

Public and Community Health Benefits of Green Infrastructure



Kathleen Wolf, Ph.D.
Research Social Scientist

University of Washington (Seattle)
School of Environmental and Forest Sciences
US Forest Service, Pacific NW Research Station

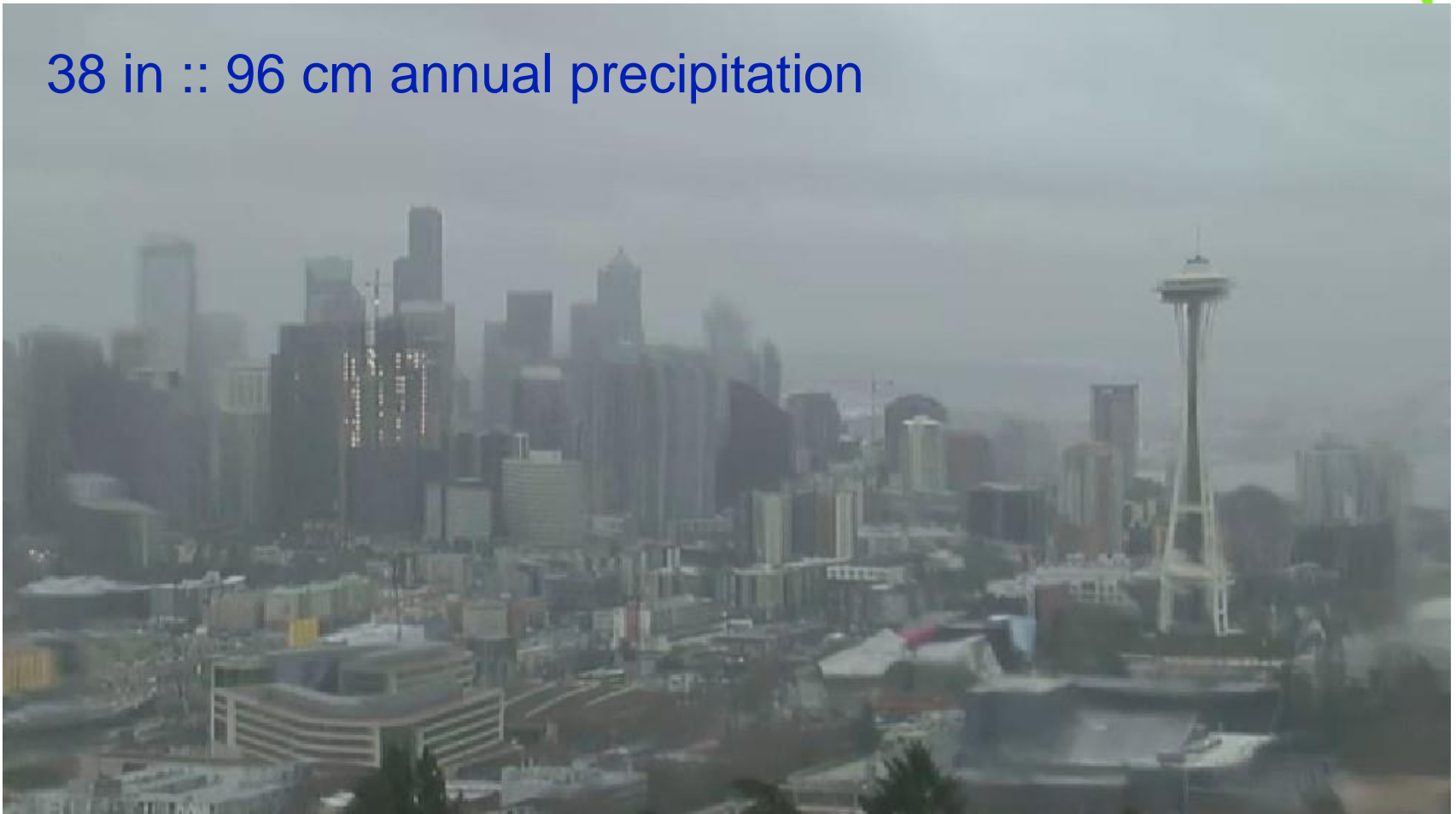
Green Infrastructure Forum
Centro Ecológico del Estado, Hermosillo, Sonora
May 18-19, 2017



Seattle, Washington State :: wet climate



38 in :: 96 cm annual precipitation





credit: Cliff Mass





Protecting Seattle's Waterways

City of Seattle Stormwater Manual

JANUARY 2016



Green Infrastructure

improved function
reduce costs
cleaner water
improved habitat
community connection
flexible strategies

Human Health & Wellness

co-design for
co-benefits



Topics

city systems – sanitary to sustainable
green infrastructure solutions
nature in cities & human health
(mental health & wellness)
economic benefits



sanitary city

efficient and hygienic
supply & removal
of materials and services
natural systems disconnect

Industrial Age – city squalor



credit: BlendSpace



credit: blogs.isb.bj.edu.cn



08/04/2005

Baltimore: Public Works Museum

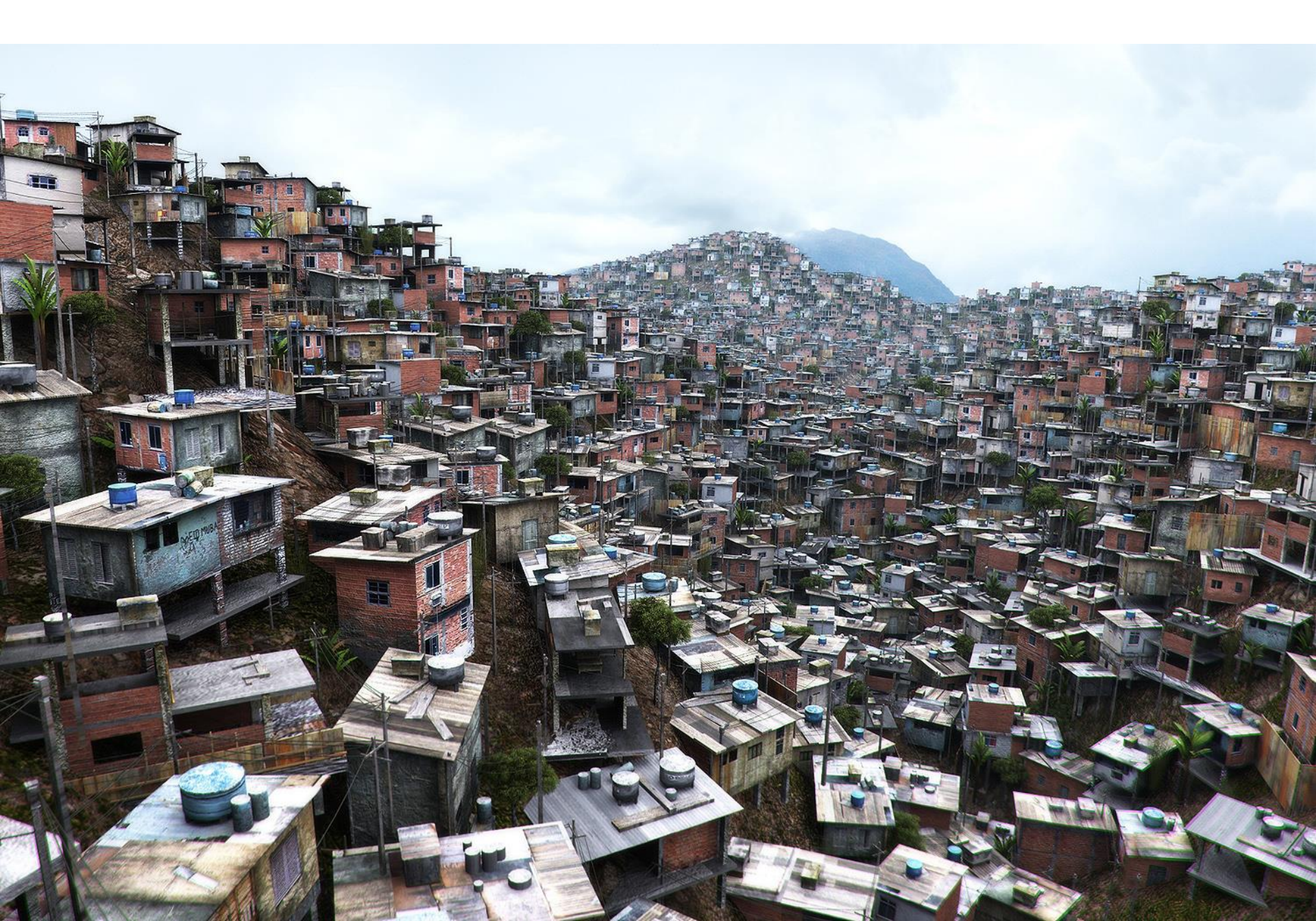




GAS

SANITARY

STORM DRAIN







sustainable city

ecological function,
green infrastructure, &
'revealed' processes

Pincetl, S. 2010. From the sanitary city to the sustainable city. Local Environment

Reducing Stormwater Runoff

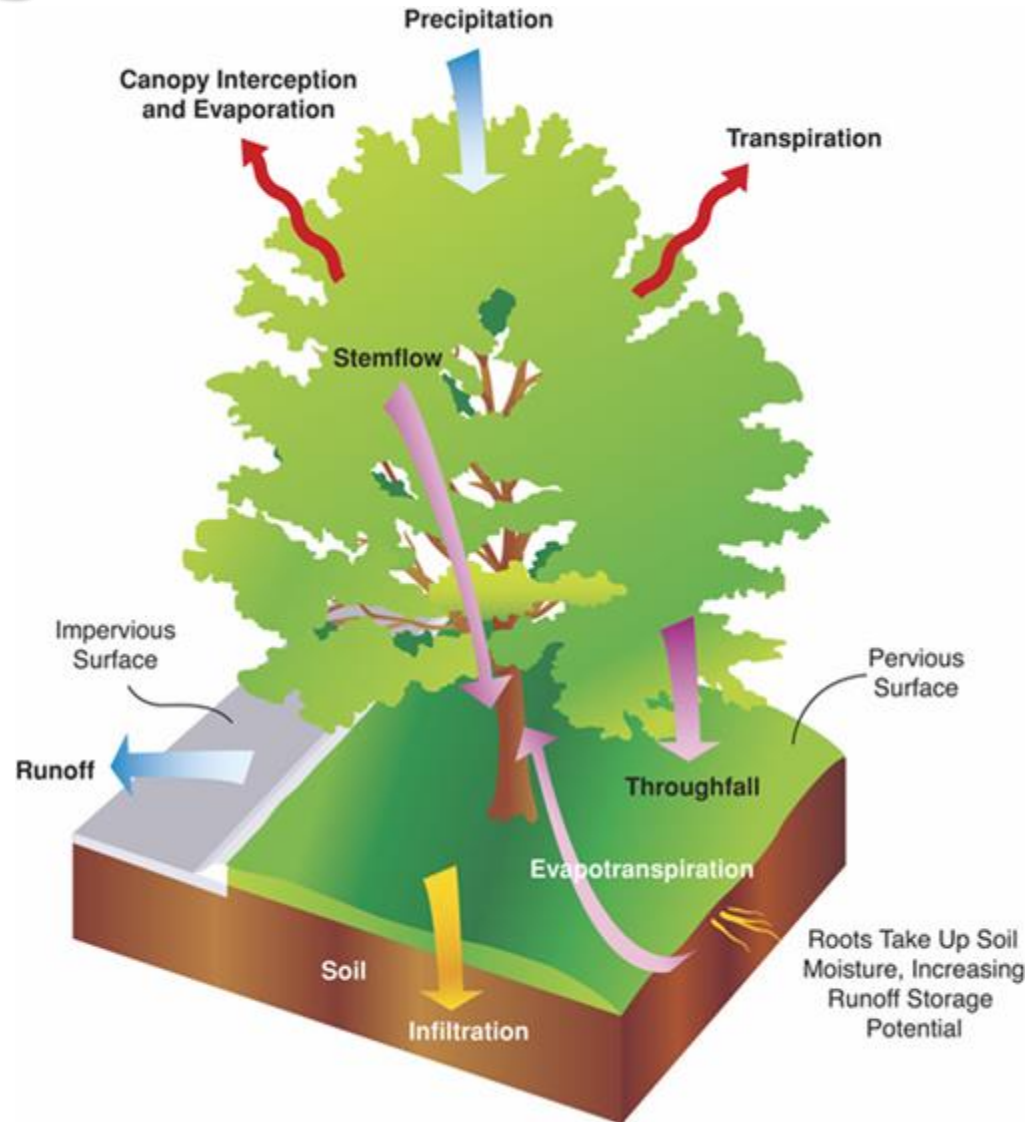
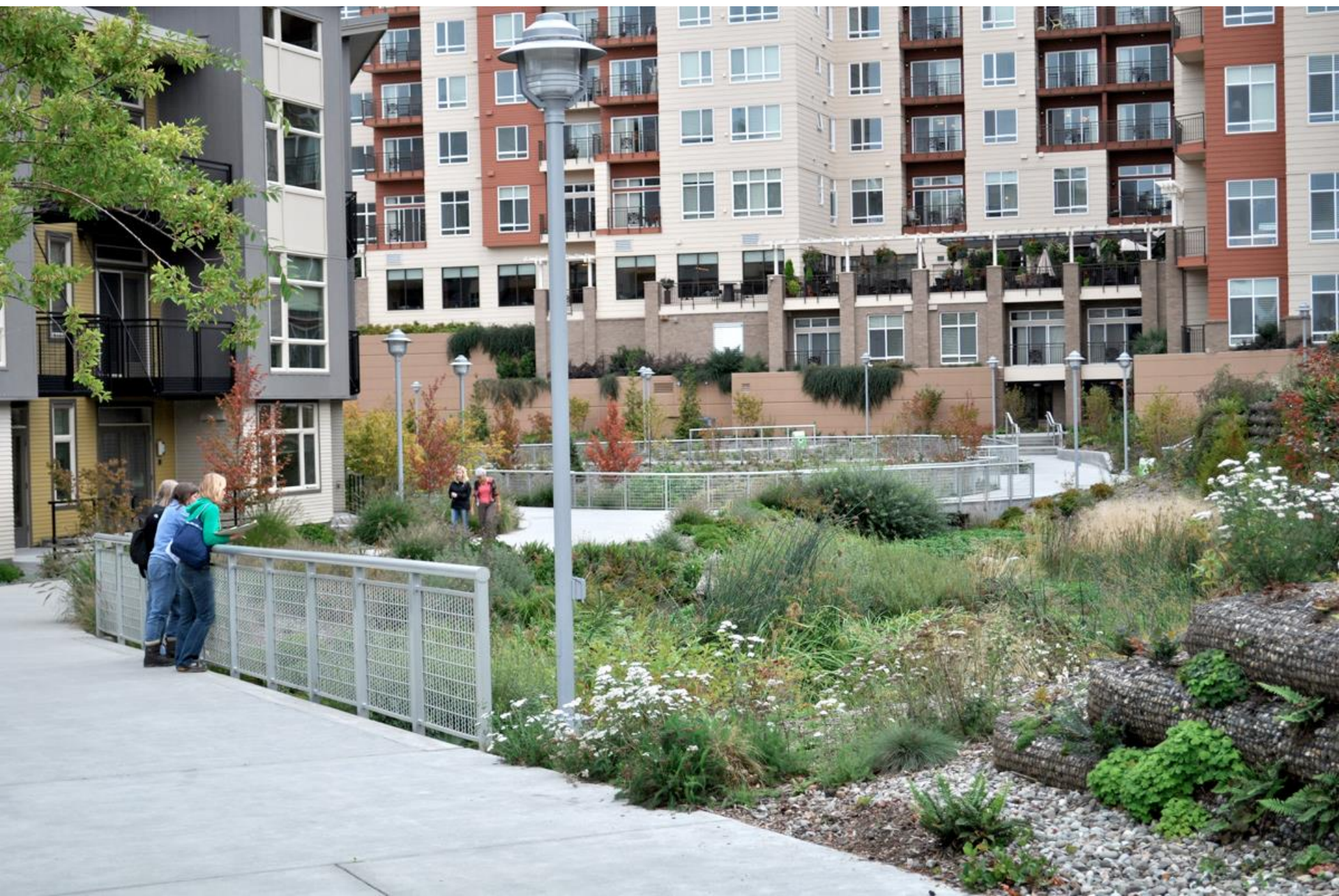


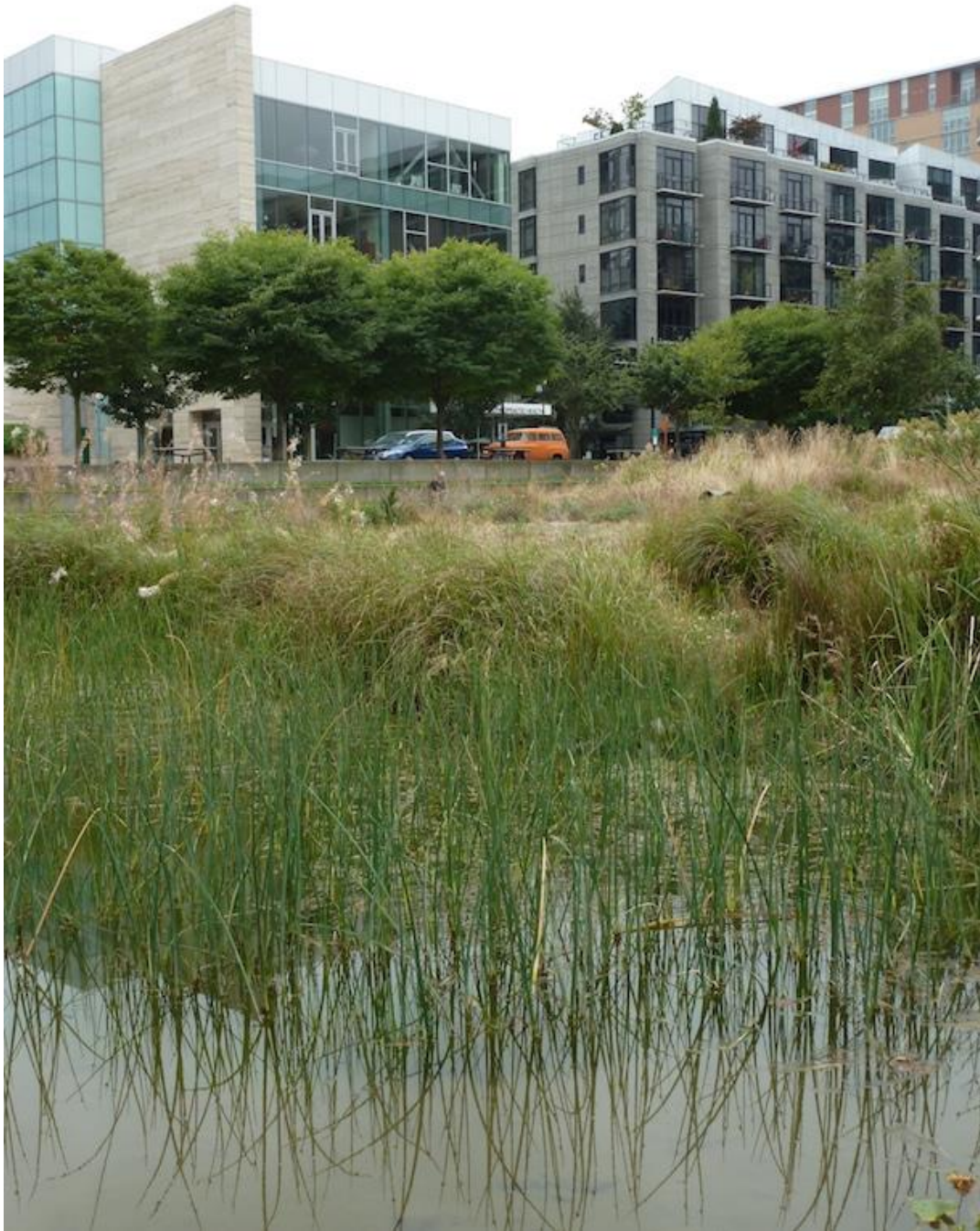
Image courtesy of the Center for Urban Forest Research

Stormwater Management



Thornton Creek Water Quality Channel (Seattle, SvR Design)
1 hectare, treats runoff from 275 hectares (1 hectare = 2.47 acres)





Tanner Springs Park

Portland OR



linked to active living network



**neighborhood
social cohesion**



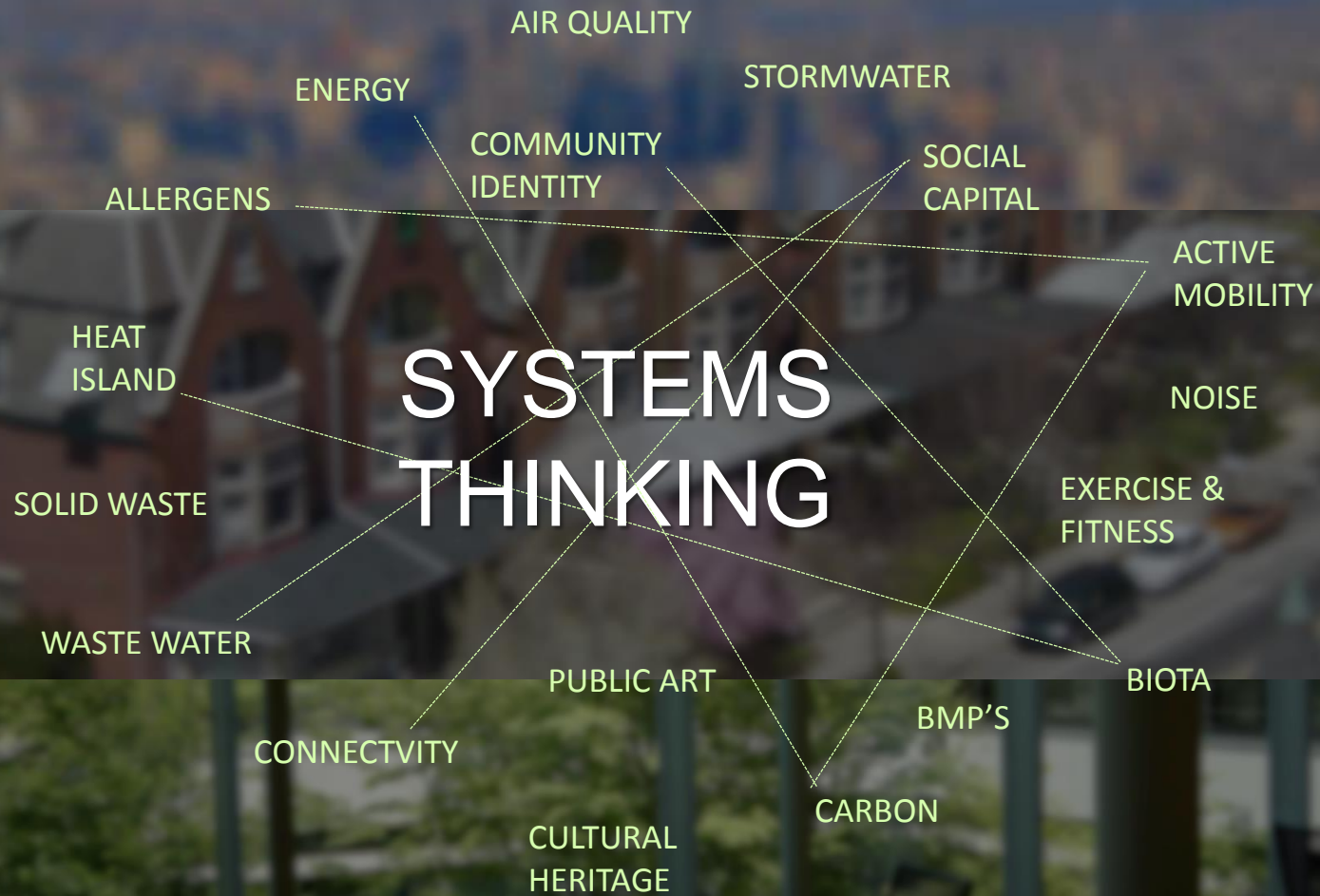
**environmental
education &
social learning**





Green Infrastructure

systems solutions
ecology that works
co-design for co-benefits



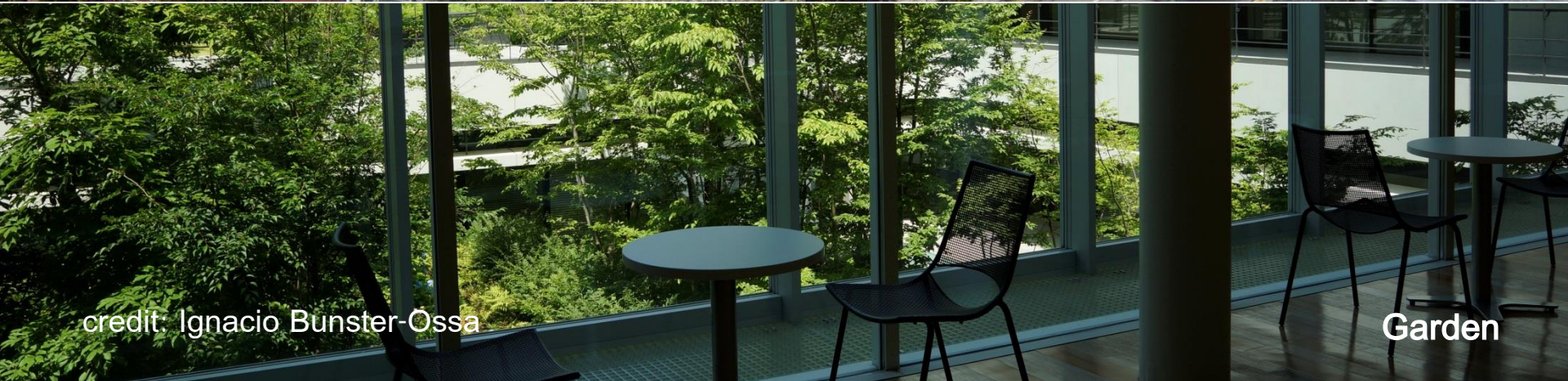
credit: American Planning Association



Landscape



Community



credit: Ignacio Bunster-Ossa

Garden

GSI Tool

Bioretention



Rain Gardens



Stormwater Cisterns



Dispersion



Dry Well/
Infiltration
Trench



Biofiltration



GSI Tool

Permeable
Paving



Green Roofs



Depaving



Tree Canopy



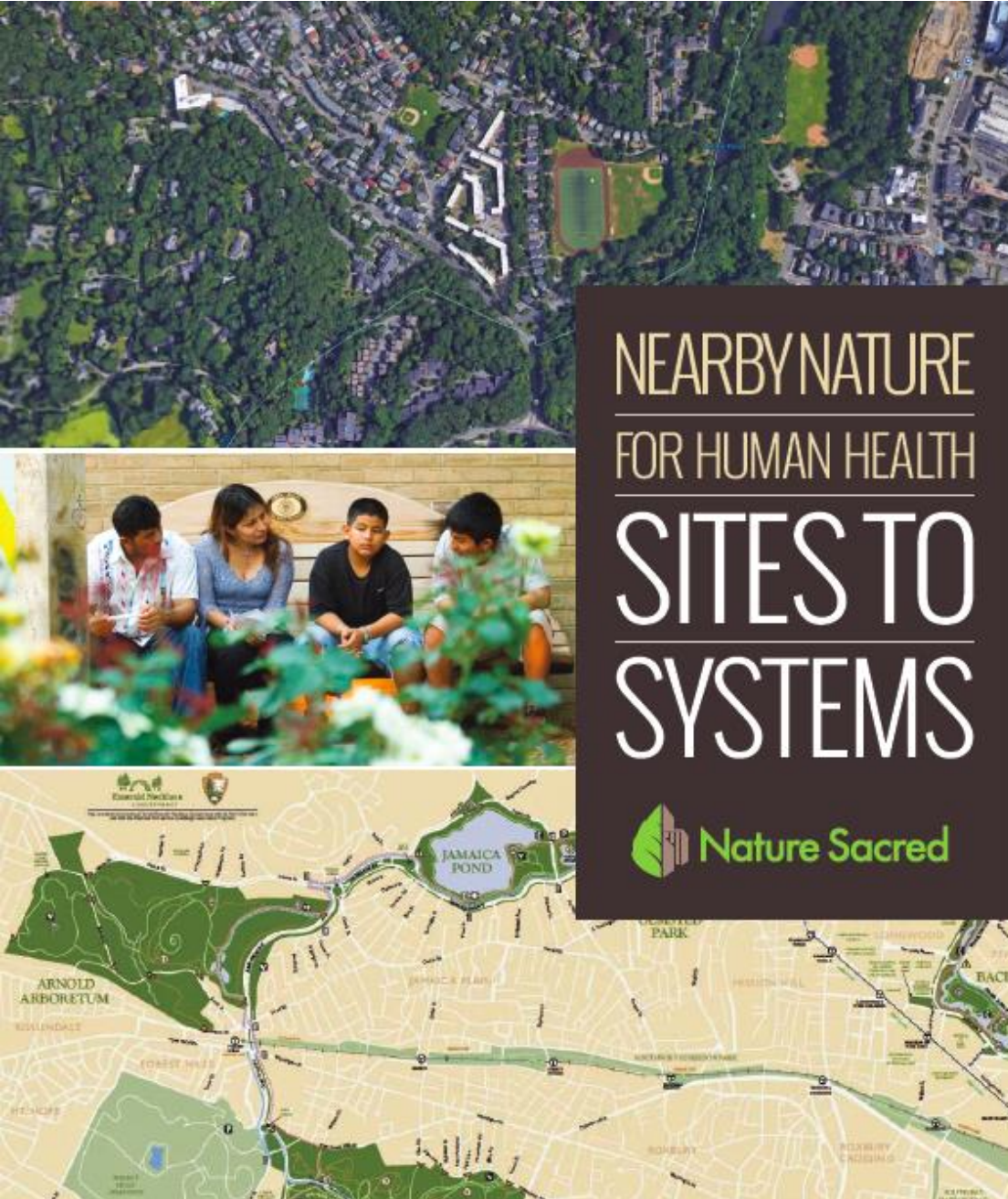
Compost &
Mulch



green
infrastructure
tools &
strategies

= mini parks?

credit: Seattle
Public Utilities



spatial
linkages:
the city
becomes
a park

TKF
Foundation ::
Nature Sacred
initiative

nature in cities for human health



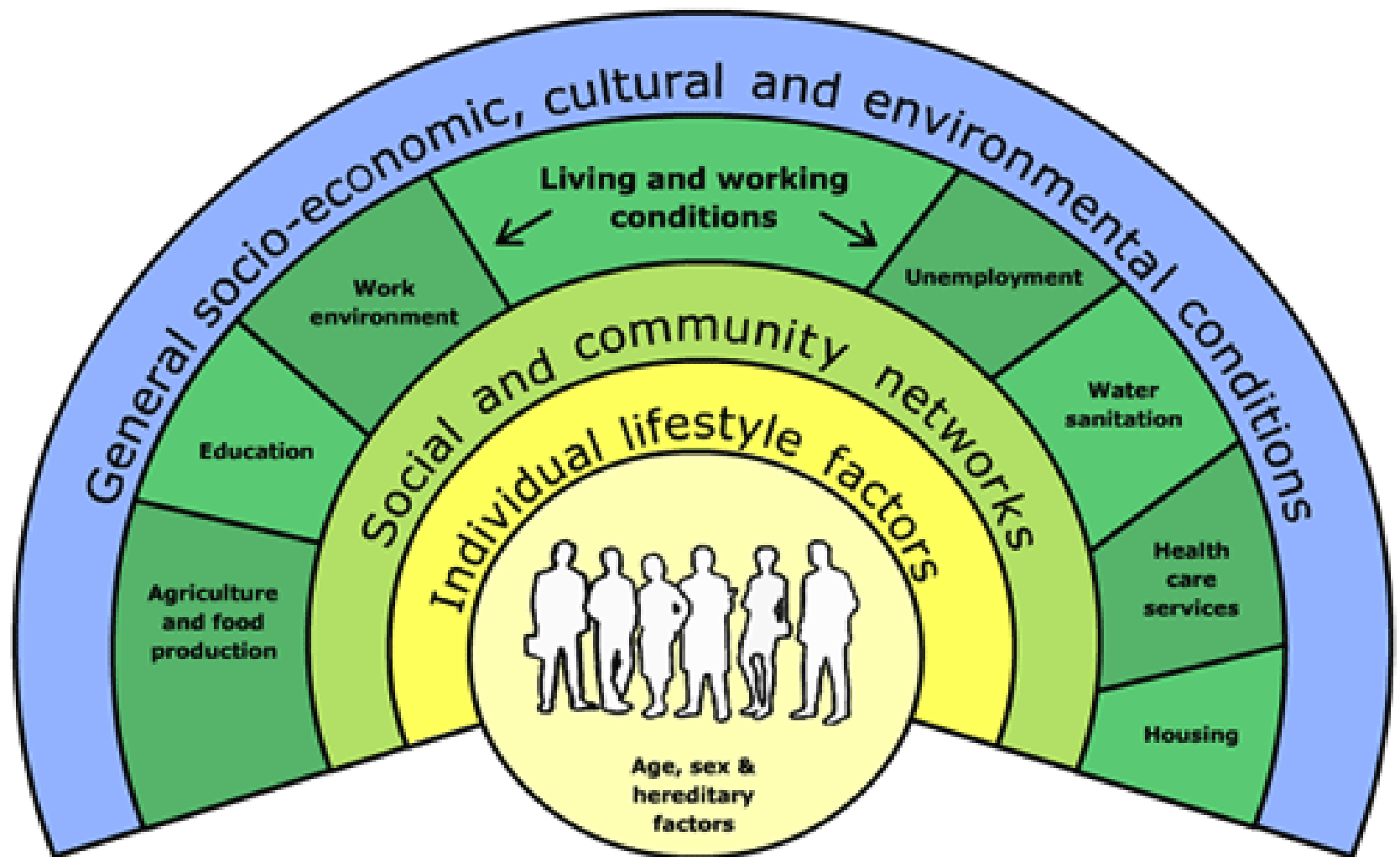
quality of life
livable places
disease prevention
health promotion



WHO Health Definition

*A state of complete
physical, mental, and social well-being
and not merely the absence
of disease or infirmity (1946)*

Determinants of Health



Green Cities: Good Health

www.greenhealth.washington.edu

Sponsors:

USDA Forest Service, U&CF Program

University of Washington

NGO partners

Thanks!

to U of WA students:

Katrina Flora

Mary Ann Rozance

Sarah Krueger



Research Reviews & Summaries

Green Cities: Good Health



INTRODUCTION RESOURCES FUTURE RESEARCH REFERENCES

Community Building

Local Economics ▶

Place Attachment & Meaning

Crime & Fear ▶

Safe Streets ▶

Active Living ▶

Reduced Risk

Wellness & Physiology

Healing & Therapy

Mental Health & Function ▶

Work & Learning

Culture & Equity

Lifecycle & Gender

Local Economics

Trees in cities are not grown and managed for products that can be bought and sold on markets, but they do provide many intangible services and functions! This article serves two purposes. First, it introduces valuation methods that are used to convert intangible benefits to dollar sums.^{1,2} Then, it shows how nonmarket valuations can support local decision-making.

Fast Facts

- The presence of larger trees in yards and as street trees can add from 3% to 15% to home values throughout neighborhoods.
- Averaging the market effect of street trees on all house values across Portland, Oregon yields a total value of \$1.35 billion, potentially increasing annual property tax revenues \$15.3 million.⁹
- A study found 7% higher rental rates for commercial offices having high quality landscapes.¹⁴
- Shoppers claim that they will spend 9% to 12% more for goods and services in central business districts having high quality tree canopy.³⁴
- Shoppers indicate that they will travel greater distance and a longer time to visit a district having high quality trees, and spend more time there once they arrive.³⁴

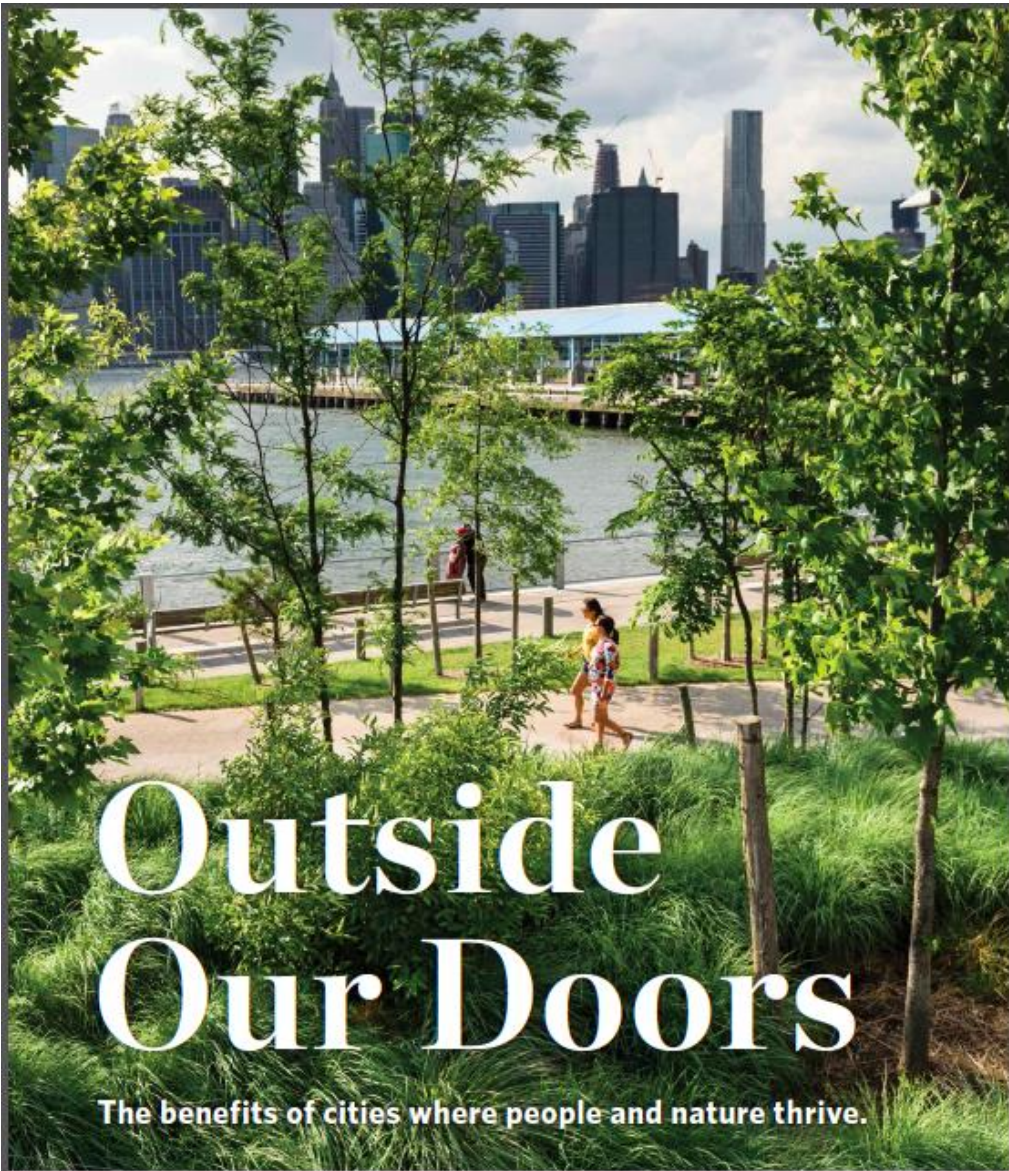
[RSS Feed](#)

[Print](#)



street trees boost market value of houses, providing tax revenue for communities





Outside Our Doors

The benefits of cities where people and nature thrive.

The Nature
Conservancy 
Washington

design:  milepost

co-author 

co-author & printing:
The Nature
Conservancy 

Evidence-based 'Story'

what are the 'stories'

Mental Health & Wellness for all People

nearby nature & health evidence

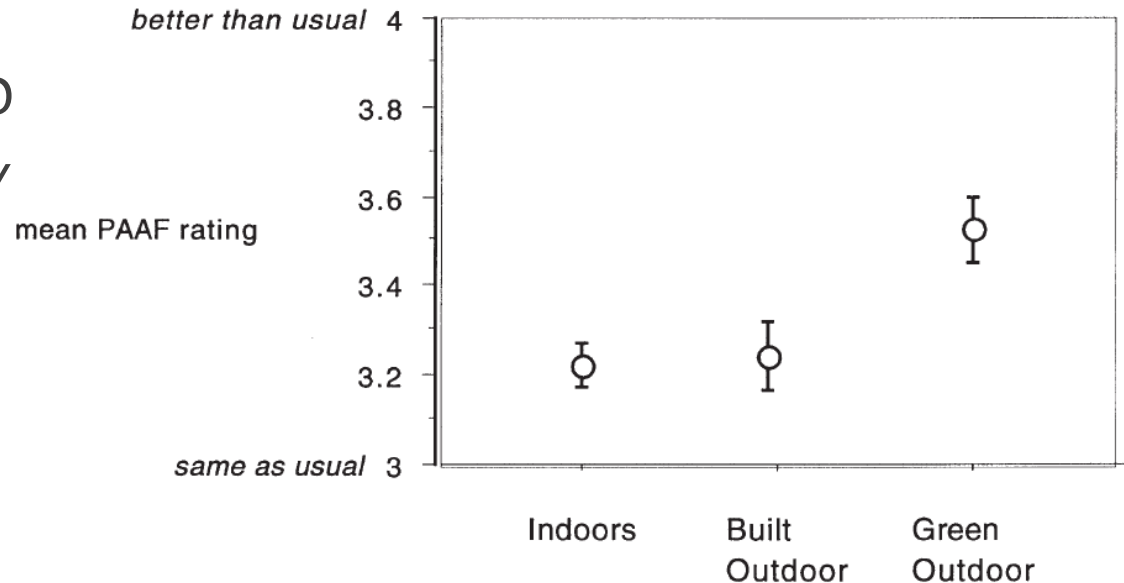
> 40 years of research

>3,500 publications



ADHD and nature contact

- 96 children aged 7-12 diagnosed ADD or ADHD
- Parents gave *postactivity attentional functioning ratings* (PAAF) –
- 4 measures:
 - focusing on unappealing tasks (homework or chores)
 - completing tasks
 - listening and following directions
 - easily distracted



Faber Taylor. 2001. *Environment & Behavior*

ADHD and nature contact

- 17 children aged 7-12 with diagnosed ADHD
- 20-minute guided walks
 - Park
 - Neighborhood
 - Downtown
- Pre-walk puzzles
- Post-walk cognitive test



Faber Taylor & Kuo. 2009.
Journal of Attention Disorders

Classroom Views & Stress



School No.1



School No.4



Li & Sullivan.
Landscape &
Urban Planning,
2016

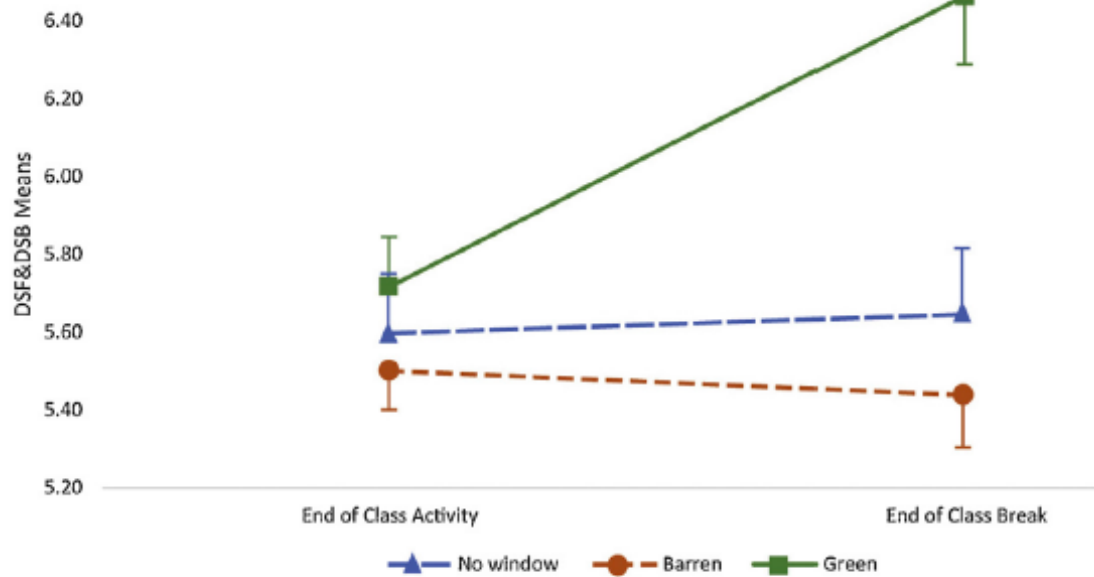


Fig. 2. Attention scores at the end of class activity and break (Means and SE).

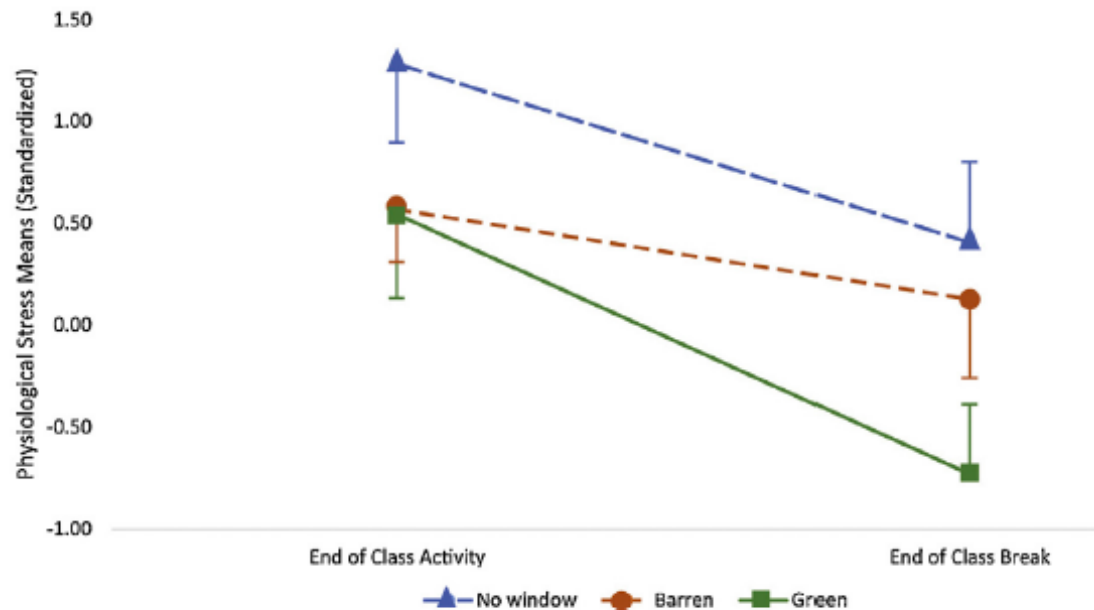


Fig. 3. Physiological stress at the end of class activity and break (Mean and SE).

attention
scores

Classroom
Views & Stress
high school
student response

stress
scores

Green High School Campuses

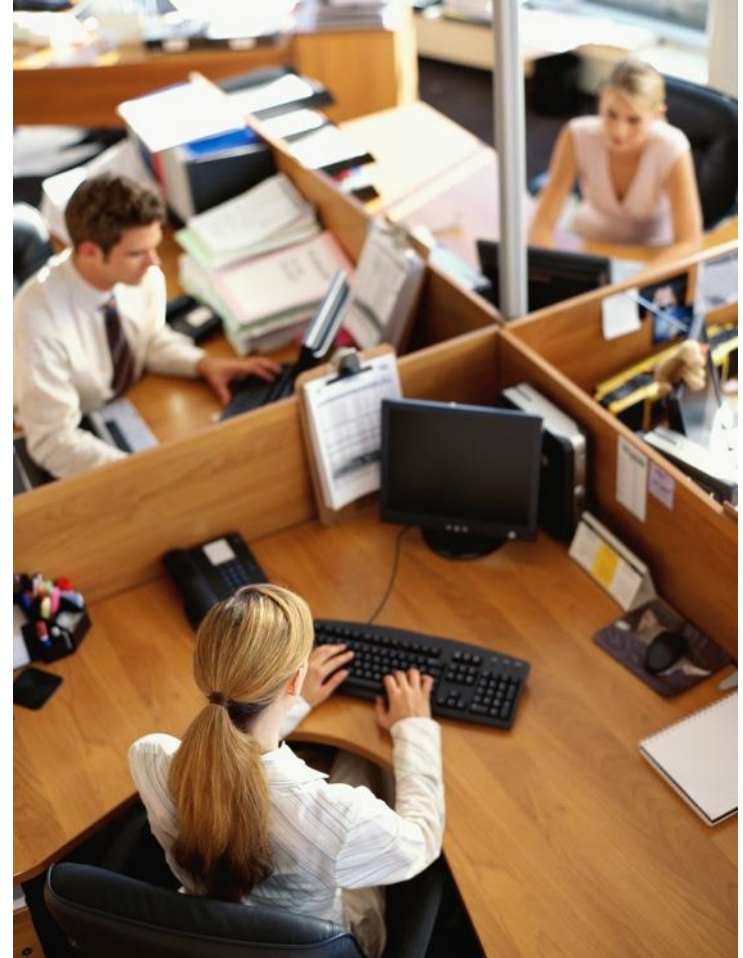
- cafeteria & classroom window views with greater quantities of trees and shrubs
- positively associated with:
 - standardized test scores,
 - graduation rates
 - %s of students planning to attend a four-year college
 - fewer occurrences of criminal behavior

our evolution?!



Attention Restoration Theory

Rachel & Stephen Kaplan, U of MI



directed attention fatigue





Workplace Nature & Attention Recovery

Well-being

-  desk workers without view of nature reported 23% more ailments in prior 6 months

Job Satisfaction

-  less frustrated and more patient
-  higher overall job satisfaction and enthusiasm



Kaplan, R. 1993. Landscape and Urban Planning

Walking Meetings

creativity, energy, communication, health



CDC moderate activity recommendations



parks, active living, active transit

• CANINE CONSTITUTIONAL



Tom Ravell / Otago

A brisk walk in the park keeps Marey B in shape between dog shows. His owner, Columbus resident Cathy Stumbo, got up early

to give her 3-year-old Doberman his regular workout. They typically log 15 miles in Berliner Park.

Parks Prescription

R_X for Health

Date: _____

Dr: _____

Name: _____

I recommend:

☐ Walking ☐ Other: _____

_____ minutes a day

_____ days per week

* Health Canada suggests moderate activity of 30 minutes per day | 5 days a week

Benefits of daily activity

- Improve overall physical and mental health
- Maintain a healthy weight
- Reduce the risk of diabetes and other chronic conditions
- Lower cholesterol levels
- Manage stress and anxiety

Signature: _____

**doctors
of bc**



Walking Programs

children
elders
families



Transport for
Greater Manchester

Greater Manchester Walking Weekends

Join our free guided walks
Routes to suit all ages and abilities

16-18 September 2016
21-23 October 2016

For more details visit:
www.tfgm.com/walking | [f/GMwalkingfestival](https://www.facebook.com/GMwalkingfestival)

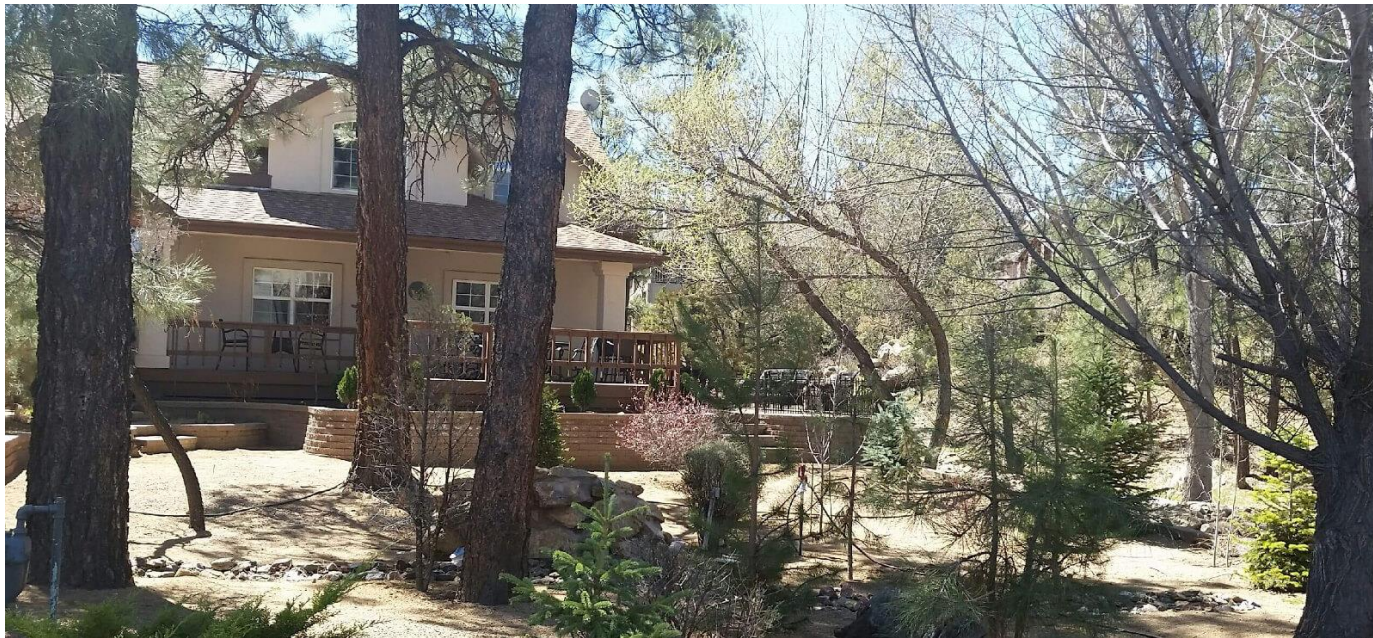


Side-track

- most research from cities in cool, temperate climates
- response in arid, desert landscapes?
- findings: universal positive health responses
- findings: diversity of nature settings



most
studies
done in
temperate
areas . . .



how to bring
this work
here?

credit: Prescott Valley Growers Landscaping

GREEN INFRASTRUCTURE

FOR DESERT COMMUNITIES





barren lot
October 2014
(community
pocket park)



October 2016

credit: Green Infrastructure
for Desert Communities



public ROW
1994



2006

credit: Brad Lancaster,
Harvesting Rainwater.com

credit: Stream
Dynamics, Inc.



Urbanite was arranged to create an outdoor seating area adjacent to the basin, converting a brown fields area to a pocket park for the community.



Back to mental wellness benefits of nature

Green Streets for Walkability

evidence of lower frustration and higher meditation when moving into the greener streets

Aspinall et al. 2013. The Urban Brain: Analysing Outdoor Physical Activity with Mobile EEG. British Journal of Sports Medicine



Improving Depression

Berman et al. 2012.
*Journal of Affective
Disorders*

20 adults with major depression
walk in a park setting and an urban setting

🌿 50-minute walks one week apart

🌿 before-after testing:

🌿 Mood: Positive and Negative Affect (PANAS)

🌿 Cognition: Backward Digit Span (BDS)



cognitive and affective
improvements after
walking in a
nature setting









Mind Full, or Mindful?

Mindfulness/Meditation Training

-  meta analysis; clinical/non situations
-  focus on moment-to-moment experience and mental awareness

Results

-  more veridical perception (reality check)
-  reduce negative affect
-  improve vitality and coping
-  medical symptoms & sensory pain

Grossman et al. 2004. Mindfulness-Based Health Benefits. Journal of Psychosomatic Research

Nature and Mindfulness

focus

soft fascination

undirected attention

Attention Restoration Theory, Kapan & Kaplan



credit: Michael Hellgren



Civic Stewardship for Resilience



E. Svendsen, L. Campbell; USFS

green infrastructure & reduced crime

Philadelphia

reduction in narcotics
arrests (18–27 %)
for green not gray

vs. 65% increase
across city

Kondo et al. 2015.
Journal of Public Health



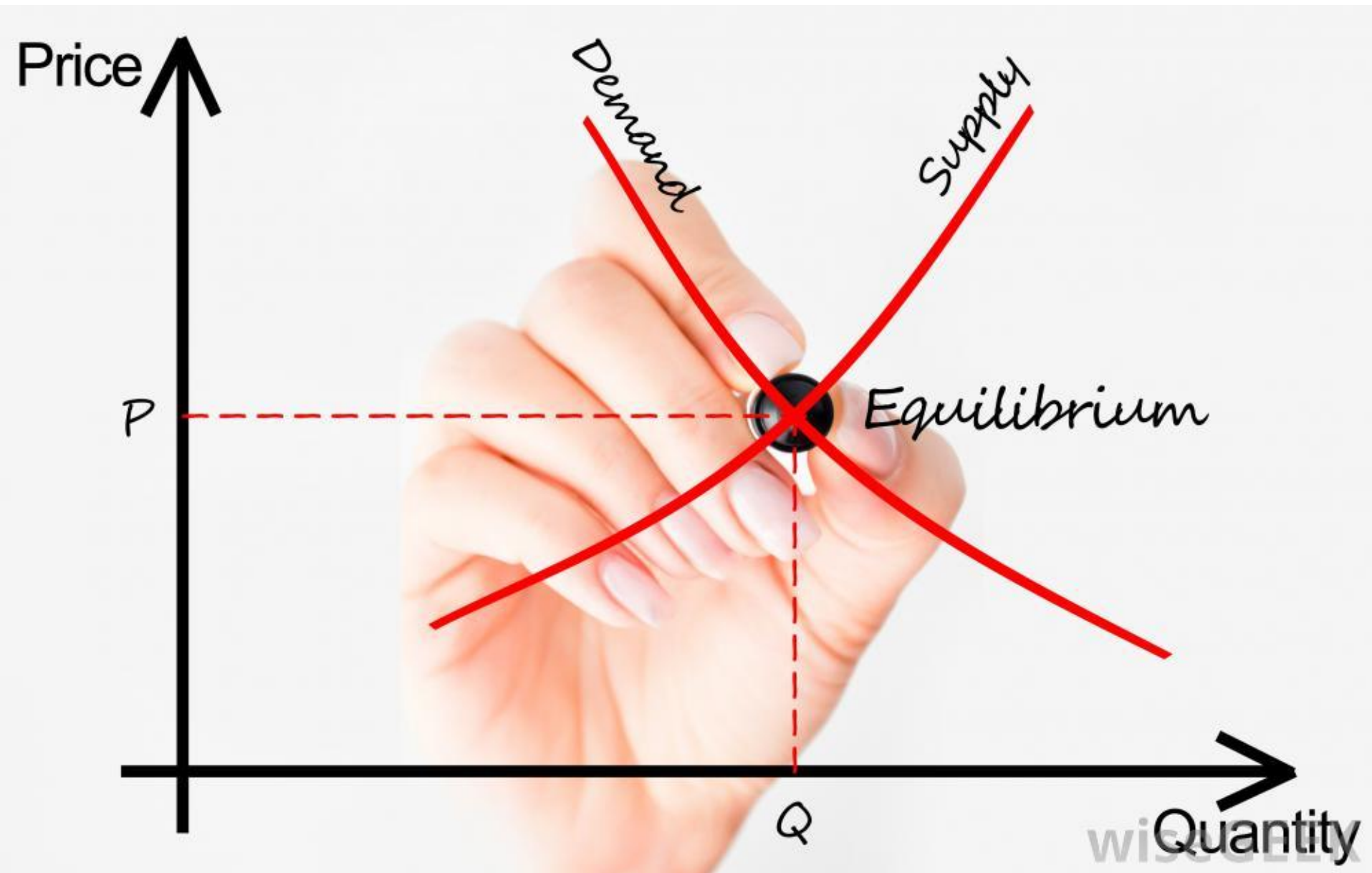
Green Infrastructure Volunteers





Topics

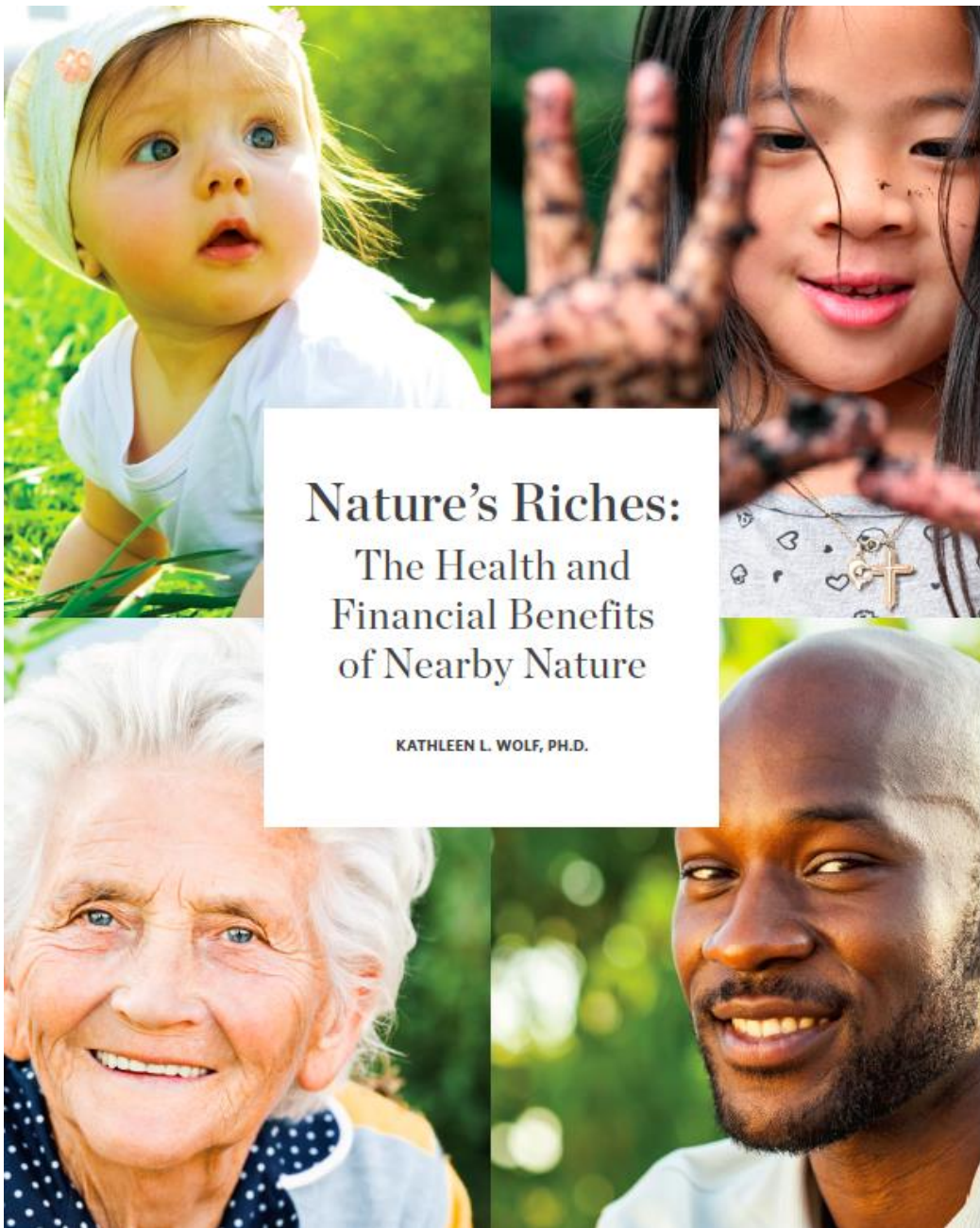
city systems – sanitary to sustainable
green infrastructure solutions
nature in cities & human health
economic benefits



source.wisegeek.com



management for co-benefits - retail



Nature's Riches:
The Health and
Financial Benefits
of Nearby Nature

KATHLEEN L. WOLF, PH.D.

design:  milepost

author: 

printing:
The Nature
Conservancy 

Nearby nature experiences are important across the entire life cycle, from cradle to grave.

INFANTS



BIRTH WEIGHT

POTENTIAL ECONOMIC VALUE:
\$5.5M SAVINGS ON ANNUAL HEALTH CARE COSTS.

Birth weight influences long-term childhood health and development, and has been linked to some adult diseases. Low birth weight is associated with both short- and long-term health care costs, such as longer hospital stays and increased illness. Pregnant women that have more tree canopy and green space near their homes generally have babies with healthier birth weights.

IMMUNE FUNCTION

ECONOMIC IMPLICATION:
STRONGER IMMUNE SYSTEM LEADS TO REDUCED ILLNESS AND CHRONIC DISEASE ACROSS A LIFETIME.

We are most vulnerable in the early months of our lives, when the body and mind are growing and developing at an astonishing rate. The 'hygiene hypothesis' suggests that early contact with outdoor microorganisms stimulates the development of a healthy immune response.

FAMILY DYNAMICS

ECONOMIC IMPLICATION:
IMPROVED FAMILY DYNAMICS, PERHAPS REDUCING MENTAL HEALTH TREATMENT AND COUNSELING SERVICES.

An infant's parents and siblings adjust their lives after a baby arrives, and the changes can bring on stress and anxiety. Nature views and walks help reduce these conditions and improve interactions between people within the household.

Note: All economic values are in 2015 U.S. dollars, and are potential annual savings across the entire U.S.

CHILDREN & TEENS



OVERALL HEALTH AND WELL-BEING

ECONOMIC IMPLICATION:
INCREASED PHYSICAL ACTIVITY, REDUCED ASTHMA (A LEADING CAUSE OF EMERGENCY DEPARTMENT VISITS, HOSPITALIZATIONS AND MISSED SCHOOL DAYS), AND REDUCED RISK OF ADULT SKIN CONDITIONS.

Negative conditions in a child's surroundings can cause both immediate and ongoing health impacts. Nature is a positive influence; playing in nature helps children develop learning, social, and intellectual skills that improve both health and later life achievement. Green spaces clean the air our children and teens breathe, give them space for moderate to vigorous activity, and shade them from too much sun exposure.

ADHD

POTENTIAL ECONOMIC VALUE:
\$39M-\$1.9B ON MEDICATION SAVINGS PER YEAR.

Millions of children ages 3-17 are treated for Attention Deficit Hyperactivity Disorder (ADHD) in the U.S. Nature exposure is a potential alternative treatment; studies show that activity within nature or green spaces, such as play or just 20 minutes of walking, can reduce symptoms.

FUTURE FINANCIAL SUCCESS

POTENTIAL ECONOMIC VALUE:
\$1.3B INCREASE IN HIGH SCHOOL GRADUATES' LIFELONG ANNUAL INCOMES.

School performance affects both near term self-esteem and long-term success. Having green views from classrooms and common spaces in schools can improve students' capacity to direct attention and feel less stressed. Green high school campus landscapes are linked to higher graduation rates.

Research about nature benefits and economic value is fairly new. Some of the quantified health benefits of nature in cities are easier to convert to economic value than others. Here are some preliminary valuations - estimated for the entire U.S. on an annual basis.

ADULTS



DEPRESSION AND STRESS

ECONOMIC IMPLICATION:
REDUCES FRUSTRATION, MENTAL DISTRESS AND DEPRESSION DISORDERS, AND IMPROVES BODY IMAGE, SELF-ESTEEM AND LIFE SATISFACTION.

Busy, highly scheduled lifestyles take their toll. Nature experiences reduce stress. Nearly 16 million adults experience major depression each year in the U.S., and mental, behavioral, and neuropsychiatric disorders are a leading cause of disability. Nature experiences support respite and mindfulness for improved mental health, mood, and life function. Improved mental health and function reduces disease treatment costs, and improves worker productivity.

CARDIOVASCULAR DISEASE

POTENTIAL ECONOMIC VALUE:
\$12-\$2.3B ANNUAL SAVINGS, BASED ON A 1-2% REDUCTION IN HISTORIC EXPENDITURES.

Cardiovascular Disease is the leading cause of premature death in the U.S. People show slightly reduced risk of CVD if their neighborhoods have greater nature coverage (particularly tree canopy), however it is worth noting the majority of studies have focused on men.

CRIME & SAFETY

POTENTIAL ECONOMIC VALUE:
\$928M IN REDUCED COSTS OF CRIME FOR VICTIMS AND PROPERTY OWNERS PER YEAR.

Personal safety and security are important conditions for quality of life. The presence of nature in neighborhoods - community gardens, forest canopy, and landscaped vacant lots - is associated with reduced personal and property crime.

OLDER ADULTS



MOBILITY & QUALITY OF LIFE

POTENTIAL ECONOMIC VALUE:
\$1.7-\$2.4B SAVINGS ON HEALTH CARE COSTS FROM FALLS PER YEAR.

One in three older adults falls each year, giving rise to fatal and nonfatal injuries. Residents' falls within elder care facilities are particularly expensive medical situations. Being out in nature sustains personal mobility, leading to reduced falls and reduced need for medications. Further, those who are socially isolated are more likely to be unhealthy, so gardening and nature walking activities that promote social interactions support positive lifestyles and quality of life.

HYPERTENSION

POTENTIAL ECONOMIC VALUE:
\$1.3-\$2.6B SAVINGS ON TREATMENT COSTS ANNUALLY.

Hypertension, or high blood pressure, is one of the five most expensive conditions impacting older adults. Views of nature, particularly forests, and 'forest bathing' (casual walks in naturalistic forest settings) decrease diastolic rates.

COGNITIVE DISORDERS

POTENTIAL ECONOMIC VALUE:
\$1.2-\$2.5B ANNUAL SAVINGS ON MEDICAL SERVICES, NOT COUNTING THE VALUE OF HOME CAREGIVERS' SERVICES.

About one in five older adults experience mental and cognitive disorders, with age being the greatest risk factor. In 2016, about 11% of people aged 65 or older were afflicted with Alzheimer's disease. Those with dementia have three times as many hospital stays per year as other elders. Encounters with nature improve symptoms related to cognitive disorders, such as agitation, depression, and reduced mobility.

contributing analysts:
Dr. Stephen Grado & Marcus Measells, MSU; Dr. Alicia Robbins, Weyerhaeuser

annual value of \$11.7 billion U.S. (2015 dollars)



- cradle to grave human life cycle
- birth weight, graduation rates, reduced crime, cardiovascular disease, elder chronic disease
- various nature settings in cities
- just beginning the analysis!

Summary



city systems
green infrastructure solutions
nature in cities & human health
economic benefits
potential new partnerships &
community engagement

Human Dimensions of Urban Forestry and Urban Greening

featuring research on peoples'
perceptions and behaviors
regarding nature in cities

Green Cities: Good Health

human health & well-being research

Projects Director
Kathleen L. Wolf, Ph.D.



What's New?

Nature and Consumer Environments

Research about how the urban forest influences business district visitors.

Trees and Transportation

Studies on the value of having quality landscapes in urban roadsides.

Civic Ecology

Studies of human behaviors and benefits when people are active in the environment.

Policy and Planning

Integrating urban greening science with community change.

Urban Forestry and Human Benefits

More resources, studies and links . . .

Sponsors

