# Understanding Tree and Root Protection During Construction

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Arlington County, VA

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This presentation has information prepared by Michael Knapp, Melissa Gildea, and Keith Pitchford, and pictures by Nora Palmatier

ARLINGTON VIRGINIA

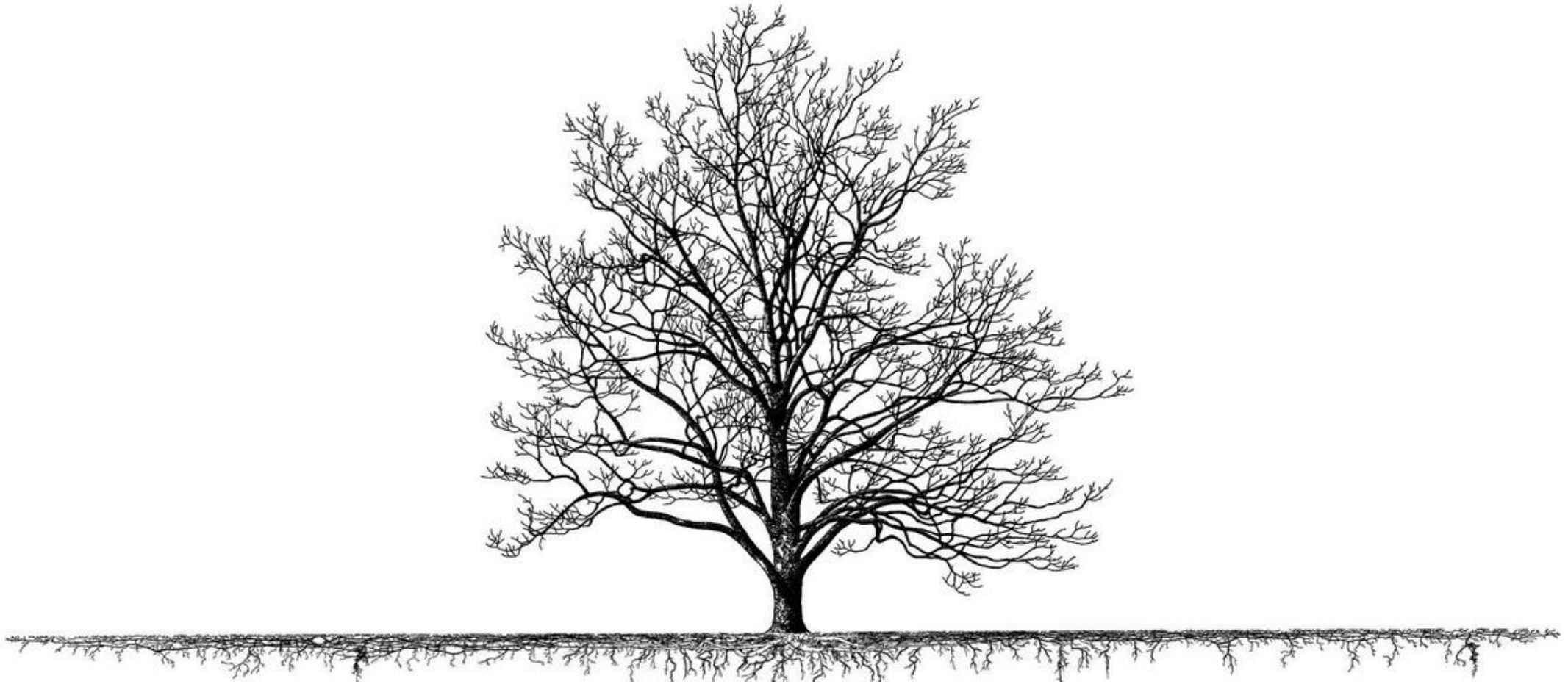
# Woody roots

- Large Lateral Roots
  - provide support (compression) anchorage (includes small lateral roots)
  - Carbohydrate storage
  - Water, mineral, organic compound transport
- Tap Roots, Sinkers, and Strikers
  - carbohydrate storage
  - water storage
  - anchorage

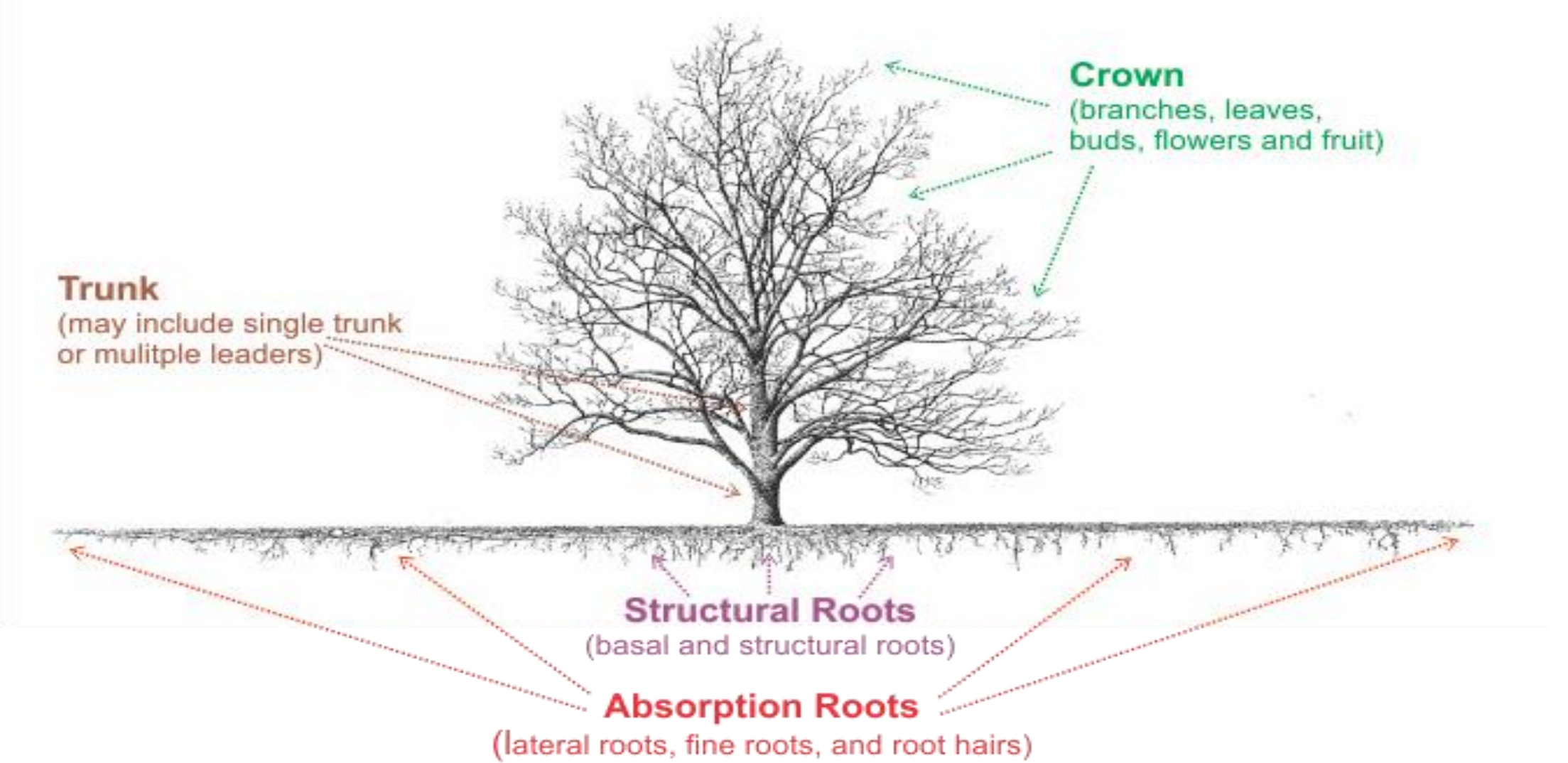
# Non-woody roots

- Small roots in the upper layer of soil
  - Carbohydrate synthesis and storage (amyloplasts)
  - Absorption of water, mineral, organic compound transport
  - Quantity and surface area (with root hairs) help with this

# Root Architecture

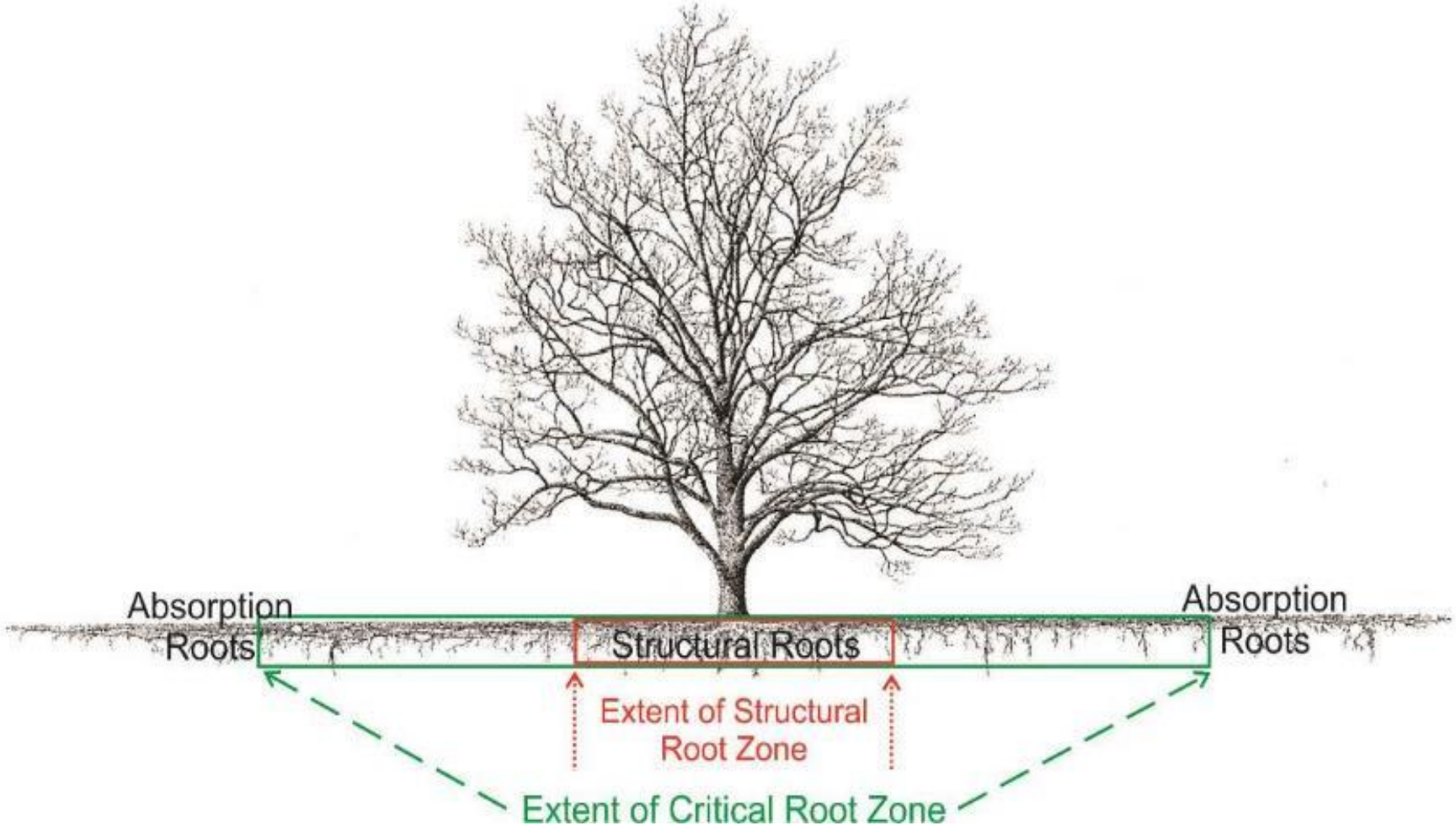


# Root Architecture

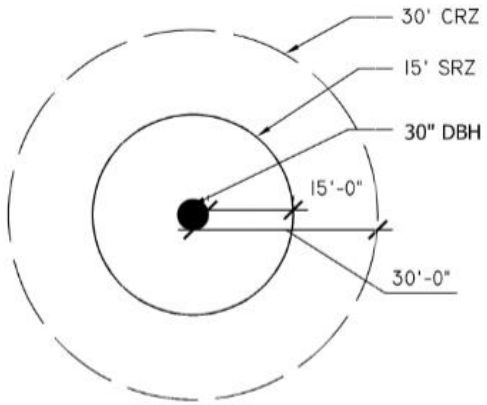


# Root location varies based on context

# Starting somewhere – Diagrams of roots

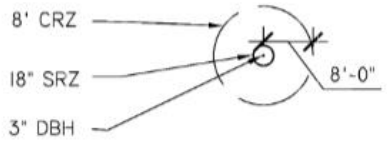


# CRZ and SRZ – Arlington County




TREES LARGER THAN 8"
1" DBH = 1' CRZ RADIUS

TREES 8" DBH AND SMALLER
8' CRZ RADIUS




**NOTES:**

1. CRZ (CRITICAL ROOT ZONE) IS THE AREA OF SOIL AROUND A TREE WHERE THE MINIMUM AMOUNT OF ROOTS CONSIDERED ESSENTIAL FOR TREE HEALTH ARE LOCATED. CRZ IS GENERALLY EQUAL TO ONE FOOT RADIUS PER INCH DBH.
2. DBH (DIAMETER BREAST HEIGHT) IS THE DIAMETER OF A TREE TRUNK MEASURED AT 4.5' FROM THE GROUND. REFER TO THE LATEST EDITION OF "GUIDE FOR PLANT APPRAISAL" WHEN TREE FORM OR SITE CONDITIONS ARE NOT STANDARD.
3. DBH FOR MULTI-STEM TREES WILL BE EQUAL TO THE SQUARE ROOT OF THE SUM OF THE DBH FOR EACH STEM, SQUARED. Example: $\sqrt{(A^2+B^2+C^2)}$= DBH
4. SRZ (STRUCTURAL ROOT ZONE) IS THE AREA ESSENTIAL FOR TREE STABILITY. SRZ IS GENERALLY A RADIUS OF 6X DBH, MEASURED FROM THE BASE OF THE TRUNK.
5. THE CRZ MAY BE ADJUSTED BASED ON CURRENT ISA BEST MANAGEMENT PRACTICES, WHERE SIZE, SPECIES, CONDITION, OR INFRASTRUCTURE PRESENCE REQUIRE MODIFICATION. THE SRZ MAY BE ADJUSTED BASED ON URBAN FORESTER GUIDANCE.

CRITICAL ROOT ZONE DELINEATION

PLAN 311300.3 (2024)

*THIS DETAIL SUPERSEDES ALL OTHER CRZ DETAILS IN ARLINGTON COUNTY.*

ARLINGTON VIRGINIA

# Two levers: Root Zone location and Damage Tolerance

- Arlington County uses 1 Ft per 1 inch DBH for CRZ, and 6 inches away from the base of the trunk, and then **limits** the impact tolerated to those zones to allow a tree to be counted for canopy:
  - Where medium-sized mature trees (12-24 inches DBH for overstory trees, 4-12 inches DBH for understory trees) have a 20% or more impact to the critical root zone, or have any impact to the structural root zone, these trees may not be counted for tree canopy.
  - Where large-sized mature trees (greater than 24 inches for overstory trees, greater than 12 inches DBH for understory trees) have a 10% or more impact to the critical root zone, or have any impact to the structural root zone, these trees may not be counted for tree canopy.
  - Where trees below the above sizes have a 30% or more impact to the critical root zone, or have any impact to the structural root zone, these trees may not be counted for tree canopy.

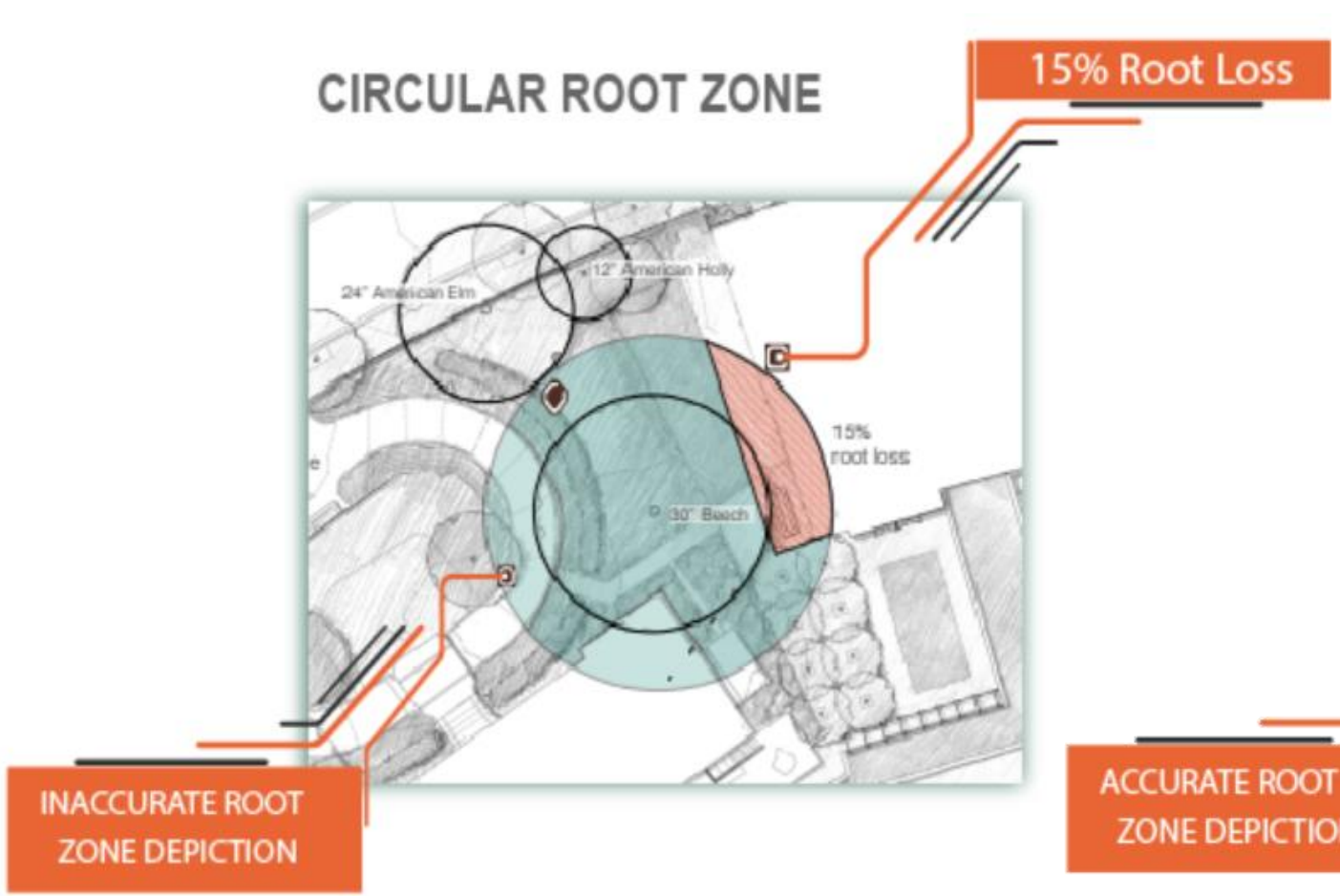
# Showing alternative root zone locations

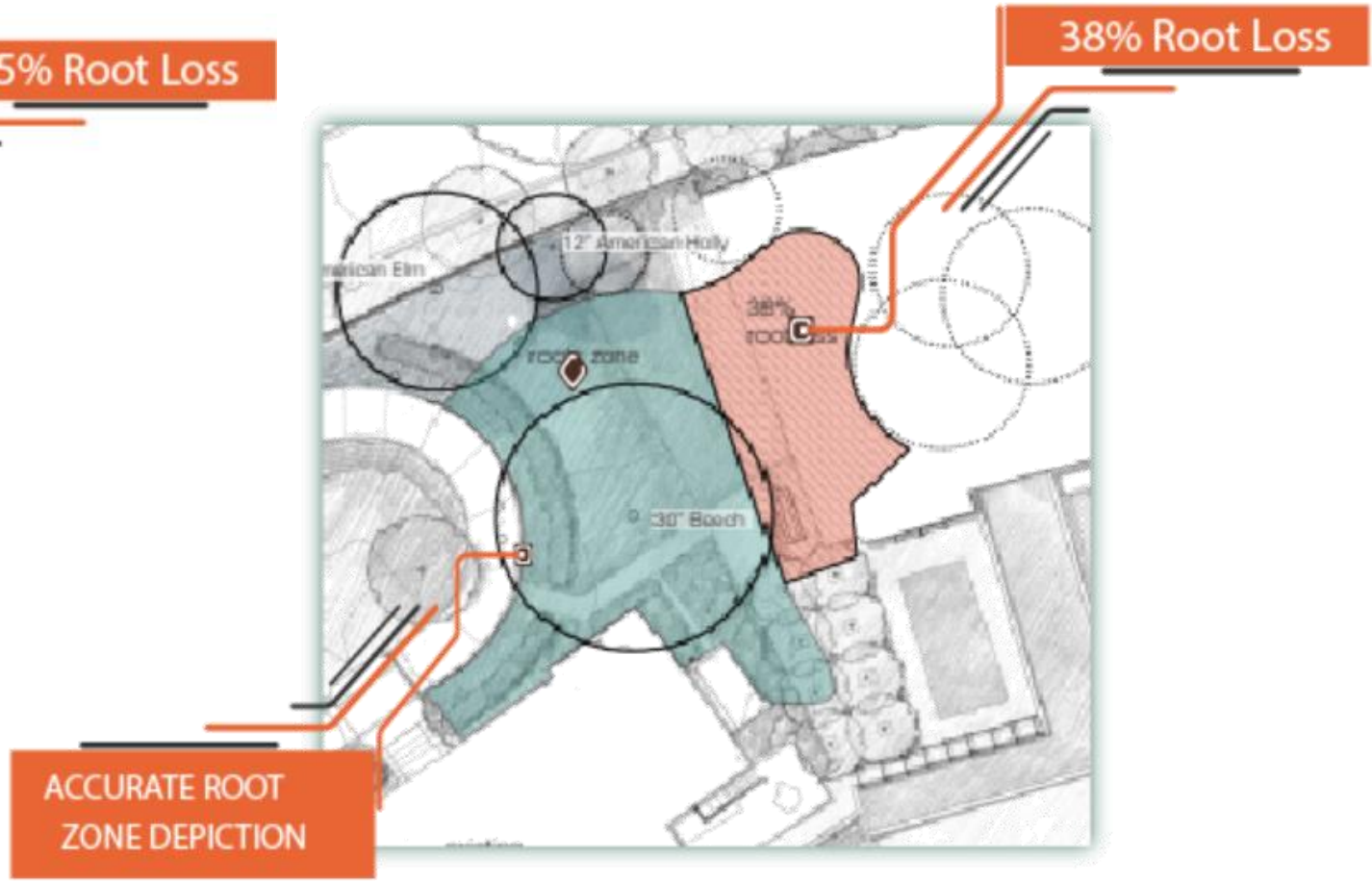
- If the critical root zone is deemed to not represent the actual location of the tree's roots, and/or there is a desire to count the conserved tree for tree canopy, show on the plan and in a narrative:
  - How root impact is minimized through alternative root protection and construction methods, and/or;
  - After-care provided during and beyond construction, and/or;
  - Provide alternative drafts of where the critical root zone may be, if buildings and other barriers may restrict the spread of roots.
- The Urban Forester may designate trees that are poor candidates for conservation not to be counted for tree canopy. Site-specific conditions, a tree's size, or the species' relative tolerance to construction impact may be considerations in this designation.

# In urban contexts, trees rarely look like this

# Exploring other illustrations of root locations

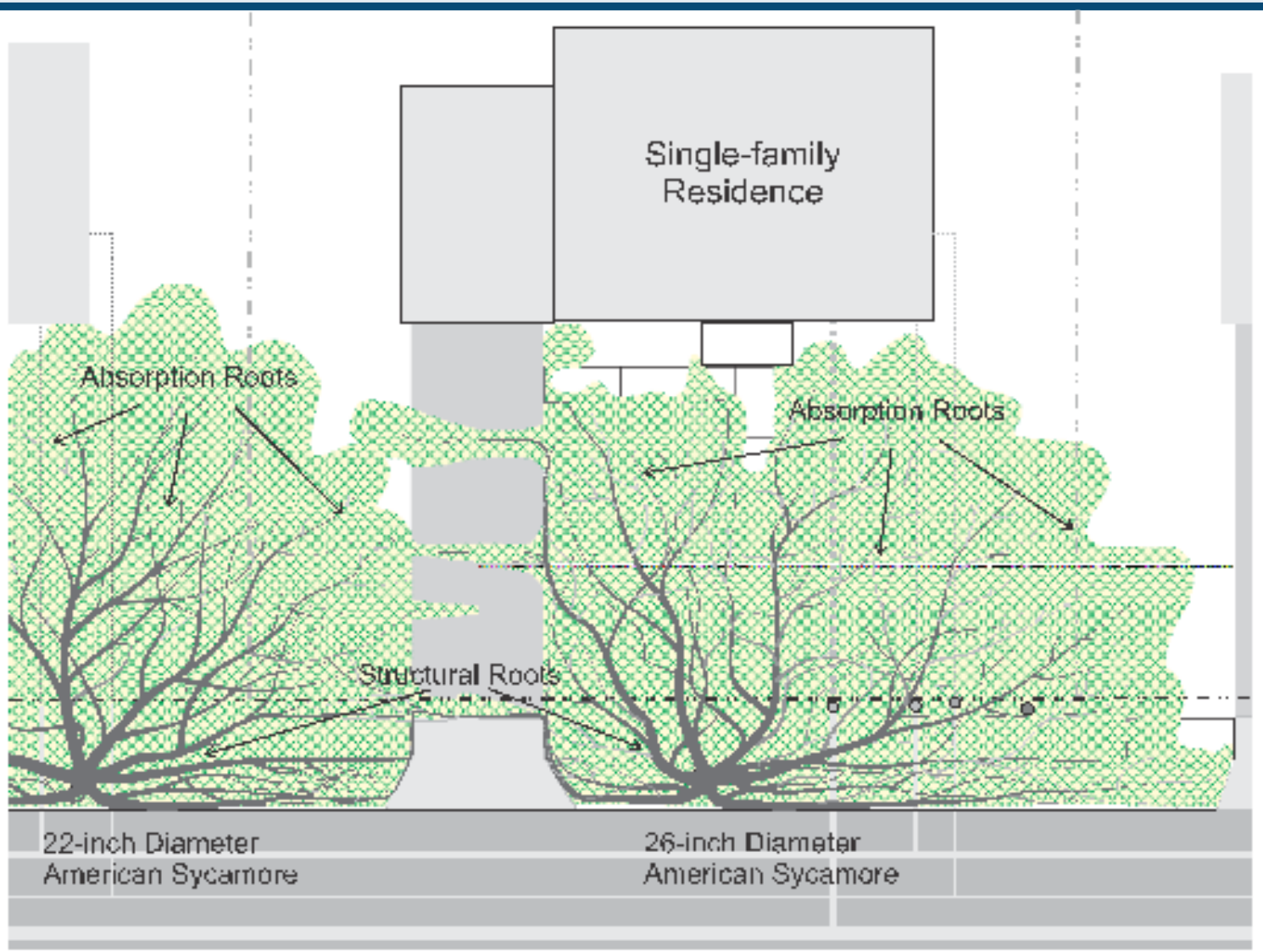
Tree Matrix:



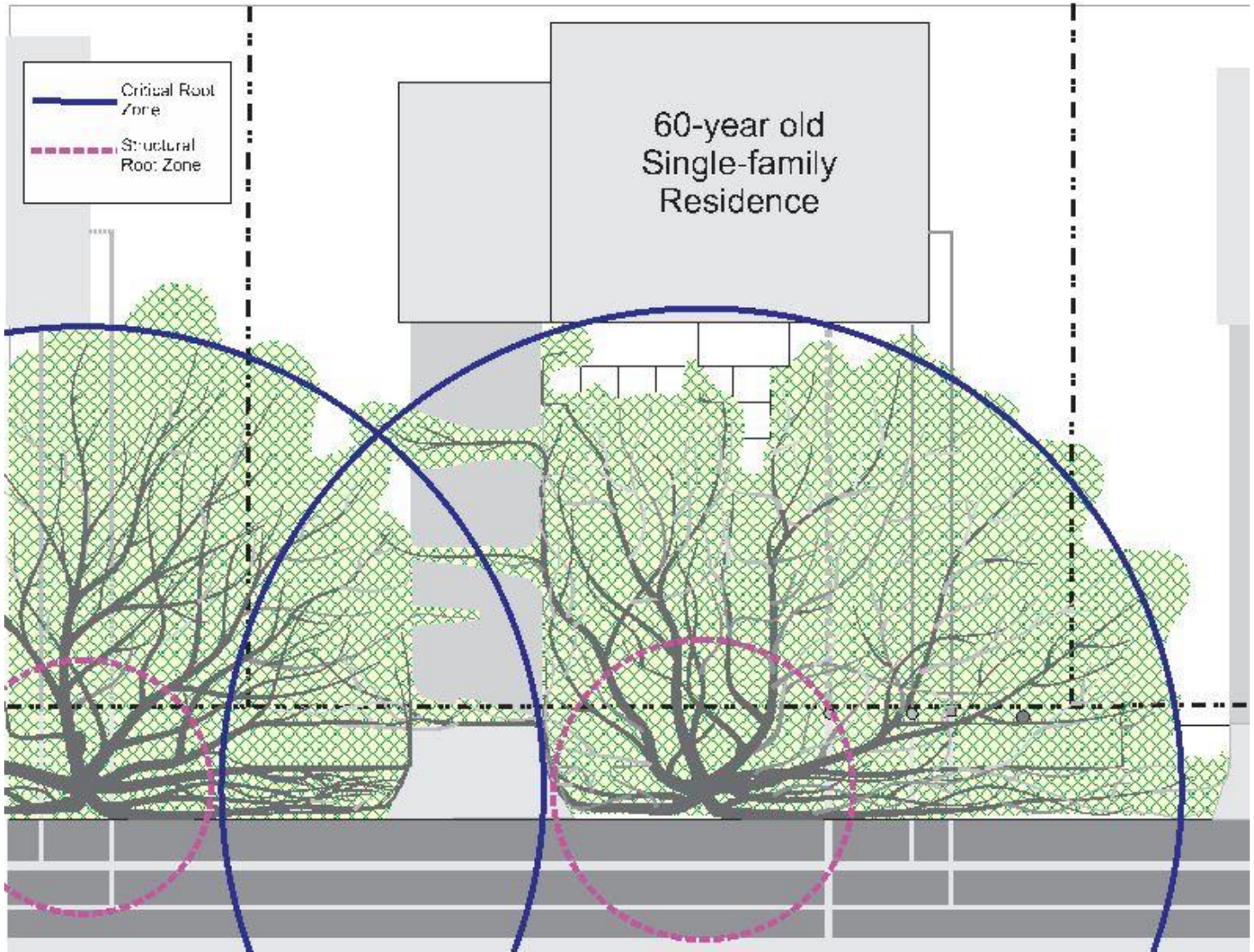



# Exploring other illustrations of root locations

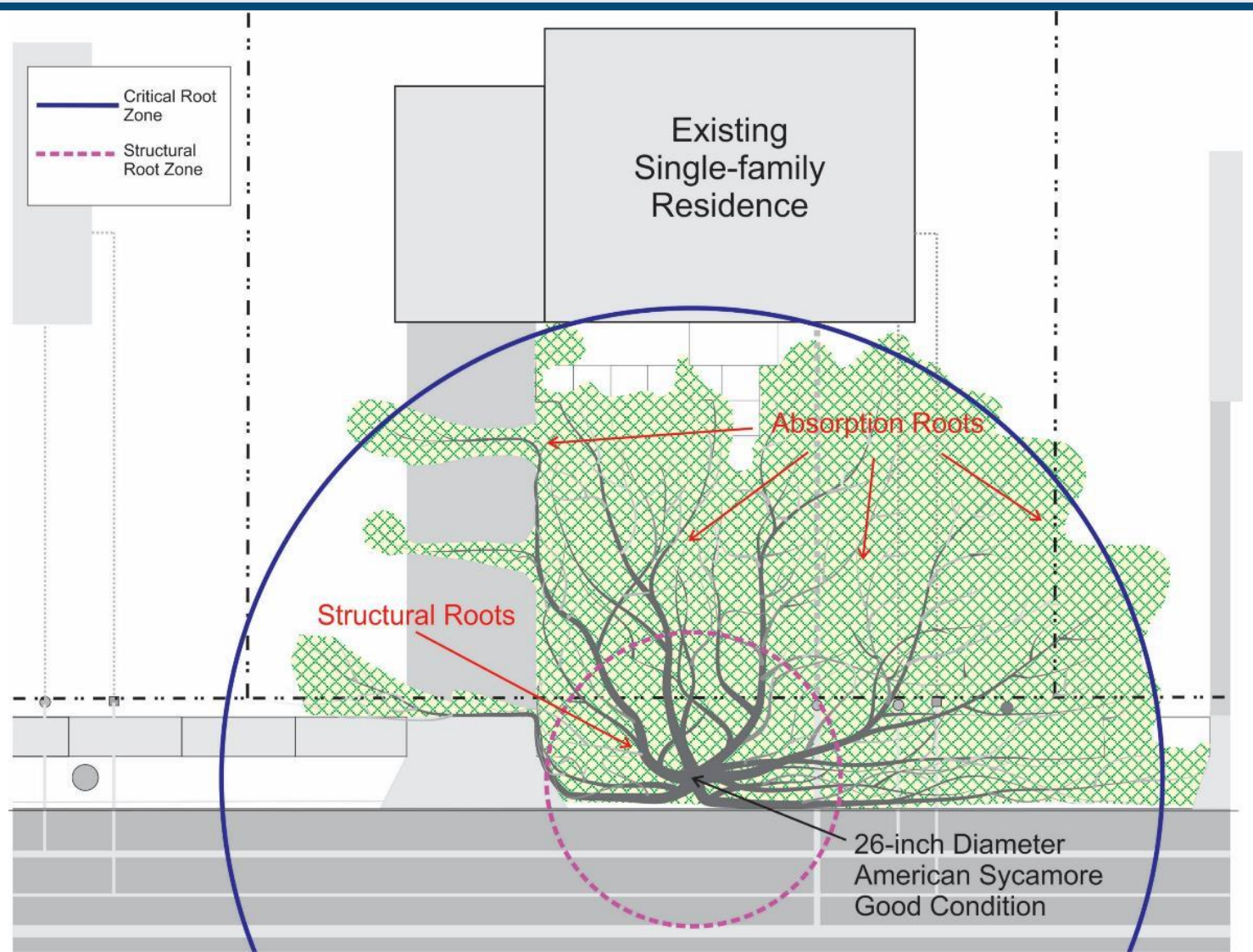
Illustrative:



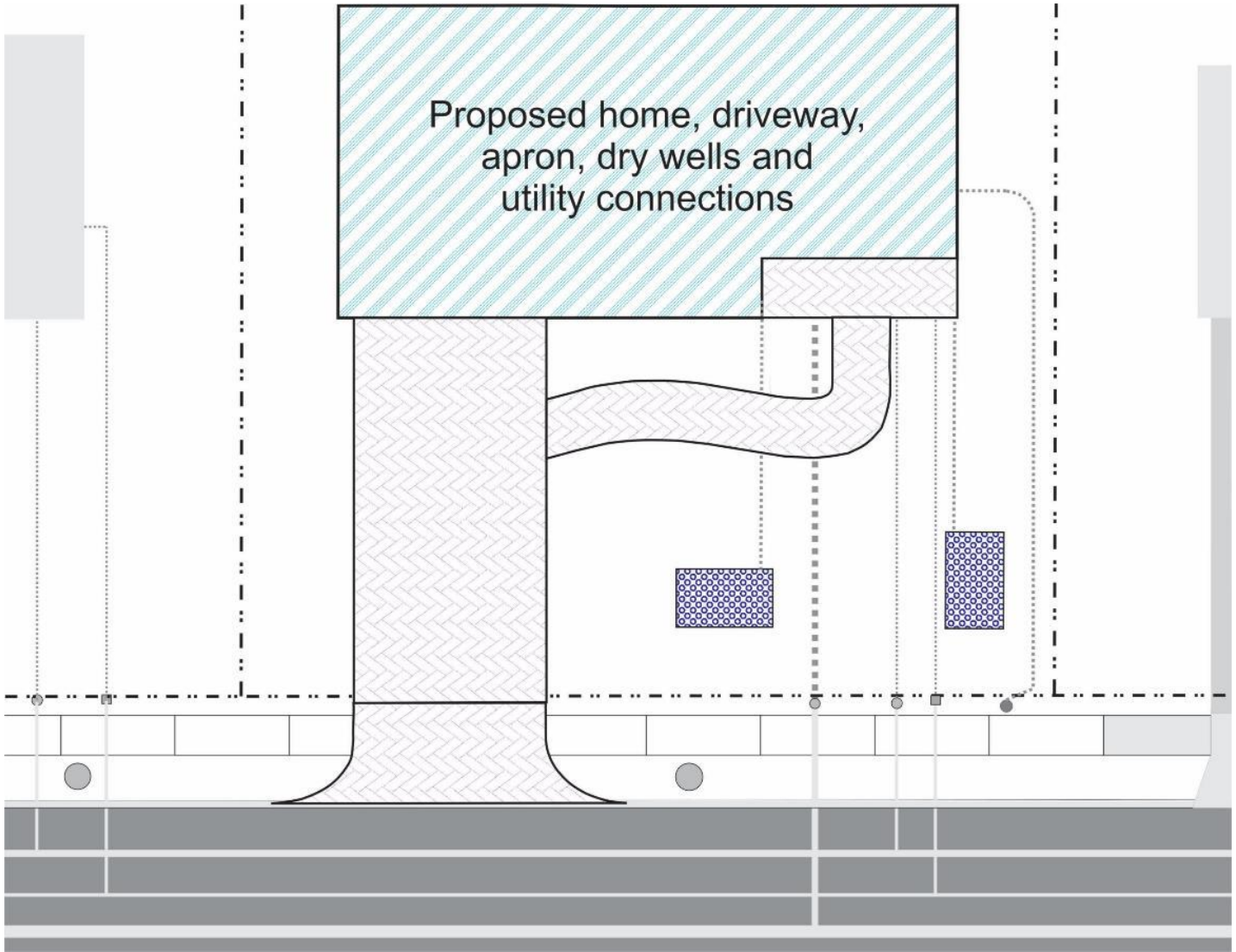
# How to kill a tree with disturbance



# Where are this tree's roots really?



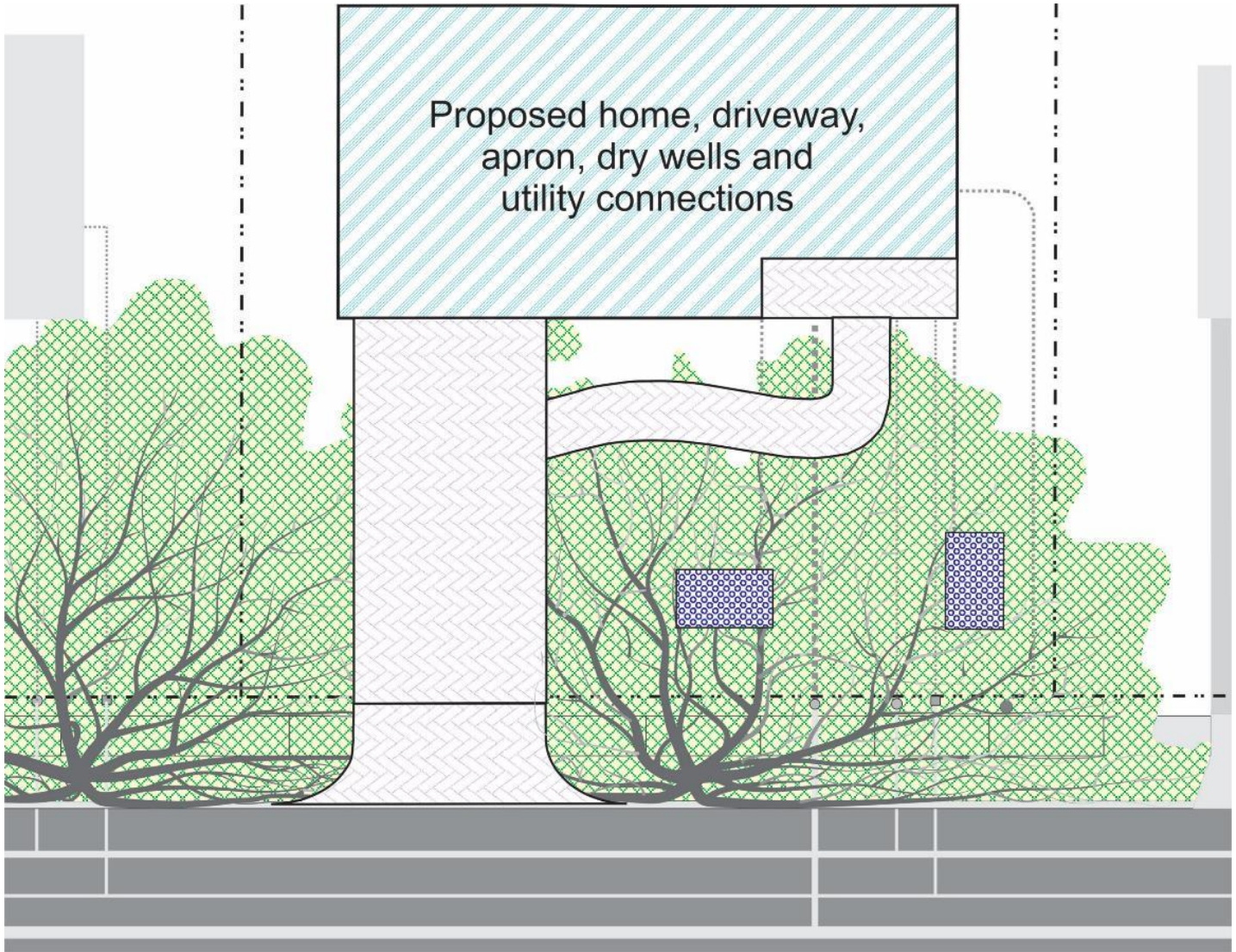
# What is being proposed?



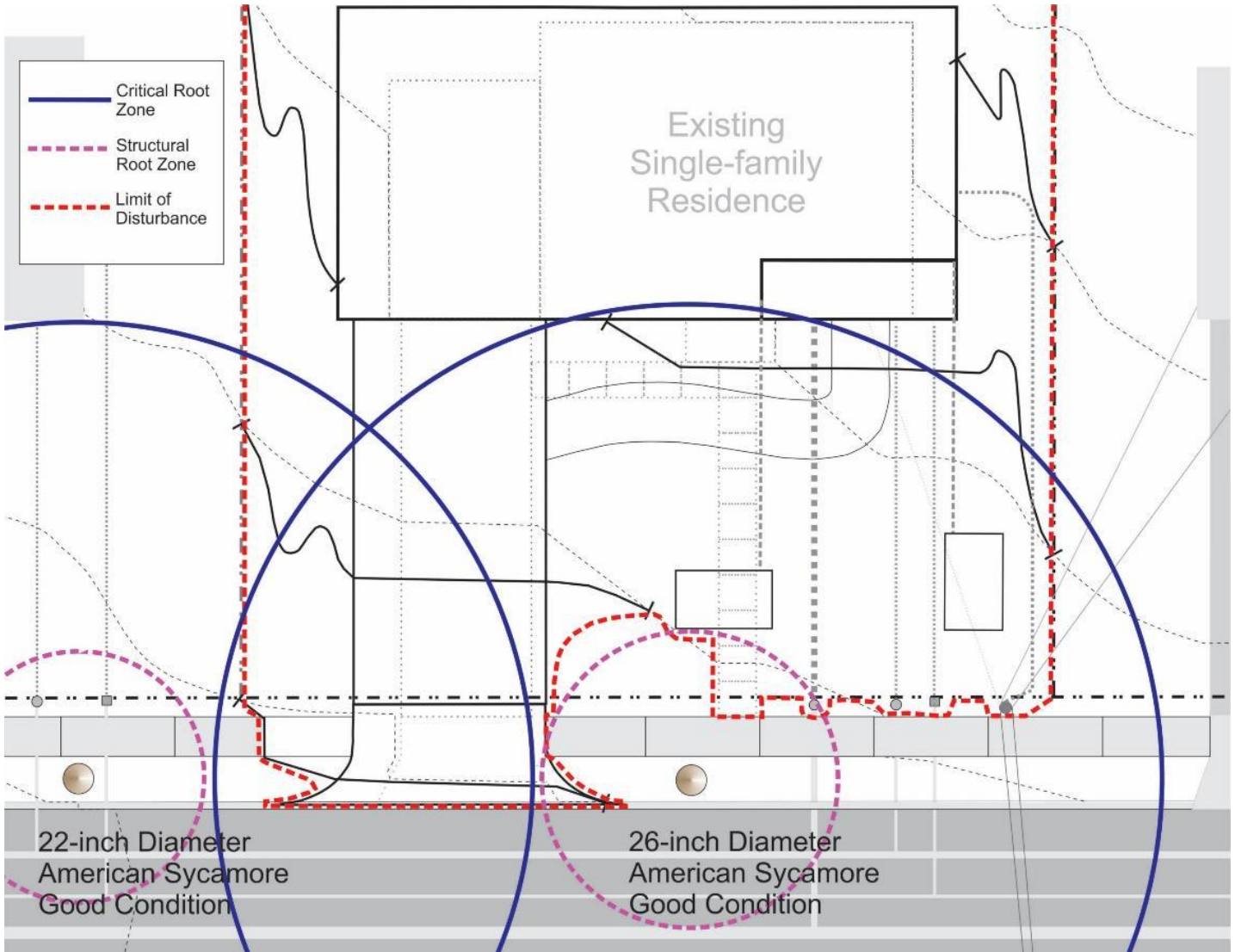

Greatest drivers of disturbance

- New building
- Grading
- Driveways
- Utilities

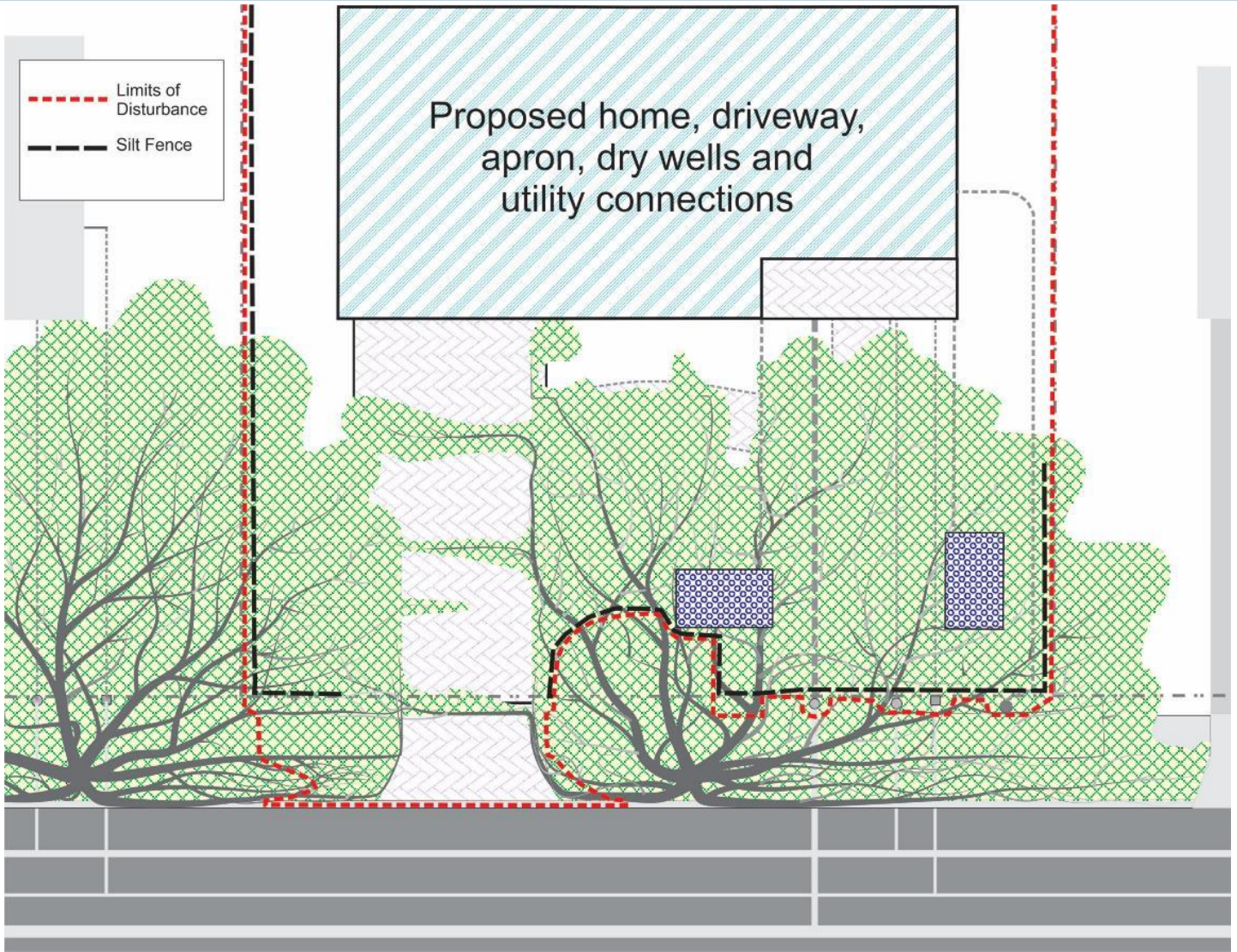
# What is being proposed – with actual roots



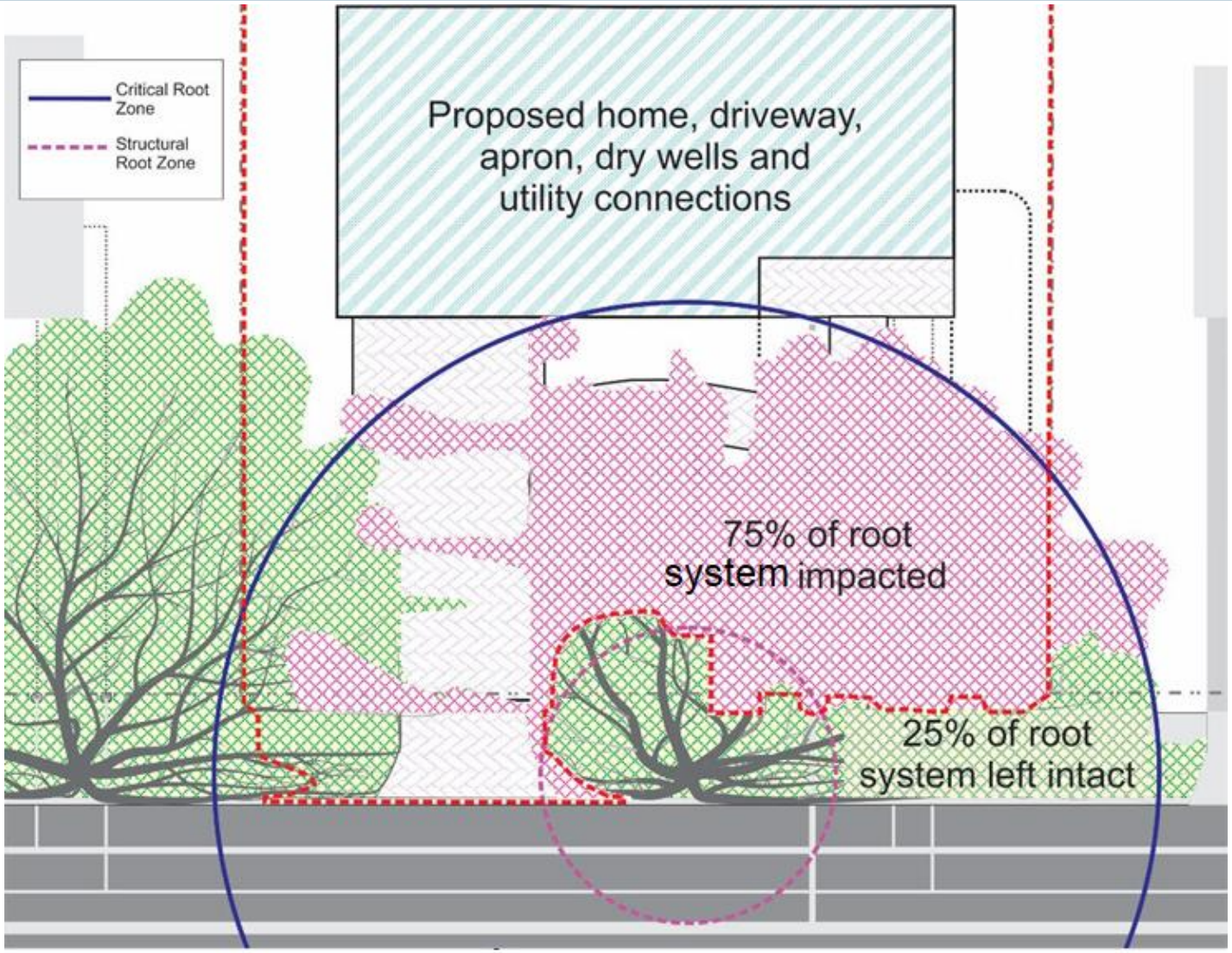
# What is being proposed? – with CRZ



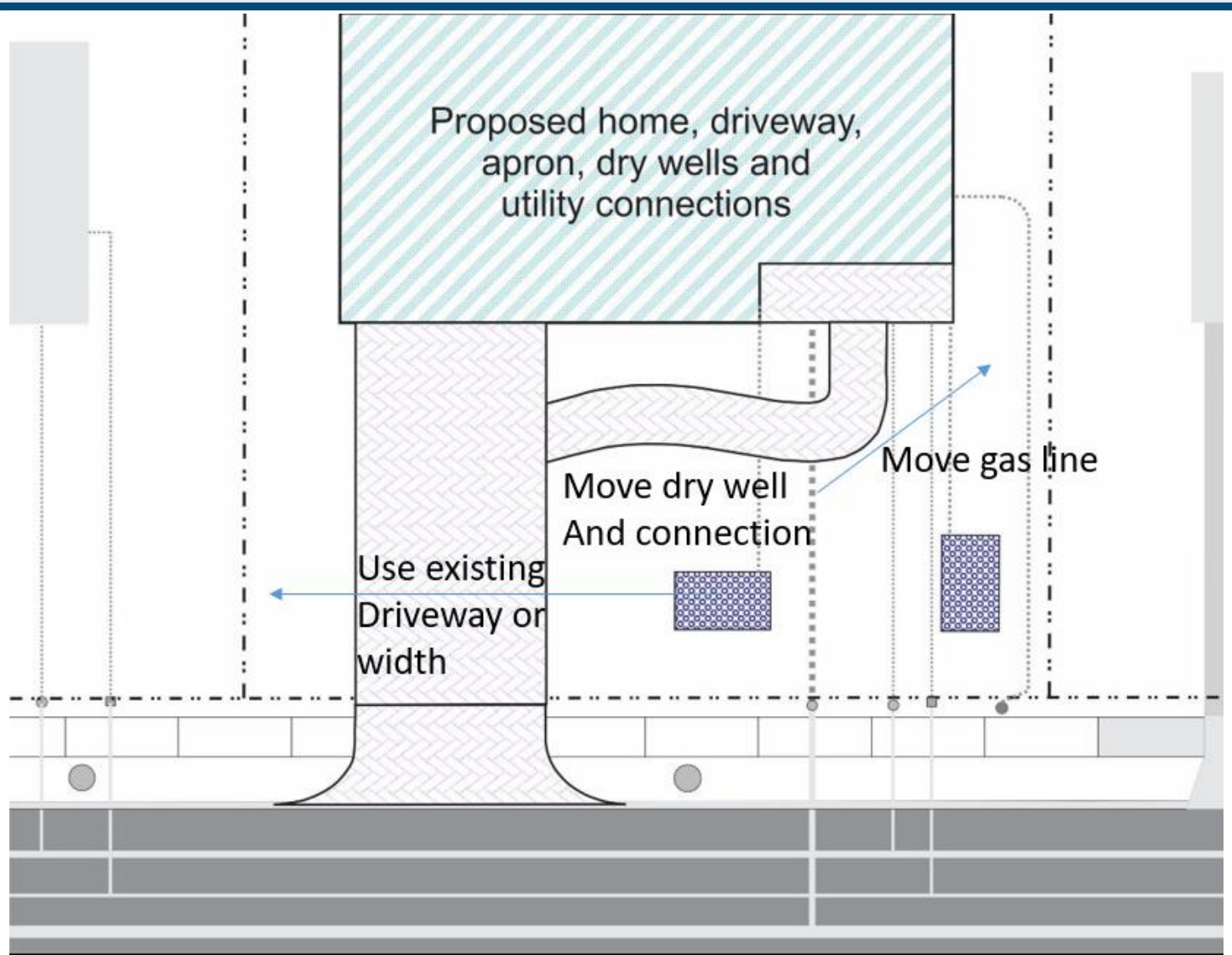
# Overlay


Limits of Disturbance
Silt Fence
Proposed home, driveway, apron, dry wells and utility connections

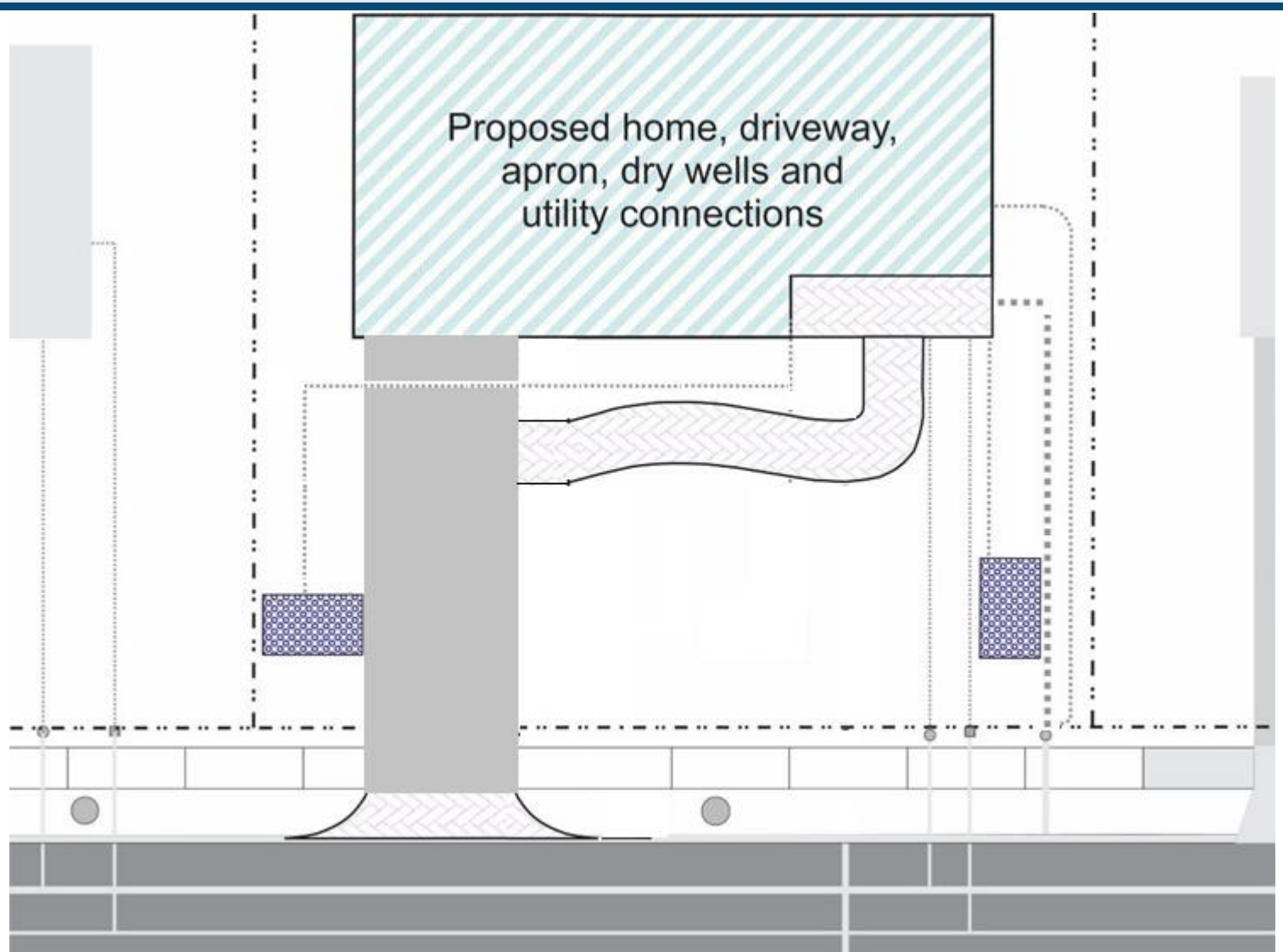
# Impact


Critical Root Zone
Structural Root Zone
Proposed home, driveway, apron, dry wells and utility connections
75% of root system impacted
25% of root system left intact

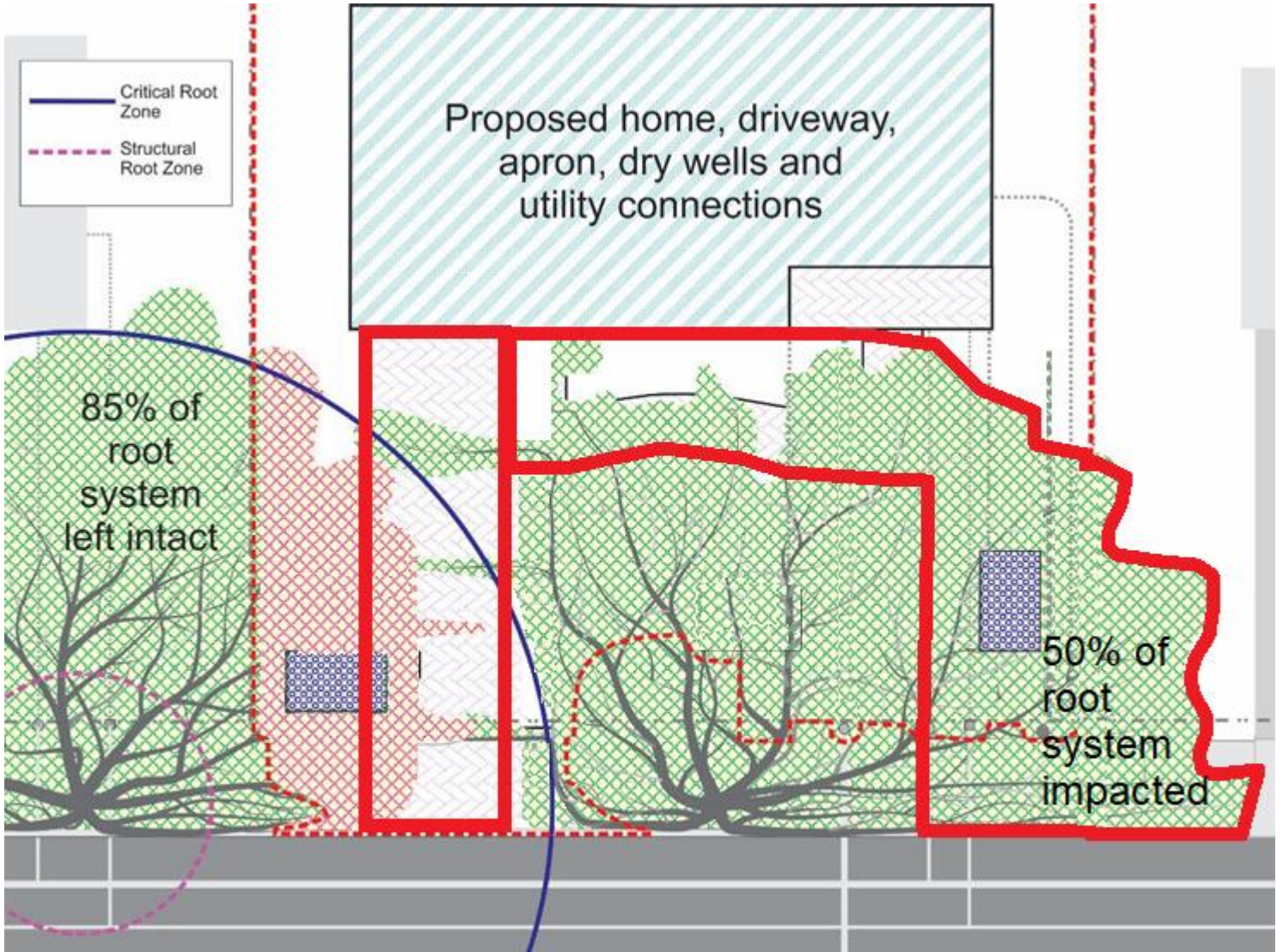
# Let's try to un-kill it



# Move those features!



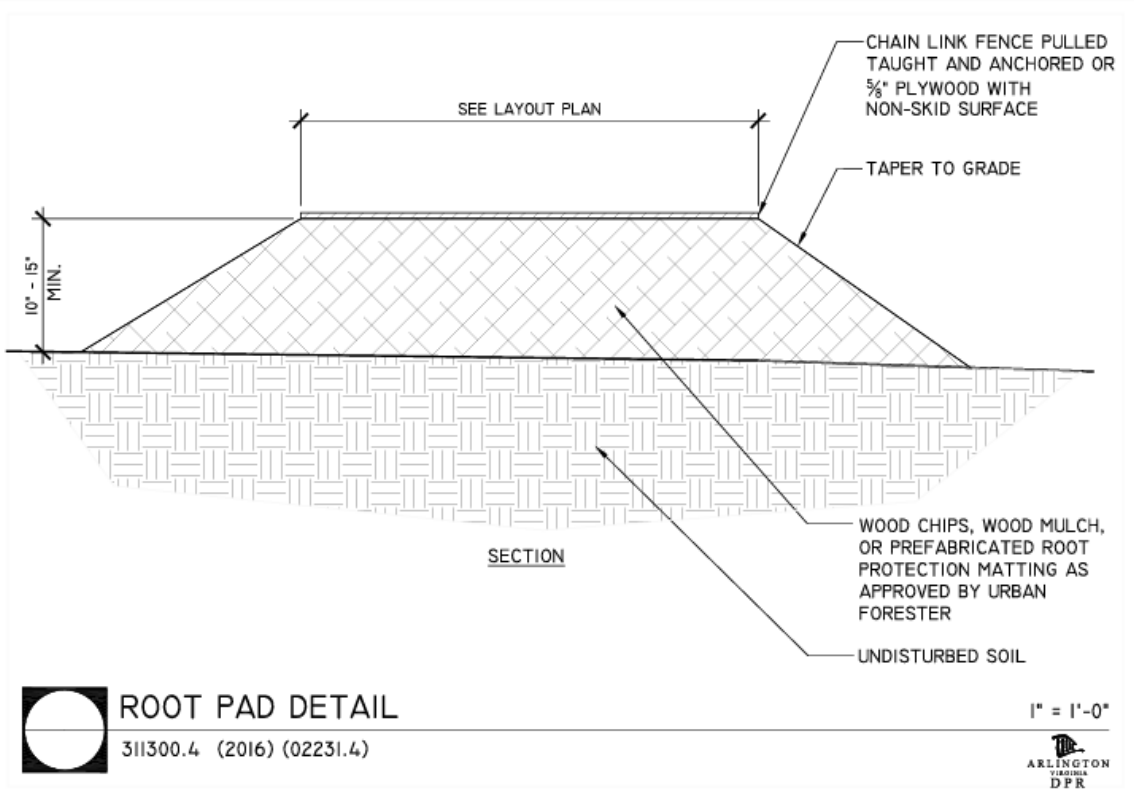
# Is this enough?



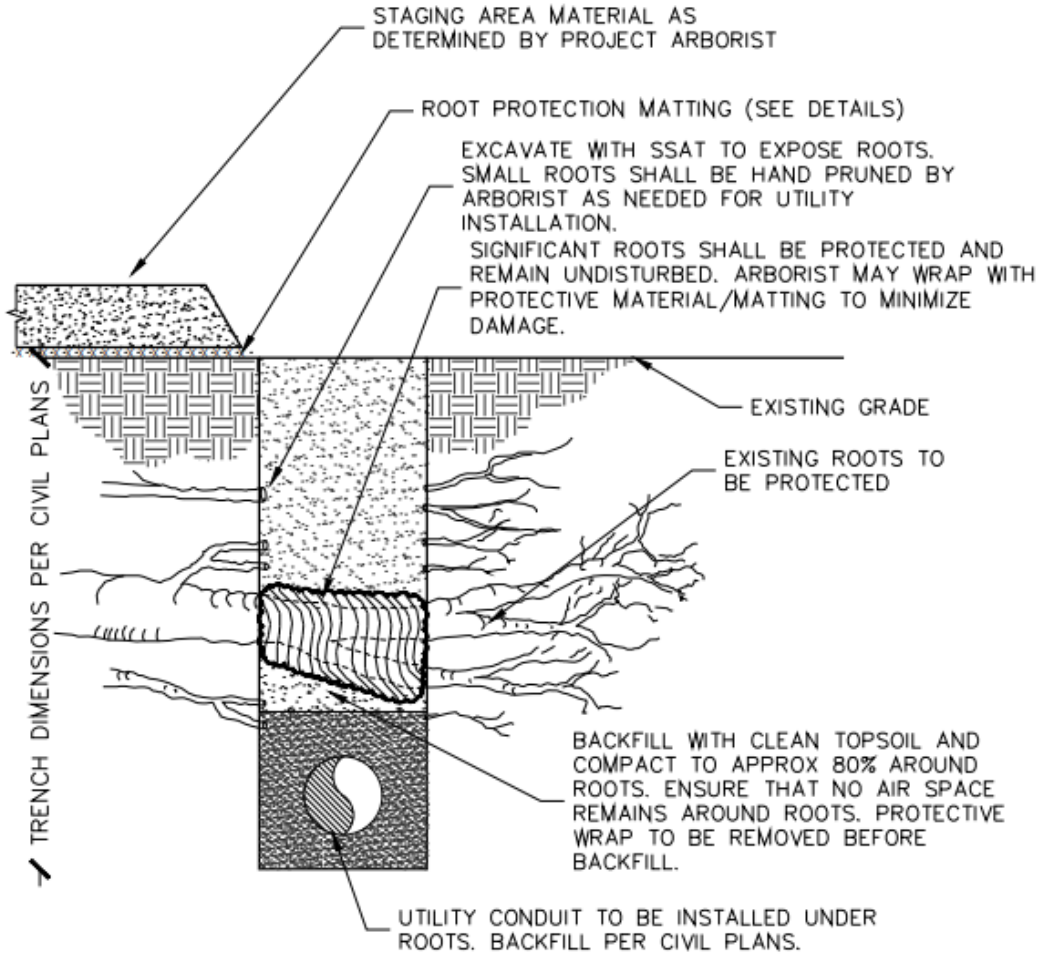
# Could we do more?

- Root padding
- Root protection during construction
- Root aeration under walkways
- Air excavation before disturbance, with the opportunity to change the design
- Aftercare – watering, mulching, integrated pest management, avoiding further damage

# Root padding

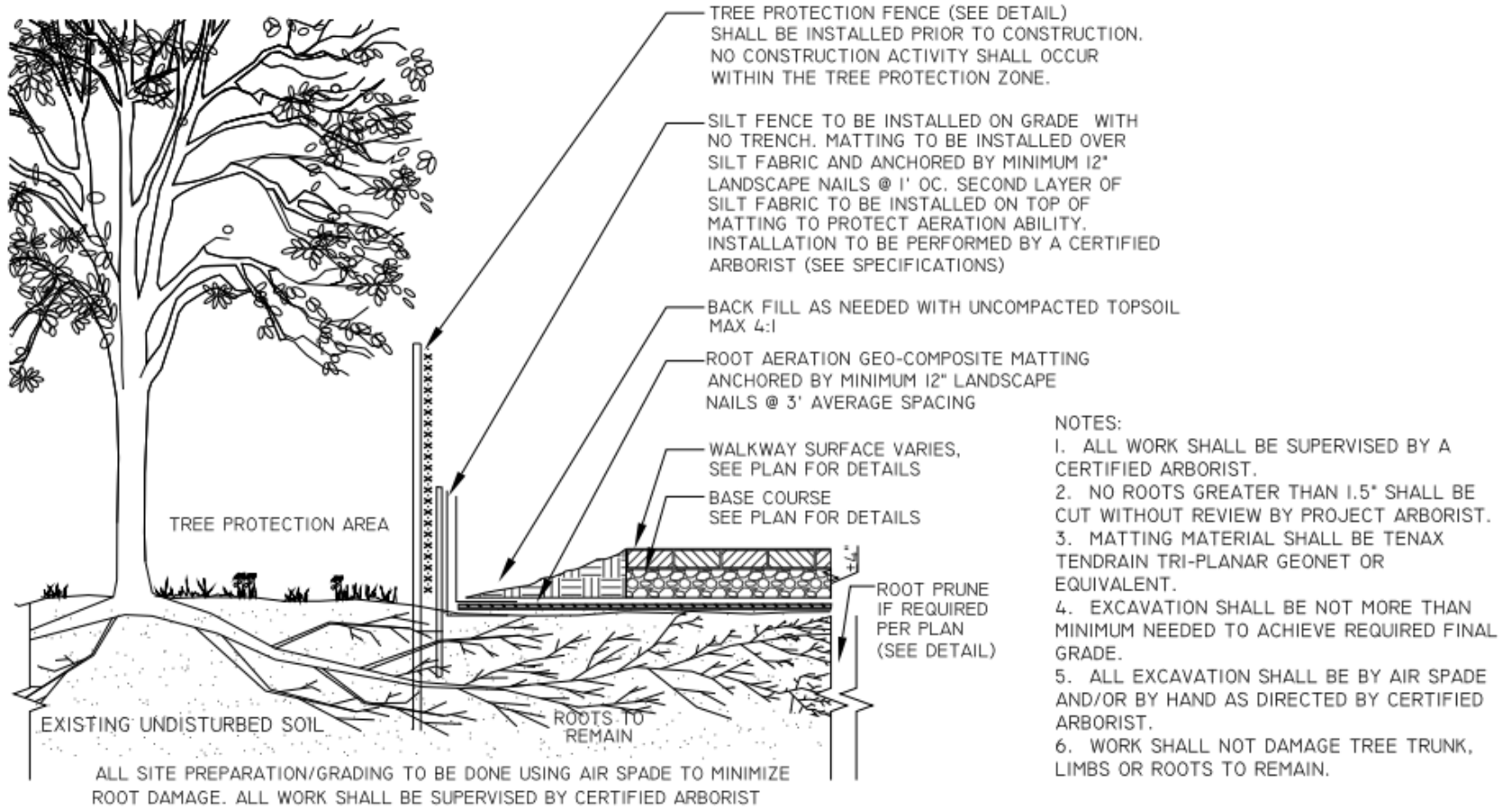



# Protecting roots during utility installation

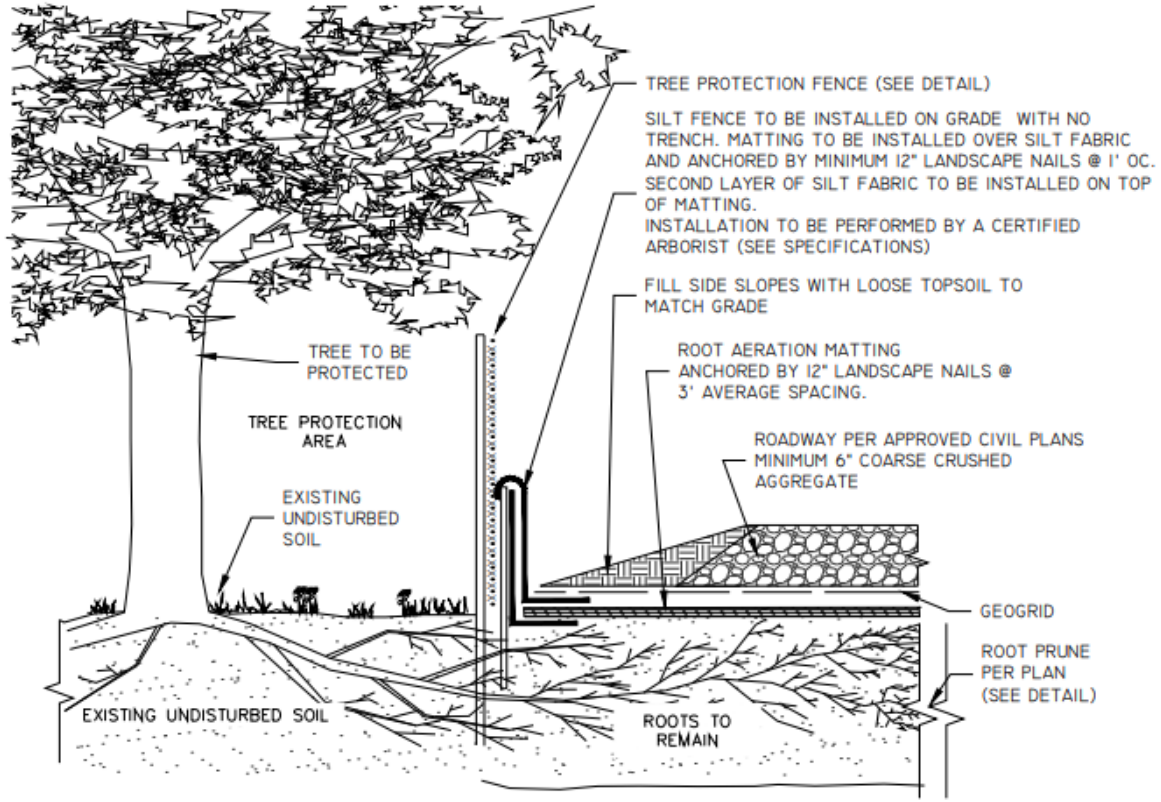



TREE PROTECTION FOR UNDERGROUND UTILITY N.T.S.

# Root aeration matting under the path



# Root aeration matting under the driveway




NOTES:

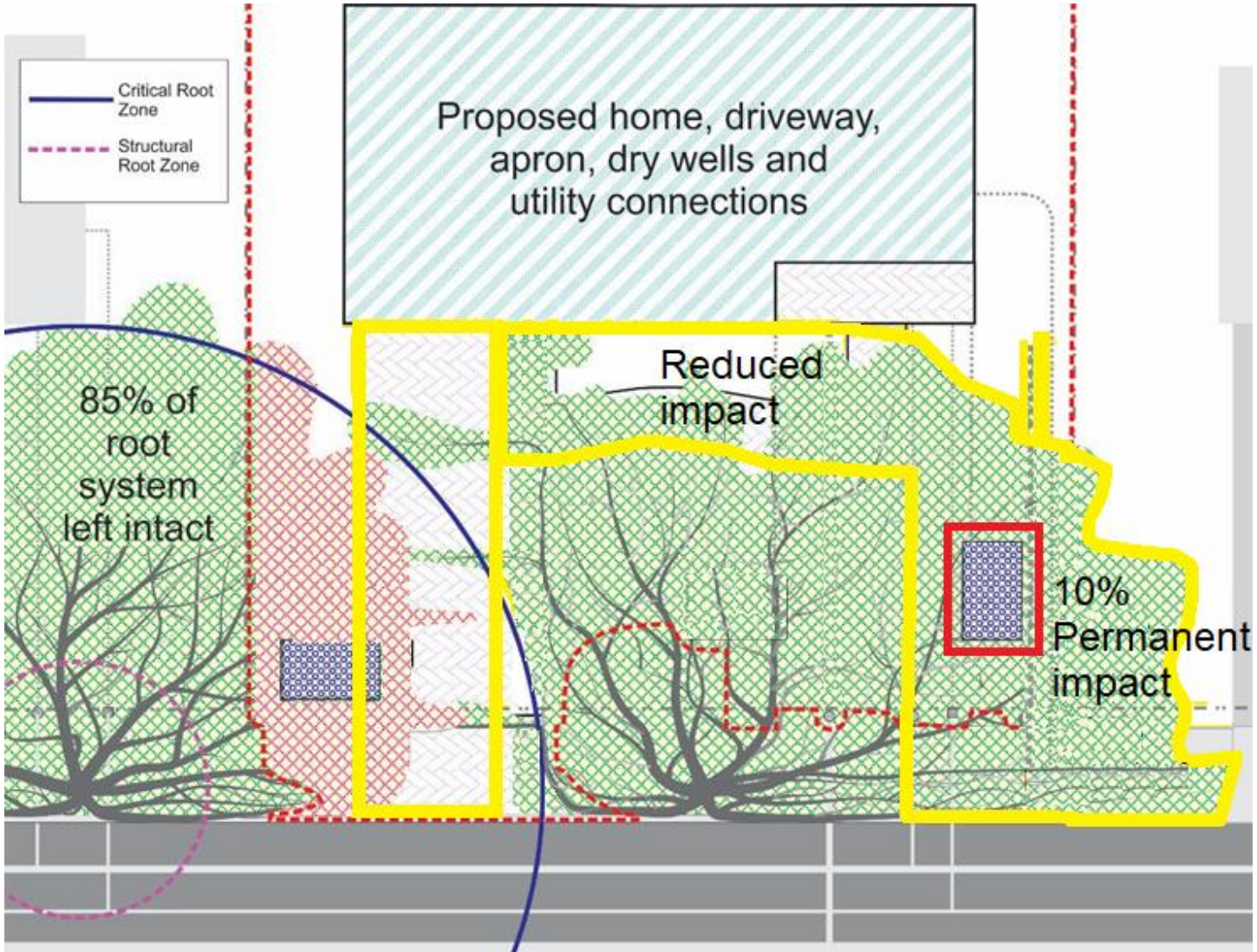
1. MATTING MATERIAL SHALL BE DOUBLE SIDED GEOCOMPOSITE, GEONET CORE WITH NON-WOVEN COVERING
2. RAM SHALL BE ANCHORED BY 12" LANDSCAPE NAILS @ 3' AVERAGE SPACING.
3. RAM SHALL BE INSTALLED BY A CERTIFIED ARBORIST EXPERIENCED WITH THESE SYSTEMS.
4. ANY REQUIRED SITE PREPARATION/GRADING TO BE DONE USING SSAT TO MINIMIZE ROOT DAMAGE.
5. ALL ADJACENT WORK SHALL BE SUPERVISED BY CERTIFIED ARBORIST
6. GEOGRID SHALL BE TENSAR TRIAX TX5 OR APPROVED EQUAL.
7. AGGREGATE FILL SHALL BE TAPERED TO MATCH EXISTING GRADE WHOLLY ON RAM MATERIAL.
8. GEOGRID AND RAM PLACEMENTS SHALL BE OVERLAPPED BY 2'.
9. TOPSOIL MAY BE PLACED LOOSELY ON SIDE SLOPES AS REQUIRED TO MATCH GRADE. TOPSOIL SHALL NOT BE COMPACTED. RAM MUST EXTEND TO DAYLIGHT AND MAY BE TRIMMED AT FINAL TOE OF SLOPE.
10. SILT FENCE SHALL NOT BE TRENCHED AND MUST BE COORDINATED WITH ARBORIST FOR INSTALLATION.
11. EQUIPMENT/TRAFFIC SHALL NOT TRAVEL DIRECTLY ON RAM/GEOGRID. TRAFFIC MAY TRAVEL ON FINAL FILL ONLY.

ROOT AERATION MATTING FOR ROADWAY N.T.S.

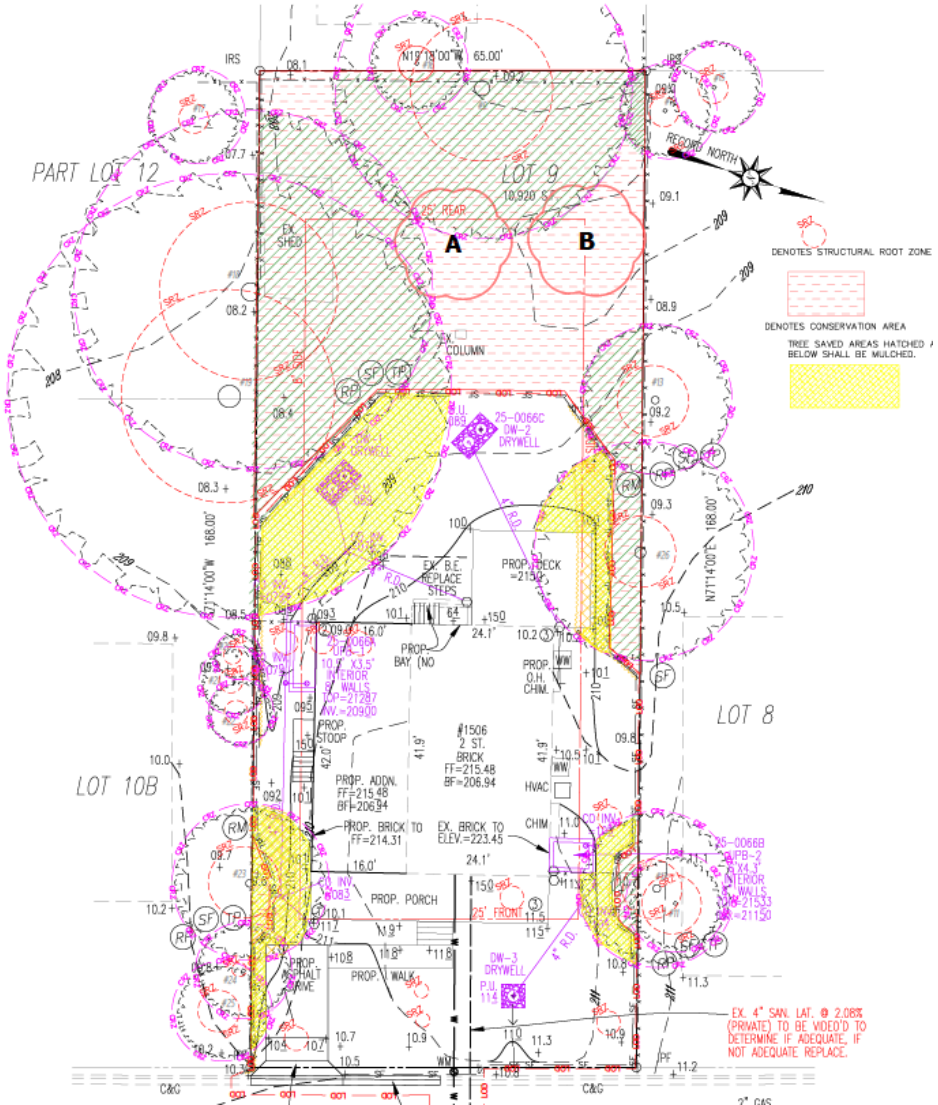
# Root exploration

- Air excavation can help find major roots
- Finding roots is a messy process, and does damage roots
- If a design or approach cannot change based on finding roots, this may not always be helpful

# Will this work, is it permitted and will it be worth it?



# Real permit examples



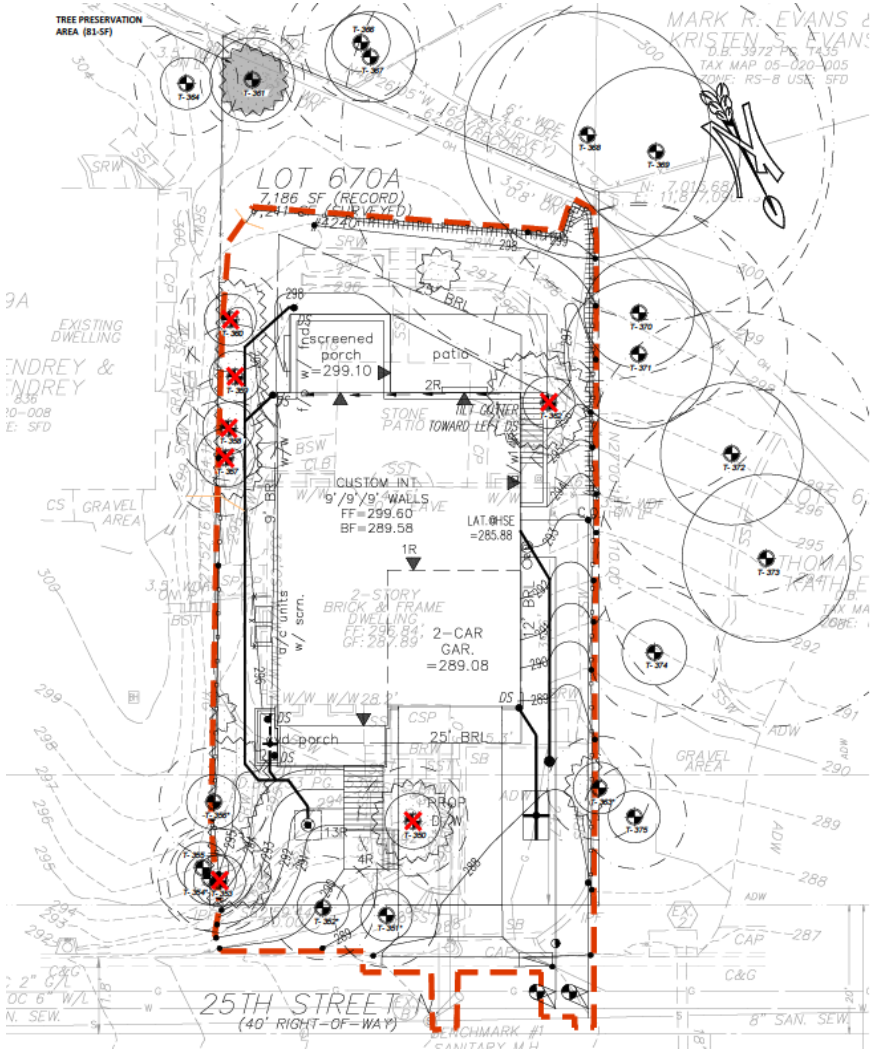

**Tree List for 1506 S. Nelson St., Arlington, VA**

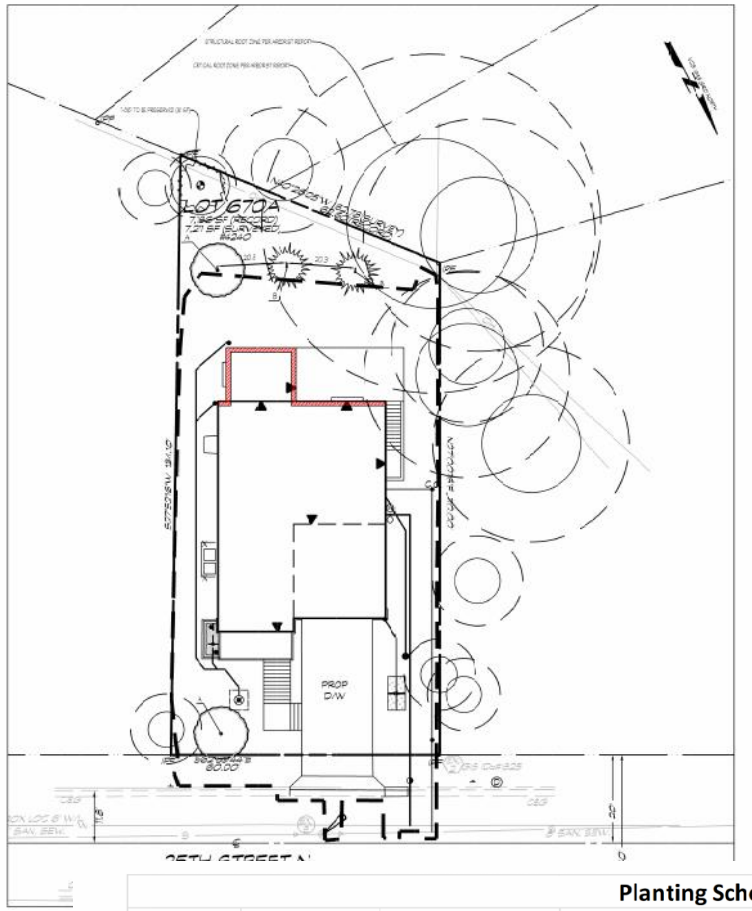
Prepared by Bill Becker, ISA Certified Arborist # MA-0216A February 14, 2025

Lot size = 10,920 s. f. requiring 2,184 s. f. tree canopy. Preserved tree canopy = 700 s. f. x 2 credit multiplier = 1,400 s. f.
N denotes neighbor's tree. R denotes right of way tree. J denotes jointly owned tree. * denotes not counted for canopy coverage.
Existing tree canopy = 700 s. f. ** denotes written permission to be obtained before removal.

| Tree # | Common Name<br>Botanical name | DBH<br>Height | Species rating | Condition rating/Comments | % CRZ impacted | Preservation Measures | Canopy Sq. Ft. |
|---|---|---|---|---|---|---|---|
| 1 | Red Maple<br>Acer rubrum | 4" | 75 | 75 | 100 | Remove – within limits of clearing and grading. | 0 |
| 2-4 | Azalea<br>Rhododendron occidentale | 5' | 75 | 75 | 100 | Remove – within limits of clearing and grading. | N/A |
| 5 | London Plane<br>Platanus acerifolia | 4" | 75 | 75 | 100 | Remove – within limits of clearing and grading. | 0 |
| 6-8 | Rose Bush<br>Rosa | 5' | 75 | 70 | 100 | Remove – within limits of clearing and grading. | N/A |
| 9 | Red Maple<br>Acer rubrum | 24" | 75 | 75 | 0 | Save – install protective fence. | 700 |
| 10 | Serviceberry<br>Amelanchier arborea | 3" | 75 | 75 | 100 | Remove – within limits of clearing and grading. | 0 |
| 11N | American Holly<br>Ilex opaca | 10" | 75 | 75 | 10 | Save – install protective fence. Root prune along fence. | N/A |
| 12N | Willow Oak<br>Quercus phellos | 10" | 75 | 75 | 25 | Save – install protective fence. Root prune along fence. | N/A |
| 13N | White Ash<br>Fraxinus americana | 12" | 65 | 75 | 5 | Save – install protective fence. Root prune along fence. | N/A |
| 14N-15N | River Birch<br>Betula nigra | 3x5" | 75 | 75 | 0 | Save – install protective fence. | N/A |
| 16N | Eastern Redcedar<br>Juniperus virginiana | 6" | 75 | 75 | 0 | Save – install protective fence. | N/A |
| 17N | Leyland Cypress<br>Cupressocyparis leylandii | 3" | 45 | 75 | 0 | Save – install protective fence. | N/A |
| 18N | Pin Oak<br>Quercus palustris | 30" | 75 | 75 | 15 | Save – install protective fence. Root prune along fence. | N/A |
| 19N | Pin Oak<br>Quercus palustris | 36" | 75 | 75 | 25 | Save – install protective fence. Root prune along fence. | N/A |
| 20N | American Holly<br>Ilex opaca | 3" | 75 | 75 | 10 | Save – install protective fence. Root prune along fence. | N/A |
| 21N | American Holly<br>Ilex opaca | 5" | 75 | 75 | 10 | Save – install protective fence. Root prune along fence. | N/A |
| 22N | Hinoki Cypress<br>Chamaecyparis obtusa | 4" | 75 | 75 | 10 | Save – install protective fence. Root prune along fence. | |
| 23N | Willow Oak<br>Quercus phellos | 12" | 75 | 75 | 30 | Save – install protective fence and matting. Root prune along matting. | N/A |
| 24N | Crape Myrtle<br>Lagerstroemia | 4x2" | 75 | 75 | 20 | Save – install protective fence. Root prune along fence. | N/A |
| 25N | Black Walnut<br>Juglans nigra | 7" | 75 | 75 | 10 | Save – install protective fence. Root prune along fence. | N/A |
| 26J | White Ash<br>Fraxinus americana | 12" | 65 | 75 | 30 | Save – install protective fence. Root prune along fence. Root Matting | N/A |

# Real permit examples




**Planting Schedule:**

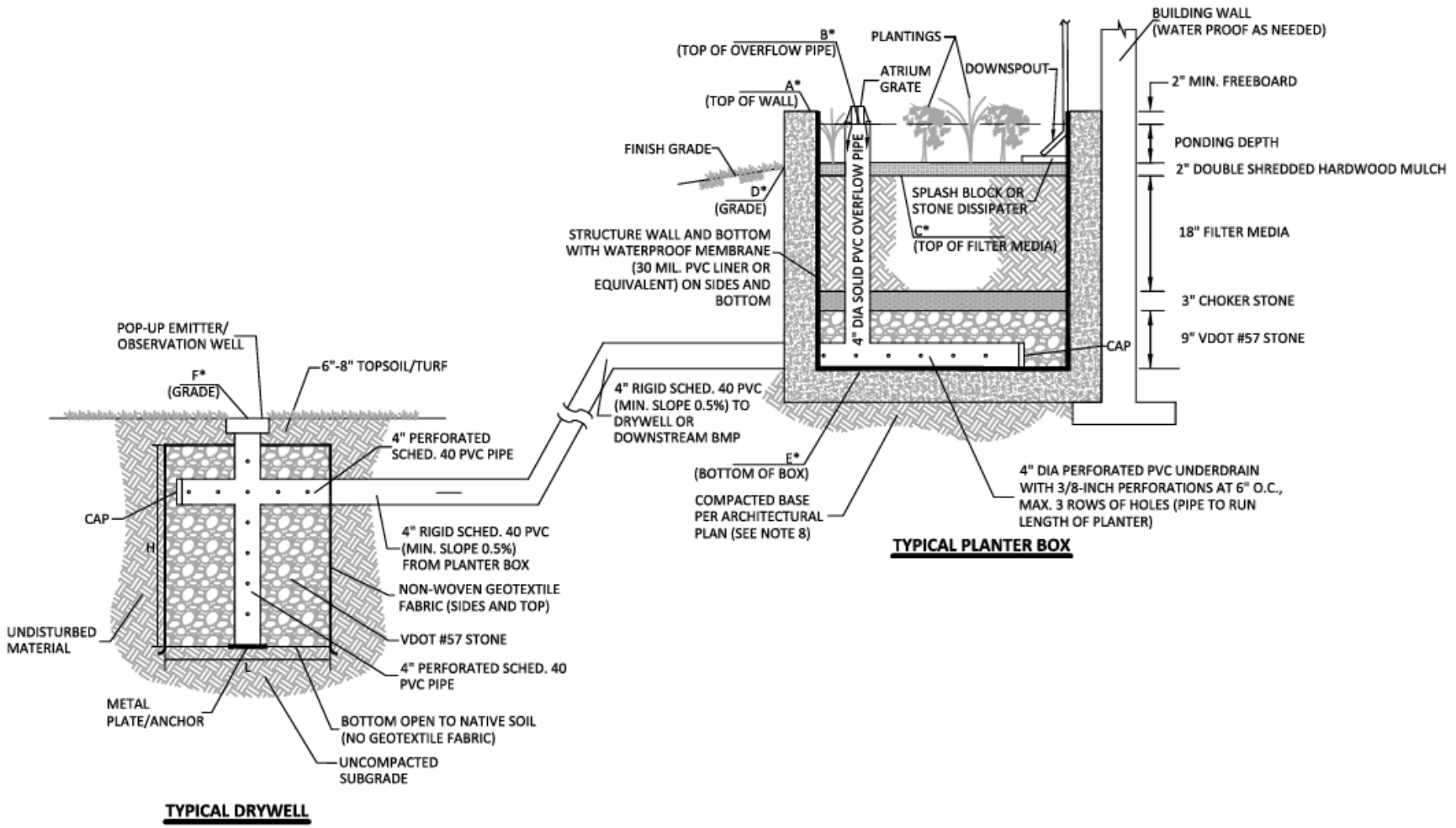
| Legend | Quantity | Tree Species | Common Name | Planting size [Height (ft.), Caliper (in.)] | Spread at Planting (ft.) | 20 Year Coverage (sq.ft.)Per Tree | Coverage Bonus (sq. ft.) Per Tree | Total Coverage |
|---|---|---|---|---|---|---|---|---|
| A | 2 | Liriodendron Tulipifera | Tuliptree | 2" - 2 1/2" | 5' to 7' | 315 | 393.75 | 787.50 |
| B | 2 | Quercus Phellos | Willow Oak | 2" - 2 1/2" | 5' to 7' | 175 | 312.5 | 625 |
| | | | | | | | **Total:** | **1412.50** |

# Stormwater management facilities and trees serve complementary functions

- Stormwater management (SWM) facilities target concentrated runoff from roofs and gutters, to slow water down, filter, and absorb
- Required for SWM compliance
- This uses a 'Treatment train' approach – e.g., planter box release to dry wells
- Dry wells are necessary to facilitate infiltration and sheet flow

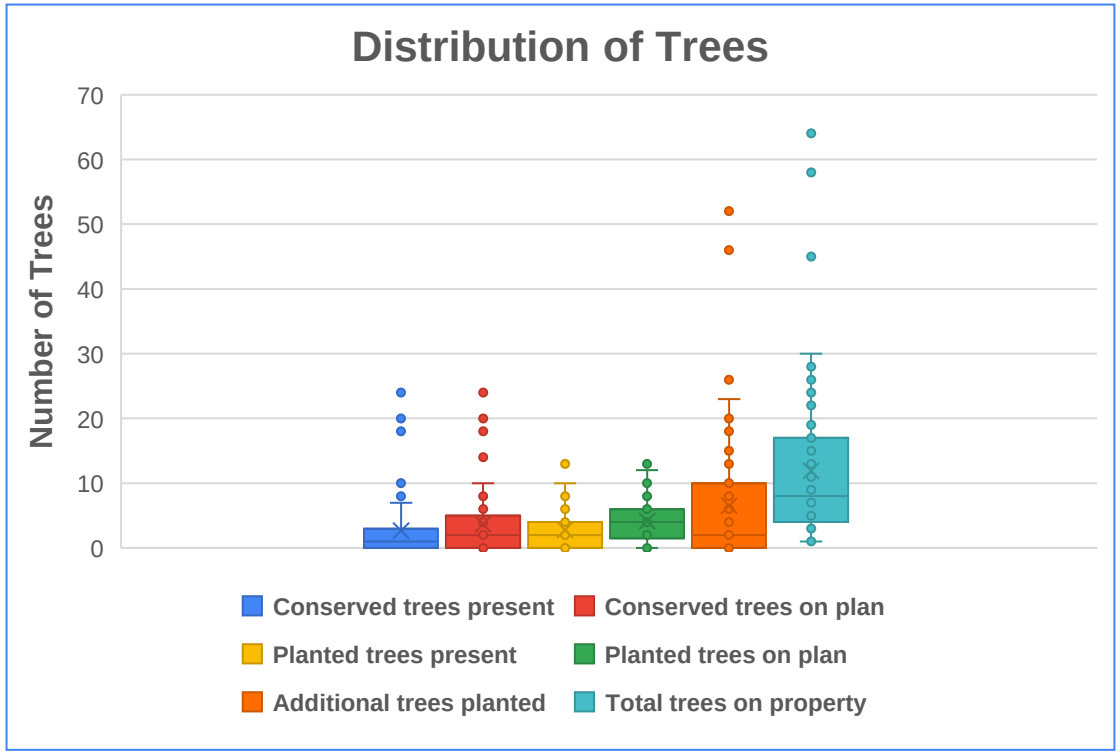
- Trees intercept rainfall where it falls, improving soil absorption, but cannot necessarily handle all stormwater events
- DEQ does not provide SWM compliance credit for individual conserved trees – however, where trees are conserved outside Limit of disturbance (LOD), there is inherent compliance benefit
- Arlington established a Stormwater quantity credit for both conserved and planted trees in 2021 for single family home projects
- Quality credit for planted trees is very limited

# Dry well example



# Tree Stewards study on survival and next steps

- The 2024 Tree Stewards study on survival of trees after construction (of properties developed in 2018) showed 26% of trees conserved on plans were no longer present 5-6 years after construction
- While some of these trees may have been removed for other reasons, tree decline from root impact is likely one major reason.
- Urban forestry as a discipline is continuing to research proper tree conservation, and the urban forestry unit will keep updating the guidance manual to reflect the most recent research.



# Questions?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