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Compost BMP Design for LEED & Green Infrastructure

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Filtrexx International

Outline

- Green Infrastructure & Green Building
- Compost & Compost BMPs
- Research, Performance, Design Tools
- LEED Credits
- LEED Platinum Case Study

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Stormwater Impact

- 850 - US cities w/ outdated & under-designed SWM infrastructure
- 75% of Americans live near polluted waters
- 48,800 TMDL listed (impaired) water bodies
- $44,000,000,000 – annual total cost to society
- Water treatment is energy intensive, therefore carbon intensive

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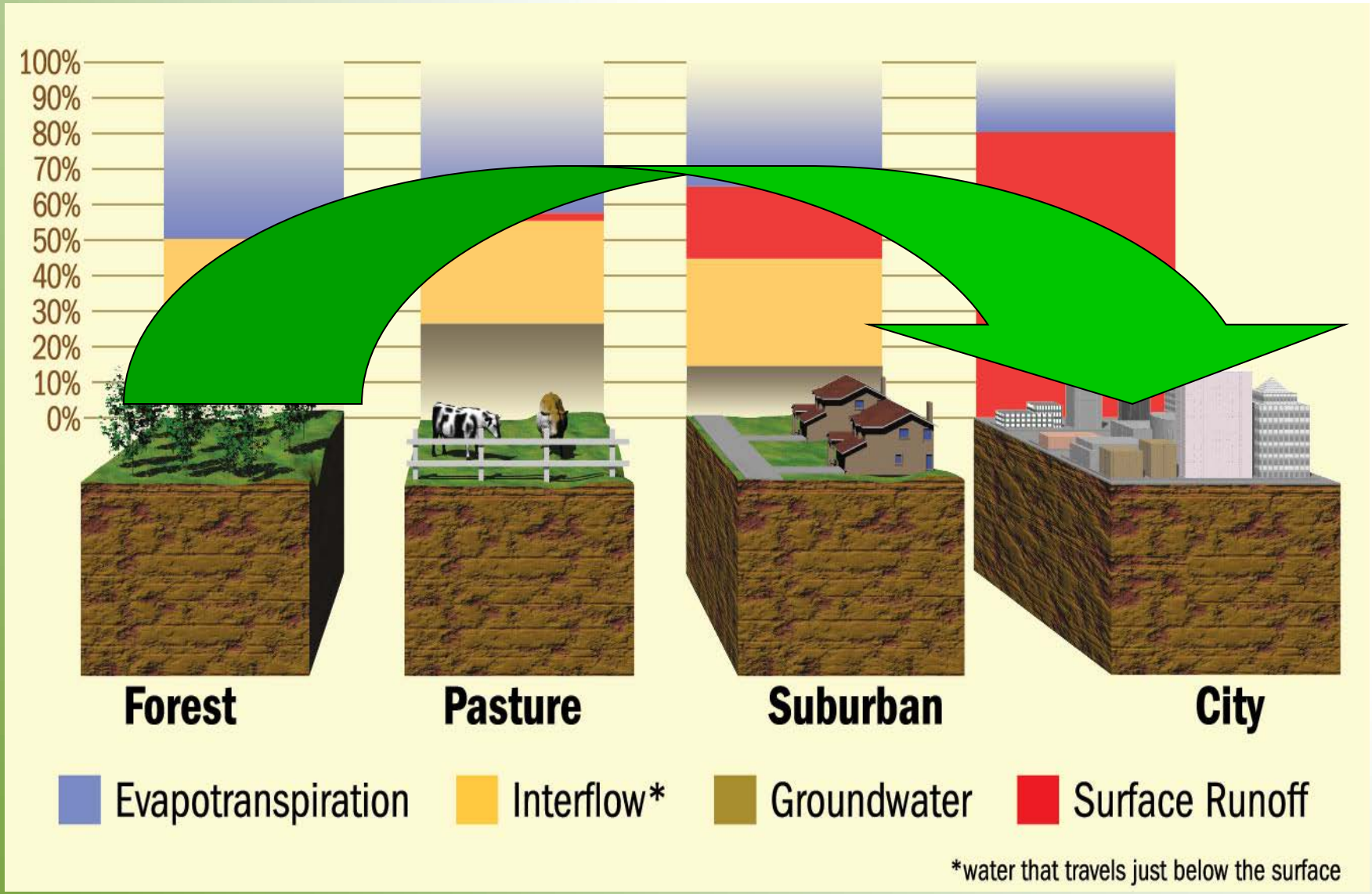
What is Green Infrastructure?



Source: Sego Jackson, 2001

Low Impact Development (LID) =

hydrology mimics natural site, distributed, decentralized

- Runoff Volume ⬇
- Runoff Rate ⬇
- Pollutant Loading ⬇
- Flooding ⬇
- CSOs ⬇

✓ *Water Quality* ⬆

✓ *Wildlife Habitat/Biodiversity* ⬆

✓ *Aesthetics/Land Value* ⬆

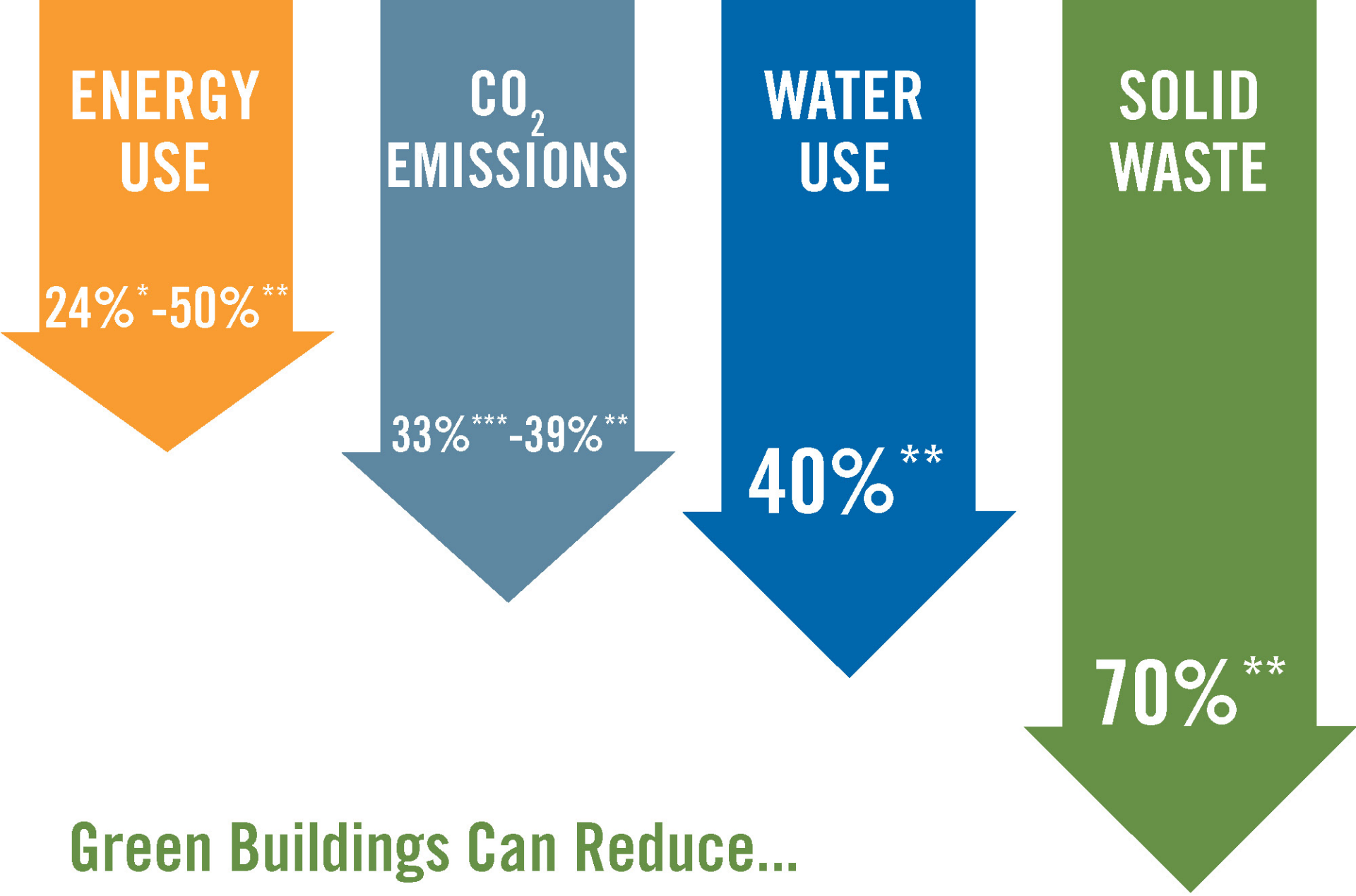
Green Infrastructure = green stormwater management; site preservation/restoration; integrated design & practices; reuse

Green Infrastructure & Building

- + 6% value w/ green infrastructure design
- + $9000/unit net (lower cost & higher sale)
- + 5-15% value for less flooding & improved water quality
- 33%-50% less energy use w/ green infrastructure

(Source: NCSU)

What Is Green Building?



Green Buildings Can Reduce...

* Turner, C. & Frankel, M. (2008). Energy performance of LEED for New Construction buildings: Final report.
** Kats, G. (2003). The Costs and Financial Benefits of Green Building: A Report to California's Sustainable Building Task Force.
*** GSA Public Buildings Service (2008). Assessing green building performance: A post occupancy evaluation of 12 GSA buildings.

Leadership in Energy and Environmental Design

A leading-edge system for certifying the greenest performing buildings in the world

Commercial LEED Registered Projects

Total Currently Registered

30,116*

Commercial LEED Certified Projects

(Cumulative)

8,579*

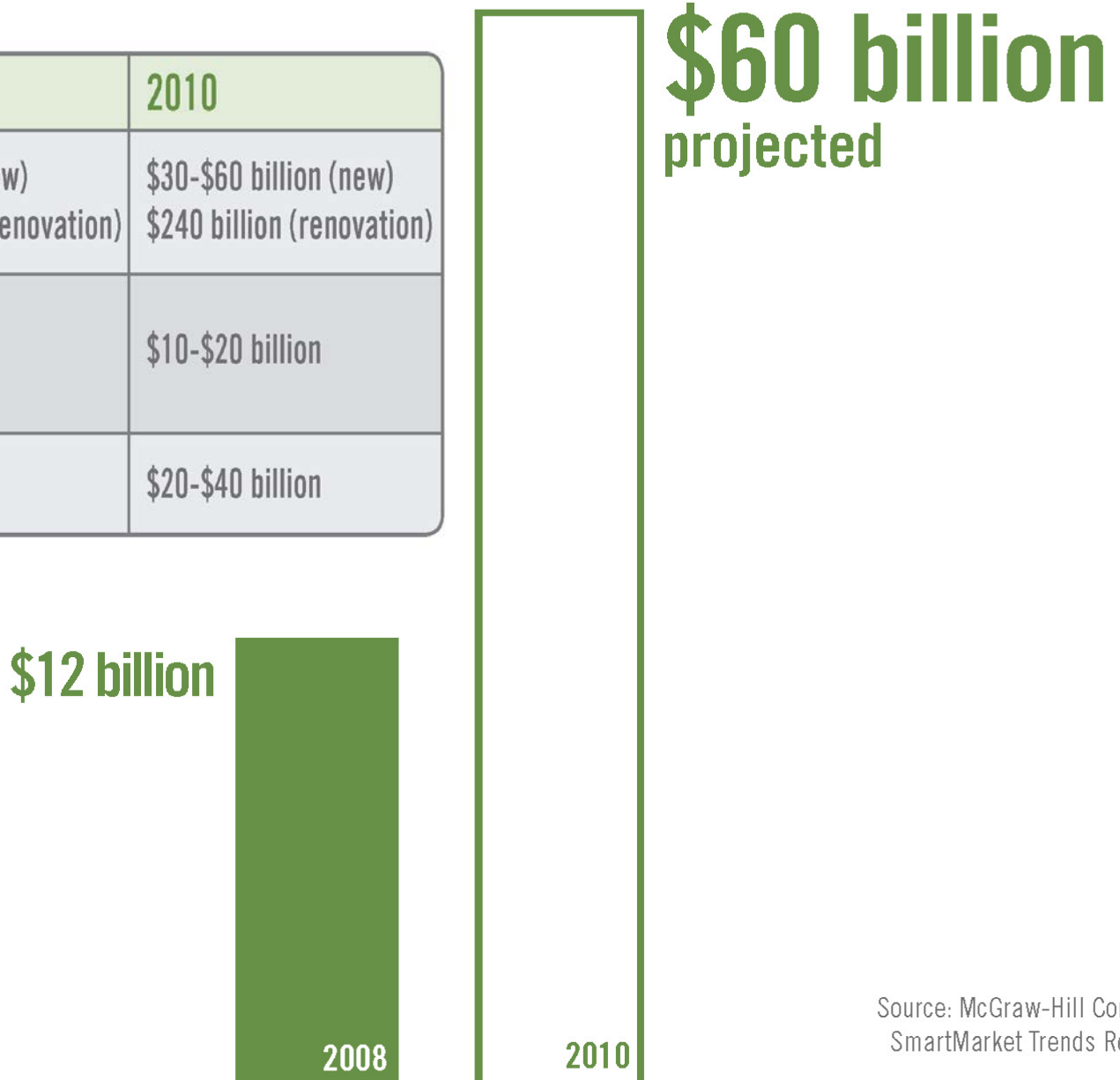
Square Footage of Commercial LEED Certified Projects

(Cumulative)

1.4 billion*

Green Building is in Demand

	2006	2010
Projection U.S. Market	$12 billion (new) $130 billion (renovation)	$30-$60 billion (new) $240 billion (renovation)
Commercial & Institutional	$4 billion	$10-$20 billion
Residential	$8 billion	$20-$40 billion



Source: McGraw-Hill Construction, SmartMarket Trends Report 2008

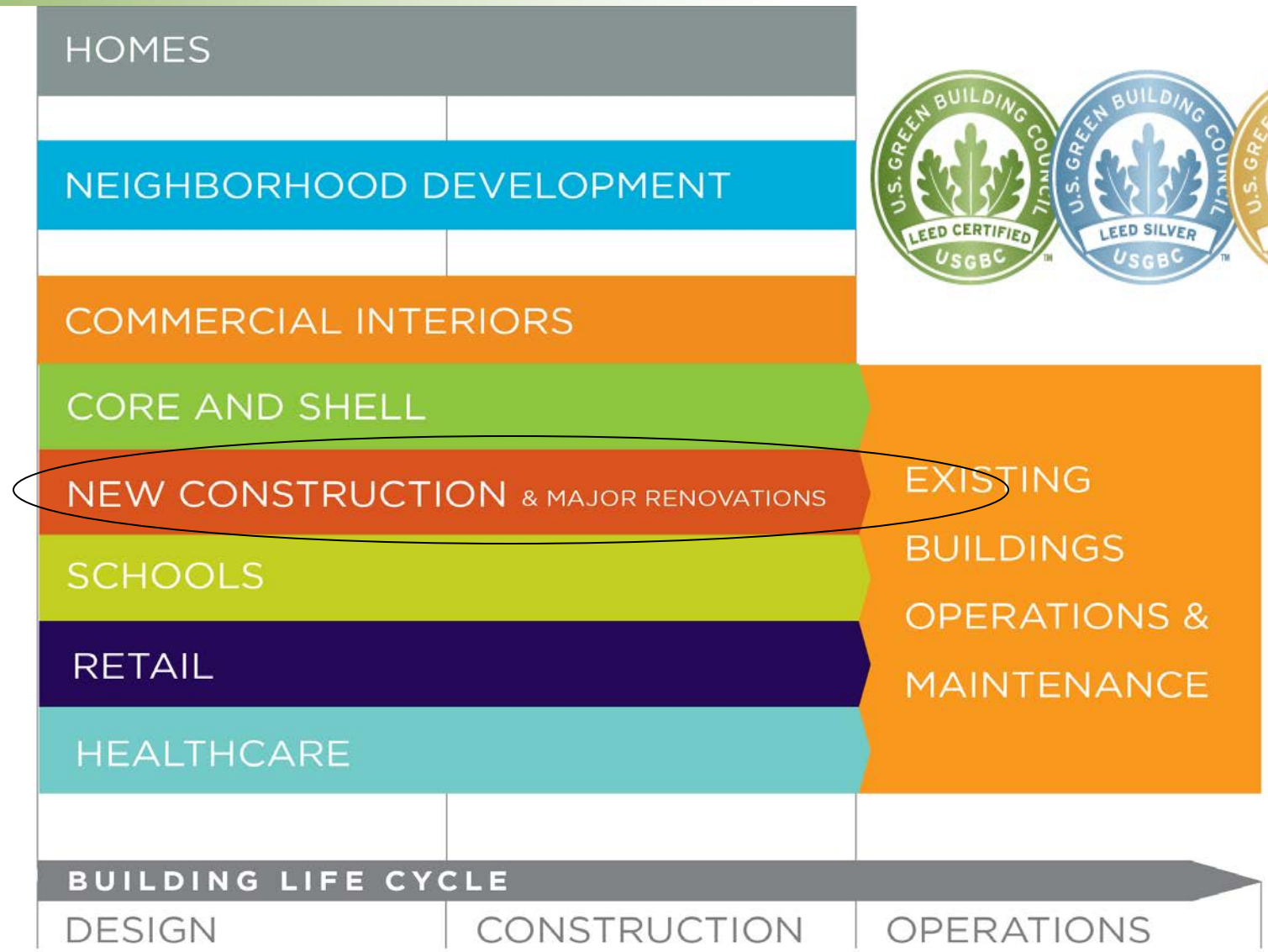
Why the Demand?

- Unprecedented level of government initiatives
- Heightened residential demand for green construction
- Improvements in sustainable materials

✓**Many municipalities *require* public buildings to be LEED Certified.**
✓**Federal government requires its new buildings to be LEED Silver**

Source: Facility Management Institute, 2008 U.S. Construction Overview

LEED Programs & Certification Levels



Compost Tools

Filter Media

- Designed for Optimum Filtration & Hydraulic-flow

Growing Media

- Designed for Optimum Water Absorption & Plant Growth

Stormwater BMPs

Erosion & Sediment Control

1. Perimeter Control
2. Inlet Protection
3. Ditch Check
4. Filter Ring/Concrete washout
5. Slope Interruption
6. Runoff Diversion
7. Vegetated Cover
8. Erosion Control Blanket
9. Vegetated Sediment Trap
10. Pond Riser Pipe Filter

Low Impact Development

11. Runoff Control Blanket
12. Vegetated Filter Strip
13. Engineered Soil
14. Channel Liner
15. Streambank Stabilization
16. Biofiltration System
17. Bioretention System
18. Green Roof System
19. Living Wall
20. Green Retaining Wall
21. Vegetated Rip Rap
22. Level Spreader
23. Green Gabion
24. Bioswale

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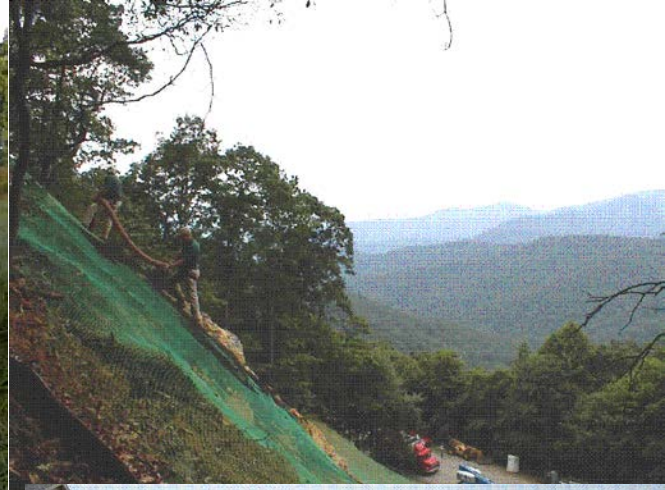









10. 30. 2001

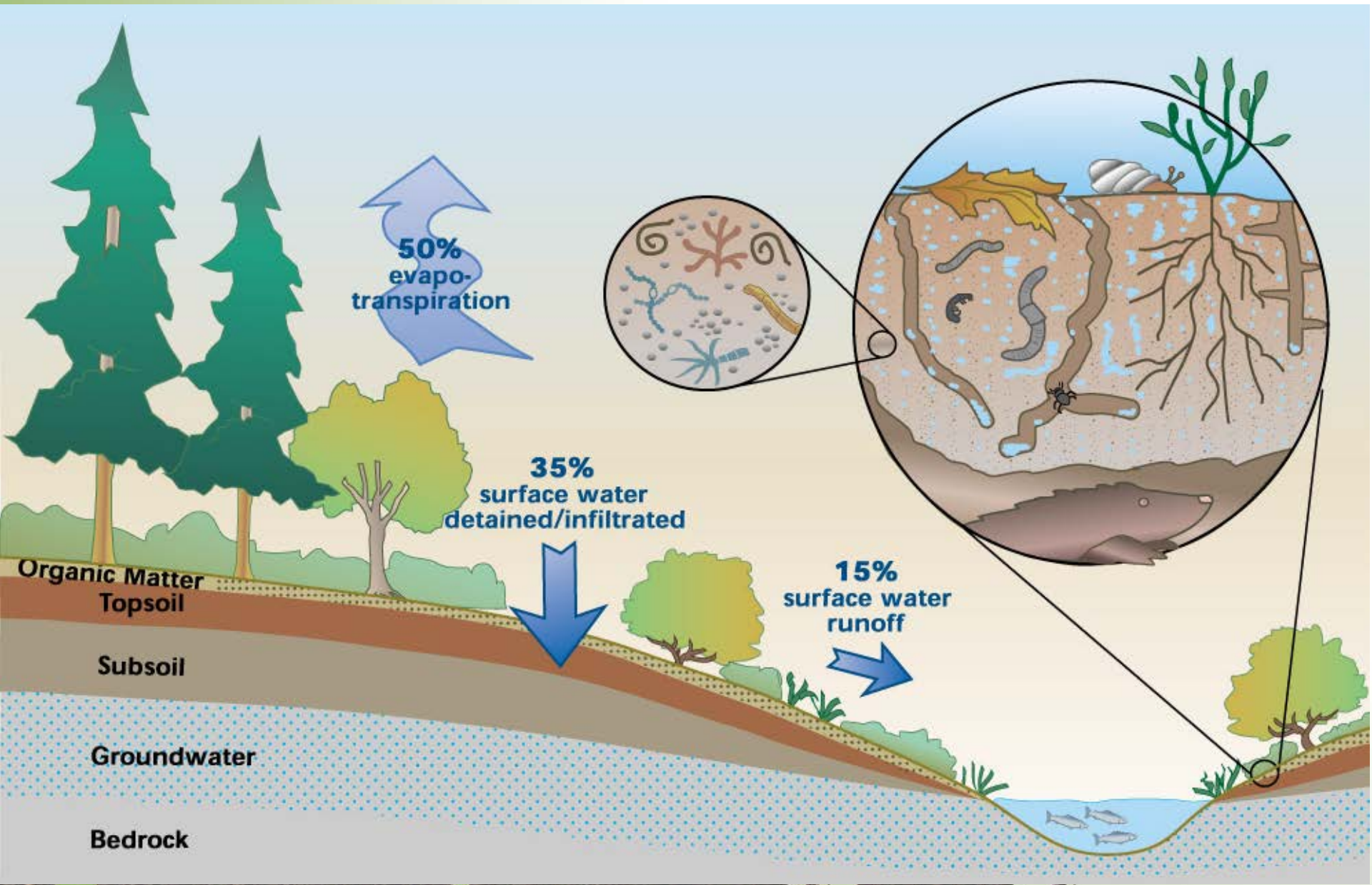




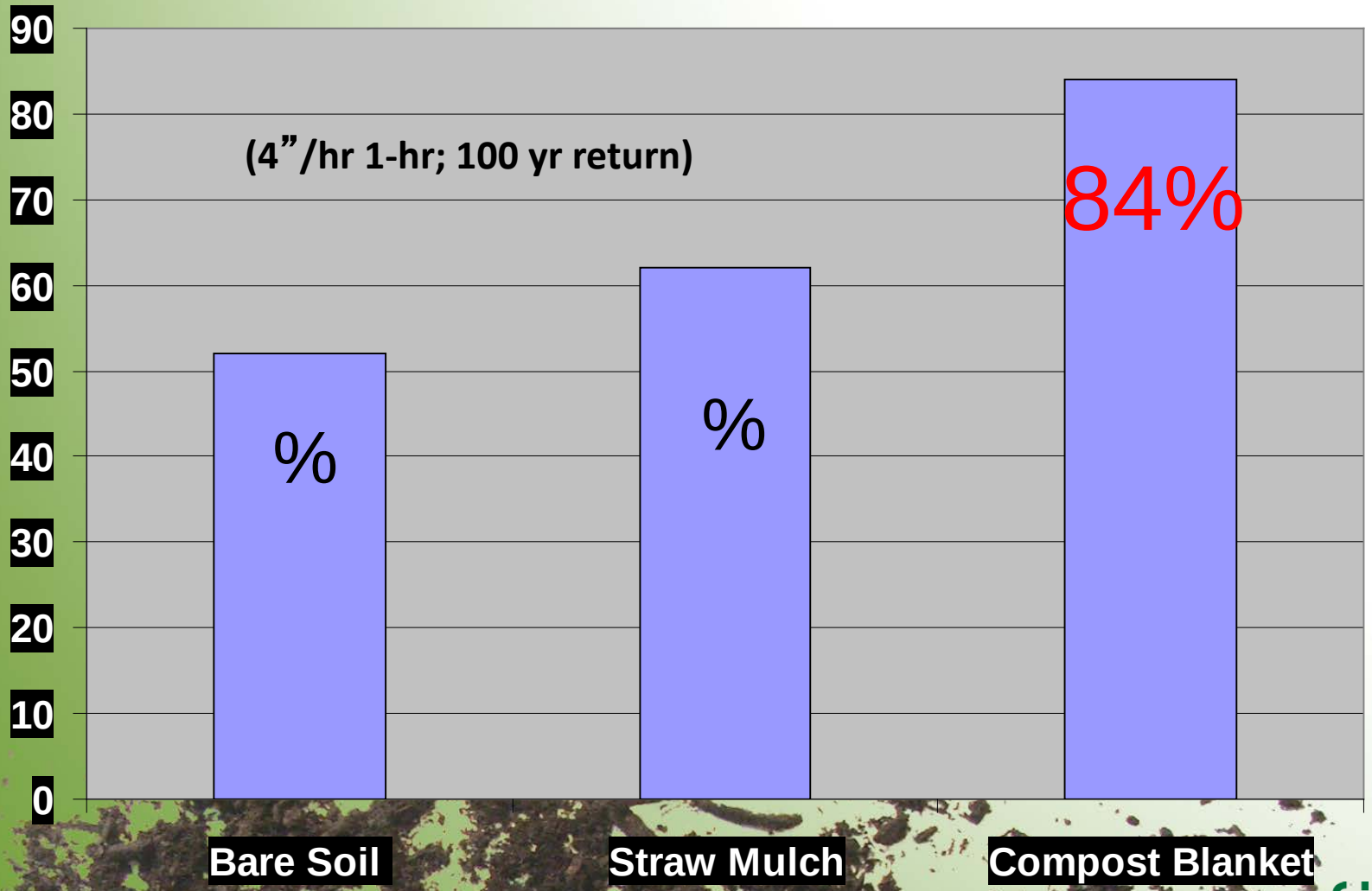




Natural Stormwater Management



LID: Rainfall Absorption



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Runoff Volume Reduction

Reduction	Influencing Factors	Reference
49%	Sandy clay loam, 10% slope, 1.5" blanket, 3.2 in/hr – 1 hr rain	Faucette et al, 2005
60%	Sandy clay loam, 10% slope, 1.5" blanket, 4.0 in/hr – 1 hr rain	Faucette et al, 2007
76%	Silty sand, 2:1 slope, 3" blanket, 1.8 in/hr - 2.4 hr rain	Demars et al, 2000
90%	Loamy sand, 3:1 slope, 2" blanket, 4.0 in/hr – 2 hr rain	Persyn et al, 2004

Peak Flow Rate Reduction

Reduction	Influencing Factors	Reference
36%	Sandy clay loam, 10% slope, 1.5" blanket, 3.2 in/hr – 1 hr rain	Faucette et al, 2005
42% **(30% relative to straw)**	Sandy clay loam, 10% slope, 1.5" blanket, 4.0 in/hr – 1 hr rain	Faucette et al, 2007
79%	Loamy sand, 3:1 slope, 2" blanket, 4.0 in/hr – 2 hr rain	Persyn et al, 2004

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Pollutant Load Reduction:

Compost Blanket vs Conventional Seeding

	Total N	Nitrate N	Total P	Soluble P	Total Sediment
Mukhtar et al, 2004 (seed+fertilizer)	88%	45%	87%	87%	99%
Faucette et al, 2007 (seed+fertilizer)	92%	ND	ND	97%	94%
Faucette et al, 2005 (hydromulch)	58%	98%	83%	83%	80%
Persyn et al 2004 (seed+topsoil)	99%	ND	99%	99%	96%

Stormwater Pollutant Removal

	TSS	Turbidity	Total N	NH_4-N	NO_3-N	Total P	Sol. P	Total coli.	E. coli.	Metals	Oil	Diesel
Filter Sock	80 %	63%	35 %	35%	25 %	60 %	92%	98%	98%	37-78%	99 %	99%

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City of Chattanooga

Analysis	2-1-2007 (Pre-retrofit)	6-8-2007	8-30-2007	12-13-2007	3-19-2008	1-28-2009	7-28-2009	% Reduction
COD	1600 mg/L	259 mg/L	255 mg/L	125 mg/L	125 mg/L	405 mg/L	214 mg/L	**75-93**
TSS	1370 mg/L	208 mg/L	38 mg/L	18 mg/L	24 mg/L	249 mg/L	177 mg/L	**82-99**
Oil/Grease	107 mg/L	27 mg/L	N/A	N/A	5 mg/L	18 mg/L	37 mg/L	**65-95**

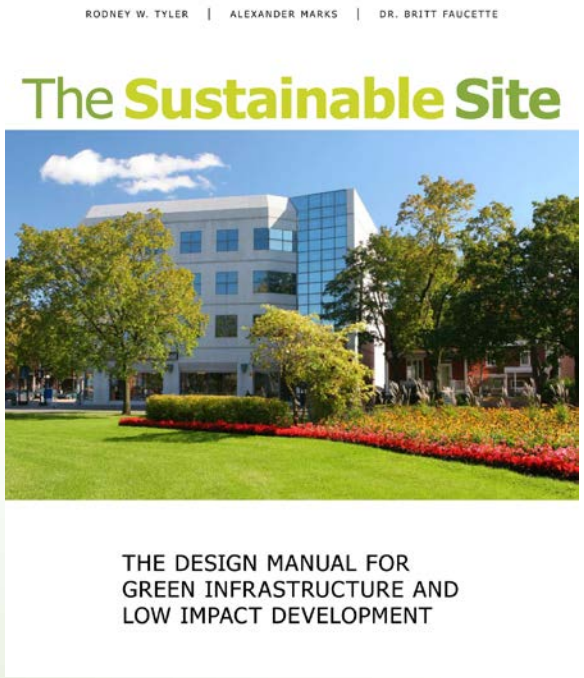
Table of Contents

24 Compost-Based BMPs Inside

*"... .*an essential tool for engineers, designers, architects, regulators, planners, managers, contractors, consultants, policymakers, builders, and water resource managers." – *Forester Press*

Specification & Design

- Purpose/Description
- Applications
- Advantages/Disadvantages
- LEED Green Building Credits
- Compost Specifications
- Performance/Research
- Engineering & Design Criteria
- Installation
- Inspection
- Maintenance
- Recycling/Disposal
- Measurements
- Engineering Drawings/Construction Details
- References



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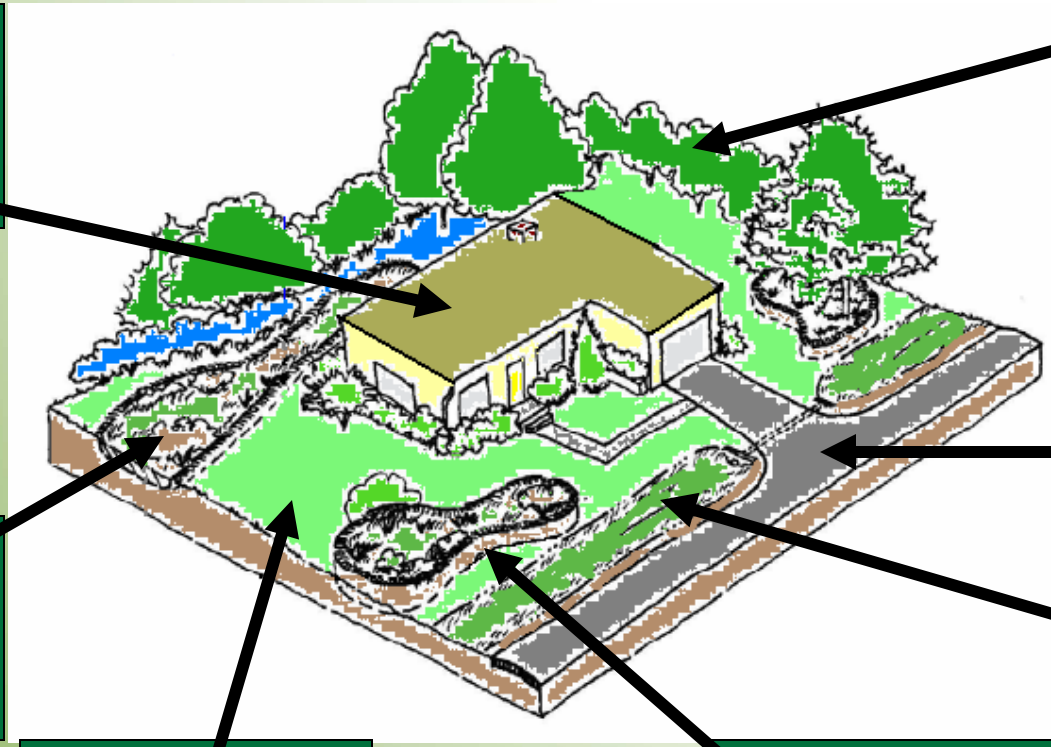
A Sustainable Site



Green Roof

Native Vegetation

Green Pav

Rain Garden/ Bioretention

Bioswale

Stormwater Blanket

Engineered Soil

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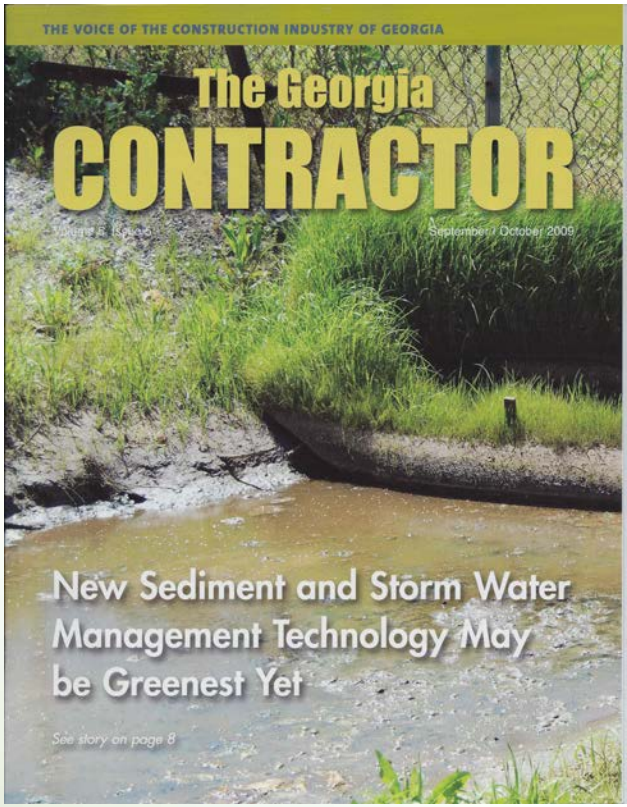
Compost - The Green BMP

- 100% Recycled
- Bio-based, organic materials
- Locally manufactured
- Reduces Carbon Footprint
- Uses Natural Principles
- Benign to *Restorative*
- High Performance



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LEED Credits & Compost for NC 3.0

- Sustainable Sites (26 [6])
- Water Efficiency (10 [6])
- Energy & Atmosphere (35)
- Materials & Resources (14[5])
- Indoor Environmental Quality (15)
- Innovation & Design Process (6)
- Regional Priority Credit (4)

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Sustainable Sites (6 credits):

- **3.0 Brownfield Redevelopment (1)**
  (Compost used for Bioremediation)
- **5.1: Site Development - Protect or Restore Habitat (1)**
  (Previously Developed Site = Restore 50%)
- **6.1: Storm Water Design - Quantity Control (1)**
  (<50% impervious=restore natural hydrology or protect receiving stream channels; >50% impervious 25% decrease in stormwater volume & peak flow)
- **6.2: Storm Water Design - Quality Control (1)**
  (80% TSS reduction or capture/treat runoff from 90% annual rainfall [0.5-1.0 in])
- **7.1: Heat Island Effect – Non-Roof (1)**
  (50% of hardscapes use open grid w/compost or shaded in 5 yrs)
- **7.2: Heat Island Effect – Roof (1)**
  (50% vegetated; or used with high value Solar Reflective Index roofing)

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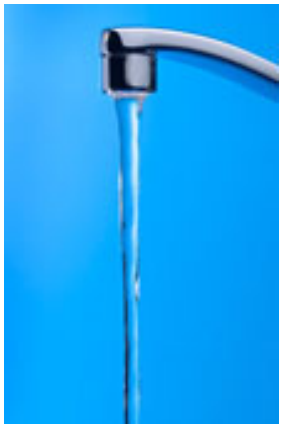
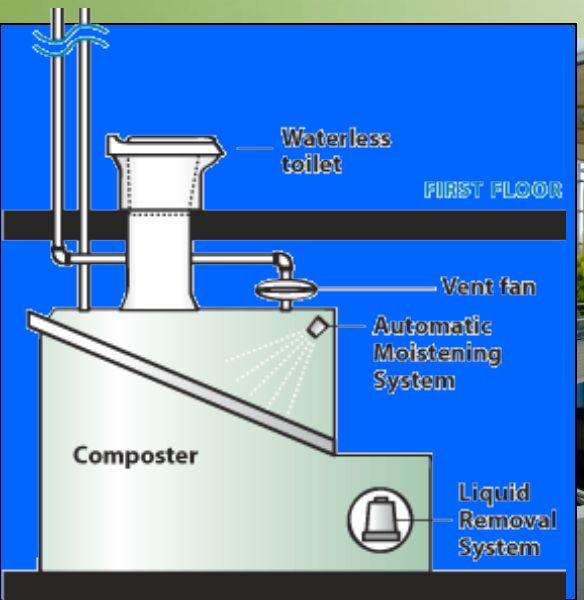
Water Efficiency (6 credits):



- 1.1: Water Efficient Landscape: Reduce 50% (2)
- 1.2: Water Efficient Landscape: Reduce 100% (2
- 2.0: Innovative Wastewater Technology (2) (Reduce 50% or Treat 50%)



Materials & Resources

- 4.1: Recycled Content – 10% (1)
- 4.2: Recycled Content – 20% (1)
- 5.1: Regional Materials (500 mi) – 10% (1)
- 5.2: Regional Materials (500 mi) – 20% (1)
- 6.0: Rapidly Renewable Materials – 2.5% (1)

NOTE:

- Excludes MEP
- Recycled content = post-consumer+1/2 pre-consumer
- 2.1 & 2.2 Construction waste management: 50% & 75% (cannot include soil or land clearing)

Southface

Responsible Solutions for Environmental Living

Eco Office

Grand Opening

August 18, 2009

- ✓100% rain/stormwater capture
- ✓Zero discharge
- ✓84% Water Savings
- ✓130,000 gal/yr

Southface

Responsible Solutions for Environmental Living

Contact Me

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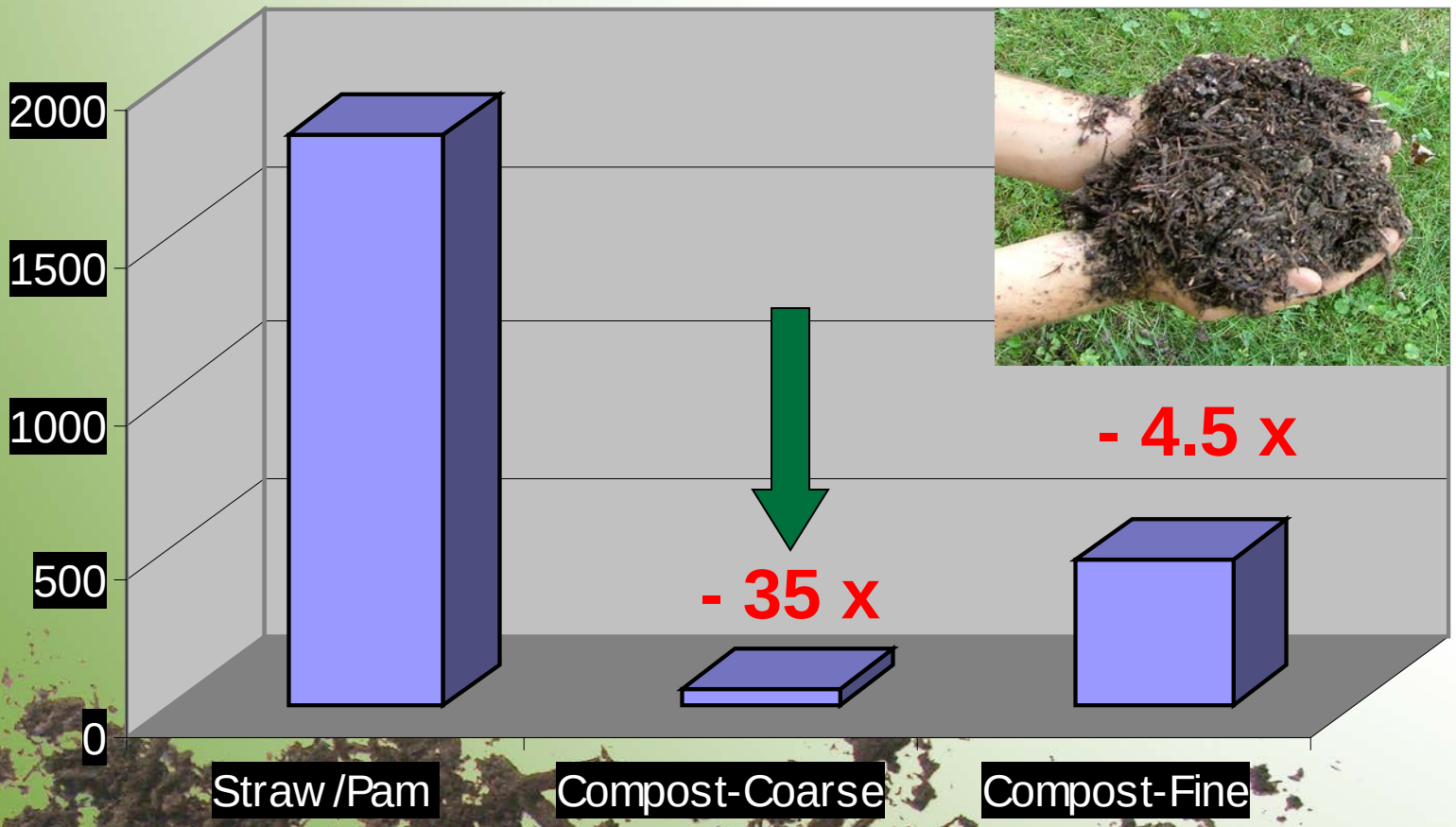
Turbidity (NTU)

Average from 4-inch Storm Event



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What is Compost?

Composting is a heat dependant, controlled microbiological process of decomposition and recycling of “ORGANIC” material into a stable and humus rich material known as compost.

- Mulch?
- Organic waste?
- Manure?

USEPA Compost Blanket Specifications

Parameters	Units of Measure	Surface to be Vegetated	Surface to be left Unvegetated
pH	pH units	5.0 – 8.5	N/A
Soluble salt concentration (electrical conductivity)	dS/m (mmhos/cm)	Maximum 5	Maximum 5
Moisture content	%, wet weight basis	30 – 60	30 – 60
Organic matter content	%, dry weight basis	25 – 65	25 – 100
Particle Size Distribution	% passing a selected mesh size, dry weight basis	- 3 in. (75 mm), 100% passing - 1 in. (25 mm), 90 – 100% passing - ¾ in. (19 mm), 65 – 100% passing - ¼ in. (6.4 mm), 0 – 75% passing Maximum particle length of 6 in (152 mm)	- 3 in. (75 mm), 100% passing - 1 in. (25 mm), 90 – 100% passing - ¾ in. (19 mm), 65 –100% passing - ¼ in. (6.4 mm), 0 – 75% passing Maximum particle length of 6 in (152 mm)
Stability Carbon dioxide evolution rate	mg CO_2–C per g organic matter per day	<8	N/A
Physical contaminants (manmade inerts)	%, dry weight basis	<1	<1

Real Value of LID

- National average real estate values down 25% from 2007 (-$82,000)
- Low Impact Development Sites:
  - $5000 more value/lot
  - $4000 less cost/lot
  - 6% - green infrastructure
  - 15% - water quality
  - 5% - reduce flooding in flood plain
  - 33-50% energy savings

(Source: NCSU)

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PERCEIVED ADVANTAGES OF BUILDING GREEN

8-9% decrease in operating costs

✓Reduced energy & water use/cost; storm water utility fees

7.5% increase in building values

6.6% improvement in ROI

3.5% increase in occupancy

✓Higher worker productivity & attendance.

3% rent increase

✓**Some municipalities *require* public buildings to be LEED Certified.**

✓**Federal government requires its new buildings are LEED Silver**

Perceived Advantages

- 8-9% Decrease in operating costs
  - Reduced energy & water use/cost; stormwater utility fees
- 7.5% Increase in building values
- 6.6% Improvement in ROI
- 3.5% Increase in occupancy
  - Higher worker productivity & attendance
- 3% Rent increase
  - Some municipalities require public buildings to be LEED Certified
  - Federal government requires new buildings to be LEED Silver

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Soil Erosion at 2:1

Erosion Control Practice	Soil loss @ 2 in/hr 20 min (0.67 in)		Soil loss @ 4 in/hr 40 min (2.0 in)		Soil loss @ 6 in/hr 60 min (4.0 in)	
	t/ac	% reduction	t/ac	% reduction	t/ac	% reduction
Bare soil	61	NA	137	NA	171	NA
CECB 2.0 in	0.02	99.8	46	66.8	48	71.9
CECB 1.0 in	0.09	99.1	53	61.1	53	68.9
CECB 0.5 in	29	52.1	96	30.1	72	57.7
Single-net straw	31	48.8	84	38.3	101	40.8
Single-net excelsior fiber	18	70.2	55	60.1	66	61.1
Double-net straw	23	62.7	62	54.7	76	56.0
Double-net coconut fiber	0.05	99.5	36	73.5	71	58.8
Tackifier	12	79.9	60	56.2	101	41.2
PAM	43	29.9	146	-6.8	158	7.7

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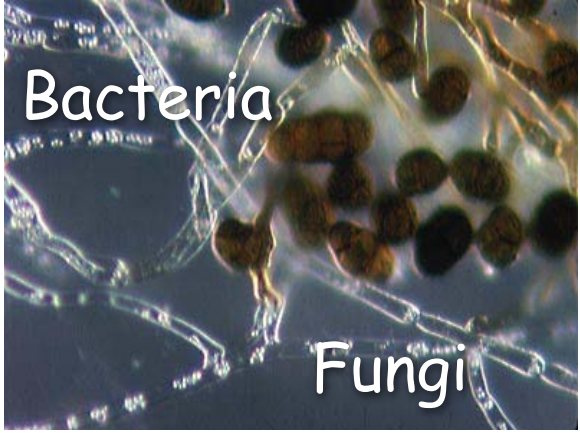
Compost Sock 3-Way Biofiltration



- Physical
  - Traps sediment in matrix of varying pore spaces and sizes
- Chemical
  - Binds and adsorbs pollutants in storm runoff
- Biological
  - Degrades various compounds with bacteria and fungi

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PREDICTIONS IN GROWTH OF GREEN

Commercial: By 2010, approximately 10% (~$23 billion) of construction starts*

Corporate America: By 2009, 80% of corporate America expected to be engaged in green at least 16% of the time; 20% engaged 60% of the time**

Institutional: Dedication to green health care and educational facilities expected to increase dramatically over the next five years**

Sources:
* McGraw-Hill Construction, Green Building SmartMarket Report, 2006
** McGraw-Hill Construction, Greening of Corporate America SmartMarket Report, 2007
*** McGraw-Hill Construction, Education Green Building SmartMarket Report, 2007 and Health Care Green Building SmartMarket Report, 2007

IMPACTS OF U.S. BUILDINGS ON RESOURCES

40% primary energy use*

72% electricity consumption*

39% CO_2 emissions*

13.6% potable water consumption**

Global CO_2 Emissions by Sector

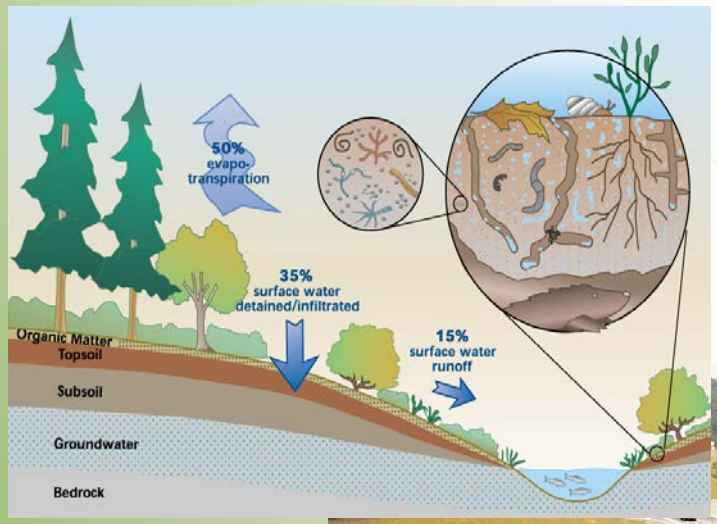
#1. Buildings

#2. Transportation

#3. Industry

Sources:
*Environmental Information Administration (2008). EIA Annual Energy Outlook.
** U.S. Geological Survey (2000). 2000 data.

Runoff + Erosion Control



Designed to: 1) dissipate energy of rain impact; 2) hold, infiltrate & evaporate water; 3) slow down/disperse energy of sheet flow; 4) provide for optimum vegetation growth

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