Green Infrastructure and the Urban Forest: Thinking Outside the Planter Box

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Watershed Management Group

Let's put a tree there!


COUNTY-CITY


MONTHLY PARKING
AVAILABLE

What is Green Infrastructure?

- **WMG: "constructed features that use living, natural systems to provide environmental services, such as capturing, cleaning and infiltrating stormwater; shading and cooling streets and buildings; and calming traffic."**

What is Green Infrastructure?

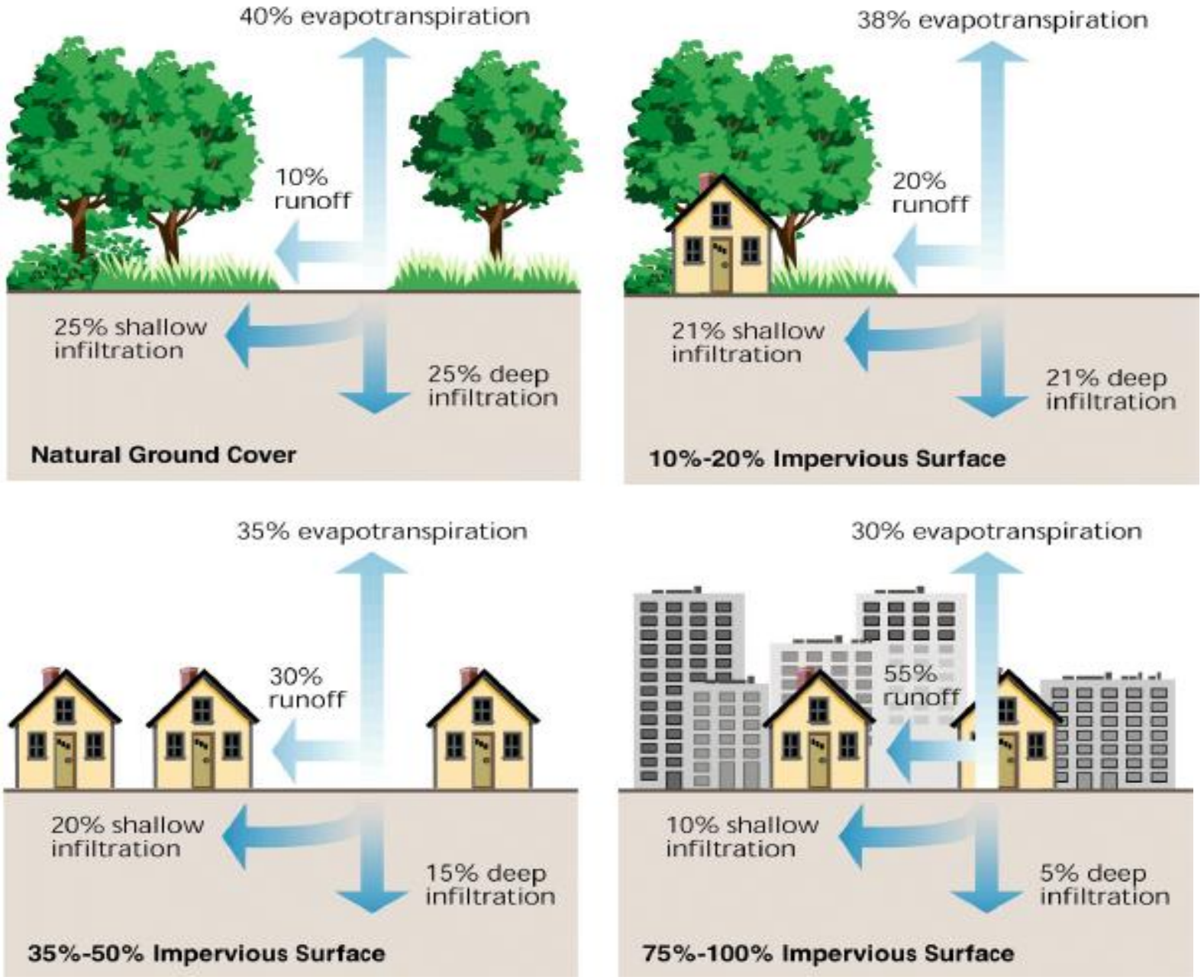
- Low Impact Development (LID)
- Integrated Water Management
- Water Sensitive Urban Design
- Best Management Practices for Stormwater Quality (BMP's)

What is Green Infrastructure?

- Bioretention
- Traffic Chicanes
- Green Roofs
- Stormwater BMPs
- Permeable Paving
- Preservation of Natural Systems

Why Green Infrastructure?

- Environmental Benefits
  - Flood Control
  - Reduce Urban Heat Island
  - Carbon Sequestration
  - Water Quality
  - Remove Pollutants

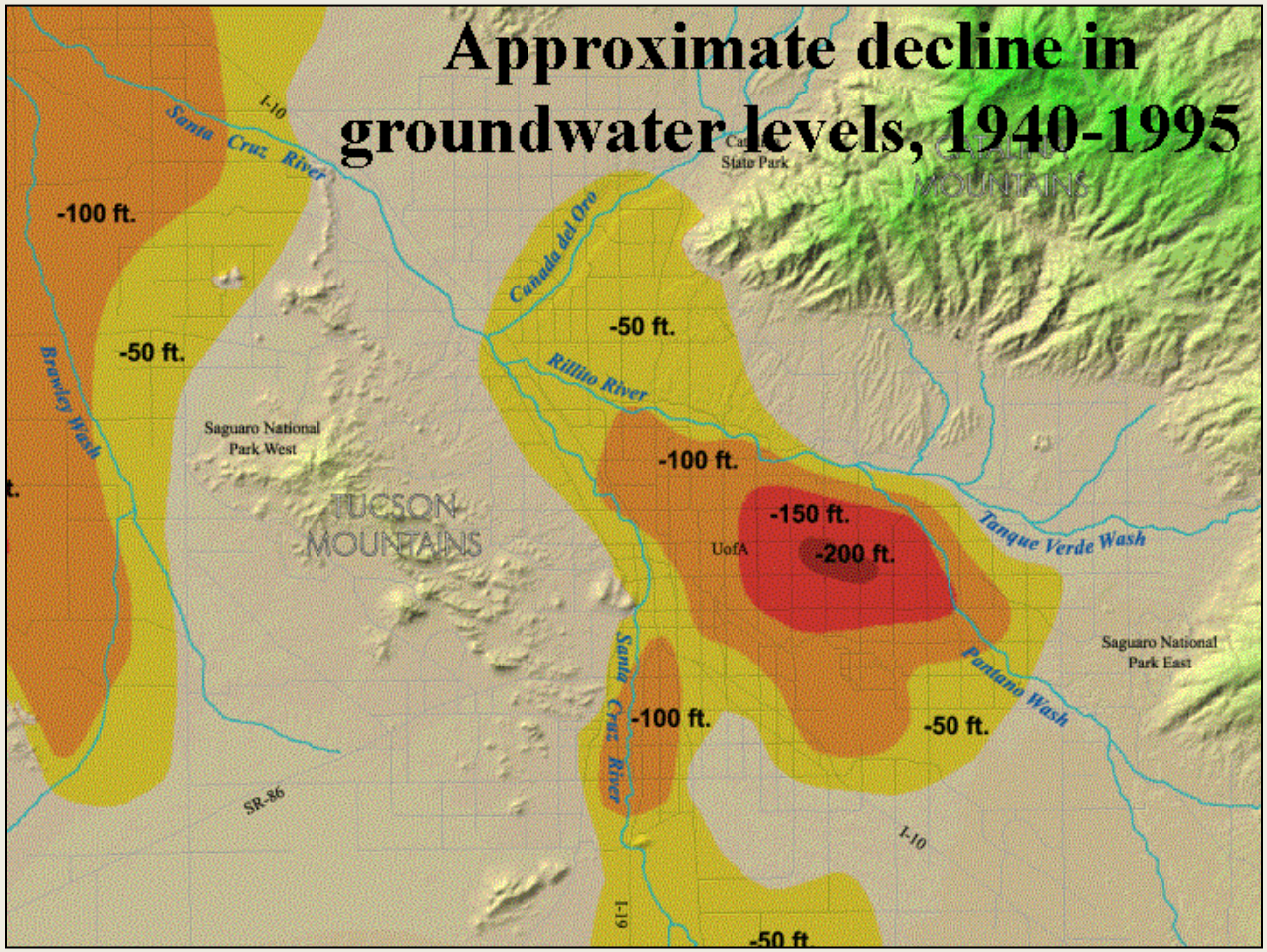

40% evapotranspiration
10% runoff
25% shallow infiltration
25% deep infiltration
Natural Ground Cover
38% evapotranspiration
20% runoff
21% shallow infiltration
21% deep infiltration
10%-20% Impervious Surface
35% evapotranspiration
30% runoff
20% shallow infiltration
15% deep infiltration
35%-50% Impervious Surface
30% evapotranspiration
55% runoff
10% shallow infiltration
5% deep infiltration
75%-100% Impervious Surface

Source: EPA

Increased Runoff and Flooding

Increased Runoff and Flooding

Decreased groundwater recharge

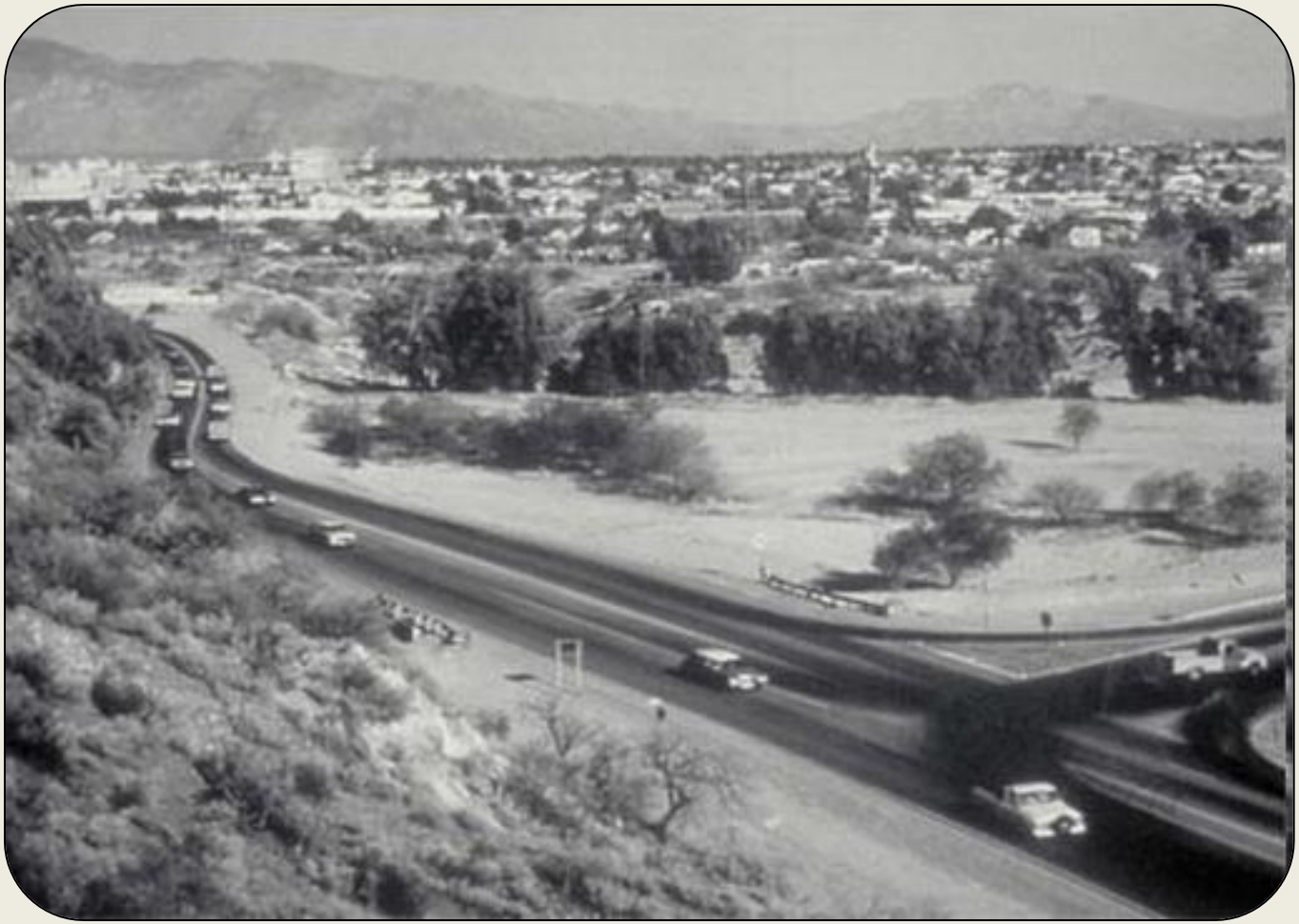


Source: Gelt, J. et al. 1999. Water in the Tucson Area: Seeking Sustainability, Water Resources Research Center, The University of Arizona

Decreased groundwater recharge

Santa Cruz River @ Tucson, 1904

Decreased groundwater recharge

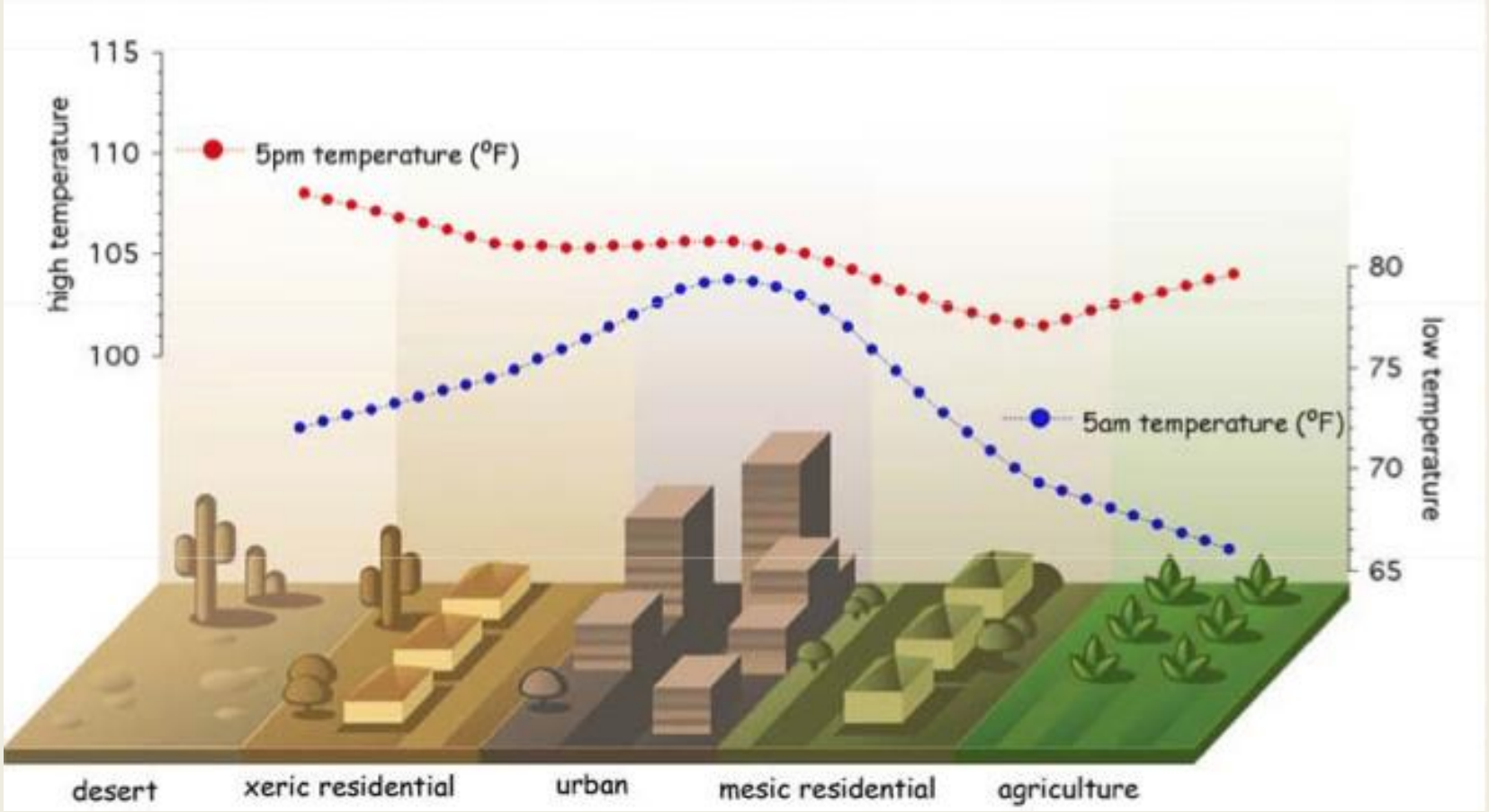


Santa Cruz River @ Tucson, 1981

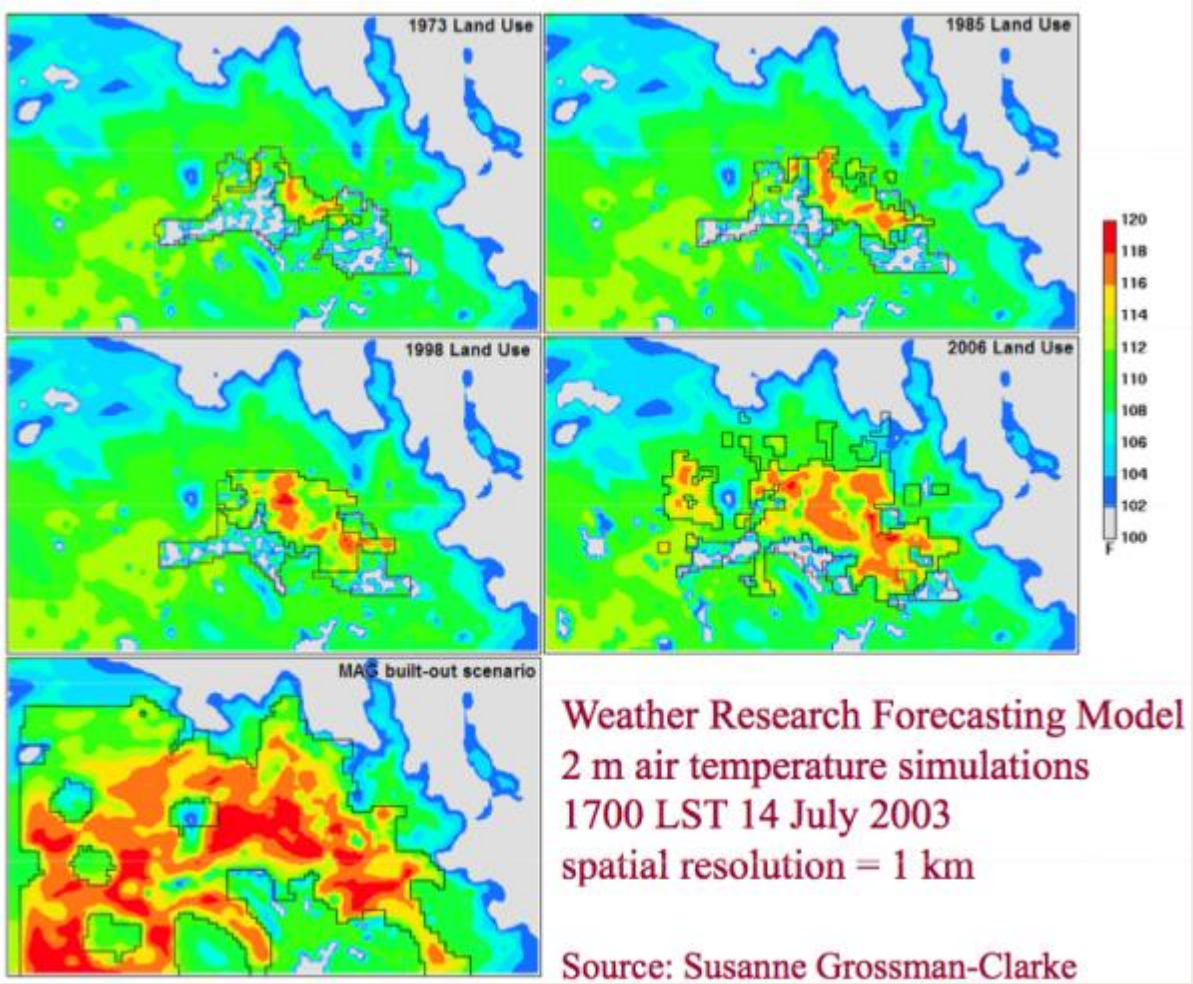
Decreased groundwater recharge

Urban Heat Island

Urban Heat Island



Urban Heat Island



Urban Heat Island

In Sun:

Grass:
91.0º F

Soil:
91.0º F

Litter:
101.1º F

Rock:
131.8º F

In Shade:

Grass:
64.1º F

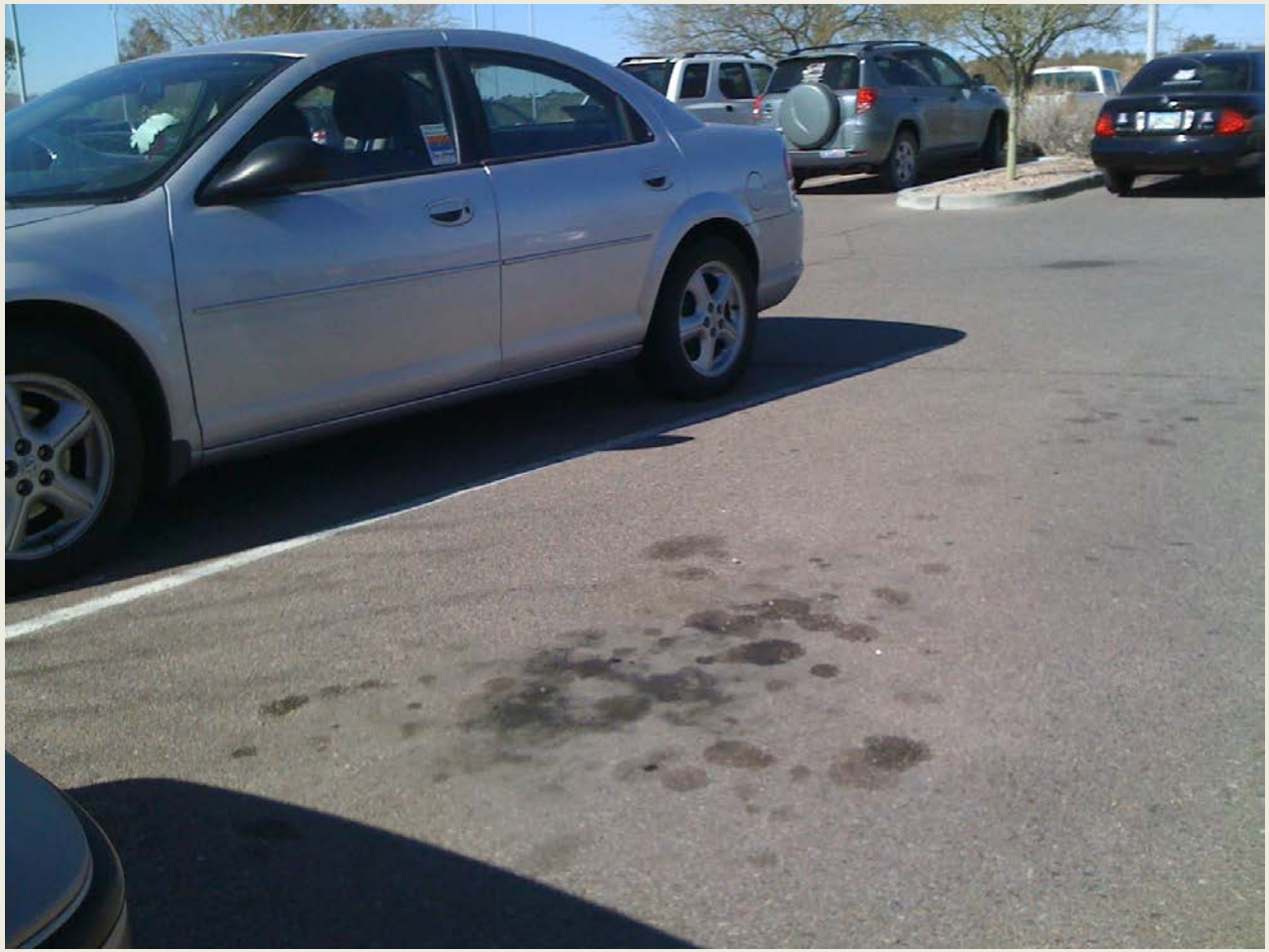
Soil:
56.2º F

Litter:
60.6º F

Rock:
Unmeasured; nearby Cement
76.9º F

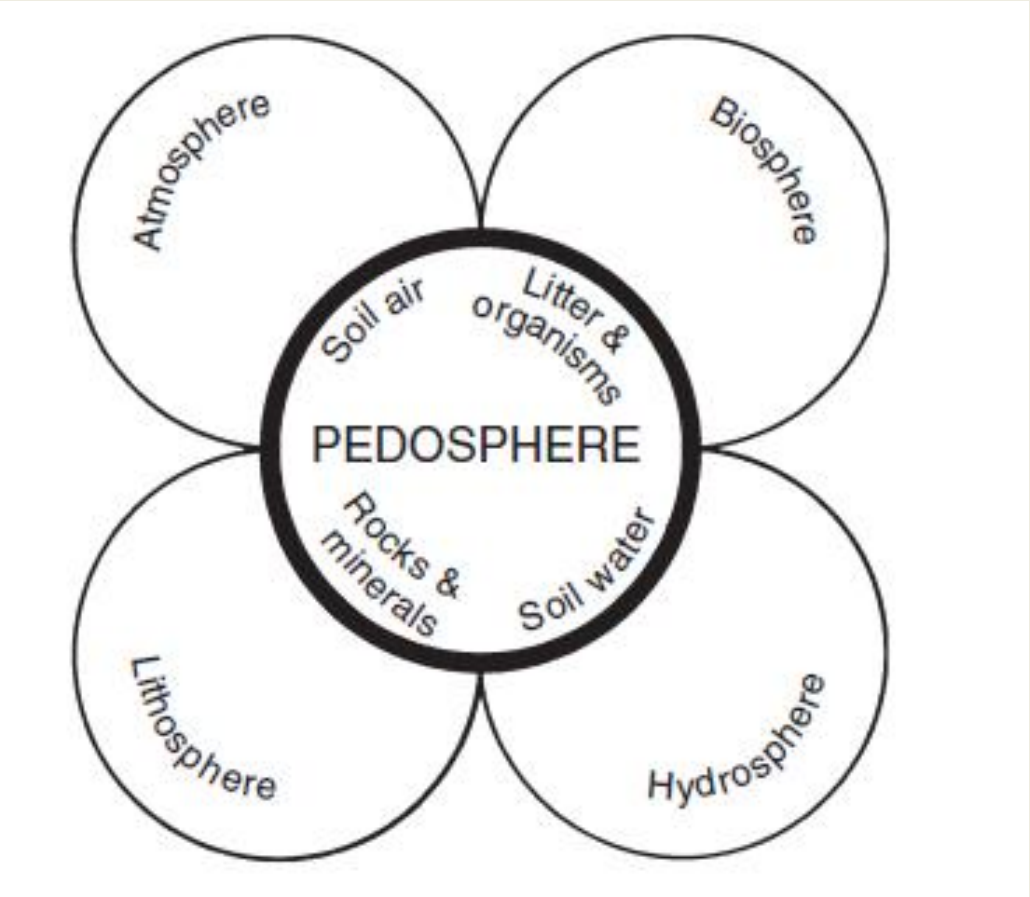
Non-Point Source Pollution

Non-Point Source Pollution



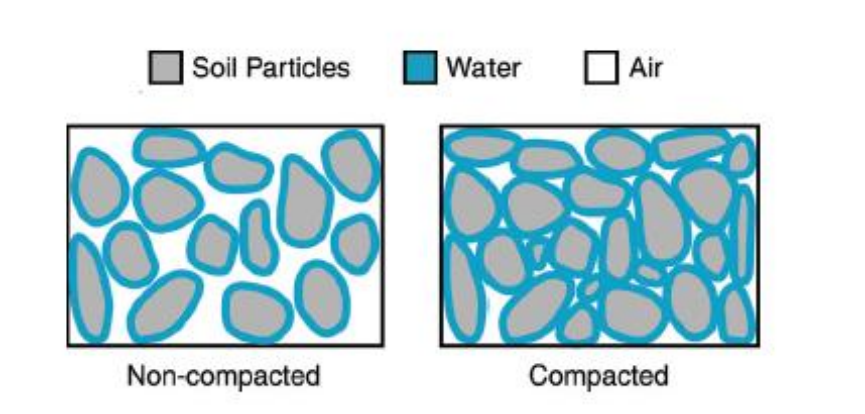
Non-Point Source Pollution

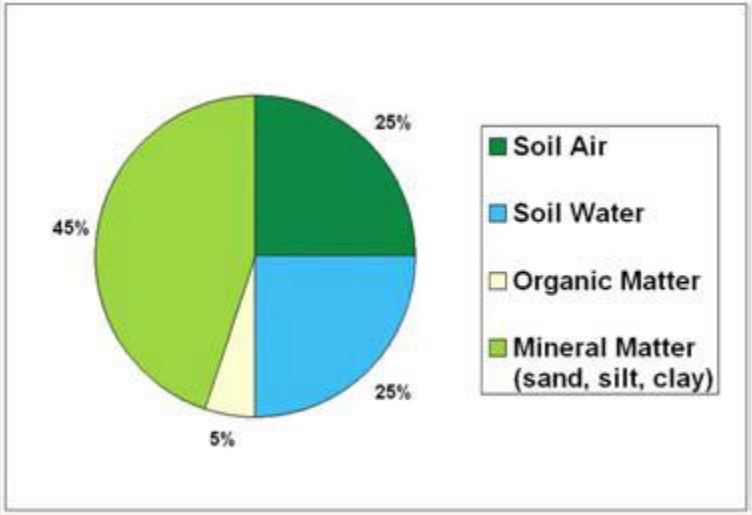
Soils and Bioretention

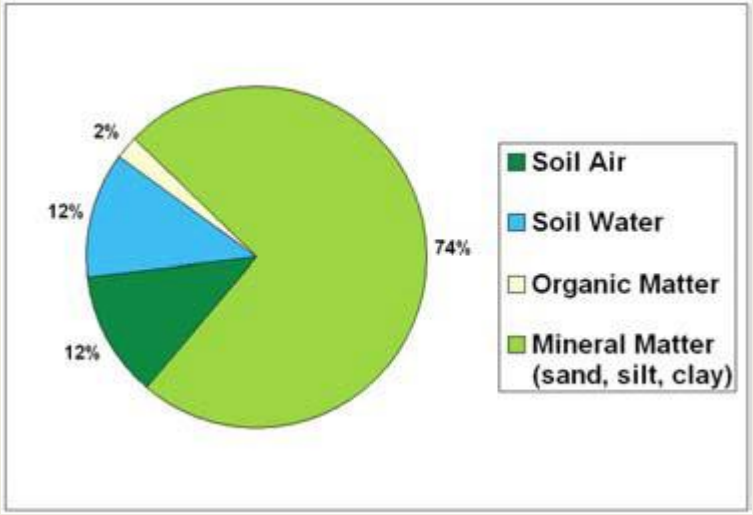


Source: Scheyer, 2005

Soils and Bioretention







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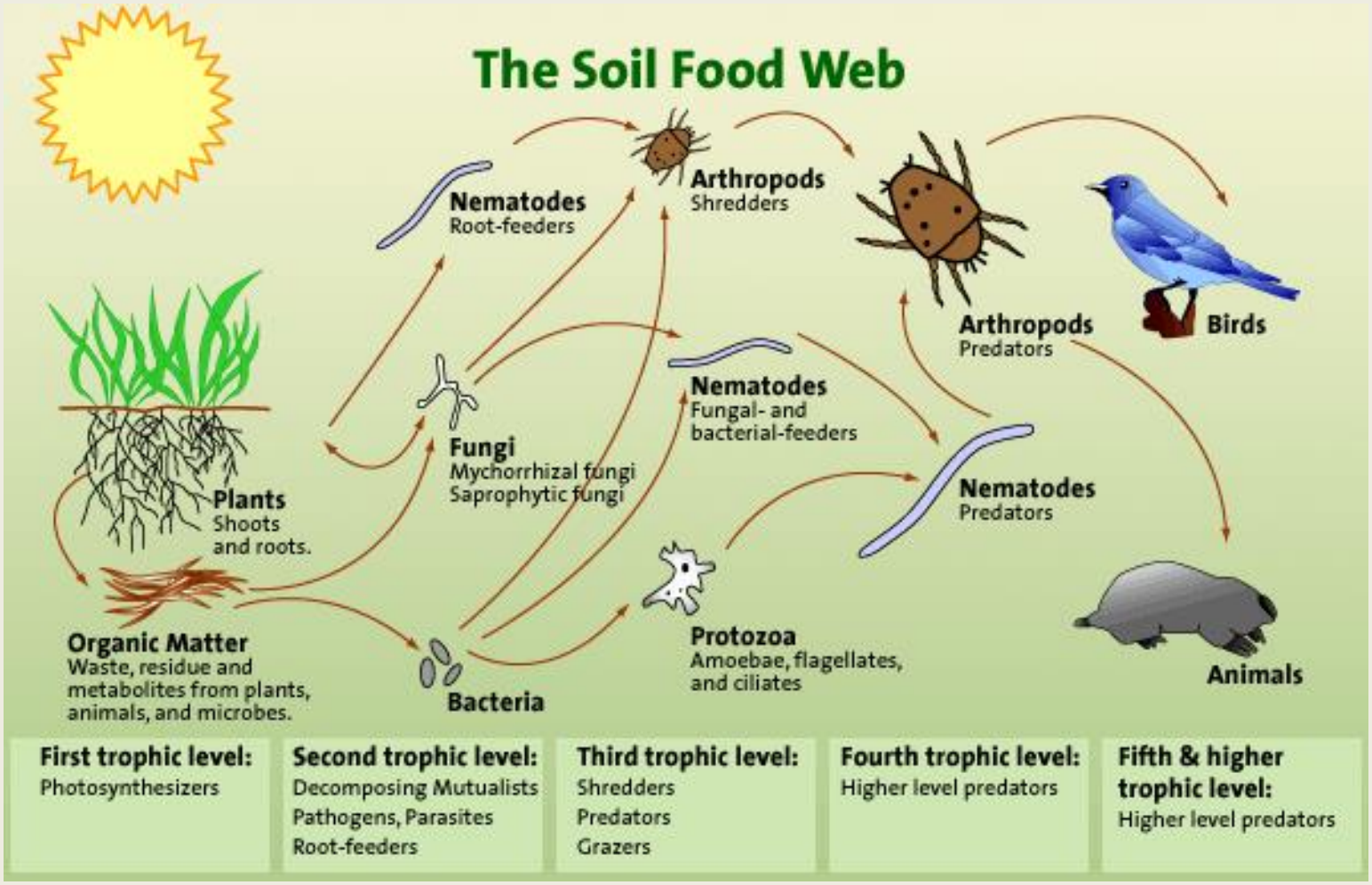

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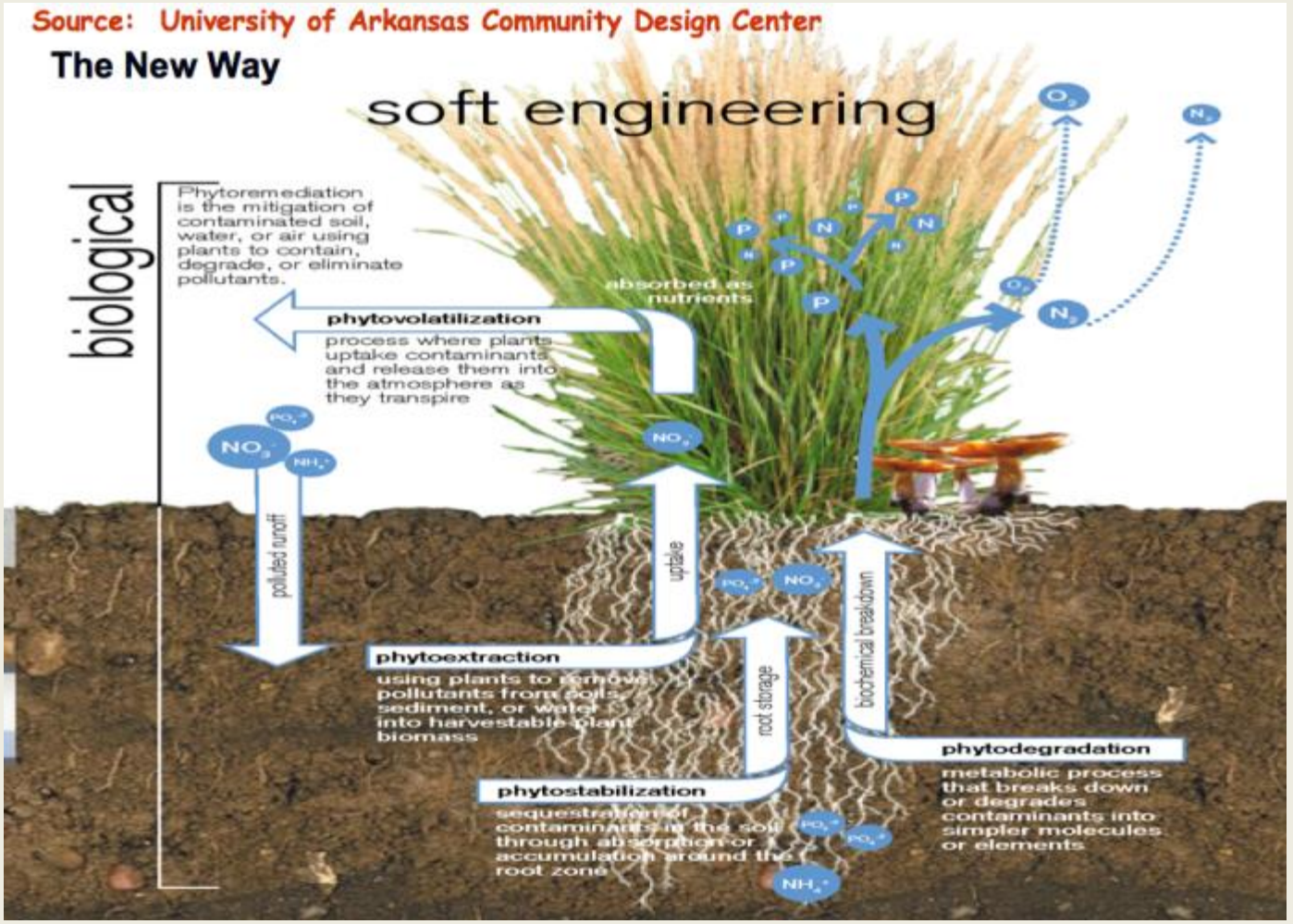

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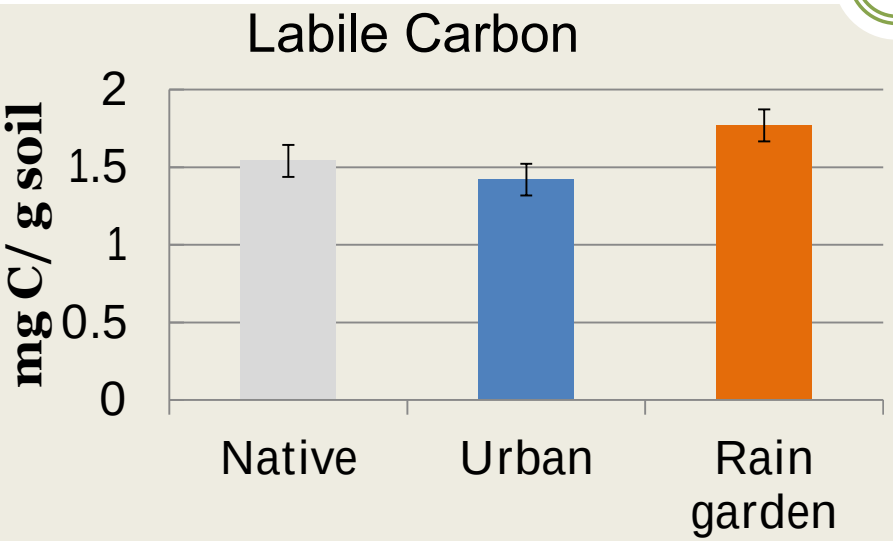
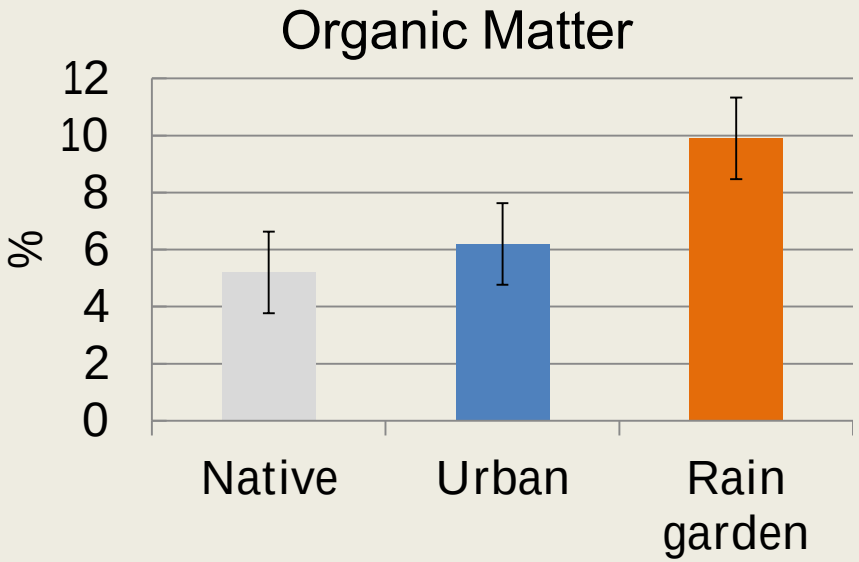
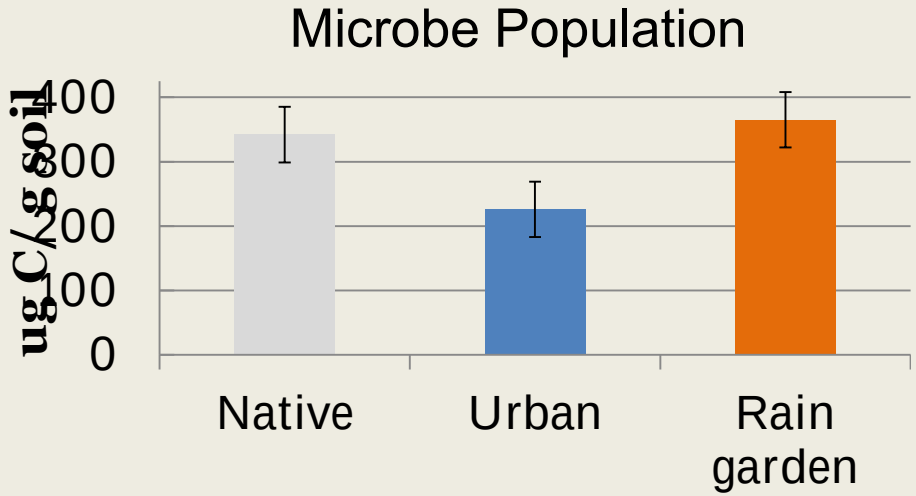
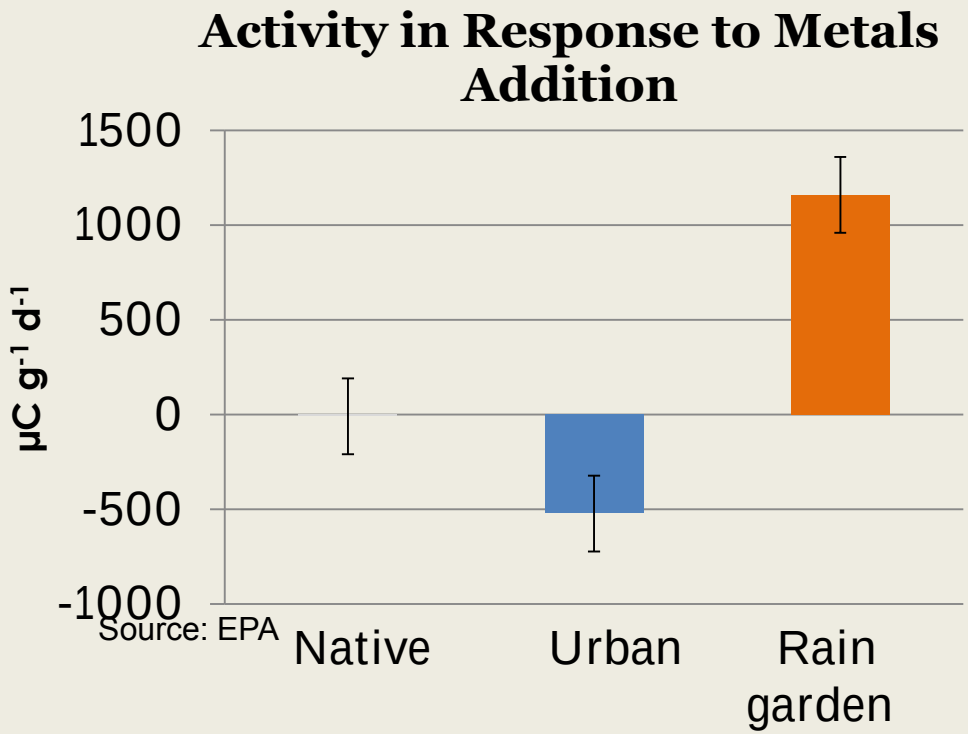






Source: Pavao-Zuckerman, 2013

Soils and Bioretention



Source: EPA

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Soils and Bioretention

TABLE 1 LABORATORY AND ESTIMATED BIORETENTION

Pollutant	Removal Rate
Total Phosphorus	70%-83% [1]
Metals (Cu, Zn, Pb)	93%-98% [1]
TKN	68%-80% [1]
Total Suspended Solids	90% [2]
Organics	90% [2]
Bacteria	90% [2]

Source: [1]Davis et al. (1998)
[2]PGDER (1993)

Source: EPA

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Gray Infrastructure vs. Green Infrastructure

Gray Infrastructure

Alters pre-development hydrology:

- Increased runoff
- Remote, large scale retention/detention results in high maintenance and wasted space
- Decreased infiltration
- Downstream flooding
- Erosion/Sedimentation

Green Infrastructure

Mimics pre-development hydrology:

- **Local micro-retention**
- **Decreases runoff**
- **Increased infiltration and local soil moisture**
- **Reduced downstream flooding and erosion**
- **Reduced burden on public storm water systems**

Photo Credit: Rainwater Harvesting for Drylands and Beyond, Lancaster

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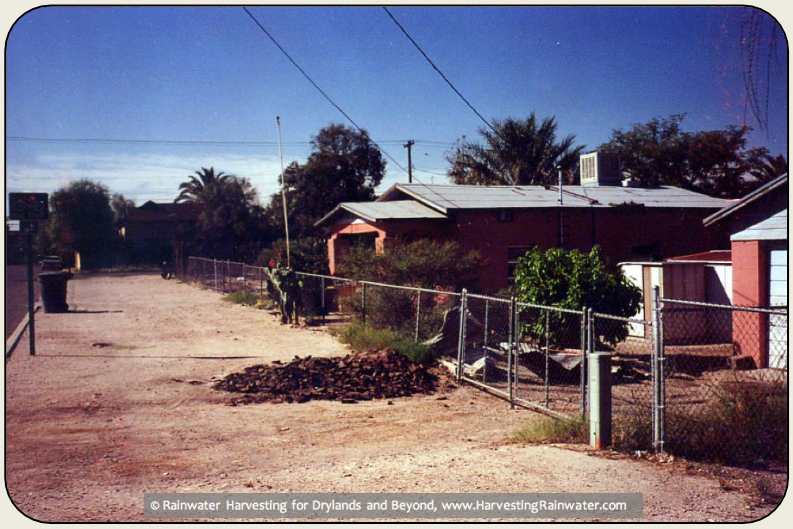
- Livability / Quality of Life
  - Shade
  - Traffic Calming
  - Increased Property Values
  - Crime Reduction
  - Community Building

Functional Goals of Green Infrastructure

- **Mimic Pre-Development Hydrology → Reduce Flooding**
- **→ Reduce Flooding and Harvest Storm →**
- **→ Increase Infiltration and Local Soil Moisture**
- **→Support Urban Forest and Reduce Urban Heat Island →**
- **→Increase Livability of Cities!**
- **Decrease up-front and lifetime project costs**



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- Economic Benefits
  - Reduce energy consumption
  - Extend life of infrastructure
  - Reduce cost of new construction

Costs of Green Infrastructure

Retrofitting:

- G.I. retrofitting slightly more costly than rehabilitating of conventional infrastructure
- G.I. retrofitted incrementally can spread cost over long period of time
- Savings realized in long term operation and maintenance

New Construction:

- G.I. often 10-20% less costly than conventional infrastructure
- G.I. less costly in lifetime operation and maintenance
- Secondary and 'trickle up' economic benefits

Redevelopment = Opportunity

Source: Natural Resources Defense Council

Costs of Green Infrastructure

Why GI/LID makes $ sense:

- Reduced street widths = less pavement, curb and gutter
- Bioretention = fewer costly detention basins
  = less piped conveyance
  = reduced burden on public stormwater system
- Reduced lot sizes = reduced grading and building prep
  = more lots available for sale
- Preserving natural systems = reduced landscape costs
  = increase property values
- Harvested Storm water = Reduced Irrigation Demand
  = Sustainable Urban Forest

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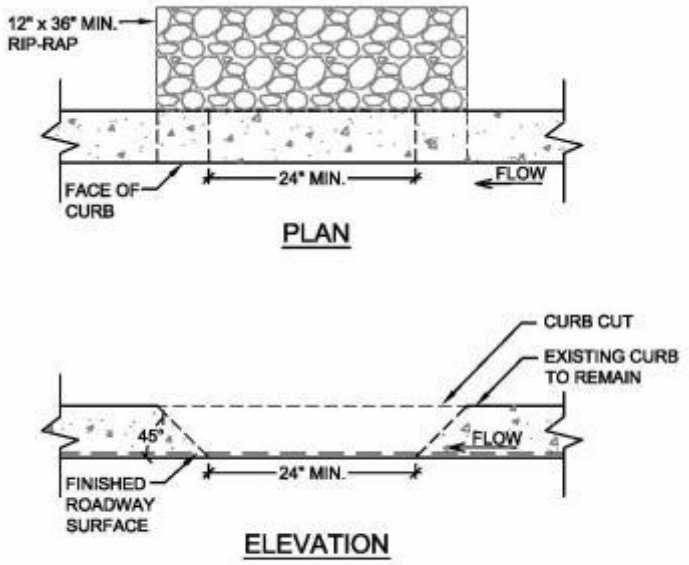
Tools for Green Infrastructure

Curb Cuts

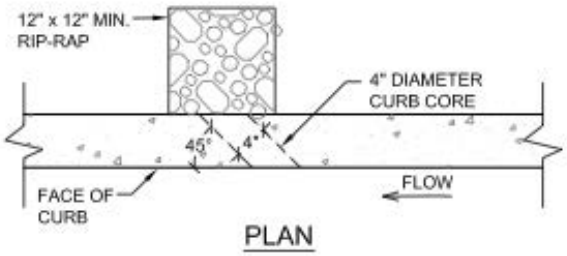


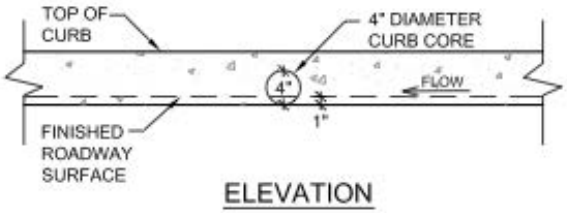
CURB CUT DETAIL

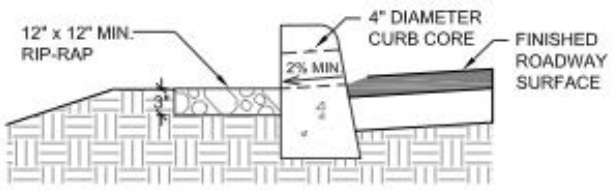
SCALE: N.T.S.

Tools for Green Infrastructure

Curb Cores







CURB CORE DETAIL

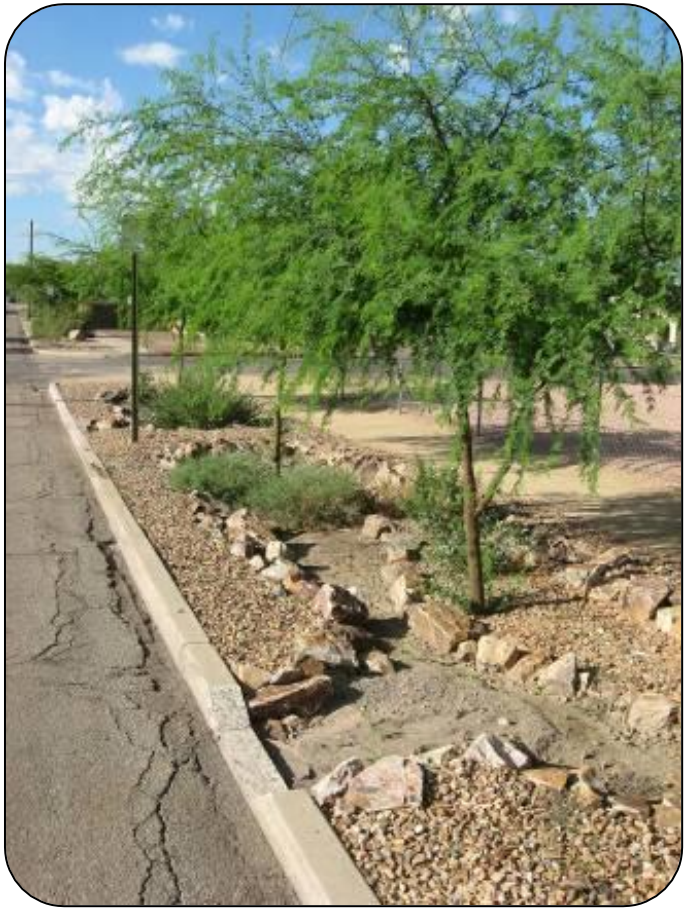
NOT TO SCALE

Tools for Green Infrastructure

Street-side Basins

Tools for Green Infrastructure

Street-side Basins

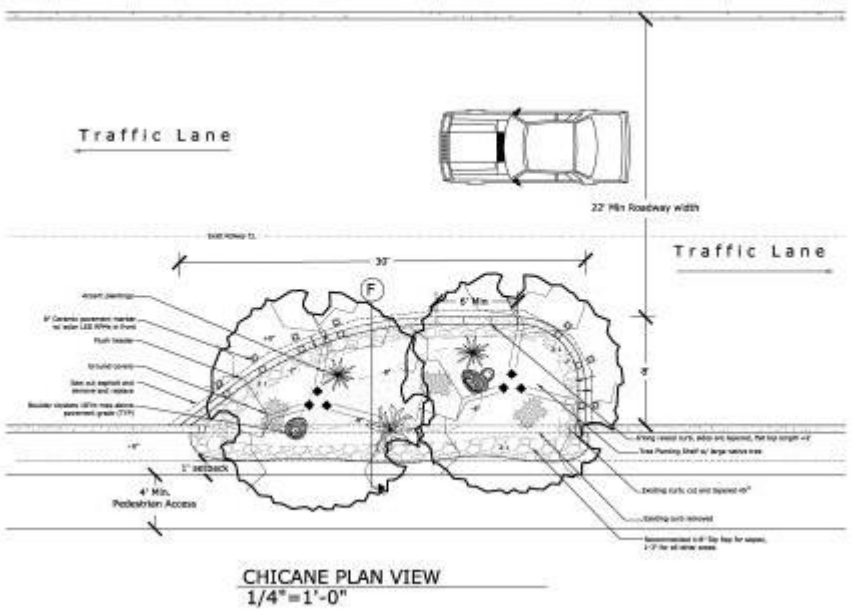


Tools for Green Infrastructure

Street-side Basins

Tools for Green Infrastructure

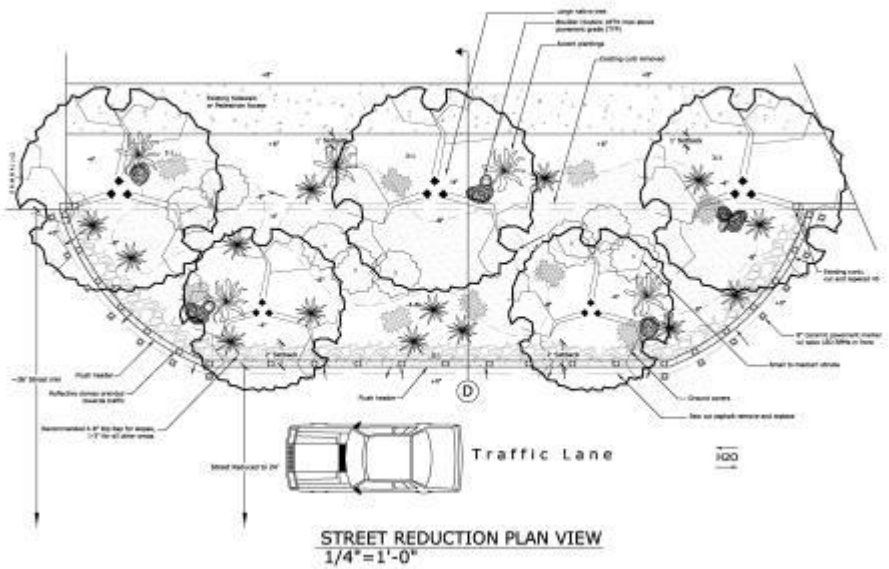
Chicanes



CHICANE PLAN VIEW
1/4"=1'-0"

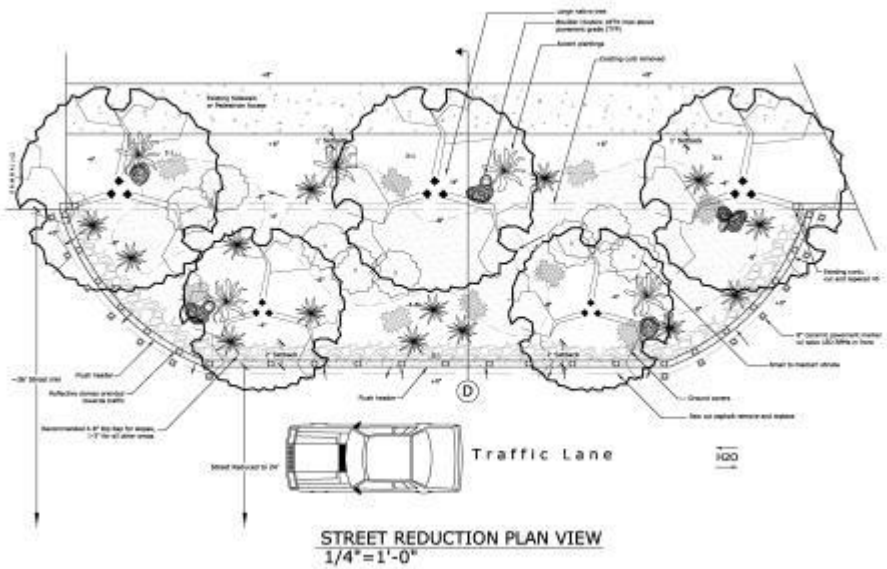
Tools for Green Infrastructure

Street-width reduction



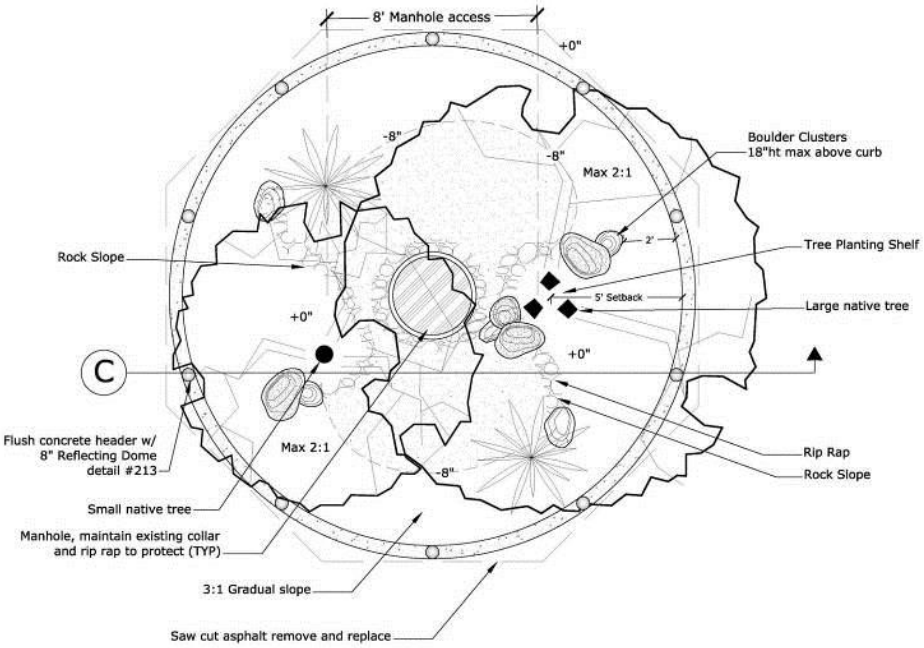
Tools for Green Infrastructure

Street-width reduction



Tools for Green Infrastructure

Traffic Circles



Tools for Green Infrastructure

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Pocket Parks

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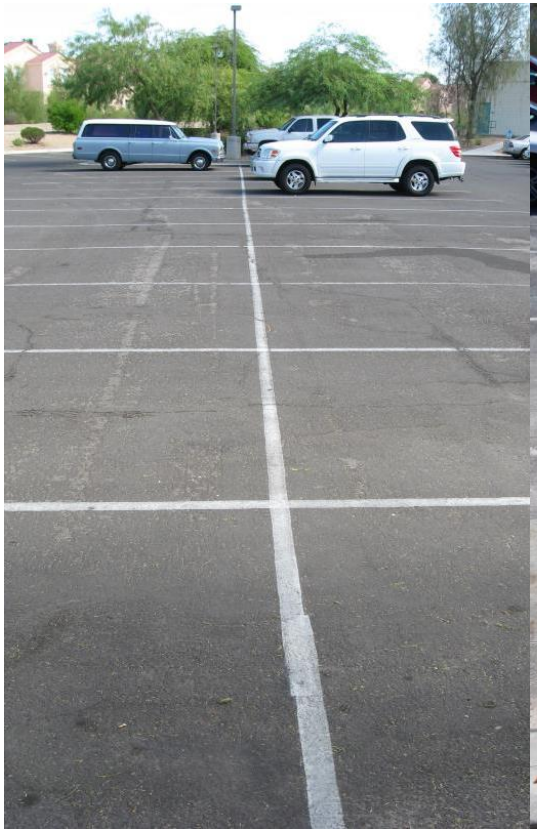
Tools for Green Infrastructure

Parking Lot Retrofits

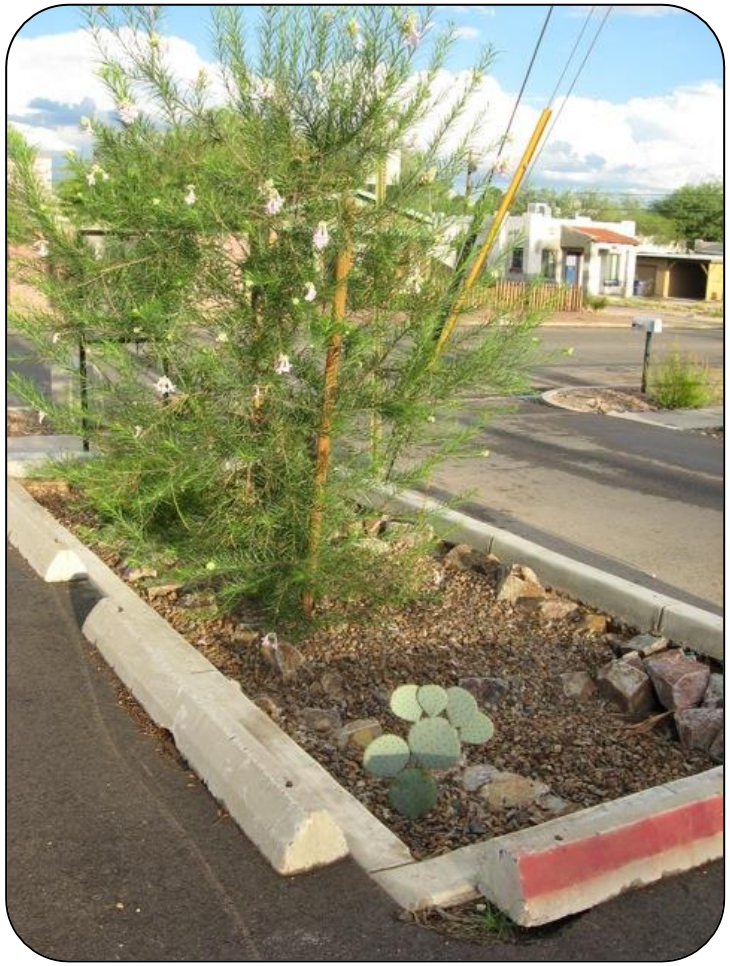


Tools for Green Infrastructure

Parking Lot Retrofit

Tools for Green Infrastructure

Parking Lot Retrofit

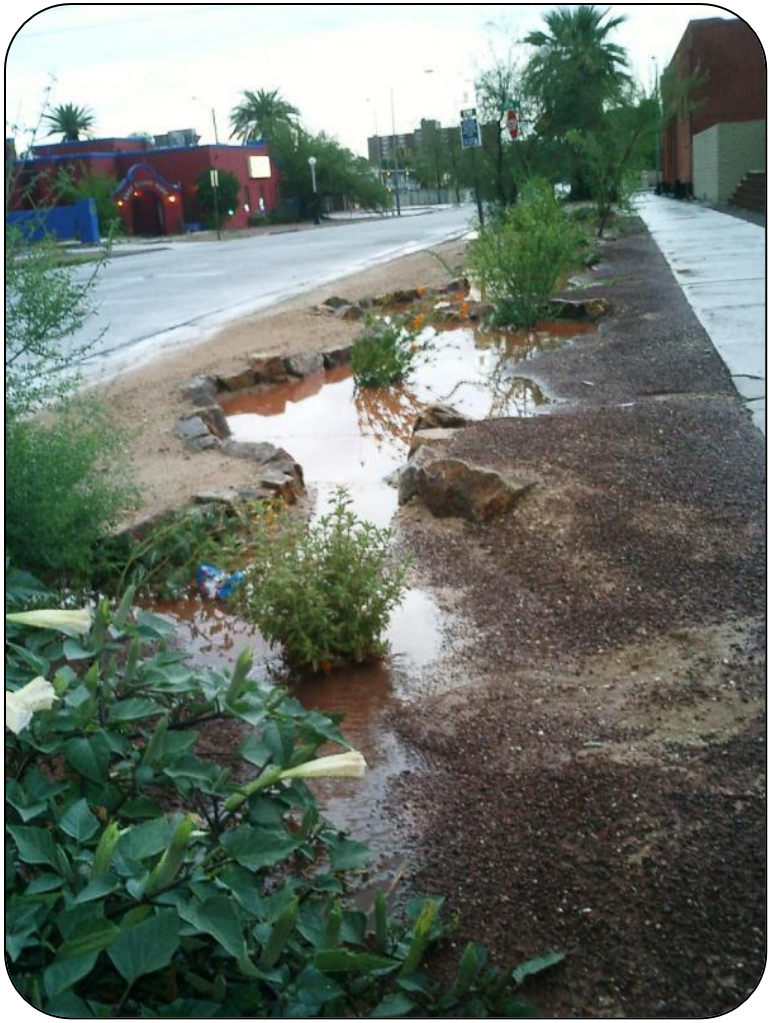


Tools for Green Infrastructure

Bioretention

Tools for Green Infrastructure

Bioretention



Tools for Green Infrastructure

Bioretention

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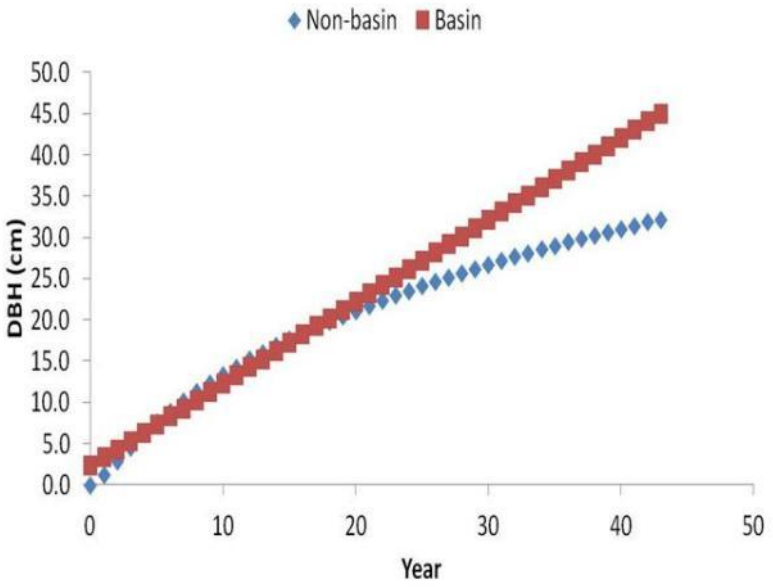
Tools for Green Infrastructure

Bioretention & Urban Forests



	CO_2 Sequestered (kg/tree)	Aboveground Biomass (kg/tree)
Basin tree	1754.2	745.7
Non-basin tree	678.0	288.2

Best Practices

- Utility placement and setbacks
- Runoff Management
- Planting – Right Plant, Right Place
- Overflow
- Sediment Management
- Maintenance, Maintenance, Maintenance!!!

Best Practices

- **Maintenance, Maintenance, Maintenance!!!**

Best Practices

- **Maintenance, Maintenance, Maintenance!!!**

Best Practices

- **Maintenance, Maintenance, Maintenance!!!**

Upcoming Retrofits

Watershed Management Group

Green Infrastructure Retrofits

Tucson:

Ward 1 Council Office

April 24, 2013

Upcoming Retrofits

Watershed Management Group

Green Infrastructure Retrofits

Phoenix:

Sky Harbor Neighborhood

April 21, 2013

Roosevelt Row Neighborhood

April 27, 2013

...thank you!

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Watershed Management Group