Wet Weather Management as if Water Truly Mattered

Green Infrastructure in a Changing World

Steve Wise
Natural Resources Program Manager

EPA Wet Weather for Green Infrastructure San Antonio

February 17, 2009

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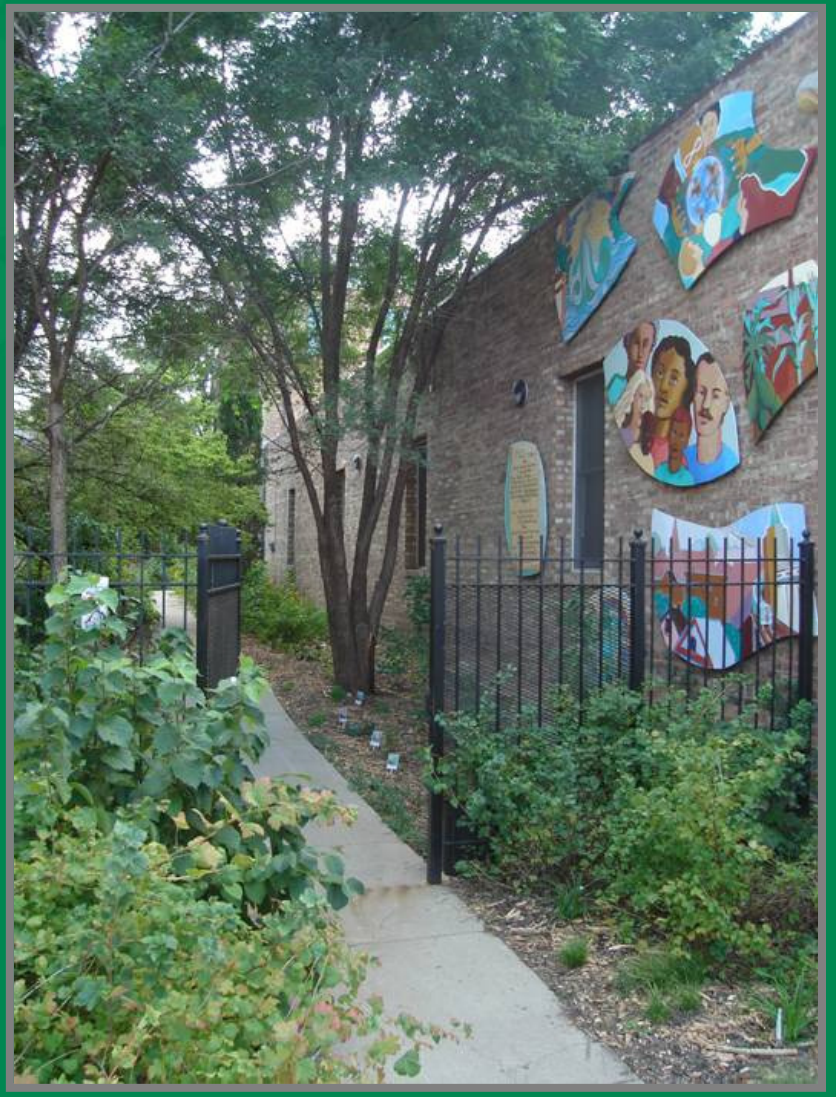
The Center for Neighborhood Technology

- 30 year old Chicago-based non-profit
- Sustainable energy, transportation, natural resource, climate strategies:
  - Research
  - Advocacy
  - Demonstration projects
  - Scaling up, replication
- Green Infrastructure agenda
  - Planning/Analysis Toolbox
  - Policy
  - Education
  - Practice



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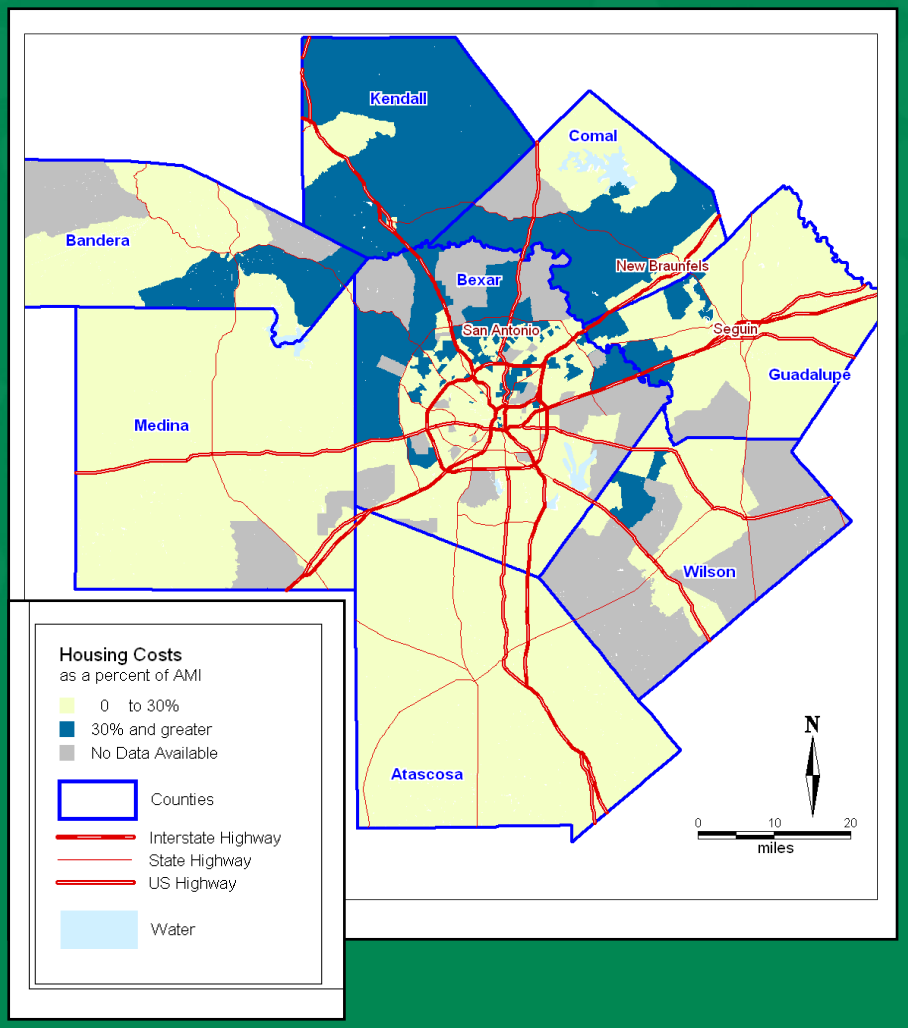
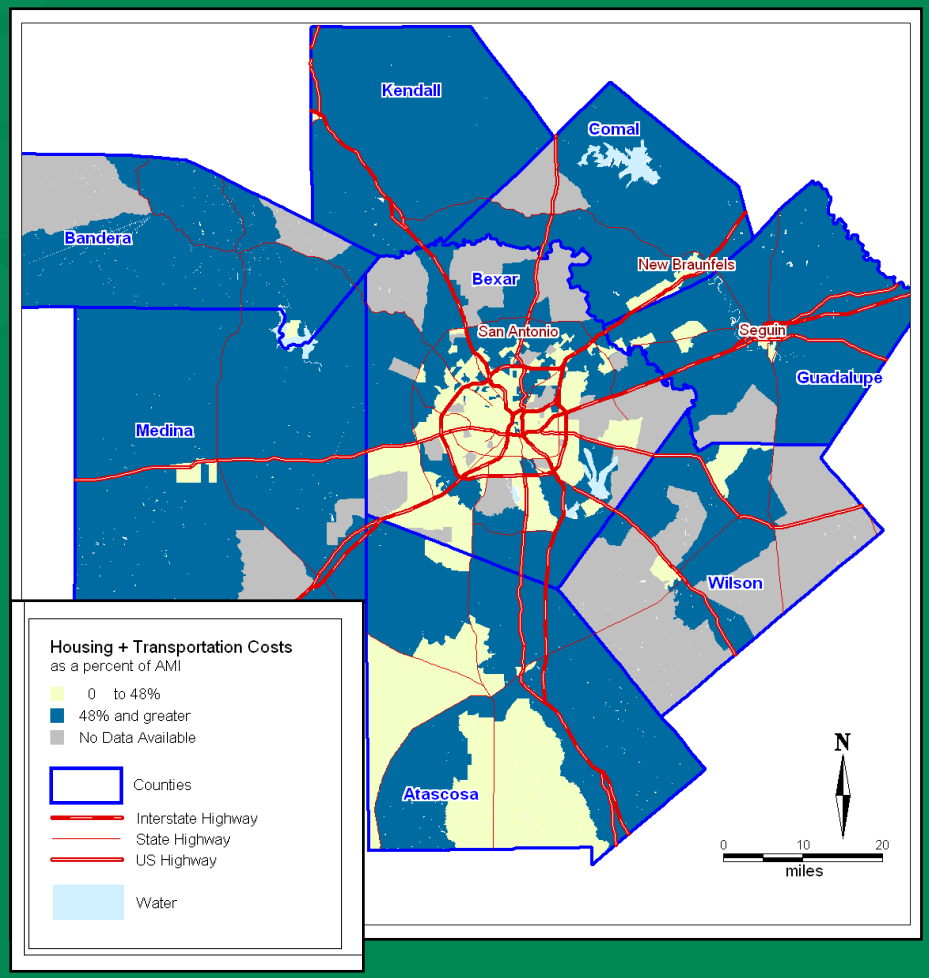
Housing + Transportation





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The Challenge: (Re)Capture Natural Capacity

- Adapt, (re)naturalize built landscape to absorb, clean and hold water
- Create peak and baseload capacity via conservation
- Get it right in new and retrofit development, public and private

Portland, Oregon "Green Streets"

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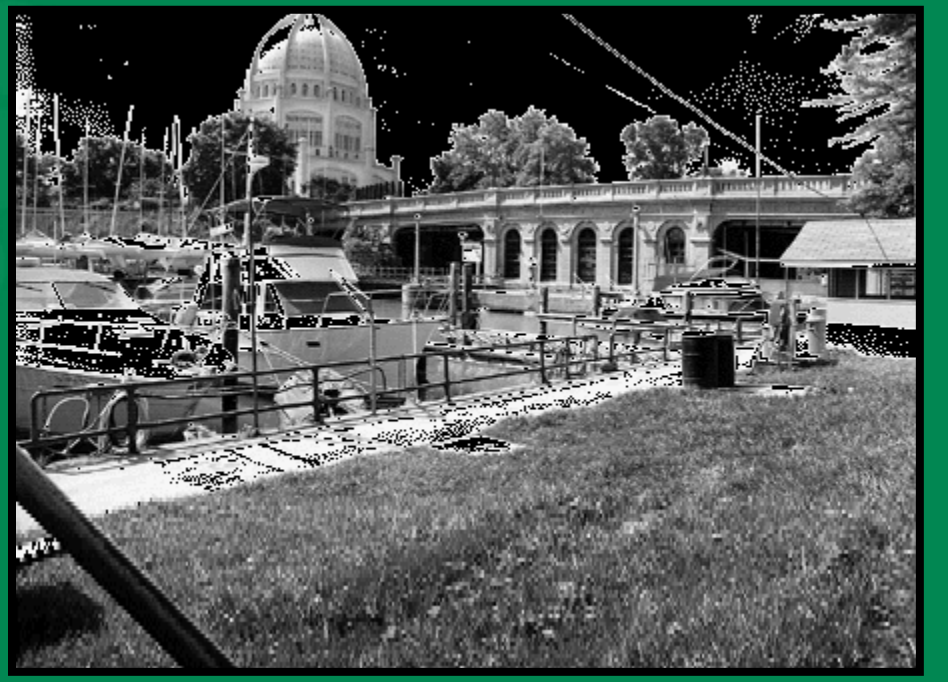
Chicago, August 2007

- 100 year storm, following days of rain
- ~ **225 million gallons Combined Sewer Overflow (CSO)** into Lake Michigan
- Minimized by deep tunnel



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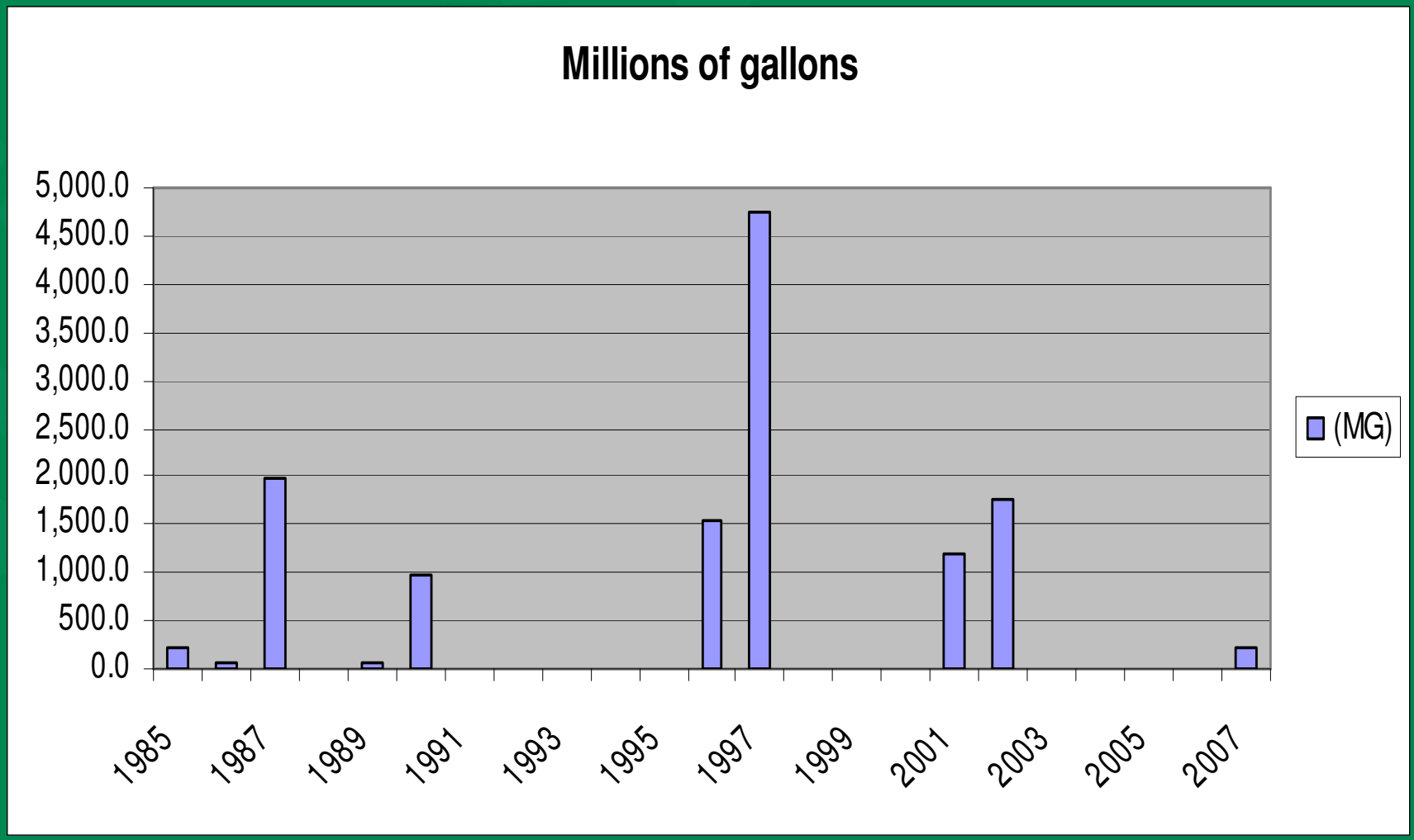
Chicago Lake Overflows



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Climate and Water

“ The frequency of heavy precipitation events (or proportion of total rainfall from heavy falls) will *very likely* increase over most areas during the 21st century, with consequences to the risk of rain-generated floods.”

Intergovernmental Panel on Climate Change
Technical Paper on Climate Change
and Water, April ‘08

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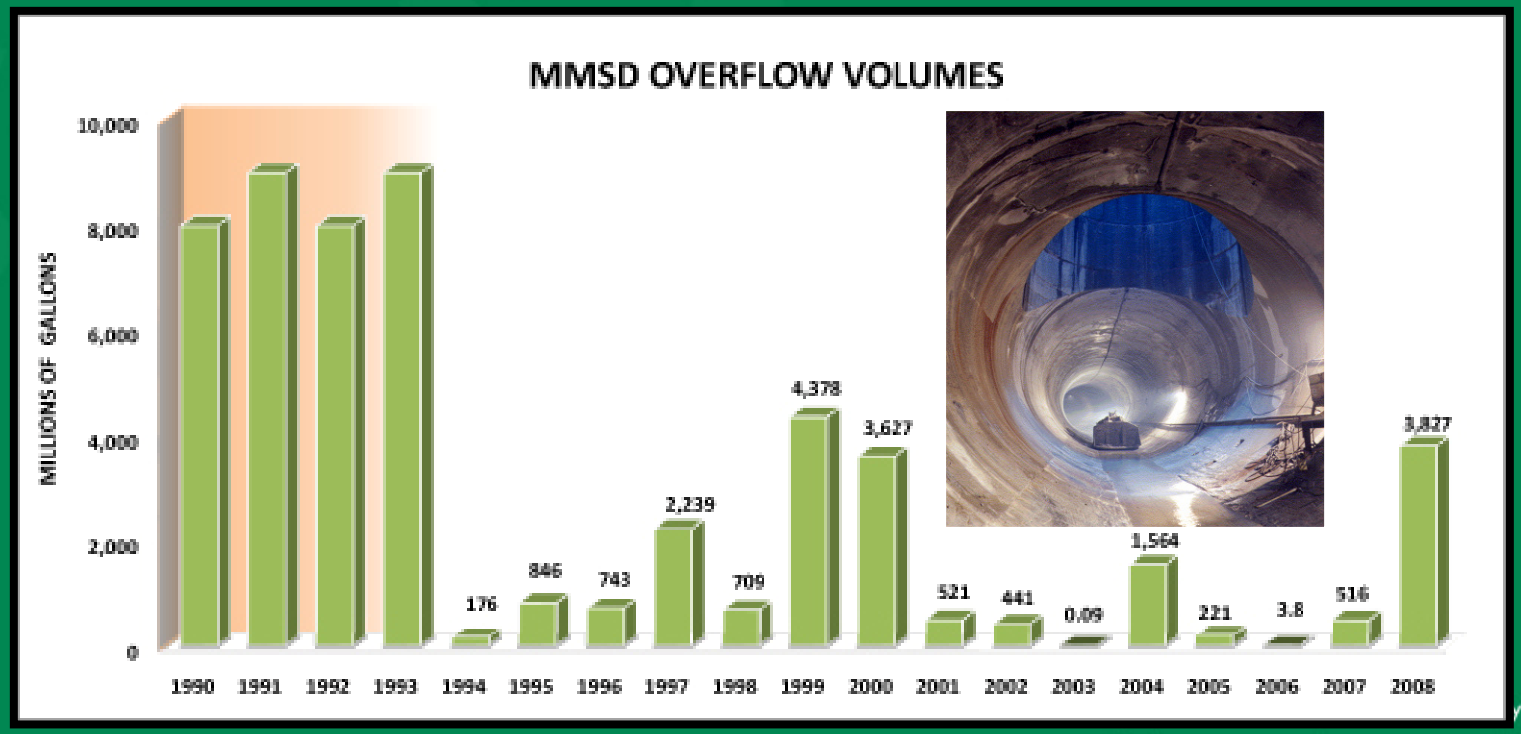
Milwaukee, June 2008

- 100 year storm
- Deep tunnel filled in 56 minutes
- ~ 3 billion gallons CSO
  into Lake Michigan



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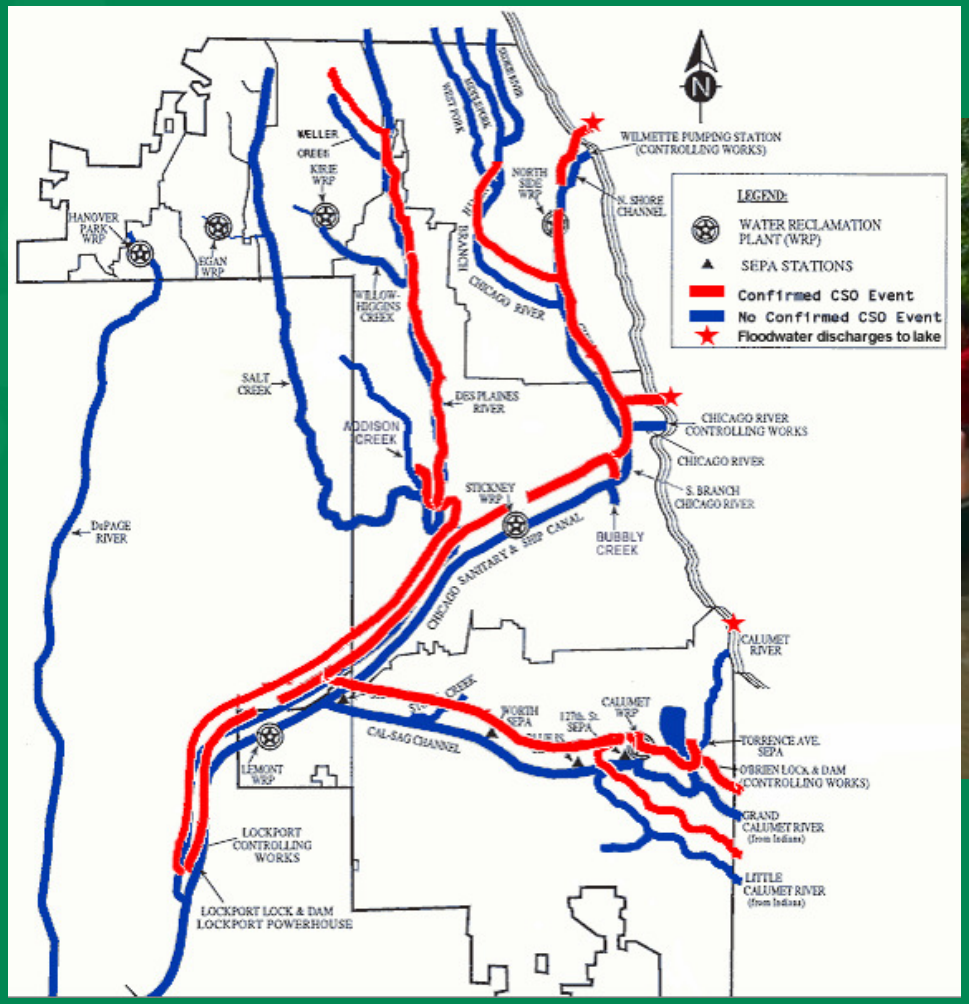
Chicago, September 13, 2008

- 500 year storm (6-9 inches in 24 hours), following days of rain
- ~ **11 Billion gallons CSO** into Lake Michigan
- + 50 Billion overflow to Mississippi



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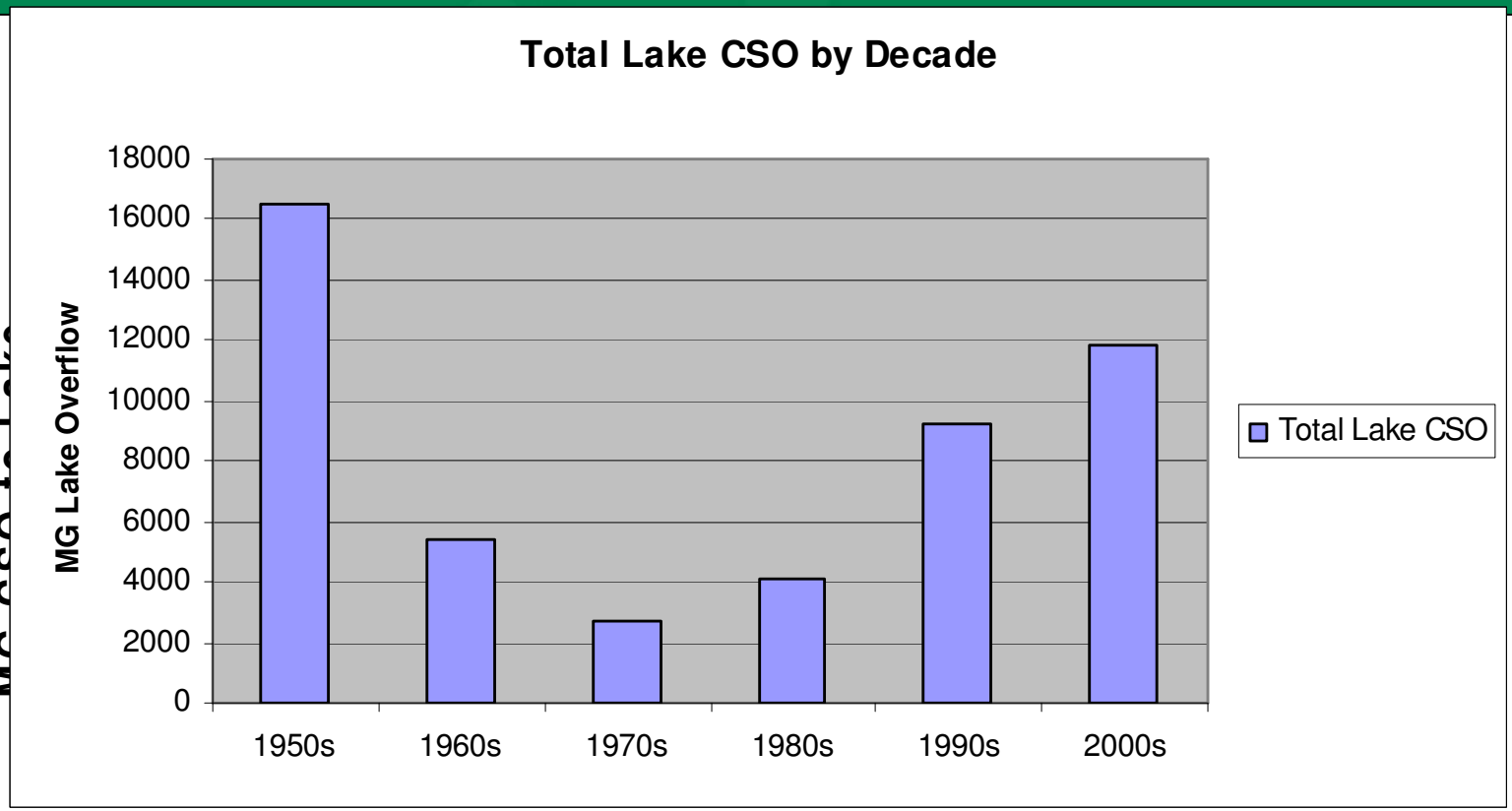
Chicago Lake Overflows



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Increasing Storm Intensity

- 36% increase in design rainfall intensity (5 year return storm) from 1st to 2nd half of 1900s
- "to maintain the same design and service standards, **the diameter of every sewer pipe in the Chicago region would have been increased by up to 17%** if rainfall IDF relationships were updated properly in time." (Guo, 2006)
- "Using 6.4 cm (2.5 in) of daily precipitation as the threshold for initiating combined sewer overflow into Lake Michigan, **the frequency of these events is expected to rise by 50% to 120% by the end of this century**." (Patz 2008)

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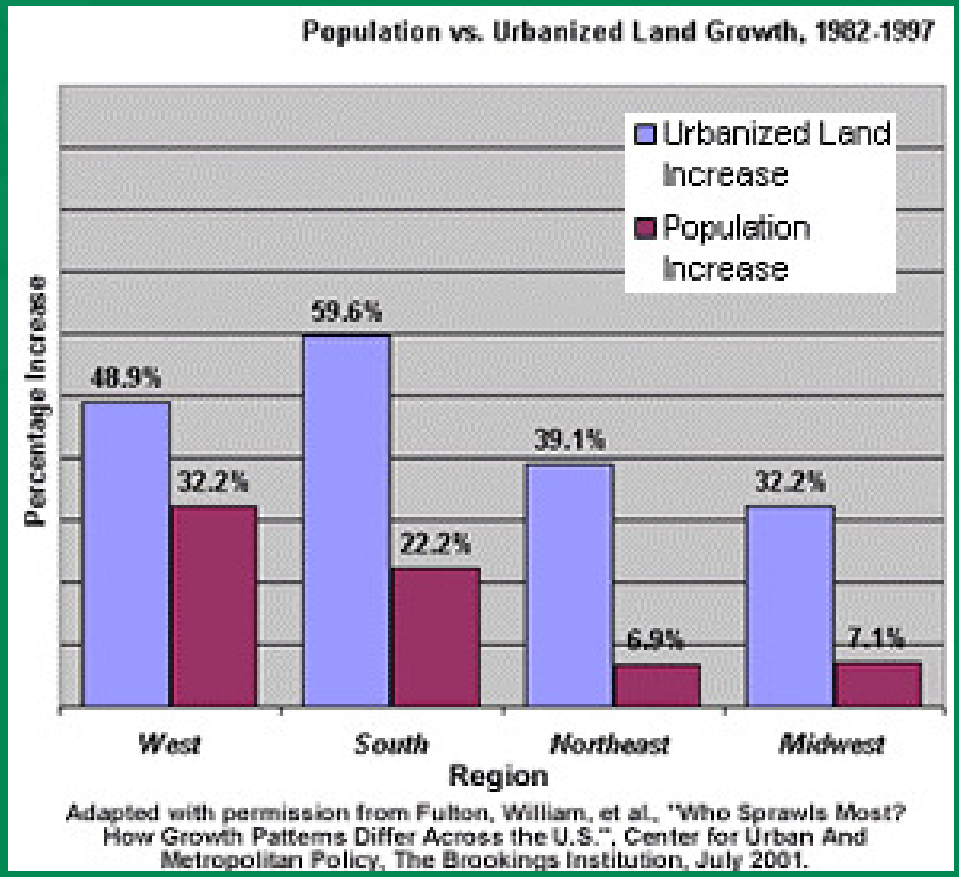
Increasing Development Intensity

- **Between 1982 and 1997 Chicago Population increased 12 %**
- **Land Developed increased 25%**
- **10-24 Billion Gallon loss in infiltration**

-- Paving our Way to Water Shortages (2002)



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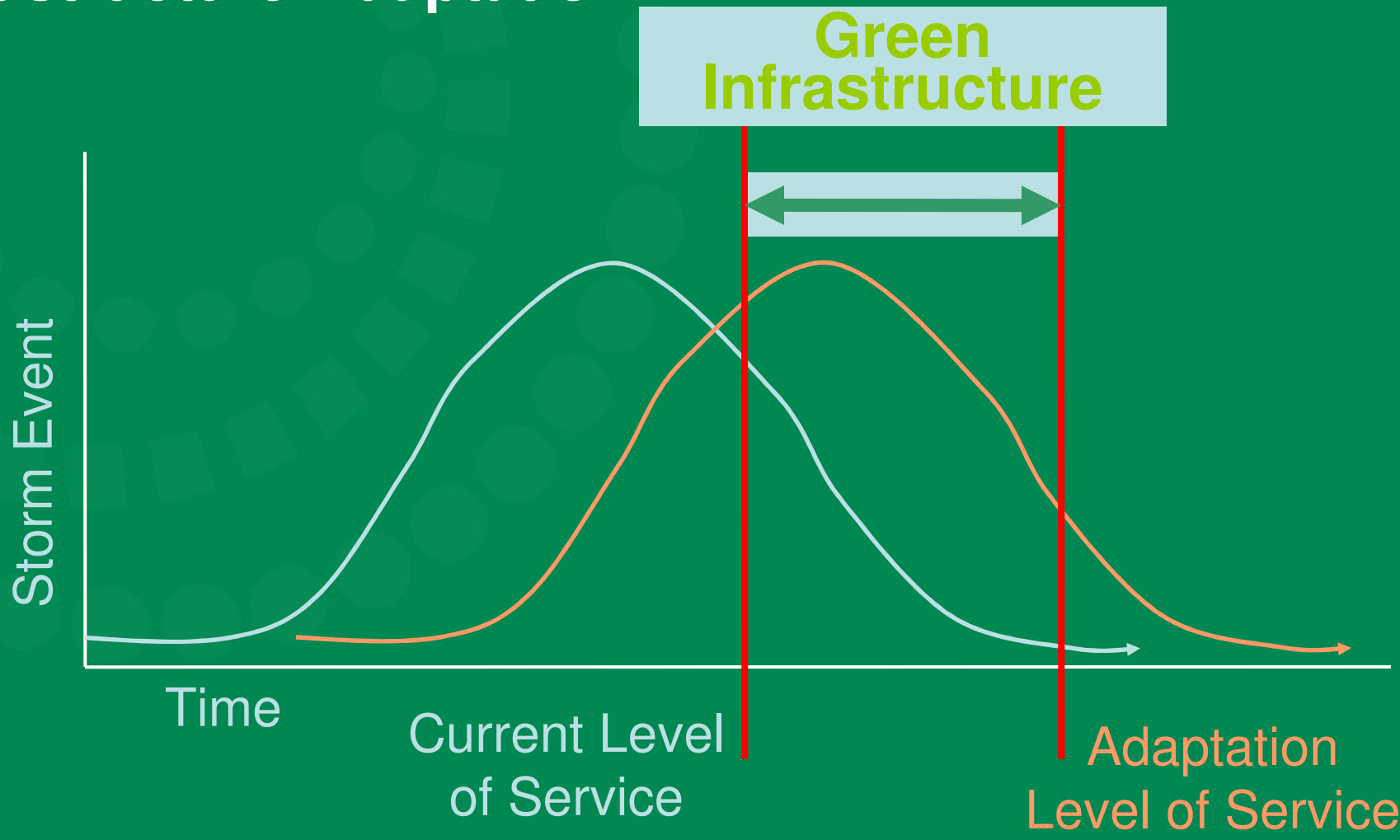
Climate Change and Infrastructure Adaptation



Source: Chicago Dept of Transportation

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Thinking Outside the Pipe

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Rethinking Performance

- Performance measured, valued in 'Anti-Gallons' left in natural drainage
- Drainage, flood control, pollution prevention move upstream from treatment plant to distibuted sites at water's origins
- Account for full range of economic, ecological benefits

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CNT Green Infrastructure Tools

Outreach

Policy Development

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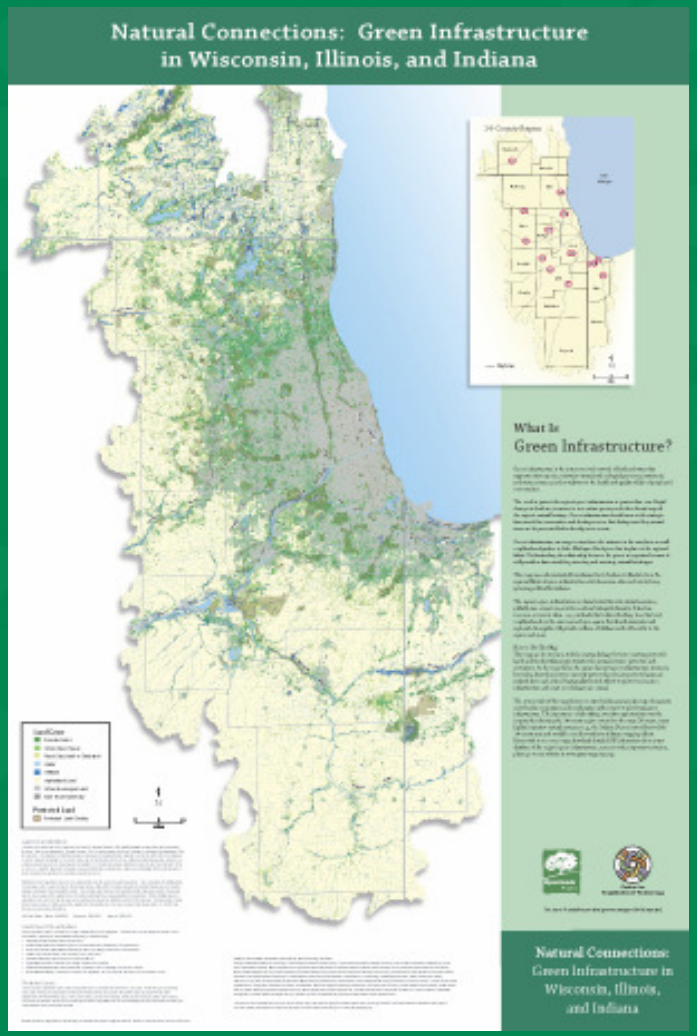
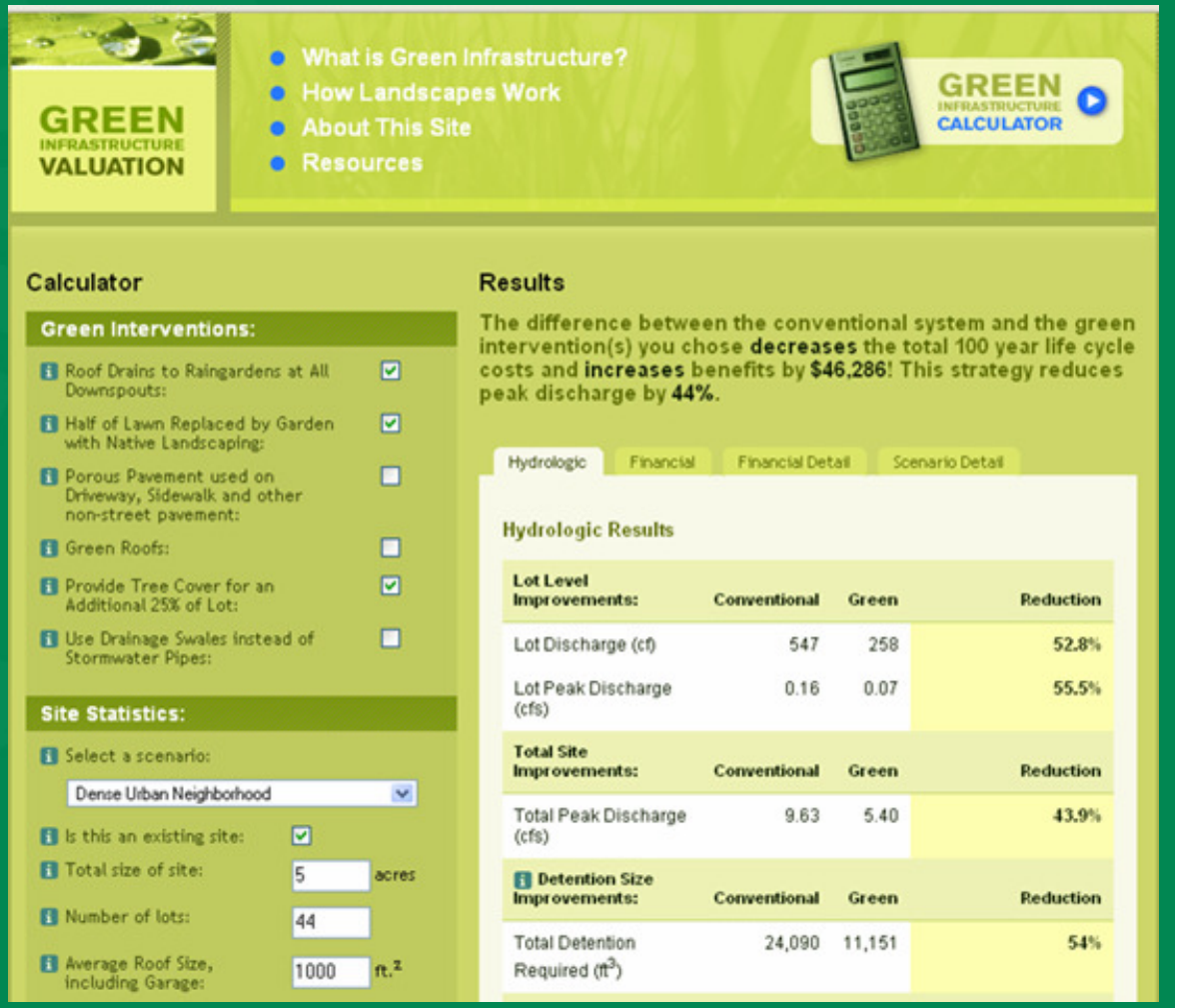
CNT Green Infrastructure Tools



greenmapping.org



greenvalues.cnt.org

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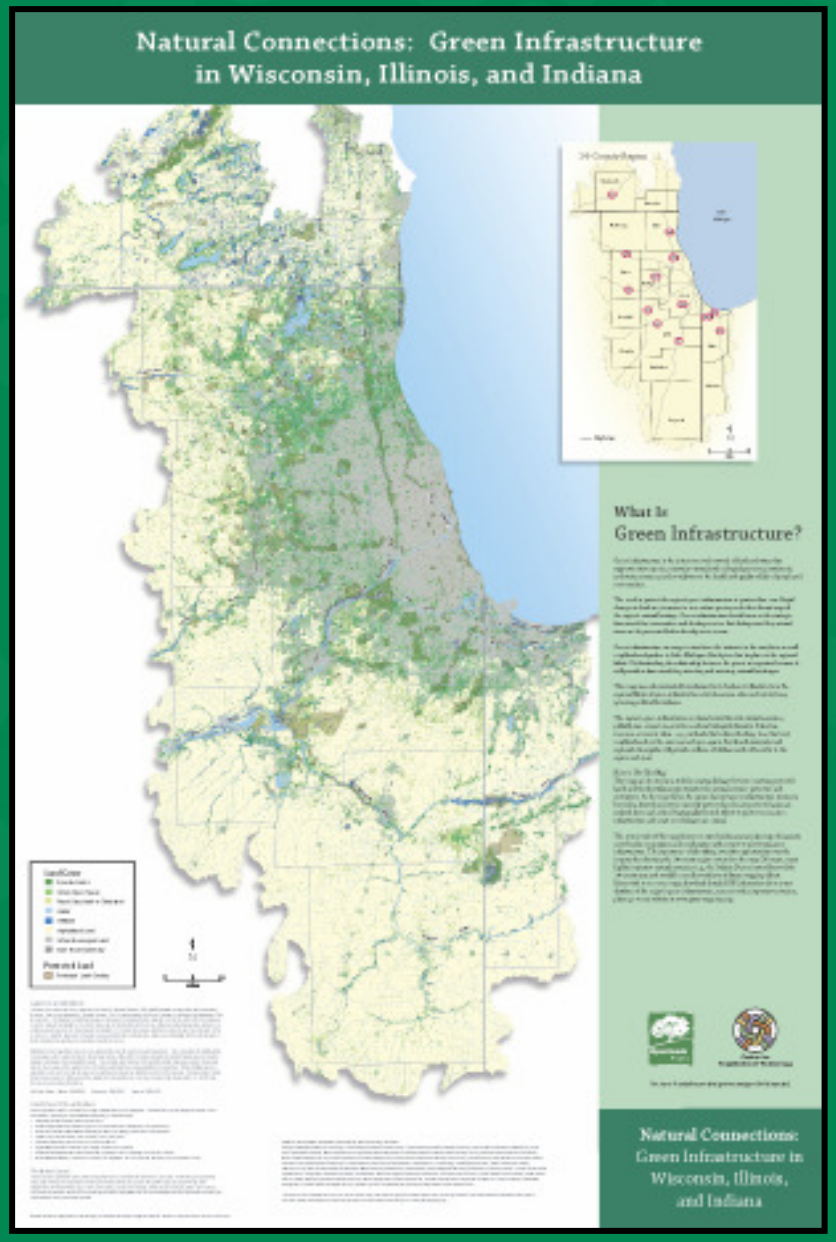

greenmapping.org

- 170 GIS layers
- Land status, current and historic
- Interactive, searchable
- Shows ***where baseline GI network can be extended***

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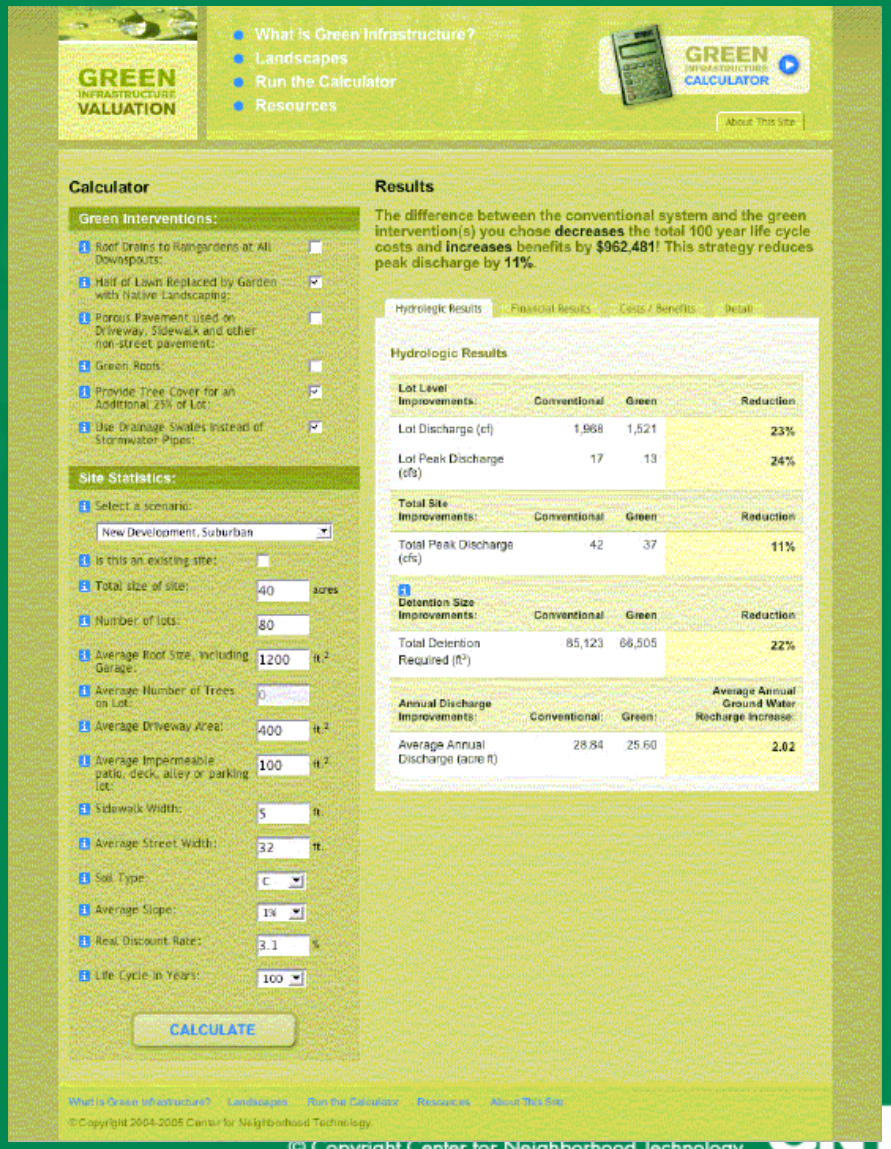
Green Values® Calculator

http://greenvalues.cnt.org

- Estimates green infrastructure's financial and hydrologic effect on a single lot or across a neighborhood.
- Compares green and conventional 'grey' infrastructure life cycle costs including GI's diverse economic, environmental, and social benefits
- Adaptable for local ordinance verification – in use in Chicago
- Updated National Version 5/09



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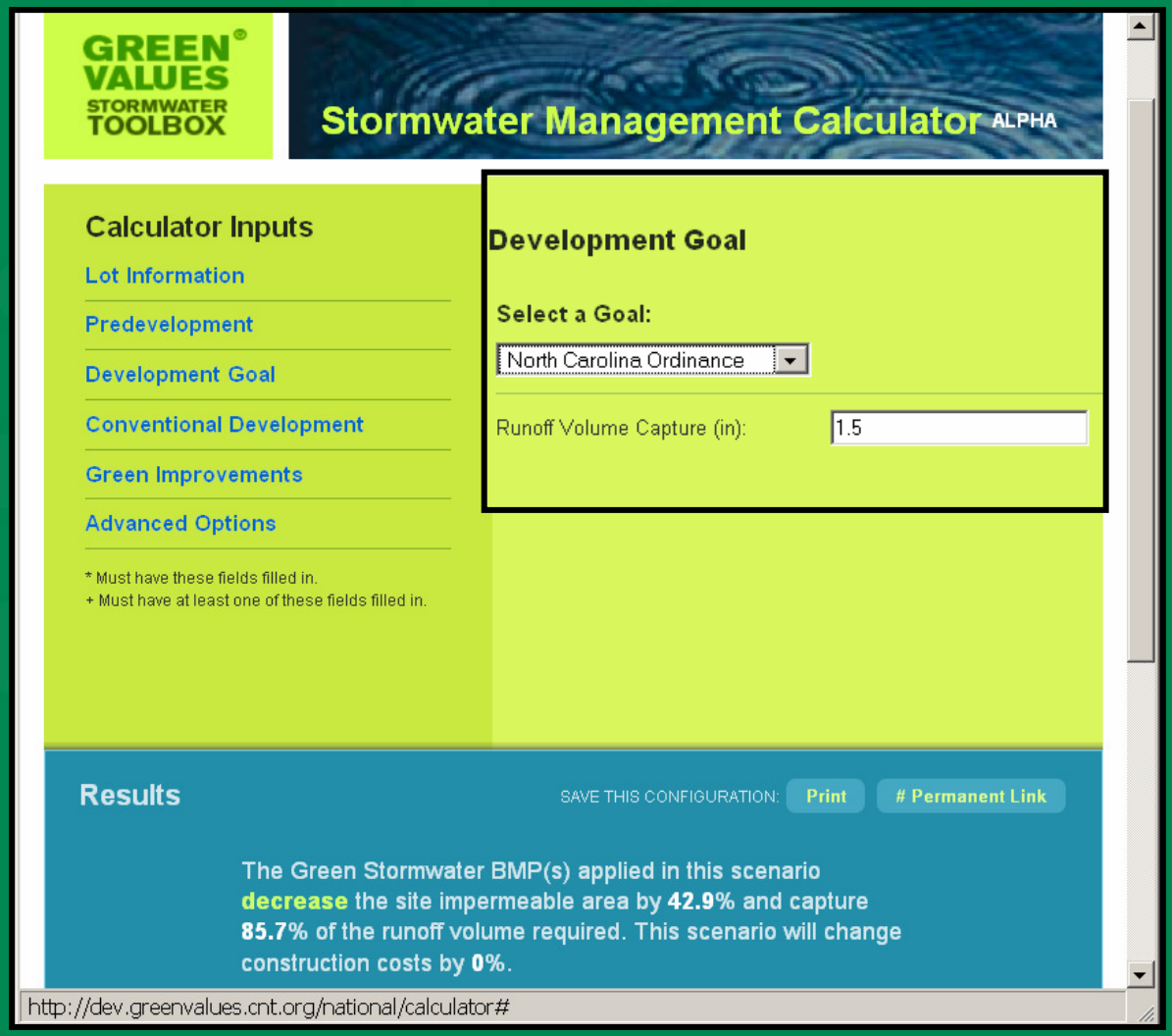
Coming soon:
National Green Values Calculator



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Why Green Infrastructure?

- **Restores, recycles, extends** natural and built regional infrastructure

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Monitored Demonstrations

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St Margaret Mary Church

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St Margaret Mary 9/13/08

"For the first time ever in a major storm, much less a record…we had no problem"

-- Jack Kent, Margaret Mary Church

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Why Green Infrastructure?

- **Restores, recycles, extends** natural and built regional infrastructure
- **Highly effective for stormwater runoff reduction and pollutant removal**

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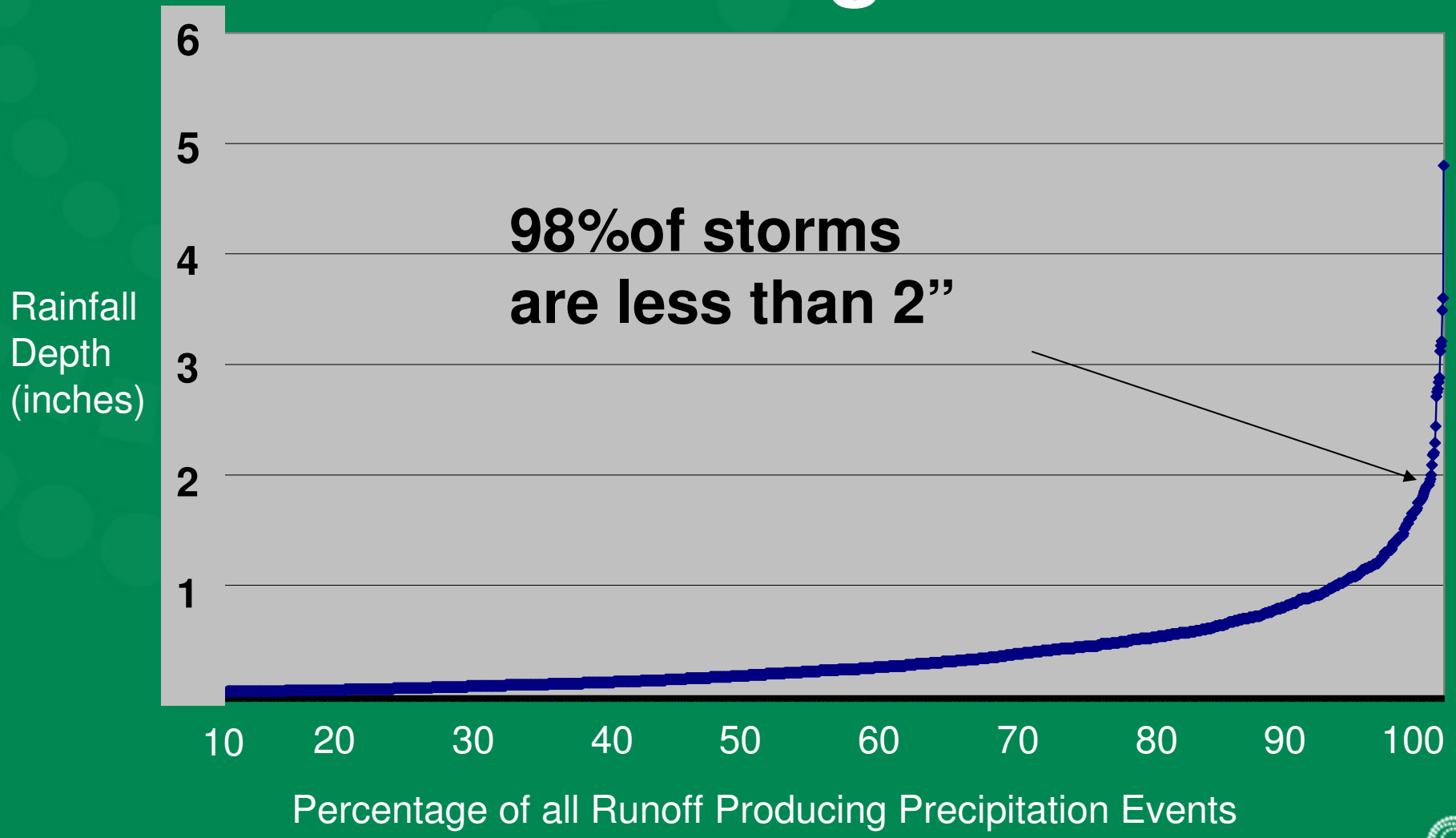
Effectiveness and Performance: Chicago



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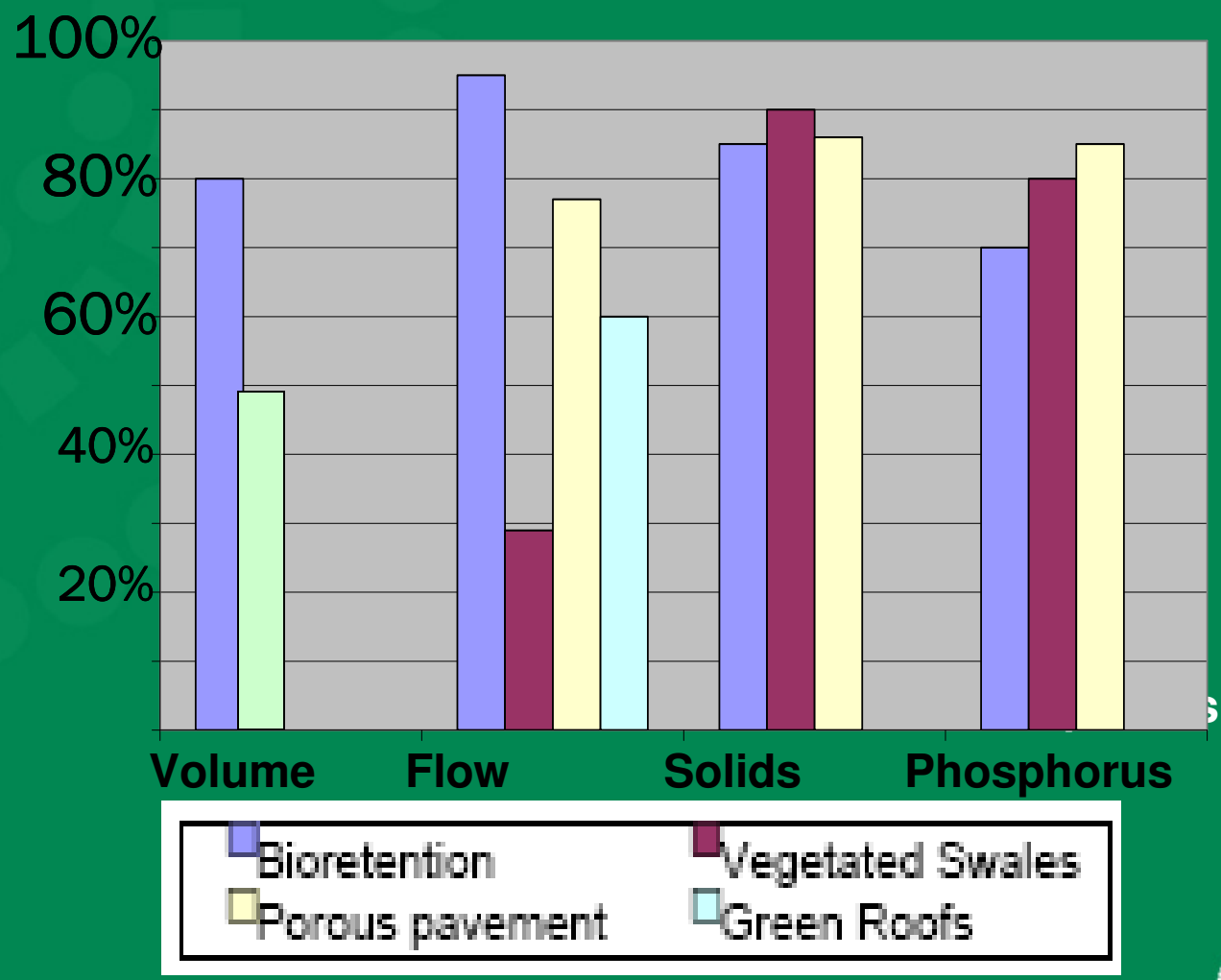
High Performance Standard

Stormwater runoff, pollutant reductions



Portland, Oregon Sustainable Stormwater Program

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Raingarden Performance

- Infiltration reduces peak discharge rate
- Vegetative uptake of stormwater pollutants
- Pretreatment for suspended solids
- plus
- Groundwater recharge
- Aesthetic Improvement

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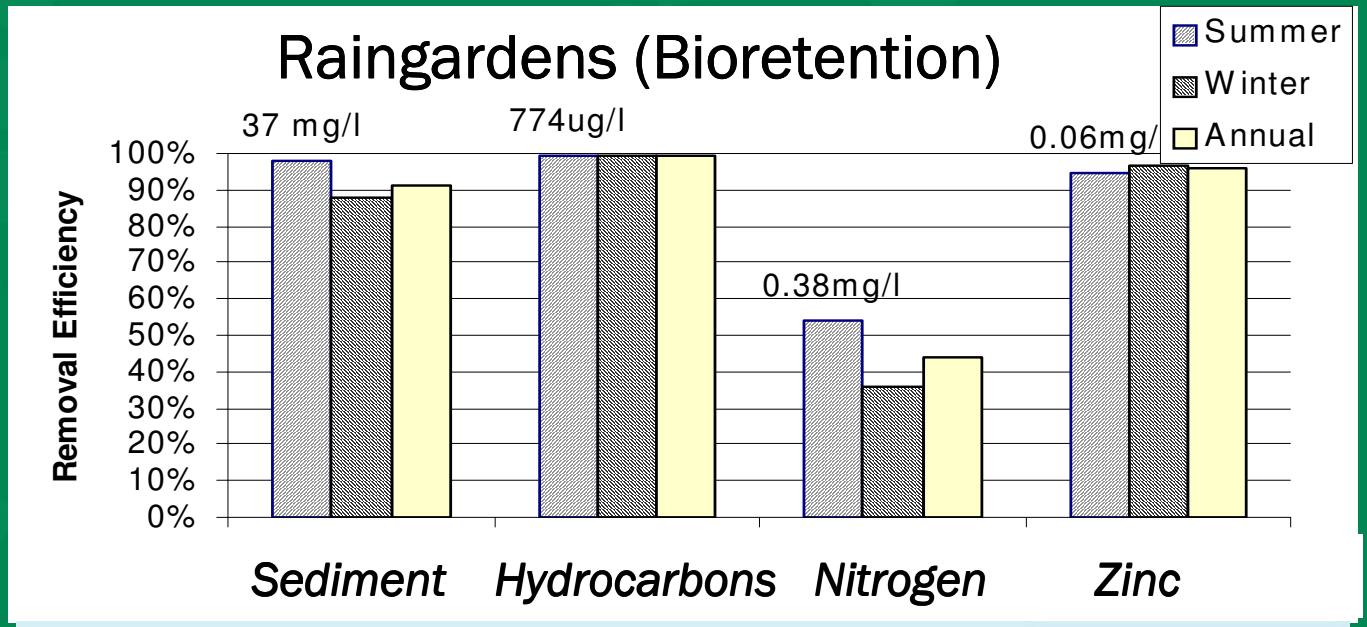
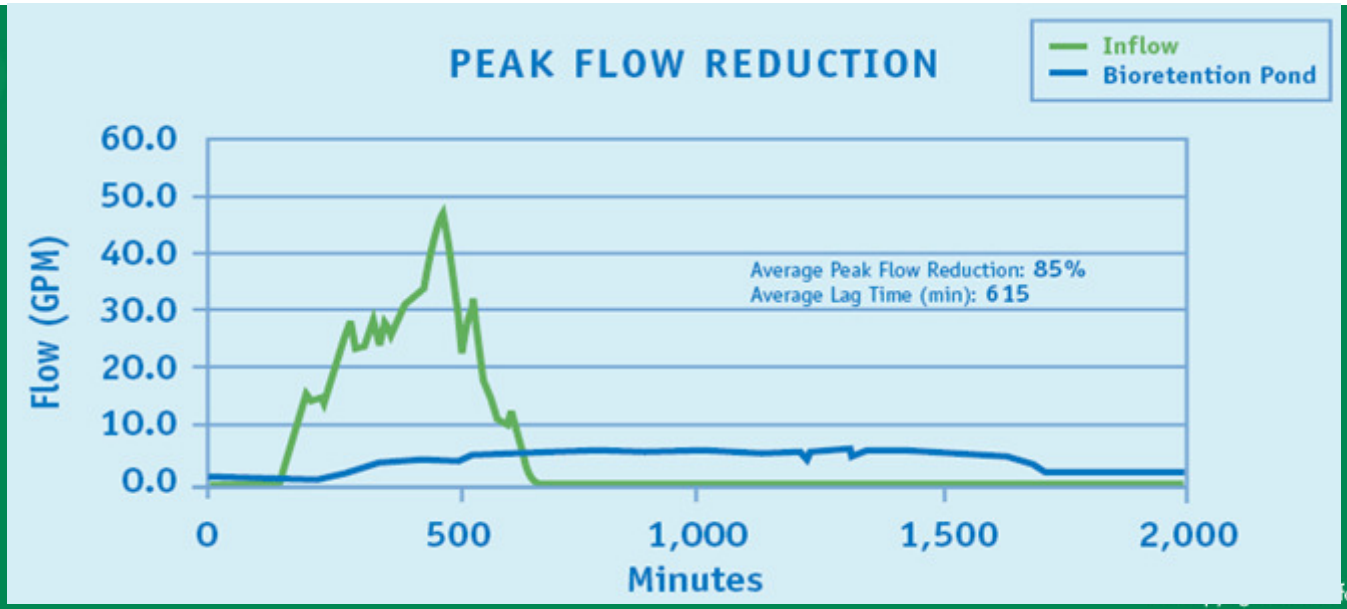
Performance Efficiencies –Filtration/Infiltration

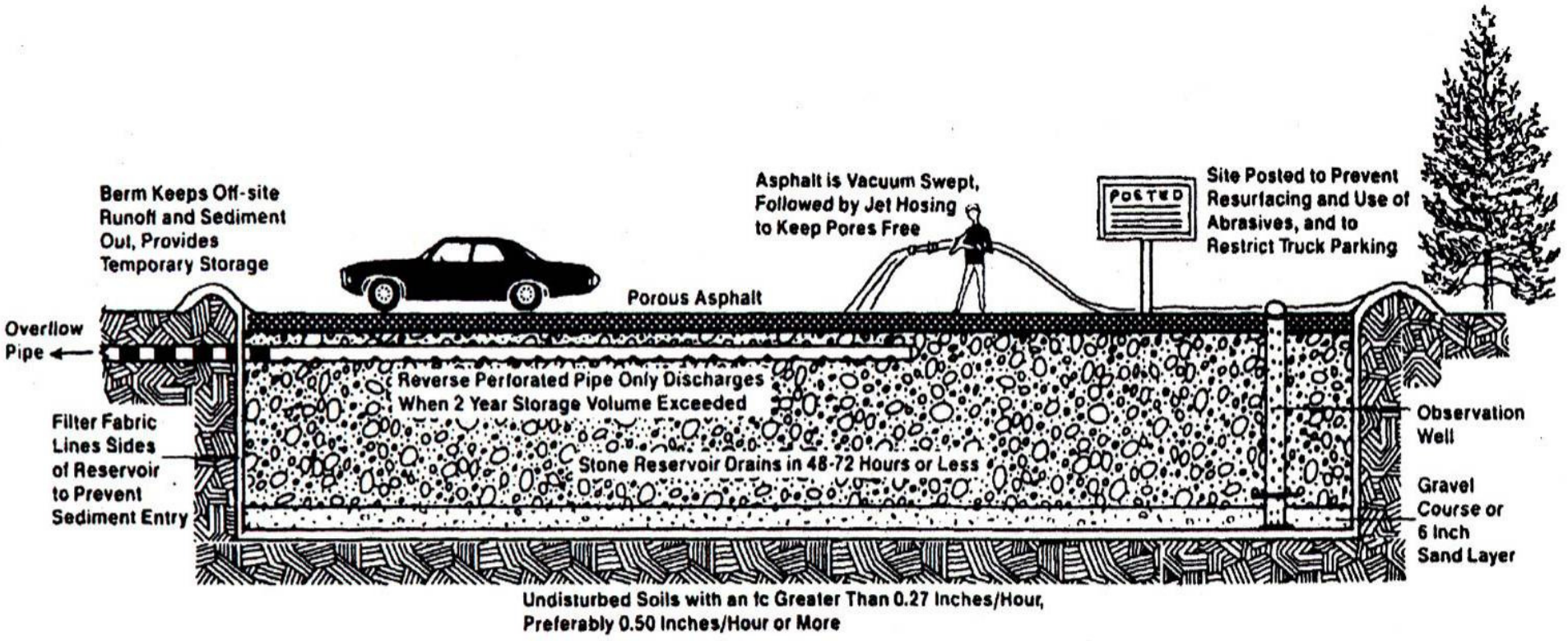




University of New Hampshire Stormwater Center

for Neighborhood Technology CNT

Permeable Pavement



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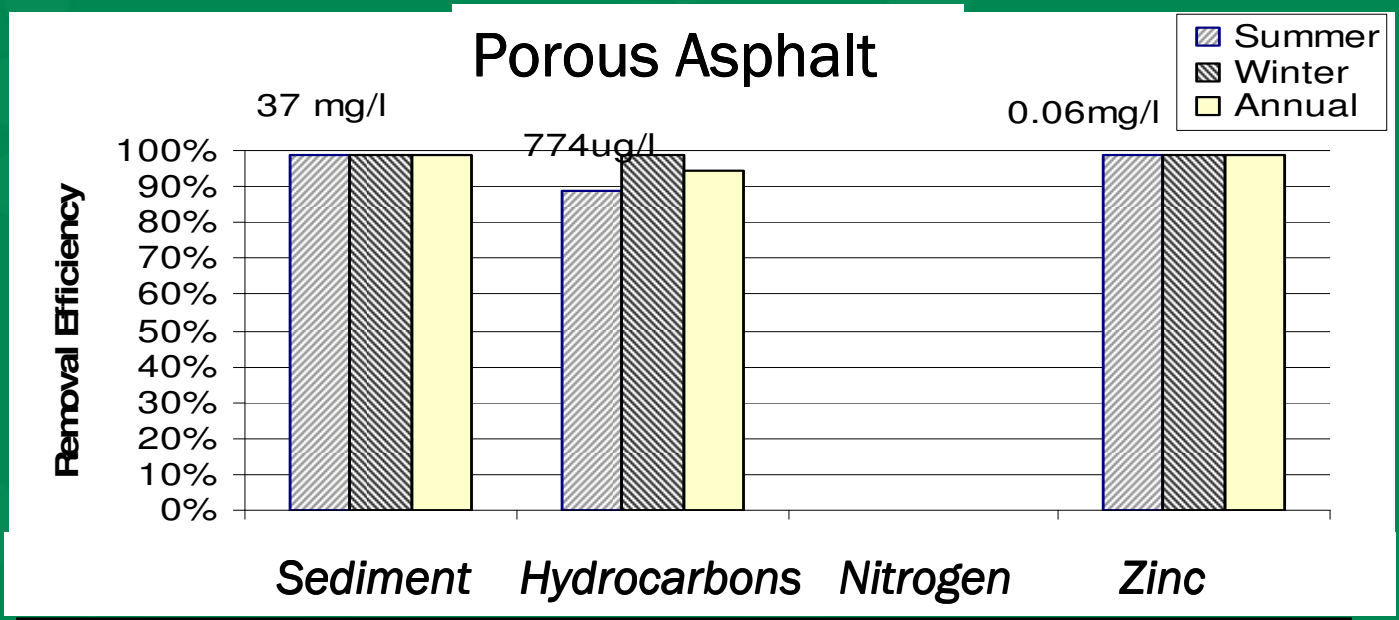
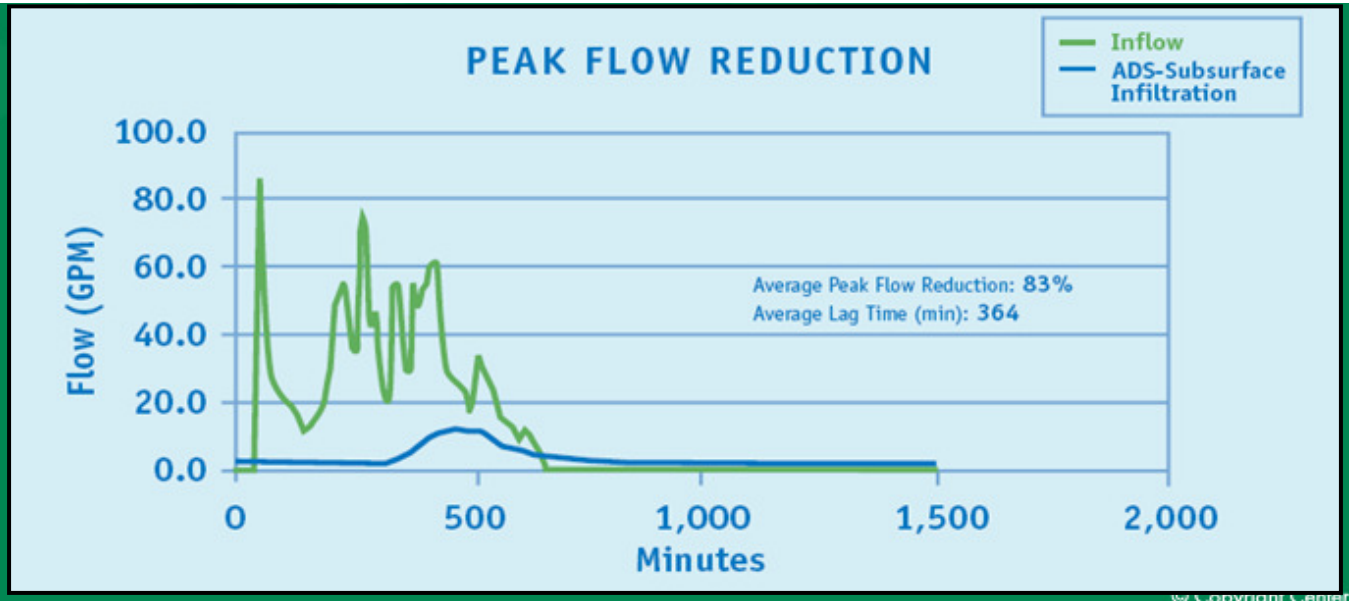
Performance Efficiencies –Filtration/Infiltration





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Milwaukee School of Engineering

- **"Water quality sampling and testing was not possible because the pervious pavements do not discharge runoff even during the simulated rainfalls. The pervious parking lot is 100% effective at eliminating discharge of contaminants through surface runoff during rainfall events."**

  (2007 MMSD Monitoring Report)

- **Comparable cost to conventional asphalt**

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Why Green Infrastructure?

- Restores, recycles, extends natural and built regional infrastructure
- Highly effective for stormwater runoff reduction and pollutant removal
- **Saves money compared to conventional infrastructure**

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Cost-Effectiveness: Seattle SEA Streets

- vegetated strips, no curbs = 11% reduction in impermeable surface
- 90+% runoff reduction
- 25% cost savings compared to conventional design

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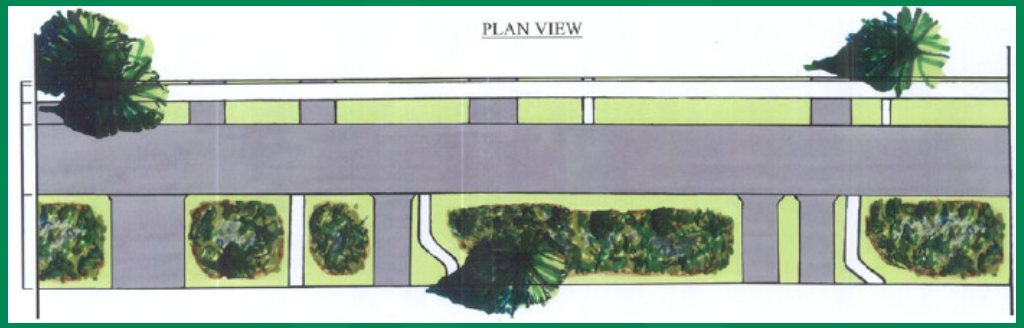
Cost-Effectiveness: Seattle Green Grid



- 86% annual volume
- Serves 5 blocks (49 acres)
- "double the stormwater benefit for the same cost" as SEA Street 1

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Green Infrastructure Cost-Effectiveness

Portland, Oregon Green Streets Program

- Citywide priority – included in development, redevelopment or enhancement
- 40% cost savings compared to conventional design
- 80-85% CSO peak flow reduction

1% fee on street construction to establish Green Streets fund

- $50 million Grey to Green initiative in 5 years

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Streets or Sewers? Autumn Trails

Item	Permeable	Concrete	Asphalt
Paving/sf	$2.25	$8.00	$3.00
Excavating/sf	$1.00	$1.00	$1.00
Stone/sf	$2.00	$1.50	$1.50
Installation/sf	$4.00	(in paving cost)	$1.50
Curbs	$1.50	$1.50	$1.50
Maintenance	$0.20	0	Not known
Replacement	None	None	Every 12 years
Detention/Retention required	None	Yes	Yes
Storm Sewer System/sf paving	None	$3.00	$3.00
Total/sf	**$10.95**	**$14.00**	**$11.50**
Total/linear foot muni street	**$171**	**$218**	**$179**
Total/linear ft 30’ wide street	**$230**	**$280**	**$230**

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EPA GI Cost-effectiveness Study

Table 2. Summary of Cost Comparisons Between Conventional and LID Approaches[a]

Project	Conventional Development Cost	LID Cost	Cost Difference[b]	Percent Difference[b]
2nd Avenue SEA Street	$868,803	$651,548	$217,255	25%
Auburn Hills	$2,360,385	$1,598,989	$761,396	32%
Bellingham City Hall	$27,600	$5,600	$22,000	80%
Bellingham Bloedel Donovan Park	$52,800	$12,800	$40,000	76%
Gap Creek	$4,620,600	$3,942,100	$678,500	15%
Garden Valley	$324,400	$260,700	$63,700	20%
Kensington Estates	$765,700	$1,502,900	–$737,200	-96%
Laurel Springs	$1,654,021	$1,149,552	$504,469	30%
Mill Creek[c]	$12,510	$9,099	$3,411	27%
Prairie Glen	$1,004,848	$599,536	$405,312	40%
Somerset	$2,456,843	$1,671,461	$785,382	32%
Tellabs Corporate Campus	$3,162,160	$2,700,650	$461,510	15%

EPA 'Reducing Stormwater Costs through LID Strategies and Practices

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Long Term Control Plan Savings

go green louisvi!!e

- Proposed LTCP includes $86 million for green roofs, streets, biofiltration
- Saves estimated $40 million from original LTCP of $324 million
- Conservative assumptions → average cost $.09/gallon removed
- "green infrastructure can be a very cost competitive solution, with successful partnerships and cost sharing, when compared to more traditional gray controls "

-- *Louisville Metropolitan Sewer District Integrated Overflow Abatement Program Draft summary 9/20/08*)

(budsmith.com)

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Why Green Infrastructure?

- Restores, recycles, extends natural and built regional infrastructure
- Highly effective for stormwater runoff reduction and pollutant removal
- Saves money compared to conventional infrastructure
- **Delivers multiple community benefits along with stormwater management**

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How many problems can your community solve for $3 billion?

- **CSO Tunnel/Grey Infrastructure:**
  - Reduce sewerage overflows to our rivers

- **Land-Based Storm Water Strategies:**
  - Reduce sewerage overflows to our rivers
  - Create green space, urban land restoration, mitigate global climate change, reduce heat island, improve quality of life, water conservation, energy use, education, recreation, riparian buffers, flood control, access, unimpaired streams…

(Philadelpia Watersheds Office)

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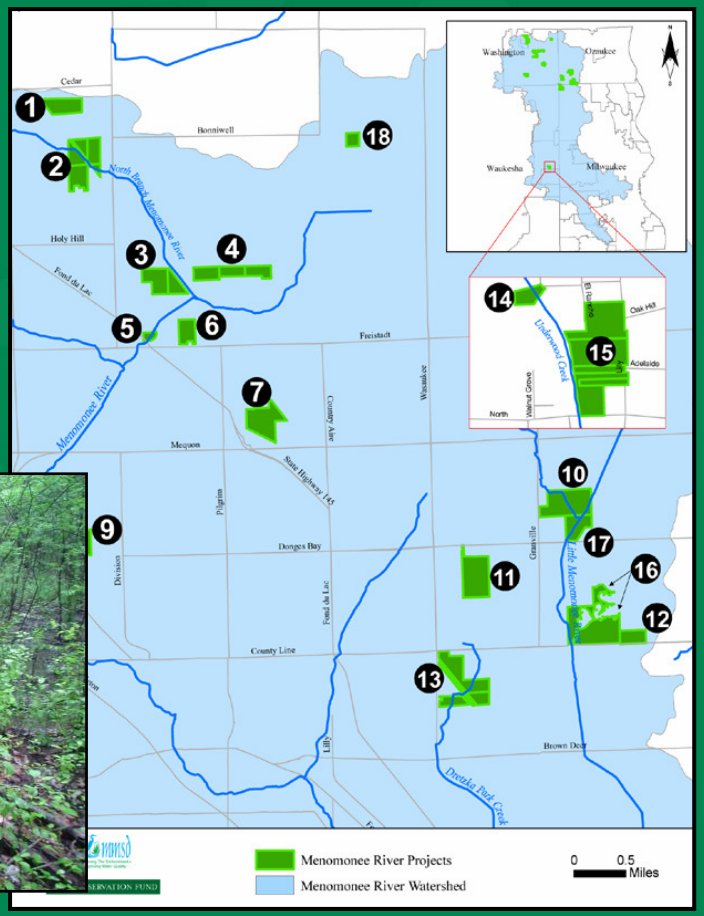
Source Protection - Milwaukee



- **Purchases undeveloped land for permanent open space in growth areas**
- **Upstream flood control, infiltration, recreation, habitat**
- **$15 million capital committed over 8 years**
- **2007: 460 acres, $3.9 million**

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Real Estate Value: *A Philadelphia Story*

- **Vacant land improvements increased surrounding housing values by as much as 30%**
- **New tree plantings increased surrounding housing values by approximately 10%**

(University of PA data)

(Philadelpia Watersheds Office photos))

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"Tree Increment Financing"

Tree Plantings:

- $4 million property value gain
- 20 years taxed at 2.64% = **$2,112,000**

Lot Improvements:

- $12 million gain through
- 20 years taxed at 2.64% = **$6,336,000**

U of PA study only 2 of 50 zip codes

Now citywide: 423 parcels (13 acres) since 2000

PA Horticultural Society photos

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Air Quality

- One square meter green roof can remove .2 kg particulates per year
- 5 square meters = capture from 10,000 vehicle miles traveled

Sydney Conservatorium of Music (image courtesy www.wsud.org)

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Urban Cooling

- Trees:
  10% canopy increase
  →
  5-10% energy savings
  from shading, windblocking
- Toronto study: permeable pavements reduce heat island

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Chicago Citywide Green Roof Potential

- **Chicago citywide projection: $100 million energy savings and 720 megawatts (= 3 coal fired power plants)**

Data source: Weston Design Consultants

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Chicago Roofs Less Graveled

2 million square feet built, 4 million planned

~ annual particulate capture from 74,322 cars

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Los Angeles Green Roof Potential

- 15% Green Roof Coverage
- 5-9 degree heat island reduction
- .5 - 1 **Gigawatt** peak power savings
- Proposition O: $500M

Lawrence Berkeley Labs Heat Island Group, 2000

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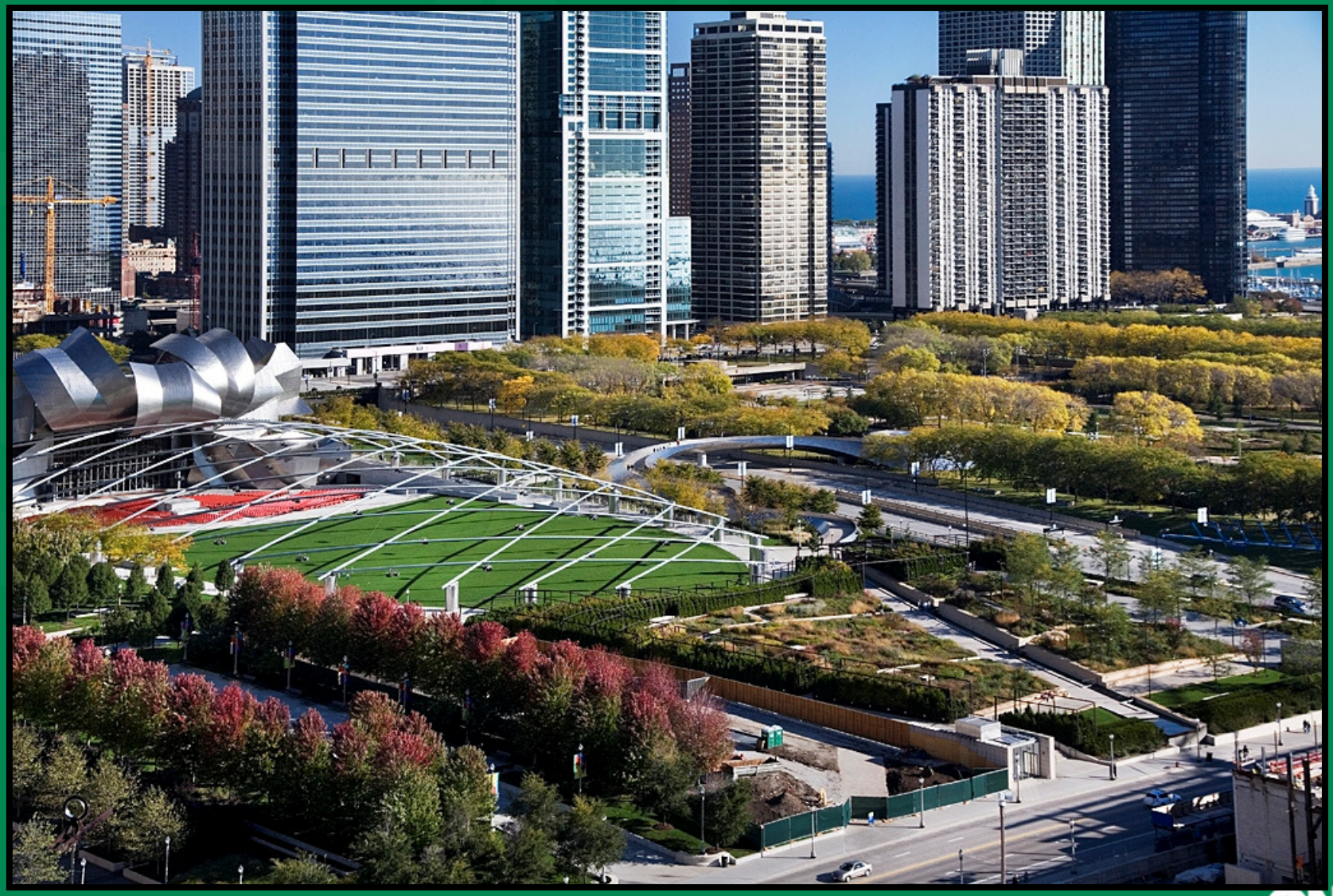
Put the ‘Park’ Back in ‘Parking’



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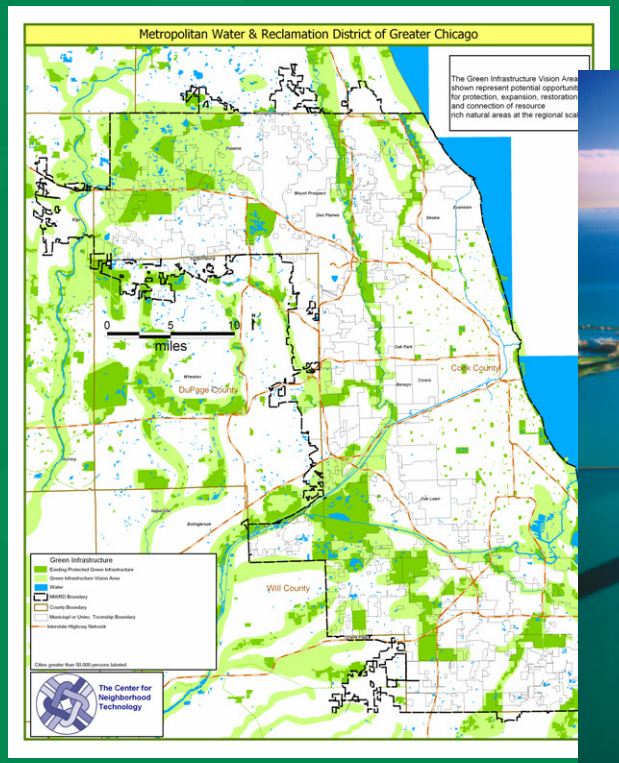
Getting to Scale – Water Supply

- Cook County Estimate: Apply Various Green Infrastructure →
- 40% runoff reduction
- Aquifer & lake recharge equivalent to additional supply for >1 million people



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Public Safety

Compared with areas that had little or no vegetation, buildings with high levels of greenery had 52% fewer crimes

Landscape and Human Health Laboratory
University of Illinois at Urbana-Champaign

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Community Health

"exposure to green surroundings reduces mental fatigue and the feelings of irritability that come with it. The ability to concentrate is refreshed by green views, along with the ability and willingness to deal with problems thoughtfully and less aggressively. And, in this study, ***even small amounts of greenery—a few trees and a patch of grass—helped inner city residents have safer, less violent domestic environments****."*

Landscape and Human Health Laboratory
University of Illinois at Urbana-Champaign

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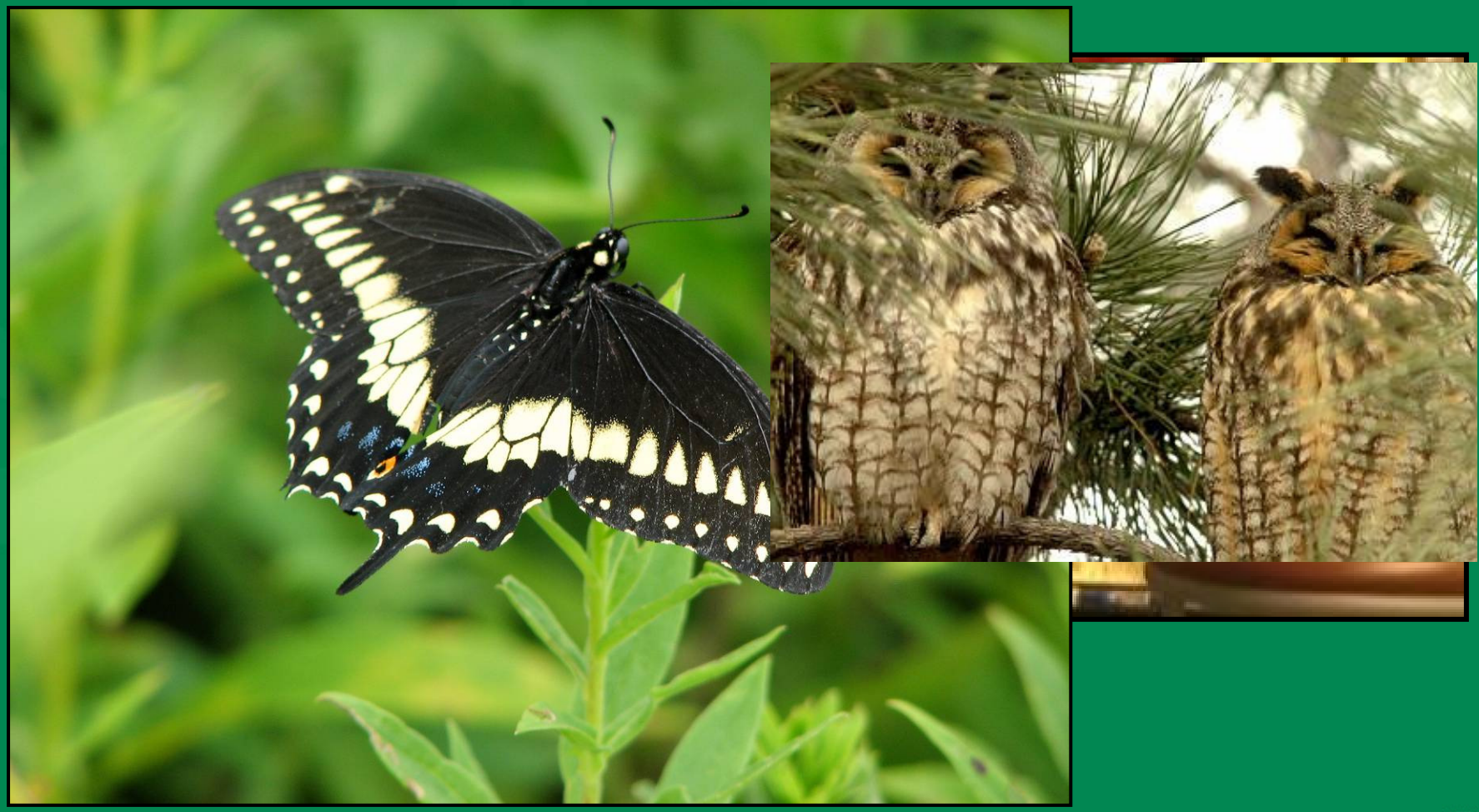
Habitat



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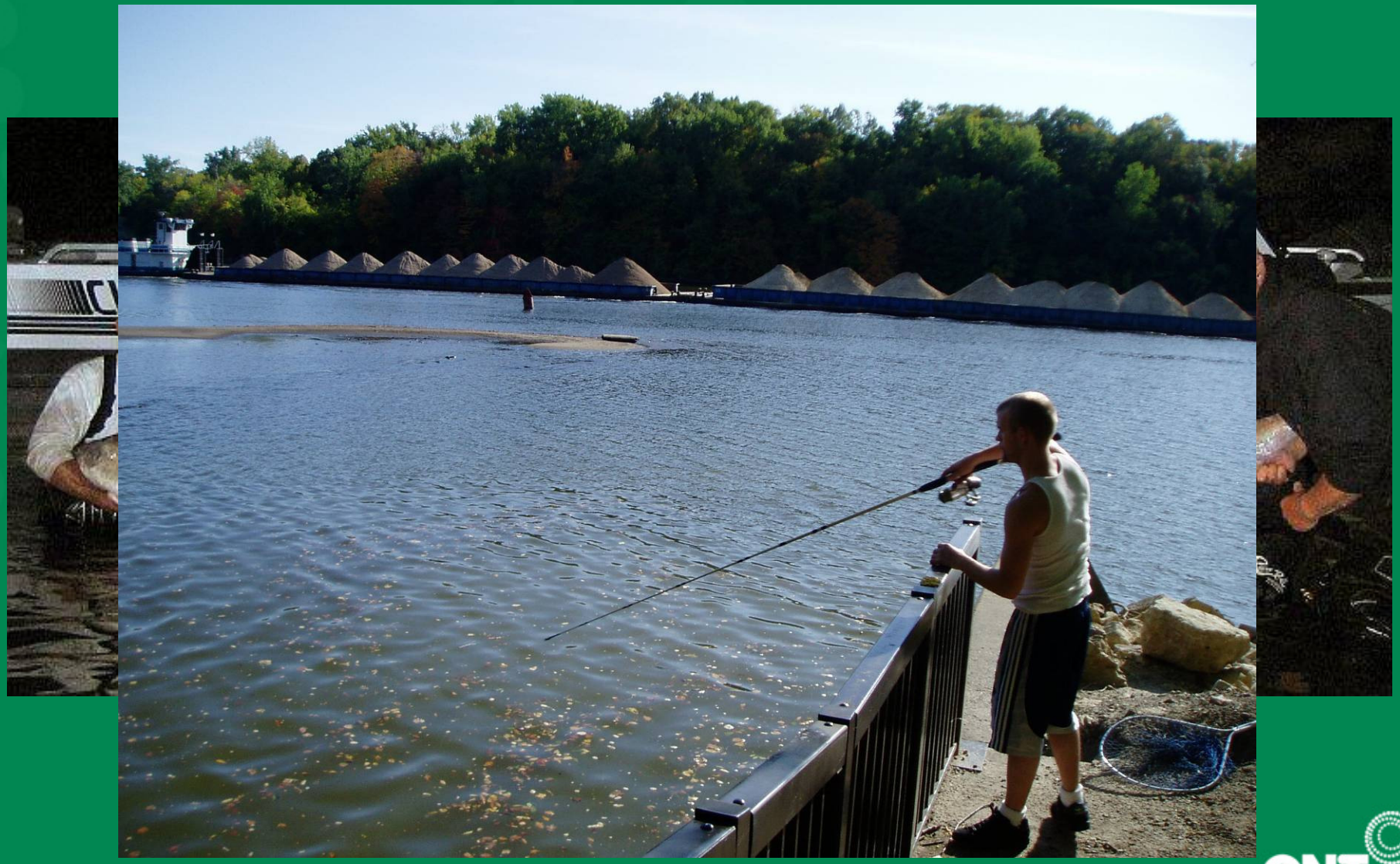
Recreation



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… Jobs Strategy

- Entry level landscaping: Job skills with inspiring purpose
- “For the first time, I can go home and tell my mother I’m proud of what I’m doing”

Chicago GreenCorps at Our Lady Gate of Heaven project site

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Jobs Strategy

- **Certified installers:**
  - Permeable pavement
  - EPA Watersense

- **High skilled engineering, landscape architecture, monitoring**

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‘Holier’ than Thou

“We are ahead of the Pope.”

-- Fr. Jim Barrett

“…the greenest ward in the greenest city in America.”

-- Alderman Joe Moore

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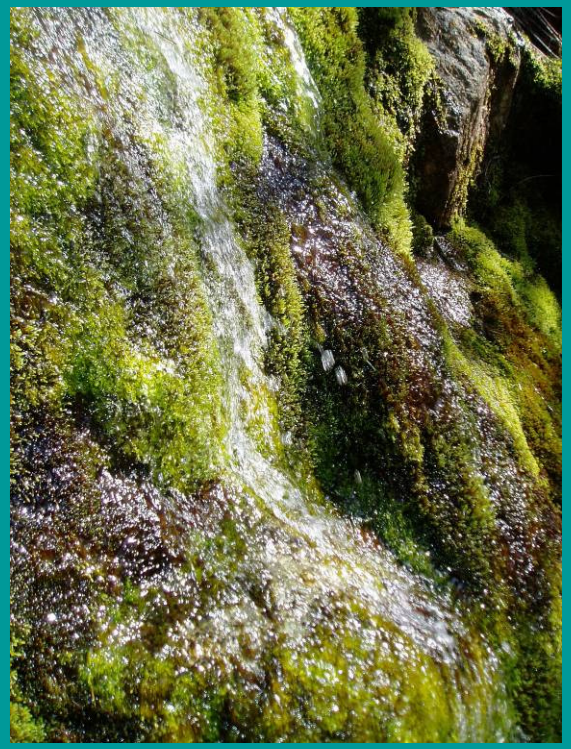
Beauty



Opal Creek, Oregon

opalcreek.org

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Community Connection

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‘Getting Out of the Gutter’

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“Drain’ge We Can Believe In”

- ***Trickle Down Economics*** – cost effective reduction of capital intensive infrastructure
- ***1000 Points of Infiltration*** – emphasizing distributed approach to manage clean water asset in place
- ***Supply Side Theory*** – preventing stormwater treatment also boosts groundwater supply, extends capacity of existing treatment systems
- ***‘Are you more permeable today than you were 4 years ago?’***

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Answering the Global Challenge

"It is this kind of project that needs to be replicated a billion times around the world."

-- Nobel Peace Laureate Wangari Maathai

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Thank You

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