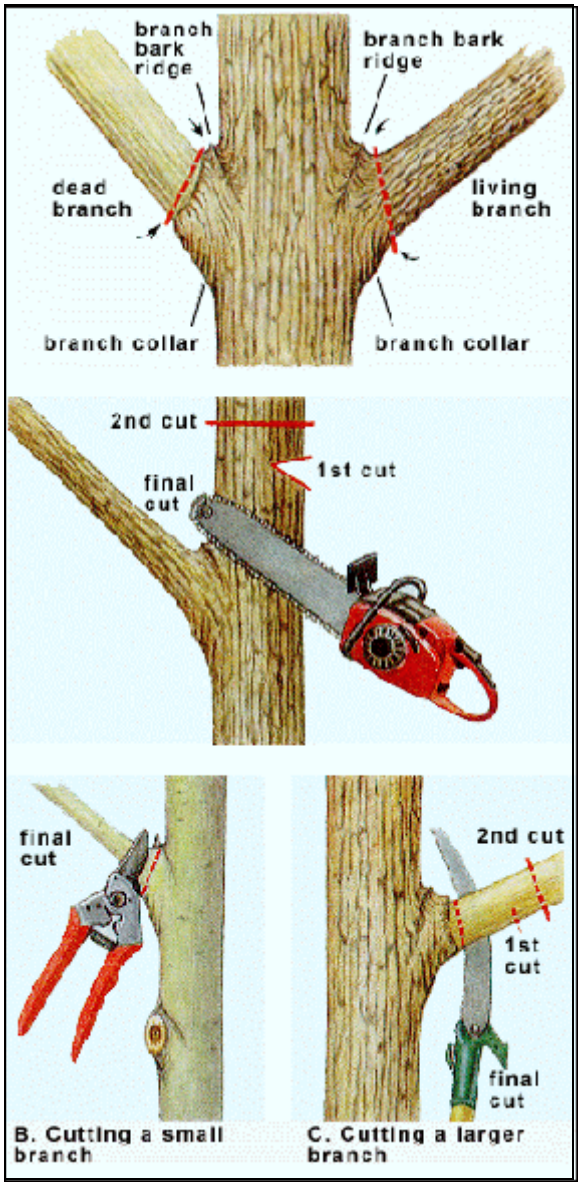


Figure 6. Pruning cuts

to cut the branches cleanly without tearing. Branches large enough to require saws should be supported with one hand while the cuts are made. If the branch is too large to support, make a three-step pruning cut to prevent bark ripping (Fig. 6C).

1. The first cut is a shallow notch made on the underside of the branch, outside the branch collar. This cut will prevent a falling branch from tearing the stem tissue as it pulls away from the tree.
2. The second cut should be outside the first cut, all the way through the branch, leaving a short stub.
3. The stub is then cut just outside the branch bark ridge/branch collar, completing the operation.

2. *Pruning dead branches* (Fig. 6)

Prune dead branches in much the same way as live branches. Making the correct cut is usually easy because the branch collar and the branch bark ridge, can be distinguished from the dead branch, because they continue to grow (Fig. 6A). Make the pruning cut just outside of the ring of woundwood tissue that has formed, being careful not to cause unnecessary injury (Fig. 6C). Large dead branches should be supported with one hand or cut with the three-step method, just as live branches. Cutting large living branches with the three step method is more critical because of the greater likelihood of bark ripping.

3. *Drop Crotch Cuts* (Fig. 6D)

A proper cut begins just above the branch bark ridge and extends through the stem parallel to the branch bark ridge. Usually, the stem being removed is too large to be supported with one hand, so the three cut method should be used.

1. With the first cut, make a notch on the side of the stem away from the branch to be retained, well above the branch crotch.

2. Begin the second cut inside the branch crotch, staying well above the branch bark ridge, and cut through the stem above the notch.
3. Cut the remaining stub just inside the branch bark ridge through the stem parallel to the branch bark ridge.

To prevent the abundant growth of epicormic sprouts on the stem below the cut, or dieback of the stem to a lower lateral branch, make the cut at a lateral branch that is at least one-third of the diameter of the stem at their union.

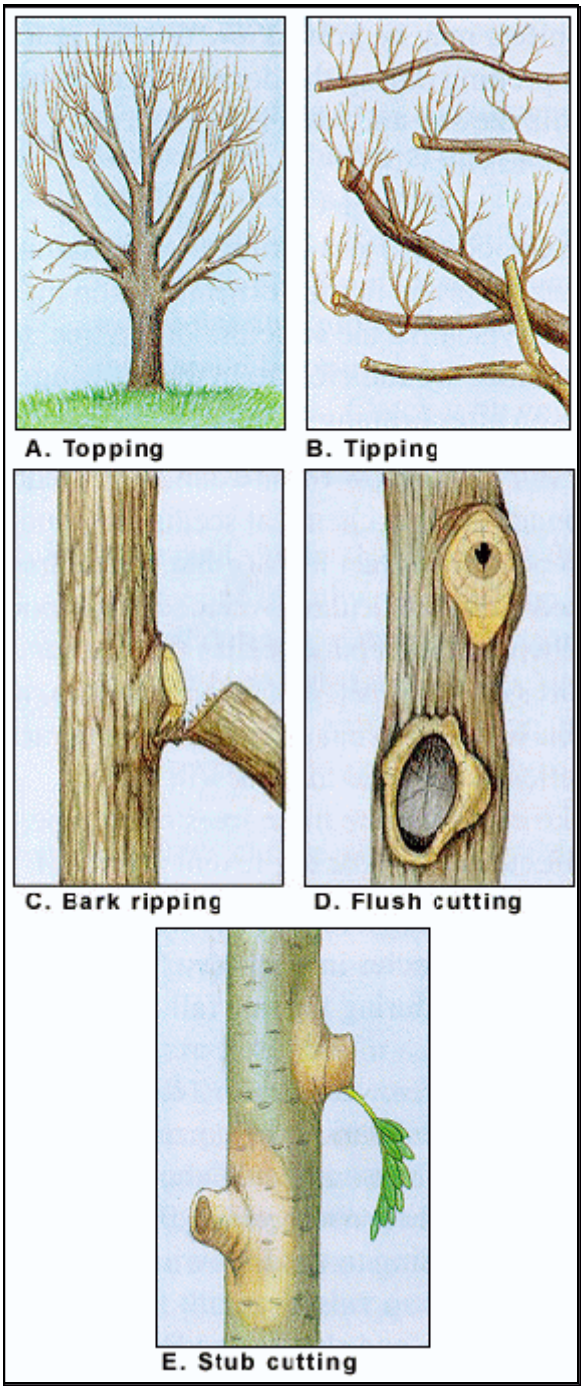
Pruning Practices That Harm Trees

Topping and **tipping** (Fig. 7A, 7B) are pruning practices that harm trees and should not be used. Crown reduction pruning is the preferred method to reduce the size or height of the crown of a tree, but is rarely needed and should be used infrequently.

Topping, the pruning of large upright branches between nodes, is sometimes done to reduce the height of a tree (Fig. 7A). Tipping is a practice of cutting lateral branches between nodes (Fig. 7B) to reduce crown width.

These practices invariably result in the development of epicormic sprouts**,** or in the death of the cut branch back to the next lateral branch below. These epicormic sprouts are weakly attached to the stem and eventually will be supported by a decaying branch.

Improper pruning cuts cause unnecessary injury and bark ripping (Fig. 7C). Flush cuts injure



stem tissues and can result in decay (Fig. 7D). **Stub cuts** delay wound closure and can provide entry to canker fungi that kill the cambium, delaying or preventing woundwood formation (Fig. 7E).

When to Prune

Conifers may be pruned any time of year, but pruning during the dormant season may minimize sap and resin flow from cut branches.

Hardwood trees and shrubs *without showy flowers*: prune in the dormant season to easily visualize the structure of the tree, to maximize wound closure in the growing season after pruning, to reduce the chance of transmitting disease, and to discourage excessive sap flow from wounds. Recent wounds and the chemical scents they emit can actually attract insects that spread tree disease. In particular, wounded elm wood is known to attract bark beetles that harbor spores of the Dutch elm disease fungus, and open wounds on oaks are known to attract beetles that spread the oak wilt fungus. Take care to prune these trees during the correct time of year to prevent spread of these fatal diseases. Contact your local tree disease specialist to find out when to prune these tree species in your area. Usually, the best time is during the late fall and winter.

Flowering trees and shrubs: these should also be pruned during the dormant season for the same reasons stated above; however, to preserve the current year's flower crop, prune according to the following schedule:

- Trees and shrubs that flower in early spring (redbud, dogwood, etc.) should be pruned immediately after flowering (flower buds arise the year before they flush, and will form on the new growth).
- Many flowering trees are susceptible to fireblight, a bacterial disease that can be spread by pruning. These trees, including many varieties of crabapple, hawthorn, pear, mountain ash, flowering quince and pyracantha, should be pruned during the dormant season. Check with your county extension agent or a horticulturist for additional information.
- Trees and shrubs that flower in the summer or fall always should be pruned during the dormant season (flower buds will form on new twigs during the next growing season, and the flowers will flush normally).

Dead branches: can be removed any time of the year.

Pruning Tools

Proper tools are essential for satisfactory pruning (Fig.6). The choice of which tool to use depends largely on the size of branches to be pruned and the amount of pruning to be done. If possible, test a tool before you buy it to ensure it suits your specific needs. As with most things, higher quality often equates to higher cost.

Generally speaking, the smaller a branch is when pruned, the sooner the wound created will seal. Hand pruners are used to prune small branches (under 2.5 cm diameter) and many different kinds are available. Hand pruners can be grouped into by-pass or anvil styles based on the blade configuration. Anvil style pruners have a straight blade that cuts the branch against a small anvil or block as the handles are squeezed. By-pass pruners use a curved cutting blade that slides past a broader lower blade, much like a scissors. To prevent unnecessary tearing or crushing of tissues, it is best to use a

by-pass style pruner. Left- or right-handed types can be purchased.

Slightly larger branches that cannot be cut with a hand pruner may be cut with small pruning saws (up to 10 cm) or lopping shears (up to 7 cm diameter) with larger cutting surfaces and greater leverage. Lopping shears are also available in by-pass and anvil styles.

For branches too large to be cut with a hand pruner or lopping shears, pruning saws must be used. Pruning saws differ greatly in handle styles, the length and shape of the blade, and the layout and type of teeth. Most have tempered metal blades that retain their sharpness for many pruning cuts. Unlike most other saws, pruning saws are often designed to cut on the "pull-stroke."

Chain saws are preferred when pruning branches larger than about 10 cm. Chainsaws should be used only by qualified individuals. To avoid the need to cut branches greater than 10 cm diameter, prune when branches are small.

Pole pruners must be used to cut branches beyond reach. Generally, pruning heads can cut branches up to 4.4 cm diameter and are available in the by-pass and anvil styles. Once again, the by-pass type is preferred. For cutting larger branches, saw blades can be fastened directly to the pruning head, or a separate saw head can be purchased. Because of the danger of electrocution, pole pruners should not be used near utility lines except by qualified utility line clearance personnel.

To ensure that satisfactory cuts are made and to reduce fatigue, keep your pruning tools sharp and in good working condition. Hand pruners, lopping shears, and pole pruners should be periodically sharpened with a sharpening stone. Replacement blades are available for many styles. Pruning saws should be professionally sharpened or periodically replaced. To reduce cost, many styles have replaceable blades.

Tools should be clean and sanitized as well as sharp. Although sanitizing tools may be inconvenient and seldom practiced, doing so may prevent the spread of disease from infected to healthy trees on contaminated tools. Tools become contaminated when they come into contact with fungi, bacteria, viruses and other microorganisms that cause disease in trees. Most pathogens need some way of entering the tree to cause disease, and fresh wounds are perfect places for infections to begin. Microorganisms on tool surfaces are easily introduced into susceptible trees when subsequent cuts are made. The need for sanitizing tools can be greatly reduced by pruning during the dormant season.

If sanitizing is necessary it should be practiced as follows: Before each branch is cut, sanitize pruning tools with either 70% denatured alcohol, or with liquid household bleach diluted 1 to 9 with water (1 part bleach, 9 parts water). Tools should be immersed in the solution, preferably for 1-2 minutes, and wood particles should be wiped from all cutting surfaces. Bleach is corrosive to metal surfaces, so tools should be thoroughly cleaned with soap and water after each use.

Treating wounds

Tree sap, gums, and resins are the natural means by which trees combat invasion by pathogens. Although unsightly, sap flow from pruning wounds is not generally harmful; however, excessive "bleeding" can weaken trees.

When oaks or elms are wounded during a critical time of year (usually spring for oaks, or throughout the growing season for elms) -- either from storms, other unforeseen mechanical wounds, or from necessary branch removals -- some type of wound dressing should be applied to the wound. Do this immediately after the wound is created. In most other instances, wound dressings are unnecessary, and may even be detrimental. Wound dressings will not stop decay or cure infectious diseases. They may actually interfere with the protective benefits of tree gums and resins, and prevent wound surfaces from closing as quickly as they might under natural conditions. The only benefit of wound dressings is to prevent introduction of pathogens in the specific cases of Dutch elm disease and oak wilt.

Pruning Guidelines

To encourage the development of a strong, healthy tree, consider the following guidelines when pruning.

General

- Prune first for safety, next for health, and finally for aesthetics.
- Never prune trees that are touching or near utility lines; instead consult your local utility company.
- Avoid pruning trees when you might increase susceptibility to important pests (e.g. in areas where oak wilt exists, avoid pruning oaks in the spring and early summer; prune trees susceptible to fireblight only during the dormant season).
- Use the following decision guide for size of branches to be removed: 1) under 5 cm diameter - go ahead, 2) between 5 and 10 cm diameter - think twice, and 3) greater than 10 cm diameter - have a good reason.

Crown Thinning

- Assess how a tree will be pruned from the top down.
- Favor branches with strong, U-shaped angles of attachment. Remove branches with weak, V-shaped angles of attachment and/or included bark.
- Ideally, lateral branches should be evenly spaced on the main stem of young trees.
- Remove any branches that rub or cross another branch.
- Make sure that lateral branches are no more than one-half to three-quarters of the diameter of the stem to discourage the development of co-dominant stems.

- Do not remove more than one-quarter of the living crown of a tree at one time. If it is necessary to remove more, do it over successive years.

Crown Raising

- Always maintain live branches on at least two-thirds of a tree's total height. Removing too many lower branches will hinder the development of a strong stem.
- Remove basal sprouts and vigorous epicormic sprouts.

Crown Reduction

- Use crown reduction pruning only when absolutely necessary. Make the pruning cut at a lateral branch that is at least one-third the diameter of the stem to be removed.
- If it is necessary to remove more than half of the foliage from a branch, remove the entire branch.

Glossary

Branch Axil: the angle formed where a branch joins another branch or stem of a woody plant.

Branch Bark Ridge: a ridge of bark that forms in a branch crotch and partially around the stem resulting from the growth of the stem and branch tissues against one another.

Branch Collar: a "shoulder" or bulge formed at the base of a branch by the annual production of overlapping layers of branch and stem tissues.

Crown Raising: a method of pruning to provide clearance for pedestrians, vehicles, buildings, lines of sight, and vistas by removing lower branches.

Crown Reduction Pruning: a method of pruning used to reduce the height of a tree. Branches are cut back to laterals that are at least one-third the diameter of the limb being removed.

Crown Thinning: a method of pruning to increase light penetration and air movement through the crown of a tree by selective removal of branches.

Callus: see woundwood.

Decurrent: a major tree form resulting from weak apical control. Trees with this form have several to many lateral branches that compete with the central stem for dominance resulting in a spherical or globose crown. Most hardwood trees have decurrent forms.

Epicormic Sprout: a shoot that arises from latent or adventitious buds; also know as water sprouts that occur for on stems and branches and suckers that are produced from the base of trees. In older wood, epicormic shoots often result from severe defoliation or radical pruning.

Excurrent: a major tree form resulting from strong apical control. Trees with this form have a strong central stem and pyramidal shape. Lateral branches rarely compete for dominance. Most conifers and a few hardwoods, such as sweetgum and tuliptree, have excurrent forms.

Flush Cuts: pruning cuts that originate inside the branch bark ridge or the branch collar, causing unnecessary injury to stem tissues.

Included Bark: bark enclosed between

branches with narrow angles of attachment, forming a wedge between the branches.

Pollarding: the annual removal of all of the previous year's growth, resulting in a flush of slender shoots and branches each spring.
Stub Cuts: pruning cuts made too far outside the branch bark ridge or branch collar, that leave branch tissue attached to the stem.

Tipping: a poor maintenance practice used to control the size of tree crowns; involves the cutting of branches at right angles leaving long stubs.

Topping: a poor maintenance practice often used to control the size of trees; involves the indiscriminate cutting of branches and stems at right angles leaving long stubs. Synonyms include rounding-over, heading-back, dehorning, capping and hat-racking. Topping is often improperly referred to as pollarding.

Topiary: the pruning and training of a plant into a desired geometric or animal shape.

Woundwood: lignified, differentiated tissues produced on woody plants as a response to wounding (also known as callus tissue).

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"How to Prune Trees" was written to help people properly prune the trees they care about. If you doubt your ability to safely prune large trees, please hire a professional arborist. Information in this publication can be used to interview and hire a competent arborist.