The Money Question: Quantifying the Benefits (and Costs)

Huron River Watershed Council

Ric Lawson

Watershed Planner

http://www.jacksonsnursery.com/rain_gardens.htm

Overview

- Documenting Benefits of GI
  - Calculating Cost Savings
  - Quantifying and Calculating Benefits
- Tools and Examples
- Translating to Project Funding

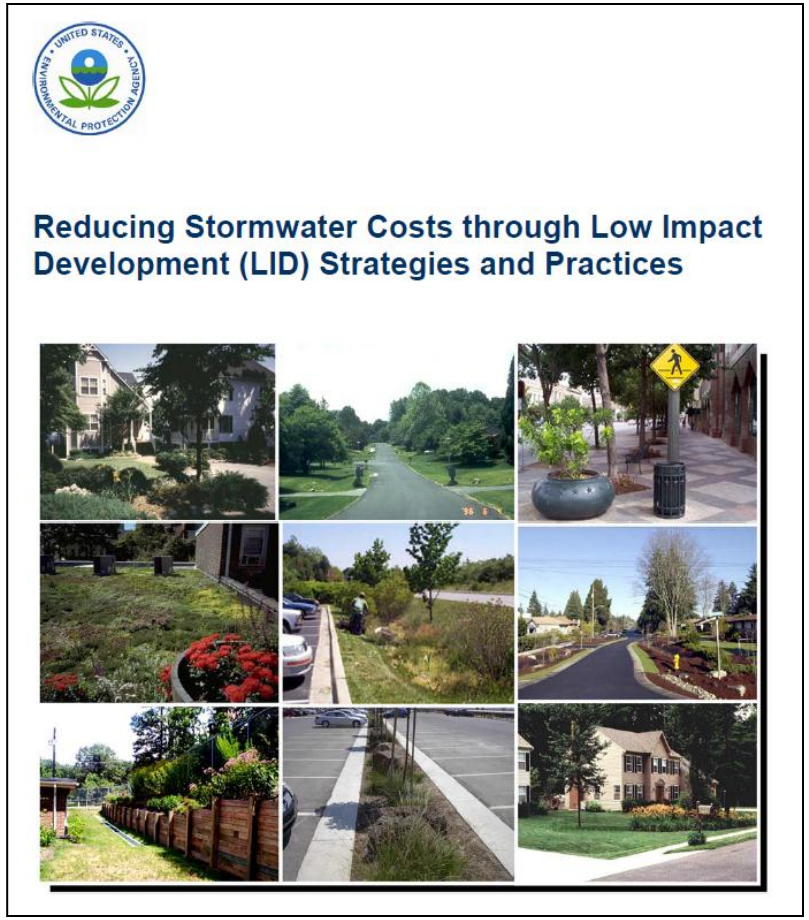
Cost Savings of GI: Is it really cheaper?

Financial Benefits

EPA Case Studies, 2007

"The news is good. In the vast majority of cases, the U.S. EPA has found that implementing well-chosen LID practices saves money for developers, property owners, and communities while protecting and restoring water quality."

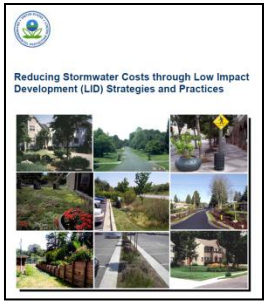
This is GI

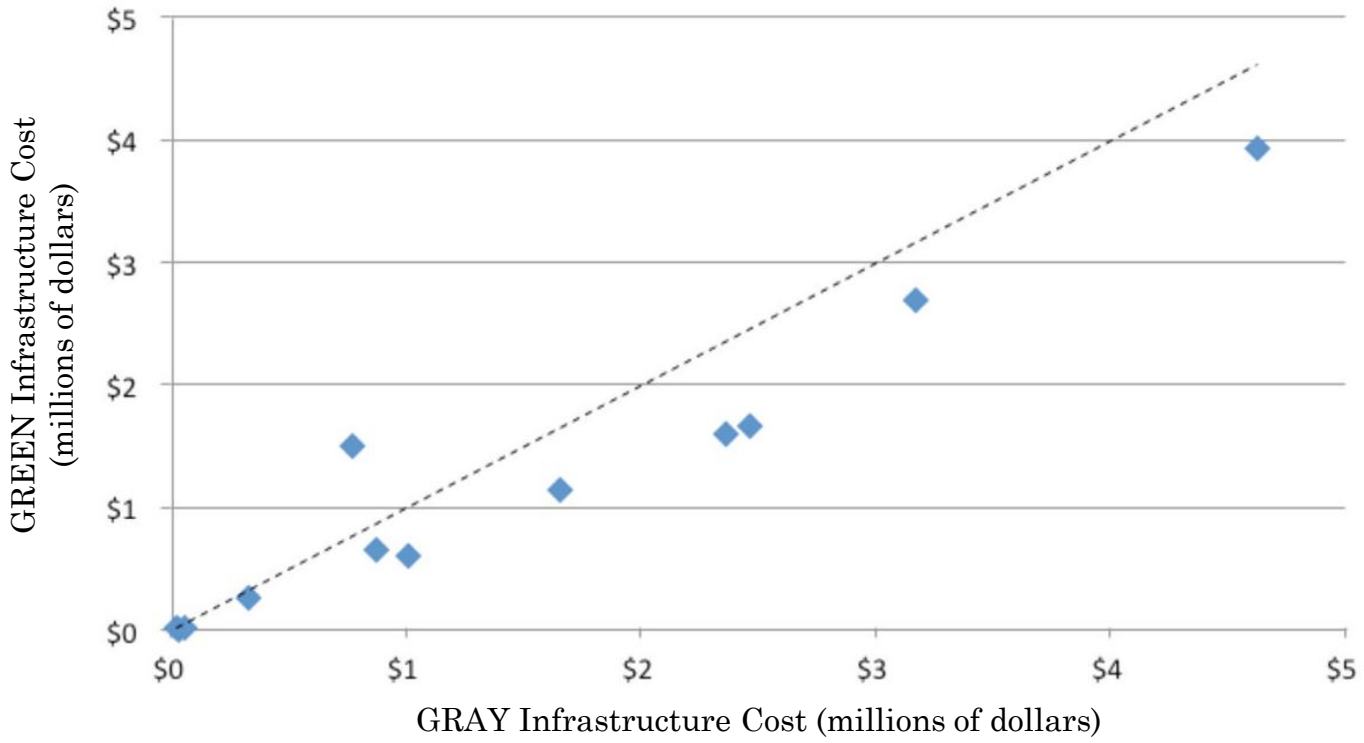


http://www.epa.gov/owow/NPS/lid/costs07/documents/reducingstormwatercosts.pdf

Cost	Benefits
Cost	Benefits

EPA Case Studies, 2007



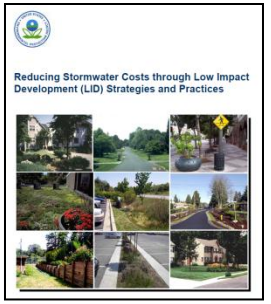


Cost | Benefits

Cost | Benefits

Data from EPA, 2007, but graph from American Rivers, 2012: http://www.americanrivers.org/assets/pdfs/reports-and-publications/banking-on-green-report.pdf

EPA Case Studies, 2007



- Total capital cost savings with LID: 15-80%
- Did not monetize additional benefits of LID
- Example:

Table 15. Cost Comparison for Tellabs Corporate Campus[61]

Item	Conventional Development Cost	Tellabs LID Cost	Cost Savings	Percent Savings	Percent of Total Savings
Site preparation	$2,178,500	$1,966,000	$212,500	10%	46%
Stormwater management	$480,910	$418,000	$62,910	13%	14%
Landscape development	$502,750	$316,650	$186,100	37%	40%
Total	**$3,162,160**	**$2,700,650**	**$461,510**		—

Cost | Benefits

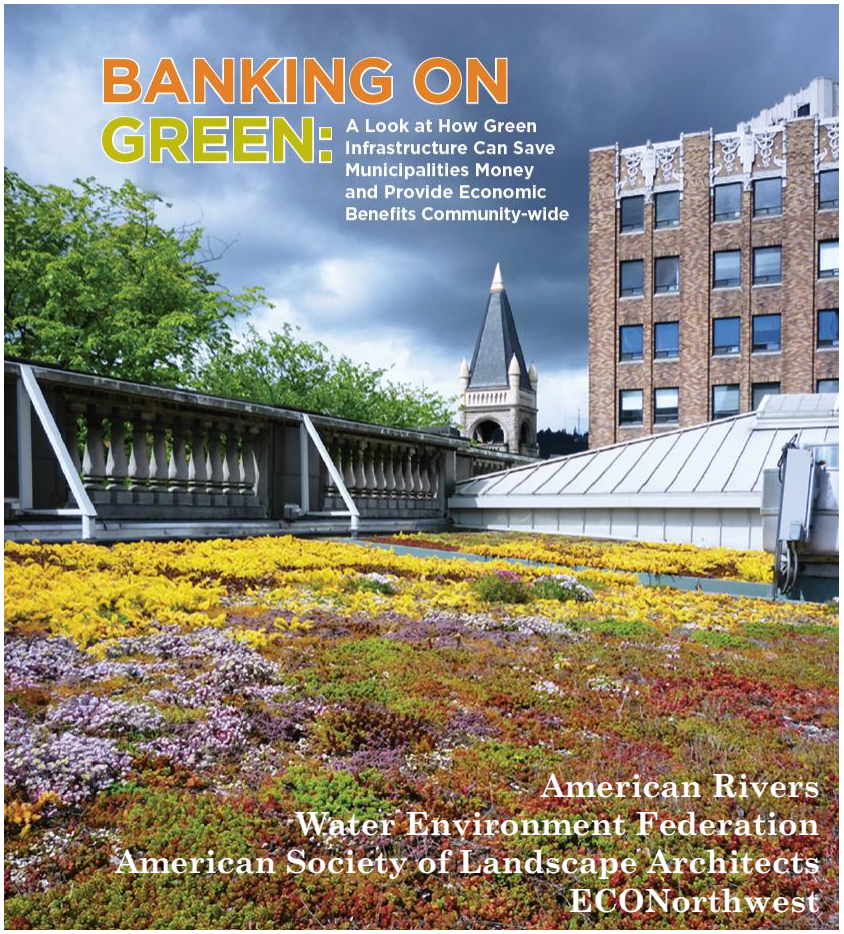
Cost | Benefits

Banking on Green

- Requested by EPA, 2012
- Broad analysis of 479 GI projects to quantify the economic benefits of GI

75% of GI projects cost less than or equal to gray infrastructure solutions.

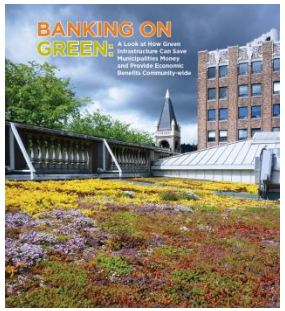
Reduced costs	44%
Did not influence costs	31%
Increased costs	25%



http://www.americanrivers.org/assets/pdfs/reports-and-publications/banking-on-green-report.pdf

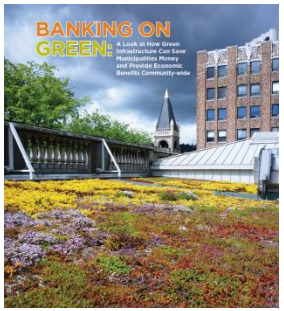
Link to the case studies:
http://www.asla.org/stormwateroverview.aspx

Banking on Green



- Stormwater management realities:
  - EPA 2002: Funding gap for water infrastructure in the U.S. is in the hundreds of billions of $ (link)
  - National Academy of Sciences 2009: gray infrastructure is not working; recommend GI (link)
- Facts to consider:
  - 55% designed to meet local ordinances
  - 68% received local public funding

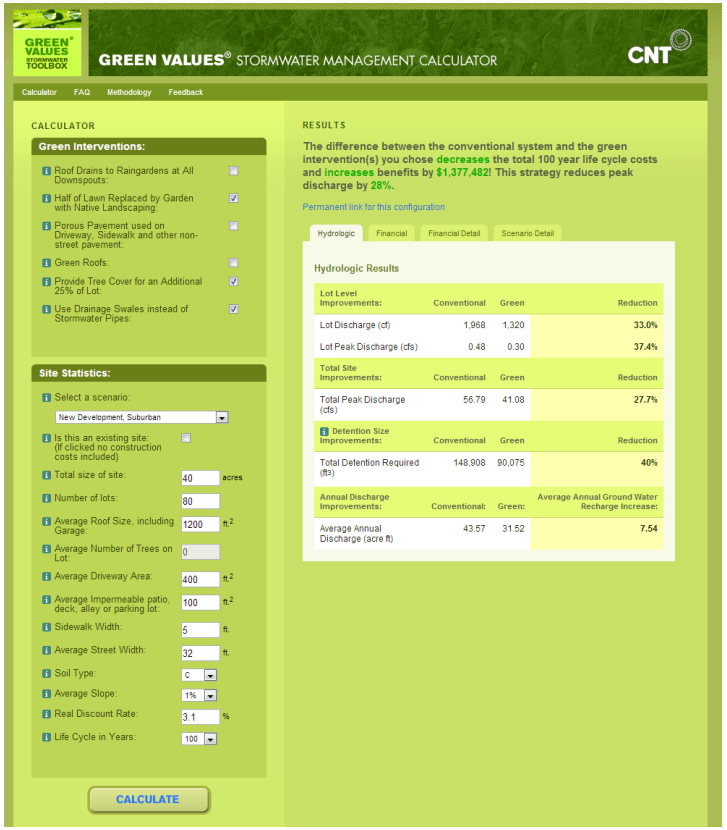
Banking on Green: Conclusions



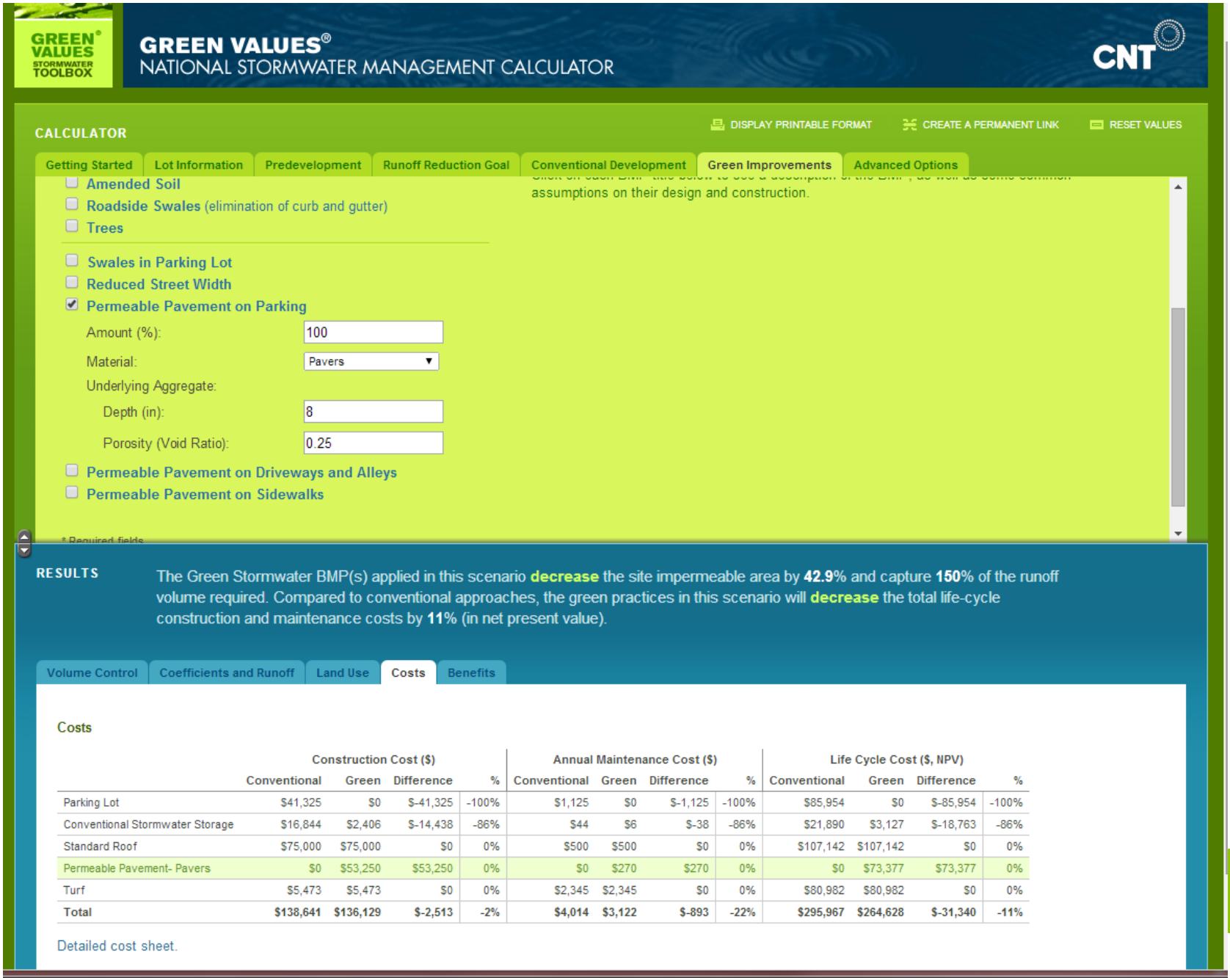
1. GI construction costs can be lower than conventional infrastructure costs
2. GI costs over time may be lower, even though maintenance may be more frequent
   - Performance may increase over time
3. GI benefits can extend beyond stormwater
   - (Still at site-specific scale)
   - Space and landscape requirements
   - Maintenance (snow, ice, erosion, flooding)

Green Values Stormwater Management Calculator

- Center for Neighborhood Technology 2009
- "Developed primarily for use by planners, engineers and other municipal staff."
- Calculates lifecycle cost/benefit of difference scenarios of green v. gray infrastructure
  - Neighborhood or site level



http://greenvalues.cnt.org/


GREEN VALUES STORMWATER TOOLBOX
GREEN VALUES®
NATIONAL STORMWATER MANAGEMENT CALCULATOR
CNT
CALCULATOR
DISPLAY PRINTABLE FORMAT
CREATE A PERMANENT LINK
RESET VALUES
Getting Started
Lot Information
Predevelopment
Runoff Reduction Goal
Conventional Development
Green Improvements
Advanced Options
Amended Soil
Roadside Swales (elimination of curb and gutter)
Trees
Swales in Parking Lot
Reduced Street Width
Permeable Pavement on Parking
Amount (%): 100
Material: Pavers
Underlying Aggregate:
Depth (in): 8
Porosity (Void Ratio): 0.25
Permeable Pavement on Driveways and Alleys
Permeable Pavement on Sidewalks
assumptions on their design and construction.
* Required fields
RESULTS
The Green Stormwater BMP(s) applied in this scenario decrease the site impermeable area by 42.9% and capture 150% of the runoff volume required. Compared to conventional approaches, the green practices in this scenario will decrease the total life-cycle construction and maintenance costs by 11% (in net present value).
Volume Control
Coefficients and Runoff
Land Use
Costs
Benefits
Costs
Construction Cost ($)
Annual Maintenance Cost ($)
Life Cycle Cost ($, NPV)
Conventional Green Difference % Conventional Green Difference % Conventional Green Difference %
Parking Lot $41,325 $0 $-41,325 -100% $1,125 $0 $-1,125 -100% $85,954 $0 $-85,954 -100%
Conventional Stormwater Storage $16,844 $2,406 $-14,438 -86% $44 $6 $-38 -86% $21,890 $3,127 $-18,763 -86%
Standard Roof $75,000 $75,000 $0 0% $500 $500 $0 0% $107,142 $107,142 $0 0%
Permeable Pavement- Pavers $0 $53,250 $53,250 0% $0 $270 $270 0% $0 $73,377 $73,377 0%
Turf $5,473 $5,473 $0 0% $2,345 $2,345 $0 0% $80,982 $80,982 $0 0%
Total $138,641 $136,129 $-2,513 -2% $4,014 $3,122 $-893 -22% $295,967 $264,628 $-31,340 -11%
Detailed cost sheet.

Benefits of GI: What Can We Count?

Quantifying Benefits

EPA ON LID, 2007

"While this study focuses on the cost reductions and cost savings that are achievable through the use of LID practices, it is also the case that communities can experience many amenities and associated economic benefits that go beyond cost savings . . .

These economic benefits are real and significant."

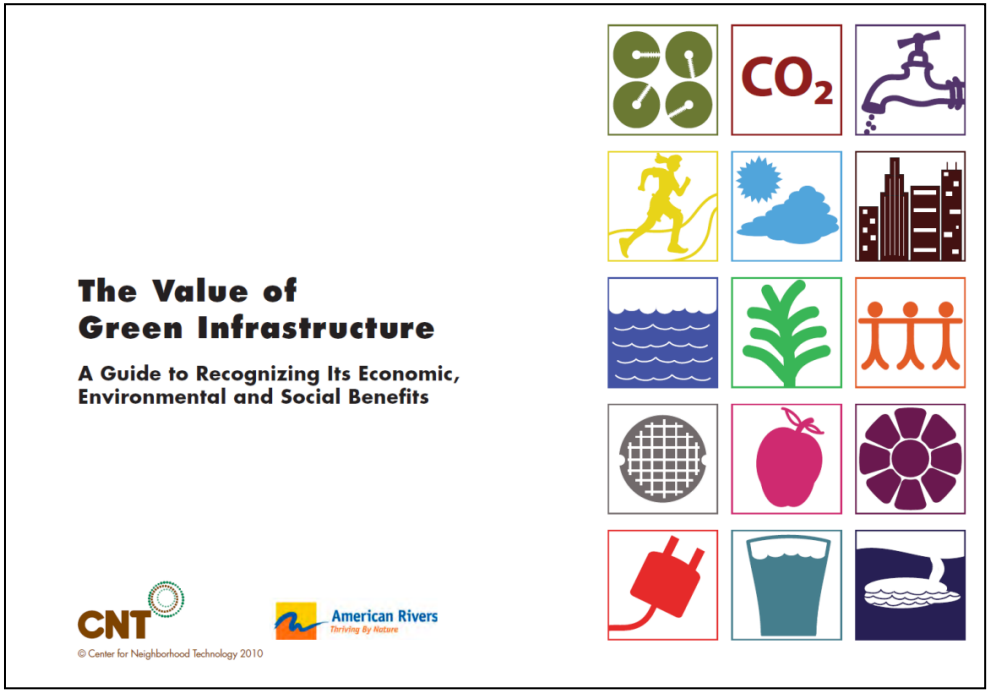
http://www.epa.gov/owow/NPS/lid/costs07/documents/reducingstormwatercosts.pdf

Cost | **Benefits**

Cost | **Benefits** | **Additional economic benefits**

GI Valuation Tool

- Center for Neighborhood Technology 2010
- Beyond construction cost savings (EPA 2007)
- Steps for calculating additional GI benefits

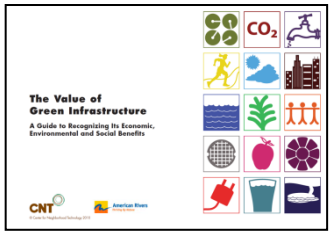


http://www.cnt.org/publications?keyword=The+Value+of+Green+Infrastructure&issue=&submit=Go&submitted=1

Cost | Benefits

Cost | Benefits | Additional economic benefits

GI Valuation Tool



Benefit	Reduces Stormwater Runoff				Increases Available Water Supply	Increases Groundwater Recharge	Reduces Salt Use	Reduces Energy Use	Improves Air Quality	Reduces Atmospheric CO_2	Reduces Urban Heat Island	Improves Community Livability					Improves Habitat	Cultivates Public Education Opportunities
	Reduces Water Treatment Needs	Improves Water Quality	Reduces Grey Infrastructure Needs	Reduces Flooding								Improves Aesthetics	Increases Recreational Opportunity	Reduces Noise Pollution	Improves Community Cohesion	Urban Agriculture		
Practice																		
Green Roofs	●	●	●	●	○	○	○	●	●	●	●	●	◒	●	◒	◒	●	●
Tree Planting	●	●	●	●	○	◒	○	●	●	●	●	●	●	●	●	◒	●	●
Bioretention & Infiltration	●	●	●	●	◒	◒	○	○	●	●	●	●	●	◒	◒	○	●	●
Permeable Pavement	●	●	●	●	○	◒	●	◒	●	●	●	○	○	●	○	○	○	●
Water Harvesting	●	●	●	●	●	◒	○	◒	◒	◒	○	○	○	○	○	○	○	●

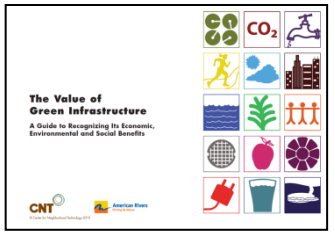
● Yes ◒ Maybe ○ No

No "valuation" of these benefit

Step 1: Quantification of benefits

Step 2: Valuation of benefits

GI Valuation Tool Process



- Step 1: Quantification of Benefits

[annual precipitation (inches) * GI area (SF) * % retained] * 144 sq inches/SF * 0.00433 gal/cubic inch = total runoff reduction (gal)

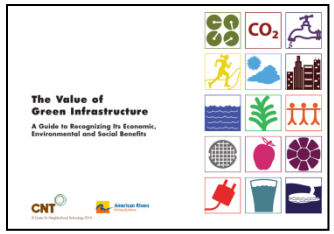
- Step 2: Valuation of Benefits

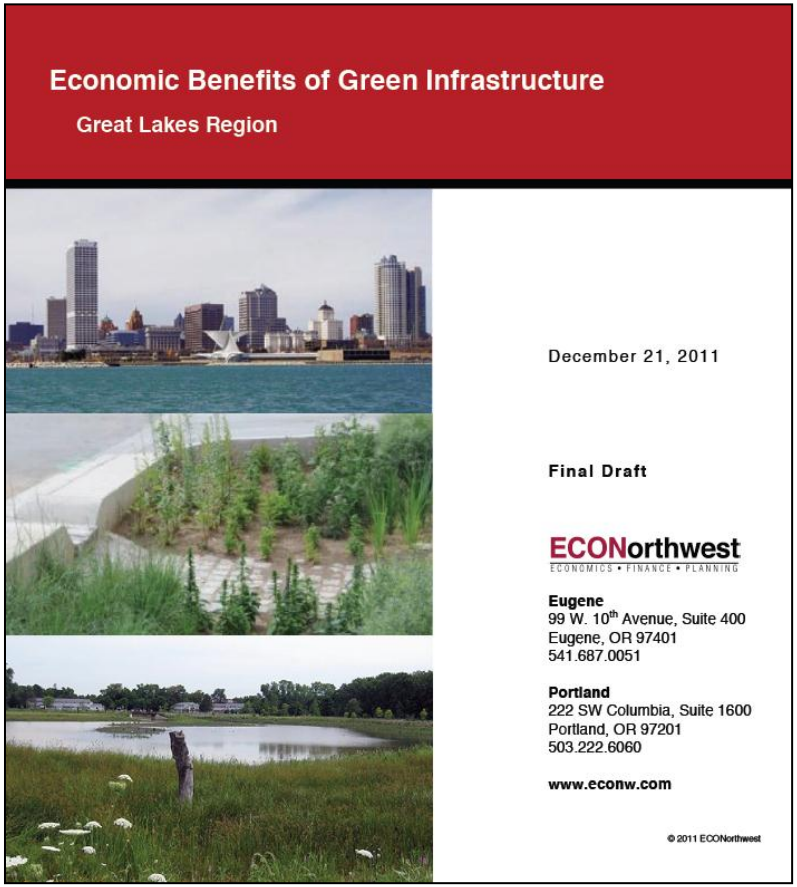
kWh reduced * $0.0959/kWh = value of cooling or electricity savings

Btu reduced * $0.0000123/Btu = value of heating natural gas savings

Regional Examples

- American Rivers
- Ann Arbor
- Milwaukee



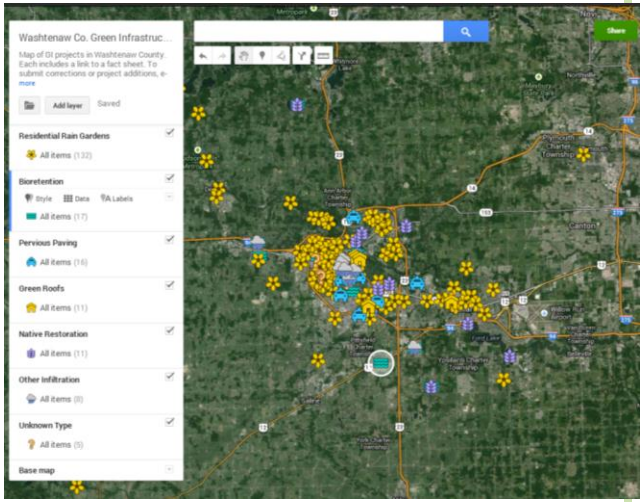


- Quantifies benefits where possible

http://www.americanrivers.org/newsroom/resources/going-green-to-save-green.html

Ann Arbor GI Benefits Summary

- NPV* of "quantifiable services" provided by existing GI in AA ~ $100 million
  - (NPV = total benefits – total cost over 50 yrs.)
- Based on:
  - Mary Beth Doyle wetland
  - 2 green streets
  - 50 rain gardens
- Overlooked city's other GI projects
- Other benefits identified, but not quantified



hrwc.org/green-infrastructure

Local GI Benefits Summary

- Scale matters!

"The majority of quantifiable benefits accrue to the community as a whole or are even more widespread. .

"Community wide benefits require community-wide coordination. . .

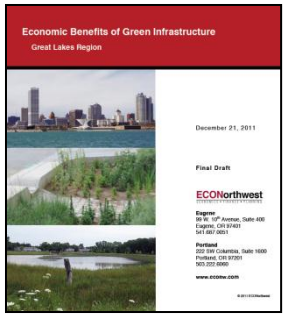
"By themselves . . . onsite benefits likely are not sufficient in motivating home and business owners to provide GI to the level that makes economic sense."

Local GI Benefits:

Water-Related Benefits

- Reduction: 1.5 billion gallons of stormwater/ yr.
  - 97% from Mary Beth Doyle Park wetland
- Avoided cost associated with stormwater runoff and water quality
  - Reduced volume, sedimentation, building future gray infrastructure, O&M
  - Save $2-7 million / yr. (NPV: $53-184 million)

Local GI Benefits:



Water-Related Benefits

- Reduced flooding
  - AA data unavailable; used Chicago case study*
  - Improved water quality and flood risk →
    - Increase in property value 0-5%
  - Avoid flood damage →
    - Increase property value 5%+ for properties in floodplain
  - Extrapolation, but gives an idea of the magnitude of benefit

*Johnston, "The Downstream Economic Benefits from storm Water Management: a Comparison of Conservation and Conventional Development" (2004). 2004. Paper 23. http://opensiuc.lib.siu.edu/ucowrconfs_2004/23

Local GI Benefits:

Energy-Related Benefits

- Decreased energy consumption → decreased cost

- Green roofs and trees
  - Internal climate regulation, shade, windbreaks
- Used multiple variables
- Benefits are very local
- Insufficient AA data from the four projects

Local GI Benefits:

Air Quality-Related Benefits

- Decreased emissions from energy production; Removing pollutants already in the air
  - Decreased air quality compliance costs (NO_2, SO_2)
  - Decreased health-related costs (respiratory illness)

- Benefits are community/region-wide
- Insufficient data for AA →
  - Reduced emissions from avoided stormwater treatment*: $18,000 / yr. (NPV: $500k)

*Incorrectly assumed combined sewers; however, nutrient, biota and bacteria TMDLs require stormwater treatment.

Local GI Benefits:

Climate Change-Related Benefits

- Reduced energy demand and CO_2 production
- Increased carbon sequestration

- Estimated from green roofs and trees
- Insufficient data for AA→
  - Reduced emissions from avoided stormwater treatment*: $10-54k / yr. (NPV: $0.3-2.4 million)

HRWC estimates water and wastewater treatment in the watershed generates annual carbon emissions equivalent to 252,000 cars!

Local GI Benefits:

Heat Island Effect

- Temp in comparison to surrounding rural landscape
  - Especially evening temps
- Reduced heat-attracting infrastructure
- Increased shade and water vapor (transpiration)

- Insufficient data for AA
- But reduced local temps throughout communities in downtown streets

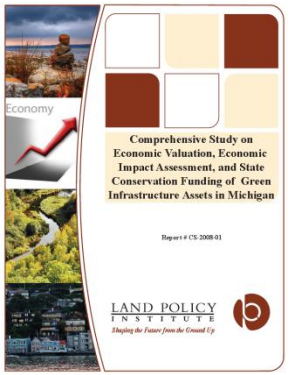
annarbor.com

Local GI Benefits:

Community Livability

- Increasing home values (aesthetics)
- Increasing health/well-being (recreation)
- Decreased noise pollution

- Very local benefits
- Insufficient data for AA
- But documented and quantified in the literature
  - Example: MSU Land Policy Institute 2008 study (Hillsdale and Oakland counties)



http://www.landpolicy.msu.edu/modules.php?name=Documents&op=viewlive&sp_id=587

Local GI Benefits:

Habitat-Related Benefits

- Wetland services: amenity, fishing, birding, etc.
- Small-scale habitat

- Insufficient data for AA
- Average wetland service value: $2-12k / acre / yr.
  - Mary Beth Doyle Park: $48,000 / year (NPV: $1.3m)
- Habitat: when designed for local wildlife, can increase birds, butterflies, insects, rare species

Local GI Benefits:

Public Education Benefits

- Education about natural processes
- Education about personal impacts on environment
- Example of cooperative planning

http://hpigreen.com/tag/interpretive-graphics/

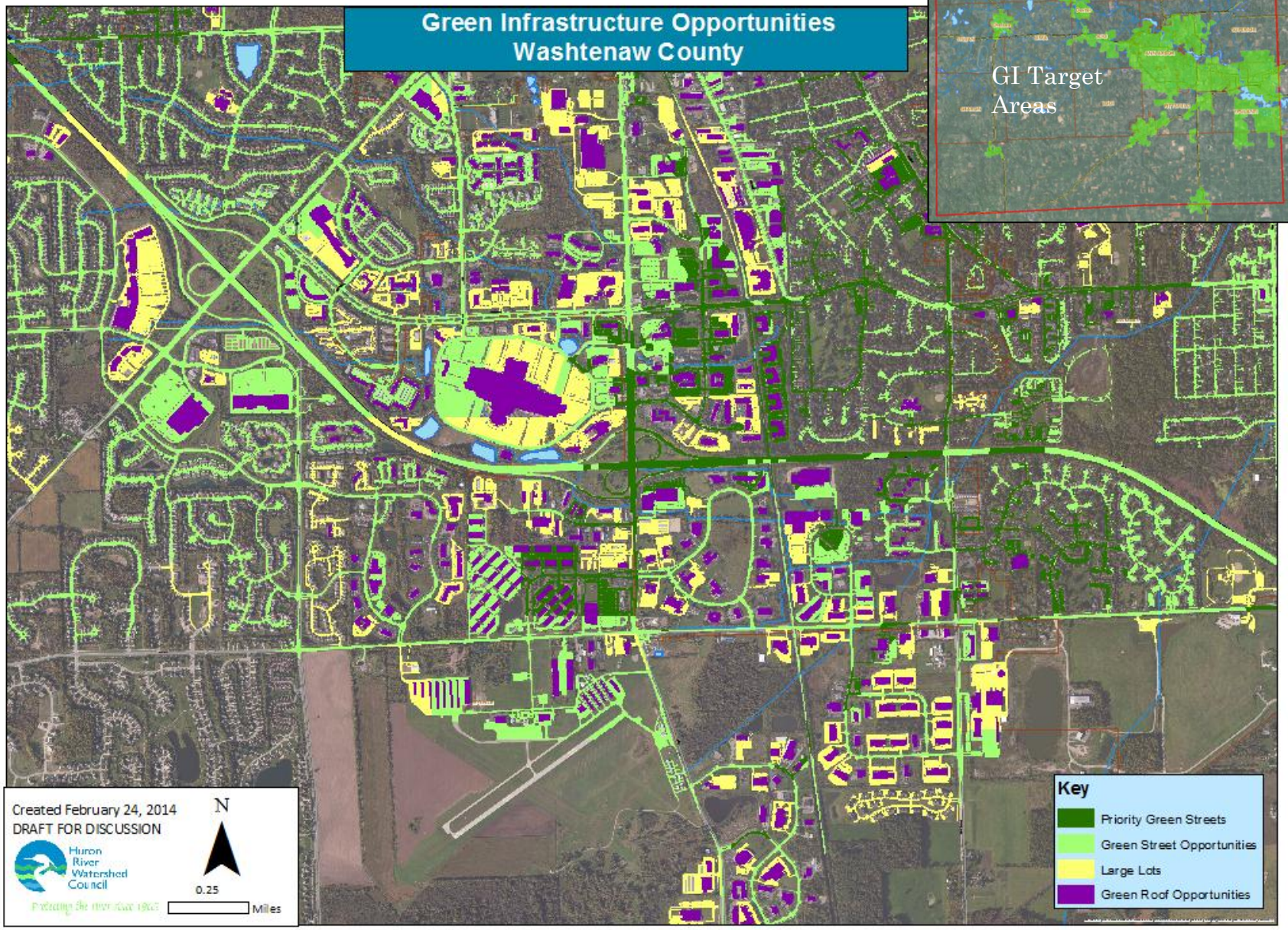
- Not quantified in this report

Local GI Benefits:

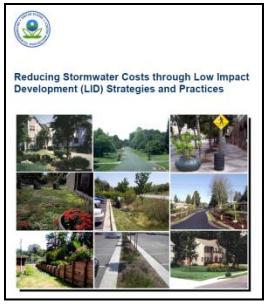
Summary

- Greatest benefit: avoided costs from reduced stormwater runoff
- However, other more local benefits can build support for GI (community livability, education)
- Few GI pieces evaluated in AA – new process
- Benefits might outweigh costs at local scale
- Benefits definitely outweigh costs at community or regional scale

GI Opportunities Maps



Other benefits (EPA, 2007)



- Lot yield
  - No set-asides for large ponds → more units
- Water quality improvements / reduced treatment costs
- Reduced maintenance costs
  - LID: 3-6% of construction cost annually
  - Gray: 5-7% of construction cost annually

Benefits Summary

- Water (avoid cost of runoff and flooding)
- Energy (reduced energy use)
- Air quality (reduced NO_2/SO_2 emissions, remove pollutants)
- Climate change (reduced CO_2 emissions, sequestration)
- Heat Island (reduced infrastructure, increased shade)
- Community livability (home values—aesthetics, health)
- Habitat (wetland services, wildlife)
- Public Education (natural processes, personal impact)
- Lot yield (no ponds, more space for more units)
- Reduced treatment costs (cleaner water to treat)
- Reduced maintenance costs

Using the Valuation: How to get funding?

Typical Funding Sources for GI

- Federal: State Revolving Fund, §319
- Michigan: Strategic Water Quality Incentives, SAW, TAP
- Local: Stormwater utility, drainage districts, SAD, others

- Common denominator: sell the project!

Using Benefits Valuations

- State and Federal Funders:
  - Use benefits and valuations to justify need
  - Increase the project value over grant cost to funder
  - Neighborhood or regional set better than site GI
  - "Spin" values (e.g. energy, carbon reduction) for non-typical grants
- Local Support:
  - Develop benefits case to sell utility, drainage district or other mechanisms
  - Argue for life-cycle costing; diverse funding pots
  - Target neighborhoods or areas with failing infrastructure – try as pilot

Questions?

Ric Lawson

734-769-5123 ext. 609

rlawson@hrwc.org

hrwc.org/green-infrastructure

Huron River Watershed Council