



Watershed Restoration: Scope and Scale



What Are Your Goals?

How Do You Achieve Them?

What Are Your Goals?

- **Reduce:**
 - **Sediment**
 - **Pathogens**
 - **Nitrogen and Phosphorous Pollution**
 - **Flooding & Excessive Runoff**
- **Removal of Impaired Status – Clean Water Act**
- **Wild Trout**

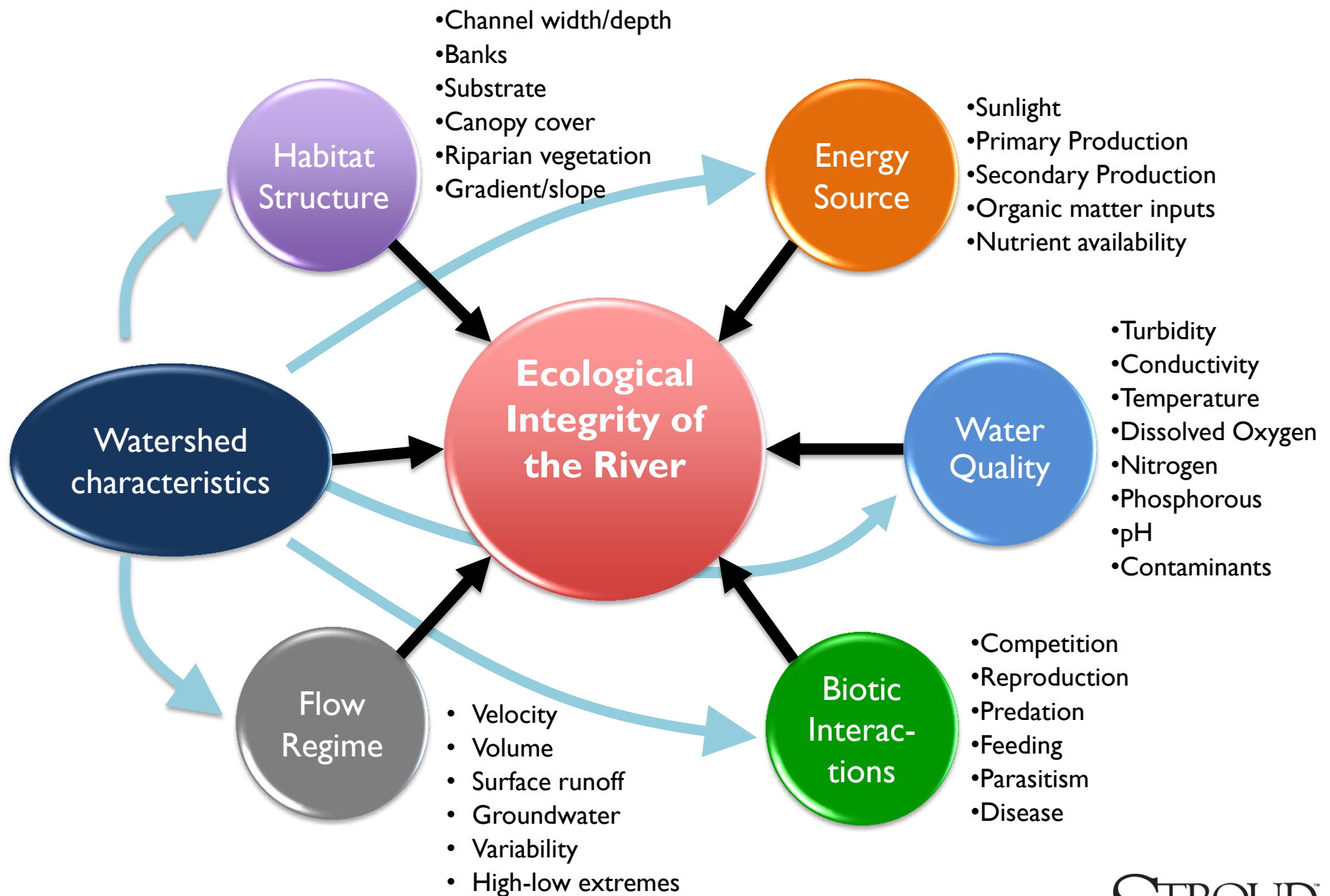


What Are Your Goals?

How Do You Achieve Them?

What will we do or change?





What will we do or change?

Improved Crop Field Management

Stabilize Roadway

Plant Forest Buffer

Improve Pasture Management

Exclude Livestock From Stream

Stop Barnyard Runoff

Manure Storage



What will we impact?:

- Bacteria
- Sediment
- Water Temp
- Infiltration/Hydrology
- Soil Carbon?
- Macroinvertebrates
- Fish
- Algae



Problem Barnyard



Improved Barnyard



Lititz Run – Before Forest Buffer



Lititz Run - 18 Year Old Forest



We Still Have Work To Do





Other Measurable Outcomes?:

- **Milk Production**
- **Herd Health**
 - **Infectious Disease**
 - **Hoof Problems**

Happy & Healthy Cows



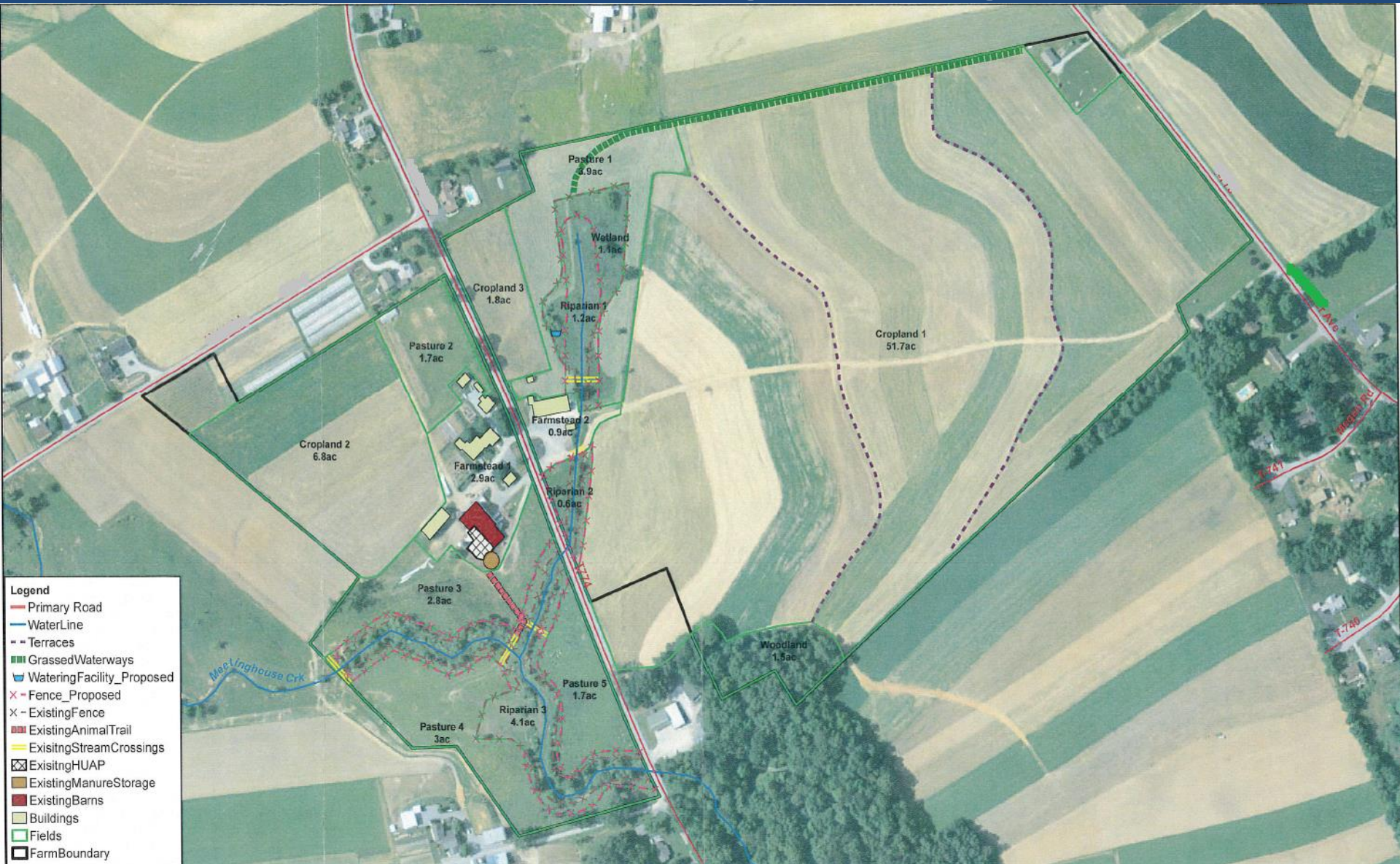


What Are Your Goals?

- **Reduce:**
 - **Sediment**
 - **Pathogens**
 - **Nitrogen and Phosphorous Pollution**
 - **Flooding & Excessive Runoff**
- **Removal of Impaired Status – Clean Water Act**
- **Wild Trout**

Typical Farm Project

How Much Change is Enough?



How Many Farms is Enough?

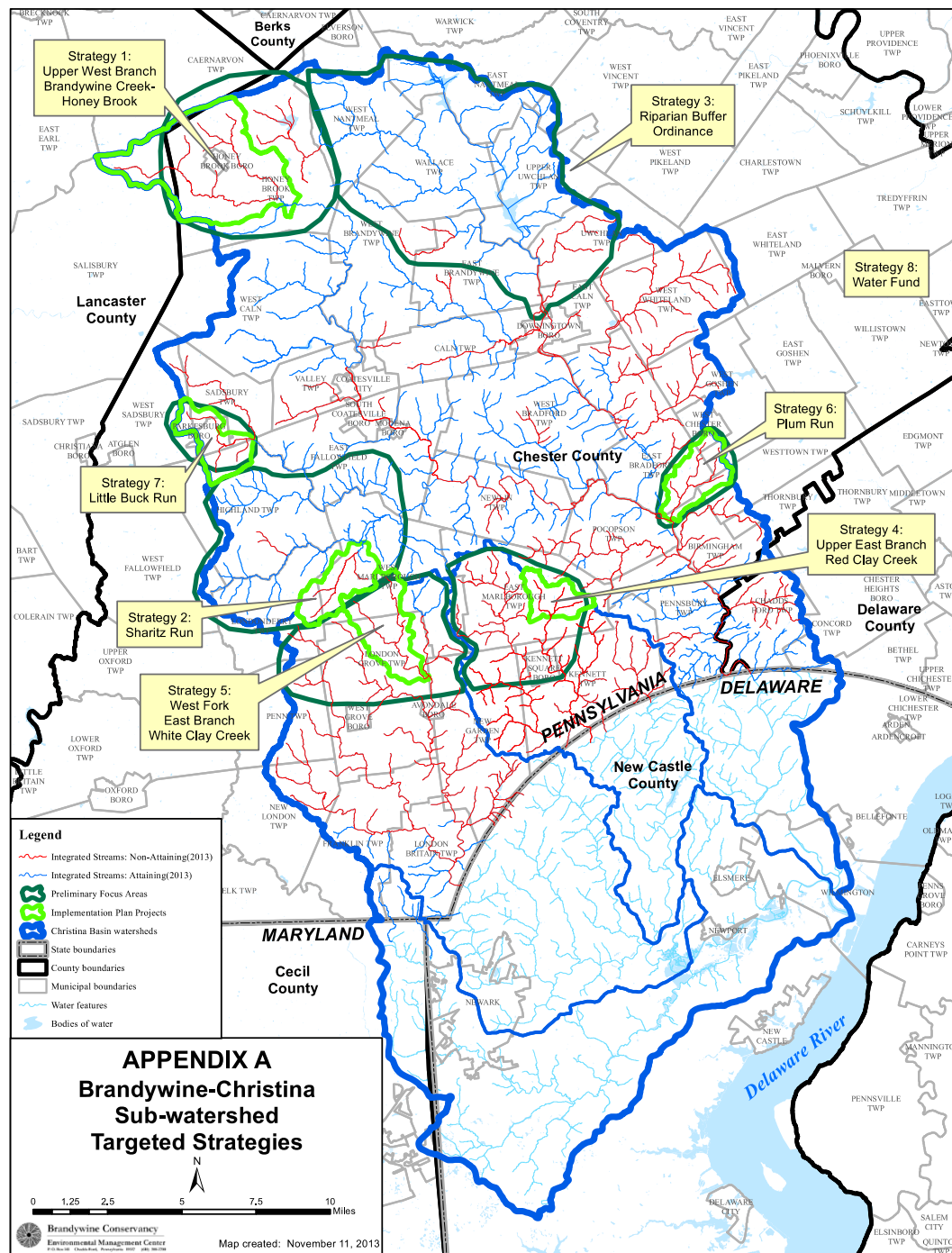


Lancaster Mill Creek Section 1

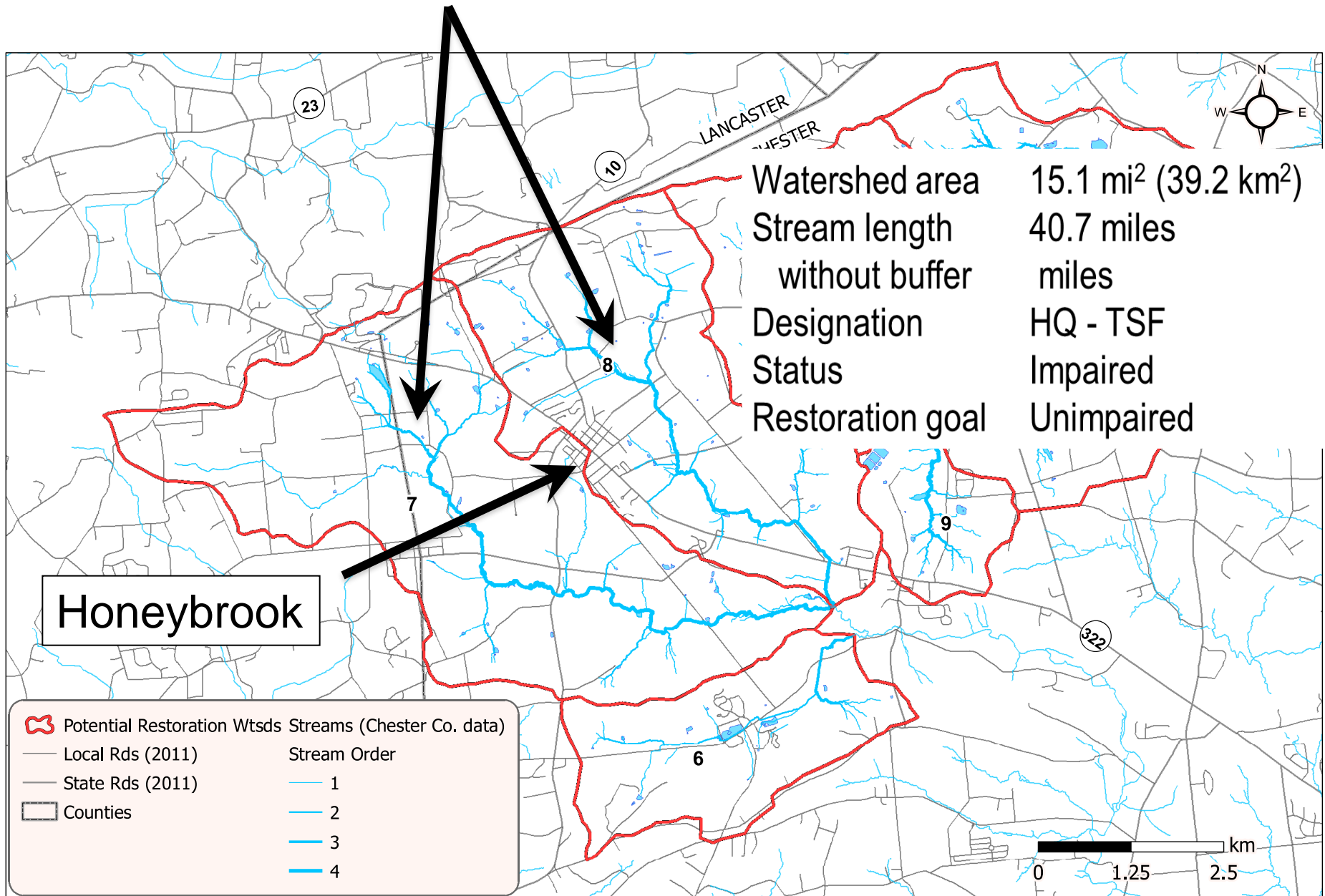


13 Parcels
11 farms





West Branch Brandywine Creek - Honeybrook



Agricultural Conservation Easement Projects

Honey Brook Township, Chester County PA
Salisbury Township, Lancaster County PA

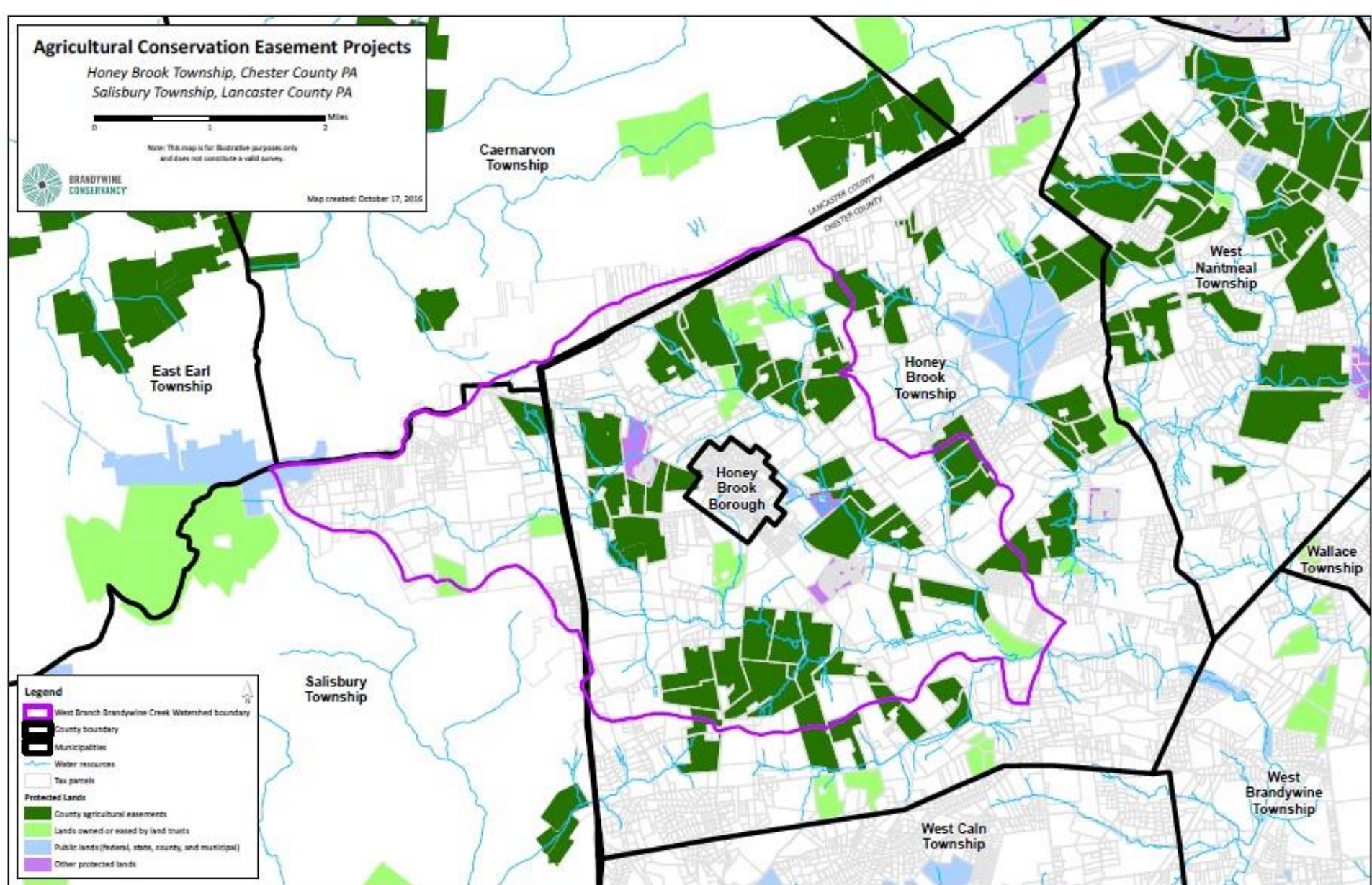
0 1 2 Miles

Note: This map is for illustrative purposes only
and does not constitute a valid survey.

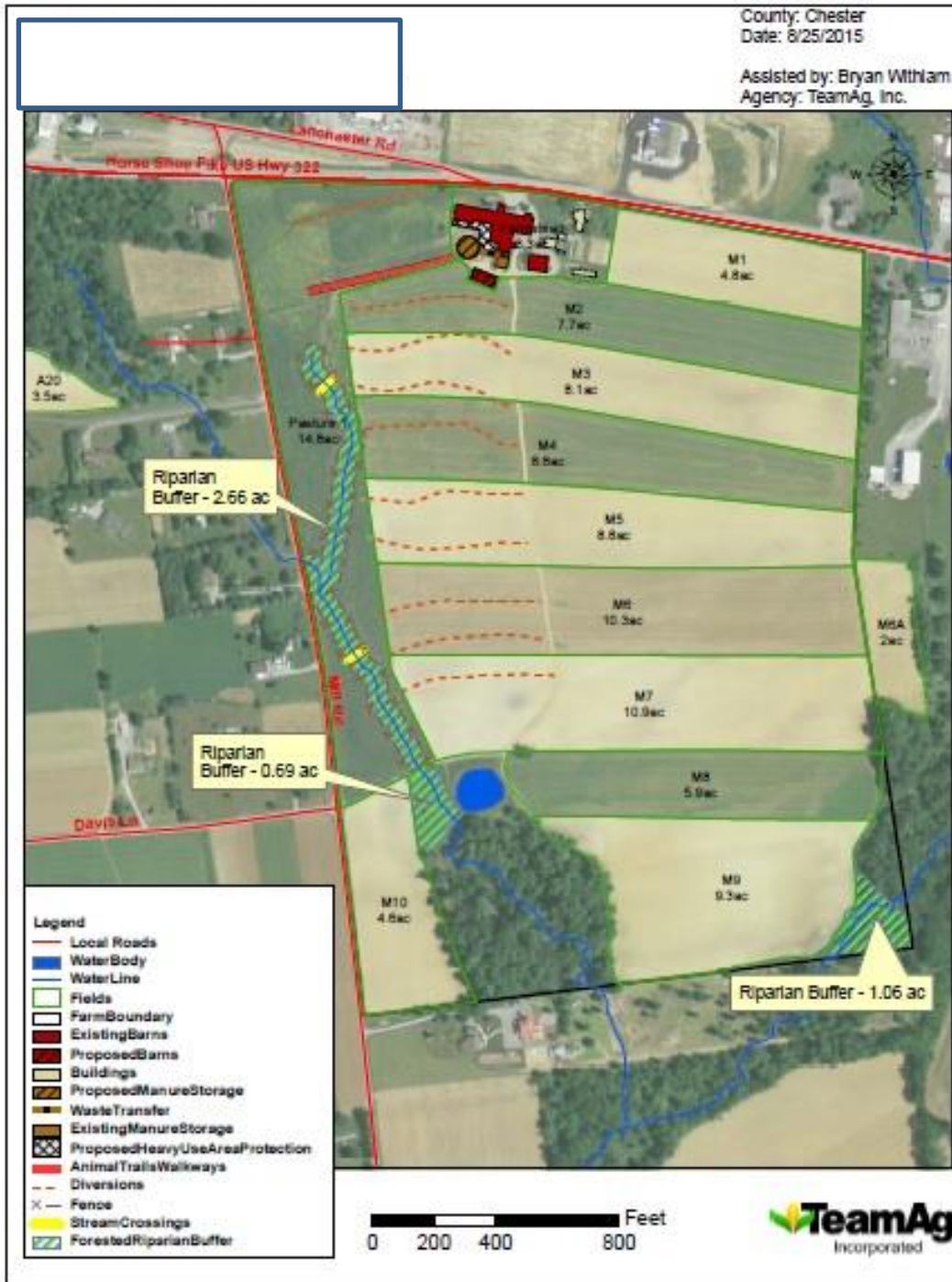


BRANDYWINE
CONSERVANCY

Map created: October 17, 2016



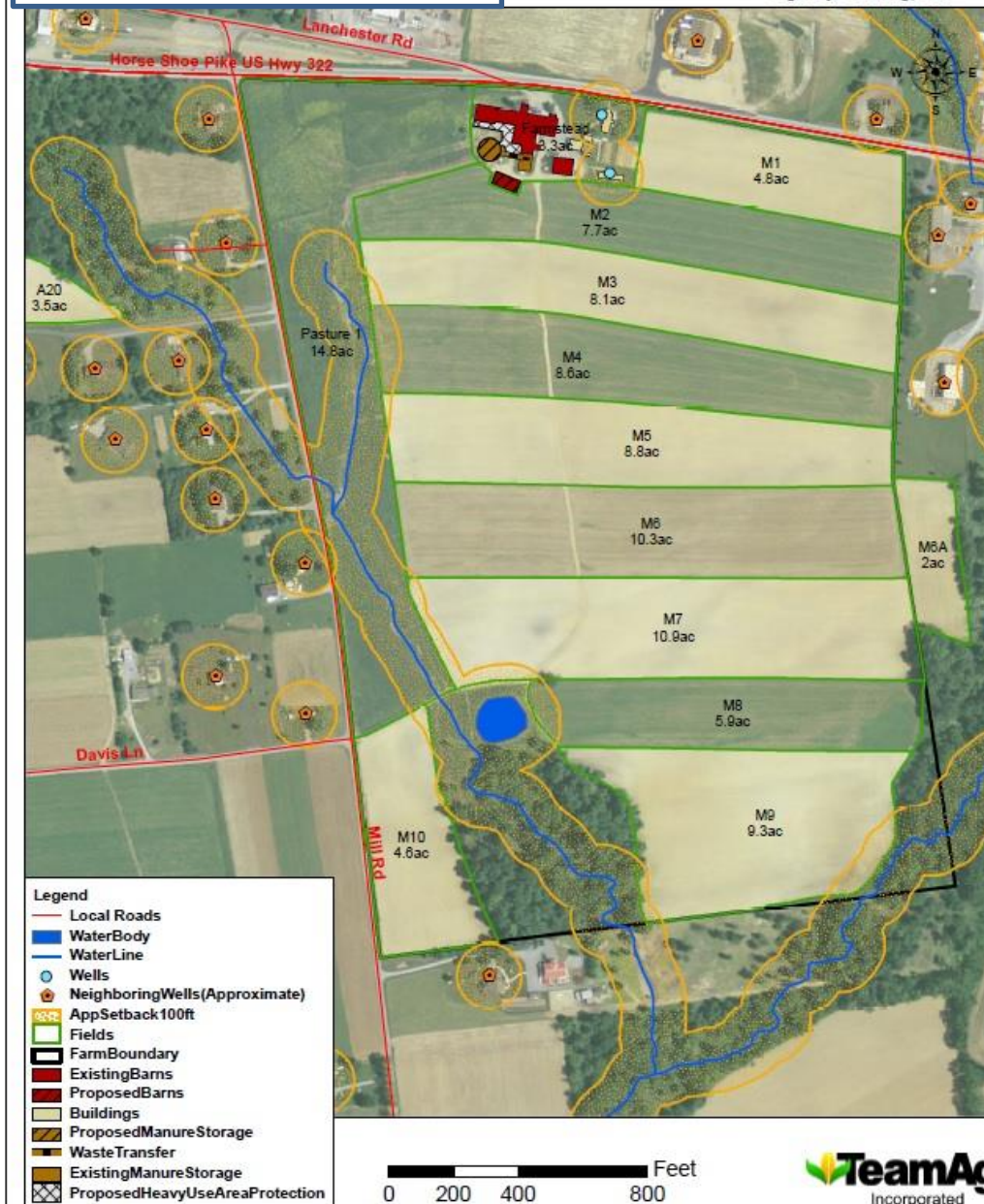
Conservation Plan



Manure Management Plan

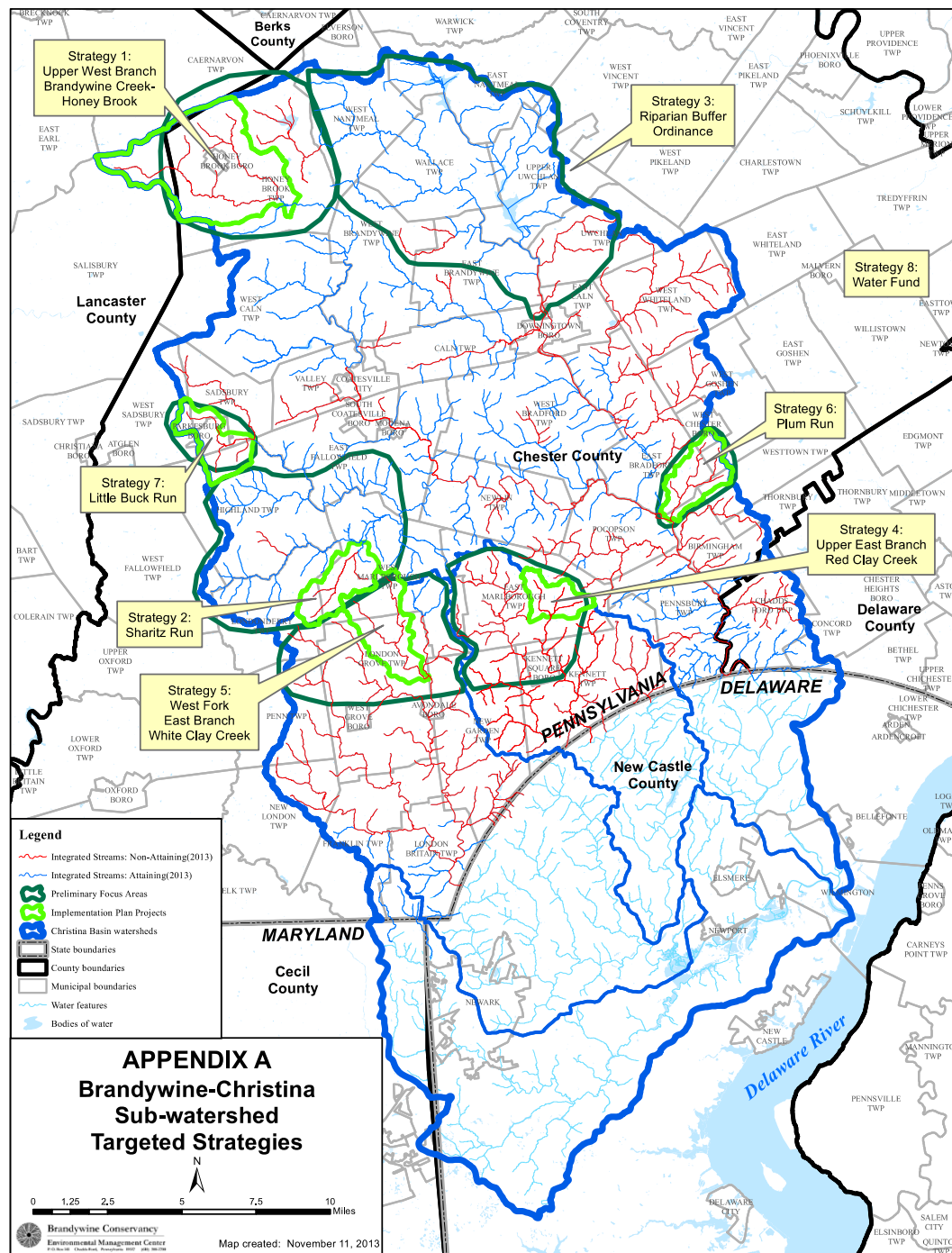
County: Chester
Date: 8/25/2015

Assisted by: Bryan Withiam
Agency: TeamAg, Inc.

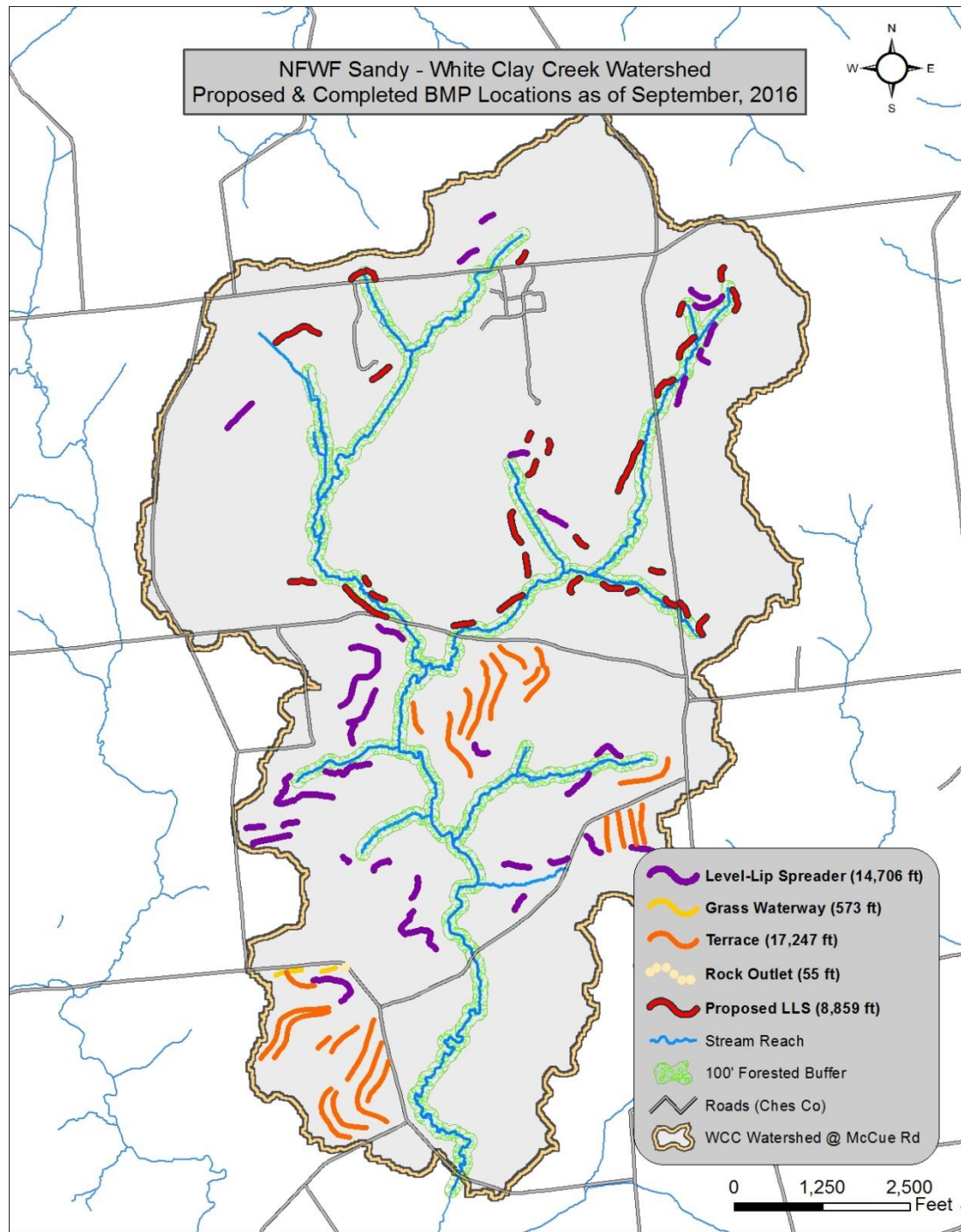
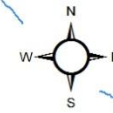


TeamAg
Incorporated

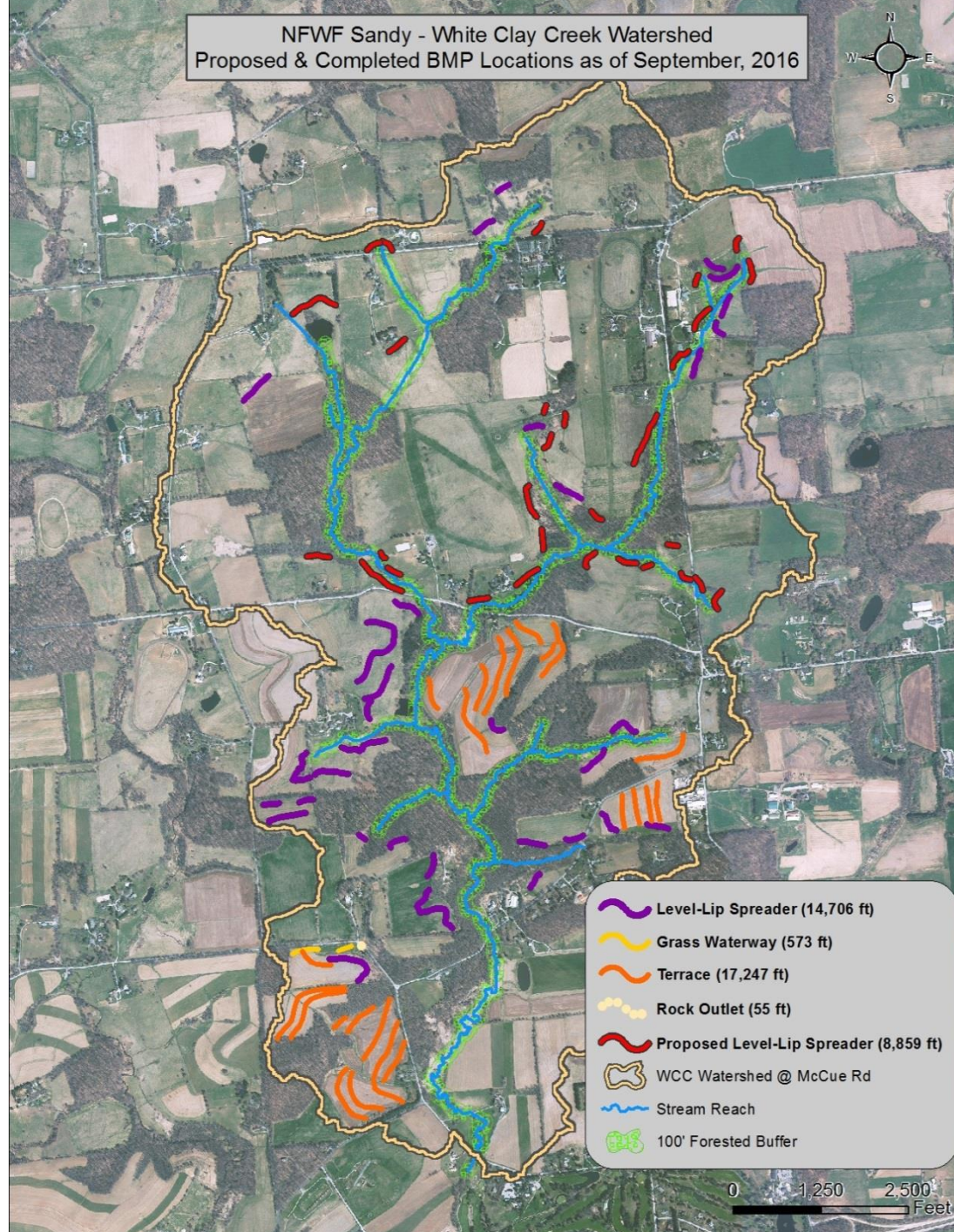
STROUD
WATER RESEARCH CENTER



NFWF Sandy - White Clay Creek Watershed
Proposed & Completed BMP Locations as of September, 2016

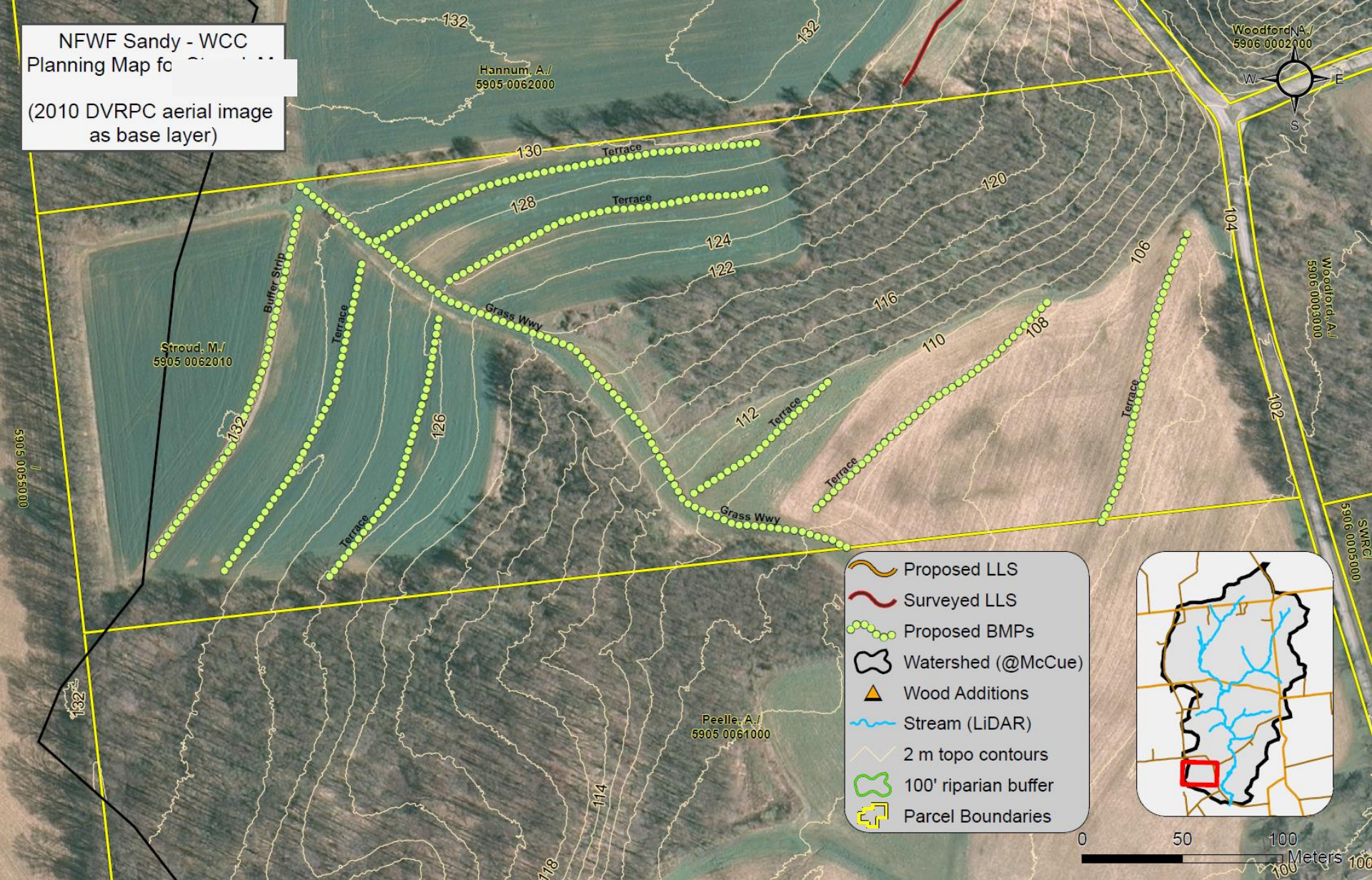


NFWF Sandy - White Clay Creek Watershed
Proposed & Completed BMP Locations as of September, 2016



NFWF Sandy - WCC
Planning Map for

(2010 DVRPC aerial image
as base layer)





“Level-lip spreader” located behind Stroud Water Research Center before construction



Level-lip spreader during construction



Level-lip spreader during construction



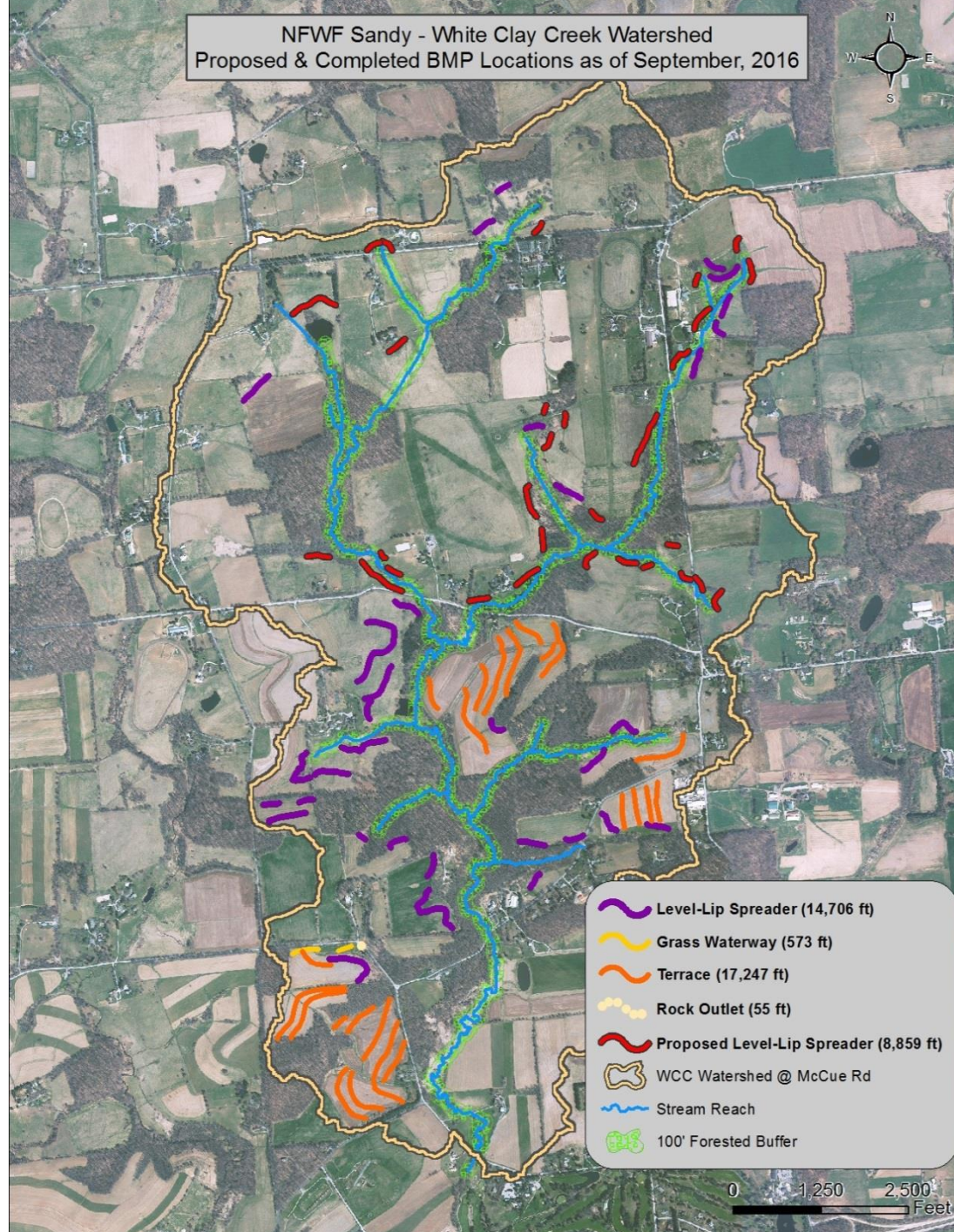
Level lip spreader after construction



“Level-lip spreaders” are shallow conservation swales built along the contour of the slope that collect surface runoff during rainstorms. With most storms the water that is collected will infiltrate into the ground, sediments settle out, and the water flows as groundwater to the stream. In big storms the water will flow over the level-lip evenly into the streamside forest before reaching the stream. Level-lip spreaders help reduce flooding and prevent nutrients and sediments from reaching the stream. These swales are being designed by Chester County Conservation District in partnership with the Stroud Center.



NFWF Sandy - White Clay Creek Watershed
Proposed & Completed BMP Locations as of September, 2016

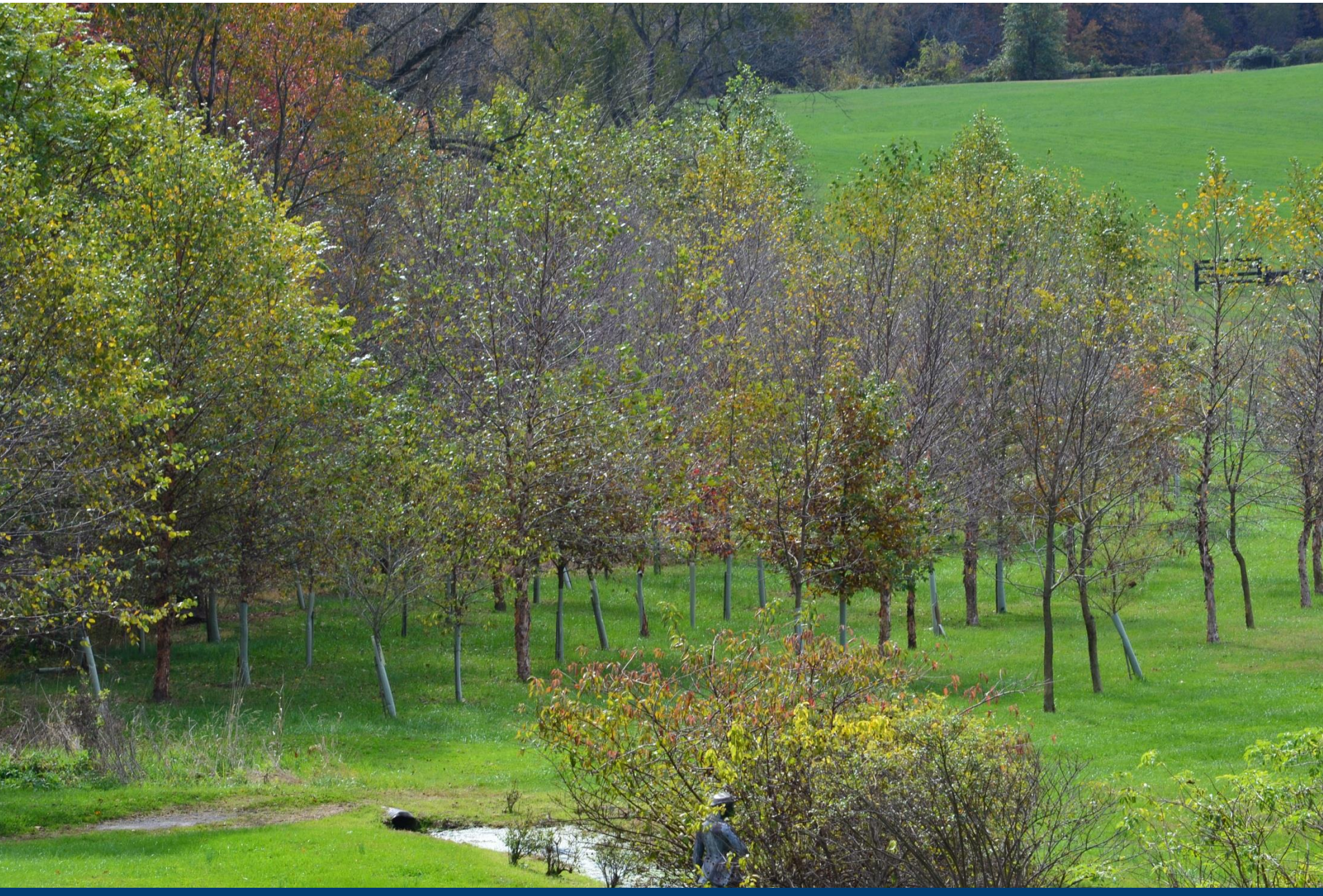




Planted Apr 2007
Photo Aug 2008



Spring 2014



WHITE CLAY CREEK FLOODPLAIN RECONNECTION AND RESTORATION CONCEPT PLAN UPPER PROJECT EXTENT

AREA OF FILL TO BE REMOVED TO RE-ESTABLISH
OVERFLOW DIVERSION INTO EXISTING MILL RACE

FLOODPLAIN ENHANCEMENT
ZONE THROUGH WETLAND
CREATION – INSIDE OF
RIVERINE BUFFER

EXCAVATED SEDIMENT TO BE
SPREAD ON ADJACENT FIELDS

HIGH QUALITY
WETLANDS NOT
TO BE DISTURBED

FLOODPLAIN ENHANCEMENT
ZONE THROUGH WETLAND
CREATION – WITHIN ADJACENT
AGRICULTURAL FIELD

FLOODPLAIN ENHANCEMENT
ZONE THROUGH WETLAND
CREATION – OUTSIDE OF
RIVERINE BUFFER

PENNSYLVANIA COUNTY MAP



PH PRINCETON HYDRO, LLC.
1108 OLD YORK ROAD
P.O. BOX 728
RINGGERS, NJ 08851
*with offices in NJ, PA and CT

1 inch = 50 feet
0 100 feet

NOTES:

PROJECT EXTENTS

STROUD RESEARCH CENTER
FLOODPLAIN RECONNECTION
AND RESTORATION
WHITE CLAY CREEK
CHESTER COUNTY, PENNSYLVANIA

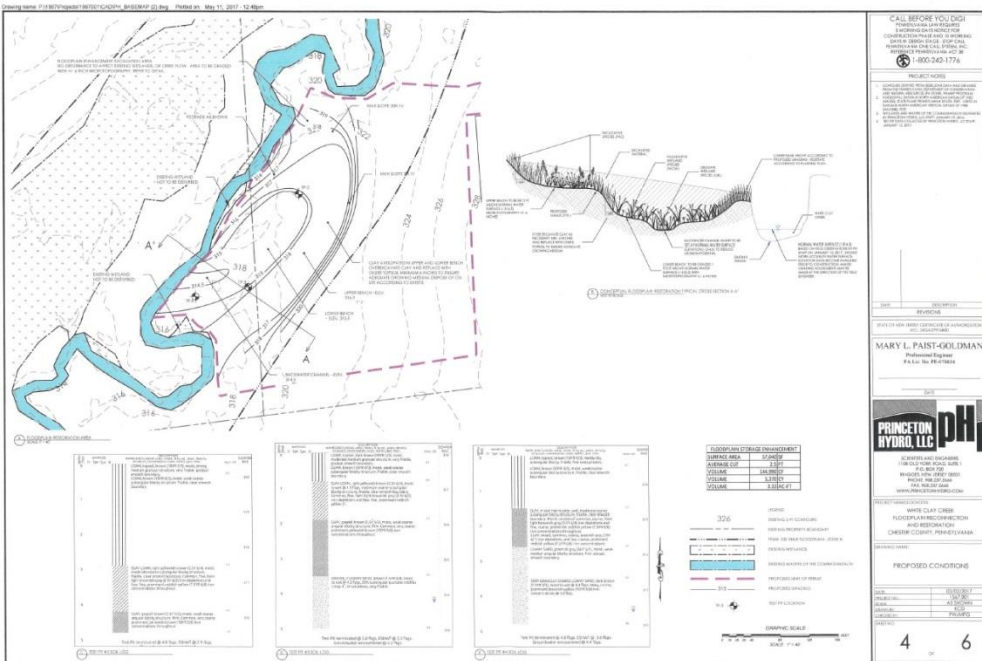
Legend

- Site Access
- Stream line - from LIDAR
- Wetland Line
- Sediment Excavation**
 - Outside Buffer
 - Wetland Buffer
 - Optional
 - 50' Stream Buffer
- Wetland Areas**
 - Wetlands
 - Wetlands
 - Wetlands
- Delineation**
 - Wetlands
 - Wetlands
 - Wetlands
- Parcels

Flood Storage

Level Lip Spreaders and Wetland storage totals over 9,200 m³ of storage
That's approximately 25% of a 2 inch, 24 hour storm event

How Do Other Factors
Impact Flood Storage and
Timing?



Conserving Water Quantity and Quality by Improving Soil Health



Photo: Kelley King, King Photography

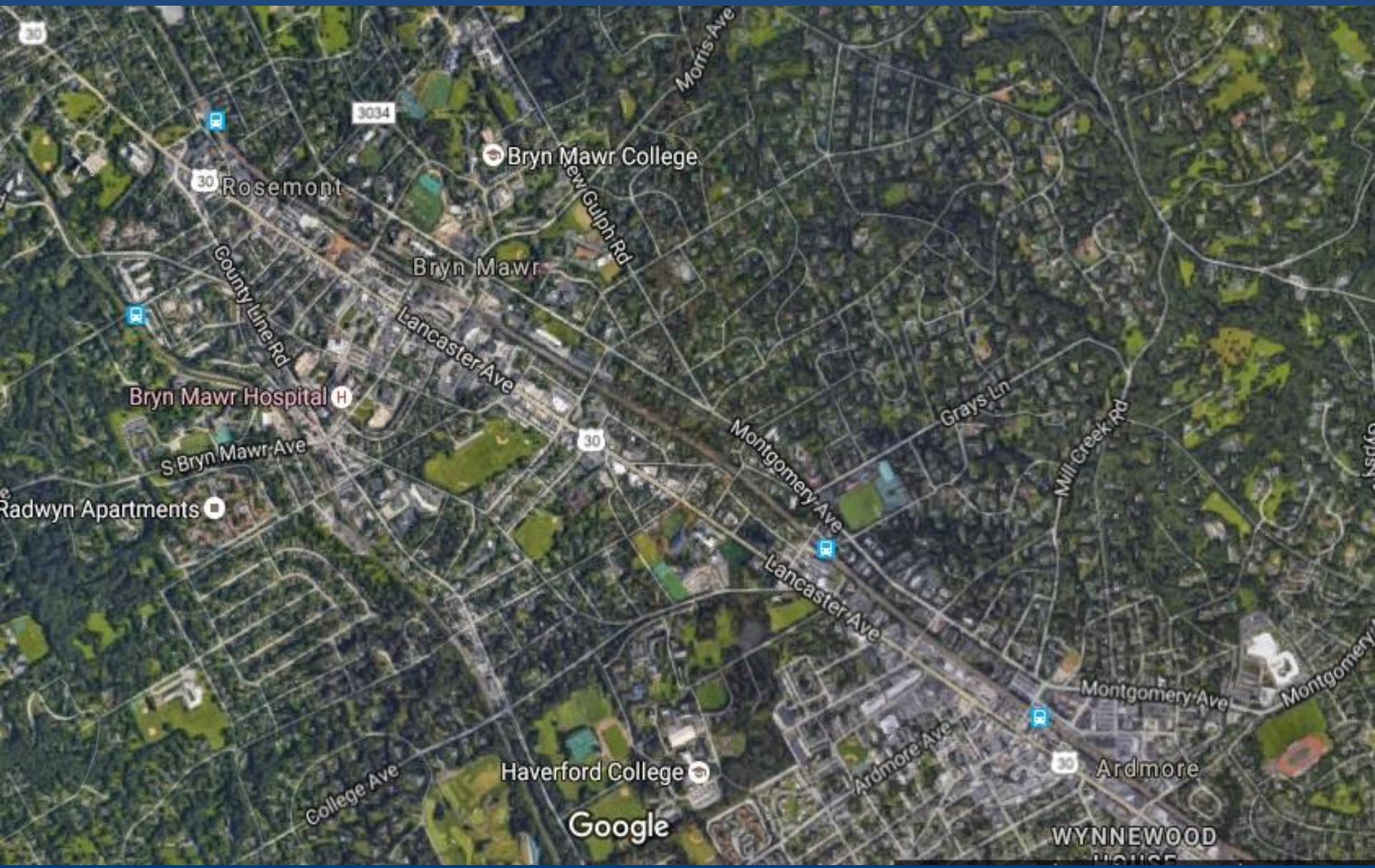
3x-4x Increase in Water Infiltration



Pristine?



What is possible in a Suburban Watershed?



Management Issues

Water Quality
Water Quantity





+

-

📍

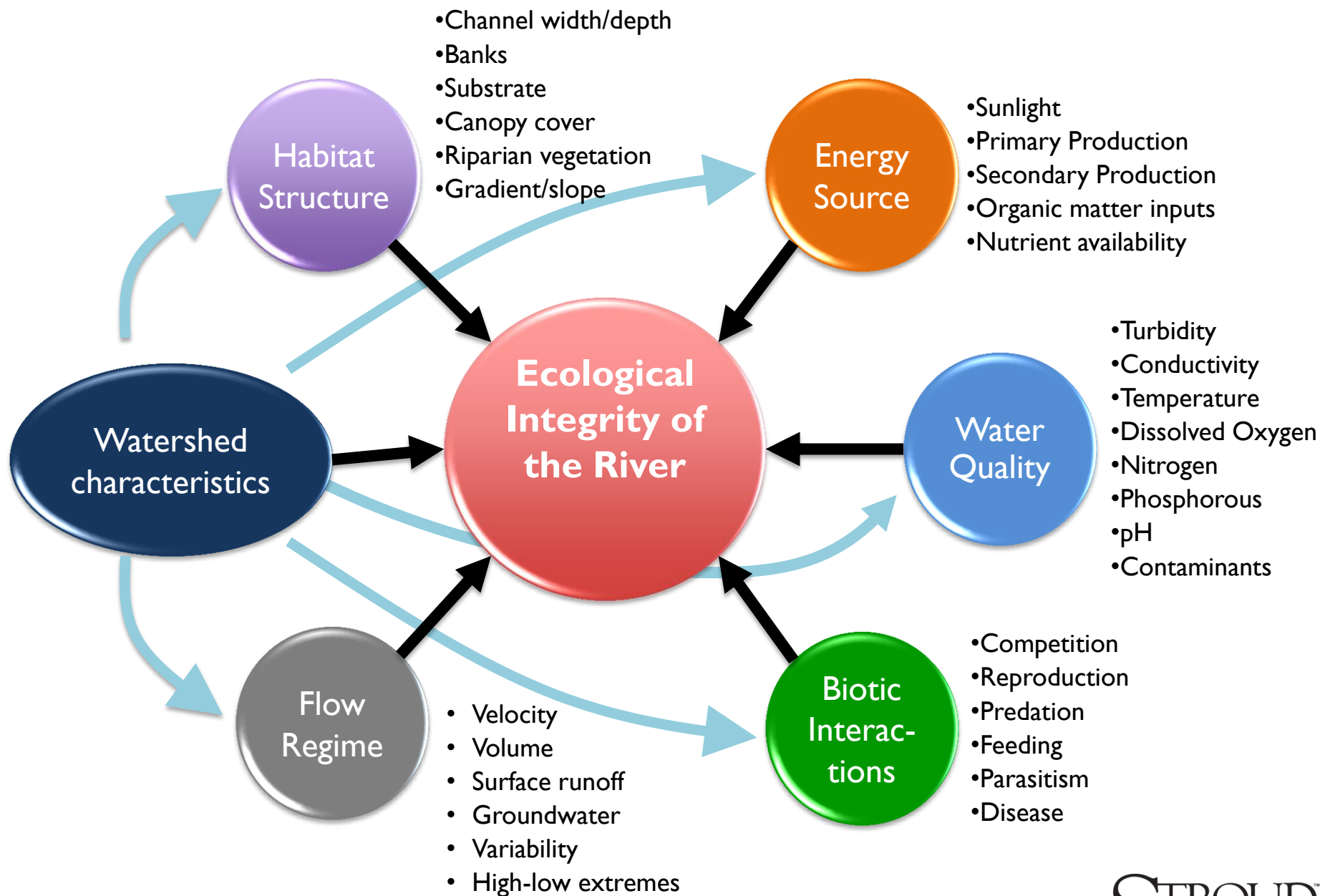
🔄

📏

🌐

We have strengthened the connection between our lives and the stream.







**Invisible
or
unknown
pollutants**

TRUGREEN ChemLawn®

Rain Garden / Infiltration Basin



Buffer Area



Infiltration / Detention Basin







Reveal banner highlights

YOUR WATERSHED

WATERSHED ISSUES

WHAT WE'RE DOING

WHAT'S IN IT FOR YOU

Events

Residents

Businesses

Reduce Your Stormwater Fees

Green Business Tips

Green Infrastructure Projects

Developer's Guide to Stormwater Management

Schools

Community

Reduce Your Stormwater Fees

The City of Philadelphia offers a number of programs to assist non-residential customers to reduce their stormwater fees by managing the runoff from their property.

How Do Stormwater Rates Work?

- Stormwater runoff contains contaminants such as motor oil, pesticides, automotive fuel, industrial waste and other chemicals that pollute streams and rivers.
- Every parcel of land in the city, including residential, commercial, institutional and public properties, is billed by the Philadelphia Water Department for management of the stormwater it produces.
- Philadelphia stormwater fees calculated based on the amount of impervious surface (such as parking lots, sidewalks, driveways and buildings) that a parcel contains.
- Parcels with greater amounts of impervious surface produce larger amounts of stormwater, and as such are charged higher rates for stormwater management.

For More Information:

[Stormwater Billing Information](#)

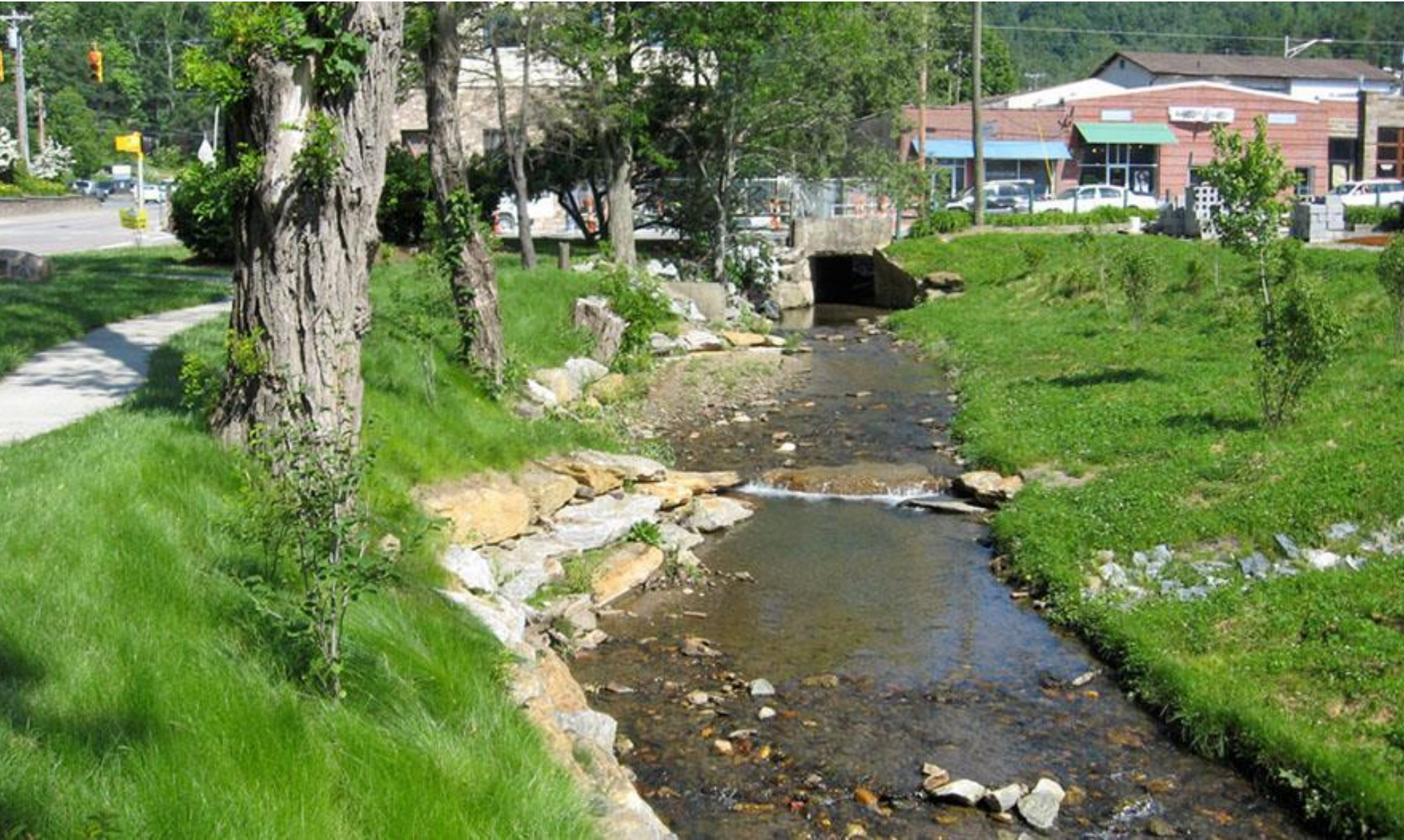
[View Your Parcel's Impervious Surface Area](#)

[Use our Credits Explorer to Install Virtual Stormwater Management Practices](#)

How Can I Reduce My Stormwater Rates?

- Non-residential customers, including businesses, institutions, non-profits and public agencies, can reduce their stormwater rates and help clean up our waterways by implementing green infrastructure projects.
- Green infrastructure projects include: Rain Gardens, Green Roofs, Basins and Ponds, Wetlands, Swales, Underground Projects, Downspout Planters, Rainwater Harvesting, Porous Pavement and Reducing Impervious Surfaces.
- Projects that reduce the amount of impervious surface on a site can result in a stormwater credit that will permanently reduce your water bill.
- Technical assistance in developing stormwater management projects is available through the [Green Guide For Property Management](#).
- Philadelphia Water Department and the Philadelphia Industrial Development Corporation offer the [Stormwater Management Incentives Program](#). The SMIP Grant will provide financial assistance to non-residential property owners who desire to build green stormwater infrastructure to manage private property runoff.

Kristan Cockerill and Bill Anderson's paper, "Creating False Images: Stream Restoration in an Urban Setting," has received the 2015 Boggess Award for the best paper published in the journal (American Water Resources Association) in 2014.



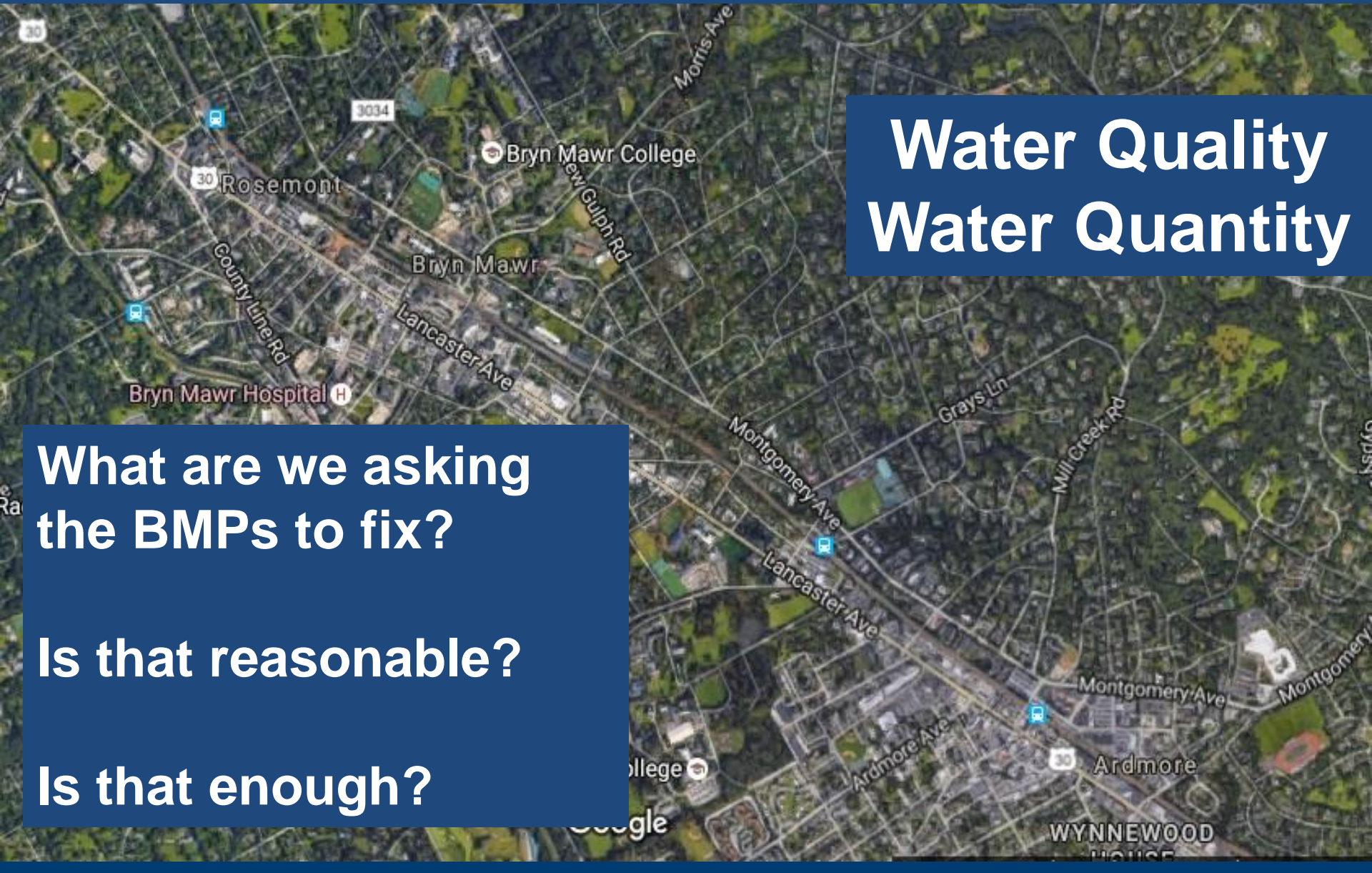
Management Issues

Water Quality
Water Quantity

**What are we asking
the BMPs to fix?**

Is that reasonable?

Is that enough?



Pristine?



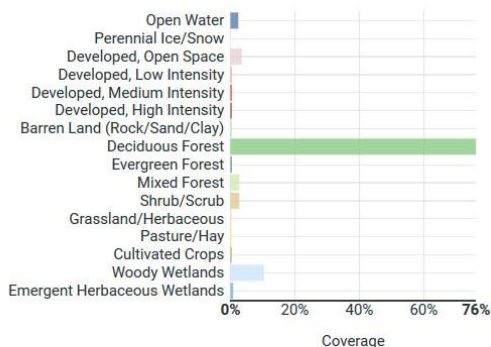
Continental US Medium Resolution 225 km²

Streams **Land** Soil Terrain Climate Pt Sources Animals Water Qual

Land cover distribution

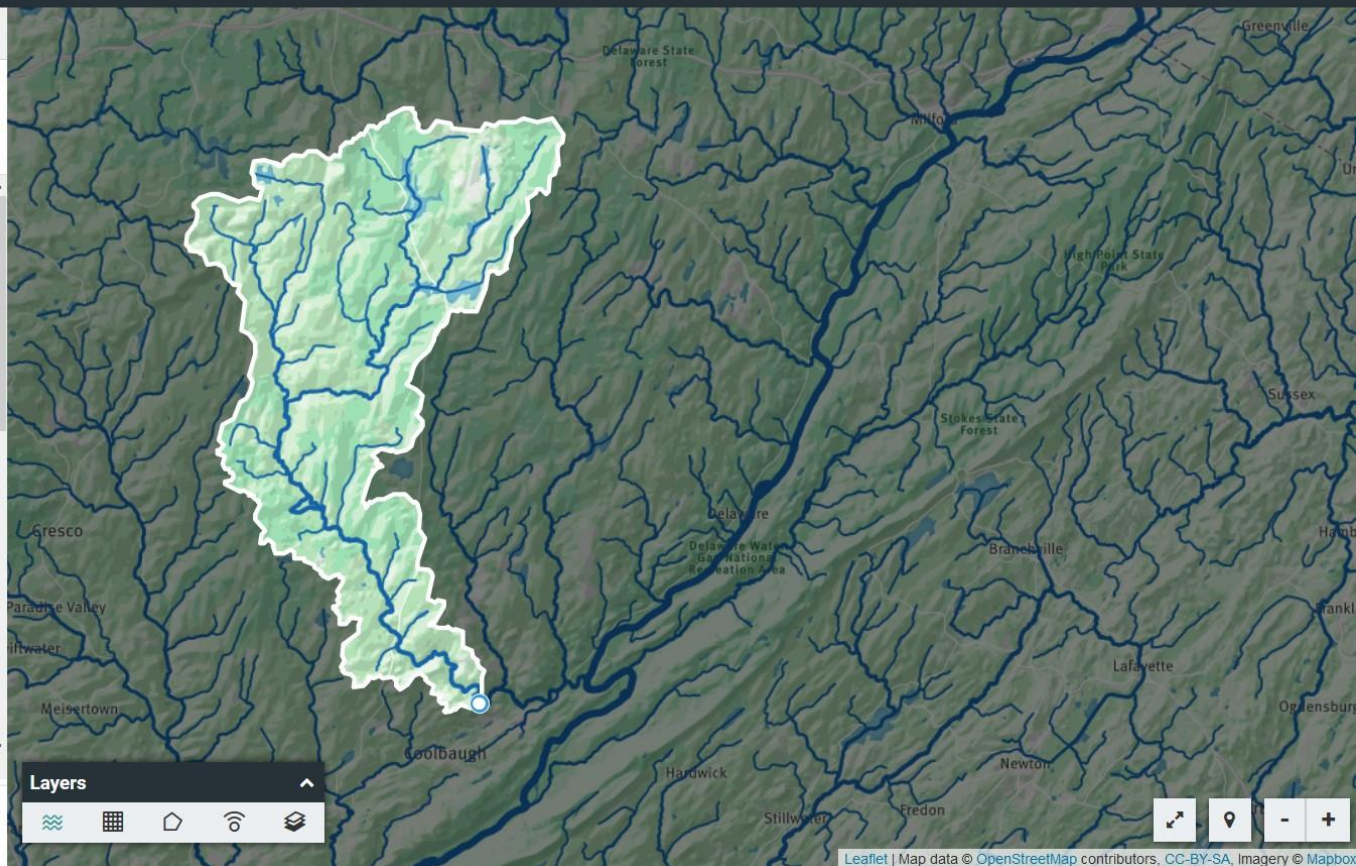
Related Layer: National Land Cover Database ☒ Turn on

Source: National Land Cover Database (NLCD 2011) ⓘ



Type	Area (km²)	Coverage (%)
Open Water	5.47	2.4

Change area



Land Protection:

What Are The Goals?

How Do We Achieve Them?



What Are Your Goals?

**How Do You Achieve
Them?**

A photograph of a forest stream. The water flows over large, moss-covered rocks, creating a small waterfall. In the background, a large fallen log lies across the stream. The forest is dense with green foliage and trees.

Matthew J. Ehrhart
Director of Watershed Restoration
Stroud Water Research Center

mehrhart@stroudcenter.org
610 268 2153 ext 308