32 93 43 – Trees

1. **Introduction**

   A. This Construction & Design standard provides a guideline for the specification, selection and installation of trees to be used in conjunction with other related sections listed below:

   - 01 56 39   Temporary Tree & Plant Protection
   - 32 01 90   Operation and Maintenance of Planting
   - 32 01 90.23 Pruning
   - 32 01 90.26 Watering
   - 32 90 00   Planting
   - 32 91 00   Planting Preparation
   - 32 91 13   Soil Preparation
   - 32 91 13.26 Mulch
   - 32 92 19   Seeding
   - 32 92 23   Sodding
   - 32 93 00   Plants
   - 32 93 13   Groundcovers

   B. Designers should coordinate with Duke University Landscape Services (LS) to coordinate selection and execution requirements for Trees.

2. **References**


3. **Definitions**

   A. Field grown trees (B&B): Trees growing in field soil for at least 12 months prior to harvest.

   B. Root ball: The mass of roots including any soil or substrate that is shipped with the tree within the root ball package.

   C. Spade harvested and transplanted: Field grown trees that are mechanically harvested and immediately transplanted to the final growing site without being removed from the digging machine.

   D. Stem: The trunk of the tree.
E. Stem Girdling Root: Any root more than one-fourth inch diameter or one-third of the diameter of the trunk currently touching the trunk, or with the potential to touch the trunk, above the root collar approximately tangent to the trunk circumference or circling the trunk. Roots shall be considered as stem girdling that have, or are likely to have in the future, root to trunk bark contact.

F. Structural Root: One of the largest roots emerging from the root collar.

G. Tree: Single and multi-stemmed plants with mature height approximately greater than 15 feet.

4. Design Standards

A. All tree stock must meet ANSI Z60.1 standard. Trees should be healthy, single stem (unless specified multi-stem), with a clear dominate leader and good branch spacing. Trees with poor form, diseases, or extensive damage will be rejected and replaced at no cost to the owner.

B. Proper Identification: All trees shall be true to name as ordered or shown on planting plans and shall be labeled individually or in groups by genus, species, variety and cultivar.

C. Compliance: All trees shall comply with federal and state laws and regulations requiring observation for plant disease, pests, and weeds. Observation certificates required by law shall accompany each shipment of plants.

1. Clearance from the local county agricultural commissioner, if required, shall be obtained before planting trees originating outside the county in which they are to be planted.

5. Documentation and Review Requirements

A. Installation plan shall be submitted a minimum of 14 days prior to the schedule installation. Plan should describe the methods, activities, materials and schedule to achieve installation of trees.

B. When selecting trees in the nursery, each tree shall have a numbered seal applied by the Contractor. The seal shall be placed on a lateral branch on the north side of the tree. The seal shall be a tamper proof plastic seal bearing the Contractors name and a unique seven-digit number embossed on the seal. Do not place seals on branches that are so large that there is not sufficient room for the branch growth over the period of the warranty.

C. The Owner’s Representative shall review the progress of work at key times in the construction process. Reviews include but are not limited to the following:

1. Site conditions prior to the start of planting to review soil and drainage conditions.
2. Plant layout at completion of the plant layout staking.

3. Delivery: Review tree quality prior to unloading where possible, but in all cases prior to planting.

4. Completion of the planting.

6. **Installation and Performance Requirements**

   A. The tree planting season is from October 1st to March 31st.

   B. Trees must be installed according to specifications equal to or more rigorous than the ANSI 300 standard. Trees installed improperly must be reinstalled, or in some cases, replaced.

   C. **Tree Quality**

      1. Provide healthy stock, grown in a nursery and reasonably free of die-back, disease, insects, eggs, bores, and larvae.

      2. Tree Quality Above the Soil Line shall comply with crown acceptance details and the following:

         a. Crown: The form and density of the crown shall be typical for a young specimen of the species or cultivar pruned to a central and dominant leader. Crown specifications do not apply to plants that have been specifically trained in the nursery as topiary, espalier, multi-stem, clump, or unique selections such as contorted or weeping cultivars.

         b. Leaves: The size, color, and appearance of leaves shall be typical for the time of year and stage of growth of the species or cultivar. Trees shall not show signs of prolonged moisture stress or over watering as indicated by wilted, shriveled, or dead leaves.

         c. Branches: Shoot growth (length and diameter) throughout the crown should be appropriate for the age and size of the species or cultivar. Trees shall not have dead, diseased, broken, distorted, or otherwise injured branches.

            (1) Main branches shall be distributed along the central leader not clustered together. They shall form a balanced crown appropriate for the cultivar/species.

            (2) Branch diameter shall be no larger than two-thirds (one-half is preferred) the diameter of the central leader measured 1 inch above the branch union.

            (3) The attachment of the largest branches (scaffold branches) shall be free of included bark.
d. Trunk: The tree trunk shall be relatively straight, vertical, and free of wounds that penetrate to the wood (properly made pruning cuts, closed or not, are acceptable and are not considered wounds), sunburned areas, conks (fungal fruiting bodies), wood cracks, sap leakage, signs of boring insects, galls, cankers, girdling ties, or lesions (mechanical injury).

e. Temporary branches, unless otherwise specified, can be present along the lower trunk below the lowest main (scaffold) branch, particularly for trees less than 1 inch in caliper. These branches should be no greater than 3/8-inch diameter. Clear trunk should be no more than 40% of the total height of the tree, unless specific clearance height is specified.

f. Trees shall have one central leader. If the leader was headed, a new leader (with a live terminal bud) at least one-half the diameter of the pruning cut shall be present.

g. All graft unions, where applicable, shall be completely closed without visible sign of graft rejection. All grafts shall be visible above the soil line.

h. Trunk caliper and taper shall be sufficient so that the lower five feet of the trunk remains vertical without a stake. Auxiliary stake may be used to maintain a straight leader in the upper half of the tree.

D. Root Ball Package Options: The following root ball packages are permitted. Specific root ball packages shall be required where indicated on the tree list.

1. B&B Trees

a. All B&B trees shall be field grown, and the root ball packaged in a natural fiber burlap and natural fiber twine and/or natural fiber burlap and wire basket package.

b. Trees shall be harvested with the following modifications to standard nursery practices.

   (1) Prior to digging any tree that fails to meet the requirement for maximum soil and roots above the root collar, carefully removed the soil from the top of the root ball of each plant, using hand tools, water or an air spade, to locate the root collar and attain the soil depth over the structural roots requirements. Remove all stem girdling roots above the root collar. Care must be exercised not to damage the surface of the root collar and the top of the structural roots.

   (2) Trees shall be dug for a minimum of 4 weeks and a maximum of 52 weeks prior to shipping. Trees dug 4 to 52 weeks prior to shipping are defined as hardened-off. Digging is defined as cutting all roots and lifting the tree out of the ground and either moving it to a new location in the nursery or placing it back into the same hole. Trees that are stored out of the ground shall be placed in a
holding area protected from extremes of wind and sun with the root ball protected by covering with mulch or straw and irrigated sufficiently to keep moisture in the root ball above wilt point and below saturation.

(3) If wire baskets are used to support the root ball, a “low profile” basket shall be used. A low profile basket is defined as having the top of the highest loops on the basket no less than 4 inches and no greater than 8 inches below the shoulder of the root ball package.

(a) At nurseries where sandy soils prevent the use of “low profile baskets”, baskets that support the entire root ball, including the top, are allowable.

(4) Twine and burlap used for wrapping the root ball package shall be natural, biodegradable material. If the burlap decomposes after digging the tree then the root ball shall be re-wrapped prior to shipping if roots have not yet grown to keep root ball intact during shipping.

2. Spade harvested and transplanted trees shall meet all the requirements for field grown plants and trees.

a. Root ball diameters shall be of similar size as the ANSI Z60.1 requirements for Balled and Burlapped trees.

b. Trees shall be harvested prior to leafing out (bud break) in the spring or during the fall planting period except for plants known to be considered as fall planting hazards. Plants that are fall planting hazards shall only be harvested prior to leafing out in the spring.

c. Trees shall be moved and planted within 48 hours of the initial harvesting and shall remain in the spade machine until planted.

E. Site Conditions

1. It is the responsibility of the Contractor to be aware of all surface and sub-surface conditions, and to notify the Owner’s Representative, in writing, of any circumstances that would negatively impact the health of the trees. Do not proceed with work until unsatisfactory conditions have been corrected.

a. Should subsurface drainage or soil conditions be encountered which would be detrimental to growth or survival of the trees, the Contractor shall notify the Owner’s Representative in writing, stating the conditions and submit a proposal covering cost of corrections. If the Contractor fails to notify the Owner’s Representative of such conditions, he/she shall remain responsible for trees under the warranty clause.
2. It is the responsibility of the Contractor to be familiar with the local growing conditions, and if any specified trees will be in conflict with these conditions. Report any potential conflicts, in writing, to the Owner’s Representative.

3. Do not install trees into saturated or frozen soils. Do not install trees during inclement weather, such as rain or snow or during extremely hot, cold or windy conditions.

F. Planting Around Utilities

1. Contractor shall carefully examine the civil, record, and survey drawings to become familiar with the existing underground conditions before digging.

2. Determine location of underground utilities and perform work in a manner that will avoid possible damage. Hand excavate, as required. Maintain grade stakes set by others until parties concerned mutually agree upon removal.

3. Notification of North Carolina One Call and a dig permit are required for all planting areas: The Contractor is responsible for knowing the location and avoiding utilities that are not covered by the NC One Call. In High Priority Areas on campus, or in cases where a crane will be used, the Contractor must attend Risk Mitigation and obtain a permit from the Risk mitigation Group.

4. All digging and excavation must follow Duke Universities Excavation Program SOP.

G. Delivery of Trees

1. Observe each tree after delivery and prior to installation for damage of other characteristics that may cause rejection of the tree. Notify the Owner’s Representative of any condition observed.

2. Once trees arrive on site, the contractor is responsible for installing them in a timely manner. Contractors are responsible for replacing trees which die due to improper handing or installation.

H. Installation of Trees

1. No more trees shall be distributed about the planting area than can be planted and watered on the same day.

2. All girdling roots must be corrected before planting and root collars must be exposed to the root flair. Beyond removing broken branches, no pruning shall be done to the tree within the first year.

3. For trees to be planted after bud break, place the trees before bud break in an irrigated bed of pea gravel.

   a. The pea gravel bed shall be 18 inches deep over a sheet of plastic.
b. Space trees to allow the unbundled branches to grow without shading each other.

c. Once stored in pea gravel, allow the trees sufficient time for the new root system to flush and spring growth of leaves to fully develop before planting.

d. Pea gravel stored trees may be kept for up to one growing season.

e. Pea gravel stored trees shall be dipped, packaged and shipped similar to the requirements for freshly dug bare root trees above.

4. When trees are planted in a group, prepare the planting bed instead of individual holes.

5. The root system of each tree, regardless of root ball package type, shall be observed by the Contractor, at the time of planting to confirm that the roots meet the requirements for plant root quality in Tree and Plant Quality. The Contractor shall undertake at the time of planting, all modifications to the root system required by the Owner’s Representative to meet these quality standards.

6. Excavation of the Planting Space: Using hand tools or tracked mini-excavator, excavate the planting hole into the Planting Soil to the depth of the root ball measured after any root ball modification to correct root problems, and wide enough for working room around the root ball or to the size indicated on the drawing or as noted below.

a. For trees planted in soil areas that are NOT tilled or otherwise modified to a depth of at least 12 inches over a distance of more than 10 feet radius from each tree, the soil around the root ball shall be loosened as defined below or as indicated on the drawings.

   (1) The area of loosening shall be a minimum of 3 times the diameter of the root ball at the surface sloping to 2 times the diameter of the root ball at the depth of the root ball.

   (2) Loosening is defined as digging into the soil and turning the soil to reduce the compaction. The soil does not have to be removed from the hole, just dug, lifted and turned. Lifting and turning may be accomplished with a tracked mini excavator, or hand shovels.

b. If an auger is used to dig the initial planting hole, the soil around the auger hole shall be loosened as defined above for trees planted in soil areas that are NOT tilled or otherwise modified.

c. The measuring point for root ball depth shall be the average height of the outer edge of the root ball after any required root ball modification.
d. If motorized equipment is used to deliver trees to the planting area over exposed planting beds, or used to loosen the soil or dig the planting holes, all soil that has been driven over shall be tilled to a depth of 6 inches.

7. Set top outer edge of the root ball at the average elevation of the proposed finish. Set the tree plumb and upright in the center of the planting hole. The tree graft, if applicable, shall be visible above the grade. Do not place soil on top of the root ball.

8. The Owner’s Representative may specify the plant orientation or request the tree be rotated when planted based on the form of the tree.

9. Backfill the space around the root ball with the same planting soil or existing soil that was excavated for the planting space.

10. Brace root ball by tamping Planting Soil around the lower portion of the root ball. Place additional Planting Soil around base and sides of ball in six-inch (6”) lifts. Lightly tamp each lift using foot pressure or hand tools to settle backfill, support the tree and eliminate voids. DO NOT over compact the backfill or use mechanical or pneumatic tamping equipment. Over compaction shall be defined as greater than 85% of maximum dry density, standard proctor or greater than 250 psi as measured by a cone penetrometer when the volumetric soil moisture is lower than field capacity.

   a. When the planting hole has been backfilled to three quarters of its depth, water shall be poured around the root ball and allowed to soak into the soil to settle the soil. Do not flood the planting space. If the soil is above field capacity, allow the soil to drain to below field capacity before finishing the planting. Air pockets shall be eliminated and backfill continued until the planting soil is brought to grade level.

11. Where indicated on the drawings, build a 4-inch high, level berm of Planting Soil around the outside of the root ball to retain water. Tamp the berm to reduce leaking and erosion of the saucer.

12. Thoroughly water the Planting Soil and root ball immediately after planting.

13. Remove all nursery identification tags and ribbons as per Owner’s Representative instructions. Remove all other materials after planting.

I. Tree Staking and Guying Material

   1. Tree guying to be flat woven polypropylene material, 3/4 inch wide, and 900 lb. break strength. Color to be Green. Product to be ArborTie manufactured by Deep Root Partners, L.P. or approved equal.

   2. Stakes shall be lodge pole stakes free of knots and of diameters and lengths appropriate to the size of plant as required to adequately support the plant.
3. Below ground anchorage systems to be specified per each site

4. Submit manufacturer’s product data for approval.

J. Staking and Guying

1. Do not stake or guy trees unless specifically required by the Contract Documents, or as approved by the Owner’s Representative.
   a. The Owner’s Representative shall have the authority to require that trees are staked or to reject staking as an alternative way to stabilize the tree.
   b. Trees that required heavily modified root balls to meet the root quality standards may become unstable. The Owner’s Representative may choose to reject these trees rather than utilize staking to temporarily support the tree.

2. Trees that are guyed shall have their guys and stakes removed after one full growing season or at other times as required by the Owner’s Representative.

3. Tree guying shall utilize the tree staking and guying materials specified. Guying to be tied in such a manner as to create a minimum 12-inch loop to prevent girdling. Refer to manufacturer’s recommendations and the planting detail for installation.
   a. Plants shall stand plumb after staking or guying.
   b. Stakes shall be driven to sufficient depth to hold the tree rigid.

4. For trees planted in planting mix over waterproofed membrane, use dead men buried 24 inches to the top of the dead man, in the soil. Tie the guy to the dead man with a double wrap of line around the dead man followed by a double half hitch. When guys are removed, leave the dead men in place and cut the guy tape 12 inches above the ground, leaving the tape end covered in mulch.

K. Pruning (Refer to section 32 01 90.23 Pruning)

L. Tree Warranty

1. The Contractor agrees to replace defective work and defective trees. The Owner’s Representative shall make the final determination if trees meet these specifications or that trees are defective.

2. Tree warranty shall begin on the date of Substantial Completion Acceptance and continue for the following periods, classed by plant type:
   a. Trees – 1 Year.

3. When the work is accepted in parts, the warranty periods shall extend from each of the partial Substantial Completion Acceptances to the terminal date of the last
warranty period. Thus, all warranty periods for each class of tree warranty, shall terminate at one time.

4. All trees shall be warrantied to meet all the requirements for tree quality at installation. Defective trees shall be defined as trees not meeting these requirements. The Owner’s representative shall make the final determination that trees are defective.

5. Trees determined to be defective shall be removed immediately upon notification by the Owner’s Representative and replaced without cost to the Owner, as soon as weather conditions permit and within the specified planting period.

6. Any work required by this specification or the Owner’s Representative during the progress of the work, to correct tree defects including the removal of roots or branches, or planting trees that have been bare rooted during installation to observe for or correct root defects shall not be considered as grounds to void any conditions of the warranty. In the event that the Contractor decides that such remediation work may compromise the future health of the tree, the tree or trees in question shall be rejected and replaced with trees that do not contain defects that require remediation or correction.

7. Replacements shall closely match adjacent specimens of the same species. Replacements shall be subject to all requirements stated in this specification. Make all necessary repairs due to tree replacements. Such repairs shall be done at no extra cost to the Owner.

8. The warranty of all replacement trees shall extend for an additional one-year period from the date of their acceptance after replacement. In the event that a replacement tree is not acceptable during or at the end of the said extended warranty period, the Owner’s Representative may elect one more replacement items or credit for each item. These tertiary replacement items are not protected under a warranty period.

9. During and by the end of the warranty period, remove all tree wrap, ties, and guying unless agreed to by the Owner’s Representative to remain in place. All trees that do not have sufficient caliper to remain upright, or those requiring additional anchorage in windy locations, shall be staked or remain staked, if required by the Owner’s Representative.


   a. At the end of the warranty period, the Owner’s Representative shall observe all warranted work, upon written request of the Contractor. The request shall be received at least ten calendar days before the anticipated date for final observation.
b. End of Warranty Final Acceptance will be given only when all the requirements of the work under this specification and in specification sections Planting Soil and Irrigation have been met.

M. Clean-Up

1. During installation, keep the site free of trash, pavements reasonably clean and work area in an orderly condition at the end of each day. Remove trash and debris from the site no less than once a week.
   
a. Immediately clean up any spilled or tracked soil, fuel, oil, trash or debris deposited by the Contractor from all surfaces within the project or on public right of ways and neighboring property.

2. Once installation is complete, wash all soil from pavements and other structures. Ensure that mulch is confined to planting beds and that all tags and flagging tape are removed from the site.

3. Make all repairs to grades, ruts, and damage by the plant installer to the work or other work at the site.

4. Remove and dispose of all excess planting soil, subsoil, mulch, plants, packaging, and other material brought to the site by the Contractor.

N. Protection During Construction

1. The Contractor shall protect trees and planting and related work and other site work from damage due to planting operations, operations by other Contractors or trespassers. Maintain protection during installation until Substantial Completion Acceptance. Treat, repair or replace damaged work immediately.

2. Damage done by the Contractor, or any of their sub-contractors to existing or installed trees, or any other parts of the work or existing features to remain, including roots, trunk or branches of large existing trees, soil, paving, utilities, lighting, irrigation, other finished work and surfaces including those on adjacent property, shall be cleaned, repaired or replaced by the Contractor at no expense to the Owner. The Owner’s Representative shall determine when such cleaning, replacement or repair is satisfactory.

O. Tree Maintenance Prior To Substantial Completion Acceptance

1. During the project work period and prior to Substantial Completion Acceptance, the Contractor shall maintain all trees.

2. Maintenance during the period prior to Substantial Completion Acceptance shall consist of pruning, watering, cultivating, weeding, mulching, removal of dead material, repairing and replacing of tree stakes, tightening and repairing of guys,
repairing and replacing of damaged tree wrap material, resetting plants to proper grades and upright position, and furnishing and applying such sprays as are necessary to keep plantings reasonably free of damaging insects and disease, and in healthy condition. The threshold for applying insecticides and herbicide shall follow established Integrated Pest Management (IPM) procedures. Mulch areas shall be kept reasonably free of weeds, grass.

P. Substantial Completion Acceptance

1. Upon written notice from the Contractor, the Owners Representative shall review the work and make a determination if the work is substantially complete.
   
a. Notification shall be at least 10 days prior to the date the contractor is requesting the review.

2. The date of substantial completion of the tree planting shall be the date when the Owner’s Representative accepts and signs off that all work is complete and meets standards.

3. The Tree Warranty period begins at date of written notification of substantial completion from the Owner’s Representative.