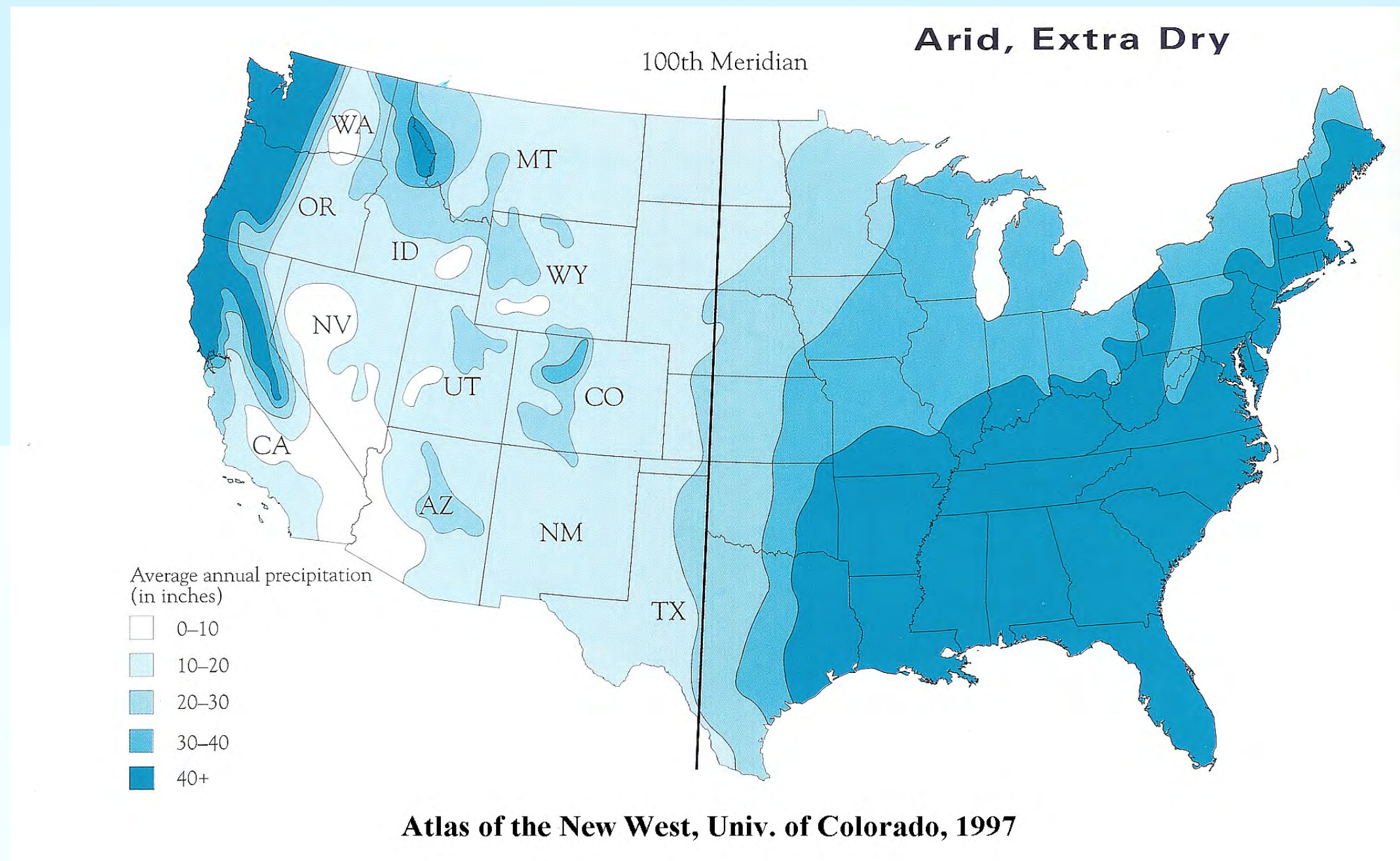


# APA Sustainable Communities Webinar: Nature Based Systems in the West





The Built Environment =  
a nested ecosystem

Frame: Bioregion and  
Community Standards

Elements and Systems

Allied Professionals



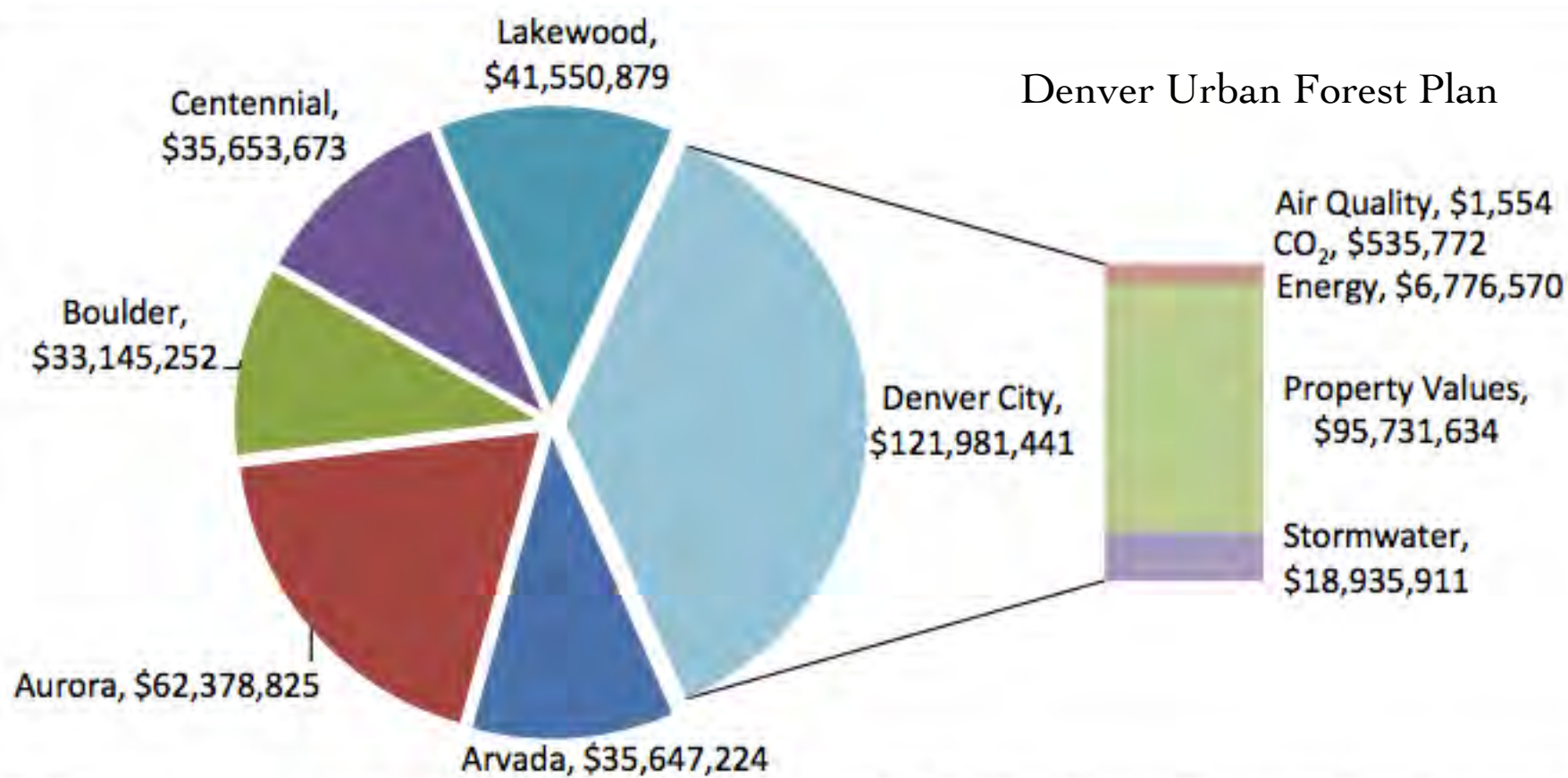


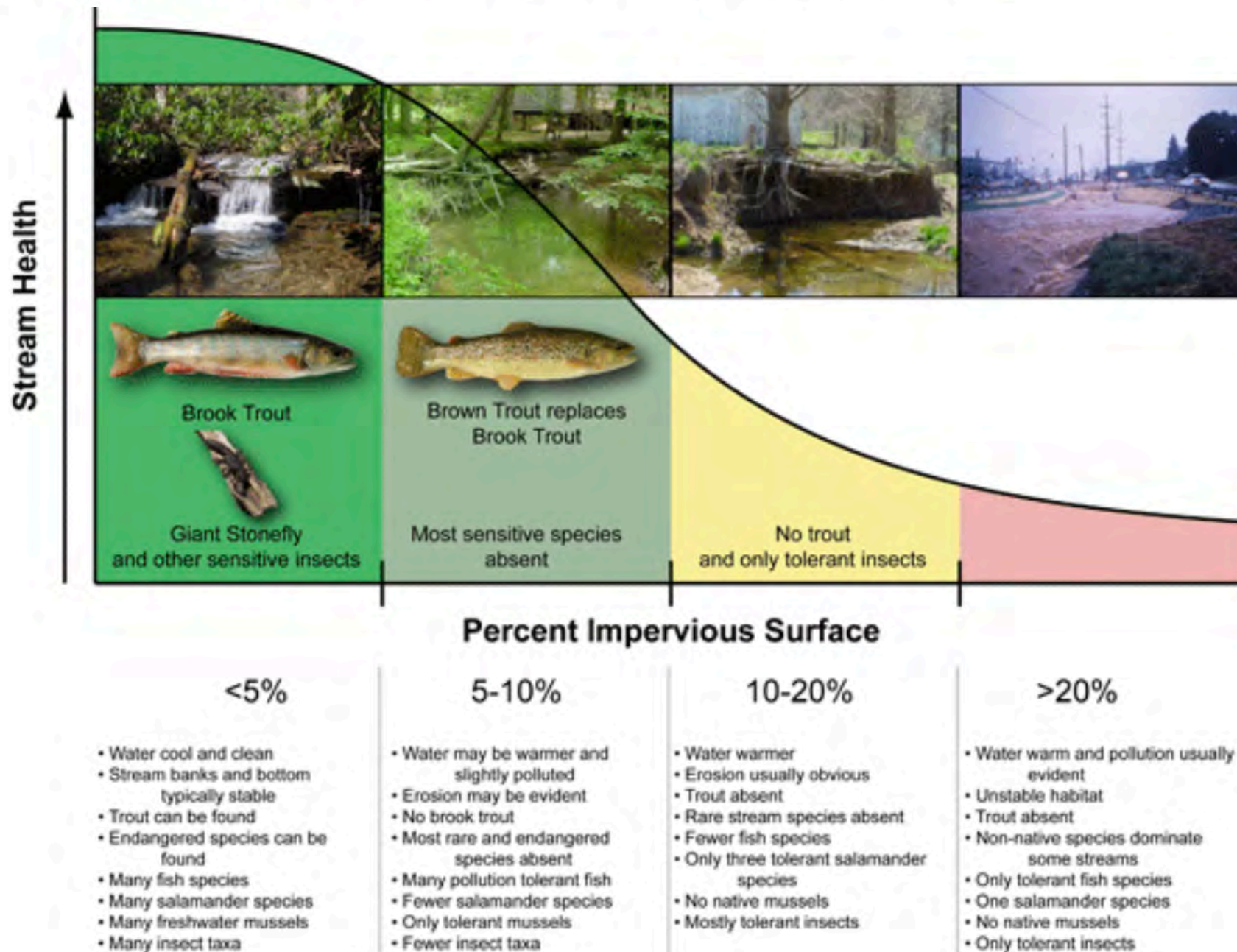
Fig 2. Annual monetary value of services from the existing urban forest for the City of Denver and the four cities with the highest annual monetary value.

Landscapes  
are valuable assets  
for many  
Colorado cities.





# Less Impervious Surfaces, Healthier Streams





# Rethink Storage.... Green Water Matters



<u>Water in Biosphere (km<sup>3</sup>)</u>	
Groundwater	4000.0
Freshwater Lakes	125.0
Soil Moisture	67.0
Rivers	1.2

after Wetzel, SUNYsf.edu  
1 km<sup>3</sup> ~ 264 Bg



^ Marcia Tatroe,  
Aurora, CO

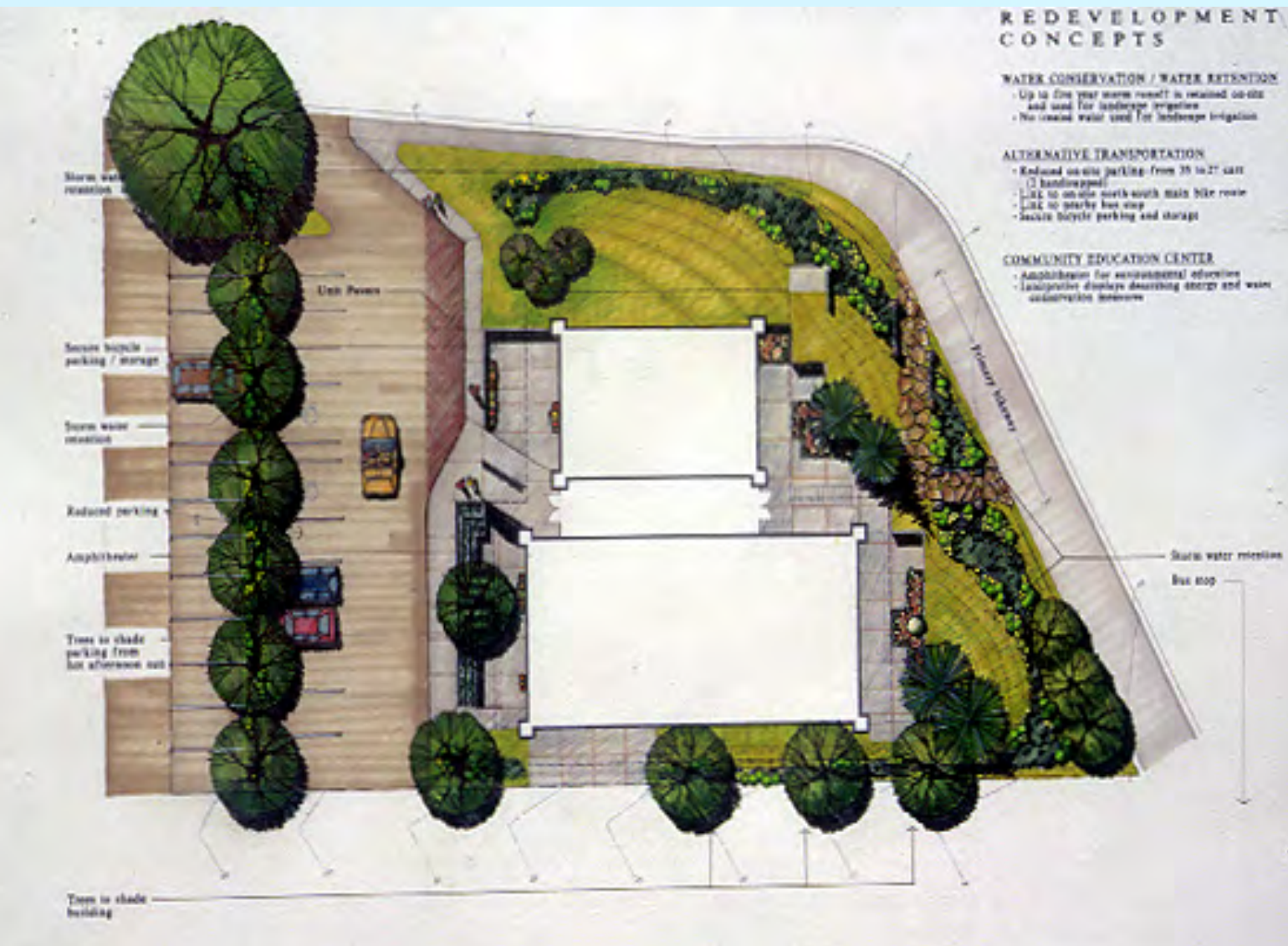
Brad Lancaster:  
Tucson, AZ >



HarvestingRainwater.com ©2008 Brad Lancaster



# Water Budgets Explained

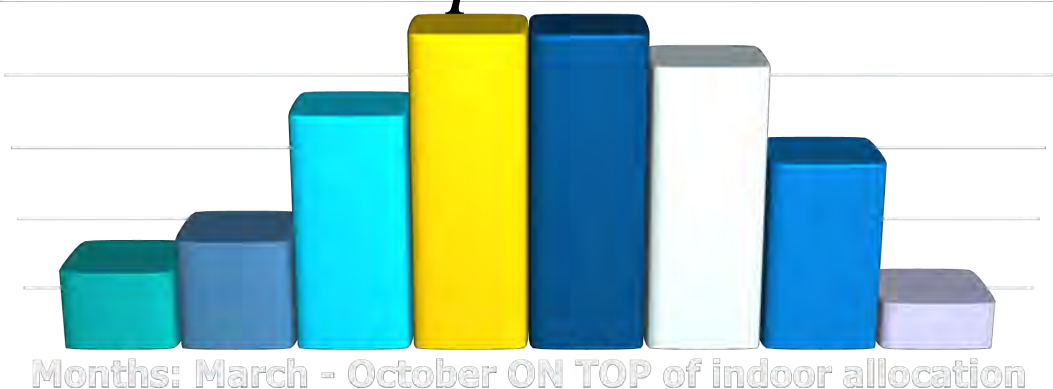


1. Calculate ^

2. Allocate >

## WATER BUDGET

Indoor (5000 gal/month)  
*plus*



Outdoor Allocation  
15 gal/sq.ft x LS sq.ft.  
(ET curve Mar-Oct)





# Origins of Denver's Green Buildings Ordinance

Learn about the 2017 voter mandate and subsequent joint task force leading to the creation of the Green Buildings Ordinance

## ADDITIONS (25,000 – 49,999 SQ. FT.) & ROOF PERMITS FOR EXISTING BUILDINGS (25,000 SQ. FT. AND UP)

Include a cool roof and one of options described below.

Choose an option:

Choose how much to install:

Green space or green roofs



Total roof replacement / Additions

- 2% of the building or addition's GFA
- 18% of the total roof area, or
- All available roof area.

Replacing roof section(s)

- $\frac{(2\% \text{ of the building GFA} \times \text{roof section area})}{\text{total roof area of the building}}$
- 18% of the roof section(s), or
- All *available* area on the roof section(s).

Payment to Green Building Fund



- \$50 per square foot of green space required but not provided

On-site solar panels\*



Total roof replacement / Additions

- 5% of the building or addition's GFA
- 42% of the total roof area, or
- Generate 100% of the building's average annual electricity use.

Replacing roof section(s)

- $\frac{(5\% \text{ of the building GFA} \times \text{roof section area})}{\text{total roof area of the building}}$
- 42% of the roof section(s), or
- Generate 100% of the building's average annual electricity use.

Energy conservation  
(Additions only)



- An estimated energy cost savings of at least 4% above building code requirements

Green building certification



- LEED BD+C or O&M Silver, Enterprise Green Communities, NGBS ICC/ASHRAE 700 Silver, or equivalent

Energy Program  
(Roof replacements only)



- Includes option to purchase off-site solar energy
- Enroll now and complete program requirements within 5 years. See [denvergov.org/EnergizeDenver](http://denvergov.org/EnergizeDenver) > Energy Program for details.

The following project types only need to do a cool roof and are exempt from choosing a compliance option above: residential buildings 5 stories or less or under 62.5 feet in height; roof recovers only; emergency roof replacements; hail-damaged roofs with insufficient insurance coverage to meet this ordinance (exemption only valid through November 2, 2019); and buildings that have already met the ordinance as a new building or campus.

Other rules and exemptions are detailed at [denvergov.org/greenroofs](http://denvergov.org/greenroofs).



## Pollinator Pathways



**Pollinator Pathways** are corridors of diverse plants that support cooling temperatures and foster biodiversity, especially for native pollinators. Creating and expanding an interconnected network of these corridors on both public and private land will provide important habitats and help manage carbon and water in ways that reduce the impacts of climate change.

This work has already begun in the Goss Grove neighborhood. Initial partners include the City of Boulder's Climate Initiatives Department, Planning Department, Bee Chicas, Butterfly Pavillion, CSU Extension, Eco-Cycle, People and Pollinators Action Network, Resource Central, and the Xerces Society.

## Connected Canopies



To help **reduce temperatures** and expand access to the benefits of urban trees, Boulder needs major investments to both maintain the health of the existing tree canopy and plant thousands of additional trees, most of which will need to be located on private land.

This work builds on a recent regional strategy for urban forestry expansion. Initial partners include Boulder JCC, the City of Boulder's Climate Initiatives Department and Parks & Recreation, Boulder Valley Rotary, Citizen Science Soil Health Project, Eco-Cycle, Eco-Warriors, and PLAY Boulder Foundation's Tree Trust.

## Absorbent Landscapes



Absorbent Landscapes hold more carbon, more water, and more thermal energy, helping to cool our city as well as prevent dangerous flooding that Boulder is prone to. This collaborative effort is focused on improving carbon sequestration, soil health, and water retention/management through regenerative agriculture, sustainable grasslands and turf management, and other actions in the landscaped areas within our City as well as in the working lands surrounding Boulder.

Initial partners include Boulder Housing Partners, the City of Boulder's Climate Initiatives Department, Open Space and Mountain Parks, Planning Department, and Parks & Recreation, Drylands Agroecology Research, Eco-Cycle, Resource Central, Watershed Center, and Wildland Restoration Volunteers.





# Improved Public Health

Provide Shade

Optimize Water Use



Climate Resilient Urban Landscapes

Plants for Pollinators

Capture storm water





# GARDEN IN A BOX

## Colorado Oasis

**\$123.00**



60 sq. ft.



Adaptable

### Includes:

- 15 starter plants
- 1 plant by number map
- Comprehensive Plant & Care Guide

**\$25 discounts** available in participating cities on select products. Applied at checkout. [Learn More.](#)

Sold Out



### Description

**15/15**

plants  
native to  
Colorado



hardy to  
7,000 ft.



mature  
height range  
6 in. - 5 ft.



blooms  
spring to fall



attracts  
pollinators

**8/15**

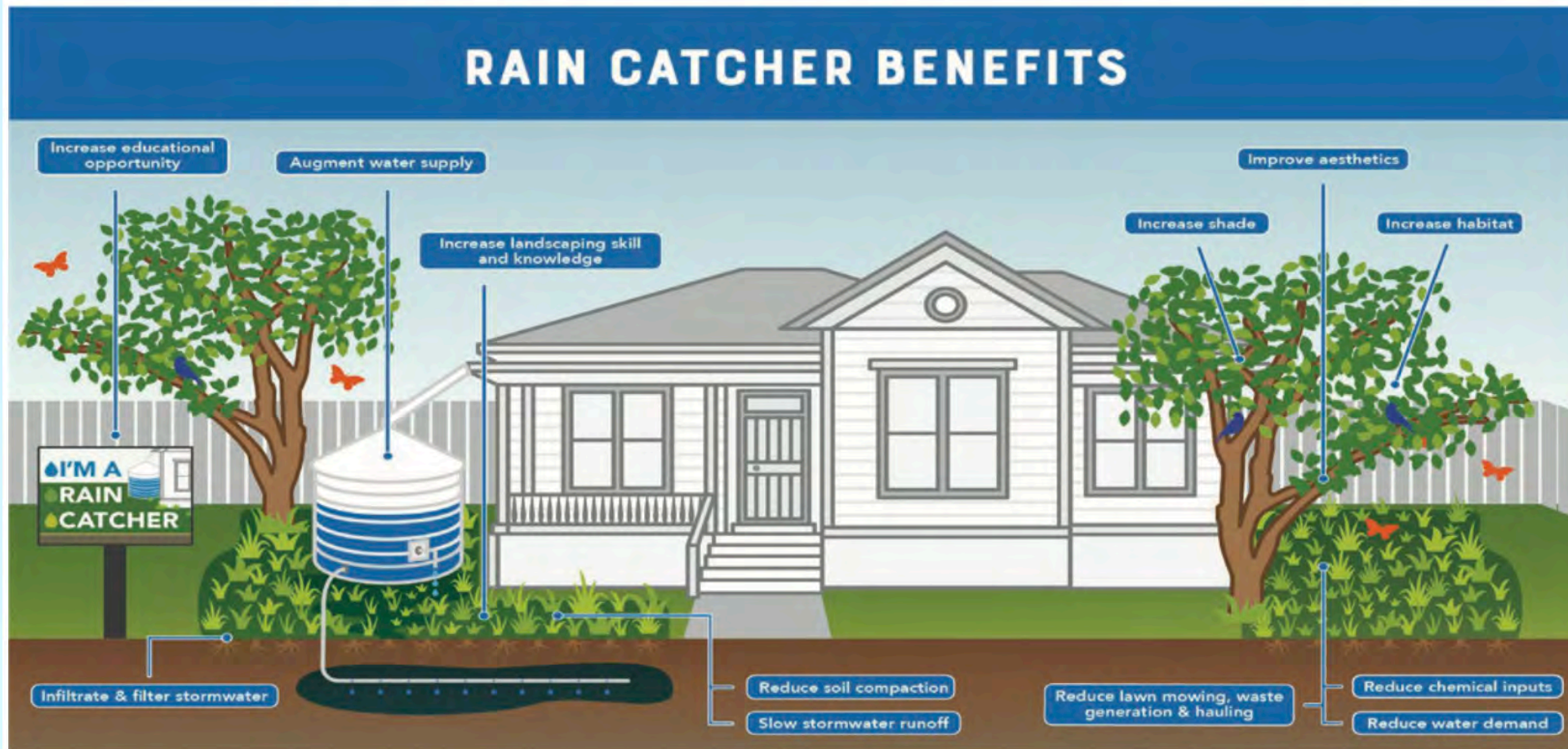
plants resistant  
to deer\*

**6/15**

plants resistant  
to rabbits\*

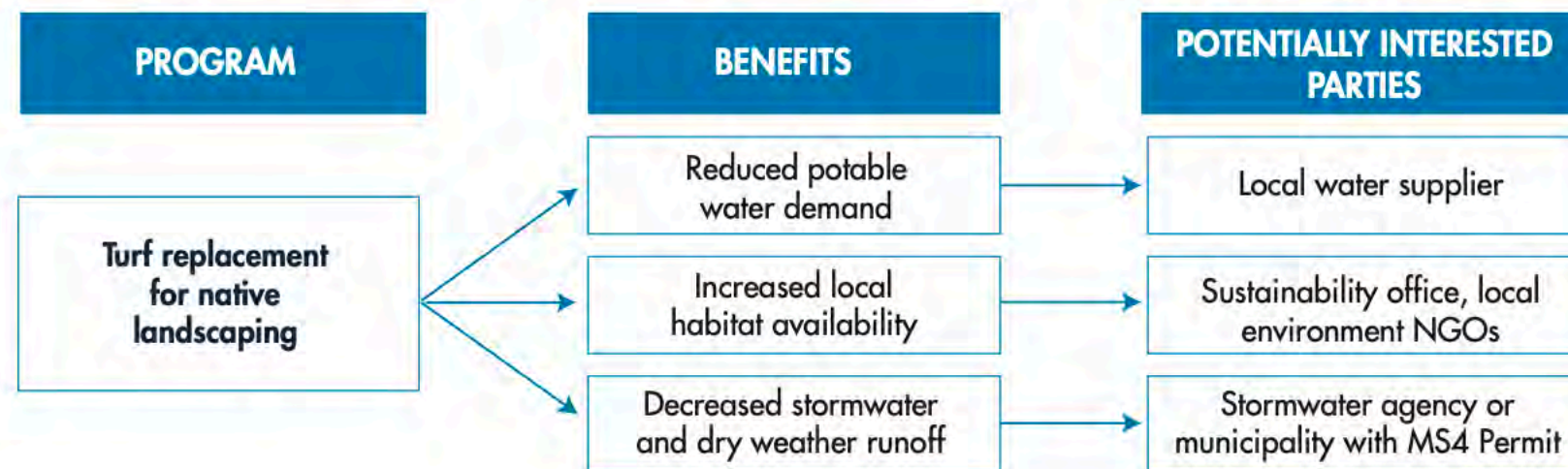


Figure 2. Identifying Benefits of Rainwater Capture as Part of Austin's Rain Catcher Pilot Program 🔍



Source:

Figure 4. Example of Identifying Program Benefits and Identifying Potentially Interested Parties 🔍



Collaboration and Partnerships are Key





*Floodplain of the IJssel river before (left) and after (right) the Room for the River project. Credits: Rijkswaterstaat*

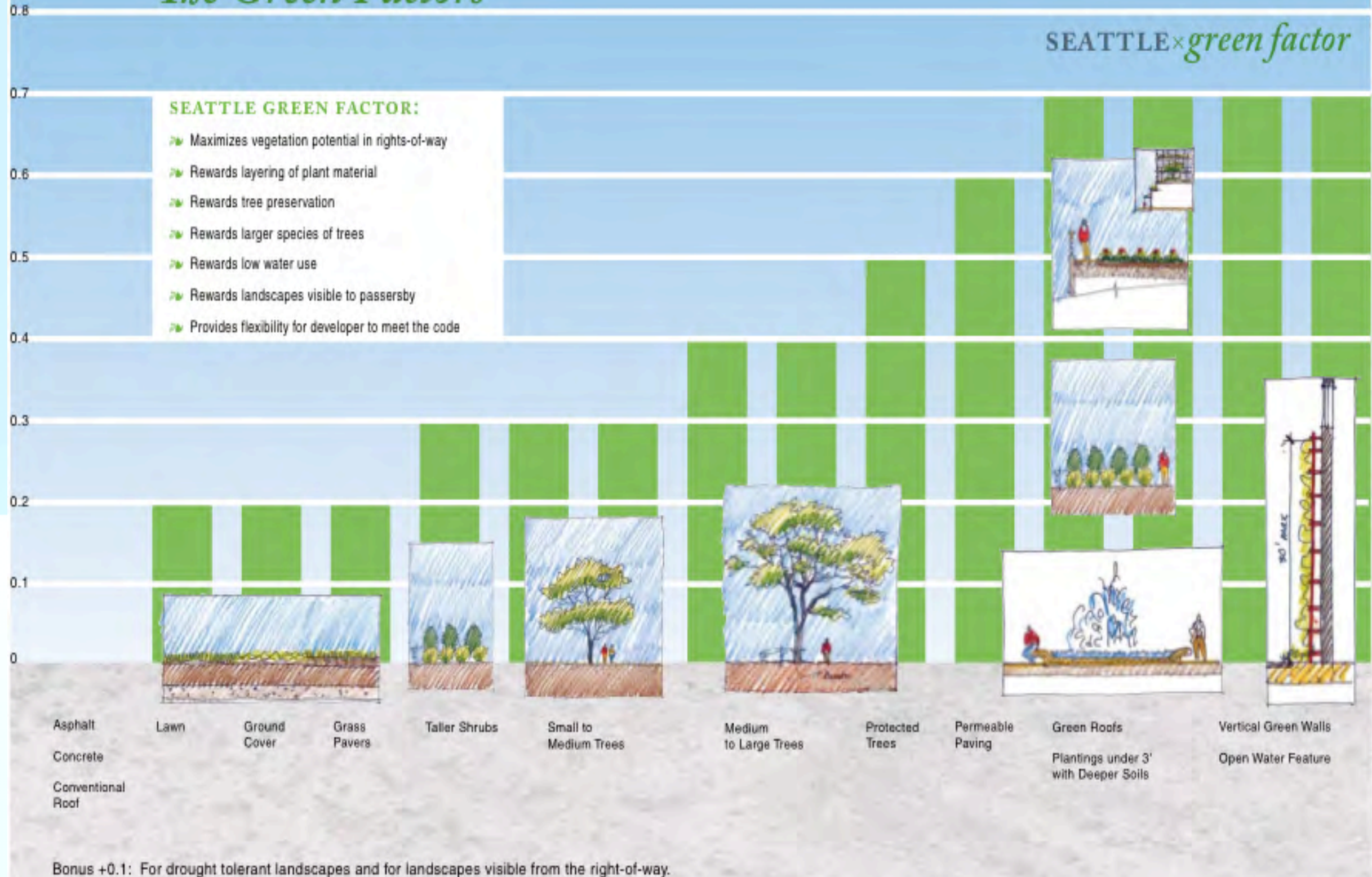


# The Green Factors

SEATTLE *green factor*

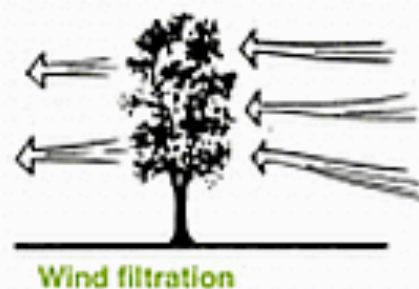
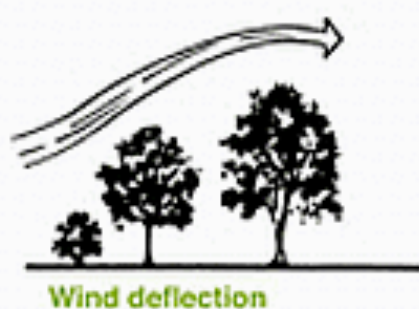
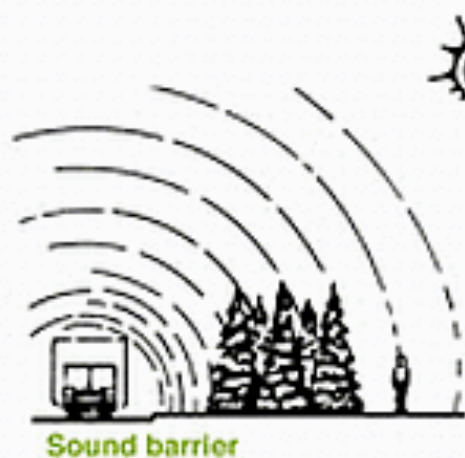
## SEATTLE GREEN FACTOR:

- Maximizes vegetation potential in rights-of-way
- Rewards layering of plant material
- Rewards tree preservation
- Rewards larger species of trees
- Rewards low water use
- Rewards landscapes visible to passersby
- Provides flexibility for developer to meet the code





The value of trees for their aesthetic functions is obvious. Many other less obvious functions contributing to the value of trees are illustrated here.



## Nature Based Systems are valuable assets

### *Benefit Summary for Pittsburgh's Street Trees*

+ Benefits	Total (\$)
Energy	\$1,205,133
CO2	\$35,424
Air Quality	\$252,935
Stormwater	\$334,601
Aesthetic/Other	\$572,882
<b>Total Benefits</b>	<b>\$2,400,975</b>



**Table 5-1. Summary of Tool Application Case Studies.**

	<b>Saint Paul, MN</b>	<b>Lancaster, PA</b>	<b>Seattle, WA</b>	<b>Cleveland, OH</b>
Description	Compares benefits and costs of two alternatives – gray- and GSI-based approaches – for mixed-use, 134-acre redevelopment site.	Evaluates benefits and costs of a citywide GSI-based stormwater management plan implemented over 25-years.	Examines benefits and costs of three ROW bioretention projects in high priority watershed.	Evaluates benefits and costs of multiple grant funded GSI projects in combined sewer are of District.
Project proponents	Capitol Region Watershed District/City of Saint Paul	City of Lancaster	Seattle Public Utilities	Northeast Ohio Regional Sewer District.
Key highlights	Results compared to similar analysis using Autocase tool. Compares incremental costs / benefits of gray and GSI scenario.	Results compared to a similar analysis developed using <i>CNT/American Rivers Guide</i> . <sup>a</sup> .	Incorporates MODA <sup>b</sup> framework that SPU uses to assess GSI project priorities / benefits.	Includes customized property value analysis and analyzes distributed projects.
GSI scenario	Centralized GSI corridor; 4.8 acres of bioretention; 300 trees, large retention pond / wetland system; 10-acres of green space. Stream restoration links development site to recreation/natural area.	Manages 1,265 IA / 1,060 MG of runoff/year through GSI: bioretention (56%); permeable pavement (26%); trees (13%); green roofs (4.5%); RWH (1%).	ROW bioretention projects managing 6 impervious acres; includes 89 trees, pedestrian/safety improvements, and community gathering space.	Nine distributed projects including bioretention, permeable pavement, and underground systems.
Avoided infrastructure		★		★
Avoided maint./replace.		★		★
Energy savings	★	★	★	★
Water supply		★		★
Air quality	★	★	★	★
Heat stress	★	★		
Recreation	★	★	★	
Enhanced aesthetics	★	★	★	★
Green job creation	★	★	★	★
Water quality/habitat	★		★	
Carbon reduction	★	★	★	★
Terrestrial ecosystem	★	★	★	★
Flood risk reduction	★			
Total PV benefits (\$M)	\$27.9 (GSI); \$15.1 (gray); (28-year PV)	\$521.8 (50-year PV)	\$8.98 (50-year PV)	\$5.20 (40-year PV)
Total PV costs (\$M)	\$21.5 (GSI); 18.8 (gray) (28-year PV)	\$241.5	\$5.87	3.49
Benefit-cost ratio	1.3 (GSI); 0.8 (gray)	2.16	1.53	1.455
(a) CNT and American Rivers 2010 (b) MODA = Multiple Objective Decision Analysis				

Triple

Bottom

Line





PUBLIC HEALTH



## Green strategies to improve public health and save billions

There are some things you cannot put a price on – but social scientists at the **University of Washington** led by **Dr Kathleen Wolf** are working hard to demonstrate that green infrastructure and urban landscapes have incredible public value



**Resources : Nature Based Systems - land and water planning**

*American Planning Association*

[planning.org/divisions/groups/water](http://planning.org/divisions/groups/water)

*Lincoln/Babbitt*

[lincolninst.edu/our-work/babbitt-center-land-water-policy](http://lincolninst.edu/our-work/babbitt-center-land-water-policy)

*Center for Neighborhood Technology*

[CNT.org](http://CNT.org)

*Pacific Institute*

[pacinst.org/publication/stacked\\_incentives](http://pacinst.org/publication/stacked_incentives)

*Rocky Mountain Institute*

[rmi.org](http://rmi.org)

“ Growing to Its Potential The Value of Urban Nature for Communities,  
Investors, and the Climate “

*Sonoran Institute*

[sonoraninstitute.org](http://sonoraninstitute.org)

*Water Research Foundation*

[waterrf.org](http://waterrf.org)

“Economic Framework and Tools for Quantifying and Monetizing the Triple  
Bottom Line Benefits of Green Stormwater Infrastructure”

Paul W. Lander, PhD, M.Larch, LEED A.P.

dakota ridge partners

Boulder CO 303-717-5268

[paul.dakotaridge@gmail.com](mailto:paul.dakotaridge@gmail.com)

[paul.w.lander@colorado.edu](mailto:paul.w.lander@colorado.edu)





# Stormwater Strategies for an Uncertain Climate Future

## Presenter:

**Jennifer Johnson**, PE, CFM, LEED AP, Director of Resilience Planning & Design

May 5, 2023



@nitscheng

Building better communities with you



# Nitsch Engineering

Building better communities with you

- Professional engineers registered in 21 states and the District of Columbia, and with NCEES
- Offices in Washington, DC and Boston, Worcester, Lawrence, MA
- 35 LEED & 1 SITES Accredited Professionals/Green Associates
- 14 Institute for Sustainable Infrastructure ENVSPs
- 100+ LEED Registered or Certified Projects
- Award-Winning Sustainable Design Green Infrastructure Projects
- Leaders in Sustainable Stormwater and Green Infrastructure



SURVEY

CIVIL

PLANNING


STRUCTURAL TRANSPORTATION

GIS INFRASTRUCTURE

GREEN





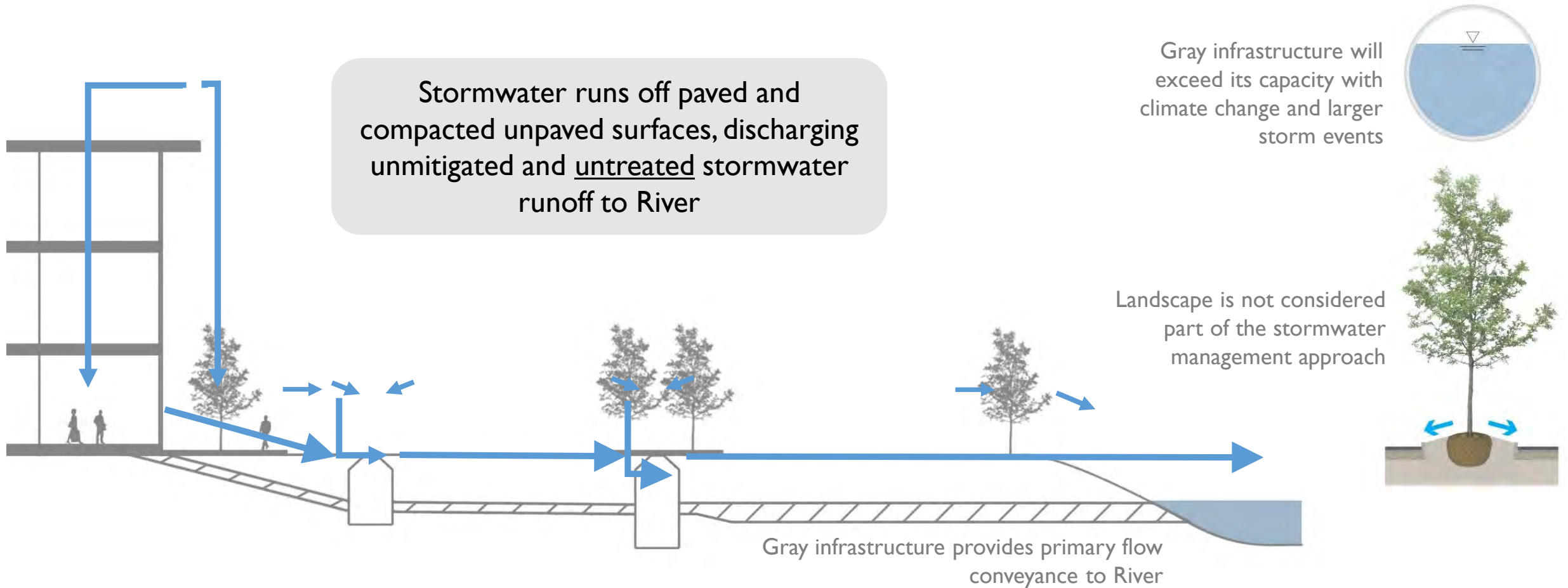


**Nitsch Engineering's *Resilience Planning & Design* team delivers adaptable and multi-beneficial solutions for more sustainable and resilient communities.**

**The *Resilience Planning & Design* team leverages its members' diverse expertise to collaboratively develop holistic solutions in anticipation of climate change and other stressors that will impact our environment.**



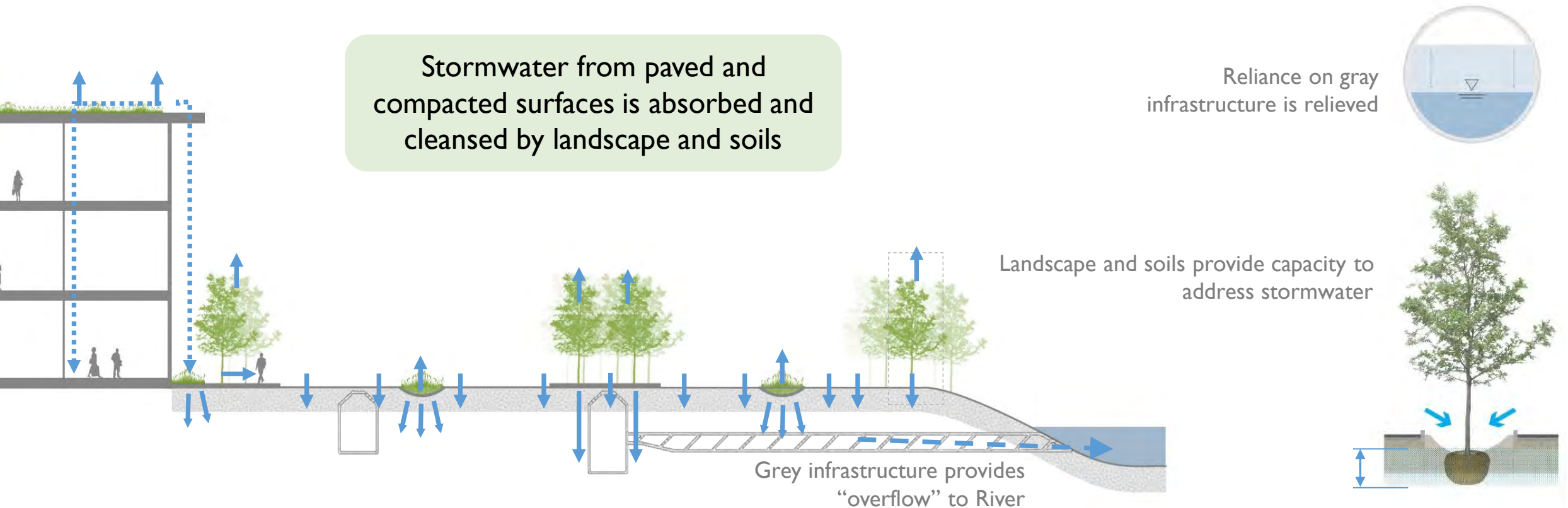
# Compounding Issues of Gray Infrastructure



**Age of systems, undersized infrastructure, and single purpose design**



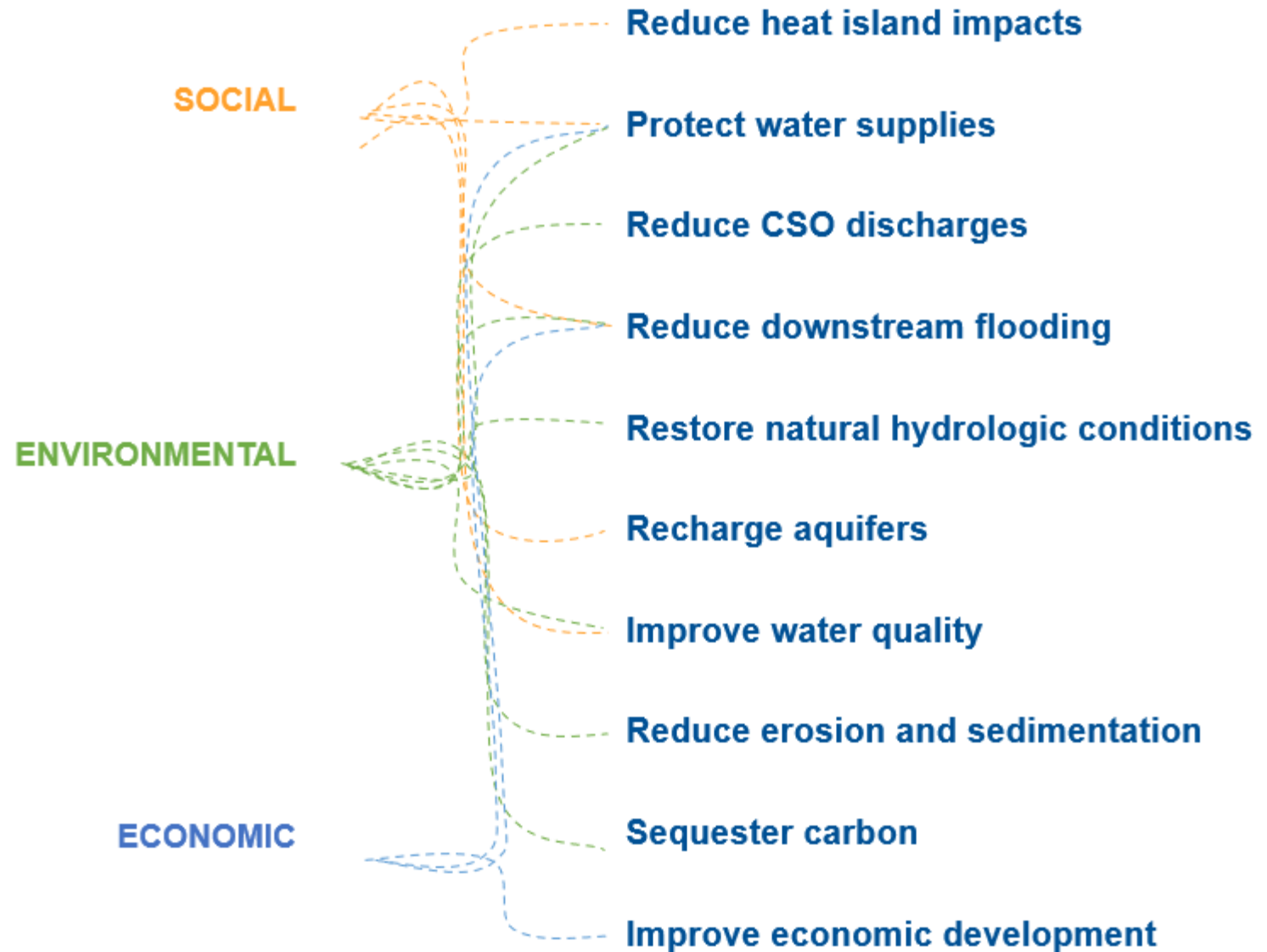
# Increasing Sustainability and Resilience with Nature-Based Solutions



**Green and gray infrastructure partnered for maximum impact**

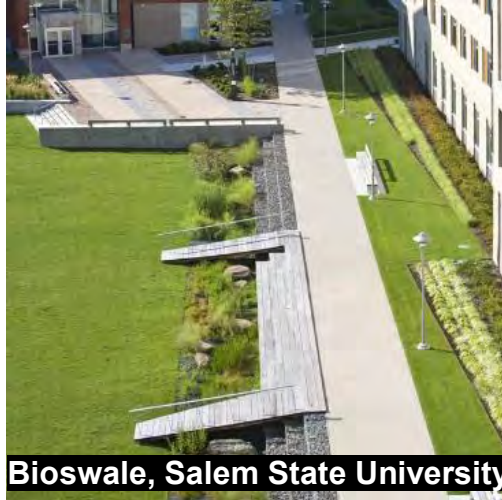


# Triple-Bottom Line of Nature-Based Solutions / Green Infrastructure





# Implementing multi-beneficial nature-based strategies across communities...



**Bioswale, Salem State University**



**Green Roofs, Princeton University**



**Permeable Pavement, Gallery Automotive. MA**



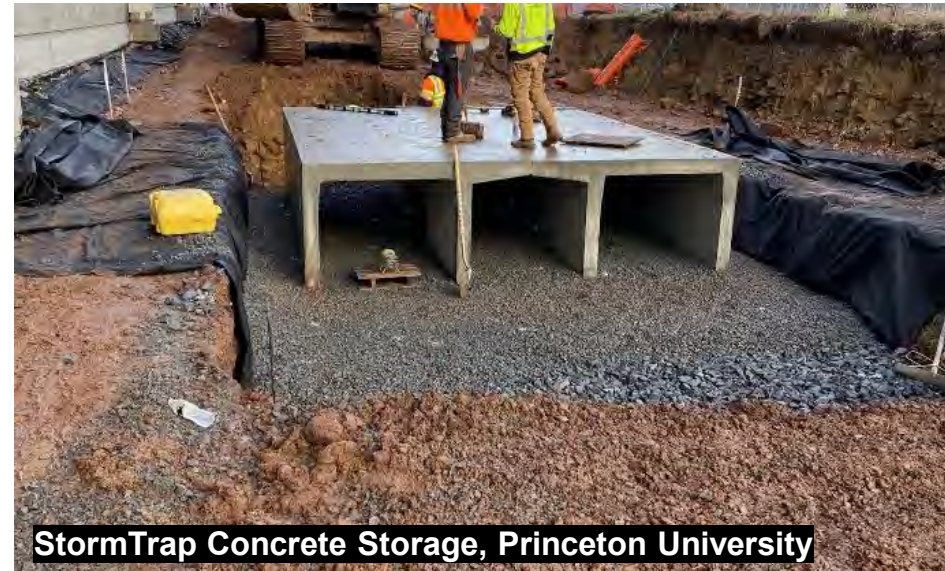
**Wet Meadow, Frick Park Environmental Center**



**Bioretention, University of Virginia**



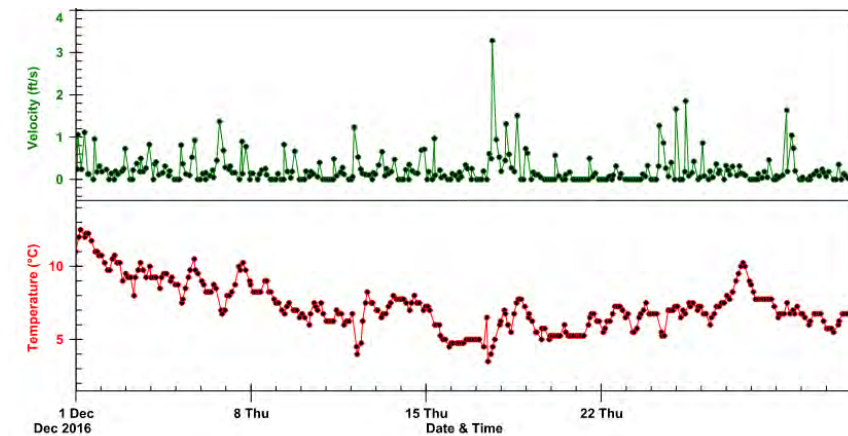
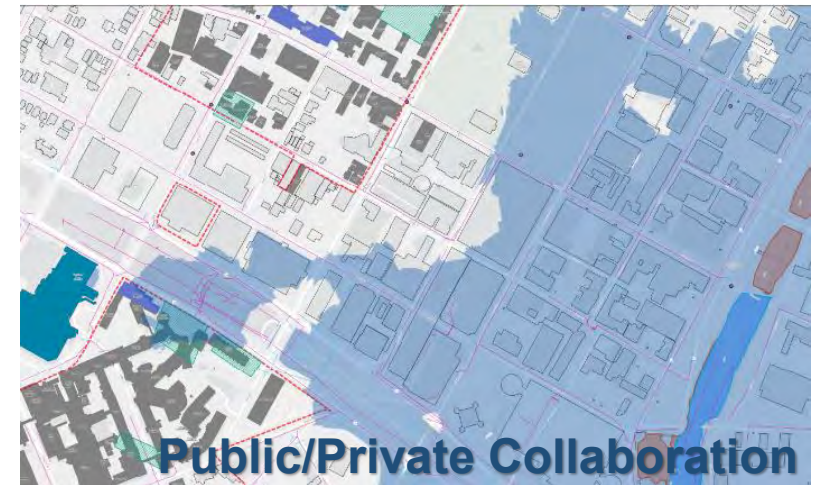
# ...while balancing ecological stormwater management and flood mitigation





# Tools for Resilient Communities

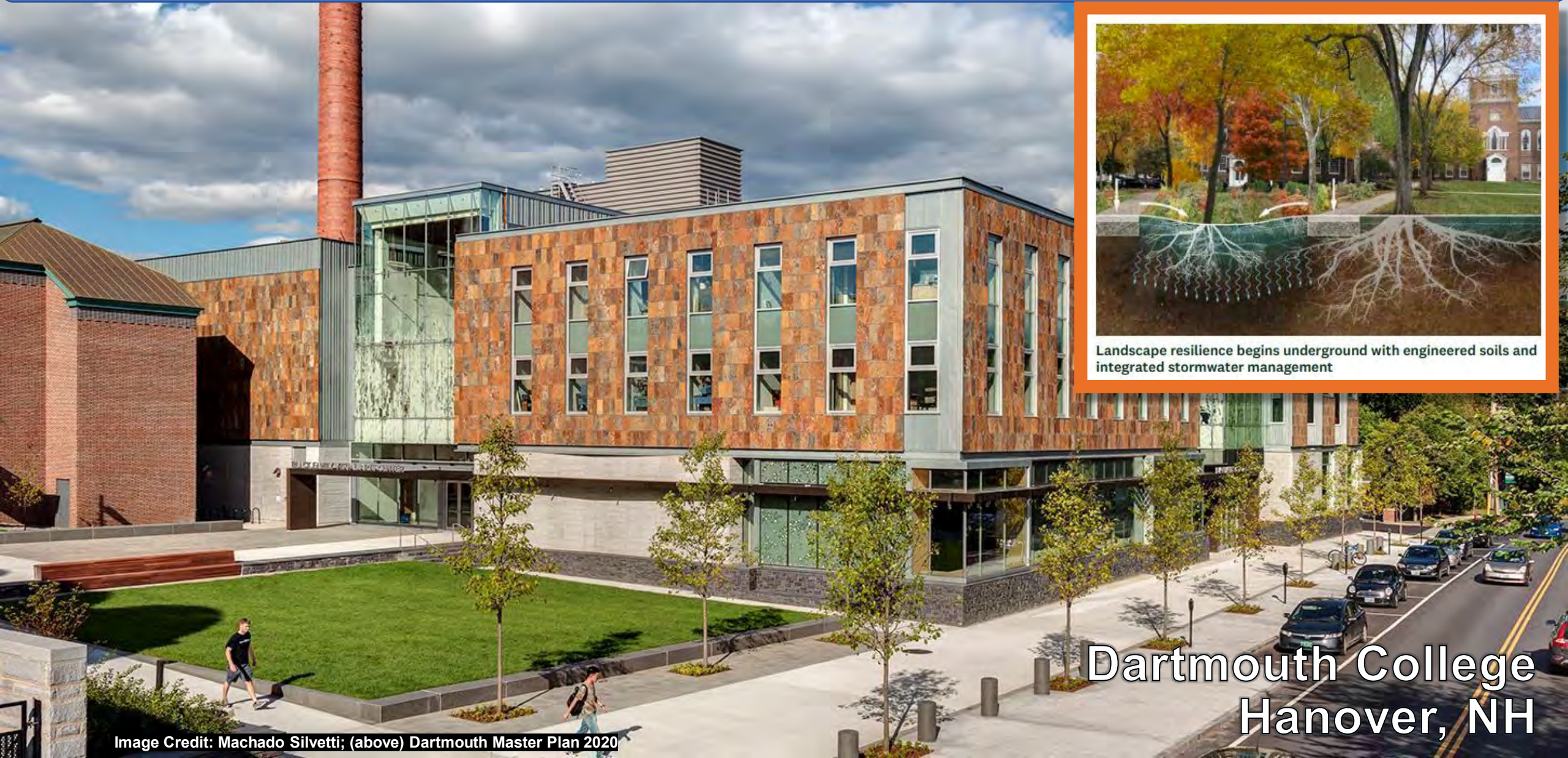
Every aspect of site planning and design must be considered



**Data-Driven Design**



# Restoring Hydrology and Landscape Ecology



Landscape resilience begins underground with engineered soils and integrated stormwater management

Dartmouth College  
Hanover, NH



# Increasing Resilience to Climate Change



Image Credit: Todd Robinson

Boston and Cambridge, MA



# Balancing Restoration, Performance, Program



Boston City Hall Plaza



# Building Consensus and Driving Innovation

## Boston Green Infrastructure Planning and Design Handbook



Boston Water and  
Sewer Commission

Suitability Matrix

EXISTING SITE CONDITION	RANGE	INFILTRATION PRACTICES			
		 Subsurface Infiltration	 Infiltration Trench	 Surface Infiltration Basin	 Tree Filter
Development Density	High Density	Most Suitable	Most Suitable	Suitable	
	Low Density	Suitable	Suitable	Most Suitable	
Existing Soil Permeability	Low	Suitable	Suitable	Suitable	
	High	Most Suitable	Most Suitable	Most Suitable	
Microclimate	Full Sun	Suitable	Suitable	Most Suitable	
	Full Shade	Most Suitable	Most Suitable	Suitable	
Slope	Moderate (<6%)	Most Suitable	Most Suitable	Most Suitable	
	Steep (6-10%)	Suitable	Most Suitable	Suitable	
Treatment Train Location	Overland Flow	Suitable	Most Suitable	Most Suitable	
	Piped Inflow	Most Suitable	Suitable	Suitable	
OTHER CONSIDERATIONS					
Avg. Annual Maintenance Cost		\$	\$	\$	

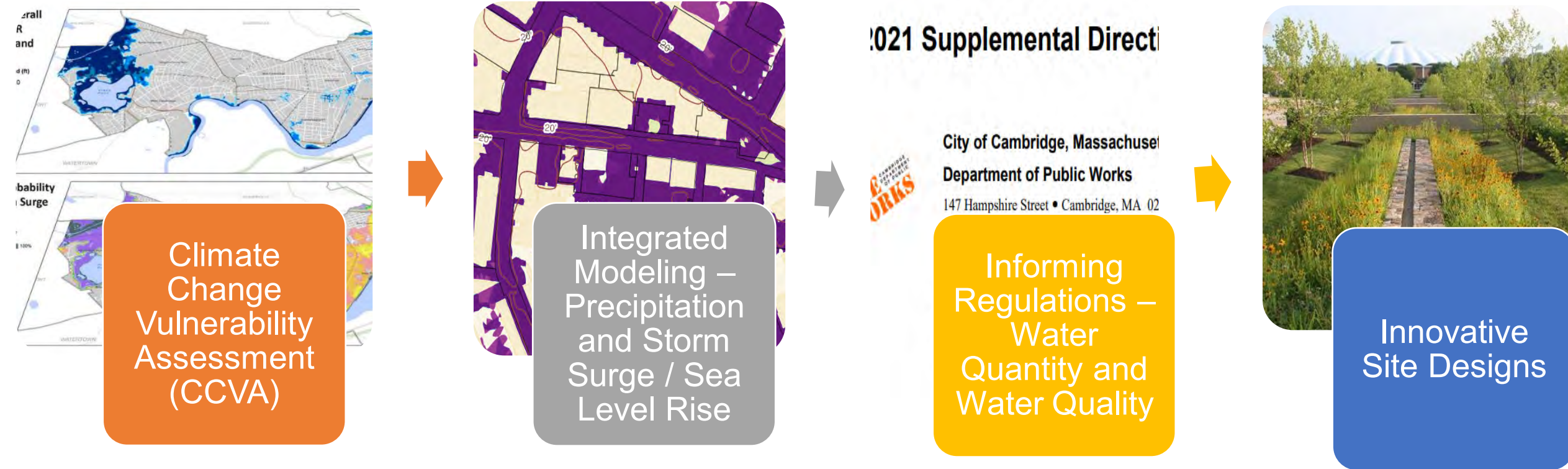
Performance Matrix

		INFILTRATION PRACTICES					BIOPRACTICES
		 Subsurface Infiltration	 Infiltration Trench	 Surface Infiltration Basin	 Tree Filter	 Bioretention (Infiltration)	Bioretention (Infiltration)
PEAK RATE MITIGATION	Detention Storage & Slow Release	5	5	5	5	4	Bioretention through bioretention control
		Infiltration practices provide temporary storage of runoff through surface or subsurface storage; typically perforated pipe or pre-fab structures embedded in a stone reservoir. Controlled overflow occurs from outlet control structure and/or underdrains, if present.					
VOLUME REDUCTION	Infiltration & Groundwater Recharge	5	5	5	5	4	Bioretention and infiltration media conditions
		Infiltration techniques provide a storage reservoir to retain and infiltrate stormwater using surface storage, subsurface structures, and/or gravel media; used when existing soils are permeable.					
WATER QUALITY	Evaporation or Reuse	2	2	3	3	3	Stormwater surface plant evaporation
		Sub-surface applications: stormwater is captured and stored in structures and gravel media, leaving little opportunity for evaporation. Surface infiltration basins may provide some evaporation from temporary surface storage.					
WATER QUALITY	TSS Removal	5	5	5	5	5	Sediment device filtration
		With adequate pre-treatment, infiltration practices are highly effective at removing sediment and other pollutants through settling and infiltration.					
WATER QUALITY	Phosphorus Removal	5	4	5	4	5	Phosphorus through
		Infiltration practices are highly effective at phosphorus removal through filtration and infiltration processes.					

Low 1 2 3 4 5 High



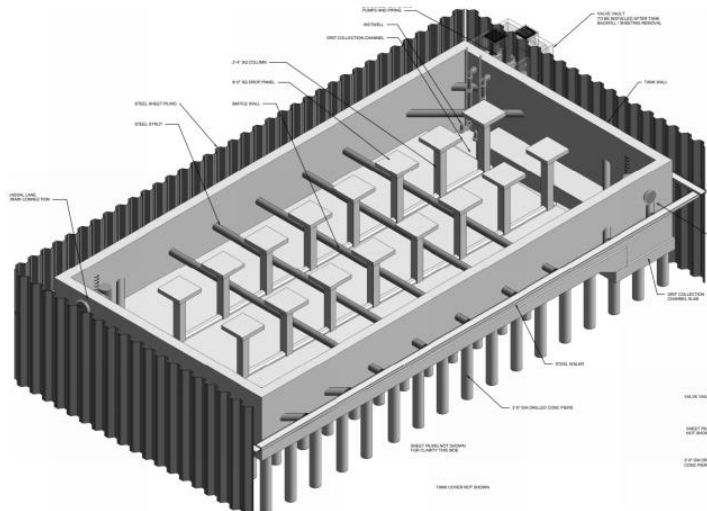
# Building Consensus and Driving Innovation



**Cambridge, MA**



## Considering Scalable Solutions



# Tobin Montessori and Vassal Lane Upper School





# Elevating Sustainability & Stewardship Initiatives



Chao Center, Harvard Business School  
Boston, MA



# Planning for Future Development



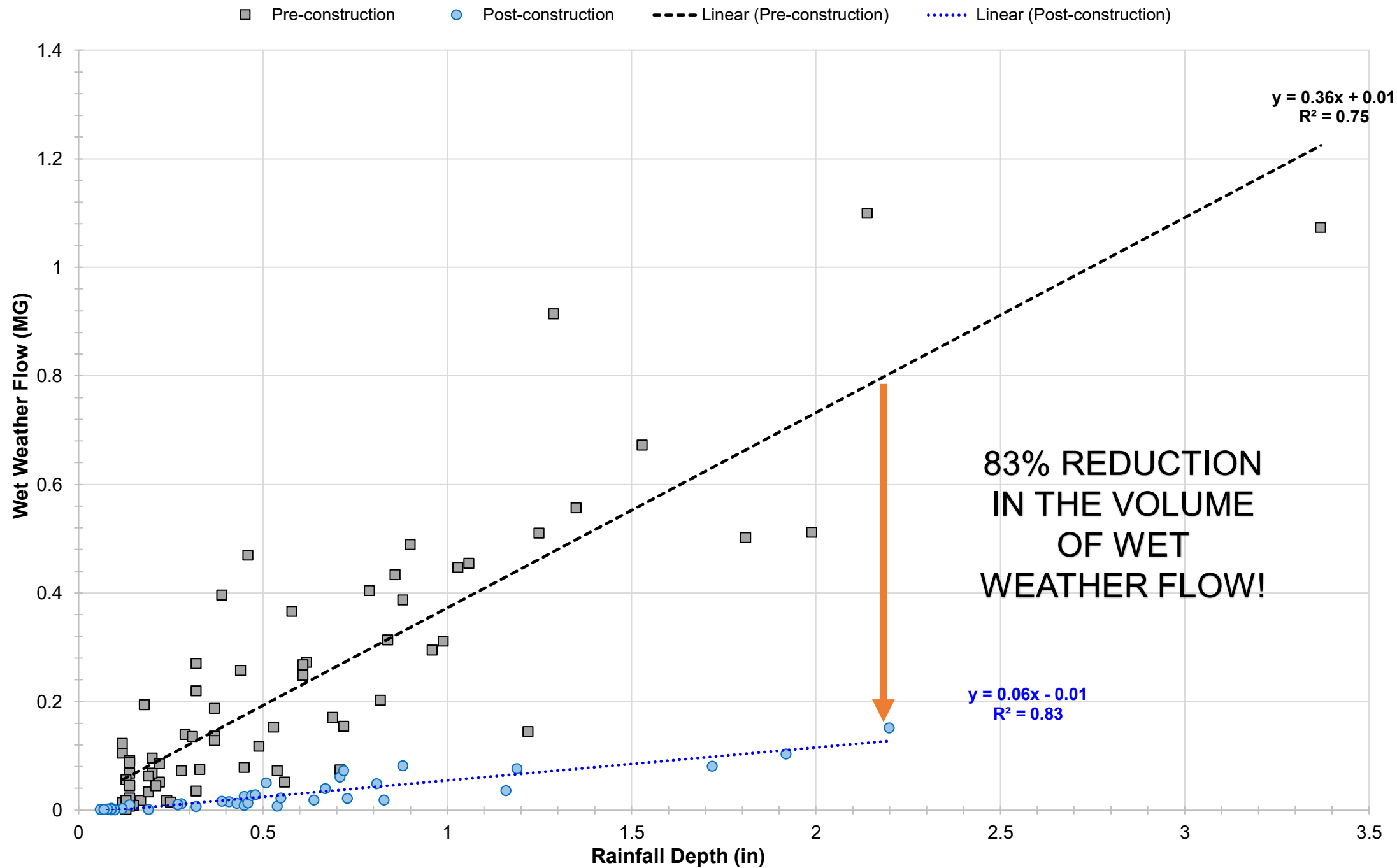


# Measuring Impact to Catalyze Future Projects



Kennedy Street  
Washington, DC









**Dialogue**



# NATURE-BASED SOLUTIONS IN DEVENS:



*How Devens supports Green Infrastructure and LID*

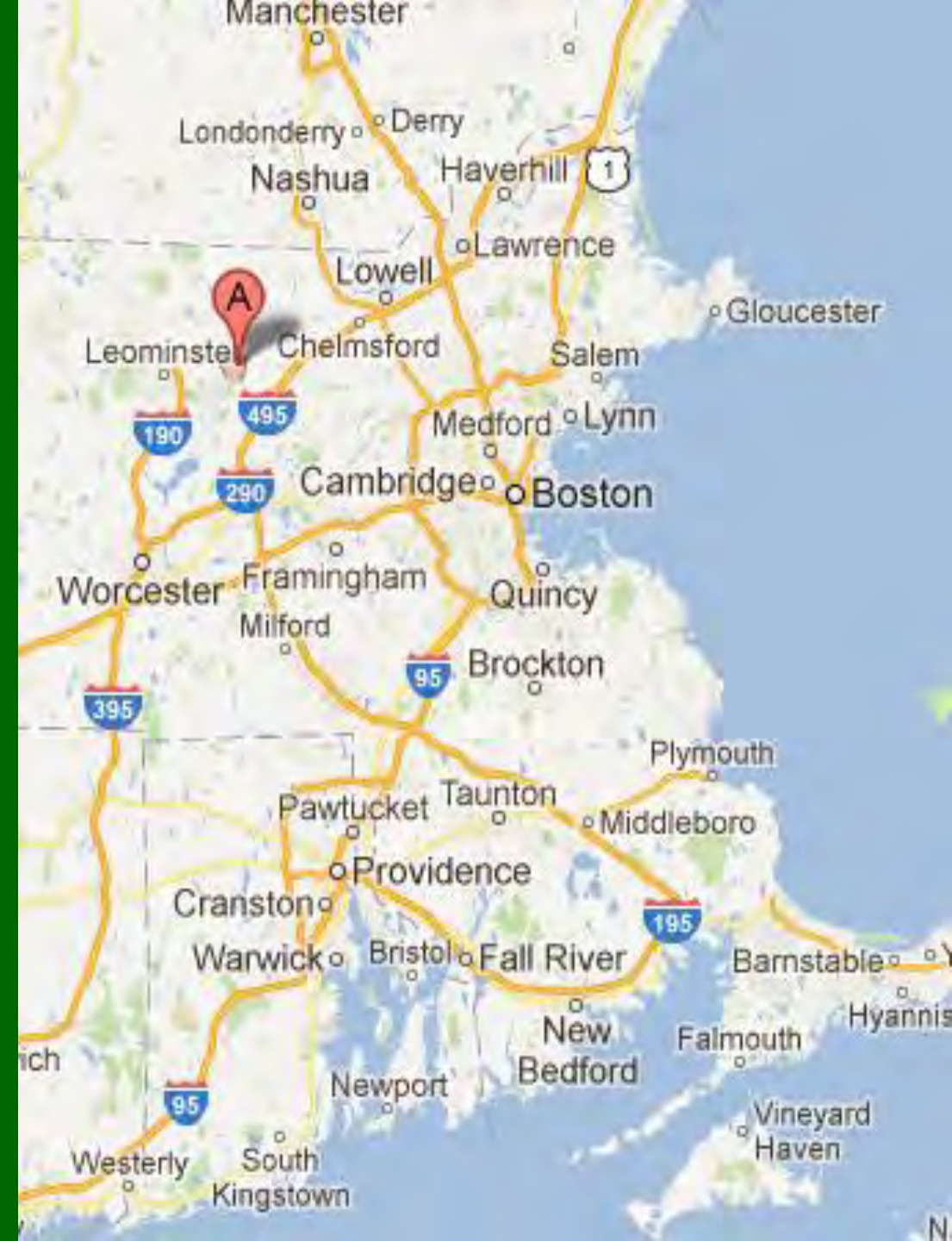


**Neil Angus, FAICP CEP, LEED AP, LFA**  
Environmental Planner  
Devens Enterprise Commission  
[neilangus@devensec.com](mailto:neilangus@devensec.com)



# Devens Overview

- 35 miles outside Boston
- 4400 ac. former base
- Superfund Site
- 1993 Sustainable redev.
- NBS and GI as 1 tool to meet SD goal
- DEC – Regulatory Authority
- One-Stop Unified Permitting





# Regulating NBS and GI: Site Plan (974 CMR 3.04)

- Tree Preservation, Steep Slope Requirements
- Limit Construction Impact Zones/ Prohibit Clear-Cutting
- Penalty for removal of trees to be preserved
- Native Landscaping requirements
- Functional landscaping - reconnecting ecosystems
- Green Roof & Green Wall Regs
- Parking maximums







Parking Garage  
(2 additional stories)

Existing  
Lab/Office

Existing Manufacturing Bldg.

New BDB

New CMB

## BMS NBS:

- Cluster
- Tree preservation (habitat)
- LID drainage (SWM)
- Green Building (WE, EE, IAQ, GHG red.)



# BMS: Integrating NBS into buildings:

- Green roofs (AQ, SWM, EE, <UHI)
- White roofs (EE, <UHI)
- Green walls (SWM, AQ, Viewshed)





# Regulating LID& NBS: Stormwater (974 CMR 4.08):

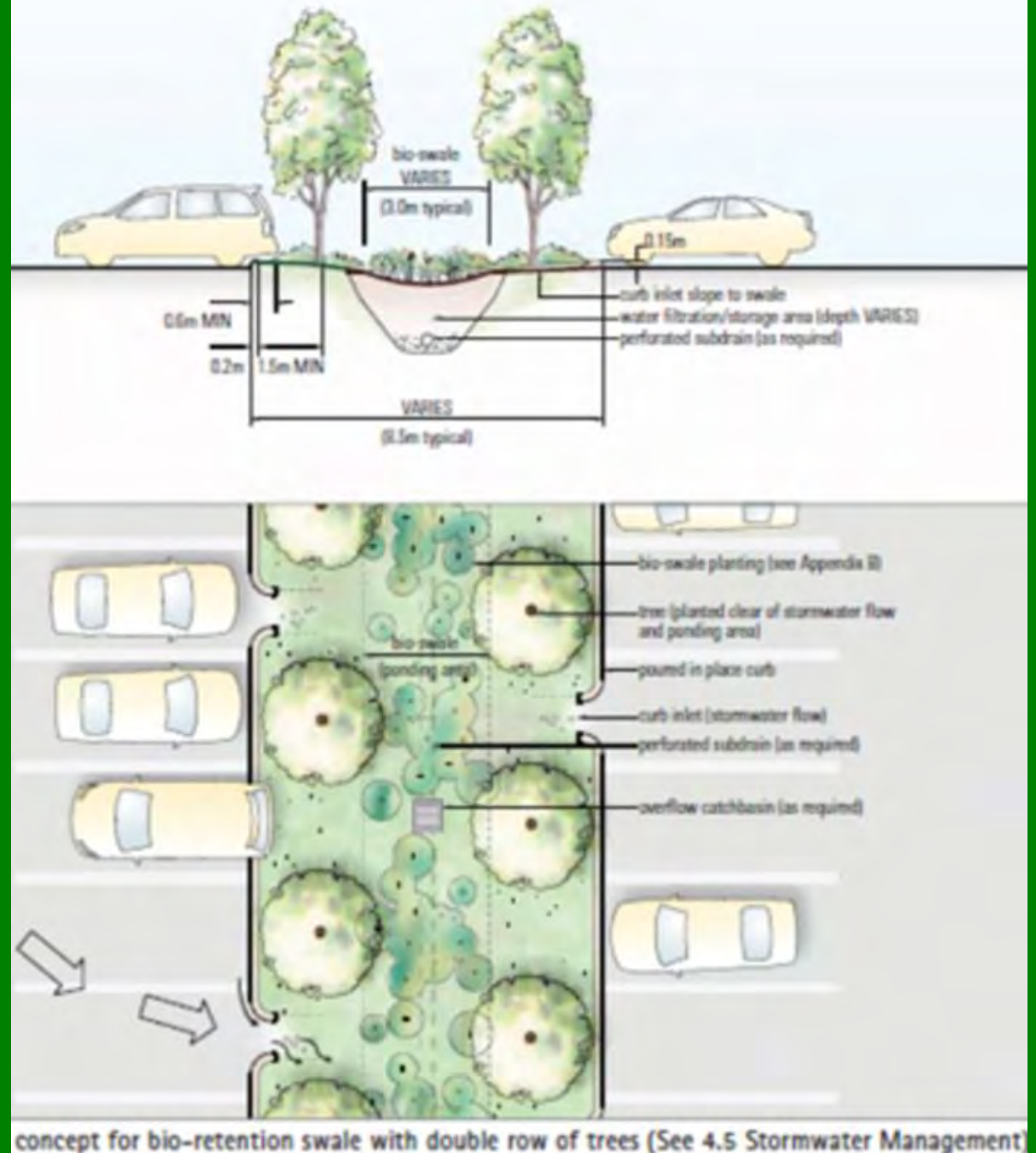
Replicate natural cond. (90% on-site):

- NBS & LID as a tool to meet infiltration requirements
- Decentralized systems (recharge/preserve land)
- Specifications for LID for guidance (make it easy!)
  - Veg roof
  - Permeable pavement
  - Reinforced turf, etc...
- MA DEP, UNH SW Center

<https://bit.ly/MADEPSWMS>

<https://extension.unh.edu/stormwater-center>

[www.devensec.com/devserv.html](http://www.devensec.com/devserv.html)





# Bio-filtration Landscape Islands: 27 Jackson Road

- MWCC 300+ spaces
- Proper design and construction key to durability





# Regulating NBS: Subdivision (974 CMR 2.07)

- Additional street types – more green, less grey
- Green & Complete Streets Standards (street trees, LID drainage, reduce pave widths, ped scale design)
- Cluster subdivision – 5,000 sf lots, min. setbacks
- Traffic calming measures (chicanes, bump-outs – additional LID planting within grey infra.)
- Lot-level LID (pervious pavers, reinforced turf)
- NBS and LID adds to community character





# Regulating GI and NBS:

## Rainwater Harvesting (974 CMR 4.00 & 8.00)

- Required for comm/ind. irrigation
- Inexpensive supply of water
- Preserves drinking water supplies
- Requires little treatment for non-potable reuse (\$\$)  
(toilet flushing/irrigation)
- Reduces SW runoff, NPS pollution & erosion
- Reduces peak summer demand
- Easy to install/screen
- Plan early in design





- Rainwater harvesting (90%)
- Pollinator plantings – natural pest control, SWM
- Automated process, pesticide-free
- LID SWM – No CB's, Biofiltration + GW Recharge
- Locally sourced/farm to table same day (reduced F & VMT)







Biomass-potential energy source

Biomass, habitat and nutrients for birds and other wildlife

Reduction in storm water runoff and flooding

Visual screening for large expanses of pavement and utilities

Decreased Energy demands for adjacent buildings

# How did we get support for these regulations?

Education, Awareness, and Guidance:  
Seeing is Believing!

Extended pavement life from shading

Reduced Urban Heat Island Effect

Reduce solar glare for drivers

Provides context and aids drivers in better assessing their speed (traffic calming)

Define street edge and protect pedestrians

Reduced UV exposure for pedestrians

Rehabilitation and stress relieving attributes

Increase in Property Values





# Case Studies: 27 Jackson Road

Reduced site paving	-\$32,000
Reduced curbing	-\$50,000
Reduced stormwater piping	-\$14,000
Reduced stormwater structures	-\$68,000
Increased landscaping	+\$12,000
Increased site preparation	+\$10,000
<u>Increased soil mix</u>	<u>+\$18,000</u>
Total Estimated Savings:	-\$124,000





## LID Peer to Peer: 155 Jackson Road

- 70+ spaces
- Connected developer with DPW & other developers on “how to’s” for construction and O&M



# Pilot Residential Lot Level NBS and LID strategies:

- No gutters
- Pervious walkways
- Rain gardens
- Reduced lawn areas (cluster sub.)
- Street trees
- GI & UHI reduction
- It can be done and IS being done!



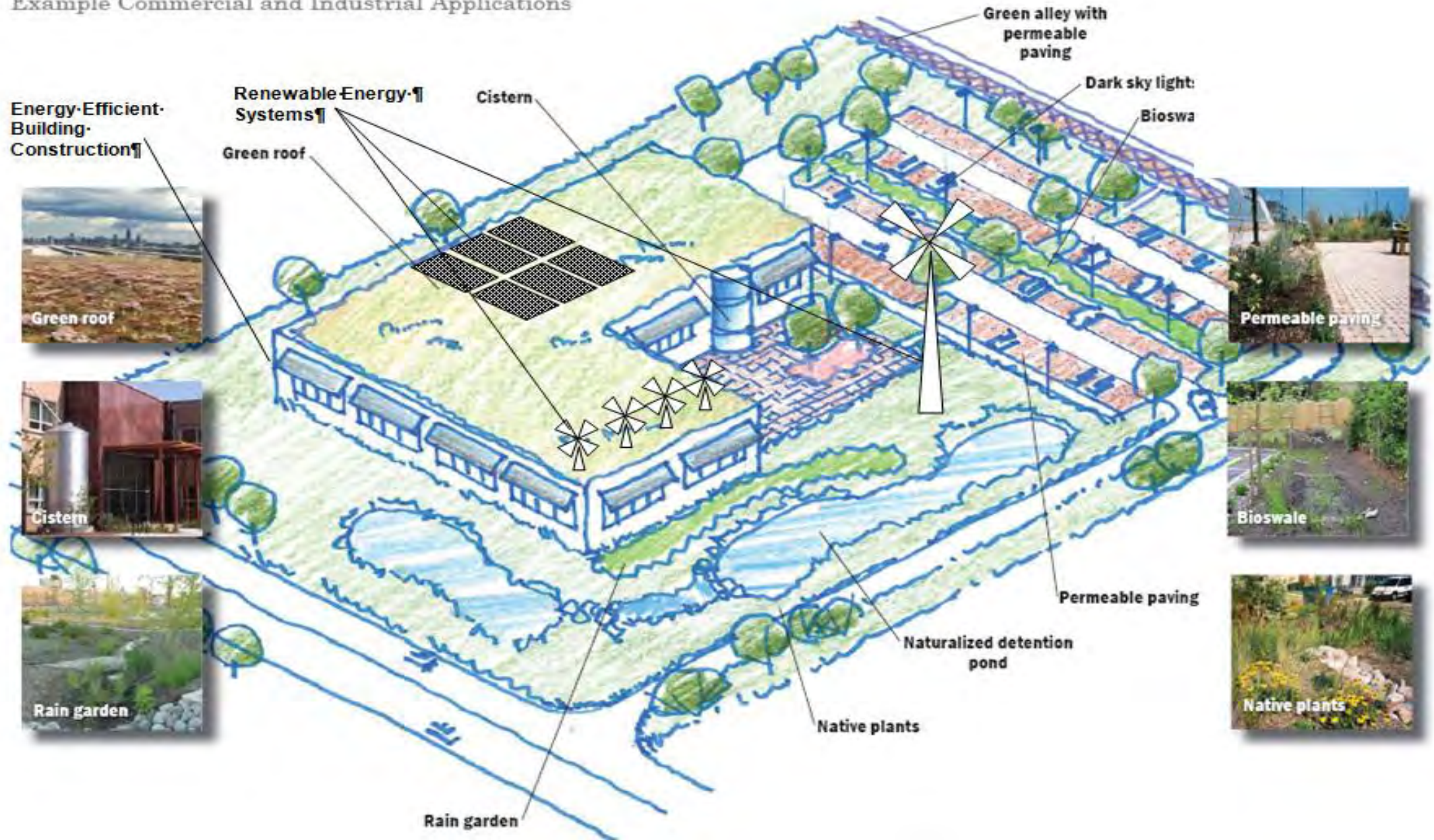


# GI Guidelines:

Example Commercial and Industrial Applications

Make it even easier to do the right thing!

<http://www.devensec.com/planning-docs.html>







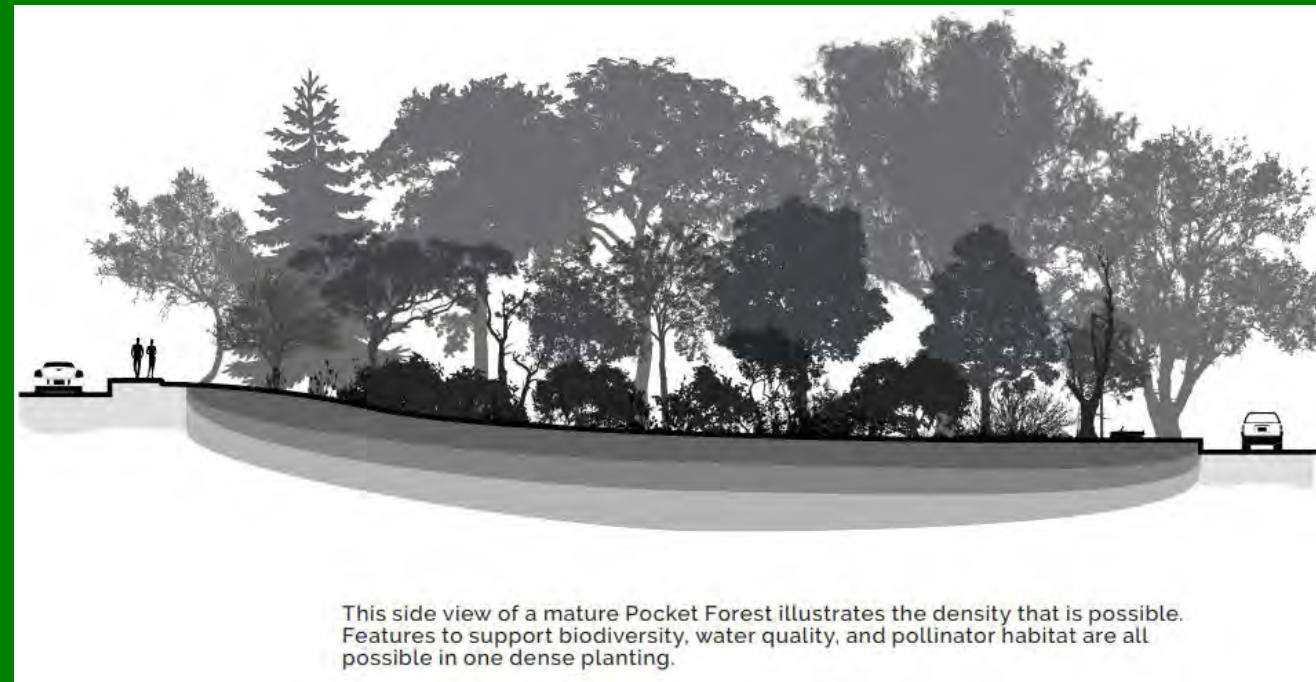
## NBS & Tactical (sub)Urbanism

- Pilot bump out - reduced pavement width, still accommodating emergency egress, localized infiltration, reduced heat-island, habitat



# More Pilot Projects to show it works!

- Pocket Forests: additional NBS and GI Tool
  - Mental & Physical Health Benefits
  - Healthy soils for SWM and GHG reduction
  - Air Quality/UHI
  - Reducing lawns; Habitat Connections
  - Additional GI tool





# Promoting NBS & LID as a climate adaptation/resiliency strategy:

- Flexibility/durability for changing conditions
- Local GW recharge/decentralized systems
- Reduced flooding
- UHI mitigation (better AQ & WQ)
- GHG reduction





# Education & Awareness:

**APPLE COUNTRY** Natural Climate Solutions Project

BOLTON • DEVENS • HARVARD

<https://climateresilient.wixsite.com/applecountry>

Home | Project Story | Field Tour | Data Viewer | Wetlands | Forests | Natural Solutions | Global Context | More

Collaborating with Nature to Create Climate Resilience

- Trees/Forests as Carbon sinks
- Soils too!
- Wetlands sequester even more! (30-50x) 3% of earth area but storing 20-30% of global CO2
- Ecological benefits, public health
- NBS as a tool to integrate nature with development (GI network)
- Strengthens argument for preservation of existing forests, wetlands, and soils



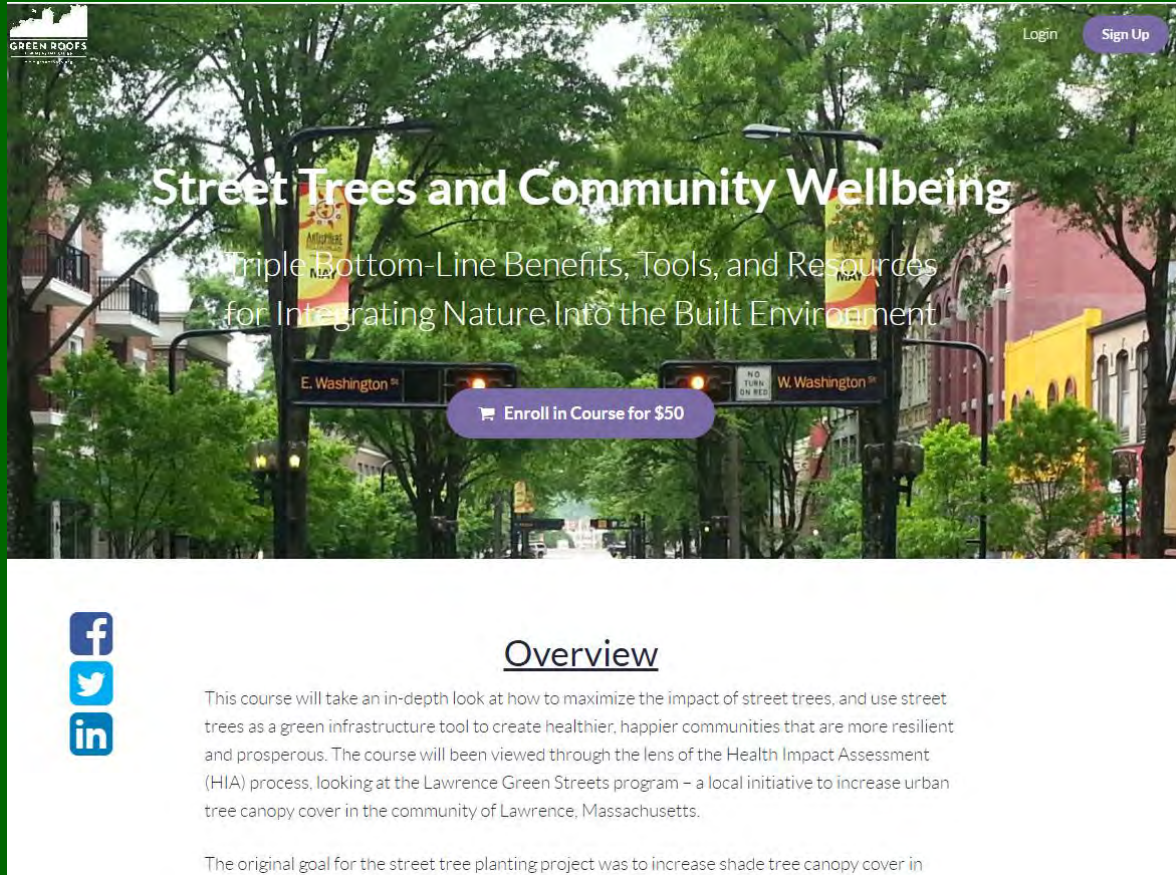


# Education & Awareness:

- Health Benefits of NBS and Integrating GI into Urban Areas

- Living Architecture Course on Street Trees and GI:  
Reconnecting people with nature

- Street Tree Health Impact Assessment



**Street Trees and Community Wellbeing**  
Triple Bottom-Line Benefits, Tools, and Resources  
for Integrating Nature Into the Built Environment

Enroll in Course for \$50

**Overview**

This course will take an in-depth look at how to maximize the impact of street trees, and use street trees as a green infrastructure tool to create healthier, happier communities that are more resilient and prosperous. The course will be viewed through the lens of the Health Impact Assessment (HIA) process, looking at the Lawrence Green Streets program – a local initiative to increase urban tree canopy cover in the community of Lawrence, Massachusetts.

The original goal for the street tree planting project was to increase shade tree canopy cover in

<https://livingarchitectureacademy.com/p/street-trees-and-community-wellbeing>



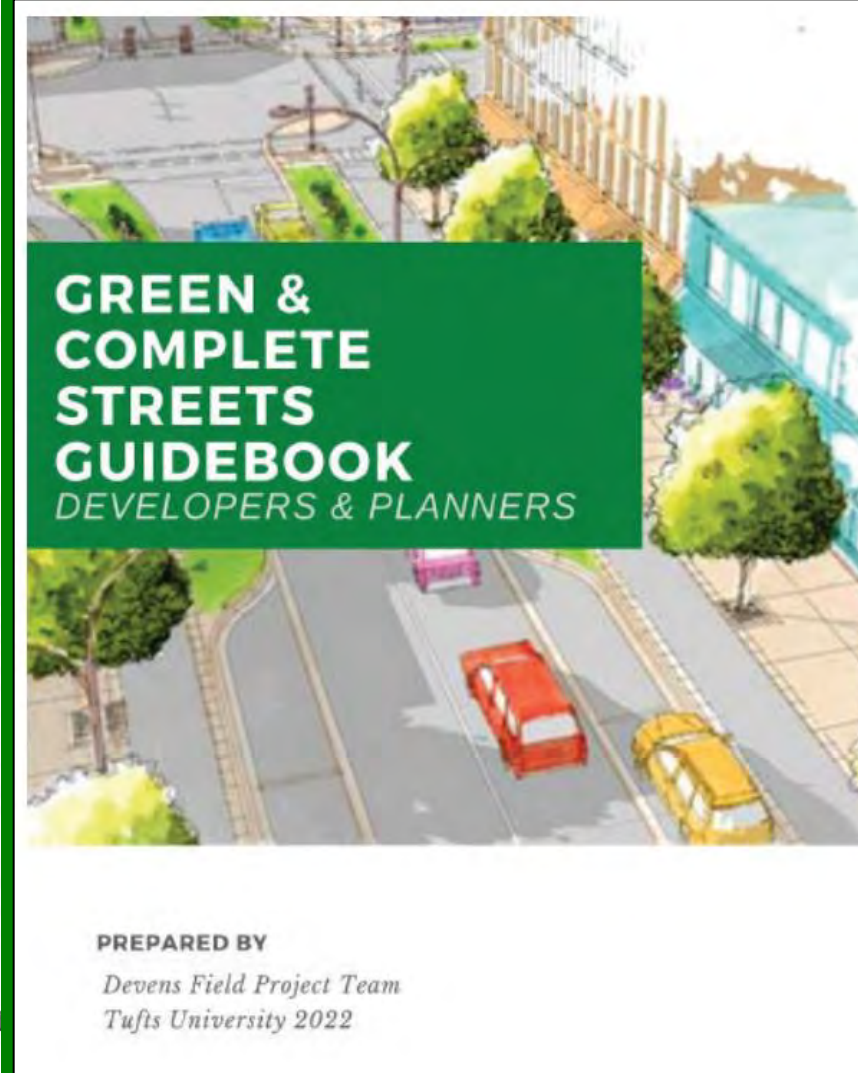
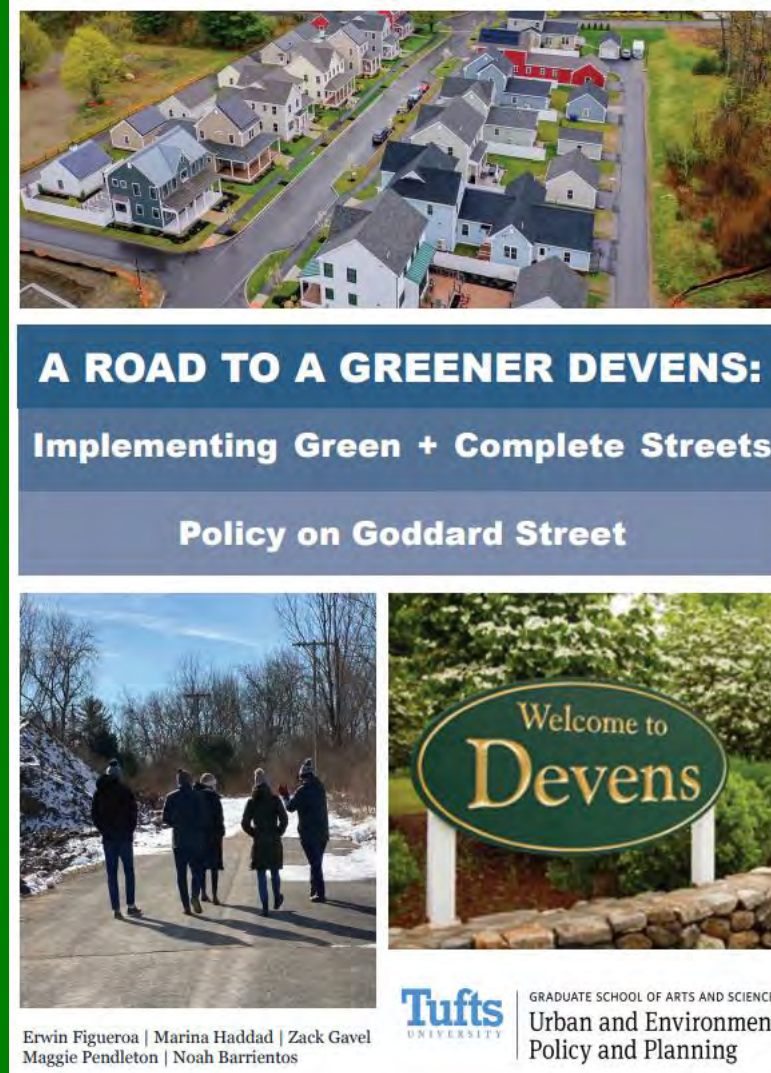
<https://bit.ly/GreenStreetsHIA>



# Education & Awareness:

## Green & Complete Streets Policy & Project

- Combined Policy to achieve SD goals
- Integrating NBS into ROW
- Combating climate change
- improving public health & safety
- Long-term cost savings
- Creating socially engaging spaces.
- Partnership – Tufts & Developer, DPW, Fire
- Design alt. for next phase
- Developed guides for different audiences



<https://bit.ly/DECGCPolicy>

<https://devensec.com/sustain.html>



# Regulation Audit Tools:

## *MassAudobon Nature-Based Solutions By-Law Review Toolkit*



<https://bit.ly/AudobonLID>

## *Making Your Community Forest-Friendly: A Worksheet for Review of Municipal Codes and Ordinances* - US Forest Service and Center for Watershed Protection

**Forest-Friendly Code and Ordinance Worksheet**

**1. Planning and Zoning**

Question 1	Yes	No	Codes are Silent	N/A
Is there a natural resources protection zone or an overlay zone that includes important forest resources, such as high-quality forest stands, forested stream buffers, forests on steep slopes, or headwater forests?	<input checked="" type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
<i>Notes: 974 CMR 4.09 Water Resource Protection Districts - need to include management standards for protected open space</i>				

*Forests can be protected using either natural resources protection zones or overlay zoning. Natural resources protection zones map out the areas to be protected and outline permitted and prohibited uses within these zones. To protect specific types of forest resources, such as forested stream buffers or forests on steep slopes, an overlay zone may be more desirable than natural resources protection zoning. With an overlay zone, additional standards.*

<http://bit.ly/Forestfriendly>



# Collaboration is Key to Build Support!

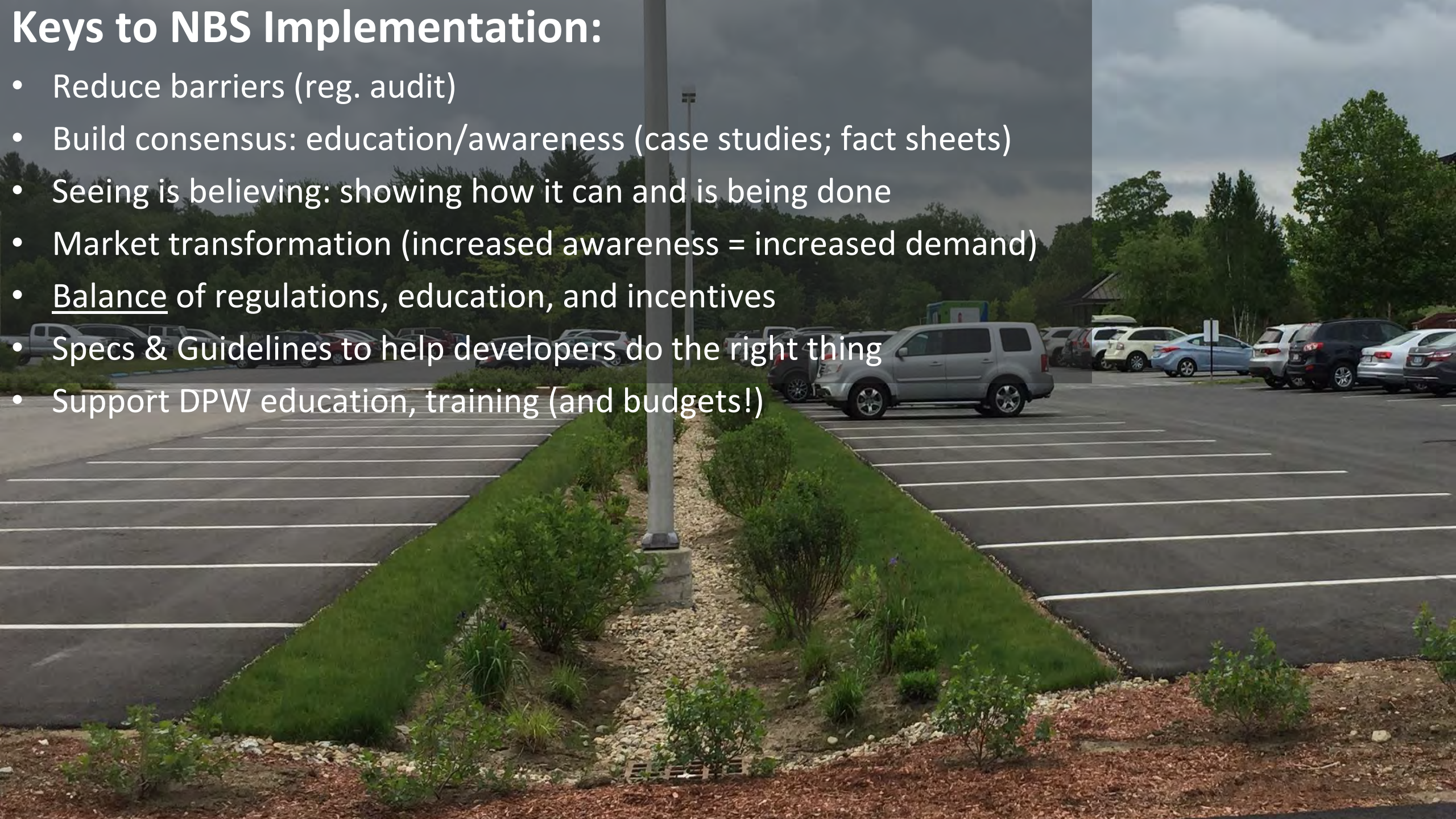
- GI benefits vs Grey infrastructure
  - Maintenance, extended pavement life, decreased flood damage, exponential increase in value vs. grey (depreciates), not out of sight!
- Partnerships with Public Works, Engineering, and Fire Dept.
- Training for Engineering and DPW staff. Creating manuals
- Connecting local Boards and Commissions:
  - ID shared interests: efficient LU, public health, SWM, wetland protection, climate change – PZC, BOH, CC, Eco. Dev.





# Keys to NBS Implementation:

- Reduce barriers (reg. audit)
- Build consensus: education/awareness (case studies; fact sheets)
- Seeing is believing: showing how it can and is being done
- Market transformation (increased awareness = increased demand)
- Balance of regulations, education, and incentives
- Specs & Guidelines to help developers do the right thing
- Support DPW education, training (and budgets!)







Thanks!  
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