The Challenges To Establishing Newly Planted Trees

Challenges Exist On Many Levels

Part One:
The Early Years

The Reality Of Growing Canopy In Urbanized Landscapes

The Reality Of Growing Canopy In Urbanized Landscapes

Photo Credit: Jim Blake

After The First Two Years Following Planting: Failure Rate Was 34% (Nowak et al., 1990)

Less Than 60% Of Planted Trees Are Alive Five Years Later (Roman et al, 2014)

The Challenges Of A Transplant

- Size
- Species
- Harvest Type
- Boulevards vs Parks
- Stock Quality
- Watering Frequency
- Planter Training & Supervision

How Does Size Matter? Or, Does It?

No Experimental Evidence That Size Alone Matters

- Size & Species Matters: e.g. Many Oaks, Hickories
- Size & Harvest Matters: e.g. Undersized Root System According to ANSI Z60.1
- Size & Poor Site Preparation Matters

Breger et al, 2019 Found No Relationship Between Species & Survival


Vigor 1


Vigor 2


Vigor 3


Vigor 4


Standing Dead

- 749 Trees
- Boulevards to Public Landscapes
- Two Years of Observation

Probability of Mortality for 25 Tree Species*

*Wattenhofer, Dan, and Gary Johnson. 2021. Understanding why young urban trees die can improve future success. Urban Forestry & Urban Greening 64:2021.

Table 6
Adjusted average percent probability of mortality by tree taxa.

Taxa	Adjusted Average Percent Probability of Mortality
Catalpa speciosa (Warder) Warder ex Engelm.	2.03
Amelanchier x grandiflora Rehder 'Autumn Brilliance'	2.74
Aesculus glabra Willd.	3.33
Ulmus spp. (Asiatic Elms)	4.71
Ulmus americana L.	5.71
Gymnocladus dioicus (L.) K. Koch	6.27
Malus spp.	6.48
Acer x freemanii A.E. Murray	7.53
Syringa reticulata (Blume) H. Hara	7.88
Celtis occidentalis L.	9.33
Ostrya virginiana (Mill.) K. Koch	10.63
Maclura pomifera (Raf.) Schneid.	11.37
Tilia americana L.	12.68
Platanus × *acerifolia* (Alton) Willd.	12.76
Ginkgo biloba L.	13.02
Zelkova serrata (Thunb.) Makino	13.30
Amelanchier laevis Wiegand	13.54
Carpinus betulus L.	14.22
Quercus bicolor Willd.	14.31
Cladrastis kentukea (Dum. Cours.) Rudd	16.41
Quercus rubra L.	17.17
Quercus macrocarpa Michx.	17.32
Gleditsia triacanthos (L.) forma *inermis* Schneid.	17.50
Taxodium distichum (L.) Rich.	20.34
Nyssa sylvatica Marshall	45.76
Average	12.25

Does Harvest Type Matter? Yes…or No

- Bare Root
- Bare Root From Gravel Bed
- Containerized
- Balled-&-Burlapped

Bare Rooted Trees – Spring Planted

Bare Rooted From Gravel Bed – Summer & Autumn Planted

Bare Rooted From Gravel Bed

Freeman Maple Before

Freeman Maple After

Containerized Trees – Spring, Summer Autumn Planted

Containerized Trees

Balled-&-Burlapped

Table 5

Comparison of mortality rates by nursery production types* (With P-Values).

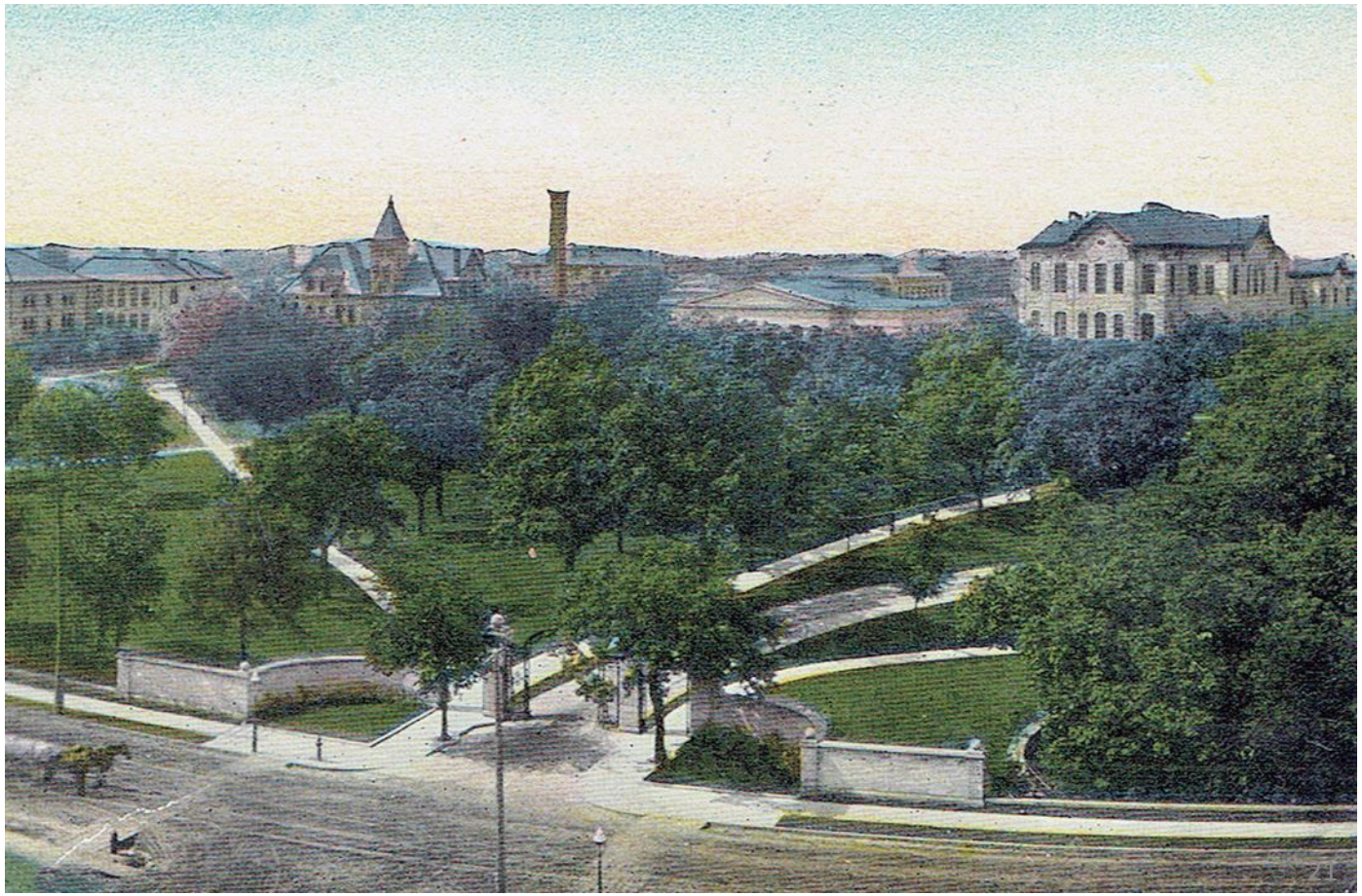
Rootstock Type A	Mortality Ratio of Stock Type A: Stock Type B	Rootstock Type B	Pr(>|z|)
Bare Root	2.86	B&B	<0.001
Bare Root	5.56	Container	<0.001
Bare Root	1.31	Gravel Bed Bare Root	0.04
Gravel Bed Bare Root	2.54	B&B	<0.001
Gravel Bed Bare Root	4.24	Container	<0.001
Container	no statistically significant	B&B	0.30

B&B n = 566. Container n = 698. Bare Root n = 2,645. Gravel Bed Bare Root n = 2,146.

* First year mortality rates by nursery production type were B&B @ 4.0 %; Container @ 8%; Bare Root @ 13 %; Gravel Bed Bare Root @ 10 %.

Does Location Make A Difference?

- Boulevard/Street Trees
- Park/Campus Trees
- Residential Trees



Park vs. Boulevard Trees

Park vs. Boulevard Trees

Park Trees Are 1.4 times More Likely to Die Within 5 Years

Wattenhofer and Johnson, 2021

No Evidence Stock Quality Plays a Role

Except?

- Pot-bound Stock
- Uncorrec-ted Pot-bound Stock

Irrigation As A Contributing Factor

- Frequency
- Amount (dose)

Most Important:

- Frequency: 2x/week
- Dose: 1.5-2.0 gallons per caliper inch
- Water Where The Roots Are
- Don’t pay attention to weather reports

Bassuk, Nina. Cornell University
Gillman, Ed. University of Florida

Planter Training & Supervision As A Factor

Planting Entity (aka, “who” planted the tree?)

- Contracted Planters
- Municipal/Agency Employees
- Trained & Supervised Volunteers

No Differences Among Planting Entities

Table 6: Comparison of planting entity types (with P-values).

Linear Hypothesis	Pr(>|z|)
Staff - Contractor == 0	0.96
Volunteer - Contractor == 0	0.91
Volunteer - Staff == 0	0.96

Based on 6055 Trees Planted:

566 B&B Trees
698 Containerized Trees
2,645 Bare Root Trees
2146 Gravel Bed Bare Root Trees

So, What Mattered?

Table 4: ANOVA table for statistical significance of variables.

Variable	Df	Sum Sq	Mean sq	F value	Pr(>f)
Planting Entity	2	0.0	0.015	0.180	0.835
Site Type	1	3.7	3.711	43.634	4.31e-11
Species	25	18.8	0.753	8.856	<2e-16
Stock Type	3	7.5	2.499	29.382	<2e-16

Indicators From Other Research?

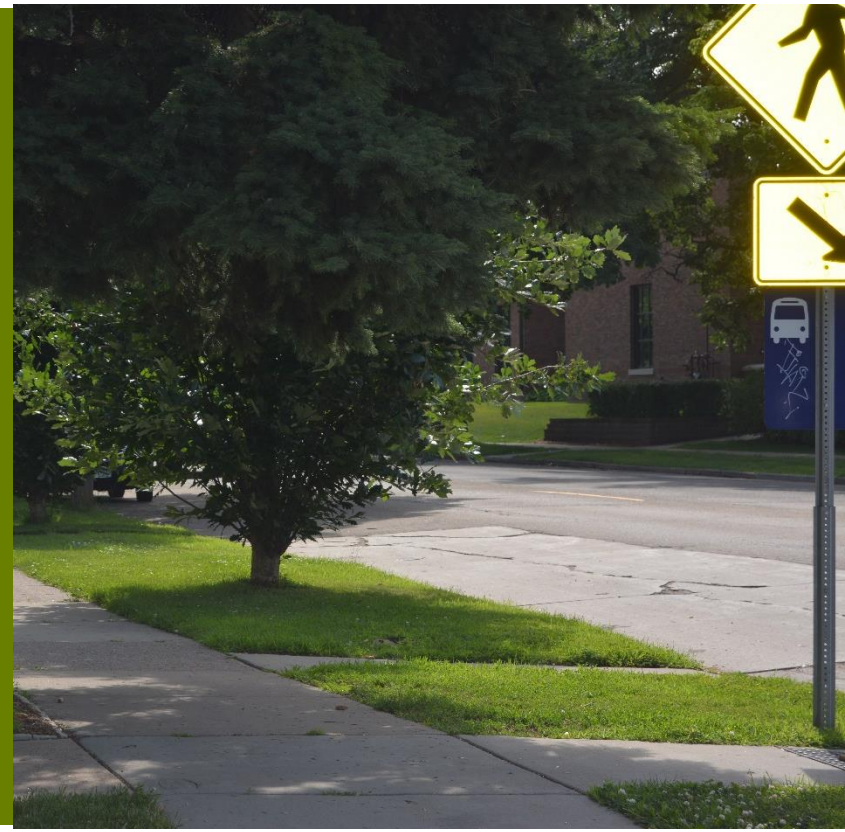
- Property Ownership (436 Trees)
- Root Pruning In Production Nurseries (Gillman, Watson, others)
- Tree Stewardship by Municipality, County, Funding Groups Almost 6 Times Greater Survival Rates (749 Trees)
- Neighborhoods With Higher Education Rates (436 Trees)
- Planting Depths (Scores of studies, beginning with John Evelyn in 1664)
- Seasonal Droughts (Scores of studies)
- Proximity to Fraternity Houses* (Johnson et al, 2011)

*Is There A Higher Mortality/Vandalism Rate For Trees Planted Near UMN Fraternity Houses?

Frat Houses + Drunk Frat Boys = More Tree Vandalism…Was There Any Correlation?

- No. No Funds Available For Breathalyzers
- Same Vandalism Rate Across The City
- More Specifically, Same Rate For Trees Planted In Boulevards 3 Feet Or Less In Width
- Trees Vandalized Were In 2-3 Foot Wide Boulevards, Along The Two Streets Connecting A Public Parking Lot And The Football Stadium, Hockey Stadium, Basketball Stadium
- 2014 Urban Forestry Capstone Course Study, FNRM 4501/5501, University of MN

Part II: The Establishment Years



Factors Challenging Establishment

- Planting Practices
- Construction Activities
- Landscape Management Practices
- Diseases & Insect Pests
- Tree “Inconveniences”
- Delayed Pruning
- Weather Aberrations

Planting Practices That Catch Up

- Not Correcting
  Encircling Root Systems
- Burying Trees, Not Planting Trees

Uncorrected Encircling Root Systems

Correcting Encircling Root Systems

“Boxing” or “Shaving”
Pot-bound Root Systems

8 Weeks After Boxing

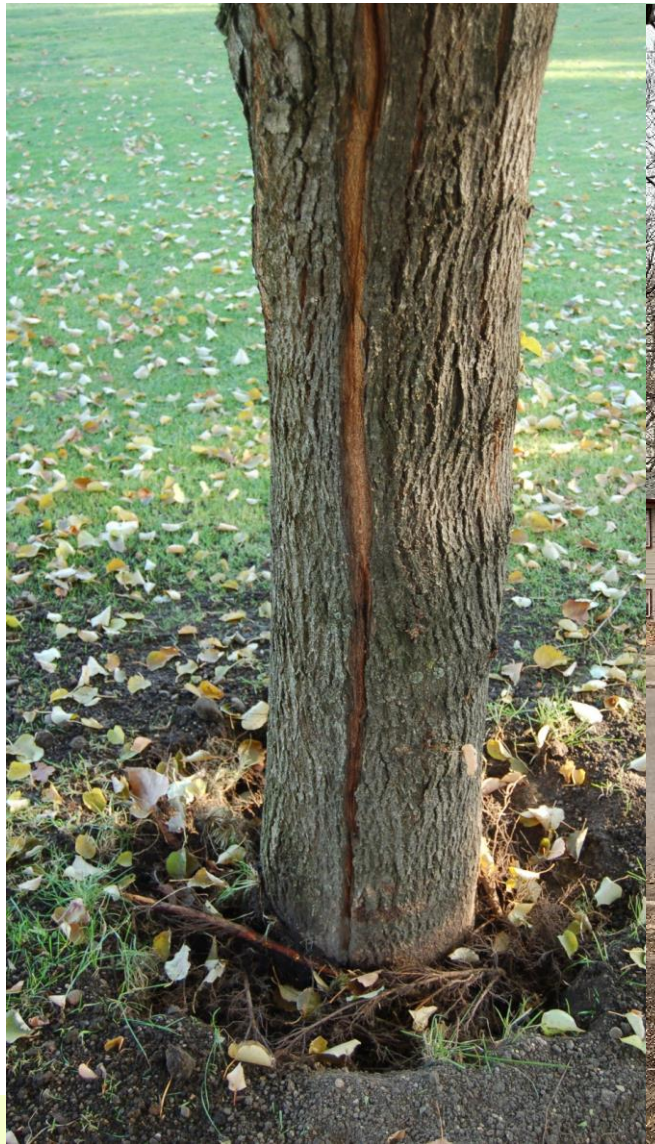
Avoiding Encircling Root System Problems

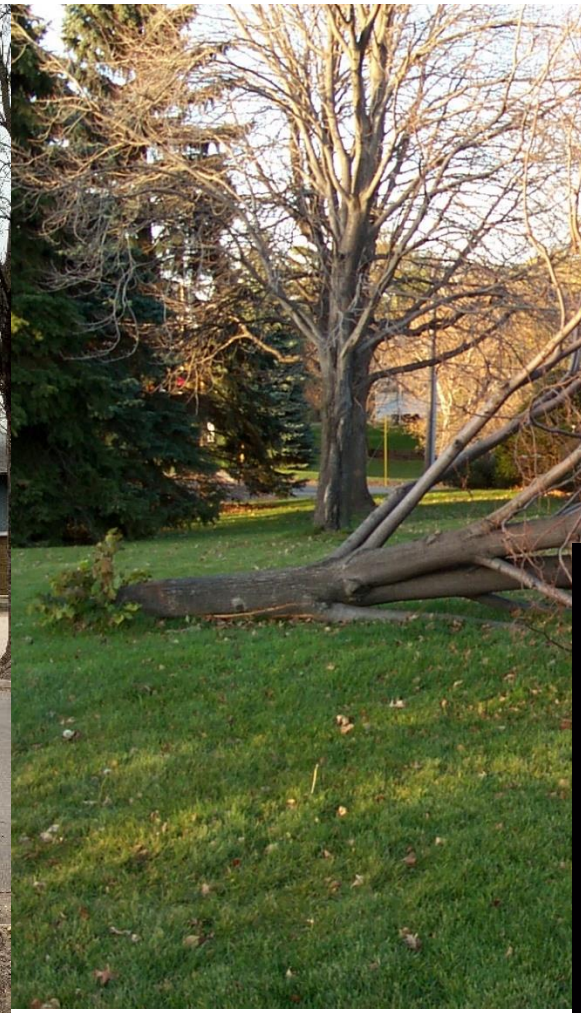
Buried Root Systems, Not Planted Trees

Green Ash, Buried 6” Too Deep For 6 Weeks, Finger on Original First Main Order Root

Littleleaf Linden, Buried >10” Too Deep, 10 Years Later

Buried Root Systems, Not Planted Trees





Correcting Buried Root Problems At Planting Time

Crimson King Maple, 15 Years After Burying

Published Research On Burying vs. Planting

- John Evelyn, 1664. *Sylva, or a Discourse of Forest Trees and the Propagation of Timber.*
- Lyons and Yoder, 1981. *Poor Anchorage of Deeply Planted Peach Trees.*
- Johnson and Hauer. 2000. *A Practioner's Guide To Stem Girdling Roots.*
- Hauer and Johnson. 2021. *Relationship of structural root depth on the formation of stem encircling roots and stem girdling roots: Implications on tree condition.*

Construction Activities Near Trees

Sidewalk Replacement & Wind Loading Events

Sidewalk Replacement & Wind Loading Events

Within 5 Years of Sidewalk Replacement:

1. Trees 2.4 x More Likely To Fail
2. Larger Trees Even More Likely
3. Boulevards < 8 Feet, Even More Likely

G. Johnson et al, 2019. Boulevard Tree Failures During Wind Loading Events. Arboriculture & Urban Forestry 45(6).

Landscape Management Practices

- Lawnmower, String Trimmer Damage
- Non-target Chemical Drift
- Weed-free Turf vs. Healthy Trees

Lawnmower, String Trimmer Damage

Non-target Chemical Drift (Dicamba Drift)

Glyphosate Sprayed On Tree Trunks To Kill Poison Ivy

Misused Or Over-used Lawn Chemicals vs. Healthy Trees: Worst Offenders

- Broad-leaved Herbicides (Dicamba, 2,4-D ester)
- Non-selective Herbicides (Glyphosate)
- Pre-emergent Herbicides (Preen, Treflan)
- Fungicides (More common in golf courses)
- Insecticides (Imidacloprid)

- *Good References: Suzanne Simard, Douglas Tallamy.*

Diseases & Insect Pests

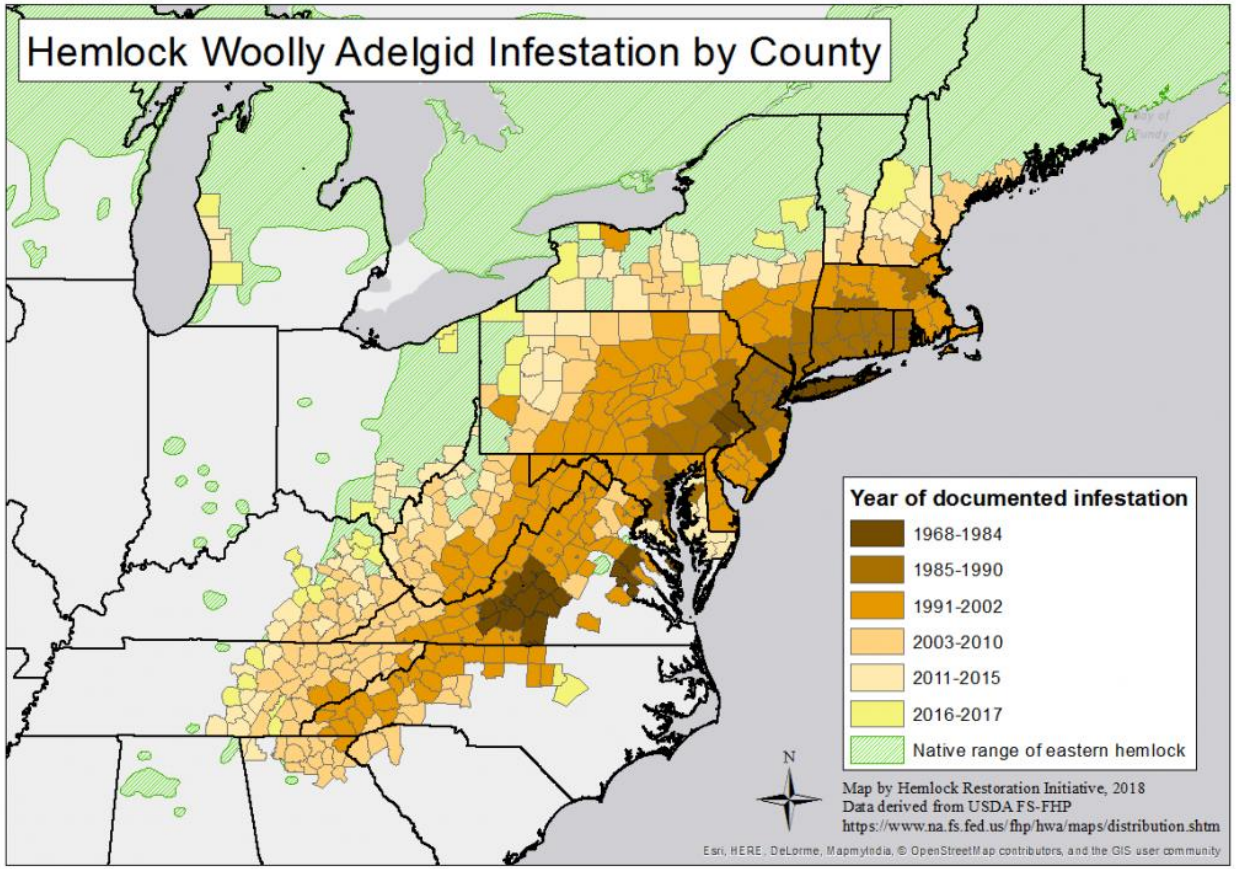
- Primaries:
  - Dutch Elm Disease
  - Emerald Ash Borer
  - Thousand Cankers of Walnut
  - Hemlock Wooly Adelgid
- Contributing:
  - Wood Boring/Bark Insects (Bronze Birch Borer, Ips Beetles)
  - Fungal Target Cankers
  - Scale Insects
  - Decay

Dutch Elm Disease

Emerald Ash Borer

Target Cankers

Hemlock Wooly Adelgid



Scale Insects

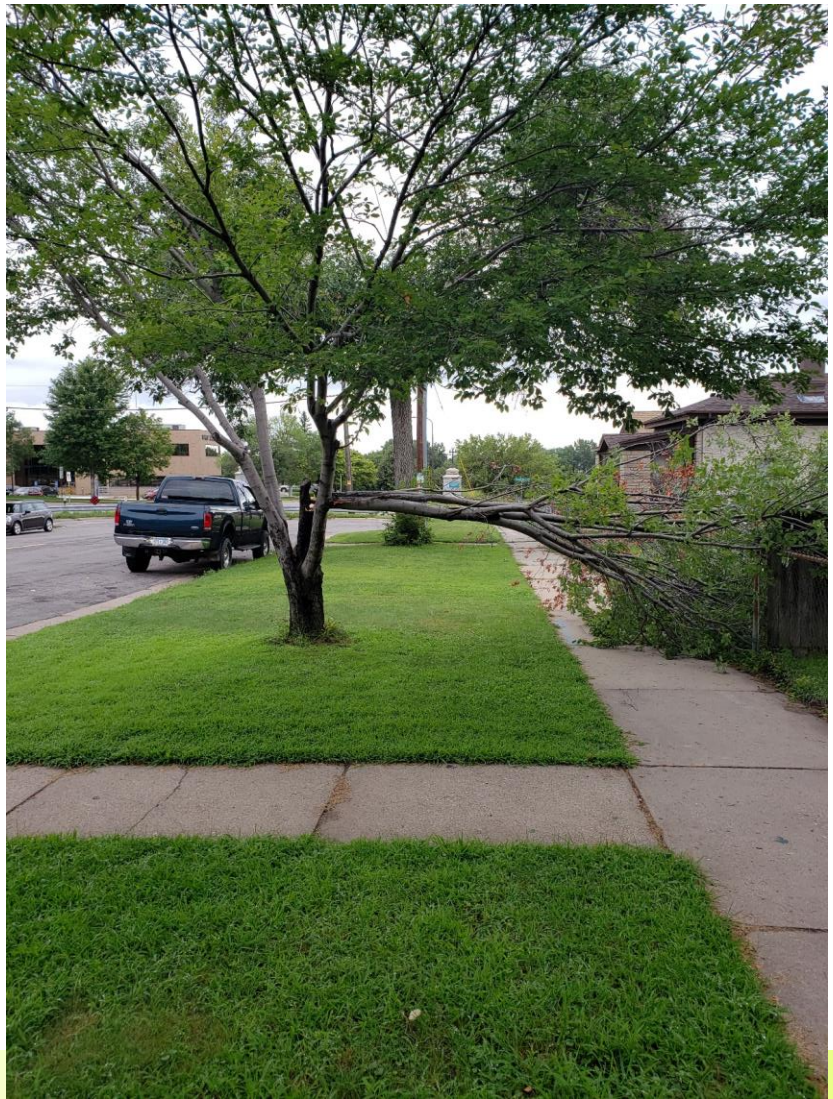
Elm Scales

Tree Inconveniences

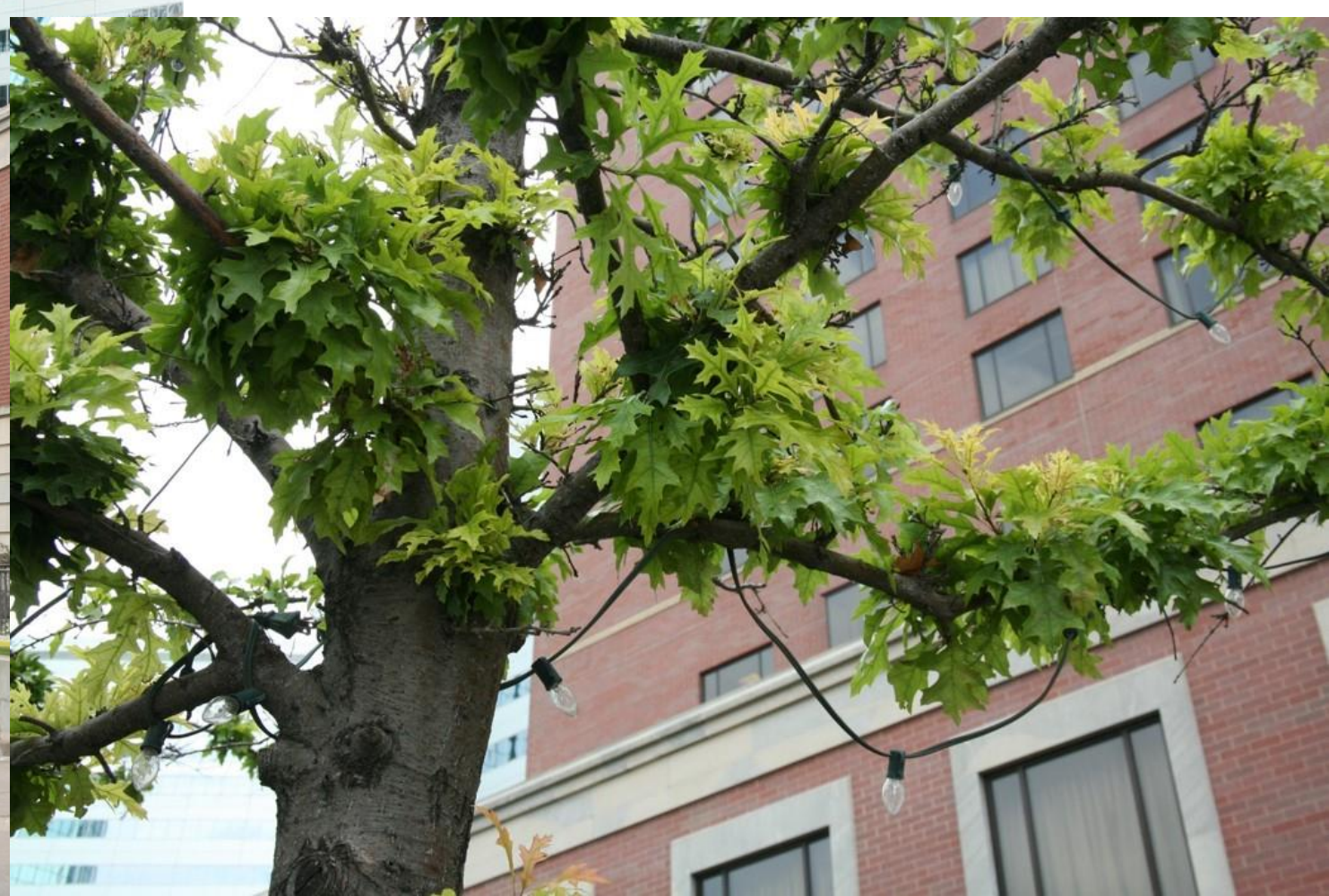
Ginkgo biloba Seeds & Flesh

Cottonwood “Cotton”

Delayed Pruning & Wind Loading Events



Highly Disturbed, Unnatural Urban Sites



The End

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