

USC Landscape & Irrigation Standard Guidelines

USC LANDSCAPE & IRRIGATION GUIDELINES

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USC LANDSCAPE STANDARD GUIDELINES

1. GENERAL

- 1.1. The desire is to consistently match the existing landscape themes at USC. For area repairs, match existing tree and shrub sizes and varieties. Match grass and ground cover types. New construction must be compatible with existing campus themes. New construction need not match area exactly but must be consistent with themes across campus.
- 1.2. Minimum Design Criteria for Landscape: Landscape design shall consider selection of materials that are generally water efficient, pest-resistant, low maintenance and that are appropriate to the surrounding campus environment or site conditions as well as being consistent with existing themes. Ground cover shall be designed to minimize erosion. All trees, shrubs, lawns, and ground cover to be provided shall be of varieties having compatibility with existing soils, available sunlight, existing foliage themes, and irrigation requirements. Sizes of materials selected should be adequate to assure their survival. Use of small plants is encouraged to maximize adaptability to site conditions. All plant materials shall be guaranteed for ninety (90) days after the owner's acceptance of work. Tree should be chosen in combinations to provide color year round and minimal litter such as tree fruits and flowers. Desire is to provide variations in color with minimal clean-up.

2. MATERIAL SELECTION

2.1. TREES:

- 2.1.1. Need to be low maintenance including manual pick-up requirements and must be balanced with the need to provide seasonal color variations. Type of trees to avoid: Coral trees, Silk Oaks, Olive, Female Ginkos, or any fruit bearing tree,

2.2. SHRUBBERY:

- 2.2.1. Prefer natural growing, open type structure minimizing maintenance requirements. Drought tolerant plant material must be used. Avoid hedge type shrubbery.

2.3. GROUND COVER:

- 2.3.1. Must be compatible with natural litter that will be falling. Avoid types that are brittle and incompatible with litter removal. Avoid large leaf ivy, and other types that will provide shelter for rodents. Ground cover must be drought tolerant.

2.4. LANDSCAPE COLOR:

- 2.4.1. Must be appropriate for soil, season, available irrigation, sunlight, and must be disease resistant. Use color with healthy root structure. Use of color is encouraged around entrances and focal points.
- 2.5. TURF:
 - 2.5.1. Use Marathon III water saver and slow growth turf. Exceptions are areas with limited sunlight. In those areas, use shade tolerant grass with similar blade structure to Marathon.
- 2.6. PLANTS:
 - 2.6.1. Plants shall be in accordance with the California State Regulations for Nursery Inspection of Rules and Grading, and shall conform with American Association for Nurserymen Standards, ANSI Z60, in all ways.
 - 2.6.2. All plants shall have a normal habit of growth and shall be sounds, healthy and vigorous. All plants shall have vigorous and fibrous root systems which are not root bound. Plants with circling or girded roots will not be accepted.
 - 2.6.3. Plants shall be symmetrical and typical for variety and species.
 - 2.6.4. Plants shall be nursery grown under climatic condition Plants shall be nursery grown under climatic conditions similar to those in Los Angeles County or shall be acclimatized prior to planting.
- 2.7. FERTILIZERS:
 - 2.7.1. Appropriate soil tests shall be performed and fertilizers, amendments, and application rates shall be recommended based on those tests and other relevant site conditions.
- 2.8. TOPSOIL:
 - 2.8.1. Topsoil can be stockpiled on the site for future use.
 - 2.8.2. If insufficient topsoil has been stockpiled on the site to complete the work as indicated on the drawings and herein specified, supply imported topsoil of sufficient quantity to complete the work.
 - 2.8.3. Provide Combination Fertility, Agricultural Suitability, and Particle-Size Test, performed by a soils laboratory approved by the Architect and conforming to the requirements of Section 01400. Services of the laboratory shall be paid for by the Contractor.
 - 2.8.3.1. Agricultural Suitability:
 - Salinity (ECE x 10(3)): 0-2
 - Sodium (SAR): 0-4
 - Boron (PPM in Saturated Extract): 0-.7

- 2.8.4. Imported topsoil shall consist of relatively nonexpansive and predominately granular soils such as sandy loam.

PARTICLE SIZE	MINIMUM	MAXIMUM
Clay and Silt	20%	50%
Fine Sand	30%	40%
Coarse Sand	5%	20%
Gravel (Max. Aggregate size $\frac{3}{4}$ ")	0%	8%
Decomposed Organic Matter	2%	50%

- 2.8.5. Should the samples not meet all of the standards given above, the soil laboratory may submit in the report what additives should be installed to correct these problems.

- 2.8.6. Soil shall be similar to existing topsoil and the approval of the Architect must be obtained before delivery of topsoil to the site.

2.9. HERBICIDES:

- 2.9.1. Any pre-emergent or post-emergent herbicide used for weed control must be approved for use by the Owner's Office of Safety.

3. EXECUTION

3.1. Soil Preparation:

3.1.1. Soil Testing

- 3.1.1.1. A soils test will be executed prior to the planting of any and all plant material. The soils test will be done by the Testing Agency and furnished to the Owner. The location of the soil samples on the site will be determined by the Owner's Architect and the Project Manager.

- 3.1.1.2. The soils test must include existing soils analysis, as well as recommendations for general soil amendments and planting backfill mix.

3.1.2. Grades

- 3.1.2.1. Subgrades for areas to receive topsoil: Subgrades shall be 1 inch below finished grades, plus or minus 1 inch, allowing for 6 inches of topsoil and soil amendments.

- 3.1.2.2. Grades of planting areas not to receive topsoil shall be established to within 1 inch of finished grade.

3.1.3. Soil Loosening

- 3.1.3.1. No finish grading or installation of topsoil shall be done until soil loosening has occurred. Soil in all planting areas shall be cultivated to the depths specified below:

- Subgrade of areas to receive topsoil: 8" deep

- Areas not to receive topsoil: 8" deep

3.2. Planting

3.2.1. Planting of Trees and Shrubs:

3.2.1.1. Dig holes for trees a minimum 24 inches greater in diameter than the diameter of the rootball on natural spread of roots, and provide 12 inches of clearance under the rootball. Similarly dig holes for shrubs and vines a minimum of 12 inches greater than the rootball. Allow minimum of 6 inches under all plant balls. Trees requiring staking shall be staked with 2 x 2 x 9' redwood stakes or lodge pole pine tree stakes. Do not put stakes through root ball. Stake all trees according to the "Harris Method".

3.2.1.2. Please refer to Section – Tree Planting Specifications.

3.2.2. Planting of Trees Near Hardscape and Buildings:

3.2.2.1. Trees will be planted at a distance that will prevent cracks and upheaval of hardscape. Trees planted within hardscape will be deep root type trees or will use a deep root planting method. Architect to spec method.

3.3. Soil Conditioning

3.3.1. General:

3.3.1.1. After soil preparation has been completed and high and low spots graded, add soil amendments as indicated and rototill, making repeated passes with the cultivator to the depth specified and the amendments have been thoroughly mixed.

3.3.2. Tree and Shrub Planting Holes:

3.3.2.1. Planting Holes

- Locate planting holes per planting plans bringing any conflicts with underground utility lines to the attention of the Owner's Project Manager.
- Excavate square holes to the sizes and depths indicated on the drawings for box trees.
- Excavated soil may be spread evenly over shrub beds provided that required finished grades are maintained, and previously completed soil conditioning is not covered over. Rocks ½ an inch in diameter or greater and debris must be removed and disposed of off the site.
- Scarify the sides and bottom of the holes.

3.3.2.2. Backfilling

- Backfill the planting holes with the backfill mix amended as per the Soils Analysis to be suitable to the site and the particular planting.
- Water-settle backfill thoroughly or compact by other approved method prior to planting so plants do not settle.
- Provide a watering basin berm at all planting holes.

3.3.2.3. Backfill Mix

- Materials: topsoil with added amendments as recommended by the Soils Analysis.
- Mixing:
 - Prepare the mix in stockpiles on site; do not mix at each individual planting hole.
 - Mix thoroughly, leaving no layers of soil amendments or clods of soil.
- Fertilizer Tablets: Place tablets in the backfilled planting holes per the manufacturer's printed recommendations at the following rates.

1 gallon containers	2 tablets
5 gallon containers	2 tablets
15 gallon containers	6 tablets
24" boxes	8 tablets
36" boxes	12 tablets

3.4. Maintenance

3.4.1. Establishing Maintenance Period:

- 3.4.1.1. As soon as all planting is completed, a planting review to determine the condition of the plantings will be held.
- 3.4.1.2. Upon approval of the work by the Owner's Representative, the 90 day maintenance period shall begin.

3.4.2. Maintenance of Planting:

- 3.4.2.1. Continuously maintain all plantings in areas included in the contract from the beginning of contract work, during the progress of work, and for a period of 90 days after completion of all work or until final acceptance of all contract work by the Owner (whichever is later).

3.4.2.2. Scope:

- New plantings.
- Existing plantings within the construction area.
- Continuous operations of watering, weeding, cultivating, mowing, trimming, edging, rolling, fertilizing, insect, pest, fungus, and rodent control,

and any other operations to assure normal healthy growth.

- Contractor shall be on-site at least once a week during the maintenance period.

3.4.2.3. Fertilizing: In addition to fertilizing of trees and shrubs as required, furnish and apply any additional fertilizers necessary to maintain plantings in a healthy, vigorous state during the maintenance period.

3.5. Guarantee

- 3.5.1. All trees, shrubs, groundcovers, and other plant materials shall have a guarantee period which encompasses the replacement of dying, unhealthy, unsightly or non-typical habit plant material from the time of final acceptance for one calendar year.
- 3.5.2. Any trees or other plant materials that die back and lose the form and size originally specified, shall be replaced, even though they have taken root and are growing after the die-back.

USCTREE PLANTING STANDARD GUIDELINES

MAINTENANCE COMPONENTS

RESPONSIBILITY

Facilities Management Services Operations and Maintenance (FMS O&M) at The University of Southern California shall be responsible for managing the urban forest on campus. Management and administration of the tree asset shall include work documentation, regular inspections, and periodic comprehensive tree surveys. The department is also responsible to enforce the specifications and guidelines for planting, pruning, removals, and construction management.

Work Documentation

Any work performed on a campus tree shall be documented in the ArborPro Database Program. This is to include both tree work done by USC staff and contracted personnel. All documentation should include:

- specific work performed
- date work was performed
- Whether work was done in-house or by contractor

Inspections

Tree inspections of trees shall take place during landscape inspections. The intent of the inspection is to get a general impression of the trees' condition. When conducting the inspection, the following criteria shall be considered:

- General tree appearance
- Tree structure
- Dangerous or heavy tree limbs
- Trunk taper; evidence of girdling surface roots
- Evidence of disease or insects
- Site conditions – sidewalk damage, walkway light obstruction, etc.

Daily inspections should be performed by Team Leaders and groundworkers in their respective zones while making their rounds. The main objective of the daily inspection is to notice any broken or hanging branches, and any abnormal or unsafe tree condition.

TREE SELECTION AND PLANTING

FMS O&M shall be responsible for the planting of all trees. Guidelines have been developed to promote the health and safety of trees on campus. Specifications have been established to maintain tree health and safety from planting time

through maturity. These specifications are required for any tree planted on campus.

Season to Plant

All trees shall generally be planted between mid-Fall and early Spring. This time of year takes advantage of cooler weather and the dormant period for most trees. If any tree is planted outside of this time window, the site must have an automatic irrigation system to ensure the tree gets the proper amount of water.

Planting Sites

It is the objective of USC to plant trees in all practical vacant sites throughout campus. The desire is to plant trees in areas where they will thrive and acclimate to their surroundings. The practicality of each site shall be based upon the following criteria:

1. Spacing

The spacing overhead, underground, and radially allow for the healthy unimpeded growth of the tree to its mature size. Specific examples making a site unsuitable for planting include:

- A. Inappropriate canopy room between existing trees or buildings.
- B. Too close a proximity to existing utilities.
- C. Potential conflict with overhead power lines.
- D. Inadequate width of planter or parkway for accommodating the tree's girth.

2. Traffic Clearance

To ensure there is adequate line of sight visibility between normal vehicular or pedestrian traffic, necessary signage, and walkway lighting or views.

3. Maintenance Resources

The planting site has a consistent and adequate water source available; preferably automated.

4. Funding

There is funding available in the current fiscal year's budget for the purchase of trees and planting materials.

Nursery Stock Standards

FMS O&M shall make every effort to ensure that it plants only vigorous, healthy trees which can easily be trained into an attractive, natural form, with strong roots, and good crown development.

Acceptable nursery stock shall adhere to the following specifications:

1. All trees shall be true to type or botanical name as ordered or shown on planting plans
2. Smaller container grown trees shall be of appropriate size for the container as specified in the most recent addition of the American Standard for Nursery Stock.
3. All trees shall have a single fairly straight trunk with good taper and good branch distribution vertically, laterally, and radially.
4. The root ball shall be moist throughout and the crown shall show no sign of moisture and stress.
5. All trees shall comply with Federal and State laws requiring inspection for plant disease and pest infestations.
6. No tree will be accepted that has been severely topped, pollarded, headed back, or lion-tailed.
7. No tree will be accepted that has co-dominant leaders or excessive weak branch attachments that can not be trained out without jeopardizing the natural form of the species.
8. No tree will be accepted that is root bound shows evidence of girdling or kinking roots, or has roots protruding above the soil.
9. Plants will not be accepted in a wilted condition.

FMS O&M shall reserve the right to refuse any nursery stock that does not meet any of these standards. In the event a contractor plants such sub-standard trees, on USC property, the trees will be removed and replaced at their expense.

Planting Material Standards

Unless otherwise approved by USC or their consulting arborist, all trees shall be planted using materials that meet the following criteria:

1. Tree stakes shall be two sturdy, 8-12 foot long lodge pole pine stakes. Stakes will be placed on the outer edge of the root ball on either side of the tree, perpendicular to prevailing winds. Acceptable substitutes are 10' Wonder stakes or Reddy stakes.
2. Staking ties shall be ArborTie™ or VIT Cinch tie to be fastened to each stake with galvanized roofing nails. Ties will be pulled around the tree's trunk in a figure eight manner that supports the top-heaviness of the canopy, but is loose enough to allow for free movement of the tree in the wind. This will help develop and increase the tree's caliper.
3. Trunk guards shall be placed around the base of the trunk, just above the soil grade. The guard must be approved in advance by the University. The trunk guard helps eliminate wounds and mechanical damage caused by weed whips and mowers.
4. A 3-4" wood chip mulch shall be placed within the planting basin of the tree. The mulch shall be placed 3" away from the tree's trunk to allow airflow and to restrict moisture from standing at the base of the tree. Mulch shall be composted for at least six weeks and shall be free of decomposition odors.

Fine particles shall be screened out. The particle size range shall be from ½ to 3 inch. Bark products are not permitted.

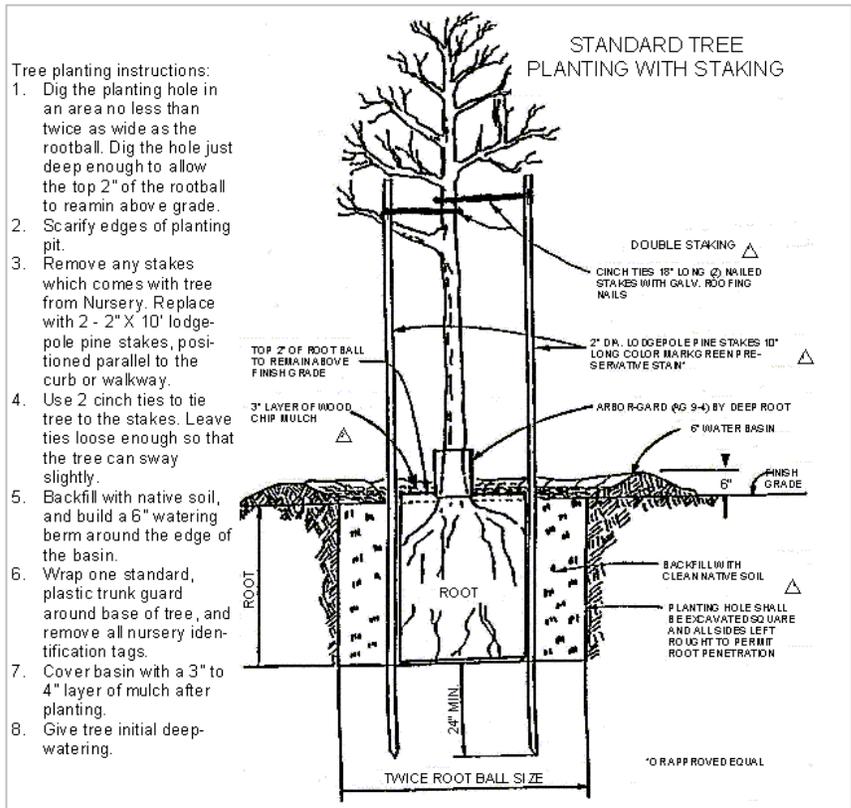
Tree Planting Specifications

All trees shall be planted immediately after the planting container is removed. Containers shall not be cut or otherwise damaged prior to delivery of the trees to the planting area.

The planting hole is one of the most important factors in establishing a healthy tree. Measure the width and depth of the root ball prior to digging. The diameter of the hole shall be dug at least twice the size of the root ball. The depth of the planting hole shall be dug slightly shallower than the depth of the root ball to allow for the top 2" of the root crown to remain above the finished grade. Before placing the tree into the planting hole, tamp down the base of the hole to allow the tree to stand straight and to avoid the potential of the tree settling below the finish grade. Scarify and scrape the side of the planting hole to break down any glazing and compaction, which may occur as a result of digging.

Position the tree in the hole so that the tree stands upright and the top of the root crown is slightly exposed above the grade. Then, backfill the planting holes with clean, native soil no higher than half way up the root ball. Slightly tamp the soil to remove air pockets, but be sure to not compact the soil too much or disturb the root ball. Complete the backfilling to the finish grade. Once again tamp the soil lightly to remove air pockets. If the root ball settles below grade, it must dug up and set at the proper grade as described above.

Form a watering basin out of the backfill material, approximately 6" high around the planting basin of the tree. Remove all nursery stakes, ties and ribbons from the tree, and install the stakes, ties, and trunk guard as specified above. Give the tree an initial deep watering.



Trees in windy areas or high traffic areas will need staking. Trees delivered from the nursery without stakes (e.g. palms) and planted in protected areas do not need staking. Where needed, staking and/or guying shall be completed immediately after planting. Trees larger than three inches in caliper shall be guyed using 3 guy wires and ground anchors. Ground anchors are to be driven at approximately 45 degrees and distributed at 120 degree intervals around the trunk. Trees up to five inches in caliper shall have 4 inch anchors driven at least 2 feet deep. Trees up to seven inches in caliper shall have 6 inch anchors driven at least 3.5 feet deep. Larger trees shall use 8 inch anchors driven at least 4 feet deep. Guying cable shall be 5 strand, 3/16 inch diameter steel cable. Cables shall be marked for clear and lasting visibility using a method approved by the University.

Tree stakes and ties should be removed from the tree within two years after planting.

Palms delivered as container grown specimens shall be planted according to the specifications above. Palms delivered as field dug specimens shall be planted in clean #16 graded sand. The planting pits shall be one foot wider on each side than the rootball and the same depth as the rootball. Planting pits shall be tested for water percolation and drainage provided where needed (<1"/hour). Palms that will not or may not stand on their own shall be braced or guyed, but not planted deeper to provide stability.

Tree Pruning at Planting Time

Only trees with broken or dead limbs, and approved as such by the Consulting Arborist shall be pruned. The spacing, balance and attachment of limbs should be evaluated prior to pruning. All pruning cuts should be made per ANSI A-300 standards. Properly pruned shall mean:

- a. Prune only dead or broken limbs.
- b. All broken limbs shall be removed to the next sound branch or vigorous bud.
- c. All dead limbs or dead portions thereof shall be removed to the next live branch or well-placed bud.
- d. In turf, all limbs less than two (2) feet from the ground shall be removed, unless doing such would cause irreparable damage or leave the tree unbalanced. Multi-trunk trees are exceptions.
- e. All pruning cuts shall be made at the branch collar, without damaging the collar (see Trimming Standards).
- f. The primary terminal bud shall not be removed.

Young Tree Maintenance

All newly planted trees shall be placed on a schedule to receive young tree maintenance immediately after completion of a planting program.

PRUNING

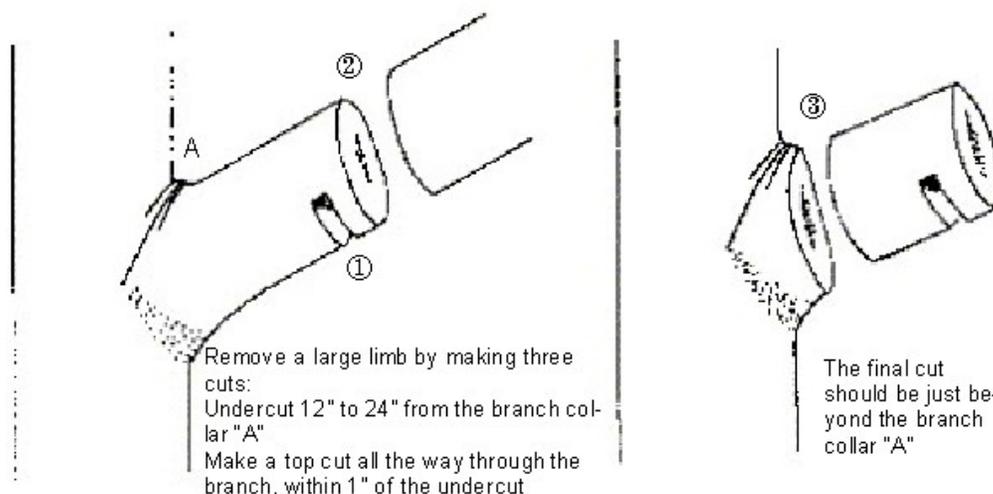
FMS O&M shall be responsible for all pruning of University of Southern California trees. All USC trees shall be pruned on a regular basis using professionally accepted tree pruning standards. These standards are established by the International Society of Arboriculture (ISA), National Arborists Association (NAA), and American National Standards Institute (ANSI) Section Z133.1. All trees shall be pruned in a manner to encourage good development while preserving their overall health, structure and natural appearance. Topping, heading back, lion tailing, or pollarding of campus trees is strictly forbidden. Any variation to these trimming guidelines must be approved prior to work commencing by the University or their consulting arborist.

Pruning Techniques

“Thinning” cuts, or “drop crotching” cuts in mature trees, are the standard pruning technique for all trees. A thinning cut can be defined as the removal of a branch at its point of origin, or the shortening of a branch to a lateral that is large enough to assume the terminal role. Pruning cuts should be made just outside the branch bark ridge and collar. Cutting inside of the branch bark ridge and collar shall be avoided. “Flush cut” is the term used to describe the location of this type of cut. A “flush cut” creates a larger wound and exposes trunk tissues to the possibility of decay. When no collar is visible, the cut angle should parallel the angle formed by the bark branch ridge and trunk.

When reducing the length of a large branch, the final cut should be made just beyond the branch bark ridge of the branch being cut. The remaining branch should be no less than 1/3 the diameter of the branch being removed. The remaining branch should also have enough foliage to assume the terminal role.

PRUNING A LIVE BRANCH



Pruning cuts should be made clean and smooth. Tearing or stripping of the bark shall be avoided at all times. To avoid tearing and stripping of bark, a three-cut process can be performed. The first cut, or undercut, is made approximately a quarter to a third of the distance of the branch being removed. A second cut is then made 6 –8 inches beyond the undercut. Once the weight of the branch is removed, the final cut is made just outside the branch bark ridge and collar. This technique will help minimize unnecessary wounding to the tree.

Training Young Trees

It is important to train and develop young trees in the first three years they are planted. Properly trained trees will become structurally strong and develop into well-suited trees for their surrounding environment. A well-trained tree will require very little corrective pruning as they mature. A maturing tree should have a sturdy, well-tapered trunk with well spaced branches that are smaller in diameter than the trunk. If a tree is properly trained and pruned in its first couple of years, less pruning and maintenance will need to be performed on the tree once it's mature.

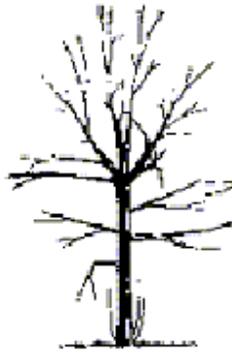
Each tree shall be scheduled for training at least once within the first two years after being planted. This trim shall include cleaning out of any dead wood and pruning the tree in a manner as to develop good structure. Also, young trees shall be inspected to ensure stakes and ties are providing adequate support for the tree. Lastly, the tree shall be examined to verify it is getting the correct amount of water.

Example:
Not Pruned When Young



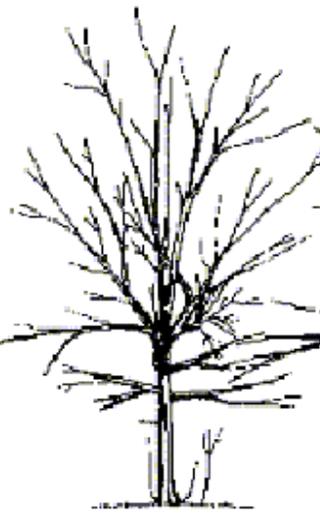
At Planting

You may receive instructions to the contrary, but little should be done to the tree at this stage. In most cases, it is best to leave all the leaf surface possible to manufacture food that will build a larger root system. It has been found that both roots and top will be larger after one year if left unpruned.



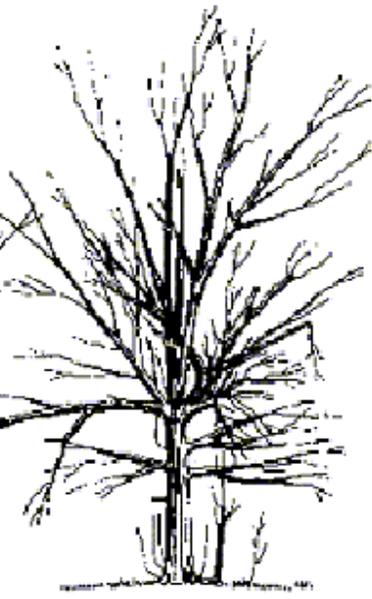
After 3-4 Years

By the time many transplants are in their new home for 2 to 4 growing seasons, sprouts and suckers may appear. The root suckers protruding near the base sap strength from the tree. The sprouts are disproportionately vigorous and weakly attached to the tree. And look at the broken limb. By now, it has sprouted numerous branches just below the break—too many, in fact.



After 5-7 Years

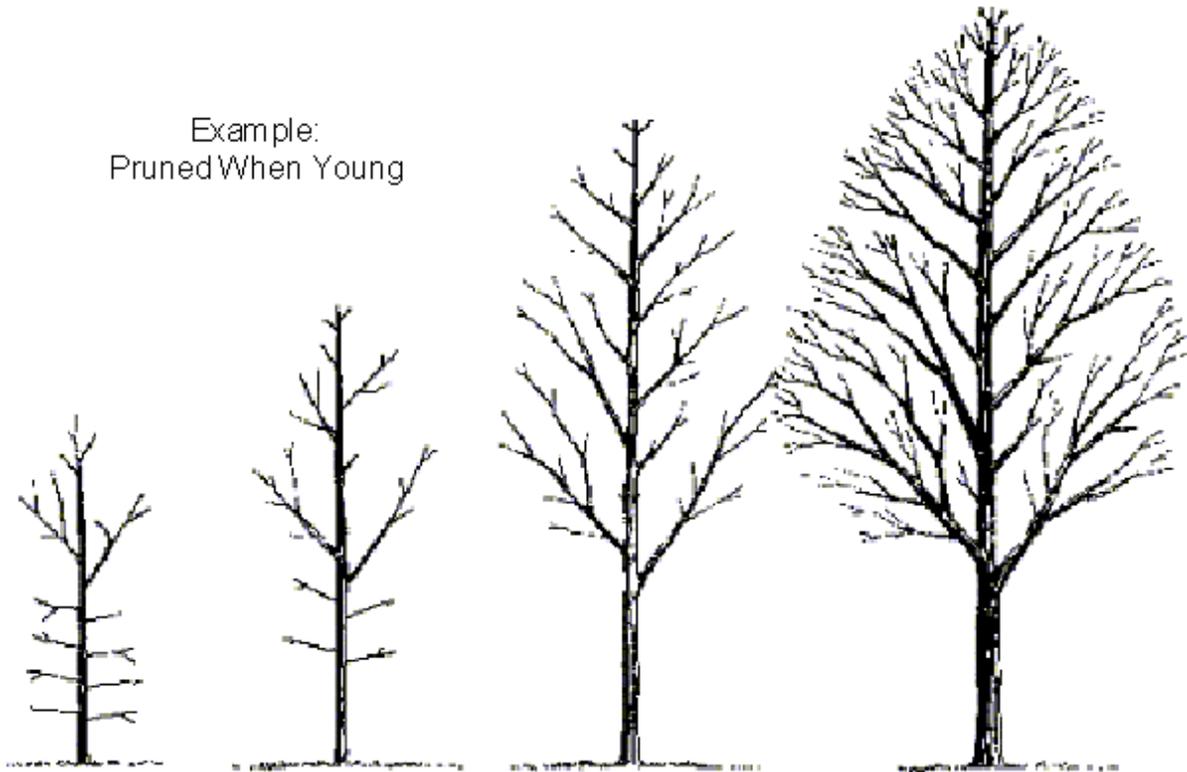
The baby is quickly becoming an adult. The results of not making corrections early in life are now quite visible, although some are still not obvious to the untrained eye. To the more careful observer, the form of the future crown is apparent.



15 Years After Planting

The tree is now not only unattractive, but dangerous, especially when the wind is blowing. Lopsided and dense, the tree in full leaf catches the wind like a sail. Also, the narrow branch angles and multiple leaders have resulted in a weak top. The broken branch not only attracted insects, but may soon break off under the weight of too many sprouts. Decay has entered the trunk where the little bent branch tore off many years ago and a jagged stub protrudes just above it. The tree is an accident waiting to happen. It is becoming more of a liability than an asset for the property.

Example:
Pruned When Young



At Planting

At planting there was a broken branch and a branch that was competing with the leader. Both were pruned close to the trunk. Another, swollen from the sting of an insect laying eggs (a gall), was snipped off. Otherwise, all branches were left intact to provide maximum leaf surface to manufacture food during the first year of life in its new home.

After 3-4 Years

By now root growth should be well on its way to anchoring the transplant and expanding to the size necessary to nourish the growing branches. The root suckers and sprouts in the crown are cut off. Other excessive branches are thinned to reduce competition for light, water and nutrients, and a co-dominant leader is removed. A few of the lowest limbs are also removed, but others are temporarily left to help the trunk develop more taper and strength. Growth is far enough along to reveal problems developing such as branches that rub or are growing in an undesirable direction. Narrow angles are also eliminated.

After 5-7 Years

Now is the time to make a good tree even better. Lower limbs are pruned off to "raise" the bottom of the crown well out of the way of human heads. The lowest limbs are now the permanent lowest limbs. *An important fact is recognized here. Branches do not move upward as a tree grows taller. The center of a branch at 5 feet will always be at 5 feet.* Higher up, a few overzealous branches are cut back so they do not protrude beyond the graceful outline of the crown. A branch here and there is removed for more even spacing—but basically the job of sculpturing the tree is now complete.

15 Years After Planting

This tree survived a major wind storm one summer day. While many other trees suffered split tops and broken limbs, this one stood strong and firm. Proper pruning gave strength to the branches and allowed the wind to pass harmlessly through the thinned crown. Early each spring the tree gets scrutinized and dead or damaged limbs are cut off using proper pruning methods.

* Illustration Courtesy of National Arbor Day Foundation

Pruning Mature Trees

As trees mature the need for structural pruning should decrease. The focus should then be on maintaining tree structure, form, health, and appearance. One of the following three trim methods shall be used to accomplish this.

1. **Crown Cleaning** is the removal of dead, dying, broken, diseased, crossing, weakly attached, and low-vigor branches from a tree's crown. It also includes the elimination of water sprouts, sucker growth, and foreign materials from the entire tree. Crown cleaning shall be completed on an as needed basis.
2. **Crown Restoration** improves structure and appearance of trees that have sprouted vigorously after being broken, topped, or severely pruned using heading cuts. One to three sprouts, on main branch stubs, should be selected to form a natural appearing crown. More vigorous sprouts may need to be thinned or cut to a lateral to control length growth or ensure adequate attachment for the size of the sprout. Crown restoration may require several prunings over a number of years. Crown restoration shall be done as needed. It will be based upon the specific condition and circumstances surrounding the tree.
3. **Crown Thinning** is the selective removal of branches to increase light penetration and air movement through the crown. Thinning opens up the tree, reduces weight on heavy limbs, distributes growth and vigor throughout the tree, and helps retain the tree's natural form.

As a rule, no more than 20% to 30 % of live growth should be removed when a trimming is performed. In sensitive or slower growing trees, no more than 10% of live growth shall be removed. Trees always need to be trimmed to their natural form. Well-shaped inner lateral branches with foliage shall be retained through this process. Thinning trees and branches makes mechanical stress more evenly distributed along the branch and throughout the tree.

4. **Palm trees** shall be pruned by removing all dead and live fronds so that the remaining healthy fronds are existing at an upward 80-degree angle in relation to a horizontal plane at the head of the palm tree. All frond sheaths shall be removed along the entire length of the tree.

Pruning Cycles

Pruning frequency is important to a tree's health. Pruning cycles are determined by safety, health, and aesthetics. Other factors should be based upon species growth rate and pattern, susceptibility to breakage, and environmental factors. The campus has been split into three trimming districts. In general, each tree will be put on a three year trim cycle. There will be exceptions made for certain tree

species that may need to be trimmed more frequently. Examples of these trees are Palms and Corals. These trees will be put on an annual or bi-annual trim cycle.

Trees such as Pines may need to go to a four or five year cycle. This will be determined at each three year cycle. If a tree is scheduled to be trimmed, but does not need it at the time, it will be deferred to the following year. Necessary maintenance required on individual trees shall have priority over the regular pruning cycle. This includes trees infested with insects or diseases. If a tree can become stressed due to trimming at its normal cycle, it will be skipped and trimmed at a better time for it to cope with stress.

Sidewalk, Parking Lot, and Visibility Clearance

Crown raising is the appropriate technique for clearance standards. This process involves the removal of lower branches in order to provide clearance for vehicles, pedestrians, and bicyclists. Remove only those branches needed to achieve the proper height clearance standard. All pruning cuts must be made back to the nearest lateral branch above the required height.

Young trees should be maintained to keep at least one half (1/2) of the foliage on the branches that originate on the lower two-thirds of the tree. This helps establish a significant and well-tapered trunk and also distributes stress within the tree.

The following are height clearance specifications:

1. Sidewalks/Pathways

Limbs shall be raised to a minimum of seven feet and to a maximum of ten feet from grade to wood. Where no sidewalk exists, limbs may be retained below this minimum height standard as long as they conform to the natural shape of the species. If limbs do not interfere with traffic, they can be retained below this minimum height standard.

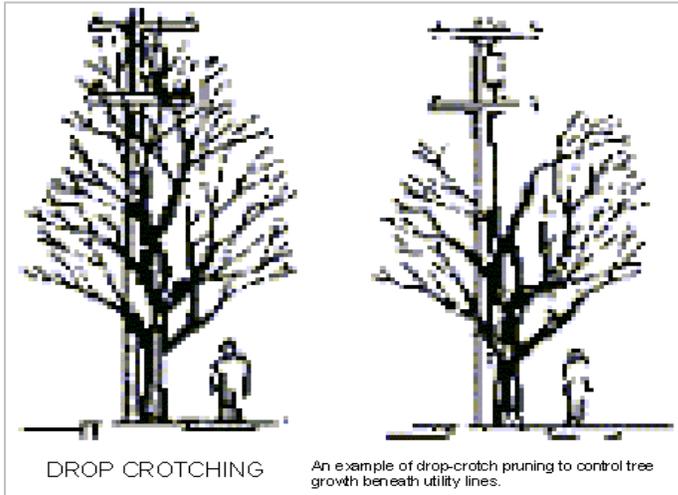
2. Streets/Parking Lots

Limbs shall be raised gradually from eight feet at the curb to thirteen feet over traffic lanes from grade to wood. The limb should give an appearance of an arch rather than an angle.

Clearance for lights or signs shall be achieved through “windowing” through the foliage of the tree. Severely raising or reducing the crown should be avoided whenever possible. Only branches and foliage blocking visibility shall be removed. All branches shall be removed to the nearest lateral found away from the structure to be cleared.\

Utility Clearance Pruning

Anyone working in or around high voltage wiring must be trained as a line-clearance tree worker. All line-clearance work shall adhere to utility pruning standards established by the International Society of Arboriculture and the Utility Arborists Association.



Lateral or directional pruning is the best form of tree pruning under utility lines. It preserves the tree's health and is less costly in the long run. Directional pruning is the removal of a branch to the trunk or a significant lateral branch growing away from the conductor. Heading cuts, or pollarding, encourages vigorous, weak sprouting. Pollarding increases the

frequency of pruning cycles and the cost of maintenance.

Where possible, trees should be allowed to attain normal height, with crown maturing away from high voltage conductors. To achieve clearance, pruning should be restricted to removal of branches at crotches within the tree's crown. Cuts should be restricted as much as possible to achieve the required clearance.

Pruning cuts shall be determined by anatomy, structure and branching habit. Under no circumstance are limbs to be arbitrarily removed, based on a pre-established clearing limit.

"Roundover" or "hedging" cuts are not acceptable pruning practices. These types of cuts cause rapid, vigorous growth, resulting in the need to increase the frequency of pruning. Both roundover and topping of trees for line clearance is prohibited.

Climbing Techniques

Climbing and pruning practices shall not injure the tree except for the pruning cuts. Any climbing spurs or gaffs will not be allowed when pruning a tree, unless the branches are more than throw-line distance apart. In these cases, the spurs should be removed once the climber is tied in. Spurs are allowed only to rescue an injured climber or in tree removal.

Rope injuries to thin barked trees from loading out heavy limbs will be avoided by installing a block in the tree to carry the load. This technique should also be used to reduce injury to a crotch from the climber's line.

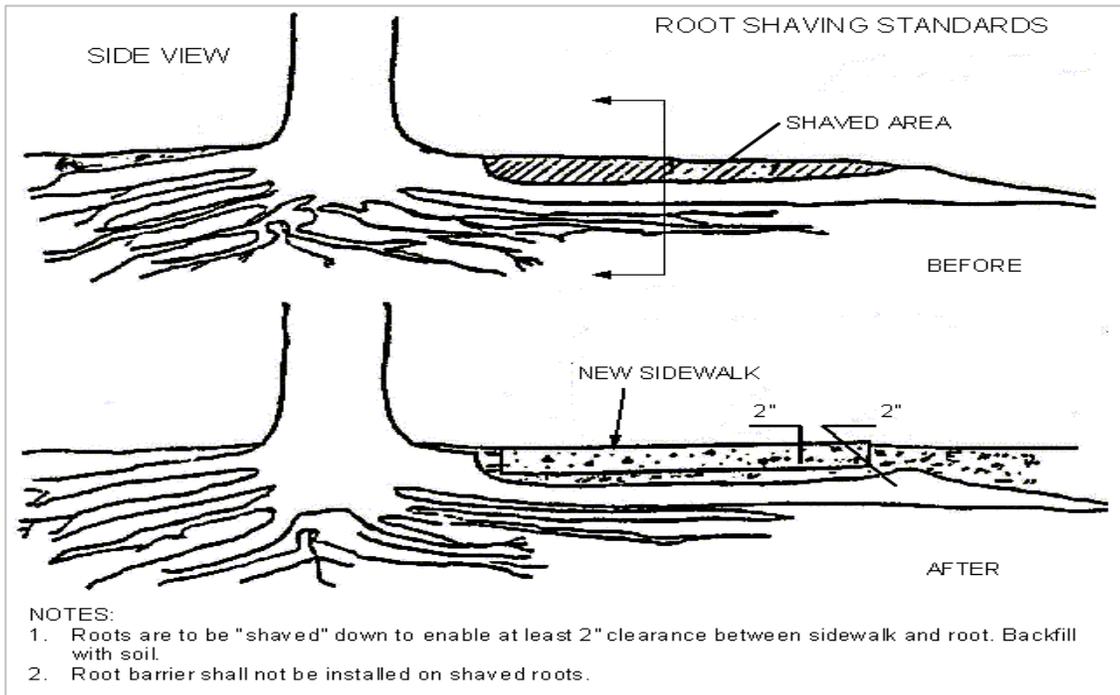
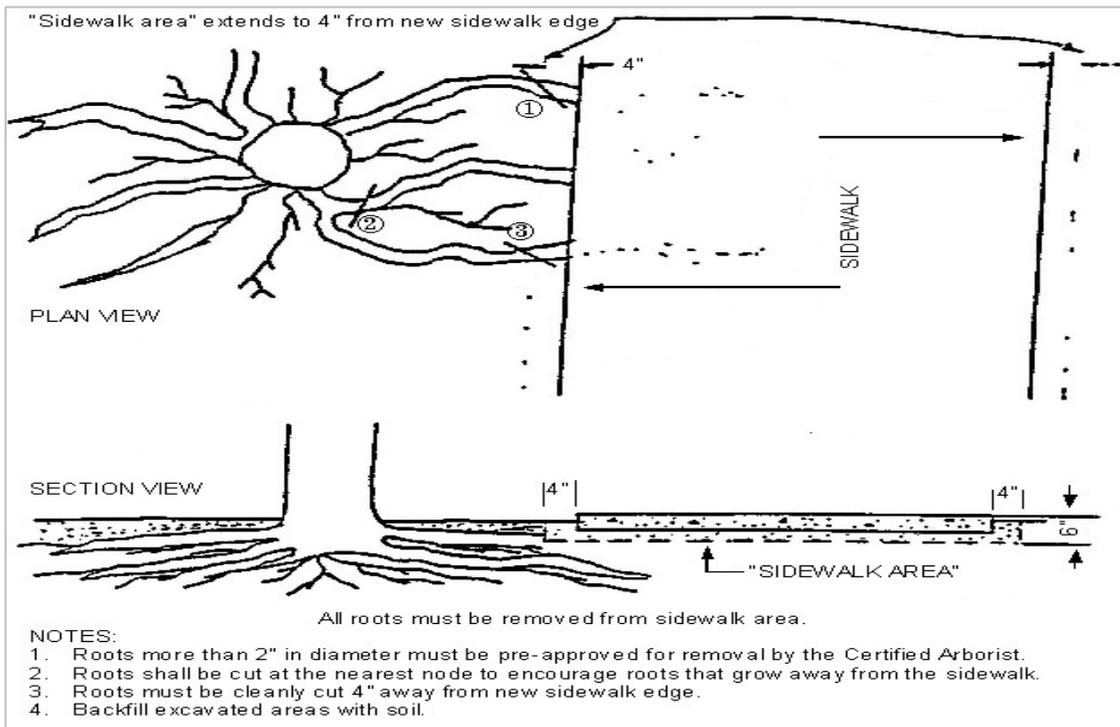
Root Pruning

Because the root system of a tree is the most important physiological component, extreme care and precaution must be taken when pruning the roots. Roots are the main source of water and mineral absorption for the tree. They provide anchorage and stability as well as act as storage area for food. Proper pruning on roots is as important as pruning a tree's crown.

Removing roots shall be avoided whenever possible. If utilities or subsurface structure need to be installed, every effort must be made to trench and dig outside of the tree's dripline. Some examples are irrigation lines, wall footings, or electrical conduit. When it is necessary to encroach into the dripline, every effort must be made to tunnel under or through the tree's root system with a minimal amount of pruning. This is preferred over trenching across the tree's roots. Roots over 2 inches in diameter must be pre-approved for removal by the Associate Director of Landscape and Grounds.

To remove roots for hardscape repair or replacement, two methods shall be utilized. The two methods are Selective Root Pruning and Root Shaving. The following are details and specifications for root pruning and shaving.

- 1. Selective Root Pruning** is the removal of specific roots which are directly interfering with a work area. When selectively pruning roots, care must be taken to retain as much of the root's surface as possible. This includes sufficient buttress root dispersal around the base of the tree. No more than 1/4 of the tree's root system shall be removed. Roots shall be cut back at least four inches from the edge of the new hardscape to the nearest node. Cuts must be made clear and smooth, avoiding tearing and crushing of the root.
- 2. Root Shaving** is the removal of a small portion of a nonessential buttress root or for at least two inches of clearance between the root and the new hardscape. No more than 1/3 of the root's diameter will be shaved off. All shaving will be clean and smooth, avoiding any crushing or tearing of the remaining root.



To avoid moisture loss and minimize drying out, the soil needs to be backfilled immediately following any root pruning or shaving activity.

Contractor Qualifications

Any contractor performing tree work shall be required to employ a Certified Arborist, as accredited by the International Society of Arboriculture (ISA) They must also have a State contractor's license for tree work and provide worker's compensation benefits to their employees. They should also have the appropriate liability insurance. Contractors must adhere to all University of Southern California standards and specifications.

Site Clean-up

The work area is to be left in a condition equal to or better than when it existed prior to work commencement. All lawn areas shall be raked, all streets and sidewalks shall be swept and all brush, branches, rocks or other debris shall be removed from the site. Any turf or shrubs damaged due to tree work must be replaced with same size or larger plants.

REMOVAL

The University of Southern California has a responsibility to protect and preserve its urban forest with healthy trees that provide valuable benefits to our environment and quality of life. The FMS O&M shall be responsible for removals of all trees on campus. The Associate Vice President of Facility Management Services shall have the authority to remove a tree based upon the following conditions:

1. Hazardous Trees

Trees that are determined to be a high risk of failure shall be removed. Some examples of trees considered to be hazardous are ones that have frequent limb breakage or danger of falling and with a high potential of hitting a target such as sidewalks, buildings, or cars. A tree with a majority of decayed, dead, or damaged foliage may be determined to be a hazard and require immediate removal.

2. Dead and Dying Trees

Trees that are dead or have been determined by the Associate V.P. to be in a state of severe decline shall be removed, even if it is determined to not be an immediate hazard.

3. Diseased/Insect Infested Trees

Trees that acquire an infectious disease or are infested by an insect that is declared to be a serious pest threat to other nearby trees shall be removed, if removal is determined to be the best pest control solution. Examples of this include trees infested with the Eucalyptus Longhorn Borer.

4. Emergency Removals

Healthy trees will be removed if an emergency condition exists, and the tree removal is determined to be the only option available. An example would be to allow repair of a sewer main located directly under the tree trunk, or to remove a tree split by a storm and it cannot be feasibly restored to a safe condition.

5. Hazardous Condition Removal

When a tree causes a serious visibility hazard, it should be removed. Removal shall be considered only if pruning to correct the hazard would seriously disfigure the tree or where the continuing cost to maintain the tree would outweigh the value of the tree. An example would be a tree that blocks the visibility of a stop sign.

6. Other Removals

The following shall warrant the removal of a tree:

- If hardscape repairs cannot be completed without severe root pruning which would jeopardize the health and stability of the tree.
- If a tree causes structural damage to a building, and the condition cannot be corrected without removing the tree.

Reasons that are NOT valid for removal:

- Leaves getting into gutters or a nuisance to remove.
- Messy fruit.
- Roots getting into sewer line.
- Hardscape damage if a feasible, economic solution exists to save the tree.

Post Construction Inspection

Immediately after construction is complete notify the University's Representative of completion, and request a Post Construction Tree Inspection. If trees are undamaged, a Certification will be sent to the Contractor within one week of the inspection. If the trees are damaged, the loss in value due to the damages will be determined using the Guide for Plant Appraisal, 9th (or current) Edition, by the Council of Tree and Landscape Appraisers. If the Consulting Arborist determines that corrective tree work is needed, the Contractor will be responsible for the cost of such work. The Contractor will be back-charged for the value of damages or the cost to correct such damages. Since in some cases the value of the trees could exceed the contract amount, it will be in the Contractor's interest to make

sure the work he is hired to do and the storage of his equipment and supplies does not damage or kill these trees. If there are questions, the Contractor may contact the Consulting Arborist through the University's representative for answers and clarification.

Concealed root damage caused by construction activities may also weaken trees and result in toppling. Any unreported and concealed root damage may create financial liability for the damage to people or property if the tree falls. If large roots must be, or are accidentally cut, it is the Contractor's responsibility to document and report such cutting to the University's representative.

All trees planted by a contractor shall be guaranteed for one year. The contractor will replace any tree that shows signs of decline through the guarantee period with a tree of the same size and type.

Site Clean-up

Work areas shall be left in a condition equal to or better than that in which it existed prior to planting. All debris shall be cleaned up each day before the work crew leaves the site. All lawn areas shall be raked, all streets and parking lots swept, and all brush, limbs, rocks, or other debris shall be removed from the site.

CONSTRUCTION MANAGEMENT

Trees and other woody plants respond in specific and predictable ways to injury. The effects of injuries to the above or below ground parts of trees may take several years to become apparent. Large mature trees are especially vulnerable, but take more time to show the effects of injury.

Tree protection must take priority over trying to repair injuries. Once injured, trees do not replace the damaged tissue with new tissue, but must compartmentalize the damage and build new tissue in a new location. In short, injuries are permanent. Compartmentalizing and walling off damaged tissue is done at the cost of stored carbohydrates and can "starve" older trees to death.

The University considers the trees on its campus to be a valuable asset, important to the physical environment and ambiance of the campus. In order to promote construction practices at USC which encourage the protection of tree structure and health, the following policies have been established. Not all contractors working in the area surrounding trees understand trees. These specifications are presented to help guide their work so as to protect the University's old and valuable trees.

Design Phase

As a construction project enters the design phase, an on-site survey will be provided to the Project Manager. This survey will be provided by the Associate Director of Grounds and will specify:

- Every tree on the construction site
- The species type
- Diameter at Breast Height (dbh)
- General condition of each tree
- Approximate value of each tree

General Site Evaluation

As part of the review for a location planned for development, a report from a consulting arborist must be written on the appropriate measures to take regarding trees existing on the project site. The arborist will identify which trees need to be removed and how those removals will be mitigated, and which trees shall be preserved and how those trees will be protected. The arborist shall also examine site access and traffic route considerations, excavation limitations, appropriate locations for the piling of soil and debris, and the storage of equipment and vehicles as each of these activities pertain to trees on the project site.

The awarded contractor must abide by the protective measures specified by the consulting arborist. Not adhering to the arborist's tree protection measures will result in the contractor paying for damages up to and including the value of each affected tree.

Protection Zone

The protection zone is defined as the predetermined radius necessary to protect the canopy, trunk and a sufficient portion of the root zone to maintain good health, stability, and sound structural condition of the trees surrounding the project. The Consulting Arborist will determine the protection zone based on the health, age and species of the trees on a project by project basis.

Protection Measures

The following protection measures shall be used when working near USC trees. Failure to protect USC trees may cause irreversible, long-term or fatal injuries. Damages will be assessed and back-charged to the Contractor based on a monetary appraisal using the Guide for Plant Appraisal, 9th (or current) Edition, by the Council of Tree and Landscape Appraisers.

- **Protection Barrier**

A protection barrier shall be installed around the tree or trees to be protected. The barrier shall be constructed of six-foot high chain-link fencing or other pre-approved material. The barrier shall be placed as far from the base of the tree(s) as possible, at the drip-line or the edge of the Protection Zone, whichever is greater. The fencing shall be maintained in good repair throughout the duration of the project, and shall not be removed, relocated, or encroached upon, without prior written approval by the Consulting Arborist.

- **Material Storage**
There shall be NO storage of materials or supplies of any kind within the area of the protection barriers. Concrete and cement materials, block, stone, sand and soil shall not be placed within the Protection Zone of the tree(s). Compaction of the root zone cannot be fully repaired without removing the tree.
- **Fuel Storage**
Fuel storage shall NOT be permitted within 150 feet of any tree to be preserved. Refueling, servicing and maintenance of equipment and machinery shall NOT be permitted within 150 feet of protected tree(s).
- **Debris and Waste Materials**
Debris and waste from construction or other activities shall NOT be permitted within the Protection Zone. Acid washes or wash down of concrete or cement handling equipment, in particular, shall NOT be permitted within 150 feet of protected trees. Paint residue, asphalt, metal shavings, and various small amounts of some building materials can be toxic to trees.
- **Grade Changes**
Grade changes can be particularly damaging to trees. Even as little as two inches of fill can cause the death of a tree. Lowering the grade can destroy major portions of a root system. Any grade changes proposed should be approved by the Consulting Arborist before construction begins, and precautions taken to mitigate potential injuries.
- **Damages**
Any damages or injuries to trees should be reported to the Consulting Arborist as soon as possible. Severed roots shall be pruned cleanly to healthy tissue, using proper pruning tools. Broken branches or limbs shall be pruned in accordance to International Society of Arboriculture Pruning Guidelines and ANSI A-300 Pruning Standards or the guidelines established in this manual.
- **Preventive Measures**
Fencing the entire canopy is preferred over other protection measures. However, situations may require access through the protection zone. Before construction begins pruning of the tree canopies and branches should be done at the direction of the Consulting Arborist to remove any dead or broken branches, and to provide the necessary clearances for the construction equipment. In addition to clearance pruning, steel plates or one inch plywood over a four inch layer of coarse mulch may be required

to avoid soil compaction. Tree trunks may need to be wrapped with carpet remnants for protection

Irrigation Requirements

All trees affected by the construction must be maintained on a regular irrigation schedule. Trees must be irrigated to maintain optimum moisture levels for each tree. If automated systems are not available, trees should be watered manually to achieve adequate moisture levels. Irrigators or other moisture sensing devices are encouraged to be utilized to monitor moisture levels in the soil around the tree.

Post Construction Inspection

Immediately after construction is complete notify the University's Representative of completion, and request a Post Construction Tree Inspection. If trees are undamaged, a Certification will be sent to the Contractor within one week of the inspection. If the trees are damaged, the loss in value due to the damages will be determined using the Guide for Plant Appraisal, 9th (or current) Edition, by the Council of Tree and Landscape Appraisers. If the Consulting Arborist determines that corrective tree work is needed, the Contractor will be responsible for the cost of such work. The Contractor will be back-charged for the value of damages or the cost to correct such damages. Since in some cases the value of the trees could exceed the contract amount, it will be in the Contractor's interest to make sure the work he is hired to do and the storage of his equipment and supplies does not damage or kill these trees. If there are questions, the Contractor may contact the Consulting Arborist through the University's representative for answers and clarification.

Concealed root damage caused by construction activities may also weaken trees and result in toppling. Any unreported and concealed root damage may create financial liability for the damage to people or property if the tree falls. If large roots must be, or are accidentally cut, it is the Contractor's responsibility to document and report such cutting to the University's representative.

USC IRRIGATION STANDARD GUIDELINES

1. GENERAL

1.1. DESIGN GUIDELINES

- 1.1.1. Available static pressure: 50 psi after the Backflow Prevention device.
- 1.1.2. Use a drip system in shrubs, hedges, and ground cover areas instead of a sprinkler/ stream bubbler/ or gear drive system.

1.2. SUBMITTALS

In addition to the information below, reference USC Standard Close-out Guidelines for additional information.

1.2.1. Material List:

- 1.2.1.1. The Contractor shall furnish the articles, equipment, materials or processes specified by name in the Drawings and Specifications. No substitution will be allowed without prior written approval by the Landscape Architect.
- 1.2.1.2. Complete material list shall be submitted prior to performing any work. Material list shall include the manufacturer, model number and description of all materials and equipment to be used. Although manufacturer and other information may be different, the following is a guide to proper submittal format:

<u>Item</u>	<u>Description</u>	<u>Manufacturer</u>	<u>Model No.</u>
1.	Backflow preventer	Watts	909
2.	Quick coupling valve	Rainbird	33DLVC
3.	6" pop-up spray head	Rainbird	1806 w/ MPR nozzles
4.	N. O. Master valve	Superior	3100

- 1.2.1.3. Irrigation submittal must be specific and complete. All items must be listed and should include solvent/primer, wire, wire connectors, valve boxes, etc.
- 1.2.1.4. Equipment or materials installed or furnished without prior approval of the Owner's Irrigation Supervisor may be rejected and the Contractor required to remove such materials from the site at his own expense.
- 1.2.1.5. Manufacturer's warranties shall not relieve the Contractor of his liability under the guarantee. Such warranties shall only supplement the guarantee.

1.2.2. Record Drawings:

- 1.2.2.1. The Contractor shall provide and keep up to date a complete record set of prints which shall be corrected daily and show every change from the original Drawings and Specifications and the exact in place locations, sizes, and kinds of equipment. Prints for this purpose may be obtained from the Landscape Architect at cost. This set of Drawings shall be kept on the site and shall be used only as a record set.
- 1.2.2.2. These Drawings shall also serve as work progress sheets and shall be the basis for measurement and payment for work completed. The Contractor shall make neat and legible annotations thereon daily as the work proceeds, showing the work as actually installed. These Drawings shall be available at all times for inspection and shall be kept in a location designated by the Landscape Architect.
- 1.2.2.3. Before the date of the final inspection, the Contractor shall transfer all information from the record prints to a CAD as-built. All work shall be neat and subject to the approval of the Landscape Architect.
- 1.2.2.4. The Contractor shall dimension from two permanent points of reference, building corners, sidewalk or road intersections, etc., the location of the following items:
 - Connection to existing water lines.
 - Connection to existing electrical power.
 - Ball valves.
 - Routing of sprinkler pressure lines (dimension maximum 100 feet along routing).
 - Sprinkler control valves.
 - Routing of control wiring.
 - Quick coupling valves.
 - Other related equipment as directed by the Owner's Irrigation Supervisor.
- 1.2.2.5. On or before the date of the final inspection, the Contractor shall deliver the corrected and completed as-builts to the Owner. Delivery of the as-builts will not relieve the Contractor of the responsibility of furnishing required information that may be omitted from the prints.

1.2.3. Controller Charts:

- 1.2.3.1. Record Drawings shall be approved by the Owner before controller charts are prepared.

- 1.2.3.2. Provide two controller charts for each controller supplied. One for the controller enclosure and one to the Owner.
- 1.2.3.3. The chart shall show the area controlled by the automatic controller and shall be on an 8-1/2" x 11" or 11" x 17" sheet.
- 1.2.3.4. The chart shall be a bond print and a different color shall be used to indicate the zone of coverage for each station.
- 1.2.3.5. When completed and approved, the chart shall be laminated.
- 1.2.3.6. These charts shall be completed and approved prior to final inspection of the irrigation system.
- 1.2.4. Operation and Maintenance Manuals:
 - 1.2.4.1. Prepare and deliver within ten calendar days prior to completion of construction, two hard cover binders with three rings containing the following information:
 - Index sheet stating Contractor's address and telephone number, list of equipment with name and addresses of local manufacturer's representatives.
 - Guarantee statement.
 - Catalog and parts sheets on every material and equipment installed under this contract.
 - Complete operating and maintenance instruction on all major equipment. This shall include maintenance information published by the manufacturer.
 - 1.2.4.2. In addition to the above mentioned maintenance manuals, provide the Owner's maintenance personnel with instructions for major equipment and show evidence in writing to the Landscape Architect at the conclusion of the project that this service has been rendered.
- 1.2.5. Equipment to be Furnished:
 - 1.2.5.1. Supply as part of this contract the following tools:
 - Two keys for each automatic controller.
 - 1.2.5.2. The above mentioned equipment shall be turned over to the Owner at the conclusion of the project. Before final inspection can occur, evidence that the Owner has received material must be shown to the Landscape Architect.

1.3. QUALITY ASSURANCE

- 1.3.1. Applicable Standards: Comply with the current applicable provisions of the following, with applicable codes and regulations of the City of Los Angeles and as specified.

- "UPC" - Uniform Plumbing Code published by the Association of Western Plumbing Officials
 - "ASTM" - American Society for Testing and Materials
- 1.3.2. Permits and Fees: The Contractor shall obtain and pay for any and all permits and all inspections as required.
- 1.3.3. Manufacturer's Directions: Manufacturer's directions and detailed Drawings shall be followed in all cases where the manufacturers of articles used in this contract furnish directions covering points not shown in the Drawings and Specifications.
- 1.3.4. Ordinances and Regulations: All local, municipal and state laws, and rules and regulations governing or relating to any portion of this work are hereby incorporated into and made a part of these Specifications and their provisions shall be carried out by the Contractor. Anything contained in these Specifications shall not be construed to conflict with any of the above rules and regulations or requirements of the same. However, when these Specifications and Drawings call for or describe materials, workmanship or construction of a better quality or higher standard than is required by the above rules and regulations, the provisions of these Specifications and Drawings shall take precedence.

1.4. EXPLANATION OF DRAWINGS

- 1.4.1. Due to the scale of Drawings, it is not possible to indicate all offsets, fittings, sleeves, etc. which may be required. The Contractor shall carefully investigate the structural and finished conditions affecting all of his work and plan his work accordingly, furnishing such fittings, etc. as may be required to meet such conditions. Drawings are generally diagrammatic and indicative of the work to be installed. The work shall be installed in such a manner as to avoid conflicts between irrigation systems, planting and architectural features.
- 1.4.2. The word Landscape Architect as used herein shall refer to the Owner's authorized representative.
- 1.4.3. All work called for on the Drawings by notes or details shall be furnished and installed whether or not specifically mentioned in the Specifications.
- 1.4.4. The Contractor shall not willfully install the irrigation system as shown on the Drawings when it is obvious in the field that obstructions, grade differences or discrepancies in area dimensions exist that might not have been considered in engineering. Such obstructions or differences should be brought to the attention of the Owner's authorized representative. In the event this notification is not performed, the irrigation contractor shall assume full responsibility for any revision necessary.

1.5. PRODUCT DELIVERY, STORAGE, AND HANDLING OF PVC PIPE AND FITTINGS

- 1.5.1. The Contractor is cautioned to exercise care in handling, loading, unloading and storing of PVC pipe and fittings. Any section of pipe that has been dented or damaged will be discarded and, if installed, shall be replaced with new piping.

1.6. SUBSTITUTIONS

- 1.6.1. If the irrigation contractor wishes to substitute any equipment or materials for those equipment or materials listed on the irrigation Drawings and Specifications, he may do so by providing the following information to the Owner for approval:
 - 1.6.1.1. Provide a statement indicating the reason for making the substitution. Use a separate sheet of paper for each item to be substituted.
 - 1.6.1.2. Provide descriptive catalog literature, performance charts and flow charts for each item to be substituted.
 - 1.6.1.3. Provide the amount of cost difference if the substituted item is approved.
- 1.6.2. The Owner's authorized representative shall have the sole responsibility in accepting or rejecting any substituted item as an approved equal to those equipment and materials listed on the irrigation Drawings and Specifications.

1.7. GUARANTEE

- 1.7.1. The guarantee for the sprinkler irrigation shall be made in accordance with the contract. The general conditions and supplementary conditions of these Specifications shall be filed with the Owner or his representative prior to acceptance of the irrigation system.
- 1.7.2. A copy of the guarantee form shall be included in the Operations and Maintenance manual.
- 1.7.3. The guarantee form shall be retyped onto the Contractor's letterhead and contain the following information.

"GUARANTEE FOR IRRIGATION SYSTEM

We hereby guarantee that the irrigation system we have furnished and installed is free from defects in materials and workmanship, and the work has been completed in accordance with the Drawings and Specifications, ordinary wear and tear and unusual abuse, or neglect expected. We agree to repair or replace all defects in material or workmanship which may develop during the period of one year from date of acceptance and also to repair or replace all damages resulting from the repair of such defects at no additional

cost to the Owner. We shall make such repairs or replacements within a reasonable time, as determined by the Owner, after receipt of written notice. In the event of our failure to make such repairs or replacements within a reasonable time after receipt of written notice from the Owner, we authorize the Owner to proceed to have said repairs or replacements made at our expense and we will pay the costs and charges therefore upon demand.

PROJECT:

LOCATION:

CONTRACTOR/COMPANY:

LICENSE NO:

ADDRESS:

PHONE:

DATE OF FINAL ACCEPTANCE:

SIGNED:

DATE: "

2. PRODUCTS

2.1. MATERIALS

Use only new materials of brands and types noted on Drawings, specified herein or approved equals.

2.1.1. PVC Pressure Mainline Pipe and Fittings:

- 2.1.1.1. Pressure mainline piping for sizes 2 inches and larger, shall be PVC Class 315. Use primer in all solvent weld pipes and fittings.
- 2.1.1.2. Pipe shall be made from an NSF approved Type I, Grade I, PVC compound conforming to ASTM resin specification D1784 and product design specification ASTM 2241. All pipe must meet requirements as set forth in Federal Specification PS-22-70, with an appropriate standard dimension (S.D.R.) (solvent-weld pipe).
- 2.1.1.3. Pressure mainline piping for sizes 1-1/2 inches and smaller shall be PVC Schedule 40. Use primer in all solvent weld pipes and fittings.
- 2.1.1.4. Pipe shall be made from NSF approved Type I, Grade I PVC compound conforming to ASTM Resin Specification D1784 and product design specification ASTM 1785. All pipe must meet requirements as set forth in Federal Specification PS-21-70 (solvent-weld pipe).

- 2.1.1.5. PVC solvent-weld fittings shall be Schedule 40 unless owner specifies it to be schedule 80.
- 2.1.1.6. Solvent cement and primer for PVC solvent-weld pipe and fittings shall be of type and installation methods prescribed by the manufacturer.
- 2.1.1.7. All PVC pipe must bear the following markings:
 - Manufacturer's name
 - Nominal pipe size
 - Schedule or class
 - Pressure rating in psi.
 - NSF (National Sanitation Foundation) approval
 - Date of extrusion
- 2.1.1.8. All fittings shall bear the manufacturer's name or trademark, material designation, size, applicable I.P.S. schedule and NSF seal of approval.
- 2.1.2. PVC Non-Pressure Lateral Line Piping:
 - 2.1.2.1. Non-pressure buried lateral line piping shall be PVC schedule 40 with solvent-weld joints.
- 2.1.3. PVC Schedule 80 Risers and Nipples:
 - 2.1.3.1. Polyvinyl Chloride Schedule 80 Risers and Nipples. Type 1, Grade 1, Schedule 80, high impact molded, manufactured from virgin compounds as specified for piping. Threaded ends shall be molded threads only . Machined threads are not be acceptable. PVC Schedule 80 nipples and risers shall conform to ASTM D-2464.
- 2.1.4. Brass Pipe and Fittings:
 - 2.1.4.1. Where indicated on the Drawings, use red brass screwed pipe conforming to Federal Specification No. WW-P-351.
 - 2.1.4.2. Fittings shall be red brass conforming to Federal Specification No. WW-P-460.
- 2.1.5. Ball Valves:
 - 2.1.5.1. Ball valves 2 inches and smaller shall be full port bronze with treaded ends. Use Watts B-6080 or equivalent.
 - 2.1.5.2. Ball valves larger than 2 inches shall be either cast iron or bronze, full port and flanged. Use Watts G-4000 series or equivalent.
 - 2.1.5.3. It is not acceptable to substitute a gate valve for a ball valve.

- 2.1.5.4. All ball valves shall be installed per installation detail.
- 2.1.6. Backflow Prevention Units: Watts 909 QTPC (quarter turn internal polymer coated)
 - 2.1.6.1. All irrigation equipment installed under this section shall be downstream of an approved, working Reduced Pressure type backflow prevention device.
 - 2.1.6.2. Install an isolation ball valve before the backflow assembly.
 - 2.1.6.3. Install an inline bronze wye-type strainer Watts 777 between the isolation ball valve and the backflow device.
 - 2.1.6.4. Install brass union joints upstream and downstream of the backflow device.
- 2.1.7. Control Wiring:
 - 2.1.7.1. Connections between the automatic controllers and the electric control valves shall be made with direct burial copper wire AWG-U.F. 600 volt. Pilot wires shall be a different color wire for each automatic controller. Common wires shall be white with a different color stripe for each automatic controller. Install in accordance with valve manufacturer's specifications and wire chart. In no case shall wire size be smaller than 14 gauge.
 - 2.1.7.2. Wiring shall occupy the same trench and shall be installed along the same route as pressure supply or lateral lines wherever possible.
 - 2.1.7.3. Where more than one wire is placed in a trench, the wiring shall be taped together at intervals of 10 feet.
 - 2.1.7.4. An expansion curl shall be provided at each major change of direction and within 3 feet of each wire connection. Expansion curl shall be of sufficient length at each splice connection at each electric control valve, so that in case of repair, the valve bonnet may be brought to the surface without disconnection of the control wires. Control wires shall be laid loosely in trench without stress or stretching or control wire conductors.
 - 2.1.7.5. USC's irrigation department must be notified at all times whenever existing control wires are accidentally disturbed. All underground wire splices must be water proof and installed in a valve box.
 - 2.1.7.6. Always provide 3 additional extra red wires to the farthest valve from the controller. In cases where the mainline branch out at different directions, extra red wires needs to be provided to each branch.
 - 2.1.7.7. All wires must be marked with the corresponding station number at the controller.

2.1.8. Water Proof Wire Connectors:

- 2.1.8.1. All splices shall be made with Scotch-Lok No. 3576 connector sealing packs, Rainbird snap-tite wire connector, Spears SP DS-400 or approved equal. Use one splice per connector sealing pack.
- 2.1.8.2. Field splices between the automatic controller and electrical control valves shall not be allowed without prior approval of the Landscape Architect.

2.1.9. Automatic Controllers:

- 2.1.9.1. Proposed location for new controllers must check for radio signal strength by radio technician of Calsense Irrigation. Controller must be properly grounded with a 5/8" x 8' ground rod and a AWG #6 solid copper wire. Follow Calsense's grounding specifications.

	Description	Manufacturer	Model
1.	Irrigation Controller	Calsense	ET2000E-40-LR-RR
2.	Stainless steel top open enclosure	Calsense	SSE-IR

2.1.10. Remote Control Valves:

- 2.1.10.1. All remote control and pressure reducing valves shall be as indicated on the irrigation plans.
- 2.1.10.2. All remote control valves must be installed with a Schedule 80 PVC union joint on both sides of the valve; upstream and downstream side of the valve.
- 2.1.10.3. Provide and install one rectangular valve box for each remote control valve assembly.
- 2.1.10.4. Remote Control Valves Rain Bird PESB-R Series

2.1.11. Control Valve Boxes:

- 2.1.11.1. Use 10 inch x 10-1/4 inch round box for all ball valves, NDS #212 BC with green bolt down cover or approved equal. Extension sleeve shall be PVC - 6 inch minimum size.
- 2.1.11.2. Use 12 inch x 17 inch x 12 inch rectangular box for all remote control valve assembly, NDS #214 BC with green bolt down cover.
- 2.1.11.3. Use NDS #214 BC rectangular box for all filters and automatic line flush valves. Provide box extensions for all filters 1 size or larger. Provide gravel filled box extensions as drain sumps for all automatic line flush assemblies.

- 2.1.11.4. Use 10 inch x 10-1/4 inch round box for all irrigation wire splices with green bolt down cover or approved equal.
- 2.1.11.5. All valve box lids must be branded with the corresponding station number and controller ID. Consult Owner's Irrigation Supervisor for controller ID.
- 2.1.12. Master Valves:
 - 2.1.12.1. Install a normally open master valve of the same backflow device size. Use Superior Model 3100
- 2.1.13. Flow Meter:
 - 2.1.13.1. Calsense model #FM-mainline size. Install flow meter per manufacturer's specifications
- 2.1.14. Sprinkler Heads:
 - 2.1.14.1. Turf areas:
 - Rainbird 5004 plus with MPR nozzles
 - Rainbird 1804
 - 2.1.14.2. Color beds:
 - Rainbird 5012 plus with MPR nozzles Rainbird 1812
 - 2.1.14.3. Shrubs and Hedges and Ground Cover:
 - Netafim Drip system (Techfilter, Techline RW dripperline, techline fittings.)
 - 2.1.14.4. .Trees:
 - Rainbird 1404 bubblers
- 2.1.15. Drip System:
 - 2.1.15.1. Valves: Rain Bird PESB-R Series
 - 2.1.15.2. Filter: NETAFIM Tech filter
 - 2.1.15.3. Drip tube: NETAFIM Techline RW (Reclaimed Water)
 - 2.1.15.4. Fitting: All NETAFIM Fittings

3. EXECUTION

3.1. INSPECTION

- 3.1.1. Site Conditions:
 - 3.1.1.1. All scaled dimensions are approximate. The Contractor shall check and verify all size dimensions and receive the Landscape Architect's approval prior to proceeding with work under this section.
 - 3.1.1.2. Exercise extreme care in excavating and working near existing utilities. Contractor shall be responsible for damages to utilities

which are caused by his operations or neglect. Check any existing utility drawings for existing utility locations. Contractor will be responsible for calling DIGALERT 1-800-227-2600 to identify locations for underground utilities.

3.2. PREPARATION

3.2.1. Physical Layout:

- 3.2.1.1. Prior to installation, the Contractor shall stake out all pressure supply lines, routing and location of sprinkler heads.
- 3.2.1.2. All layout shall be approved by Landscape Architect prior to installation.

3.2.2. Water Supply:

- 3.2.2.1. The irrigation system shall be connected to water supply points of connection as indicated on the Drawings.
- 3.2.2.2. Connections shall be made at approximate locations as shown on the Drawings. Contractor is responsible for minor changes caused by actual site conditions.

3.2.3. Electrical Supply:

- 3.2.3.1. Electrical connections for automatic controller shall be made to electrical points of connection as indicated on the Drawings.
- 3.2.3.2. Connections shall be made at approximate locations as shown on the Drawings. Contractor is responsible for minor changes caused by actual site conditions.

3.3. EXCAVATING AND TRENCHING

3.3.1. General:

- 3.3.1.1. Perform all excavations as required for installation of work, including shoring of earth banks, if necessary.

3.3.2. Trenching:

- 3.3.2.1. Dig trenches straight and support pipe continuously on bottom of trench. Lay pipe to an even grade. Trenching excavation shall follow layout indicated on drawings and as noted.
- 3.3.2.2. Provide for a minimum cover of 18 to 24 inches for all pressure supply lines.
- 3.3.2.3. Provide for a minimum cover of 12 to 18 inches for all non-pressure PVC lines.
- 3.3.2.4. Provide for a minimum cover of 18 inches for all control wiring.

3.3.3. Backfilling:

- 3.3.3.1. The trenches shall not be backfilled until all required tests are performed. Trenches shall be carefully backfilled with the

excavated materials approved for backfilling, consisting of earth, loam, sandy clay, sand or other approved materials, free from large clods of earth or stone. Backfill shall be mechanically compacted in landscaped areas to a dry density equal to adjacent undisturbed soil. Backfill will conform to adjacent grades without dips, sunken areas, humps or other surface irregularities.

3.3.3.2. A fine granular material backfill will be initially placed on all lines. No foreign matter larger than 1/2 inch in size will be permitted in the initial backfill.

3.3.3.3. Flooding of trenches will be permitted only with approval of the Landscape Architect.

3.3.3.4. If settlement occurs and subsequent adjustments in pipe, valves, sprinkler heads, lawn or planting or other construction are necessary, the Contractor shall make all required adjustments without cost to the Owner.

3.3.4. Trenching and Backfilling Under Paving:

3.3.4.1. Trenches located under areas where paving, asphaltic concrete or concrete will be installed shall be backfilled with sand (a layer 6 inches below the pipe and 3 inches above the pipe) and compacted in layers to 95% compaction, using manual or mechanical tamping devices. Trenches for piping shall be compacted to equal the compaction of the existing adjacent undisturbed soil and left in a firm unyielding condition. All trenches shall be left flush with the adjoining grade. The sprinkler irrigation contractor shall set in place, cap and pressure test all piping under paving prior to the paving work.

3.3.4.2. Generally, piping under existing walks is done by jacking, boring or hydraulic driving, but where any cutting or breaking of sidewalks and/or concrete is necessary, it shall be done and replaced by the Contractor as part of the contract cost. Permission to cut or break sidewalks and/or concrete shall be obtained from the Owner's Irrigation Supervisor. No hydraulic driving will be permitted under concrete paving. Compact all backfill to 95% dry density and dispose of waste off site. Replacement pavement shall match existing in structure, material and appearance.

3.3.4.3. Provide for a minimum cover of 18 inches between the top of the pipe and the bottom of the aggregate base for all pressure and non-pressure piping installed under asphaltic concrete paving.

3.3.5. Conduit and Sleeves:

- 3.3.5.1. Coordination: Sleeving and Conduit will be existing only when installed under another contract, as in the case of all installations under the concrete deck. For all other installations and when connecting to existing sleeving and Conduit, provide materials and coordinate installation with other trades as required to facilitate smooth construction sequence.
- 3.3.5.2. Conduit: Furnish and install conduit where control wires pass under or through walls, walks and paving. Conduits to be of adequate size to accommodate retrieval for repair of wiring and shall extend 12 inches beyond edges of walls and pavement.
- 3.3.5.3. Sleeving: Install sleeves for all pipes passing through or under walks and paving as shown on the Drawings. Sleeving to be of adequate size to accommodate retrieval of wiring or piping for repair and shall extend 12 inches beyond edges of paving or other construction.
- 3.3.6. Assemblies:
 - 3.3.6.1. Routing of irrigation lines as indicated on the Drawings is diagrammatic. Install lines (and various assemblies) in such a manner as to conform with the details per plans.
 - 3.3.6.2. Install all assemblies specified herein in accordance with respective detail. In absence of detail drawings or specifications pertaining to specific items required to complete work, perform such work in accordance with best standard practice with prior approval of Owner's Irrigation Supervisor.
 - 3.3.6.3. PVC Pipe and fittings shall be thoroughly cleaned of dirt, dust and moisture before installation. Installation and solvent welding methods shall be as recommended by the pipe and fitting manufacturer. Install no assembly into a trench which has standing water.
 - 3.3.6.4. On PVC to metal connections, the Contractor shall work the metal connections first. Teflon tape or approved equal, shall be used on all threaded PVC to PVC and on all threaded PVC to metal joints. Light wrench pressure is all that is required. Where threaded PVC connections are required, use threaded PVC adapters into which the pipe may be welded. Use strap-type friction wrench only -- no metal jawed wrench.
- 3.3.7. Line Clearance:
 - 3.3.7.1. All lines shall have a minimum clearance of 6 inches from each other and from lines of other trades. Parallel lines shall not be installed directly over one another.
- 3.3.8. Automatic Controller:

- 3.3.8.1. Proposed new controller locations must be check for radio signal strength by Calsense's communication technician, call 1-800-572-8608. In the event of an insufficient communication signal, contractor will be responsible for moving the controller to an alternative location recommended by Calsense's communication technician.
- 3.3.8.2. Insure existing controller is in good working condition. Remote control valves shall be connected to controller in numerical sequence as shown on the Drawings. Control wires must be labeled numerically at the controller enclosure.
- 3.3.9. Remote Control Valves:
 - 3.3.9.1. Install where shown on the Drawings and details. When grouped together, allow at least 12 inches between valves. Install each remote control valve in a separate valve box. Align all boxes in a row. Valves shall be install in locations that are easilily accessible by maintenance personnel. Stake locations for approval before installation. Valve box lids must be labeled numerically with a branding iron.
- 3.3.10. Quick Coupling Valves:
 - 3.3.10.1. Install a quick coupler valve at a minimum of 75 feet spacing throughout the mainline. Install as detailed on the Drawings. Quick coupling valves must always be installed in a valve box.
- 3.3.11. Point of Connection:
 - 3.3.11.1. There must be a dedicated point of connection for every controller for flow monitoring purposes.
- 3.3.12. Flow Meter:
 - 3.3.12.1. A compatible flow meter with a manual read back up capability must be installed for every controller / point of connection.
 - 3.3.12.2. Flow meter Calsense FM-mainline size #
- 3.3.13. Sprinklers:
 - 3.3.13.1. Turf:
 - Rain Bird 1804 SAM series with MPR nozzles
 - Rain Bird 5004 plus with MPR nozzles
 - Sports fields: Rain Bird 7005
 - 3.3.13.2. Color beds:
 - Rain Bird 1812 and shrub adapter on schedule 80 riser with MPR nozzles
 - Rainbird 5012 plus with MPR nozzles

- 3.3.13.3. Swing joint assembly:
 - Use 3 street elbow and 1 PVC schedule 80 nipple per assembly.
- 3.3.13.4. Shrubs and Hedges:
 - Use NETAFIM drip system (Techfilter, Techline RW dripperline, Techline fittings) NO substitute.
- 3.3.14. . Flushing of System:
 - 3.3.14.1. Cap or plug all openings as soon as lines have been installed to prevent the entrance of debris or any contaminants that will obstruct pipe line or foul small orifice emitters. Leave in place until connections can be completed.
 - 3.3.14.2. After all new irrigation system valves, pipelines and risers are in place and before connection of lateral lines, the control valves shall be opened and a full head of water used to flush out the system.
 - 3.3.14.3. Sprinkler heads shall be installed only after flushing of the entire system, including lateral lines and swing joints, has been accomplished to the complete satisfaction of the Landscape Architect.

3.4. TEMPORARY REPAIRS

- 3.4.1. The Owner reserves the right to make temporary repairs as necessary to keep the sprinkler system equipment in operating condition. The exercise of this right by the builder/developer shall not relieve the Contractor of his responsibilities under the terms of the guarantee as herein specified.

3.5. EXISTING TREES

- 3.5.1. Where it is necessary to excavate adjacent to existing trees, the Contractor shall use all possible care to avoid injury to trees and tree roots. Excavation in areas where 2 inch and larger roots occur shall be done by hand. All roots two inches and larger in diameter, shall be tunneled under and shall be heavily wrapped in burlap, to prevent scarring or excessive drying. Where a ditching machine is run close to trees having roots smaller than 2 inches in diameter, the wall of the trench adjacent to the tree shall be hand trimmed, making clean cuts through. Trenches adjacent to trees should be closed within 24 hours; and where this is not possible, the side of the trench adjacent to the tree shall be kept shaded with moist burlap or canvas.

3.6. FIELD QUALITY CONTROL

- 3.6.1. Adjustment of the System:

- 3.6.1.1. If it is determined that adjustments in the irrigation equipment will provide better uniformity of coverage, the Contractor shall make such adjustments prior to planting.
- 3.6.1.2. Lowering and raising valve boxes or any other adjustments by the Contractor shall be accomplished within ten days after notification by Owner.
- 3.6.2. Testing of Irrigation System:
 - 3.6.2.1. The Contractor shall request the presence of the Owner's Irrigation Supervisor in writing at least 48 hours in advance of testing.
 - 3.6.2.2. Test all pressure lines under hydrostatic pressure of 150 pounds per square inch and prove watertight.
 - 3.6.2.3. Note: Testing of pressure mainlines shall occur prior to installation of electric control valves.
 - 3.6.2.4. All piping under paved areas or on structure shall be tested under hydrostatic pressure of 150 pounds per square inch and proved watertight, prior to paving.
 - 3.6.2.5. Sustain pressure in lines for not less than two hours with no measurable drop in pressure. If leaks develop, replace joints and repeat test until entire system is proven watertight.
 - 3.6.2.6. All hydrostatic tests shall be made only in the presence of the Landscape Architect or other duly authorized representative of the Owner. No pipe shall be backfilled until it has been inspected, tested and approved in writing.
 - 3.6.2.7. Furnish necessary force pump and all other test equipment.
 - 3.6.2.8. Furnish all materials and perform all work required to correct any inadequacies of coverage.

3.7. MAINTENANCE

- 3.7.1.1. The entire irrigation system shall be under full automatic operation for a period of seven days prior to any planting.
- 3.7.1.2. The Owner's Irrigation Supervisor reserves the right to waive or shorten the operation period.

3.8. CLEAN-UP

- 3.8.1.1. Clean-up shall be made as each portion of work progresses. Refuse and excess dirt shall be removed from the site, all walks and paving shall be broomed or washed down and any damage sustained on the work of others shall be repaired to original condition.

3.9. FINAL INSPECTION PRIOR TO ACCEPTANCE

- 3.9.1.1. The Contractor shall operate each system in its entirety for USC's Landscape Supervisor and the Architect at time of final inspection. Any items deemed not acceptable by the inspectors shall be reworked to the complete satisfaction of the Owner's Irrigation Supervisor.
- 3.9.1.2. The Contractor shall show evidence to the Landscape Architect that the Owner has received all maintenance manuals, documentation of backflow testing, irrigation accessories, charts, record drawings and equipment as required before final inspection can occur.

3.10. OBSERVATION SCHEDULE

- 3.10.1.1. Contractor shall be responsible for notifying the Landscape Architect / Owner's Irrigation Supervisor in advance for the following observations, according to the time indicated:
- Prejob conference - 7 days
 - Pressure supply line installation and testing - 48 hours
 - Automatic controller testing - 48 hours
 - Control wire installation - 48 hours
 - Lateral lines - 48 hours
 - Coverage test - 48 hours
 - Final observation - 7 days
- 3.10.1.2. When observations have been conducted by other than the Landscape Architect, show evidence of when and by whom these observations were made.
- 3.10.1.3. No observation will commence without the record drawings. In the event the Contractor calls for an observation without record drawings, without completing previously noted corrections or without preparing the system for observation, he shall be responsible for reimbursing the Landscape Architect at the hourly rate in effect at the time of the observation portal (plus transportation costs) for the inconvenience. No further observations will be scheduled until this charge has been paid.