urban habitat: the case for green roofs

Haven Kiers, UC Davis Arboretum & Public Garden

definitions

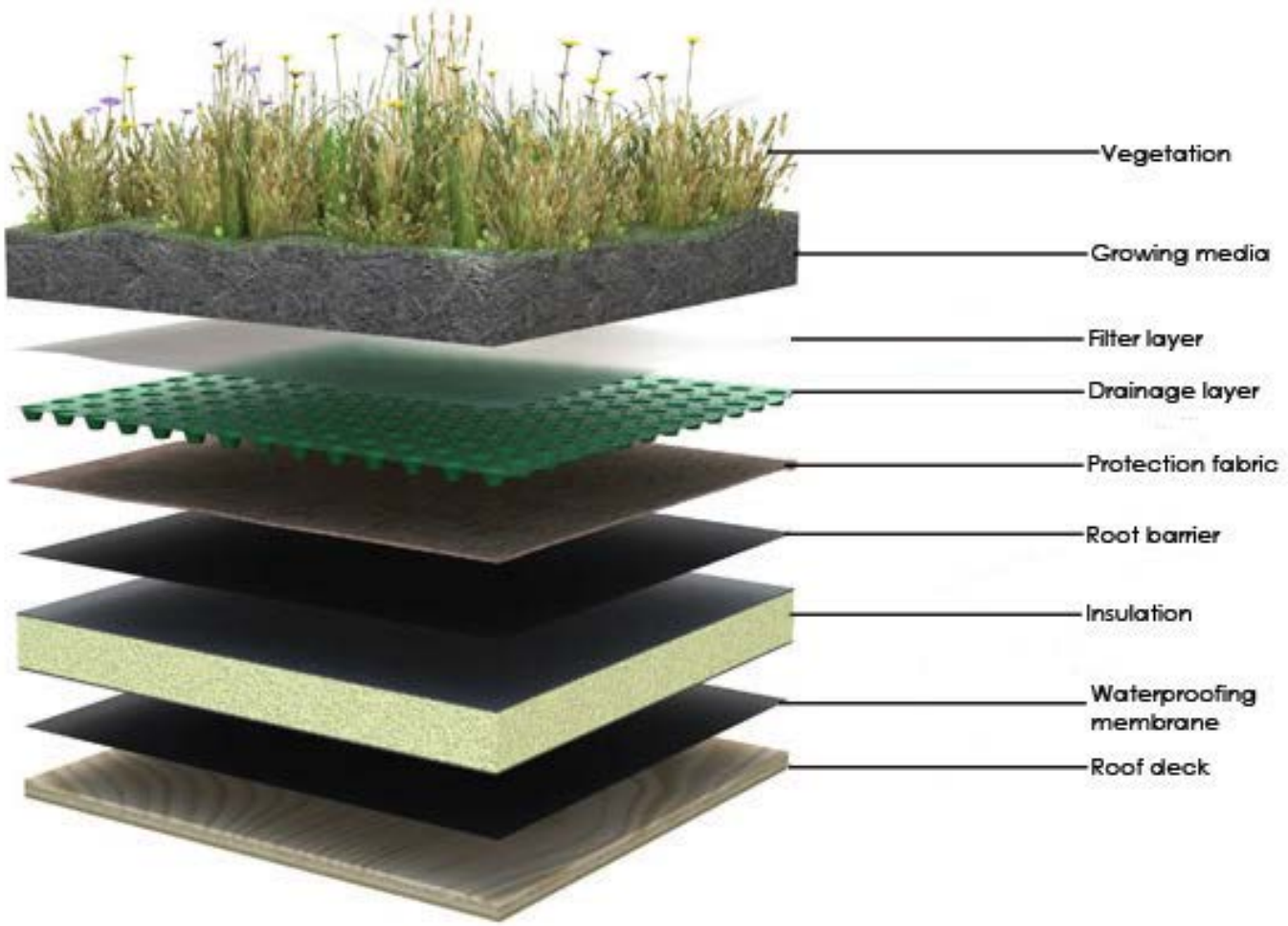
Green Roof: An area of planting built up on a roofed structure below, above, or at grade, that is separated from the natural ground by a man-made structure. Also referred to as –

- Living roofs
- Vegetated roofs
- Rooftop gardens
- Brown roofs (spontaneously seeded)
- Eco-roofs

Extensive Roof: low-to-no maintenance green roof landscaping consisting of shallow soil depths (<6”) with plant varieties restricted to primarily succulents, herbs, and grasses capable of withstanding harsh growing conditions.

Intensive Roof: green roof landscaping requiring regular maintenance consisting of deeper soil depths (>6”) with a wide variety of plants, including shrubs and small trees.

components



A green roof is an extension of the existing roof which involves the use of a root repellant system, a drainage and filter layer, a growing medium and plants.

function

Structure: Membrane, Drainage, Filter Fabric

Perform –

- Hydrology
- Aeration
- Physical separation of elements

Biology: Growing Medium, Plants

Perform –

- Ecological functions

MODULAR SYSTEMS

LOOSE LAID SYSTEMS

benefits

ECONOMIC

- Energy Efficiency - Reducing Cooling Costs for Buildings
- Increased Solar Panel Efficiency
- Prolonged Membrane Durability and Longevity
- Fire Prevention
- Local Job Creation - Design, Mfg, Installation and Maintenance
- Meeting Regulatory Requirements for Water Treatment of Urban Runoff
- Reduce Community Resistance to New Developments
- Noise Reduction
- LEED
- Marketing Opportunities

ENVIRONMENTAL

- Stormwater Management/Water Filtration
- Creation and Preservation of Habitat/Biodiversity
- Improved Air Quality
- Waste Diversion
- Urban Heat Island Effect Reduction
- Improved Liveabilty/Aesthetics

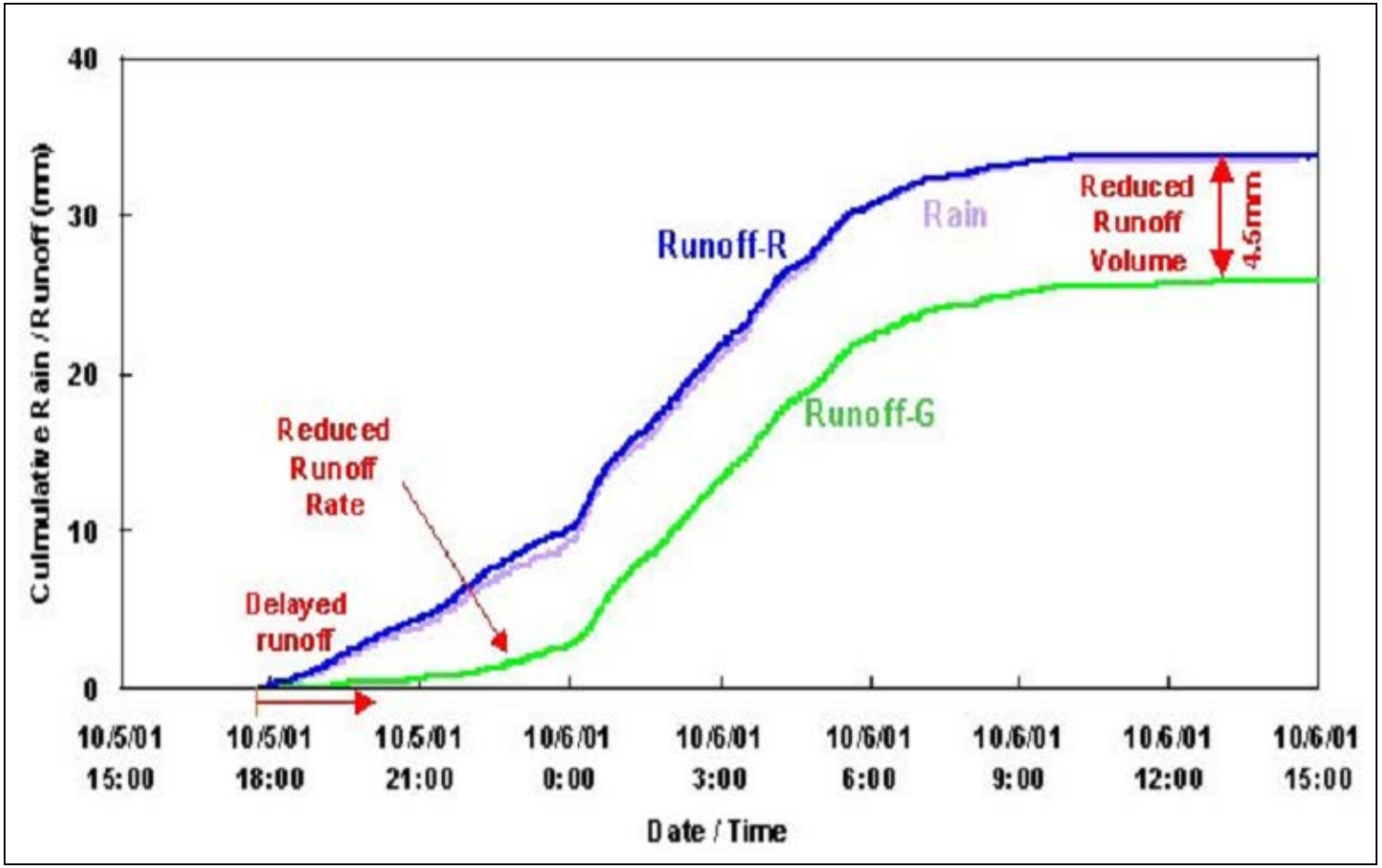
a closer look

- Improved stormwater management
- Ability to reduce heating and cooling demand load
- Improved marketability
- Creation and Preservation of habitat/biodiversity

IMPROVED STORMWATER MANAGEMENT

- Reduced stormwater runoff volumes
- Delayed stormwater runoff volumes
- Stormwater pollutant reductions
- Reduced sewer overflow events

Reduced and delayed stormwater runoff volumes



Source: National Research Council , Institute for Research in Construction

Stormwater pollutant reductions

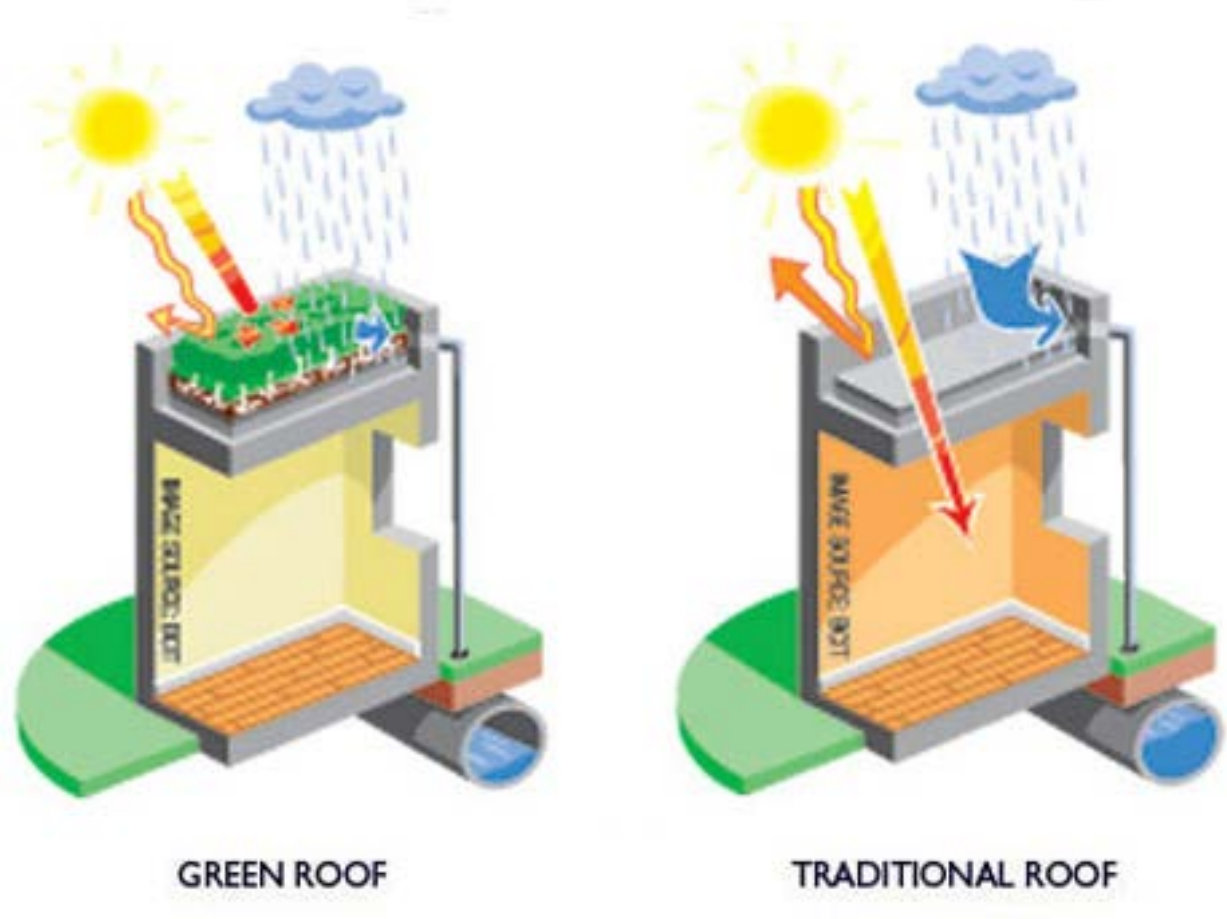
Runoff from green roofs has reduced levels of metals, PAHs, other pollutants, and bacteria due to a green roof's capacity for:

- Soil absorption
- Plant uptake
- Microbial activity
- Filtration
- Evapotranspiration

Reduced sewer overflow events

energy

ABILITY TO REDUCE HEATING AND COOLING LOAD

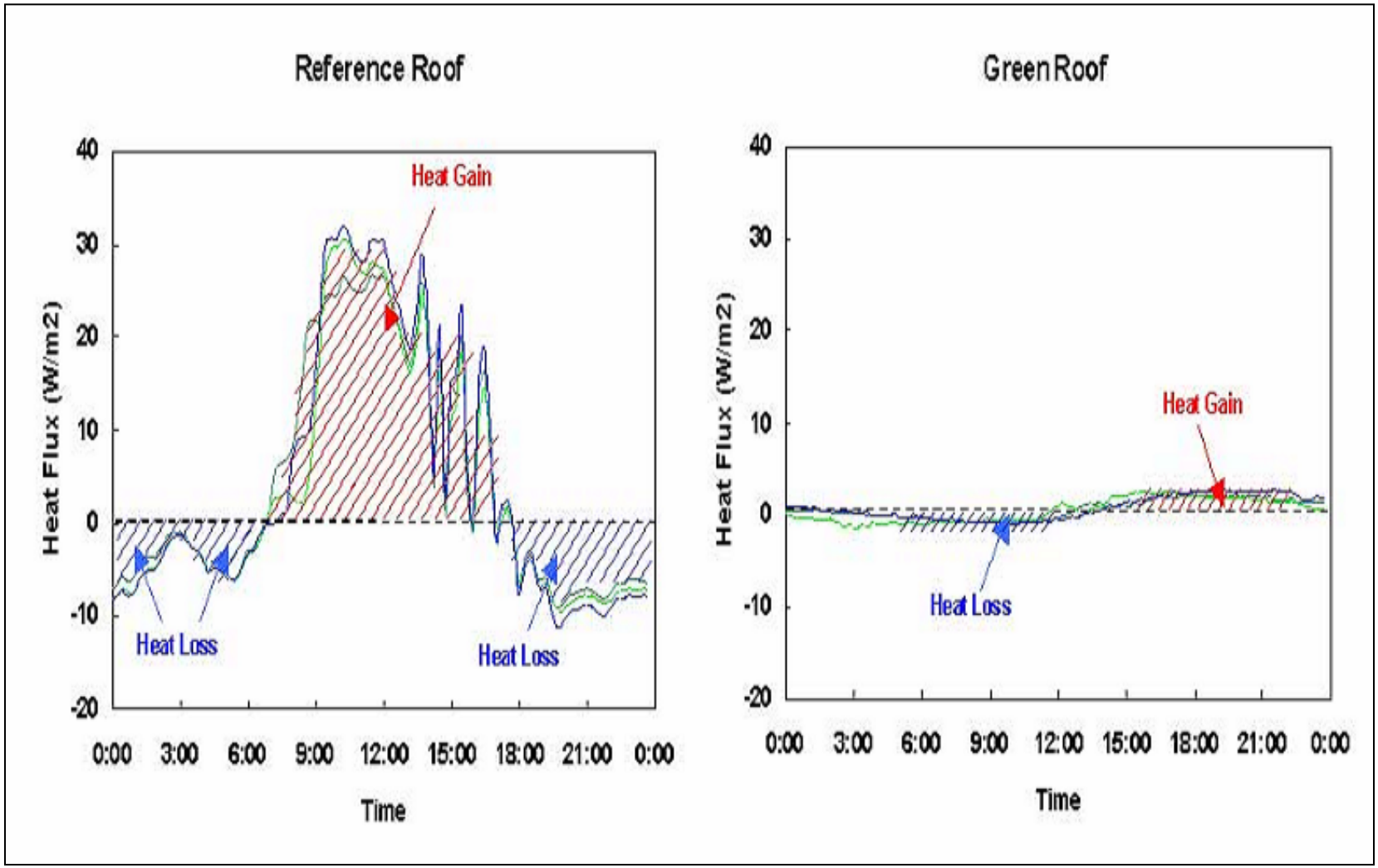


GREEN ROOF

TRADITIONAL ROOF

- In summer, the green roof protects the building from direct solar heat.
- In winter, the green roof minimizes heat loss through added insulation on the roof.
- Energy conservation translates into fewer greenhouse gas emissions.

Reduced roof temperature variability



marketability

IMPROVED MARKETABILITY

Green roofs, as a part of the green building movement, have been identified as facilitating:

- Sales
- Lease outs
- Increased property value
- Easier employee recruiting
- Lower employee turnover
- Improved corporate image

biodiversity

INCREASED BIODIVERSITY

- Creation of migration islands for species of insects and birds
- Improved urban habitat
- Stabilization of native and local populations
- Protection of endangered plants
- Rooftops can serve as refuge for creatures that struggle for survival (like ground nesting birds)

current typology

GREEN ROOF STANDARDS

- Highly engineered growing medium (mostly inorganic)
- Simple sedum plant palette
- Standardized systems and details
- Typology of manicured roofs

a new typology

DESIGNING FOR BIODIVERSITY



"Green roofs need to be seen less from the perspective of ornamental gardening and energy conservation and more from a regional perspective of landscape and ecological planning. The functional and technical approach taken by most green roof developers today can be enhanced by the spatial approach taken by conservation science practitioners."

precedents

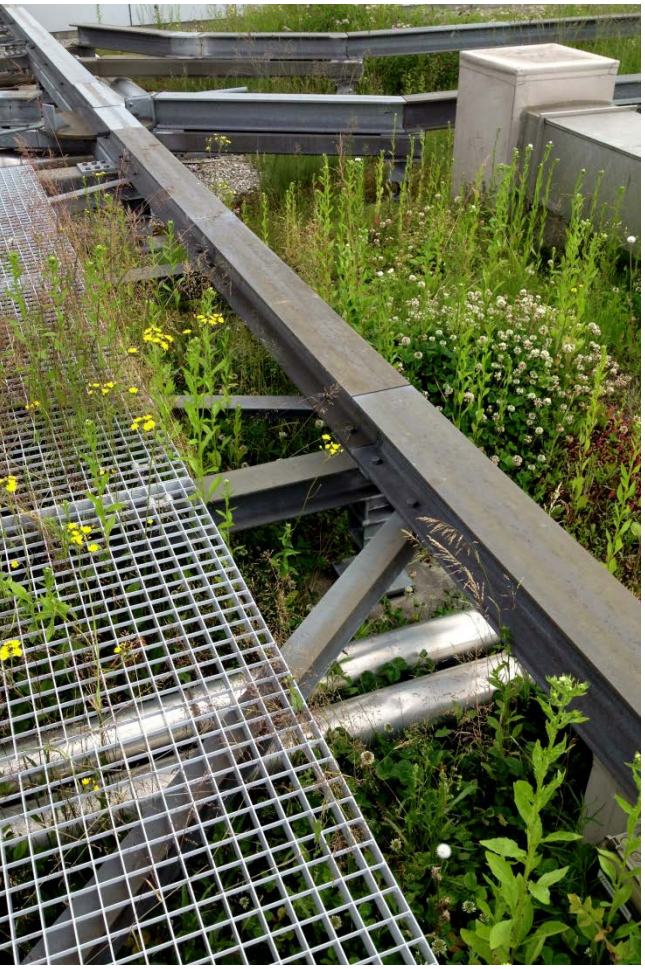
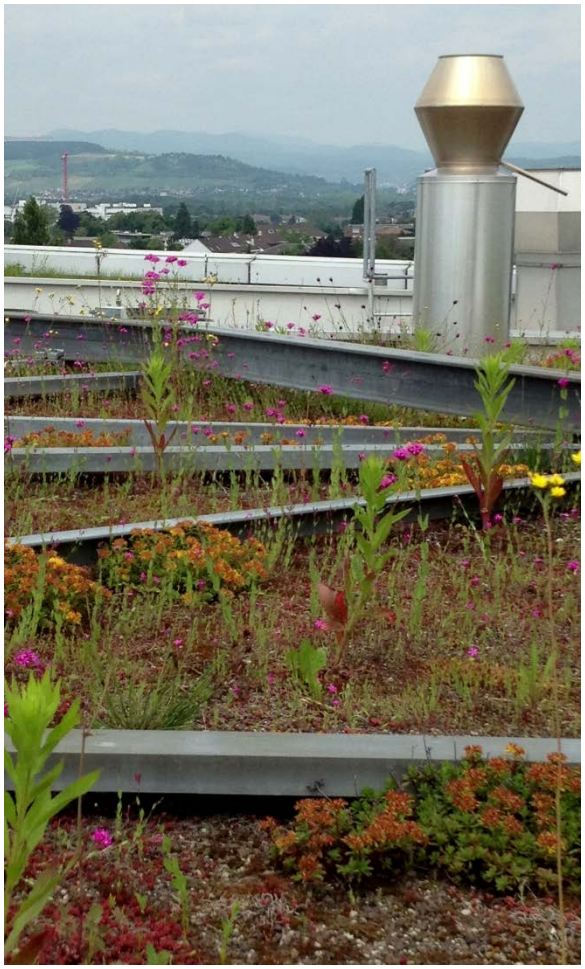
Lake Water Plant “Moos,” Zurich

- 100 year old roof - 1914
- 10 different orchid species
- 175 different plant species
- Protection of endangered plants taken from the original surrounding wet meadows (now developed)

Tram Depot Wiesenplatz, Basel

- 1996 – 1st Green Roof Campaign (subsidies and incentives)
- 2002 – Basel Building Code requires all new flat roofs to be green
- 2005 – 2nd Green Roof Campaign (subsidies and incentives)
- 2006 – 23% of all flat roofs are green (over 1700)

Jacob Burckhardt Haus, Basel


“When a new development receives planning permission, it includes detailed instructions on how to maximise the nature conservation properties. Personal advice from a green roof expert is also made available, funded by the government.”

Alex Gemperle AG, Sins

Earth House Settlement, Dietikon

Sheep Run, Chicken Coop, and Tea Garden

precedents - CA

California Academy of Sciences, San Francisco

- Invertebrate research
- Native bee habitat
- Red tail hawk flying school
- Nesting kildeer
- 95 native plant species – 1.7 million plants

Salmon Creek School, Sonoma County

- 12 species succulents; 3 are CA natives
- Net zero run off to protect Salmon
- Mounded soil (3.5 – 10”)
- Large volcanic rocks distributed across roof for invertebrate habitat

Heron's Head Eco Center, San Francisco

- Layered with rocks, logs, shells for habitat
- Incorporates a small roof wetland

Cooper Point, Big Sur

- 24 varieties of native/ rare plants and wildflowers
- Hand seeded
- Minimal site disturbance

“Isn´t it against all logic, if a whole urban surface remains unused, missing the dialogue with the stars?“

- Le Corbusier

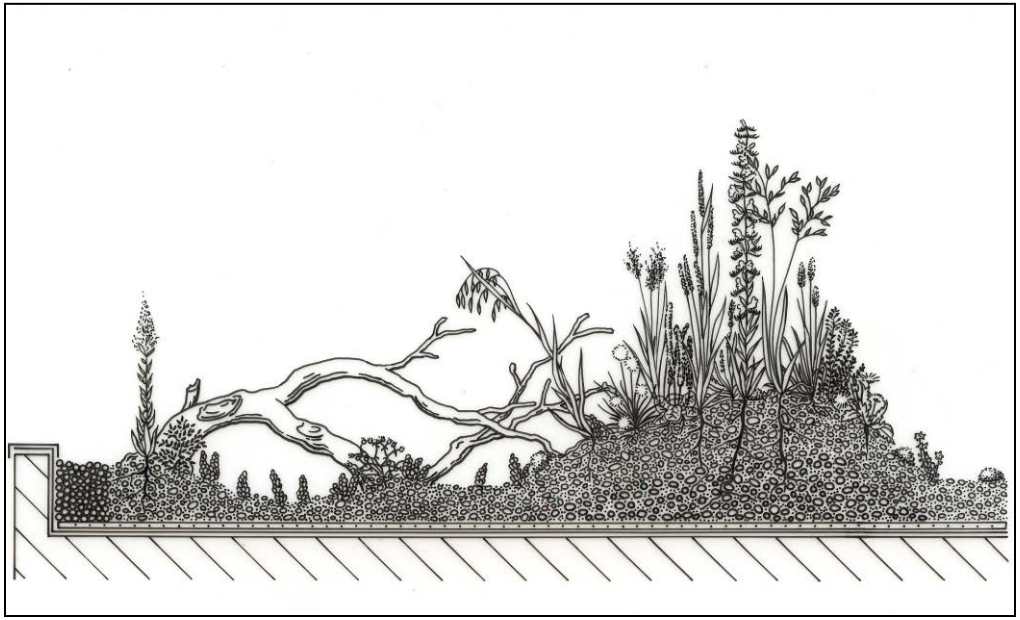
guidelines

- Green roofs don’t have to be green.
- A green roof doesn’t need to have an expensive “system” in order to work effectively.
- There is nothing to be afraid of.

design specifics

Factors that enhance a green roof's ecological biodiversity include:

- Plant type, height, foliar mass, and root depth.
- Growing medium composition and depth.
- Surface and material variation (e.g. gravel, logs and branches).
- Building height.



Basel's green roof biodiversity regulations

- The growing medium should be composed of native regional soils — the regulation recommends consulting a horticulturalist
- The growing medium should be at least 10 cm deep (4")
- Mounds 30cm (12") high and 3m (9') wide should be provided as habitat for invertebrates
- Vegetation should be a mix of native plant species, characteristic to Basel.
- Green roofs on flat roofs over 1,000 m2 (10,000 sf) must involve consultation with the city's green roof expert during design and construction




designing for birds

Green roofs can provide for birds:

- Food habitat
- Predator-free breeding habitat for ground nesting birds including Skylark, Oystercatcher, Ringed & Little Ringed Plovers, Killdeer, Tern and Lapwings
- Habitat lost to development (Black Redstart)

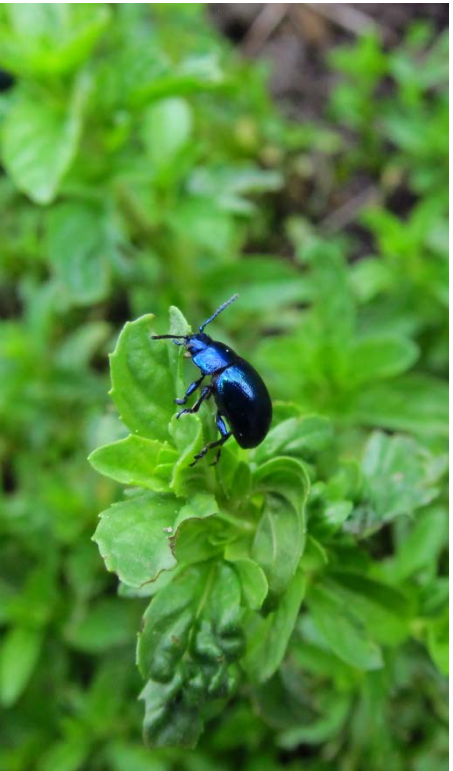
Design specifics:

- Incorporate larger stones and logs for birds to use as perches while searching for food
- For birds like the White Wagtail, include areas with little or no vegetation
- Use local soil to encourage a healthy invertebrate population

designing for insects

Green roofs can create places of refuge for invertebrates

- One Swiss green roof contained 79 species of beetles (13 endangered) and 40 species of spiders (7 endangered)
- A London study found a higher abundance of invertebrates on green roofs than on brownfield sites and at least 10% of the target species are nationally rare



Design specifics:

- Use dried or sunbeaten logs for insects to nest in
- Incorporate rotting logs to host a range of invertebrates including stag beetles
- Create areas with boulders and bare soil for spider species such as money, wolf and crab to use as hunting grounds
- Larger stones and pieces of timber can provide added humidity on roofs for spiders and beetles
- Consider adding solar panels to create shady areas

designing for bees

Green roofs create habitat for bees in the urban environment

- It is crucial for bees to find foraging sites from early spring to late summer

- Green roofs planted with a wide selection of wildflowers can attract bees and provide suitable forage habitat

Design specifics:

- Create small mounds of coarse sand as habitat for mining and solitary bees to nest on the roof
- Select a mix of wildflowers for continuous bloom from spring to late summer
- Include perennial and annual seeds and ephemerals that will thrive in the local climate
- Incorporate native plants whenever possible
- Consider adding bee hives or insect hotels to the roof

designing for butterflies

Green roofs have the potential to aid in rare species conservation

• Green roofs can be designed with plants that are important food sources for endangered butterflies such as the Pipevine Swallowtail or the Bay Checkerspot

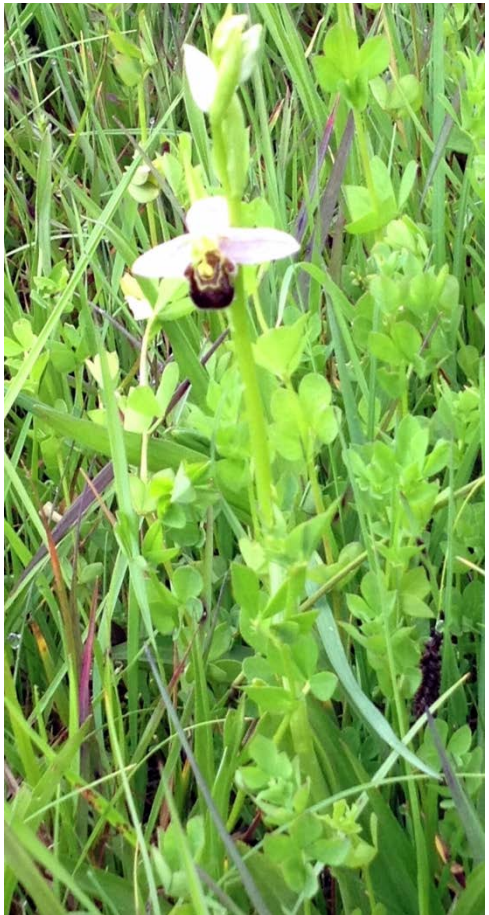
Design specifics:

- Include primary food plants of the butterfly caterpillars
- Select plants that provide nectar for the adult butterflies
- Ensure that desired butterfly populations exist (or can be introduced) within the vicinity of the green roof

designing for flowers

Green roofs provide an urban refuge for rare regional plants

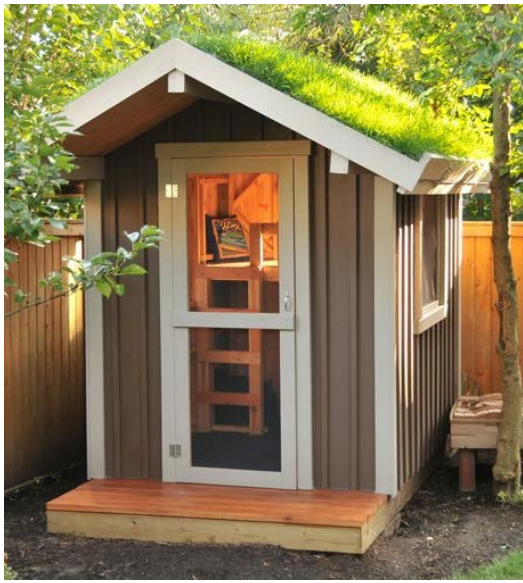
- Because a roof is not exposed to the typical disturbances of sites on the ground such as development, foot traffic, pesticides, grazing, etc., endangered plant communities have a protected growing environment

Design specifics:

- Use local soil to encourage native plants to colonize on the roof and flourish
- Recreate the lost habitat of endangered plants by mimicking earlier growing conditions
- Consider adding solar panels to:
    - provide areas of shade and improve plant biodiversity
    - create water run off from the panels' surface and concentrate moisture at the foot of the panel
- Experiment with a wide variety of plants

small scale

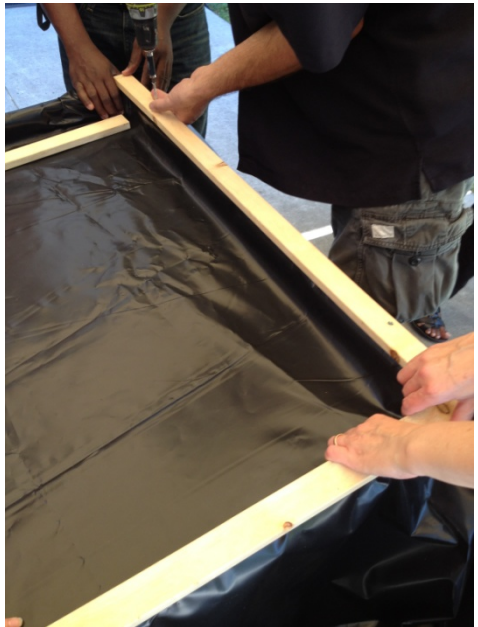



PENFIELD

diy






experiment
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