The Urban Forest as Green Infrastructure

nature based solutions for resilient cities

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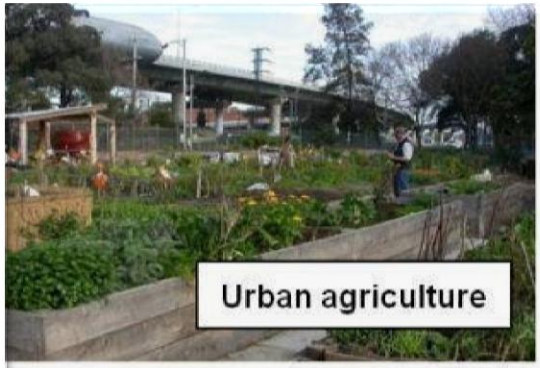
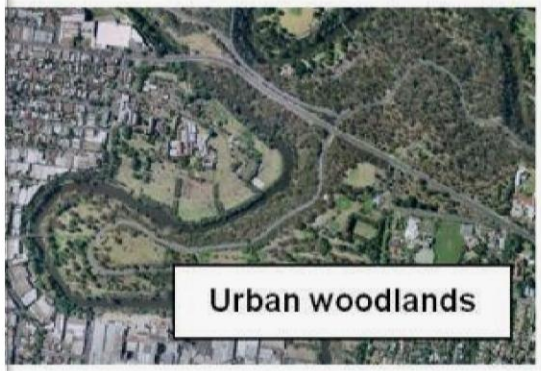
Urban green infrastructure





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Trees as Green Infrastructure

- Cost effective alternative/supplement to gray infrastructure
- Trees provide natural stormwater management
- Brings ecological services back into the city
- Trees remove pollutants from the air
- Improves resiliency, attracts investment and increases property values
- Trees cool the surrounding environment

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CITY OF CHESTER

JUNE 2017

DELAWARE VALLEY dvrpc REGIONAL PLANNING COMMISSION

GREEN STORMWATER INFRASTRUCTURE PLAN

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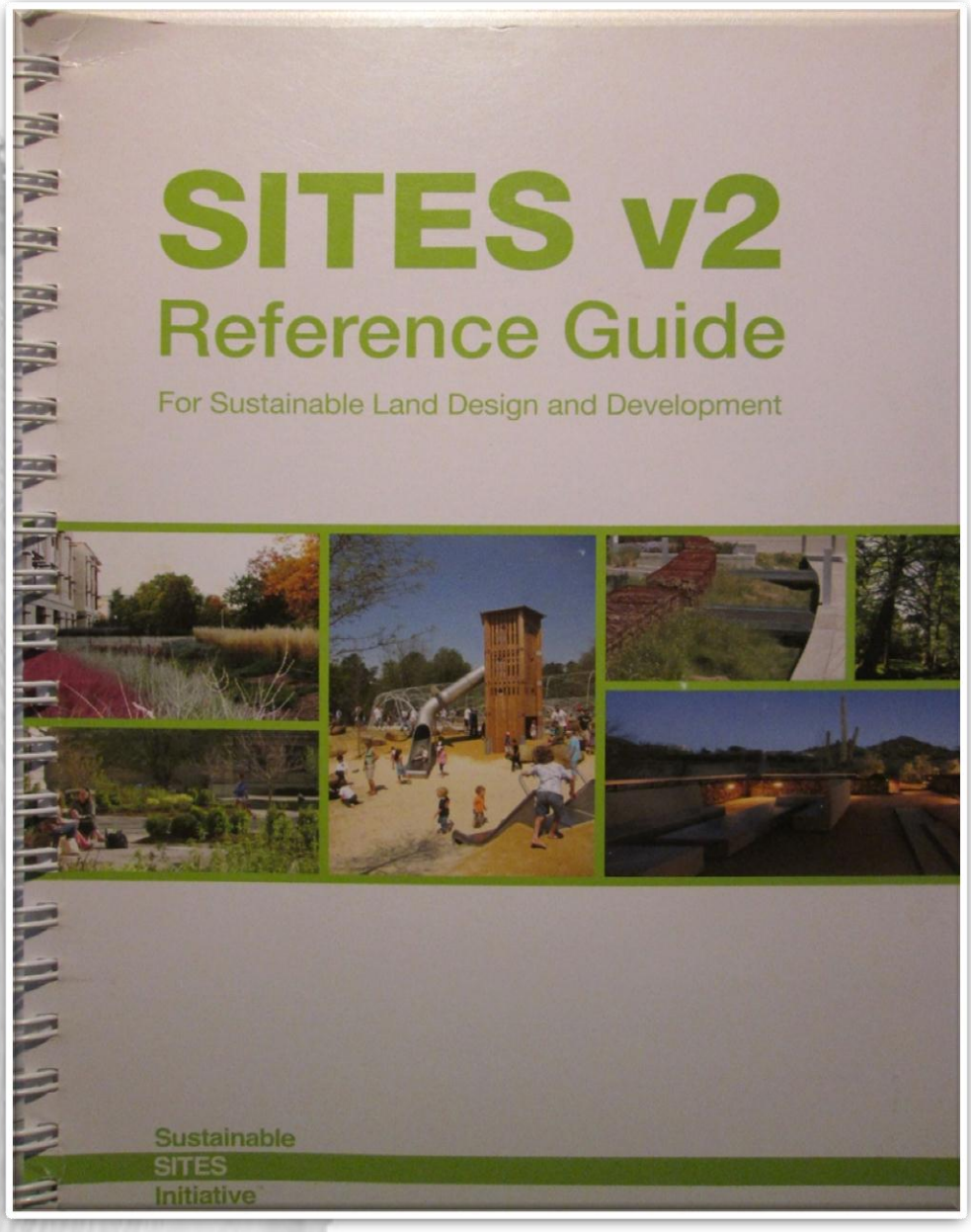

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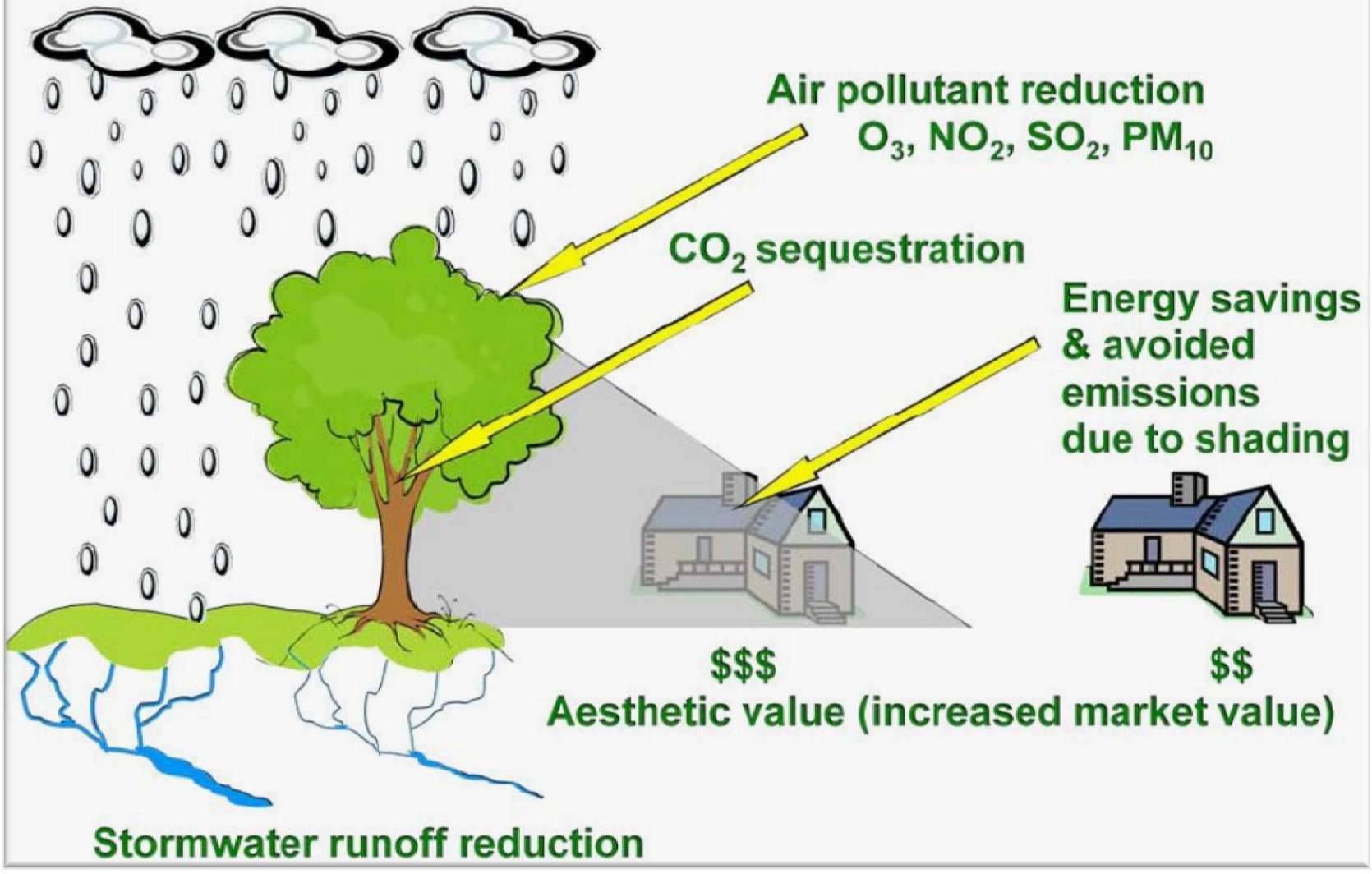
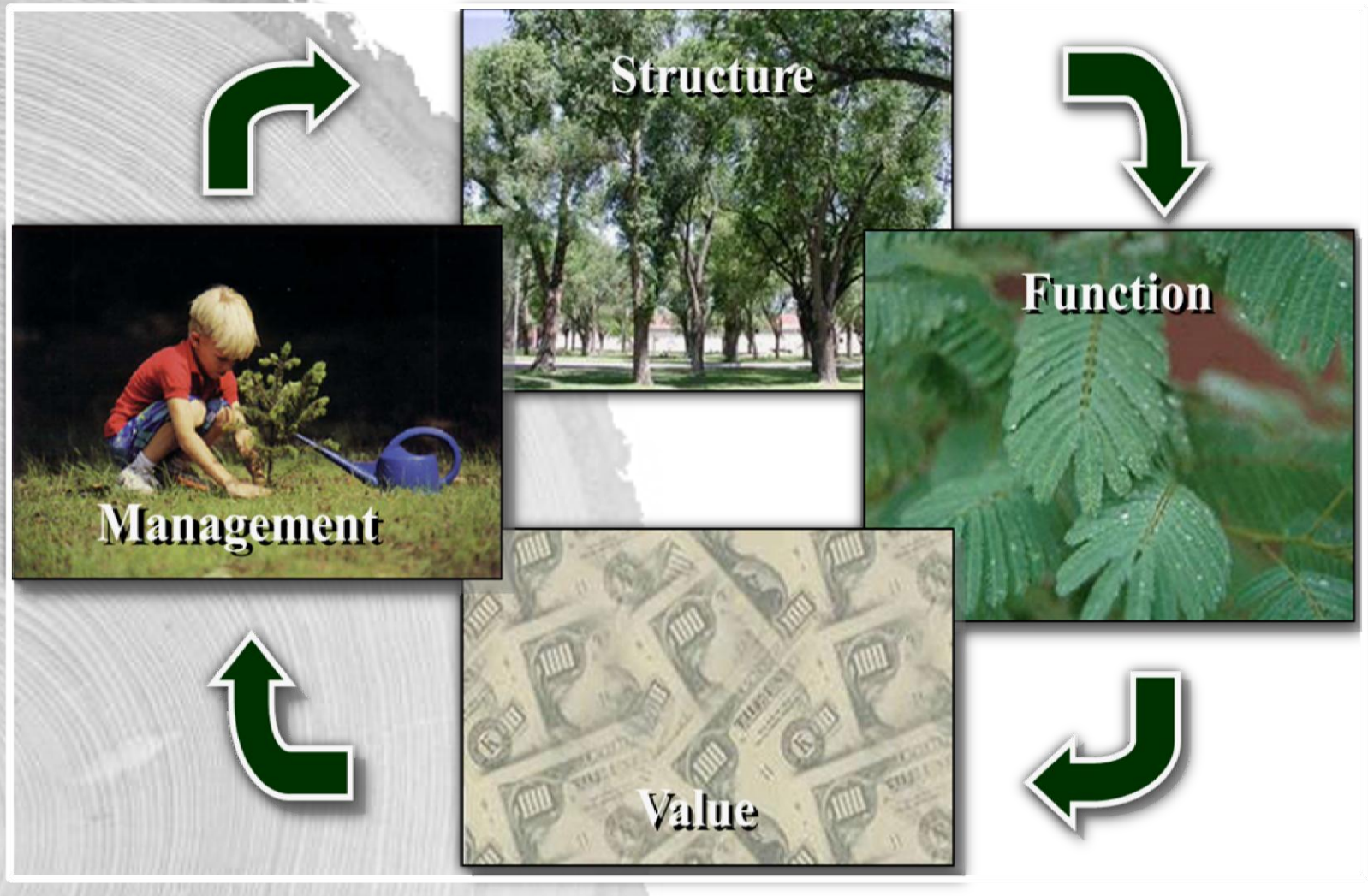
Ecosystem services provided by urban trees





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i-Tree: Putting US Forest Service science into the hands of users.

- Benefits-based approach
- Based on peer-reviewed research
- Technical support provided
- Continuously improved
- A 12 year collaborative effort
- 184,000 users globally

www.itreetools.org

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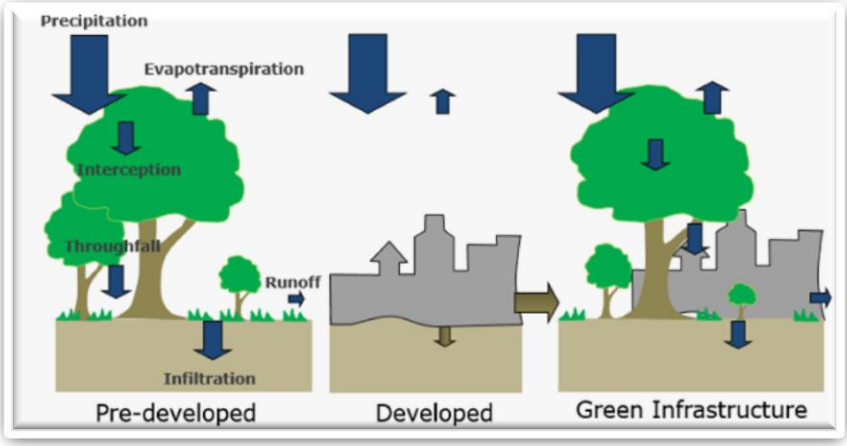
Geared to showing the benefits provided by trees:

- Carbon Dioxide storage and sequestration
- Air Pollution removal
- Storm Water management

Depending on the i-Tree application, up to six hydrologic variables may be estimated:

1. Potential Evaporation
2. Potential Evapotranspiration
3. Evaporation
4. Transpiration
5. Precipitation Interception
6. Avoided Runoff



Estimations are highly dependent on the leaf area of various species.

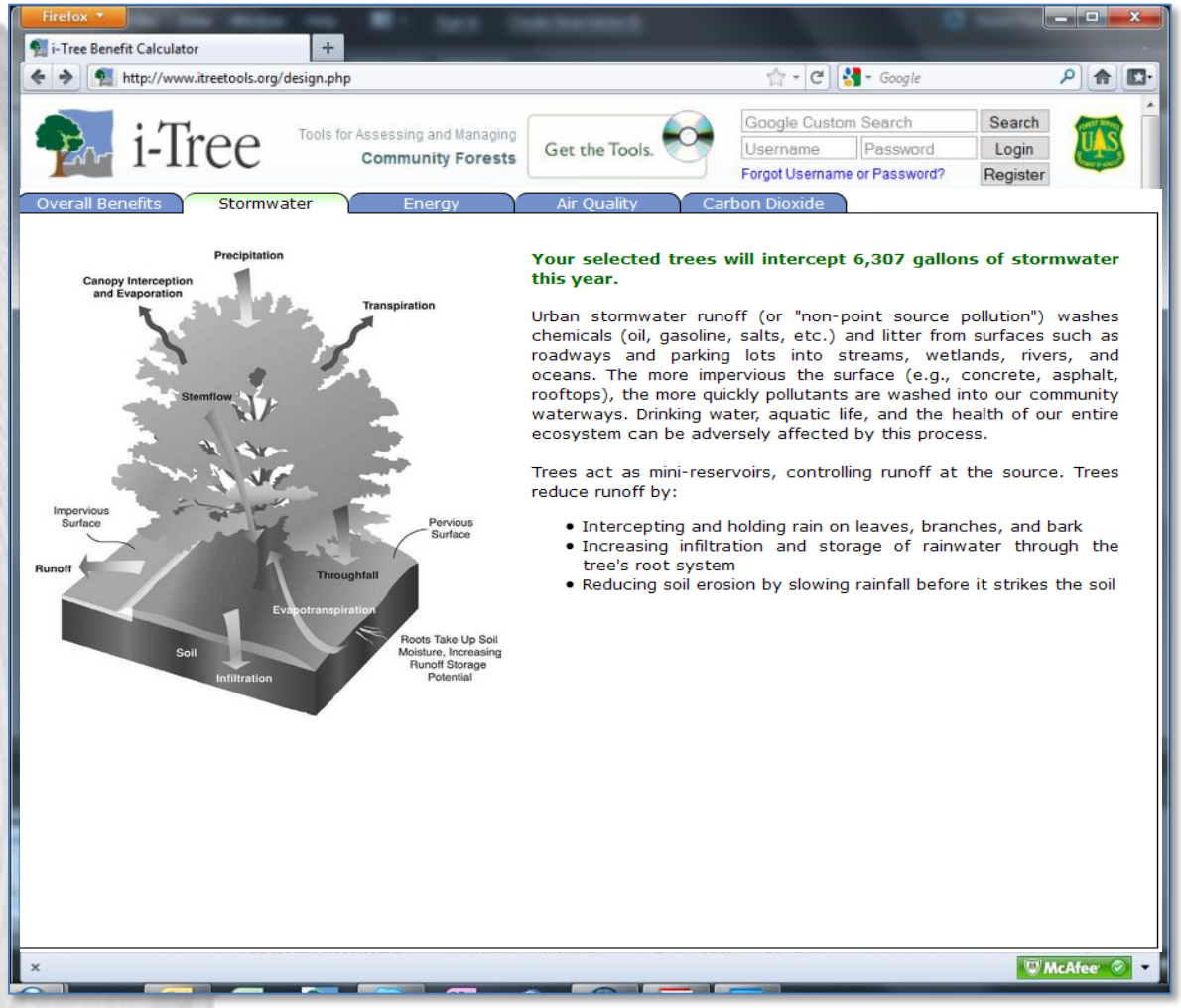
i-Tree Design

design.itreetools.org

Web application
(any web browser)

Homeowner /
Parcel level tool.

Easy to use.



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i-Tree Design v6.0

Tree Benefit Report - 05/07/2018
3560 Stapp Dr, Tucker, GA 30084, USA
Trees Evaluated: 1

Total Projected Benefits (2018-2038) - Over the next 20 years, based on forecasted tree growth, i-Tree Design projects total benefits worth $1,026:

- $826 of stormwater runoff savings by intercepting 83,476 gallons of rainfall
- $19 of air quality improvement savings by absorbing and intercepting pollutants such as ozone, sulfur dioxide, nitrogen dioxide, and particulate matter; reducing energy production needs; and lowering air temperature
- $180 of savings by reducing 10,203 lbs. of atmospheric carbon dioxide through CO_2 sequestration and decreased energy production needs and emissions

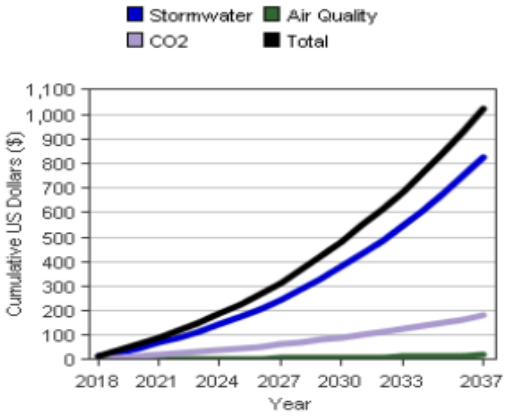

Figure 1. Tree benefit forecast for 20 years

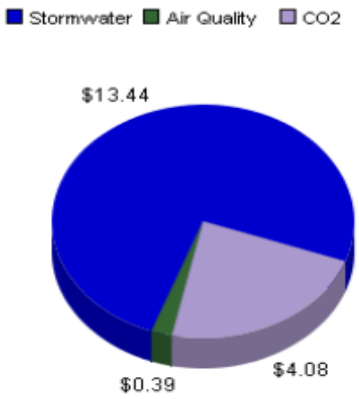

Figure 2. Annual tree benefits for 2018

Current Year - For 2018, i-Tree Design estimates annual tree benefits of $17.91:

- $13.44 of stormwater runoff savings by intercepting 1,358 gallons of rainfall
- $0.39 of air quality improvement savings
- $4.08 of carbon dioxide reduction savings

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Individual Tree Benefits

Tree	DBH (in)	Condition	Location to Structure	Benefits			
				Current Year (2018)	Future Year (2038)	Projected Total (2018-2038)	Total to Date
1. Loblolly pine	10	Excellent	N/A	$13.46	$89.51	$860	$56
2. Loblolly pine	10	Excellent	N/A	$13.46	$89.51	$860	$56
3. Loblolly pine	10	Excellent	N/A	$13.46	$89.51	$860	$56
4. Loblolly pine	10	Excellent	N/A	$13.46	$89.51	$860	$56
5. Loblolly pine	10	Excellent	N/A	$13.46	$89.51	$860	$56
Total				**$67.30**	**$447.55**	**$4,302**	**$279**

Individual Tree Benefits

Tree	DBH (in)	Condition	Location to Structure	Benefits			
				Current Year (2018)	Future Year (2038)	Projected Total (2018-2038)	Total to Date
1. Willow oak	10	Excellent	N/A	$17.91	$98.42	$1,026	$74
2. Willow oak	10	Excellent	N/A	$17.91	$98.42	$1,026	$74
3. Willow oak	10	Excellent	N/A	$17.91	$98.42	$1,026	$74
4. Willow oak	10	Excellent	N/A	$17.91	$98.42	$1,026	$74
5. Willow oak	10	Excellent	N/A	$17.91	$98.42	$1,026	$74
Total				**$89.55**	**$492.10**	**$5,129**	**$372**

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For Example,
The Urban Forest in United States Cities :

- *Annually, sequesters an estimated $460 million in Carbon*
- *Annually, removes pollutants with this ecological service valued at $3.8 billion*

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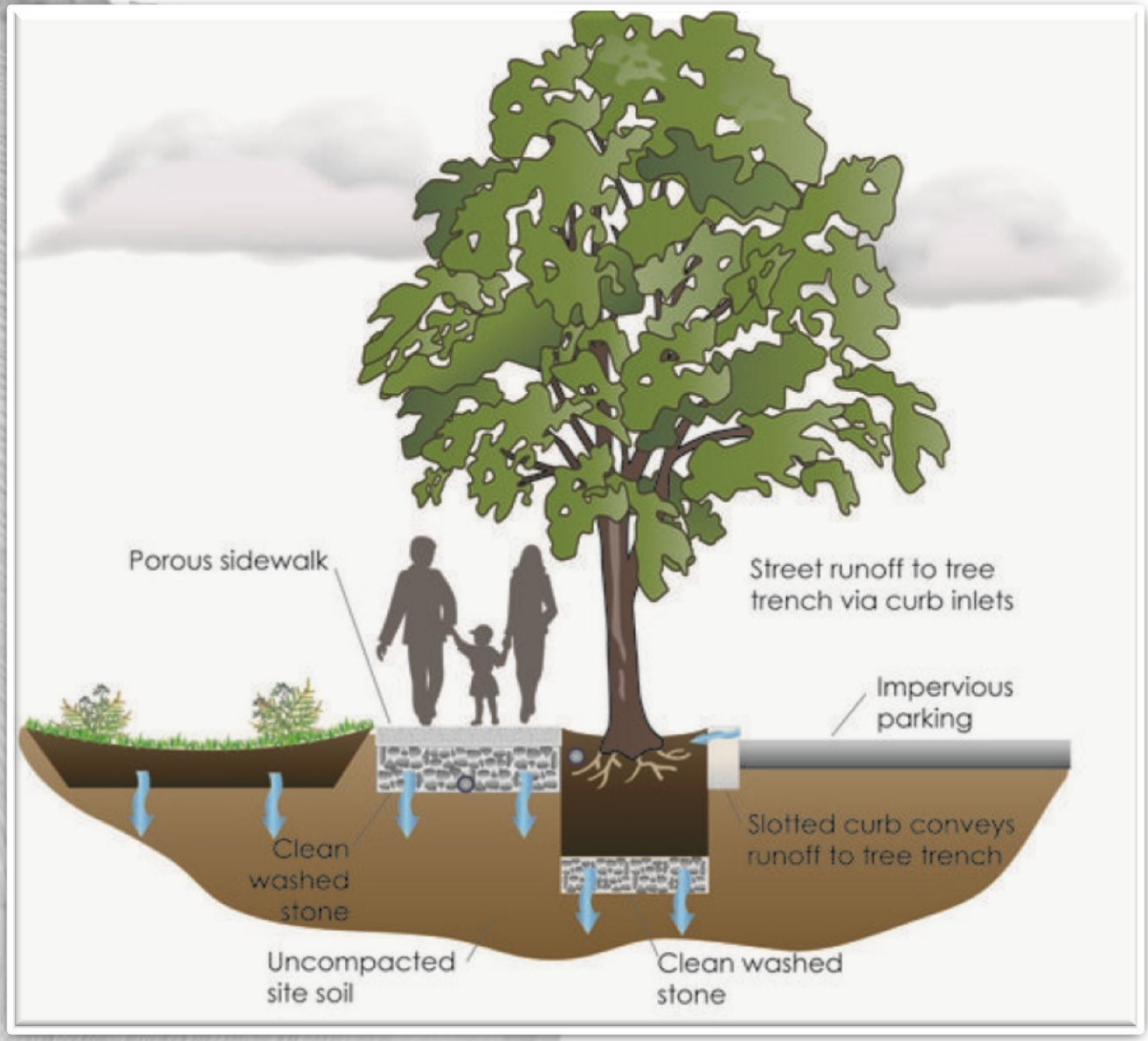

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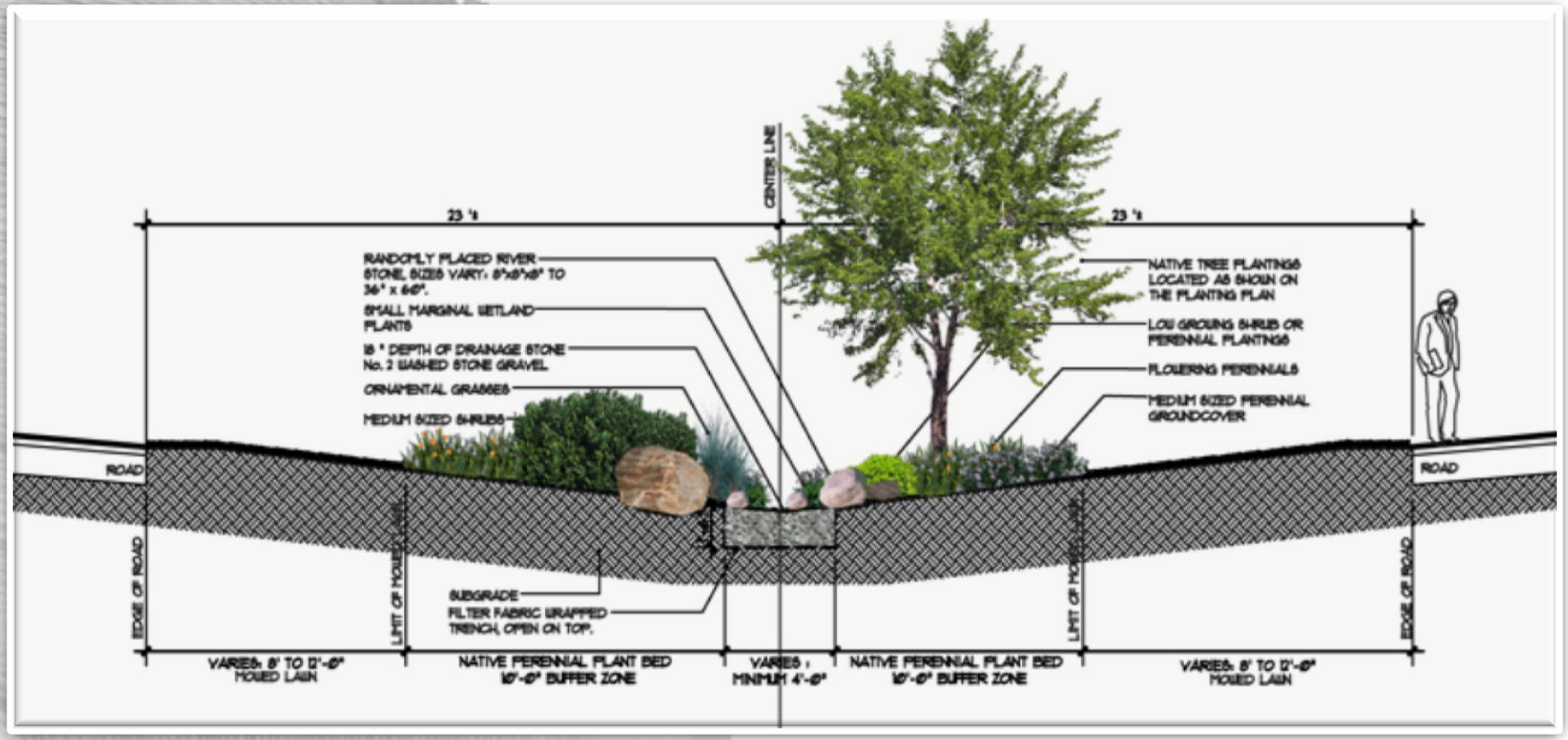

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Nationally, urban forests are declining, with approximately four million city trees being lost annually

Concurrently, the average city gains approximately 2.8% of impervious surface

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"The mortality rate for urban trees is very high, with studies suggesting that 40% to 60% of (newly planted) urban trees die within the first 10 years"

Bryant Scharenbroch
Director, The Morton Arboretum Soil Science Laboratory

Erik Ness, Digital Library News, December 11, 2015

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An estimated 80% of urban tree problems can be attributed to a poor soil environment

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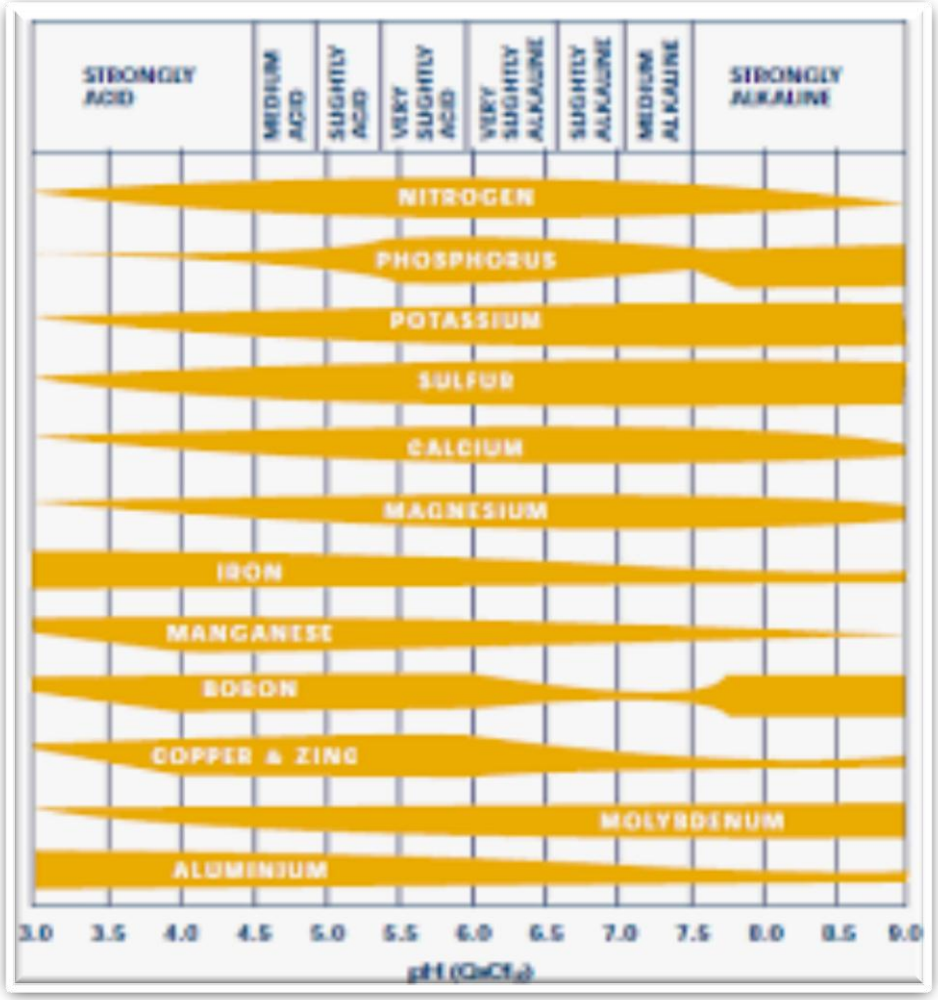
- pH of 6.0 to 7.0 is favorable for most plant growth
- An important effect of pH on tree growth is the availability of essential nutrients
- At certain pH levels, nutrients may be made insoluble
- In alkaline soils iron and manganese may be unavailable
- In acidic soils aluminum will become soluble



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The Anthropocene Era

- The Era of human influence
- Humans as geologic agents, i.e., we can effect millions of years of geologic change in days
- Man as the sixth soil forming factor
- Anthrosols, the 13th soil order
- Presents severe challenges to new tree establishment in these severely modified soil environments

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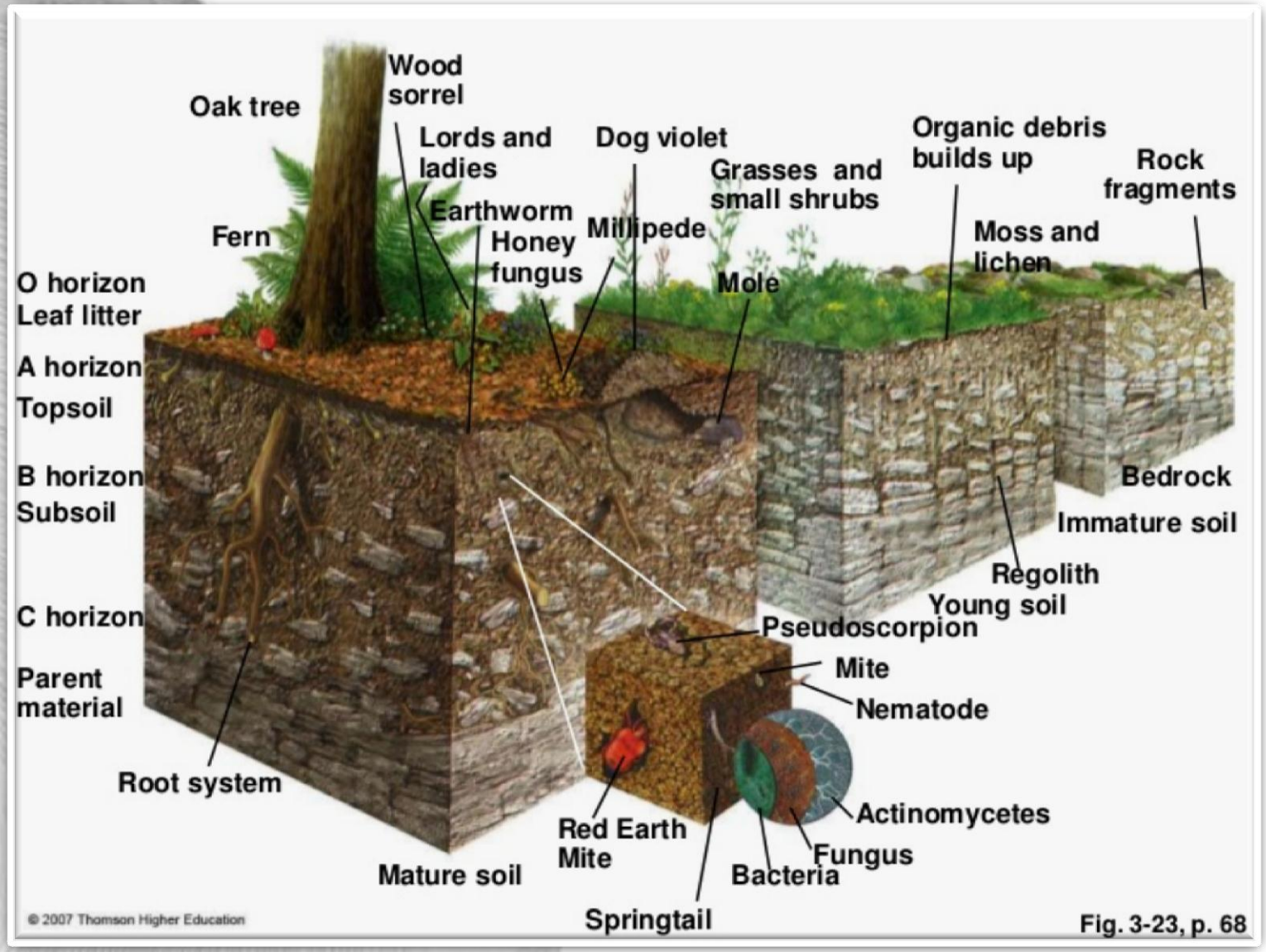

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Healthy, biologically active soils are the single most important factor for tree growth

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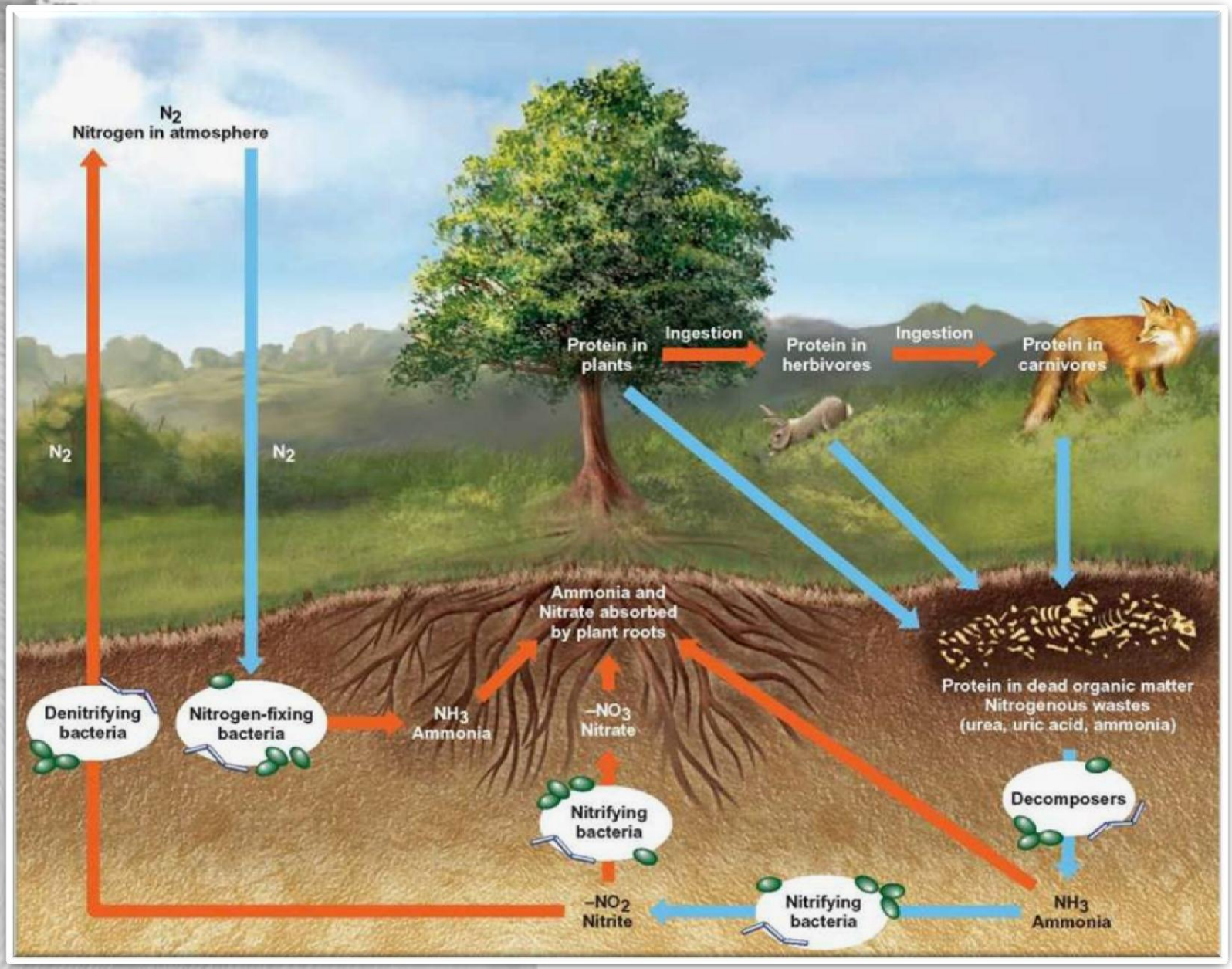

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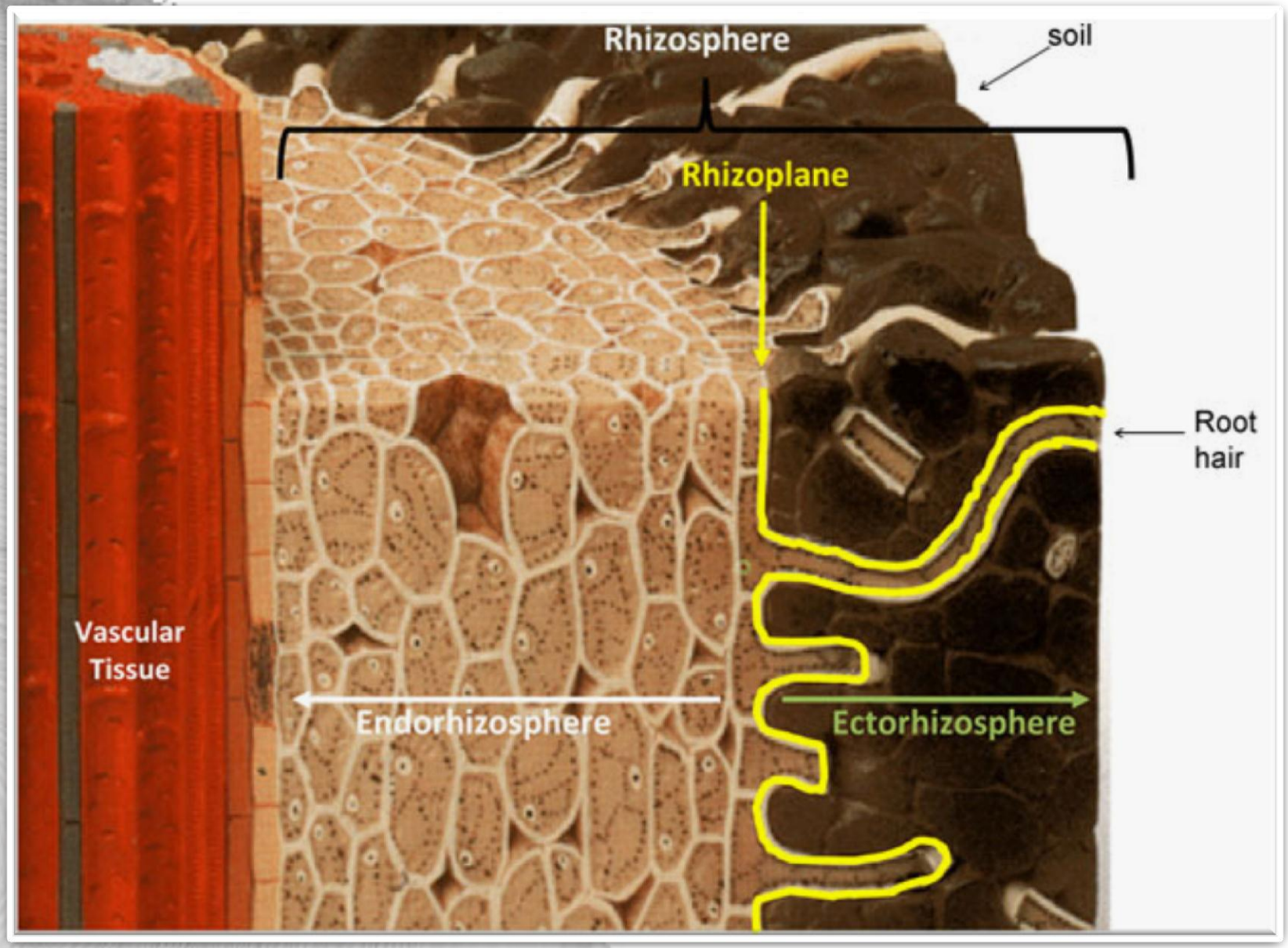

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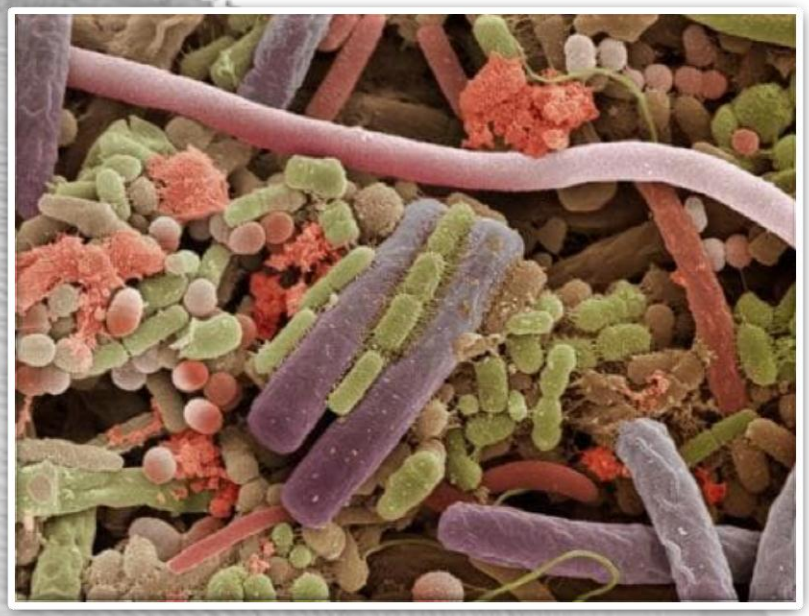

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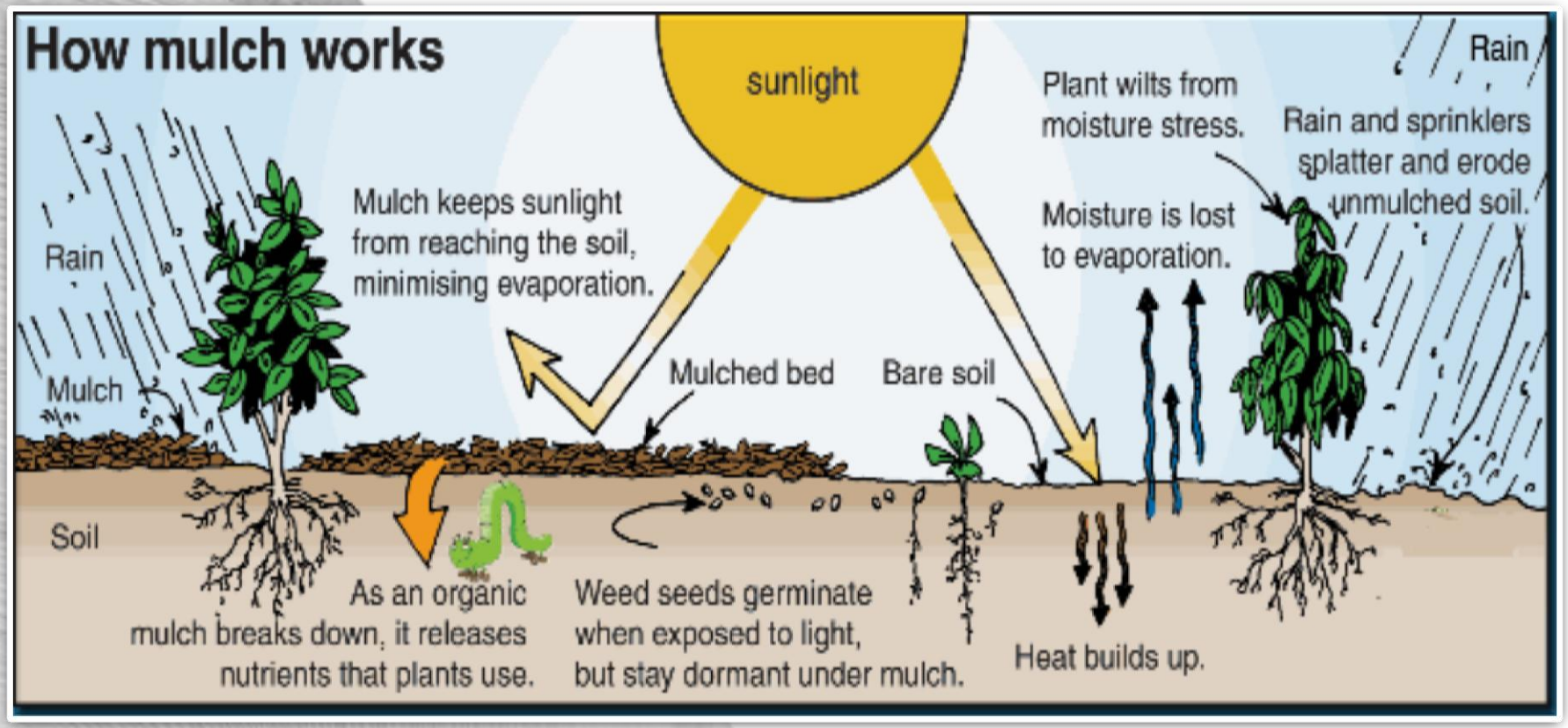
Establishment of Soil Microbiology



Benefits of Composted Wood Mulch

- Reduce evapotranspiration
- Insulates soil from temperature extremes
- Adds soil microorganisms and macroinvertebrates
- Improves soil physical properties

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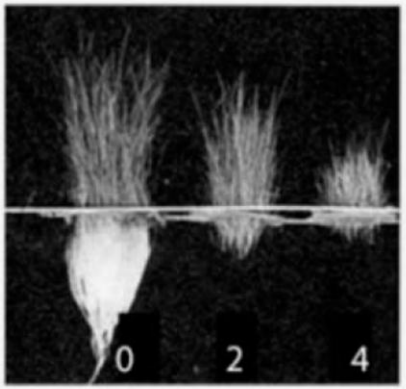
Gypsum as a Soil Amendment



Al^{3+} is highly toxic to most plant roots.

← Fescue grown in nutrient solution containing soluble Al^{3+}

Al^{3+} Concentration (ppm)

Figure 2-7. Effects of aluminum (Al^{3+}) on growth of fescue. (Illustration adopted from Buckman and Brady (1969) and kindly provided by Dr. Jerry Bigham, The Ohio State University.)

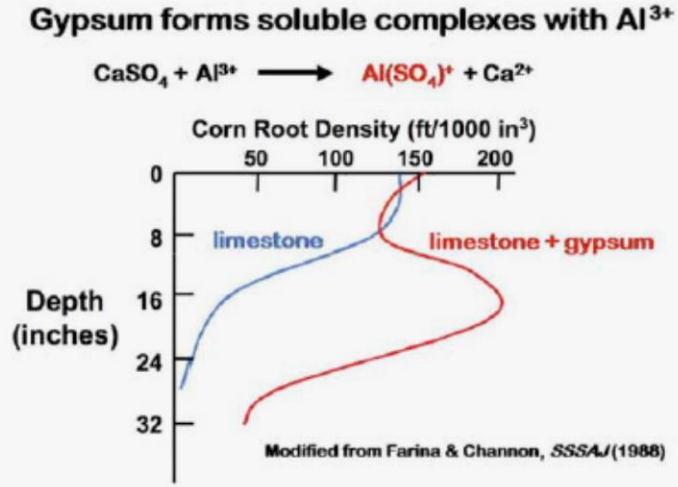


Figure 2-10. Soluble aluminum (Al^{3+}) is toxic to plants. Gypsum can react with Al^{3+}, thus removing it from the soil solution and greatly reducing its toxic effects on plant roots. (Illustration kindly provided by Dr. Jerry Bigham, The Ohio State University.)

- Gypsum is one of the earliest forms of fertilizers, in use for more than 250 years in the United States
- Gypsum can improve physical and chemical properties of soil
- Currently a large amount of flue gas desulfurization (FGD) gypsum is produced from coal fired electric generating plants that is suitable as a soil amendment

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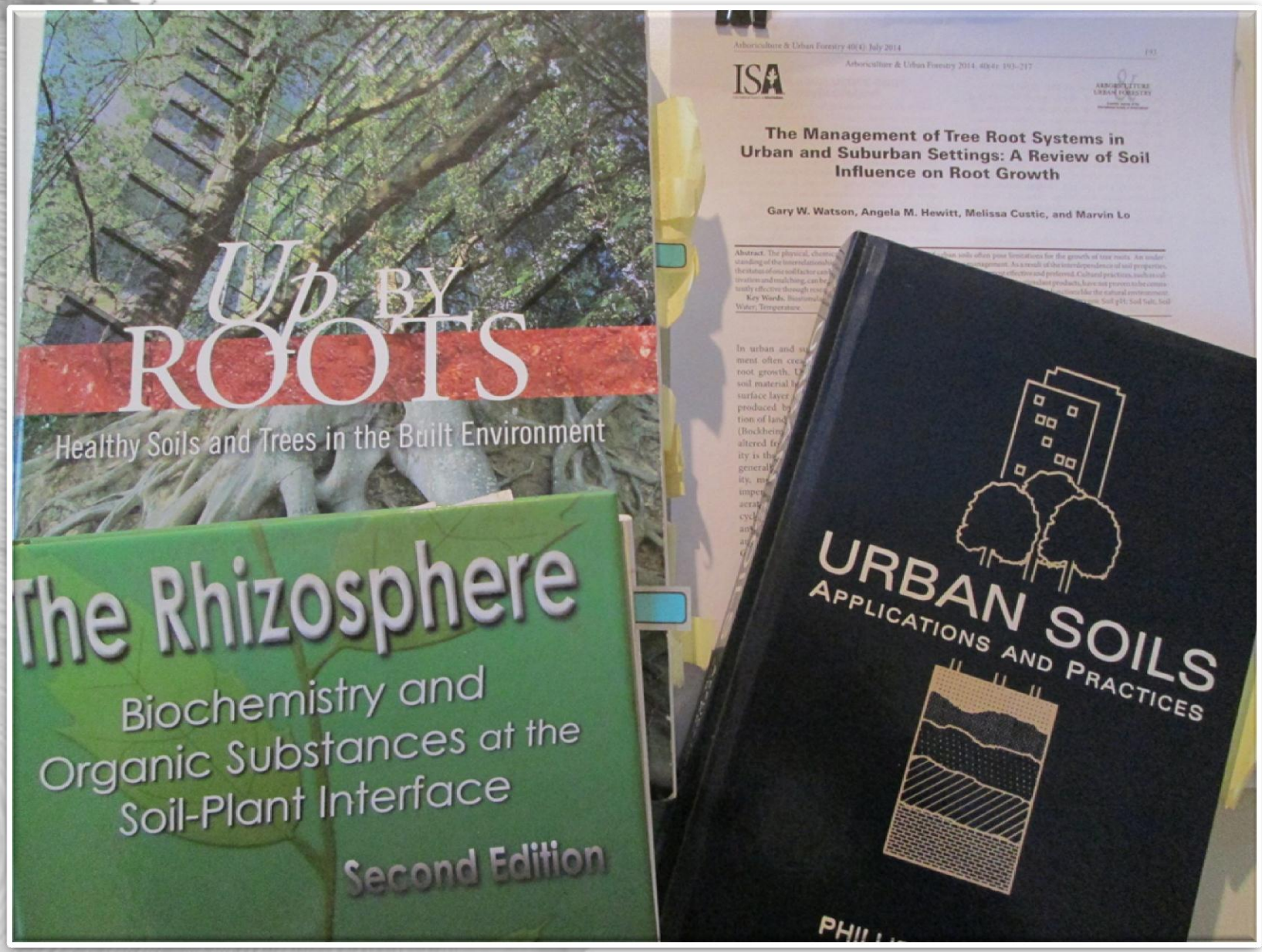

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David Dechant LEED® AP, SITES ® AP

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ISA Certified Municipal Specialist
ISA Qualified Tree Risk Assessor

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