Wissahickon Creek Watershed Act 167 Study

Update -October 25, 2011

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Wissahickon Creek Watershed Act 167 Study

- Product : Stormwater Management Plan for the Watershed
- Study Team:
  - Center for Sustainable Communities
  - NTM Engineering, Inc.
  - Data and assistance from PWD and municipalities
- Timetable: October 2010 – March 2013
- 21 Work Tasks
- This presentation provides and update on Tasks 1-10.

Wissahickon Watershed

- Drainage Area = 64 mi^2
- 16 Municipalities
- Population = 160,000

Act 167 Plan:

- Watershed assessment of stormwater conditions
- Ordinance provides for implementation of sound stormwater management practices.
- Inventory of drainage problems in the watershed. Improvement of these can help address MS4 WLA's.
- Inventory of potential stormwater improvements.

Information provided by Philadelphia Water Department, Office of Watersheds
http://www.phillywatersheds.org/your_watershed/

Background References – Wissahickon Watershed

- Fort Washington Area Improvement Study - 2008- Temple CSC

- Wissahickon Watershed Comprehensive Characterization Report – 2007 – Philadelphia Water Department

- Preliminary Flood Insurance Study Update for Montgomery County - 2010 – Federal Emergency Management Agency

- Draft Act 167 Study for Sandy Run Watershed – 2010 Under review by the PADEP

- Montgomery County Natural Hazards Mitigation Plan Montgomery County Planning Commission -2007

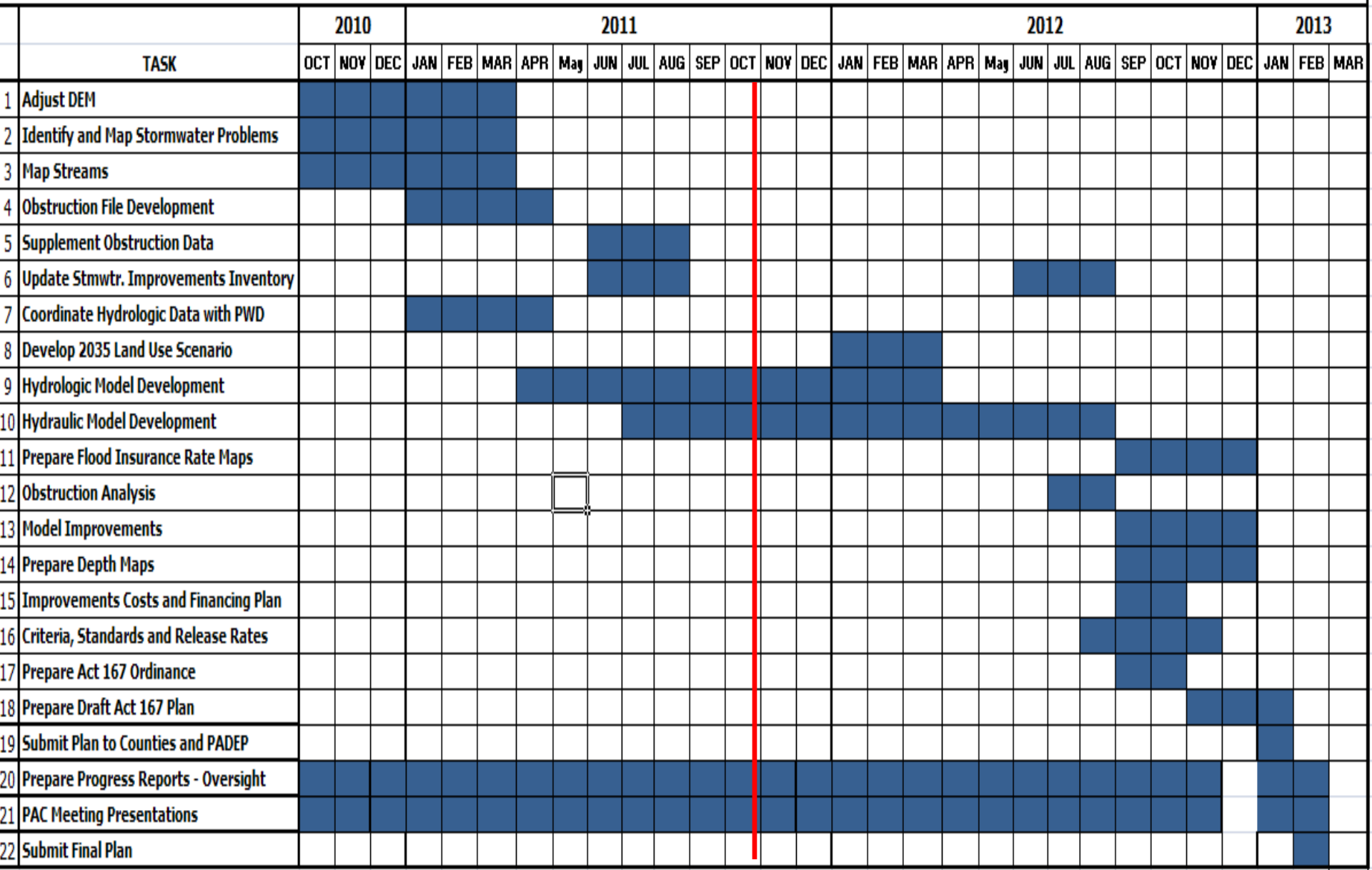
- Upper Wissahickon Creek Special Area Management Plan Delaware River Basin Commission and Montgomery County Planning Commission- 2008

Project Schedule And Task Status

PROJECT SCHEDULE

Wissahickon Creek ACT 167 Task Completion Schedule

Temple University's Center for Sustainable Communities and NTM Engineering, Inc

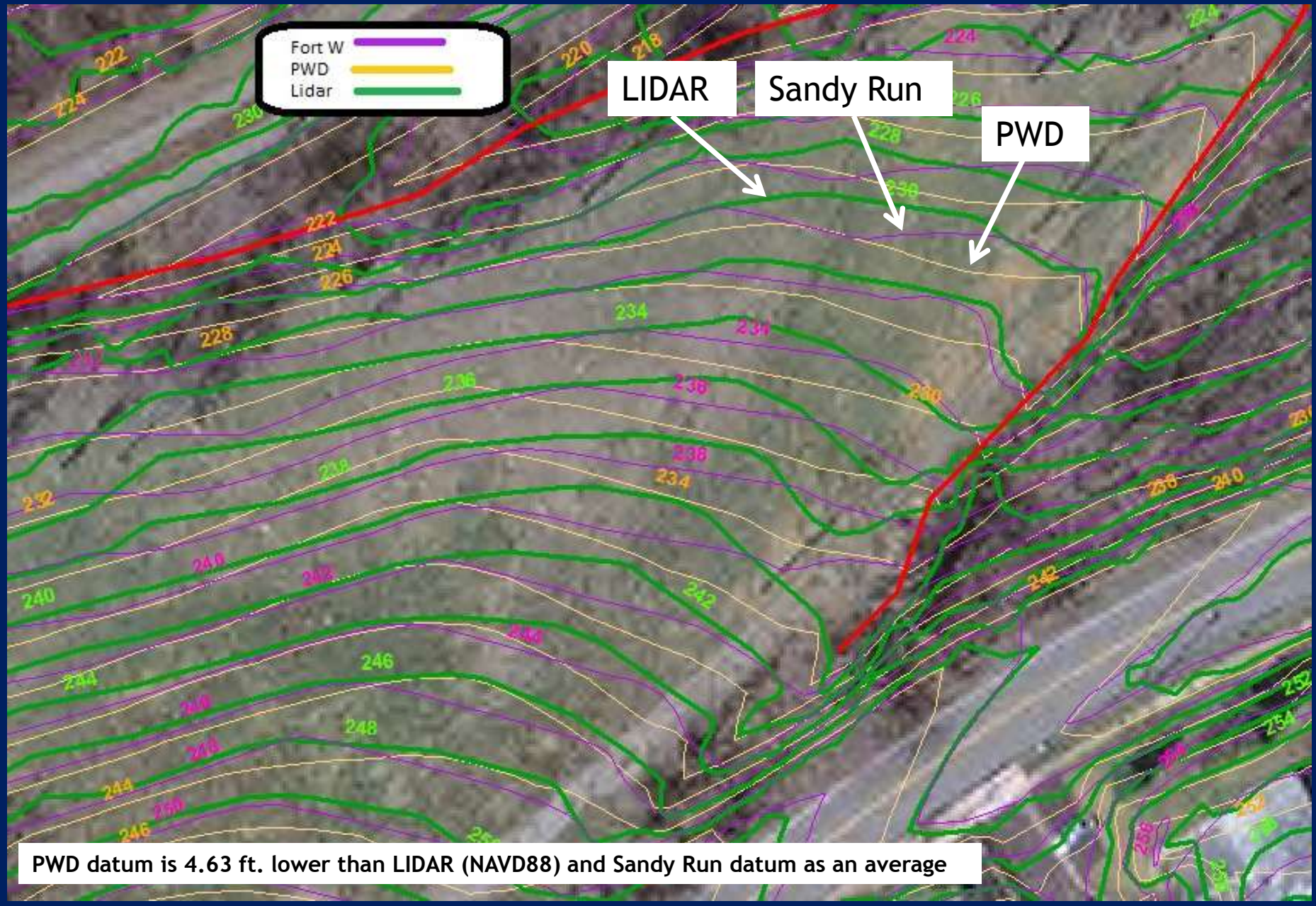


Study Work Tasks

Tasks 1-5

1. Adjust DEM
2. Identify and Map Stormwater Problems
3. Map Streams
4. Map Obstructions
5. Supplement Obstruction Data

Task 1: LiDAR data for the DEM and 2 ft. contours is available for 2008 through PAMAP. LiDAR is the most recent elevation data set and is being used for the modeling.



PWD datum is 4.63 ft. lower than LIDAR (NAVD88) and Sandy Run datum as an average

Difference in contouring for stream channel – LIDAR vs. PWD data
Pine Run east of PA Turnpike Interchange

LiDAR data from PAMAP do not have stream break lines for small tributaries.

This is needed for hydraulic modeling.

Contractor (BAE) hired to add break lines for areas where hydraulic modeling and flood mapping is funded. (Ambler area at this time)

Funding required to Complete mapping for the Entire watershed Estimated at $500,000

Task 2: Stormwater Problems

Water Quality Impairment

- Erosion
- Sedimentation/Siltation

Majority of watershed streams are classified as impaired due to siltation.

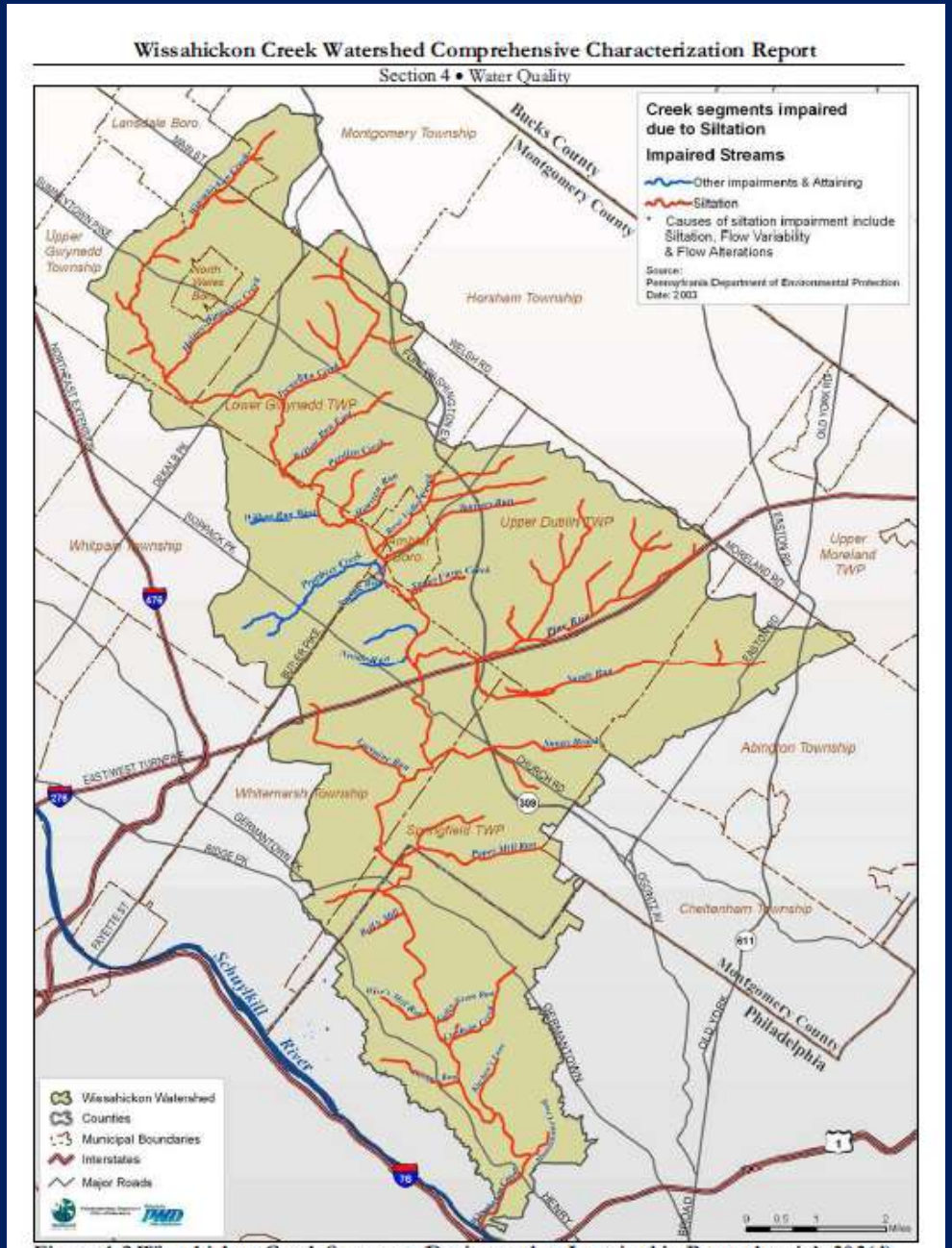
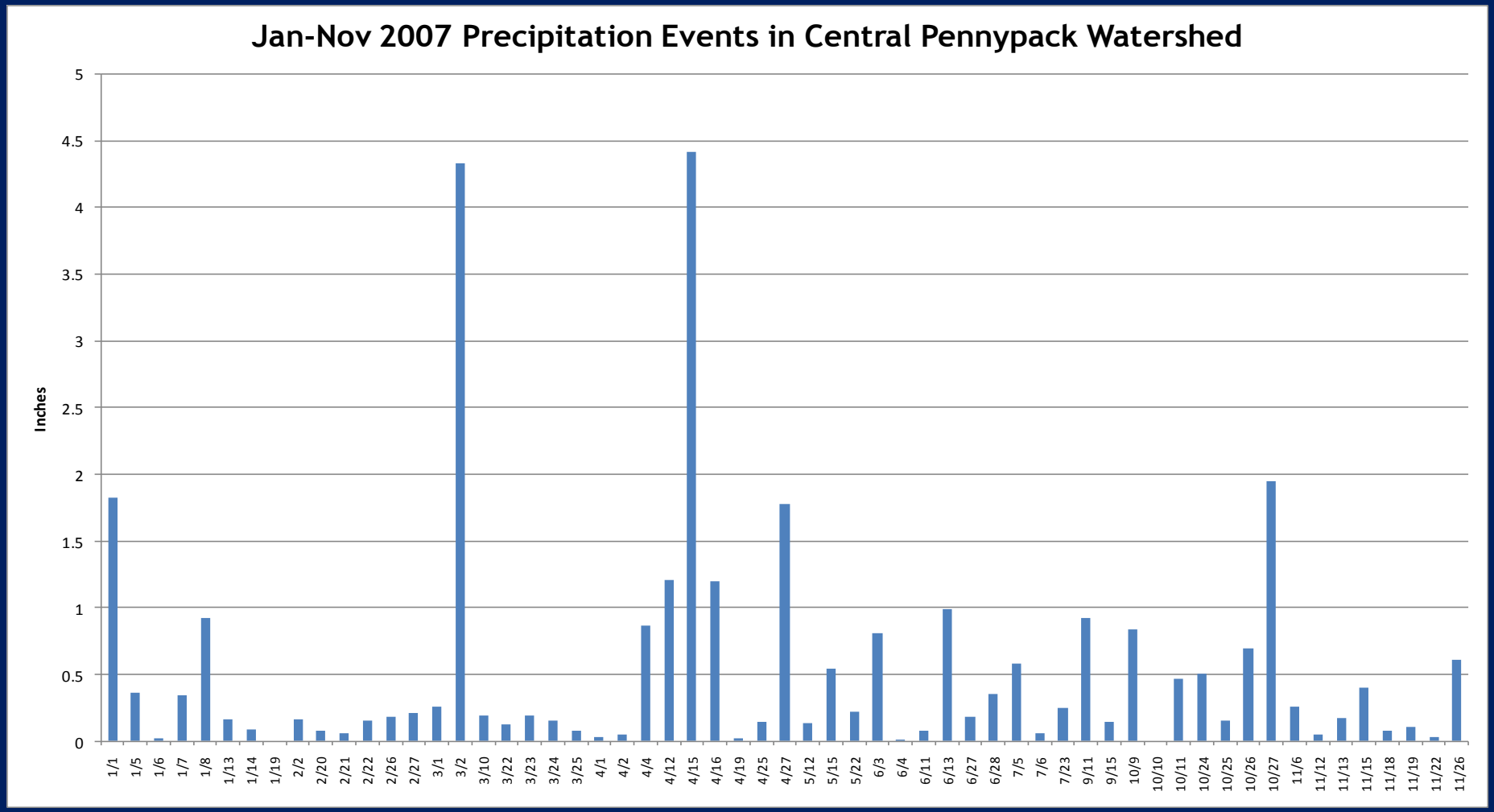


Figure 4-2 Wissahickon Creek Segments Designated as Impaired in Pennsylvania's 303(d) List Due to Siltation

Source: Comprehensive Characterization Report – Wissahickon Watershed, 2007, Philadelphia Water Department

Most of the annual runoff volume is the result of smaller storm events for which development has had the most significant impact on runoff.



Precipitation Data Provided by the City of Philadelphia Water Department

Task 2: Stormwater Problems

Flood Damage

- Increased Impervious Cover
- Extensive Floodplain Development
- More Frequent Extreme Precipitation Events
- Higher Peak Flows
- Higher Runoff Volumes

Structures within Wissahickon Watershed Floodplains

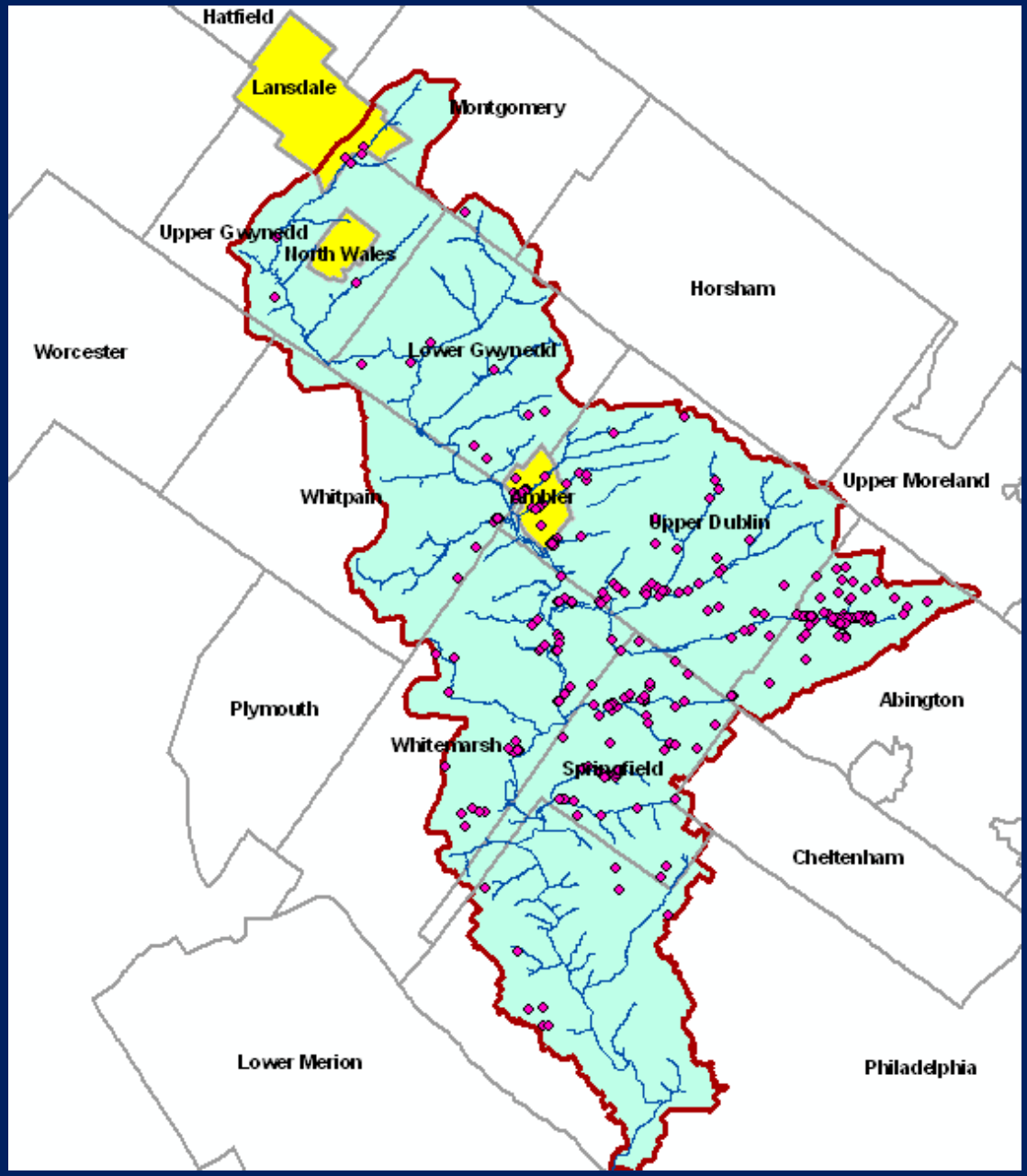
Municipality	Building Footprints in Floodplain	
	100 Year	500 Year
Abington	303	354
Ambler	90	91
Cheltenham	0	0
Horsham	0	0
Lansdale	16	32
Lower Gwynedd	104	124
Montgomery	6	6
North Wales	5	66
Philadelphia	5	16
Springfield	234	430
Upper Dublin	92	209
Upper Gwynedd	59	74
Upper Moreland	0	0
Whitemarsh	27	96
Whitpain	29	48
Worcester	0	0
Total	**941**	**1546**

Notes: Buildings considered within floodplain if any portion of building footprint within delineated floodplain
Data Sources: PAMAP Orthoimagery (Montgomery and Philadelphia Counties), PWD Municipal Boundaries, FEMA Floodplain Maps (Floodway, 100, and 500 Floodplains – FEMA Q3 Overlay)

Flood Damage

Flood Insurance Payments: January 1978 – March 2010

Total paid claims = 610
Total payments = $26.2 million



Flood Insurance Data provided by FEMA. Total claims payments do not represent all flood damage.

Recent Major Flood Events in the Wissahickon Watershed

Floyd 1999

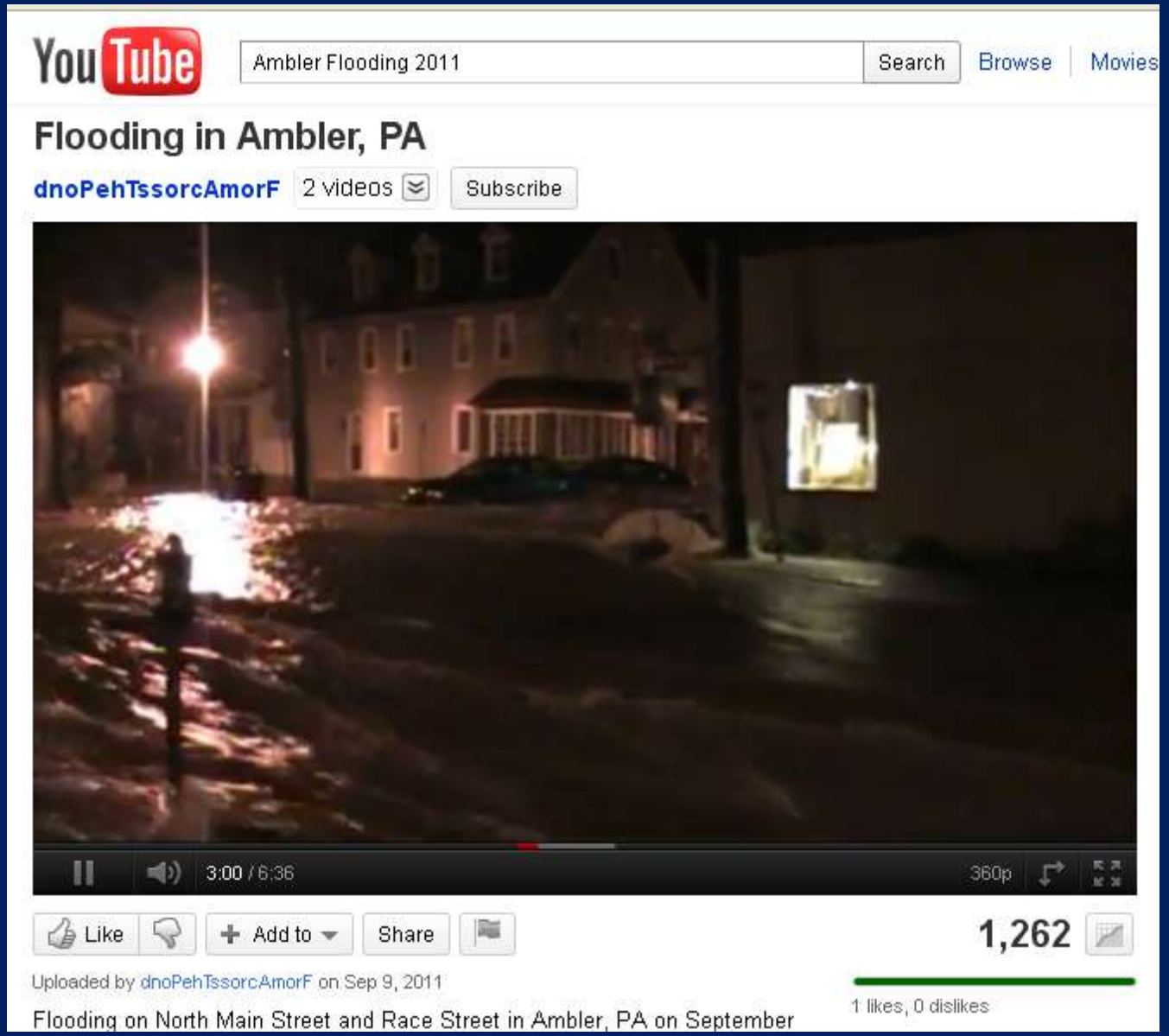
Allison 2001

Ivan 2004

Irene 2011

Lee 2011

For the main stem of The Wissahickon Creek In Montgomery County, each of these events produced peak flows larger than the 100 yr. flood used for the FIRMS.



http://www.youtube.com/watch?v=By66AeIVqv8

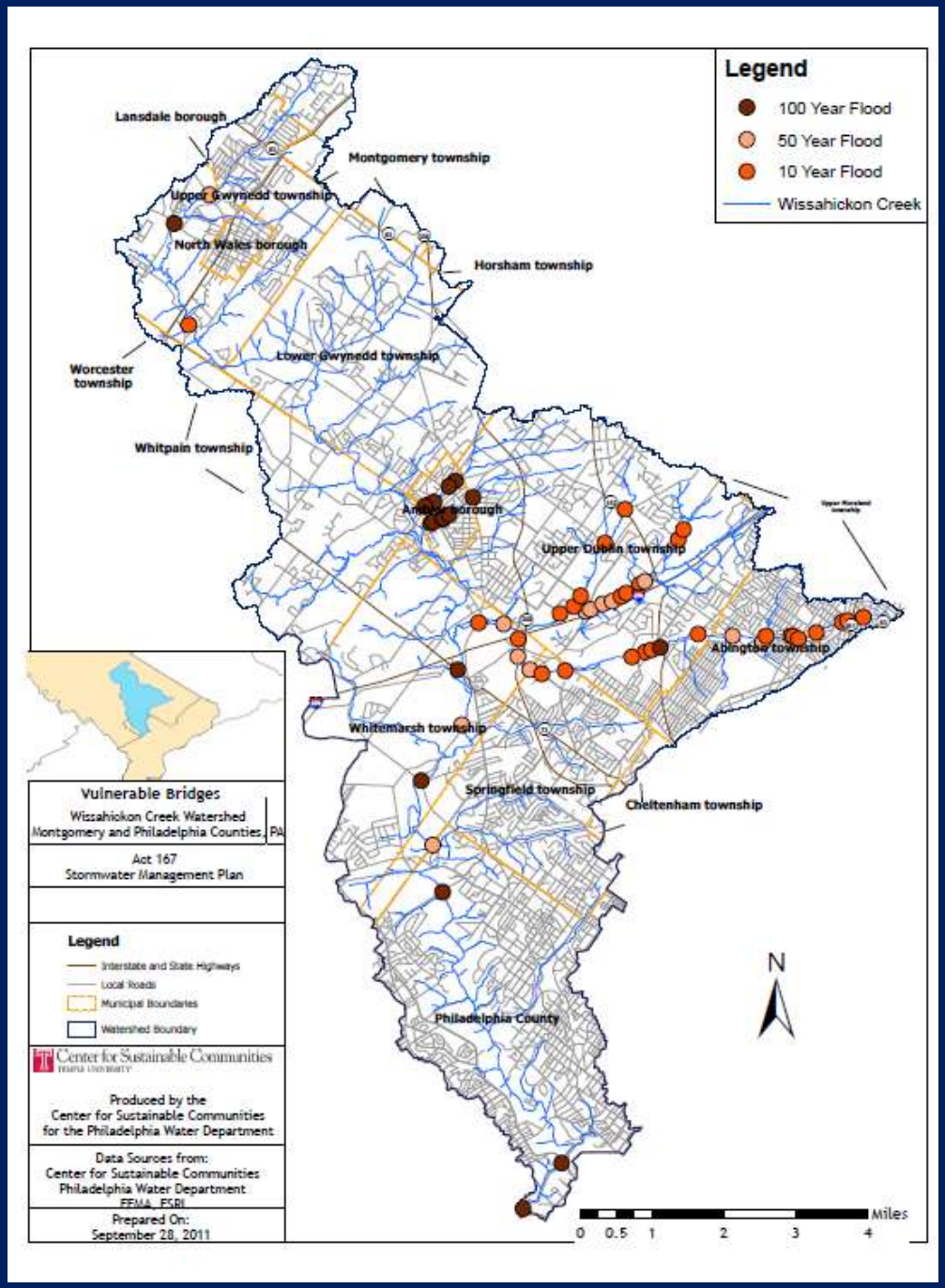
Task 2: Stormwater Problems

Obstruction Capacity

- The CSC has reviewed the preliminary update of the Montgomery County Flood insurance Study (July 2010) to determine obstructions vulnerable to overtopping.

- Once calibrated, the hydrologic developed for the Act 167 study will be used to further evaluate obstructions vs. peak flows.

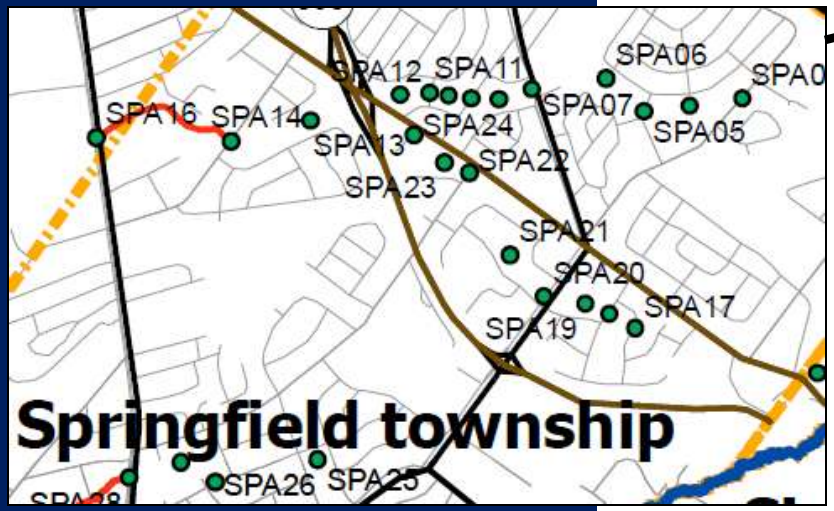
- If funded, hydraulic modeling for the remainder of the watershed would allow for more thorough analysis of obstructions.



Task 2: Stormwater Problems

Municipal Survey

- Eleven of the sixteen municipalities have responded to the survey.
- The information has been entered in to a GIS database and mapped.
- The information is useful for identifying specific problem locations.



Task 2: Stormwater Problems

Last Update: 10-21-2011

Wissahickon Creek Watershed - Stormwater Management Plan - Data Collection Form Status

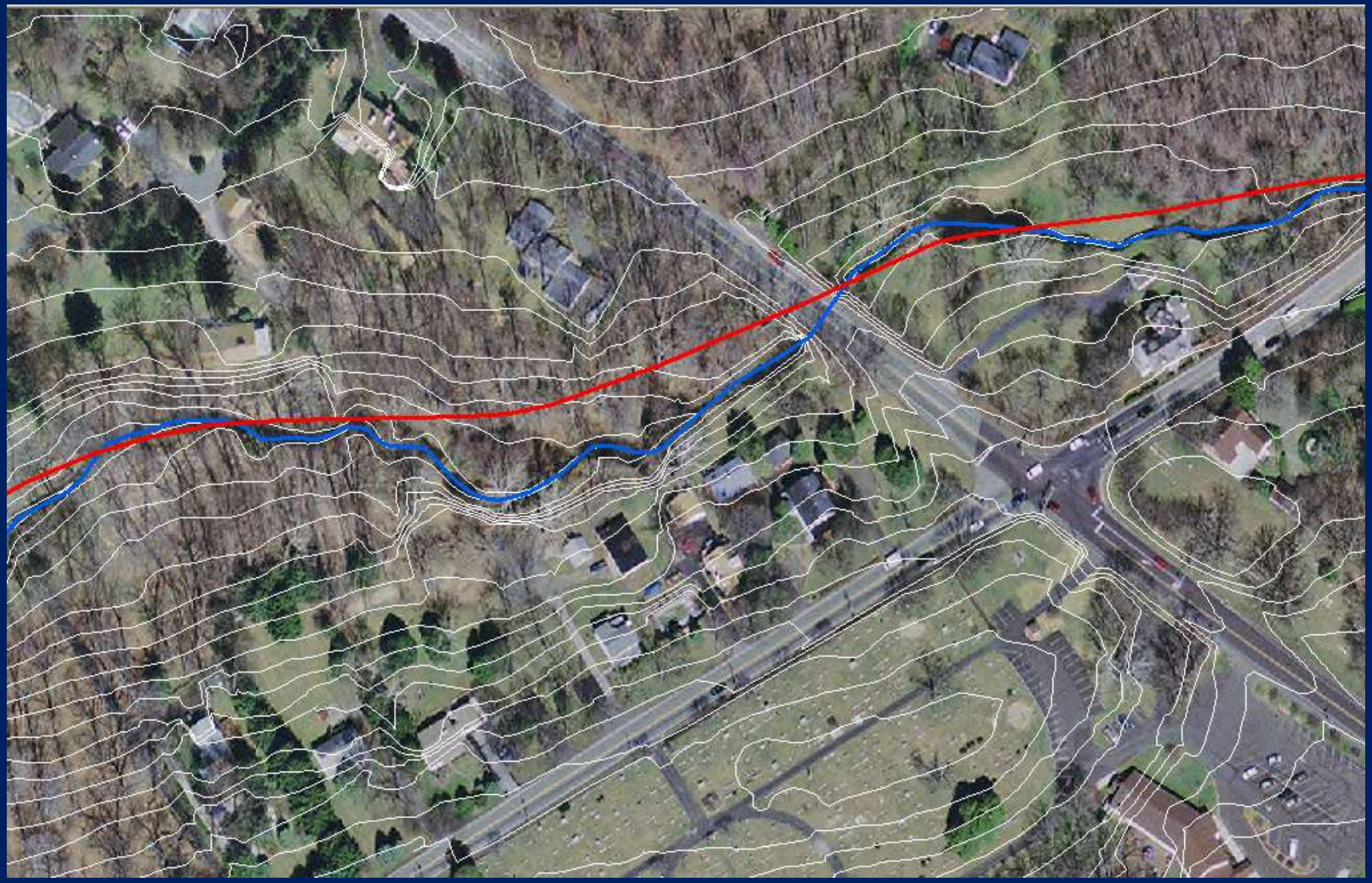
Municipality	Contact, Affiliation	Form Status Received	Date Received
Abington Township	Celeste Tompkins,		
Ambler Borough	Mary Aversa (Manager) and Susan Curry (EAC)		
Cheltenham Township	Rudy Kastenhuber, Cheltenham	Forms A, E, & G	2010.11.05 - E-Mail
Horsham Township	Bill Walker		
Landsdale Borough	Dan Shinskie, Lansdale	Forms A, C, G, & I	2010.11.30 - Mail
Lower Gwynedd Township	CKS Engineers	Forms A, C, & F	2011.01.24 - Mail
Montgomery Township	John Chambers, Chambers Associates, Inc.	Form G	2010.12.13-E-Mail
North Wales Borough	Nate Dysard	Forms A, C, E, & G	2011.08.24-E-Mail
City of Philadelphia	Joanne Dahme	Forms A, B, C, D, E,F,G, H, & J	2011.08.10-E-Mail
Springfield Township	Amy Montgomery,	Form A	2011.2.24 - E-Mail
Upper Dublin	Tim Haney, Upper Dublin		
Upper Gwynedd Township	John Katsaros ,CZOP/Specter Engineers	Forms A & D	2010.12.06 - Mail
Upper Moreland Township	David Dodies	NONE	2011.08.08 - Email
Whitemarsh Township	Bruce Horrocks		
Whitpain Township	Jim Blanch	Forms A & G	2010.12.21 - Mail
Worcester Township	Joseph Nolan,CKS Engineers	Forms A, C, F, G, & H	2010.12.06 - Mail

Task 3: Stream Mapping - Primary data set provided by PWD

Difference in stream channel location – 10 ft. vs. 2 ft contour intervals

Older Delineation

PWD Delineation with 2 ft. Contours

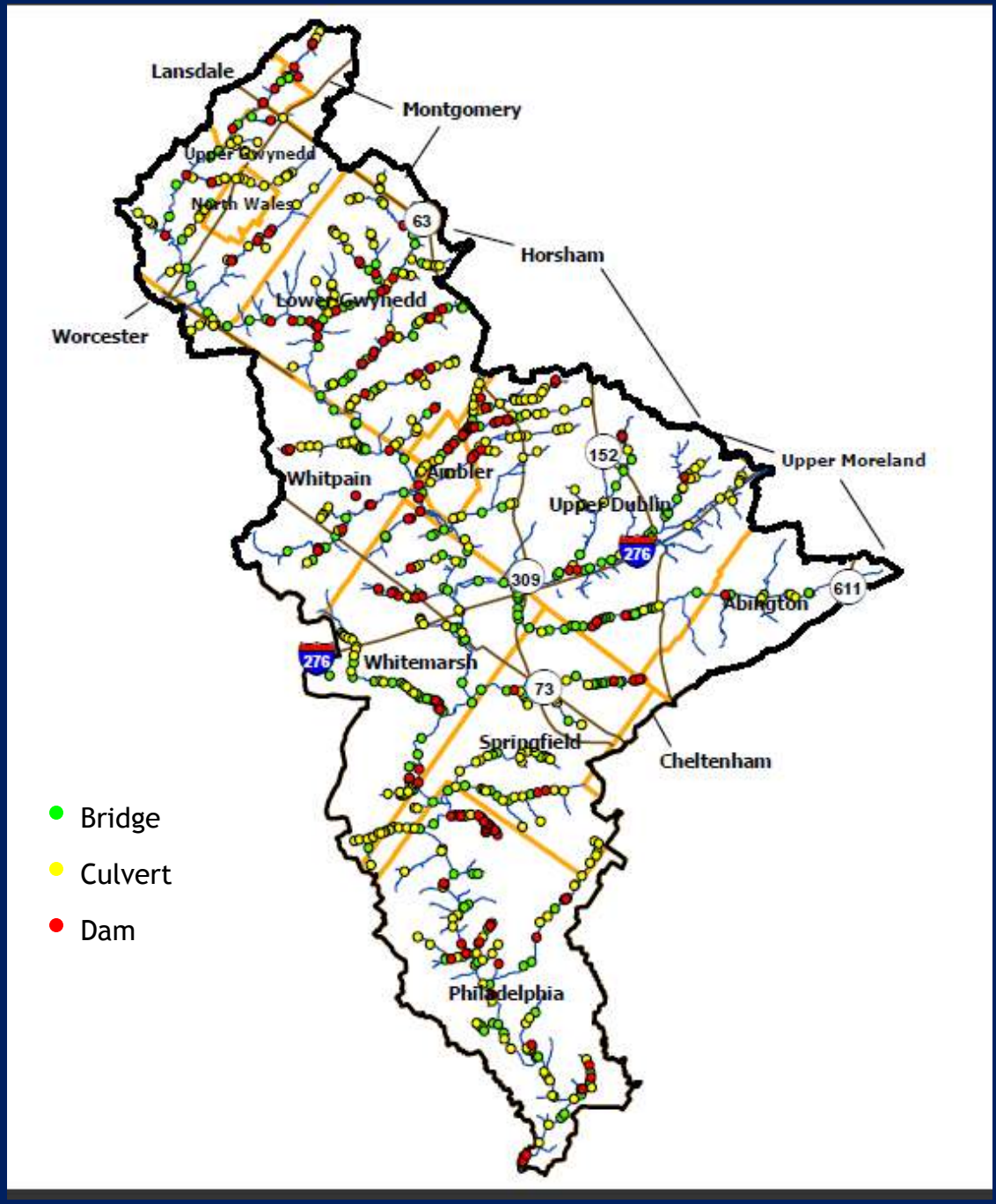


Benefits of new strem file for flood mapping:

Example of previously mapped floodplain vs. updated stream location, based on newer elevation data and ortho photos.

Task 4: Mapping Obstructions

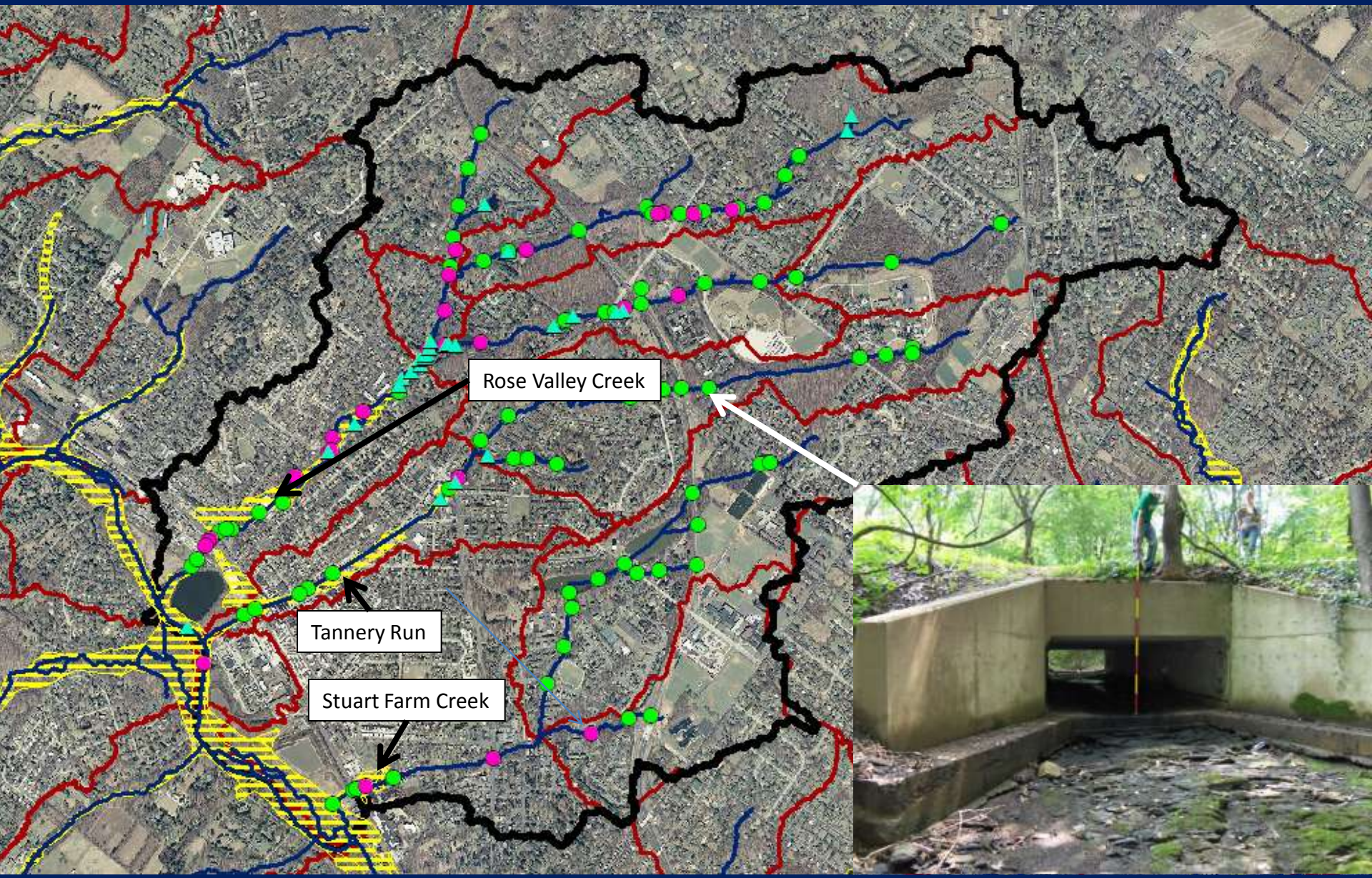
- The PWD provided GIS files for over 800 bridges, culverts and dams in the watershed.
- PWD reviewed the bridges and culverts and identified approximately 250 that are significant obstructions to flow.
- The CSC has identified and mapped additional obstructions in the Ambler and Sandy Run watersheds.



Task 5: Supplement Obstruction Data

*The CSC and PWD are re-measuring significant obstructions.

* Sandy Run and Ambler area watersheds have been completed at this time.



Study Work Tasks

Tasks 6-10

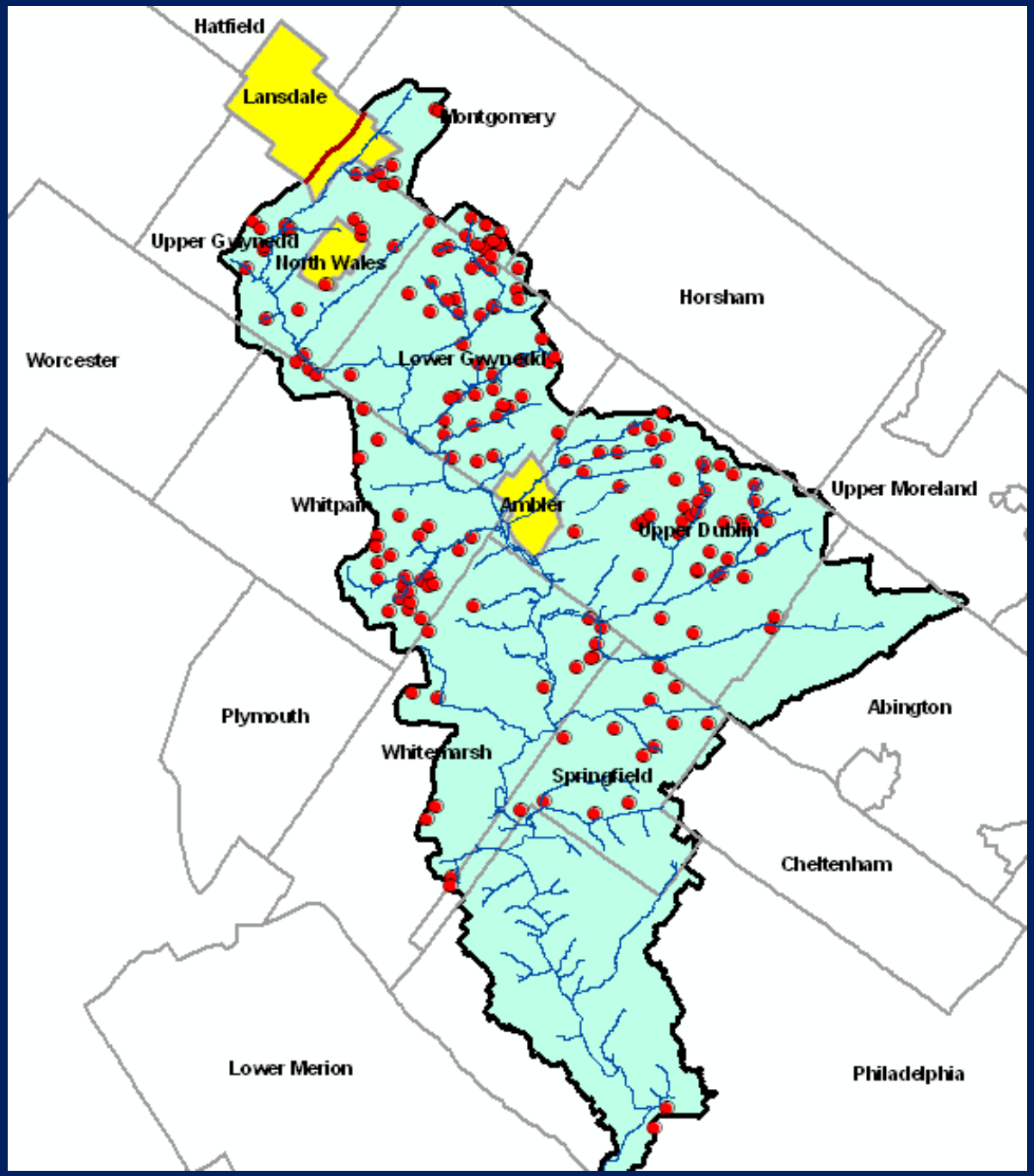
6. Update Stormwater Improvements Inventory
7. Update Hydrologic Data
8. Develop 2035 Land Use Scenario (Winter 2012)
9. Hydrologic Model Development
10. Hydraulic Model Development

Task 6
Stormwater Improvements

- 2009 Work for the PEC identified potential improvements.

Detention Sites – 240 Acre-Ft
Infiltration Sites – 118 Acres
Riparian Buffers Rest.– 407 Acres
Total Volume – 294 Acre-Ft

- Additional sites have been identified in the Ambler portion of the watershed, with additional funding, other portions of the watershed could be evaluated as well.



Honey Run/Stuart Farm Creek – Ambler Watershed

Task 7: Update Data

GIS Data	Source
County and municipal boundaries	PennDOT, PASDA
Road centerlines	PennDOT or DVRPC
Streams	PWD
Water bodies	PWD, PAMAP
Watershed boundary	Delineated from LiDAR DEM from PAMAP
Wetlands	U.S. Fish and Wildlife Service National Wetlands Inventory (NWI), PWD
High Resolution Digital Ortho Photographs	PAMAP - 2008, DVRPC - 2010
Digital Elevation Model (DEM)	LiDAR from PAMAP Program - 2008
Existing Land Use	DVRPC - 2005
Future Land Use	DVPRC, CSC
Impervious Surface Areas	PWD
Hydrologic Soil Groups	NRCS, PWD
Geology	USGS, PWD
Obstructions	PWD, CSC, FEMA, Municipalities
Floodplains (FEMA Q3)	FEMA

Task 9: Hydrologic Model

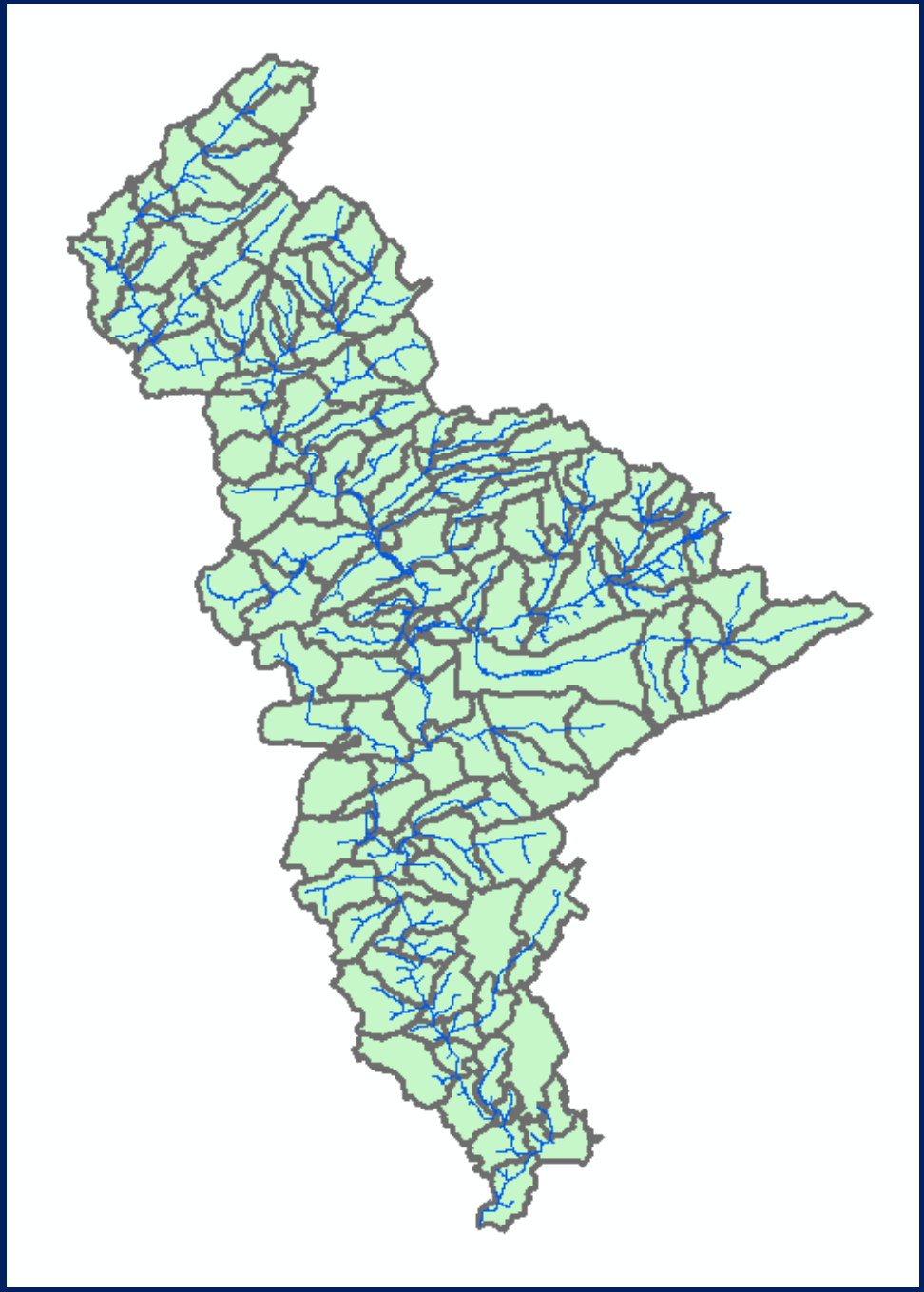
- HEC-HMS model

- Inputs based on:
  - 2008 LiDAR from PAMAP
  - 2005 Land use from DVRPC
  - Soils data from NRCS, PWD
  - Stream and x-sect. data from PWD
  - 2008 Ortho imagery from PASDA
  - Storm Sewer Shed data from PWD

- ArcHydro and HEC-GeoHMS used to prepare input for HEC-HMS model

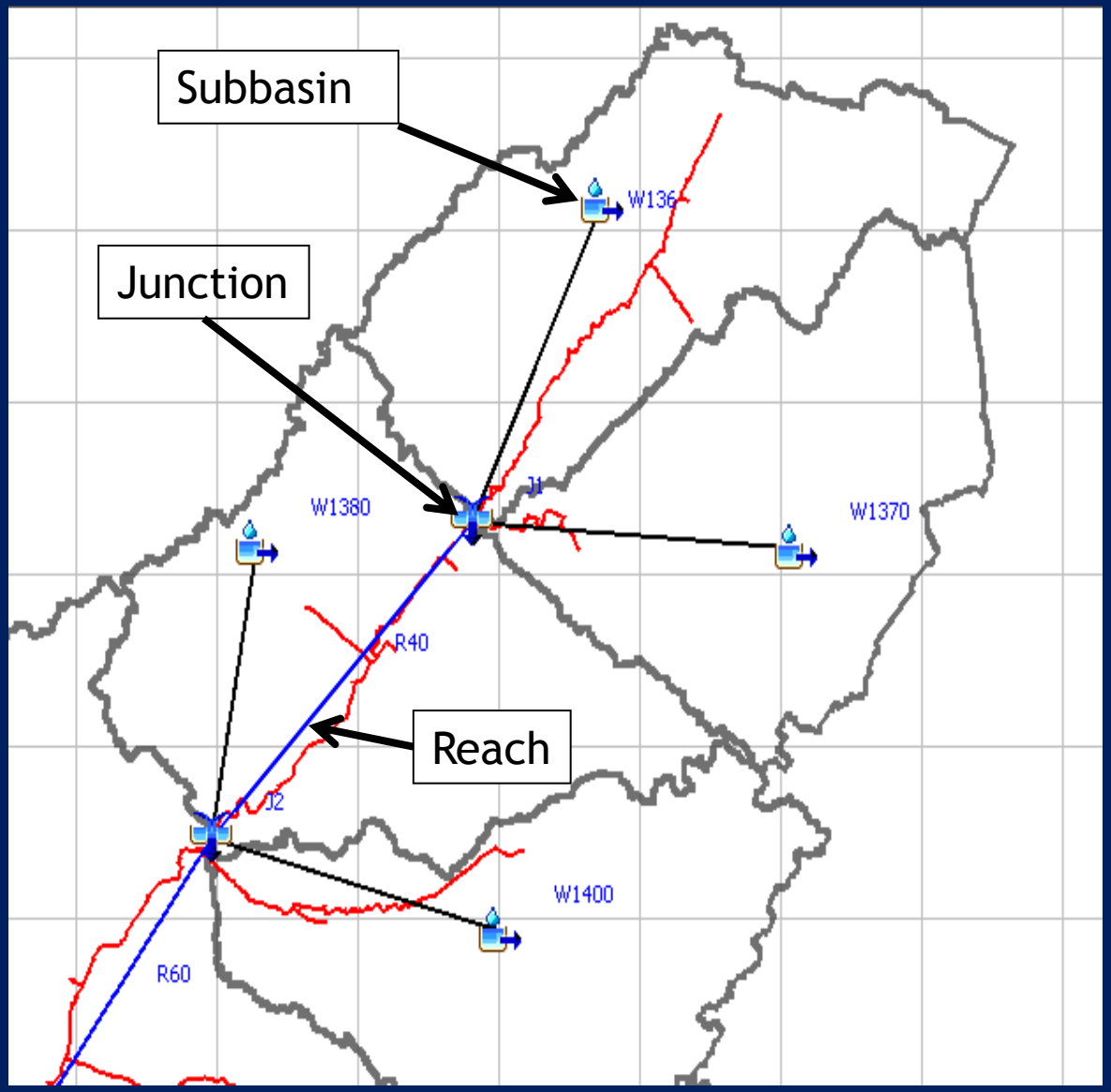
- 137 subbasins delineated

- Average Drainage Area = 0.46 square miles



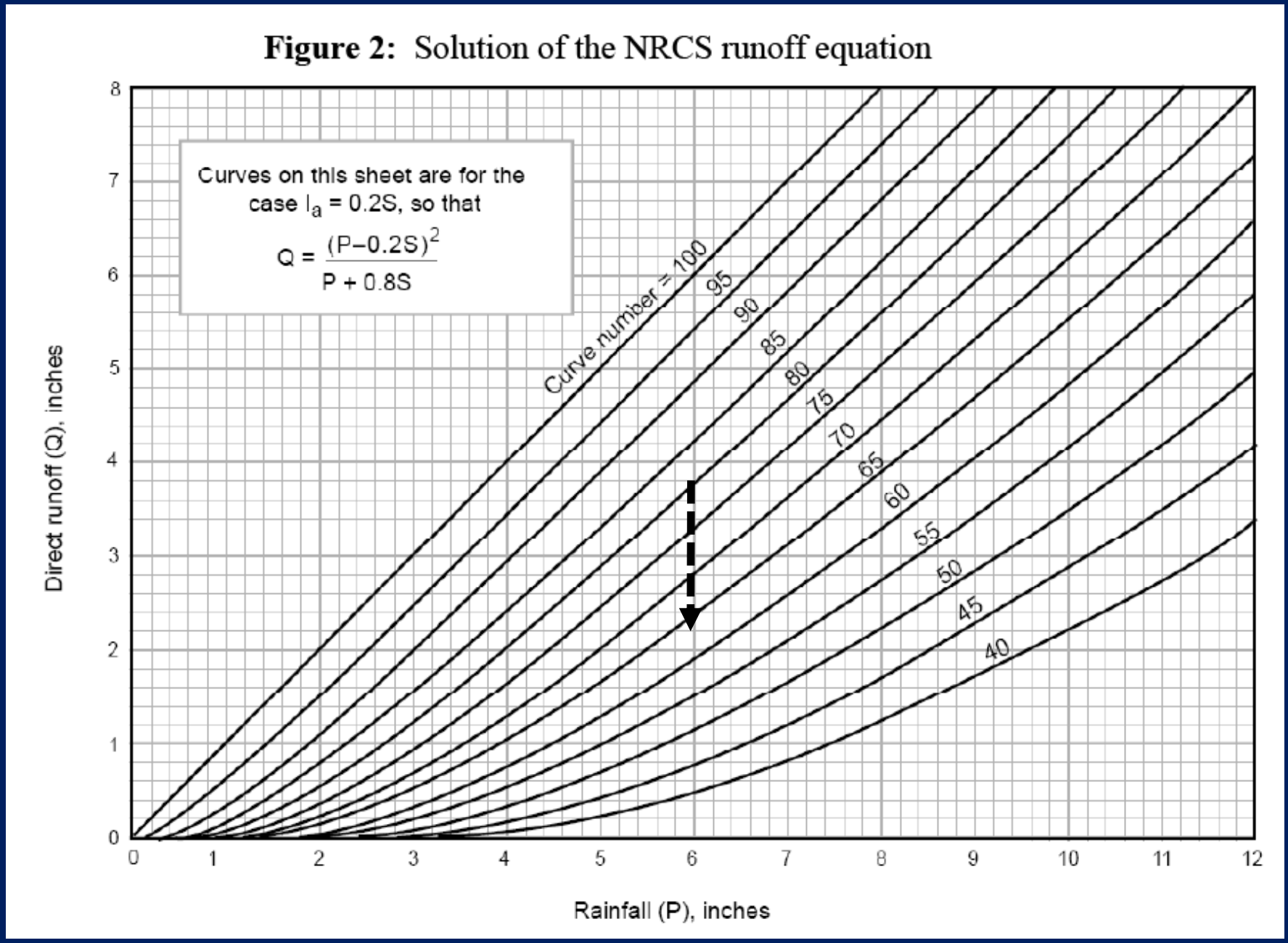
Task 9: Hydrologic Model Development Steps

- Subbasin Delineation
  - -2008 LiDAR data
  - - PWD storm sewer sheds in Philadelphia County
- Subbasin Properties
  - -Drainage Area
  - -Runoff Curve Number
  - -Time of Concentration
    - *Related to slope and land cover
- Reach Properties
  - - Channel Slope
  - - Cross Section
  - - Roughness



HEC-HMS Model Schematic

Curve number provide a means to generatre runoff volume for hydrologic modeling

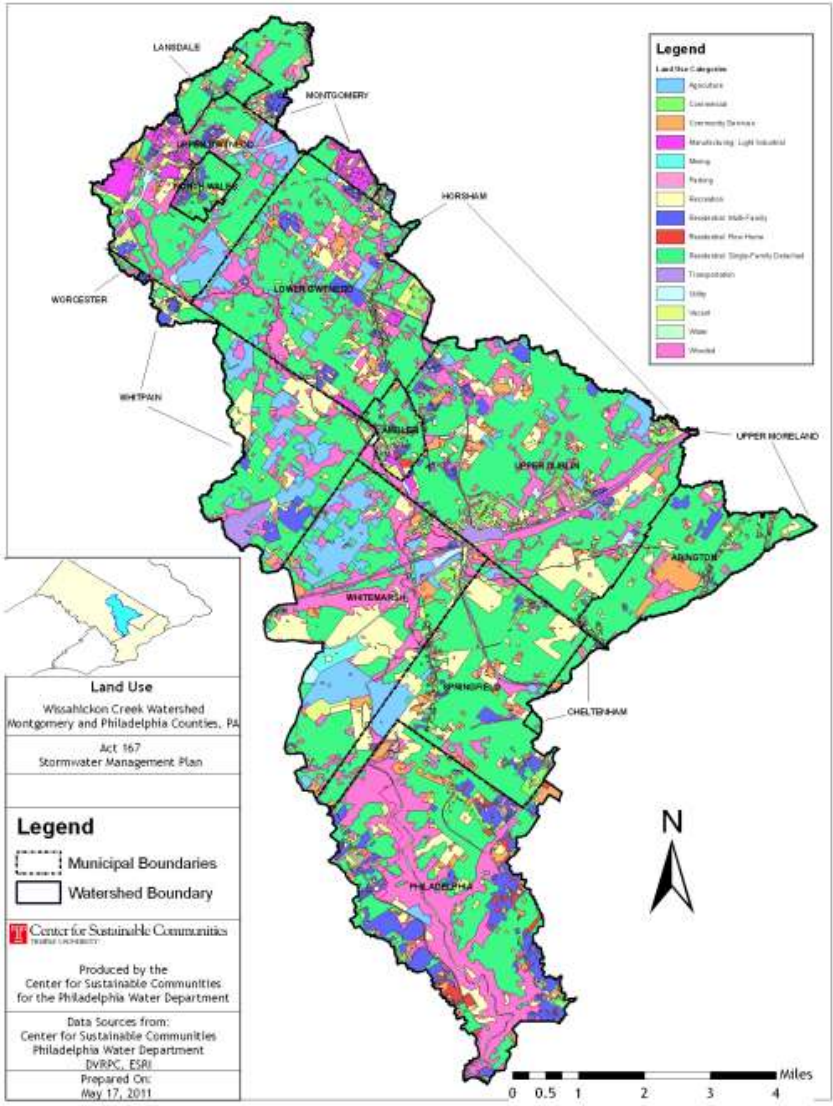


Curve Number Assignment is based on land use and hydrologic soils group. GIS was used to determine a weighted curve number for each subbasin

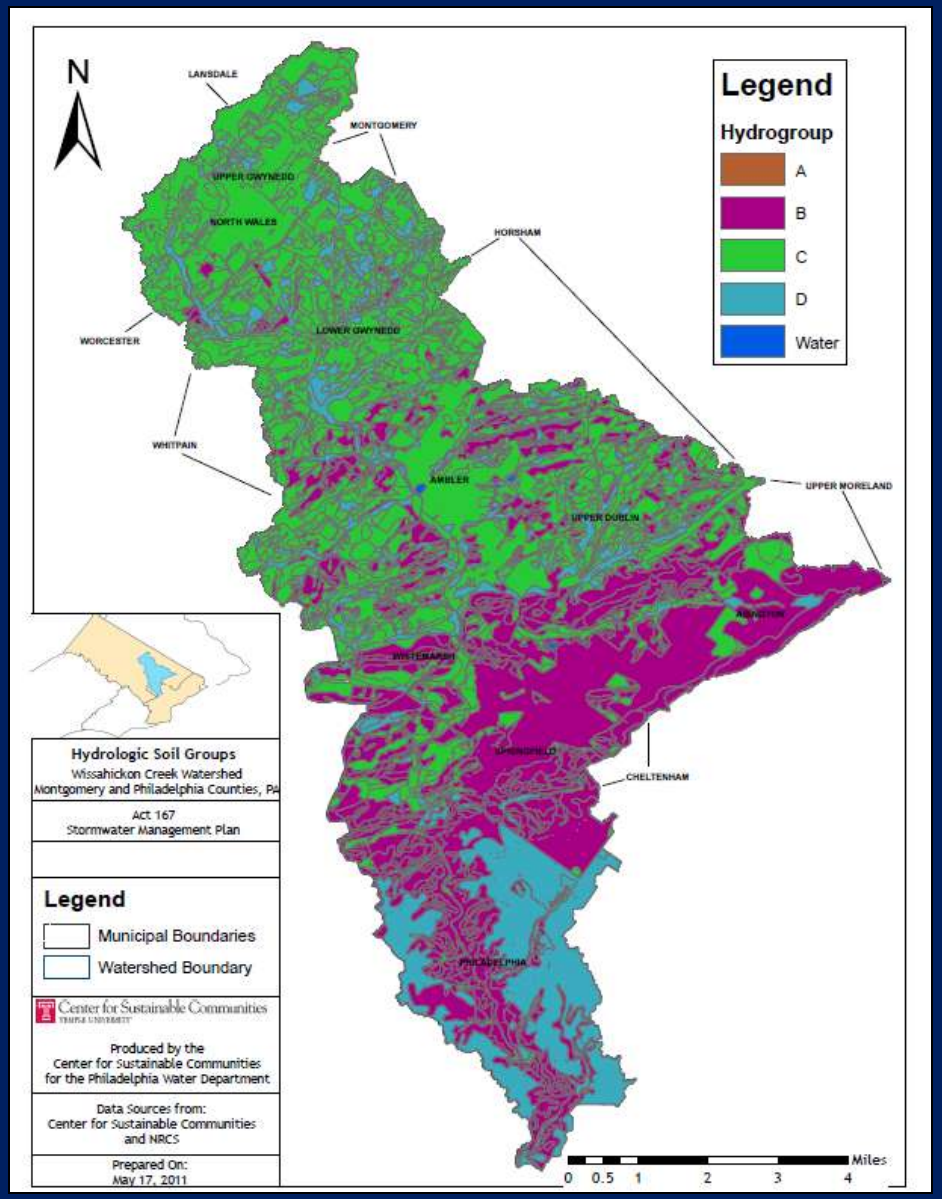
	Hydrologic Soil Group			
Landuse Description (2005 Data)	A	B	C	D
"Residential: Single-family detached"	57	72	81	86
Agriculture	49	69	79	84
Wooded	36	60	73	77
Vacant	77	85	90	92
Water	100	100	100	100
Residential:Multi-Family	77	85	90	92
Parking	98	98	98	98
Residential:Row Home	77	85	90	92
Residential: Mobile-Home	77	85	90	92
Manufacturing:Light Industrial	81	88	91	93
Transportation	83	89	92	93
Utility	89	92	94	95
Commercial	89	92	94	95
Community Services	81	88	91	93
Military	63	77	85	88
Recreation	49	69	79	84

GIS was used to overlay land use and hydrologic soil group for each subbasin to generate CN

Land Use



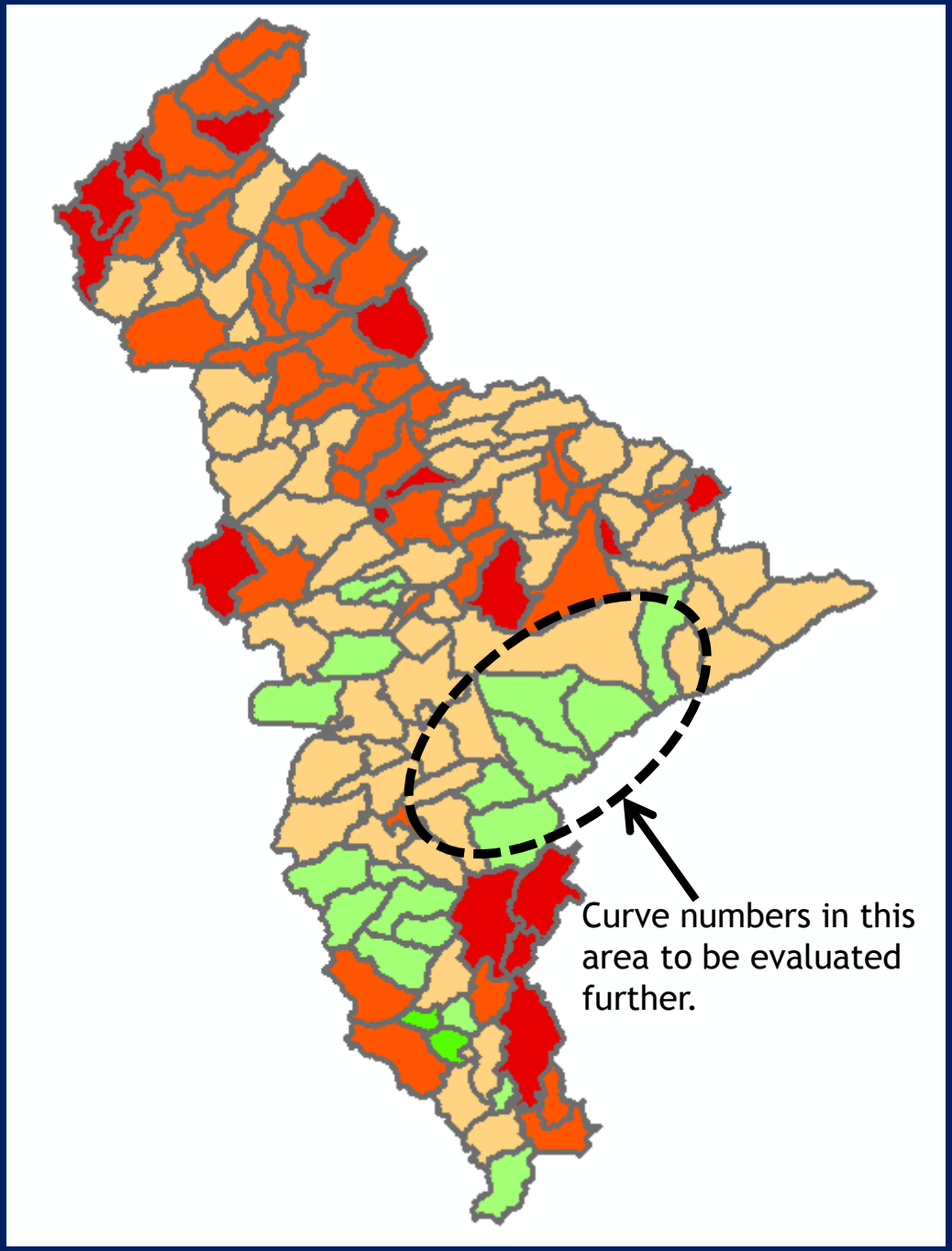
Hydrologic Soil Group



Curve Number Distribution for Wissahickon Subbasins

- CN>85
- CN 80-85
- CN 75-80
- CN 70-75
- CN <70

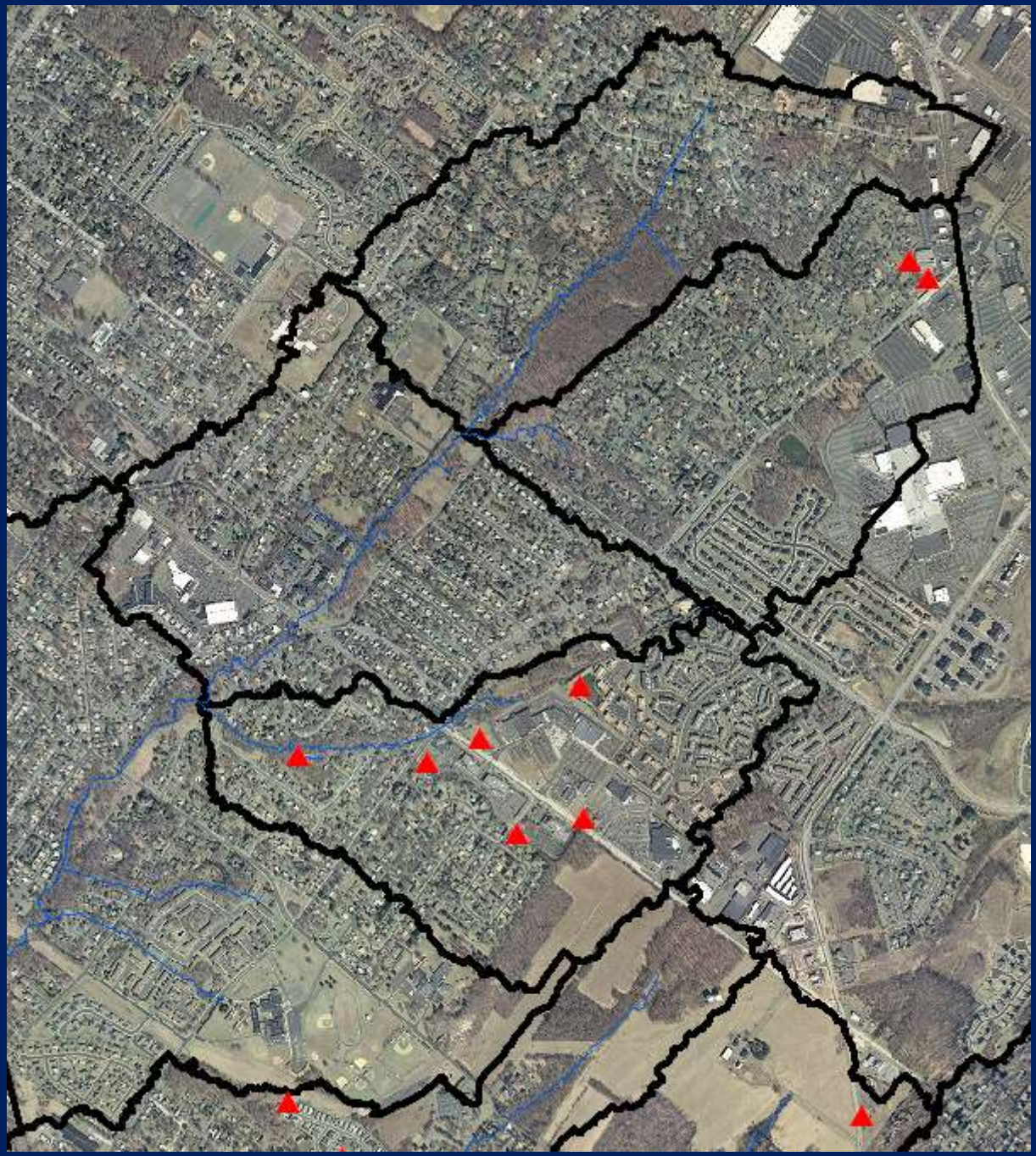
Approximately 25 % of the watershed is covered by impervious surfaces such as roofs, parking lots and roads.



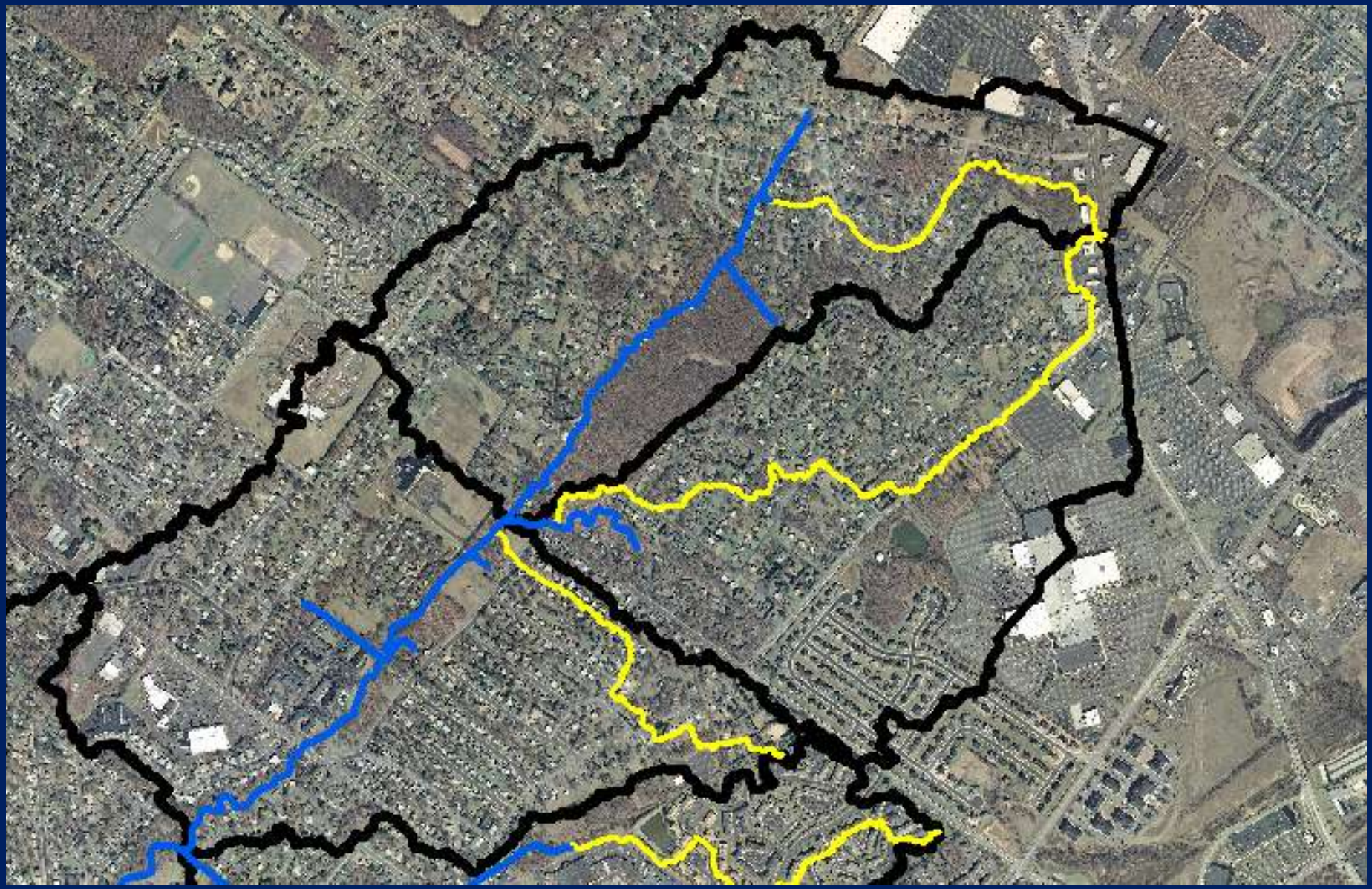
Existing Detention Storage

Summed for each subbasin and added to the potential storage. The Curve number will then be adjusted.

The PWD and CSC inventories are being used to determine total detention.



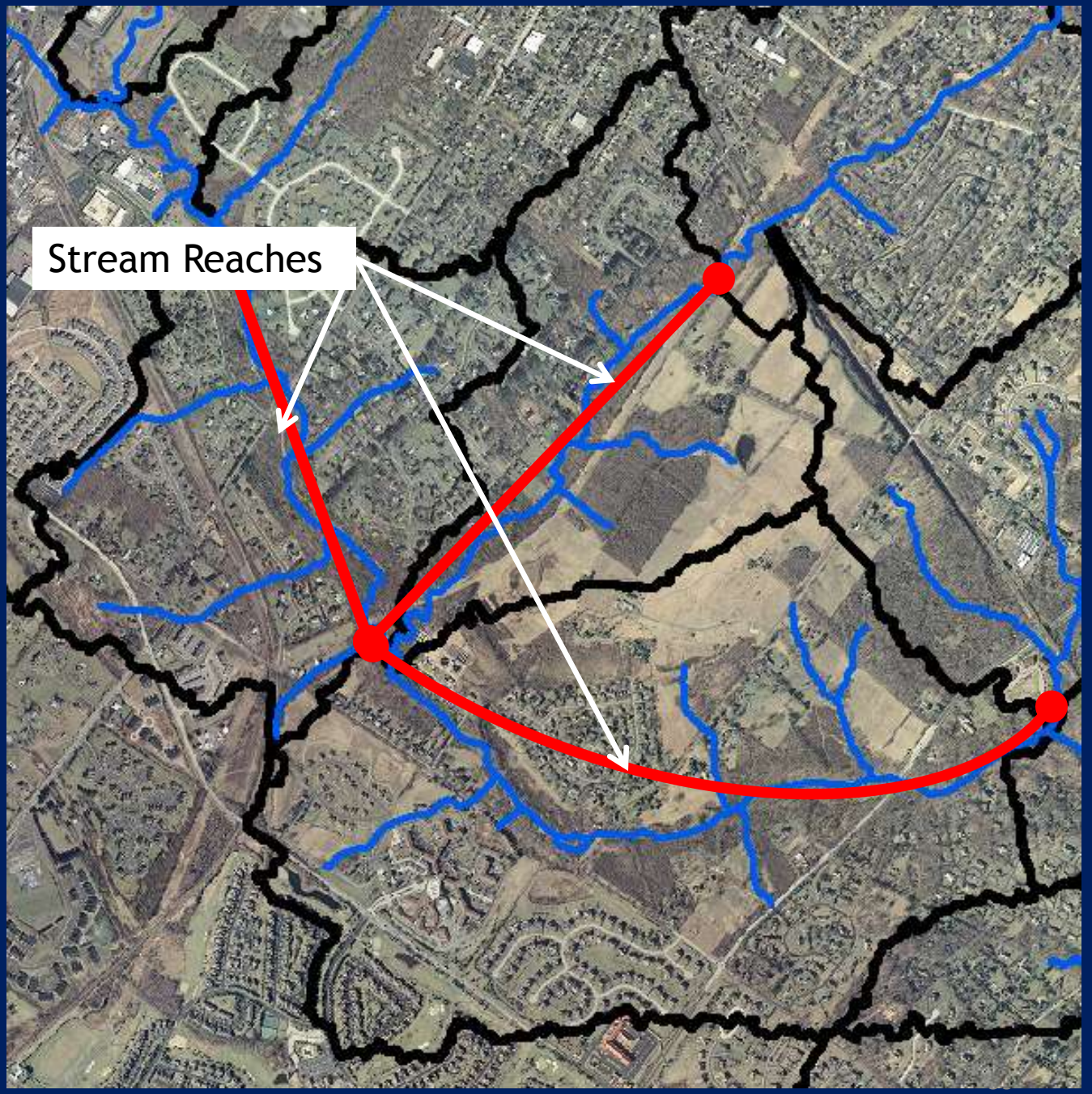
Time of concentration: Calculated as the sum of sheet flow, shallow concentrated flow, and channel flow travel times. ArcHydro was used to determine the path of longest flow through each subbasin.



Stream Reaches

87 reaches were modeled using Muskingum-Cunge Routing.

Representative channel x-sections and Manninigs N values were estimated from contours and ortho images, and from field survey data provided by the PWD.



Model Calibration

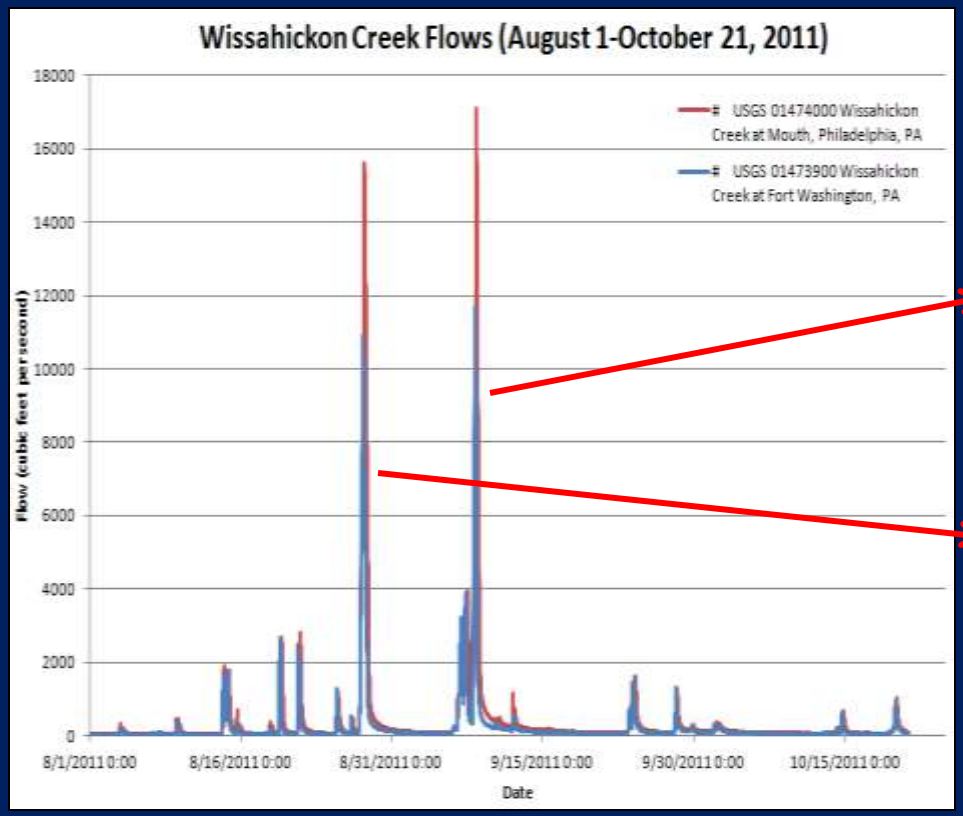
The model will be tested for multiple rainfall events and calibrated against observed flow data at stream gages.

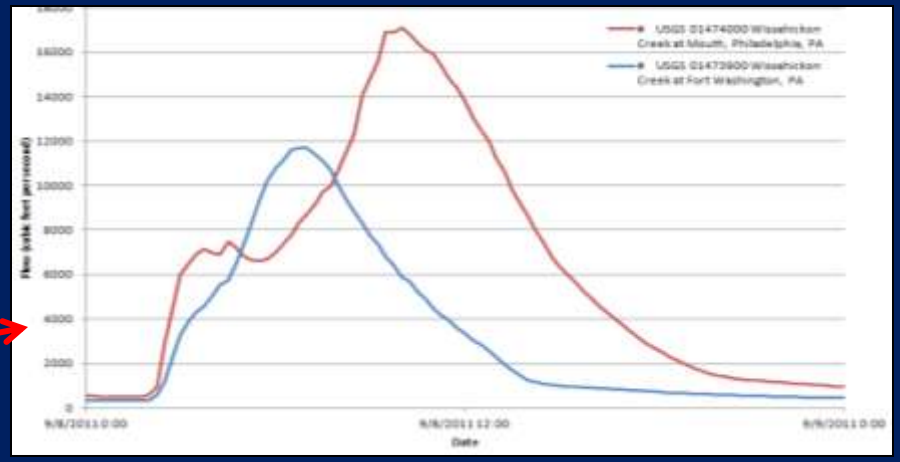
-Fort Washington
-Philadelphia

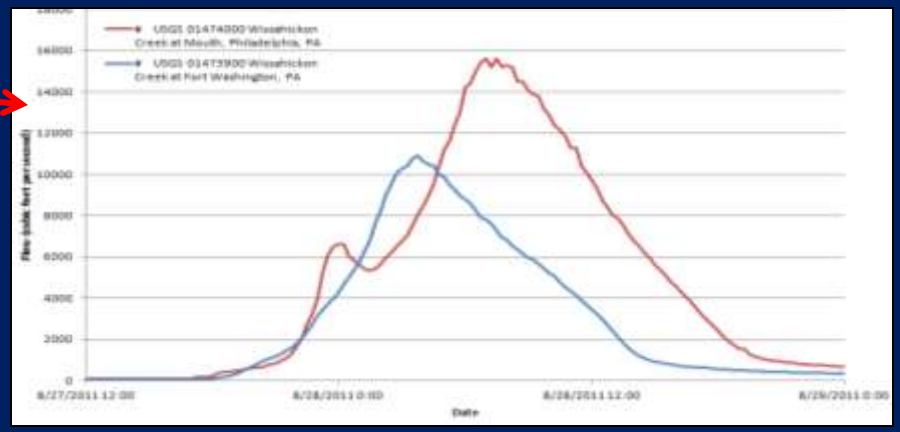
Design rainfall events will be based on NOAA Atlas 14 precipitation frequency data.

Model Calibration

Continuous (measured every 15 minutes) streamflow data is available at both USGS gage stations. Precipitation from several runoff-producing events will be run through the hydrologic model. The model will be calibrated so that it produces flows that are consistent with those measured by the USGS gages.



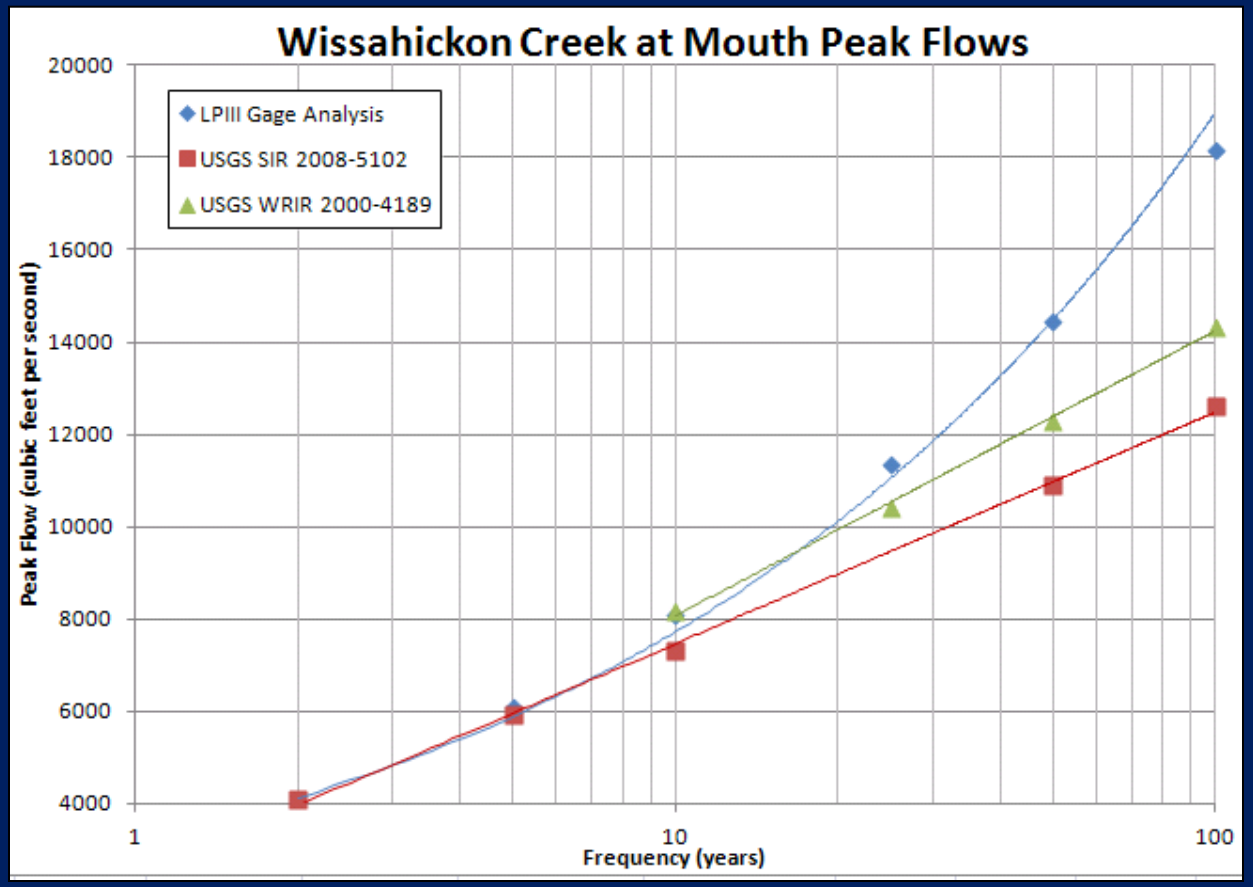




Model Calibration

The calibrated model output will be compared with peak flow estimates calculated using several widely accepted methods.

Wissahickon Creek Peak Flows at Mouth			
Event	LPIII Gage Analysis	USGS SIR 2008-5102	USGS WRIR 2000-4189
2	3858	4080	3742*
5	6091	5910	6202*
10	8093	7320	8150
25	11360	9457*	10419
50	14440	10900	12300
100	18160	12600	14343
* Peak flow extrapolated/interpolated from other calculated events			



Task 10: Hydraulic Model – HEC-RAS model with HEC-GeoRas interface for GIS

At this time funding has been received to develop the hydraulic model for the Amber portion of the watershed. This is in progress. Combined with Sandy Run, this represents about ¼ of the watershed. Funding for the remainder of the watershed is being sought.