



INTEGRATING GREEN INFRASTRUCTURE TO REVITALIZE OUR COMMUNITIES



April 14, 2015
American Planning Association - Pennsylvania
Spring Forum
"Solutions of the Alphabet Soup of Water Regulation"



The City of Lancaster: Overview

- Incorporated in 1742 as a borough and in 1818 as a City
- Served as the temporary National Capital during the Revolution
- ~60,000 residents in the 2010 census
- 7.34 square miles
- Historic building stock (median home age of 100 years)
- Surrounded by some of the most productive non-irrigated farmland in the U.S.
- Environmental Justice Community





Lancaster's Clean Water Act History

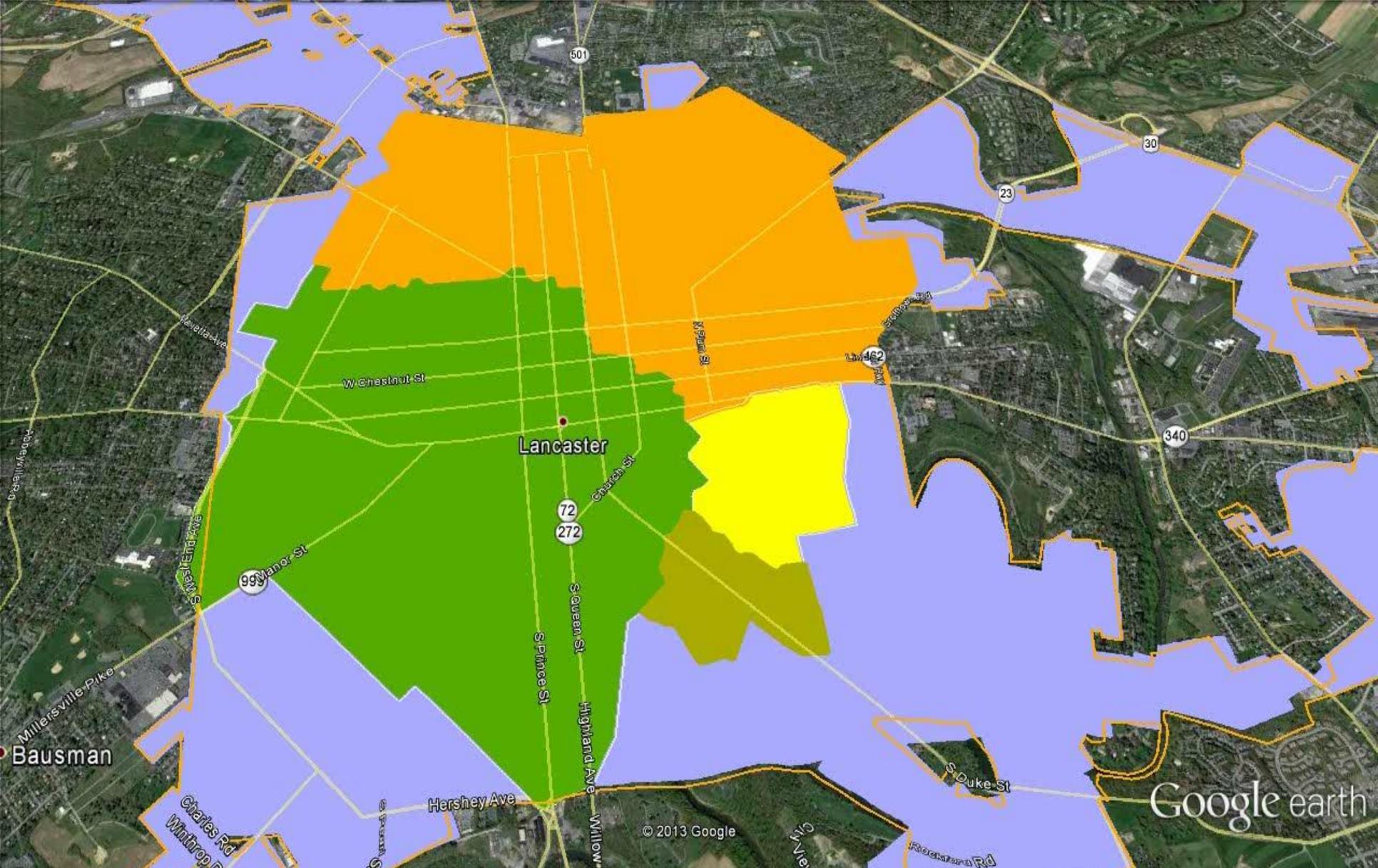
We are not alone! Many municipalities have combined sewer overflows (CSOs).



US EPA:

- 772 CSO Communities
- Approximately 40 million people

45% Combined, 55% Separate Storm Sewers



The City has been proactively implementing its CSO LTCP

- CSO LTCP Completed in 1998
- PA DEP approval of LTCP on 12/17/1998
- The LTCP plan
 - Cited that WQS were being attained in the Conestoga River
 - Adopted a goal of 85% capture

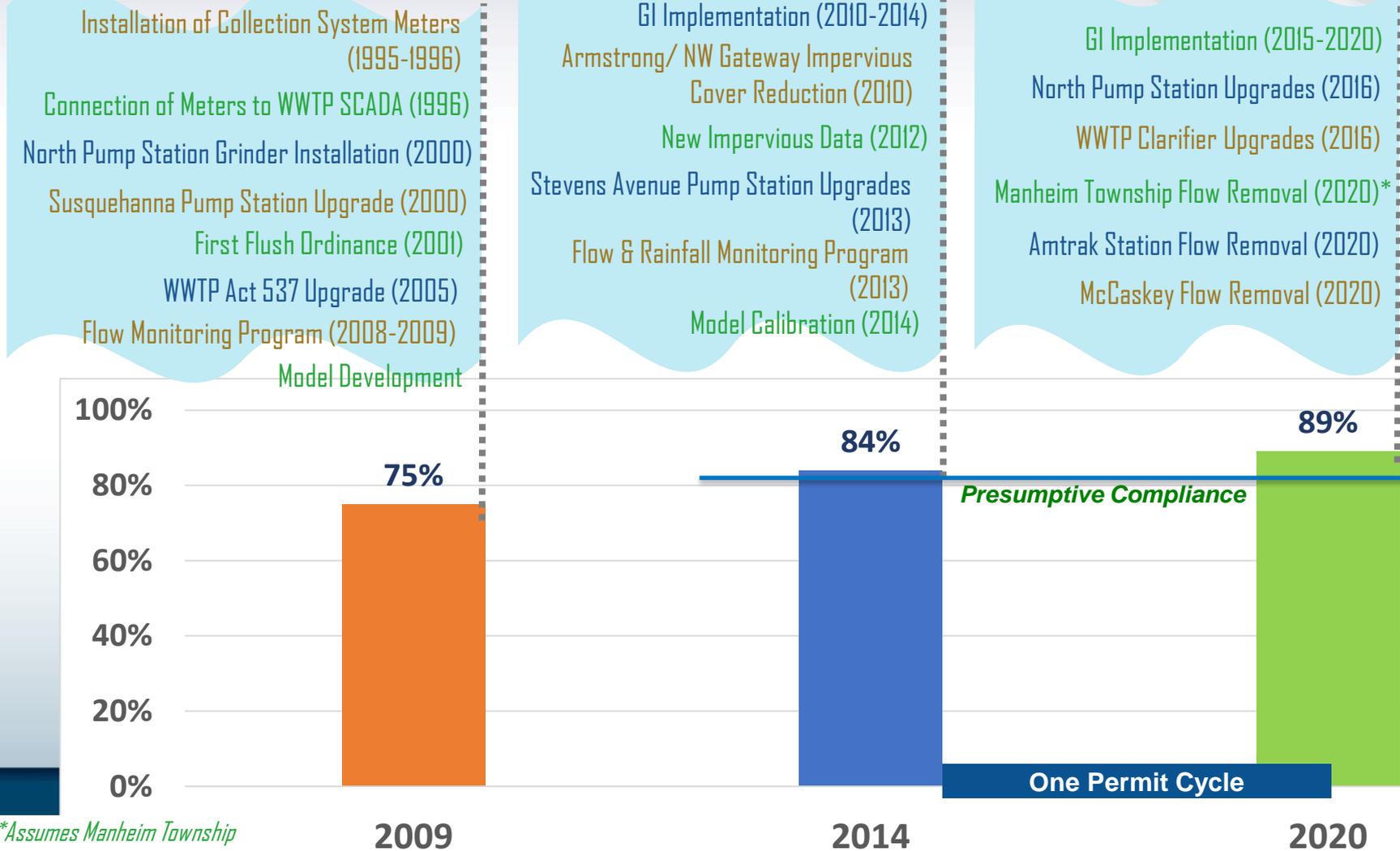
Lancaster Municipal Authority Combined Sewer Overflow Plan

Final Long-Term Control Plan
September 1998



lh
BUCHART
HORN, INC.

Aggressive WW and CSO CIP achieved 84% capture and will attain presumptive compliance by 2016



**Assumes Manheim Township buy-in/participation*

MS4 Challenges





The Future Vision

Multiple Additional Clean Water Challenges Require An Integrated and Equitable Solution

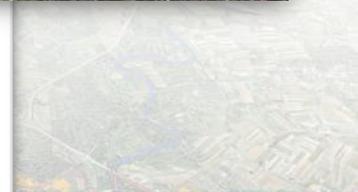
- CSO Discharges
- MS₄ Permits
- TMDLs: Chesapeake Bay Requiring 60% reduction in nutrients by 2017
- Integrating these efforts and implementing them consistently can greatly reduce CSO discharges and nutrients from the urban area such as MS₄ Communities



Part VII

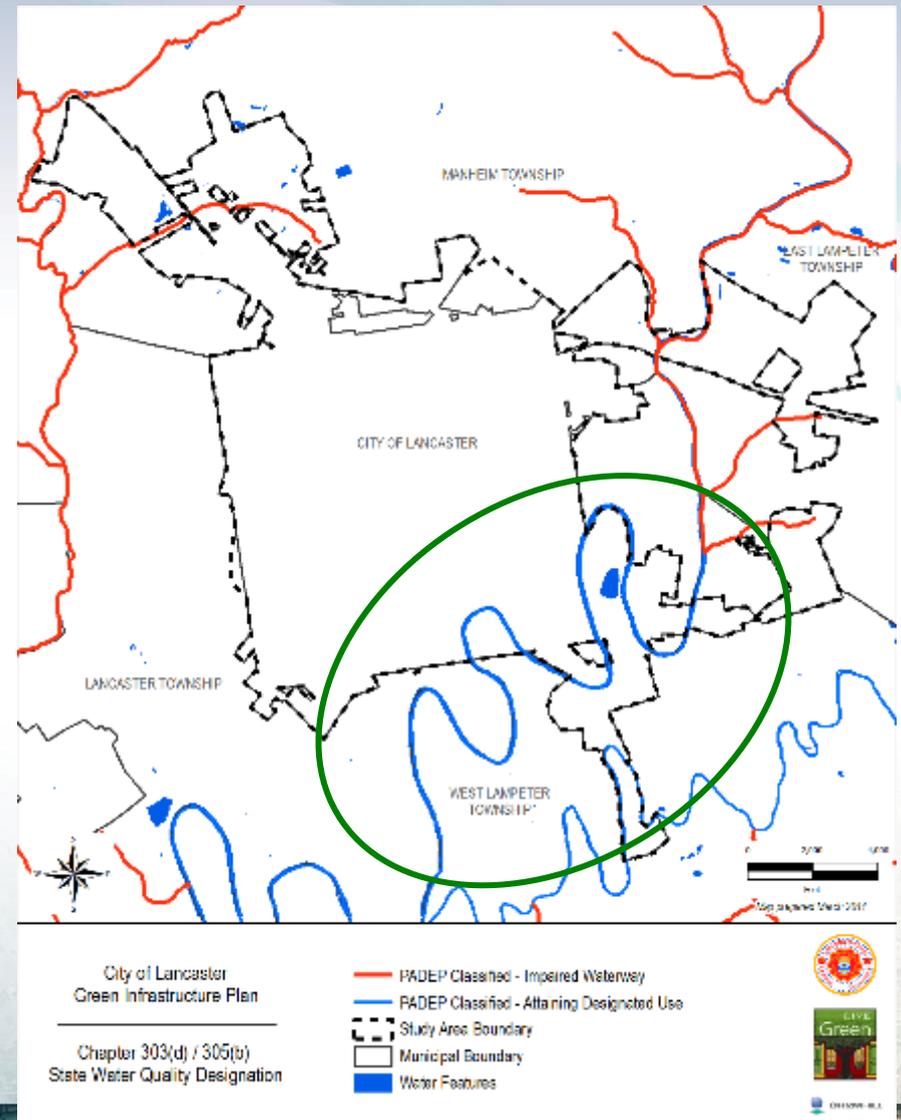
Environmental Protection Agency

Combined Sewer Overflow (CSO) Control Policy; Notice



Conestoga River is Attaining its Designated Use

- PA DEP 2014 Integrated list shows the Conestoga River Below Lancaster CSOs as Attaining
- Focusing on a Watershed-based approach to value future CWA investment



Source – PA DEP 2014 Integrated List

Chesapeake Bay Total Maximum Daily Load (TMDL)

Watershed Implementation Plan (WIP)

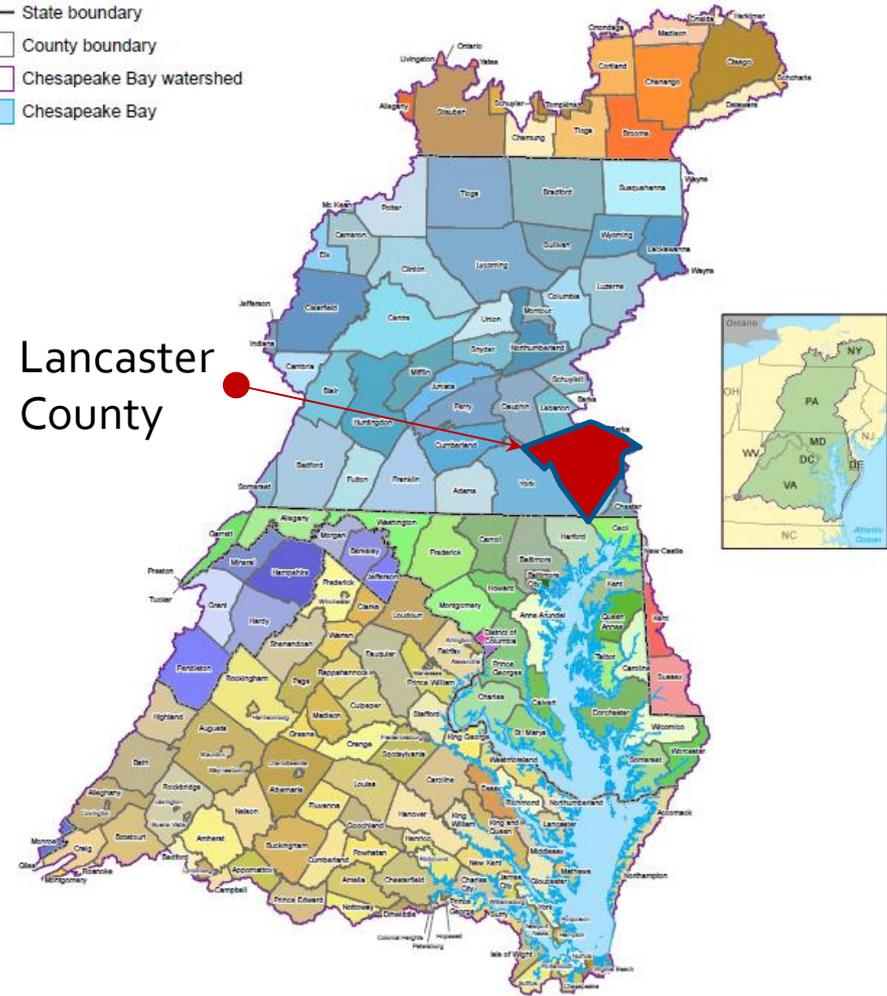
for Lancaster County includes reductions of:

- 39% for TSS
- 35% for TN
- 27% for TP

Chesapeake Bay Counties



Lancaster County



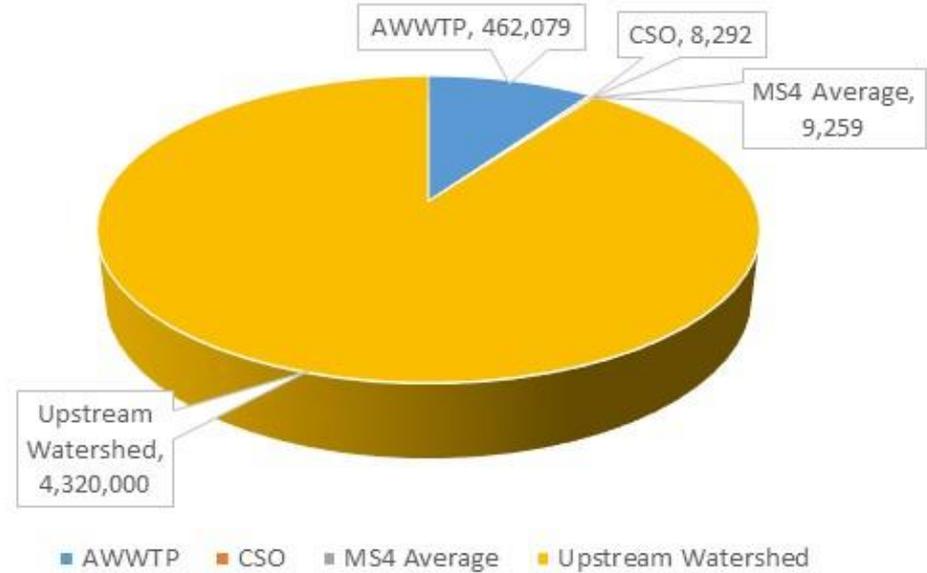
Estimated Conestoga River Watershed Loads

City contributes approximately:

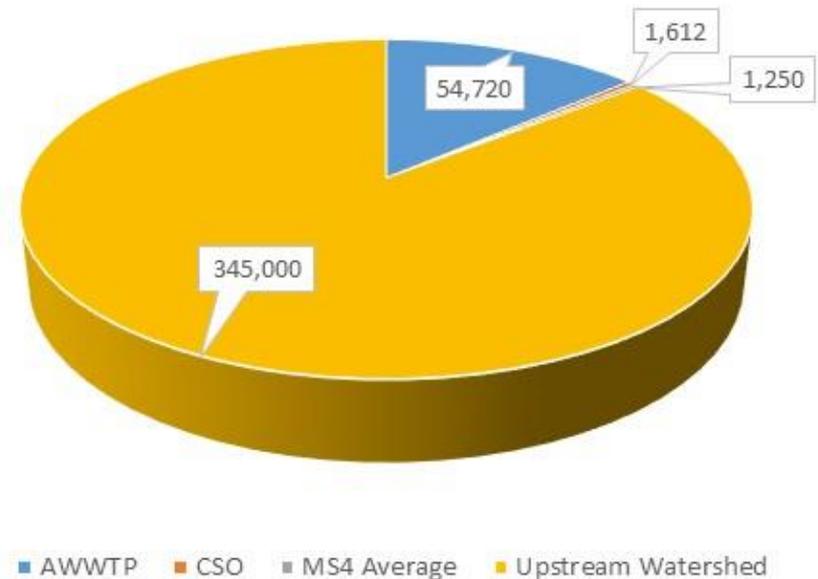
- 0.7% TSS
- 10% TN
- 14% TP

of the total loads to the Conestoga River at the City.

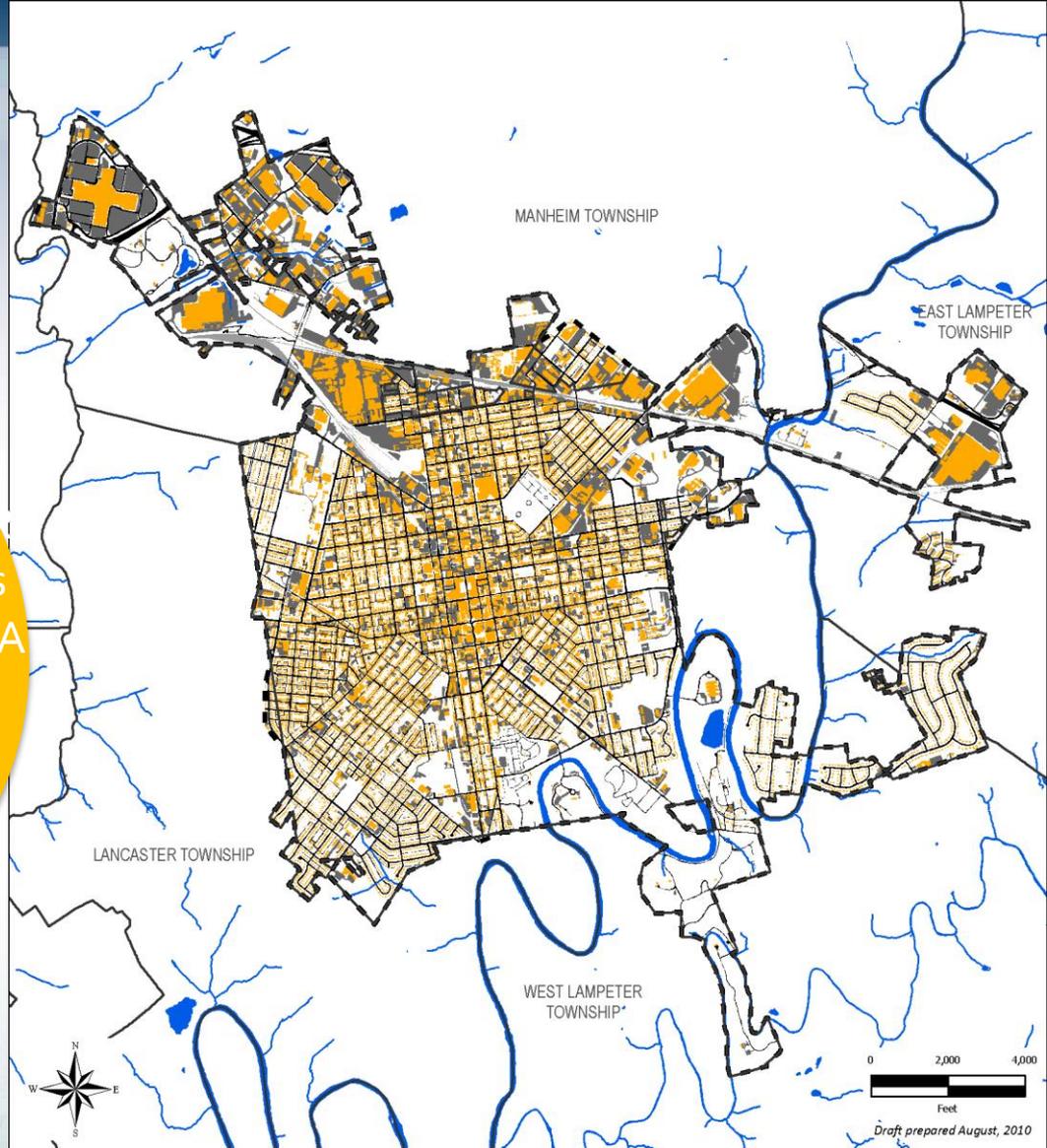
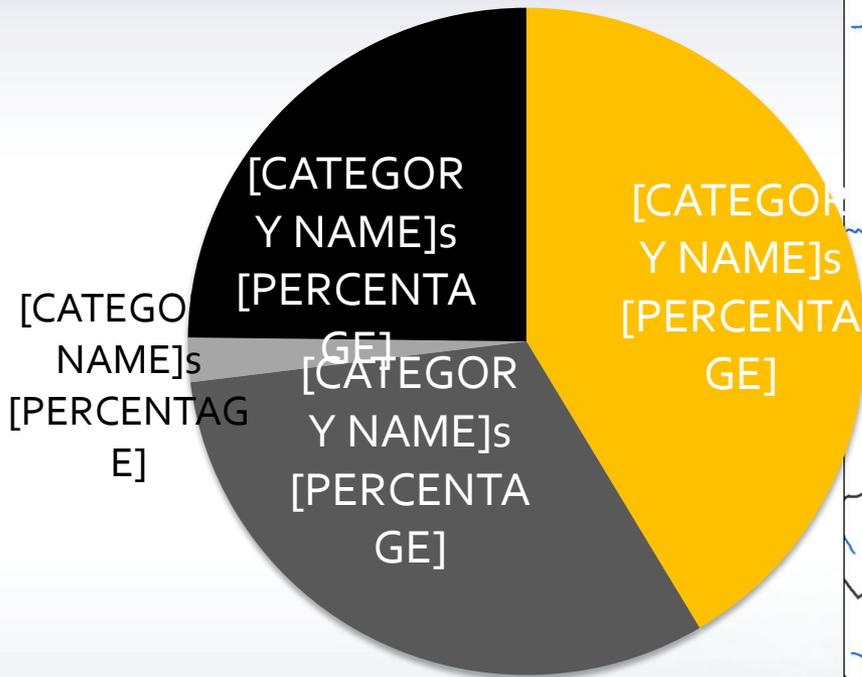
Estimated Watershed TN Loads (lb/yr)



Estimated Watershed TP Loads (lb/yr)



48% of the City is Impervious Cover



City of Lancaster
Green Infrastructure Plan

Impervious Area
Classification

- Study Area Boundary
- Municipal Boundary
- Streams
- Waterways
- Building
- Railroad
- Parking Lot
- Roadway



The Green Infrastructure Benefit Calculator Projects Future Benefits for CSO and MS4 Areas

Table 5-11 – Green Infrastructure Calculator for long-term (approximately 25-year) period

Impervious Area / Impervious Source Area Type	Impervious Contributing Area (acres)	Impervious Percent	Green Infrastructure Project / Technology	Assumed Percent of Impervious Area Managed	Impervious Area Managed (acres)	Total SW Runoff (MG/yr)	Assumed BMP Volume	Average Runoff Reduction	Annual Runoff / Runoff Reduction (MG/yr)
Roads / Alleys	529	100%	Green Streets	30%	159	513	1.0	86%	132.4
Parks	241	8%	Park Improvements / Greening	85%	17.0	19	1.0	86%	14.2
Sidewalks	124	100%	Disconnection, Porous Pavement	35%	43.3	120	1.0	86%	36.1
Parking Lots	648	100%	Porous Pavement, Bioretention	20%	130	628	2.0	97%	121.3
Flat Roofs	218	100%	Vegetated Roofs / Disconnection	15%	32.7	212	1.0	86%	27.3
Sloping Roofs	654	100%	Disconnection/Rain Gardens	25%	164	635	1.0	86%	136.5
Street Trees	N/A	N/A	Enhanced Tree Planting	N/A	45.1	44	0.3	49%	21.5
Public Schools	175	29%	Green Schools	75%	38.4	50	1.0	86%	32.0
Various (Ordinance)	1274	100%	First-Flush Ordinance	50%	637	1236	1.0	86%	531.6
Total					1,265	3,752			1,053

55%

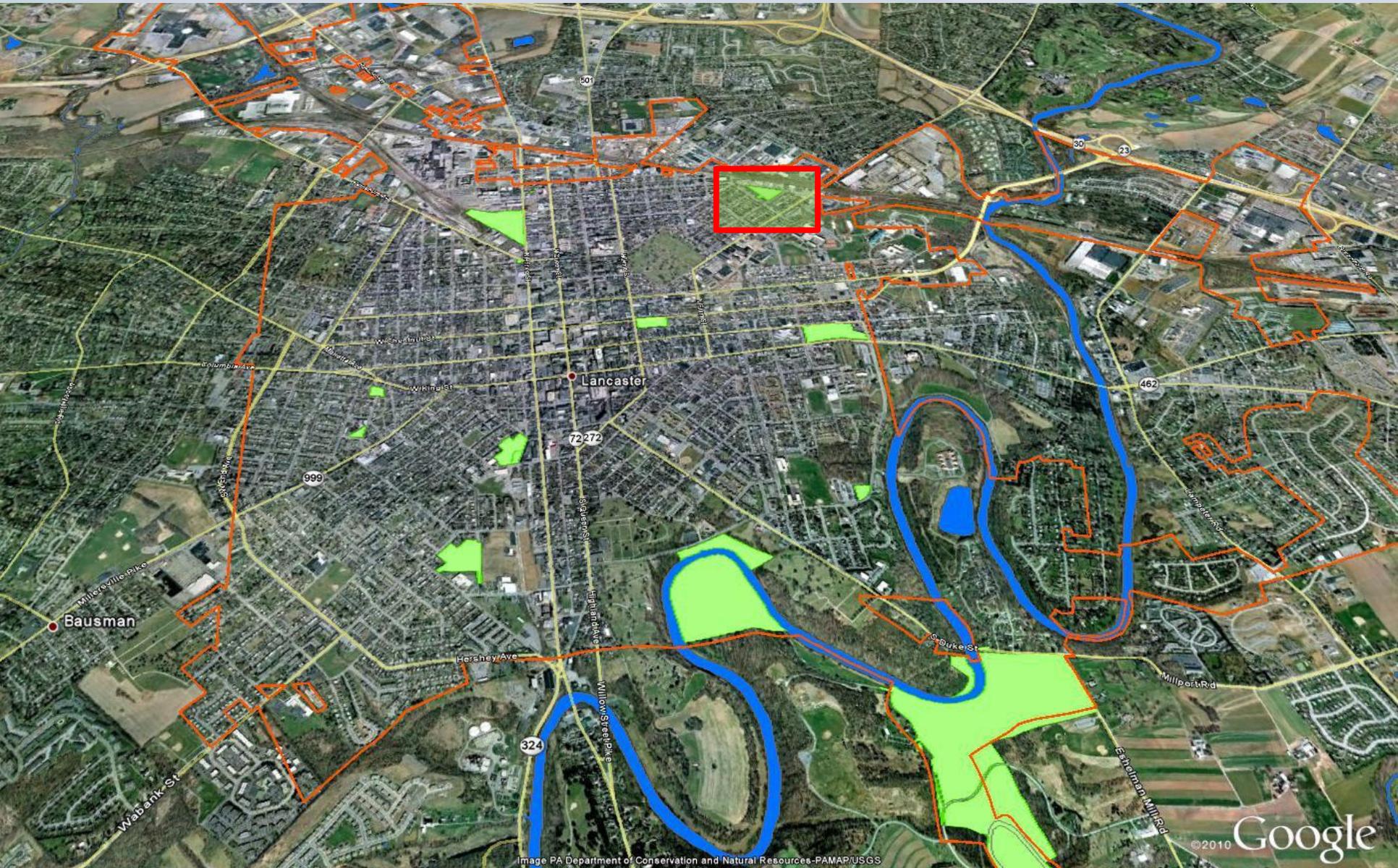
Pollutant	Average Stormwater Concentration* (mg/l)	Average CSO Discharge Concentration (mg/l)	Pollutant Reduction from Stormwater (lb/yr)	Pollutant Reduction from CSOs (lb/yr)	Total Est. Pollutant Reduction (lb/yr)
Total Suspended Solids (TSS)	1.2	5.5	3,485	24,267	1,457,000
Total Phosphorus (TP)	1.2	5.5	3,485	24,267	27,800
Total Nitrogen (TN)	0.7	13.5	2,033	59,564	61,600

**Based on the midpoint pollutant concentrations in USEPA's CSO Report to Congress, 2001*

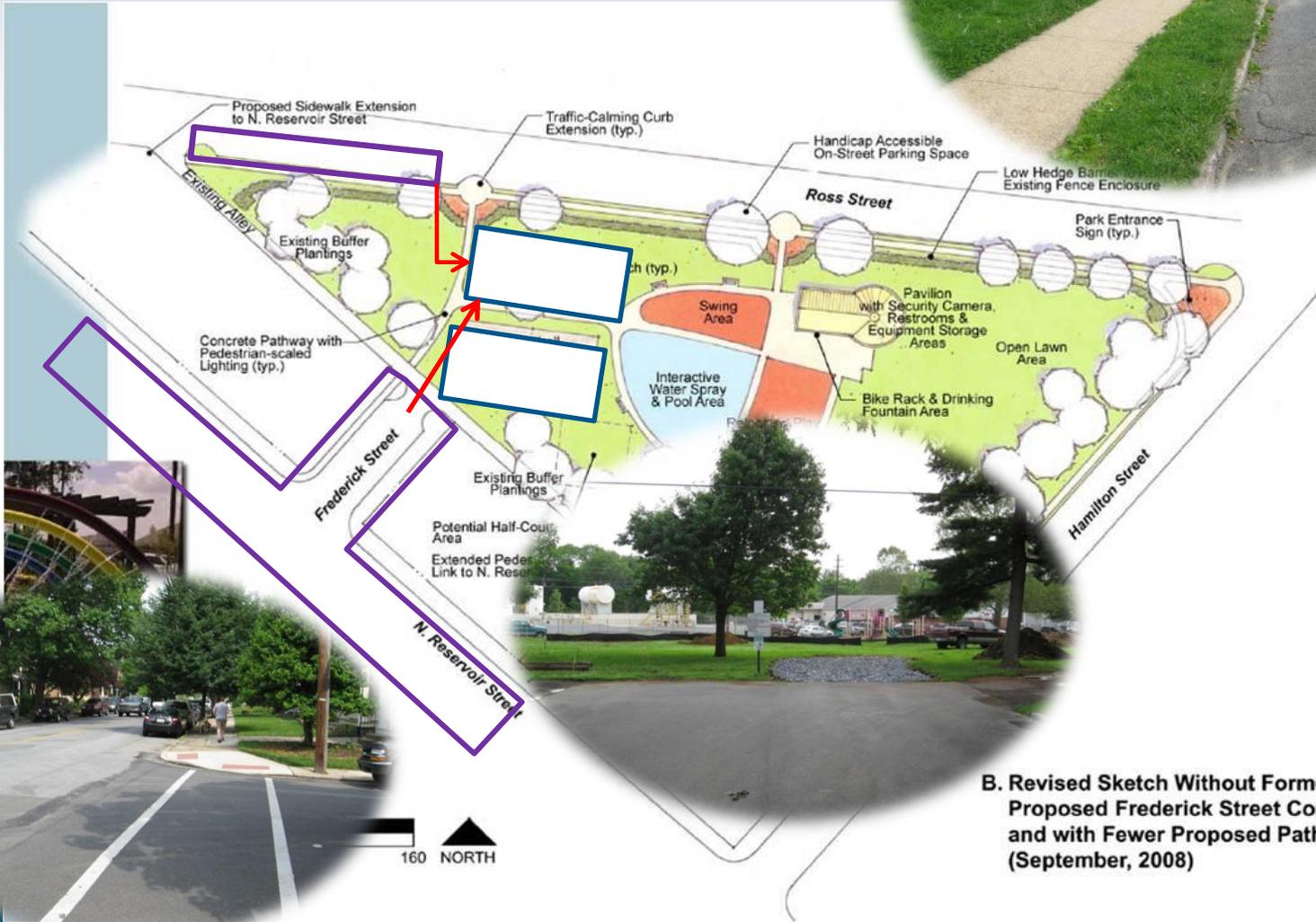
**25-Year Plan to manage over 1,200 Acres of Impervious Area
Capture over 1 Billion Gallons of Stormwater Runoff over the long term**



Green Parks



6th Ward Park: Extending the Benefit of the Playcourt



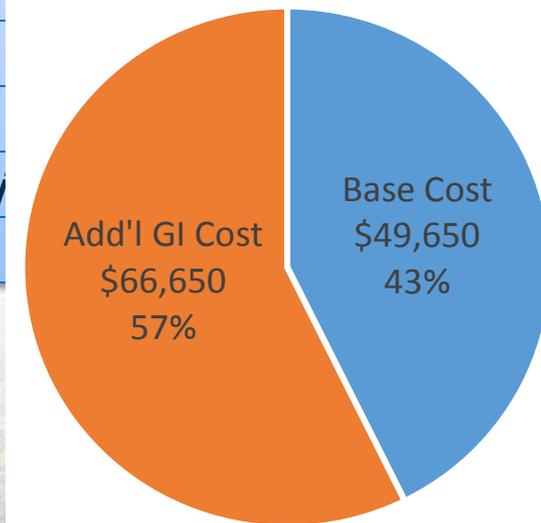
B. Revised Sketch Without Formerly Proposed Frederick Street Connection and with Fewer Proposed Pathways (September, 2008)

6th Ward Park Rededication Ceremony



First Demonstration Project at 6th Ward Park Reveals High Cost/Benefit

Runoff Reduction	695,000	gallons / yr
Bid	\$ 116,300	
Cost of Court Only	\$ 49,650	
Incremental Cost of GI	\$ 66,650	
Total Cost	\$ 0.17	/gallon
Incremental Cost of GI	\$ 0.10	/gallon
	<i>[43% savings through integrati</i>	
Grey Storage Cost	\$ 0.25-0.30	/gallon



Funding from DCNR, DEP and Chesapeake Bay Stewardship Fund (NFWF)

Green Parks



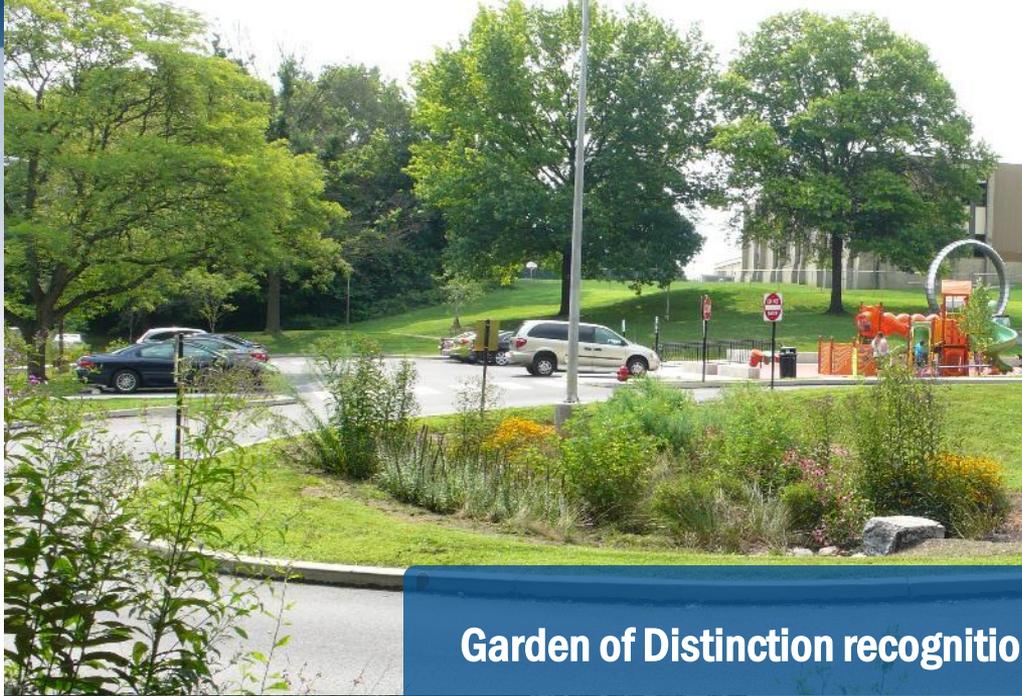
Brandon Park



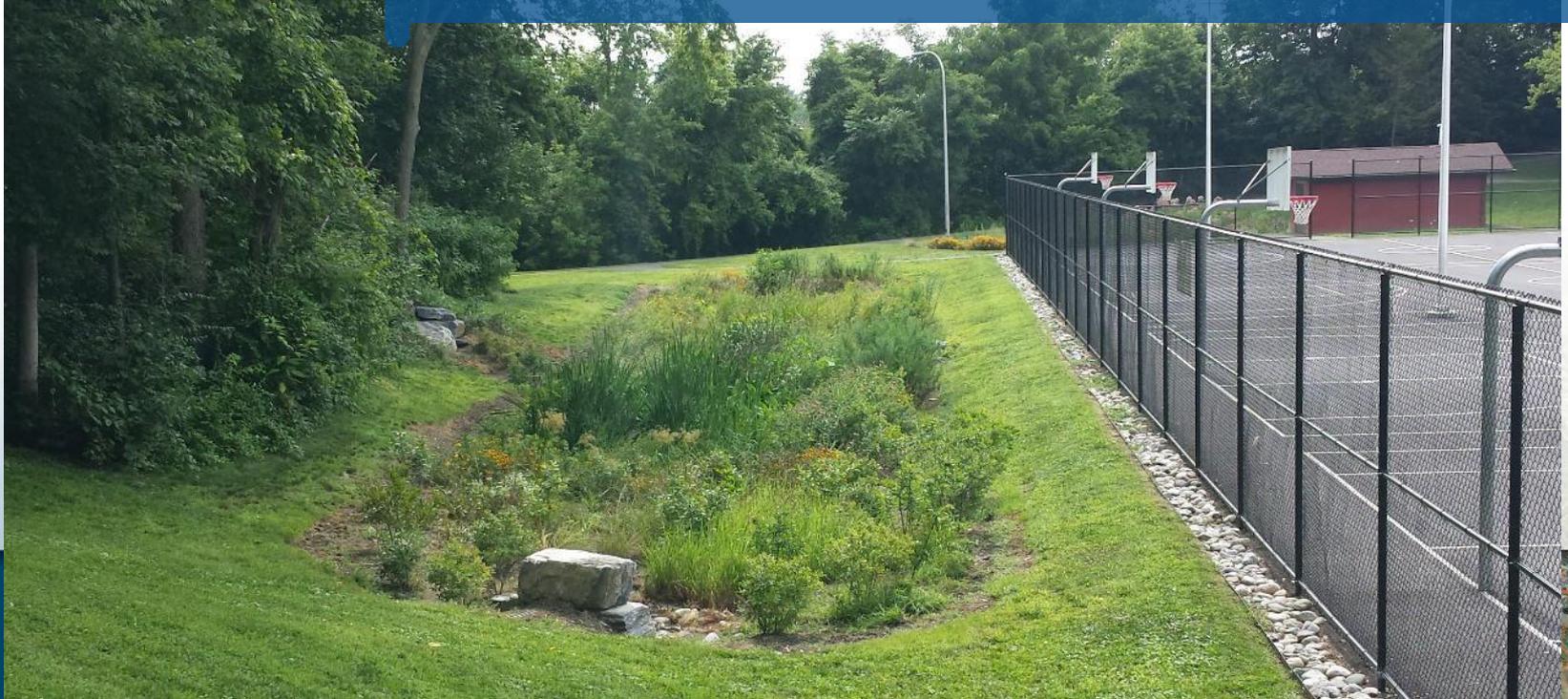
4 Million Gallons / year reduction in runoff volume → \$0.15/gal

Brandon Park – Wabank St. Curb Extensions

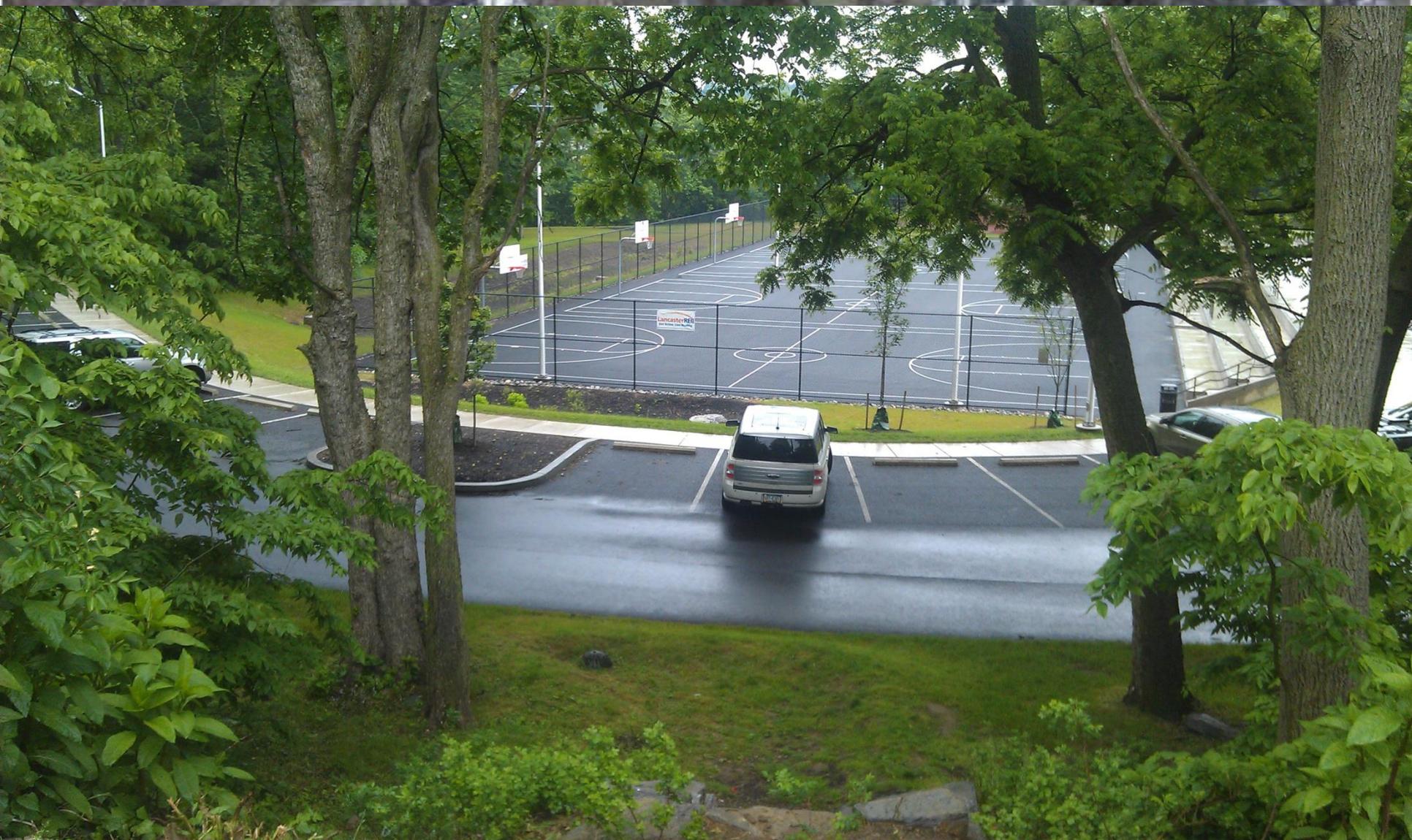




Garden of Distinction recognition from Pennsylvania Horticultural Society



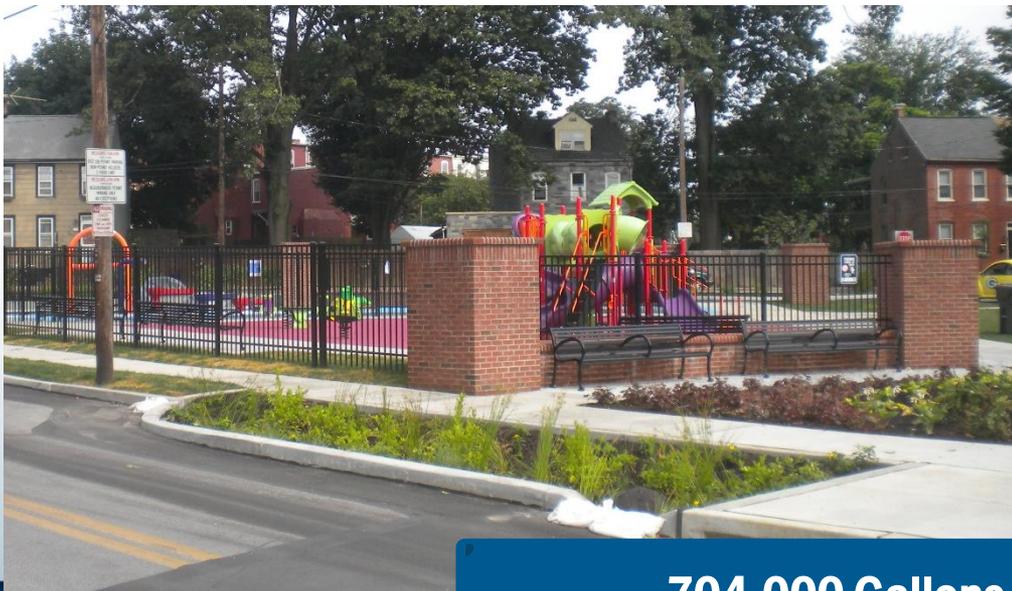
Brandon Park



Brandon Park



Rodney Park



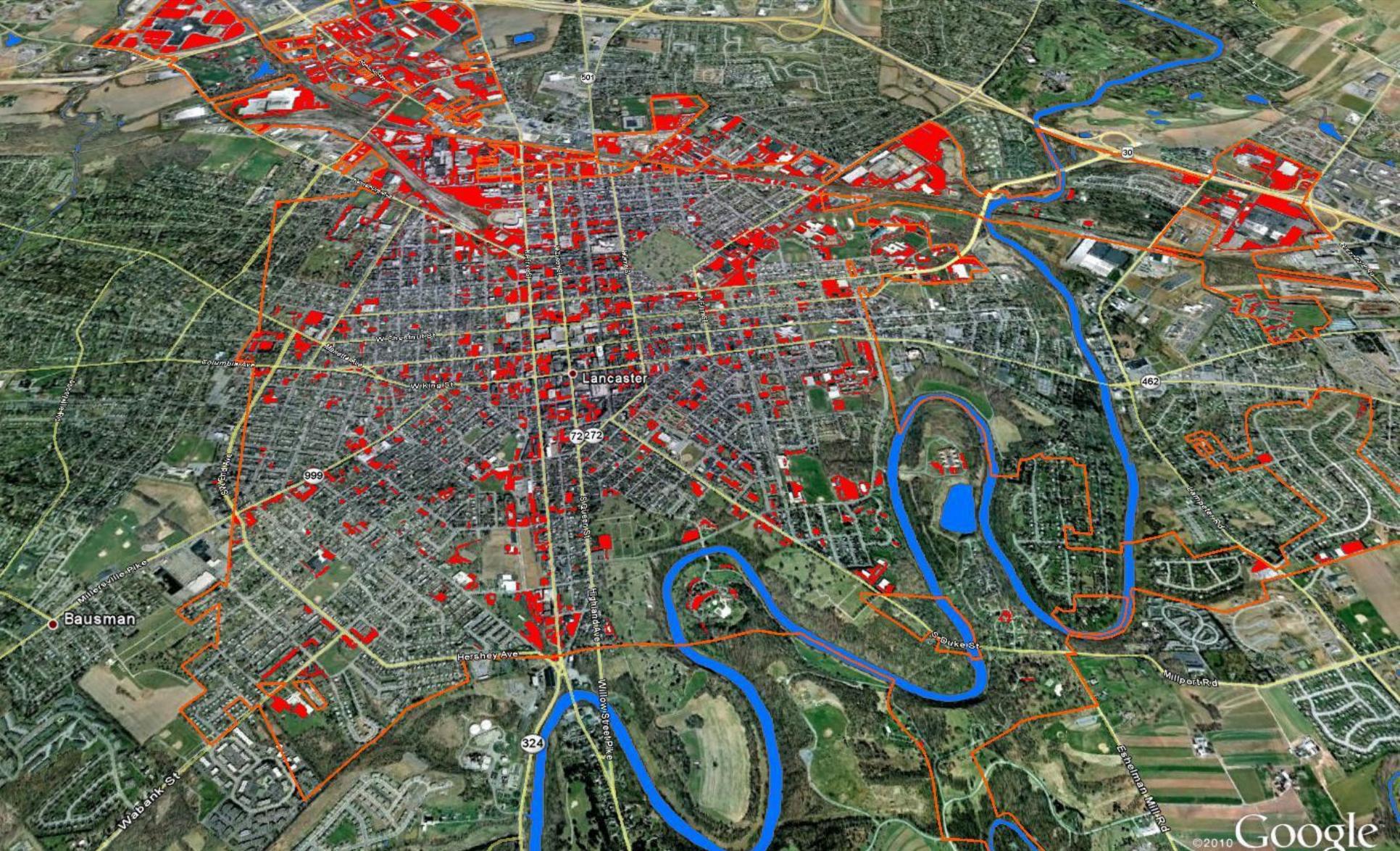
704,000 Gallons / year reduction in runoff volume

Crystal Park



1,320,000 Gallons / year reduction in runoff volume

Parking Lots



Mifflin Street Parking Lot



281,000 Gallons / year reduction in runoff volume

Plum Street Parking Lot



731,000 Gallons / year reduction in runoff volume

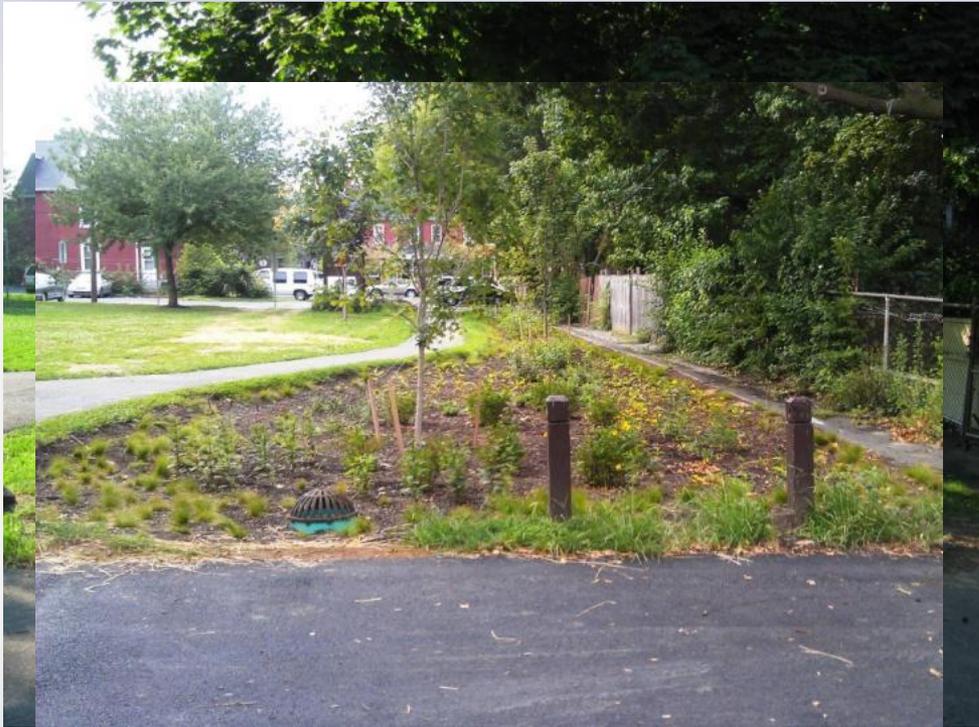


Penn Ave Parking Lot



538,000 Gallons / year reduction in runoff volume

Dauphin Street Parking Lot



452,000 Gallons / year reduction in runoff volume

Summary of City-Owned Parking Lot Retrofit Projects

Parking Lot	Drainage Area	GI Area	Capture Volume	Capital Costs with Contingency
Plum Street	23,402	4,680	511,000	\$89,862
Dauphin	20,582	4,516	411,000	\$61,822
Penn	22,758	4,219	455,000	\$60,749
Mifflin	13,242	1,324	265,000	\$27,013
TOTAL			1,642,000	\$239,446

COST PER GALLON = \$0.14/gallon



Green Roofs

- Over 100,000 sf of green roofs in Lancaster City.
- 10 green roofs in PENNVEST funding planned.
- Approximately 1.5 square foot per person!
- Additional 50,000 sf under design for next year using PENNVEST funds

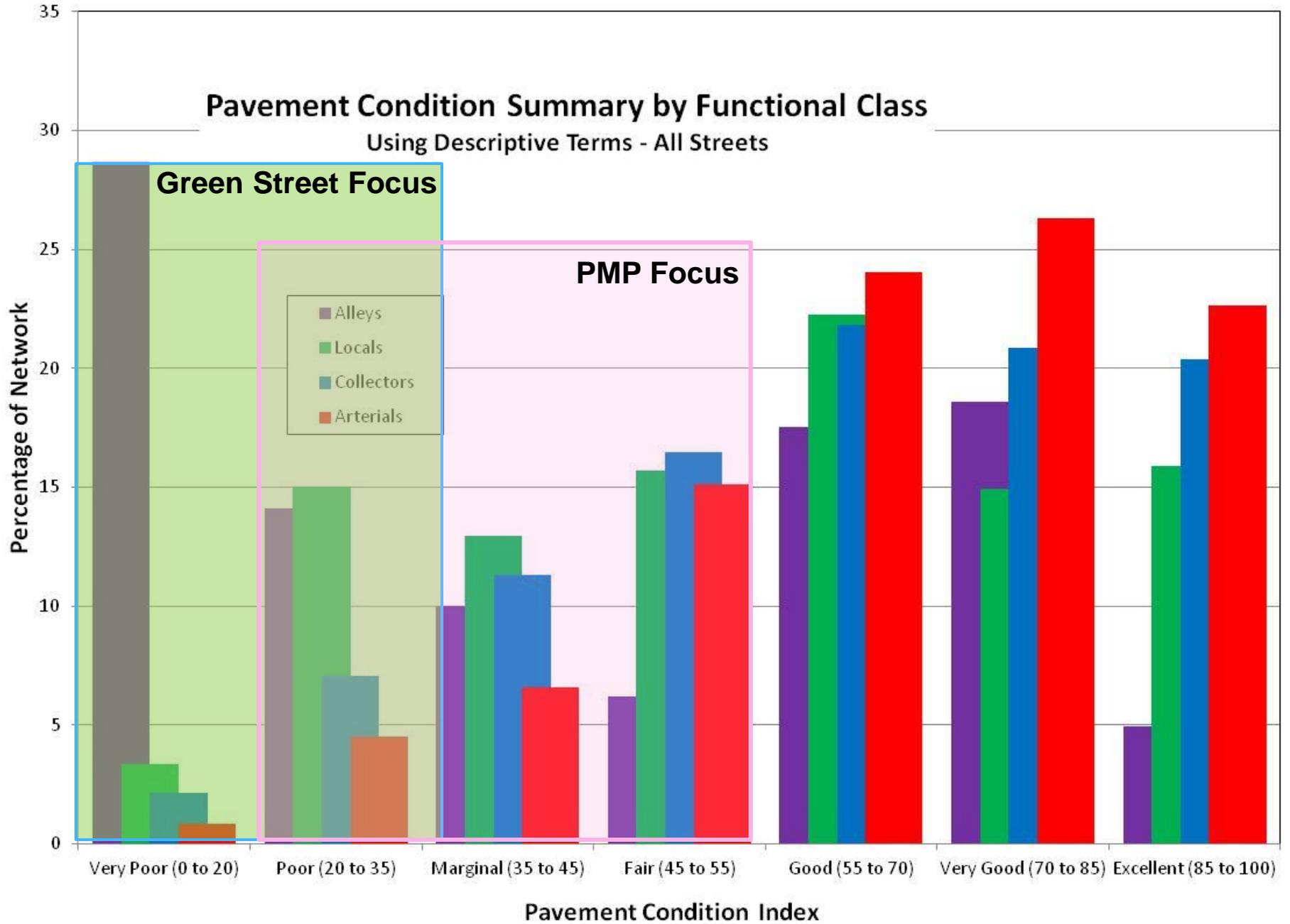


Pavement Condition Scores Guide Selection of Green Streets & Alleys



Pavement Condition Summary by Functional Class

Using Descriptive Terms - All Streets



Integrated Infrastructure: Finding Cost-Effective Green Streets Opportunities



1st Green Alley



Alley 148 Greened for 10% Additional Cost

Before (July 2011)

After (February 2012)

Component	Conventional Unit Cost (\$/square foot)	Green Unit Costs (\$/SF)
Pavement Removal/Excavation	\$1.08	\$1.08
Crushed Stone w/ geotextile	\$0.35	\$1.39
Pipes/Cleanouts/etc.	---	\$0.82
8-inch reinforced concrete	\$18.89	\$18.89
Permeable Pavers	---	\$19.44
Total Weighted Average	\$20.32	\$22.37
Additional Green Cost (\$/SF)	---	\$2.05
Additional Green Cost (%)	---	10%

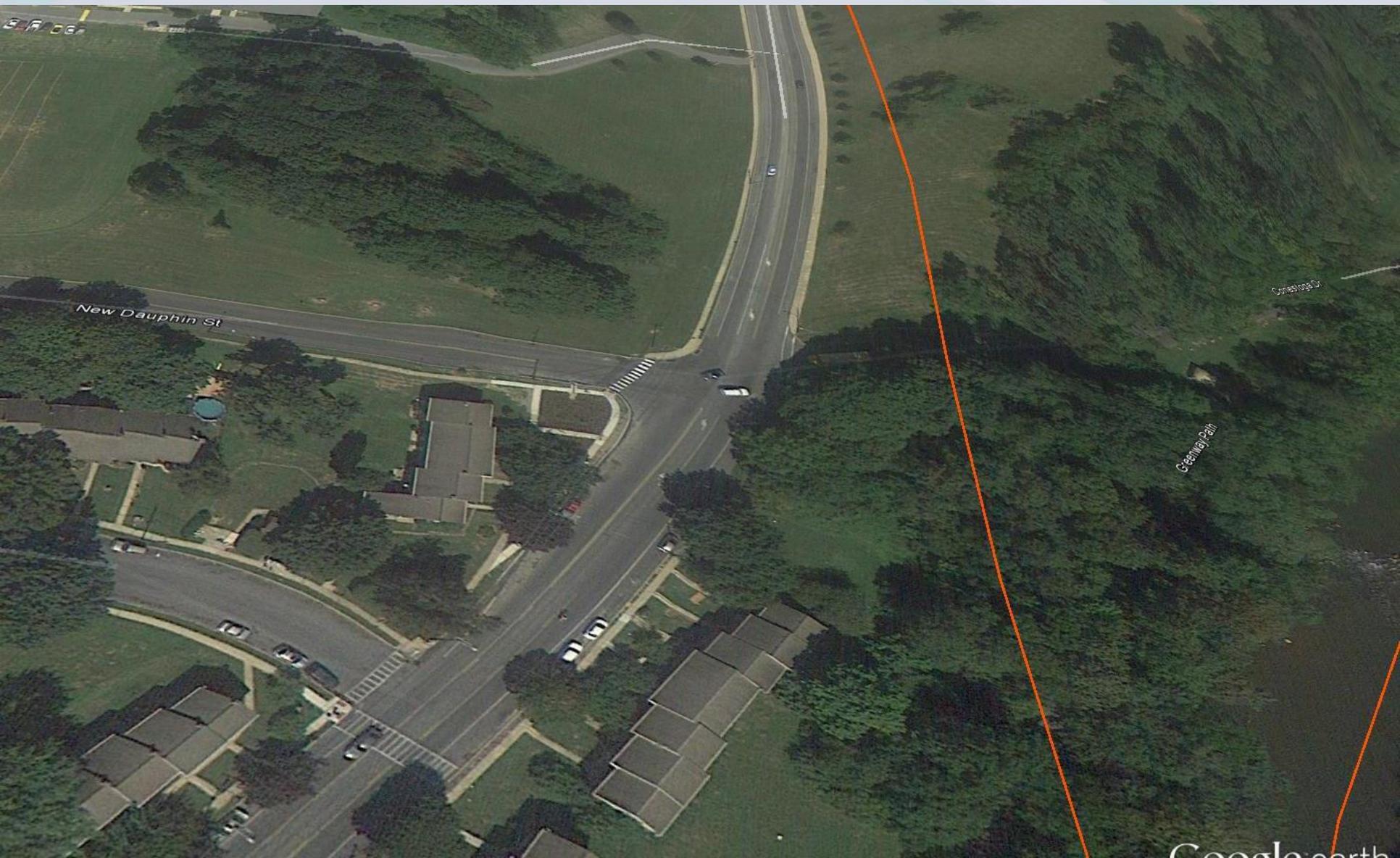


~\$20.30/SF for conventional reconstruction (8-inch reinforced concrete)

~\$22.40/SF for green alley retrofit (permeable pavers with infiltration trench)

195,000 Gallons / year reduction in runoff volume

Broad St & New Dauphin Street Green Street



Project Reference ID	P-121
Project Name	Pavement Removal at New Dauphin and N. Broad St.
GI Prototype Project Type	Alley/Street
Construction Year (Actual)	2012
Impervious Area Contributing (ft ²)	31,000
GI Area (ft ²)	3,000
Calculated Estimated Capture Volume (gal/yr)	554,000
Estimated Constructed Cost (Class 3)	\$86,000
Bid GI Construction Cost	\$80,000
Cost / Stormwater Volume (\$/gal)	\$0.14



550,000 Gallons / year reduction in runoff volume

Broad St & New Dauphin Street Green Street



Constructed 2012



Intersection at Charlotte and Orange Streets

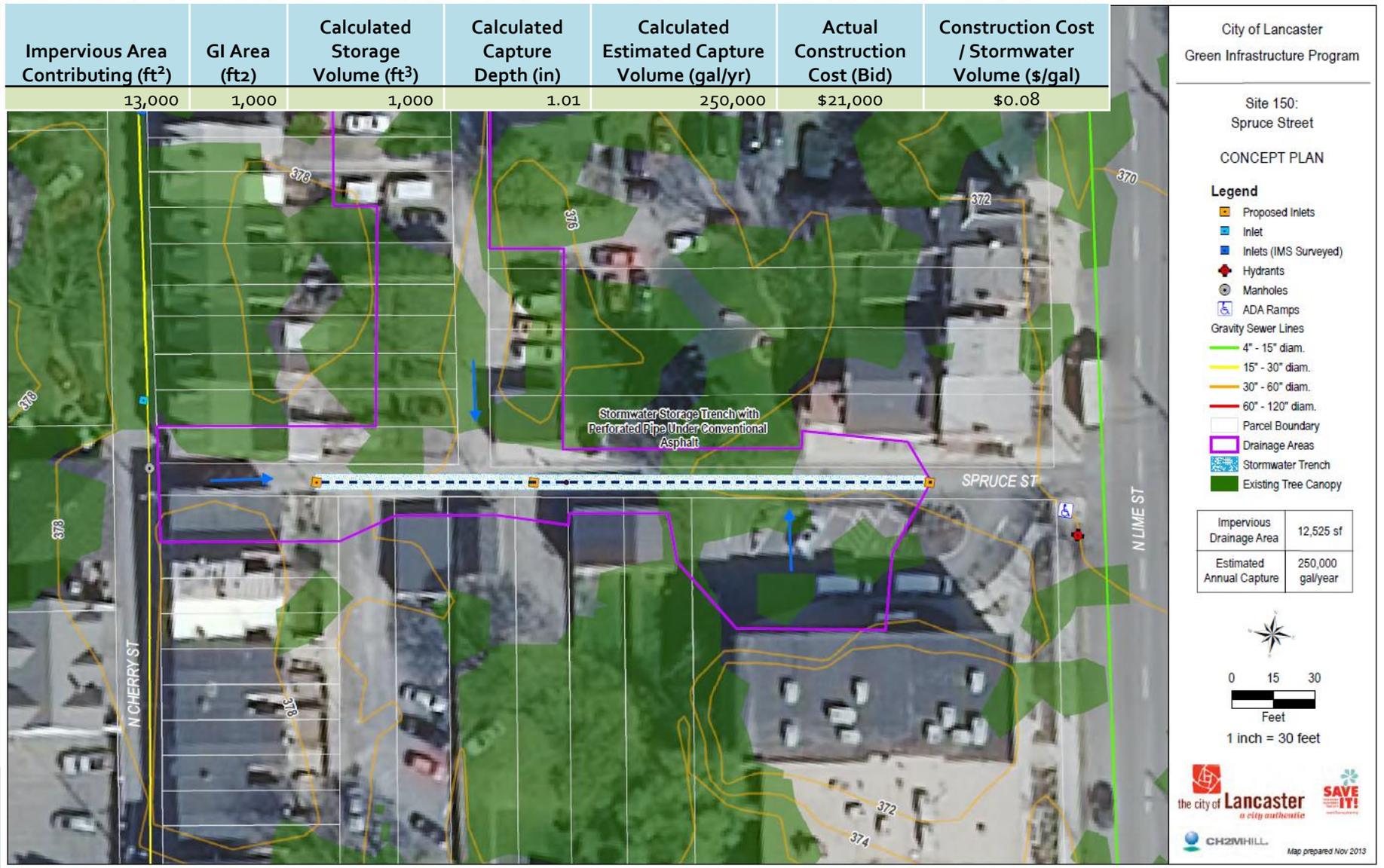


Cost \$0.12/gal

Orange and Charlotte St



Integrating with water and sewer upgrades – Greening Spruce Street



Spruce Street Greening Project (2014)



250,000 Gallons / year reduction in runoff volume

Using Traffic Safety and Transportation Funding to Reduce Accidents *and* Runoff

2014 Governor's Award for Environmental Excellence
Commonwealth Award and the 2014 *Best Urban BMP in the Bay* Award

5 MPH reduction in average traffic speed!

Lancaster Brewing Company (Plum and Walnut)

- Dangerous Intersection Conditions
- Adjacent to National Register Historic Building
- Gateway into the City's downtown



The Lancaster Brewing Company "Beer Garden" is Coming!



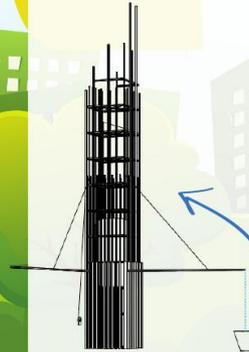
700 Gallon Cistern Functions As Public Art and Irrigates Planters



700 Gallon Cistern Functions As Public Art and Irrigates Planters



LBC Educational Placemat



Lancaster's
Gateway
Bundle

Ever wonder where all the rain and snow goes after a storm?

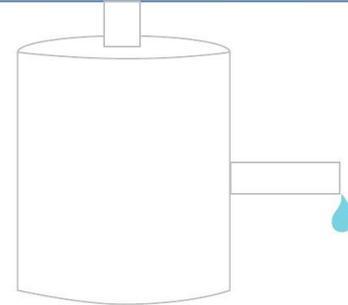
Water that rains down washes over streets, lawns, parking lots and off of roofs, like the one over your head, and eventually into storm drains (the grates you see on sidewalks and streets). Along the way, the water gets really dirty from things like litter, pet waste, chemicals, oils and car fluids.

While some of it can be cleaned up at a treatment center, some of that dirty water ends up in our creeks, ponds and lakes like the Conestoga River, and eventually flows all the way to the Chesapeake Bay!

Each year, 750 million gallons of polluted water from Lancaster City ends up in the Bay. That's a lot of dirty water! *What if we could keep it clean?!*



TURN THIS CISTERN INTO YOUR OWN PIECE OF ENVIRONMENTAL ART:



(don't forget to draw all the plants the cistern will help water!)

There are lots of ways we can all help recycle water.

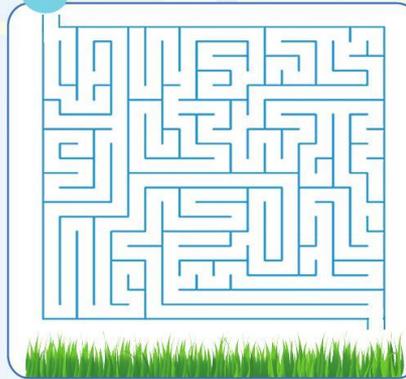
And one of those ways is *right here where you are eating*— the cool Public Artwork outside this restaurant, called "Lancaster's Gateway Bundle."

When rain falls or snow melts on the roof, it flows right into the giant "bucket" (called a cistern) attached to the building. The cistern catches that water before it flows through the drains into the rivers. It can hold 750 gallons of water (that's enough to fill your bathtub over 30 times!)

And guess what? Not only do we keep that dirty water from going into our rivers and streams, that water can be used to water the plants in the restaurant's garden outside.

NOW THAT'S COOL!

HELP THE RAINDROP FIND ITS WAY TO THE RAIN GARDEN



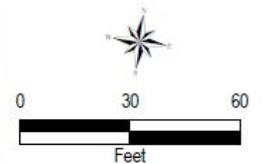
BREWERY ALLEY - BEFORE





PROPOSED CONCEPT PLAN

- Legend**
- ◆ Hydrants
 - Existing Inlets
 - Proposed Inlets
 - Manholes
 - Gravity Sewer Lines
 - 4" - 15" diam.
 - 15" - 30" diam.
 - 30" - 60" diam.
 - 60" - 120" diam.
 - ▭ Parcel Boundary
 - Existing Tree Canopy
 - ▭ Drainage Areas
 - ▨ Slow Release/Detention
 - Porous Pavement



274,000 Gallons / year reduction in runoff volume from 15,000 sf contributing area

BREWERY ALLEY - AFTER

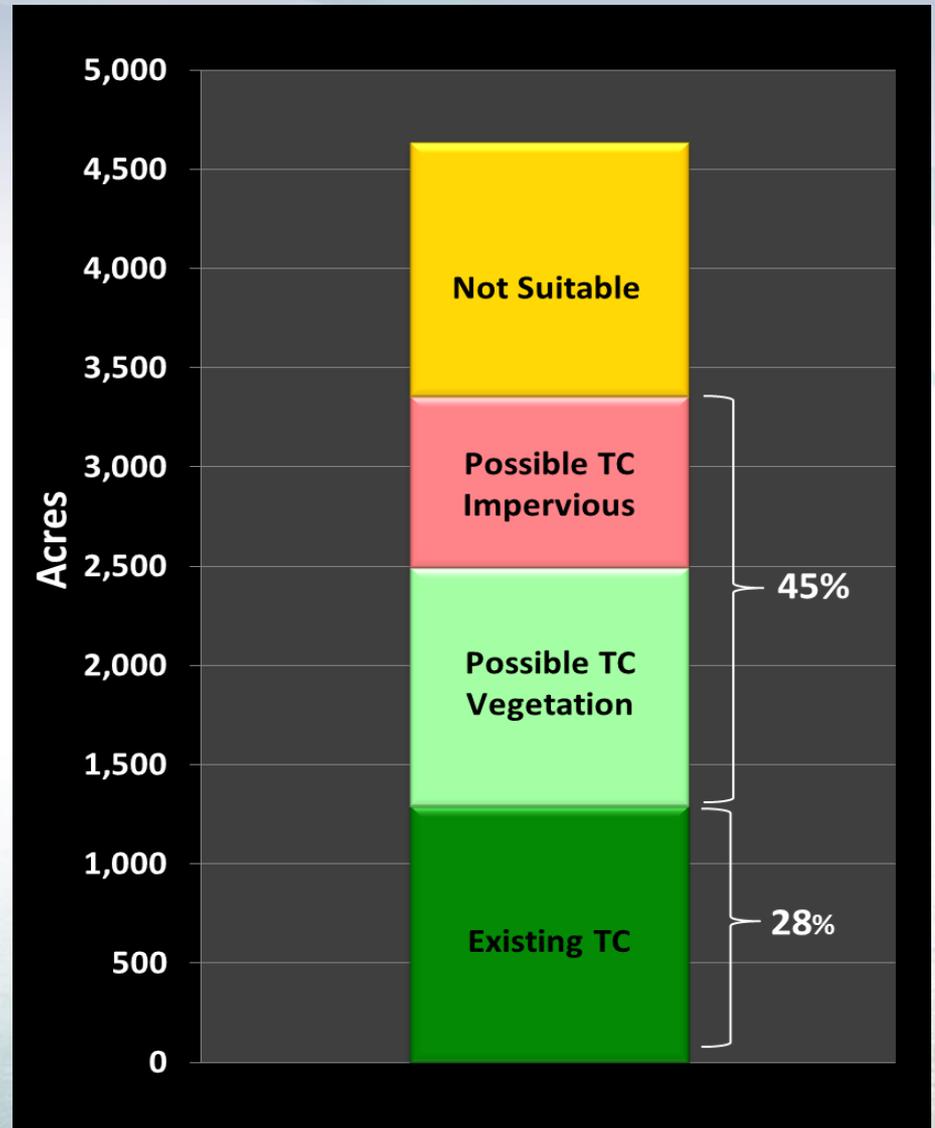


Urban Tree Canopy

- Current: 28%
- Potential: 45%
- Goal: 40%

Variety of Benefits:

- Clean Air
- Curbing Heat Island Effect (shading and cooling)
- AND of course Stormwater Management



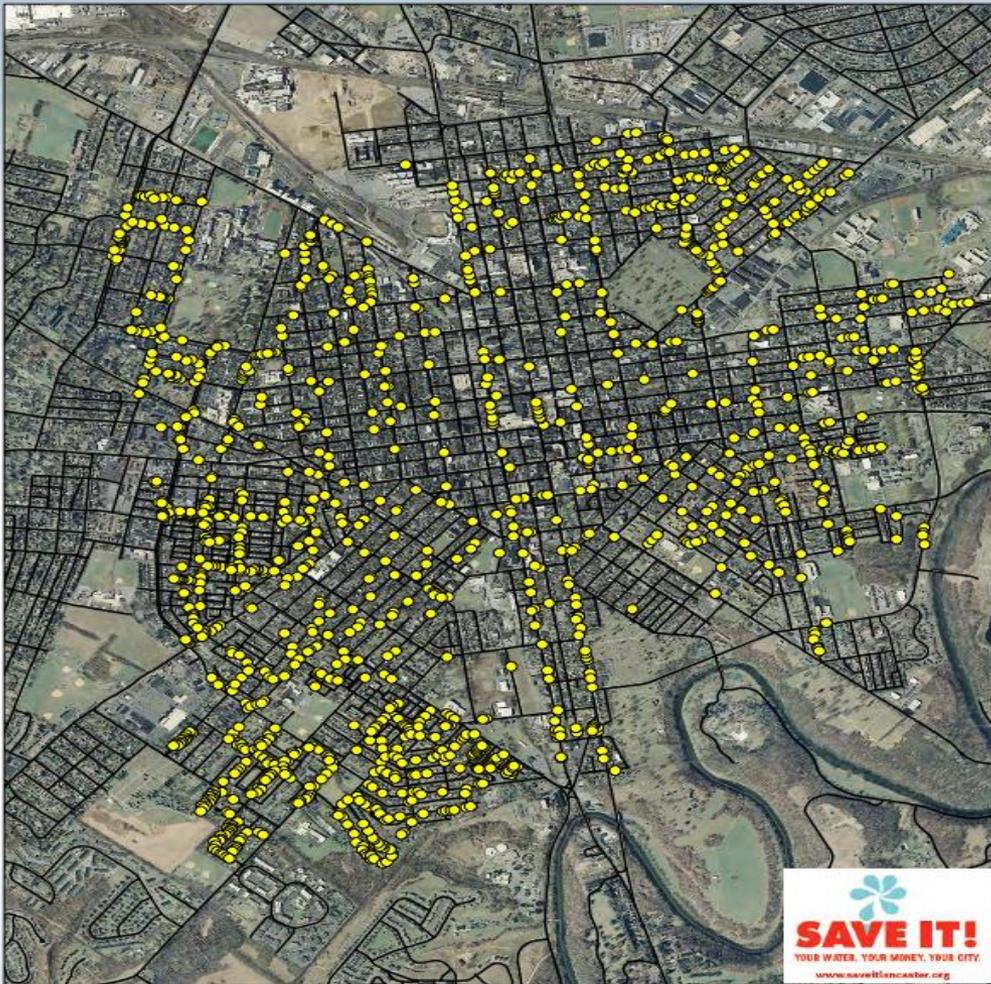
Benefits of Tree Canopy in EJC

“There is growing interest in the public health benefits from the presence of nature and trees in the urban environment. Research is being conducted on several aspects of these benefits including creating environments conducive to an active lifestyle, reducing stress and violence, and positively affecting behavior.”¹

- Create spaces fit for active and passive recreation to combat obesity
- Decrease physical and emotional stress
- Reduce violence
- Effect of green settings on ADD



Empty Tree Wells



Tree Wells in Lancaster City

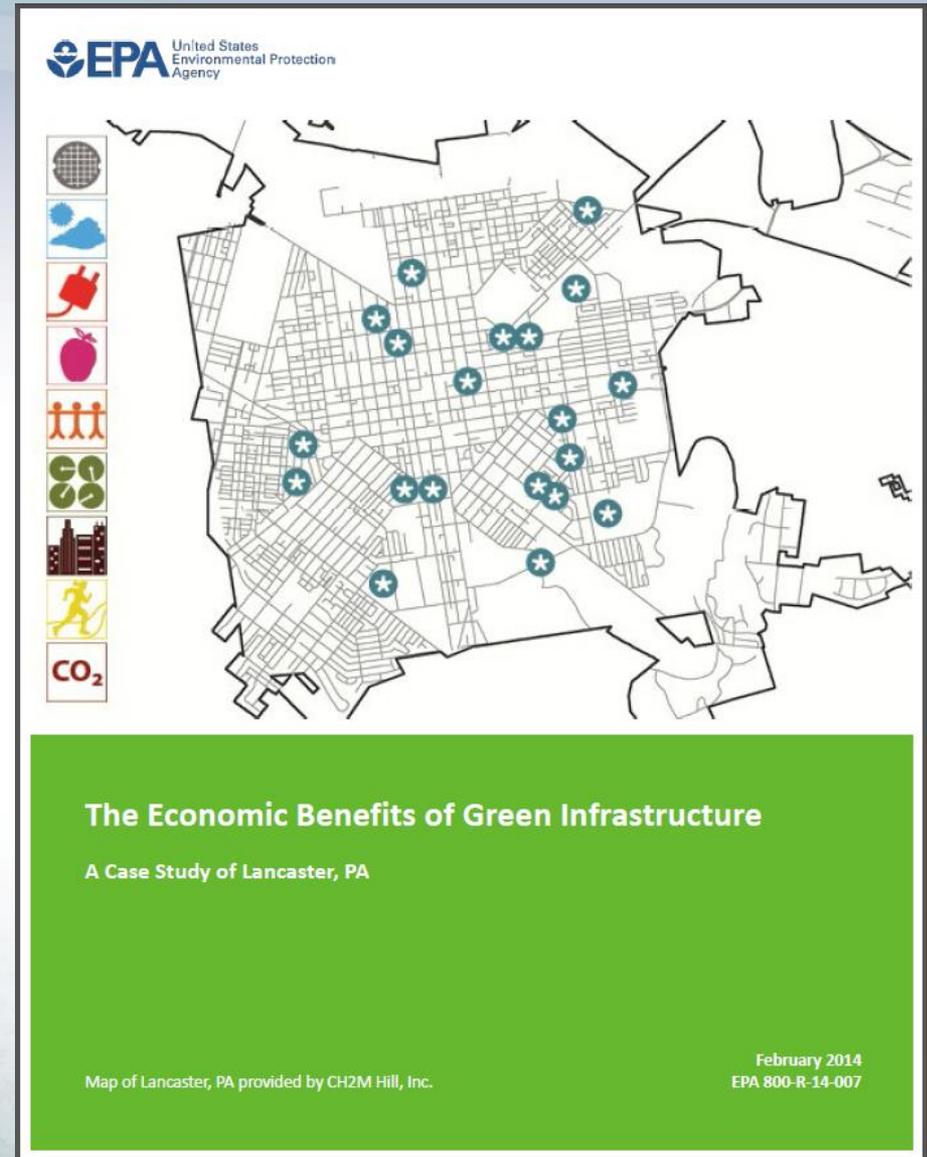
0 1,000 2,000 4,000 Feet



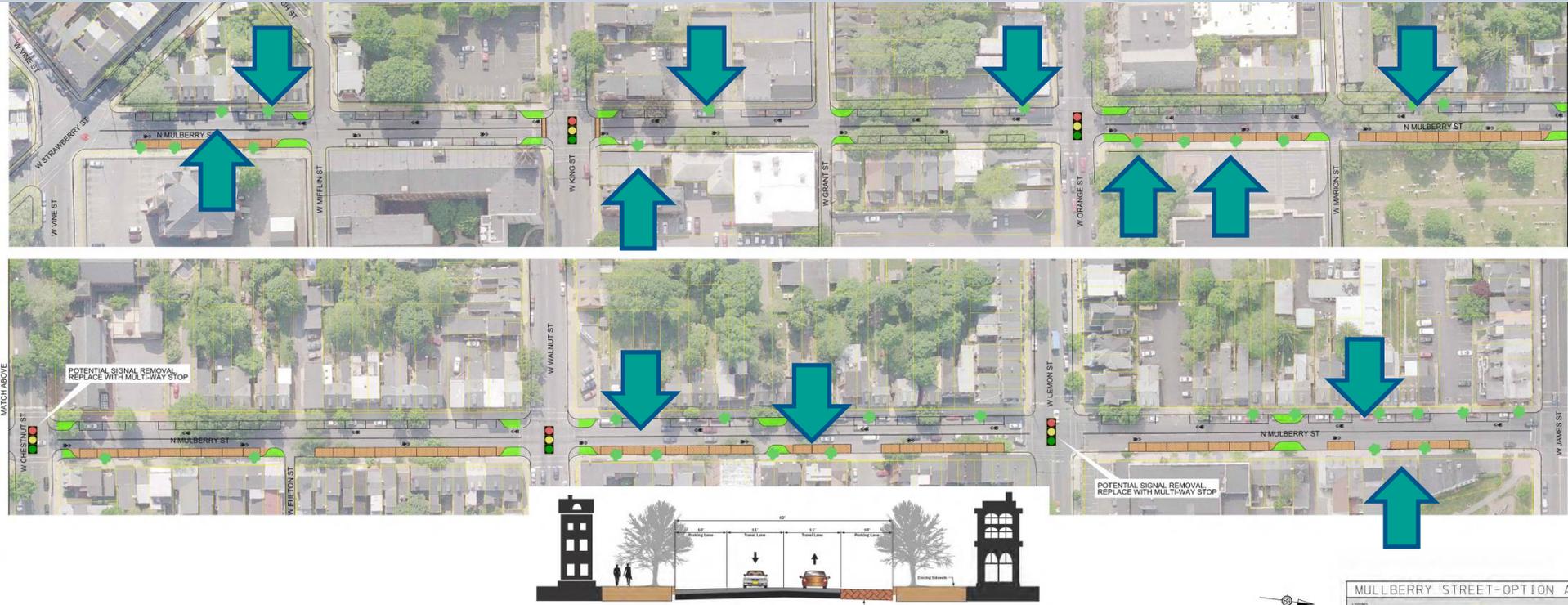
Triple Bottom Line Benefits

2014 EPA report estimates the following benefits of implementing the GI Plan:

- \$4.2 million/year in energy, air quality, and climate-related benefits
- \$660,000 annually in reduced wastewater pumping and treatment costs (at current costs)
- \$120 million in avoided gray infrastructure (e.g., tanks, tunnels)
- For an GI investment of \$80 - \$140 million (depending on level of integration)



Mulberry Street Two-Way Conversion Project



Current Conditions

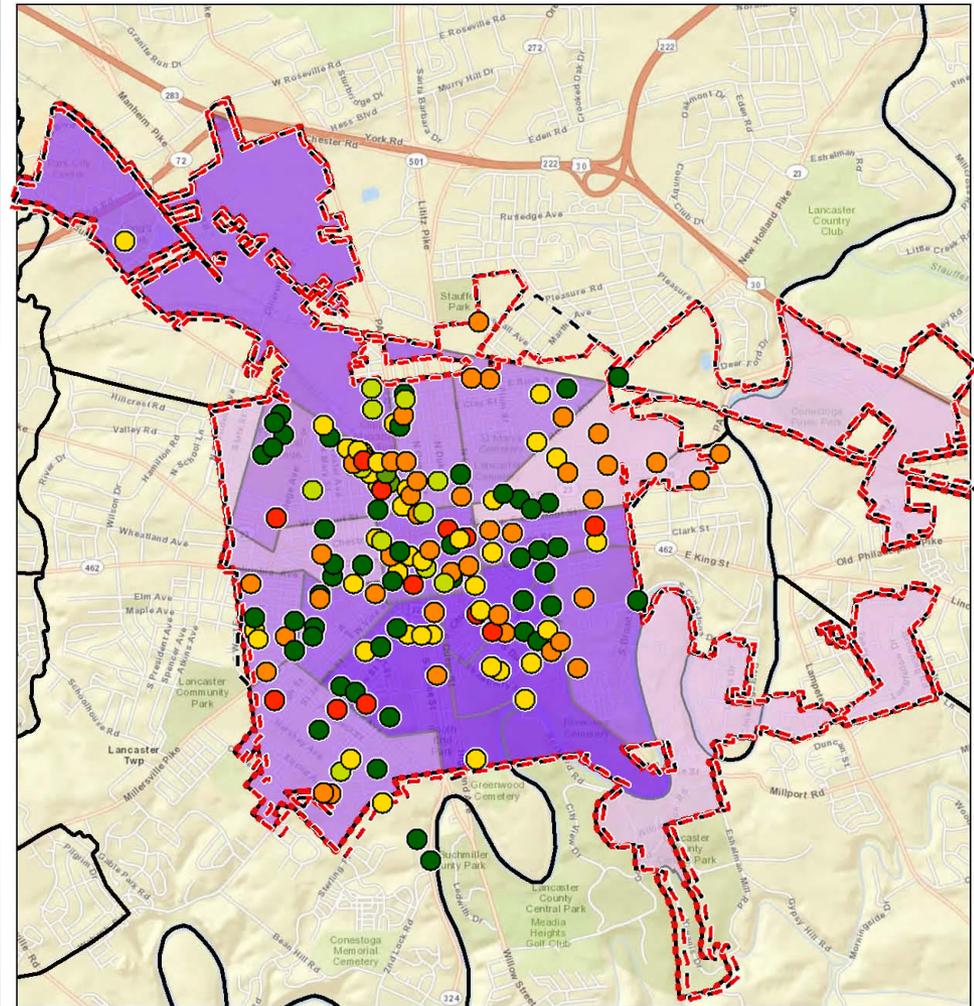


Proposed Design



**OTHER ENVIRONMENTAL
JUSTICE COMMUNITY PROJECTS**

GI Program Focuses On Improving the City Economy



**Census Tracts
Percent Below Poverty Level
Past 12 Months**

Legend

- Lancaster City Boundary
- Municipal Boundaries
- 2% - 10%
- 11% - 20%
- 21% - 30%
- 31% - 40%
- 41% - 50%



1 in = 4,000 ft

2012 US Census Bureau data: S1701: Poverty Status in the Last 12 Months. 03/26/14

South Ann Street Neighborhood Association Transforms Parking Lot



Status

\$3.64 M in grants used to date. Matched by \$3.7 M in local/city funds

City of Lancaster Green Infrastructure Program

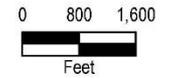
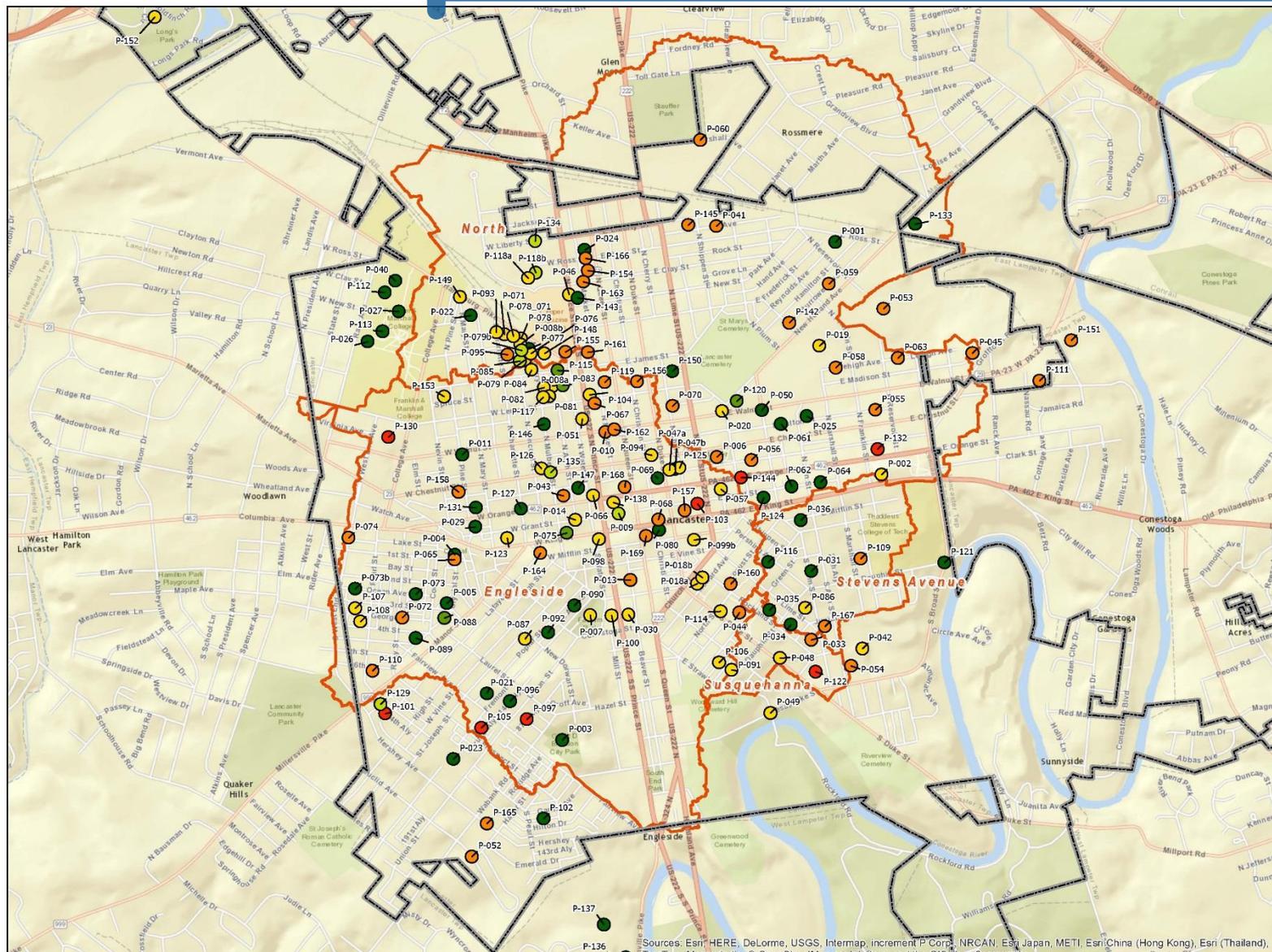
Green Infrastructure Projects
and Status

November 2014

Legend

GI Project Status (11/14)

- Complete
- Under Construction
- Design
- Concept
- Idea
- On Hold
- Combined Sewer System Basins
- Municipal Boundary



1 inch = 1,600 feet



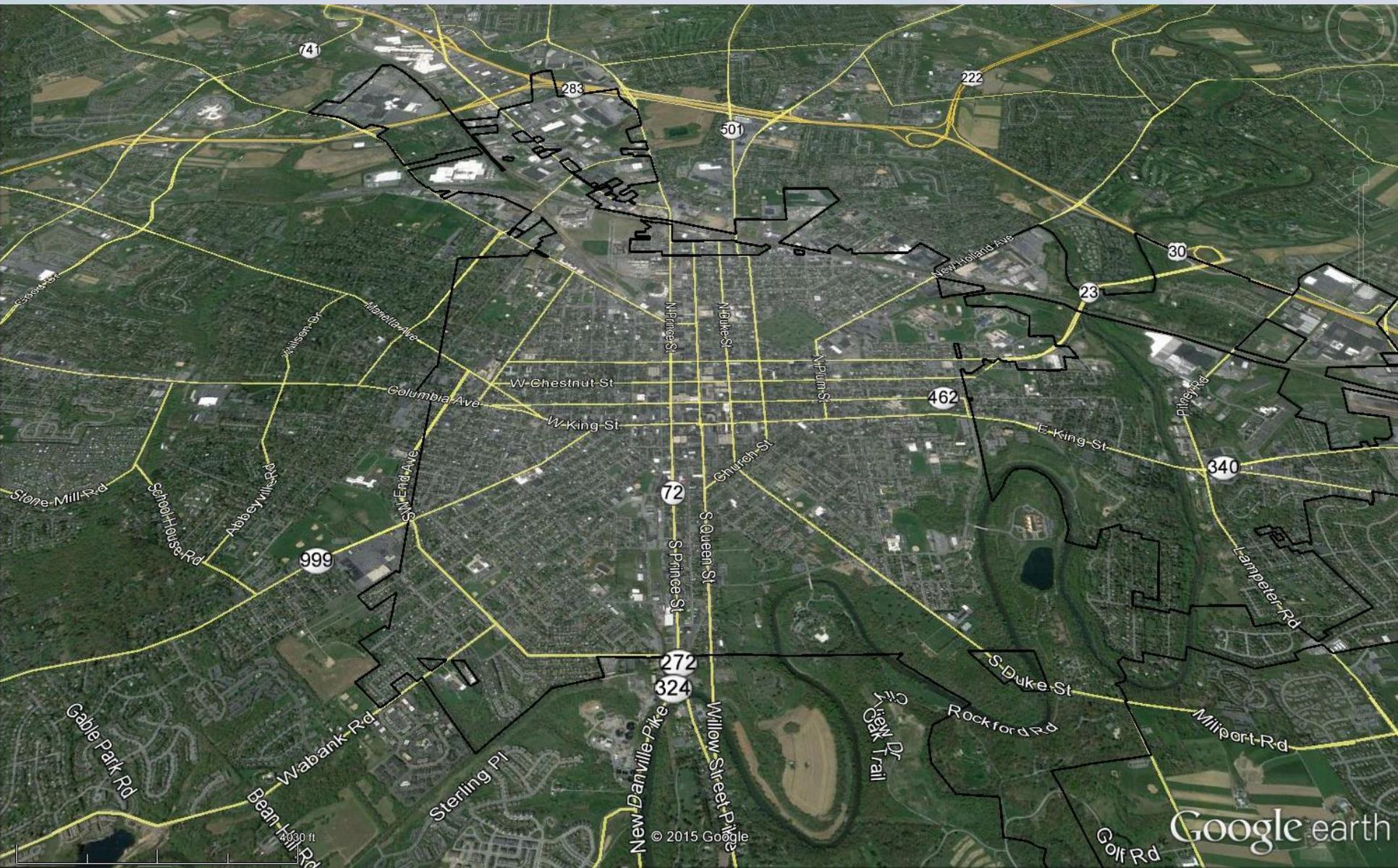
Sources: Esri, HERE, DeLorme, USGS, Intermap, increment P Corp., NRCAN, Esri Japan, METI, Esri China (Hong Kong), Esri (Thailand), TomTom, Mapnyndia, © OpenStreetMap contributors, and the GIS User Community

Green Infrastructure Implementation Status

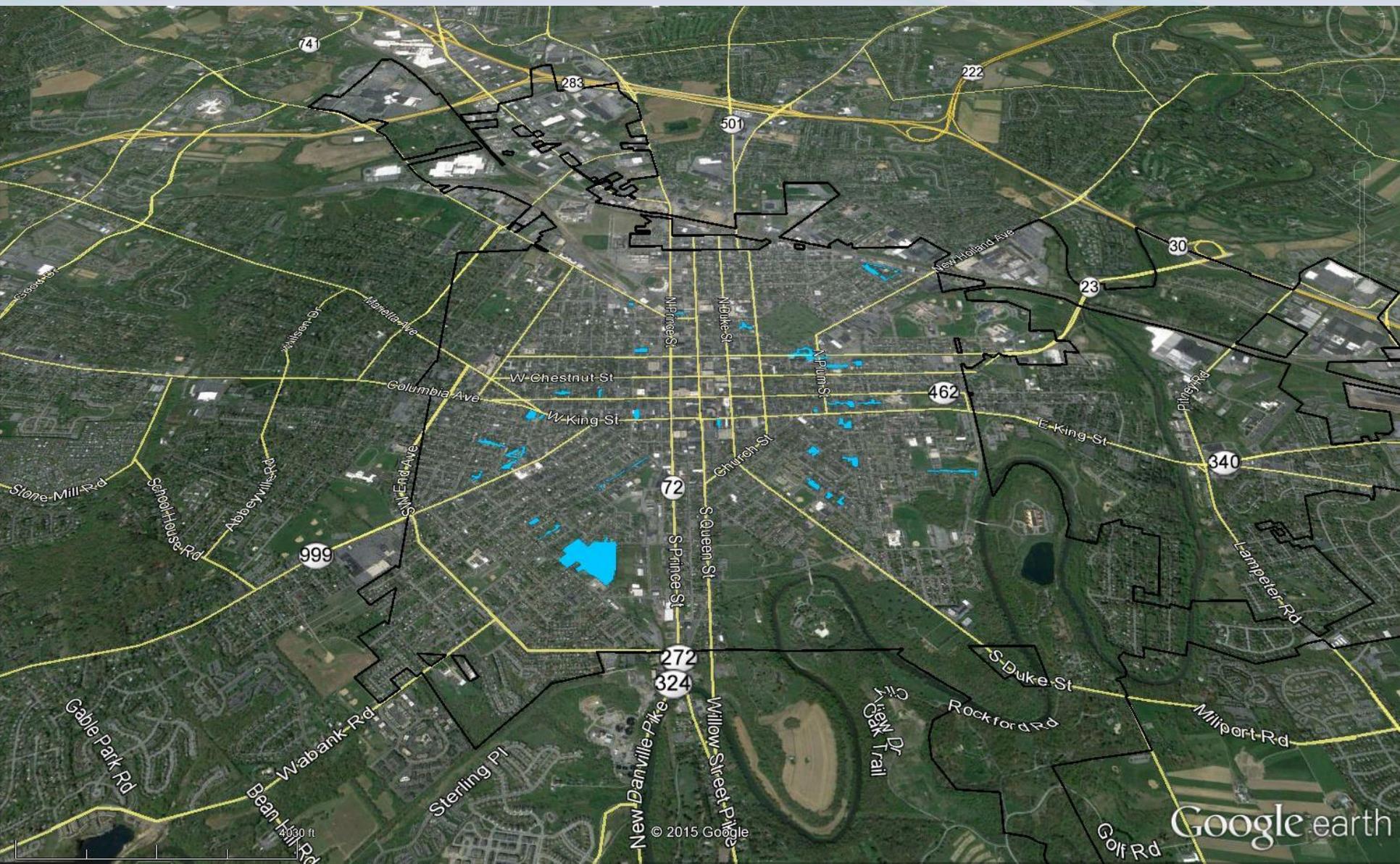
Status	Number of Projects	Impervious Area Managed (sq. ft.)	Impervious Area Managed (acres)	Annual Runoff Capture (Gal/yr)
Constructed / Under Construction	52	1,009,587	23	20,172,000
In Design for Construction	14	943,000	22	17,984,000
Conceptual Designs (non-PV/GGP)	24	640,000	15	12,262,000
PENNVEST Concepts	19	367,000	8	7,033,000
Growing Greener Plus Concepts	1	46,000	1.1	881,000
In Project Planning	52	-	-	-
Total	162	3,005,587	69	58,332,000



Implementation Status Overview



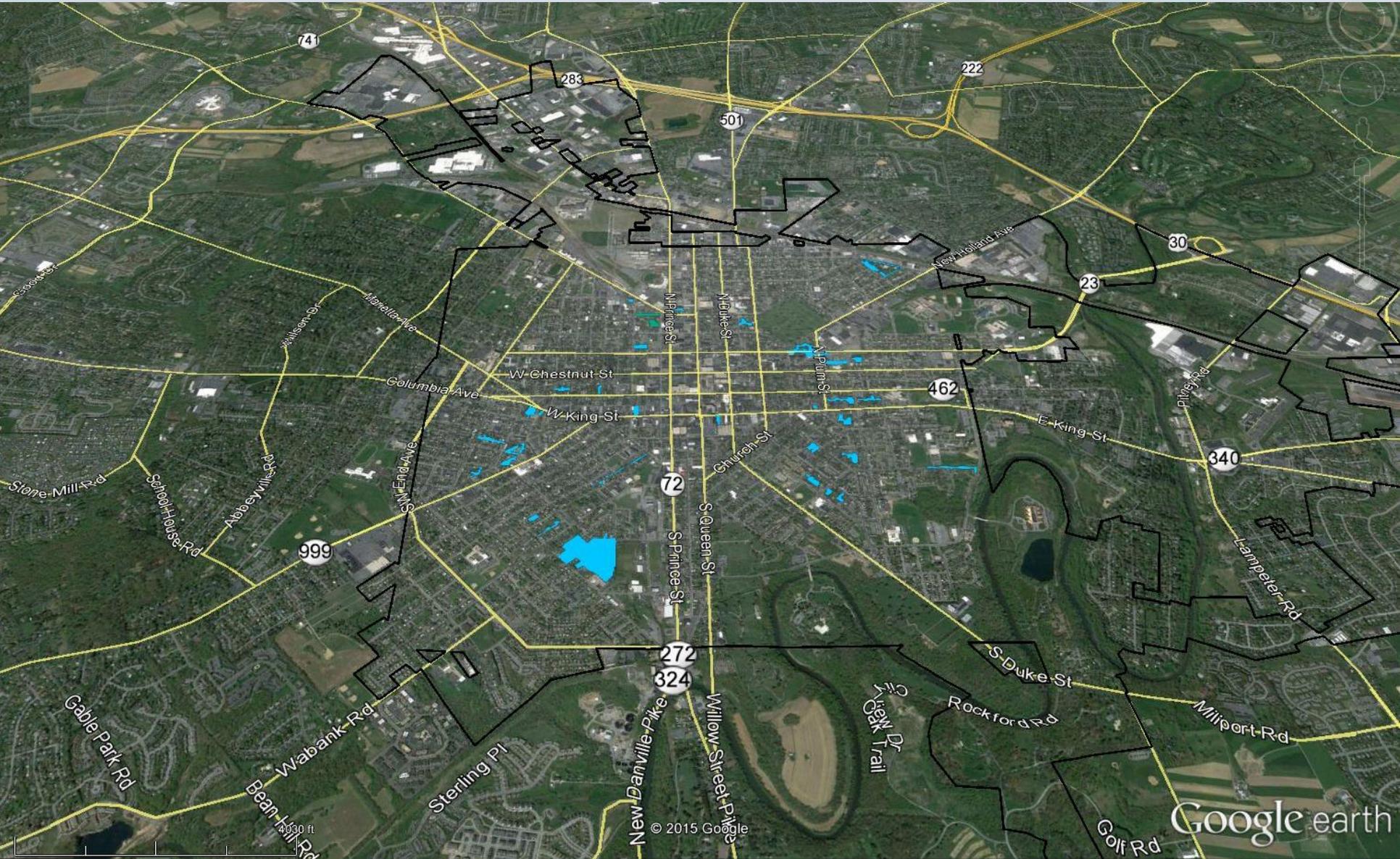
Completed Projects



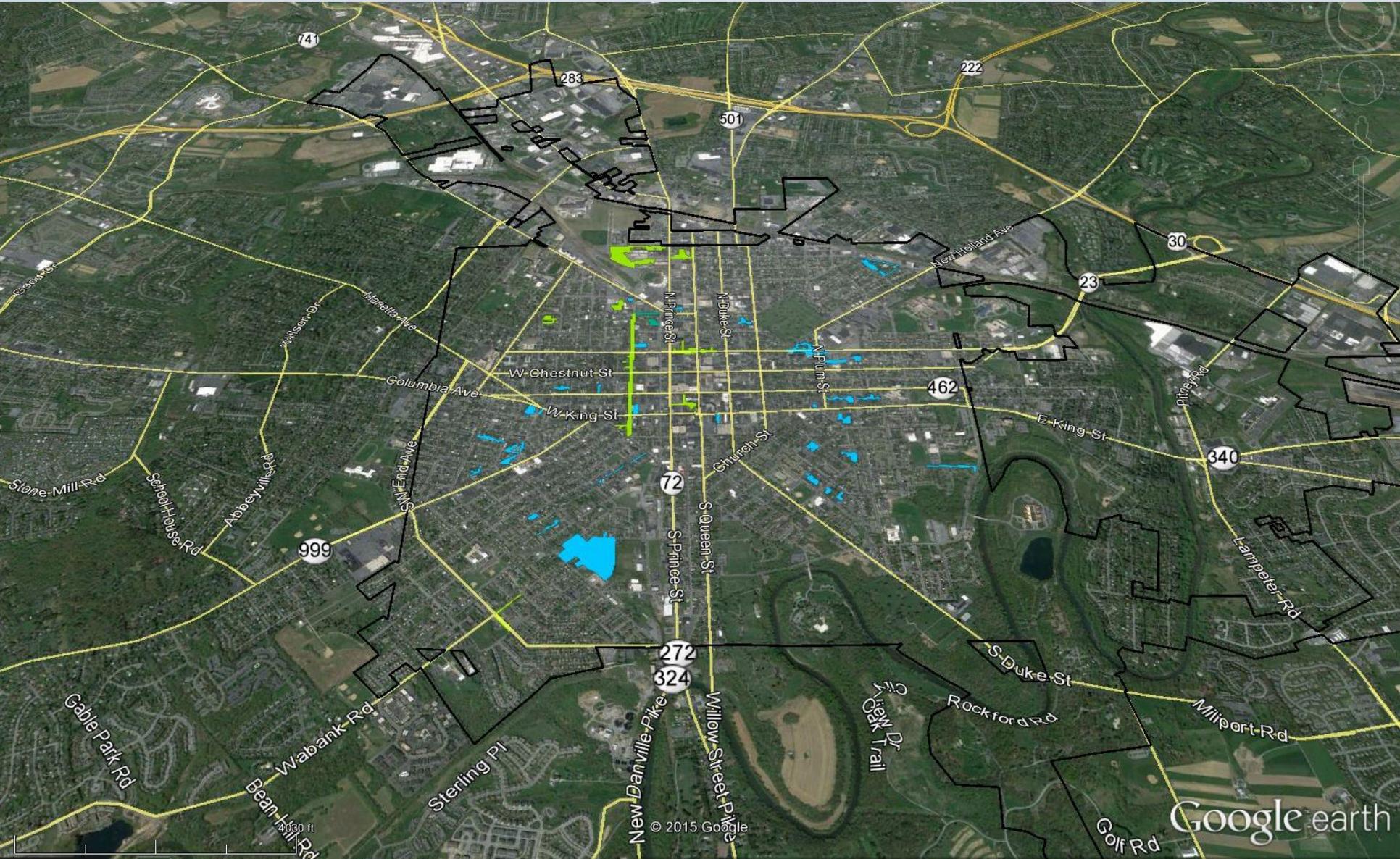
© 2015 Google

Google earth

+ Projects Under Construction



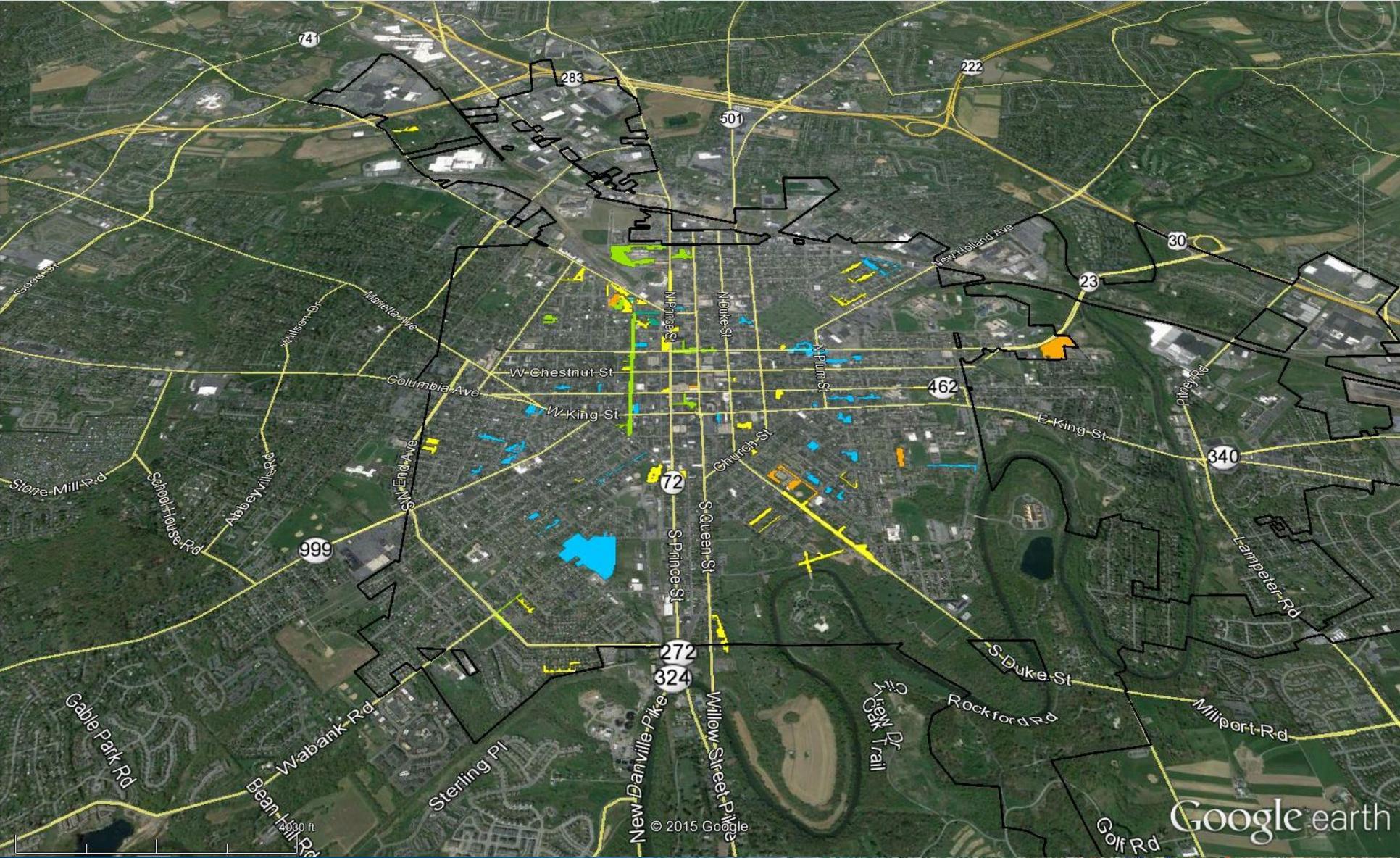
+ Projects In Design



+ Project Concepts



+ Project Ideas



Summary of Project Drainage Areas

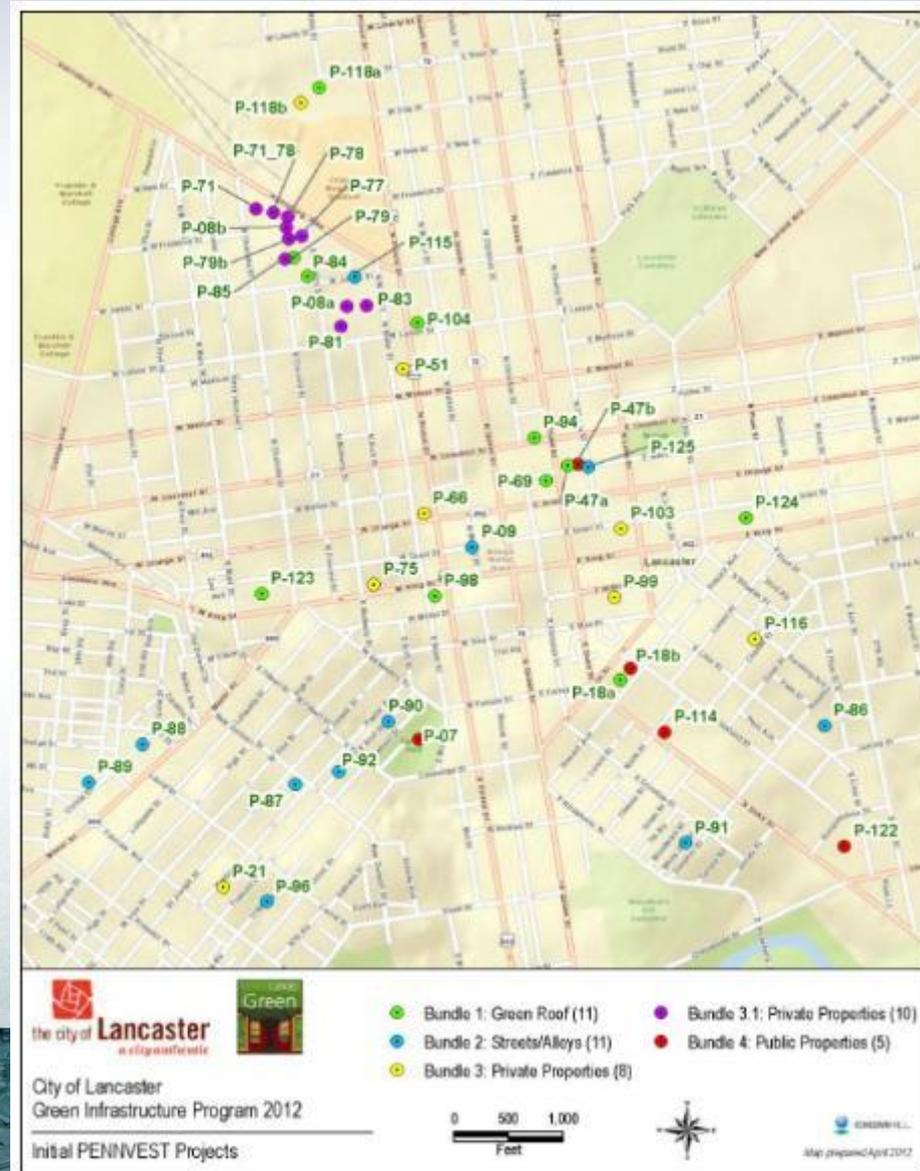




Paying for it!

Innovative Public-Private Partnership enables private investments in CWA progress

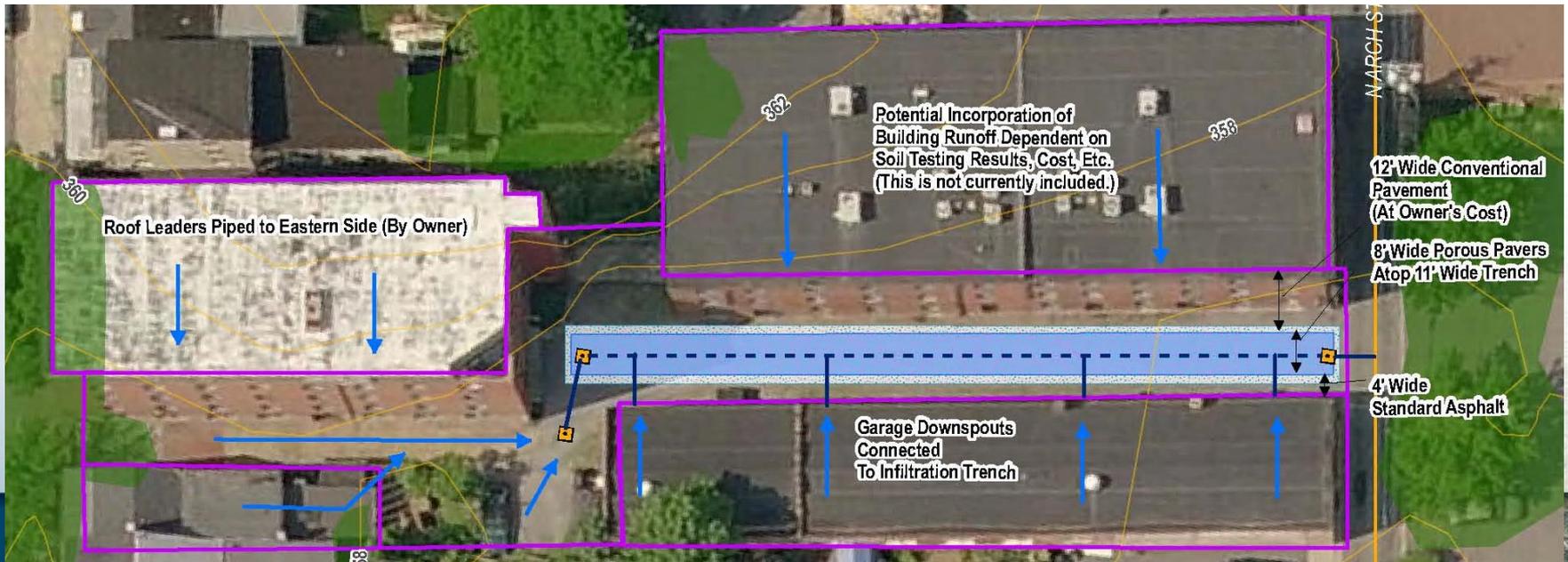
- \$7M SRF PENNVEST Loan to fund implementation of GI on public & private property
- 45 initial GI/BMP sites
- City pays up to 90% of GI Costs
- Property owner pays remainder and signs on to long-term maintenance agreement
- SW Utility implementation also motivating additional private investment in CWA controls



317 N. Mulberry

Impervious Area Contributing (ft ²)	20,000
GI Area (ft ²)	2,000
Calculated Estimated Capture Volume (gal/yr)	399,000
Estimated Constructed Cost (Class 3)	\$75,000
Estimated Construction Cost (Class 4)	\$75,000
Bid GI Construction Cost	\$75,000
Cost / Stormwater Volume (\$/gal)	\$0.19
Primary Funding	PENNVEST

- PENNVEST project coordinated with redevelopment
- Challenging coordination/sequencing
- Developer expanded decorative pavers to full driveway
- Captures large neighboring building
- Hosted EPA Press Conference on GI in April 2014





Shawn Garvin, US EPA Region 3,
EPA Press Conference on GI in April
2014



399,000 Gallons / year reduction in runoff volume

Two Dudes Painting Company

Impervious Area Contributing (ft ²)	17,000
GI Area (ft ²)	4,000
Calculated Estimated Capture Volume (gal/yr)	295,000
Estimated Constructed Cost (Class 3)	\$93,000
Estimated Construction Cost (Class 4)	\$93,000
Cost / Stormwater Volume (\$/gal)	\$0.32
Primary Funding	PENNVEST



City of Lancaster
Green Infrastructure Plan
Demonstration Project

Site 21:
Two Dudes Painting Company

PROPOSED CONCEPT PLAN

Legend

- Hydrants
- Storm Inlets
- Manholes
- Downspout

Gravity Sewer Lines

- 4" - 15" diam.
- 15" - 30" diam.
- 30" - 60" diam.
- 60" - 120" diam.

Parcel Boundary

G_ID

- GI-01
- GI-11
- GI-16
- Existing Tree Canopy
- Proposed Trees (4)

0 40 80
Feet

295,000 Gallons / year reduction in runoff volume



TWODUDES
PAINTING COMPANY









Steeple View Lofts

- PENNVEST project coordinated with redevelopment
- Permeable Pavers / Infiltration Trench
- Porous Asphalt / Infiltration Bed

Impervious Area Contributing (ft ²)	11,000
GI Area (ft ²)	4,000
Estimated Capture Volume (gal/yr)	237,000
Estimated Constructed Cost (Class 3)	\$76,000
Estimated Construction Cost (Class 4)	\$76,000
Bid GI Construction Cost	\$68,400
Cost / Stormwater Volume (\$/gal)	\$0.29
Primary Funding	PENNVEST



237,000 Gallons / year reduction in runoff volume

GREEN INFRASTRUCTURE ADVISORY COMMITTEE

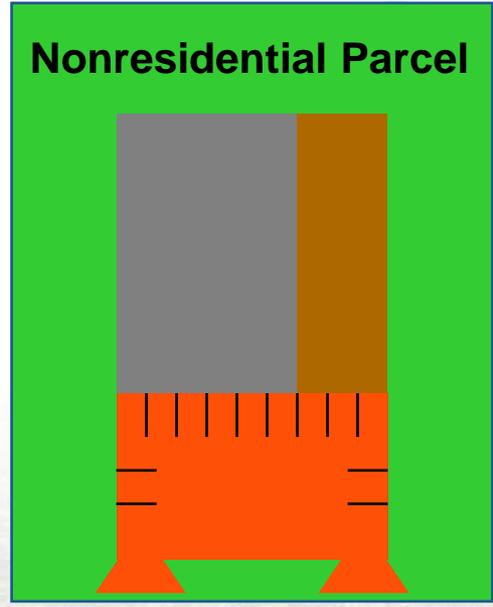
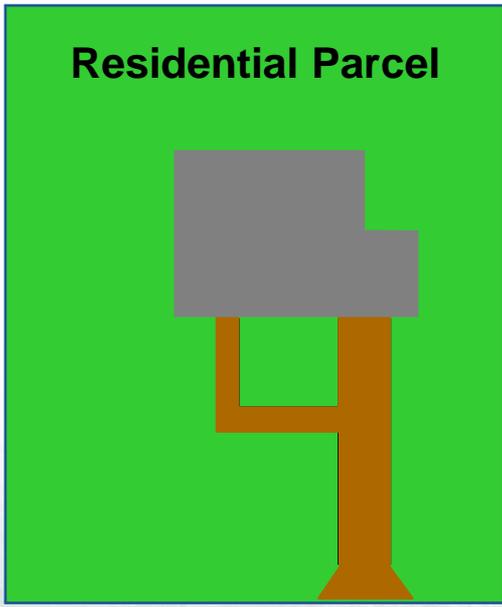
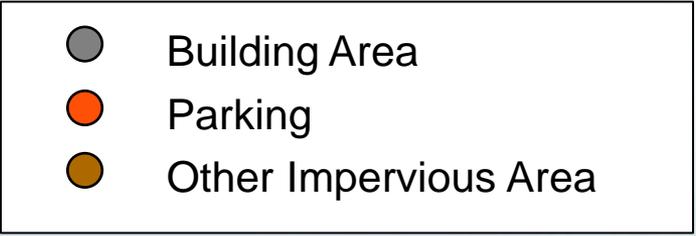
- Included representatives from:
 - business owners,
 - citizens,
 - institutions,
 - environmental groups,
 - state government,
 - Lancaster City government, and
 - Lancaster County government.
- Met 6 times between April and September 2012 on funding options and policy issues



was convened to evaluate fair and equitable ways to fund the City's stormwater program.

■ Potential funding sources:

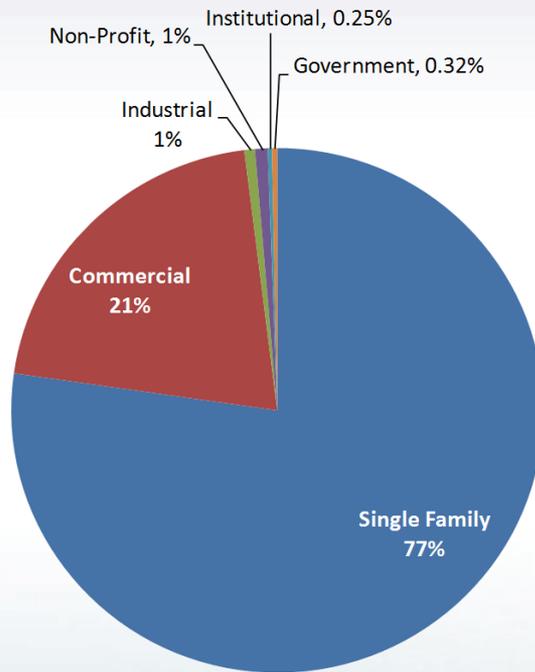
- Increase property taxes
- Raise sewer bills
- Implement a fee based on stormwater runoff



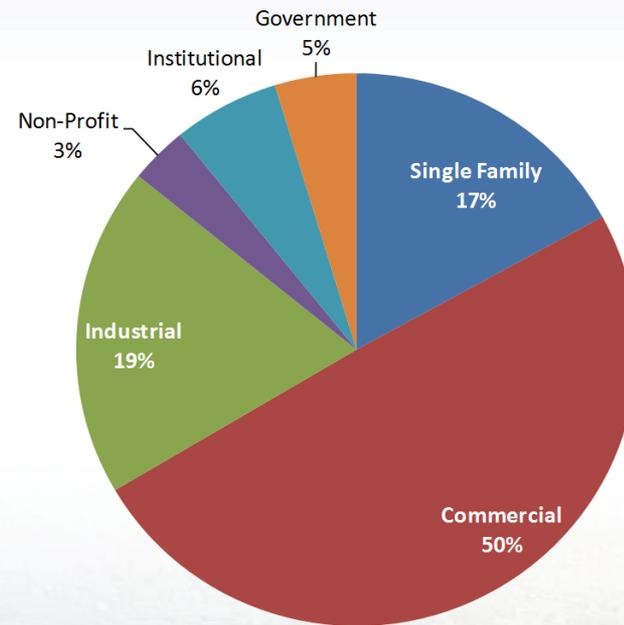
Stormwater runoff is measured by impervious area = roofs and pavement where rain runs off, rather than soaking into the ground

Impervious Area Fee Analysis

Number of Properties



Number of ERUs



■ Single Family
■ Non-Profit

■ Commercial
■ Institutional

■ Industrial
■ Government



The Green Infrastructure Committee Studied the Funding Details

Level of Service Cost Estimate Summary

	Estimated Annual Costs		
	Low	Medium	High
Operating and Maintenance			
Green Infrastructure*	n/a	\$162,000	\$202,500
Dry and Wet Ponds (inspection)	\$2,300	\$2,300	\$2,300
Street Sweeping	\$168,800	\$168,800	\$234,100
Catch Basin	\$201,000	\$201,000	\$402,000
Storm Drainage	n/a	n/a	n/a
MS4 Implementation	\$451,566	\$536,412	\$612,412
Program Administration	\$142,000	\$219,000	\$296,000
Capital Costs			
Green Infrastructure	\$7,000,000	\$7,000,000	\$7,000,000
Storm Drainage	\$1,720,000	\$1,720,000	\$1,720,000
Catch Basin	\$164,000	\$164,000	\$164,000
Total	\$1,860,266	\$4,806,612	\$7,491,712

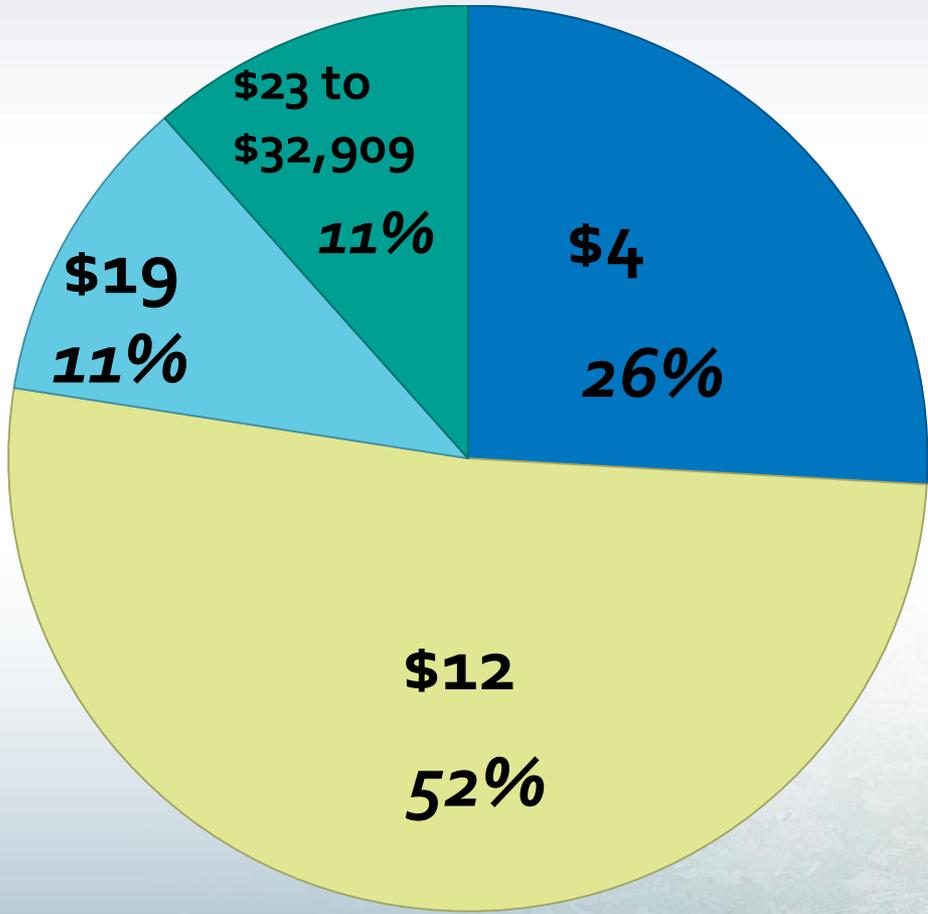
GIAC recommended the Medium Level of Service

\$4,806,612



The GIAC recommends:

implementing a rate structure with four "tiers" based on impervious area.



- Tier 1 (0-999 sq. ft.)
- Tier 2 (1,000-1,999 sq. ft.)
- Tier 3 (2,000-2,999 sq. ft.)
- Tier 4 (≥3,000 sq. ft.) ← Actual

Percentages refer to percent of all properties

Rates are estimated first year fees per quarter, for Medium Level of Service

For example – average fee per quarter:
Residential: \$10
Commercial: \$139

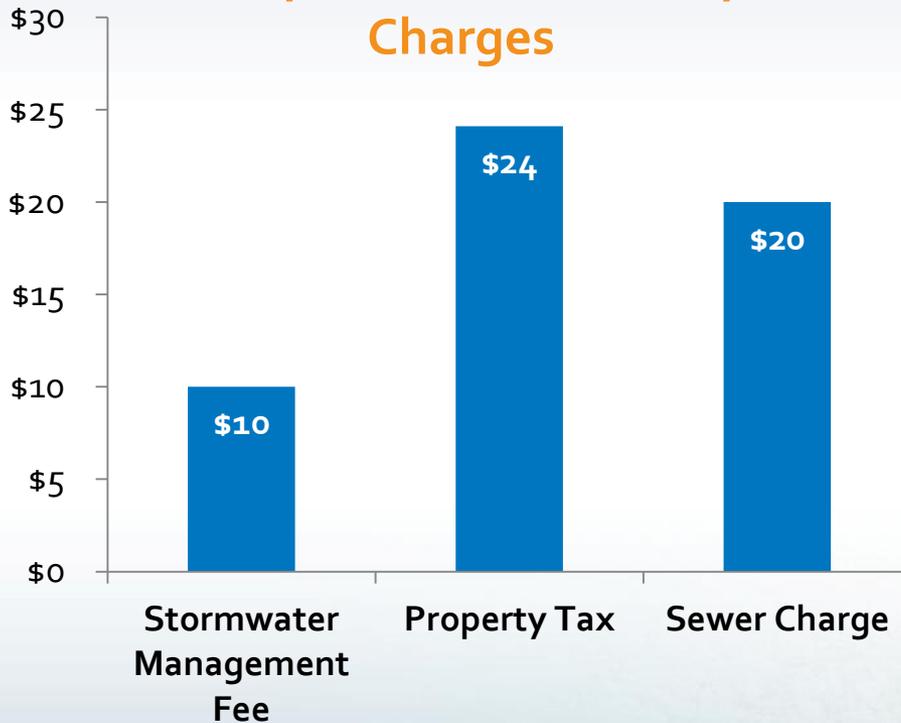


Comparison of Charges

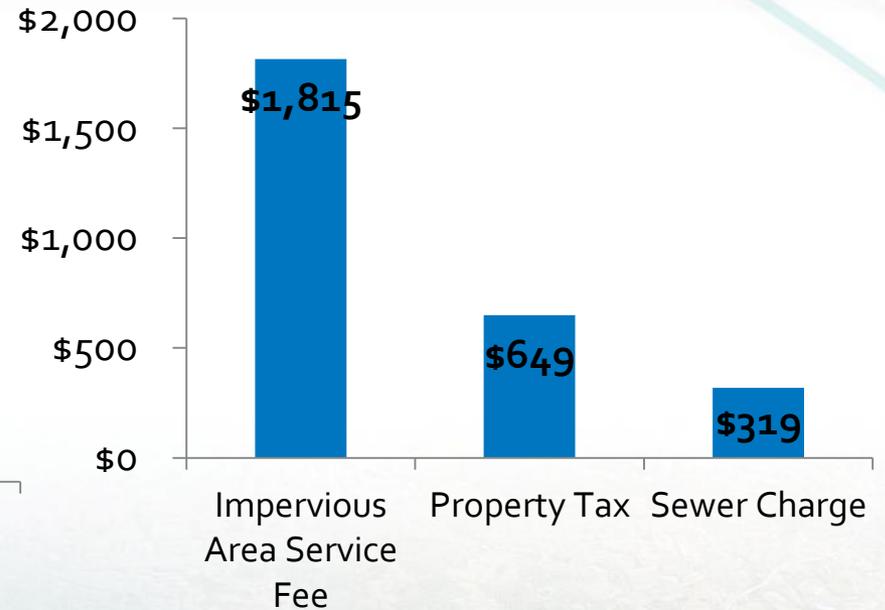
Average Residential

Average Industrial

Comparison of Quarterly Charges



Comparison of Quarterly Charges

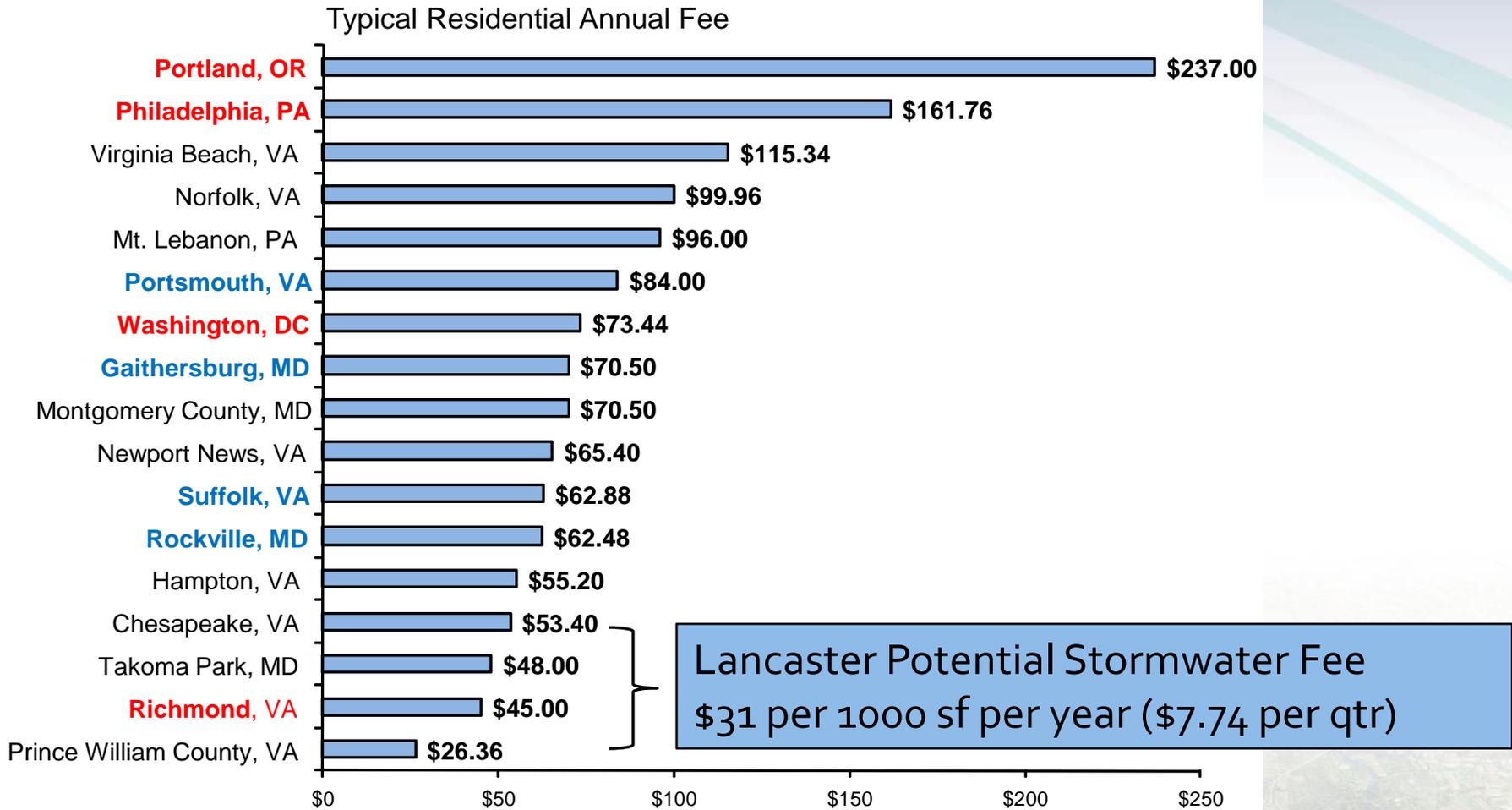


Rates and charges assume medium level of service
(\$4,800,000 annual program)
And rate of \$7.74/1,000 square feet/quarter

including an incentive program to provide fee relief.

- **Rebates or Grants** – 1 time assistance with construction cost (PENNVEST)
- **Credits** – a percentage reduction in the annual impervious area fee
 - Total credit applications: 47 received – 40 approved, 3 denied, 4 under review
- **Appeals** – Total appeals received is 116: 58 approved, 50 denied, 2 withdrawn, 5 on hold and 1 under review
- **Benefits:**
 - Help property owners reduce their annual stormwater fee
 - Provide incentive for implementing green infrastructure on private property
 - Provide incentive to maintain facilities

Typical Residential Stormwater Fees



SAVE IT!

YOUR WATER.
YOUR MONEY.
YOUR CITY.

Home | About | Contact



- What's the Problem?
- What Can I Do?
- Benefits
- Local Projects
- Resources
- What's New?
- FAQs

WATER HEROES



Chestnut Hill For Doreen Landis, Chestnut Hill Cafe's owner, Lancaster City's stormwater problem hits home. Literally.



Your Water.
Your Money.
Your City.

Lancaster, you can help SAVE IT!

Lancaster City needs to save 750 million gallons of water annually from entering its combined sewer system to preserve clean drinking water, avoid costly fines and continue to build a healthy, vibrant community. Join our list serve and stay informed!

Enter your email ▶

BABY STEPS:

I've got 5 minutes,
What can I do?

Take a shower instead of a bath

BIG STEPS:

I've got 5 hours,
What can I do?

Install a rain barrel

GIANT STEPS:

I've got 5 days,
What can I do?

Install a green roof



Lessons Learned / Keys to Success

- Garner political or high level leadership support early in process
- Start the public education or “setting the stage” from the get go – MESSAGE, MESSAGE, MESSAGE – test the messaging and hone as you proceed.
- Lead by example – NOT “do as I say, not as I (don’t) do”!
- Use stakeholders from all affected rate paying classes and geographical representation on a GI advisory group
- Use demonstration projects to rally neighbors around the issues and garner their support of the overall program
- Figure out your funding strategies; use the GI to leverage other funding; and stretch the limited dollars and resources that we all face – INTEGRATED INFRASTRUCTURE
- Grants, grants, grants!
- Include 3 years of maintenance in contract as part of rain gardens since there is a high mortality rate
- Do NOT underestimate the value of educating the public throughout the process



Questions?

Contact information

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