Presentation Outline

- History - Abridged
- Benefits
- Types
- Construction - Structure, Soil, Plants
- Examples
- The Lazarus Green Roof

History of Green Roofs

- Hanging Gardens of Babylon
  (What Is Old is New Again)

Why a Green Roof?

Green Roof Benefits

- Reduces and Slows Stormwater Runoff
- Decreases Heating and Cooling Costs
- Reduces Heat Island Effect in Cities
- Extends Roof Life
- Adds Habitat for Plants and Animals
- Reduces Noise
- Adds Moisture to Air
- Adds Beauty
**Storm Water Benefits:**

- Reduces and Slows Runoff
  - An extensive green roof like this stores 75% of water in plants and soil layer
  - 25% percolates through vegetation to drainage outlet and is released to storm drains after several hours
  - Reduces peak flow, especially during brief, intense downpours

**Runoff from Vegetated Roof Covers 3-14 inches in thickness**

**Green Roofs**

**Storm Water Monitoring**

**Buildings account for 36% of U.S. energy consumption:**

- Heating
- Cooling
- Lighting

**Energy Benefits: decreases heating and cooling costs:**

- Green Roofs provide thermal insulation
- In new construction, a green roof can allow a building to be designed with a smaller HVAC system, requiring less maintenance
Temperature Variation
Philadelphia Roofmeadow

Extends Roof Life

- Reduces daily expansion and contraction caused by temperature fluctuations
- Shields roof from sun’s harmful UV rays
- Protects from abrasion and physical wear
- Extends service life of underlying waterproofing system

Habitat Replacement Benefits

- Birds
- Insects
- Native Grasses
- Wildflowers
- Rare and Endangered Indigenous Plants

Microclimate Modification

- Adds moisture to atmosphere through vegetative transpiration
- Potential to reduce urban heat island effect

Noise Reduction Benefits

- Acoustic Insulation
- 50 decibel reduction with 6” sod

Aesthetic Benefits

- Add color
- Soften hard edges
- Echo natural forms such as surrounding mountains
Types of Green Roofs

- **Extensive**
  - 1” soil depth
  - Add 15-50 pounds/s.f.
  - Not accessible
  - Built for environmental benefits

- **Intensive**
  - Minimum 12” soil to create a traditional roof garden with large trees and shrubs
  - Elaborate drainage and irrigation
  - Adds 80-150 pounds/s.f.
  - Accessible

LEED Scoring

Leadership in Energy and Environmental Design
US Green Building Council

- One category specifically related to Green Roof (Urban Heat Island), worth 1 credit
- Contributes to 5 other categories, worth up to 16 credits
  - Storm water management
  - Water efficient landscaping
  - Improved energy performance
  - Recycled material content
  - Local and regional materials

Soil Specifications

- No Topsoil (Too heavy and compacting)
- Sample Growing Medium (2”-6” typical profile)
  - 25% Coarse Sand
  - 25% Forest Humus
  - 10% Red Lava
  - 15% Fir Humus
  - 25% Aged Humus

Soil Depth Specifications

- For sedum (stonecrop – non-native): 2” soil depth
- For native plants and prairie grasses: 3 - 6” soil depth
- For trees and shrubs: several feet of soil depth
- Weight of garden may require additional steel reinforcing

Vegetation Specifications: native plants and prairie grasses

- Root system is deep so need more soil (more weight requires stronger structural support)
- Need to control weeds and supply ample water while getting established
- Irrigation may be necessary to prevent drying out (a problem during fireworks)
- Need to mow at least once a year to minimize weeds and allow natives to predominate.
Vegetation Specifications: Sedum

- Shallow root system needs less soil
- Out-competes weeds
- Drought tolerant
- Easily planted through cuttings and then hydroseeding
- Evergreen
- Withstands climate extremes
- Flowers summer through fall - pinks, purple, yellow, white, red fall color
- Need more than 2 varieties to outsmart potential disease problems. Eight species were used at the Ford River Rouge truck plant.

Plants for Extensive Roofs
- Sedum album
- Sedum reflexum
- Sedum sexangulare
- Sedum spurium
- Sedum flavescent
- Achillea millefolium
- Ammi visnaga
- Dianthus deltoides
- Festuca glauca
- Hieracium pilosella
- Origanum vulgare
- Petrohagia saxifraga
- Anthemis tinctoria
- Potentilla verna
- Prunella graniflora
- Aster linosyris

GREEN ROOFS
William McDonough & Partners
Examples
- The GAP Corporate Campus – San Bruno, CA
- Computer History Museum Design Competition – Mountain View, CA
- Grand Rapids Art Museum Project – Grand Rapids, MI
- Museum of Life and the Environment – York County, S. Carolina
- Habitat @22 – Spain
- National Museum of Science and Industry – Wroughton, UK
- Ford Rouge River Truck Plant – Dearborn, MI

Chicago City Hall: Before and After

Heinz 57 Center
During Planting and 18 months later
Northern Kentucky Sanitation District #1

Geauga Park District
West Woods Nature Center

Lazarus Green Roof: In The Beginning...

Green Roof covers 15,988 s.f. on the southwest quadrant (15% of roof)
Lazarus Green Roof: liner installation summer 2006

Ballasted rail system with recycled plastic planters and concrete pavers

Irrigation lines run through the rail system to the planters
Summer 2007: Be patient...

Lazarus Green Roof

- 7 zones: 4 irrigated, three with drought-tolerant plants not requiring irrigation
- Captures first 1” of rainfall for building’s grey water system, used to flush toilets
- Only recycled water used for irrigation, stored in classic “L” Lazarus Department Store water tank on top of the building
- More than 60 plant varieties (24,000 plugs to start, 6 inches apart)
- Shallow areas include achillea (yarrow), allium (garlic), dianthus, dragon’s blood sedum, prostrate asters and potentillas
- 8” deep areas include some herbs like catmint and a few crocus bulbs
- 12” deep irrigated area includes grasses such as meadow fescue. Deeper areas are over the building support columns and I-beams.
Garden path made of discarded rubber toys and other recycled products

Paver tiles made of recycled automobile tires. (No high heels, please!)

Be more patient: Vines will eventually cover some fences around the HVAC units

OhioEPA would like to thank:

- Dave Long, Ohio Equities
- Columbus Downtown Development Corporation
- Gary Lichtenfels, Lichtenfels Nursery
- Roofscapes, Inc www.roofmeadow.com
- Brian Ezzell and Edgar Lampert, The Georgetown Company