

Not Your Father's Tax Ditch

*Enhancing Delaware's Drainage Network Through the
Use of Natural Channel Design Techniques*



**Division of Watershed Stewardship
Drainage Program**

Presented at the National Conference on Ecological Restoration
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A little bit about the First State

- 2 – Physiographic Provinces
 - Appalachian Piedmont
 - Atlantic Coastal Plain
- Avg. Elevation is 60 ft. above mean sea level
 - Lowest in the US
- Avg. Annual Rainfall 45”
 - Tied for 14th highest in U.S.



Delaware's Tax Ditch Law

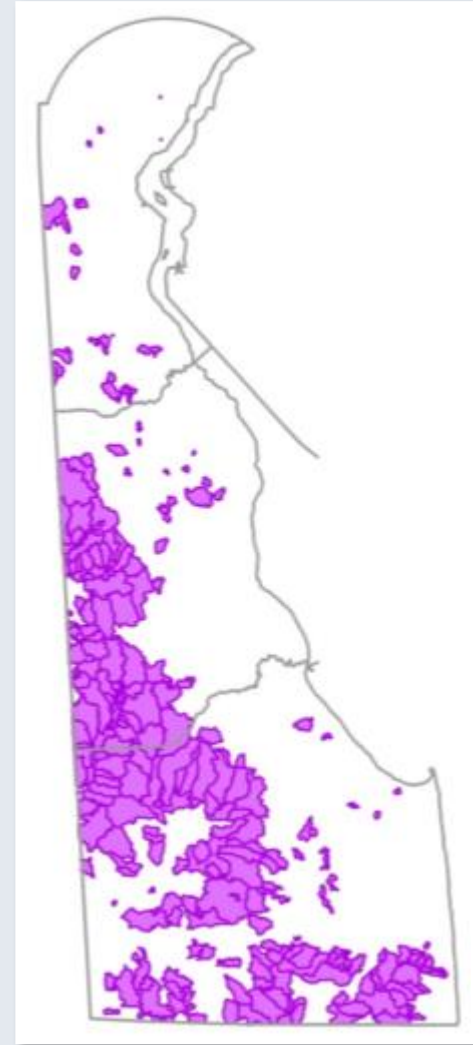
- Title 7, Chapter 41 of the Delaware Code passed in 1951 last revised in 2008
 - Law declared: “... that the drainage and the prevention of flooding of lands and the management of water for resource conservation shall be considered a public benefit and conducive to the public health, safety and welfare.”
 - Sets out a court process that creates the tax ditch organization as a Governmental Subdivision of the State
 - Process starts with a petition
 - Referendum
 - Superior Court Order



Tax Ditch Organizations are formed on a watershed basis to construct and maintain a water management system. The organizations are managed by officers elected by the taxable's.

Statewide Tax Ditch Facts

- 236 Tax Ditch Organizations
- Drainage System is over 2,000 Miles
- Providing benefit to
 - Over $\frac{1}{3}$ of Delaware Lands
 - $\approx \frac{1}{2}$ State Maintained Roads
 - Over 37,000 Parcels
- Over 15,000 parcels have a Tax Ditch Right-of-Way
- 56,000 acre Marshyhope Creek
- 2 acre Alban Park



Traditional Tax Ditch Construction & Maintenance



Traditional Tax Ditch Construction & Maintenance



Traditional Tax Ditch Construction & Maintenance



Traditional Tax Ditch Construction & Maintenance

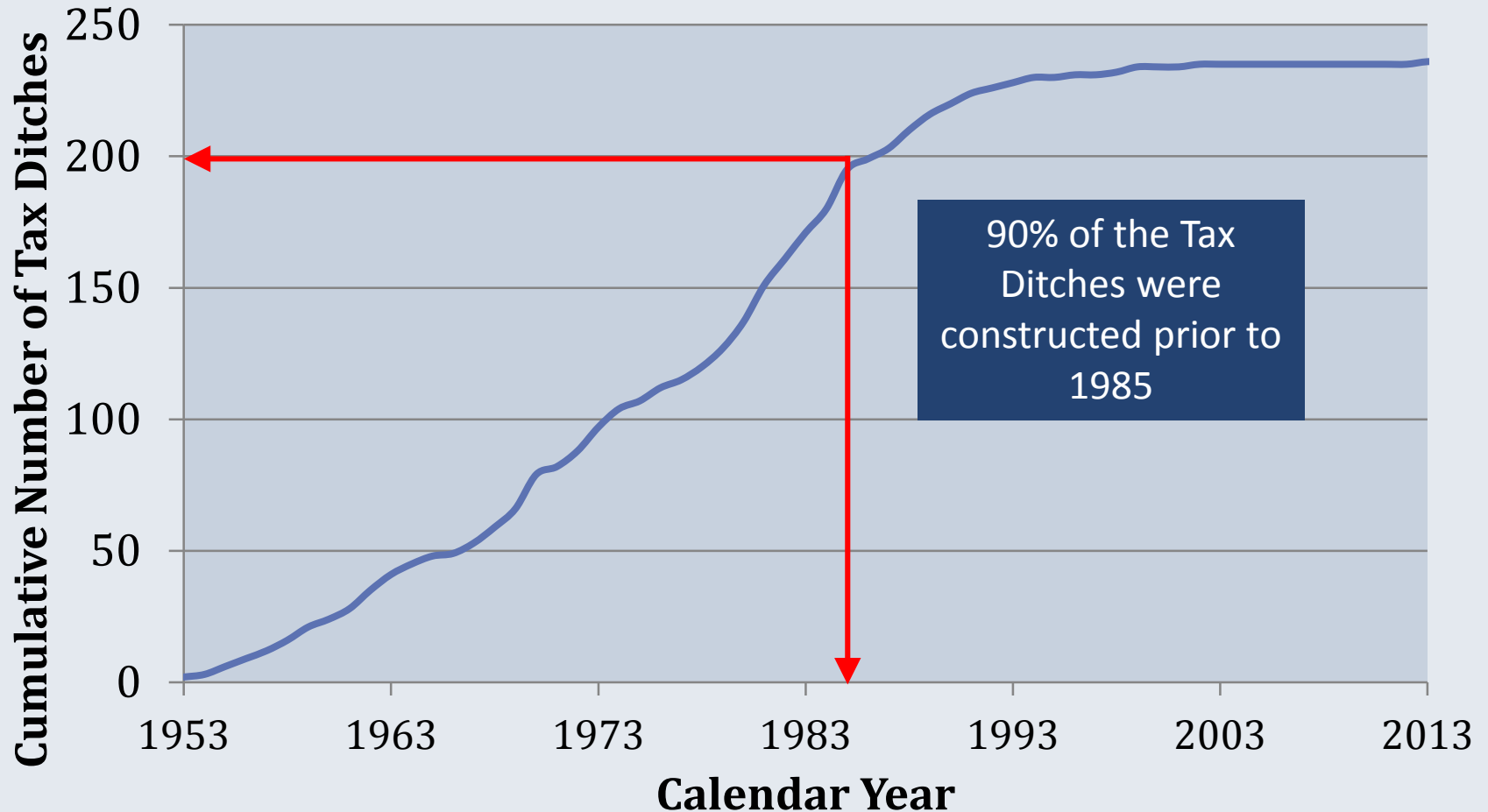


Traditional Tax Ditch Construction & Maintenance



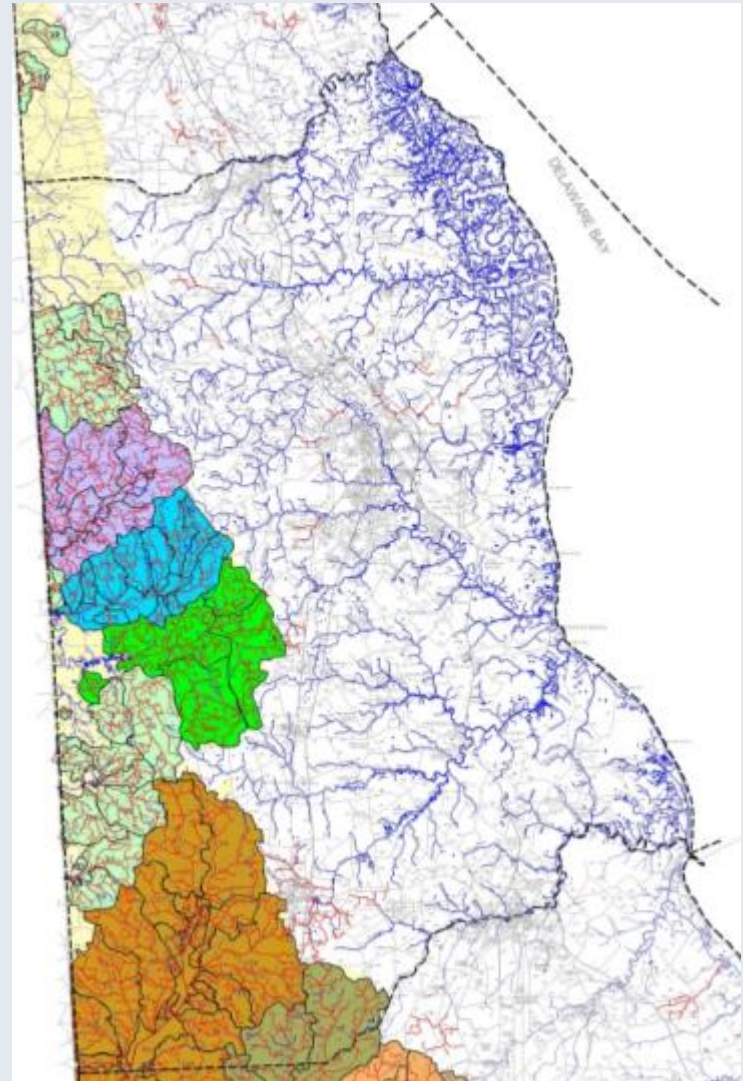
Aging Infrastructure

NUMBER OF TAX DITCHES FORMED IN DELAWARE OVER TIME

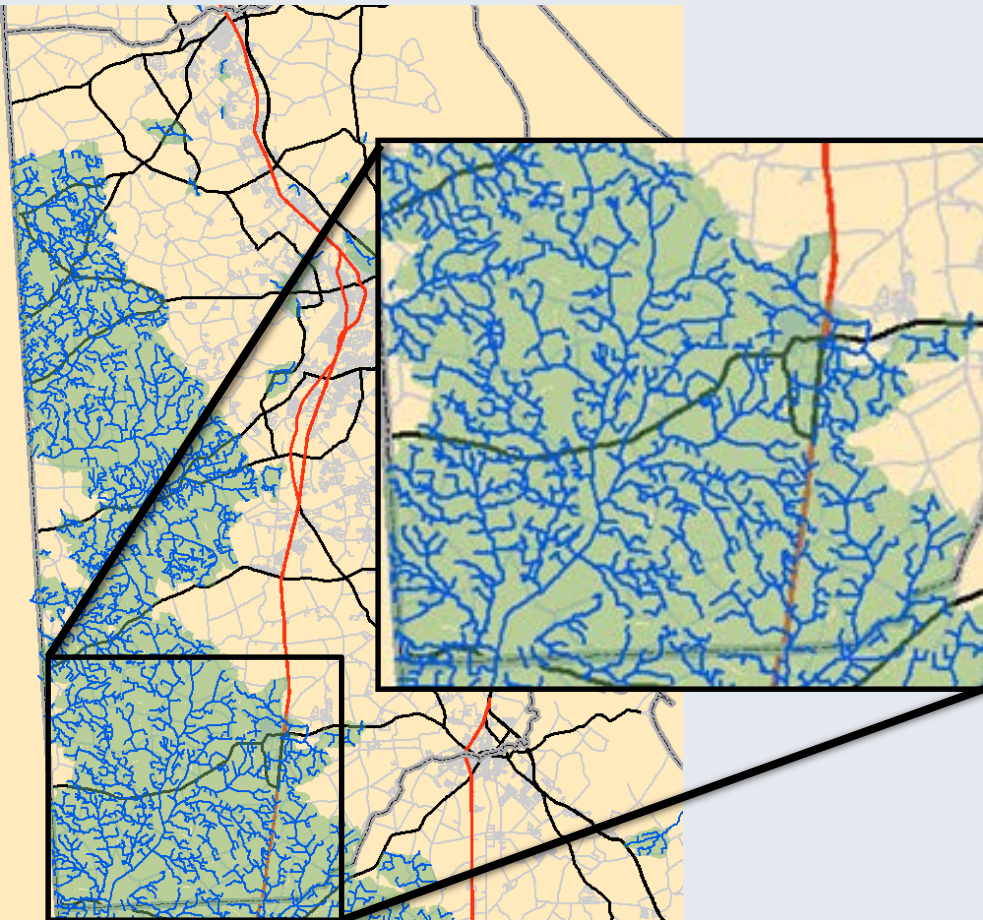


Tax Ditches: Highways for Runoff

- Formed to solve Drainage Problems
- Engineered to remove excess runoff over a 24 hour period
- Landowners pay taxes based on drainage benefit

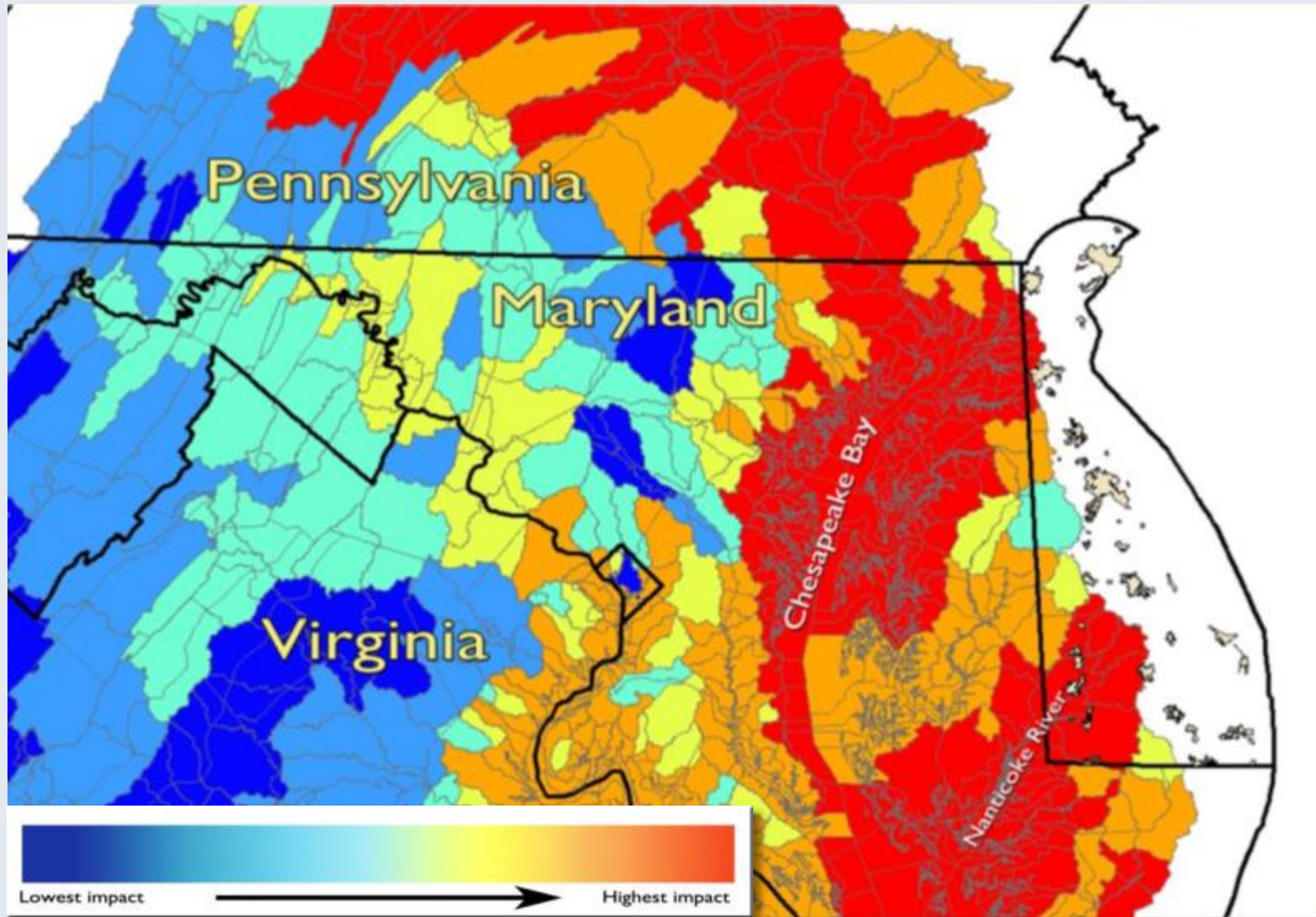


Tax Ditches: Highways for Runoff



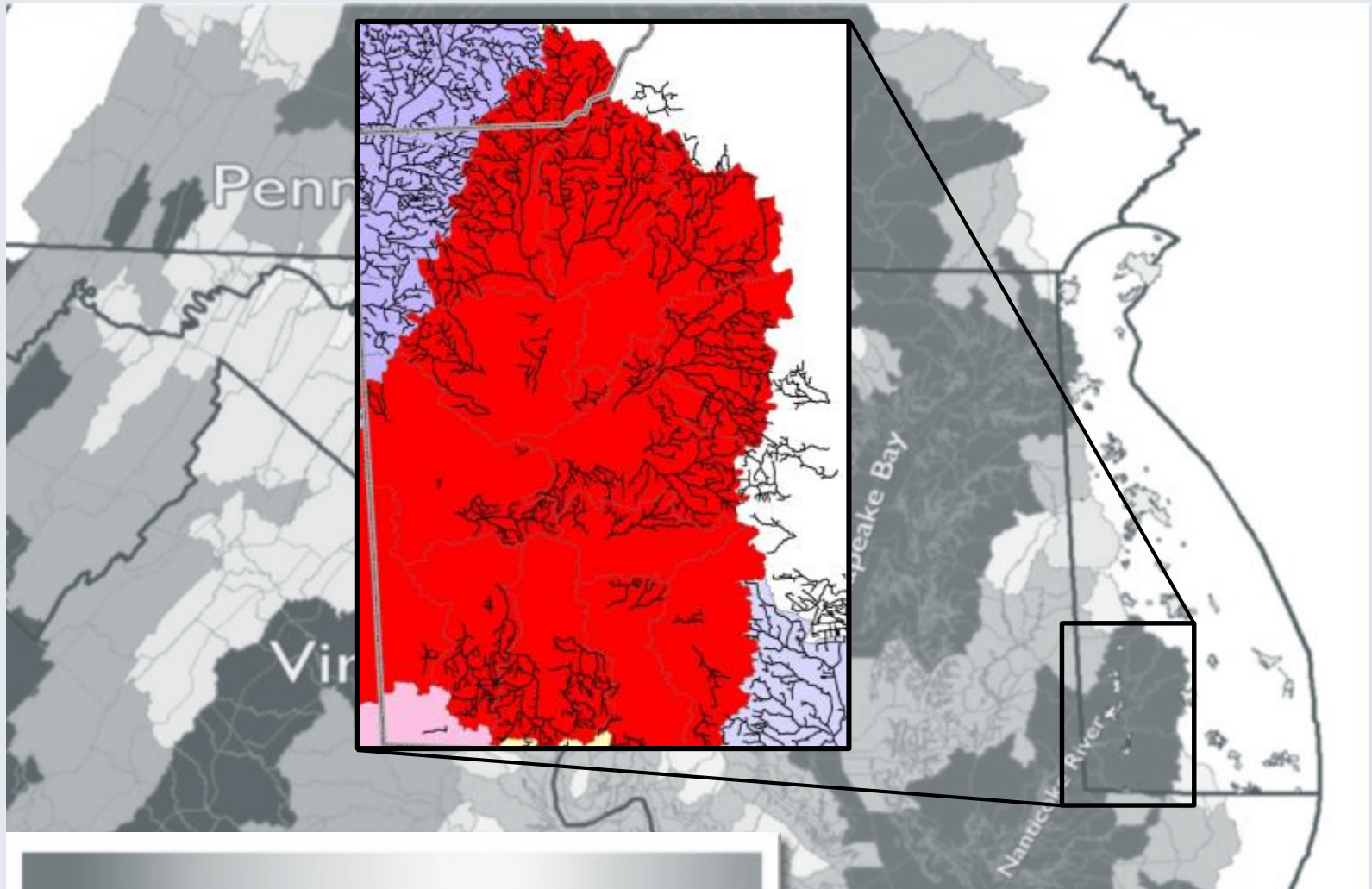
- Dense network of ditches effectively move runoff from the land to receiving water body.
- So they also carry pollutants downstream
 - N, P, & TSS
- Speed limits some natural processes
- Disconnected from Floodplains

Delaware is an Effective Polluter of the Bay



Impact of red areas on Bay water quality at least 10 times higher than blue areas

Delaware is an Effective Polluter of the Bay



Are Tax Ditches the Problem or the Solution?
Maybe Both!

An Opportunity

Degraded Infrastructure

- Age of the Tax Ditch network
- Changes in hydrology from development
- High number of large weather events over last 5 years
- Need for Funding

Chesapeake Bay WIP

- Challenged to meet TMDL goals
- Looking for “In-stream” BMP’s
- Grant Funding for Implementation



**Non-Traditional Partnership between
Water Quality Programs and Drainage Program**

Approaches & Practices

Agricultural Water Control Structure

Are permanent structures placed in a ditch that maintain a desired water surface. This is typically done with flashboard risers and improve water quality by elevating the water table and reducing drainage outflow.

Source: NRCS Conservation Practice Standard 587



Approaches & Practices

Agricultural Water Control Structures

- Cost Effective Projects
 - \$5,000 - \$7,000 per structure
 - Varies by size and site conditions
- Worked with local metal fabricator to reduce costs.
- Nitrogen Reduction Efficiency of 33%



Hrupsa WCS Project

Installation of Structure



Hrupsa WCS Project

Installed



Hrupsa WCS Project

Complete



Approaches & Practices

Bioengineered Bank Stabilization

defined as the use of living and nonliving plant materials in combination with natural and synthetic support materials for slope stabilization, erosion reduction, and vegetative establishment.

Source: NEH 654 (USDA 2007)



“Natural” Approaches & Practices

Bioengineered Bank Stabilization

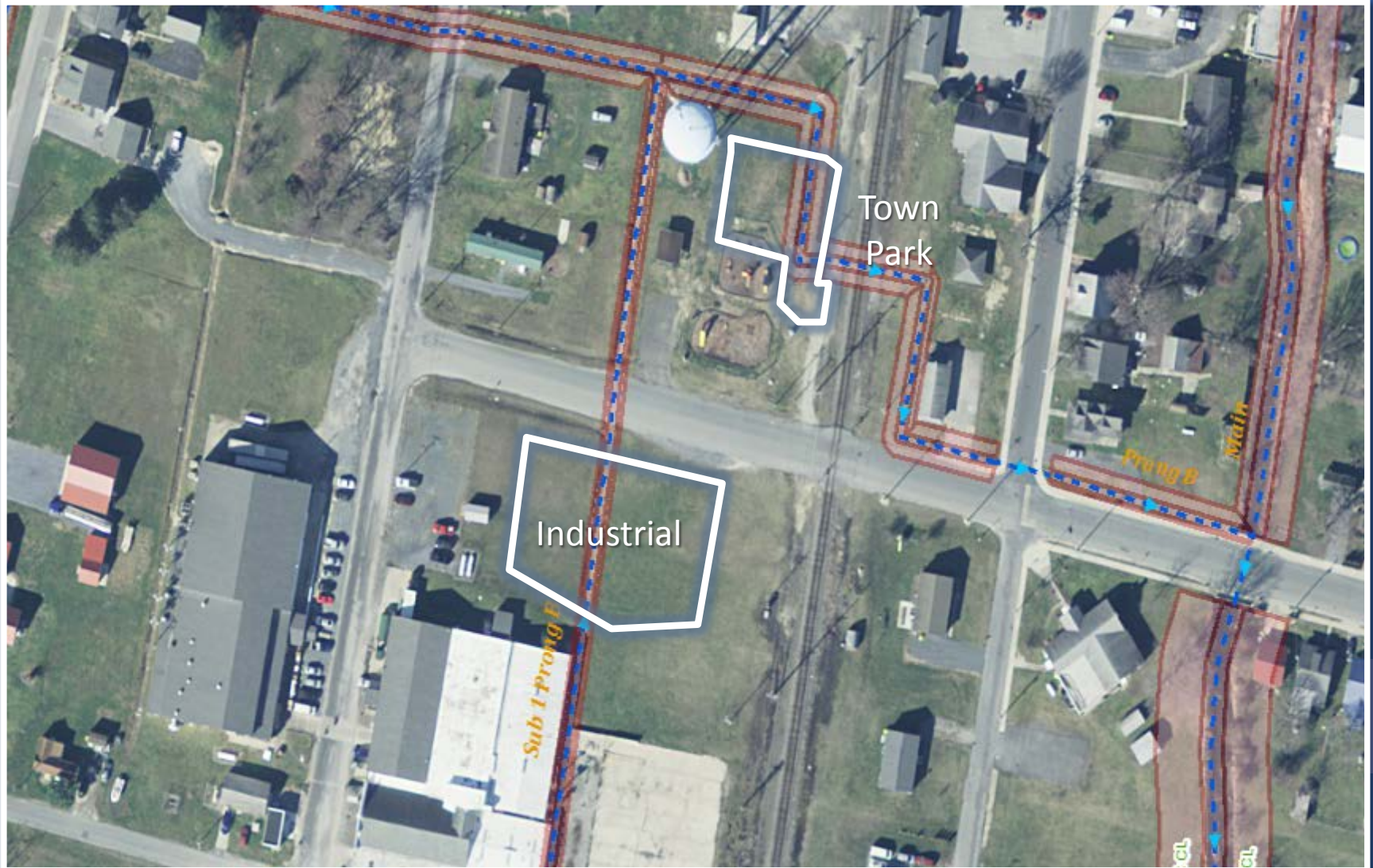
Benefits Include:

- Nutrient consumption by plant materials
- Shade
- Habitat



Cart Branch Tax Ditch

Floodplain Creation and Compost Log/Scour Stop Stabilization



Cart Branch Tax Ditch

Before – Town Park – Outer Bend Erosion and Confined Channel



Cart Branch Tax Ditch

During – Town Park – Compost Log Stabilization for Outer Bend



Cart Branch Tax Ditch

During – Town Park – Compost Log Stabilization and Floodplain



Cart Branch Tax Ditch

During – Town Park – Compost Log Stabilization and Floodplain



Cart Branch Tax Ditch

After – Town Park – Compost Log Stabilization and Floodplain



Cart Branch Tax Ditch

After – Town Park – Compost Log Stabilization and Floodplain



Cart Branch Tax Ditch

Before – Town Park – Outer Bend and Culvert Erosion



Cart Branch Tax Ditch

During – Town Park – Scour-Stop Culvert and Bend Protection



Cart Branch Tax Ditch

After – Town Park – Scour-Stop Culvert and Bend Protection



Cart Branch Tax Ditch

After – Town Park – Scour-Stop Culvert and Bend Protection



Approaches & Practices

Stream Restoration

Utilizing principles of stream geomorphology to create a state of dynamic equilibrium among water, sediment, and vegetation to stabilize stream channels

Source: Good Recipes for the Bay Pollution Diet; U-4 Urban Stream Restoration



Approaches & Practices

Stream Restoration

- Projects have been priority level 2-3
- Projects are expensive.
 - \$175 - \$200 per lf
- Urban Removal Rates (lb/ft/yr):
 - TN = 0.075
 - TP = 0.068
 - TSS = 15.13 (coastal plain)



Bridgeville Branch Tax Ditch

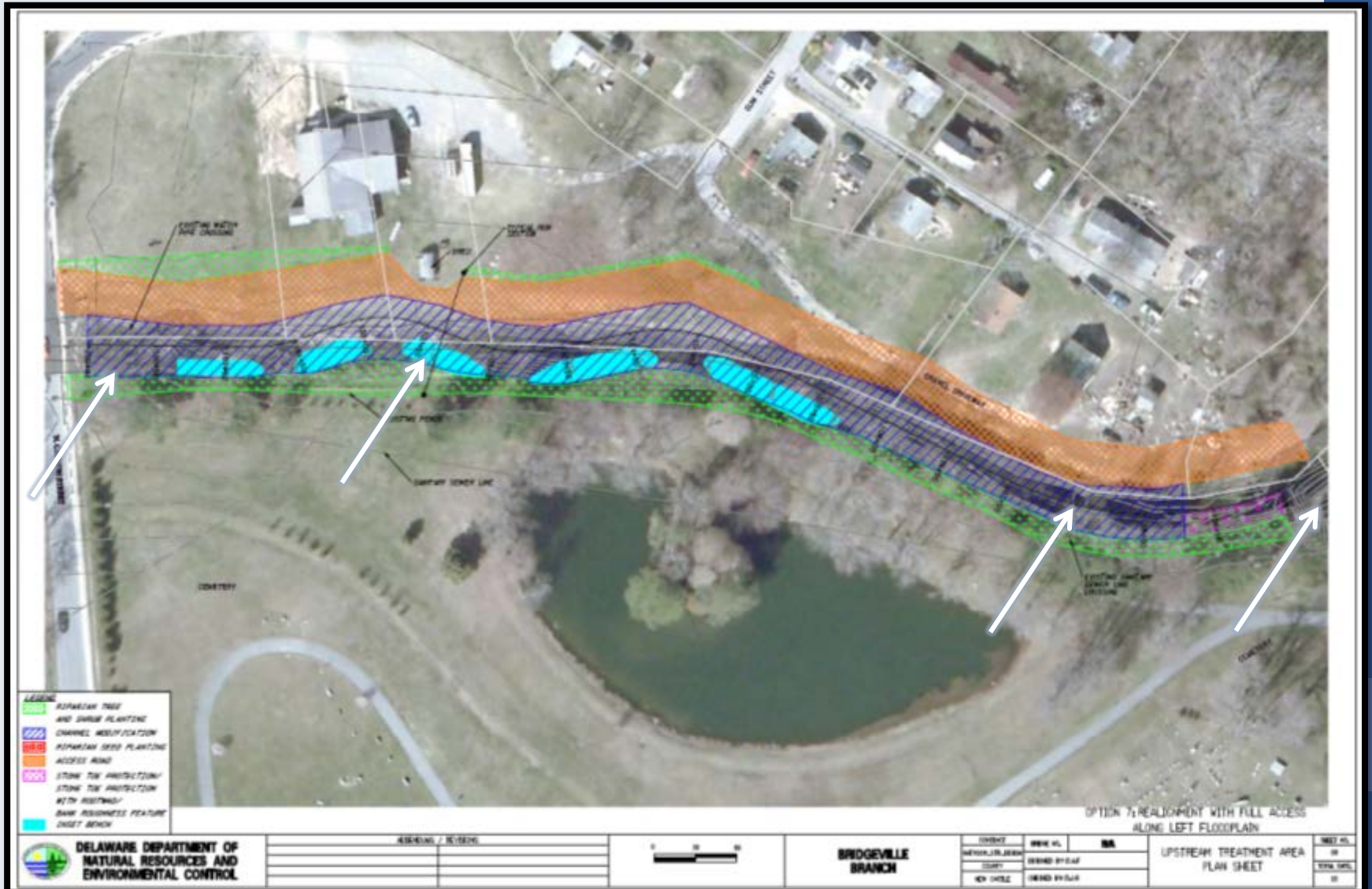
Restoration Project



- 1,500 ft. of Stream Restoration
- Construction started in Sept. 2015
- Completion projected for Dec. 2015
- Construction Cost \$460,000
- Drainage Area \approx 8 sq. mi.
- TD Design Bottom Width = 20'
- Bank Full Discharge = 82 cfs

Bridgeville Branch Tax Ditch

Design – Concept Plan



Bridgeville Branch Tax Ditch

Before – Exposed Water Main



Bridgeville Branch Tax Ditch

During – Protected Water Main



Bridgeville Branch Tax Ditch

After – Protected Water Main



Bridgeville Branch Tax Ditch

During – Transformed Tax Ditch with Floodplain and Scour Protection



Bridgeville Branch Tax Ditch

Before – Traditional “Ditch” with 1:1 Side Slopes and Culvert Erosion



Bridgeville Branch Tax Ditch

During – Transformed Tax Ditch with Floodplain and Riffles/Pools



Bridgeville Branch Tax Ditch

During – Transformed Tax Ditch with Floodplain and Riffles/Pools



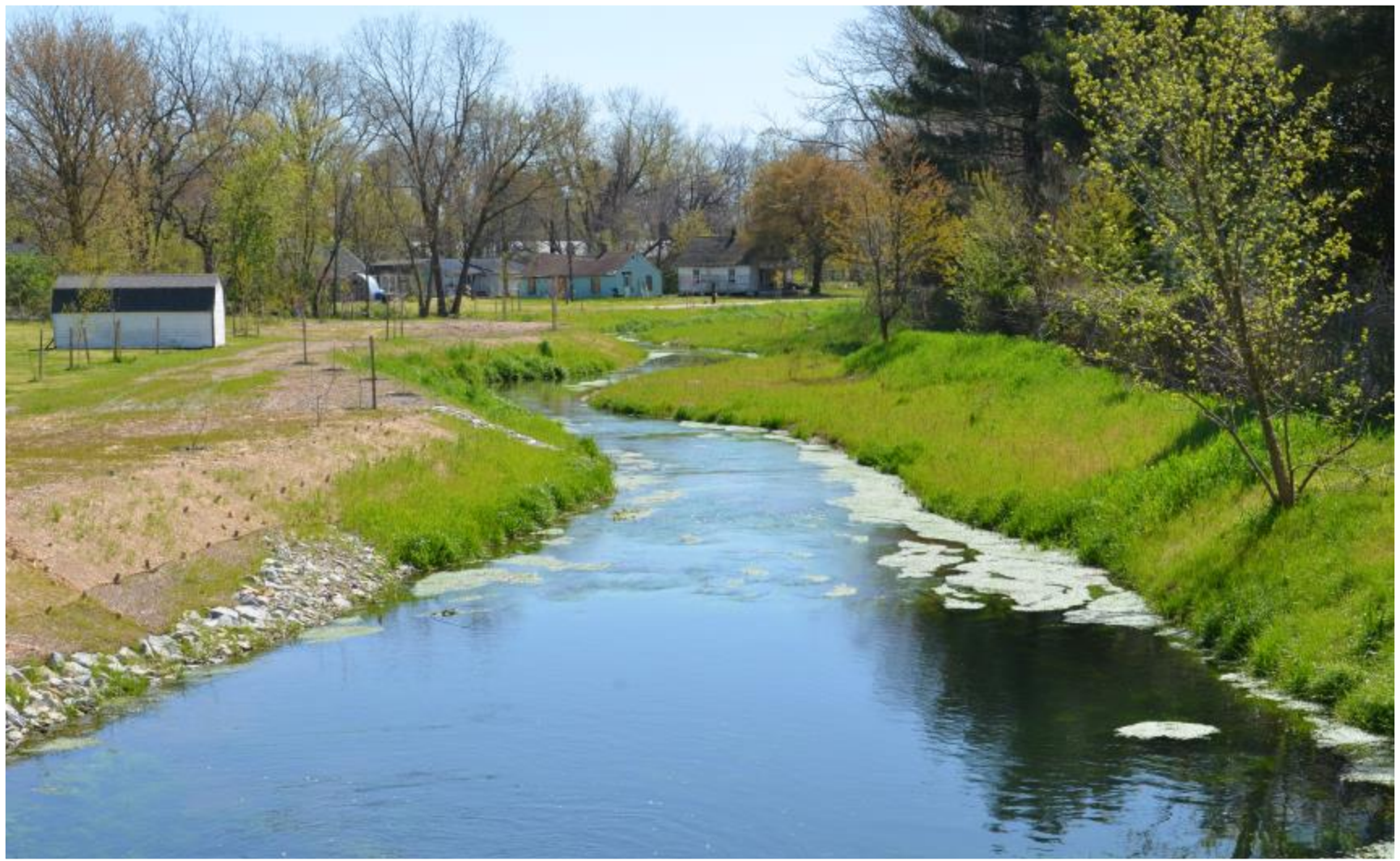
Bridgeville Branch Tax Ditch

After – Transformed Tax Ditch with Floodplain and Riffles/Pools



Bridgeville Branch Tax Ditch

After – Transformed Tax Ditch with Floodplain and Riffles/Pools



Bridgeville Branch Tax Ditch

Before – Traditional “Ditch” with 1:1 side slopes



Bridgeville Branch Tax Ditch

During – Transformed Tax Ditch with Floodplain and Riffles/Pools



Bridgeville Branch Tax Ditch

After – Transformed Tax Ditch with Floodplain and Riffles/Pools



Bridgeville Branch Tax Ditch

After – April 2016



Bridgeville Branch Tax Ditch

After – April 2016



Bridgeville Branch Tax Ditch

Before – Scour Around Bend Jeopardizing Sewer Main



Bridgeville Branch Tax Ditch

During – Soil Lift and Live Layering



Bridgeville Branch Tax Ditch

During – Soil Lift and Live Layering



Bridgeville Branch Tax Ditch

During – Soil Lift and Live Layering



Bridgeville Branch Tax Ditch

During – Soil Lift and Live Layering



Bridgeville Branch Tax Ditch

After – Soil Lift and Live Layering



Bridgeville Branch Tax Ditch

After – April 2016



Bridgeville Branch Tax Ditch

After – Soil Lift and Live Layering



Nanticoke River Tax Ditch

Stream Restoration Project

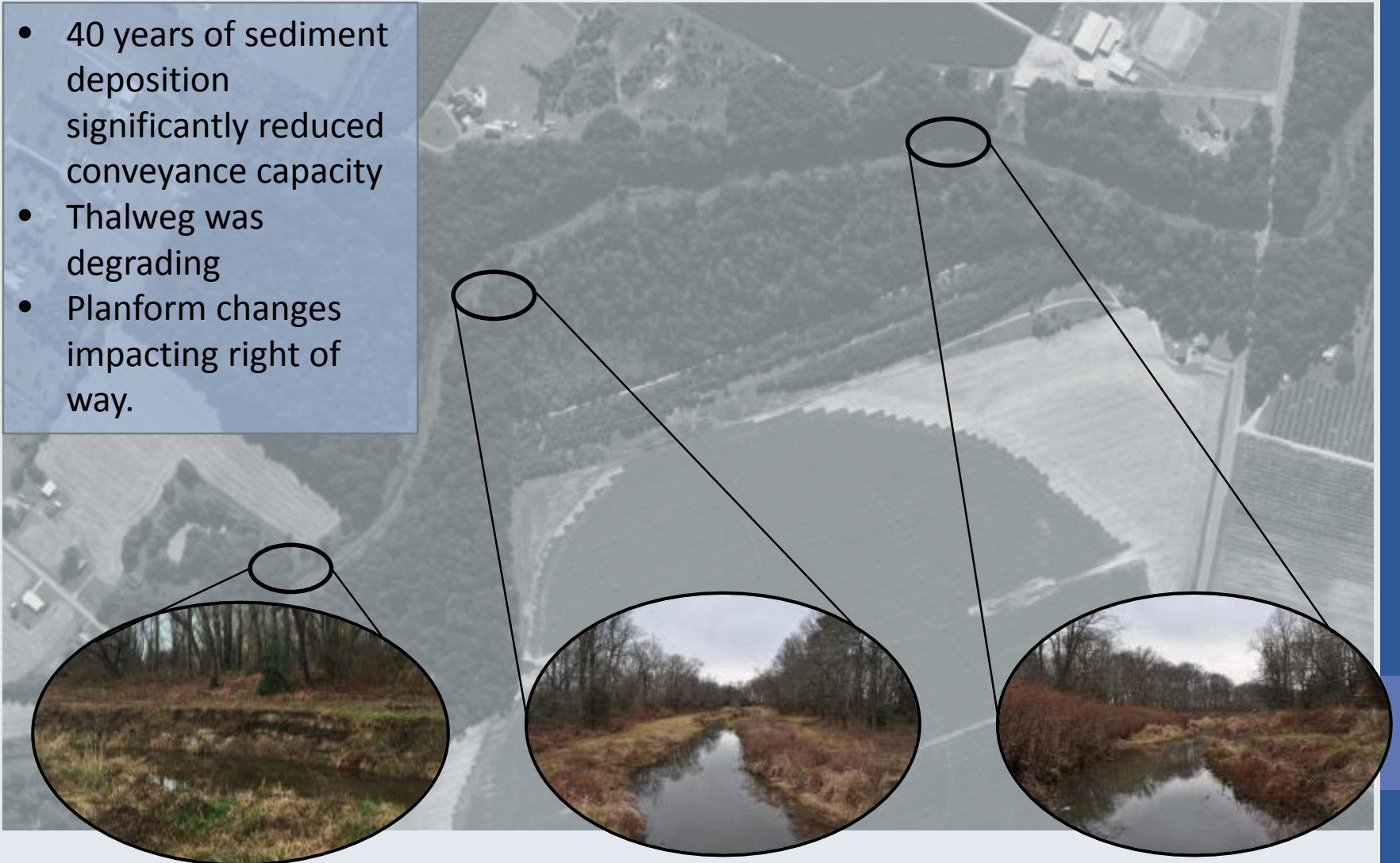


- 4,300 ft. of Stream Restoration
- Construction started in Jan. 2016
- Completion projected for June 2016
- Construction Cost \$850,000
- Drainage Area \approx 70 sq. mi.
- TD Design Bottom Width = 45'
- Bank Full Discharge = 220 cfs

Nanticoke River Tax Ditch

Stream Restoration Project

- 40 years of sediment deposition significantly reduced conveyance capacity
- Thalweg was degrading
- Planform changes impacting right of way.



Nanticoke River Tax Ditch

Grade Control



Nanticoke River Tax Ditch

Rock Cross Vane with Step



Nanticoke River Tax Ditch

Rock Cross Vane with Step



Nanticoke River Tax Ditch

Rock Cross Vane with Step



Nanticoke River Tax Ditch

Rock Cross Vane with Step



Nanticoke River Tax Ditch

Severely Eroded Banks



Nanticoke River Tax Ditch

Toe Wood



Nanticoke River Tax Ditch

Toe Wood



Nanticoke River Tax Ditch

Severely Eroded Banks



Nanticoke River Tax Ditch

Toe Wood



Nanticoke River Tax Ditch

Severely Eroded Banks

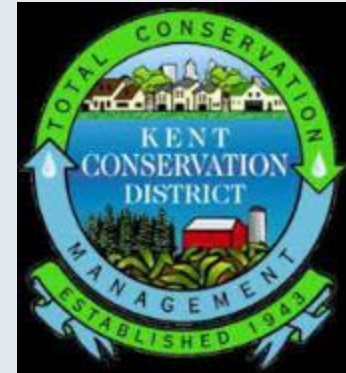


What's Next?

- Wood Chip Bio-Reactor
- NRCS Regional Conservation Partnership Program
 - Watershed Channel Restoration Projects in Sussex County, Delaware
- Stream Assessment and Prioritization of Degraded Tax Ditches



Partners



Questions?



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