Madison needs a Mandatory Soil Volume Standard For Large, Healthy & Mature Street Trees

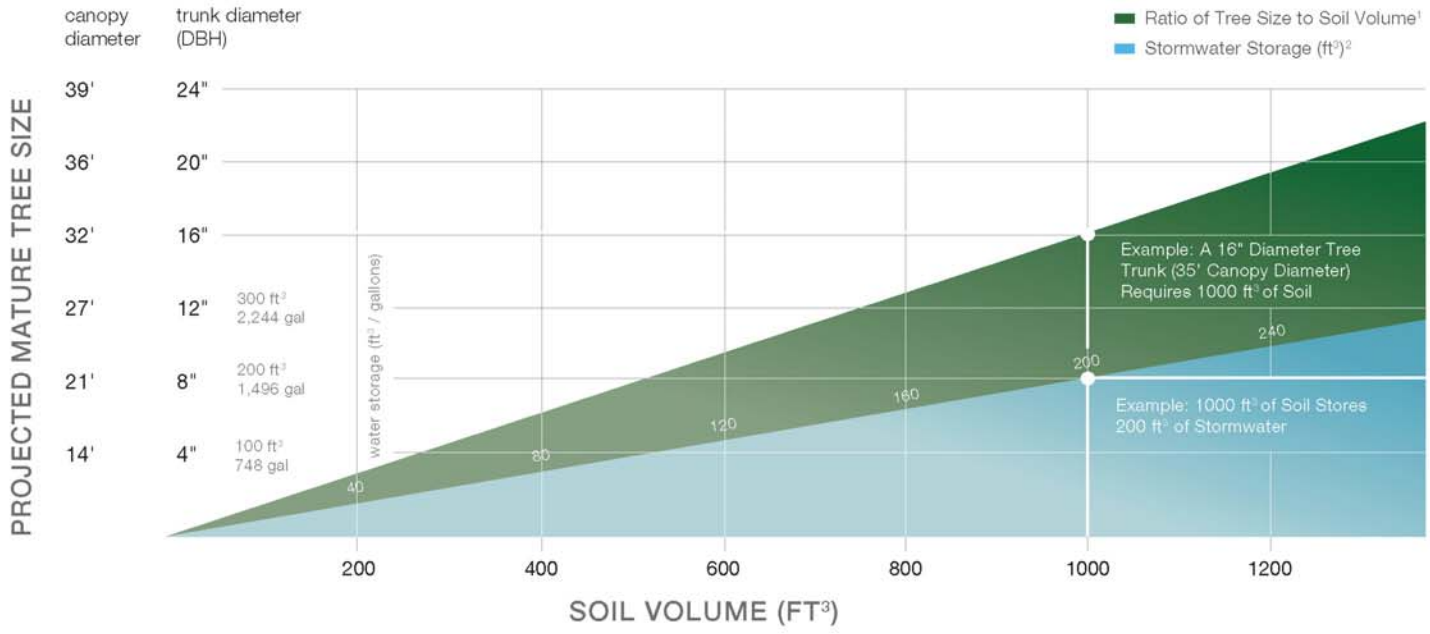
Nearly all of the associated problems result from one underlying cause:
loss of the water-retaining and evapotranspirating functions of the soil and vegetation in the urban landscape.*

Tree Development Standard**

Development Future	Required Tier 1	Specifications, Definitions, and Resources	Potential Strategies
Urban Forest: Encourage Tree Growth Enhance the urban forest	EC 2.1 Plant a minimum of one tree on-site for every 30m2 of post development site area covered by soft landscaping. EC 2.2 Trees in hardscaping (hard landscaping): For 2 or more trees planted in primarily hardscaped areas, provide a minimum of volume of 15m3 of high quality soil per tree. A single tree planted in hardscape requires a minimum volume of 30 m3 of soil. EC 2.3 Trees in softscaping (soft landscaping): Provide trees planted in softscaping with a minimum volume of 30 m3 of high quality soil. EC 2.4 Provide a watering program for trees for the	1. Soft landscaping should contain well drained, uncompacted, permeable growing medium, with a minimum depth of 50cm, that can support plants and trees and that may be covered by planted ground cover. It may also be covered by decorative stones on an uncompacted sub surface. Soft landscaping does not include decorative stonework, retaining walls, walkways, or similar landscape architectural elements over a compacted surface. 2. Areas dedicated for playing fields and sustainable local food production are exempt from the calculation of softscape area 3. The soil volumes of 15 m3 and 30 m3 respectively, should be based on a soil depth of a minimum of 0.8m and a maximum of 1.2m of high quality soil above a well drained sub soil or drainage layer. Ensure that groups of trees planted in hardscape can share soil volume, for example, through the use of continuous soil planters. If trees can share soil, providing at least 15m3 per tree ensures that each tree actually has access to closer to 30m3. The use of soil cells is also encouraged. 4. The soil volume of 30m3 should be based on a soil depth of a minimum of 0.8m and a maximum of 1.2m of high quality soil above a well drained sub soil or drainage layer. The objective for trees in softscaping is to achieve species maturity; a higher soil volume is specified. The lower volume for hardscaped areas recognizes species maturity may not be possible in confined conditions, but still allows reasonable growth. 5. Non-potable water for the tree watering program is preferred.	Soil cells Continuous soil Planters Rainwater harvesting irrigation system DeepRoot®

*** Toronto Green Development Standard*

HOW MUCH SOIL TO GROW A BIG TREE?



RATIO OF TREE SIZE TO SOIL VOLUME

Soil volumes depicted in this chart is based on the amount of roots loam soil can support with optimum compaction for root growth.

Several studies[3,4,5] have calculated a relationship between tree growth and soil volume. Below is an example from one such study, and its soil volume methodology.[6]

Crown projection (drip line area)
x Leaf area index
x Evaporation rate
x Evaporation ratio
= Volume of water used by tree daily (water loss)

Water loss
x Percent water holding capacity of soil
= Volume of soil (to hold water used by the tree)

Volume of Soil
x Rainfall frequency (estimated number of days between rain events)
= Volume of soil (to meet demands of the tree for a certain period of time)

This soil volume methodology indicates that every 1 ft³ to 3 ft³ of soil results in 1 ft² of projected tree canopy diameter. Field observations indicate that trees that share soil may need less soil volume per tree. For example, 25-year old street trees sharing soil in Charlotte, North Carolina, with 700 ft³ of soil per tree have grown an average of 16" DBH (diameter at breast height) and have a 98% survival rate. 25-year old trees sharing soil in Bethesda, Maryland with 600 ft³ soil per tree have grown 14"- 20" DBH and continue to flourish.

STORMWATER STORAGE

The line on the graph is based on 20% soil water holding capacity in a bioretention soil mix. This is a conservative estimate based on bioretention research[7] and soil water properties.[8]

Total soil porosity
- Field capacity of soil
= Available water storage within soil

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4. Perry, T.O. (1988) Conditions for plant growth. Proc Fourth Urban Forest Conference. St. Louis, Missouri.
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7. Breen, R.A., Hunt, W.F., & Kennedy, S. G. (2008) Urban Waterways Series: Designing Bioretention with an Internal Water Storage Layer. North Carolina Cooperative Extension.
8. Rawls, W., Brakensiek, D., & Saxton, K. (1982). Estimation of Soil Water Properties. Transactions of the American Society of Agricultural Engineers. Vol. 25, No. 5, pp. 1316-1320, 1328.

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