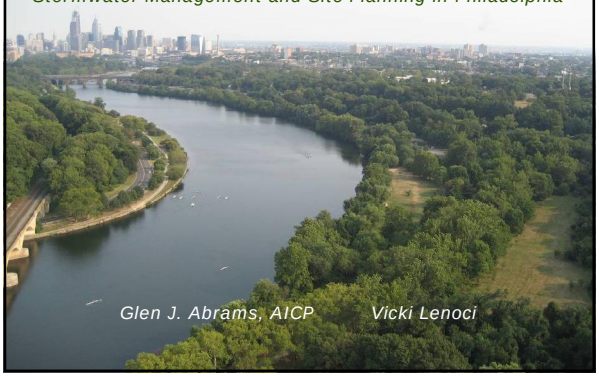
Planning & Implementing the Green City

Stormwater Management and Site Planning in Philadelphia



Glen J. Abrams, AICP *Vicki Lenoci*

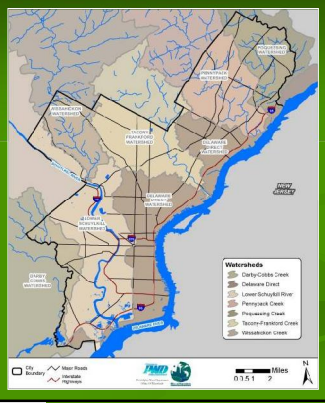
Philadelphia Water Department

- An integrated utility:
  - Drinking Water
  - Wastewater
  - Stormwater
- A new integrated approach:
  - Land
  - Waterways
  - Infrastructure
  - Community

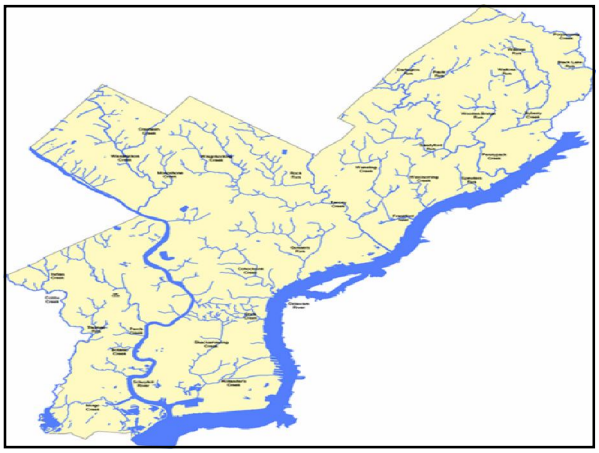
The Green Water Utility

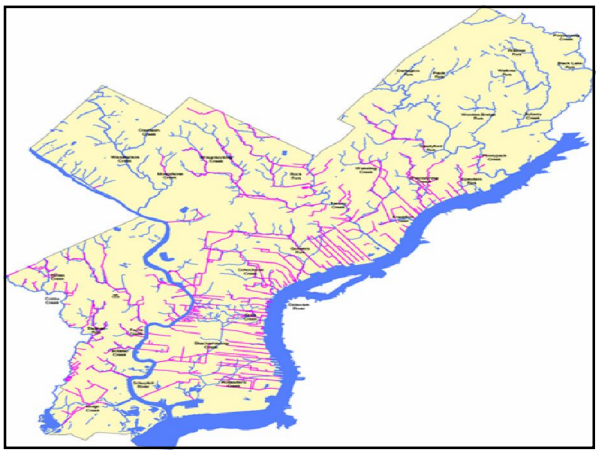
- Environmental Stewards
- Providers of Resource Management & Protection
- Leaders in Sustainability and Green Design
- Recognize our regional role and the importance of partnerships
- Using very different approaches, strategies and priorities

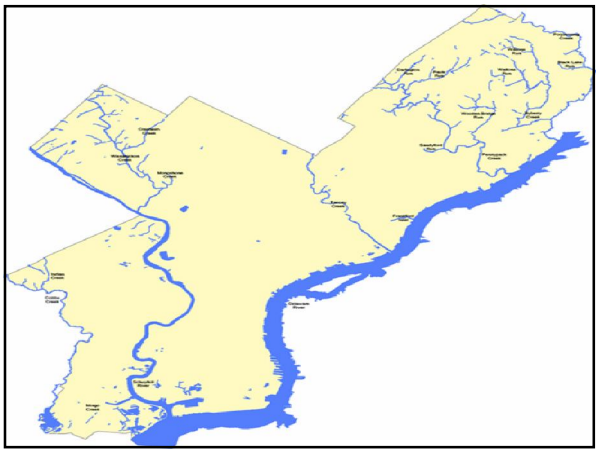
Philadelphia's Watersheds

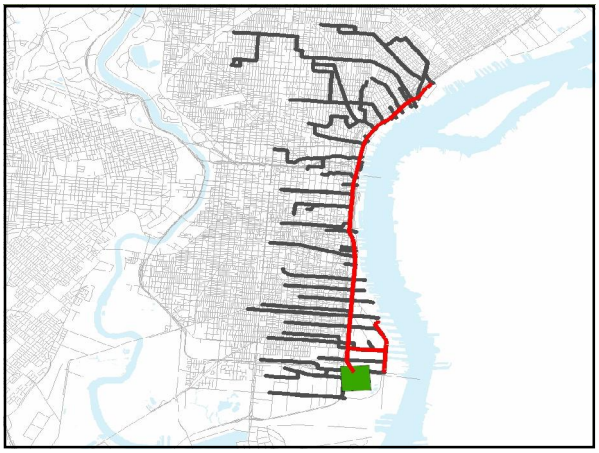


Our Water History





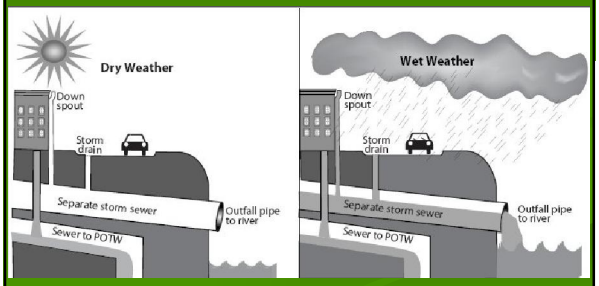




Sewer Infrastructure: Separate Sewers

Dry Weather: sewage to treatment plant

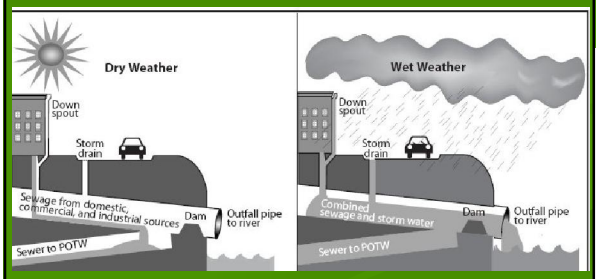
All storms: sewage to treatment plant, all stormwater to streams

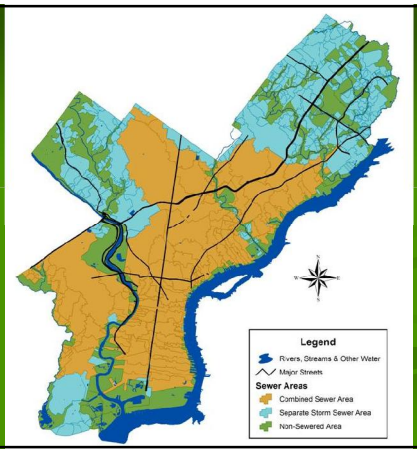


Sewer Infrastructure: Combined Sewers

Dry Weather and small storms: sewage and stormwater to treatment plant

During larger storms: overflow mix of stormwater and sewage to stream





Why Manage Stormwater?

Stormwater Runoff Contributes to Combined Sewer Overflows

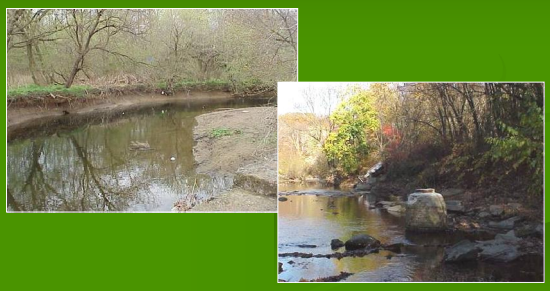
Stormwater Runoff Becomes Easily Polluted with:

- Fertilizers, herbicides, and insecticides
- Oil, grease, and toxic chemicals
- Sediment
- Bacteria and nutrients

The Environmental Protection Agency estimates that this type of pollution is now the single largest cause of the deterioration of our nation's water quality

Why Manage Stormwater?

High Storm Flows Destroy Valuable Aquatic and Riparian Habitat



Why Manage Stormwater?

- City Stormwater Permit
- State Requirements - MS4 Phase II
- CSO Reductions
- Local Flooding
- Protect Drinking Water Supply
- Response to Development Community

How to Manage Stormwater

Old Approach –

Collect it and pipe it away quickly!

How to Manage Stormwater

New Approach –

Temporarily hold it on site to allow it to:

- Infiltrate
- Evaporate
- Be Reused

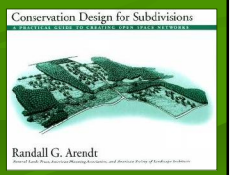
What is Low Impact Development (LID)?

LID is an ecologically friendly approach to site development that aims to mitigate development impacts to land, water, and air by conserving or replicating natural systems.

Related Development Strategies

Conversation Design

- "Density-neutral" approach to balance conservation and development objectives
- Focuses on "clustering" housing to set aside open space and sensitive lands



Smart Growth

Focuses on how and where new development should be accommodated

Smart Growth Principles

1. Mix Land Uses
2. Take Advantage of Compact Building Design
3. Create a Range of Housing Opportunities and Choices
4. Create Walkable Neighborhoods
5. Foster Distinctive, Attractive Communities with a Strong Sense of Place
6. Preserve Open Space, Farmland, Natural Beauty, and Critical Environmental Areas
7. Strengthen and Direct Development Towards Existing Communities
8. Provide a Variety of Transportation Choices
9. Make Development Decisions Predictable, Fair, and Cost Effective
10. Encourage Community and Stakeholder Collaboration in Development Decisions

LID and Stormwater Management

LID aims to mimic the natural water cycle by using small-scale, decentralized practices that infiltrate, evaporate, and transpire rainwater.

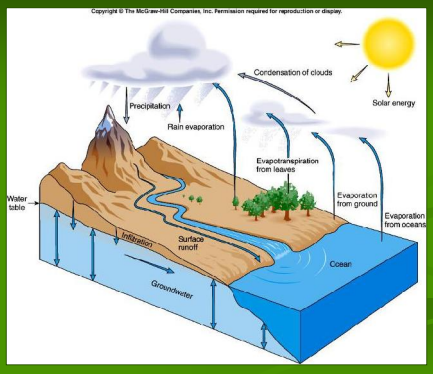
Primary Goal of LID

Low Impact Development Center

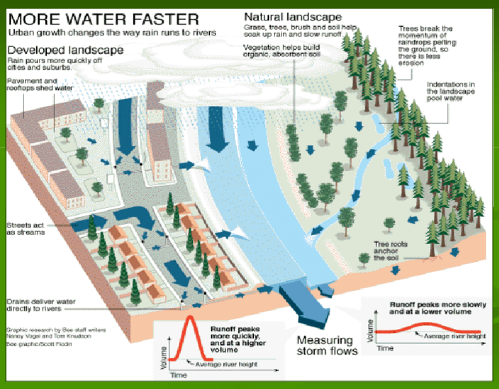
Design each development site to protect, or restore, the natural hydrology of the site so that the overall integrity of the watershed is protected. This is done by creating a "hydrologically" functional landscape.

Distributed Integrated Management Practices

Hydrologic Cycle - Constant recycling process of water



Disruption of the Hydrologic Cycle



Basic LID Principles

1. Conserve natural areas
2. Minimize development impacts
3. Maintain site runoff rate
4. Use integrated management practices
5. Implement pollution prevention, proper maintenance, and public education programs

1. Conserve Natural Areas

- Much like Conservation Design:
  - ø Start site planning with an assessment of natural areas
  - ø Identify most sensitive and highest value areas
  - ø Open space is determined based on assessment and identification
  - ø Roadways and lots designed around open space
- However, special attention is paid to existing hydrology of the site, with special emphasis placed on providing stream and wetland buffers

2. Minimize Development Impacts

- Minimize grading
- Minimize soil compaction
- Minimize tree removal
- Reduce impervious surfaces
- Reduce road widths
- Cluster buildings
- Reduce building footprints

3. Maintain Site Runoff Rate

- Maintain natural flow paths
- Lengthen flow paths
- Use open drainage
- Avoid creating steep slopes
- Disperse drainage
- Maximize sheet flow

Seattle, WA

4. Integrated Management Practices

- Small-scale stormwater controls
- Distributed throughout site
- Maintain flow patterns, filter pollutants and maintain or re-create hydrology

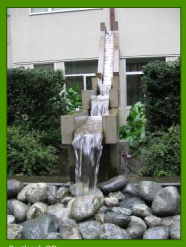
Common Stormwater Best Management Practices

- Disconnectivity
- Stormwater Harvesting
- Bioretention Systems
- Infiltration Systems
- Open Swales
- Porous Pavements
- Green Roofs
- Infiltration Planters

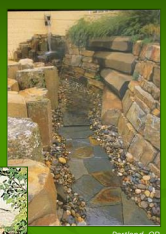
BMPs are interconnected and directly relate to site hydrology

Disconnectivity

Instead of being directly connected to stormwater infrastructure, rain leaders are “disconnected” and allowed to discharge across a lawn or into a rain garden, swale or infiltration bed.



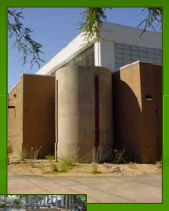
Portland, OR



Portland, OR

Rainwater Harvesting

Put that rainwater to work! Collected rainwater can be used to water your garden or houseplants, for washing the car, or even for flushing toilets.

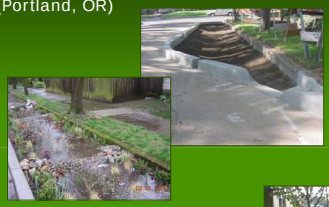


Bioretention Areas (Rain Gardens)

Stormwater directed to these shallow topographic depressions in the landscape is filtered, stored, and infiltrated into the ground using specialized vegetation and soils.

Philadelphia, PA

Bioretention and Urban Streetscape (Portland, OR)





Bioretention and Architecture

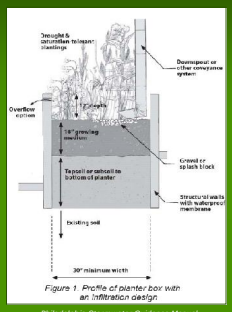


Figure 1. Profile of planter box with an infiltration design

Philadelphia Stormwater Guidance Manual

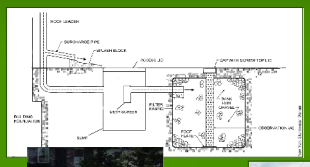

Portland, OR


Philadelphia, PA


Portland, OR

Infiltration Systems

Any system designed to promote stormwater infiltration into groundwater. Include basins, trenches, drywells, stone beds beneath pervious pavement, etc.




Philadelphia, PA


Portland, OR


Philadelphia, PA

Open Swales/Surface Channels

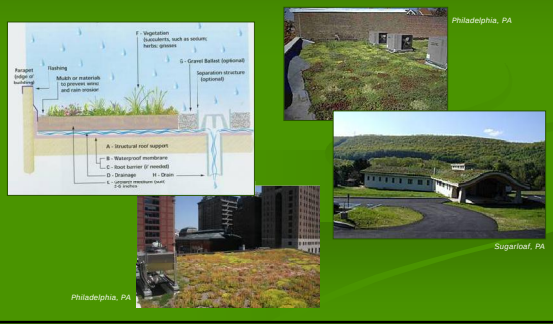
A swale is a long, shallow depression used to direct water along the surface of the ground. Stormwater is slowed, cleaned, and absorbed into the ground and/or evaporated.

Porous Pavements

A type of pavement that allows rain or snowmelt to pass through it. Can be specialized asphalt or concrete, dry-laid interlocking pavers, or other materials.

Green Roofs

Roofing systems specially designed to grow vegetation, normally consisting of a special waterproof and root repellant membrane, drainage system, filter cloth, lightweight growing medium, and plants.



PWD Enforces Strong Stormwater Regulations and Billing Mechanisms

AND

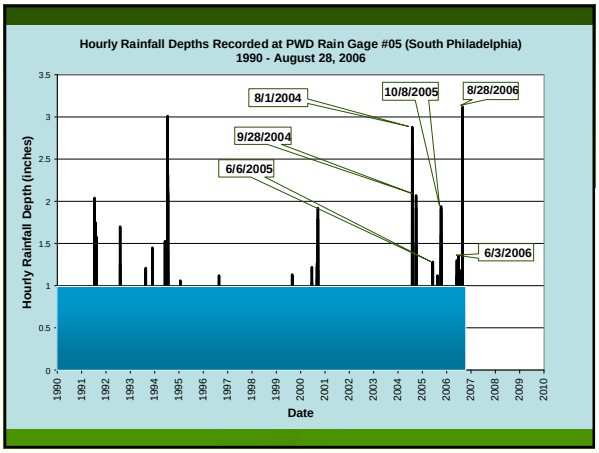
PWD has created a Green Infrastructure Program

- Green Streets
- Green Alleys, Walkways & Driveways
- Green Schoolyards
- Public Facilities
- Green Parking
- Parks, Recreation & Open Spaces
- Green Homes
- Green Businesses & Commerce
- Green Industry
- Green Institutions

Stormwater Regulations

Impacts New and Redevelopment with earth disturbance exceeding 15,000 s.f.

- Water Quality
  - Clean rainfall by managing the first 1”
- Channel Protection
  - Infiltrate or slow release 1-year, 24-hour storm (2.6 inches)
- Flood Control
  - Peak Rate Control of post to pre-development conditions
- Non-structural Site Design
  - Use existing site features



A Closer Look: Water Quality

- Collect and treat the first inch of runoff from all Directly Connected Impervious Area (DCIA) within limits of earth disturbance
  - Recharge the groundwater table and restore more natural site hydrology
  - Reduce pollution in runoff
  - Reduce combined sewer overflows (CSO) from the City's combined sewer systems

Water Quality: Can you Infiltrate?

- Some sites cannot infiltrate
- Water Quality volume must be routed through a Stormwater Management Practice (SMP) that provides volume reduction
  - Treatment and release requirements differ for separate and combined sewer areas.
    - Combined Sewer – 20% of the DCIA
    - Separate Sewer – 100% of the DCIA

A Closer Look: Flood Control

- Based upon Pennsylvania Stormwater Management Act (Act 167)
  - Determines flood management districts for controlling peak rates of runoff
- Watershed specific
- Possible exemption if 20% decrease in impervious cover is shown
- Does not apply to projects within direct discharge areas

A Closer Look: Channel Protection

- Management of 1-year, 24-hour storm event: 2.64 inches
  - Protect quality of streams
  - Reduce quantity, frequency of CSO's
- Watershed specific
- Possible exemption if 20% decrease in impervious cover is shown

Disconnected Impervious Cover (DIC)

Impervious cover that can be disconnected by directing the flow over a pervious area

- Provides infiltration, increased time of concentration
- DIC treated as pervious when:
  - Determining stormwater control requirements
  - Meeting 20% reduction

Types of Disconnected Impervious Cover

- Rooftop Disconnection
- Pavement Disconnection
- Maximize Tree Canopy
- Green Roofs
- Porous Pavement

Providing Incentives for Green Development

Instituted a Green Project Review

- Redevelopment projects disconnecting 95% or more of the impervious area in the post construction condition
  - Utilizing DIC
  - Maximize Pervious Cover
- Guaranteed shorter review time

Green Incentives through Stormwater Regulations

- LEED certification
- Building green roofs
- Brownfield re-development
- Rain Water Harvesting
- Compact development
- Shading hardscapes
- Increasing tree canopy
- Encouraging native plant choices
- Reduced parking footprint
- Minimize site disturbance
- Water conservation

PWD Stormwater Review Process & the Development Process

- Conceptual Review
  - Prerequisite approval for City Zoning Permit
- Technical Review
  - State NPDES Permit review
  - Prerequisite approval for City
- PWD Inspections
  - Ensure Operation and Maintenance

What Have We Seen?

Time Period		Earth Disturbance	Stormwater Flow Reduction	Cumulative Totals of Approved Acres	
		(*Acres*)	(*Million Gallons*)	Green Roof	Porous Pavement
2006	Jan-Jun	137.7	130.8	0.0	0.0
	Jul-Dec	75.5	71.7	0.8	0.7
2007	Jan-Jun	240.1	228.2	2.4	3.7
	Jul-Dec	325.6	309.4	4.1	5.2
2008	Jan-Jun	159.8	151.8	5.6	12.9
	Jul-Pres.	16.6	15.7	6.9	13.4

New Stormwater Rate Structure

- Parcel-based billing based on Gross Area (20%) and Impervious Cover (80%)
- From hidden costs to dedicated fees
- Truer cost of service
- Encourage BMP Retrofits

Create Financial Incentives for Better Land Management

Gross Area = 600,000
Imperv Area = 500,000

Existing Charge = $ 400
New Charge = $ 2,500

Rewarding Urban Redevelopment

Gross Area = 24,000	Existing Charge = $ 4,700
Imperv Area = 24,000	New Charge = $ 120

PWD Enforces Strong Stormwater Regulations and Billing Mechanisms

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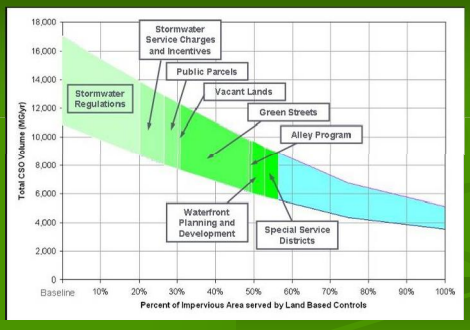
- Green Industry
- Green Institutions

These Programs Create a Unique Approach to CSO Reduction



Joint Statement on Green Infrastructure and Water Pollution

- US Environmental Protection Agency
- Natural Resources Defense Council
- National Assoc. of Clean Water Agencies

Green infrastructure is now recognized as:

- Cost effective,
- Environmentally preferable, and
- An acceptable solution to Clean Water Act goals

Philadelphia Sustainability Plan Goals

- Become a Strategic Consumer, Manager, and Producer of Energy
- Meet Climate Commitments on Greenhouse Gas Emissions
- Deliver Equitable Access to Healthy Environments
- Decrease Government and City's Environmental Footprint
- Deploy Green Space as a Public Utility
- Achieve State of the Art Resilient Infrastructure
- Reduce Philadelphia's Vulnerability to Rising Energy Prices
- Extend our Lead as a Walkable and Transit-Rich City and Region
- Use Demand for Conservation to Generate Jobs and Guide Training
- Leverage Competitive Edge of Low Energy-Intensity and Low Resource Footprint

Gray Infrastructure Solutions Green

How Many Problems Can One Solve for $3 Billion?

- CSO Tunnels:
  - Reduce sewerage overflows to our rivers
- Land-Based Strategies (Green Infrastructure):
  - Reduce sewerage overflows to our rivers
  - Create green space, improve quality of life, support green development, conserve water and energy, support education and recreation, create riparian buffers, create trails and access, provide fish habit, mitigate urban heat island, improve air quality . . .

Green Streets

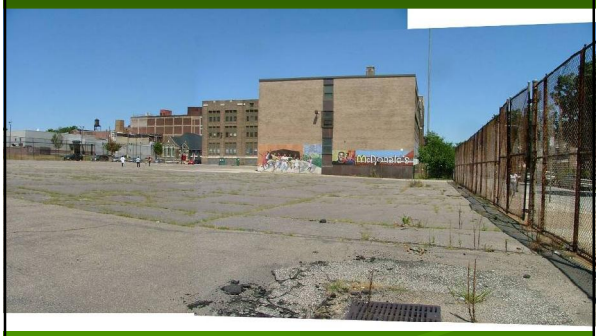
Green Streets

Green Streets

Green Streets – Near Term Goals

Category	*Estimated Number of Projects*	*Estimated Impervious Area Managed (ac)*	*Estimated Cost (million)*
PWD Facilities	6	17.5	$4.5
Other City Facilities	6	4.6	$1.2
Parks & Recreation	15	57.4	$15.0
Philadelphia School District	10	11.7	$3.1
Universities	5	10.1	$2.6
Other	5	5.0	$1.3
TOTAL	47	106.3	$27.7

Green Schools



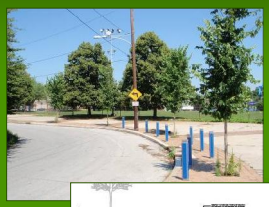
Green Schools

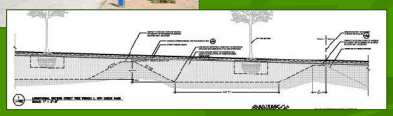
Green Schools – Near Term Goals

Category	*Estimated Number of Projects*	*Estimated Impervious Area Managed (ac)*	*Estimated Cost (million)*
Philadelphia Schools	35	94.1	$20.5
Universities	7	19.5	$5.1
TOTAL	42	113.6	$25.6

Example Demonstration Projects: Green Streets

West Mill Creek



BMPs:
Disconnected Inlets, Pervious Pavers, Subsurface Infiltration

Example Demonstration Projects: Green Streets

Waterview Rec Center



BMPs:
Disconnected Inlets, Pervious Concrete, Subsurface Infiltration

Example Demonstration Projects: Green Streets

Columbus Square



BMPs:
Sidewalk Rain Garden Planters

Example Demonstration Projects: Green Schools

Springside




BMPs:
Rain Gardens, Disconnected Rain Leaders, Environmental Art

Example Demonstration Projects: Green Schools

Wissahickon Charter



BMPs:
Rain Gardens, Rain Barrels

Example Demonstration Projects: Green Schools

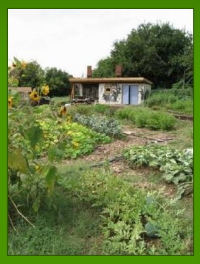
Penn Alexander




BMPs:
Subsurface Infiltration, Rain Garden, Pervious Asphalt

Example Demonstration Projects: Parks, Recreation, & Open Space

Mill Creek Farm




BMPs:
Inlet Disconnection; Vegetated Swales; Green Roof

Example Demonstration Projects: Parks, Recreation, & Open Space

Mill Creek Playground




BMPs:
Pervious Asphalt

Example Demonstration Projects: Parks, Recreation, & Open Space

Cliveden Park



BMPs:
Disconnected Inlets, Bioretention Gardens, Extended Detention

Example Demonstration Projects: Parks, Recreation, & Open Space

Saylor Grove



BMPs:
Stormwater Treatment Wetland

Example Demonstration Projects: Parks, Recreation, & Open Space

Cobbs Creek



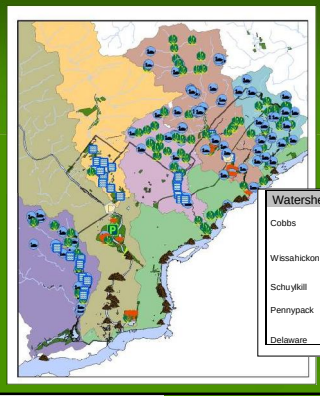

BMPs:
Streambank Restoration

Ecological Restoration

- Reconnect the City with its waterways
- Daylight streams
- Stabilize stream channels
- Restore riparian corridors
- Create wetlands
- Enhance fish passage

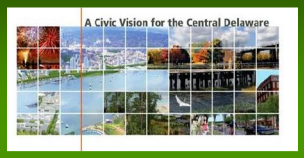


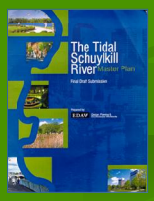

City of Philadelphia Watershed Registry

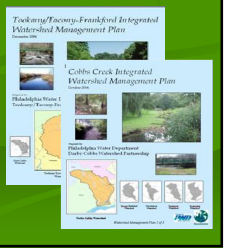


Watershed	Project Title
Cobbs	Indian Creek Daylighting Project
	Karakung Golf Course Wetland Creation
	Cobbs Creek Mainstem Stream Restoration (Phase 1)
Wissahickon	Wises Mill Stream Restoration And Wetland Creation
	Cathedral Run Stream Restoration
Schuylkill	Bells Mill Stream Restoration
	Mingo Creek Basin Wetland Creation
	Tidal Schuylkill Riverine Wetland Enhancement Project
Pennypack	Sandy Run Stormwater Wetland Creation
	Redd Rambler Run Stream Restoration
Delaware	Pleasant Hill Park Tidal Stream Creation And Wetland Enhancement Project

Partnerships & Planning







The Power of Planning ... and Imagination

WATERWORK

Grand Prize Winner
Urban Voids Competition
The Van Alen Institute

Juliet Gelfi
Clarice McAfee
Charles Loomis
Gavin Riggall

Philadelphia + vacant land + water = stormwater management + civic beauty + fun!

For more information: www.vanalen.org/urbanvoids
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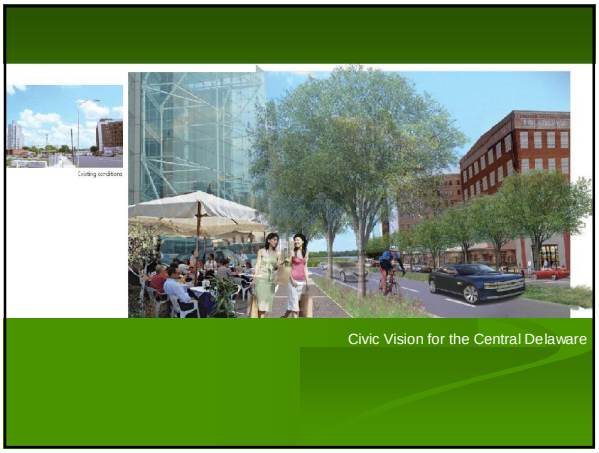
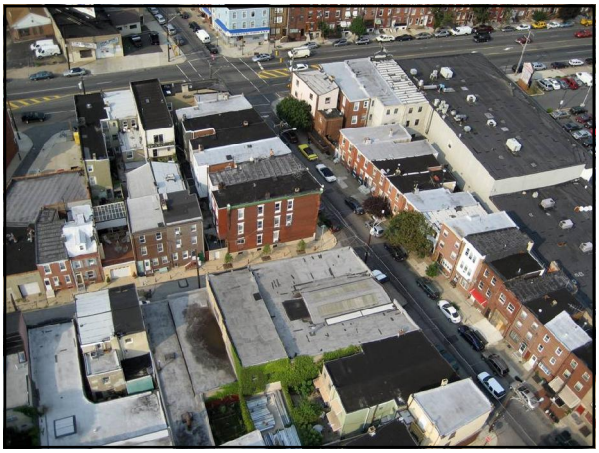
Civic Vision for the Central Delaware

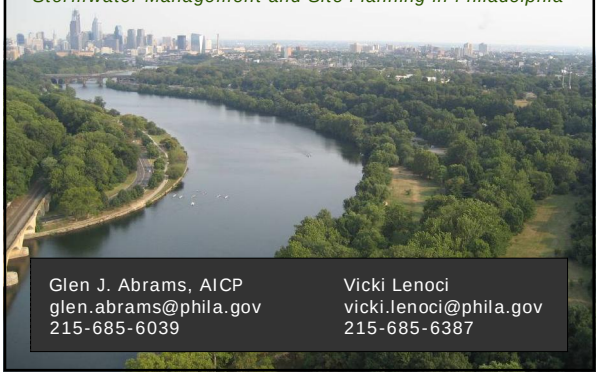


Civic Vision for the Central Delaware



Planning & Implementing the Green City

Stormwater Management and Site Planning in Philadelphia



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