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## SECTION 015640 – TREE PROTECTION AND PRESERVATION

### PART 1 - GENERAL

#### 1.1 RELATED DOCUMENTS


- A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and other Division 01 Specification Sections, apply to this Section.

#### 1.2 SUMMARY


- A. This Section includes the protection and stress reduction of existing trees and vegetation that interfere with, or are affected by, execution of the work, whether temporary or permanent. Work is to be coordinated with the contract documents which shall include a tree preservation plan authored by a certified and qualified arborist.
- B. The following specifications apply to work of the related to protection and stress reduction measures and coordination and oversight of the tree preservation Plan by Yale University. This work includes but is not limited to the following:
1. Coordination of Temporary Tree and Plant Protection
  2. Selective tree removals for “Removal by Arborist” (RBA) (Contract Arborist) within Tree Protection Areas (TPAs)
  3. Root Pruning
  4. Temporary Site and Tree Protection Fencing and temporary sign installation referenced in Temporary Facilities and Controls
  5. Composted Mulching
  6. Liquid subsurface fertilization
  7. Temporary Limb Guying or Clearance Pruning for construction access
  8. Seasonal Supplemental Watering
  9. Monitoring and Treatment of Tree Health
  10. Supersonic Air Tool (SSAT), such as AirSpade, and Hand Excavation within the Critical Root Zones (CRZs)

#### 1.3 DEFINITIONS


- A. Area of Interest (AOI): Potential areas that may be impacted by construction. The outline of this area is determined during the planning phase and must include all potential access routes to the construction area. The Project Arborist will assess all trees with a critical root zone that crosses the AOI.

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- B. Botanical Name: the scientific name given to a particular plant species. It must conform to the system of botanical nomenclature as prescribed by the International Code of Nomenclature for algae, fungi, and plants (ICN). Will be provided on the AOI report and TPAK.
- C. Canopy (Crown) Pruning: Action by the Contract Arborist of pruning specific tree limbs to improve tree health, reduce hazard, and / or provide construction clearance.
- D. Certified Arborist: Credential of an individual arborist issued and administered by the International Society of Arboriculture. This credential must be current and valid to qualify to use the copyrighted designation of “Certified Arborist”. Refer to [www.isa-arbor.com](http://www.isa-arbor.com) for additional information.
- E. Common Name: The name by which a species is known to the general public, rather than its taxonomic or scientific name. Some species may have more than one common name. Will be provided in the AOI report and TPAK.
- F. Condition Rating: Health condition of a tree at time of inventory and assessment by the Project Arborist. Ratings are Excellent, Good, Fair, Poor, Critical, and Dead, where:
1. Excellent: Tree has no observed health issues
  2. Good – Tree has minor observed health issues
  3. Fair – Tree has observed issues, but treatment may not needed at this time
  4. Poor – Tree has issues of concern that require treatment.
  5. Critical – Tree has significant health issues and is unlikely to recover. Preservation unlikely.
  6. Dead – Standing dead tree
- G. Construction Oversight: When indicated on the TPAK, these trees will require monitoring by the Contract and Project Arborist throughout construction. These trees are either of high importance to Yale (Priority Trees) and/or near the limits of disturbance. Oversight is provided to ensure tree protection measures remain in place and to monitor change in tree health. Additional management recommendations may be made during construction to increase likelihood of preservation.
- H. Contract Arborist: Arboricultural firm contracted to implement the approved tree preservation plans on site. All crews’ conducting arboricultural operations on site shall consist of at least one Certified Arborist who directly oversees all work by that crew. Arboricultural operations include, but are not limited to, pruning, tree protection device installation and maintenance (fence, matting, etc.), root pruning, air tool root excavation/exploration (SSAT), soil care activities, soil testing, mulch application, tree inspections, pesticide/chemical applications and tree removal. Special qualifications submittal is required for review and approval below. Contract Arborist will be sub-contracted by the general contractor.
- I. Critical Root Zone (CRZ): Area shown on Drawings for all trees within scope of this project with a circle. Estimated area is based upon an industry standard “rule of thumb” of 1.5 feet of radius per inch of diameter at breast height (DBH). CRZ is described as the minimum area of tree roots required to be protected to maintain tree health. Any impacts within the CRZ must be mitigated based on severity up to and including tree removal if the impact or disturbance is severe.
- J. Diameter at Breast Height (DBH): Tree trunk diameter measured at 4.5 feet above grade.


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- K. Limits of Disturbance (LOD): (also called Limits of Construction): Specific outer limits of all construction activities for the entire project.
- L. Mulch: A protective covering (as of wood chips) spread or left on the ground to reduce evaporation, maintain even soil temperature, prevent erosion, control weeds, and/or enrich the soil.
- M. Mulching of Trees: Application of a wood mulch product to areas surrounding designated trees. Mulch increases moisture-holding capacity, helps mitigate soil compaction, and increases needed soil organic composition.
- N. Priority Trees: are trees that have special designations that get attention around preservation. These trees are classified as one of the following
1. Memorial Trees: given for a deceased member of the Yale community
  2. Milestone Trees: given through the Human Resources' employee program
  3. Noteworthy Trees: trees of distinctive character, aesthetic, importance, or historical value.
  4. Specimen Trees: notable by virtue of its outstanding size and quality for its particular species
  5. Rare taxonomy: a rare or unusual species
- O. Project Arborist: Arboricultural consulting firm contracted to provide planning and design services, technical assistance and advice to the Owner and design team. Duties include but are not limited to the following: site investigation and documentation (design phase inventories, assessments, root investigations, etc.); develop tree preservation plans, methods, details and specifications; and provide final document review and monitoring of the Contract Arborist. The Project Arborist is contracted directly to the Owner or Owner's representative and acts specifically on behalf of the Owner concerning tree related issues. Project Arborist shall have authority over the Contract Arborist and any disputes shall be decided upon by the Project Arborist and Engineer.
- P. Pre- Construction Meeting: Site meeting with attendance by Project Arborist, Contract Arborist, Project Design Team. Owner, and Construction Manager to review the Tree Action Protection Key (TPAK) and discuss logistics prior to any work beginning.
- Q. Preservation Measures: Found on the TPAK. This section will indicate which tree preservation measures are recommended for each tree. Preservation measures include root pruning, installation of tree protection fencing, mulch, soil care, soil aeration, tree growth regulator, tree condition inspections, watering, temporary root protection, root aeration matting, construction oversight/monitoring.
- R. Removal by Arborist (Tree Removal by Arborist): Action whereby the Contract Arborist removes trees designated for "Removal by Arborist" selected from inside the Tree Protection Area (TPA). Trees shall be taken down by hand sectionally, or directionally felled to minimize damage to adjacent tree canopies, root systems, or adjacent structures. Work shall be completed by a qualified contract arborist.
- S. Root Aeration Matting (RAM): Geocomposite material comprised of a tri-planar geonet structure with thermally bonded nonwoven geotextiles on both sides. The purpose of the RAM is to reduce compaction of existing soils and tree roots from permanent grade fills and provide separation from newly placed and compacted materials. It also provides an opportunity for air and water exchange to the existing soils

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where roots exist.

- T. Root Pruning: Action indicated on Drawings to provide a more suitable cut for protected tree roots to minimize ripped or torn roots during excavations and grading with standard construction equipment. Various methods may be used.
- U. Structural Critical Root Zone (SCRZ): Area shown on Drawings for all trees within scope of the project with a circle. Estimated area is based upon an industry standard “rule of thumb” of 0.5 feet of radius per inch of diameter at breast height (DBH). SCRZ is described as the minimum area of tree roots required to be protected to maintain tree structural integrity. Excavation within the SCRZ must be avoided as pruning roots within this zone makes the tree more susceptible to windthrow/uprooting.
- V. Soil Amendments: Various product components applied to existing soil environment of protected trees, as indicated on Plan/TPAK Notes.
- W. Soil Care: Recommended Tree Preservation Measure indicated on the TPAK. Indicates a Soil Amendment should be applied to the tree in the noted Year/timeframe.
- X. Soil Restoration/Aeration: Tree Preservation Measure indicate on the TPAK. Use of a SSAT (AirSpade) to decompact soil and/or remove excess soil from the CRZ of a tree to be preserved.
- Y. Supersonic Air Tool (SSAT): Handheld pneumatic tool, such as an AirSpade, designed to focus highly compressed air (90-125 psi) provided from a large air compressor (185-375 cfm) at speeds close to 1400 mph at the tip of the tool. Widely used by arboricultural firms and consultants for multiple purposes including but not limited to: root collar investigation, CRZ investigation, root pruning (especially large roots > 1.5” diameter or where existing underground cables or conduits are located, radial mulching and restoration of compacted soils, excavation for utilities within protected CRZs to minimize root damage from constriction.
- Z. Support Cable: Installation of steel cables, attached to lag screws or bolts placed in tree limbs, to provide additional support or to limit movement and stress of limbs.
- AA. Temporary Root Protection Matting: Material installed over the CRZ of protected trees to allow machinery to access site. Matting should be Alturnamat or similar product approved by Project Arborist. Plywood may be acceptable for smaller machines. Equipment shall not be moved across the CRZ of a tree without Root Protection Matting installed.
- BB. Tree Condition Inspection: When indicated on the TPAK, these trees will be regularly assessed by Contract and/or Project Arborists during site visits throughout construction. This recommendation may be made for Priority Trees, those in Poor condition, and/or those that will be root pruned.
- CC. Tree Growth Regulator (*Paclobutrazol*): Product applied to designated trees used to regulate plant growth in such a way as to restrict canopy growth and free stored or produced energy for other uses in the tree. For highly impacted trees, more energy may be available for fibrous root growth (to combat root loss), thicker darker leaves (allowing for increased photosynthesis, and increased drought tolerance), and pest tolerance (often an issue with construction stressed trees); among other potential benefits.

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DD. Tree ID: Tree identification number. Will be generated by the AOI report and correspond to tree tag numbers in the campus-wide tree inventory.

EE. Tree Protection Action Key (TPAK): Matrix developed by Project Arborist and provided on Drawings for each tree indicating designated protection and stress reduction measures specified in this document.

FF. Tree Protection Zone (TPZ): Area indicated on Drawings surrounding individual trees or groups of trees to be protected during construction. AKA Tree Protection Area.

GG. Tree Protection Fencing: Fencing installed along the TPA of all protected trees in order to protect roots from damage and soil from compaction. Fencing should be 6-foot chain link fence and remain in place throughout project. No materials shall be stored within the Tree Protection Fencing.

HH. Trunk Protection: When indicated on the TPAK, tree trunk shall be wrapped with geocomposite material from root flare up to 12 feet. More than one layer may be installed to reach suitable protection from the equipment or operations designated for work in the area. Attach with banding or strong tape that will not girdle the tree during the project timeframe. No nails or other devices are to penetrate the trunk. Protection shall be removed promptly when construction is complete.

II. Value, Appraisal: TBD


JJ: Value, Ecosystem: TBD

KK: Watering: When indicated on the TPAK, tree will receive supplemental irrigation during construction. Actual amount of irrigation will depend on the environmental conditions (drought, summer vs. autumn, etc.), and timing of construction impacts (after root pruning more important than prior to) and be recommended by Project and/or Contract Arborist.

## 1.4 SUBMITTALS

A. The Contract Arborist shall provide submittals as follows:

1. Product Data: For each type of product indicated
2. Certification: For each phase, the Contract Arborist shall certify for each tree designated to remain has been protected during construction according to recognized standards and that trees were promptly and properly treated and repaired when damaged.
3. Qualification Data: For Contract Arborist Firm Qualifications, submit firm and individual qualifications as follows:
  - a. Submit a minimum of two resumes and detailed qualifications from staff or team individuals assigned to this project as detailed under Quality Assurance below. Due to the complexity of this project, standard arboricultural experience may not qualify.
  - b. Provide references for above from a minimum of three commercial, non-governmental or governmental projects for whom similar tree preservation programs have been successfully

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implemented. Include the following information:

- 1) Project Name, size and scope
  - 2) Number and species of trees involved
  - 3) Relevant photos or aerials
  - 4) Scope of services provided
  - 5) Name and contact for project owner, designer, or contractor.
4. Site Safety Plan: Contract Arborist must submit a written plan describing all protective measures proposed to be used. Protection measures shall be required for all on site tree care activities to minimize potential impact to pedestrians and property. Plan must be coordinated with the Construction Management's Safety logistics plan.
  5. Maintenance Prescription: Contract Arborist shall submit for care and protection of trees as a result of construction as indicated in the TPAK, changes in weather patterns or events, and response in health from individual trees during and after completing the Work.
  6. Soil Samples: Submit soil sample for analysis during site work phase of this project. Take representative soil samples from all areas of protected trees (landscape areas and street tree planting pits). Samples and procedures per local cooperative extension shall be followed. Forward reports to Engineer and Owner.
  7. Soil Amendments: Contract Arborist shall submit specific fertilizer formulations, application rates and methods for review by Project Arborist. All fertilization and soil amendments shall be in conformance with soil test results.
  8. Site Documentation: Submit weekly reports to the Owner containing complete documentation of all tree impacts and tree preservation activities including but not limited to root pruning, tree protection fencing, excavation within critical root zones, tree fertilization or other treatments, etc. Documentation shall include tree numbers of trees impacted and / or treated. Complete daily photographic record is also required.
  9. Existing Conditions: Documentation of existing trees and plantings indicated to remain, which establishes preconstruction conditions that might be misconstrued as damaged caused by construction activities.
    - a. Use sufficiently detailed photographs or videotape.
    - b. Include plans and notations to indicate specific wounds and damage conditions of each tree or other plants designated to remain.
  10. Tree and shrub removal of additional plants not under base contract will require a written request submitted to the Owner for approval prior to starting the removal.

## 1.5 QUALITY ASSURANCE

- A. Certified Arborist (individual) Qualifications: An arborist certified by the International Society of Arboriculture (ISA) and licensed in the jurisdiction where project is located. All work performed by



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Contract Arborist including any oversight and documentation work, shall be performed or directly supervised by at least one on-site arborist with these minimum qualifications.

#### B. Contract Arborist Firm Qualifications:

1. Contract Arborist Firm shall comply with the following:
  - a. Established business with documented experience of at least five years.
  - b. Experience working on a minimum of three commercial, nongovernmental or governmental projects where similar tree preservation programs have been successfully implemented.
  - c. Properly licensed and insured to perform arboricultural work in the jurisdiction where the project is located.
2. Provide names of each individual to comply with the following:
  - a. Minimum BS degrees in forestry, arboriculture, or related field and Certification in ISA.
  - b. Resumes should reflect combined 10 years full time experience on similar tree preservation projects.
  - c. Provide individual(s) names, certifications, and each anticipated role in this project. "Role(s)" shall be defined as one or more of the following:
    - 1) Project Manager
    - 2) Technical Oversight
    - 3) Certified Arborist
3. For each staff member, list a minimum of three construction projects and a minimum three years' experience in the following technical applications:
  - a. Soil amendment prescriptions and applications
  - b. Supersonic Air tool Excavations for underground utilities exceeding 24" depth.
  - c. Root Protection Matting or similar applications

#### C. Part of this work to extent referenced shall include but not be limited to the following:

1. ANSI A300 Standard Practices for Trees, Shrubs, and Other Woody Plant Maintenance.
2. ANSI A300 (Part 1) - 2017 Pruning
3. ANSI A300 (Part 2) - 2011 Soil Management a. Modification, b. Fertilization, and c. Drainage
4. ANSI A300 (Part 3) - 2013 Supplemental Support Systems (includes Cabling, Bracing, Guying, and Propping)
5. ANSI A300 (Part 4) - 2014 Lightning Protection Systems
6. ANSI A300 (Part 5) - 2012 Management of Trees and Shrubs During Site Planning, Site Development, and Construction
7. ANSI A300 (Part 6) - 2012 Planting and Transplanting
8. ANSI A300 (Part 8) - 2013 Root Management Standard
9. ANSI A300 (Part 9) - 2017 Tree Risk Assessment
10. ANSI A300 (Part 10) - 2016: IPM, (Integrated Pest Management)
11. ANSI Z133.1 2017 and most recent updates, Tree Care Operations – Safety Requirements

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D. Fertilizer and pesticide will be applied in strict accordance with the manufacturers label instructions and applicable federal, state, and local requirements. Fertilizer, soil conditioners, and pesticide applications must be approved by the owner prior to application. Safety Data Sheets (SDS) will be available for fertilizers and pesticides in the Contract Arborists' possession while on the site.

E. Pre-Construction Meeting: Conduct meeting at the project site prior to commencement of construction related activities.

1. Review methods and procedures related to tree protection and preservation including, but not limited to, the following:
  - a. TPAK
    - 1) Identify all trees that have recommended preservation measures.
    - 2) Confirm the preservation measures that each tree will receive from Contract Arborist.
    - 3) Locations of tree protection fencing to be agreed upon and marked.
    - 4) Project Team will ask any questions to confirm understanding and timing of TPAK recommendations.
  - b. Site Logistics Plan
    - 1) Confirm locations of all vehicle access routes
    - 2) Confirm locations for material storage/laydown
  - b. Construction schedule – verify availability of material, personnel, and equipment needed to make progress and avoid delays.
  - c. Enforcement of requirements for tree protection areas.
  - d. Responsibilities of all parties, including coordination, access and timing requirements.
  - e. Field quality control

## 1.6 PROJECT CONDITIONS


A. The following practices are prohibited within all tree protection areas except as specifically indicated herein:

1. Storage or stockpiling of construction materials, chemicals, debris, or excavation materials.
2. Parking vehicles, trailers or equipment.
3. Foot traffic.
4. Erection of sheds or structures.
5. Impoundment or discharge of water.
6. Excavation or other hand or mechanical digging unless otherwise indicated.
7. Attachment of signs to or wrapping materials around trees or plants unless otherwise indicated.

B. Do not direct vehicle or equipment exhaust toward protection zones.

C. Prohibit heat sources, flames, ignition sources, and smoking within or near protection zones and organic mulch.



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## PART 2 - PRODUCTS

### 2.1 MATERIALS

#### A. Temporary Tree Protection Fence

1. Chain-Link Fence: Galvanized steel chain-link fence with 11 gauge wire chain-link fabric; with 1-7/8 inch diameter line posts and 2-3/8 inch diameter terminal and corner posts; with tie wires, hog ring ties, gates and other accessories for a temporary fence system.
  - a. Height: 6 feet
  - b. If installed on softscape within a CRZ, the fencing will be supported using only above-ground methods such as ballast weight. Use of post holes should be avoided because they may impact protected roots.
  - c. If installed on softscape outside of a CRZ, the fencing can be installed with post holes or as above.
  - d. If installed on hardscape, the fencing will be supported with ballast weight.

#### B. Wood Chip Mulch


1. Double ground hardwood aged a minimum 6 months from production, free from deleterious materials. Green chips or mulch not aged at least 6 months shall not be used. No walnut mulch shall be used. Submittal shall include original material source(s), number and type of grindings / chippings, duration of aging, timing of turning / aeration.
2. Mulching for the duration of construction for protection and stress reduction. Mulching will increase moisture-holding capacity, minimize soil compaction, and increase needed organic composition.

#### C. Insect/Disease Control: Specific materials will be submitted based upon the actual pest observed in the field that requires treatment.

1. Material labels will be provided by Contract Arborist and approved by Owner/Project Arborist prior to application
2. All materials will be applied per label.

#### D. Tree Growth Regulator (*Paclobutrazol*)

1. Paclobutrazol is a compound used to regulate plant growth in such a way as to restrict canopy growth and free stored or produced energy for other uses in the tree. For highly impacted trees, this means more energy may be made available for fibrous root growth (to combat root loss), thicker darker leaves (allowing for increased photosynthesis, and increased drought tolerance), and pest suppression (often an issue with construction stressed trees); among countless other potential benefits. Trade name Cambistat® or equal.

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#### E. Soil Care/Soil Amendments

1. Fertilizer and soil amendment selection shall be based upon soil test results and recommendations.
2. Material labels will be provided by Contract Arborist and approved by Owner/Project Arborist prior to application.

#### F. Temporary Root Protection Matting (RPM): geocomposite material comprised of a tri-planar geonet structure with thermally bonded nonwoven geotextiles on both sides.

1. Material shall be SynTec ROADRAIN T-7 or approved equal.
2. AlturnaMAT or 1" thick steel plates may be used in lieu of RPM, subject to approval by Project Arborist.
3. Submit shop drawings/cut sheets and material samples for review by Project Arborist and project engineer.
4. Wood chip mulch or gravel is required with these materials.

#### G. Temporary Trunk/Limb Protection Wrap: to provide specific protection to tree trunks when construction activities are expected in close proximity to tree trunks and limbs.

1. Material shall be SynTec ROADRAIN T-7 or approved equal.
2. Alternative methods and materials may be submitted for review and consideration by the Project Arborist.


#### H. Permanent Root Aeration Matting (RAM): geocomposite material comprised of a tri-planar geonet structure with thermally bonded nonwoven geotextiles on both sides.

1. Material shall be SynTec ROADRAIN T-7 or approved equal.
2. Submit shop drawings/cut sheets and material samples for review by Project Arborist and project engineer

### PART 3 - EXECUTION

#### 3.1 TREE REMOVAL

- A. All trees, shrubs and hedges designated for removal shall be marked in red flagging for review and approval by the Owner's representative.
- B. All trees designated for removal shall be taken down sectionally or directionally felled to minimize damage

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to adjacent tree canopies and root systems by a qualified Contract Arborist. Gouges in turf from impacts shall be filled with approved topsoil and seeded at the direction of the Owner's representative. Damage to adjacent trees shall be reviewed by the Owner's representative for remedial recommendations or replacement.

C. All work shall be done by hand, aerial lift truck or crane operated equipment.

D. Motorized equipment shall operate on existing pavement and not enter tree preservation areas without prior approval by the Project Arborist. Temporary root protection matting may be required for such access to prevent rutting and compaction.

E. Stumps shall be ground to 8 inches below grade and grindings raked and removed from site; backfill holes with approved topsoil and mulch or seed as directed by Owner's representative. Coordinate with underground utilities prior to grinding. All stump grinding shall be performed by the Contract Arborist.

1. For tree pits where a new tree is proposed, the stump may be ground out completely (as determined by the Project Arborist) to allow the proposed tree to be planted. Backfill as above.

2. Only trees with stumps within deep excavations may have stumps removed by excavator if approved by the Project Arborist. Stump excavation may be performed by the Site Contractor under the direct supervision of the Contract Arborist.

F. Removal of shrubs and hedges designated for removal shall be cut and stumps ground out or hand dug to remove stumps. Prior to removal, verify with Owner's representative.

G. Remove all wood debris from site promptly. All wood debris shall be removed each day unless directed otherwise by the Owner's representative.

### 3.2 TREE PROTECTION AND STRESS REDUCTION MEASURES

#### A. General


1. Installation/implementation of the following measures shall be performed in the field by and ISA Certified Arborist as provided by the Contract Arborist

2. All work, substitutions and /or modifications shall be subject to review and approval by the Owner.

3. All work shall conform to applicable federal, state and local regulations and industry standards.

4. The Contract Arborist shall be responsible for all items in this section.


B. Coordination of Tree preservation plan. The work of the Contract Arborist coordination to include but not limited to the following:

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1. Existing underground utility marker conflicts brought to the attention of the Contractor for resolution as well uncovered underground utilities as a result of work.
2. Coordinate necessary survey layout of proposed construction elements in order to provide accurate locations for tree protection measures.
3. Layout location of designated tree protection based upon proposed construction and methods of construction for that area.
4. Site walk with Owner and Site Superintendent to verify location of all tree protection measures prior to execution.
5. Notify Site Superintendent and Owner if construction adjacent to tree protection does not appear to follow specifications or prior agreement or conflicts with tree protection seem eminent.
6. Coordinate with Site Superintendent and Owner, for access of deliveries, crews, equipment, start up, and cleanup of each item of work.
7. Provide “as built” of any change to location of tree protection.
8. Attend progress meetings as requested.
9. Provide submittals as required.
10. Notify Superintendent and Owner of any breach or damage to tree protection requiring attention.

#### C. Pruning and Supportive Cabling

1. Specific canopy pruning for tree health, risk reduction, and construction clearance per Contract documents
2. Size, health, species, and impact from proposed construction will be taken into consideration in determining pruning type for each designated tree. Risk Reduction Pruning will remove dead, dying, and declining limbs 2” diameter and larger. No interior green branching including sprouts will be removed unless approved by Contract Arborist.
3. Contractor, Contract Arborist, and Owner shall meet at site to determine overhead clearance conflicts between trees and construction equipment/activities to prevent breakage, impacts, or aesthetic concerns. All work shall conform to ANSI A-300 arboriculture standards. An aerial assessment shall be made for all trees climbed to report any structural weakness of concern to the Owner.
4. Prior to climbing any tree, a risk assessment will be performed using visual, sounding, or basic drilling as needed by the Contract Arborist. Trees deemed high risk should not be climbed; alternate methods should be used, and the tree reported to the Owner immediately.
5. Supportive Cabling of weak unions may be recommended by the Contract Arborist if the need is

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discovered during pruning operations. ANSI Standards apply. Cabling may be included only if submitted to the Engineer and approved by the Owner.

#### D. Root Prune

1. Purpose of the root pruning is to provide a more suitable cut to not rip or tear roots during excavations and grading with standard construction equipment. The exact location and depth along the LOD or edge of utility excavation will be determined during the layout by a Certified Arborist.
2. Root Pruning for urban sites with specimen trees or for transplanting requires the use of SSAT excavation for hand pruning. Refer to SSAT specifications in the section
3. Sufficient moisture is necessary for reducing the level of dust, increase work efficiency, and provide a hospitable environment of the tree roots and pedestrians.
4. At a pre-work site inspection by the Contract Arborist more than 72 hours in advance of work start, subsurface probing to 24-36" with a tile probe or similar method will determine if sufficient soil moisture exists. If sufficient moisture is not found, immediate coordination with the site managers shall be made to irrigate the proposed work areas. Methodology may be soaker hose, sprinklers, soaker cans with small drilled holes to release water slowly or other methods. A second follow up inspection shall be made to determine final sufficiency to begin.
5. All root pruning operations shall be performed by the Contract Arborist and directed in the field by and ISA Certified Arborist with documented experience in similar SSAT excavation and root pruning.

#### E. Temporary Tree Protection Fence

1. Type and placement of fence to be designated on the Preservation Plans and Details.
2. Attach tree protection area signs at 30' feet spacing, facing construction activity. For fence lower than 6' feet in height, attach owner provided flagging as directed. Consult with the Owner for sign content.
3. Tree protection area signs shall be high visibility and all weather to last duration of the project / phase.
4. Install tree protection after root pruning if shown, and prior to all other mobilization such as demolition, clearing and/or excavation.
5. Install tree protection at 6" – 12" outside (construction side) of the Root Prune line or within the Root Prune Trench.
6. Silt fence will be outside (construction side) the tree protection fence, unless super silt fence is used in lieu of tree protection. Trenchless installation method shall be employed per Detail if Root Protection Matting is designated.

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7. Exact placement of fence will be determined in walk-through with Contractor, Project Arborist, Contract Arborist, Engineer, and Owner.
8. Sequencing of the tree protection fence will be determined during the initial site walk. In any case, no construction activities shall occur in each phase or section until approved protection is installed.


#### F. Root Protection Matting (RPM)

1. The purpose of the RPM is to reduce compaction, rutting, and contamination of soils and root systems of trees to be retained should staging, temporary stockpile, or equipment access be required within CRZ areas due to extreme site constraints.
2. RPM shall be used for all access within CRZ areas of trees to remain. Matting is not required where existing pavements or concrete will remain undisturbed.
3. Trees anticipated receiving temporary or repetitive materials staging, foot traffic, or equipment access within protected root zones are to receive RPM. Wood chip mulch 4-6" in depth shall be installed under matting to further protect soils and roots.
4. If short duration access is needed, such as one day or less, the use of "AlturnaMATS," 1" steel plate, or approved equal may be needed to avoid rutting and compaction. These materials may be shifted and re-used as work progresses.
5. All weather staging, stockpile, or other repetitive construction operations may require a 12" depth stone layer over RPM to allow heavy vehicles have the potential to cause dynamic compaction yet without rutting original surface soils and roots. In this situation, the stone may be contained by silt fence or super silt fence where adjacent to or within a TPA.
6. All temporary RPM areas to be used beyond a single day or beyond continuous onsite supervision of the Contract Arborist shall be surrounded by temporary tree protection fence as per specifications. For temporary staging of soils beyond 24 hours, "trenchless" silt fence fabric shall be installed on the lower/downhill side or as directed by the Project Arborist.
7. If silt fence is required for erosion control in RPM areas, installation of silt fence shall be coordinated with the Contract Arborist and must be performed by the Contract Arborist to prevent damage to tree roots from trenching operations. Erosion control socks may be used in lieu of silt fabric if approved by the Engineer

#### G. Root Aeration Matting (RAM)

1. The purpose of the RAM is to reduce compaction of existing soils and tree roots from permanent grade fills and provide separation from newly placed and compacted materials. It also provides an opportunity for air and water exchange to the existing soils where roots exist.
2. Areas to receive RAM shall be protected from disturbance prior to the specific RAM and fill placement. Tree Protection Fence shall be used for this purpose.



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3. If temporary access is needed within RAM areas prior to the time of RAM and fill placement, a temporary placement Root Protection Matting (RPM) with mulch shall be made to prevent soil compaction. Steel plates or other temporary protection methods for short-term use may be used. Refer to “Root Protection Matting” in this section for additional detail.
4. Sites shall be prepared by the Contract Arborist. Any debris shall be removed by hand. Existing soils shall remain undisturbed and un-compacted unless otherwise approved. If site preparation (grading, excavation, etc.) is needed, all work shall be done in accordance with this section. Refer to “Excavation for Proposed Sidewalk within Tree Protection Areas” in this section.
5. RAM material shall be placed on undisturbed and un-compacted soil except as described herein. RAM placement shall be made by the Contract Arborist.
6. RAM material shall extend to the toe of the proposed slope and “daylight.”
7. RAM shall be pinned to the ground to prevent it from moving during fill placement. Pins shall be 12” “landscape nails” or approved alternate.
8. Seams within the RAM placement shall overlap by at least 2’ or be connected or installed as designated by the manufacturer.
9. Fill materials (aggregate, soil, or other approved fill) shall be placed directly on the RAM and compacted only to the minimum necessary as directed by the Engineer.
10. RAM shall remain in place permanently and shall not be removed or disturbed by the contractor.

#### H. Temporary Tree Trunk and Limb Protection Wrap

1. Temporary trunk protection to cover the root flare and up to 12’ height, or to the scaffold branches, or as determined for the situation.
2. Tree trunk (or limbs, as determined by Project Arborist) shall be wrapped with geocomposite material. More than one layer may be installed to reach suitable protection from the equipment or operations designated for work in the area. Attach with banding or strong tape that will not girdle the tree during the project timeframe. No nails or other devices are to penetrate the trunk.
3. Wrap shall be removed promptly after construction is complete.

#### I. Hand Excavation within Tree Protection Areas

1. For excavation within the critical root zone areas of trees to remain, the intent is to minimize tree and root damage from excavation activities.

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2. Excavation shall be performed using SSAT, hand tools (shovels, etc.), or other approved non-damaging method. Roots shall not be damaged by the excavation except for approved root pruning.
3. Refer to “Supersonic Air tool Excavation” and “Construction Oversight by Arborist” specifications in this section for additional requirements.
4. All work shall be directly supervised by Contract Arborist in collaboration with the Owner’s trades and subcontractors.
5. RPM (Root Protection Matting) shall be installed along trench sides to allow for temporary soil stockpile and access.
6. Excavate along the edge of the proposed trench closest to the trees to be protected as shown on the plans. Roots shall be uncovered, and care taken to avoid damage to roots and bark.
7. Contract Arborist shall prune the exposed roots. Excavation shall not extend beyond the line where roots were pruned.
8. Contractor may proceed with conventional excavation methods or with hand excavation methods if clearance to the tree is inadequate for equipment access.
9. No roots shall be cut by the contractor.

#### J. Supersonic Air tool (SSAT) Excavation

1. Refer to “Hand Excavation within Tree Protection Areas” specification in this section for additional requirements
2. At a minimum, all SSAT work shall include the use of a barrier system such as temporary walls or tents to protect property and pedestrians from flying debris.
3. Excavate along the edge of the proposed trench closest to the trees to be protected as shown on the plans. Roots shall be uncovered, and care taken to avoid damage to roots and bark.
4. Excavation shall proceed per the “Hand Excavation within Tree Protection Areas” specification in this section.

#### K. Wood Chip Mulch

1. Mulch shall meet the specifications and shall be three (3) inches in depth.
2. For individual trees designated on the TPAK within the TPA install mulch to a radius equal to trunk diameter inches equated to mulch ring diameter in feet (24” inch trunk diameter = 24’ feet diameter mulch ring). Where planting pit areas are restricted by hardscape, mulch the greatest area possible.
3. For linear TPAs along LOD Install mulch strips a minimum 10’ feet wide the length of critical root

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zones along the outside of the LOD/Root Prune line (just inside the Tree Protection Zone) for designated significant trees impacted by proposed construction.


4. Motorized equipment shall not enter the Tree Protection Area (TPA) unless specifically approved by the Project Arborist and specific conditions met (RPM, Alturna MATS, etc.). Any such motorized equipment shall be operated by a certified arborist while inside the TPA.
5. Do not allow mulch to contact trunk /root flare.
6. Mulch depth shall be 3” inches.

#### L. Tree Growth Regulator (*Paclobutrazol*)

1. Specific methods and dosages are contained on the label and are determined by size and species and applied by a state licensed pesticide applicator. Designated trees are shown on the Tree Protection Action Key (TPAK).

#### M. Supplemental Watering

1. This action is for high impact trees of significance during seasonal drought times of project construction. Based upon the number and size of trees various strategies can be considered to maintain adequate soil moisture during these times. These strategies may include but are not limited to the following:
  - a. Fire hydrant connection battery powered timer and drip irrigation hose/tubing;
  - b. Water tank trunk and hand applied as directed;
  - c. Temporary above grade poly tank with battery-powered timers for drip or soaker hoses at each TPA.
  - d. 30-50-gallon watering cans with 6 – 8 drilled holes in bottom to allow slow seeping of water; spacing and rotation to reach desired gallons. Equivalent means of affectively watering trees as approved by Engineer or Project Arborist.
- 2 - Trees requiring this treatment are indicated in the TPAK. Other trees will not receive this treatment.
- 3 - Drought times shall be defined as:
  - a. Periods during the growing season of two weeks or longer, where daytime high temperatures reach 80 degrees Fahrenheit or higher and less than ¾” rainfall are recorded per week. Or,
  - b. Periods during the growing season designated as “abnormally dry” or “drought” of any severity, by the U.S. Drought Monitor: <http://droughtmonitor.unl.edu/> Or,
  - c. Any period of extraordinary circumstance, as determined by the project arborist or engineer
- 4 - A prescription for the number of gallons and strategy for watering designated trees will be developed. Large mature trees with impacts to root systems require as much as 100 – 250 gallons per week during 90-degree days during summer drought times.
- 5 - Periodic inspections by the Contract Arborist at this time are critical. Depth of moisture in soils shall be determined by soil sample tube or other exploratory means.

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- 6 - Minimum watering shall be considered to be 6 applications per growing season typically July through October with the exact timing and duration to be determined by the Contract Arborist.

#### N. Overhead Clearance


1. Trees to remain shall be assessed prior to construction for overhead clearance for construction activities. Contract Arborist shall recommend either canopy pruning, temporary guying/tying of select limbs, or alternative construction methods.
2. Pruning for clearance shall not remove branches above 12' feet or over 6" inches diameter
3. All pruning proposed by the Contractor and / or Contract Arborist shall first be reviewed and approved by the Owner and Project Arborist.
4. Equipment exhaust should be directed away from trees as much as possible. Stationary equipment shall not exhaust directly under or toward trees.
5. Contractor shall use appropriate equipment near trees to ensure that trees are not damaged by construction. Contractor shall provide any specialized equipment needed at no additional cost to the owner.
6. Any pruning shall also conform to the pruning specifications in this section.

#### O. Soil Tests and Soil Care/Fertilization

1. Initial soil testing within tree protection areas is required. Conduct individual soil tests for separate tree protection areas (small adjacent areas may be tested together). Soil test shall be a representative sample from each area. Soil testing shall include a texture analysis (sand, silt, and clay percentages), soluble salts, and sodium tests.
2. Treatments to the tree protection areas for specified trees shall be based on the results of the soil analysis. Fertilization should be consistent with the recommendations of the ANSI A300 (Part 2) - 2011 Soil Management a. Modification, b. Fertilization, and c. Drainage, except as described herein.
3. Application rates shall not exceed a rate of 1 pound of actual nitrogen per 1,000 square feet annually. Fertilizer used should include humic acids, soluble seaweed extracts and soil biological inoculants (mycorrhizae, etc.).
4. Applications to confined areas (i.e. street tree planting pits) should be made by soil injection. In areas where adequate application rates cannot be achieved, injection should be made to the point of refusal.

#### P. Soil Restoration / Aeration (using compressed air-powered tool such as Airspade or equivalent)

1. Treatments using various methods to relieve soil compaction and restore healthy soil conditions

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by the introduction of air space and organic amendments into the soil, decreasing soil bulk density. Specialized root zone and soil excavation operations shall include, but not be limited to:

- a. Soil aeration and decompaction, Air Tilling (Root Invigoration).
  - b. Radial trenching.
  - c. Vertical mulching.
  - d. Root collar excavation.
  - e. Root pruning.
  - f. Bare rooting.
  - g. Soil replacement.
  - h. Transplanting.
  - i. Root training.
  - j. Root trenching.
  - k. Excavation or trenching required for construction or utility work in CRZ.
2. All proposed methods, materials, and schedule for effecting soils and critical root zones shall be in accordance with ANSI A300 (all parts), and shall be submitted by a certified Contract Arborist for review by the Project Arborist, Landscape Architect and Owner.
  3. Refer to Airspade Pneumatic Soil Excavation Technical Applications Bulletin for additional information: [www.airspade.com/guide](http://www.airspade.com/guide).


### 3.3 FIELD QUALITY CONTROL AND MONITORING

#### A. Tree Condition Monitoring

1. An ISA Certified Arborist (provided by the Contract Arborist) shall perform monitoring twice per month year-round to monitor insects, disease, soil moisture levels, weather, and health changes on all trees designated on Tree Protection Action Key.
2. The monitoring will include a report that details problematic areas that have been addressed, treatments provided to reduce the problem, and anticipated treatments forecast for 30 days. This report will be forwarded to the Project Arborist, Engineer and Owner for documentation.
3. Any treatments recommended by the Contract Arborist not already included in the project scope shall be noted in the reports for review by the Project Arborist, Engineer and Owner. No additional work is to be performed unless approved in writing by the Owner.

#### B. Construction Oversight by Contract Arborist

1. Any work within CRZs of retained trees shall be directly supervised by the Contract Arborist.
2. If roots are encountered during excavation, work shall progress as directed by the Contract Arborist. Contract Arborist, in coordination with the construction and design teams, shall determine appropriate means and methods to address the roots. Options may include, but not be limited to,

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severing the roots, hand or SSAT excavation. Contractor shall not cut roots.

3. Refer to “Hand Excavation within Tree Protection Areas” specification in the section.
4. All work shall be documented thoroughly, including photo documentation. Refer to site documentation submittal requirements.

### 3.4 CONTRACTOR DAMAGE AND PENALTIES

#### A. Remedial Measures


1. Any damage caused to the trees by the work of this contract through negligence by the contractor shall be immediately remedied by the contractor. Contractor shall be responsible for any associated costs.
2. Remedial work may include pruning, cabling, or any other measures up to and including removal and replacement, as determined by the Project Arborist and owner’s representative.
3. Remedial work shall be performed by the Contract Arborist, as approved by the Project Arborist and owner’s representative.
4. All required remedial work shall be performed to the satisfaction of the Project Arborist and owner’s representative, at no additional cost to the owner.

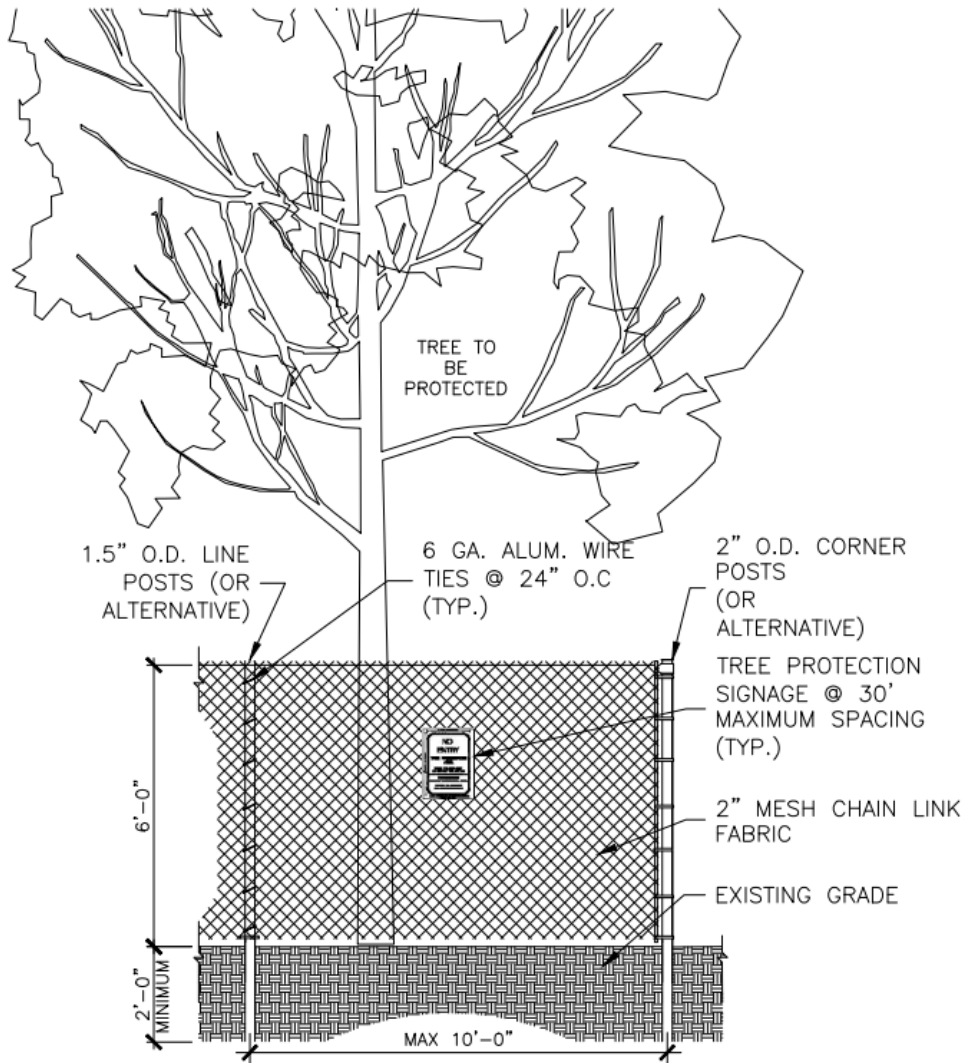
#### B. Tree Replacement

1. If damage to any tree is severe, because of negligence by the contractor as determined by the Project Arborist and owner’s representative, it shall be replaced with a new tree of equal size caliper and species as that of the damaged tree.
2. If a replacement tree of equal size and caliper is not possible as determined by the Project Arborist and owner’s representative, it shall be replaced on and inch by inch basis with new trees of a minimum caliper size of 2”-3”.
3. Replacement trees shall be supplied and installed at no additional costs to the owner, including all incidental costs including the costs of inspection of the tree at the nursery and any other incidental costs associated with tree replacement.

END OF SECTION



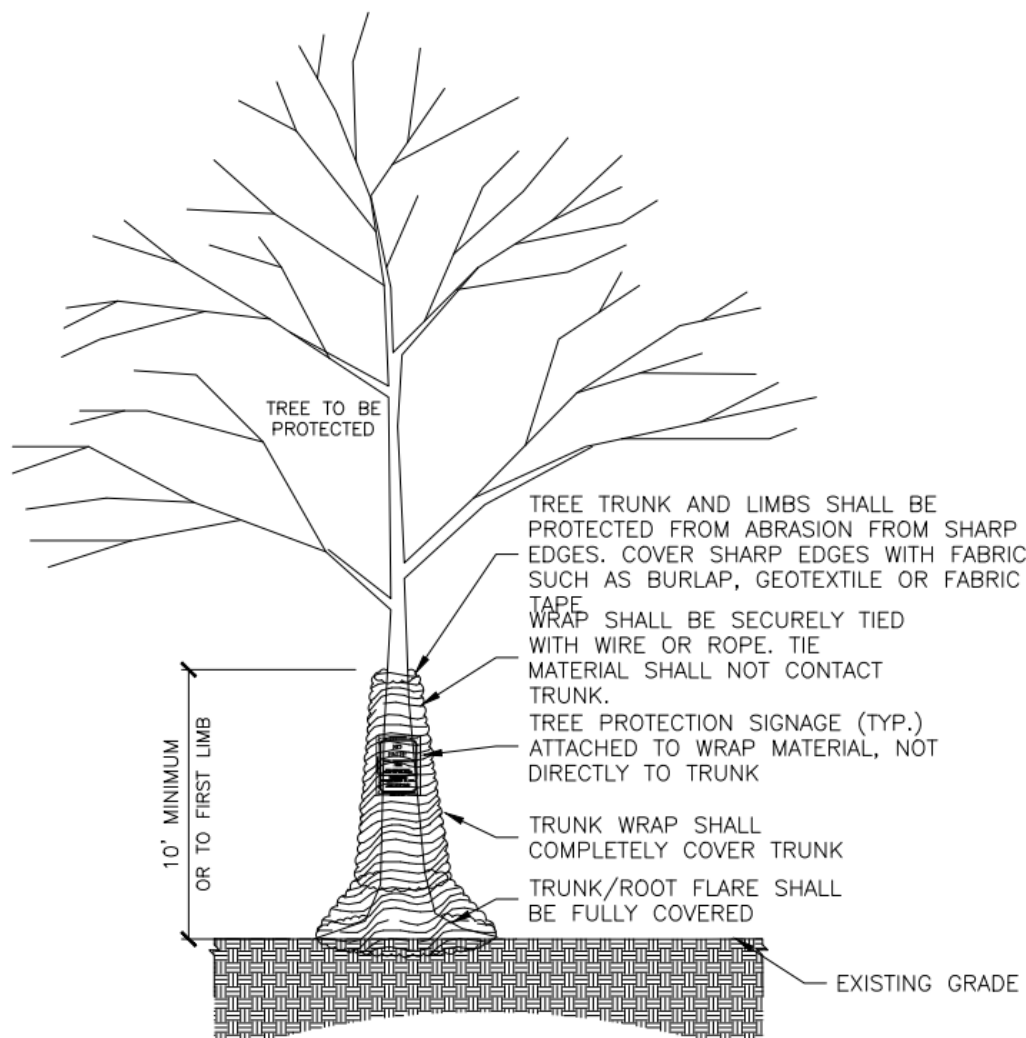
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**NOTES:**

1. TREE PROTECTION FENCE SHALL BE INSTALLED PRIOR TO ANY SITE WORK, CLEARING OR DEMOLITION.
2. SUPER SILT FENCE MAY BE USED IN LIEU OF WELDED WIRE FOR TREE PROTECTION PROVIDED IT IS INSTALLED AND MAINTAINED AS A TREE PROTECTION MEASURE AND IS POSTED WITH TREE PROTECTION SIGNS.
3. TREE PROTECTION FENCE SHALL BE MAINTAINED THROUGHOUT CONSTRUCTION. REMOVE FENCE ONLY WITH APPROVAL AND AFTER ALL SITE WORK HAS BEEN COMPLETED.

CHAIN LINK TREE PROTECTION FENCE (TYPICAL)  
SCALE: NTS

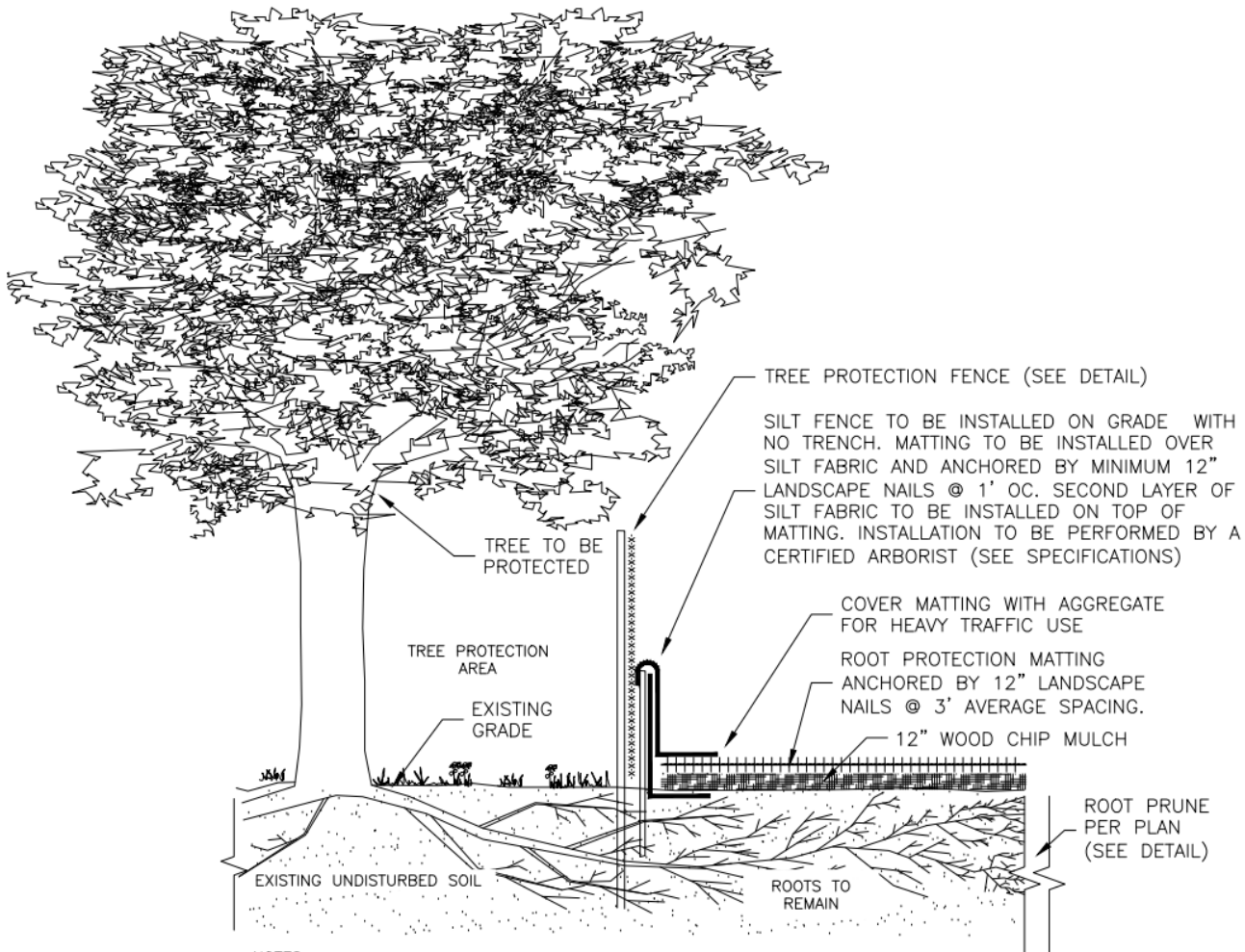


**NOTES:**

1. TRUNK WRAP MATERIAL SHALL BE DOUBLE SIDED GEOCOMPOSITE, GEONET CORE WITH NON-WOVEN COVERING (SUCH AS TENAX TENDRAIN 770/2) OR EQUIVALENT.
2. WRAP SHALL BE INSTALLED BY A CERTIFIED ARBORIST.
3. WRAP SHALL BE INSTALLED PRIOR TO ANY SITE WORK, CLEARING OR DEMOLITION.
4. WRAP SHALL BE MAINTAINED THROUGHOUT CONSTRUCTION. REMOVE WRAP ONLY WITH APPROVAL AND AFTER ALL SITE WORK HAS BEEN COMPLETED.
5. WRAP SHALL BE REMOVED PROMPTLY AFTER CONSTRUCTION.
6. MAJOR SCAFFOLD LIMBS MAY ALSO REQUIRE THIS PROTECTION AS DIRECTED BY THE PROJECT ARBORIST.

**TREE TRUNK & LIMB PROTECTION WRAP (TYP)**

SCALE: NTS




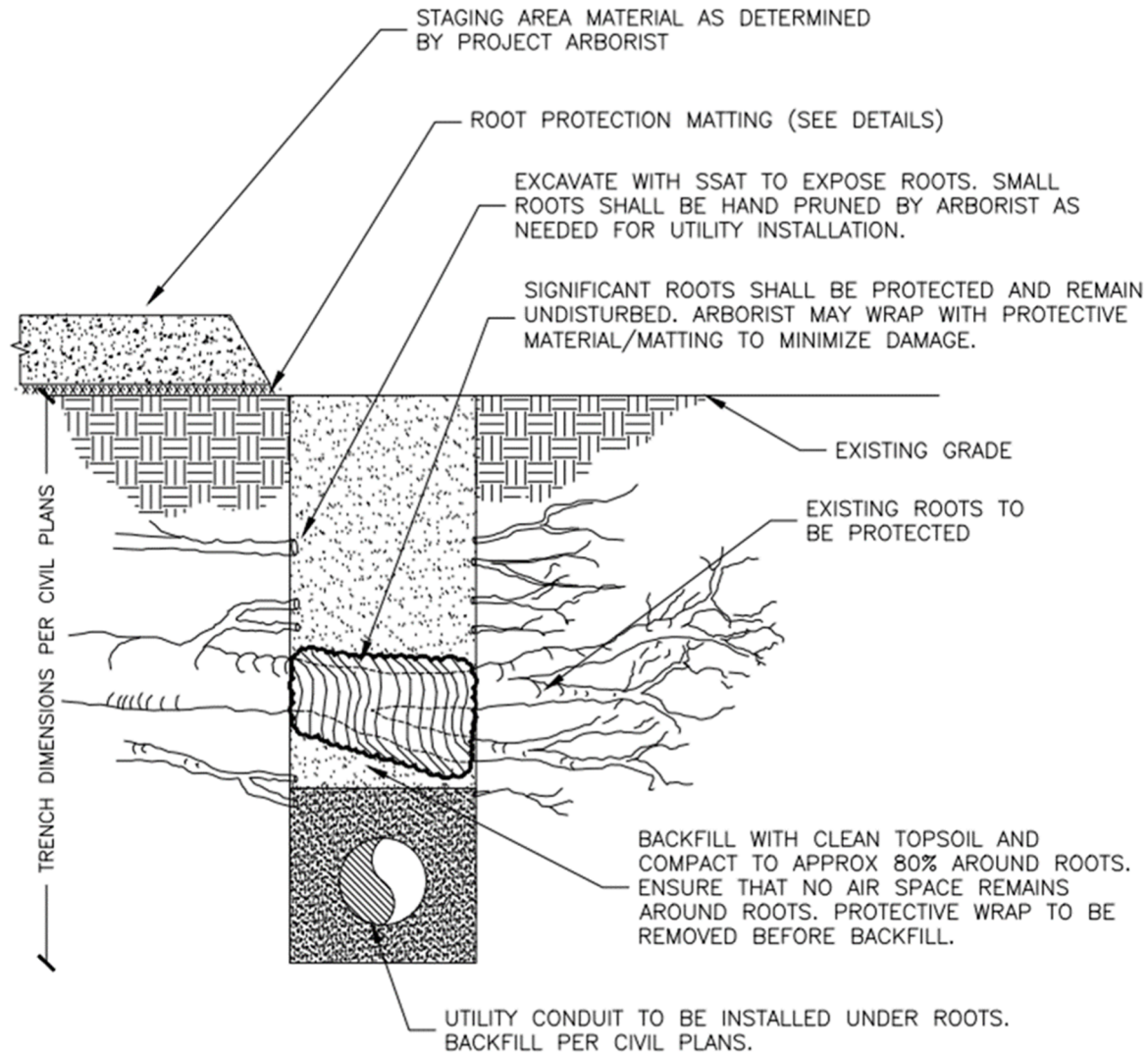
**NOTES:**

1. MATTING MATERIAL SHALL BE DOUBLE SIDED GEOCOMPOSITE, GEONET CORE WITH NON-WOVEN COVERING (SUCH AS TENAX TENDRAIN 770/2) OR APPROVED EQUIVALENT.
2. RPM SHALL BE INSTALLED BY A CERTIFIED ARBORIST.
3. TO BE USED FOR DESIGNATED TEMPORARY CONSTRUCTION/DEMOLITION ACCESS AND STOCKPILE AREAS.
4. MATTING SHALL BE PLACED ON 12" WOOD CHIP MULCH UNLESS OTHERWISE DIRECTED.
5. FOR HEAVY TRAFFIC AREAS, MATTING SHALL BE COVERED WITH 6-8" WELL GRADED CRUSHED AGGREGATE. ADDITIONAL LAYERS OF GEOTEXTILE MAY BE NEEDED.
6. STEEL PLATES, ALTURNAMATS, OR PLYWOOD, EACH WITH 12" MULCH MAY BE USED FOR SHORT TERM ACCESS.

**TEMPORARY ROOT PROTECTION MATTING (TYPICAL)**

SCALE: NTS

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## ROOT PROTECTION IN UTILITY TRENCH

SCALE: NTS

Date	Description of Change	Pages / Sections Modified	ID
Aug 2021	Entire document	-	kc, mw