

Permeable Pavement Parking

Morton Arboretum, Lisle, IL



Permeable Pavements



Permeable Concrete



Porous Asphalt



Street Retrofits



Seattle Street - Before



Seattle Street – After Retrofit





Seattle street retrofit

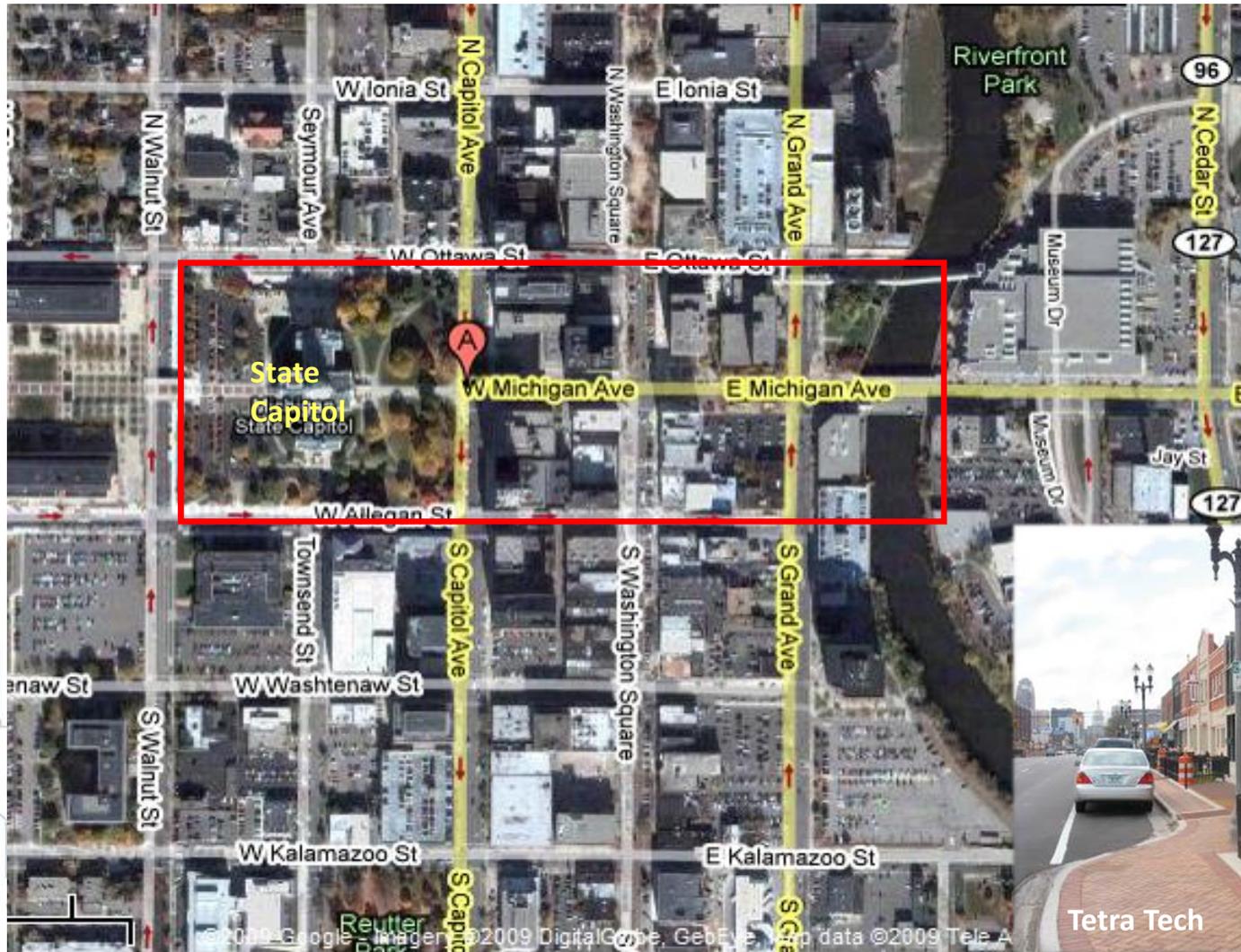
monitoring
results for two
years:

98-99%

reduction in total
runoff volume



A Commercial Street Michigan Avenue, Lansing, MI



Tetra Tech

Michigan Avenue, Lansing, MI



Before





Tetra Tech

Michigan Avenue

- 4 city blocks, both sides
- Typical garden, no overflow for 1-inch event
- 600 block north side, no overflow for 4.1-inches (25-year event)

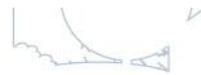
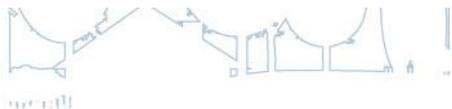
After

Tetra Tech



Green Infrastructure on Vacant Parcels





Green Infrastructure and Resiliency

- Green infrastructure can help reduce urban heat island effects in the summer
- And can sequester small amounts of carbon
- Conventional (grey) infrastructure may be relatively fixed in its capacity
 - In some cases very costly to expand or replace
- Green infrastructure can be implemented in cities to complement and add to the effectiveness of wet weather infrastructure



WARRINGTON, PA

Location: Bucks County, PA
Area: 13.8 square miles
Founded: 1734
Population: 17,580



OPEN SPACE REFERENDUM

Residents vote to borrow



\$3 Million

To be repaid through a small property tax increase



A GREEN INFRASTRUCTURE APPROACH TO LEVERAGING LOCAL PRIORITIES IN WARRINGTON TOWNSHIP, PENNSYLVANIA

Environmental Finance Center 9/30/14 Warrington Township

Telling the financing story through the use of graphics

Why Open Space?



COMMUNITY'S DESIRE TO BALANCE GROWTH WITH NATURAL AREAS

4

Priorities



- ACQUIRE undeveloped land
- LINK trail system segments
- IMPROVE existing parks
- PRESERVE historic lands

Introduction & Goals

Mill Creek Nature Trail Preserve creates an opportunity to celebrate a commitment to a sustainable future for Warrington Township. The goals of the Mill Creek Nature Trail Preserve project are to 1) create trail connectivity, 2) incorporate green infrastructure, and 3) provide opportunities for environmental interpretation and education. The proposed master plan provides for a variety of spaces, design elements and uses while making a commitment to provide for animal and plant diversity representing the local flora and fauna of the area.

Conditions & Concepts



Existing Site Conditions

Proposed Mill Creek Trail Preserve will play an important role in linking Warrington Township parks and trails. The trail preserve has a wonderful opportunity to expand and connect Warrington Township to the 202 Trail System.

Legend:
 - Road 202 Path
 - Proposed Road
 - Proposed Trail
 - Nature Play Meadow
 - Middle Meadow
 - Stump Meadow Wetland
 - Secret Pond
 - Mill Creek Trace Trail
 - Bridge at Mill Creek

Proposed Concepts

The Mill Creek Trail Preserve vision creates multiple loops, winding through a variety of habitats. These loops and site features engage a variety of activities, from leisurely afternoon strolls for empty nesters, star gazing with children, and interesting bike routes for the avid biker.



Focused User Groups



Local and Non local Bikers

will be drawn from US 202 to Mill Creek Nature Trail Preserve by the opportunities afforded by the proposed features: the overlook, winding trails to Mill Creek and ultimately continued access to Warrington Township Parks and the Bradford Reservoir Recreation Area.



Warrington Township Citizens

will take pride in the establishment of Mill Creek Nature Trail Preserve knowing that they have created a landscape that affords greater wildlife and forest protection while providing future generations access to nature. The proposed uses are compatible to creating both healthy citizens - walking, biking, and nature - and a healthy environment for a variety of upland forest, meadow and lowland-water oriented organisms.



Local Neighbors

will likely be the most frequent users of the Mill Creek Nature Trail Preserve and likely stewards of the preserve. Approaching from Billingsley Drive or King's Court, walkers can take evening strolls through Stump Meadow or enjoy the opportunity for nighttime stargazing. Residents from just a bit farther will have a convenient walk or bike ride to a destination that affords beautiful views and a variety of interesting seasonal habitats.



Students and Teachers

will find additional improved habitat in the restoration of Mill Creek Nature Trail Preserve. Reforested area, managed for invasives, will provide additional forest habitat. Proposed meadows provide the ideal setting for groups of students from a science class to learn about restoration habitats in progress: forest restoration, emergent upland wetland restoration, and the development and maintenance of meadows that foster habitats for endangered pollinators.



Wildlife

will find additional improved habitat in the restoration of Mill Creek Nature Trail Preserve. Reforested area, managed for invasives, will provide additional forest habitat. Proposed meadows provide the ideal setting for groups of students from a science class to learn about restoration habitats in progress: forest restoration, emergent upland wetland restoration, and the development and maintenance of meadows that foster habitats for endangered pollinators.

Concept Features

- Trailhead Parking and Entry at Stump Road**
This trailhead is integrated with the improved existing parking lot on the west side of Stump Road. Design and way-finding elements provide a clear and safe identity for local and non-local users.
- Primary Trail - Pennington Trail Extension**
This proposed trail segment provides a critical first link from US 202 multi-use trail to Twin Oaks Park, Lower Nike Park, and Bradford Reservoir Recreation Area.
- Nature Play Meadow**
This meadow provides an opportunity for natural play based focused activities. It is conveniently located between two subdivisions.
- Middle Meadow**
The Middle Meadow is the central non-forested open space. Users arriving to this meadow experience a clear sense that they are in the middle of Mill Creek Nature Trail Preserve.
- The Overlook at Middle Meadow**
The overlook at Middle Meadow provides an opportunity for commanding views to the east looking towards Mill Creek. The proposed feature is an intermediate destination identifiable to users of the sites.
- Stump Meadow Wetland**
The smaller of the proposed meadows, Stump Meadow Wetland provides a more intimate space that serves primarily users from the adjacent neighborhood. The proposed small wetland feature provides an opportunity to showcase a wetland restoration habitat and adds both habitat diversity and creates an opportunity for interpretive education.
- Secret Pond**
The existing pond is integrated into the proposed trail network. The pond becomes a destination along the trail and can serve to demonstrate improved riparian buffers to protect water quality and enhance animal habitats.
- Mill Creek Trace Trail**
This proposed trail section provides a more secluded woods experience. The trail also provides opportunities for interpretive education.
- The Bridge at Mill Creek**
The bridge serves as an opportunity to celebrate the central water feature of the preserve: Mill Creek.

Conceptual Master Plan



Parking Lot and Trail Entrance Concept

The proposed parking lot, designed using green infrastructure stormwater techniques, is conveniently located close to the existing 202 Parkway Trail providing an ease of access to the proposed trail-head. Local residents, distant travelers, and school groups can easily park and explore the Mill Creek Nature Trail as well as accessing neighboring townships via the existing 202 Parkway Trail.



Primary Trail Entrance at Stump Road Concept

The entrance at Stump Road is the starting point of the Mill Creek Nature Trail and the first point connecting Warrington Township to the existing 202 Parkway Trail. This 10 foot wide paved trail complete with way-finding elements and multiple places to stop and rest, smoothly winds through reforested farmlands eventually connecting to Pinkertown Road.



Stump Meadow Wetland Concept

The Stump Meadow Wetland creates a beautiful additional habitat with opportunities for interpretive learning. Families can walk and view birds nesting nearby and aquatic wildlife. Bikers can take a brief break from the main trail and enjoy the peaceful and more secluded environment of the wetland.

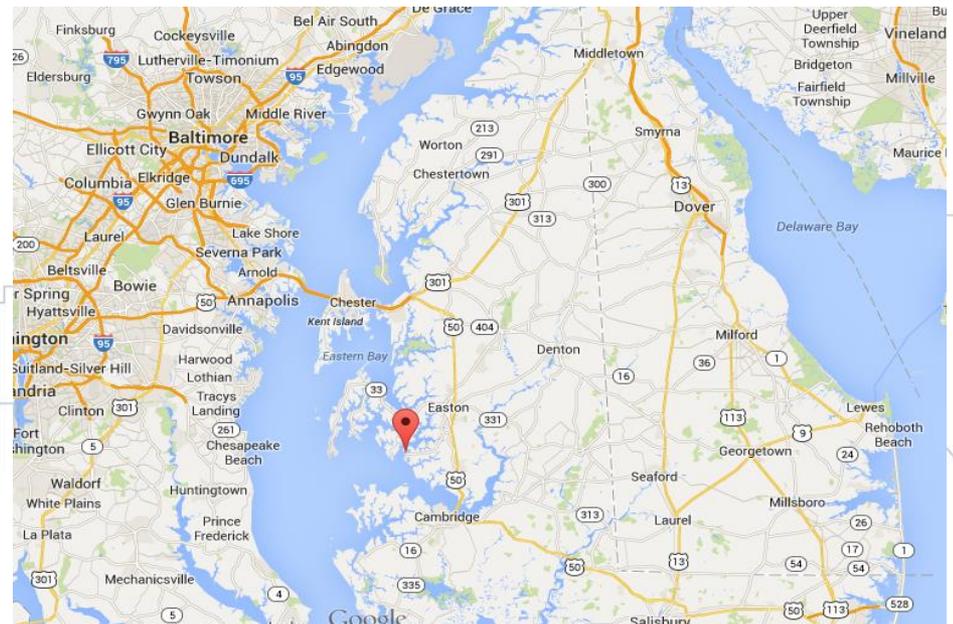
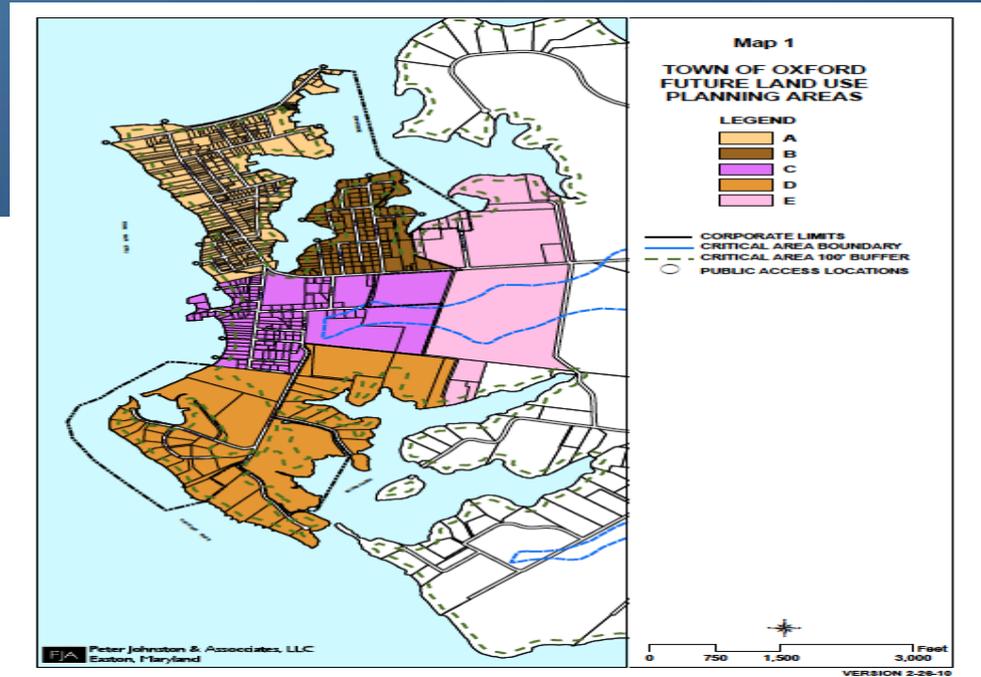
Oxford, MD

Population – 400 full time residents plus another 300 seasonal.

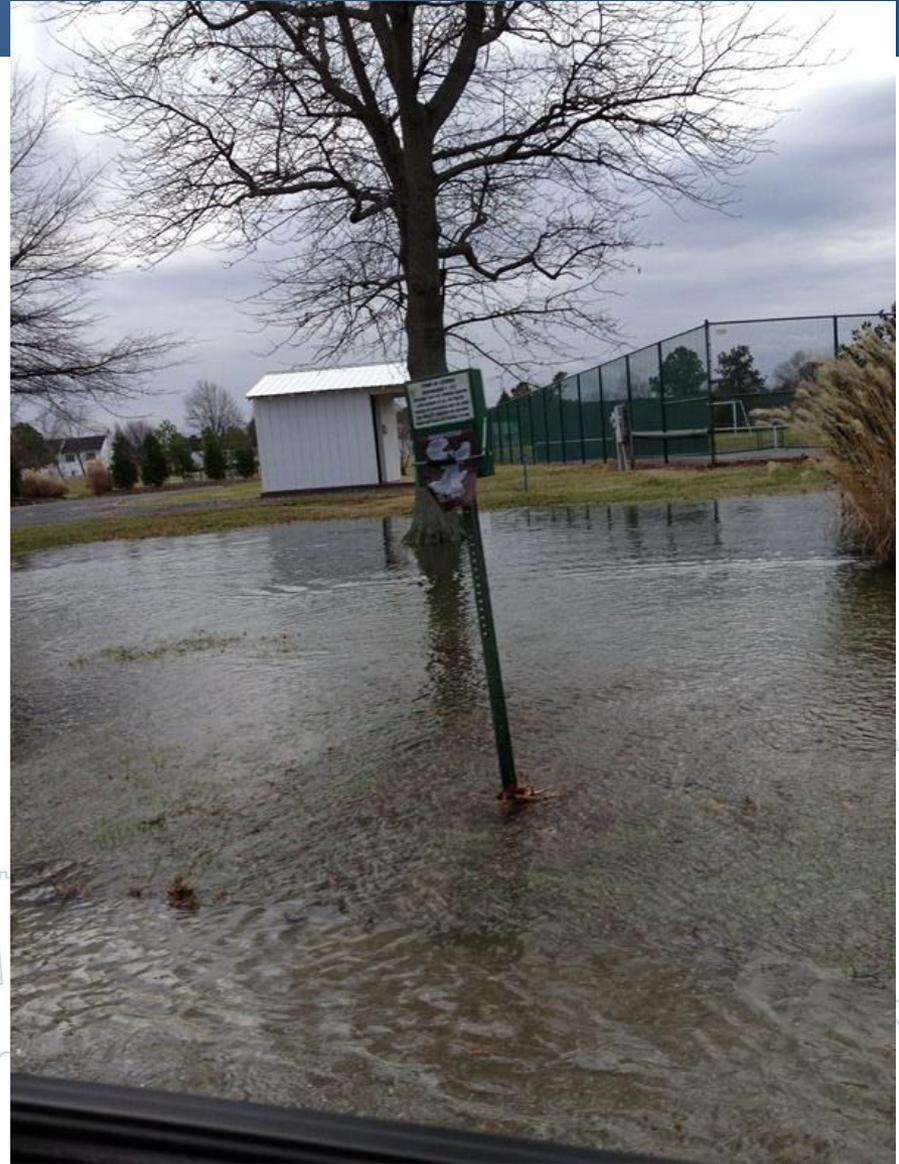
Demographics – Older and wealthier individuals with lots of time for family, friends, and community.

Economy – Historically focused on boating and fishing, now thrives on real estate, sailing, and tourism.

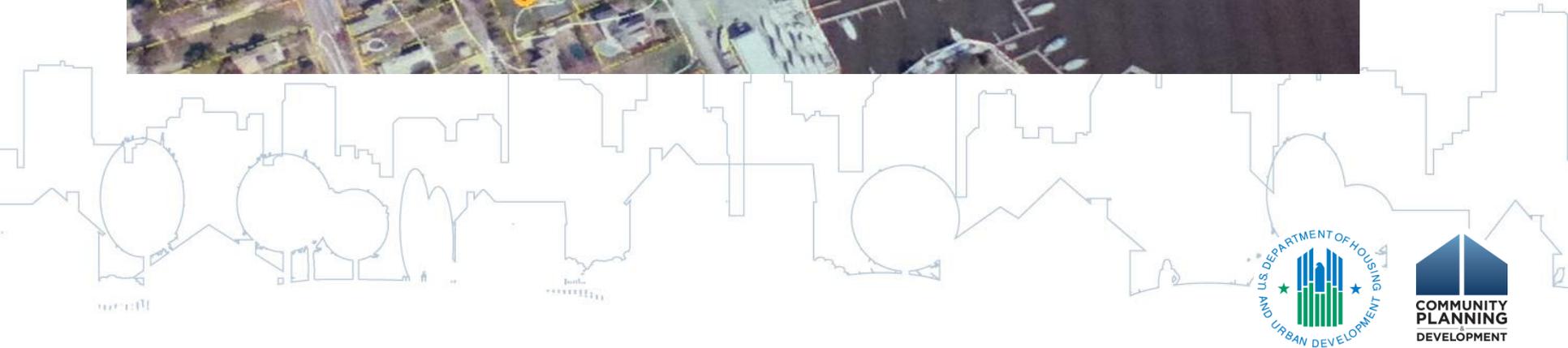
Incorporated Municipality – One of 4 municipalities in Talbot County, MD.



High Water Events



Outreach: Survey and Mapping Exercise





Oxford Stormwater Project 2013 Summer Event Series

Join the Port of Oxford and the Oxford Stormwater Task Force for an interactive event series on solutions to stormwater management in the community and on your personal property. The summer events will feature steps residents can take to reduce stormwater concerns in Oxford, Maryland.

?????

???? Saturday, April 27

Oxford Day

Stormwater Information Table
Rain Barrel Demonstration

Visit the Stormwater Task Force table in the waterfront park on Oxford Day. Tell us what steps the Port of Oxford can take to reduce stormwater concerns. Enter to win a rain barrel painted by an Oxford artist, come see a rain barrel demonstration outside the Town Office, and see how us stormwater challenges in our town maps.

Friday, May 1

River Appreciation Week in Oxford

4:30pm @ Oxford Community Center

Join the University of Maryland Extension and Talbot County Master Gardeners for a tour of Oxford's rain barrels and rain gardens followed by a living shoreline kayak excursion along the strand. For more information, contact Mikaela Boley at 410-822-1244 Ext. 12.

Wednesday, June 19

Rain Barrel and Garden Workshop

7:00pm @ Oxford Community Center

Learn how rain barrels and gardens can be used to manage stormwater and how to install them in this evening workshop. For more information, contact Sean Williamson at 802-578-5399.

???? Wednesday, July 17

French Drain Workshop

7:00pm @ Oxford Community Center

Learn from an Oxford homeowner about his experience designing and installing a French drain for managing stormwater on his property. For more information, contact Sean Williamson at 802-578-5399.

Saturday, August 24

Workshop on Stormwater Systems

3:00pm @ The Preservation Green Horticultural Center on Mill St (101 Mill St)

Philip Logan, EA, LEED AP, will share his experience in designing and installing stormwater control and filtration systems. This will include a study of the green roof in its 2nd year, rainwater filtration & cistern storage systems, pervious vs impervious surfaces, bio swales and a discussion on general stormwater management principles. For more information, contact Philip Logan at 212-358-0538.

???? Saturday, September 28

Bank Street Bio Swale Volunteer Day

Volunteers are invited to get their hands dirty as the community finishes installation of bio swale on Bank Street by planting native species. For more information, contact Sean Williamson at 802-578-5399.



The Oxford Stormwater Feasibility Study is sponsored by the National Fish and Wildlife Foundation



With assistance from Oxford Stormwater Project Partners

A Range of Spending Options for Oxford's Stormwater Program

Low Cost, Low Impact
Stormwater Program

High Cost, High Impact
Stormwater Program

Current Program – Making due with limited resources, but sometimes deferring stormwater projects while the situation does not visibly improve, and potentially worsens.

Goldilocks Program – Selectively investing in capital improvement projects and management strategies with the greatest impact while keeping costs down. Emphasis on getting “the most bang for the buck.”

The Cadillac Program – Investing in all large-scale capital improvement projects that drastically improve high water situation, but do not stop flooding all together and come with significant cost.

Where Oxford is

Where Oxford should be



Example of Stormwater Program Spending Options

Budget Number and Name	Description	5-YR Cost	Impact on Pollution and Flooding
1: Basic Program	Includes all currently scheduled repairs and construction described above.	\$506 K	Least impact – Addresses current system repairs.
2: Option 1 + mapping + planning	Includes all currently scheduled projects plus development of infrastructure map and master plan plus funds for education and outreach	\$630 K	Small direct impact, but indirectly, planning will position Oxford for success.
3: Option 2 + mapping + planning + Causeway road elevation + pumps	Includes all currently scheduled projects, plus master plan, plus major capital improvement projects at the Causeway (Pumps and rd. elevation)	\$1.5 M	Greater direct impact as a result of new capital improvement project plus planning benefits
4: Option 3 + wetland and investment in shoreline buffers	Includes constructing a 5 acre wetland, installing storm pumps, expanding coastal buffer, plus all existing projects and a master plan	\$2.3 M	Greatest impact



College Park, MD: Flooding and the Opportunity for Green Infrastructure



LEGEND

- Metro Rail
- Contours (3' Intervals)
- Streams
- Water Bodies
- Wetlands
- FEMA Floodplain
- Buildings (2009)

Data Source:

Participant response points digitized from community outreach response maps. All other data provided by the City of College Park.

- Primary Neighborhood Flooding - Location where participant felt the most serious flooding in their neighborhood occurred.
- Secondary Neighborhood Flooding - Location where participant felt flooding was serious, but not the *most* serious occurrence in their neighborhood.
- Flooding on Personal Property - Location where flooding occurred on participant's private property.
- Green Infrastructure Investment - Location where participant felt there should be investments in stormwater management and/or public green space.

OUTREACH RESPONSE MAP CITY OF COLLEGE PARK

PROJECTION:
Lambert Conformal Conic
COORDINATE SYSTEM:
NAD 1983 State Plane
Maryland, FIPS 1900

PREPARED BY:
Christopher Shipley,
Project Assistant
KFS# 4-305850

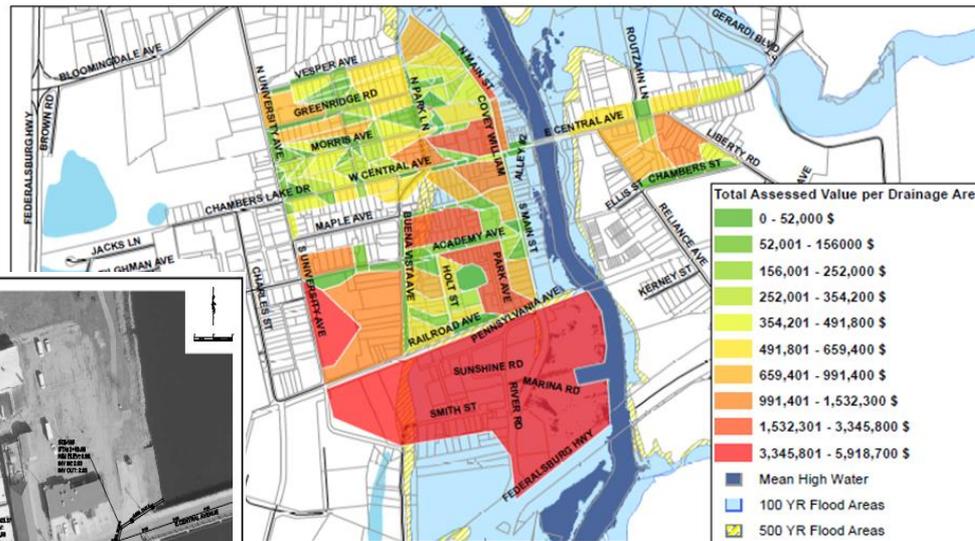
DATE: 12/15/2014
REVISIONS:

Prepared for:
THE UNIVERSITY OF MARYLAND
ENVIRONMENTAL FINANCE CENTER

EFC

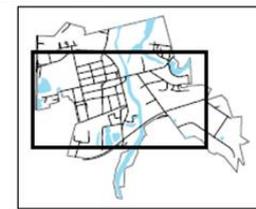
www.efc.umd.edu

Federalsburg, MD: Understanding Infrastructure Before Making Investments



Federalsburg, MD
Assessed Value of
Flood Plain
Drainage Areas

by Albert Engel
Environmental Finance Center
University of Maryland
April 1, 2014



Painesville, Ohio: Strong Leadership Made Stormwater a Priority

Existing stormwater program:

- City collects about \$427,000 from stormwater fees
- Stormwater management became priority for new city manager
- Insufficient level of service currently being provided
- No long-term clear vision or capital investment plan
- Insufficient outreach and education
- City staff unclear of exact stormwater responsibilities



Current Capital Investments

In recent years, very common things were happening to stormwater program:

- Capital investments in stormwater had steadily **decreased** over last five years
- Revenues were shifted to cover other operating expenses
- Lack of understanding about permit requirements
- Confusion about key partnerships
- Infrequent/insufficient maintenance of existing system
- Little to no program tracking, reporting, or training
- Infrastructure condition is unknown in most areas
- Low level of service provided to community



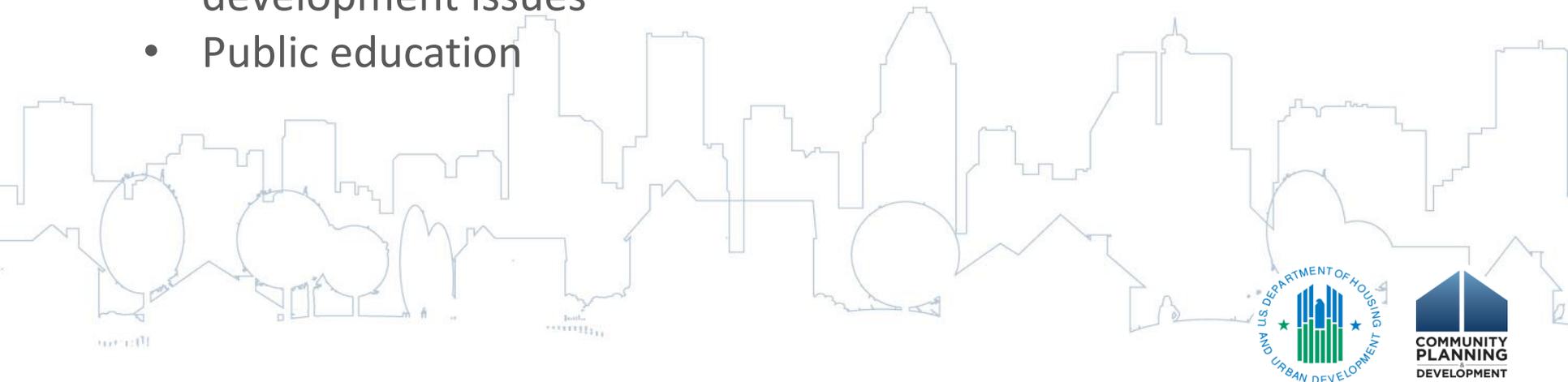
Lake County's Services Provided to Painesville

Painesville paid Lake County Stormwater Department \$53,000 to provide:

- Technical assistance in program administration, regulation and enforcement
- Assistance in public education and involvement
- Some financial services

Painesville also paid LCSWCD \$3,000 to provide:

- Erosion and sediment control
- Landowner assistance, natural resource protection, development issues
- Public education



Lake County's Level 2 Service

Covers all permit requirements and needs:

Data collection and management

Planning, design and construction of regional drainage systems

Assistance with operations and maintenance

Direct billing of stormwater customers

More grant opportunities

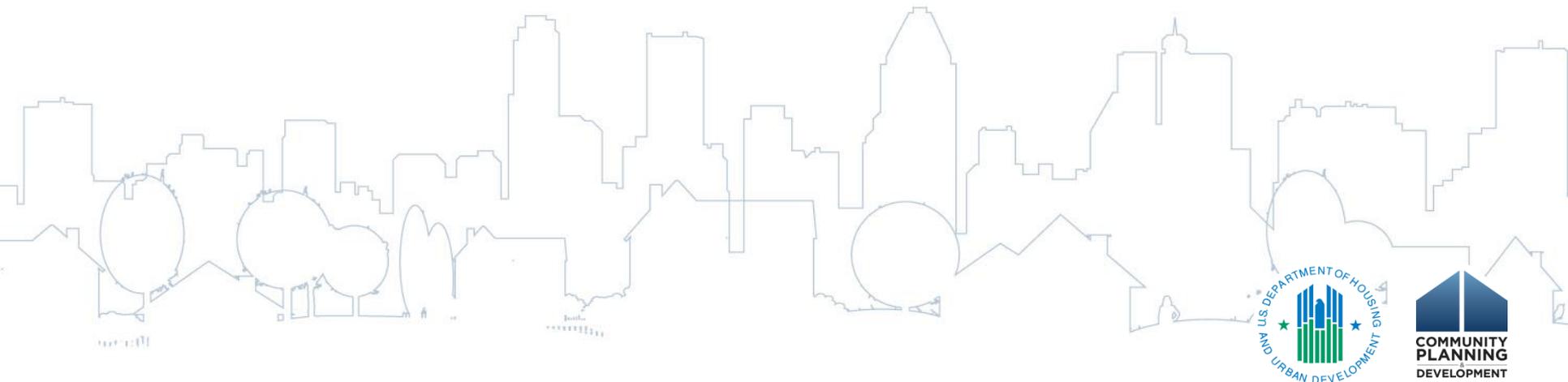
Administrative and reporting assistance

Capital investments in infrastructure



Proposed Schedule of Stormwater Projects

Project	Design	Construction	Cost/Funding
Cedarbrook Basin	2015	2016	\$1.7 M
Cedarbrook Dr. Inlet	2015	2016	20 year bond
Maplewood	2015	2016	\$288k
Mentor/Jackson	2018	2019	\$1,174k
Gingerbread	2019	2020	\$640k
Nelson	2012	2022	\$606k



Upcoming Communities to Watch

Connecting Communities with Common Concerns:

Narragansett Bay and the City of Annapolis

- ✓ Coastal Flooding
- ✓ Infrastructure needs
- ✓ Stormwater permits
- ✓ Green Infrastructure
- ✓ Sustainability



Presenter Contact Information

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Questions?

