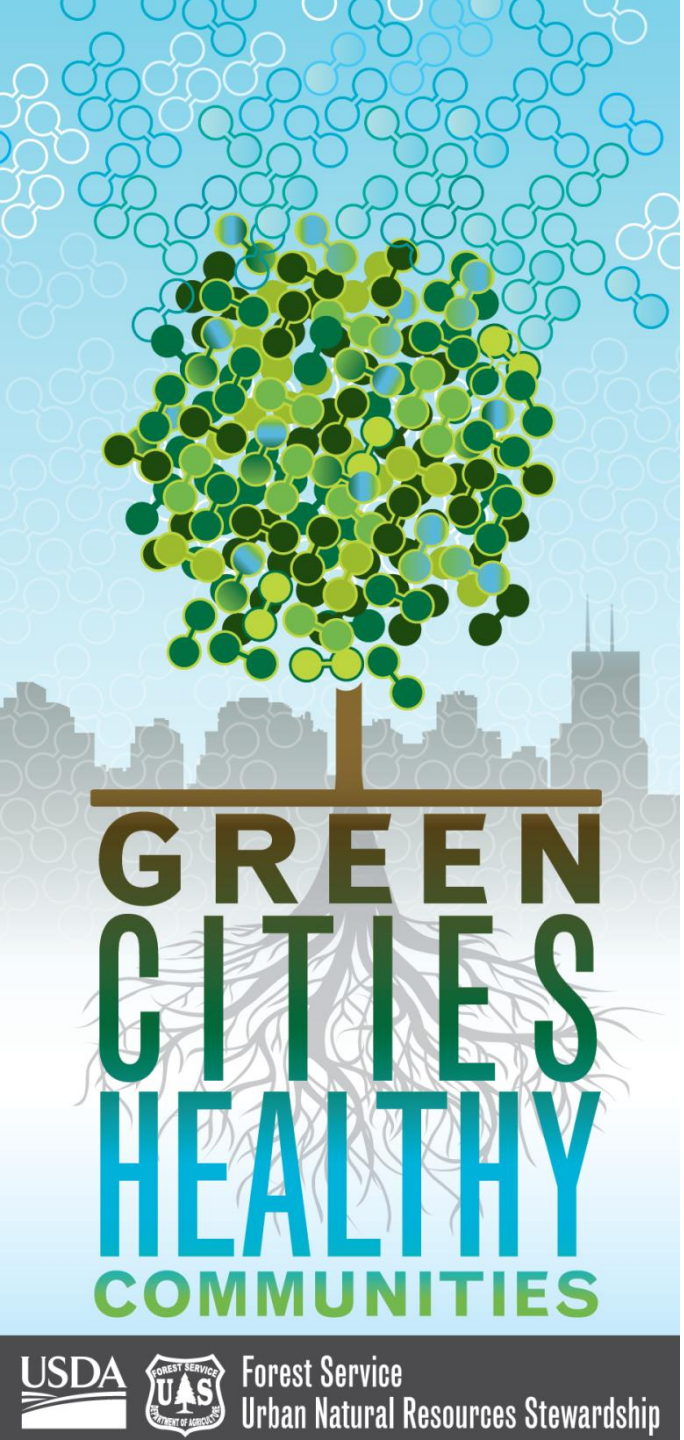


USDA Forest Service

URBAN FOREST CONNECTIONS

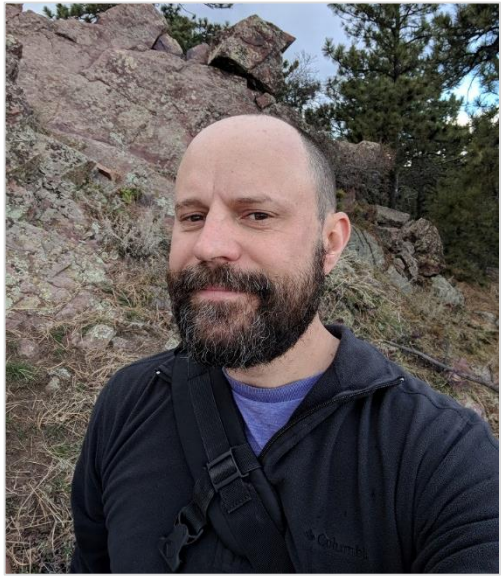
webinar series

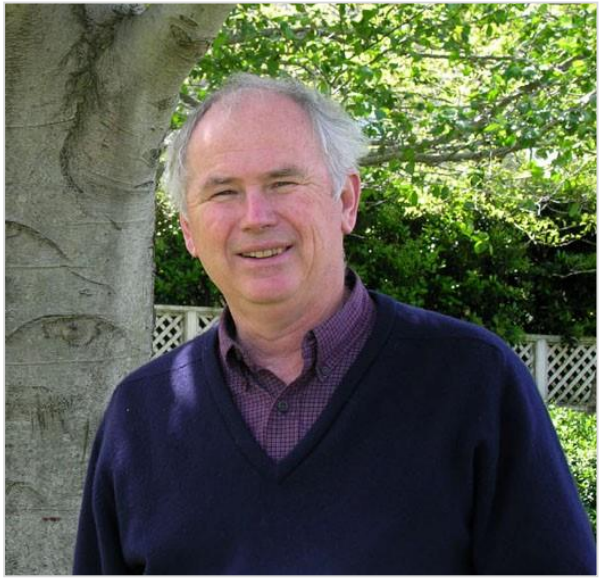
Second Wednesdays | 1:00 – 2:15 pm ET

www.fs.fed.us/research/urban-webinars

USDA is an equal opportunity provider and employer.

Construction Damage, Severe Storms, and Tree Failure Analysis





Eric North

Assistant Professor of Practice

University of Nebraska-Lincoln

eric.north@unl.edu

Larry Costello

President

Oracle Oak LLC & University of California Emeritus

larryoracleoak@me.com

Construction Damaged Trees & Severe Storms

Dr. Eric North, Regional & Community Forestry

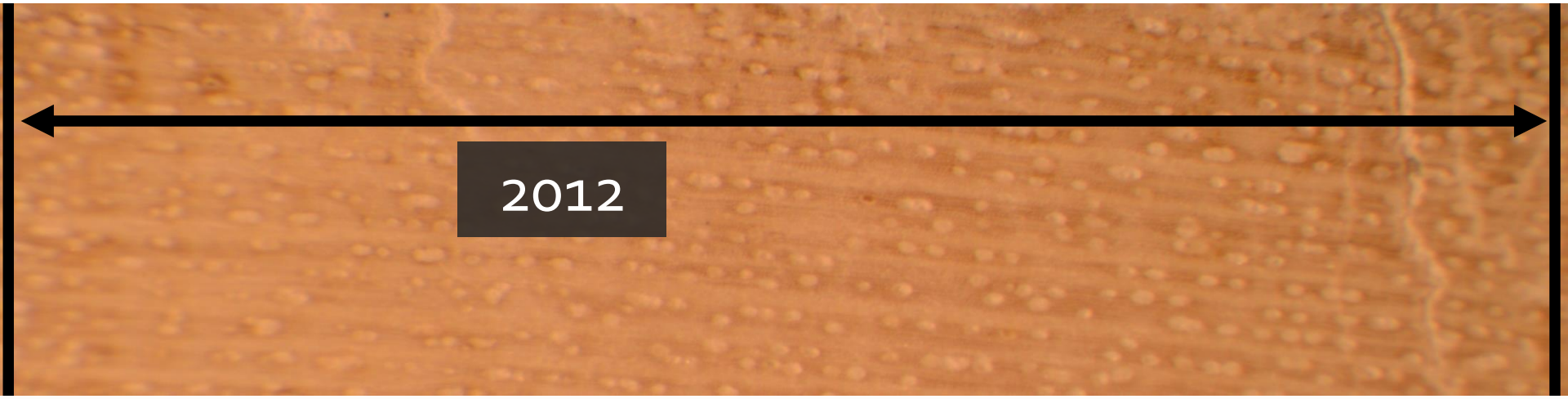
Sidewalk Construction

Evaluating Trees

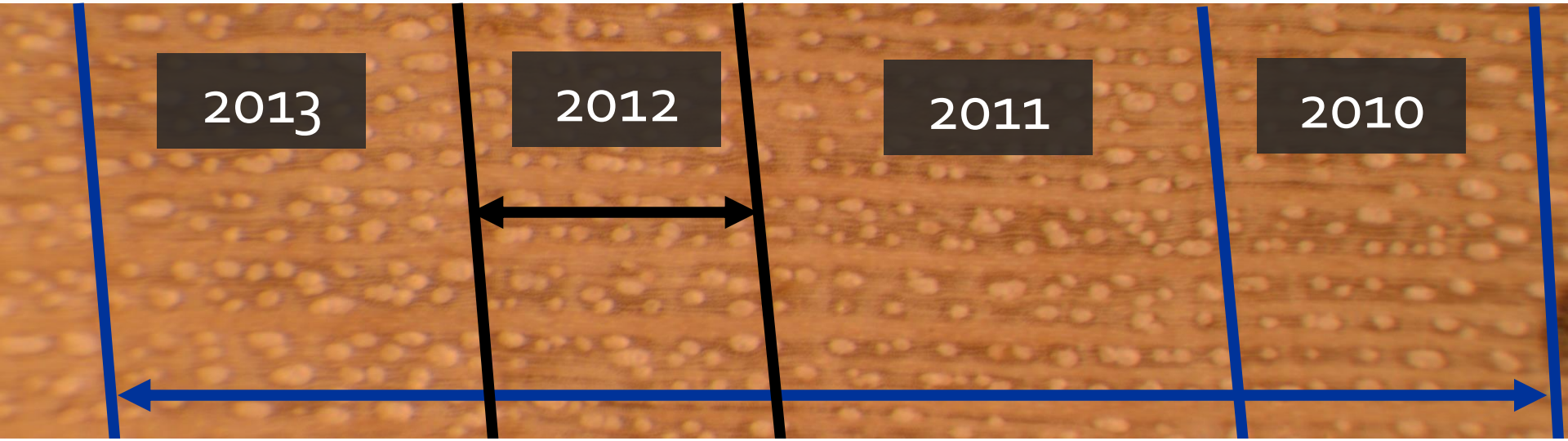
Subjective:

"…very different values for each tree using the same formula and different appraisers"

Ponco-Donoso, M., Ó. Vallejos-Barra, and F.J. Escobedo. 2017. Appraisal of urban trees using twelve valuation formulas and two appraiser groups. *Arbor. & Urb. For.* 43(2), 72-82.

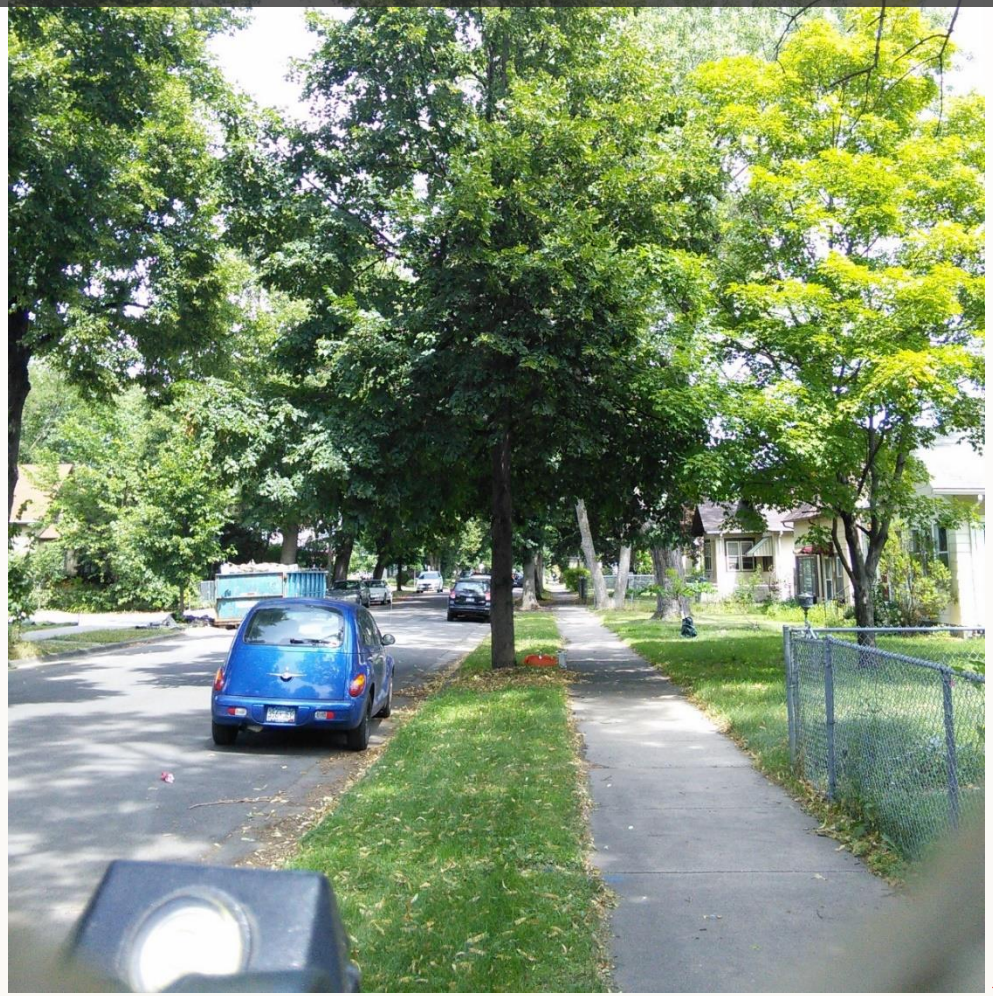


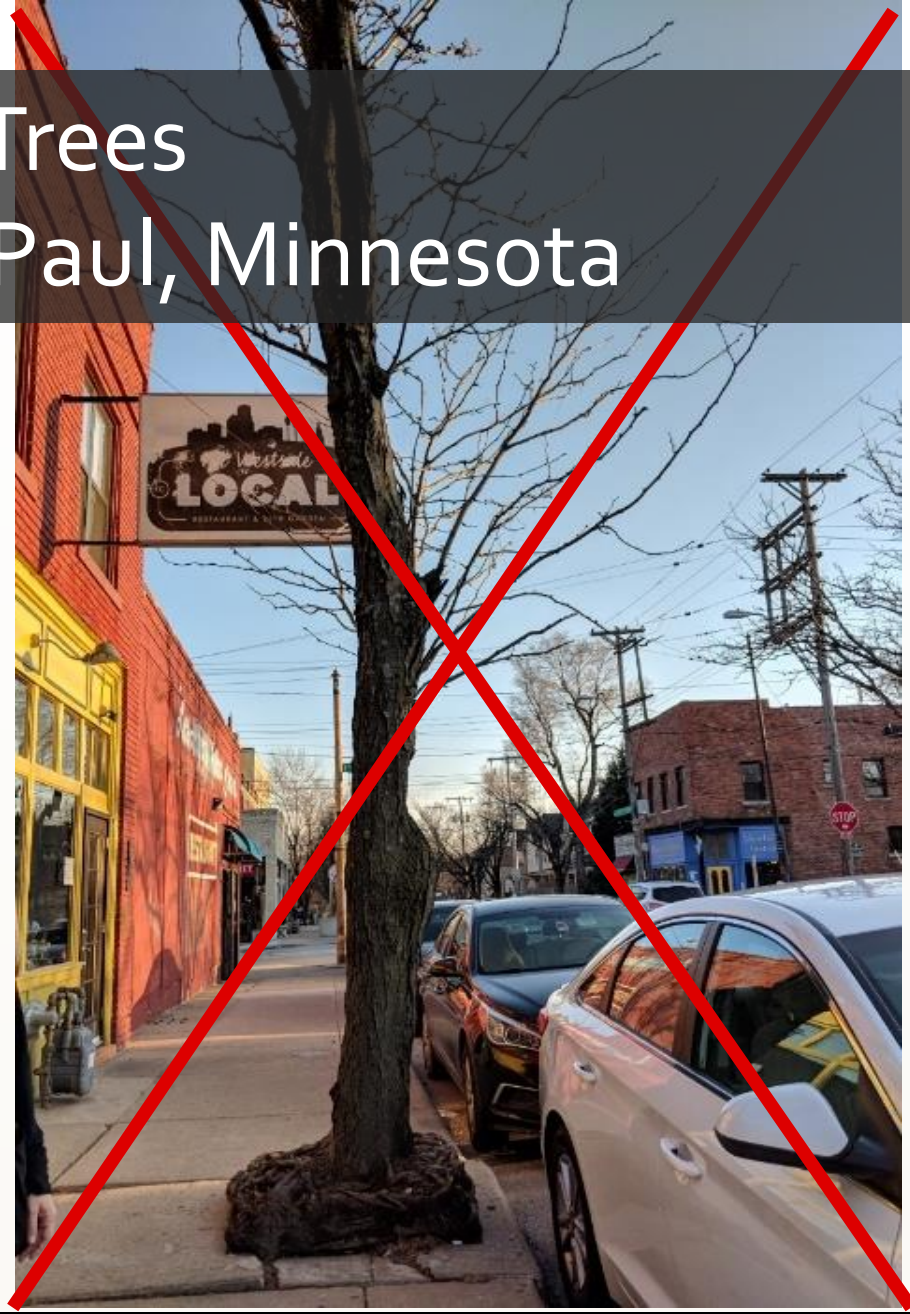
Tree Ring Analysis



Growth reduced 18 years post construction

Study Trees
Minneapolis & St Paul, Minnesota





Research Questions

1. Impact of sidewalk construction on urban tree growth? – Beyond condition rating

2. How long to recover?

3. How does tree lawn (boulevard) width impact recovery?

North E.A., A. W. D'Amato, M. B. Russell, G.R. Johnson. (2017). The influence of sidewalk replacement on urban street tree growth. Urban Forestry & Urban Greening. 24, 116-124.

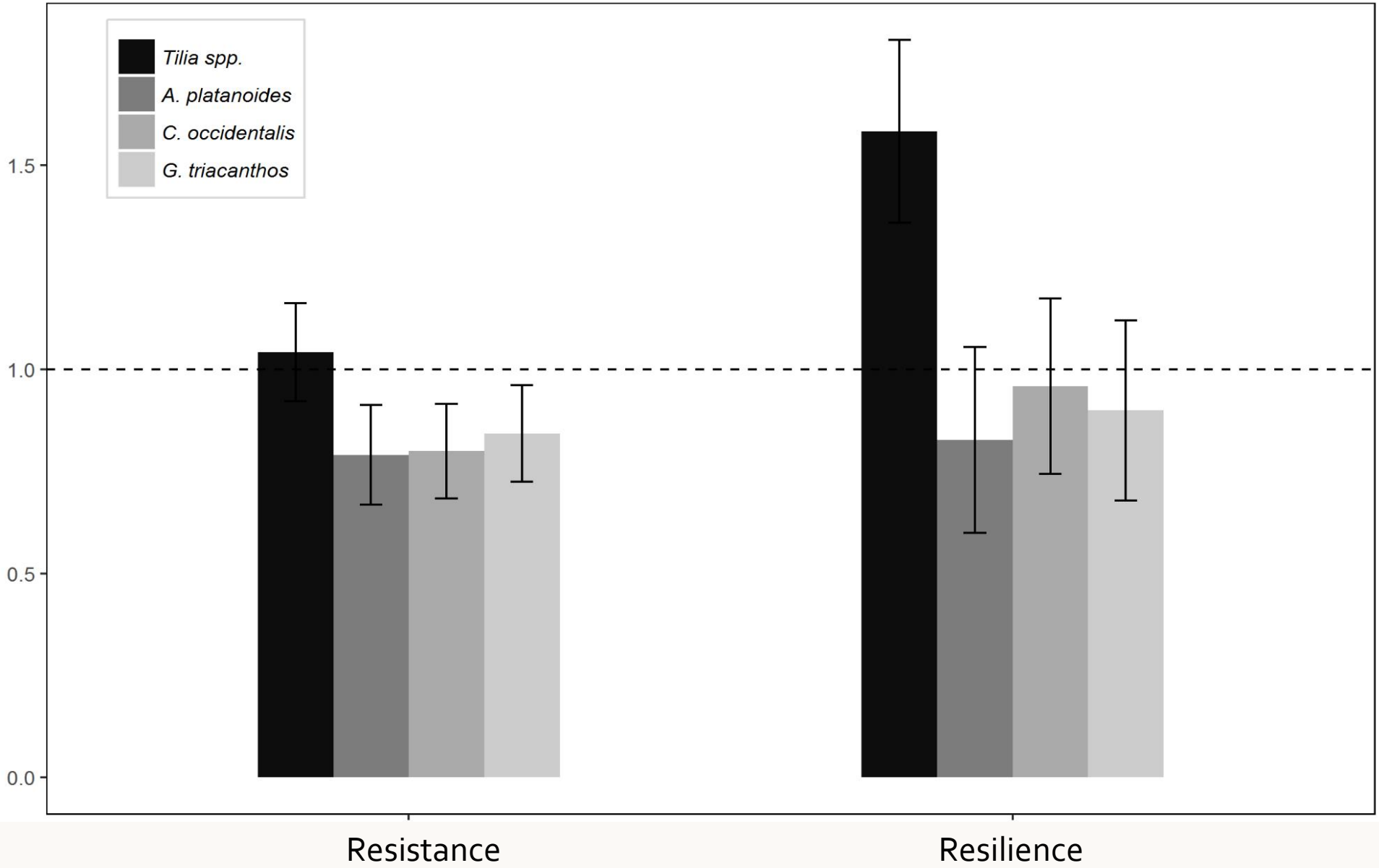
Growth Indices

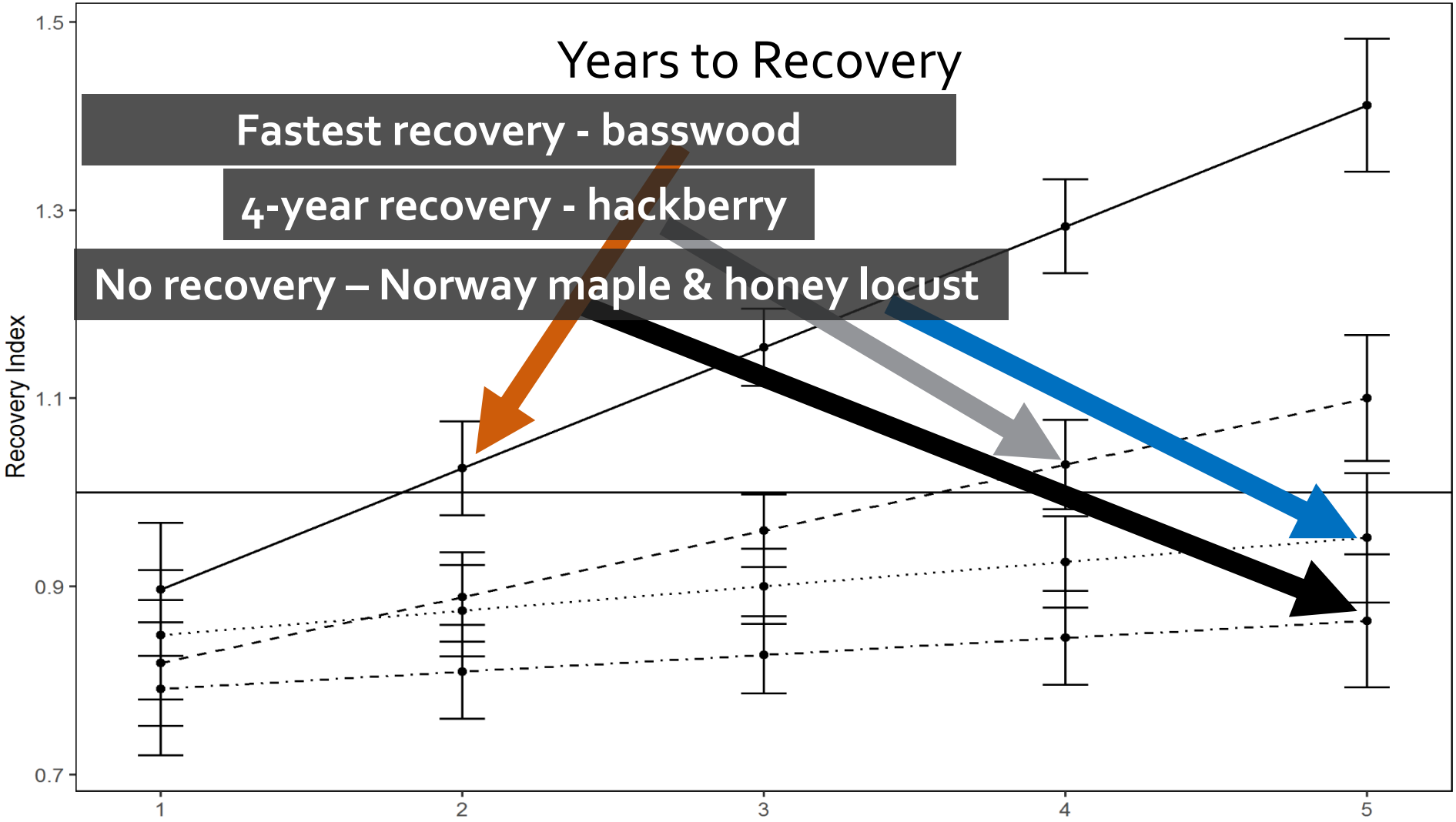
$$\text{Resistance} = \left(\frac{growth\ 1\text{−}year\ post\ construction}{average\ growth\ 5\text{−}year\ pre\text{−}construction} \right)$$

$$\text{Resilience} = \left(\frac{average\ growth\ 5\text{−}year\ post\ construction}{average\ growth\ 5\text{−}year\ pre\text{−}construction} \right)$$

$$\text{Recovery} = \left(\frac{growth\ for\ each\ year\ post\ construction}{average\ growth\ 5\text{−}year\ pre\text{−}construction} \right)$$

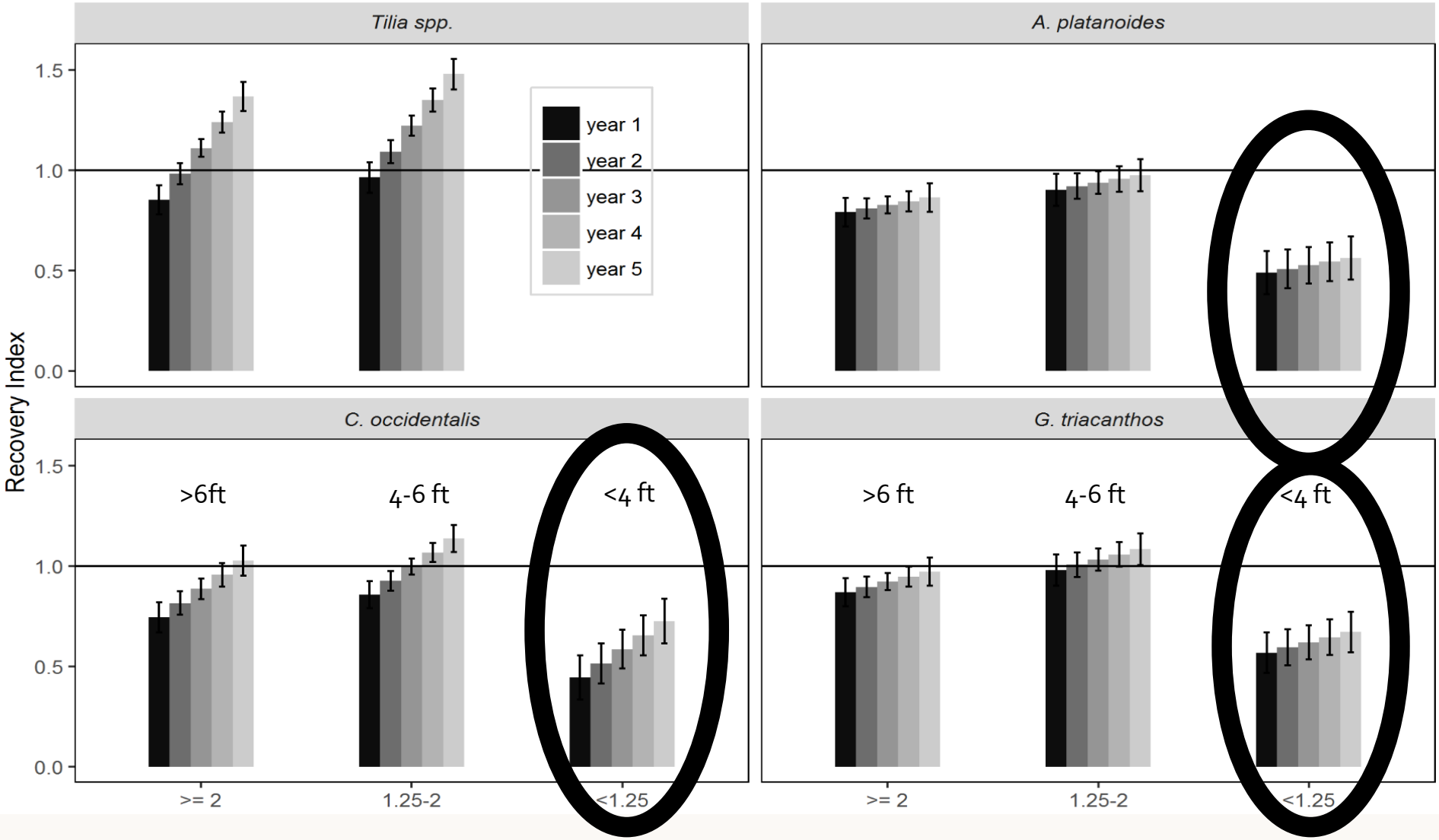
D'Amato, et al. (2013) and Fahey, et al. (2013), North et al. (2017)


Tilia spp.
A. platanoides
C. occidentalis
G. triacanthos
1.5
1.0
0.5
0.0
Resistance
Resilience



North et al. 2017. The Influence of sidewalk replacement on urban street tree growth.

Recovery & Boulevard Width



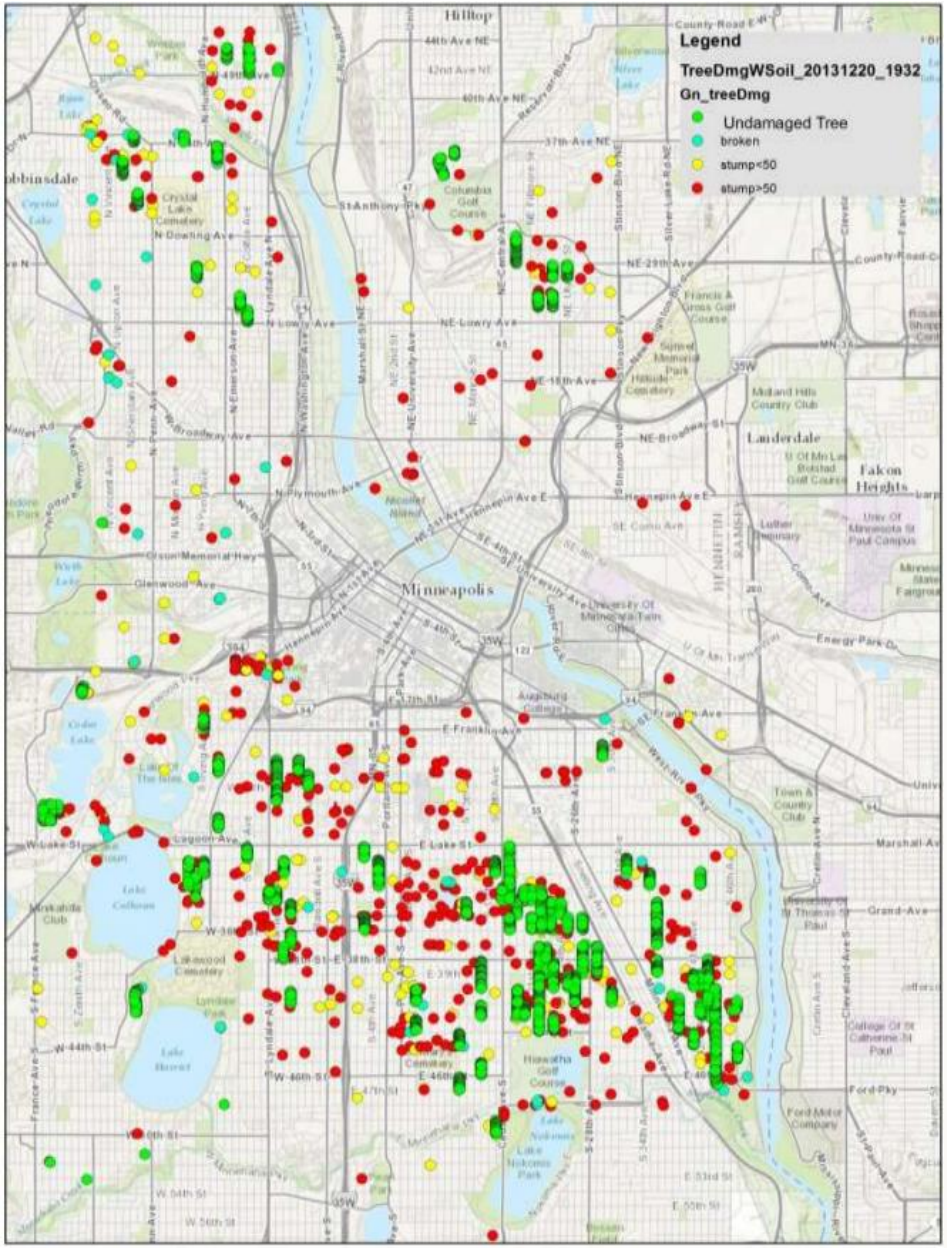
June 2013 Storm

Lots of rain - a.m & p.m.
2 wind events - a.m. & p.m.

Johnson, G., 2014. When winds and trees collide: the influence of sidewalk repair, trunk flare, and wind-loading events on boulevard tree failures. Arborist News 23 (6), 50–53.

We Noticed

Lot of downed trees
near
new pavement



Assessed

- Damaged & Undamaged Trees
- Street Trees
- Over 3,000 Trees

Tree Variables

- Species
- DBH
- Stem girdling roots

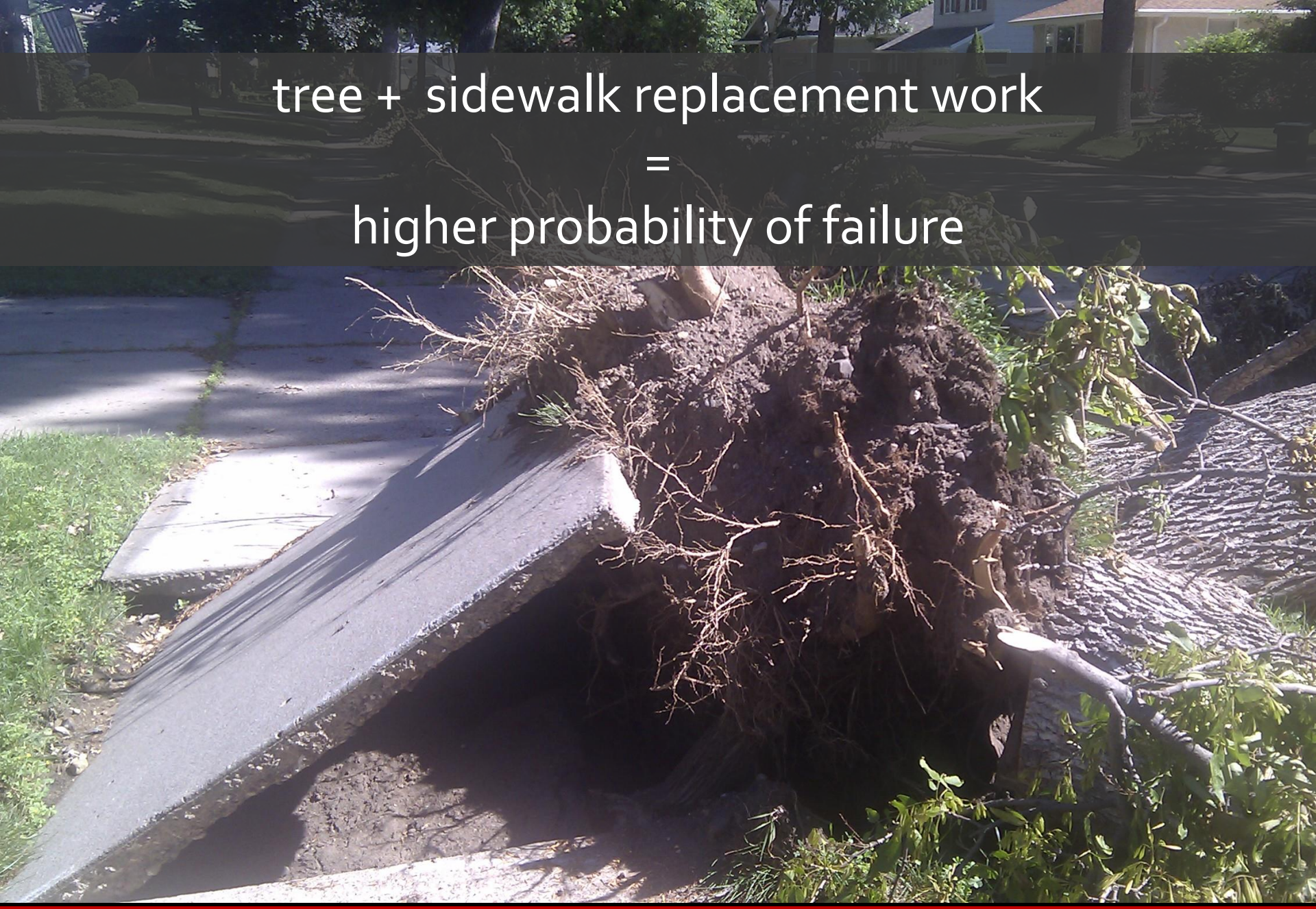
Sites Variables

- Sidewalk & curb replacement
  - 5-years or less
- Damage sidewalk & curb
- Boulevard width

Soil Variables

- Texture
- pH
- Compaction - 6″ and 12″

large DBH = higher probability of failure


tree + sidewalk replacement work
=
higher probability of failure

tree + sidewalk replacement work

=

higher probability of failure

Failure Probability

1. Basswood (*Tilia*)
2. Ash (*Fraxinus*)
3. Maple (*Acer*)
4. Elm (*Ulmus*)

narrow boulevard + sidewalk replacement
= higher probability of failure

Basswood Example

4-foot wide boulevard + sidewalk replacement = 29.4% failure rate

8-foot wide boulevard + sidewalk replacement = failure 14.6% rate

Soil Characteristics

- Texture NOT significant
- Organic matter NOT significant
- pH NOT significant
- Soil Compaction @ 6” significant

Predicting & Preventing Future Issues

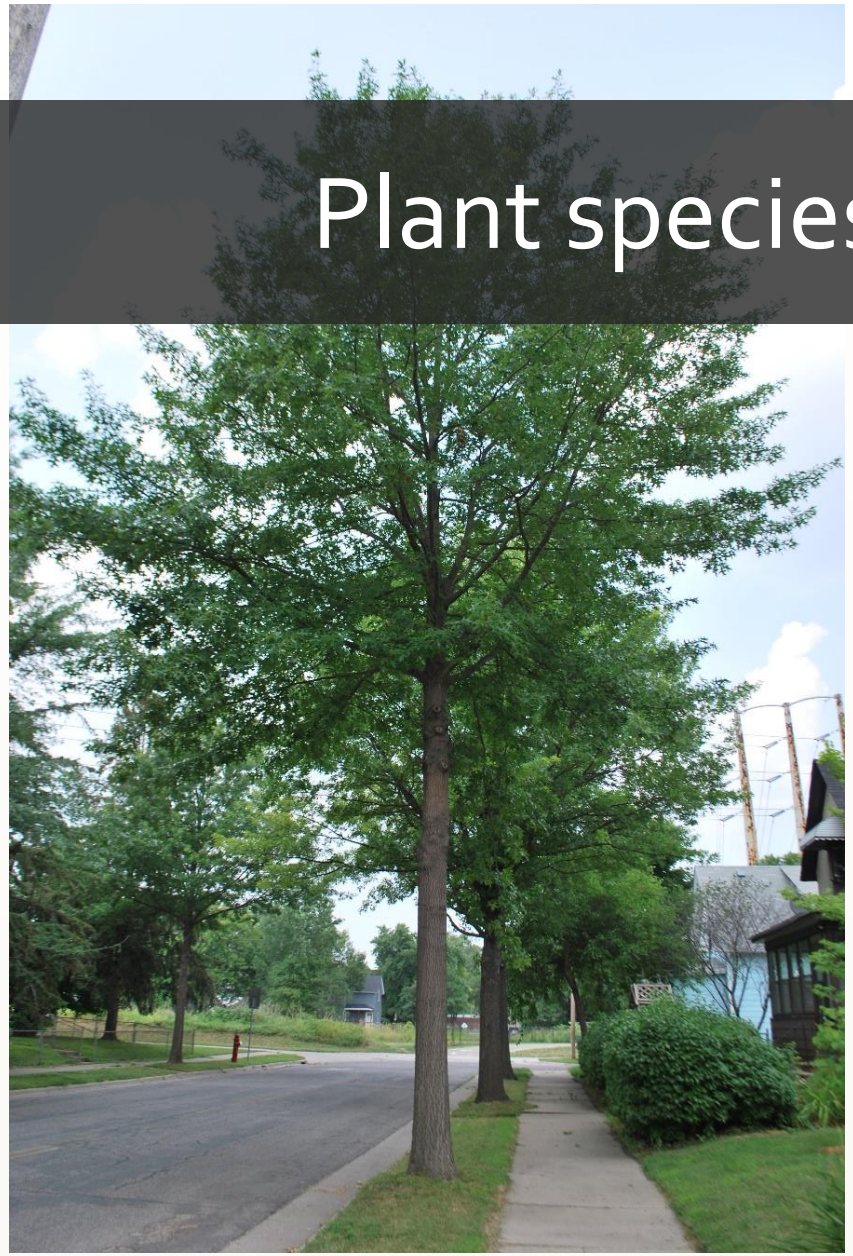
Trunk Flare Diameter Predictions

Boulevard width recommendations in feet

$$= \left(\frac{T\hat{F}D}{12} \right) + 8$$

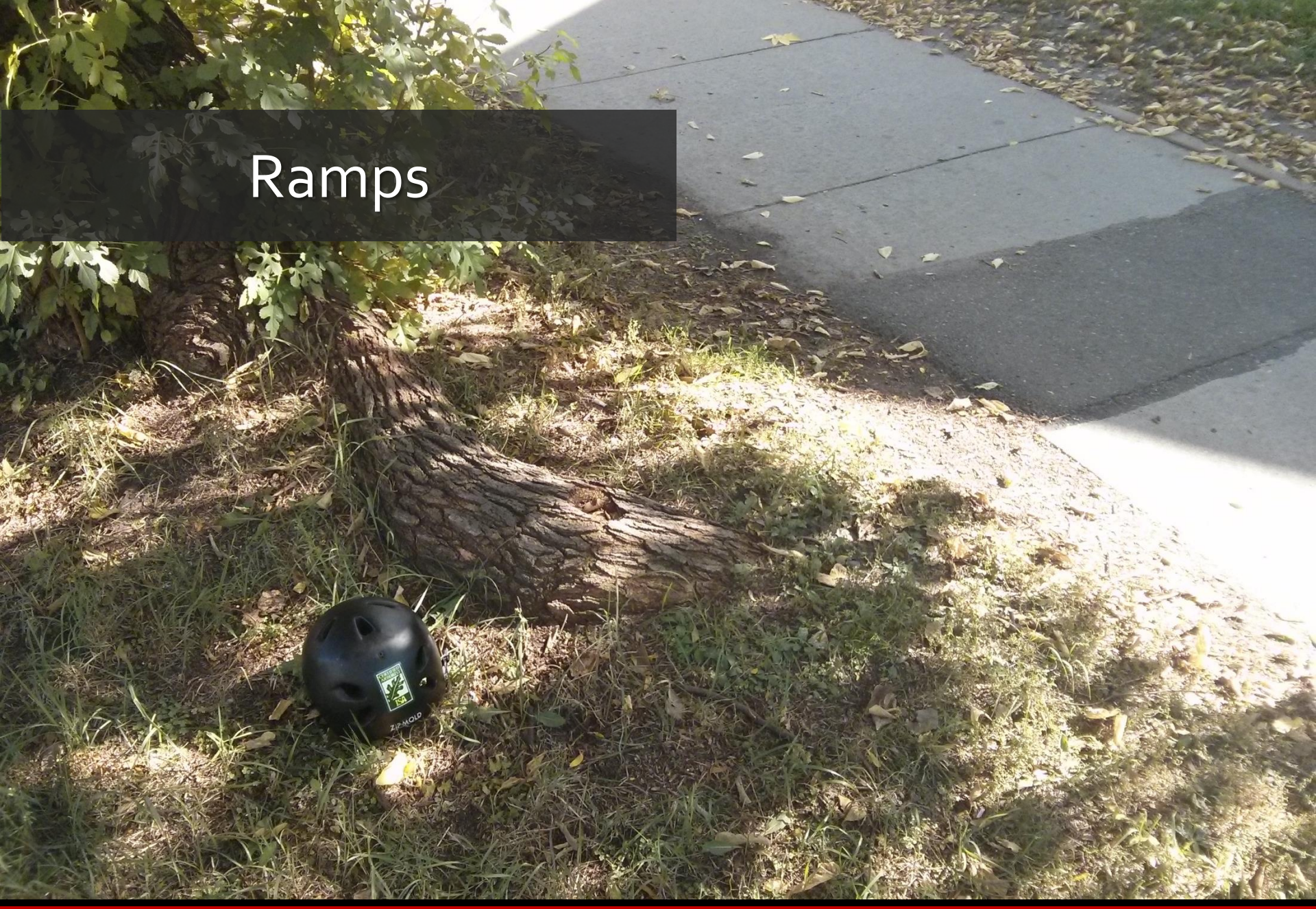
North, E.A., Johnson, G.R., Burk, T.E., 2015. Trunk flare diameter predictions as an infrastructure planning tool to reduce tree and sidewalk conflicts. Urban For. Urban Green. 14 (1), 65–71.

Plant species for long-term



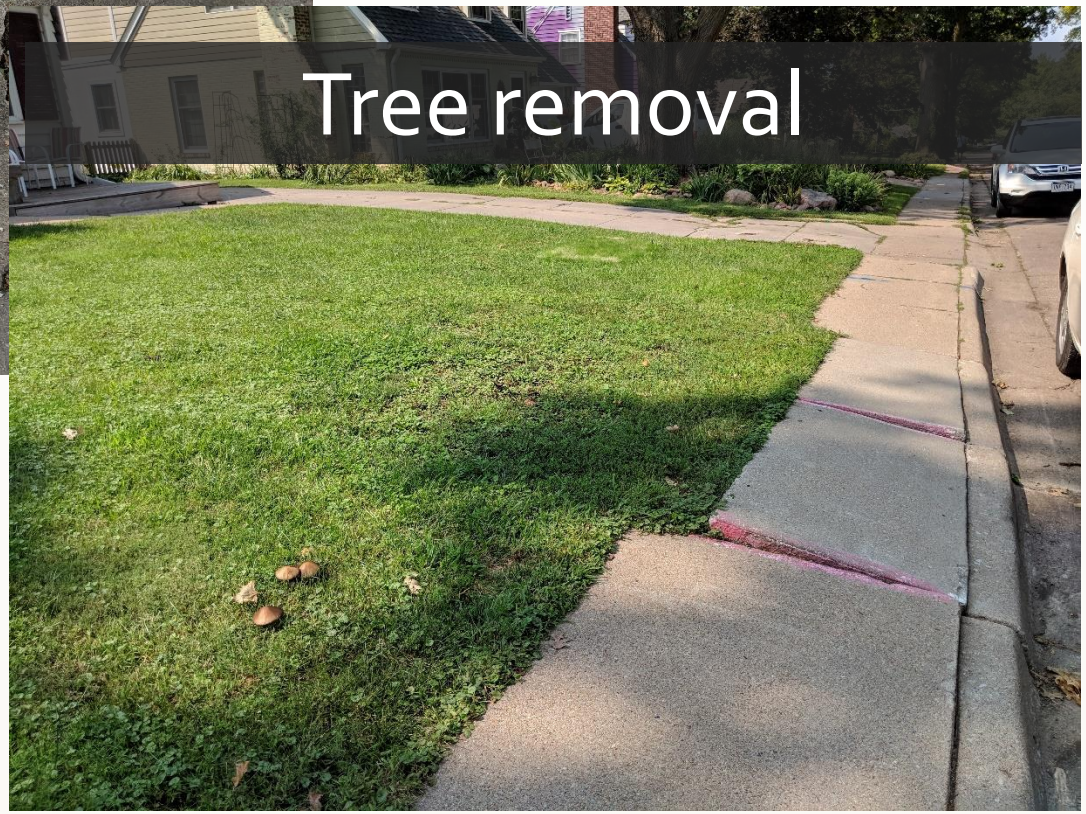
Reported to last ~7 to 8 years
Cost: $75 - $200
No root damage

Ramps



Curving & Narrowing Sidewalk

Flexible material


Tree removal

Repairs

Lasts ~2 years

Over 1" lift

60% of repaired sidewalks needed additional repairs within 7 years

Significant Finding

sidewalk replacement
= 2.24 times higher probability of failure

1. Wider boulevards are better
2. Species selection is critical
3. Root severance reduces growth
4. Root severance reduces stability for up to 5-years - possibly longer
5. Sidewalk repair solutions that don't require root severance
6. Remove tree when root severance is unavoidable

Acknowledgements

Professor Gary Johnson - University of Minnesota
Chad Giblin - University of Minnesota
Philip Potyondy - Minneapolis Park and Recreation

Minneapolis Park & Recreation Board

Department of Forest Resources
University of Minnesota

Saint Paul