

A **Green** Vision for CSO Long-Term Control Planning: How **Green** Can One City Get??



Marc Cammarata, PE - Manager, Office of Watersheds - Philadelphia Water
&
Ted Brown, PE – Water Resources Engineer – Biohabitats, Inc.

Can we solve a problem in 15 years that took 150 years to create?

Should we do it the same ways it was done many years ago?



Overflow Compliance Costs

	Washington	Pittsburgh	Philly
Population (million)	2	0.850	2
Service Area (mi ²)	725	200	286
CSO Area (mi ²)	19.5	60	64
Number of CSOs	53	> 300	166
Overflow Volume (BG/Yr)	2.5	14	14
Compliance Costs	\$ 2.65 Billion	\$2 - \$3 Billion	??? BILLIONS

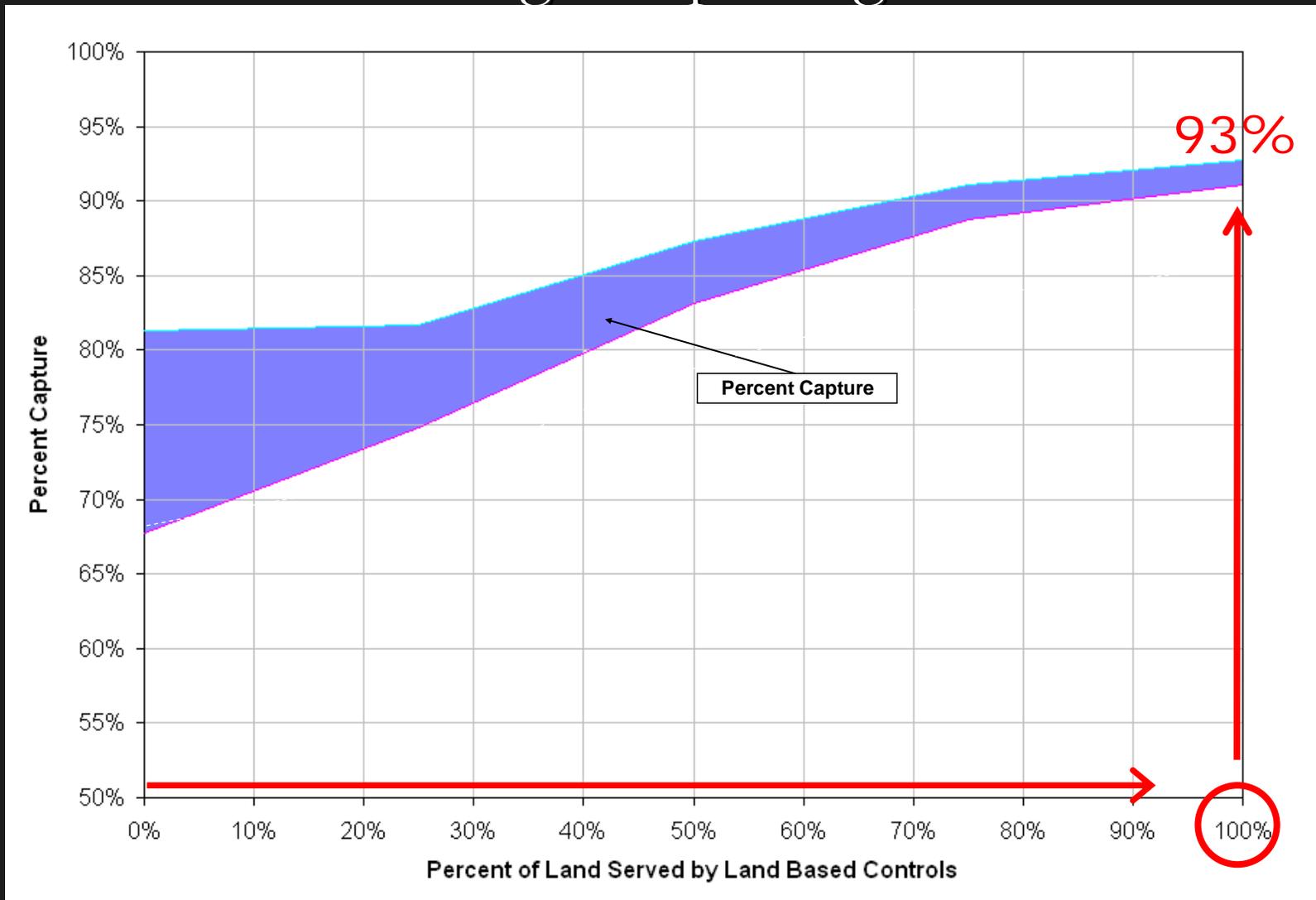
A new approach:
on the verge of BIG
CHANGE...



MSU Green Roof Research Program
(courtesy Old House Journal)



The Challenge: Capturing the 1st inch



How far can we take this approach & how long do we have?

Green Infrastructure Elements Considered as LTCPU Alternatives

- ▶ Private Lands Program
 - Industrial
 - Commercial
 - Institutional
 - Homes
 - Parking
 - Alleys, Driveways and Walkways
- ▶ Public Lands Program
 - Streets
 - Schools
 - Public Facilities
 - Open Spaces

Private Lands - Industry/Commercial/Institutional



Private Lands – Industry/Commercial/Institutional





Private Lands – Industry/Commercial/Institutional



Private Lands - Homes (Row)

Private Lands - Homes (High Rise)





Private Lands - Parking

Private Lands - Alleys / Driveways / Sidewalks



Public Lands – Streets



Public Lands - Schools



Image credit: PENN Praxis

Public Lands – Public Facilities



Public Lands - Public Open Spaces



Spring Gardens Community Garden

Public Lands - Public Open Spaces



Image credit: PENN Praxis

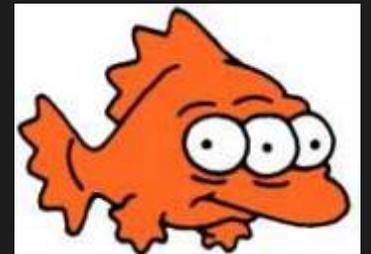
Dealing with Urban BMP Myths

- Toxic sediments
- West Nile Virus
- Infiltration in urban areas
- Trees and BMPs
- Maintenance
- Others?



1. Are Sediments Toxic?

- ▶ Research indicates they are not
- ▶ Sediments can be land applied or landfilled, depending on consistency
- ▶ Although sediments from certain stormwater hotspots may need to be tested prior to be disposal



2. Mosquitoes & West Nile

- ▶ Major concern by citizens and local public health authorities
- ▶ Most well-designed BMPs are not major mosquito problems
- ▶ Poorly designed or maintained BMPs can lead to mosquito habitat
 - unexpected ponding
 - unruly vegetation
- ▶ Maintenance can alleviate mosquito problems



4. Trees in BMPs

Urban Watershed Forestry Manual

Part 2: Conserving and Planting Trees
at Development Sites



 **NA**
United States Department of Agriculture
Forest Service
Northeastern Area
State and Private Forestry
N.C. 27646
May 2006



Unruly Vegetation



There used to be
a BMP in here
somewhere...



- ▶ Growth happens
- ▶ Design for vegetative succession
- ▶ Other benefits including shading, habitat, and rainfall interception
- ▶ Mowing greatest ongoing expense



Maintenance
can be
depressing



All Infrastructure Requires Maintenance



The Good



The Bad



The Ugly





ADD 25% TO YOUR BUDGET

Maintenance

BMPs

Vegetation management

SEDIMENT CLEANOUTS

5 SECRETS TO LOSE YOUR GUT FOR GOOD

849

WAYS TO REDUCE YOUR MAINTENANCE BURDEN in 6 WEEKS

NEW EVERY MONTH!
LID
THAT WORK

CENTER FOR WATERSHED PROTECTION

Maintenance Headaches

- ▶ Large number of BMPs
- ▶ Unaware property owners
- ▶ Access and enforcement
- ▶ Landscaping changes

Maintenance Headache Solutions

- ▶ Ensure post-construction BMPs become a community amenity rather than a chronic problem
- ▶ Anticipate public concerns and misperceptions



SEA Streets - After Construction
2nd Ave NW - NW 117th St to NW 120th St

Tip 1

Include Maintenance in Local Law

- ▶ Identify specific entity responsible for long-term, routine maintenance
- ▶ Reference design guidelines to ease the maintenance burden
- ▶ Specify regular inspection visits
- ▶ Require inspection access and/or easements
- ▶ Include special provisions to handle emergency maintenance
- ▶ Escalating levels of enforcement

Stormwater Operation and Maintenance Model Ordinance

 *This Operation and Maintenance ordinance language is not "stand-alone." Operation and maintenance language would be a part of a more comprehensive stormwater ordinance.*

Definitions

Best Management Practice (BMP) - Device, measure, facility or activity that helps to achieve stormwater management objectives at a designated site.

Non-Routine Maintenance - Maintenance activities that are expensive but infrequent, such as pond dredging or major repairs to stormwater structures.

Plan - A document approved at the site design phase that outlines the measures and practices used to control stormwater runoff at a site.

Stormwater Treatment Practice (STP) - A structural or non-structural Best Management Practice (BMP) specifically designed to remove pollutants in rainfall runoff from developed areas.

Section I. Design

- A. All STPs shall be designed in a manner to minimize the need for maintenance, and reduce the chances of failure. Design guidelines are outlined in the most recent version of _____ (Local or State Stormwater Manual).

 *Rather than incorporate specific stormwater design or maintenance standards into the ordinance itself, it is best to reference "the most recent edition" of a stormwater manual. In this way, technical information can remain up to date without making legal changes to the ordinance.*

 *The Maryland Stormwater Design Manual, is one example of an up-to-date stormwater design manual that explicitly defines design and regular maintenance measures. For more information, go to www.mdc.state.md.us. Under topics, choose "Stormwater Design Manual."*

- B. Stormwater easements and covenants shall be provided by the property owner for access for facility inspections and maintenance. Easements and covenants shall be recorded with _____ (Stormwater Agency) prior to the issuance of a permit.

 *For an example of a stormwater easement, see [Maintenance Easements](#).*

- C. Final design shall be approved by _____ (Stormwater Agency)

Section II. Routine Maintenance

- A. All STPs shall be maintained according to the measures outlined in the most recent

Tip 2

Reduce Maintenance Burden Before Construction

- ▶ Reduce maintenance headaches with tough design standards...if you don't ask for it, you won't get it!
- ▶ Thorough plan review ensures design standards are properly implemented
- ▶ Review the plan as if you were the maintenance crews

Tip 3

Educate & Involve the Maintainers

- ▶ Adopt-A-Pond
- ▶ Volunteer Clean-Ups
- ▶ Publications, Mailings

ADOPT-A-POND PROGRAM DOCUMENT

March 2003 draft



Created by the
Center for Watershed Protection
8151 Dash Street
Ellicott City, MD 21043



And the
Herring Run Watershed Association
4337 Harford Rd.
Baltimore, MD 21214



For the
Baltimore County Department of Environmental
Protection and Resource Management (DEPRM)



PROTECTING RESOURCES
PRIDE
IN DELICATE ENVIRONMENTS

Home

Watershed 101

Watershed Tour

What Can I Do?

Online Resources

BMP Guide

RPA Guide

Turf Love

Rain Gardens

Rain Gardens/Barrels

News & Projects

Mini-Grant Program

PRIDE Team



How Neighborhoods Obtain "PRIDE" Designation

For a stormwater management/BMP facility in James City County, there are two paths available to achieve "PRIDE" status (receive a neighborhood sign).

1. Achieve and maintain a BMP Rating of 5 based upon inspection by County Environmental Division staff. A rating of 5 is the best achievable under the County BMP Inventory/Inspection program;

2. Perform a watershed protection project at the BMP or in the neighborhood which enhances, retrofits or improves the water quality treatment function of the BMP or any of it's components. Some ideas include: establishing vegetative pond buffers, installing forebays, installing a micropool, planting shallow marsh or fringe wetland plants, shoreline erosion protection, invasive specie removal or an organized clean-up day, etc.

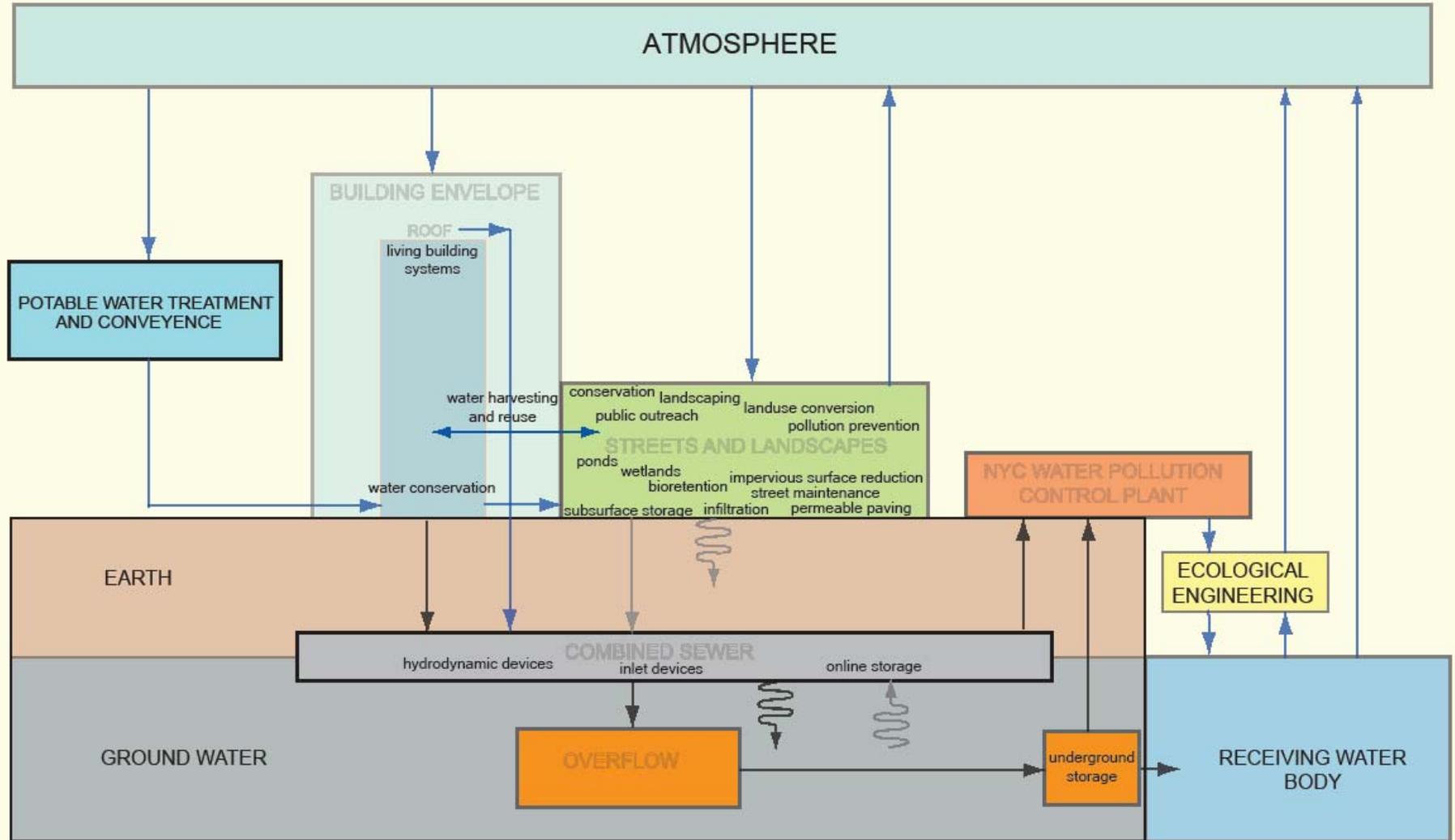
County staff will determine if a stormwater management/BMP facility qualifies for PRIDE designation using the following criteria:

- ▶ The BMP must be located in James City County.



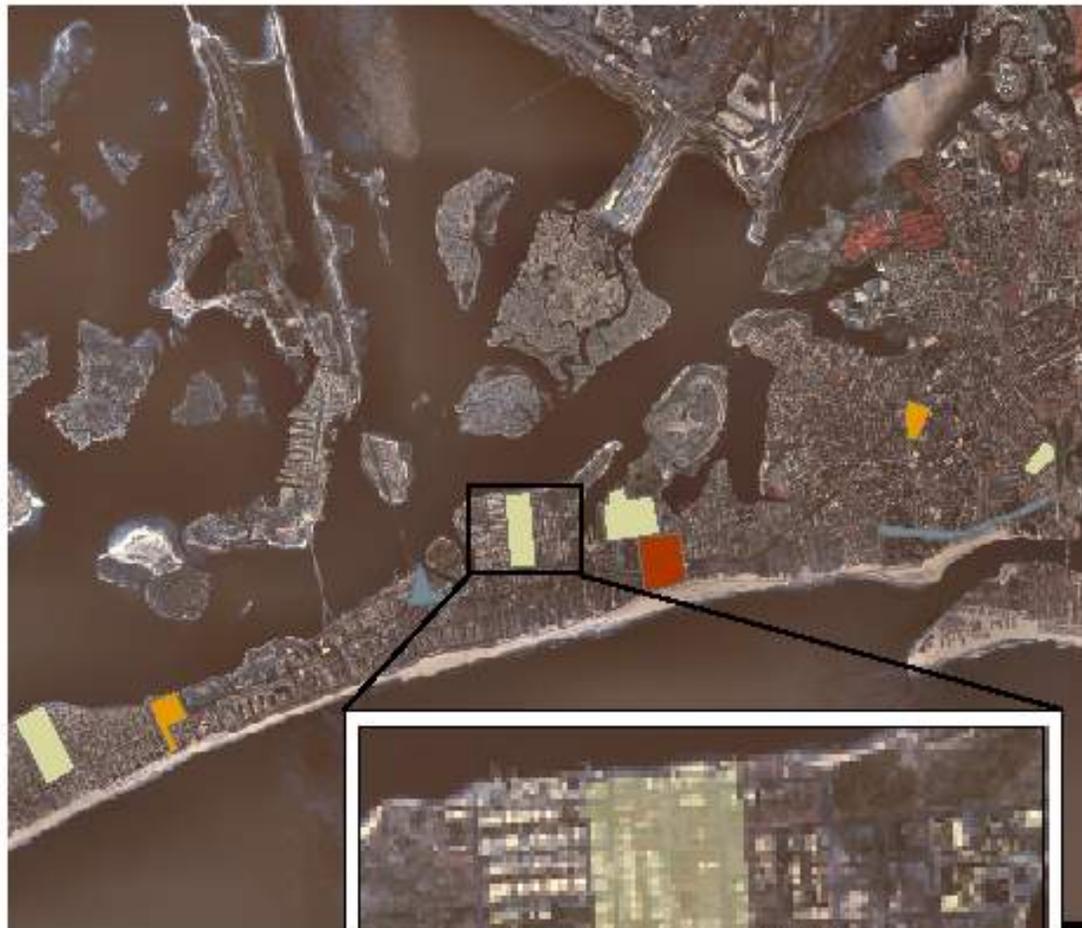
Figure 2:

HIERARCHY OF OVERFLOW REDUCTION AND TREATMENT OPPORTUNITIES



Rockaway Sewershed

Site 26-C01



Legend

Landuse

- Commercial
- Industrial
- Open Space/Park
- Residential
- Transportation



Building Envelope		Streets and Landscape	
Type of roofs - 1	sloped	% Canopy	30%
% roof type - 1	40%	Cover_Type	Mowed Grass
Type of roofs - 2	pitched	Percent Private	100%
% roof type - 2	50%	Lines of Road - 1	4
Type of roofs - 3	flat	Percent of Road - 1	100
% roof type - 3	10%	Median Width	5 - 10 ft
# of stories - 1	1-2	Plank Width	0 - 5 ft
% stories - 1	50%	Sewer - Storm Drain Inlets	
# of stories - 2	1-2	Floorables	Medium
% stories - 2	50%	Oil and Grease Visible	No
% connected downspouts	30%	Odor from Inlet	Low
% Frame	90%		
% Brick/Block Building Material	10%		
Type_use_1	single family		
%_Type_use 1	80%		
Type_use_2	duplex		
%_Type_use 2	10%		
Type_use_3	apt 4-10 units		
%_Type_use 3	10%		
Rate of Occupancy	90%		
Adjacent Vacant_Lot	Yes		

Jamaica Sewershed

Site jb-ind-02



Legend

Landuse Type

- commercial
- industrial
- open space/park
- residential
- transportation



Building Envelope		Streets and Landscape	
Type of roofs - 1	flat	% Canopy	0%
% roof type - 1	100%	Cover_Type	Paved
# of stories - 1	1-2	Percent Public	0%
% stories - 1	90%	Percent Private	100%
# of stories - 2	3-4	Lanes of Road - 1	4
% stories - 2	10%	Percent of Road -1	100%
% connected downspouts	100%	Lanes used for parking - 1	2
% Brick/Block Building Material	100%	Median Width	0
Type_use_1	warehouse	Planter Width	0 - 5 ft
%_Type_use 1	100%	Sewer - Storm Drain Inlets	
Rate of Occupancy	100%	Floatables	Medium
Adjacent Vacant_Lot	No	Oil and Grease Visible	Yes
		Odor from inlet	Low

26th Ward Sewershed

Site 26-C01



Legend

Landuse Type

- Commercial
- Industrial
- Open Space/Park
- Residential





Building Envelope		Streets and Landscape	
Type of roofs - 1	flat	% Canopy	10%
% roof type - 1	100%	Cover_Type	Paved
# of stories - 1	1-2	Percent Public	10%
% stories - 1	90%	Percent Private	90%
# of stories - 2	10-20	Lanes of Road - 1	6
% stories - 2	10%	Percent of Road - 1	60%
% connected downpouts	100%	Lanes used for parking - 1	0
% Brick/Block Building Material	100%	Lanes of Road - 2	4
Type_use_1	retail	Percent of Road - 2	40%
%_Type_use_1	60%	Lanes used for parking - 2	2
Type_use_2	commercial	Median Width	0 - 5 ft
%_Type_use_2	30%	Planter Width	0
Type_use_3	apt > 10 units	Sewer - Storm Drain Inlets	High
%_Type_use_3	10%	Flooding	Yes
Rate of Occupancy	100%	Oil and Grease Visible	Yes
Adjacent Vacant Lot	No	Odor from Inlet	Low

Green Infrastructure Elements Considered as LTCPU Alternatives

▶ Private Lands

- Industrial
- Commercial
- Institutional
- Homes
- Parking
- Alleys, Driveways
and Walkways

▶ Public Lands

- Streets
- Schools
- Public Facilities
- Open Spaces

Regulatory Tools

- ▶ **PWD Stormwater Regulations** (for new construction and redevelopment)
 - Trigger the regulations at 5000 sq ft or 2000 sq ft ?
- ▶ **Parcel-Based Stormwater Billing**
- ▶ **Amended Code/Regulations/Specs**
 - Plumbing Code
 - ▶ Allow disconnection of rain leaders to new stormwater control infrastructure
 - ▶ Allow use of Rain Barrels
 - Building Code
 - ▶ Investigate building code regarding roof live- and dead-load requirements and the relationship to green roofs
 - Fairmount Park Specifications
 - ▶ Tree plantings
 - Zoning Code
 - ▶ Buffers, setbacks, tree canopy, parking requirements, and/or planted spaces
 - Streets Department Specifications
 - ▶ Porous asphalt and pavements
 - PWD Regulations
 - ▶ Require management of runoff from all new public streets and sidewalks

New Stormwater Regulations

Maintain
Groundwater
Recharge

Maintain
W-Q

Prevent
Streambank
Erosion

Infiltrate
1.0 inch

Remaining Volume
from 1"

1-yr, 24hr
Detained,
24hrs

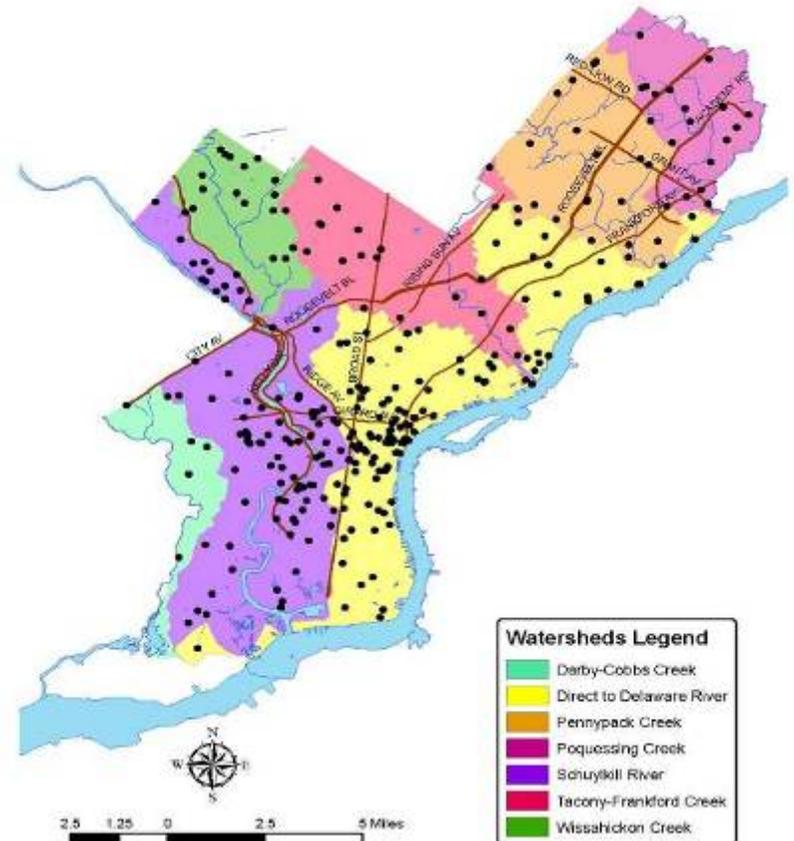
1 " Total from IMP Area

Earth Disturbances > 15,000 sq ft

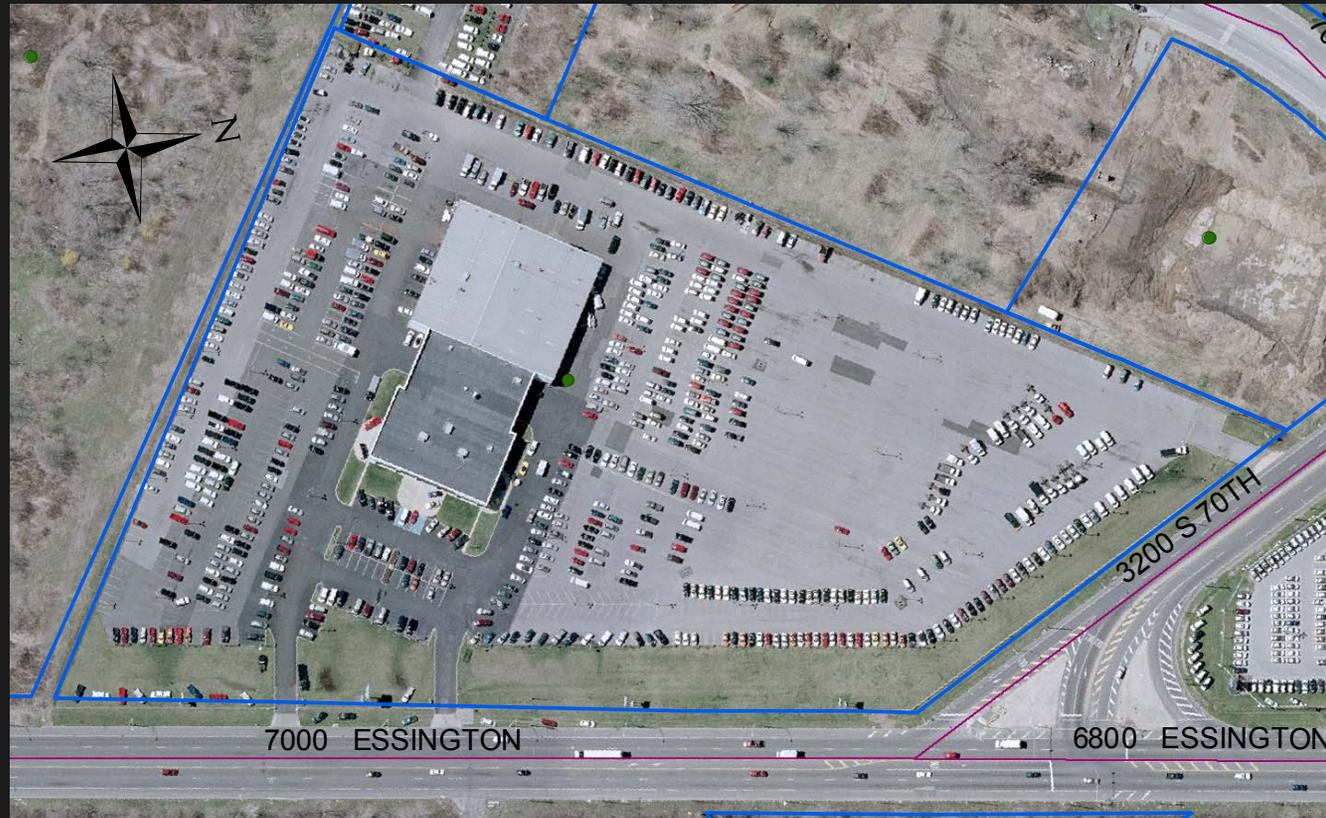
* 1000+ acres of land managed to date

* 20+ Green Roofs – Passed Conceptual
Phase of Plan Review

PWD Conceptual Submittals 2006



Typical property with increased stormwater fee – large site, small meter



Top 500 Parcels in the Combined Sewered Area make up **12.3%** of total impervious area

Gross Area = 599,744
Imperv Area = 491,035

Existing Charge = \$ 377.23
New Charge = \$ 2,496.42

Administrative Tools

- **Stormwater Billing Credits**
- Green Permit Expediting
- Encourage LEED certification
- Emphasize the stormwater aspects of LEED
- Apply Stormwater Regulations as sites redevelop or renovate
- Watershed Mitigation Registry
- Demonstration Projects & Programs
- **Cost-Sharing (PWD pays difference)**
- **Full-Cost (for integral locations)**
- **Rate incentives**
- Tax incentives
- Grant programs
- Low income assistance
- Education & Workshops

Potential Partners

- **Philadelphia Streets Department**
- Fairmount Park Commission
- Philadelphia Department of Recreation
- Philadelphia Airport
- Philadelphia Office of Housing & Community Development
- Philadelphia Housing Authority
- **Philadelphia Parking Authority**
- Philadelphia Department of Public Property
- Philadelphia Parking Association
- Pennsylvania Department of Transportation
- Special Services Districts
- Philadelphia Department of Commerce
- Philadelphia Public Schools
- Capital Programs Office
- Police
- Fire
- Library
- Sports Facilities & Convention Center
- Homeowner Associations
- **Developers** (nonprofit and for-profit)
- Private Schools
- Community College of Philadelphia
- Universities and Colleges
 - ▶ Drexel
 - ▶ LaSalle University
 - ▶ St. Joseph's University
 - ▶ Temple University
 - ▶ University of Pennsylvania
 - ▶ University of the Sciences in Philadelphia
- Neighborhood Groups and Associations
- Community Development Corporations
- Watershed Partnerships
- Many, many more.....

→ Green Industry/Commercial/Institutional

▶ Concept

- Represents **10%** (5 Ind, 4 Comm, 1 Instit) of all impervious cover in combined system
- Require compliance with **Stormwater Regulations**
- Retrofit at least 25 large properties per year
- 1.0% redevelopment projection per year

Wellness Center
Sugarloaf, PA

▶ Results by 2044?

- **95%** of Industry/Comm/Institutions

▶ Major Tools

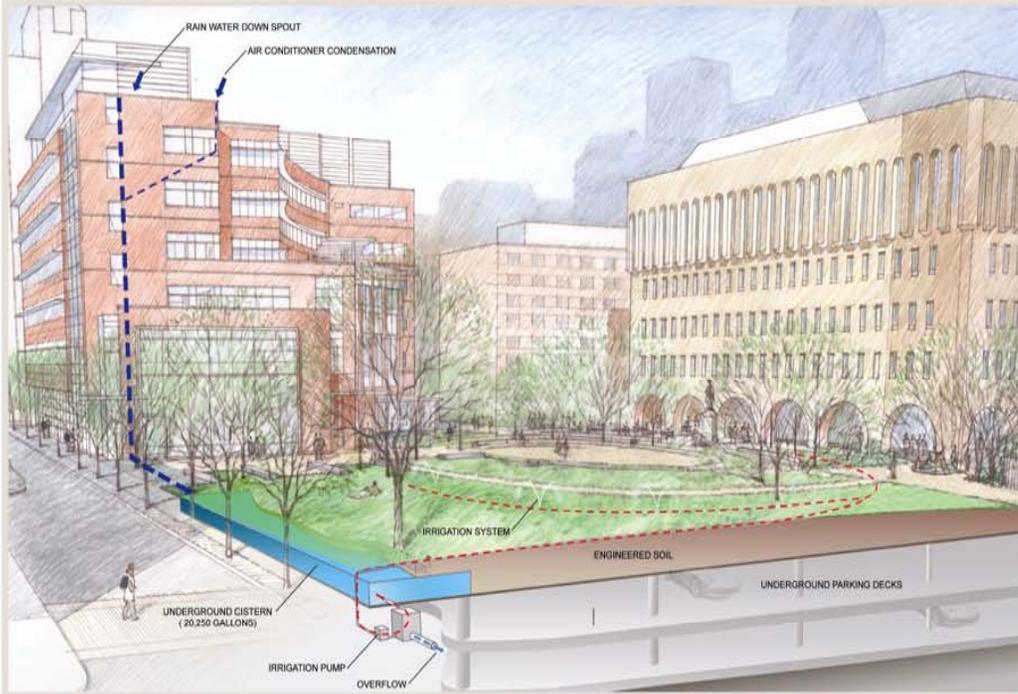
- ▶ **Parcel-Based Stormwater Billing**

▶ Major Partners

- Commerce Department
- NGOs, Hospitals, Churches, Stadiums, Universities, etc.



simple, sustainable, urban : a project for the 21st century



PROJECT CONTRIBUTIONS:

- The plaza & green will add 1.3 acres of open space to the city fabric while promoting water conservation
- Greening Philadelphia: A 1.8 acre project site, formerly 7% pervious, becomes 40% pervious
- Landscape integrated stormwater management system reduces stormwater volume & delays peak flow discharge through storage & re-use for irrigation
- Enhances Water Quality: "First Flush" is captured and filtered by plants and soils
- Contributes to the elimination of combined sewer overflow discharge to the Delaware River.

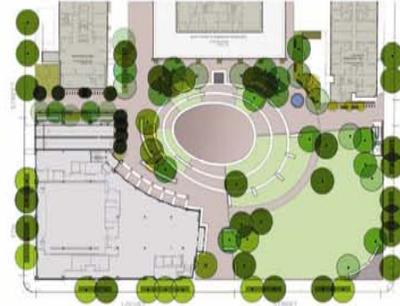
PROJECT WATERSHED:



This urban watershed produces 95 million gallons of stormwater per year with an average of 29 overflow events

PROJECT TECHNICAL FEATURES:

- Capacity to store & re-use over 20,000 gallons of storm water and air conditioner condensate for irrigation
- Gravity-fed cistern, easy to drain and maintain
- Engineered soils to hold up to 11,500 gallons of water per each % organic matter at 12" depth



Evapotranspiration further reduces stormwater volume with over 55 canopy trees & nearly 1 acre of lawn

Schuylkill Center for Environmental Education Philadelphia, PA





Comcast Center
Philadelphia, PA



→ Green Homes

▶ Concept

- 25% of the City's impervious cover in the combines system is associated with residential rooftops
 - ▶ Low Cost - Rain barrels & Rain gardens
 - ▶ Higher Cost - Porous sidewalks, driveways and walkways / Green roof

▶ Major Tools

- ▶ **Structural Engineering Analysis**
- ▶ Amended Plumbing Code
- ▶ Amended Building Code

▶ Results by 2044?

- 47% of all homes

▶ Major Partners

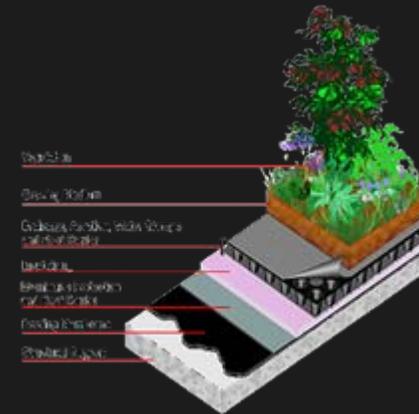
- Neighborhood Groups and Associations
- Community Development Corporations
- Watershed Partnerships
- Pennsylvania Horticultural Society



Private Lands - Homes



Credit: Maurer, City of Linz



Private Lands - Homes



From 4 Private Developments (McDonald Developments)

→ Green Parking

▶ Concept

- Parking lots represent almost **19%** of the City's impervious cover in the combined system
- Reduced summer temperatures
- No Parking loss during and after storms due to standing water
- Appearance improvements in commercial and business districts

▶ Major Tools

- **Amended Zoning Code**
 - ▶ Require buffer, setback, and/or planted space be utilized to manage runoff

▶ Results by 2044?

- **80%** of all Parking

▶ Major Partners

- Philadelphia Parking Authority
- Philadelphia Department of Public Property
- Philadelphia Parking Association

Portland BMP Manual



Morris Arboretum - Philadelphia, PA



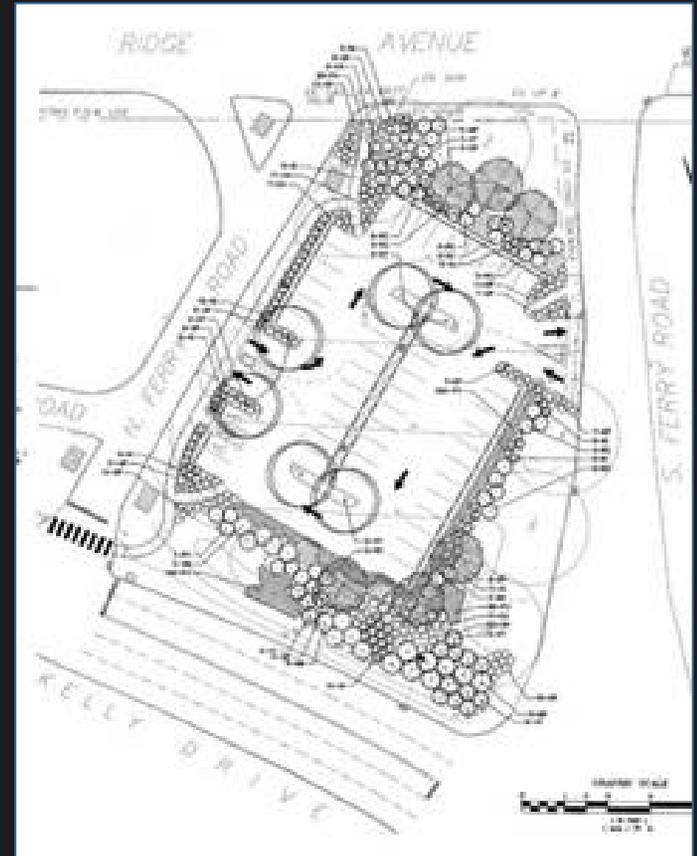
Conventional
Asphalt

Tropical Storm Floyd, September 1999

Porous
Asphalt



East Falls Community Parking Lot Philadelphia, PA



Philadelphia Airport Employee Parking Lot Expansion



→ Green Alleys, Driveways & Walkways

▶ Concept

- Alleys and Driveways represent **2%** of City's Impervious Cover
- Manage stormwater while improving aesthetics
- Potential flow pathways for rainwater harvested
- Infiltration or conveyance of stormwater to the end of the alleys or walkways

▶ Major Tools

- **Amended Streets Department Specifications**
 - ▶ Allow or require porous asphalt or other porous pavement for alleyways and driveways

▶ Results by 2044?

- **50%** of all Alleys/Driveways

▶ Major Partners

- Philadelphia Streets Department
- Philadelphia Housing Authority
- Homeowner Associations
- Developers (nonprofit and for-profit)



Chicago's Green Alley Program



Private Lands – Alleys/Driveways/Walkways



Sulzberger Outdoor Classroom - Philadelphia



Green Infrastructure Elements Considered as LTCPU Alternatives

▶ Private Lands

- Industrial
- Commercial
- Institutional
- Homes
- Parking
- Alleys, Driveways
and Walkways

▶ Public Lands

- Streets
- Schools
- Public Facilities
- Open Spaces

→ Green Streets

▶ Concept

- Streets represent **37%** of the impervious cover within the combined system
- Variety of approaches for all types of streets - Increasing tree cover, use of pervious pavements, stormwater planters, and underground infiltration/evapotranspiration/retention facilities

▶ During:

- Storm Flood Relief construction
- Water & Sewer repair/replacement
- Utility construction (cable, gas, electric)
- City Street retrofit during Repaving
- Sidewalk Retrofits – Replacement Grant Program

▶ Major Tools

- **Amended Stormwater Regulations**
 - ▶ Require management of runoff from all new public streets and sidewalks
- Amended Streets Department Specifications
- Amended Fairmount Park Specifications

▶ Results by 2044?

- **80%** of all Streets

▶ Major Partners

- Philadelphia Streets Department
- Pennsylvania Department of Transportation
- Philadelphia Department of Commerce



Portland, OR



Public Lands – Streets



Portland, OR



SEA Street total retrofit - Seattle

Public Lands – Streets



SEA Streets - After Construction
2nd Ave NW - NW 117th St to NW 120th St

Monitoring results for four years: 99% reduction in total runoff volume

After



**West Mill Creek Stormwater Tree Trench
Philadelphia, PA
PWD, Dept. of Recreation**

Public Lands – Streets



**PerVIOUS Pavers, Subsurface Infiltration,
Disconnected Inlets**



Traffic Triangle Rain Garden Philadelphia, PA PWD, UC Green



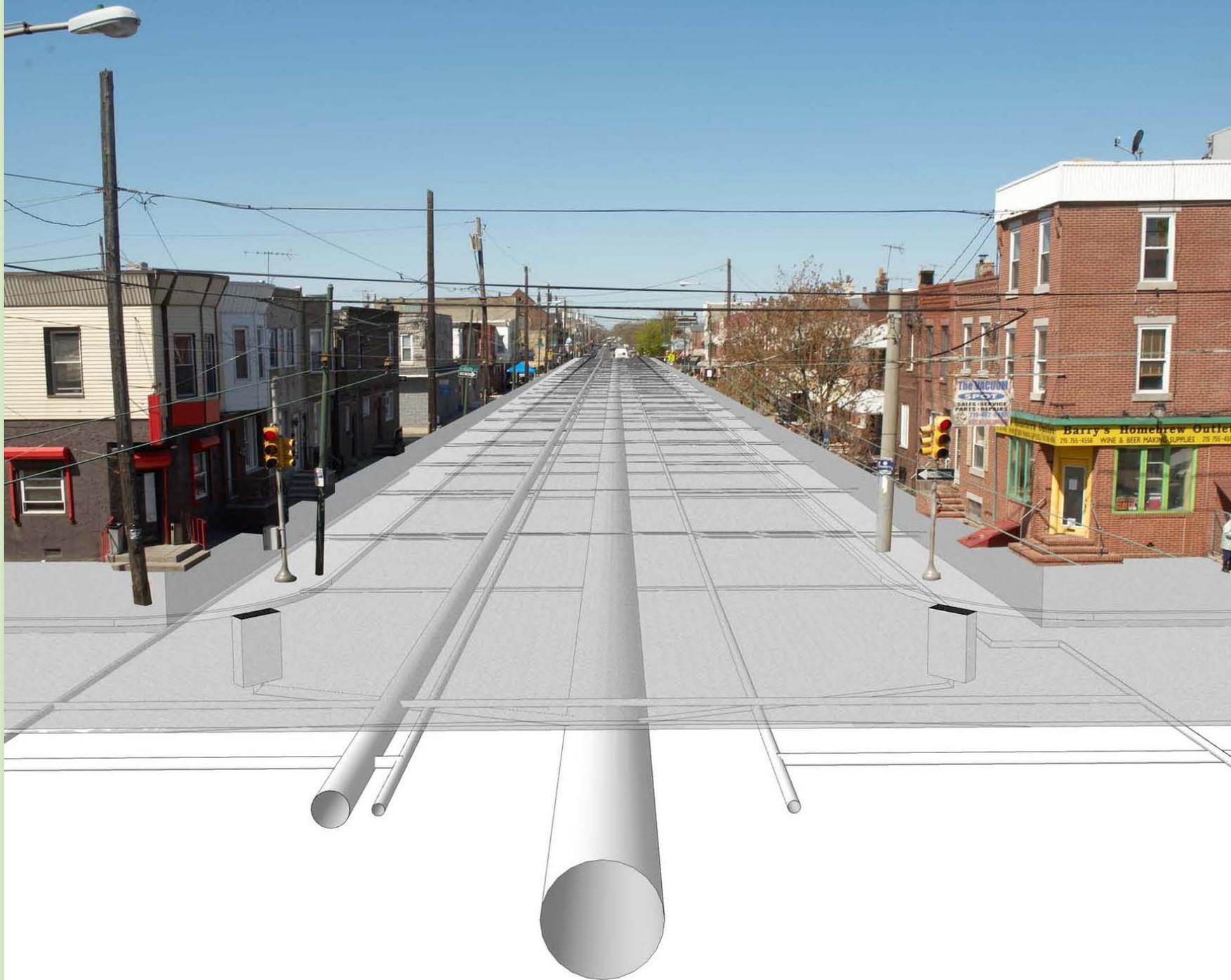
Island Avenue

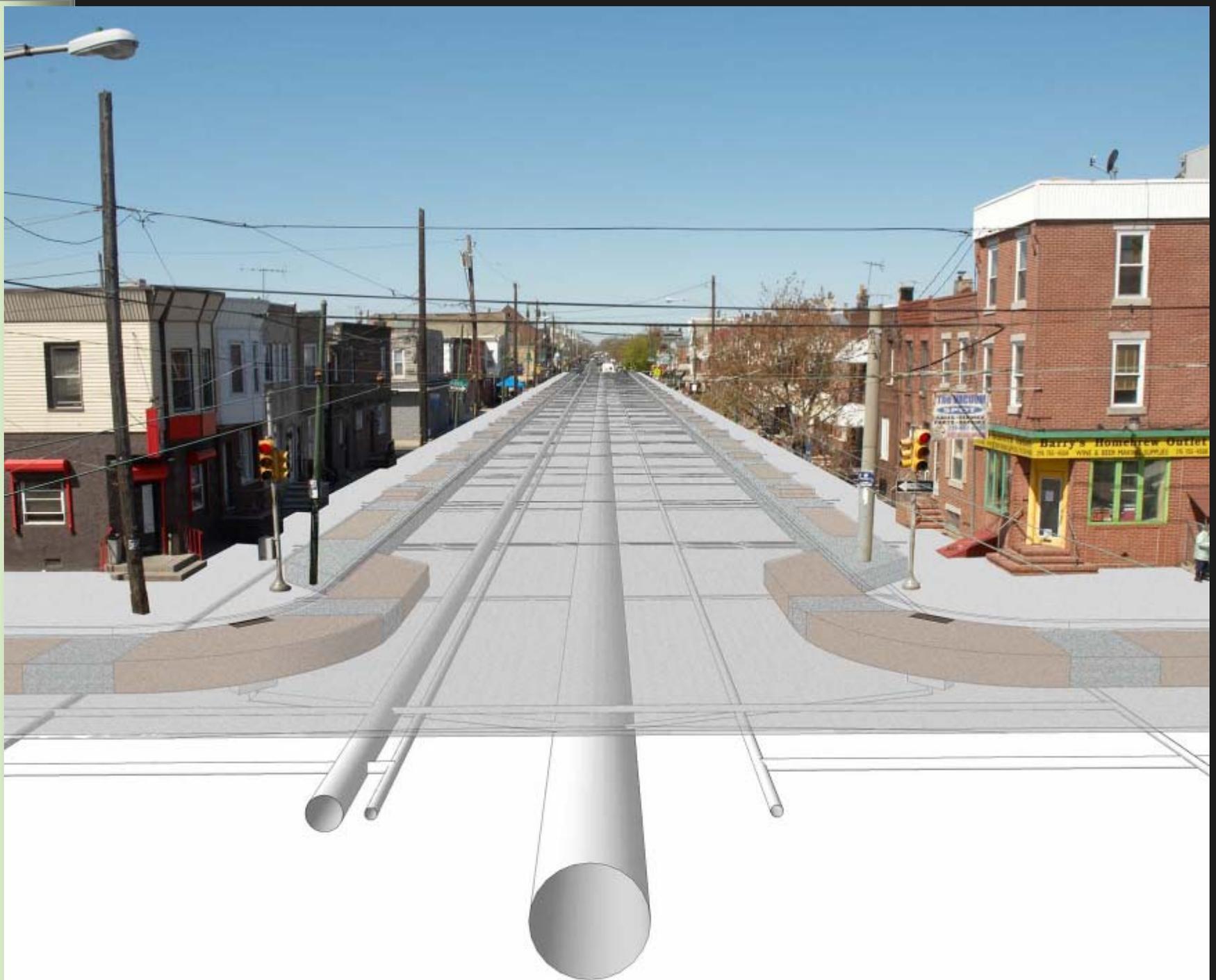
Bioretention/ Infiltration Zones

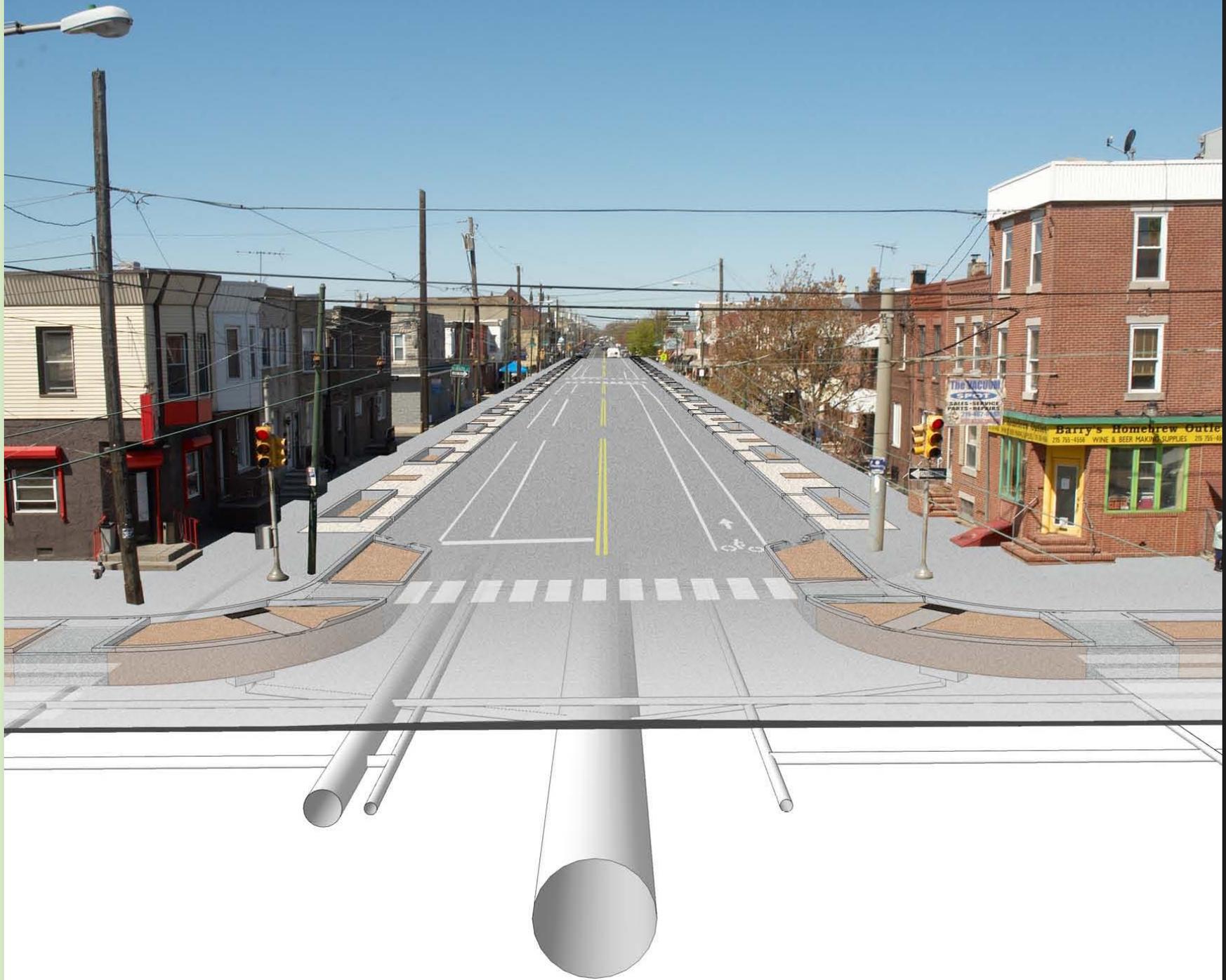
Vegetated Street Medians - PWD

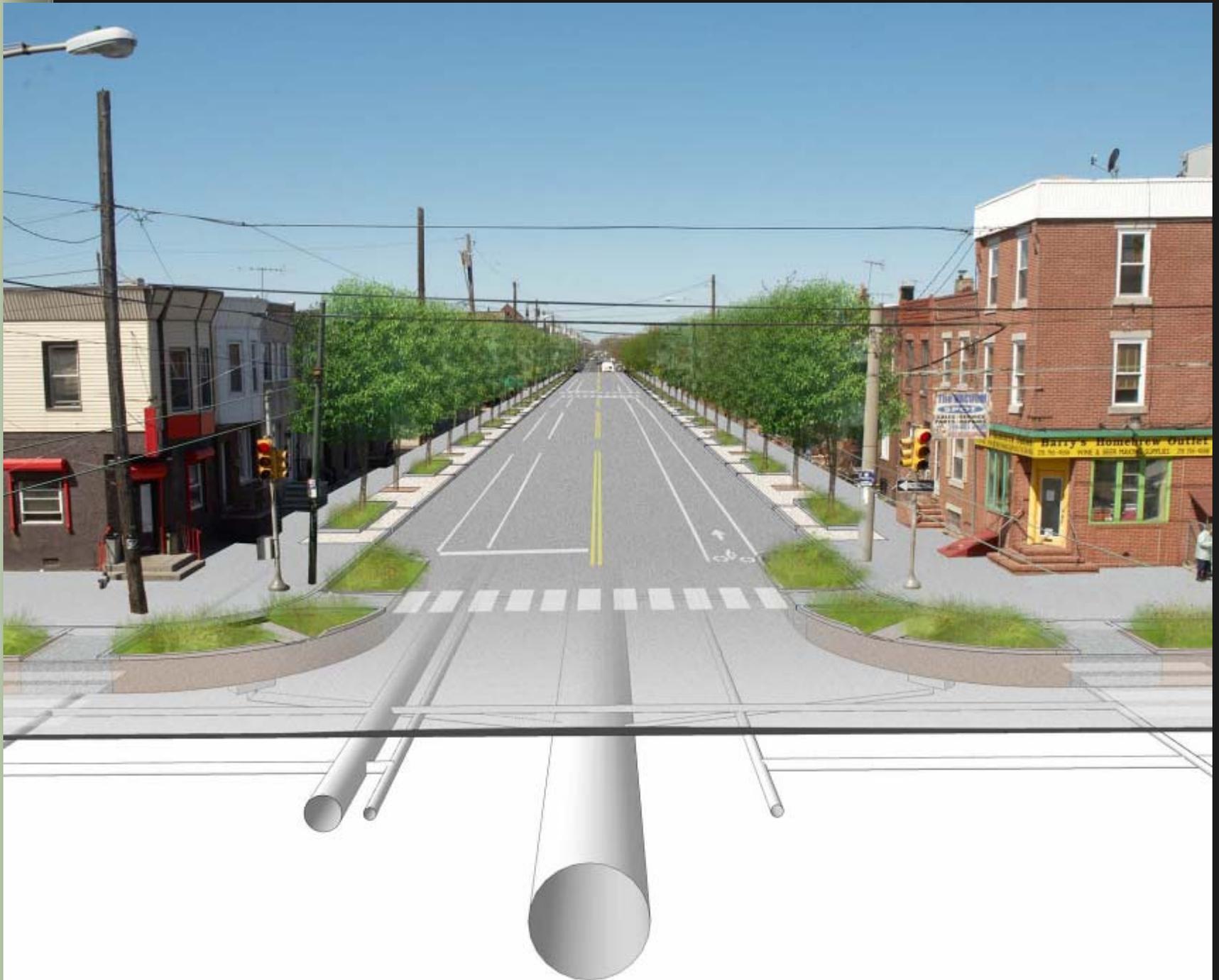


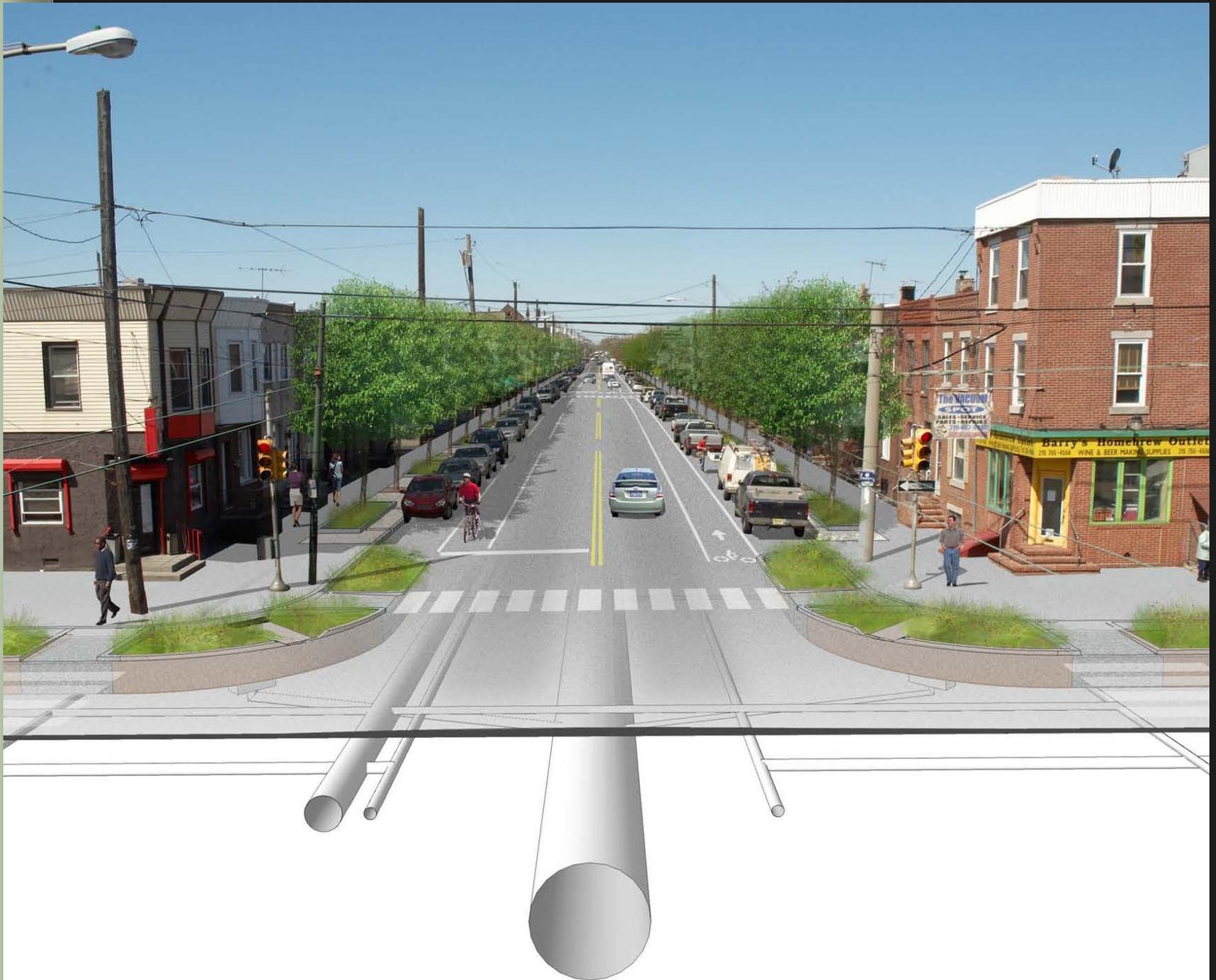




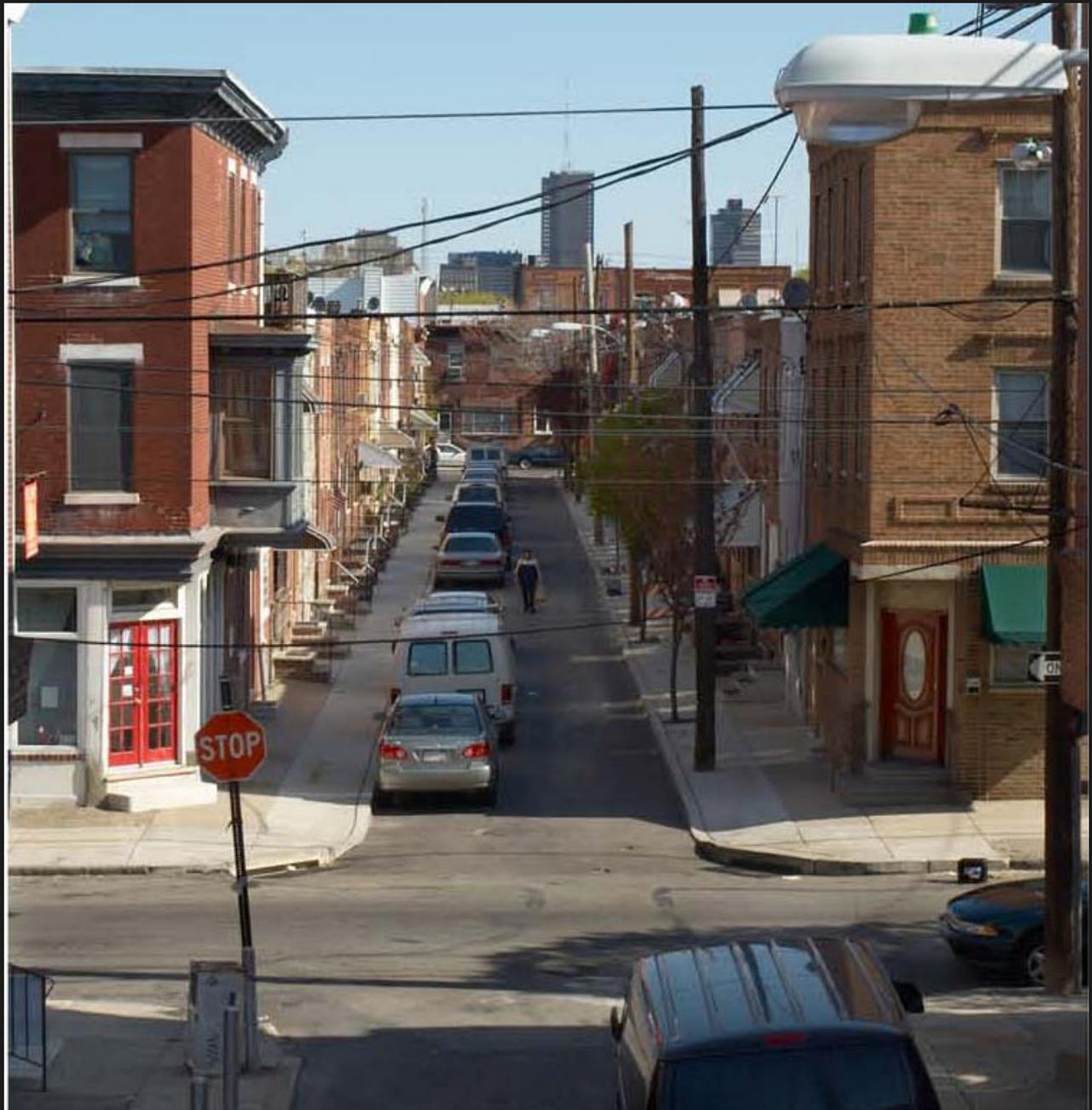












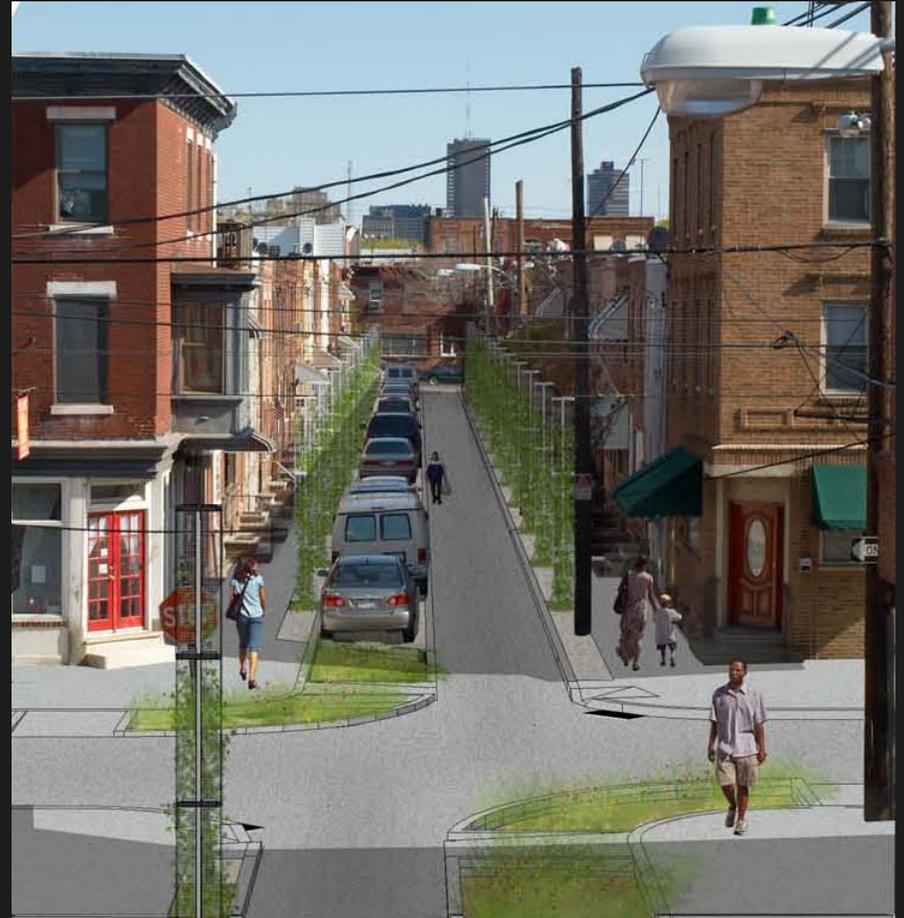
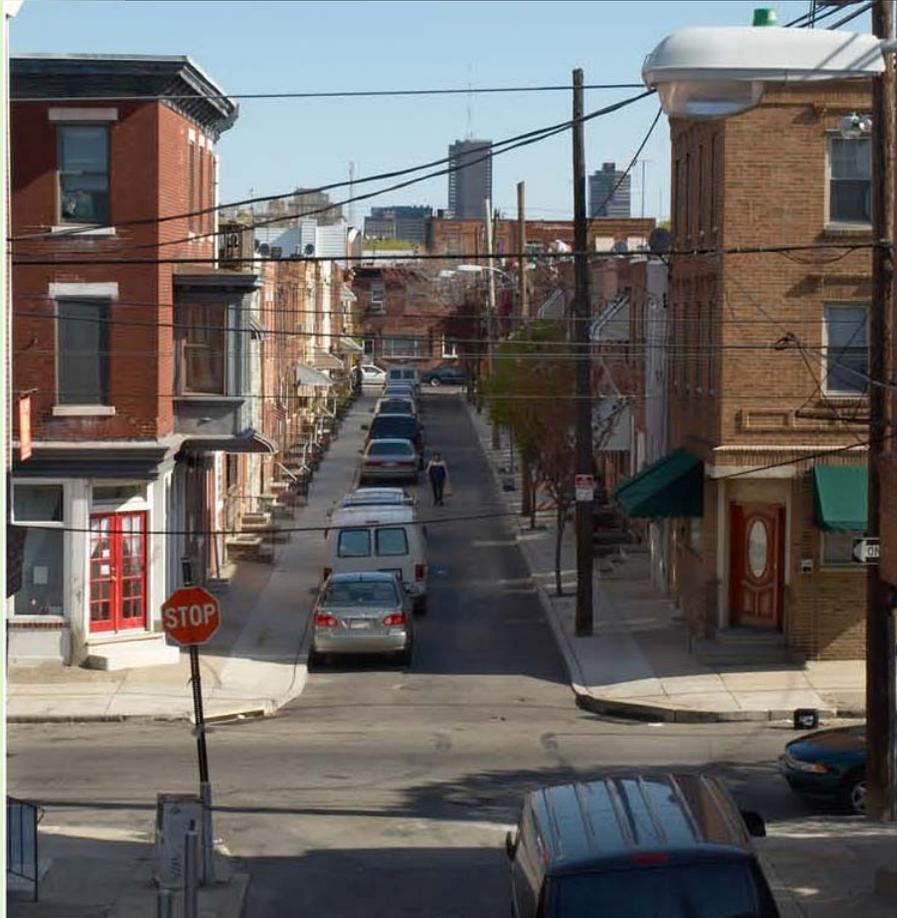












→ Green Schools

▶ Concept

- Represents **2%** of City's impervious cover in the combined system
- Highly visible locations associated with education
- Transforms heat trapping asphalt surfaces into cooler, green islands
- Capture local universities ambitious sustainability initiatives

▶ Major Tools

- **Design Standards & Design Assistance**
- Cost-Sharing & Full Cost
- Stormwater Bill Credits

▶ Results by 2044?

- **100%** of all Schools

▶ Major Partners

- Philadelphia Public Schools
- Private Schools
- Community College of Philadelphia

Wissahickon Charter School

Philadelphia, PA

Public Lands - Schools



Penn Alexander School

Philadelphia, PA

Porous pavement playground & Rain Garden

Public Lands - Schools



Penn Alexander School – Infiltration Field

Public Lands - Schools



Soccer Field



Public Lands - Schools



School of the Future – “Microsoft” High School

30,000 gallon cistern will collect
rainwater from roof and use to flush toilets

→ Green Public Facilities

▶ Concept

- Represents **1%** of impervious cover in the combined system.
- Retrofit all facilities to meet the new stormwater regulations.
- Develop cooperative greening initiatives with Rec / Fire / Police / Library / Airport / etc.

▶ Major Tools

- **Parcel-Based Stormwater Billing**
- Full Cost

▶ Results by 2044?

- **100%** of Facilities

▶ Major Partners

- Police / Fire / Libraries
- Department of Recreation
- Streets Department
- Fairmount Park Commission
- Airports
- Sports Facilities
- Convention Center



Venice Island Storage Tank

**Mill Creek
Playground**
Philadelphia, PA
PWD, Dept. of
Recreation



Porous Pavement; Subsurface Storage with Infiltration

Mill Creek Playground

PWD, Dept. of Recreation



26 4:01 PM

Waterview Rec Center

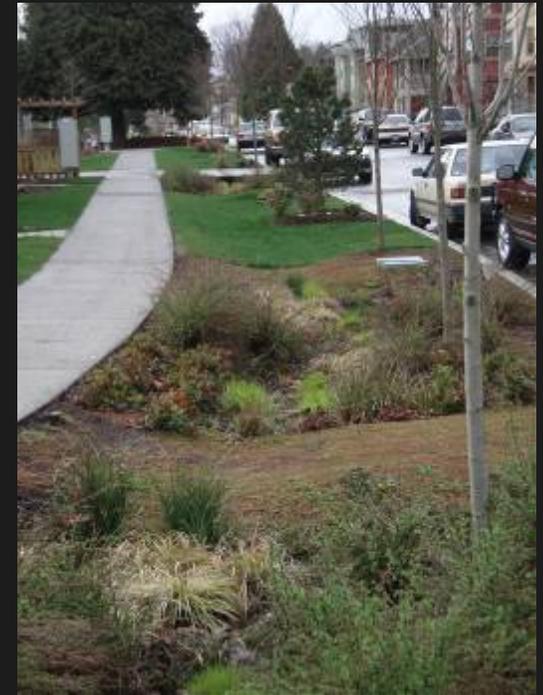
Philadelphia, PA
PWD, Dept. of Recreation



Porous Pavement;
Subsurface Storage with
Infiltration



- ▶ Prelim Designs for:
 - Belmont Water Treatment Plant
 - ▶ **Vegetated Swale** (Ford Rd.)
 - ▶ **Bump Outs** (Belmont Rd)
 - Queen Lane Water Treatment Plant
 - ▶ **Bump Outs**
 - Bureau of Laboratory Services
 - ▶ **Sidewalk Planters**
 - Sewer Maintenance Yard
 - ▶ **LEED Certified**



→ Green Public Open Spaces

▶ Concept

- Represents **4%** of City's impervious cover in the combined system
- The routing and managing stormwater from the surrounding areas where this can be done without adversely impacting the function of the public land itself.
- Vacant and Abandoned lands
 - ▶ Converted to pervious areas or that the SW regulations are implemented
- Bikeways/Trails designed for zero stormwater discharge,
- Wetland creation/restoration and stream restoration near Park land
- Golf Courses and Plazas designed to manage stormwater

▶ Major Tools

- **Revision of Stormwater Ordinance**
 - ▶ Apply regulations to disturbance of 5000 square feet or more
- **Watershed Mitigation Registry**

▶ Results by 2044?

- **50%** of all Open Public spaces

▶ Major Partners

- Fairmount Park Commission
- Philadelphia Department of Recreation
- Philadelphia Airport
- Philadelphia Horticultural Society



Mill Creek Farm

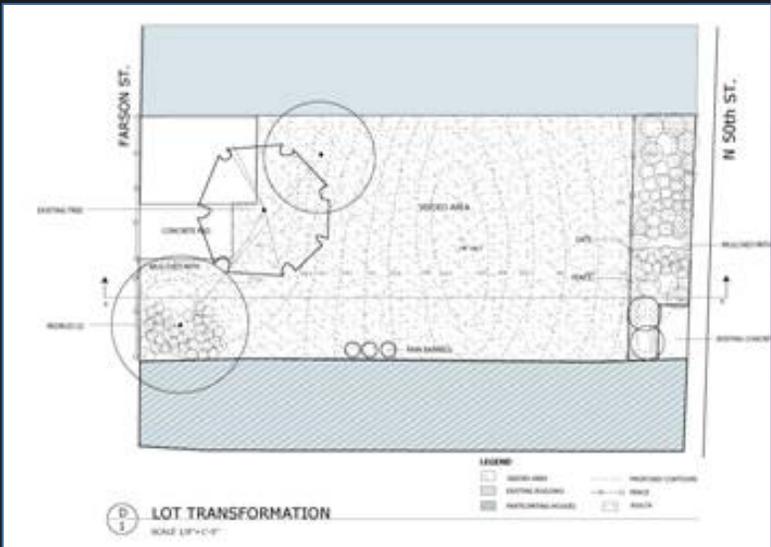
PWD, PA Horticultural Society



Inlet Disconnection; Vegetated Swales; Green Roof

Vacant Land Stabilization in West Philadelphia

Public Lands – Public Open Spaces



Pennsylvania Horticultural Society

Retentive Grading, Plantings

Clark Park Stormwater Project

Philadelphia, PA
PWD, Dept. of Recreation

Public Lands – Open Spaces



Disconnected Inlets, Subsurface Infiltration

Cliveden Park Stormwater Project

Philadelphia, PA

PWD, Dept. of Recreation

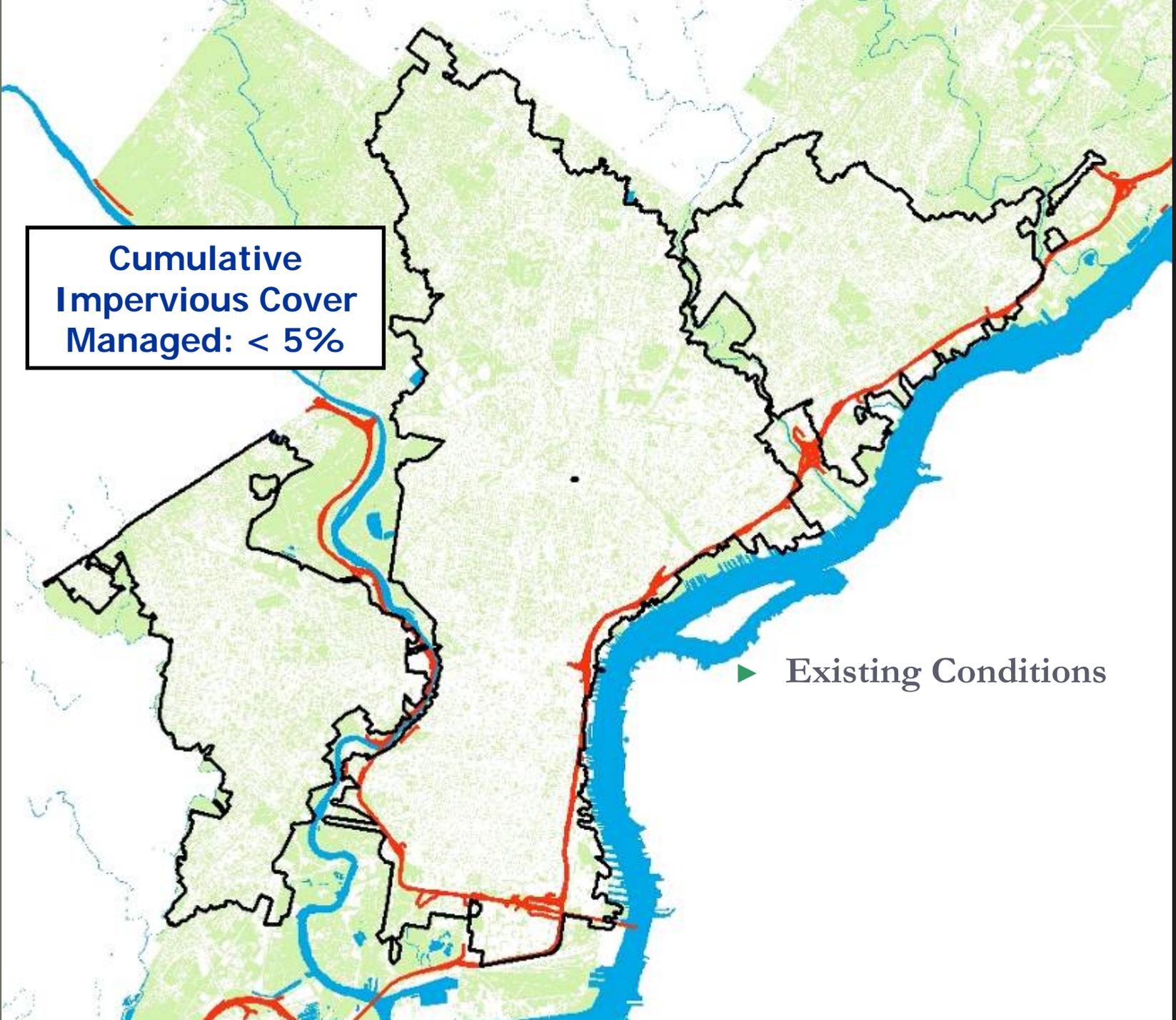


Bioretention Gardens, Disconnected Inlets

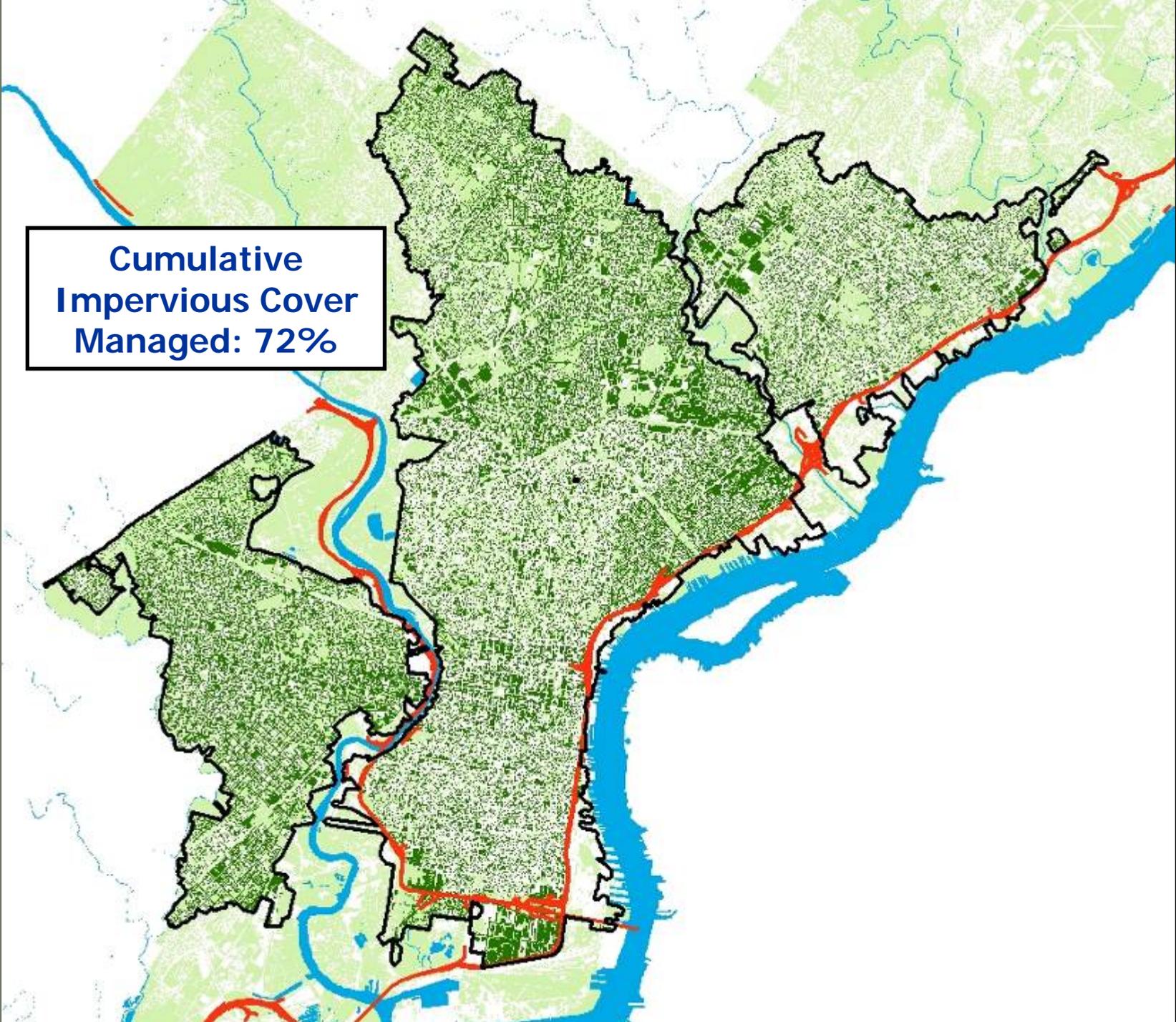
Saylor Grove Stormwater Wetland



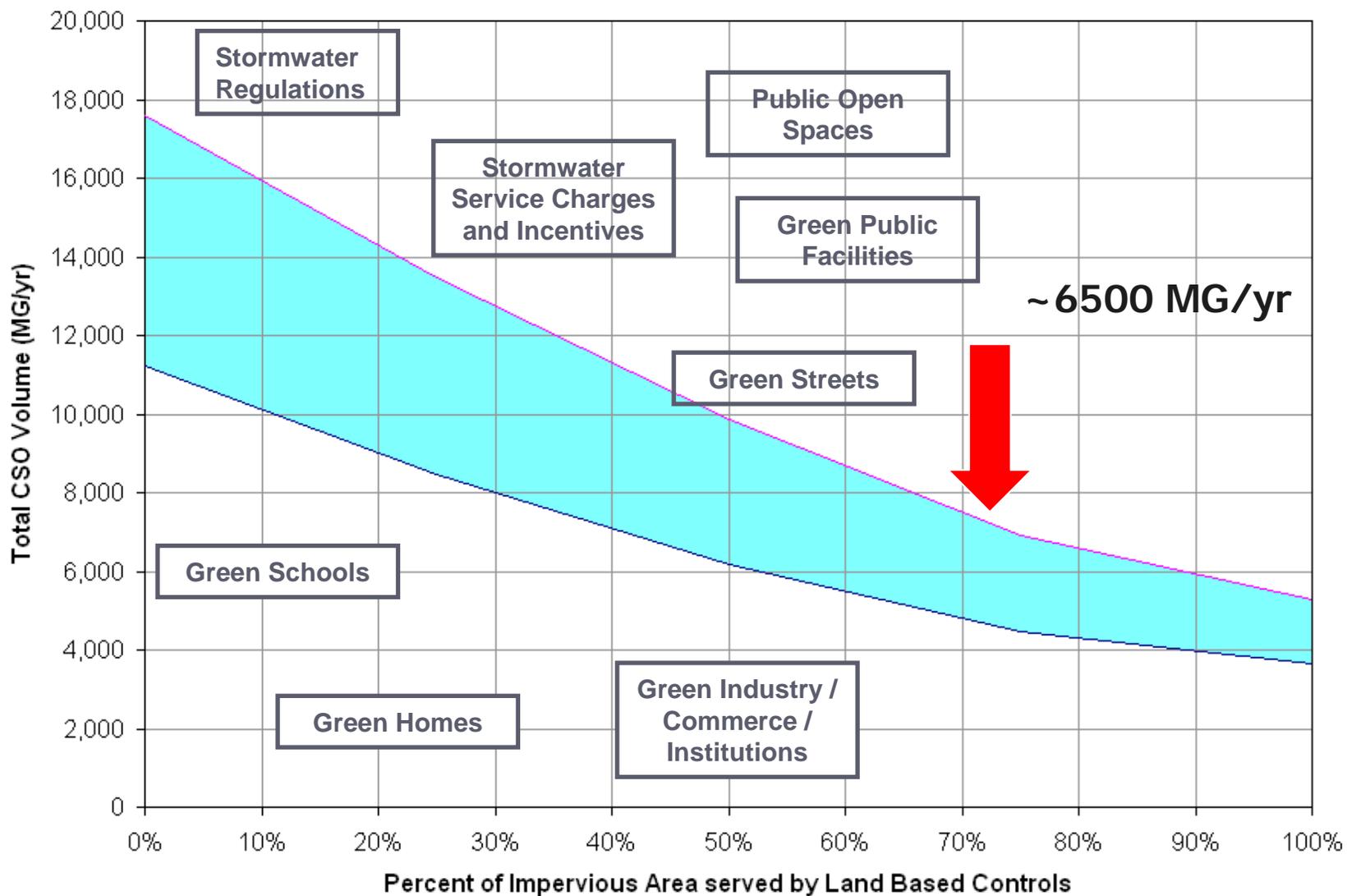
Green Infrastructure Program



Green Infrastructure Program



Green Infrastructure Program



Green Infrastructure Program

