

EPA STAR Progress Review Meeting: “Incentivizing Green Infrastructure in Philadelphia”

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Agenda

- 1 Research approach
- 2 Projects and findings
- 3 Related NSF research on smart infrastructure (with Villanova)
- 4 Questions (10-15 minutes)

Call for proposal (September 2012)

Title: “Performance and Effectiveness of Green Infrastructure Stormwater Mgmt. Approaches in the Urban Context: A Philadelphia Case Study ”

Question:

“How can GI controls for stormwater be designed, built, and maintained through alternative finance mechanisms, especially in underserved and economically disadvantaged areas? Identify the critical regulatory, credit or incentive, and financial structures which must be in place in order to support alternative financing for GI.”

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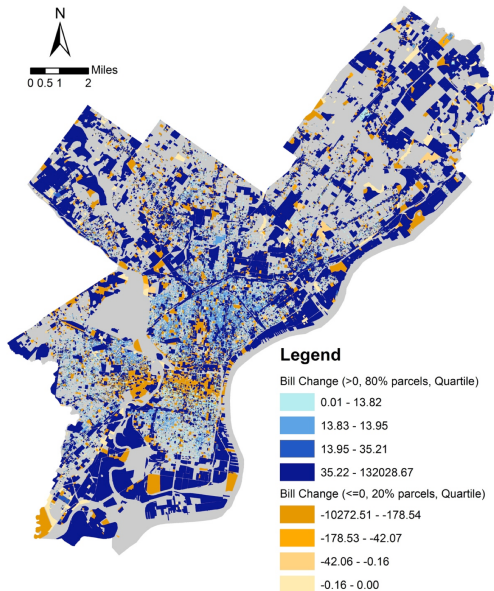
Question:

“How can GI controls for stormwater be designed, built, and maintained through alternative finance mechanisms, especially in underserved and economically disadvantaged areas? Identify the critical regulatory, credit or incentive, and financial structures which must be in place in order to support alternative financing for GI.”

Assumptions:

- ① “alternative finance mechanisms” → to what? why?
- ② “underserved and economically disadvantaged” → equity, justice
- ③ regulatory, credit, incentive, or financial struct. → markets, policies

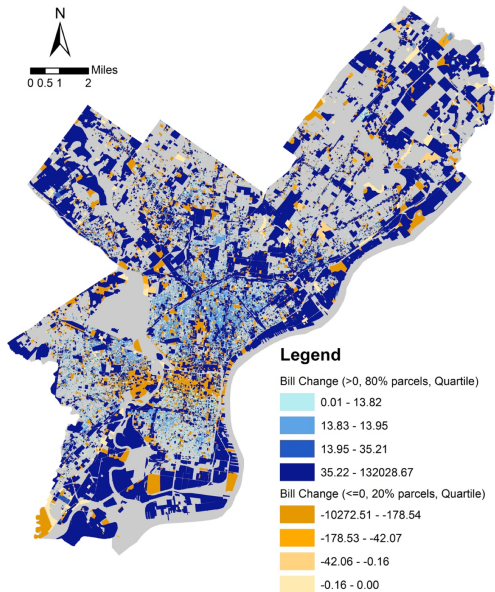
Existing financing mechanisms



Goal for the city's LTCP is to get 10,000 acres

- redevelopment ordinance (0.5% per year)

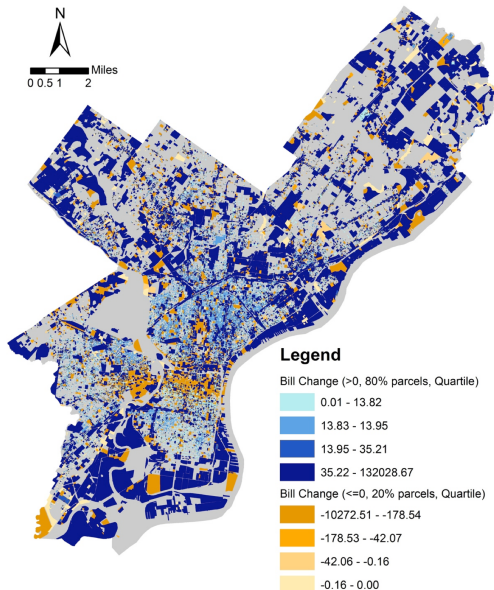
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- user fees, pricing of externality of stormwater pollution

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- redevelopment ordinance (0.5% per year)
- retrofit: area-based stormwater fees implemented in 2009
- user fees, pricing of externality of stormwater pollution
- design assistance
- credits, incentives, subsidies
- applied only to commercial and multifamily properties

Related teams & questions

Dr. Laura Toran, Temple University and other partners, 11 am:

“Using demonstrations, how can Green Infrastructure practices in highly urbanized communities be systematically evaluated in terms of the early benefits, long-term performance effectiveness, and economic viability?”

Dr. Arthur McGarity, Swarthmore College and other partners, 3:10 pm:

“What are the benefits of urban GI to neighborhoods and communities and how can they best be evaluated, both quantitatively and qualitatively, addressing ancillary value, ecosystem services, monetization, neighborhood livability, etc?”

Proposal (January 2013)

Objectives:

The overall environmental goals of the [City of Philadelphia's] Long Term Control Plan will require many citizens and owners to invest in green infrastructure (GI). This project will develop a comprehensive understanding of their motivation to invest in GI by analyzing existing policies in Philadelphia and other cities, and identifying obstacles to investment in GI. This project will also develop new tools, policies, and processes that could enable actors at all levels, including citizens, neighborhoods, institutions, and PWD, to overcome these obstacles to investment, in order to achieve the [plan's] ambitious goals."

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Themes:

- 1 existing barriers to market function
- 2 collective action requires alignment of policies, info., motivations
- 3 building tools and/or making recommendations

Research team

MIT/UPenn academic team: urban planning, real estate economists, engineers, web developers

- PI: David Hsu (MIT & UPenn)
- Co-PIs: Tom Daniels, John Landis, Susan Wachter (UPenn)

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- Students: Ricardo Martinez Campos, Alexis Alana Harrison, Sera Tolgay, Elise Harrington, Theodore Chao Lim, Emily Hosek, Brynn Leopold, Yexin Deng, David Karp

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Consultants:

- Azavea: web developer for existing city websites and databases
- AKRF: engineers working closely with PWD
- Pennsylvania Environmental Council (PEC): contact with owners and stormwater community

Research context

Two main city programs to promote green infrastructure:

- outreach / information
- economic incentives

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- residential owners, stakeholders, municipal officials
- large properties & portion of watersheds
- assumed to be economically and professionally managed

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We deliberately chose research topics useful to city policymakers:

- 2011 City Council hearings, opposition to stormwater fee
- understanding how to implement retrofits
- private property owners is major concern among utilities
- quant./qual. approaches; Philadelphia and national context

Research questions

Empirical questions (cumulative):

- 1 how have property owners acted in response to existing policies?

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- ② why? what barriers or constraints exist?
- ③ what are the costs for property owners?
- ④ how are other cities pursuing GI?
- ⑤ how do we deliver this information effectively?

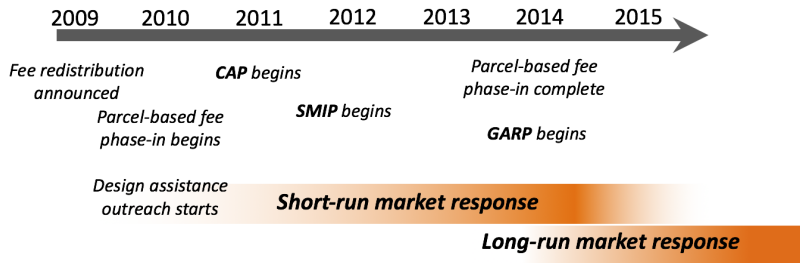
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- 2 why? what barriers or constraints exist?
- 3 what are the costs for property owners?
- 4 how are other cities pursuing GI?
- 5 how do we deliver this information effectively?

	Quantitative	Qualitative
Philadelphia	Which property owners respond to stormwater fees?	How aware are property owners of existing fees and policies?
U.S.	What kind of "smart" GI do they want?	Why do cities pursue GI for stormwater management?

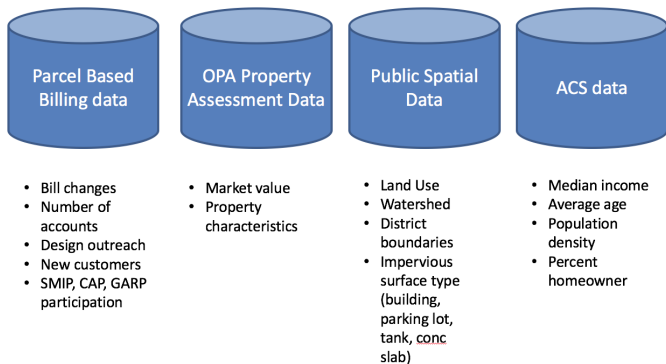
Q1: which property owners have responded to fees?



Challenging setting for quantitative analysis:

- bottom line: very low take-up of PWD programs in this 5-year period
- less than 130 or so projects with private property owners

Q1: which property owners have responded to fees?



Regression models applied to past and prospective applicants:

- based on small number of responses among many properties
- we can't assume everyone knew about the policies
- results: policies do drive takeup (+)
- effects on particular land use, types indicate targeting opportunities

Q2: why? what barriers or constraints exist?

Lack of knowledge about awareness and motivations of property owners:

- barriers to non-residential owners to invest in GI
- fielded large mail and e-mail survey about barriers, motivations
- theory of planned behavior (motivation, intention, action)

Q2: why? what barriers or constraints exist?

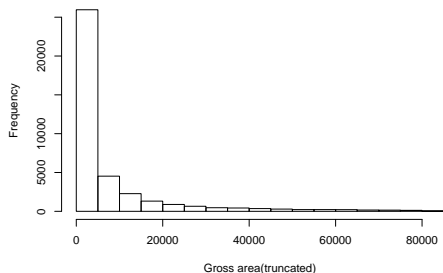
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Results:

- environmental attitudes play little or no role in willingness to retrofit
- identify key barrier as lack of knowledge of costs and benefits
- pervasive dissatisfaction with execution of fee and incentive programs

Q3: what are the costs for property owners?

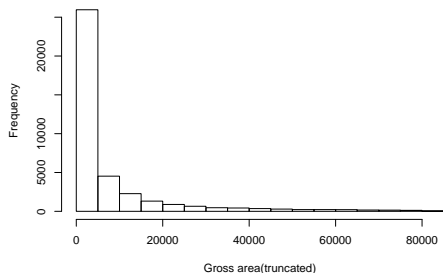


Estimation:

- $\approx 49,000$ comm. parcels
- random sample stratified by size and type
- AKRF (consultant) calculate GI costs for 250 comm. properties
- statistically infer costs for other similar parcels

Land use type\Impervious area (sf)	1000	1000-2000	2000-5500	5500+	Subtotal
Commercial	31	45	18	17	112
Residential	24	11	12	10	57
Industrial	3	4	7	17	31
Transportation	8	4	4	3	19
Civic/Institution	1	3	4	9	17
Parking/Mixed Parking	3	1	1	2	7
Culture/ Recreation	1	0	1	2	4
Park/Open Space	1	0	0	1	2
Education	0	0	0	1	1
Water	0	0	0	0	0
Subtotal	73	68	47	62	250

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<u>Water</u>	<u>0</u>	<u>0</u>	<u>0</u>	<u>0</u>	<u>0</u>
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Predictions:

- cost to reach 10,000 GA
- future GI coverage under various scenarios
- how to target

Q4: why do cities pursue GI at all?

Broad question:

- are they responding to EPA GI initiatives, regulation, or both
- if different reasons, then how to measure success? obstacles? barriers?
- grounded theory: interviews with 35 cities, 7 EPA staff, 60+ hours

Q4: why do cities pursue GI at all?

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Federal level: regulatory flexibility in permits and goals set by regions

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Cities see it as a kind of adaptive management:

- gray approach:
 - ▶ centralized, expert- and agency-driven
 - ▶ expensive (or at least big initial price tags)
- GI as adaptive management:
 - ▶ learning by doing; experimentation; change strategies if needed
 - ▶ ability to develop partnerships with other groups (NGO, private)
 - ▶ sharing, copying between cities

Q5: how do we deliver this information effectively?

Original intent:

- city has the most property information
- developers, market does not work in the absence of information
- how can we facilitate information transfer to property owners?

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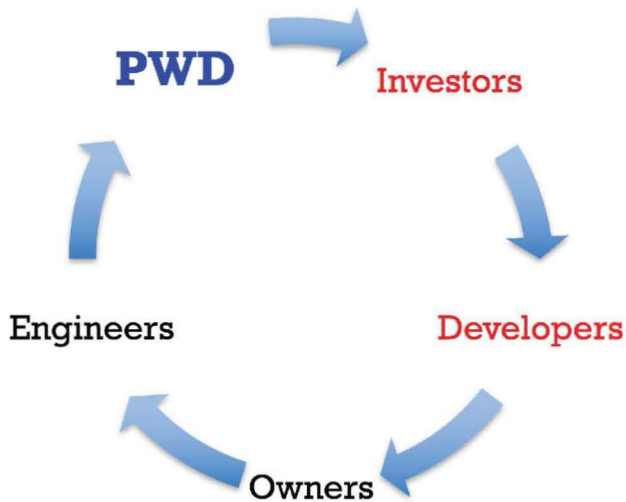
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Want to build web-based tool to daylight the city's information:

- Azavea (main consultant) is building prototypes and mock-ups
- PEC (consultant) to assemble testers
- we will run user testing process with observation and focus groups
- now working closely with PWD

Market participants



Web-Based Tools for Information

WHAT'S YOUR EXPERIAN CREDIT SCORE?

FIND OUT NOW FOR **FREE** WHEN YOU CHECK YOUR CREDIT REPORT FOR **\$1**

- ✓ Checking your own credit report will NOT lower your score
- ✓ A REAL credit report, with more information, like the one banks see
- ✓ Personalized help from a live agent plus fraud resolution support
- ✓ Identity Theft Protection with a \$50,000 product guarantee

Get Your Credit Report and Score ➔

match.com Member Sign In Take The Test

#1 in dates, relationships and marriages

I am: **Woman** Seeking: **Man**

Between ages: **25** and **35**

Near ZIP/Postal code:

View Photos ➔

craigslist philadelphia

community housing jobs

[landscaping](#)
[auto](#)
[apartments](#)
[business](#)
[cars](#)
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[general](#)
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[jobs](#)
[legal](#)
[local business](#)
[local services](#)
[lost and found](#)
[miscellaneous](#)
[pets](#)
[real estate](#)
[recreation](#)
[services](#)
[transportation](#)

Bankrate Home Rates Calculators Tools

WELCOME TO BANKRATE

1. What are you looking for?

2. Select a product

3. Compare rates

APR	MINIMUM	MAX	COMPARE
10 year fixed rate	4.28%	4.28%	4.28%
15 year fixed rate	3.22%	3.15%	3.15%
30 year fixed rate	3.27%	3.22%	3.22%

Markets & multi-sided platforms

Markets require:

- information about prices and quality
- buyers
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Multi-sided platforms:

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Multi-sided platforms:

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- platforms that match multiple groups (buyers and sellers)
- interactions can happen under very different conditions:
 - ▶ village markets
 - ▶ eBay, AirBnB, Craigslist
 - ▶ Match.com
 - ▶ Uber, Amazon
 - ▶ Facebook, Google

Market participants: owners see stormwater billing

PHL Stormwater Billing

1443 Fairmount Ave

GO

Map tools

Search: 1443 Fairmount Ave

Map Info

Address	1443 FAIRMOUNT AVE
County	PHILADELPHIA COUNTY
Property Type	Non Residential
Year Built	1900
Lot Area	14,000 sq ft
Impervious	12,000 sq ft

Associated with 332000000000

Address	1443 FAIRMOUNT AVE
County	PHILADELPHIA COUNTY
Year Built	1900
Lot Area	14,000 sq ft
Impervious	12,000 sq ft

Legend

- Water
- Impervious Surface
- Soil
- Other
- Green
- Water

1443 FAIRMOUNT AVE

FAIRMOUNT AVE

STOLLING

FAIRMOUNT A

Market participants: message to owners

Every year 3 MILLION GALLONS of stormwater runoff from impermeable industrial properties overwhelms the Philly sewer system. Help us put an end to it.

PHILADELPHIA
WATER
EST. 1801

Slash your water bill

Let Philadelphia Water fund a **stormwater retrofit** of
your **commercial or industrial property**
and get 20 years of monthly stormwater credits.

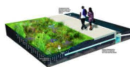
ESTIMATE YOUR SAVINGS

Find my property

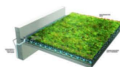
Market participants: connecting owners and developers

Your property. Your retrofit.

Team up with a PWD-approved developer to plan and construct your retrofit using green stormwater infrastructure customized to your property and preferences.



Rain Garden



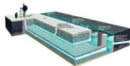
Green Roof



Stormwater Basin



Permeable Pavement



Subsurface Storage



Cistern

Want to learn more?

Tell us what you'd like to see in a retrofit and we'll connect you to local developers who can help you take the next steps.

Confirm this is your property



Spring Garden East LP
990 Spring Garden St, Philadelphia, PA 19123

[Change to a different property](#)

43,620 sqft

Gross area

43,169 sqft

Impervious area

\$467/month

Stormwater charge

Market participants: helping owners find developers

Consider these developers

These stormwater retrofit developers do projects that cover your property's location and characteristics and your stated preferences. Reach out to them directly. Or select the ones you like then fill out the form below to have them contact you.

Green Gene's Extreme Team
[Website](#) (215) 555-1212

Subsurface Storage R Us
[Website](#) (215) 555-1212

Waterbenders Inc
[Website](#) (215) 555-1212

Saving Sewers
[Website](#) (215) 555-1212

Retrofit preferences

Which stormwater infrastructure components are you considering?

- | | |
|--|--|
| <input checked="" type="checkbox"/> Rain Garden | <input checked="" type="checkbox"/> Green Roof |
| <input checked="" type="checkbox"/> Stormwater Basin | <input type="checkbox"/> Permeable Pavement |
| <input type="checkbox"/> Subsurface Storage | <input type="checkbox"/> Cistern |

I have no idea right now

Market participants: helping developers find owners

PHILADELPHIA WATER Stormwater retrofit property discovery

Impervious Area Min - Max **Gross Area** Min - Max **Cost to Develop per acre** Min - Max

Property Type
 Non-residential
 Condominium

Misc
 OK to contact
 Starred

Property 1: 1.1 acres, \$135K/acre, 990 Spring Garden St, Philadelphia, 19123

Property 2: 1.1 acres, \$128K/acre, 1100 W Girard Ave, Philadelphia, 19123

Property 3: 4.6 acres, \$120K/acre, 1501 Diamond St, Philadelphia, 19121

Property 4: 1.9 acres, \$120K/acre, 1300 Fairmount Ave, Philadelphia, 19123

Map streets: 9TH ST, 8TH ST, PERTH ST, FRA, 7TH ST, MARSHA, 6TH ST, THOMPSON ST, MASTER ST, RANDOLPH ST, 5TH ST, ORKNEY ST, DARIEN ST, 8TH ST, 7TH ST, MARSHALL ST, 6TH ST, DOLPH ST, 5TH ST, LAWRENCE ST, LEITHGOW ST, 4TH ST, GIRARD AVE.

Q: What do cities think about green and/or smart systems?

Interviews for larger survey (next paper):

- conducted in Pennsylvania (aging infrastructure, the most CSOs, fees)
- officials are the ones designing, planning, funding, building

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- concerned about more labor-intensive maintenance for GI
- surprisingly positive views about smart infrastructure
- want more information on performance and costs to reduce runoff

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Citation:

- Meng, Hsu, Wadzuk, (2016). "Green or smart? Perspectives of city and water officials in Pennsylvania towards adopting new infrastructure technologies for stormwater management," *ASCE Journal of Sustainable Water in the Built Environment*

Q: what is the willingness to pay for smart services?

“Smart” stormwater services are still being developed:

- what do officials know about these systems?
- what functions are useful? how much do they cost?

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Fielded choice modeling survey:

- posed choices of bundles of services at different costs
- higher construction costs versus reduced labor, maintenance, volume
- WKU database for stormwater fees: fielded 400 surveys, got 100 back
- estimate willing to pay 10-12% more for some smart services
- equivalent to 4% IRR

Professor Tom Daniels: planning & green infrastructure

Q: what do we know about what utilities are generally doing in stormwater management?

- based on EPA MS4 data on 700 utilities
- planning to build web-interactive mapping

Q: how can urban planners affect stormwater management?

- a policy manual
- APA survey of urban planners

Acknowledgements

This research has been supported by a grant from the U.S. Environmental Protection Agency's Science to Achieve Results (STAR) program.

Disclaimer:

This presentation was developed under Assistance Agreement No. RD-83555401 awarded by the U.S. Environmental Protection Agency to the University of Pennsylvania. It has not been formally reviewed by EPA. The views expressed in this document are solely those of [name of recipient or names of authors] and do not necessarily reflect those of the Agency. EPA does not endorse any products or commercial services mentioned in this publication.

Special thanks to:

- EPA: Angela Page, Michael Borst, Ken Hendrickson
- PWD: Joanne Dahme, Erin Williams, Diane Schrauth

Thank you!

Questions, comments:

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