Ecosystem Management in Towns and Cities

1 ISA Certified Arborist CEU available

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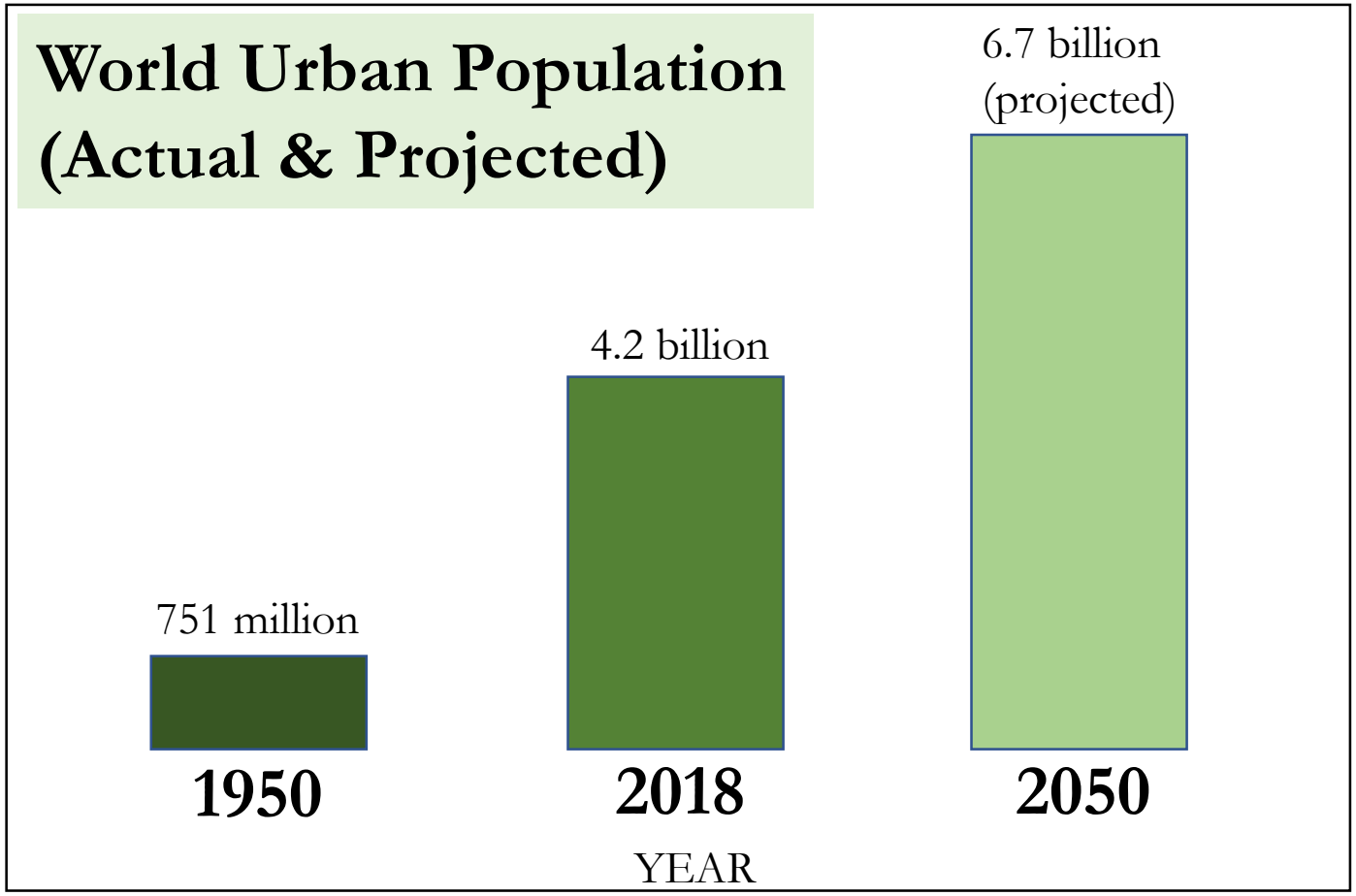
We Live In An Increasingly Urbanized World

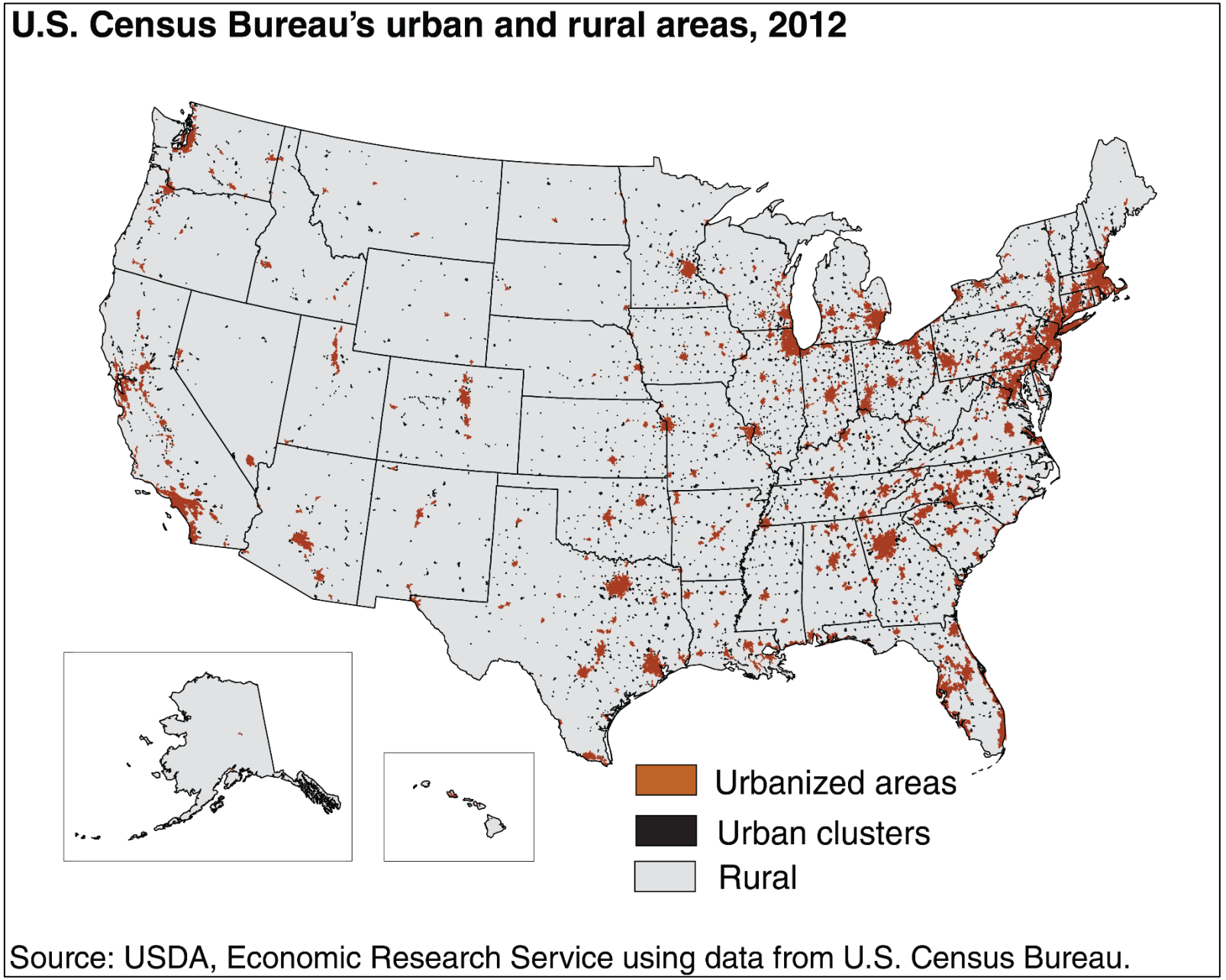
- 55% world population today lives in urban areas (projected increase to 68% by 2050)



Source: 2018, United Nations-Dept. Economic & Social Affairs

An Urbanizing Nation

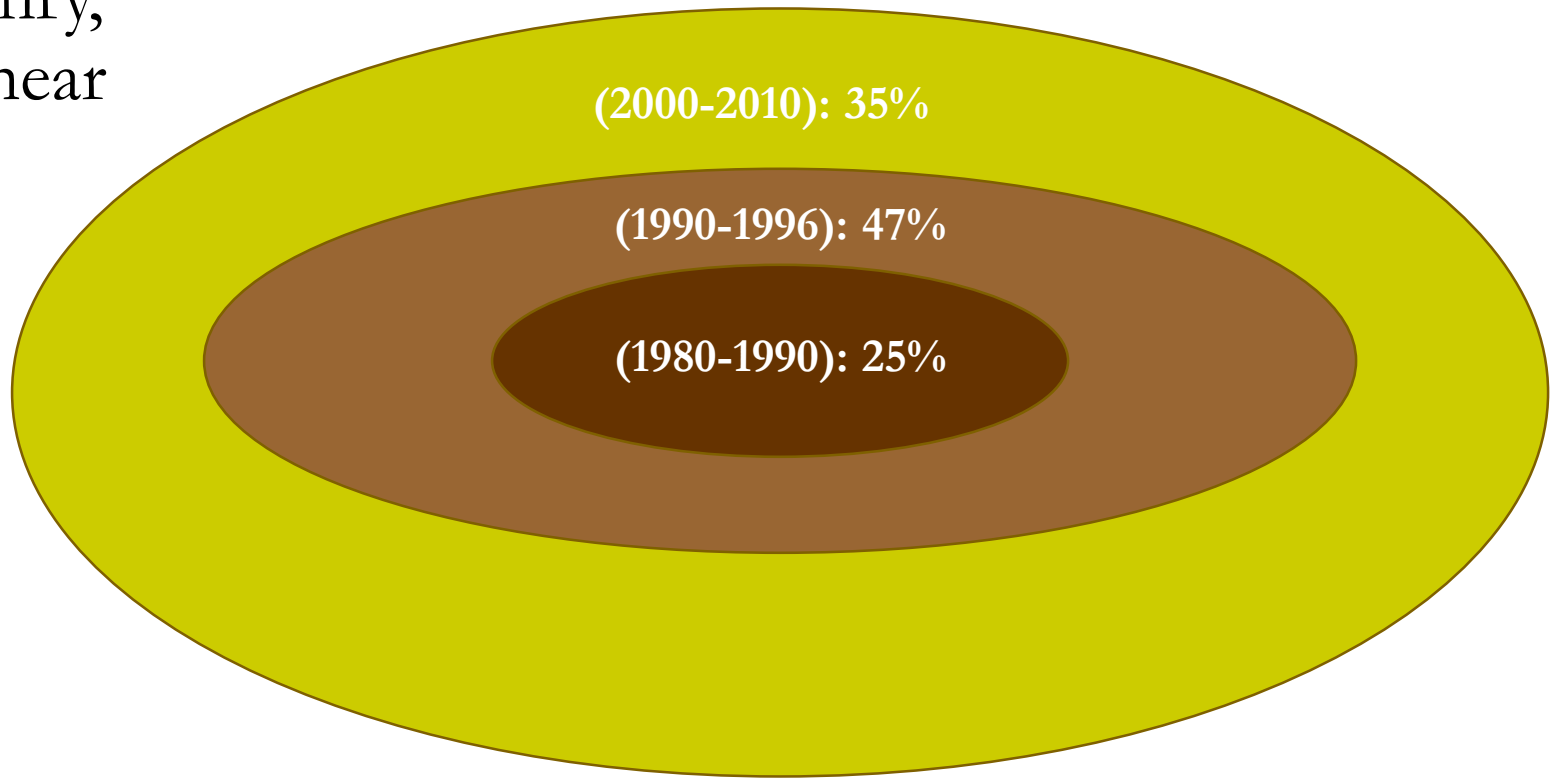
- North America- one of most urbanized areas in world
- 81.6% of the U.S. population lives in urban and suburban areas (2010 U.S. Census)



Georgia: An Urbanizing State

- 2000 – 2010: GA pop. increased over 18% (2X national average)
  - One of fastest growing U.S. states
- Fastest growing counties (Henry, Forsyth, Paulding) - all in or near Atlanta metro area
- Atlanta metro area largest in southeast (over 5 million)
- Coastal and mountain areas growing, as well

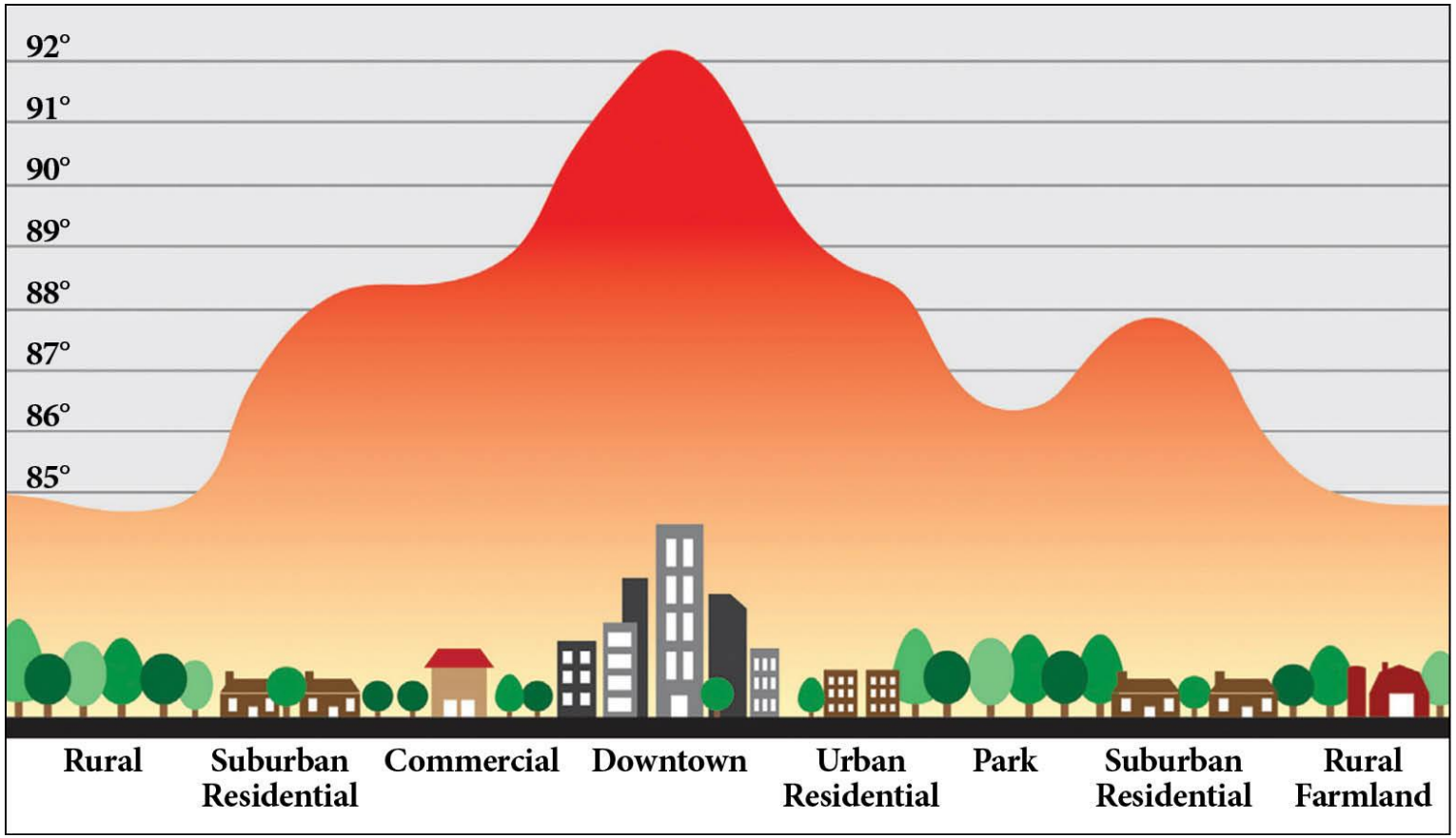
Atlanta's Expanding Urban Land Area (1980-2010)



Source: 2010, U.S. Census;
2017 Urban Sprawl-New Georgia Encyclopedia

Urban Environmental Challenges

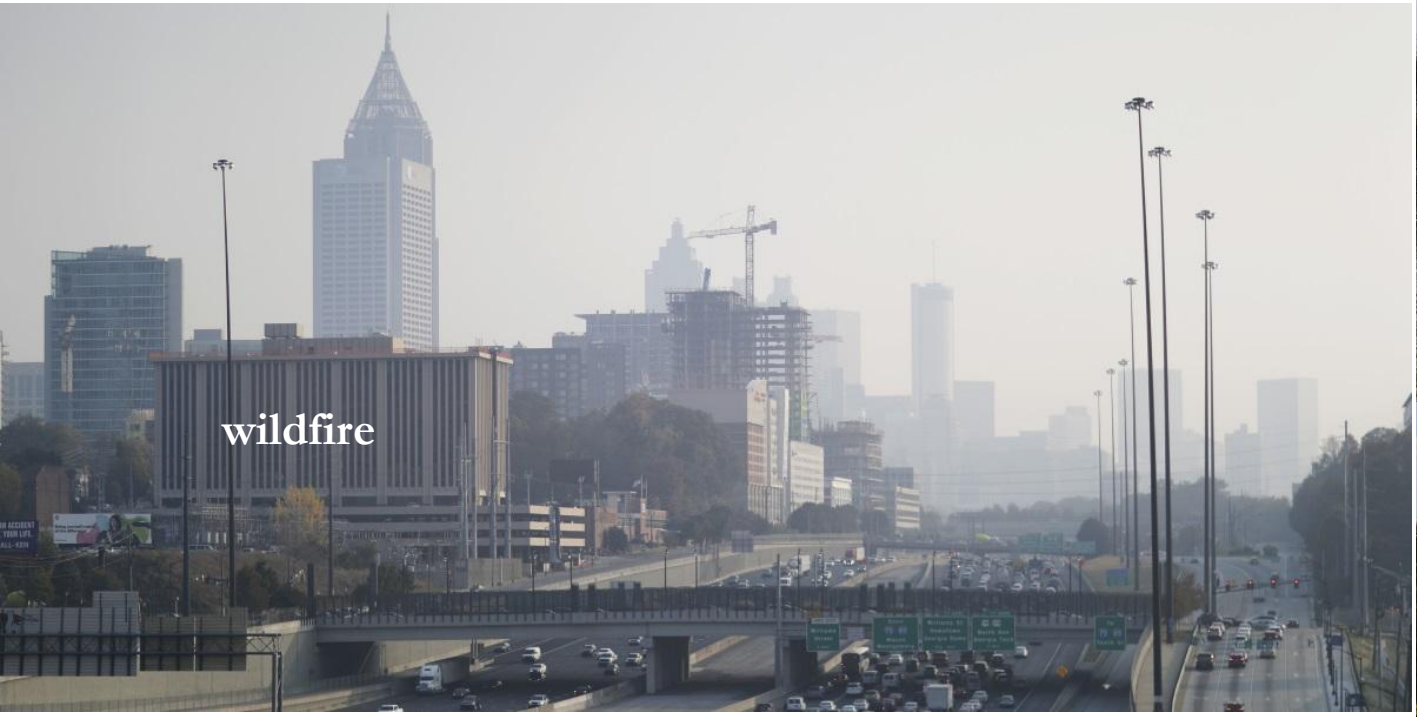
Urban Heat Island Effect



Urban Environmental Challenges

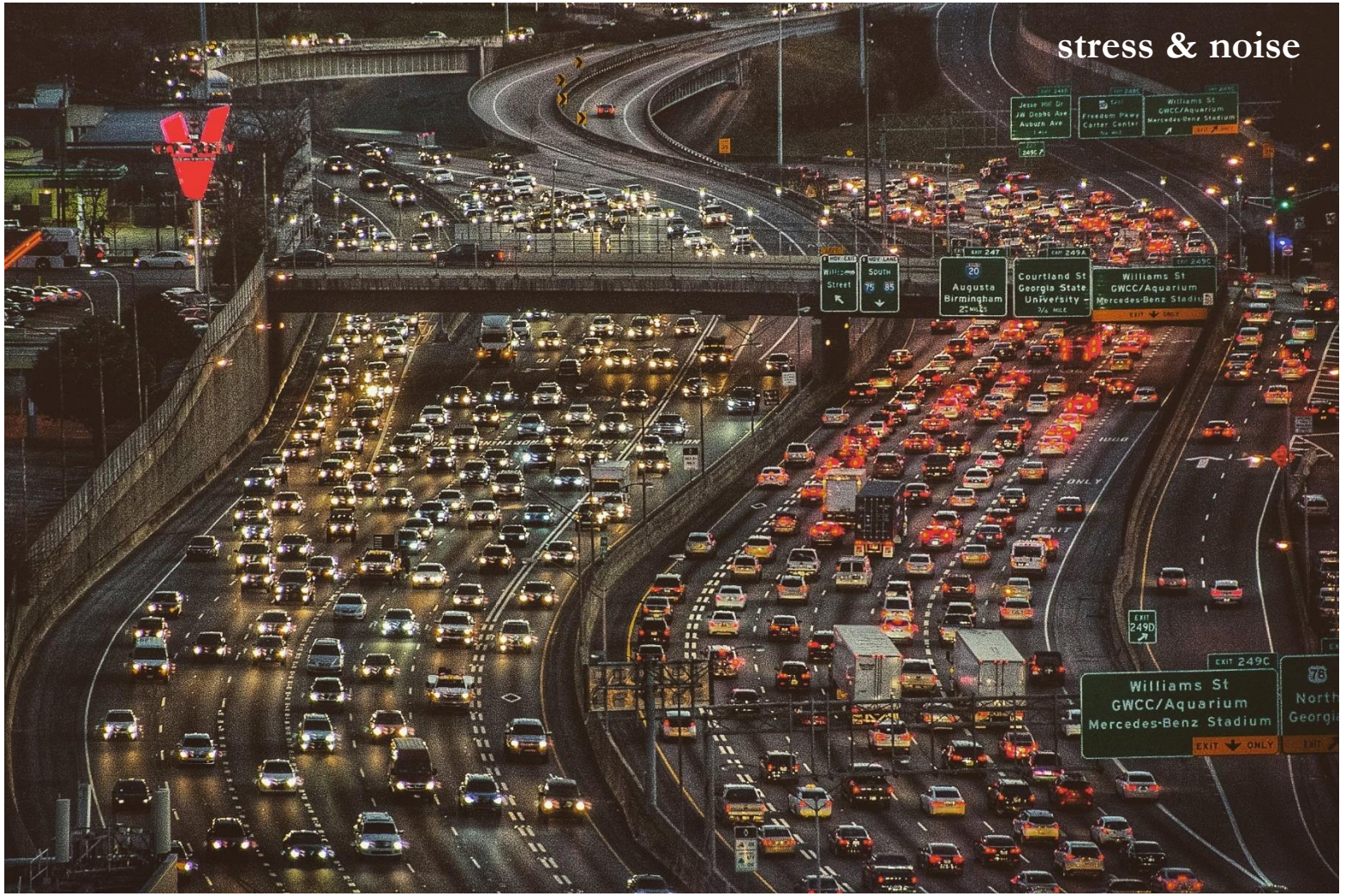
Urban Environmental Challenges

Urban Environmental Challenges: Climate Change



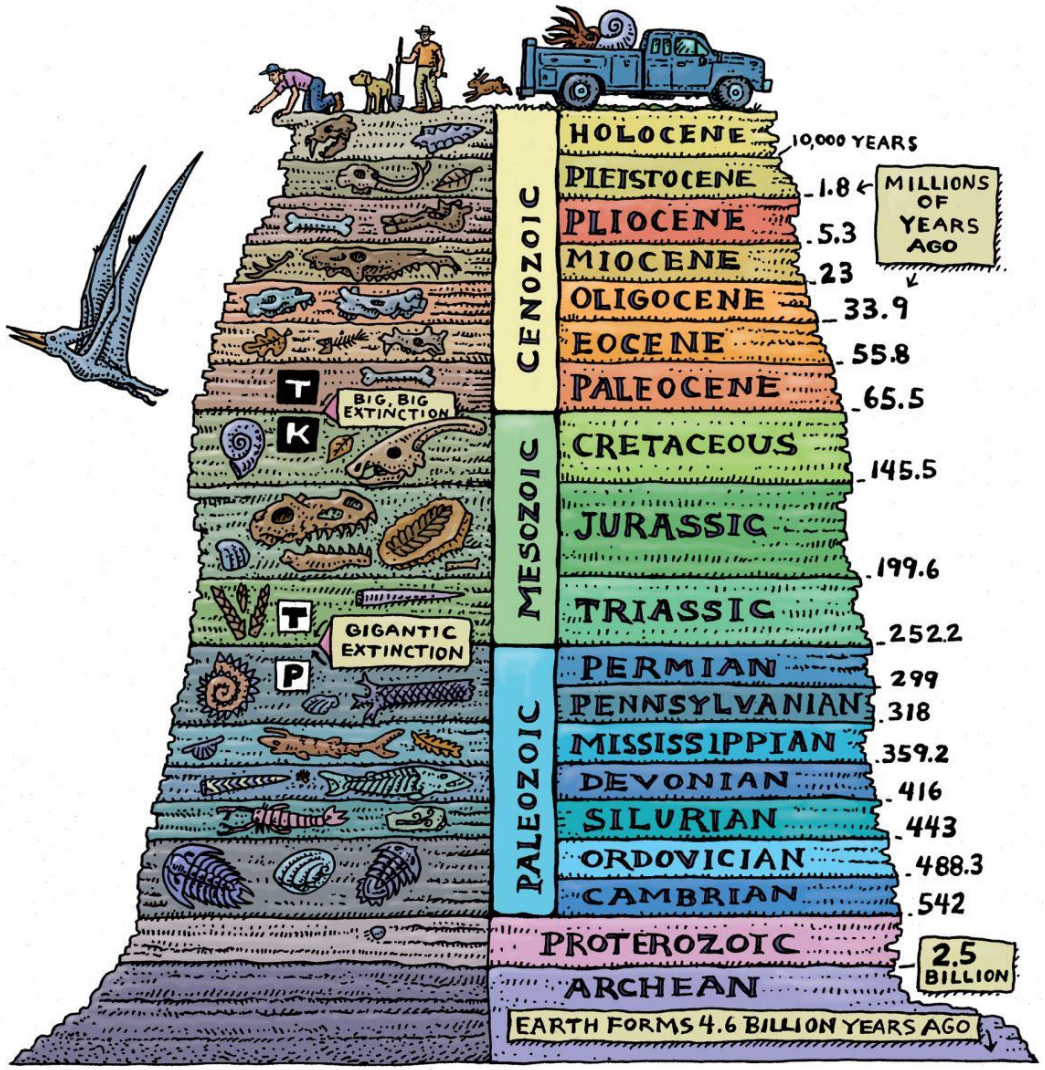
Urban Socio-Economic Challenges

- Crime
- Stress
- Health & well-being
- Income inequality & social injustice
- Gentrification
- and more…



Human Presence & Evolution on Earth: Brief Time Period - Tremendous Footprint

- Compared to the geologic history of the earth, human history has been very brief, yet our actions have drastically changed the natural environment- a world we are entirely depend on to meet all of our wants and needs.
- Anthropocene: period in the current geologic age (Holocene) when humans have had dominant influence on climate and environment.



Built vs. Natural Environment

- Urban and suburban areas (generalizations based on most urban areas):
  - Less ecologically diverse and abundant
  - Multiple pollution streams
  - Energy and resource intensive
  - Altered ecological processes (natural cycles interrupted)
  - Less resilient to affects of climate change

Our Natural World Is Dynamic & Interconnected.

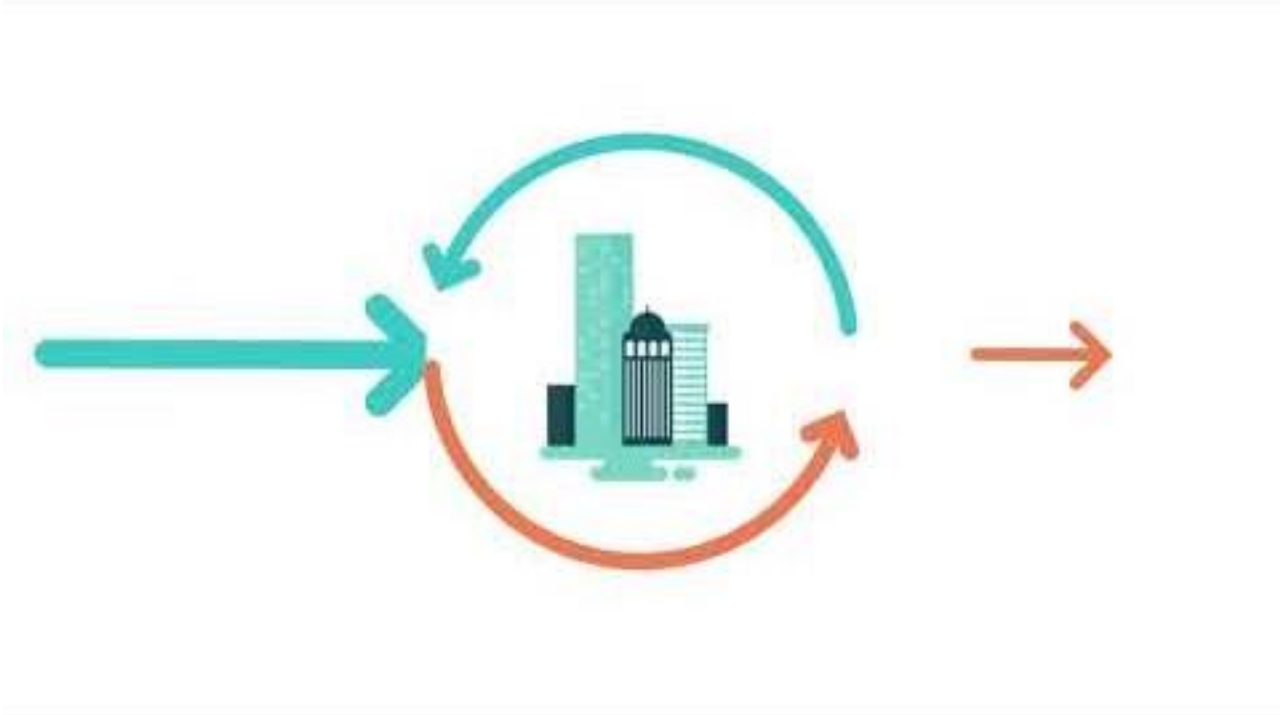
Can Our Urban Areas Also Be?

- Natural cycles (water, gas exchange, decomposition, etc.)
- Food webs
- Ecosystems (interdependencies and functions)
- Habitats
- Succession

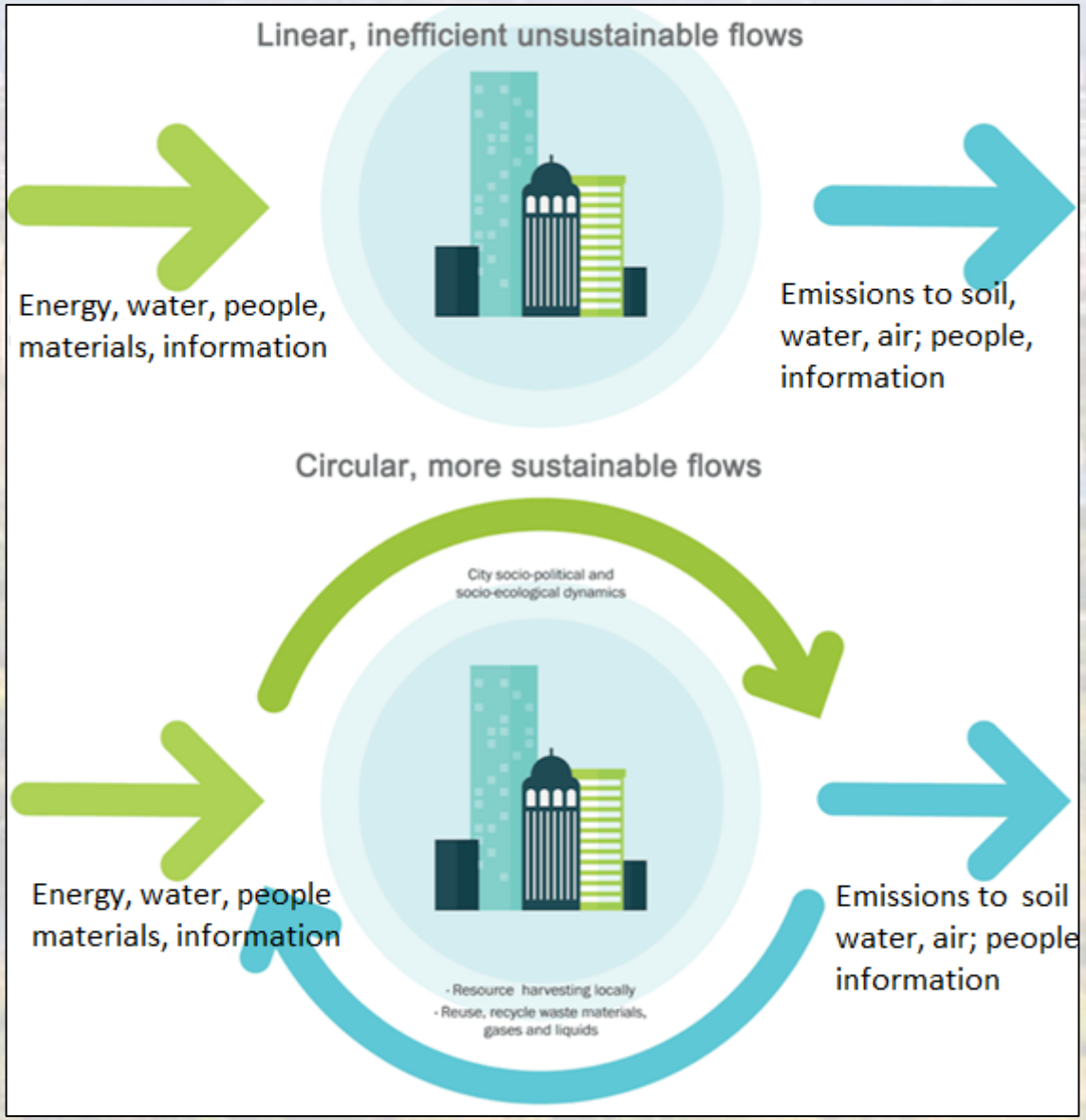
Urban Metabolism

- **Urban metabolism**: the sum total of the technical and socio-economic process that occur in cities, resulting in growth, production of energy and elimination of waste. (C. Kennedy, University of Toronto)

Urban Metabolism



Man loses 100 lbs. through vegan diet


Linear, inefficient unsustainable flows
Energy, water, people,
materials, information
Emissions to soil,
water, air; people,
information
Circular, more sustainable flows
City socio-political and
socio-ecological dynamics
Energy, water, people
materials, information
Emissions to soil
water, air; people
information
- Resource harvesting locally
- Reuse, recycle waste materials,
gases and liquids

Urban Ecology

- **Ecology:** The scientific study of the processes influencing the distribution and abundance of organisms, the interactions among organisms, and the interactions between organisms and the transformation and flux of energy and matter. (from Cary Institute of Ecosystem Studies)
- **Urban ecology**: the interdisciplinary study of ecological processes in urban environments (i.e., biodiversity). This includes all aspects of the ecology of any organisms found in urban areas as well as large scale considerations of the ecological sustainability of cities. (from Journal, *Nature*)

Key Concepts to Consider

Scale

Succession

Disturbance

Biome

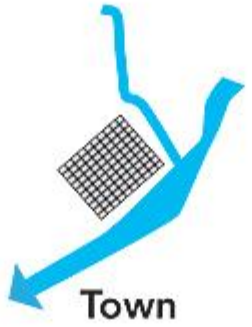
Ecosystem approach

Aspects to Consider Related to Scale

1. Spatial scales
2. Temporal scales
3. Level of ecosystem disturbance

Small to Large Spatial Scales

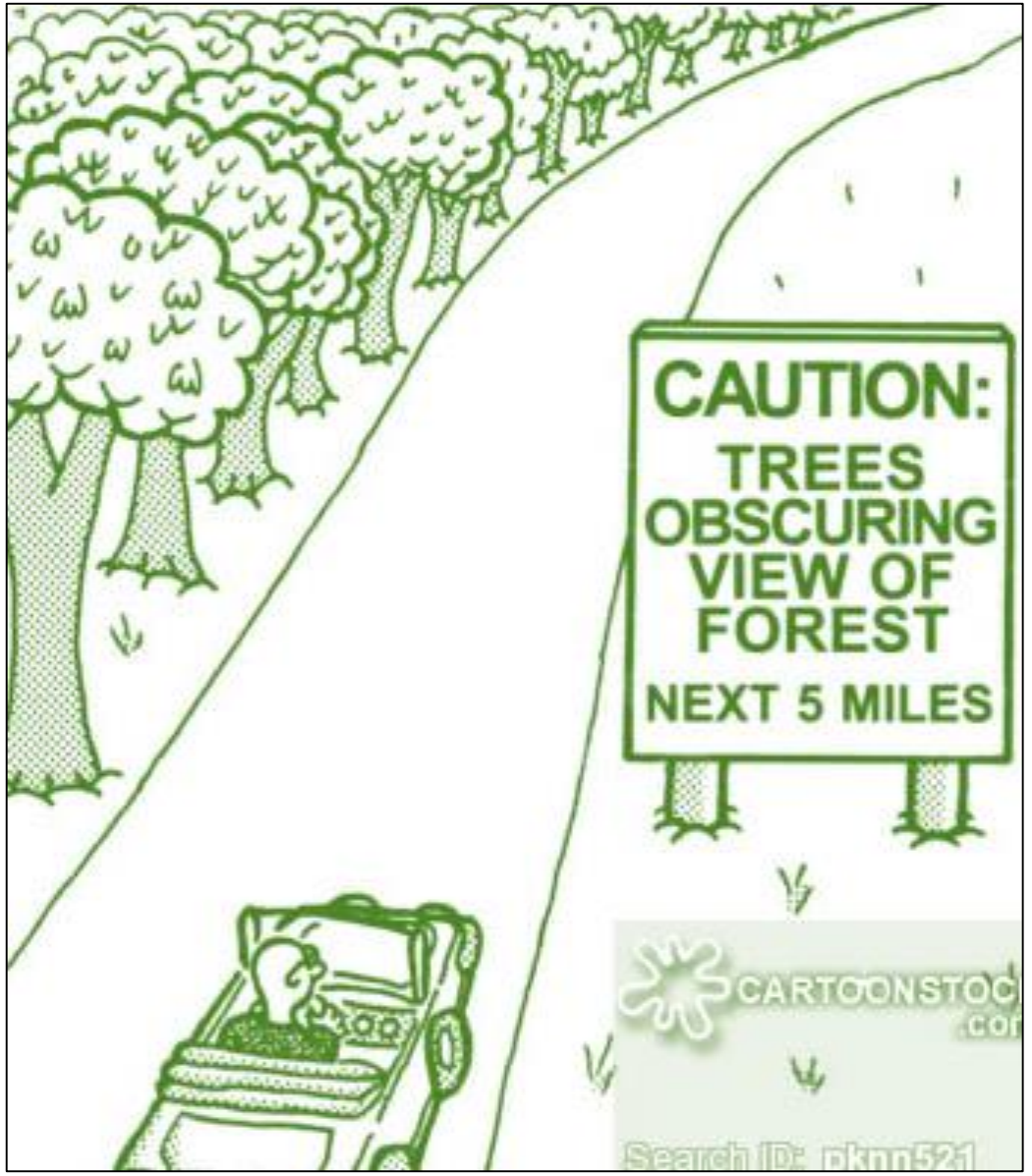
Demographic structure



Urban forestry

ESRI

Single tree vs. aggregate of trees (forest)



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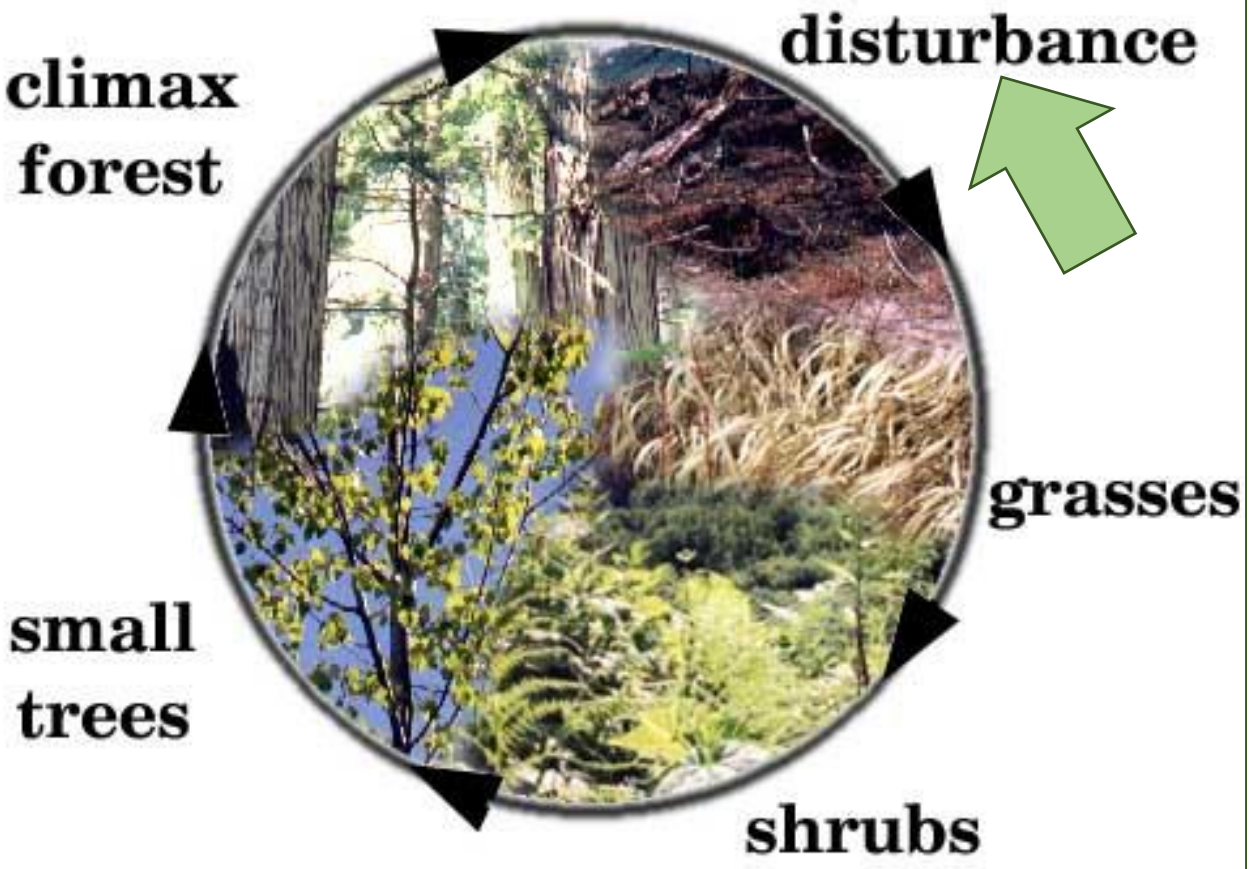
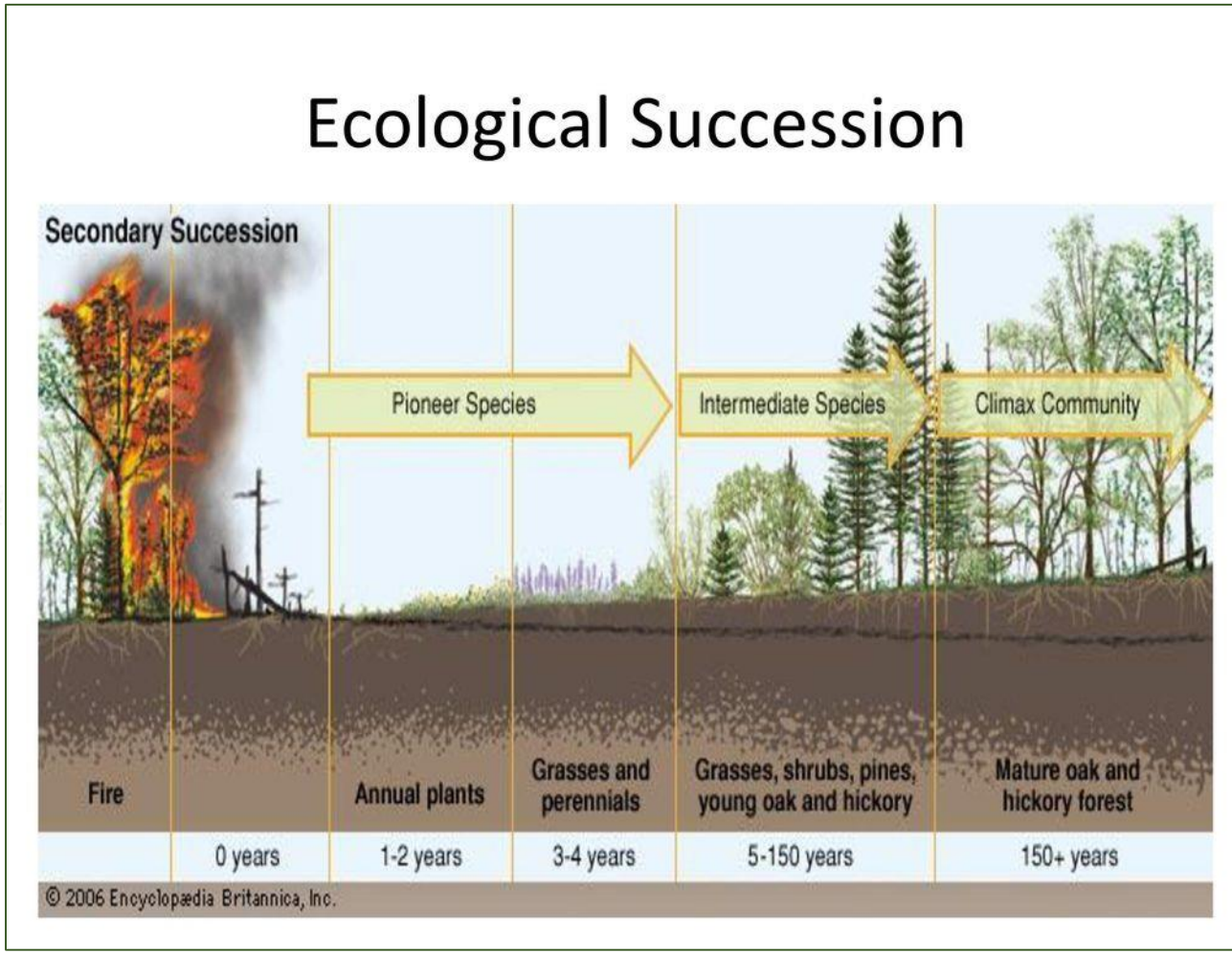
Temporal Scales & Succession





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Drivers of Landscape Change

1. The actions of all living creatures, especially people
2. The impacts about physical phenomenon

Ecosystem Disturbance

Key Concepts to Consider

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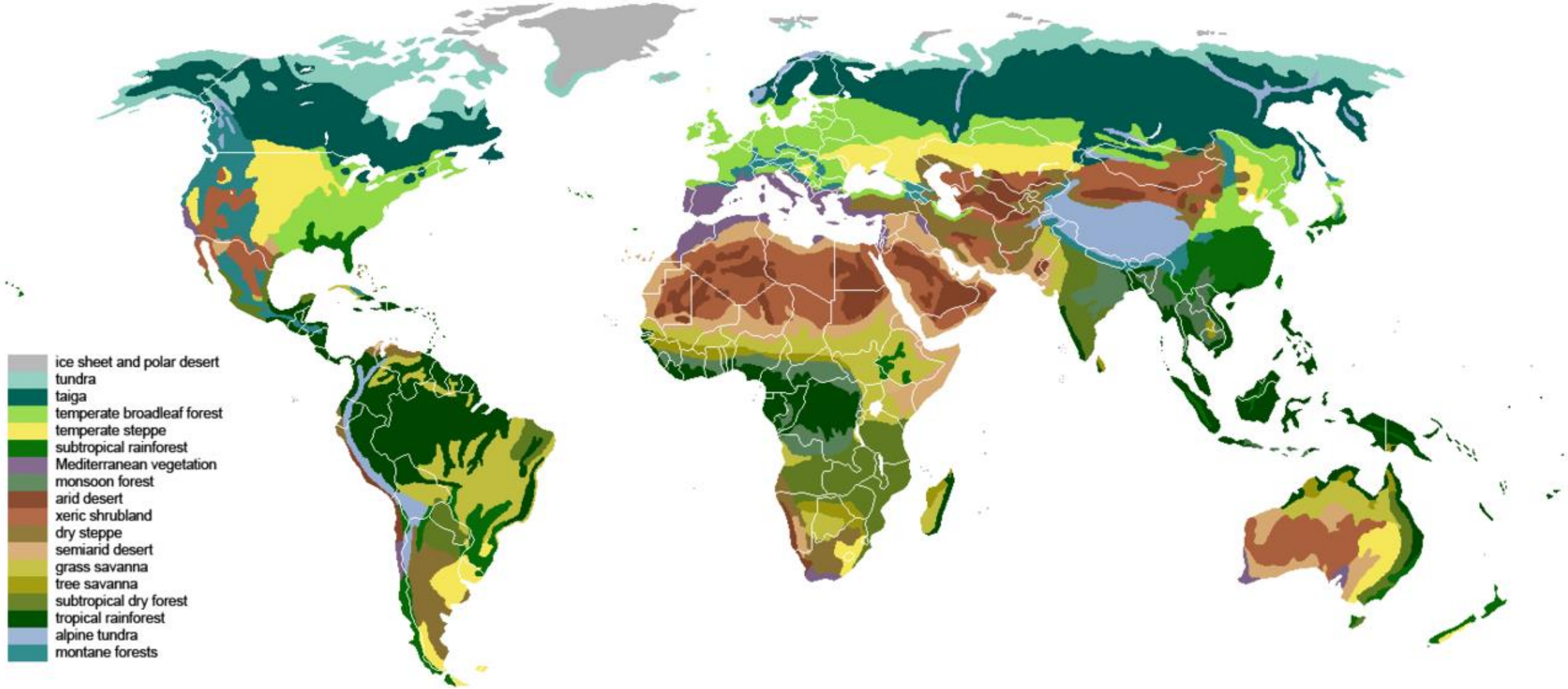
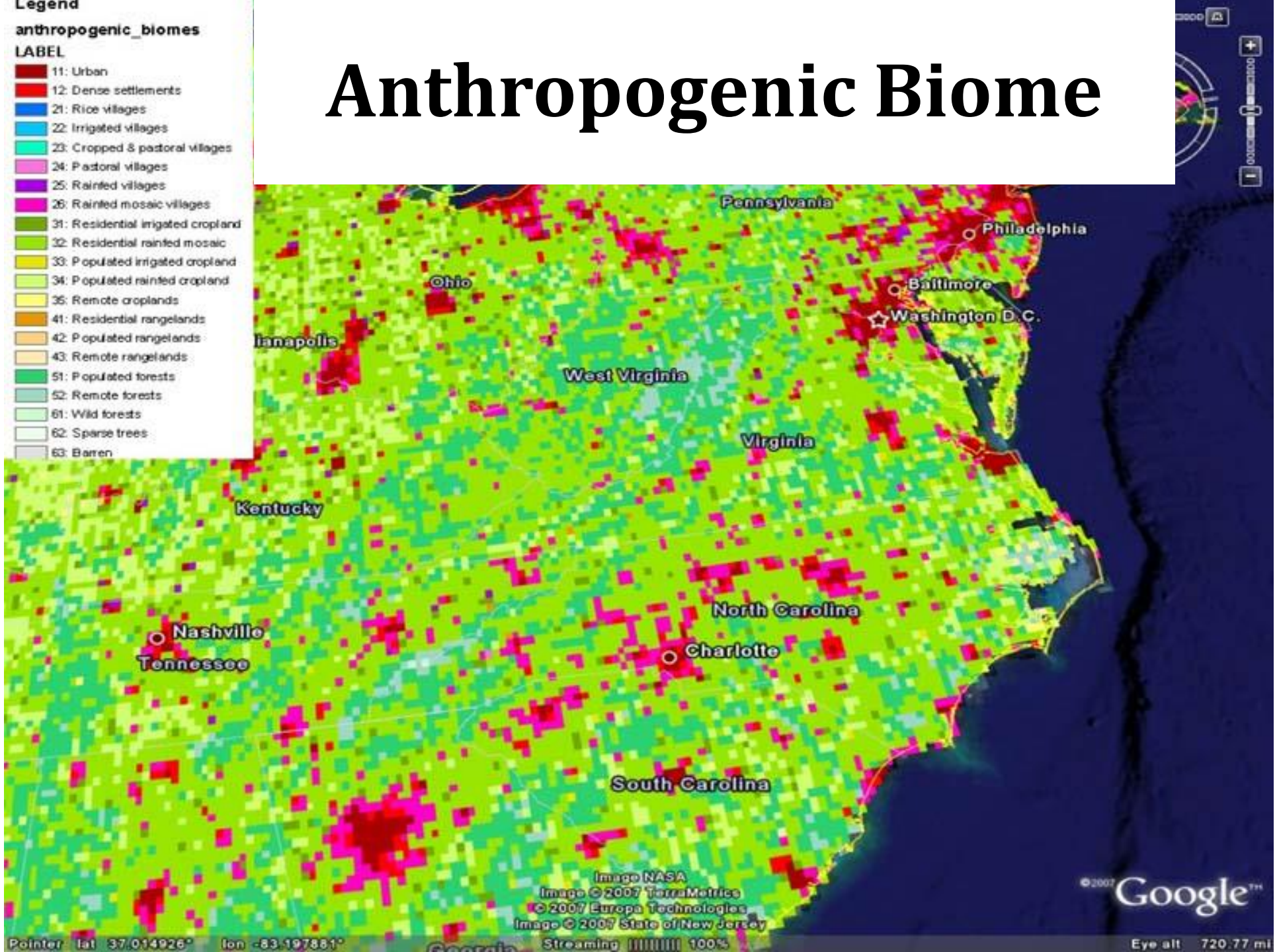
Biome

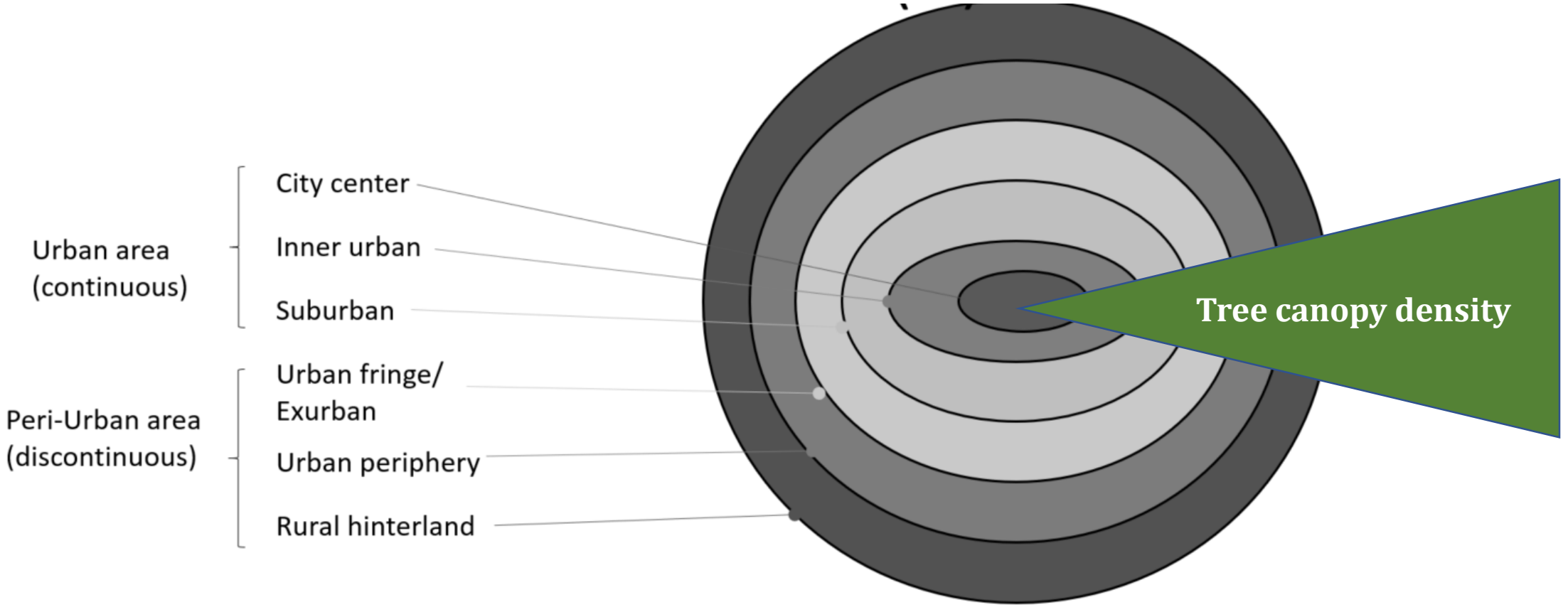

ice sheet and polar desert
tundra
taiga
temperate broadleaf forest
temperate steppe
subtropical rainforest
Mediterranean vegetation
monsoon forest
arid desert
xeric shrubland
dry steppe
semiarid desert
grass savanna
tree savanna
subtropical dry forest
tropical rainforest
alpine tundra
montane forests

Anthropogenic Biome

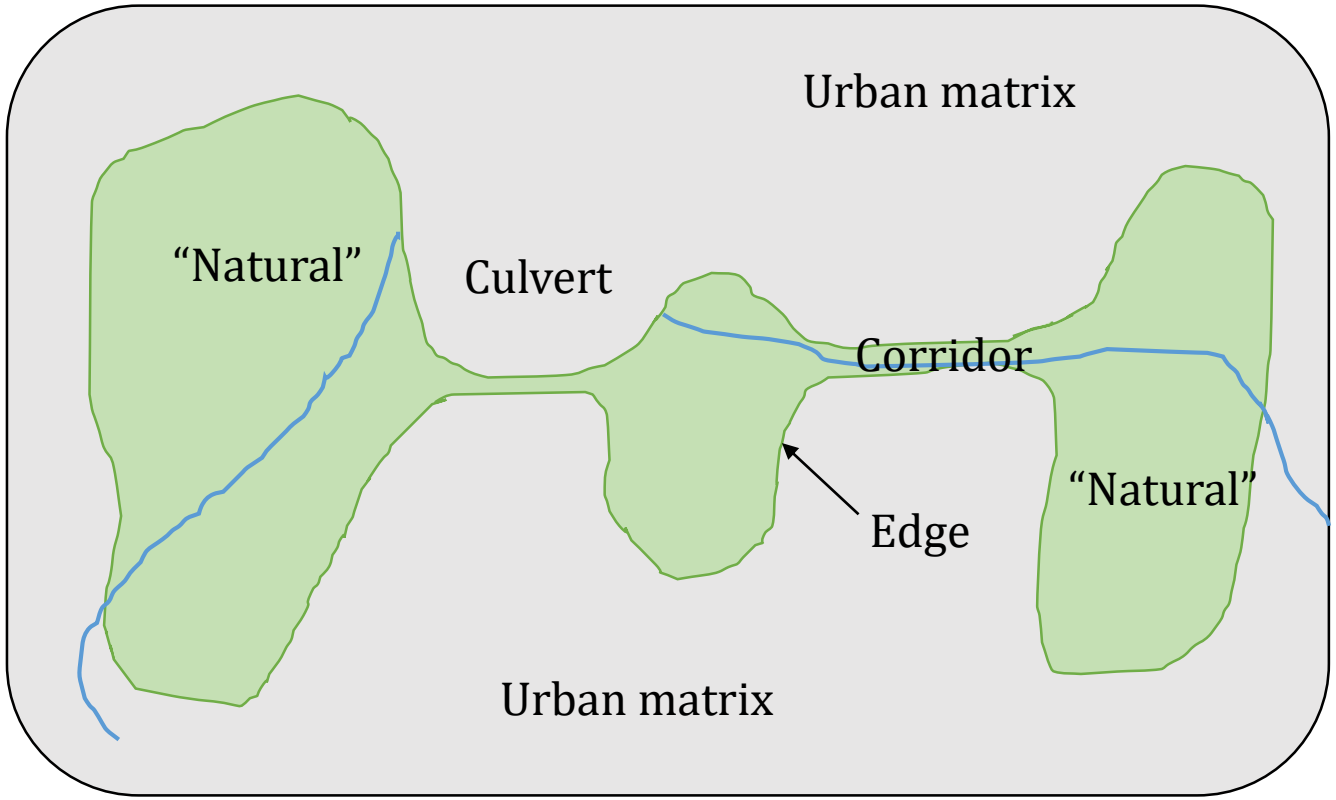


Spatial Patterns

Urban to rural gradient



Spatial Patterns



A network of corridors in close connectivity within the urban mosaic

Key Concepts to Consider

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The Ecosystem Approach

- An integrating approach with three key aspects
- Systems: It considers the whole ecosystem
- People: Puts people and sustainability at the heart of environmental management
- Values: the environment provides us with important and valuable benefits (ecosystem goods and services)

What can we do?

- Paint roofs, use cool roofing materials
- Spatial arrangement of buildings & vegetation
- Variability of building heights
- Porous pavements
- Water harvesting and green roofs
- District heating and cooling; combined heat and power; cogeneration systems to reduce emissions

Plant & Maintain Trees!

Urban & Community Forestry

Individual tree maintenance

Green engineering

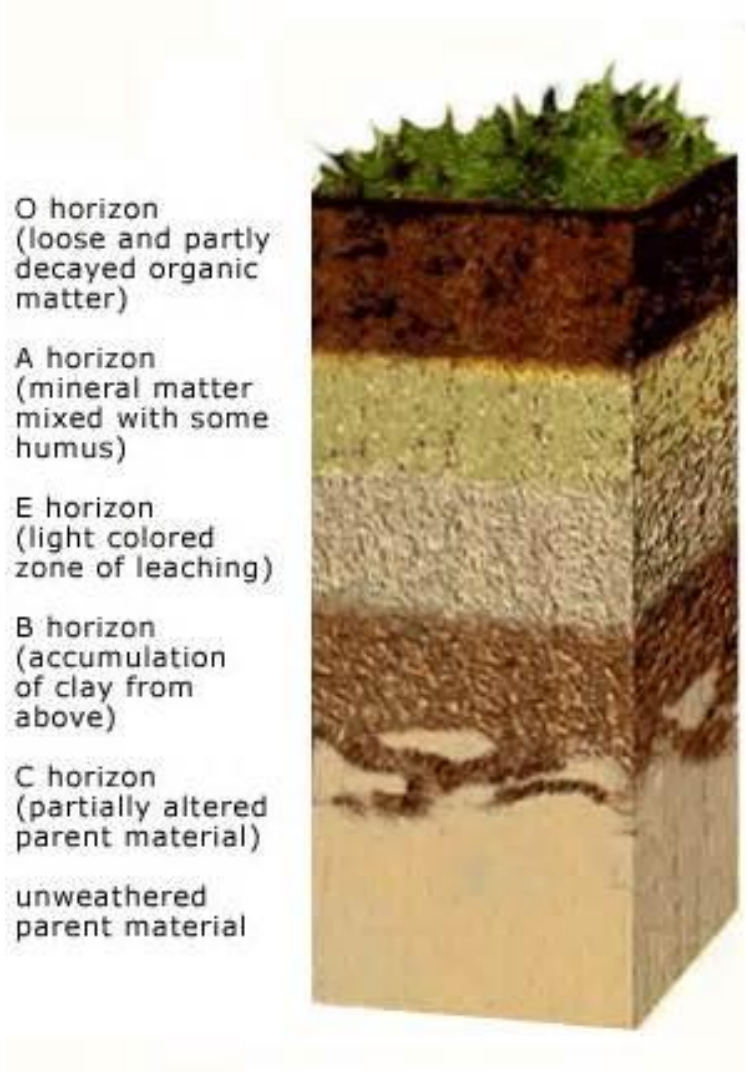
Policy

Urban silviculture

Landscape restoration

Improve & Protect Urban Soils

- Most urban soils are technosols
- Human processes (e.g., vegetation removal) exposes soil
- Plant vegetation:
  - Reduces soil erosion
  - Stabilizes hilltops
  - Improves soil moisture
  - Intercept storm water
  - Absorb energy of falling rain
  - Increases soil porosity (root penetration)



Improve & Protect Urban Soils

- Limit & ameliorate compaction
- Mulch (added or natural)
- Protect soil during construction

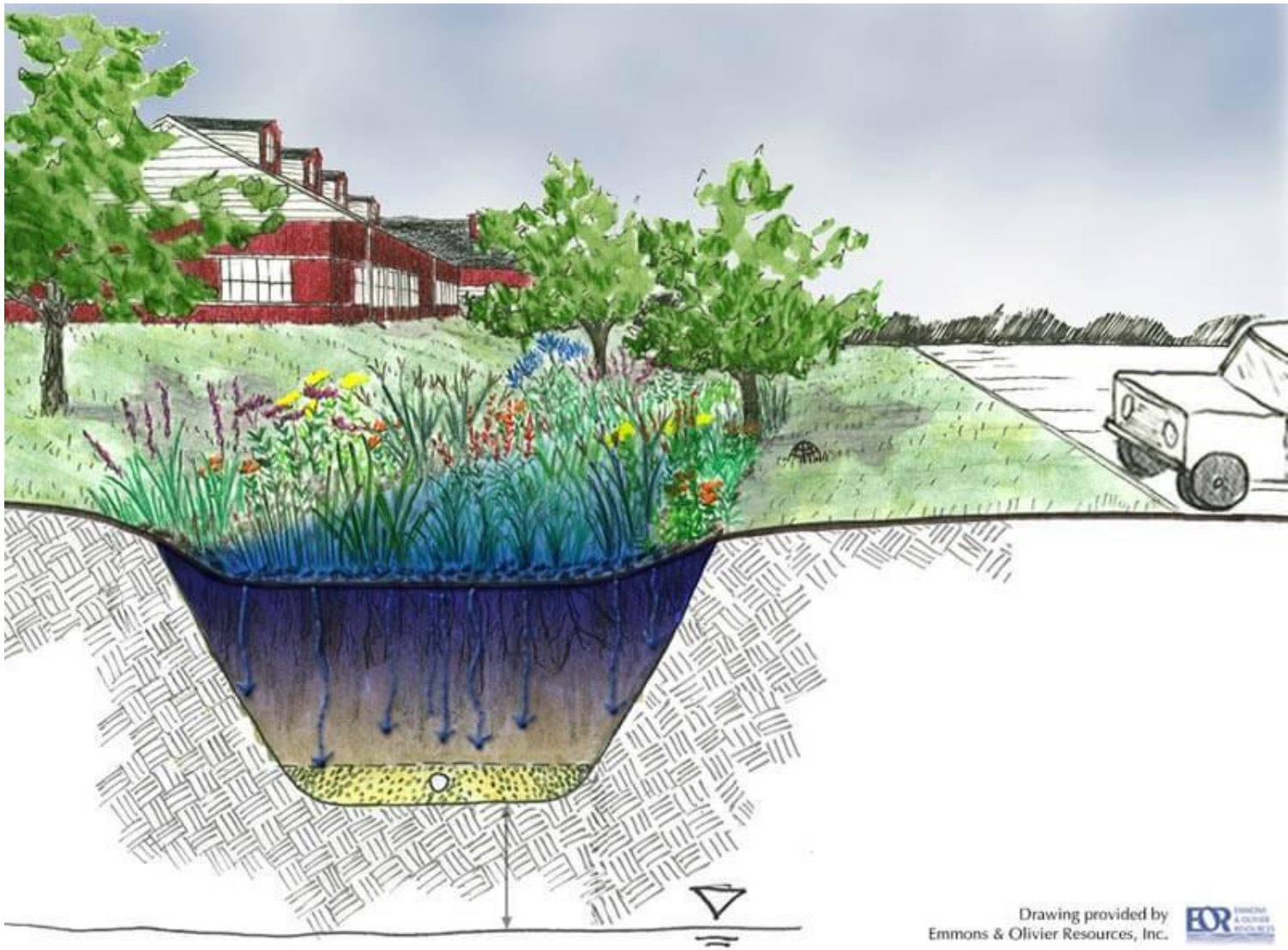
Improve & Protect Urban Hydrology

- Effects of urbanization:
  - Change in total runoff
  - Alteration of peak flow characteristics
  - Decline in water quality
  - Change in hydrological amenities of streams and their ecology
- Storm water runoff increases along the rural to urban gradient

Improve & Protect Urban Hydrology

Green infrastructure design

- Vegetation increase (canopy)
- Green roofs
- Pervious paving
- Living walls
- Rain gardens
- Bioswales
- Constructed wetlands

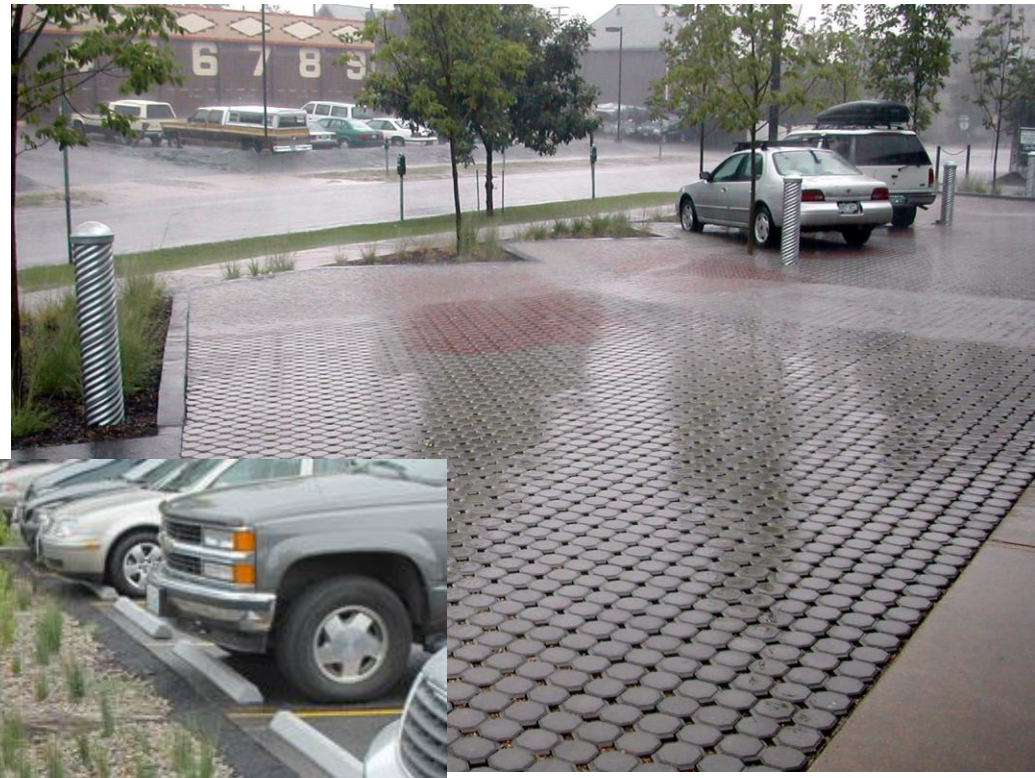


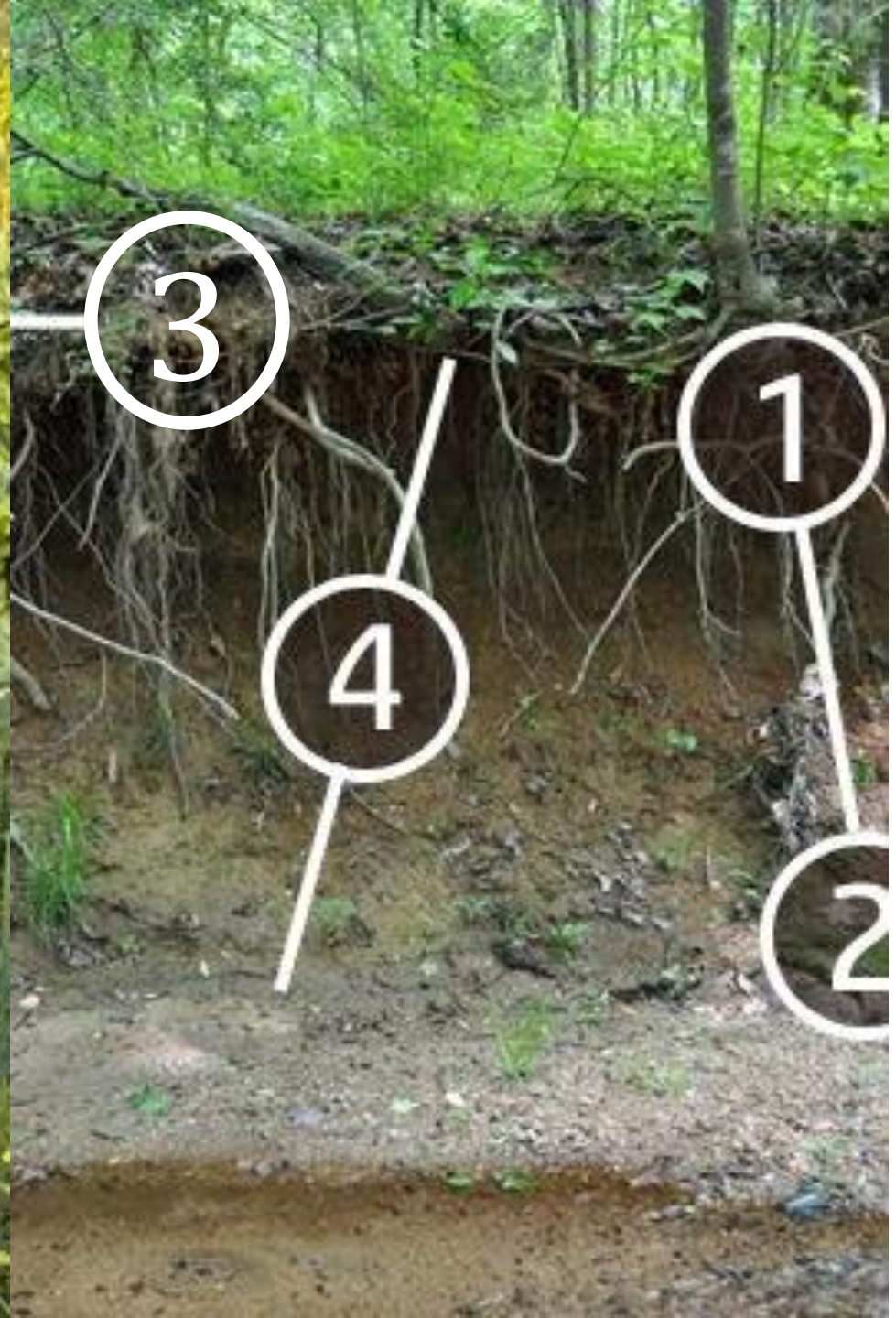
Drawing provided by
Emmons & Olivier Resources, Inc.

Improve & Protect Urban Hydrology

Sustainable Drainage Systems (SuDs)

- Permeable surfaces
- Filter strips
- Filter and infiltration trenches
- Detention basins
- Underground storage
- Wetlands/ponds
- Daylighting streams




3
1
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De-culverting or Daylighting

Cheonggyecheon Stream restoration in Seoul, South Korea in 2005

http://greatecology.com/watershed-era-urban-river-restoration/

Creating & Protecting Urban Habitats

- **Habitat** – area where an organism carries out it's life cycle. Habitat must satisfy organism's main needs (*food, water, shelter, space*). E.g., National Wildlife Federation Backyard Wildlife Habitat Gardens
- The urban mosaic is composed of vegetation with buildings and hard surfaces within which are fine-scale mosaics.
- As urban areas go through cycles of growth, decay and regeneration, society is creating an increasing number of habitats which can be used by plants and animals.
- So…urban places provide a wide diversity of habitats

Urban habitat	Sub-habitats
Natural and semi-natural greenspace	Woodlands, urban forests, tree plantations, scrub
Street trees	Single trees and small areas with scattered trees often surrounded by paved ground
Public parks and formal gardens	Maintained, unmaintained grass, canopy
Domestic gardens	Aesthetic, consumptive
Green corridors	River and canal banks, rights of way
Outdoor sports facilities	Golf courses, school playing fields, largely maintained grasslands
Amenity greenspace	Greenspaces usually in housing areas
Community gardens and urban farms	Includes arable farmland and orchards
Cemeteries, churchyards, burial grounds	Maintained, unmaintained grass, canopy
Previously developed, brownfield land, excluding domestic gardens	Derelict, contaminated and vacant land
Water bodies	Natural rivers, streams, groundwater, lakes, wetlands, ponds, ditches, canals, reservoirs

What Else Can We Do?

- Working with elected officials and planners to develop projects that support urban metabolism and ecology
- Carbon credit system for retaining or creating canopy and other reward system for carbon storage (even for stormwater management)
- Involving communities and individuals in the planning, implementation, and maintenance phases of projects
- Valuing ecosystem services
- Support arborists and urban foresters
- Educate residents about urban ecology
- Though urban issues can be complex…

Thanks! Questions?

Resources:

Urban Ecology: www.urbanecology.org/

The Nature of Cities: https://www.thenatureofcities.com/

Please be sure to check out our next webinar, *Soil Management for Community Trees*, on March 25 at 10am, http://www.forestrywebinars.net/webinars/soil-management-for-community-trees

More Information:

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*Also, please ask us about the new Community Forestry & Arboriculture degree program at UGA Warnell.