Ten Years of Classroom Examinations of Water Quality in East Branch Brandywine Creek, Pennsylvania: 2002-2012

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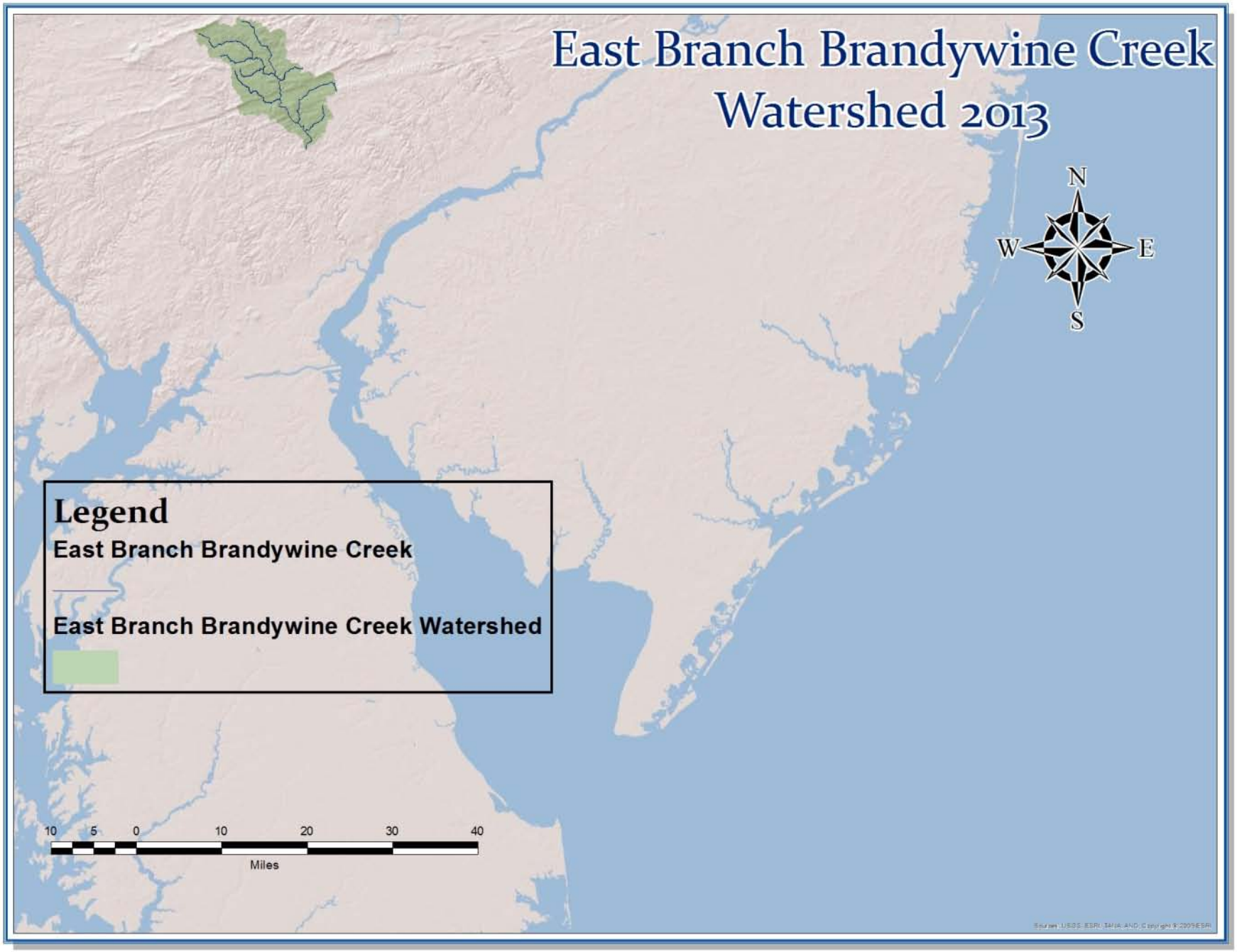
Abstract

The East Branch of the Brandywine Creek in Chester County, PA is an important tributary of the Christina River. As it meanders from it headwaters adjacent to Lancaster County near Honeybrook, PA to its confluence with the West Branch below West Chester, PA it traverses upland agricultural regions, light industrial, suburban and urban land use areas. The East Branch provides drinking water to Downingtown and West Chester, PA. Each summer since 2002, Environmental Health students at WCU have conducted an examination of water quality in the East Branch that includes measurement of DO, temperature, pH, conductivity, alkalinity, NO_3 -N, ortho-PO_4-P, total coliforms and (for some years) various metals. Physical/biological observations for the stream basin have included flow, presence/absence of various streambed characteristics and organisms, weather and descriptions of potential contamination sources. Results have shown moderately good stream health over the 10 -year period of observation despite rapid population growth and development of the surrounding watershed; most nutrient values have been consistently below target maximums. Coliform levels have been highly variable, dependent primarily on the frequency and magnitude of storms. Tabulated results will be presented that incorporate a GIS -based database to illustrate temporal and spatial variability of the findings. While these data are derived from student -generated values obtained during field and laboratory class sessions, the general results are nonetheless significant both for educational and watershed planning purposes.

E. Branch Watershed Description

- The East Branch of the Brandywine Creek is part of the Christina Watershed, with tributaries in Pennsylvania, Delaware and Maryland
  - Christina River – 565 mi^2
    - Brandywine Creek– 325 mi^2
    - West Branch Brandywine Creek– 135 mi^2
    - East Branch Brandywine Creek– 123 mi^2
- Ranges in Elevation from 660’ in Piedmont uplands to 170’ at confluence with West Branch Brandywine Creek
- Drinking water supply for Downingtown and West Chester, PA
- Two permitted municipal wastewater discharges, other NPDES sites
- Agricultural, Rural and Urban Land Use, 1/3 forested
- Impaired in sections for DO, nutrients, sediment and bacteria


East Branch Brandywine Creek Watershed 2013
N
W
E
S
Legend
East Branch Brandywine Creek
East Branch Brandywine Creek Watershed
10 5 0 10 20 30 40
Miles

"Water Quality and Health" Course Design

- Major Course for Environmental Health Students
  - Course duration 1 – 5 weeks, usually in June
  - Students of all levels, often with no quantitative chemistry or microbiological skills
  - Focus on learning lab measurement techniques, sampling protocols, QA/QC measures, and report preparation
  - Students collect grab and composite samples from all segments of the stream and each major tributary, approximately 20 sites per year, one sample per site per year
  - Field and lab observations recorded
  - Production of class-wide collaborative report

Methods

- Limitations:
  - These are grab samples only, reflective of conditions at a single point of time and space
  - While the intent was for each annual sampling to represent the "state of the watershed" that season/year, there was no control over low/high flow events that could significantly affect results
  - All data are student generated and while collection and analysis were faculty-supervised, considerable differences in analyst skill were noted
- Parameters Observed
  - Qualitative: weather, stream characteristics, visible pollutants and sources, visible biological status
  - Quantitative
    - Field measurements: Temp, DO, Conductivity, pH, Turbidity, Flow rate
    - Lab Measurements: NO_3-N, PO_4-P, Alkalinity, Metals (partial), Total Coliform
    - QA/QC: Blanks, standards and replication
- Analytical Methods
  - NO_3-N by UV screening method (Standard Methods 4500-NO_3 B) or Cadmium Reduction Method (Hach Method)
  - Ortho PO_4-P by Ascorbic Acid method (Standard Methods 4500-P E) or Hach Model PO-24 Method

Rivers and Streams Field Sheet

Rivers and Streams

Organization: _____
SARIS #: _____
River Name: _____
Town: _____
Site ID #: _____
Site Name:

General weather conditions last 3 days:
date: _____ Rain: _____ (cm) Temp: _____ (°C) Not

Sampling Crew (names of volunteers):

Date: _____ Time (24 hr): _____
Photos taken? yes no
Photo Negative Numbers:
Staff gage reading and source/type (if available):
Estimated water velocity none (0 m/s) low (0-1 m/s) medium (1-5 m/s) high (>5 m/s)

Current Weather:	Air Temperature:	Wind Conditions:	Odor:	Water Clarity:	Wa
Clear	_____ °C	Calm (0-2 km/h)	None	(check all that apply)	
Partly sunny	(°C)	Slight breeze (2-8 km/h)	Sulfide (rotten egg)	Clear	
Partly cloudy	< 0	Moderate winds (8-25 km/h)	Chlorine	Suspended solids/murky	
Overcast	0 - 5	Gusty (15-40 km/h)	Petroleum	Slightly turbid	
Foggy	5 - 10	Storm winds (> 40 km/h)	Musty (basement)	Highly cloudy	
Drizzly	10 -15	Strong gusts (25-40 km/h)	Rotting vegetables		
Light rain	15 - 20	River Water Level	Septic		
Heavy rain	20 - 25	Low (estimate minus ___ cm)	Other		
Sleet	25 - 30	Normal			
Snow	>30	High (estimate plus ___ cm)			

Presence of Algae (check all that apply)
None
Unobservable (note why in description)
Sparse (0-25%)
Moderate (25-75%)
Dense (75-100%)
Suspended
Floating

Algae Description (general type, extent, color, condition, and location):

Density of Aquatic Plants
None
Unobservable (note why in description)
Sparse (0-25%)
Moderate (25-75%)
Dense (75-100%)
Emergent
Floating
Submerged

Aquatic Plant Description (list plants in general vicinity of station; note genus and species if known and location [streambed or near bank]):

Presence of Periphyton
None
Sparse (0-25%)
Moderate (25-75%)
Dense (75-100%)
Attached (on rocks, bottom)
Epiphyton (on plants)
Filamentous slime
Green/brown benthic mat
Green/brown rocks
Brown/rusty floc

Periphyton Description (exte etc.):

Sampling Location Information (fill out for the visible stream reach, check multiple boxes if applicable, DETERMINE LEFT OR RIGHT BANK BY LO

Scum(s) yes no (include oil sheens, pollen/dust blankets and similar **floating** layers that reduce aesthetics)
Description of Scum(s)

Observed Use(s) (include indications of use even if use not observed) none swimming boating water intake fishing
Description of Observed Use(s) (include numbers) **or Indicators of Use(s)**

Objectionable Deposits none floating sunken garbage/trash aquatic weeds flocculent mass (rust colored or oth
Description of Objectionable Deposits (type, extent and area affected…)

Shoreline Erosion yes no (describe any shoreline erosion observed, note location: look for existing and potential slope failures, landslide
Description of Erosion

Wildlife Sightings none fish mammals birds reptiles (snakes, turtles) waterfowl amphibians (frogs, salamander
Description of Wildlife Sightings (include numbers) **or Indicators of Use(s)**

Potential Pollution Sources none waste outfall pipes garbage/trash dumping land clearing green lawns shoreli
other:
Description of Potential Pollution Sources:

Rivers and Streams

SAMPLE DATA Notes: _____

Bottle Sample(s) collected? yes no
Time (24 hr.) _____
Samples taken from (check all that apply)
from shore off bridge wade in boat
(look upstream to determine left or right)
left bank right bank center stream

Cooler ID: _____

SAMPLE ID #	Collection Method: Wade in	Bridge drop	Other**	Matrix: Effluent	Sediment (Z)	Water	Analyte/Bottle Group: Chemistry (C)	Nutrients* (N)	Solids (S)	Bacteria (B)	BOD/COD (D)	TOX ** (T)	Algae (I)	Metals (M)	Color (R)	Other**	Sample Type: Grab: Manual Grab	Basket	Vandorn/Kemmerer	Composite: Depth Integrated	Flow Composite	Time Composite	Other**	QA/QC: Field Blank	Duplicate***	Other**	Total # of bottles

* **preservatives used** (for water matrix nutrients) (check one) 1:1 H_2SO_4 1:1 HCl
** describe in notes
*** **for duplicate samples**: use different ID#s for each sample, check 'Duplicate' column for each and leave blank lines before and after duplicate sets

INSTRUMENT DATA

Meter ID # _____
Thermometer ID # _____
Surveyor # _____
Notes: _____

Time	Temp. (°C)	DO (mg/l)	Depth (meters)	Scond (µS/cm)	pH	% Sat	Turb (ntu)	TDS (mg/l)	Redox (mV)

Cooler Temperature (post sampling at Lab): _____

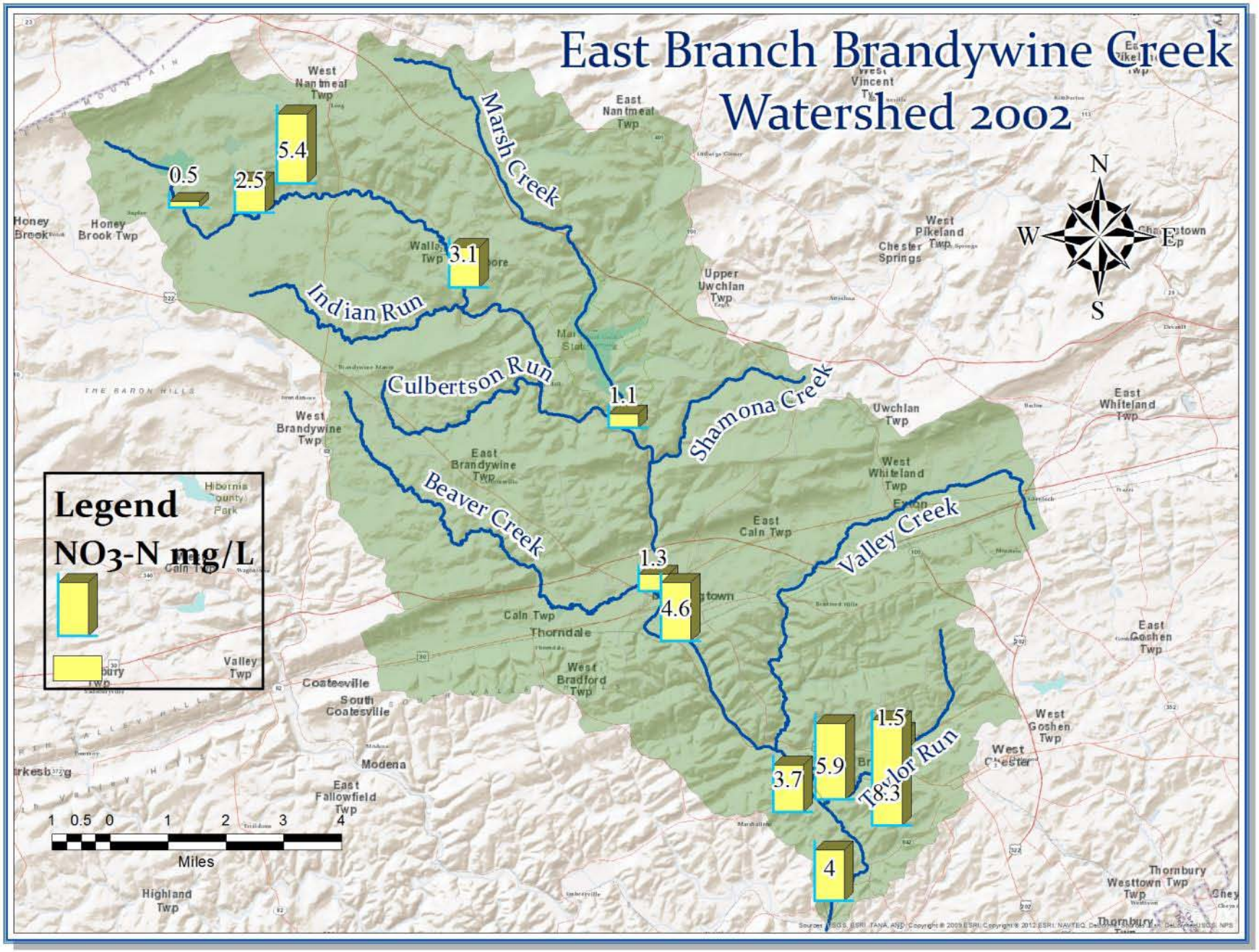
Source: http://www.mass.gov/dep/public/qappappb.pdf

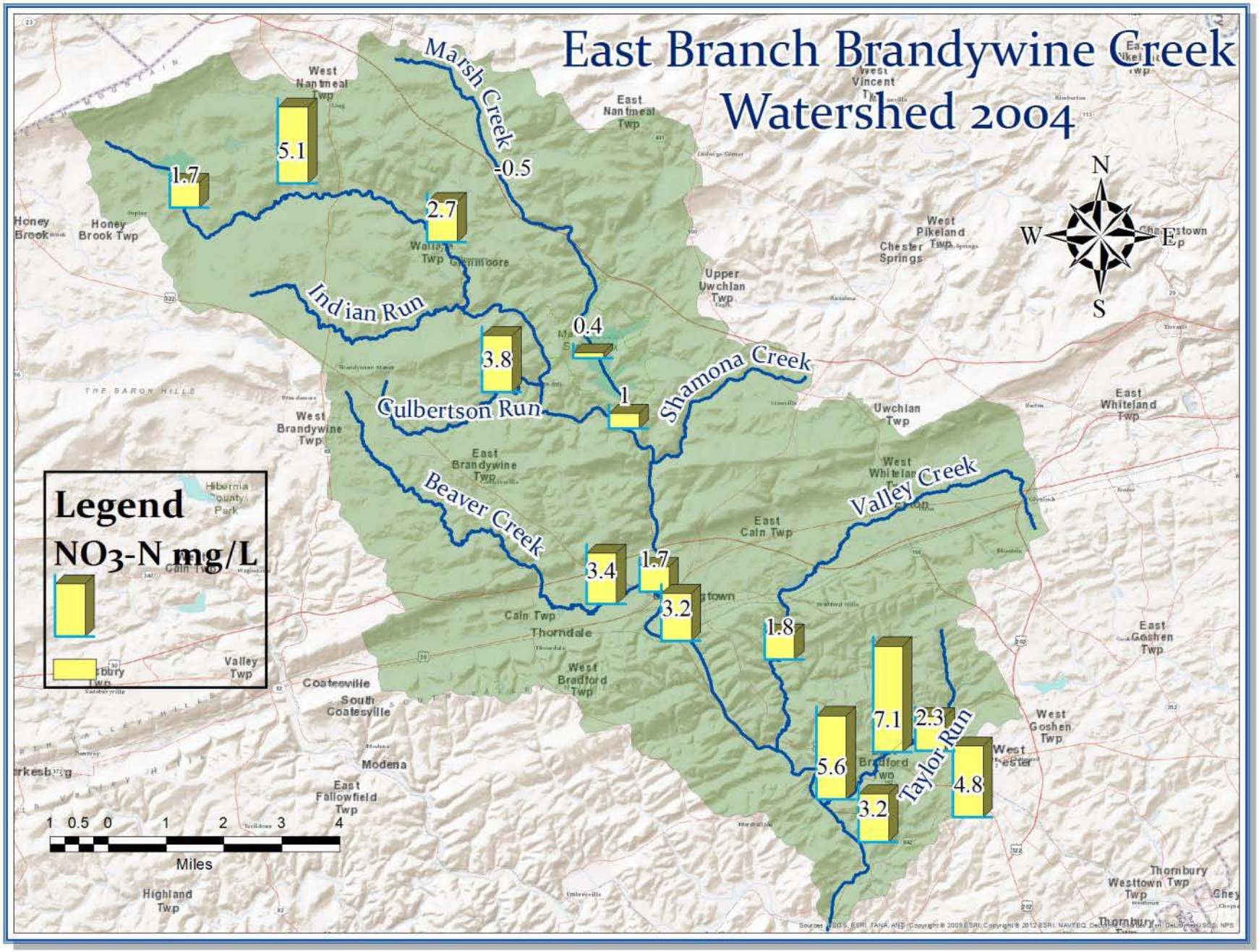
Focus of This Report:

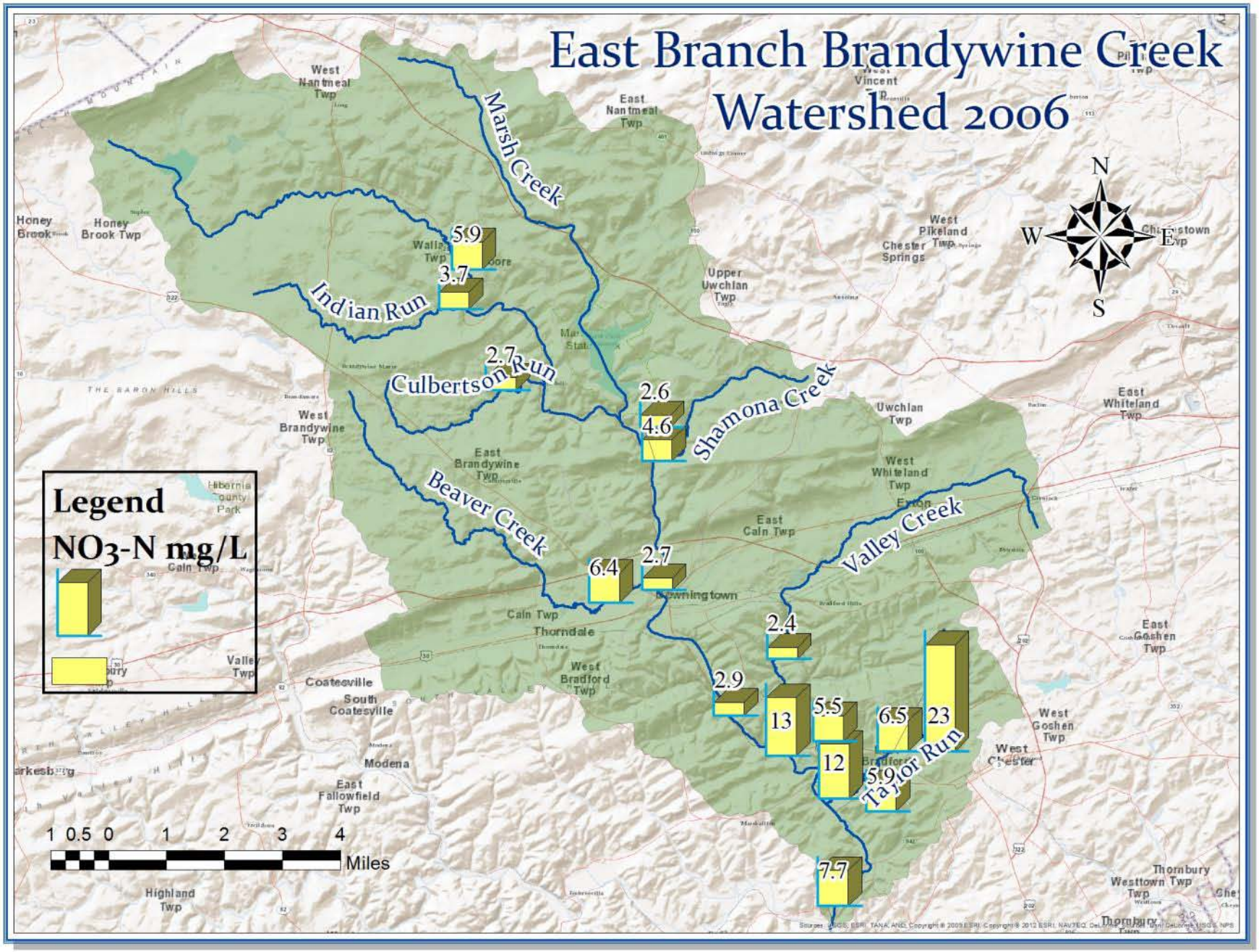
- Nutrients: NO_3-N and ortho-PO_4-P
  - Christina Basin Pollution Control Strategy (2011), http://www.dnrec.delaware.gov/swc/wa/Pages/christinabasin.aspx
    - Inorganic N, 1995-2010 medians range from 2 – 3 mg/L
    - Orthophosphate, 1995-2010 medians have declined from 0.1 to 0.04 mg/L
  - Impairment Values:
    - PADEP: 10 mg/L NO_3-N, DNREC 3.0 mg/L Total N
    - PADEP: 2 mg/L Total P; DNREC 0.2 mg/L Total P
- GIS: to demonstrate temporal and spatial variability
  - There has been much published about water quality in the Brandywine Creek
  - This report uses GIS in an overall attempt to visually examine the variability of nutrient loading to the E. Branch Brandywine over a 10-year period from 2002-2012

Results & Discussion

- Study years include 2002, 2004 and 2006 – 2012
- All samples collected between May and July in their corresponding year
- Class taught mostly in late afternoons/early evenings so samples are from late in each day
- Data entered into GIS using ArcMap 10.1, enables visualization of nutrient variability by location in watershed (spatial) and year (temporal)


East Branch Brandywine Creek Watershed 2002
Marsh Creek
Indian Run
Culbertson Run
Beaver Creek
Shamona Creek
Valley Creek
Taylor Run
0.5
2.5
5.4
3.1
1.1
1.3
4.6
3.7
5.9
1.5
8.3
4
Legend
NO3-N mg/L
N
S
E
W
1 0.5 0 1 2 3 4
Miles
West Nantmeal Twp
East Nantmeal Twp
Honey Brook
Honey Brook Twp
West Vincent Twp
West Pikeland Twp
Chester Springs
Upper Uwchlan Twp
Uwchlan Twp
East Whiteland Twp
West Whiteland Twp
West Brandywine Twp
East Brandywine Twp
East Caln Twp
Caln Twp
Thorndale
West Bradford Twp
Valley Twp
Coatesville
South Coatesville
Modena
East Fallowfield Twp
Highland Twp
West Goshen Twp
East Goshen Twp
Thornbury
Westtown Twp
Hibernia County Park
THE BARON HILLS


East Branch Brandywine Creek Watershed 2004
Marsh Creek
Indian Run
Culbertson Run
Shamona Creek
Beaver Creek
Valley Creek
Taylor Run
5.1
1.7
2.7
-0.5
0.4
3.8
1
3.4
1.7
3.2
1.8
7.1
2.3
5.6
4.8
3.2
N
S
W
E
Legend
NO3-N mg/L
1 0.5 0 1 2 3 4
Miles
West Nantmeal Twp
East Nantmeal Twp
Honey Brook
Honey Brook Twp
West Pikeland Twp
Chester Springs
Upper Uwchlan Twp
Uwchlan Twp
East Whiteland Twp
West Brandywine Twp
East Brandywine Twp
East Caln Twp
Caln Twp
Thorndale
West Bradford Twp
Valley Twp
Coatesville
South Coatesville
Modena
East Fallowfield Twp
Highland Twp
West Goshen Twp
East Goshen Twp
Thornbury Westtown Twp
Hibernia County Park
THE BARON HILLS


East Branch Brandywine Creek Watershed 2006
Marsh Creek
Indian Run
Culbertson Run
Shamona Creek
Beaver Creek
Valley Creek
Taylor Run
5.9
3.7
2.7
2.6
4.6
6.4
2.7
2.4
2.9
13
5.5
12
6.5
23
5.9
7.7
Legend
NO3-N mg/L
1 0.5 0 1 2 3 4
Miles
N
S
E
W
West Nantmeal Twp
East Nantmeal Twp
Honey Brook
Honey Brook Twp
West Pikeland Twp
Chester Springs
Upper Uwchlan Twp
Uwchlan Twp
East Whiteland Twp
West Whiteland Twp
Exton
West Brandywine Twp
East Brandywine Twp
East Caln Twp
Caln Twp
Thorndale
Downingtown
West Bradford Twp
Coatesville
South Coatesville
Modena
East Fallowfield Twp
Highland Twp
Valley Twp
West Goshen Twp
East Goshen Twp
West Chester
Thornbury
Westtown Twp
Hibernia County Park
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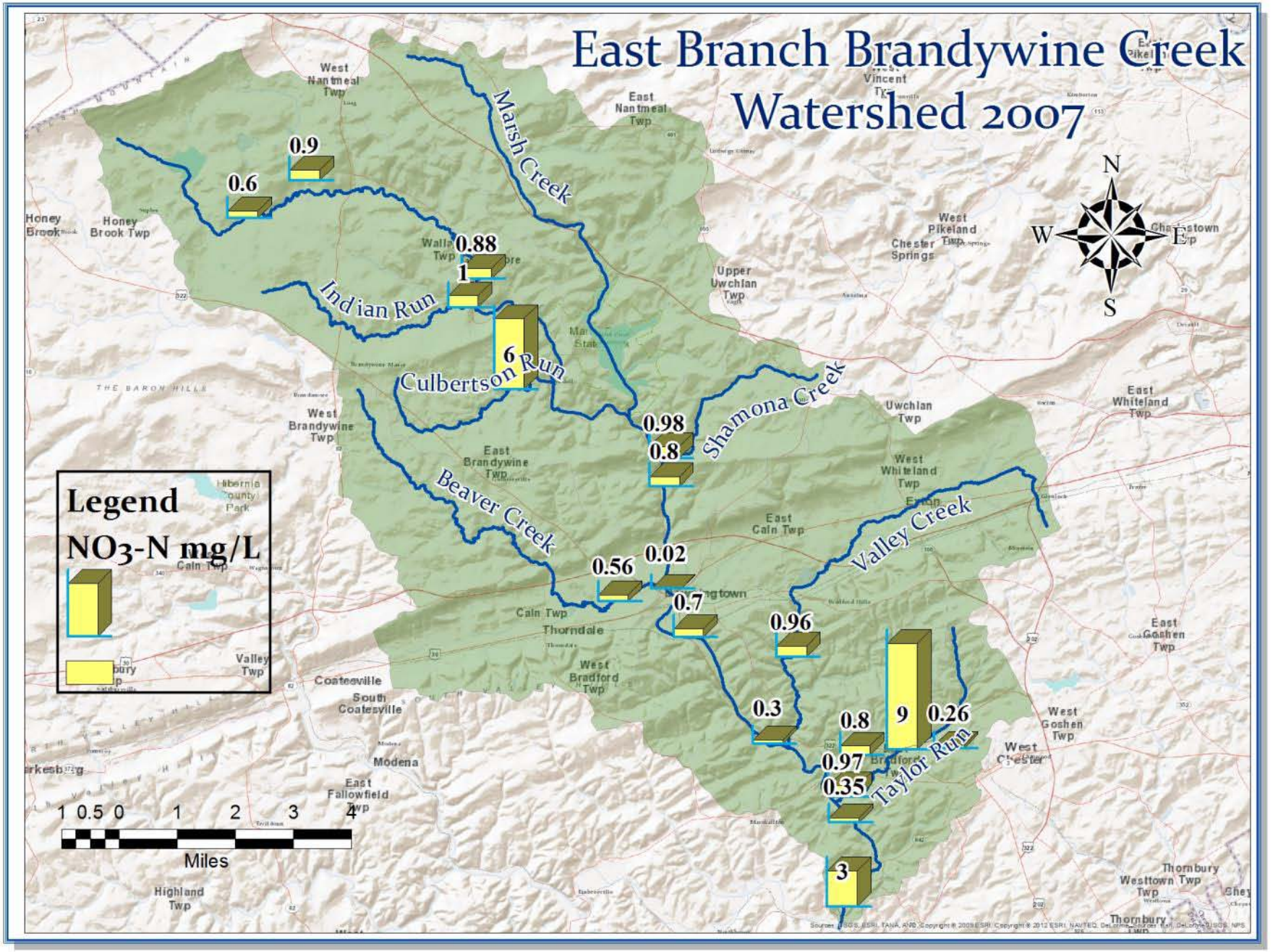
East Branch Brandywine Creek
Watershed 2007
Marsh Creek
Indian Run
Culbertson Run
Shamona Creek
Beaver Creek
Valley Creek
Taylor Run
0.9
0.6
0.88
1
6
0.98
0.8
0.56
0.02
0.7
0.96
0.3
0.8
9
0.26
0.97
0.35
3
Legend
NO3-N mg/L
1 0.5 0 1 2 3 4
Miles
N
W
E
S
West Nantmeal Twp
East Nantmeal Twp
Honey Brook
Honey Brook Twp
West Pikeland Twp
Chester Springs
Upper Uwchlan Twp
Uwchlan Twp
East Whiteland Twp
West Whiteland Twp
West Brandywine Twp
East Brandywine Twp
East Caln Twp
Caln Twp
Thorndale
West Bradford Twp
Coatesville
South Coatesville
Valley Twp
Modena
East Fallowfield Twp
Highland Twp
East Goshen Twp
West Goshen Twp
West Chester
Thornbury
Westtown Twp
Hibernia County Park
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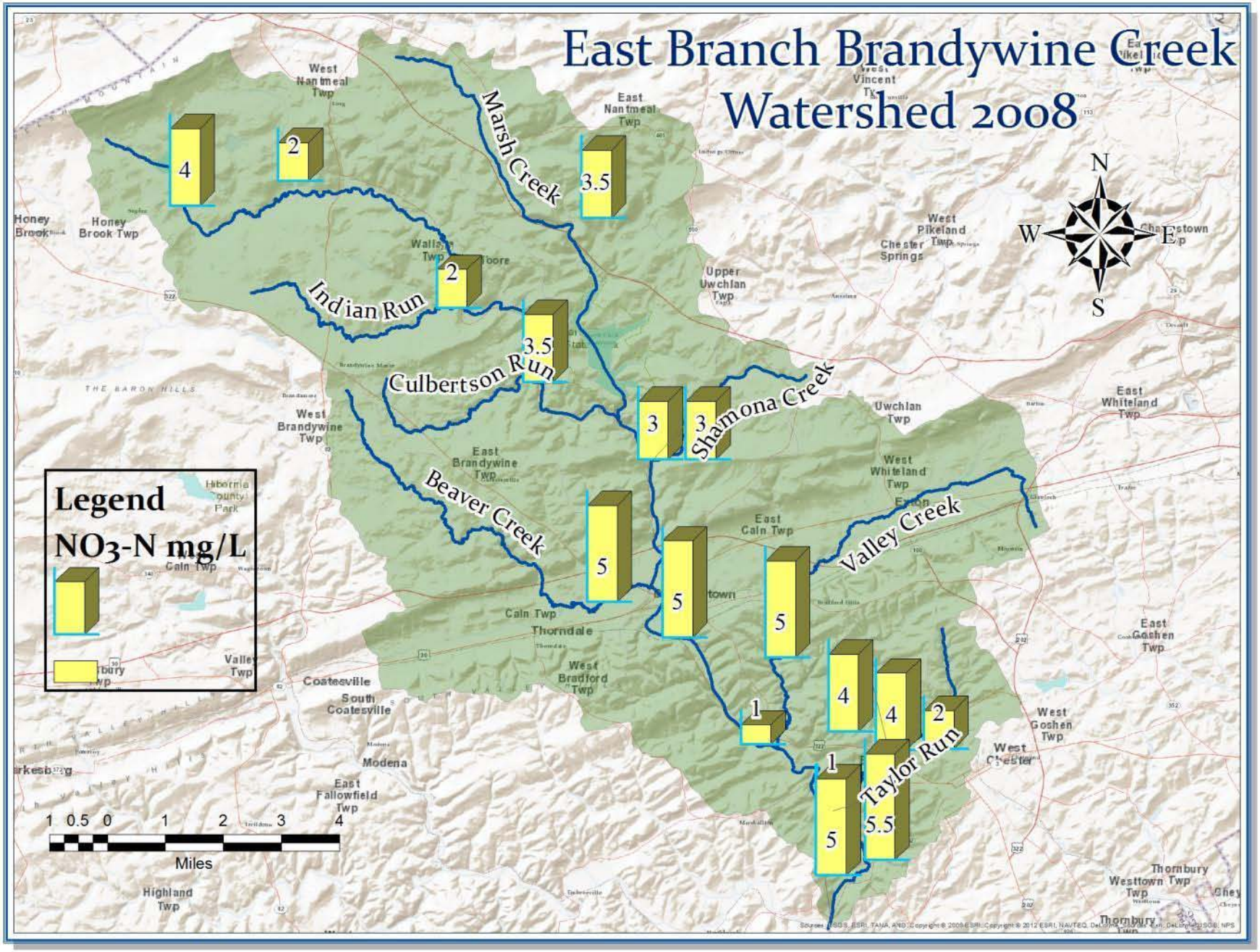
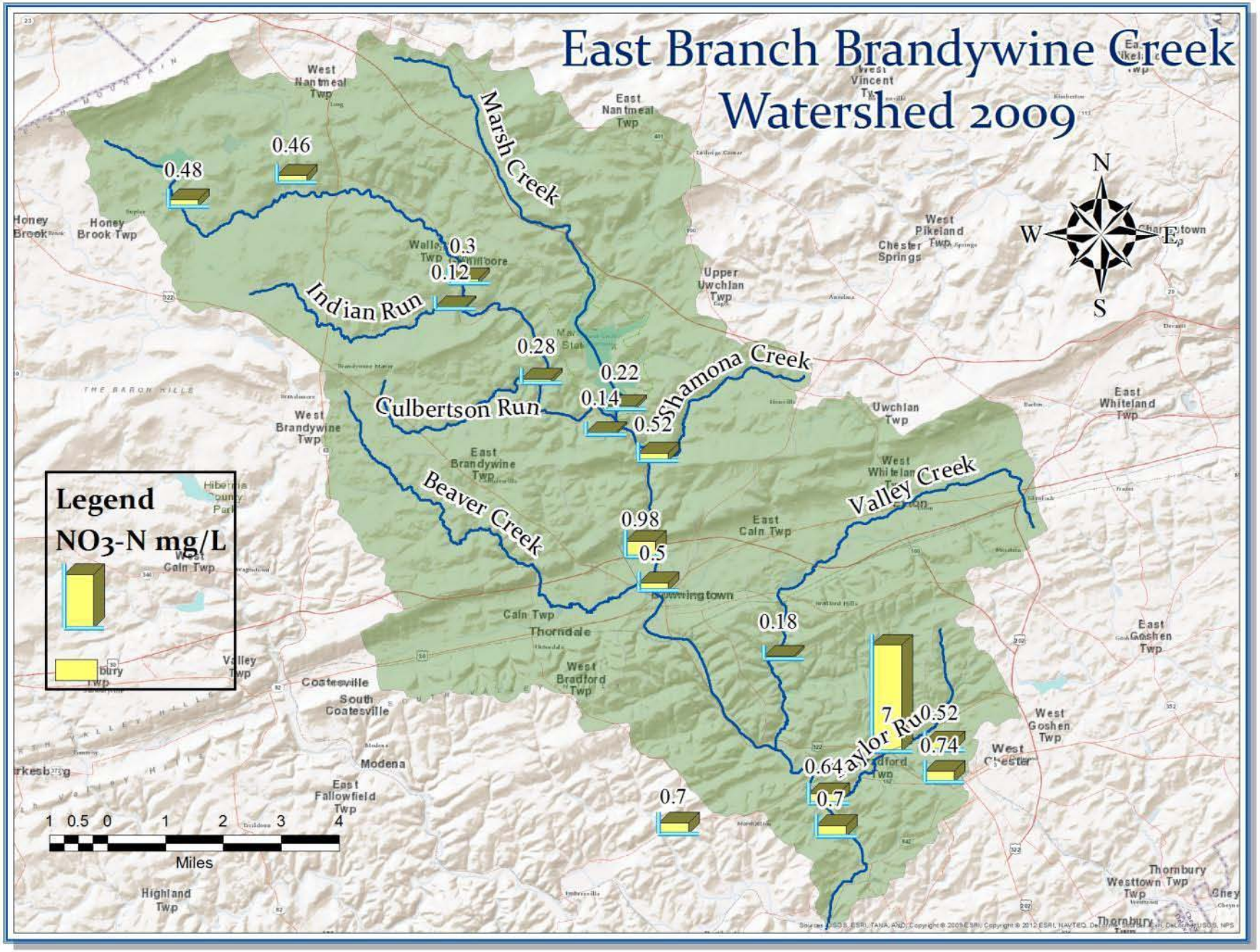

East Branch Brandywine Creek Watershed 2008
Marsh Creek
Indian Run
Culbertson Run
Shamona Creek
Beaver Creek
Valley Creek
Taylor Run
4
2
3.5
2
3.5
3
3
5
5
5
1
4
4
2
1
5
5.5
N
W
E
S
Legend
NO3-N mg/L
1 0.5 0 1 2 3 4
Miles
West Nantmeal Twp
East Nantmeal Twp
Honey Brook
Honey Brook Twp
West Pikeland Twp
Chester Springs
Upper Uwchlan Twp
West Brandywine Twp
East Brandywine Twp
Uwchlan Twp
West Whiteland Twp
East Whiteland Twp
East Caln Twp
Caln Twp
Thorndale
West Bradford Twp
Coatesville
South Coatesville
Modena
East Fallowfield Twp
Highland Twp
West Goshen Twp
East Goshen Twp
Thornbury Westtown Twp
Valley Twp


East Branch Brandywine Creek Watershed 2009
Marsh Creek
Indian Run
Culbertson Run
Beaver Creek
Shamona Creek
Valley Creek
Taylor Run
0.48
0.46
0.3
0.12
0.28
0.22
0.14
0.52
0.98
0.5
0.18
7
0.52
0.74
0.64
0.7
0.7
Legend
NO3-N mg/L
N
S
E
W
1 0.5 0
1
2
3
4
Miles
West Nantmeal Twp
East Nantmeal Twp
Honey Brook
Honey Brook Twp
West Vincent Twp
West Pikeland Twp
Chester Springs
Upper Uwchlan Twp
Uwchlan Twp
East Whiteland Twp
West Brandywine Twp
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West Whiteland Twp
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Downingtown
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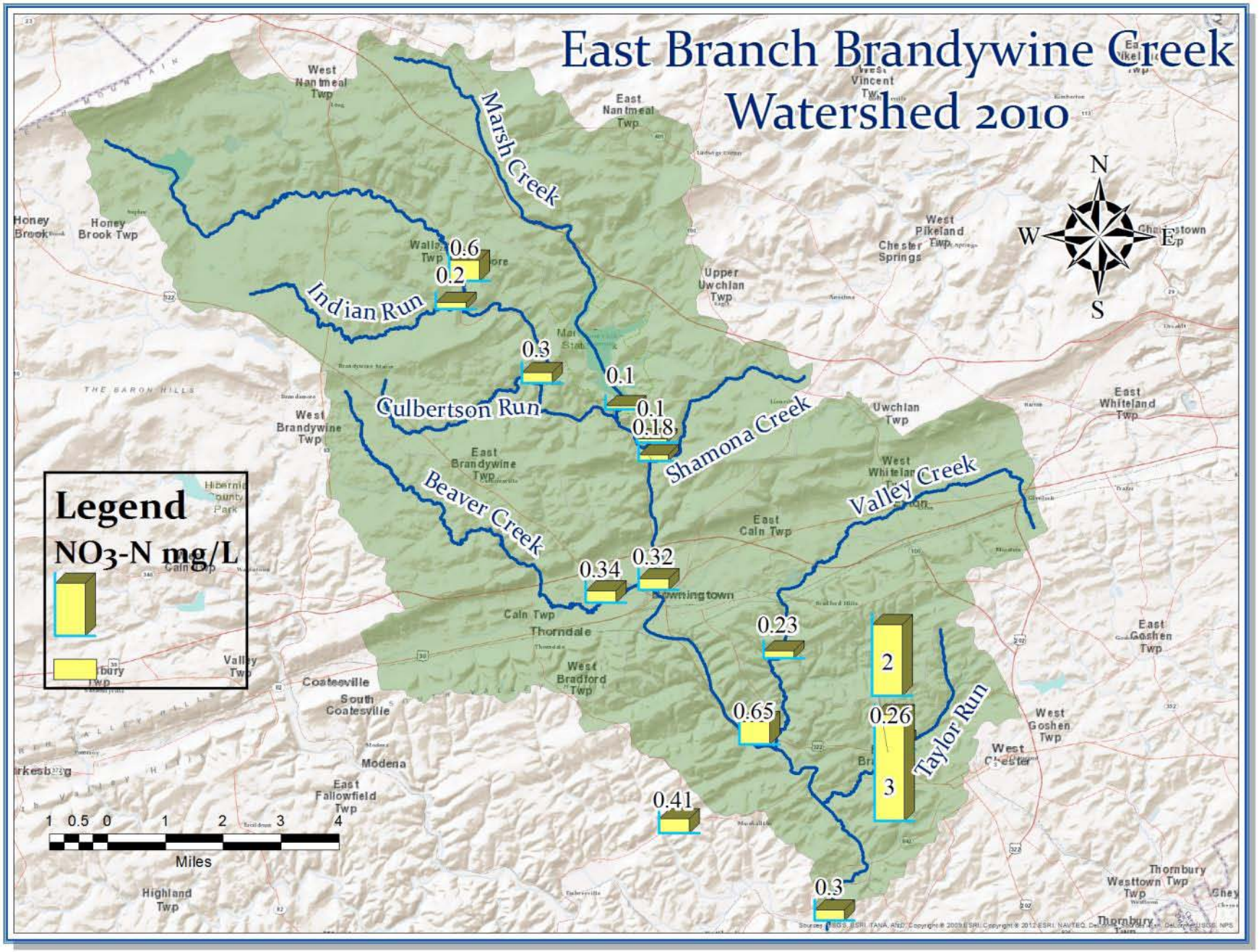
West Chester
Thornbury
Westtown Twp


East Branch Brandywine Creek Watershed 2010
Marsh Creek
Indian Run
Culbertson Run
Beaver Creek
Shamona Creek
Valley Creek
Taylor Run
0.6
0.2
0.3
0.1
0.1
0.18
0.34
0.32
0.23
2
0.65
0.26
3
0.41
0.3
Legend
NO3-N mg/L
1 0.5 0 1 2 3 4
Miles
N
W
E
S
West Nantmeal Twp
East Nantmeal Twp
Honey Brook
Honey Brook Twp
West Vincent Twp
West Pikeland Twp
Chester Springs
Upper Uwchlan Twp
Uwchlan Twp
East Whiteland Twp
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East Brandywine Twp
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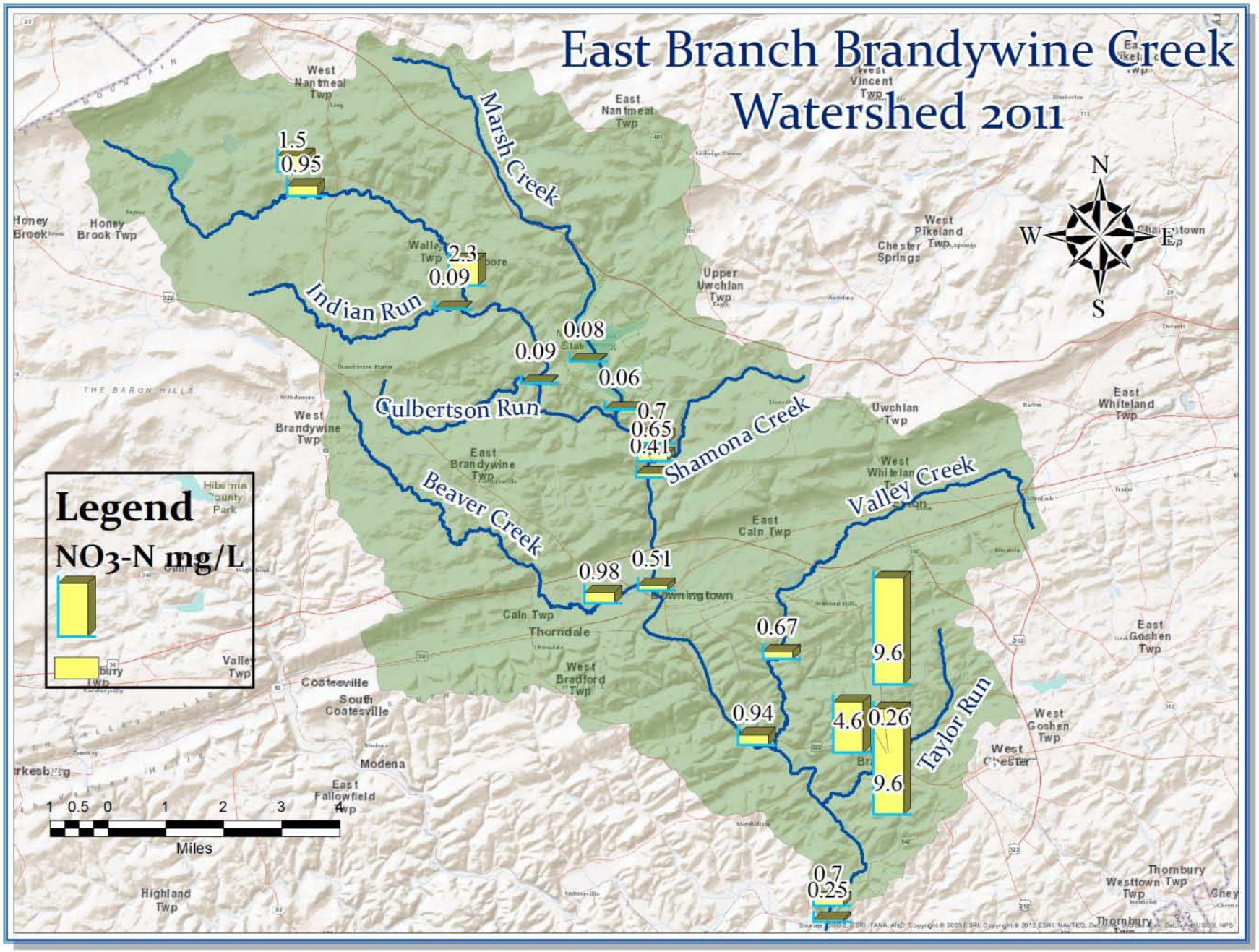
East Goshen Twp
West Chester
Thornbury
Westtown Twp
Valley Twp


East Branch Brandywine Creek Watershed 2011
Marsh Creek
Indian Run
Culbertson Run
Beaver Creek
Shamona Creek
Valley Creek
Taylor Run
1.5
0.95
2.3
0.09
0.08
0.09
0.06
0.7
0.65
0.41
0.98
0.51
0.67
9.6
0.94
4.6
0.26
9.6
0.7
0.25
N
S
E
W
Legend
NO3-N mg/L
1 0.5 0 1 2 3 4
Miles
West Nantmeal Twp
East Nantmeal Twp
Honey Brook
Honey Brook Twp
West Vincent Twp
West Pikeland Twp
Chester Springs
Upper Uwchlan Twp
Uwchlan Twp
East Whiteland Twp
West Brandywine Twp
East Brandywine Twp
West Whiteland Twp
East Caln Twp
Caln Twp
Thorndale
West Bradford Twp
Coatesville
South Coatesville
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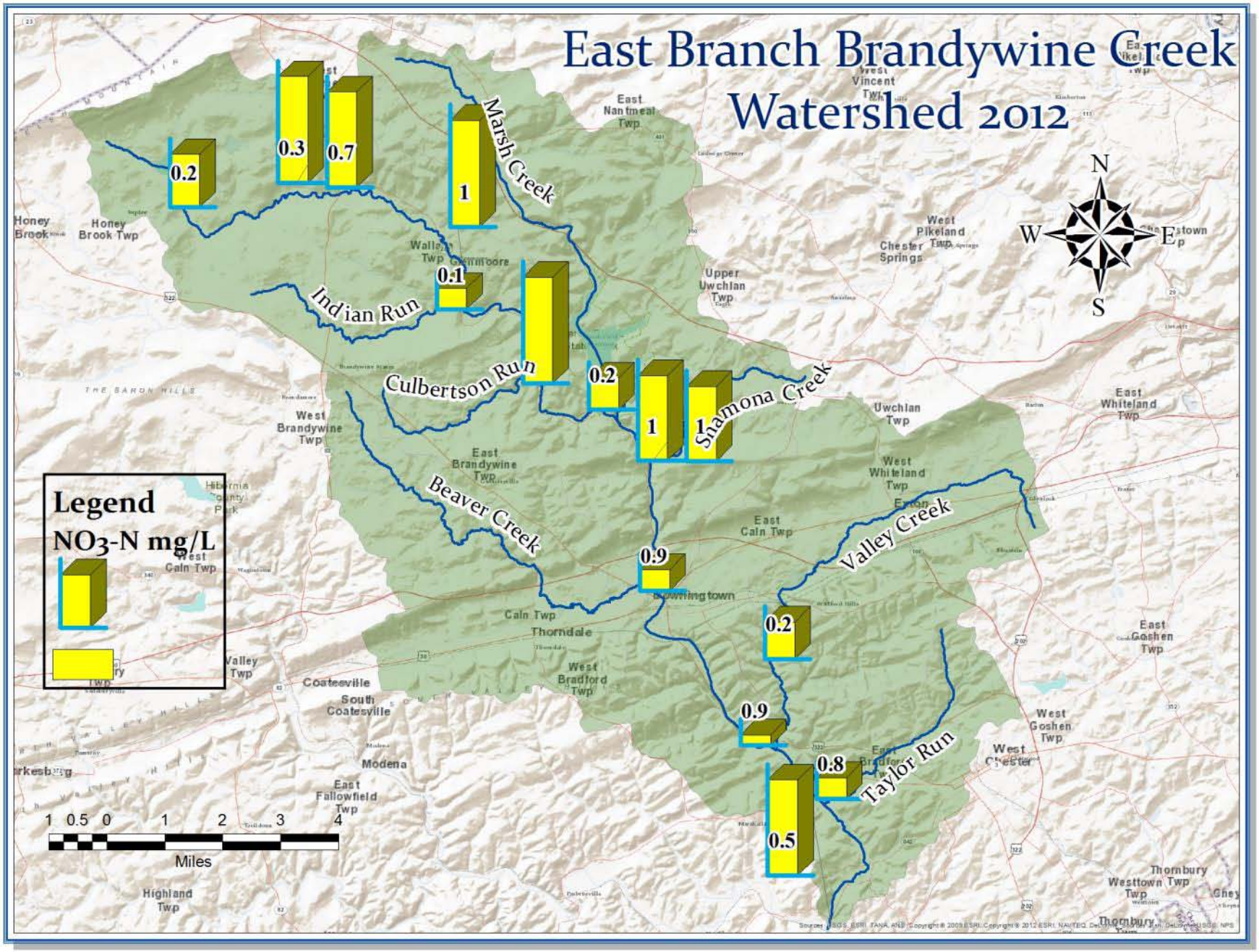
East Branch Brandywine Creek Watershed 2012
Legend
NO3-N mg/L
0.2
0.3
0.7
1
0.1
0.2
1
1
0.9
0.2
0.9
0.8
0.5
Marsh Creek
Indian Run
Culbertson Run
Beaver Creek
Shamona Creek
Valley Creek
Taylor Run
N
W
E
S
1 0.5 0 1 2 3 4
Miles
Honey Brook
Honey Brook Twp
East Nantmeal Twp
West Vincent Twp
West Pikeland Twp
Chester Springs
Upper Uwchlan Twp
Uwchlan Twp
East Whiteland Twp
West Whiteland Twp
West Brandywine Twp
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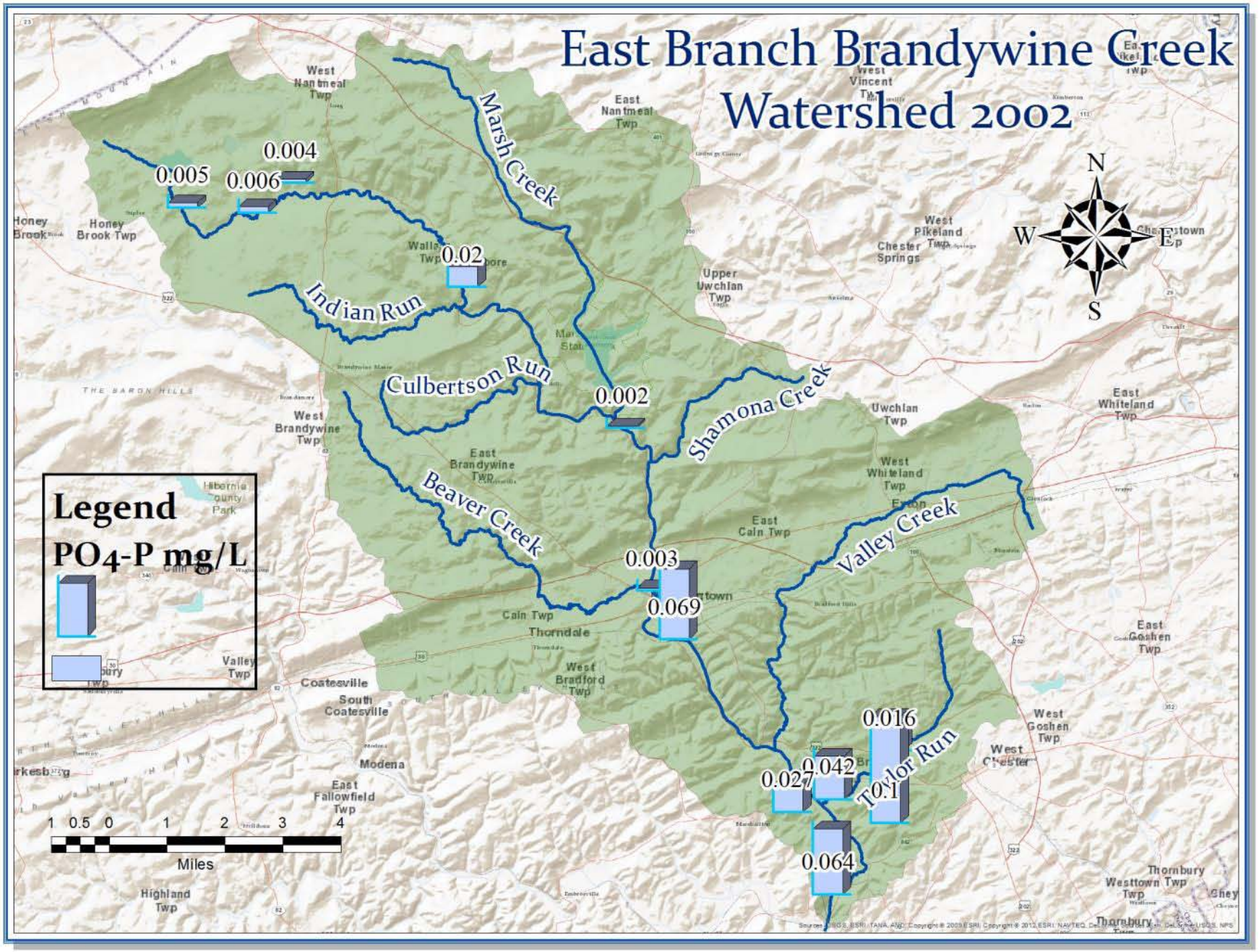
East Branch Brandywine Creek Watershed 2002
Marsh Creek
Indian Run
Culbertson Run
Beaver Creek
Shamona Creek
Valley Creek
Taylor Run
0.005
0.006
0.004
0.02
0.002
0.003
0.069
0.027
0.042
0.016
0.1
0.064
Legend
PO4-P mg/L
N
W
E
S
1 0.5 0 1 2 3 4
Miles
West Nantmeal Twp
East Nantmeal Twp
Honey Brook
Honey Brook Twp
West Vincent Twp
West Pikeland Twp
Chester Springs
Upper Uwchlan Twp
Uwchlan Twp
East Whiteland Twp
West Whiteland Twp
West Brandywine Twp
East Brandywine Twp
East Caln Twp
Caln Twp
Thorndale
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Coatesville
South Coatesville
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West Goshen Twp
East Goshen Twp
West Chester
Thornbury Westtown Twp
Hibernia County Park
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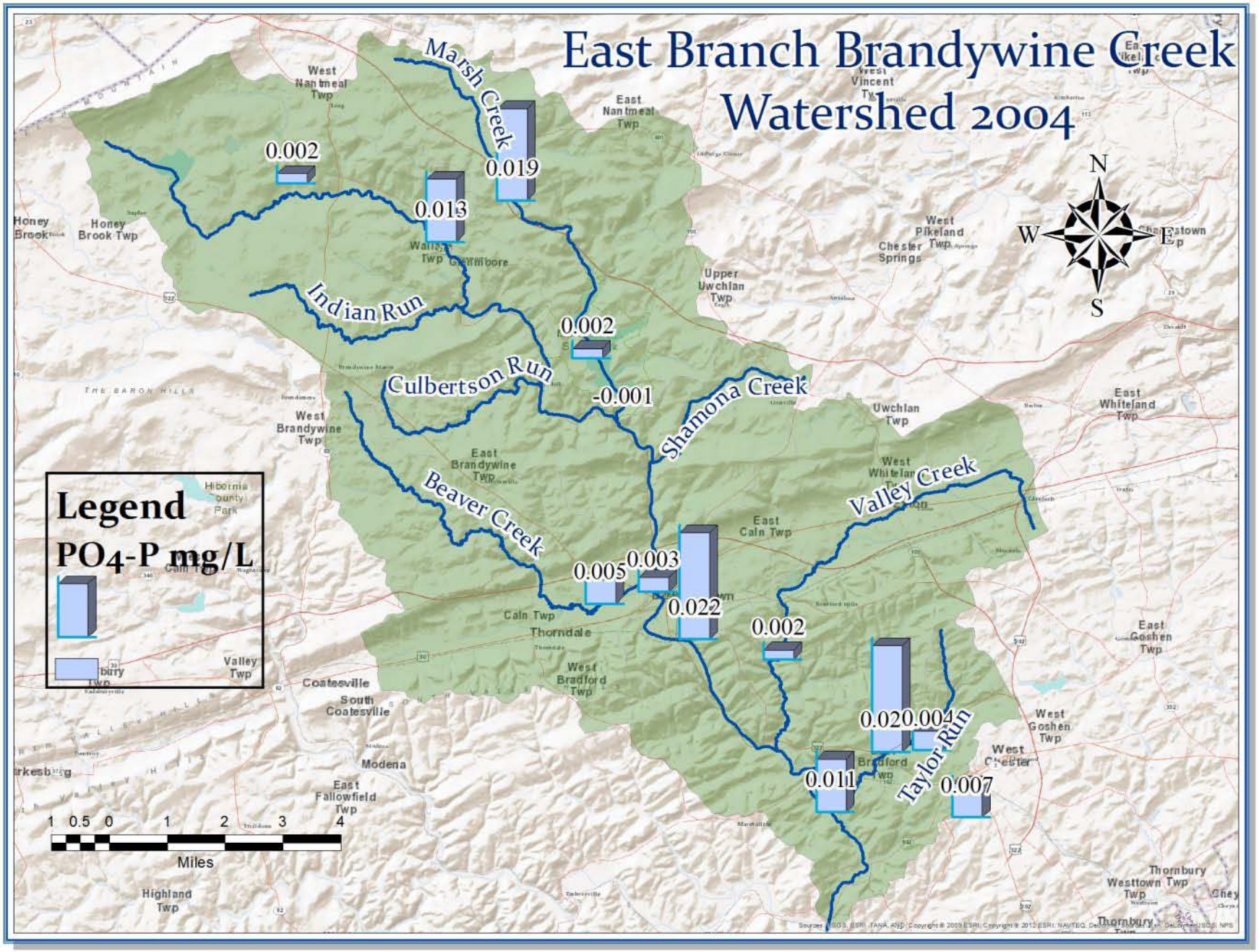
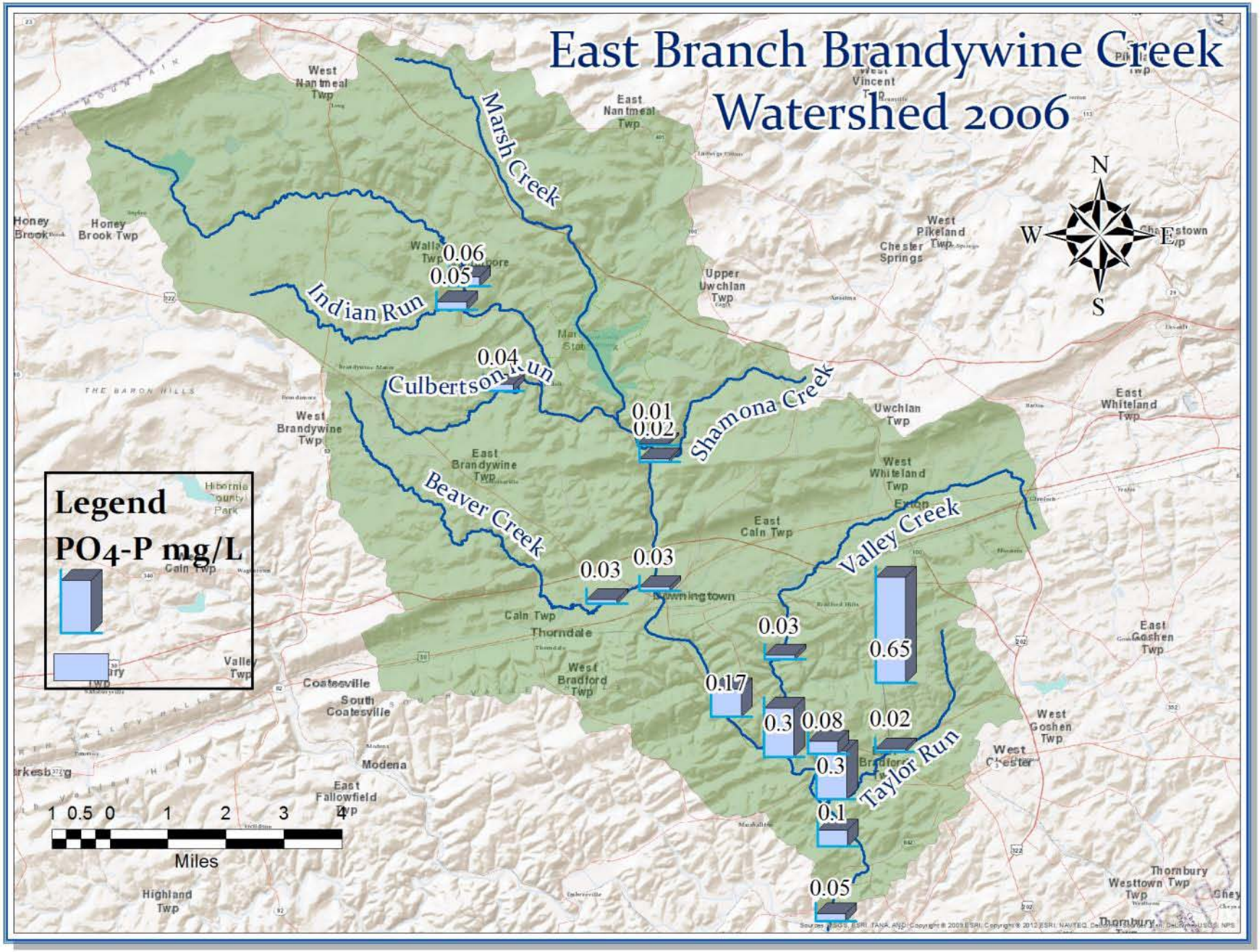
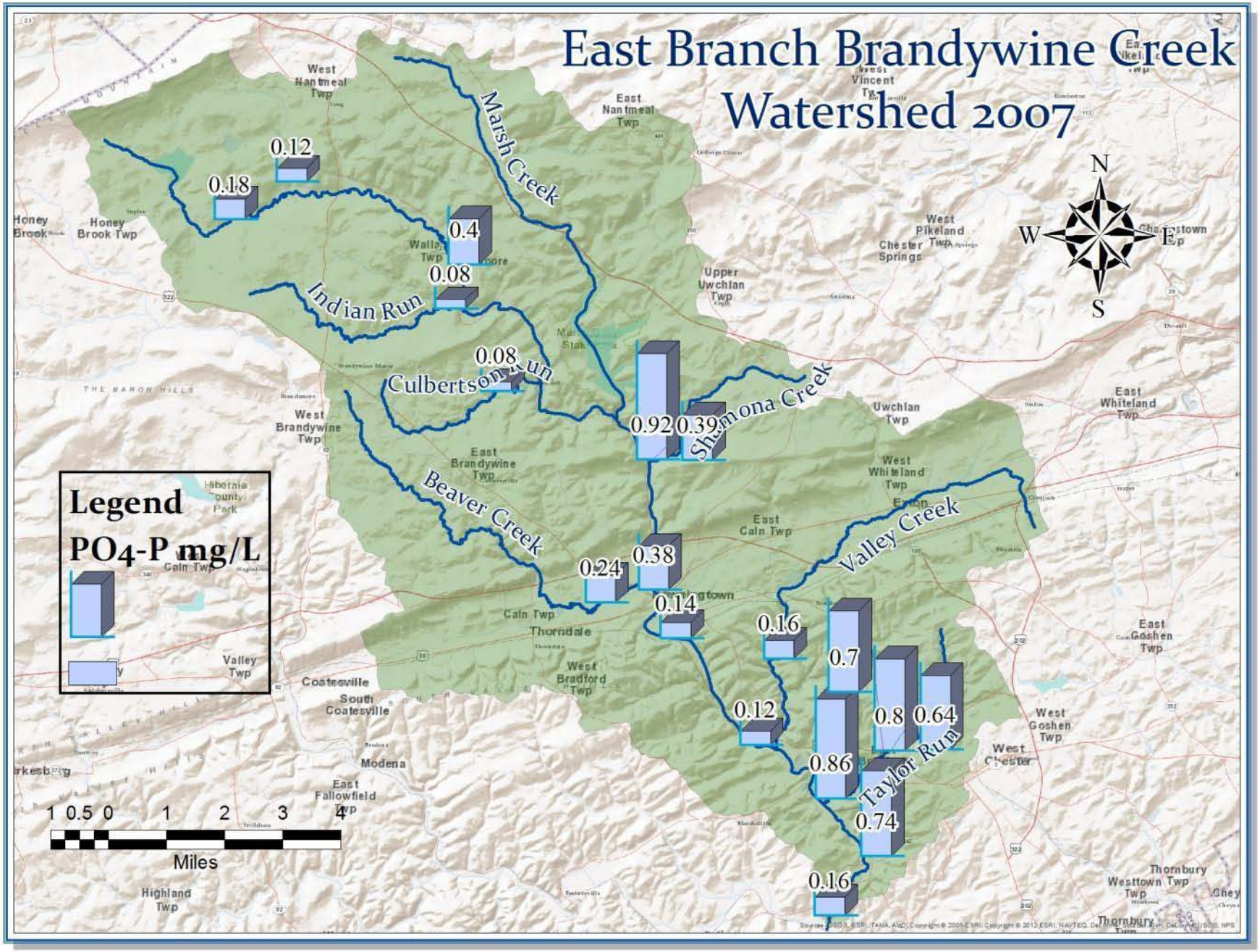
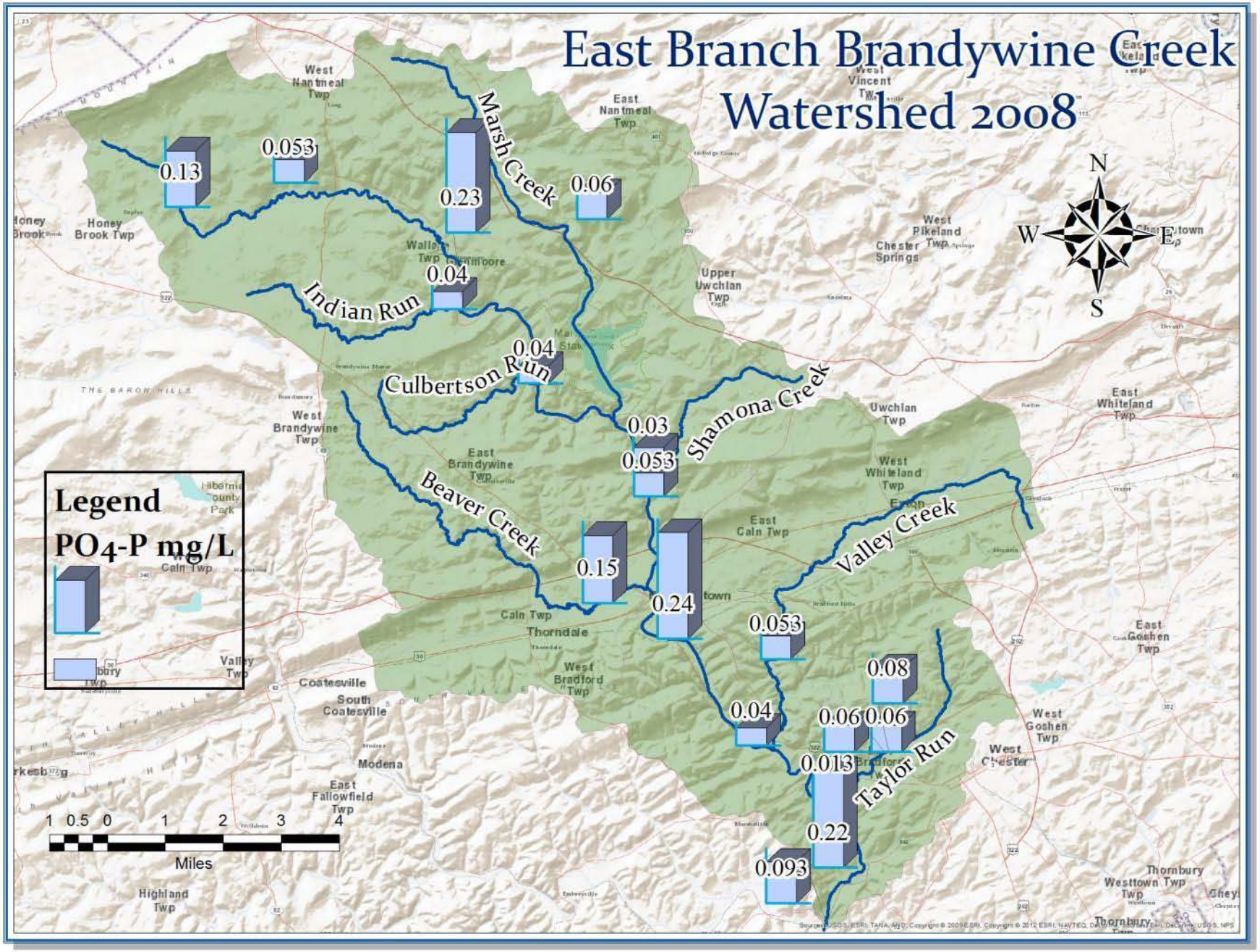
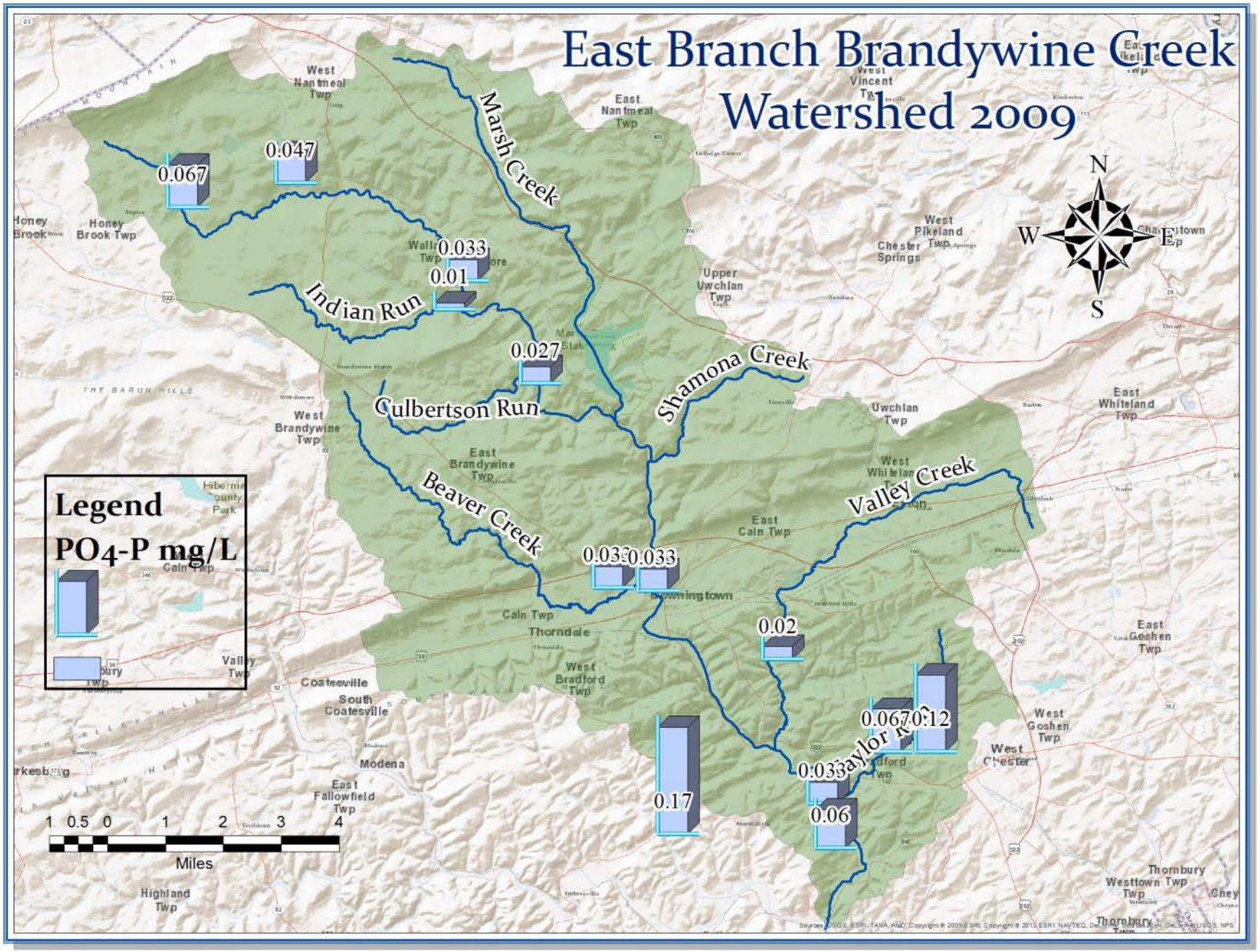
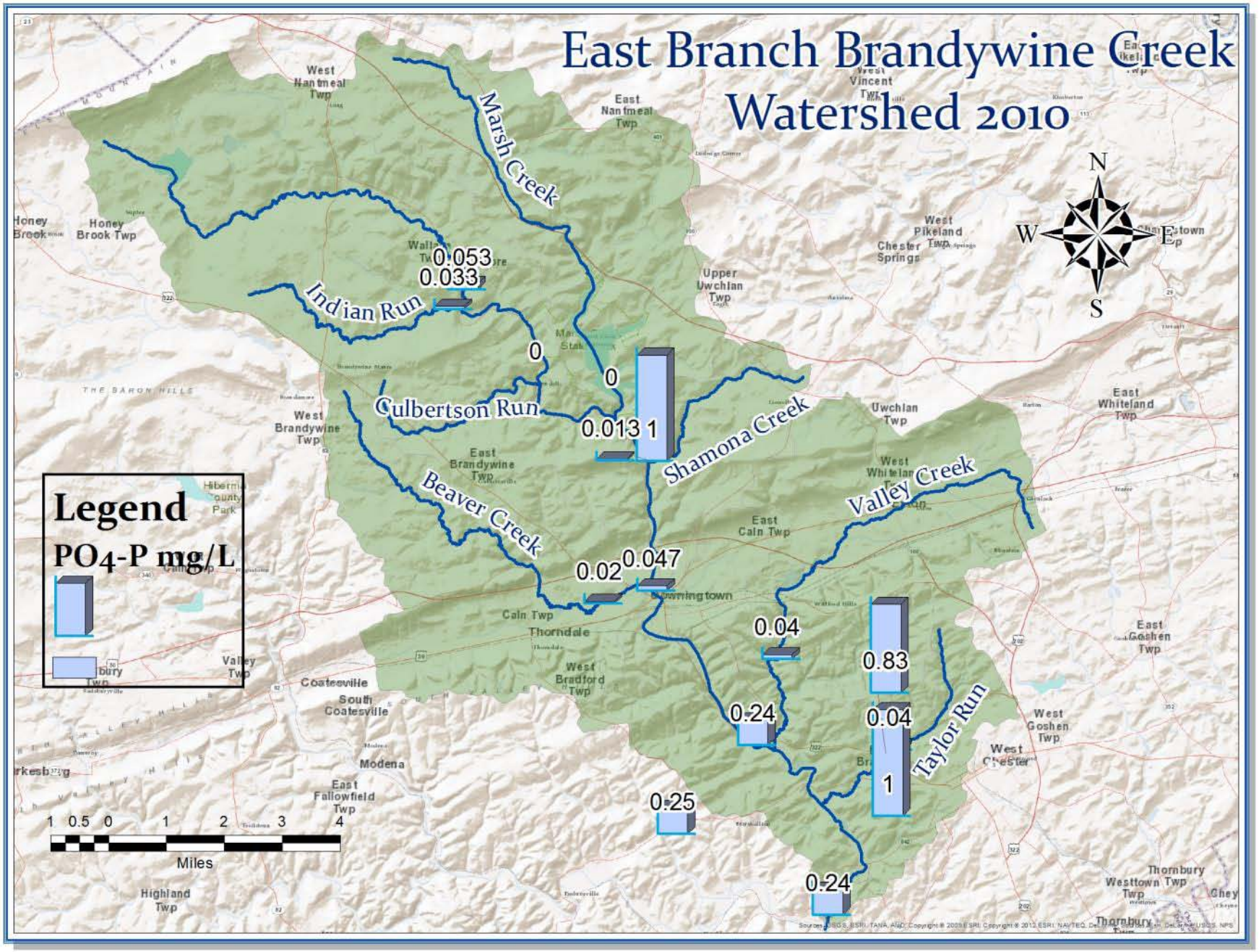

East Branch Brandywine Creek Watershed 2004
Marsh Creek
Indian Run
Culbertson Run
Shamona Creek
Beaver Creek
Valley Creek
Taylor Run
0.002
0.019
0.013
0.002
-0.001
0.005
0.003
0.022
0.002
0.020
0.004
0.011
0.007
N
W
E
S
Legend
PO4-P mg/L
1 0.5 0 1 2 3 4
Miles
West Nantmeal Twp
East Nantmeal Twp
Honey Brook Twp
West Vincent Twp
West Pikeland Twp
Chester Springs
Upper Uwchlan Twp
Uwchlan Twp
East Whiteland Twp
West Brandywine Twp
East Brandywine Twp
West Whiteland Twp
East Caln Twp
Caln Twp
Thorndale
West Bradford Twp
Valley Twp
Coatesville
South Coatesville
Modena
East Fallowfield Twp
Highland Twp
East Goshen Twp
West Goshen Twp
West Chester
Bradford Twp
Thornbury Westtown Twp
Thornbury
Hibernia County Park

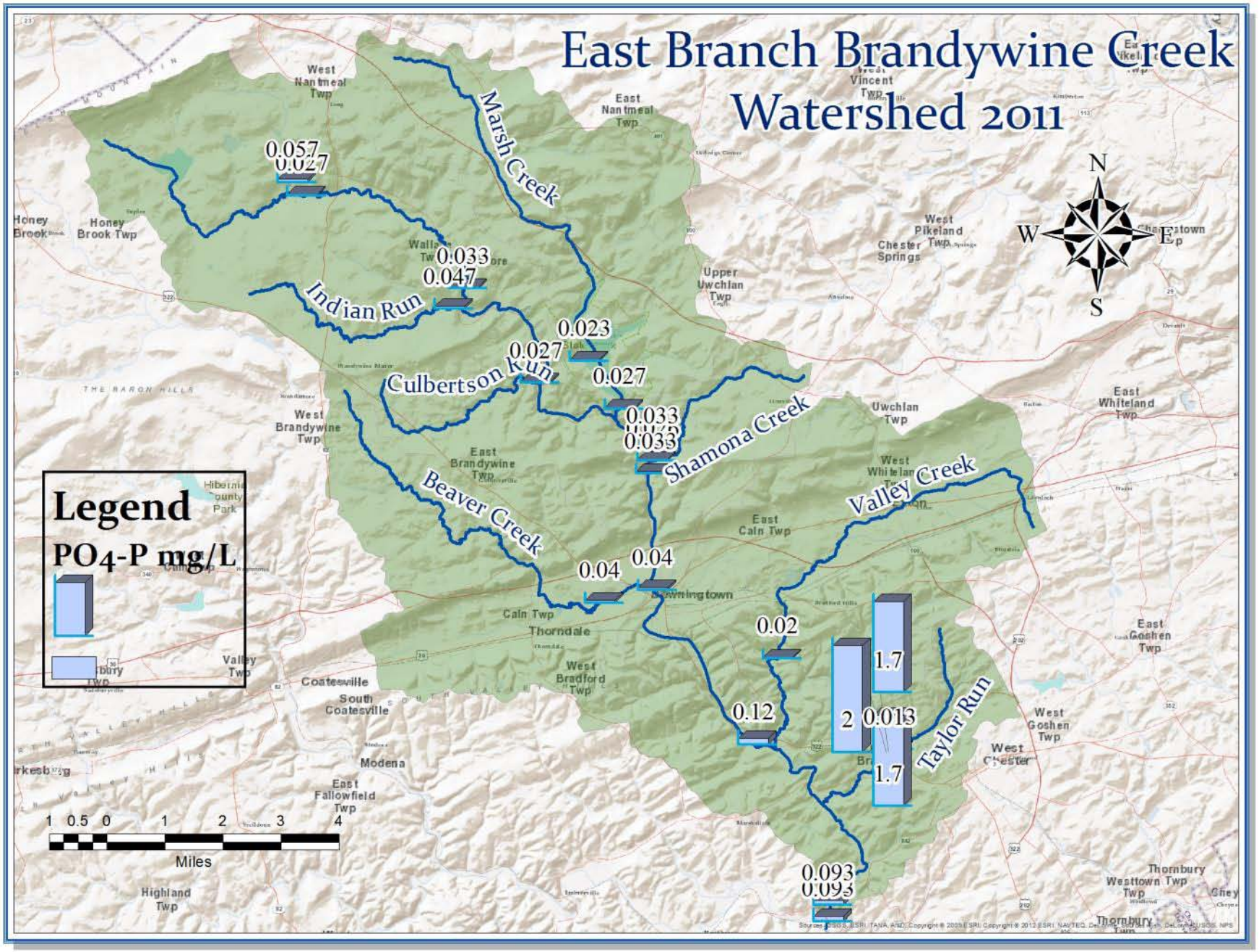

East Branch Brandywine Creek Watershed 2006
Marsh Creek
Indian Run
Culbertson Run
Shamona Creek
Beaver Creek
Valley Creek
Taylor Run
0.06
0.05
0.04
0.01
0.02
0.03
0.03
0.03
0.65
0.17
0.3
0.08
0.02
0.3
0.1
0.05
Legend
PO4-P mg/L
N
W
E
S
1 0.5 0 1 2 3 4
Miles
West Nantmeal Twp
East Nantmeal Twp
Honey Brook
Honey Brook Twp
West Vincent Twp
West Pikeland Twp
Chester Springs
Upper Uwchlan Twp
Uwchlan Twp
East Whiteland Twp
West Whiteland Twp
West Brandywine Twp
East Brandywine Twp
East Caln Twp
Caln Twp
Thorndale
Downingtown
West Bradford Twp
Coatesville
South Coatesville
Modena
East Fallowfield Twp
Highland Twp
Valley Twp
West Goshen Twp
East Goshen Twp
West Chester
Thornbury
Westtown Twp
Hibernia County Park
THE BARON HILLS

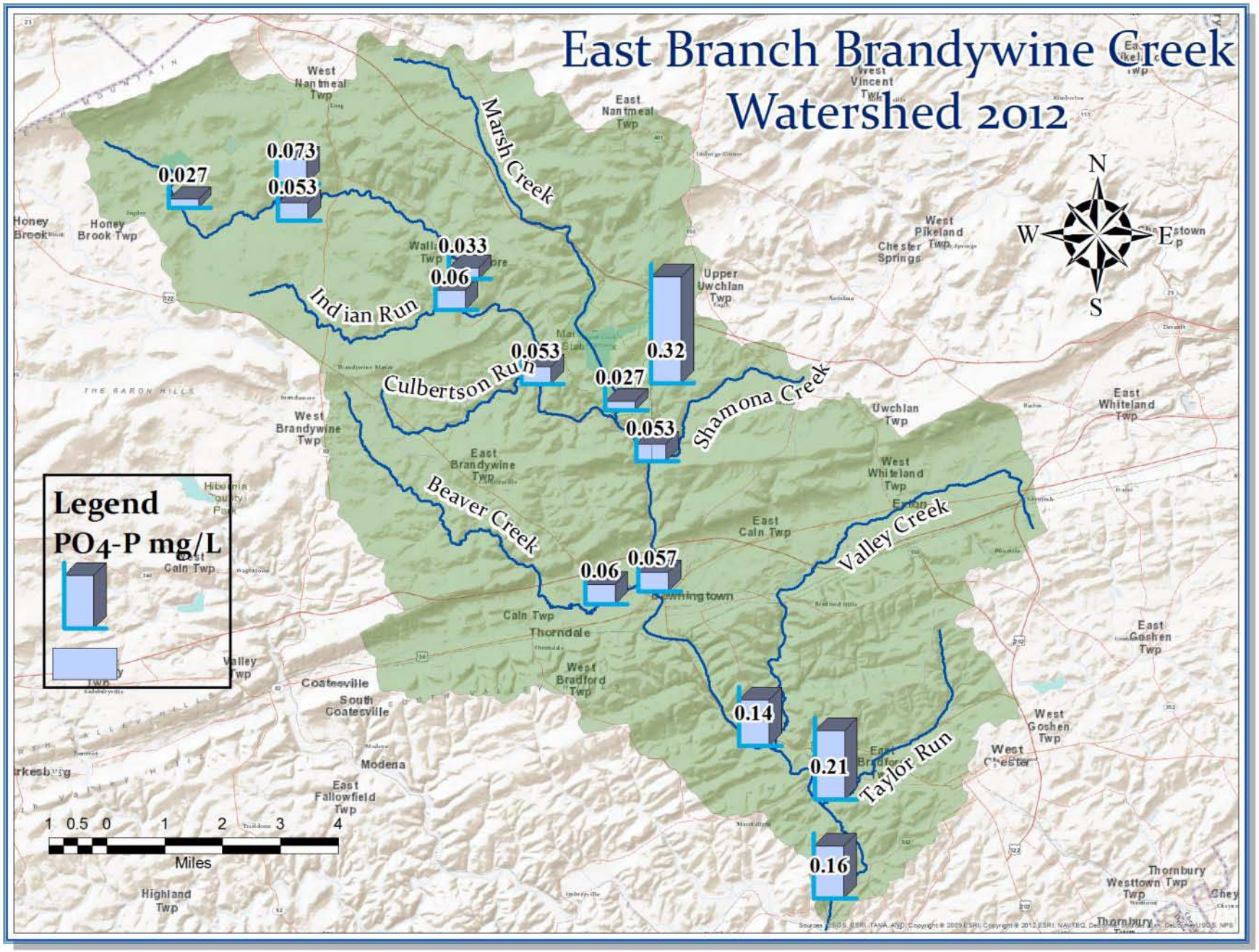

East Branch Brandywine Creek Watershed 2007
Legend
PO4-P mg/L
Marsh Creek
Indian Run
Culbertson Run
Shamona Creek
Beaver Creek
Valley Creek
Taylor Run
0.12
0.18
0.4
0.08
0.08
0.92
0.39
0.24
0.38
0.14
0.16
0.7
0.12
0.8
0.64
0.86
0.74
0.16
N
W
E
S
1 0.5 0 1 2 3 4
Miles
West Nantmeal Twp
East Nantmeal Twp
Honey Brook
Honey Brook Twp
West Vincent Twp
West Pikeland Twp
Chester Springs
Upper Uwchlan Twp
Uwchlan Twp
East Whiteland Twp
West Whiteland Twp
East Brandywine Twp
West Brandywine Twp
East Caln Twp
Caln Twp
Thorndale
West Bradford Twp
Coatesville
South Coatesville
Modena
East Fallowfield Twp
Highland Twp
Valley Twp
West Goshen Twp
East Goshen Twp
West Chester
Thornbury
Westtown Twp
Hibernia County Park
THE BARON HILLS


East Branch Brandywine Creek Watershed 2008
Marsh Creek
Indian Run
Culbertson Run
Shamona Creek
Beaver Creek
Valley Creek
Taylor Run
0.13
0.053
0.23
0.06
0.04
0.04
0.03
0.053
0.15
0.24
0.053
0.08
0.04
0.06
0.06
0.013
0.22
0.093
Legend
PO4-P mg/L
1 0.5 0 1 2 3 4
Miles
N
S
E
W
West Nantmeal Twp
East Nantmeal Twp
West Vincent Twp
Honey Brook Twp
West Pikeland Twp
Chester Springs
Upper Uwchlan Twp
Uwchlan Twp
East Whiteland Twp
West Whiteland Twp
West Brandywine Twp
East Brandywine Twp
East Caln Twp
Caln Twp
Thorndale
West Bradford Twp
Valley Twp
Coatesville
South Coatesville
Modena
East Fallowfield Twp
Highland Twp
West Goshen Twp
West Chester
East Goshen Twp
Thornbury
Westtown Twp


East Branch Brandywine Creek Watershed 2009
Marsh Creek
Indian Run
Culbertson Run
Shamona Creek
Beaver Creek
Valley Creek
Taylor Run
0.067
0.047
0.033
0.01
0.027
0.033
0.033
0.02
0.067
0.12
0.033
0.17
0.06
Legend
PO4-P mg/L
1 0.5 0 1 2 3 4
Miles
N
W
E
S
West Nantmeal Twp
East Nantmeal Twp
Honey Brook
Honey Brook Twp
West Vincent Twp
West Pikeland Twp
Chester Springs
Upper Uwchlan Twp
Uwchlan Twp
East Whiteland Twp
West Brandywine Twp
East Brandywine Twp
West Whiteland Twp
East Caln Twp
Caln Twp
Thorndale
West Bradford Twp
Coatesville
South Coatesville
Modena
East Fallowfield Twp
Valley Twp
West Goshen Twp
West Chester
East Goshen Twp
Thornbury Westtown Twp
Highland Twp
THE BARON HILLS


East Branch Brandywine Creek Watershed 2010
Marsh Creek
Indian Run
Culbertson Run
Beaver Creek
Shamona Creek
Valley Creek
Taylor Run
0.053
0.033
0
0
0.013
1
0.02
0.047
0.04
0.83
0.24
0.04
1
0.25
0.24
Legend
PO4-P mg/L
N
W
E
S
1 0.5 0 1 2 3 4
Miles
West Nantmeal Twp
East Nantmeal Twp
Honey Brook
Honey Brook Twp
West Pikeland Twp
Chester Springs
Upper Uwchlan Twp
Uwchlan Twp
East Whiteland Twp
West Brandywine Twp
East Brandywine Twp
West Whiteland Twp
East Caln Twp
Caln Twp
Thorndale
West Bradford Twp
Valley Twp
Coatesville
South Coatesville
Modena
East Fallowfield Twp
West Goshen Twp
West Chester
East Goshen Twp
Highland Twp
Thornbury Westtown Twp
THE BARON HILLS


East Branch Brandywine Creek Watershed 2011
Marsh Creek
Indian Run
Culbertson Run
Shamona Creek
Beaver Creek
Valley Creek
Taylor Run
0.057
0.027
0.033
0.047
0.023
0.027
0.027
0.033
0.033
0.04
0.04
0.02
0.12
1.7
2
0.013
1.7
0.093
0.093
N
W
E
S
Legend
PO4-P mg/L
1 0.5 0 1 2 3 4
Miles
West Nantmeal Twp
East Nantmeal Twp
Honey Brook
Honey Brook Twp
West Vincent Twp
West Pikeland Twp
Chester Springs
Upper Uwchlan Twp
Uwchlan Twp
East Whiteland Twp
West Whiteland Twp
West Brandywine Twp
East Brandywine Twp
East Caln Twp
Caln Twp
Thorndale
Coatesville
South Coatesville
West Bradford Twp
Valley Twp
Modena
East Fallowfield Twp
Highland Twp
West Goshen Twp
East Goshen Twp
West Chester
Thornbury
Westtown Twp
Thornbury Twp
THE BARON HILLS


East Branch Brandywine Creek Watershed 2012
Marsh Creek
Indian Run
Culbertson Run
Shamona Creek
Beaver Creek
Valley Creek
Taylor Run
0.027
0.073
0.053
0.033
0.06
0.053
0.32
0.027
0.053
0.06
0.057
0.14
0.21
0.16
N
W
E
S
Legend
PO4-P mg/L
1 0.5 0 1 2 3 4
Miles
West Nantmeal Twp
East Nantmeal Twp
Honey Brook
Honey Brook Twp
West Pikeland Twp
Chester Springs
Upper Uwchlan Twp
Uwchlan Twp
West Brandywine Twp
East Brandywine Twp
West Whiteland Twp
East Whiteland Twp
East Caln Twp
Caln Twp
Thorndale
Downingtown
West Bradford Twp
Coatesville
South Coatesville
Modena
East Fallowfield Twp
Valley Twp
Highland Twp
West Goshen Twp
West Chester
Thornbury Westtown Twp

NO_3-N

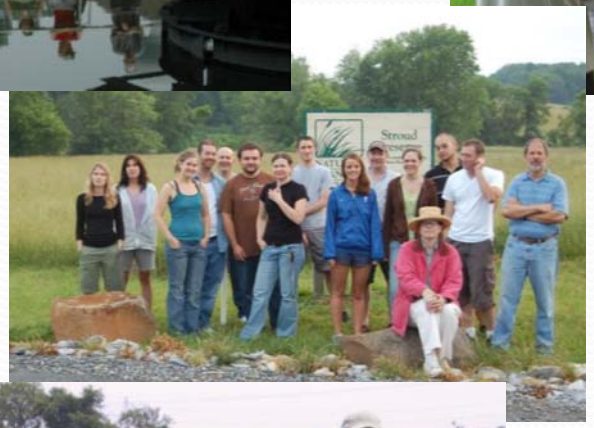
- Values ranged from 0.2 – 9.6 mg/L as N with a single outlier observation of 23 mg/L.
- Almost all values were therefore below the PADEP limit of 10 mg/L for drinking water intakes, but many were above the limit for impairment of 0.2 mg/L total-P set by DNREC.
- Most of the highest values for upper watershed zones were highest from 2002 – 2006
- Highest values seen (7.0 – 23) were in Taylor Run and the outfall of the Taylor Run Wastewater Treatment Plant
- Highest values of any year were seen in 2006, perhaps due to specific flow conditions; values were highest in lowest point of watershed indicating potential of multiple sources

PO_4-P

- Values ranged from non-detected to 2.0 mg/L, with the highest values consistently located in and around the discharge of Taylor Run Wastewater Treatment Plant
- Most values well below impairment value of 0.2 mg/L
- Over time, many PO4-P values went up, against the trend observed by the Christina Basin Pollution Control Strategy, possibly because:
  - Taylor Run values were consistently high, and not indicative of the whole watershed
  - Lower watershed values were consistently high

Conclusions

- Despite the limitations of unskilled analysts, restricted timeframe for sample collection and sample plan design, this longitudinal study shows patterns of nutrient loading over a 10-year period that are essentially consistent with other studies
- GIS visualization of nutrient values in the E. Branch Brandywine Creek shows both spatial and temporal variability in a manner that should be easily assimilated by students and professionals alike
- GIS provides a consistent database structure for future data collections in this watershed
- Future work will include:
  - Continued monitoring of selected metals
  - Expansion of sampling techniques to include time-weighted composite samples
  - Use of real-time monitors
  - Continued expansion of this GIS database



Acknowledgements