

Planting and Managing Trees in Engineered Spaces: A SF Bay Area Experience

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Sept. 11, 2018



San Francisco Bay Area



San Francisco Bay Area



Annual Rainfall
400 – 2000 mm

Annual ET
840-1450 mm



Where have all the good soils gone?



Soil Formation: Urban Style



Soil Formation: Urban Style

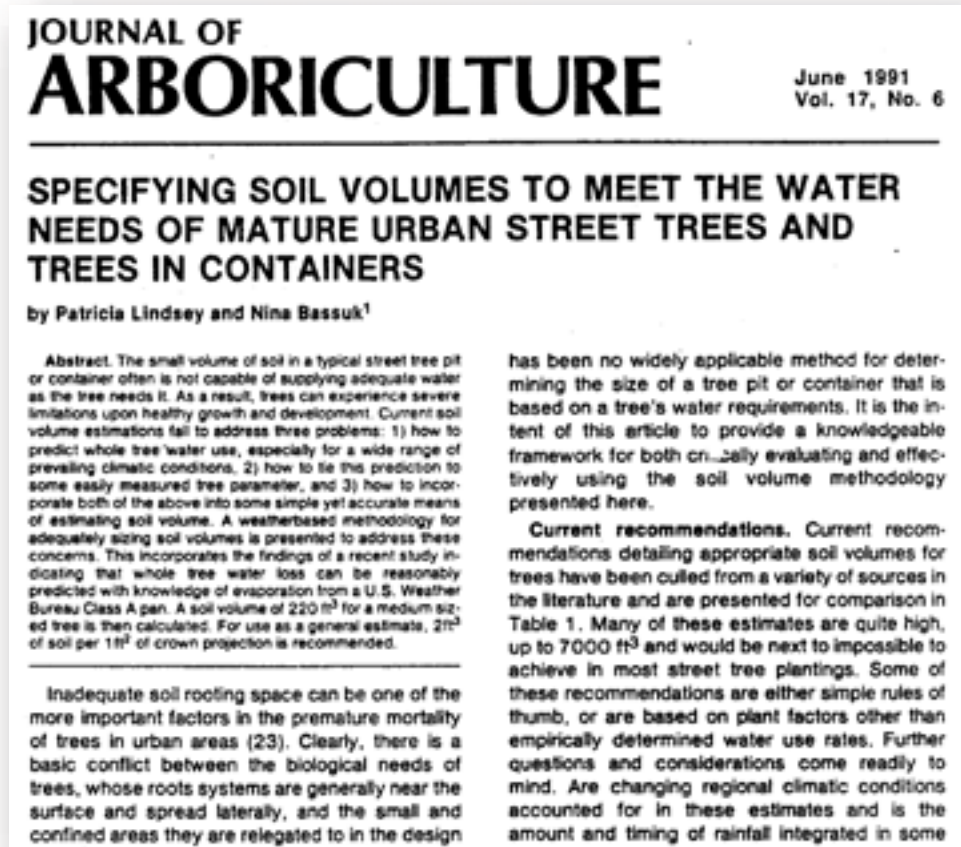


Tree soil volume requirements



Lindsey & Bassuk 1991

- A weather-based methodology for adequately sizing soil volumes
- Water is added to the soil mainly through precipitation; rain every 10 days
- Soil is a silty loam



Lindsey & Bassuk 1992

- Model applied to 6 locations in Britain.
- Great deal of similarity among values.
- Generic estimate of 0.15 m^2 of soil per m^2 of crown projection.

Arboricultural Journal 1992, Vol 16 pp 25-39
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Printed in Great Britain

REDESIGNING THE URBAN FOREST FROM THE GROUND BELOW: A NEW APPROACH TO SPECIFYING ADEQUATE SOIL VOLUMES FOR STREET TREES

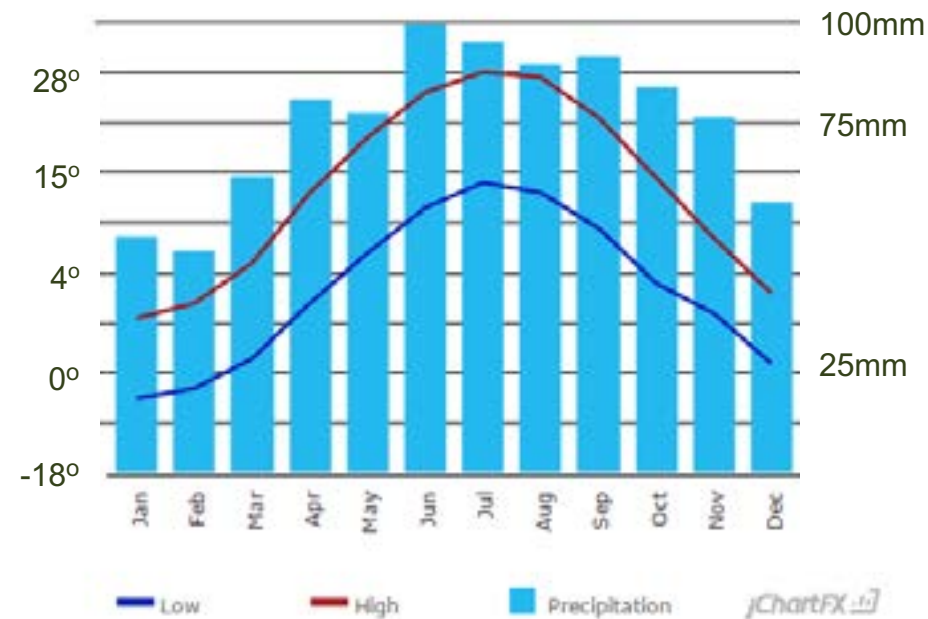
*Patricia Lindsey and Nina Bassuk**

Summary

Current surveys have dramatically documented the plight of struggling and dying urban trees. Inadequate soil rooting volume is an important cause of this premature mortality. The soil acts as a vital reservoir, holding and then supplying water as the tree demands it. A weather-based methodology has been developed that enables the arboriculturist to size a tree pit or container based on a tree's daily expected water requirements, thereby reducing or eliminating water stress over a growing season. For use as a general estimate, a soil volume of 5 m^3 for a medium sized tree is recommended.

Average monthly rainfall

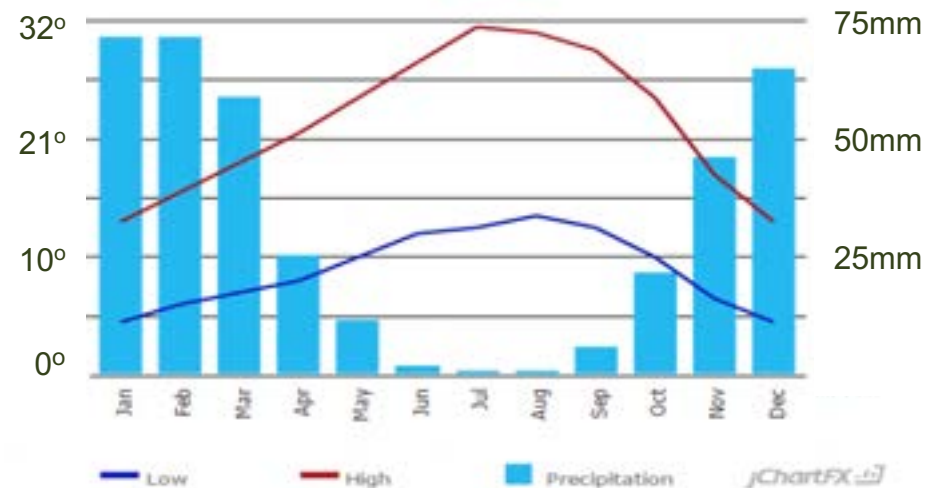
Ithaca, NY



Average Annual Precipitation

890 mm rain
1600 mm snow

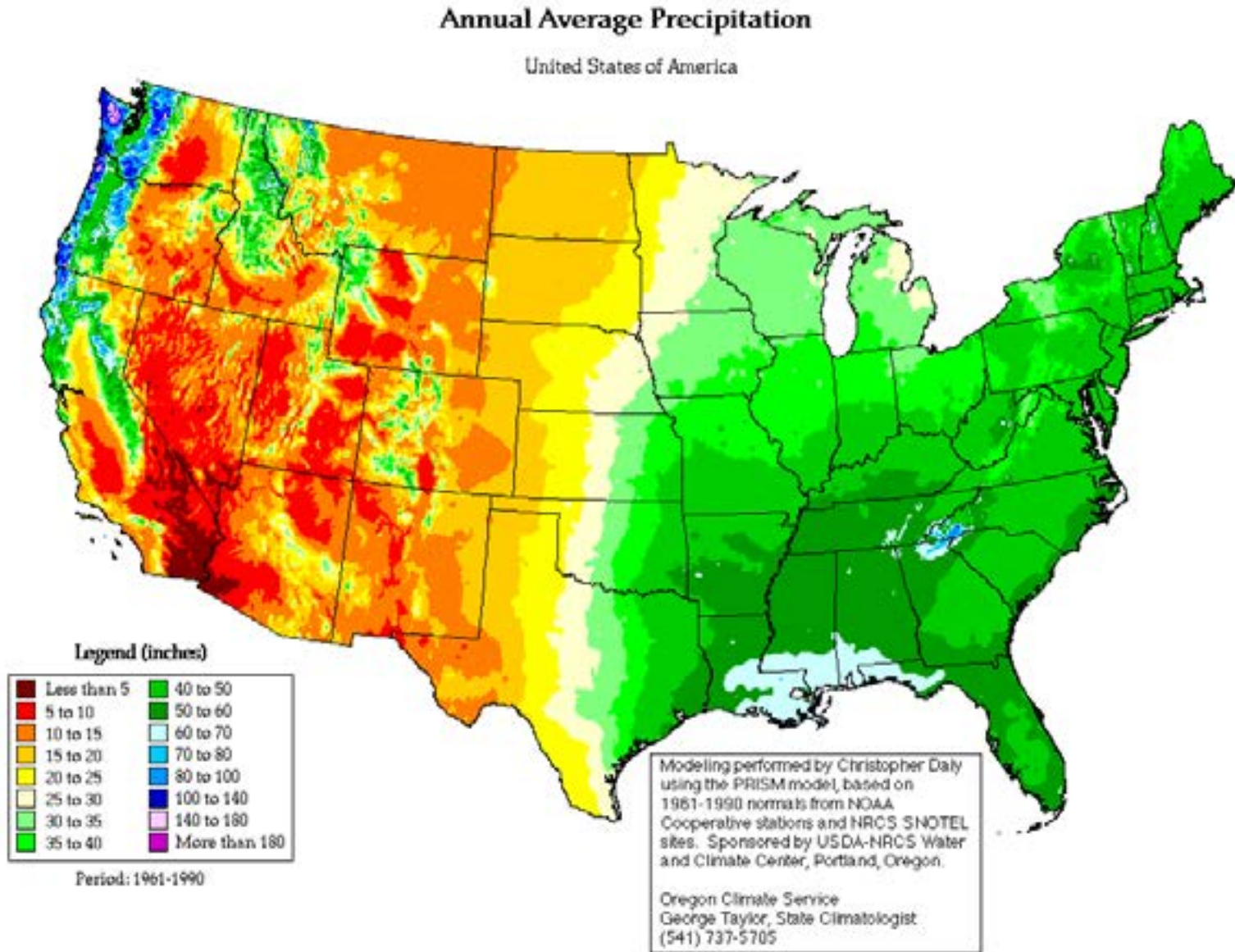
Livermore, CA



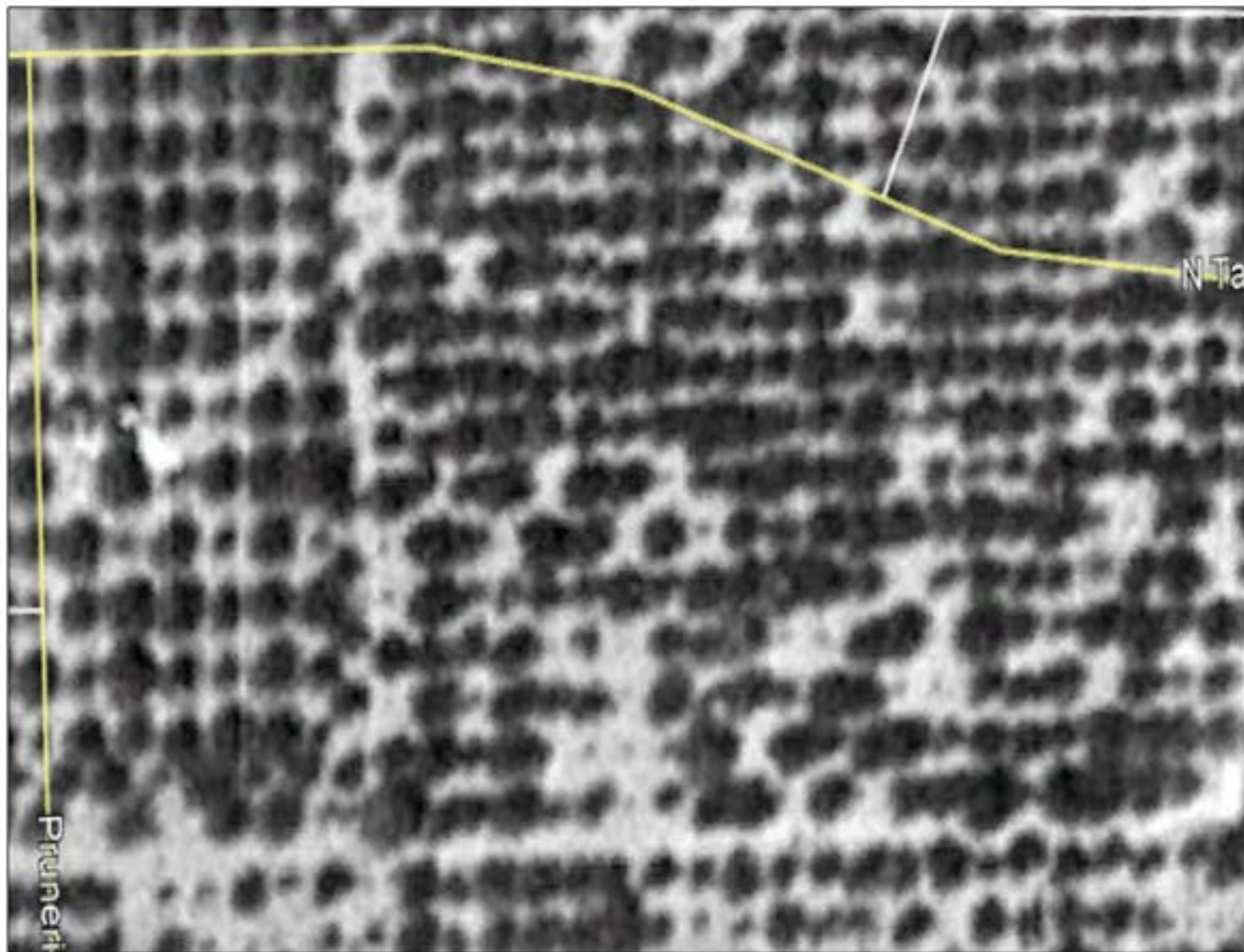
Average Annual Precipitation

380 mm

Environmental conditions make a big difference



1948



Sometime in the 1980's



April 2016



November 2016



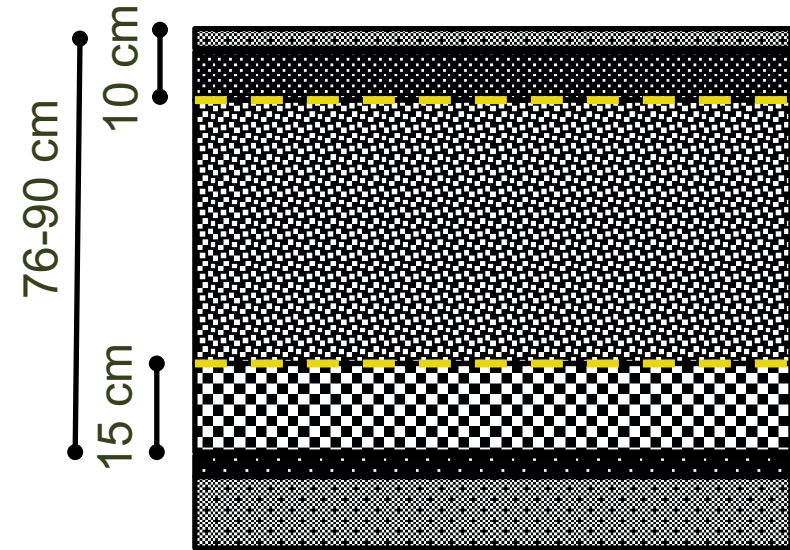
April 2017



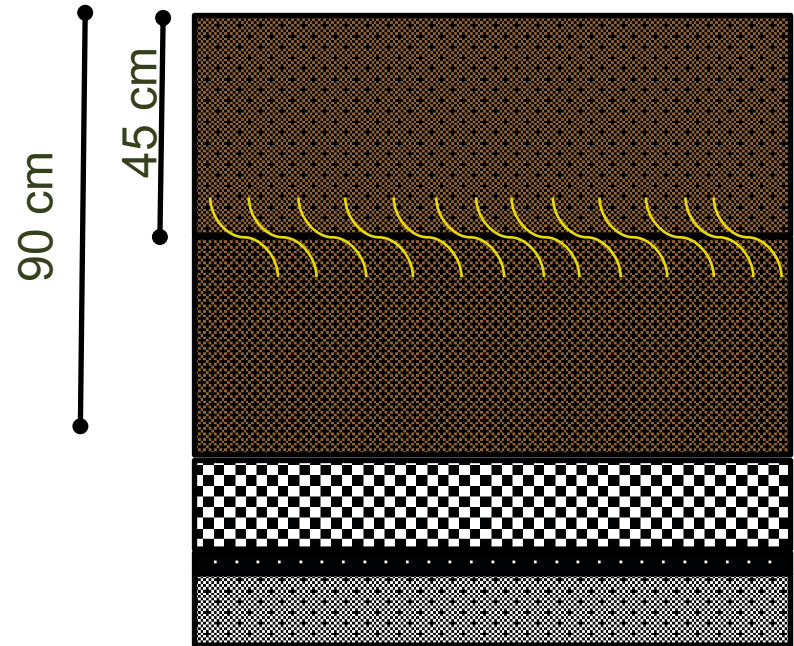
Soil Formation – Urban Style

1. Imported “top soil”
over compacted site
soil
2. Imported “top soil”
over structure
3. CU-Structural soil over
compacted site soil
4. CU-Structural soil over
structure
5. Bioretention soil

Soil Profile -- Urban Style



Structural soil
over structure



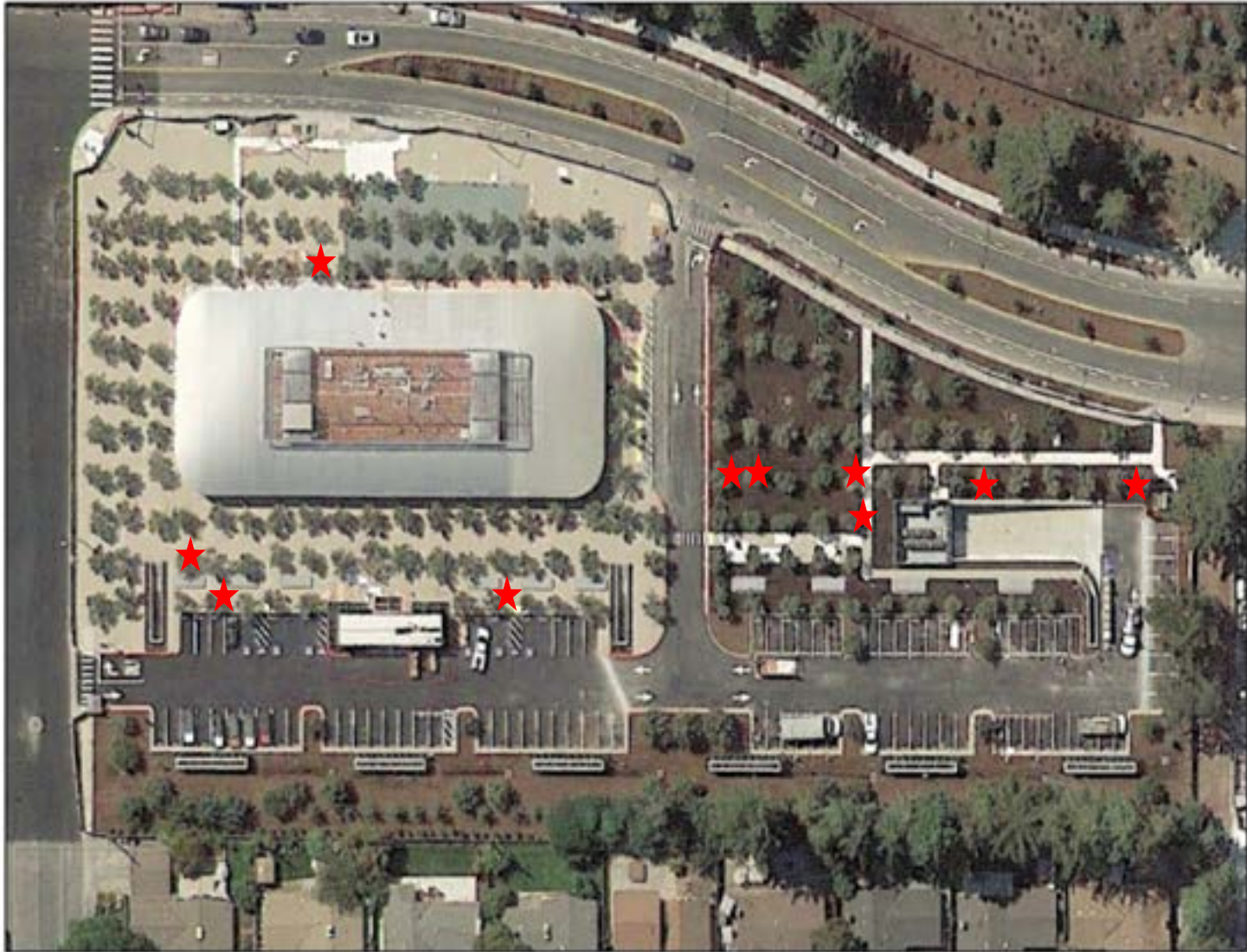
Planting over structure

September 2017





Tree replacement July - November



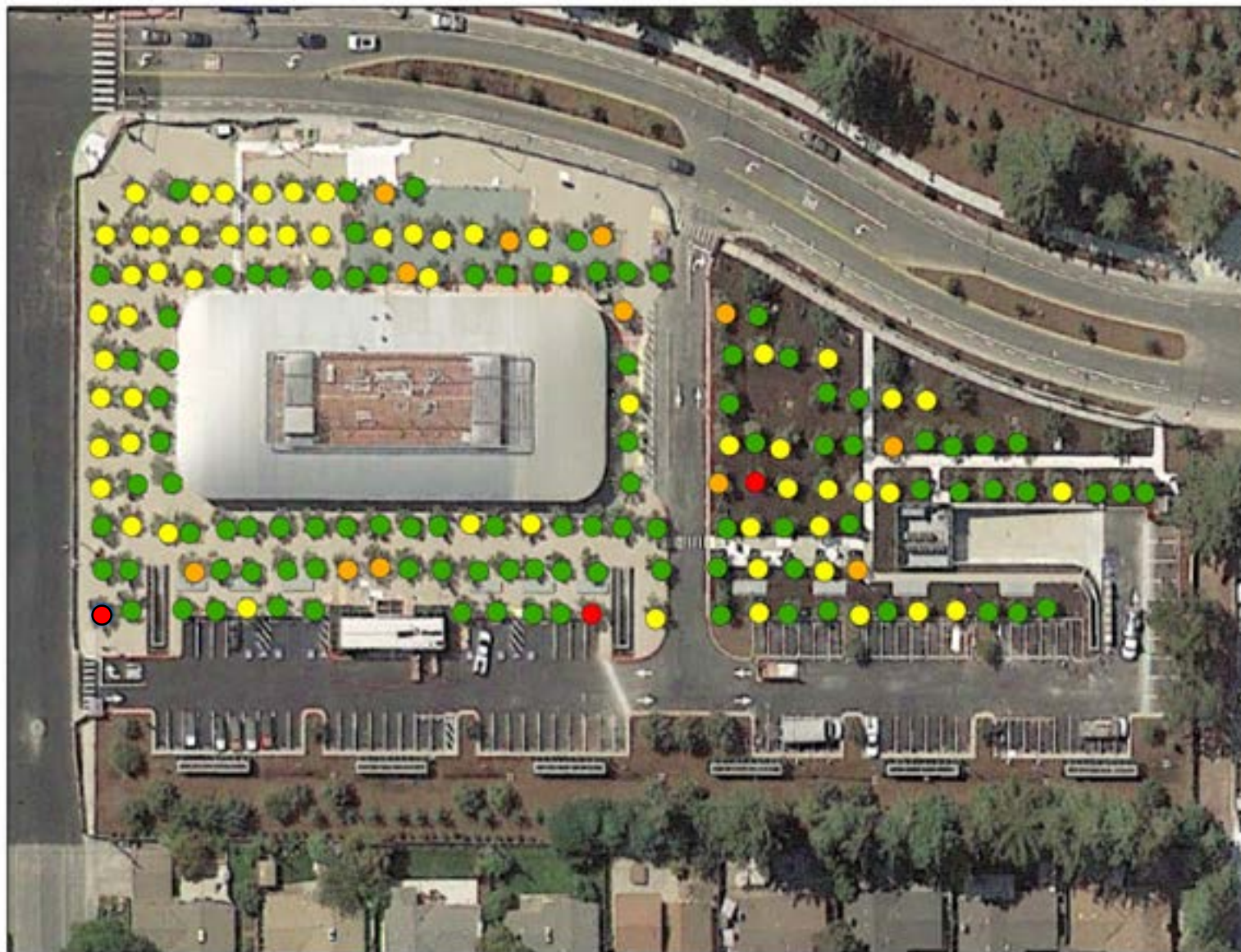
November 2017

August 2018



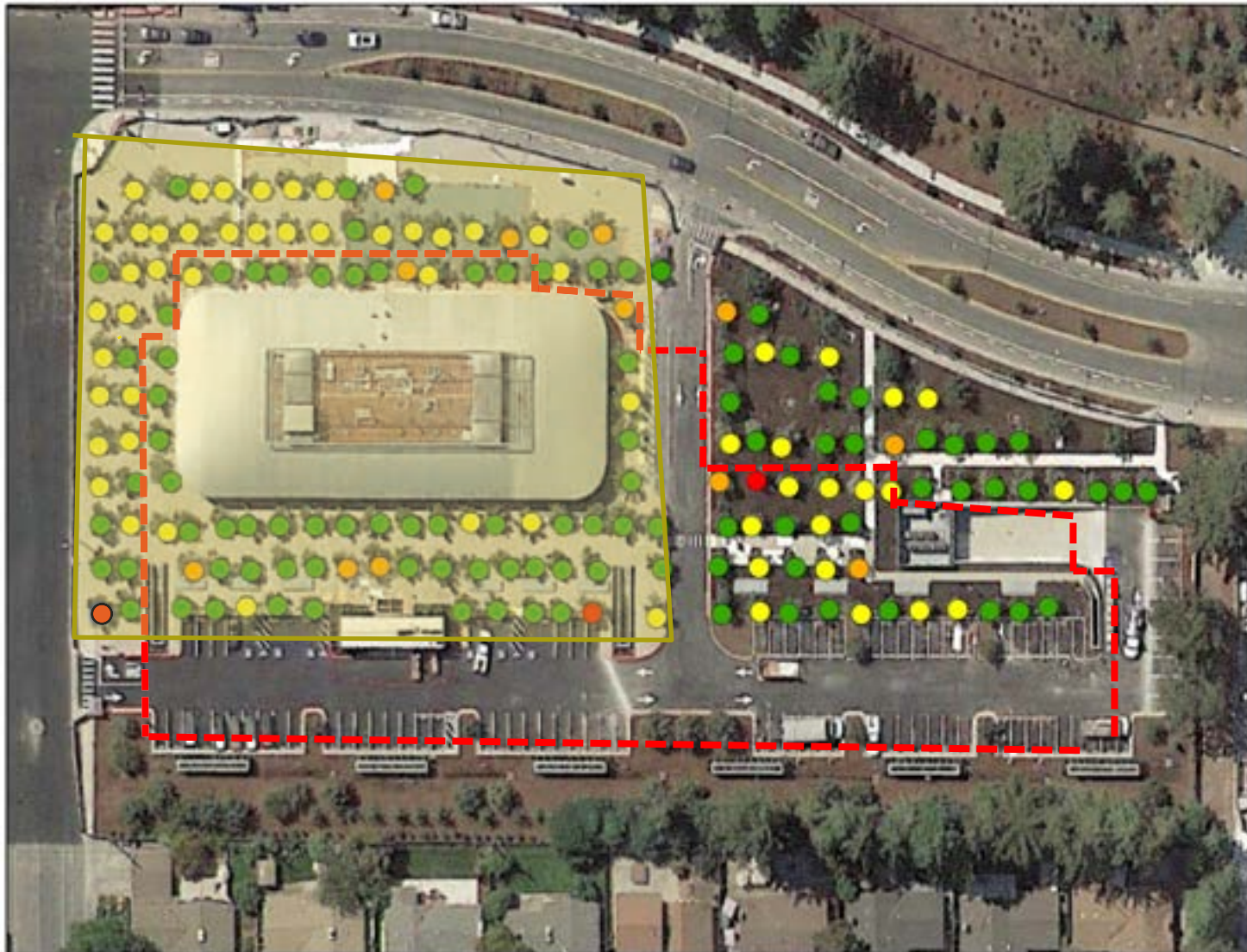
Olive tree condition

N →



- Good
- Fair
- Poor

Olive tree condition



- Good
- Fair
- Poor

A closer look at 4 trees

Structural
soil over
structure



Structural
soil over
compacted
soil



Imported
“top soil”
over site
soil over
compacted
site soil



Imported
“top soil”
over site
soil over
structure

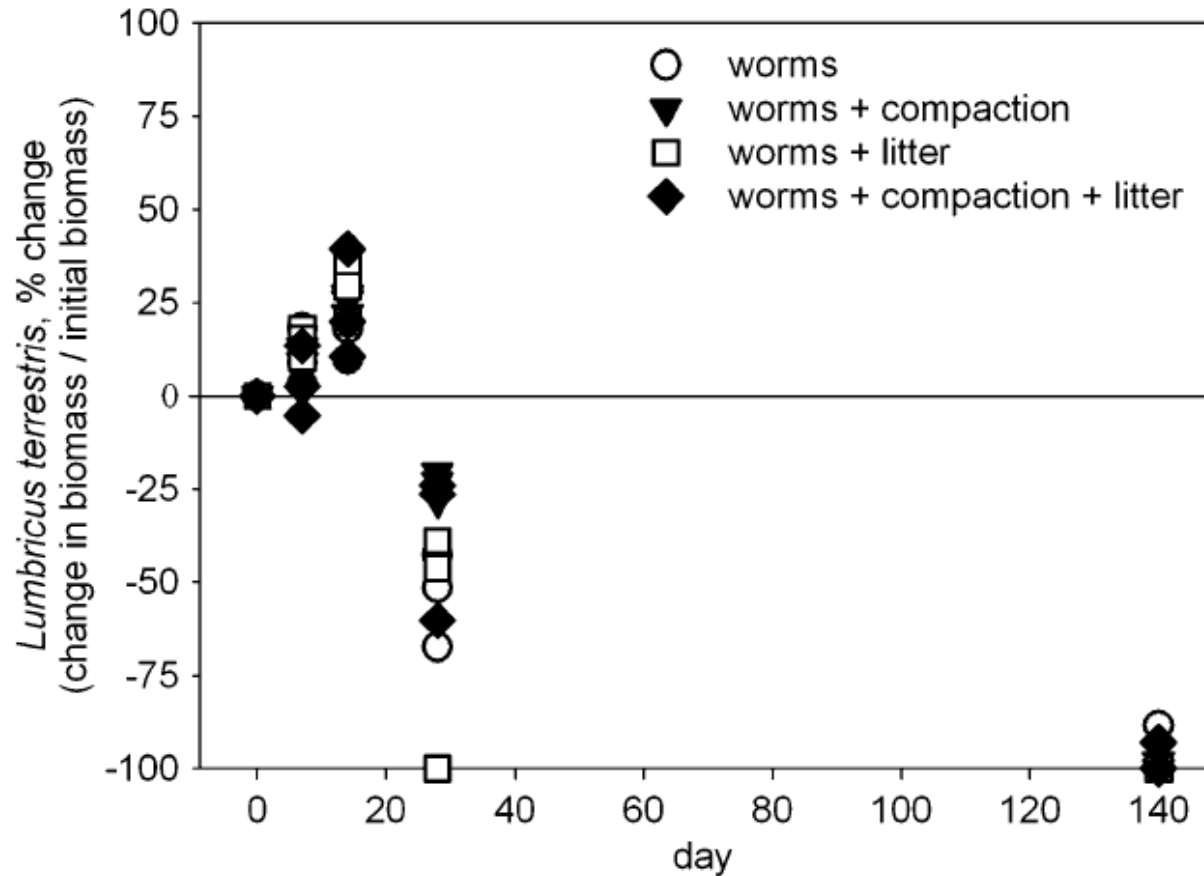
Soil quality – Give me the numbers

pH	4.8	6.9	5.8
OM%	2.2	1.3	2.4



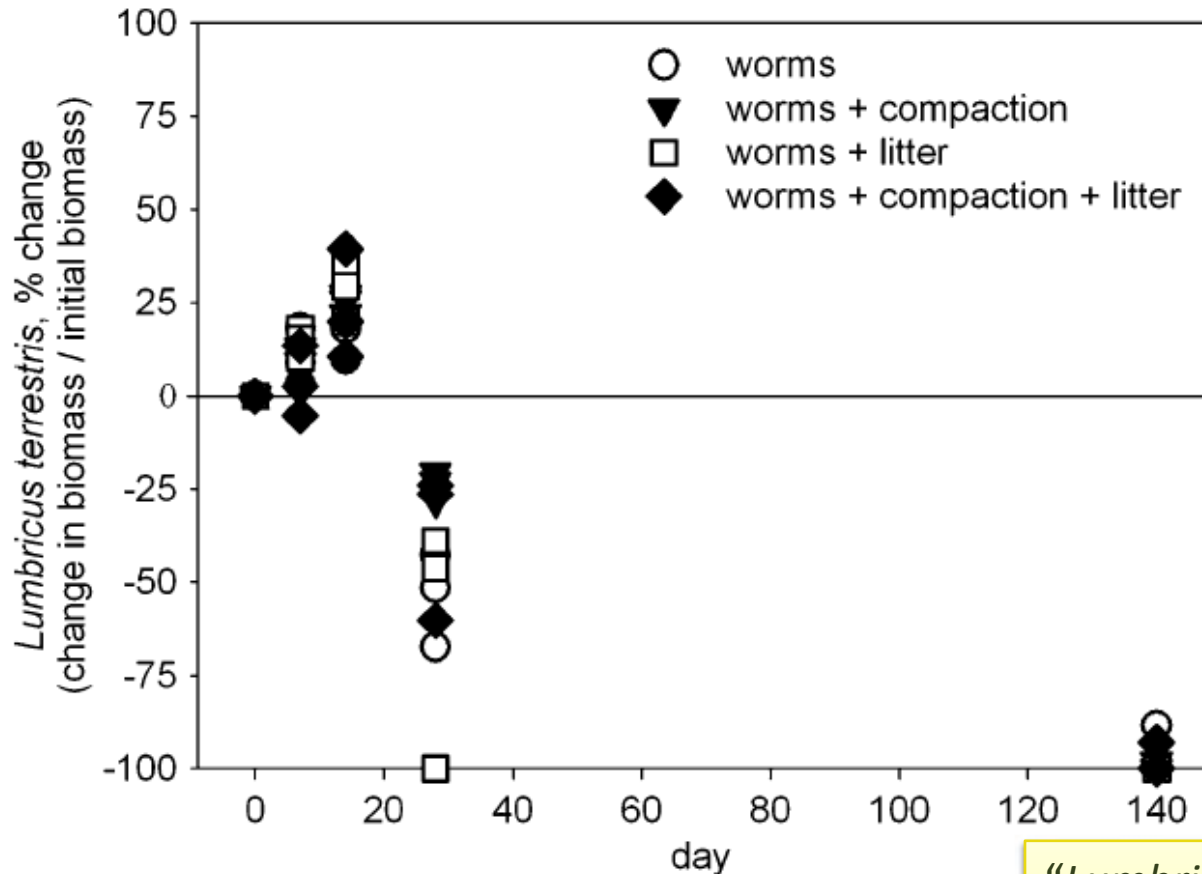
pH	7.7	7.8	8.3
OM%	2.2	1.3	2.2

Biological activity in urban soils



Nigel Cattlin, Science Source

Biological activity in urban soils

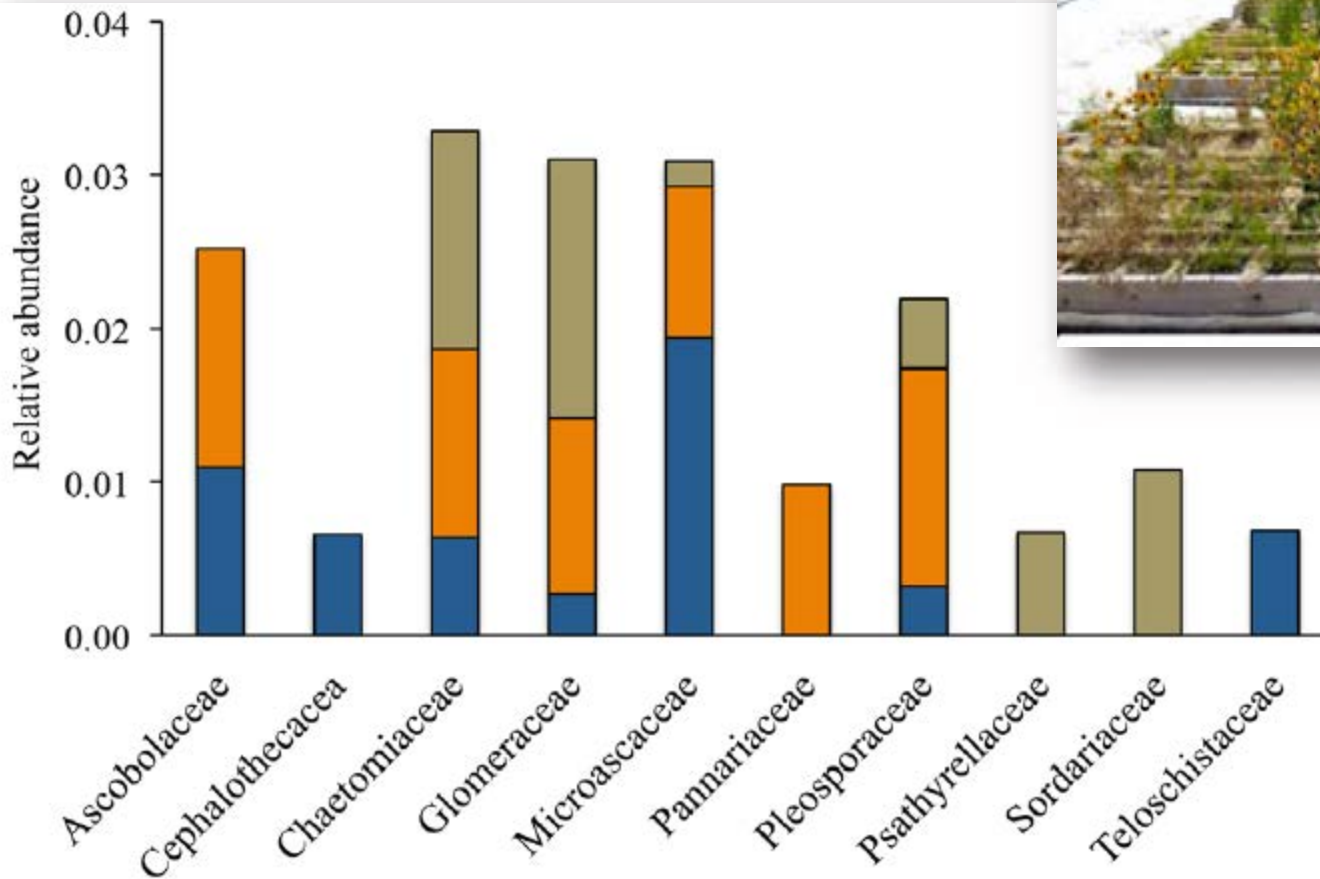


Nigel Cattlin, Science Source

Scharenbroch and Johnston
2011, Urban Ecosystems

"Lumbricus terrestris is not suited for habitation in designed urban soils."
Decline related to physical constraints of CU soil, specifically aggregate abrasion and shallow depth.

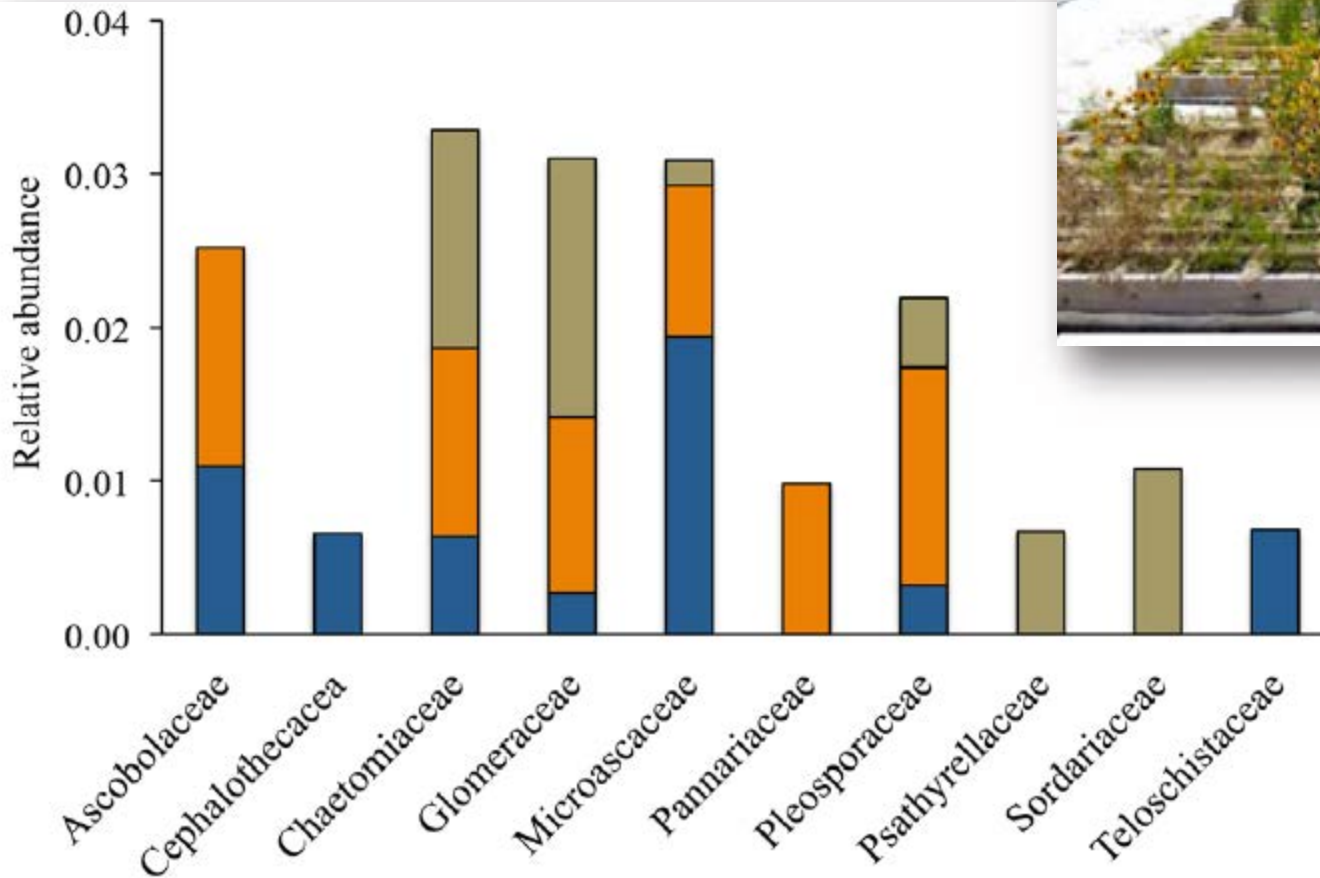
Microbial communities on NYC green roofs



McGuire and others, 2013, Plos One.

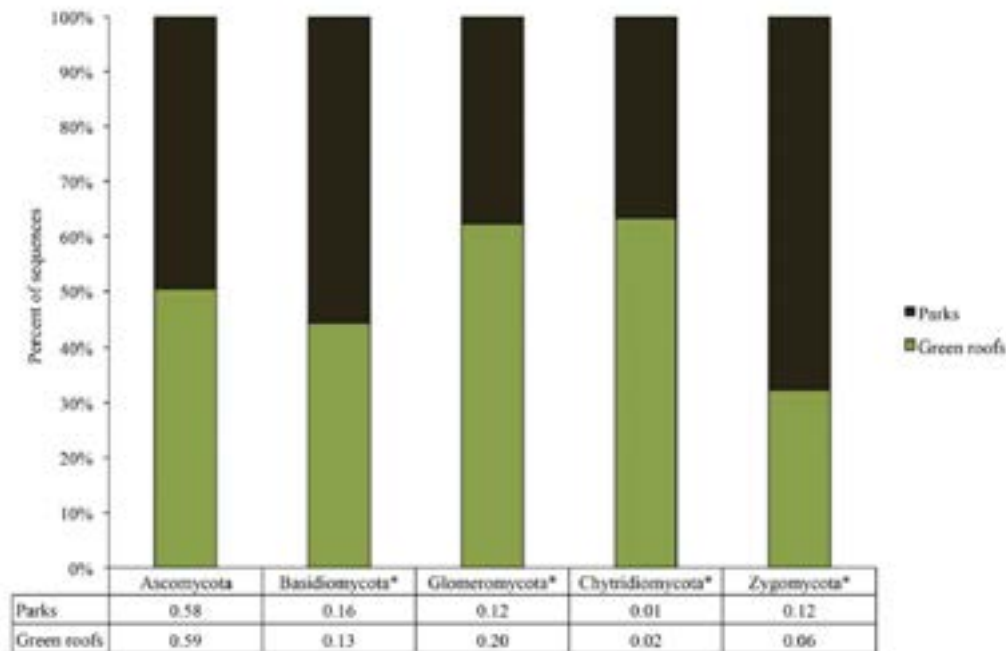
Microbial communities on NYC green roofs

Diverse fungal communities...with taxa capable of surviving in disturbed and polluted habitats.



McGuire and others, 2013, Plos One.

Microbial communities on NYC green roofs

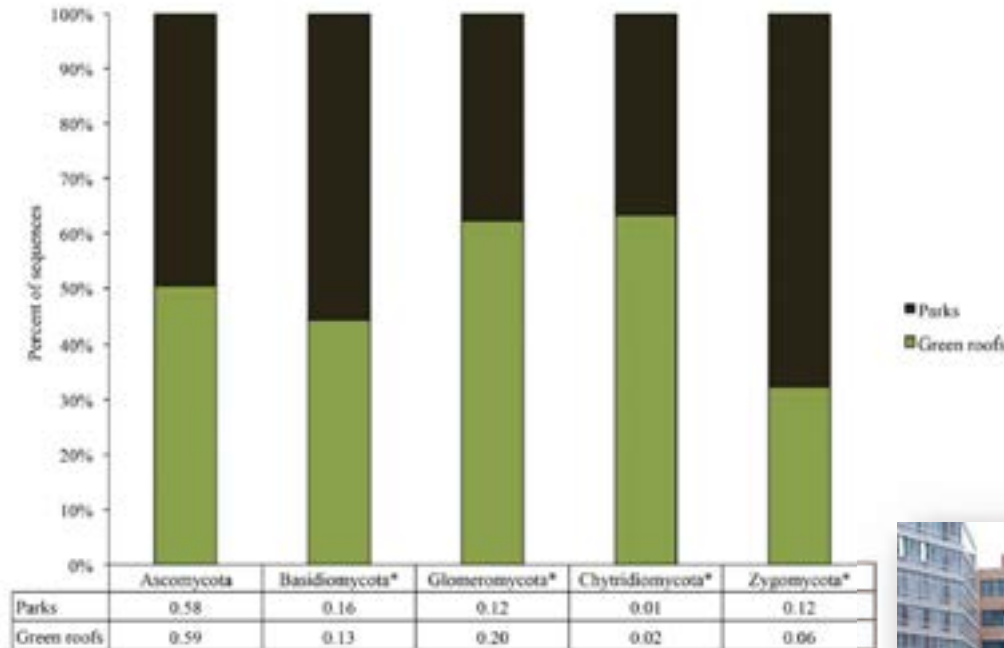


- Only 53% of the green roof taxa were found in nearby city parks.
- Park soils had greater microbial biomass.

Relative abundance of fungal phyla from green roof substrates and city park soils.

McGuire and others,
2013, Plos One.

Microbial communities on NYC green roofs



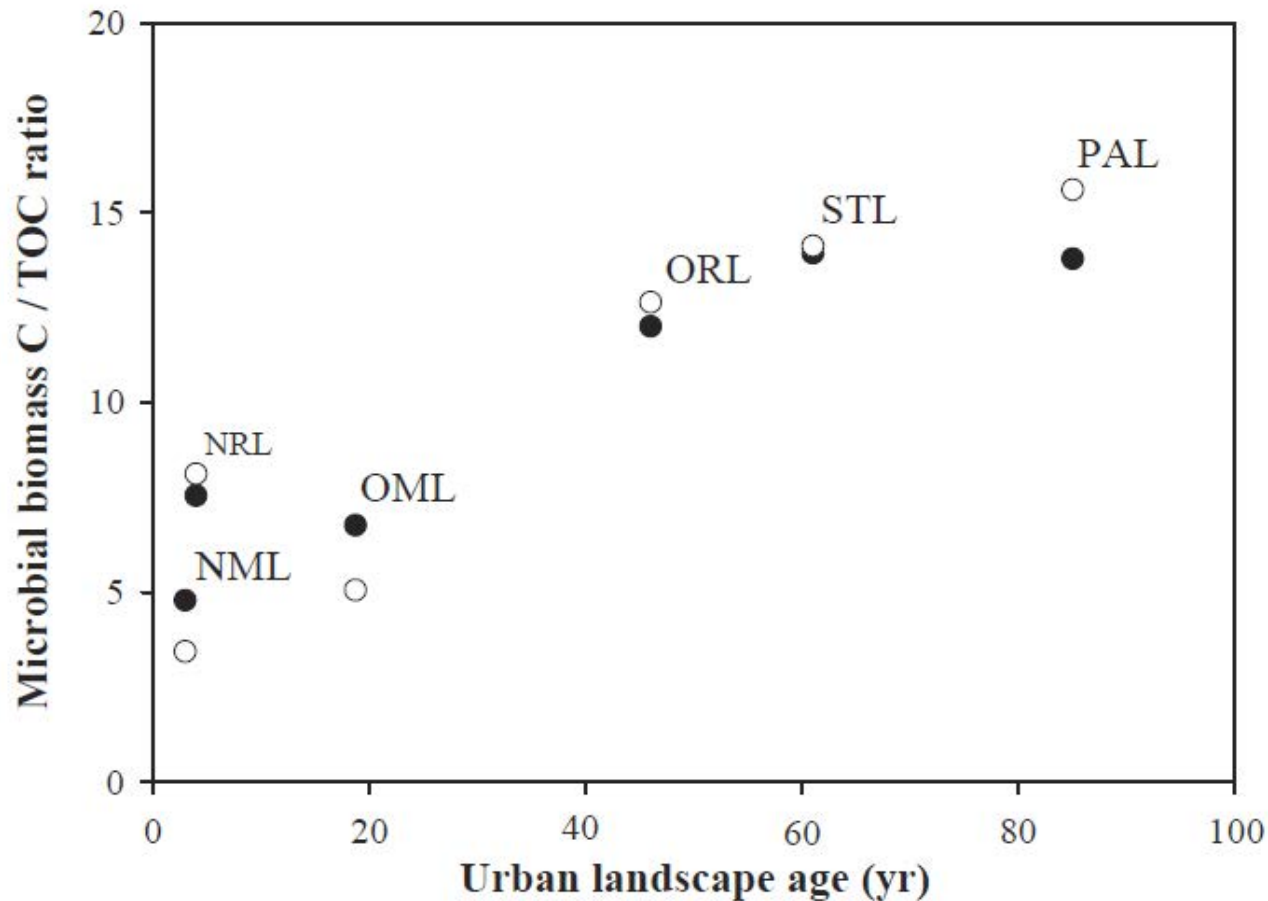
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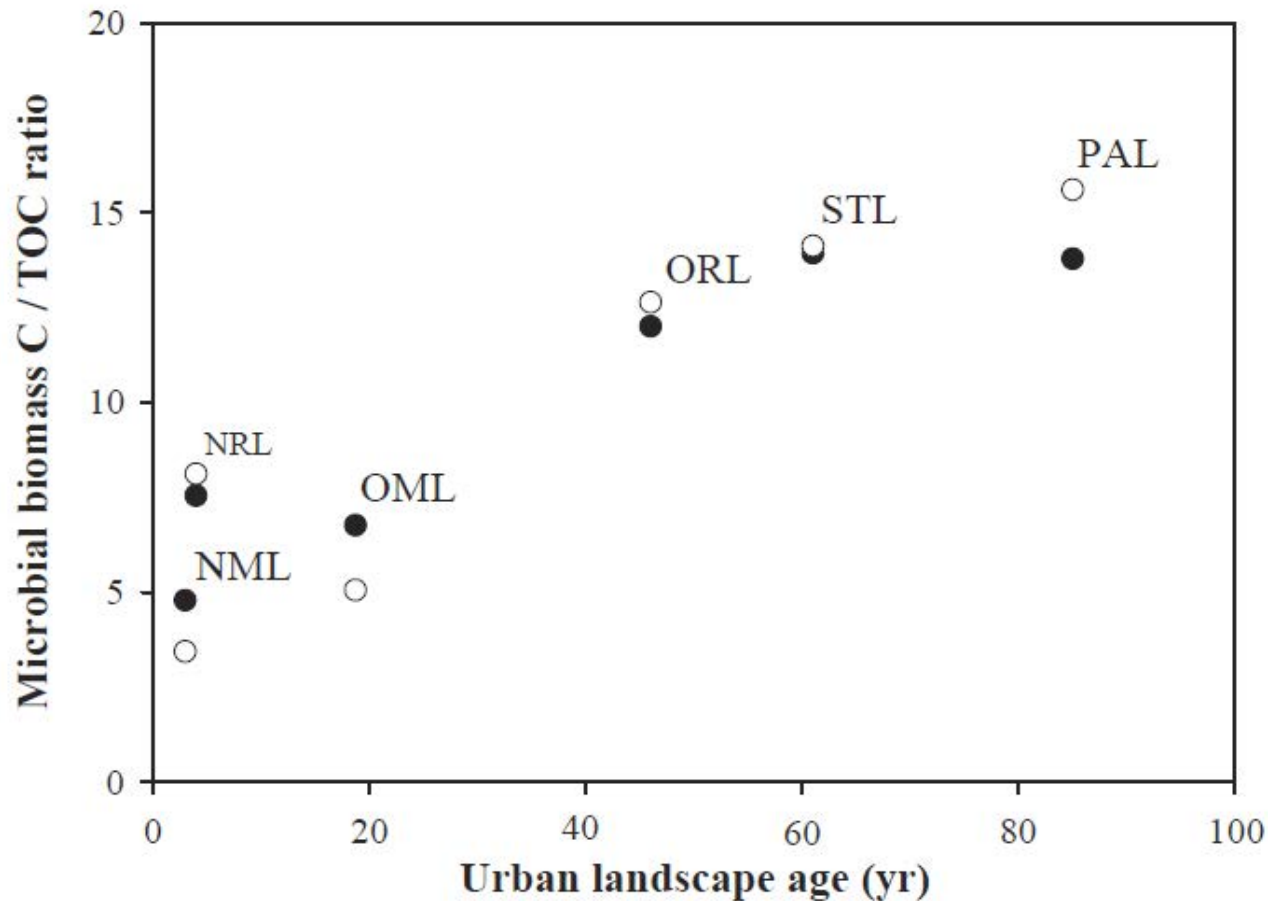
Time is a factor in urban soil formation, too



2002, 2003
Moscow ID, Pullman
WA

PAL Park
STL Street tree
ORL Old residential
OML Old mulch
NRL New residential
NML New mulch

Time is a factor in urban soil formation, too



“Of the soil forming factors, time played the most significant role in soil physical, chemical, and biological differences.”

How do we best manage trees in urban landscapes?



- Right tree
- Space
- Water
- Aeration
- Drainage

How do we best manage trees in urban landscapes?

