Environmental Planning and Design in the Face of Climate Change

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About Myself

- From N. Illinois
- Biologist
- Environmental Designer & Planner in training

https://geology.com/county-map/illinois.shtml

Personal Misconception

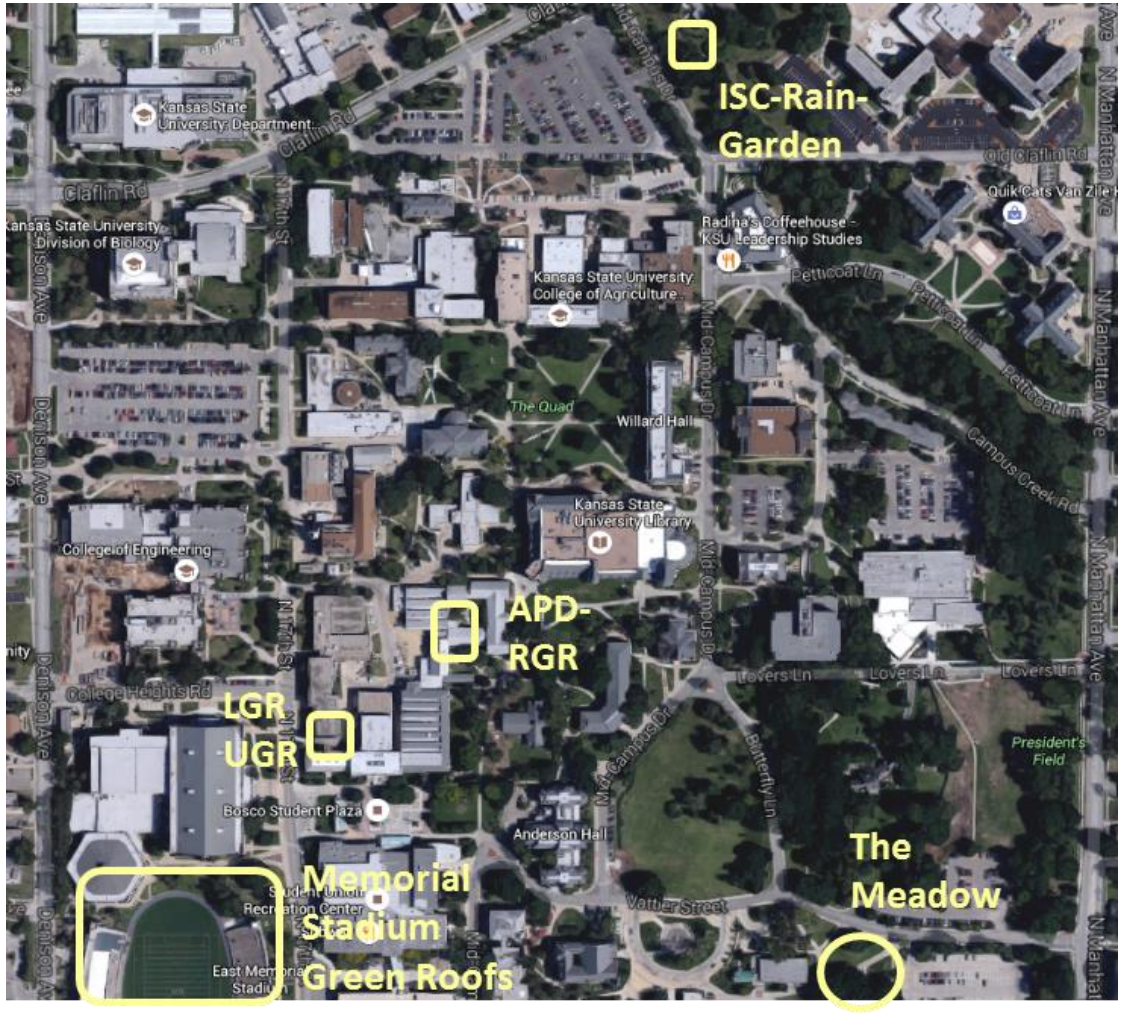
Urban = BAD

Natural = GOOD

Why Environmental Design & Planning?

- Came to a realization that although conservation is incredibly important, we need to be doing more in our urban areas

Green Roof & Green Infrastructure at K-State



Purposes of KSU Rain Gardens and The Meadow:

- Education
- Stormwater management
- Provision of native vegetation
- Habitat for insects, birds, and small mammals

Green Roof Monitoring:

- Soil/Substrate Moisture Dynamics
- Vegetation & Biomass Coverage
- Plant Species Diversity
- Pollinator & Bird Use
- Irrigation Amounts & Practices
- Maintenance (Fertilizing and Weeding Procedures & Timing)

The Meadow near the Beach Museum

http://apdesign.k-state.edu/larcp/researchandcreativeactivity/la/the_meadow/prairie_roots_run_deep.html

Manhattan Area Rain Gardens

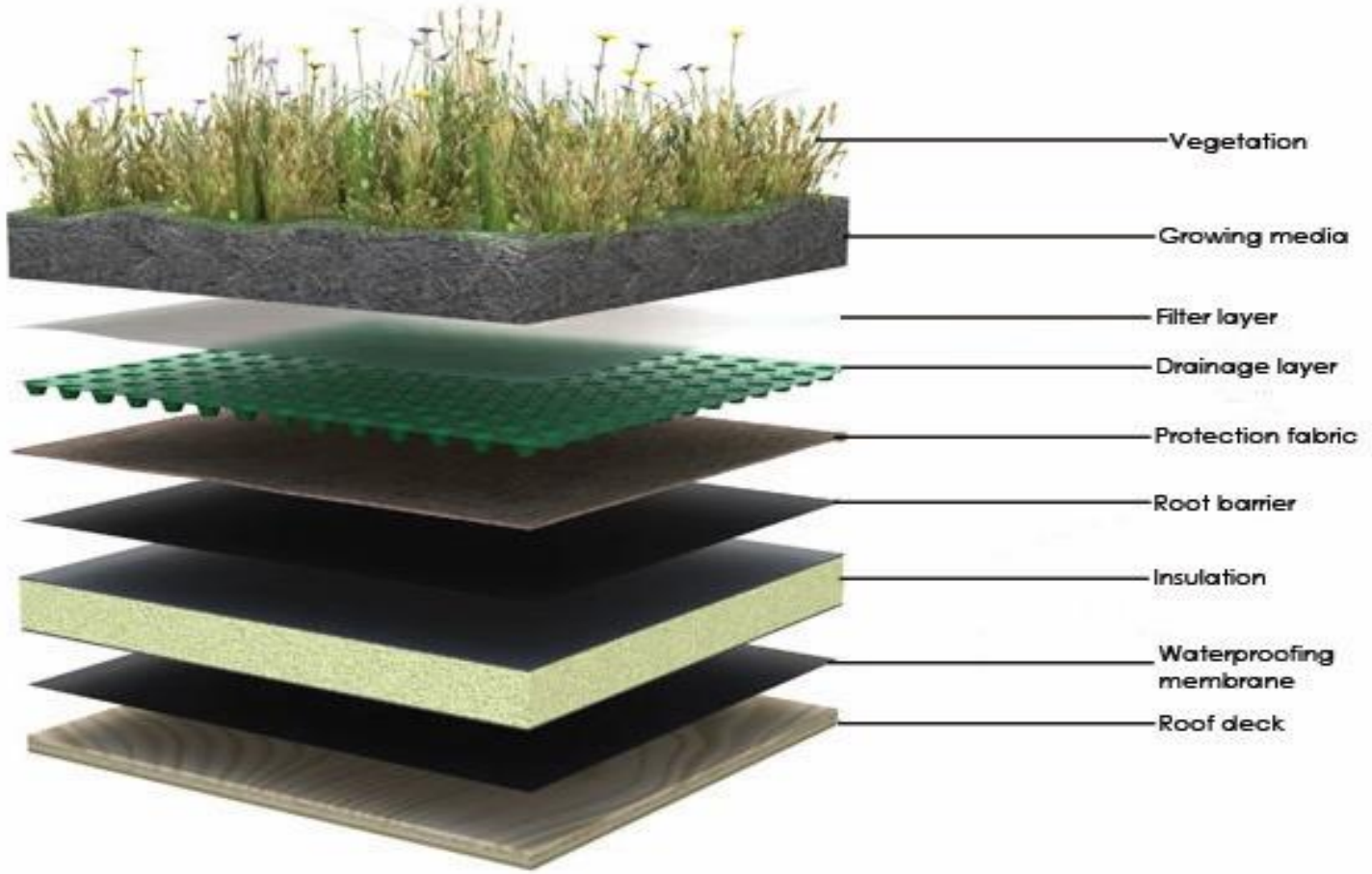
KSU International Student Center Rain Garden

KSU Engineering Rain Garden

Sunset Zoo

Green Roofs or Living Roofs

Green roofs
(also called living roofs) are engineered ecosystems consisting of vegetation and a layer of growth media over a series of additional layers.



The drainage layer typically offers both water storage & facilitates drainage, while the root barrier protects waterproofing & the roof deck.

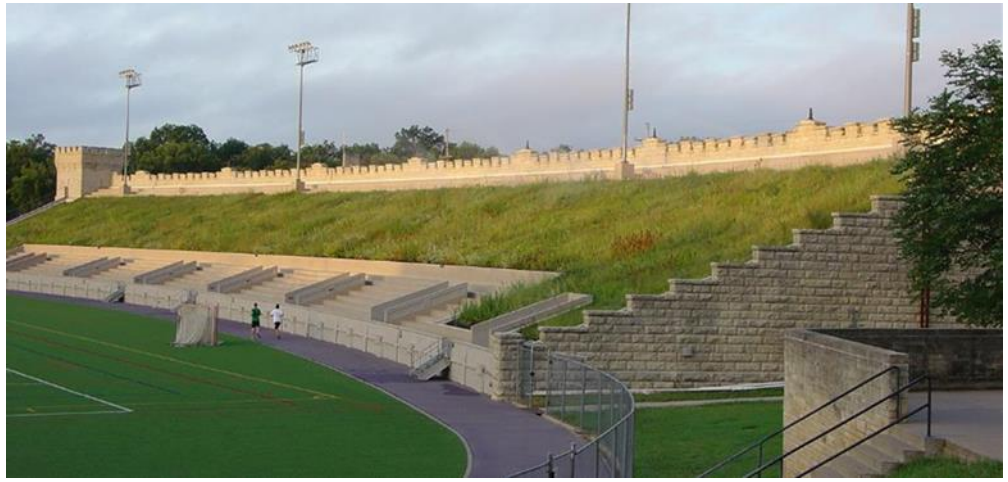
Potential Green Roof Benefits

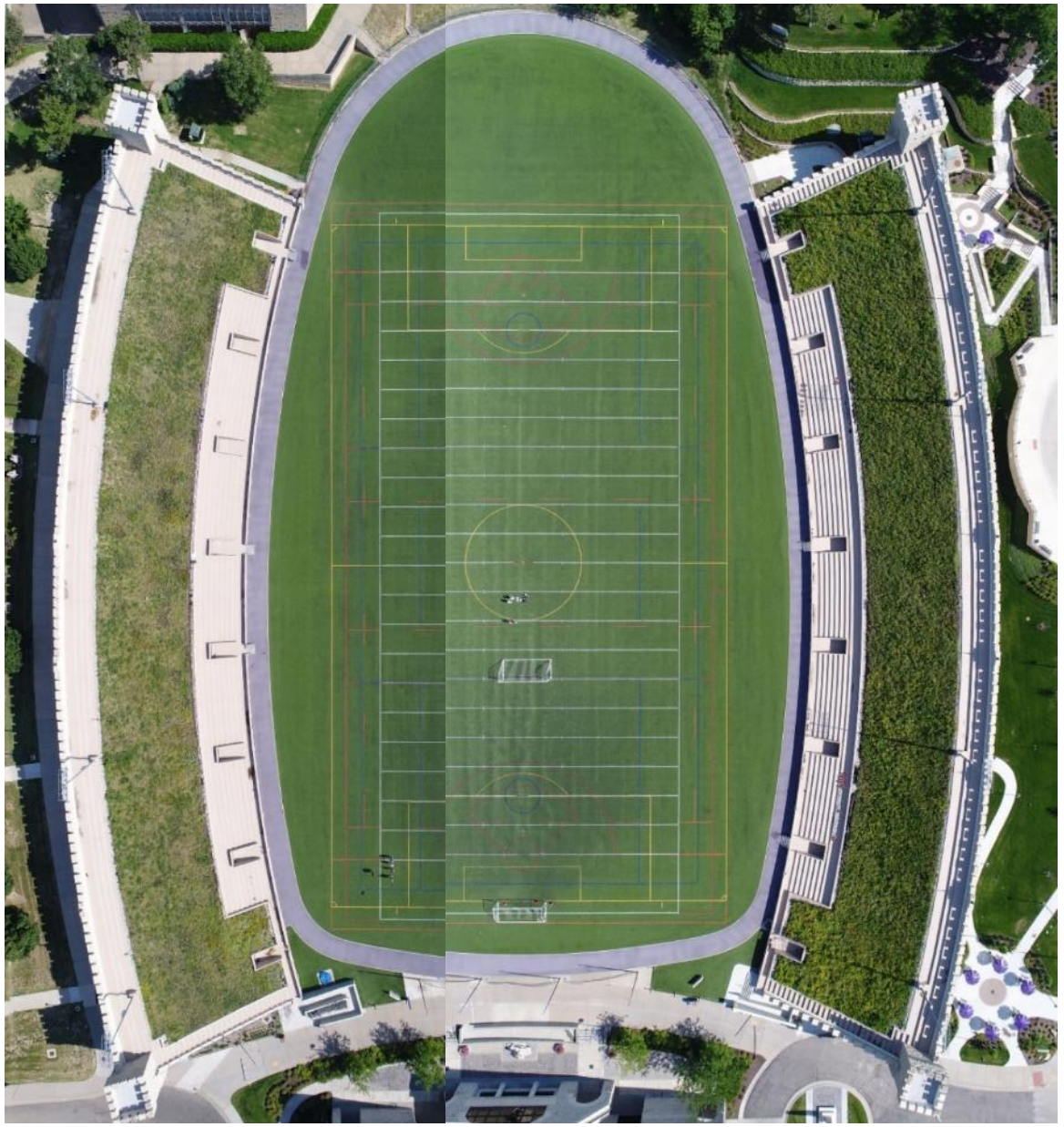
- **Reduce stormwater runoff volume & intensity**
- **Help alleviate the heat island effect**
- Increase the lifespan of roofing membranes
- Increase biodiversity and provide habitat
- Mitigate air pollution
- Provide building (rooftop) insulation
- Reduce noise
- Improve aesthetics
- Increase economic value
- Grow edible plants


Wasp on EMS-GR Penstemon

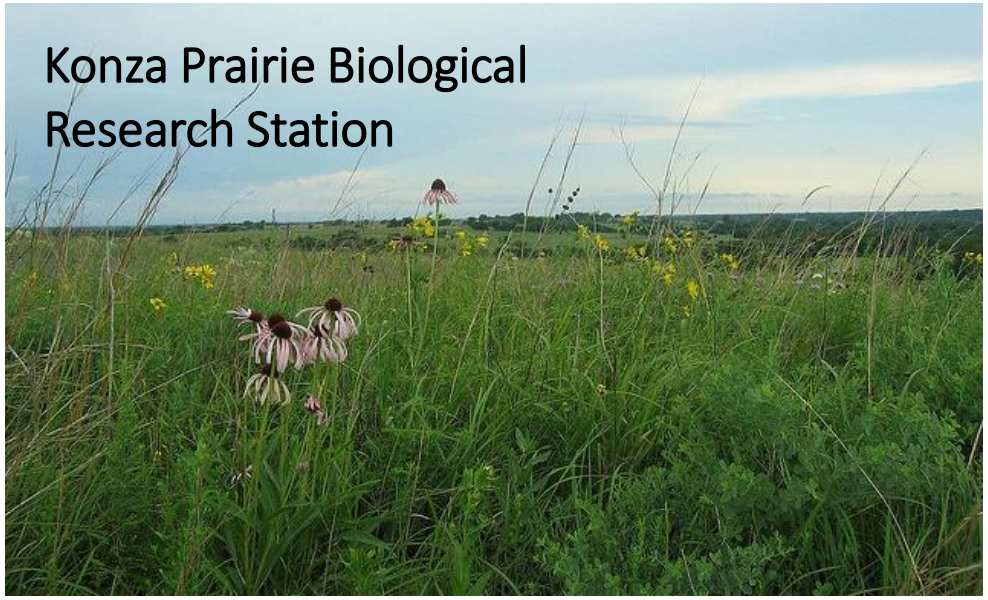

Beetle on EMS-GR Yarrow

Memorial Stadium Green Roofs





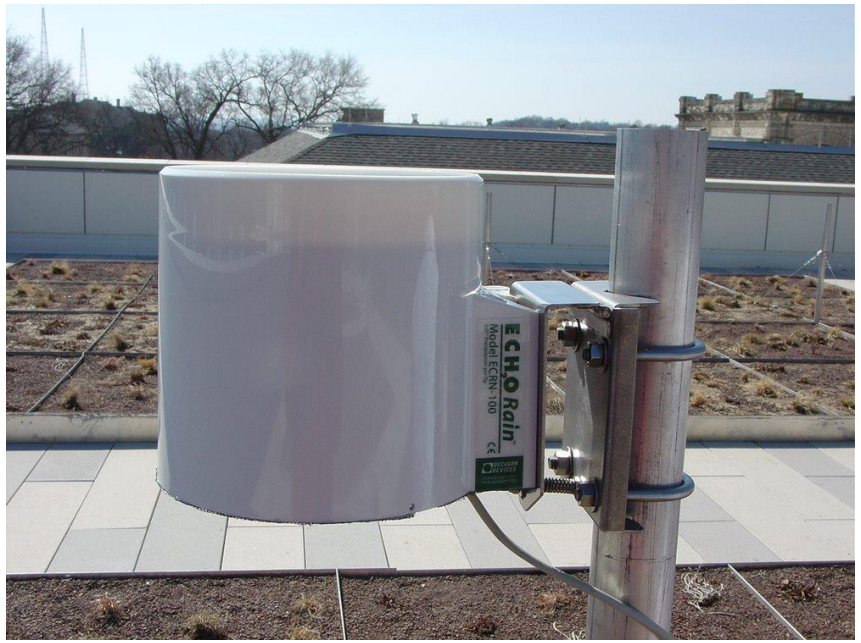
5 July 2017 - true color imagery

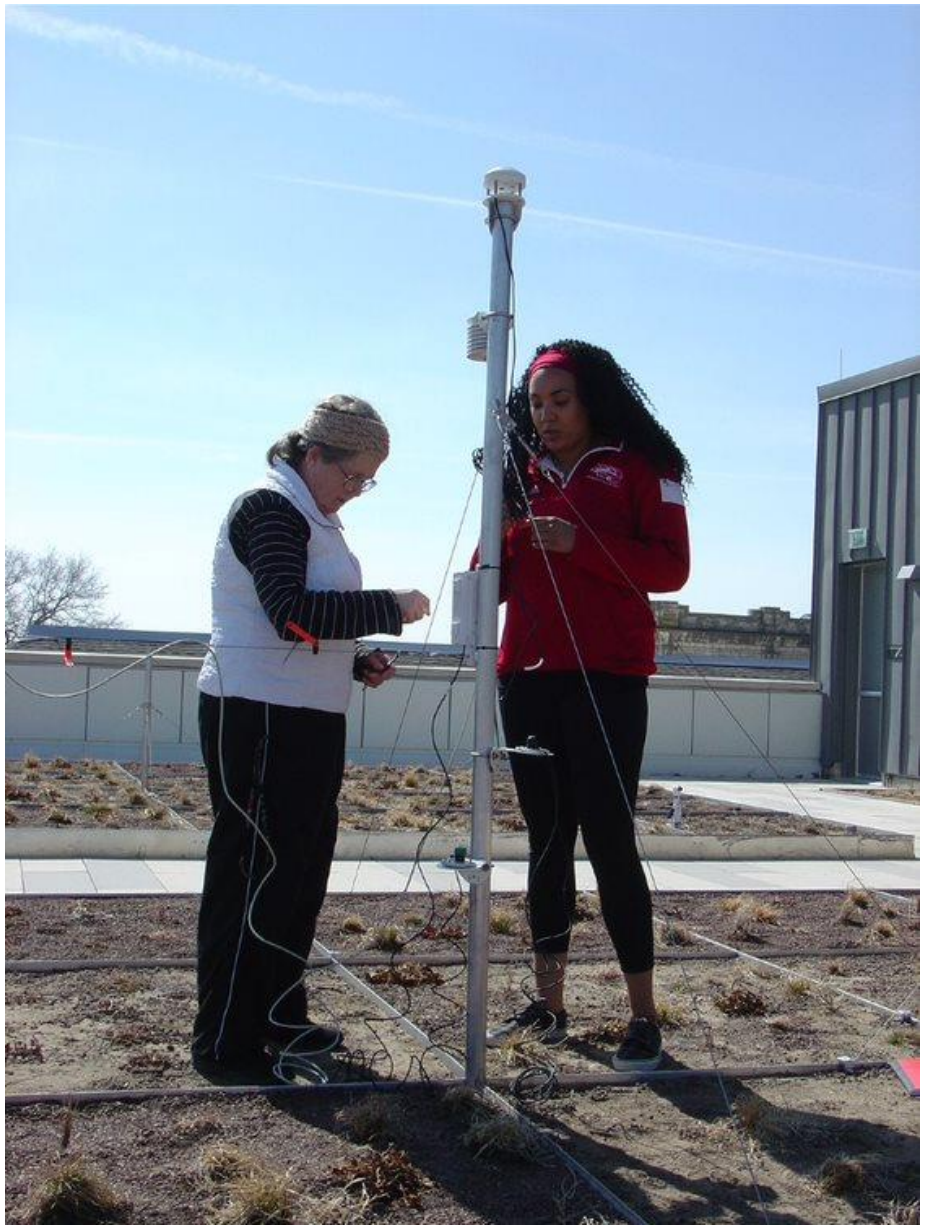


- **Native plants are adapted to local climates, frequently require no supplemental irrigation, and support local fauna.**
- Characteristics of the Flint Hills makes some prairie species very good candidates for green roof plantings.
- **Identifying native plant species capable of successfully surviving on rooftops is crucial if we are to provide habitat for local fauna while also meeting other important needs when green roofs are implemented.** Such needs include aesthetics and reasonable costs for implementation & management.

Green Roof Research

- Weather Station





Why is this work important?

- If well designed & managed, green roofs & other green infrastructure have the potential to serve as essential parts of interconnected and regenerative community open space networks.
- Landscape Ecology – bio-diverse patches can make a difference.
- We need to improve irrigation and management practices to make green roofs more sustainable and minimize non-essential costs.
- Humans exist within a wider ecosystem; conservation of this system is vital to human health, and the well-being of ecosystems and other organisms.

What does this have to do with Climate Change?

- **The way we develop/design our communities has significant impacts on greenhouse gas emissions.**
- As Environmental Designers we want to create systems that will last and can adapt to environmental changes throughout the years.
- Plant selection is one of the most important areas of knowledge when designing a green roof (and other GI projects). (Dvorak and Volder, 2010)
- Due to roof top conditions drought tolerance is critical (Wolf and Lundholm, 2008)

Community Planning

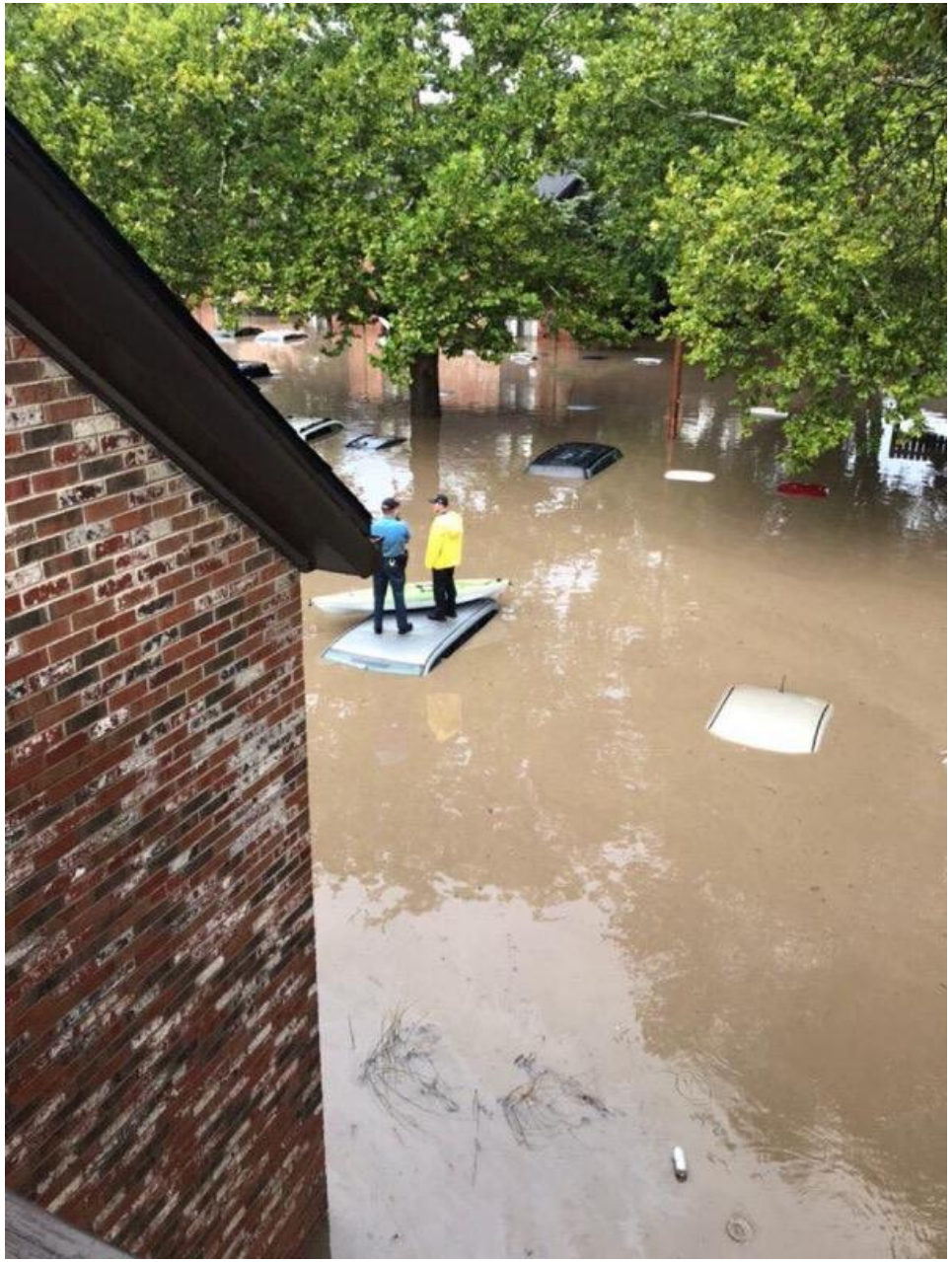
- 39 percent of carbon emissions comes from commercial and residential buildings
- Over 33 percent comes from transportation
  - The majority of that amount from passenger and freight traffic – moving people and goods around and in between our communities.
- What are Planners doing to be informed about our climate?
  - We need more collaboration between disciplines
  - Better understanding of how our land use practices contribute to the issues

Department of Energy, 2018

Future Interest

- How will design change as climate continues to change?
  - How will environmental changes affect plant selection?
  - We will need to select plants that can tolerate extreme droughts and can also extremely wet periods

Manhattan, KS - Sept 3, 2018



Questions
& Comments?

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Vijayaraghavan, K. 2016. “Green roofs: A critical review on the role of components, benefits, limitations and trends.” Renewable and Sustainable Energy Reviews 57 (5): 740-52.

Useful Resources

- https://www.epa.gov/heat-islands/using-green-roofs-reduce-heat-islands
- IPCC statement
- https://www.biohabitats.com/what-we-do/#climate-change
- https://www.nationalgeographic.org/encyclopedia/climate/
- https://www.epa.gov/smartgrowth/smart-growth-and-climate-change

Examples of Env. Design

- Rain gardens
- Bioswales & Bioretention Areas
- Green Roofs
- Choose plants that can handle water and drought. In Kansas our native prairie species are typically best

Plant Selection

- Due to roof top conditions drought tolerance is critical (Wolf and Lundholm, 2008)
- Beneficial adaptations may include: CAM photosynthesis pathways, drought avoidance and tolerance, woody growth, water storage organs, and other traits that reduce water loss and heat gain (Larson et al., 2000)
- Likely to be successful if the species is easily propagated, establishes rapidly and achieves high ground cover (Getter and Rowe, 2006)