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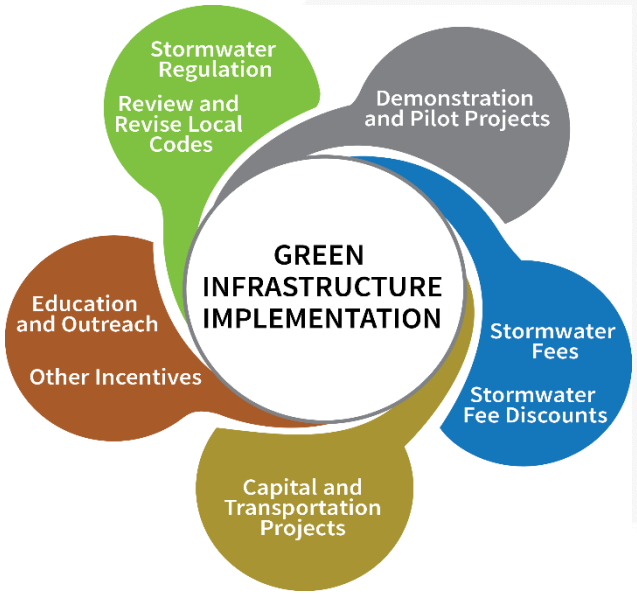
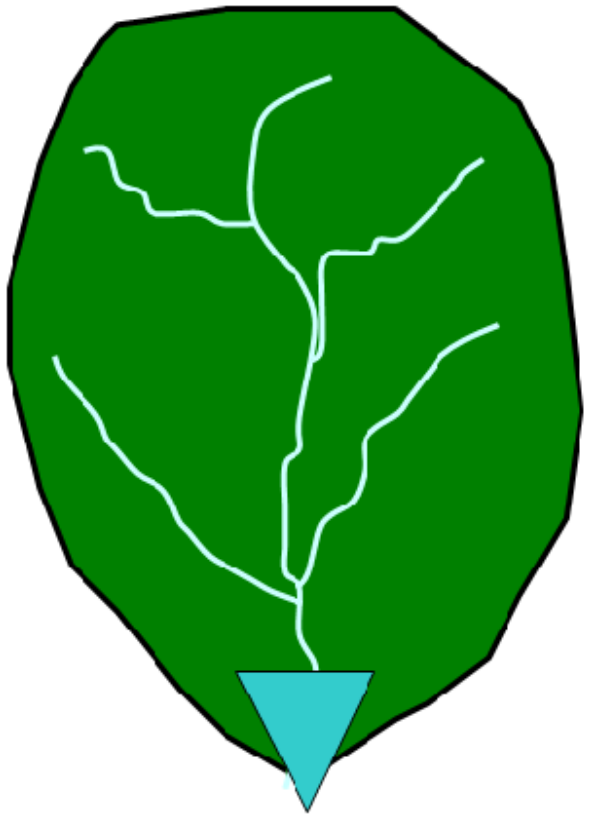
GSI for Increased Resiliency

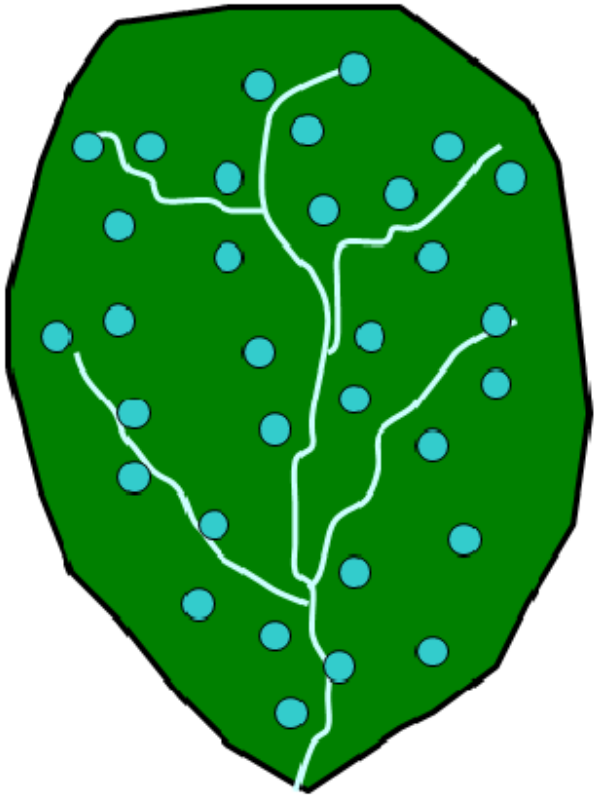


Case Studies and Examples

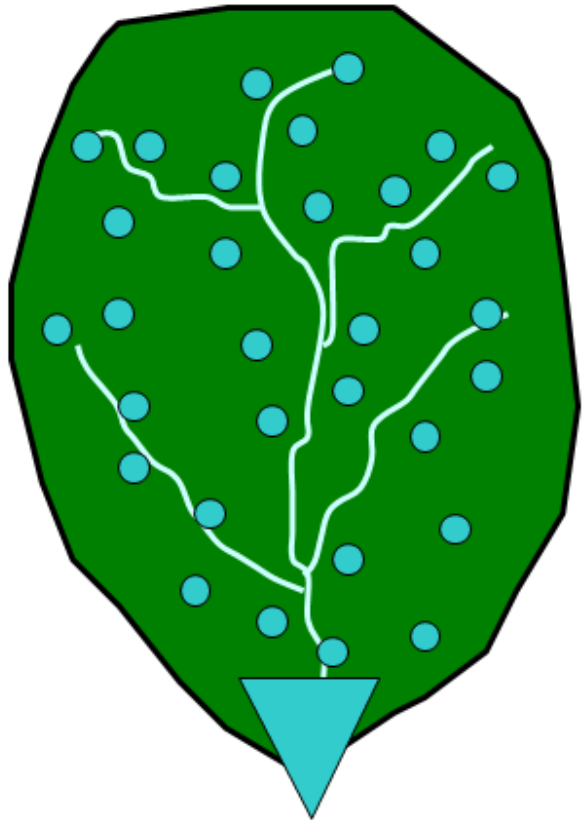
Distributed Controls



Traditional Regional Technique



Distributed Stormwater Features



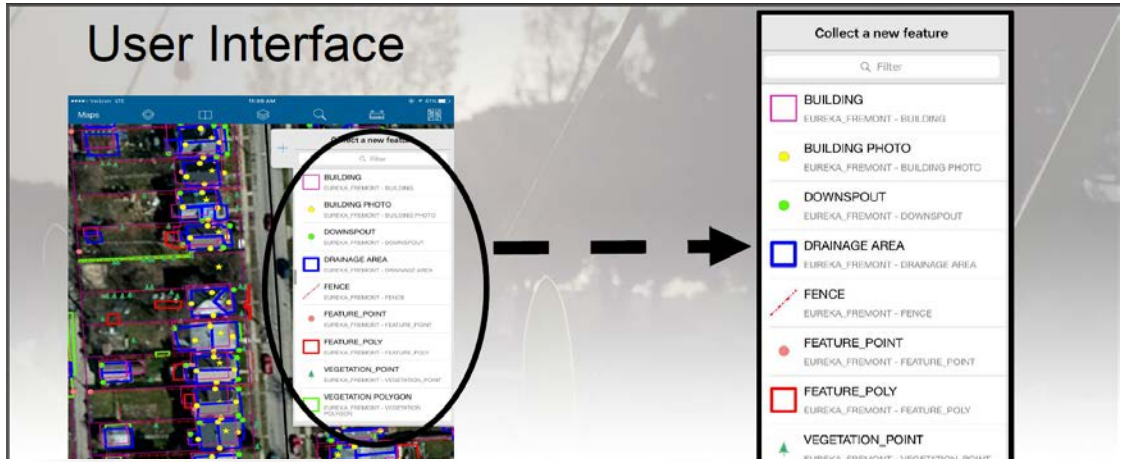
Integrated Stormwater Controls

Flood Mitigation

Blueprint Columbus
- SSO/GI implementation
- Integrated Solutions
- Flood Mitigation
- Inter-Agency Goals

Dellrose Street
- Innovative Design
- Monitoring Opportunities
- Inter-Agency Coordination
- Reduction of Stormwater Flooding

DPS Regional Basins
- Quantity Control
- Flood Control
- Inter-Agency Coordination



Blueprint Columbus Integrated Planning

- First Water Quality Driven Consent Order in the US
- Addressing WQ
- Mitigating Flooding
- Neighborhood Revitalization/Vacant Parcel Conversion
- Re-training on GI Maintenance

BLUE PRINT COLUMBUS

Blueprint Columbus Integrated Planning

Columbus, Ohio

18,400 acres

Clintonville

North Linden

South Linden

Near East

Fifth by Northwest

Miller Kelton

James Livingston

Hilltop

West Franklinton

Near South

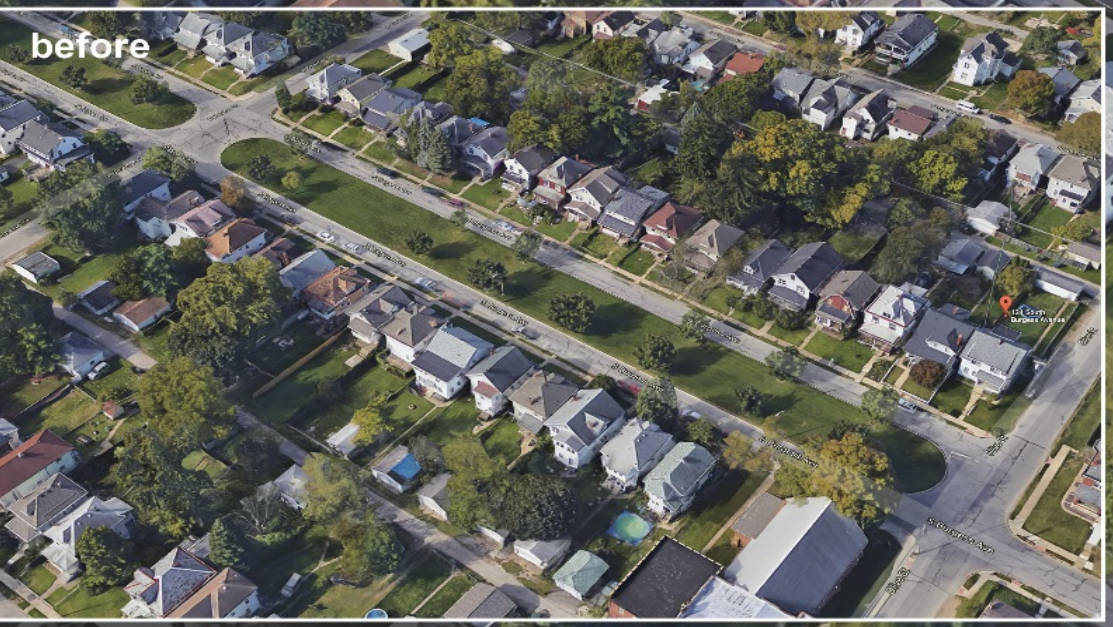
Pre-Cleaning

Post-Cleaning

Blueprint Columbus Integrated Planning

- Boulevards
- Land Bank Parcels
- In-Street and Behind-the-Curb GI
- Permeable Street Pavements
- Bumpouts

CONCEPTUAL BIRD'S EYE



S Burgess Ave

Olive St

Burgess Ave

Olive St

121 South Burgess Av

Palmetto St

S Ogden Ave

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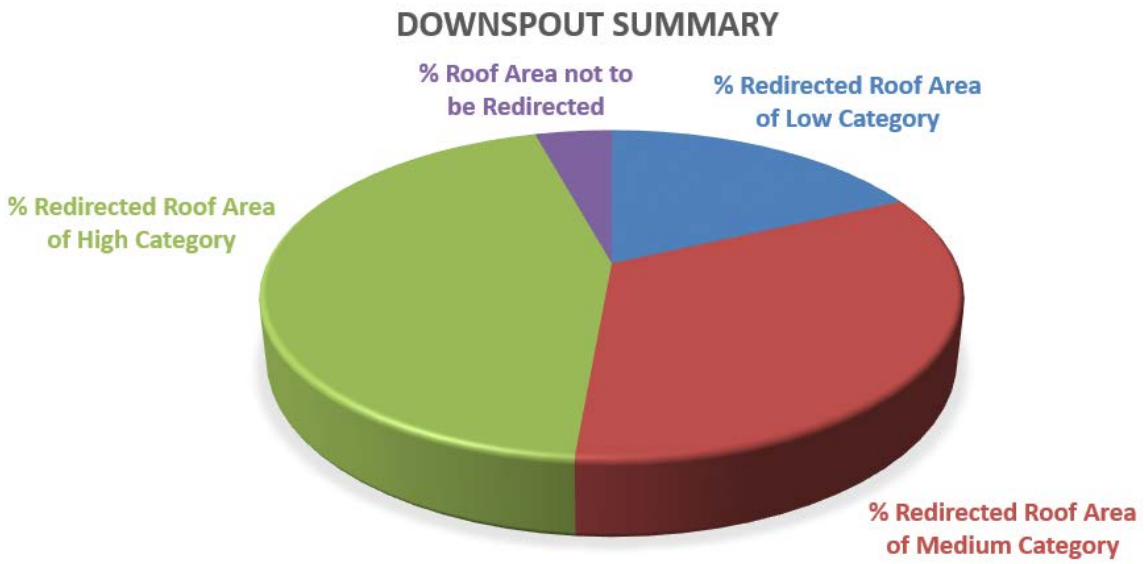
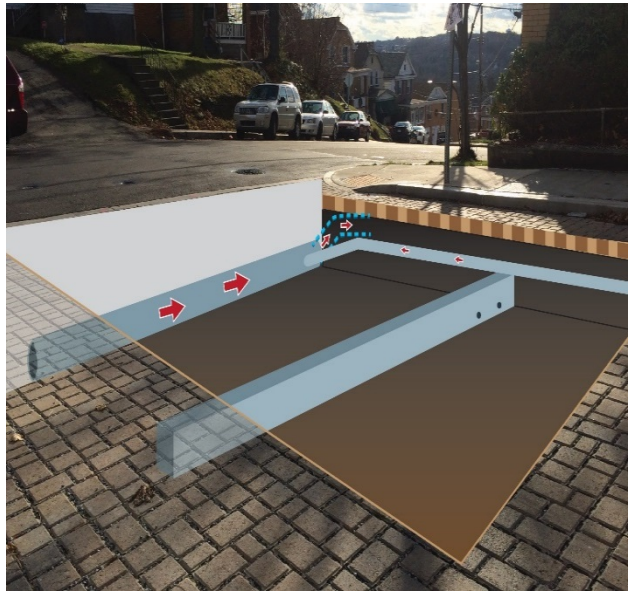
Downspout Disconnection



Summary for the Project Area with Consideration for Grade	
% Redirected Roof Area of Low Category	18%
% Redirected Roof Area of Medium Category	33%
% Redirected Roof Area of High Category	44%
% Roof Area not to be Redirected	4%

Summary of Downspout Analysis		
Category	Acres	Number of Downspouts
Total Roof Area that Could be Redirected	41.1	5642
Redirected Roof Area of Low Category	7.4	1049
Redirected Roof Area of Medium Category	13.7	1885
Redirected Roof Area of High Category	18.3	1915
Roof Area not to be Redirected	1.8	793

Permeable Streets

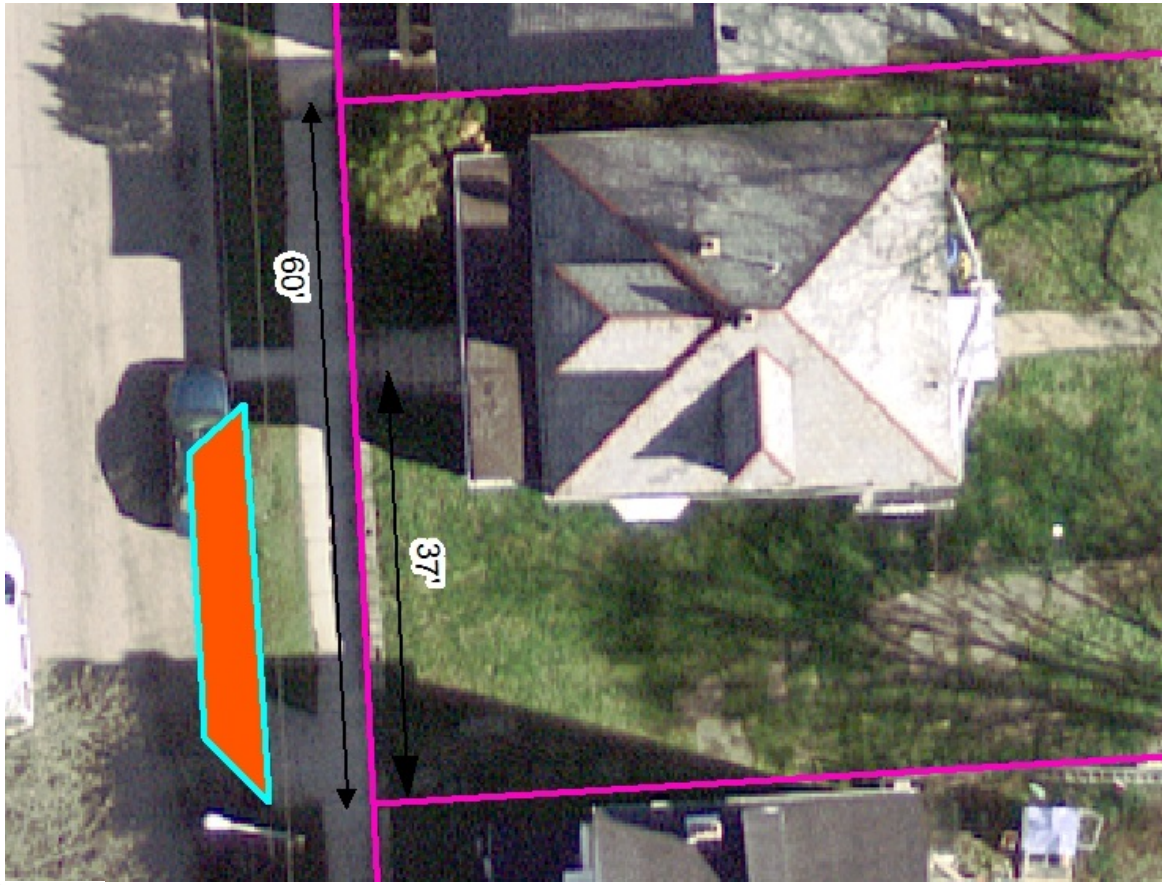


- Continued Coordination of Permeable Street Locations with DPS via DOSD.
- Richardson Ave. and Warren Ave. between Sullivant Ave. and Broad Street scheduled for resurfacing in 2018


Roadway drainage
through storm inlet
No. 9 stone
Permeable pavers
Geogrid
Engineered soil mix
Redirected downspout flow
Gravel

Inter-Agency Workshops

Lessons Learned



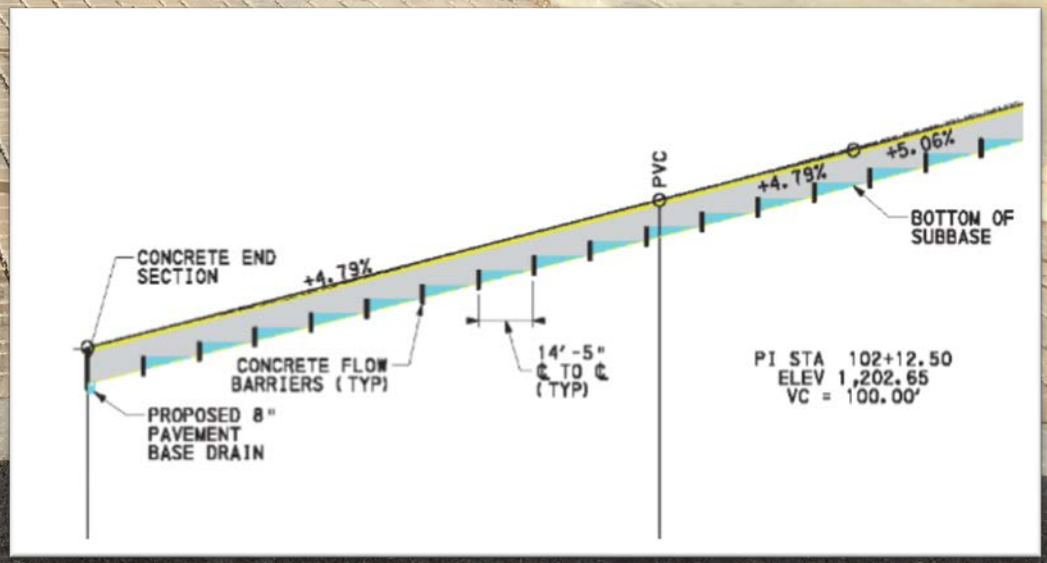
Public Perception
- Bump-Outs
- Permeables
- Buy-in from adjacent neighbors

Inter-Agency Coordination
- Workshops
- Spec Development
- Buy-in from all agencies involved

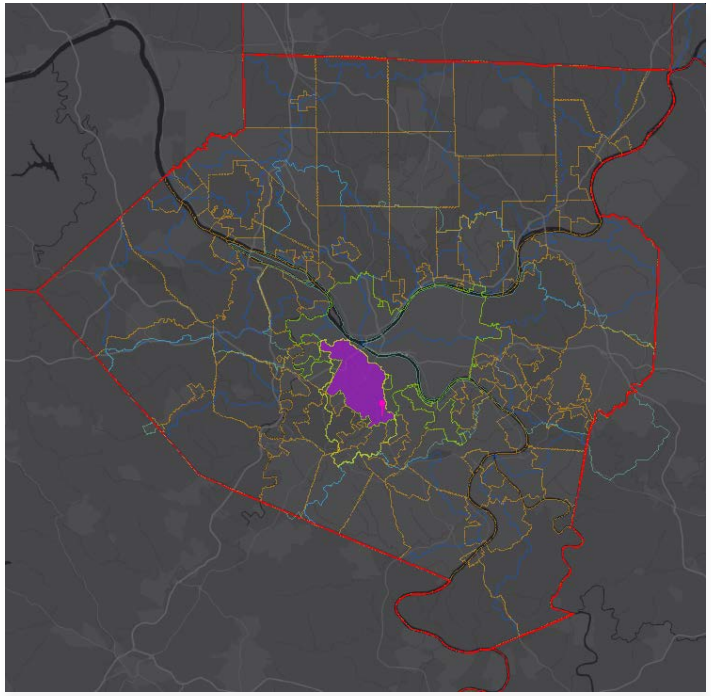
Integrated Planning is a Win-Win
- BP vision has evolved
- Water Quality first but direct benefit with Quantity
- Cost effective

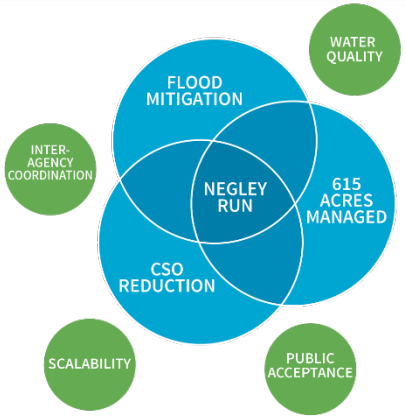
Dellrose Street Green Infrastructure

Pittsburgh, Pennsylvania



Dellrose Street-Sawmill Watershed





Dellrose Street-Sawmill Watershed

- It is encouraged, where feasible to use best management practices (BMPs) to achieve an approved method of surface/stormwater collection, conveyance, detention, and/or retention for stormwater which may minimize or even eliminate the use of PWSA sewer conveyance conduits. Stormwater facilities on private property are usually regulated by other agencies including, but not limited to City of Pittsburgh, Allegheny County Health Department (ACHD), and Pennsylvania Department of Environmental Protection (DEP). The Stormwater Manageme
for the City of Pittsbu
property surface/stormv
information for the City
end of Chapter 2.
county/state stormwater

Lessons Learned

Permeables Work!

- Minimal space disruption
- Integrated into the existing corridor
- Water quality benefit
- Steep slopes are manageable

Inter-Agency Coordination

- Leveraging agency dollars from different departments
- Life-cycle costs
- Collaboration on specs.

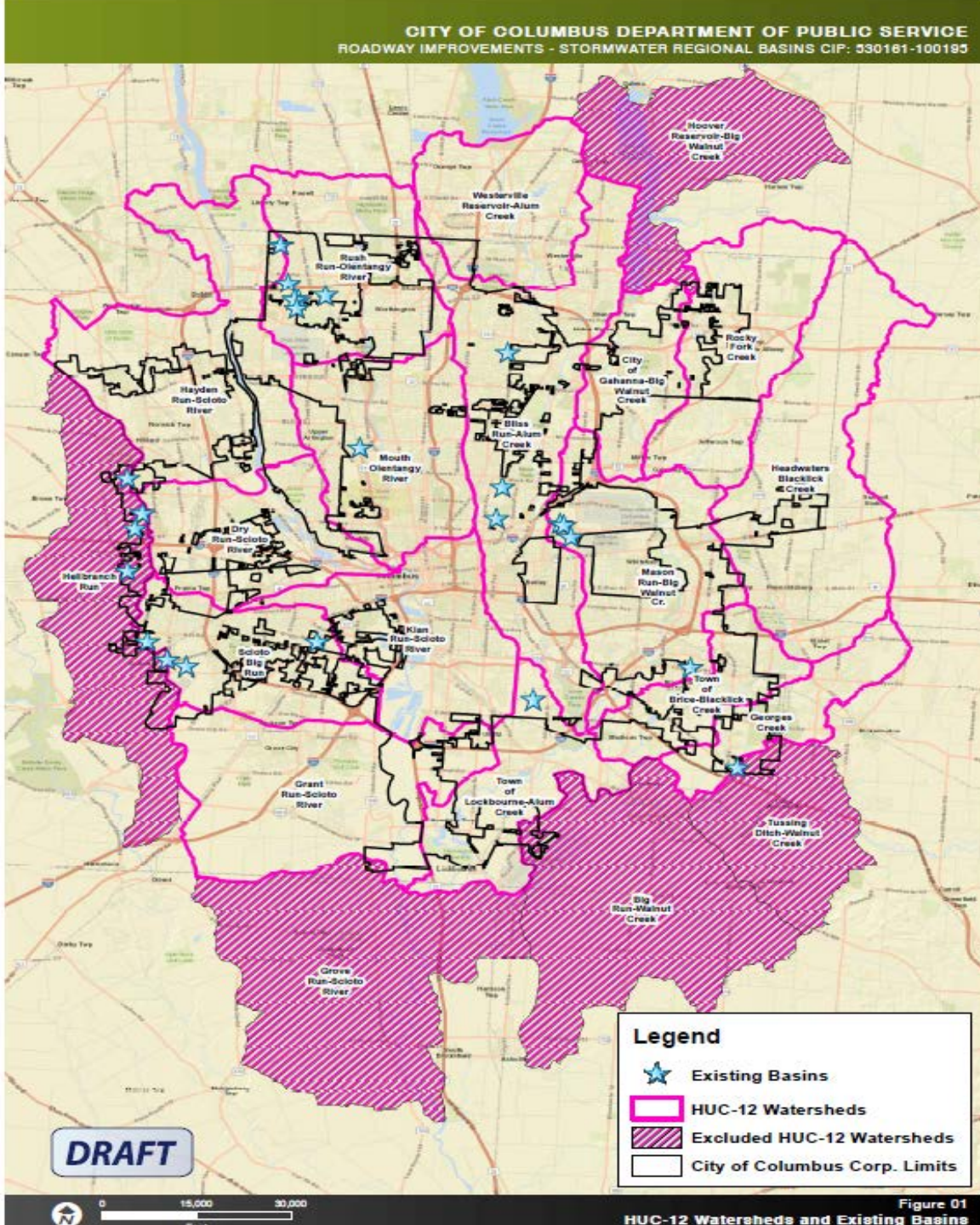
Integrated Planning is a Win-Win

- > 100 in/hr Rainfall Accepted by Permeable Pavers
- 15,000 gallons Retained as Subsurface Storage
- 18,000 gallons Retained/Conveyed (Design Storm)
- 8.1 cfs (~3,600 gpm) of Tributary Peak Runoff Rate Managed
- 1.4 cfs (~630 gpm) of Peak System Discharge

- 83% Reduction in Peak Discharge Rate (Design Storm)

DPS Regional Stormwater Basin Analysis and Flood Control Bank

Columbus, Ohio

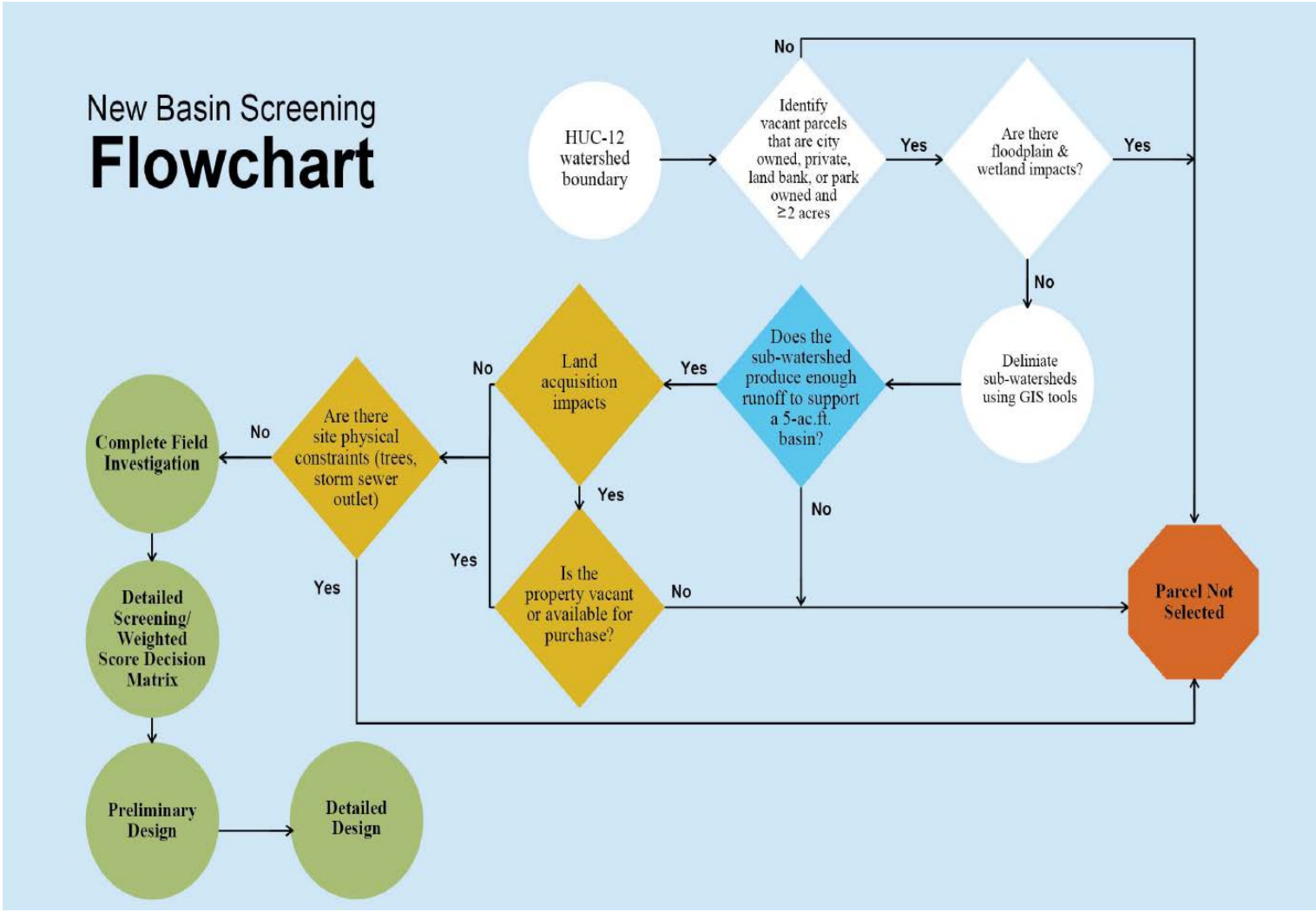


Lessons Learned

Retrofitting Existing Basins
- Low-hanging fruit
- Potential for expansion
- No right of way issues

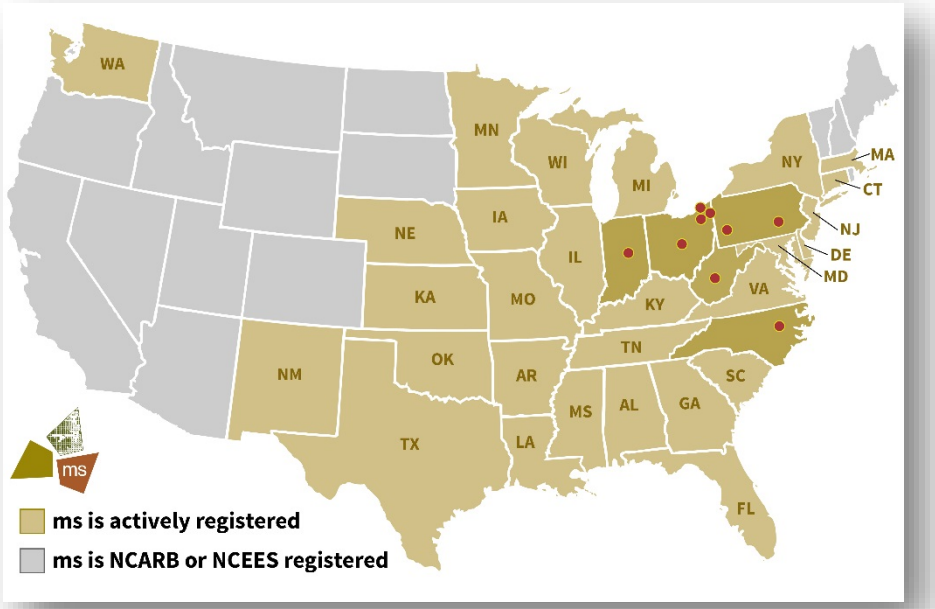
New Regional Basins
- Lifecycle Cost Analysis
- $ per cfs stored

Interagency Coordination
- Partnership with Parks
- Regional WQ benefits
- Flood Reduction Strategies



ms Business Units

Transportation Building Systems	**Water**	Construction Energy



9 offices in 5 states

Actively registered in 34 states

Full Service

In many cases, a typical project process requires that our engineers work with multiple disciplines to design and develop our implemented projects. The advantages of having these services in-house is that the professionals involved work together, generating and sharing ideas on a daily basis, providing seamless project delivery.

Discussion

www.msconsultants.com