The Delaware River Basin Project

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Antonia Price	Project coordinator
Joshua Barth	Student fellow

Center for Land Use and Sustainability
SHIPPENSBURG UNIVERSITY

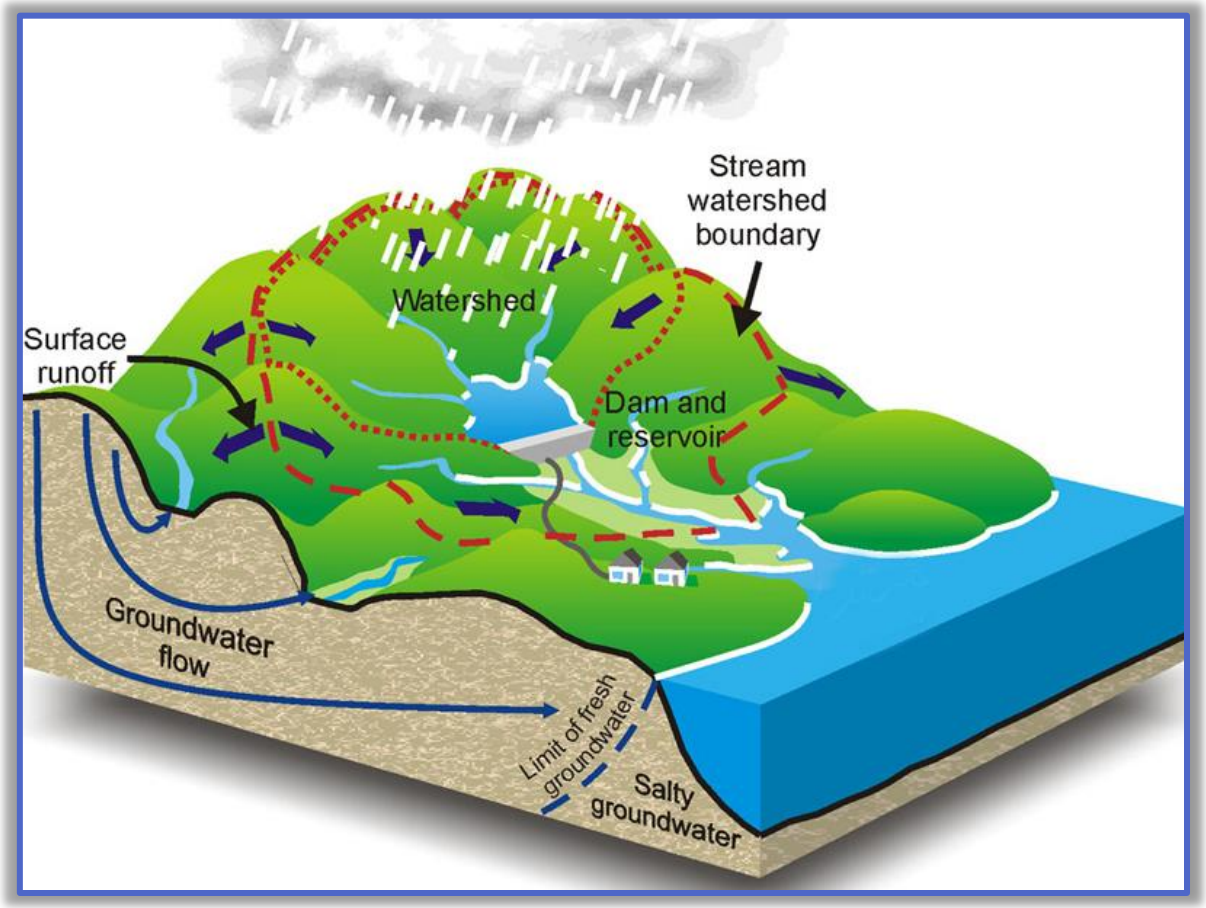
http://drbproject.org

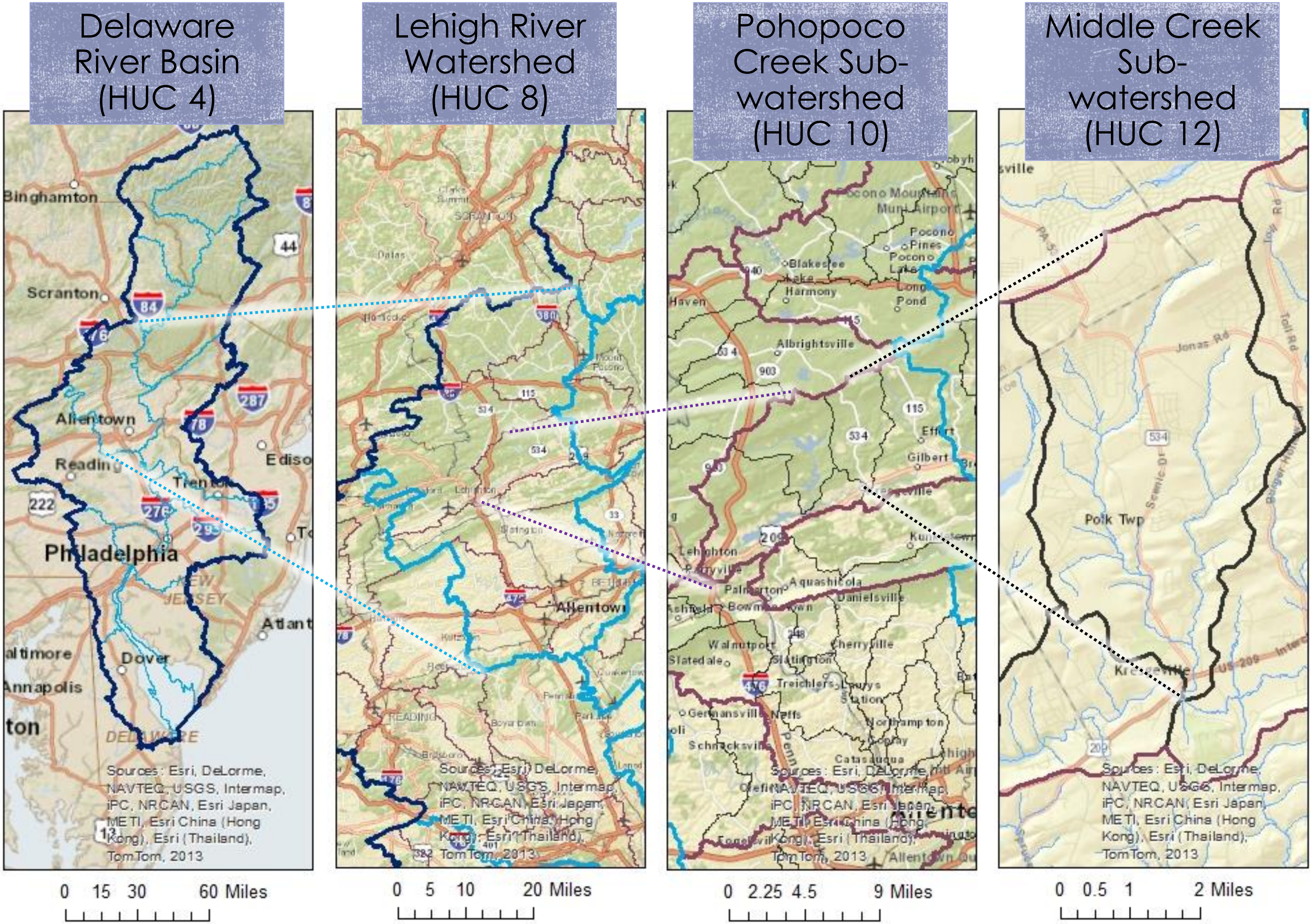
Workshop agenda

- Introductions
- Project Background
- Watershed characteristics
- Lunch
- Scenario Development

Watersheds 101

Watersheds are nested…




Delaware River Basin (HUC 4)
Lehigh River Watershed (HUC 8)
Pohopoco Creek Sub-watershed (HUC 10)
Middle Creek Sub-watershed (HUC 12)
Binghamton
Scranton
Allentown
Reading
Trenton
Philadelphia
Dover
Annapolis
NEW JERSEY
Polk Twp
Kresgeville
Palmerton
Lehighton
Albrightsville
Blakeslee
Effort
Gilbert
Sources: Esri, DeLorme, NAVTEQ, USGS, Intermap, iPC, NRCAN, Esri Japan, METI, Esri China (Hong Kong), Esri (Thailand), TomTom, 2013
0 15 30 60 Miles
0 5 10 20 Miles
0 2.25 4.5 9 Miles
0 0.5 1 2 Miles

Delaware River Basin (DRB)

35,000 sq.km (13,500 sq.mi)

8.2 million residents

3.6 million jobs*

Provides water resources and ecosystem services to more than 15 million people (5% of US pop.)

WILLIAM PENN FOUNDATION

Our purpose & objectives

To help decision-makers think holistically about the DRB

1. Listen to stakeholders, read, and mine their data
2. Produce high resolution land cover data
3. Develop useful modeling tools
4. Conduct a feasibility study to gage interest in long-term land cover change monitoring

Letters from the SAL Blogging from the Spatial Analysis Laboratory (SAL) ...

search

Classic Flipcard **Magazine** Mosaic Sidebar Snapshot Timeslide

OCT 14

OpenStreetMap Post Earthquake Mapping, Coquimbo, Chile

On September 27th, the Spatial Analysis Lab held its first Mapathon of the fall 2015 semester. The focus of this Mapathon was to create a detailed digital dataset of roads, buildings and open areas, in Coquimbo, Chile in response to the 8.3 magnitude earthquake that hit off of Chile's coast on September 16th. Coquimbo experienced widespread damage to infrastructure and flooding due to the earthquake and subsequent Tsunami that swept through parts of the city. In fact, in parts of Chile the ground shifted 4.6 feet (1.4 meters) as a result of the earthquake.

Students and community members using OpenStreetMap

Coquimbo already had some data before this recent OpenStreetMap activation in its road network.

OCT 5

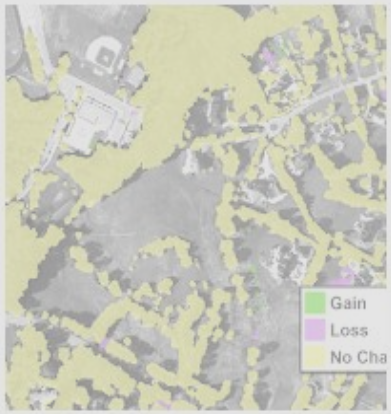
UAS team deployed to aid in train derailment

This morning the Amtrak Vermonter train derailed in Northfield, VT. Responding to a request from the Vermont Agency of Transportation, we immediately

SEP 18

Pennsylvania Statewide High-Resolution Tree Canopy

We are thrilled to announce the first public release of the Pennsylvania statewide high-



SEP 10

Montgomery County MD Tree Canopy Explorer

In late spring we completed an updated mapping of Montgomery County, Maryland's land cover. The driving factor for this

JUL 24

UAS Mapping of July 2015 Storm Damage in Barre, VT

The severe storm that dumped close to half a foot of rain on Central Vermont in a matter of hours on July 19, 2015 caused

Metadata

This page provides a summary of the dataset's metadata.

Select one of the links to view the full metadata document or download the dataset.

Metadata Summary

Pennsylvania Statewide High-Resolution Tree Canopy

Title: Pennsylvania Statewide High-Resolution Tree Canopy
Originator: University of Vermont Spatial Analysis Laboratory
Publication Date:2015

Abstract:
Pennsylvania Statewide High-Resolution Tree Canopy We are thrilled to announce the first public release of the Pennsylvania statewide high-resolution tree canopy dataset (data download link - 2.3GB!). (Technically this is the second version as the first one was for internal review). This dataset maps tree canopy for the entirety of Pennsylvania at a resolution of 1m, making it 900 times more detailed than the National Land Cover Dataset (NLCD)! With our landscapes becoming increasingly fragmented and heterogeneous high-resolution datasets add precision and accuracy to any analysis. We primarily relied upon Pennsylvania's publicly available LiDAR data, which was acquired in 2006, 2007, and 2008. We supplemented the LiDAR data

Metadata

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Select one of the links to view the full metadata document or download the dataset.

Metadata Summary

Landcover - Delaware River Basin 2010

Title: Landcover - Delaware River Basin 2010
Originator: University of Vermont Spatial Analysis Laboratory
Publication Date:20140109

Abstract:
High resolution land cover dataset for the Delaware River Basin, an area comprised of parts of six counties in the state of New York and four counties in Pennsylvania. Seven land cover classes were mapped: (1) tree canopy, (2) grass/shrub, (3) bare earth, (4) water, (5) buildings, (6) roads, and (7) other paved surfaces. The minimum mapping unit for the delineation of features was set at six square meters. The primary sources used to derive this land cover layer were 2008 LiDAR data and 2010 - 2011 NAIP imagery. LiDAR coverage was complete for the Pennsylvaia portion of the AOI, however, LiDAR was unavailable for large portions of the New York portion. Where LiDAR was not available, imagery was the primary data source. Ancillary data sources included GIS data (eg. such as hydrology, breakline and buildings) provided by the counties of Lackawana, Monroe, Pike and Wayne, PA, as well as the New York State GIS Clearinghouse. Some of these vector datasets were edited by the

Delaware Land Cover Data- Coming Soon!

A draft version of the high resolution land-cover map for the state of Delaware is being made available for review and comments by end-users! The layer is a 4-bit file in Albers Conical Equal Area projection, and is provided as an ERDAS Imagine file (.img) due to size. The University of Vermont Spatial Analysis Lab (SAL) has not yet completed full metadata for the layer, but the coding scheme is labeled in the draft metadata and in the value attribute table (see below).

In the meantime, SAL will continue working to improve automated feature extraction of the classes in this dataset, and will also manually review and edit a near-final version of the map to eliminate obvious errors and inconsistencies. Contact Jarlath O'Neil-Dunne (joneildu@uvm.edu) at SAL to request access to the draft data set.

Final product will have expanded classes: emergent wetlands, scrub/shrub, and impervious surfaces under tree canopy

Land **2014**, *3*, 1158-117

Article

Calib
Dri
M

SHIPPENSBURG UNIVERSITY

NATIONAL PARK SERVICE

THE WOODS HOLE RESEARCH CENTER

Report prepared by:

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Dept. of Geography-Earth Science
Shippensburg University

Leslie Morlock
GIS Specialist
National Park Service
Delaware Water Gap NRA

Our purpose & objectives

To help decision-makers think holistically about the DRB

1. Listen to stakeholders, read, and mine their data
2. Produce high resolution land cover data
3. Develop useful modeling tools
4. Conduct a feasibility study to gage interest in long-term land cover change monitoring

Listen to stakeholders

Philadelphia, PA	Oct. 29, 2015
Narrowsburg, NY	Nov. 10, 2015
Reading, PA	Jan. 13, 2016
Washington, NJ	Feb. 16, 2016
Dover, DE	Feb. 18, 2016

Goals for Today

Discuss current characteristics of the basin

Modified SWOT analysis

- Strengths and Weaknesses- Current
- Opportunities and Threats- Future

We need your input!

Questions?

The DRB - what do the data tell us?

Introduction: physical setting

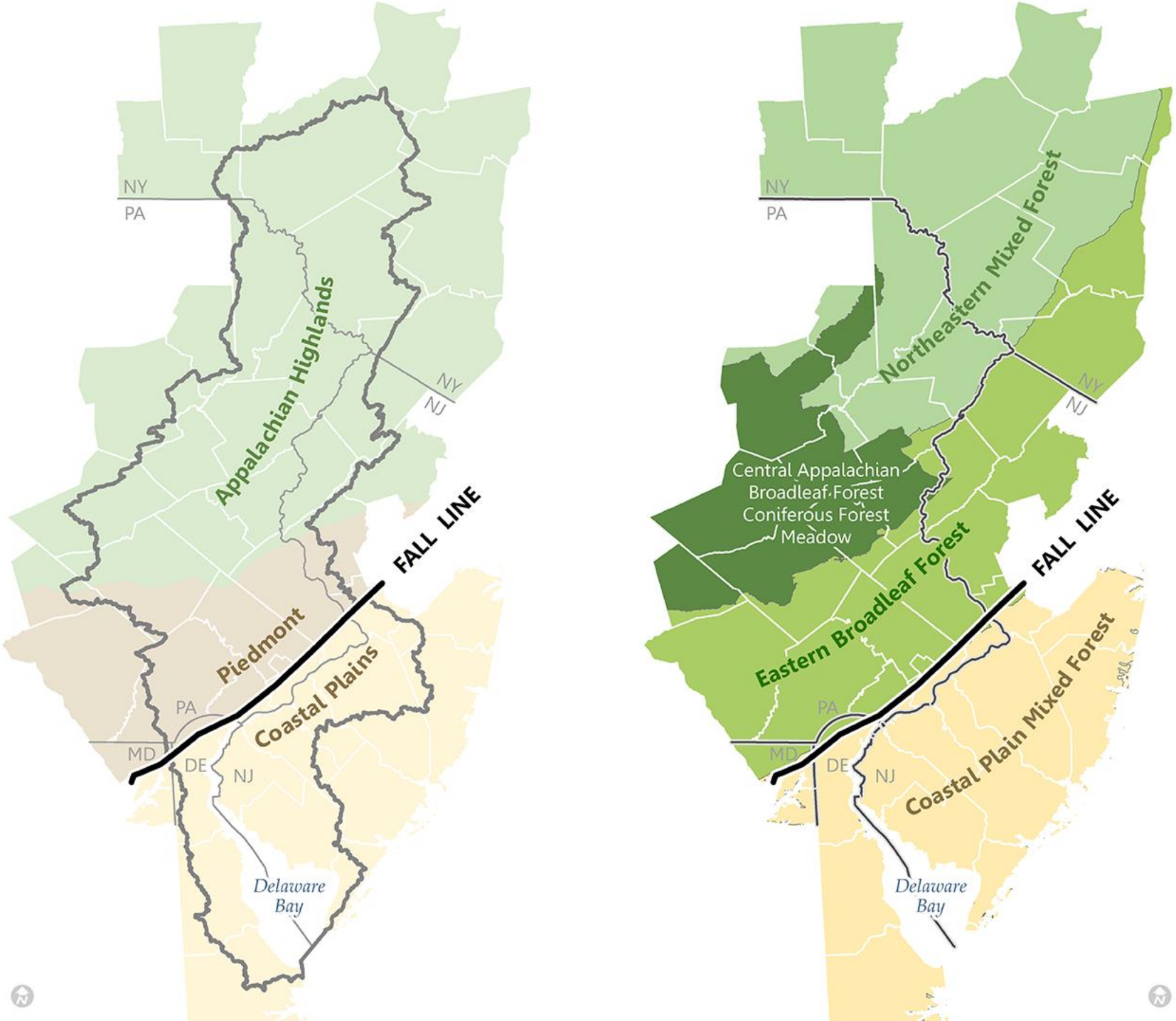
People & housing

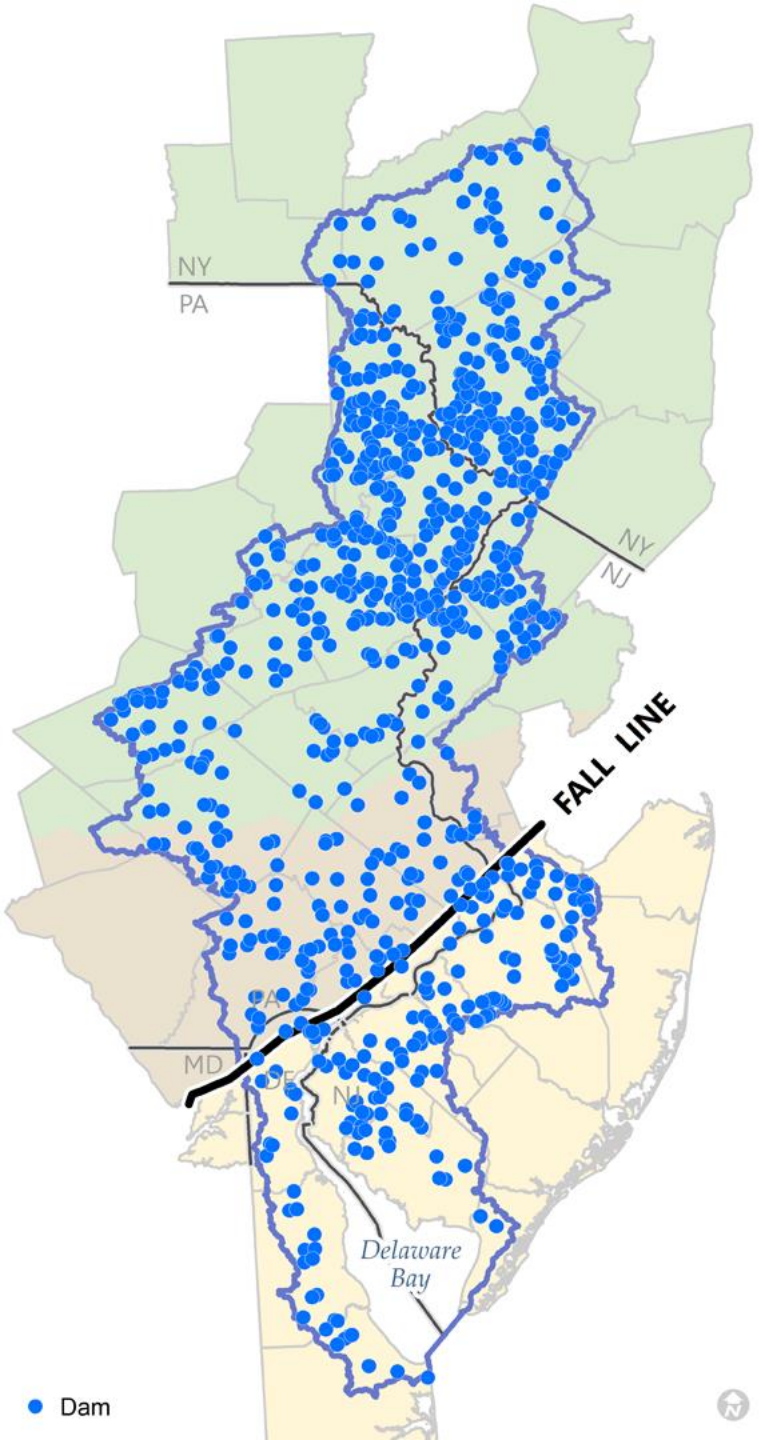
Economics & commuting patterns

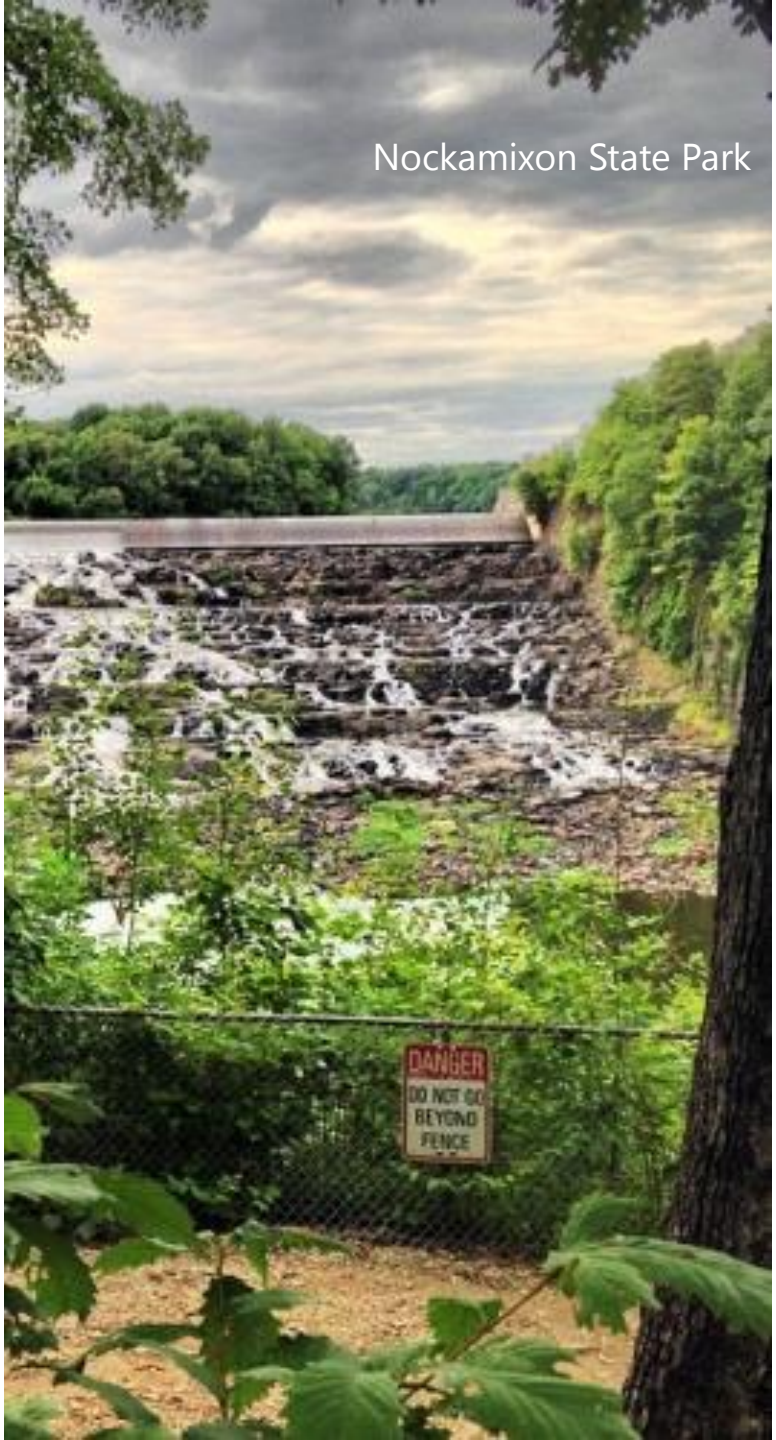
Recent land use change trends

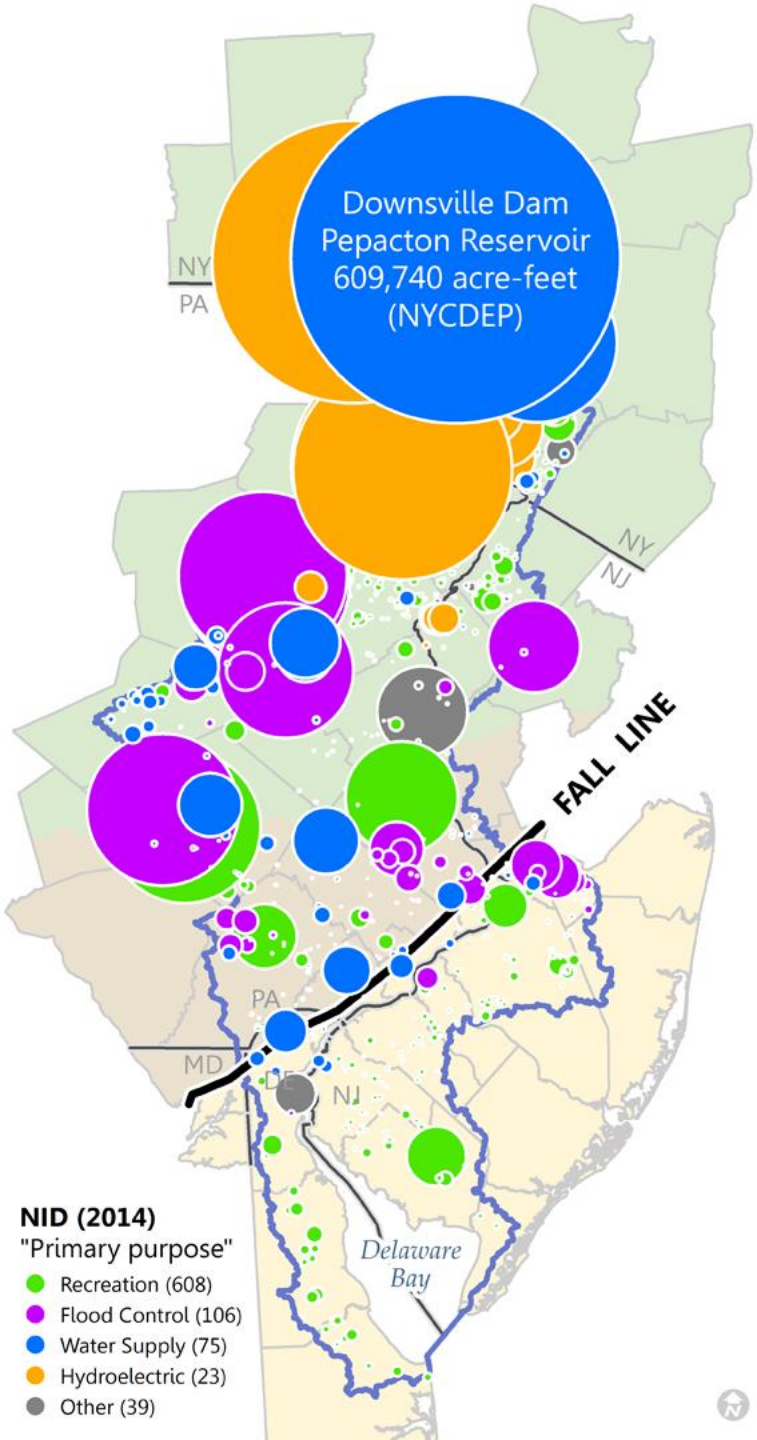
Fragmented or cohesive regional identity?

Watershed-wide planning?


NY
PA
Appalachian Highlands
NY
NJ
FALL LINE
Piedmont
Coastal Plains
PA
MD
DE
NJ
Delaware Bay
NY
PA
Northeastern Mixed Forest
NY
NJ
Central Appalachian
Broadleaf Forest
Coniferous Forest
Meadow
Eastern Broadleaf Forest
FALL LINE
PA
MD
DE
NJ
Coastal Plain Mixed Forest
Delaware Bay


NY
PA
NY
NJ
FALL LINE
PA
MD
DE
NJ
Delaware
Bay
Dam

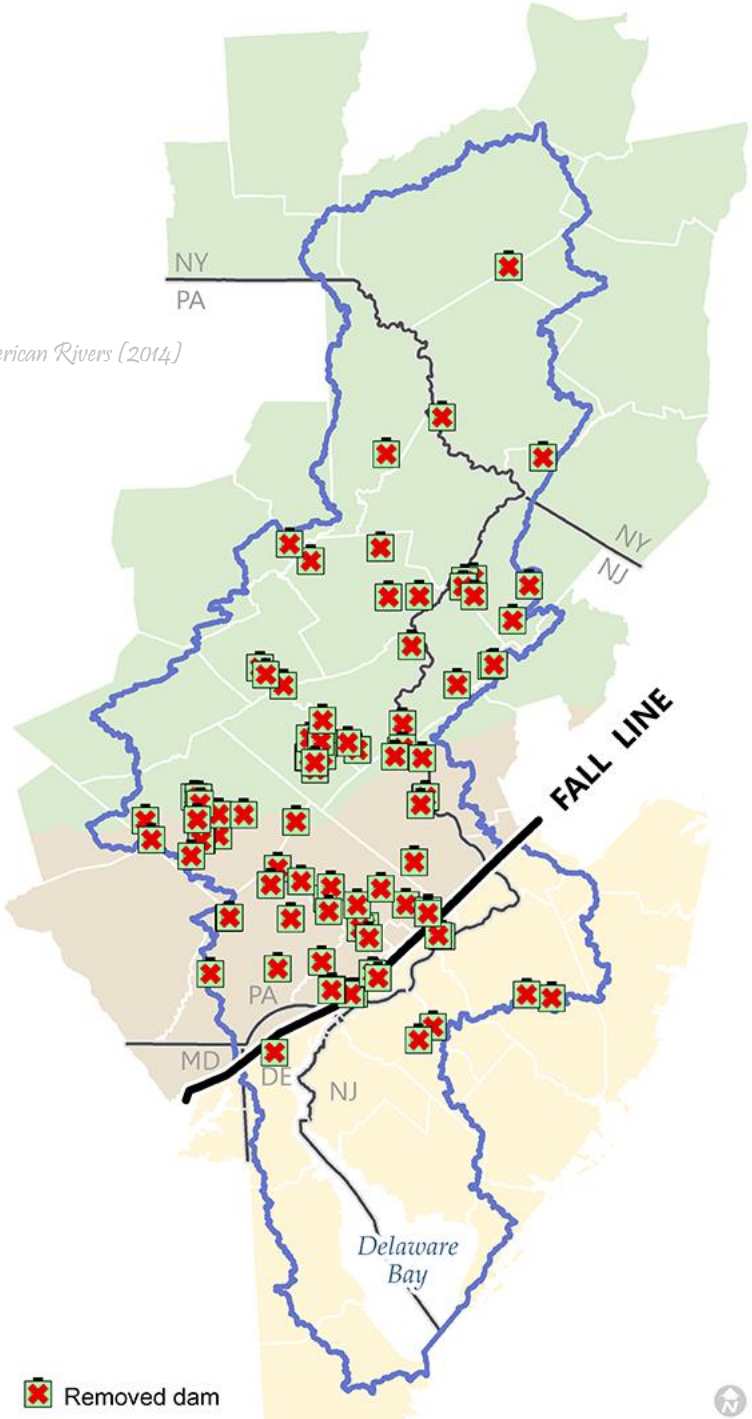

Nockamixon State Park
DANGER
DO NOT GO
BEYOND
FENCE


Downsville Dam
Pepacton Reservoir
609,740 acre-feet
(NYCDEP)
NY
PA
NY
NJ
FALL LINE
PA
MD
DE
NJ
Delaware Bay
NID (2014)
"Primary purpose"
Recreation (608)
Flood Control (106)
Water Supply (75)
Hydroelectric (23)
Other (39)

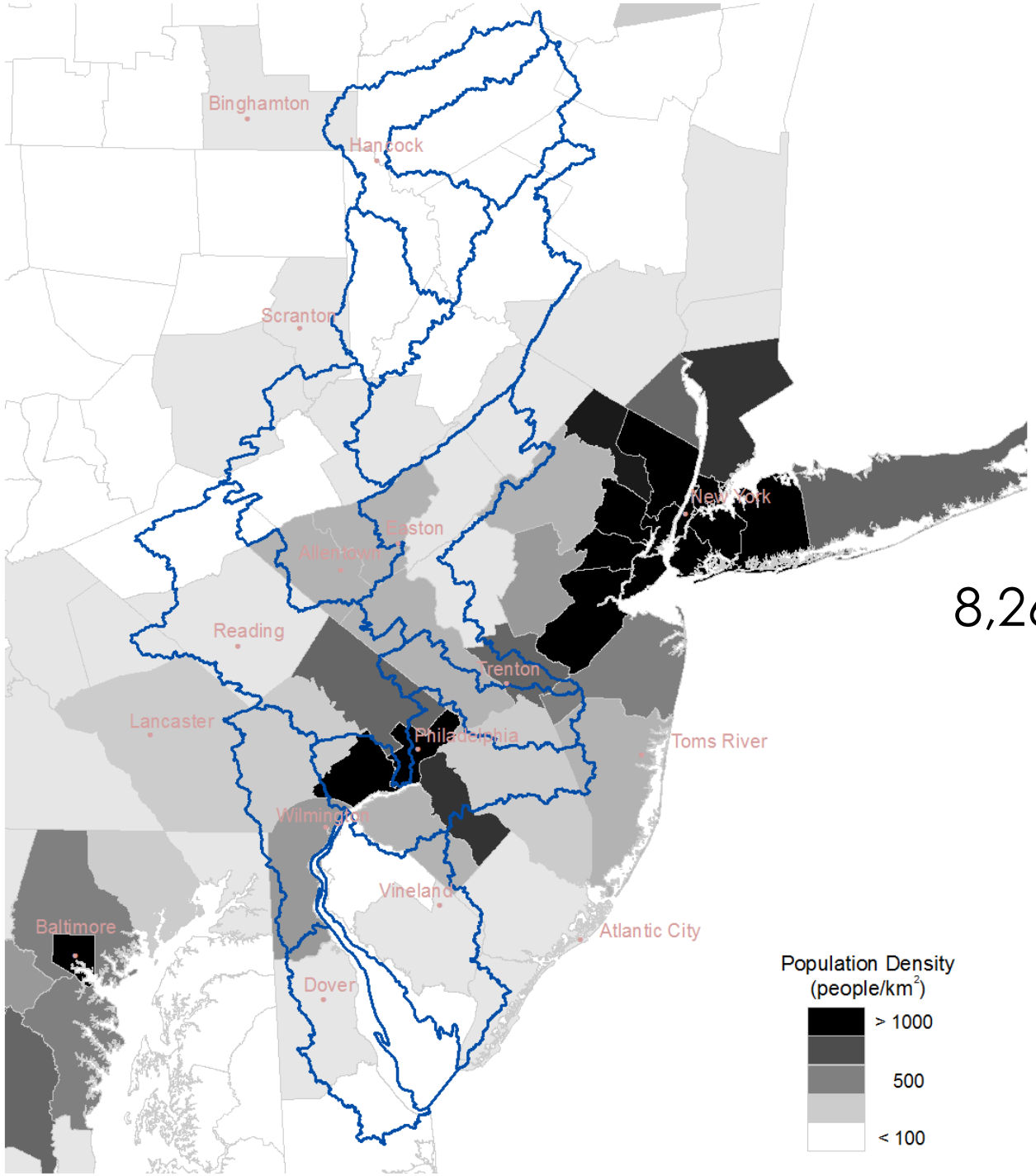

Pepacton Reservoir @ Downsville, NY

Huntington Pike Dam Removal, 2007
@ Pennypack Creek

Primary purpose of dam	Count	Avg. age (yrs)	Storage (acre-ft)
Recreation	608	82	585930
Flood control	103	41	847630
Water supply	75	95	926350
Hydroelectric	23	68	1128900
Other	17	62	59170
Fire protection, stock, fish pond	13	50	960
Fish & wildlife pond	4	95	5770
Irrigation	3	56	340
Tailings	2	35	1330
Source: USACE NID (2014) and our calculations	851	76	3,556,400

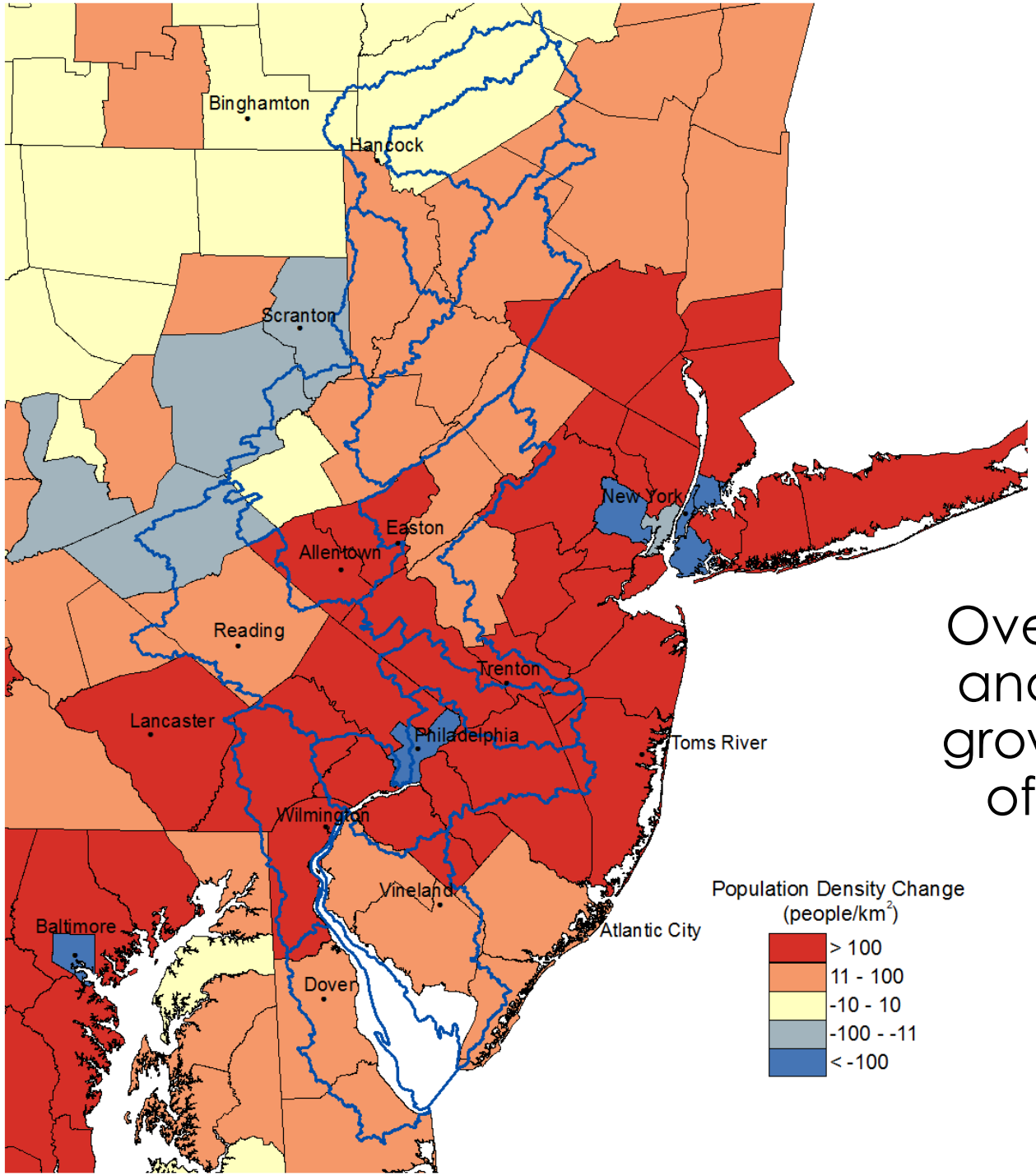


Source: American Rivers (2014)



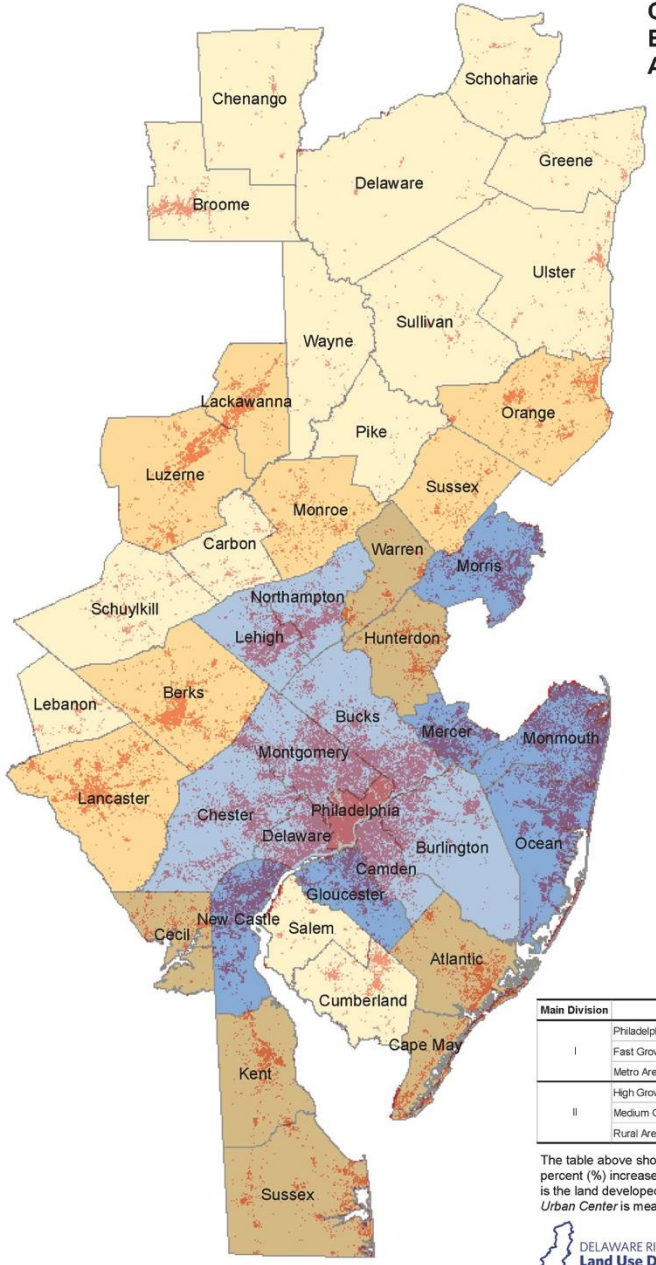
8,268,500 people call somewhere in the DRB 'home'.

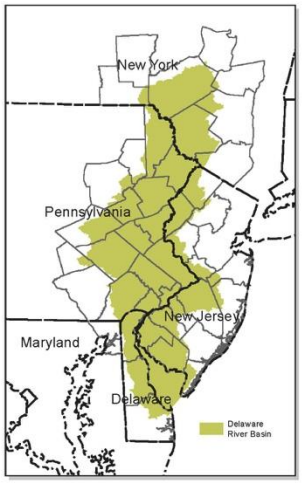
3,625,600 workers* work somewhere in the DRB.



Over the last 50 years and despite regional growth, a lesser share of people live in the DRB's largest city.

DELAWARE RIVER BASIN COUNTY CLASSIFICATION BASED ON URBAN GROWTH AND URBANIZATION DEGREE





Counties Stratification

- Philadelphia
- Fast Growth Metro Areas
- Metro Areas
- High Growth Sub-Urban
- Medium Growth Sub-Urban
- Rural Areas
- Urbanized

Scale 1:2,000,000

Main Division	Groups	Total Growth	Urban Area	Largest Urban Center
I	Philadelphia	12.05	83.07	304.81
	Fast Growth Metro Areas	2.55	30.78	196.35
	Metro Areas	1.15	32.95	221.99
II	High Growth Sub-Urban	0.55	9.95	32.29
	Medium Growth Sub-Urban	0.31	9.45	67.93
	Rural Areas	0.09	3.17	14.41

The table above shows the mean value within each group. *Total Growth* is the percent (%) increase of urban area during the period (1996-2010). *Urban Area* is the land developed out of the available land in each county (%). *Largest Urban Center* is measured in square kilometers (km^2).

DELAWARE RIVER BASIN
Land Use Dynamics
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Center for Land Use and Sustainability
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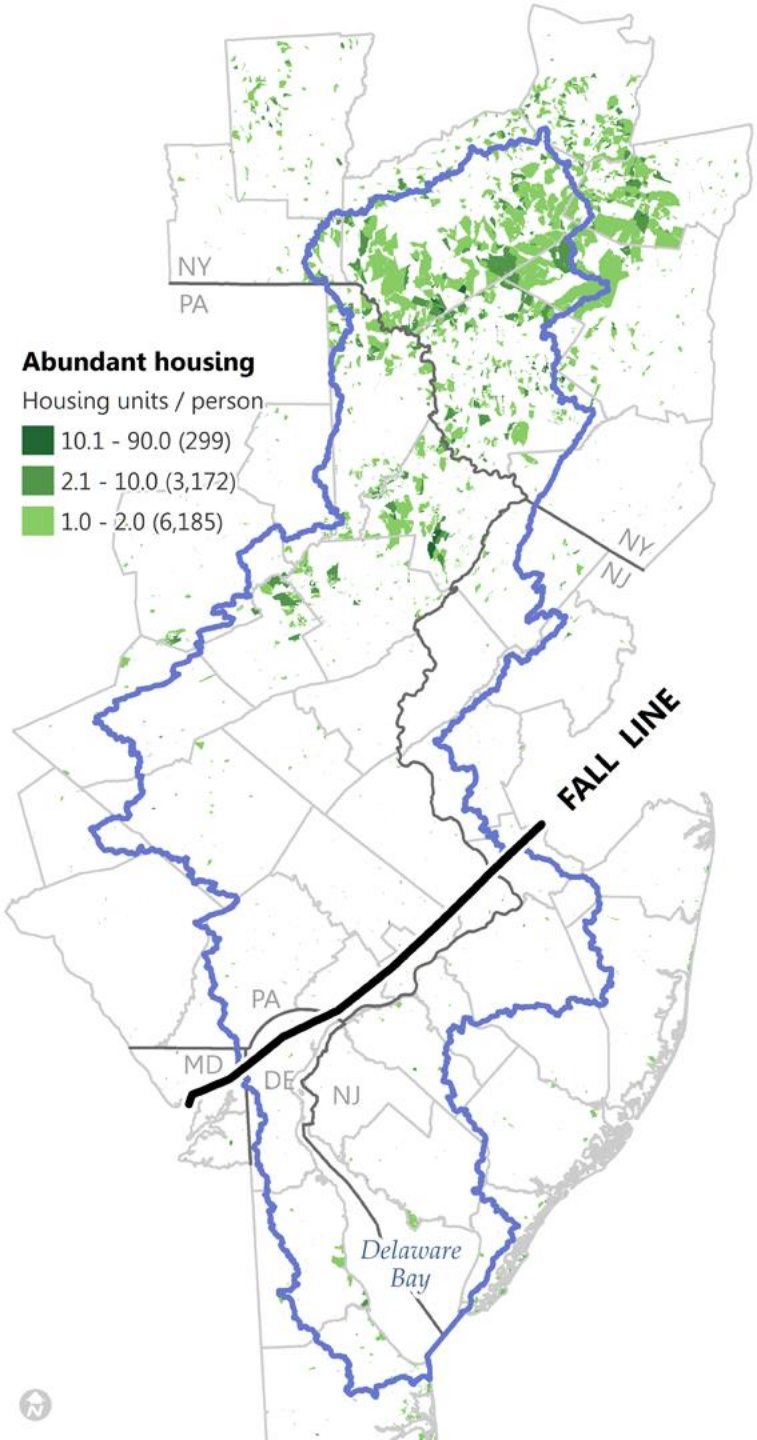
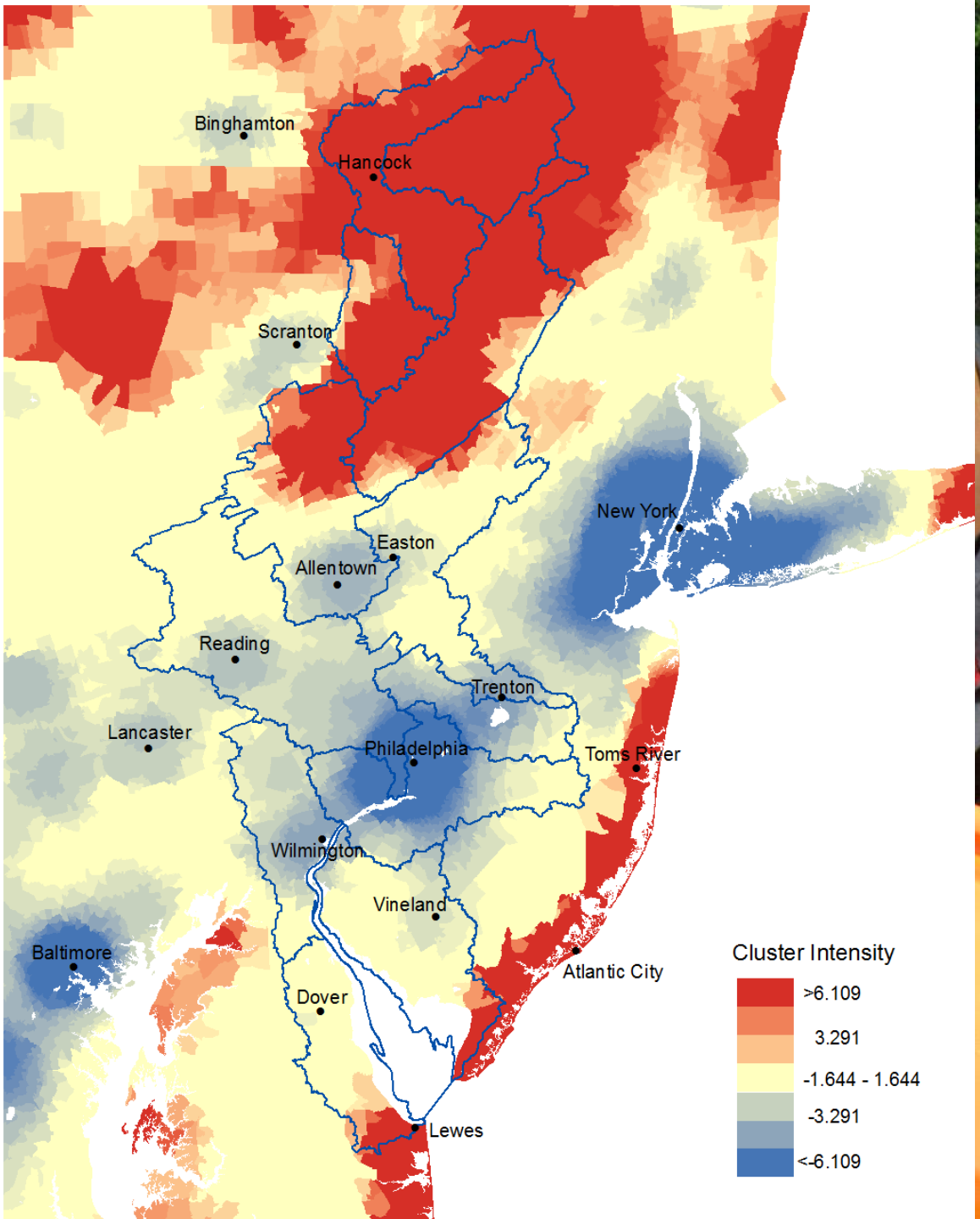
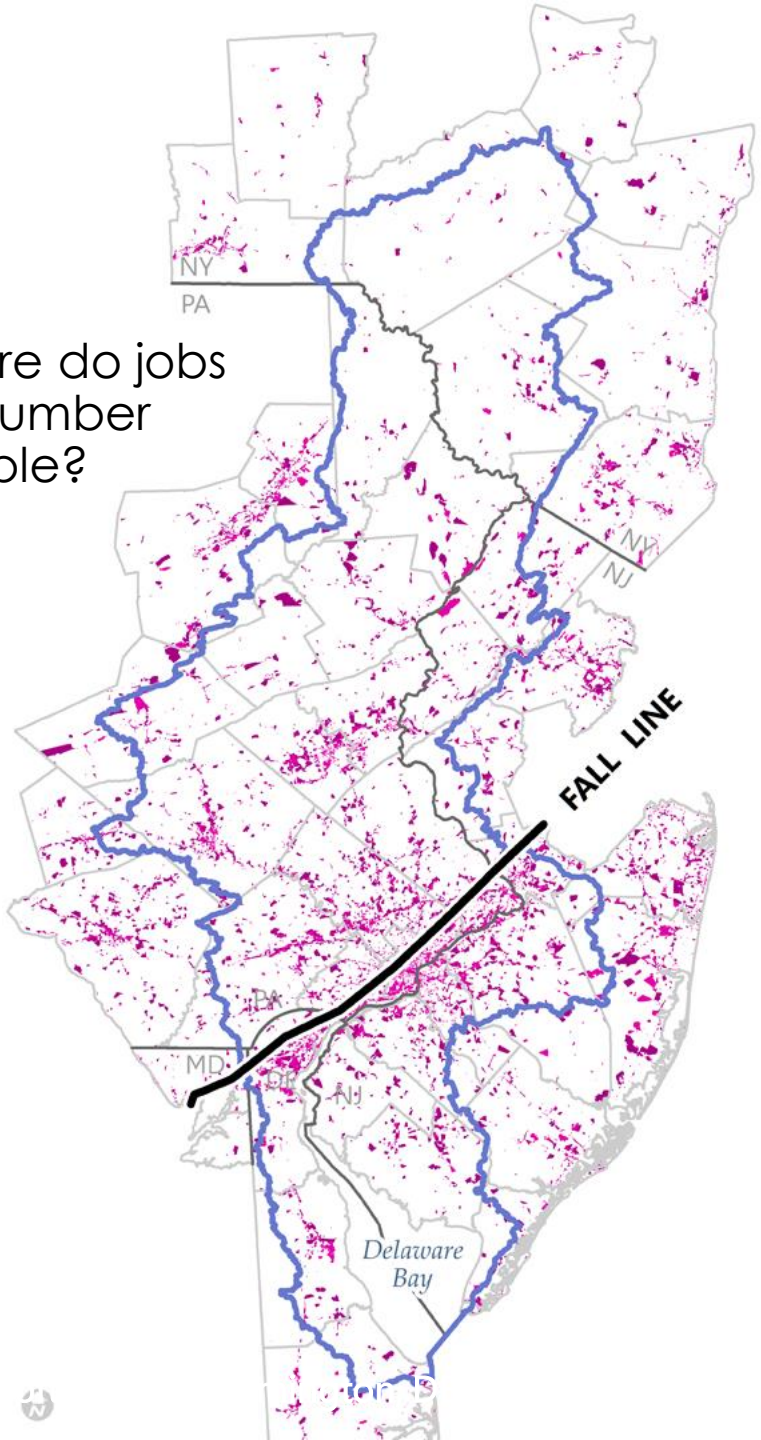
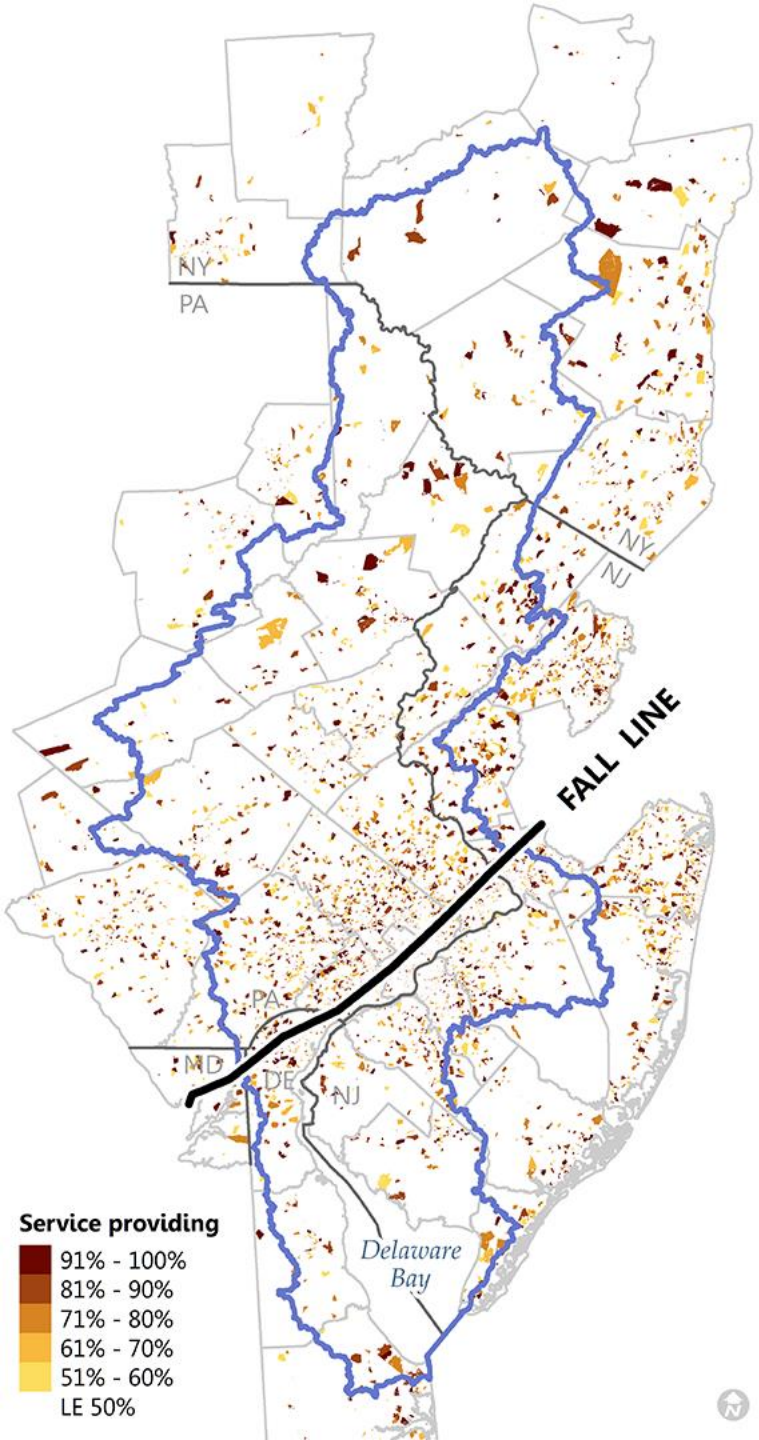


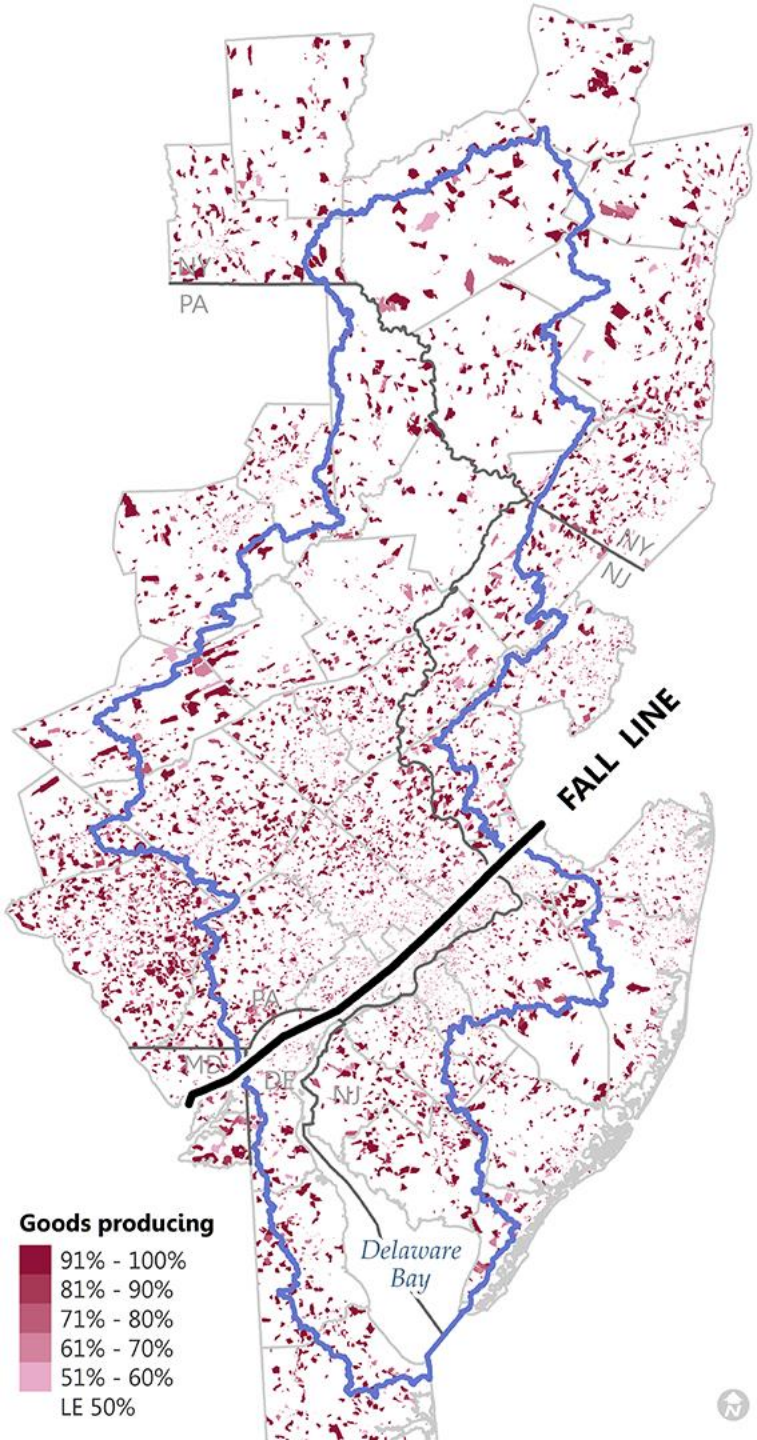
Red cabin @ Smallwood, NY


Binghamton
Hancock
Scranton
New York
Easton
Allentown
Reading
Trenton
Lancaster
Philadelphia
Toms River
Wilmington
Vineland
Baltimore
Atlantic City
Dover
Lewes
Cluster Intensity
>6.109
3.291
-1.644 - 1.644
-3.291
<-6.109

Where do jobs outnumber people?

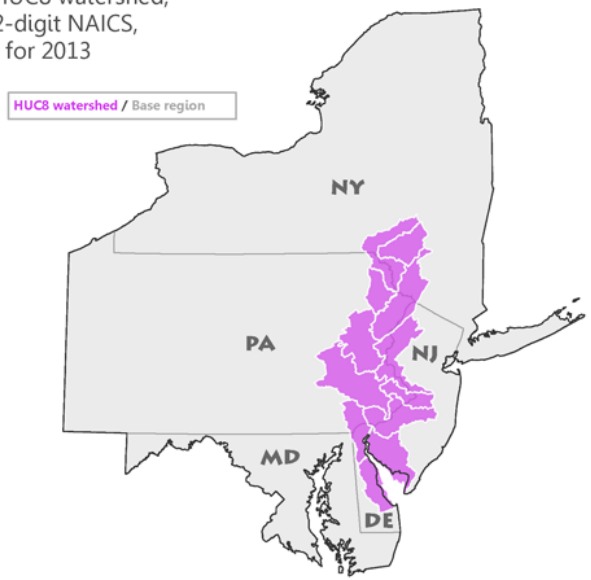



NY
PA
NY
NJ
FALL LINE
PA
MD
DE
NJ
Delaware Bay
Service providing
91% - 100%
81% - 90%
71% - 80%
61% - 70%
51% - 60%
LE 50%


NJ
PA
NY
NJ
FALL LINE
PA
MD
DE
NJ
Delaware Bay
Goods producing
91% - 100%
81% - 90%
71% - 80%
61% - 70%
51% - 60%
LE 50%

Employment concentration

by HUC8 watershed,
by 2-digit NAICS,
and for 2013



Retail trade

Transportation and warehousing

Information

Public administration

Health care and social services

Arts, entertainment & recreation

Accomdation and food services

What do the green colors mean?

Employment LQ

- 2.001 - 20.00 *Concentrated*
- 1.101 - 2.000
- 0.901 - 1.100 *on par*
- 0.501 - 0.900
- 0.060 - 0.500 *Sparse*

How were the LQs calculated?

$$LQ_{iwB} = \frac{SE_{iw} / TE_{w}}{SE_{iB} / TE_{B}}$$

Where:
LQ = the Location Quotient for industry sector i in watershed w and relative to the base region B (see map at right);
SE = Employment in sector i; and
TE = Total employment.

Summay

The maps at left were built using the US Census Bureau's 2013 Longitudinal Employer-Household Dynamics data, which track payrolled employment by census block and by 2-digit NAICS. We aggregated the census blocks that comprise each HUC8 watershed for analysis. Note: self-employed persons are not represented by these data.

A Location Quotient (LQ) is a valuable way to quantify how employment is concentrated in a particular industry in a particular watershed relative to how much it is concentrated in the hosting base region (the map above shows the five-state base region we used). A LQ can reveal what makes a particular region unique; in this case, unique in terms of jobs.

Light grey tones indicate a watershed that hosts a smaller share of workers than the base region (e.g., the paucity of those working in the Upper Delaware and in the Finance and Insurance sector). Dark green hues indicate a watershed that hosts a share of employment that is larger than the base region share (e.g., those working in the Manufacturing sector and in watersheds containing cities like Allentown, Bethlehem and Trenton). We're interested in the dark green areas because the predominance of jobs in just one or a few sectors can influence the uniqueness - identify - of the area.

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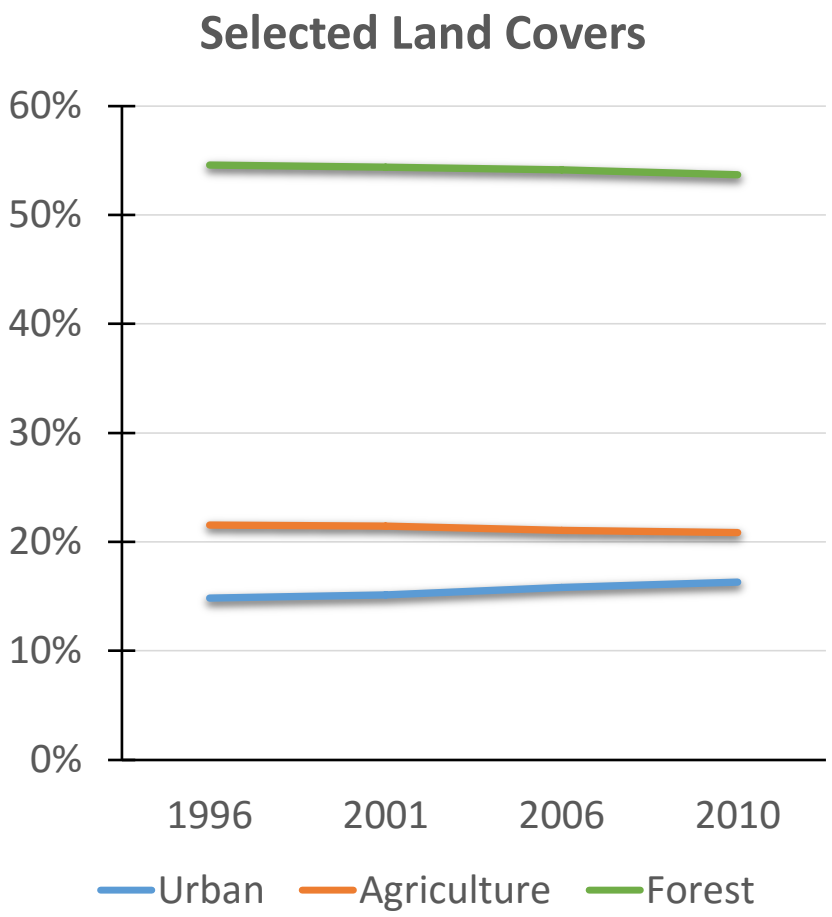
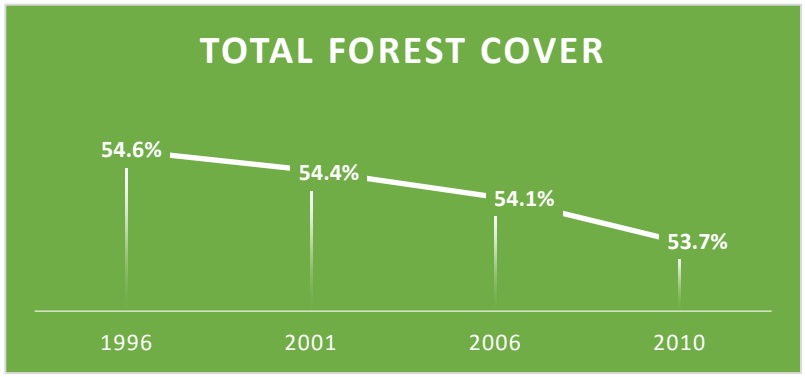
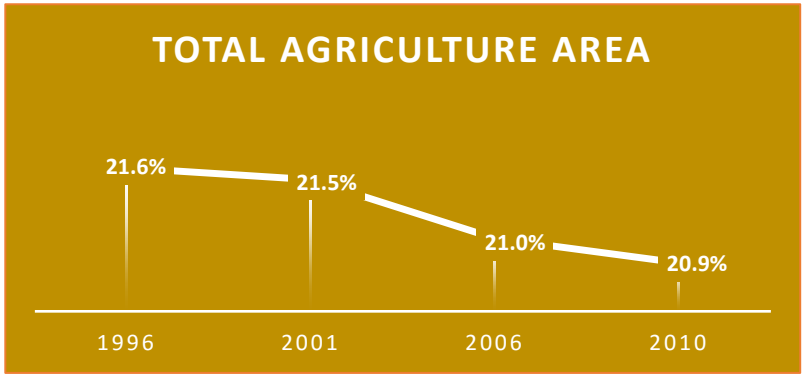
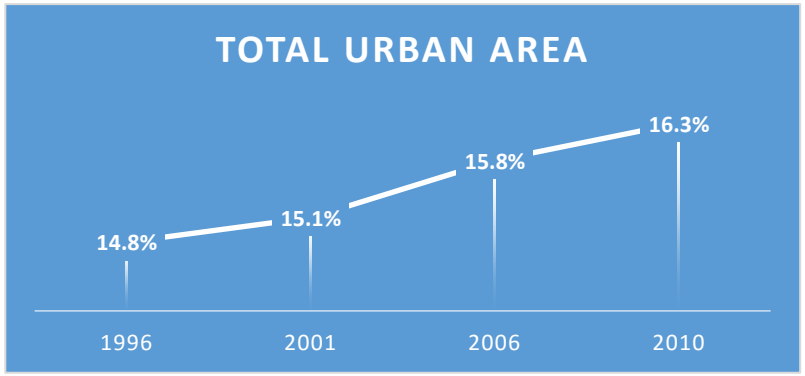
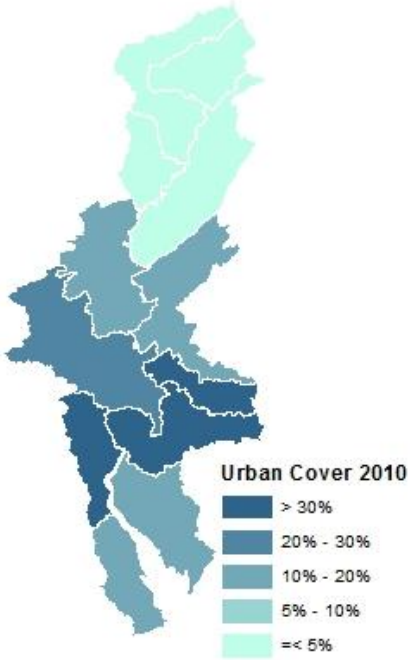
Shippensburg University

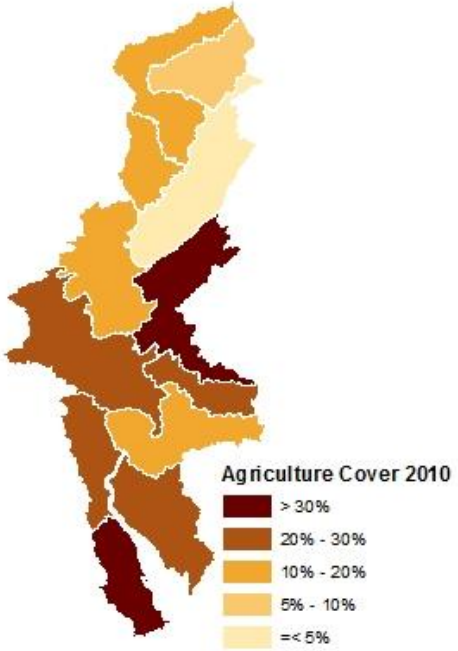

Selected Land Covers
60%
50%
40%
30%
20%
10%
0%
1996
2001
2006
2010
Urban
Agriculture
Forest

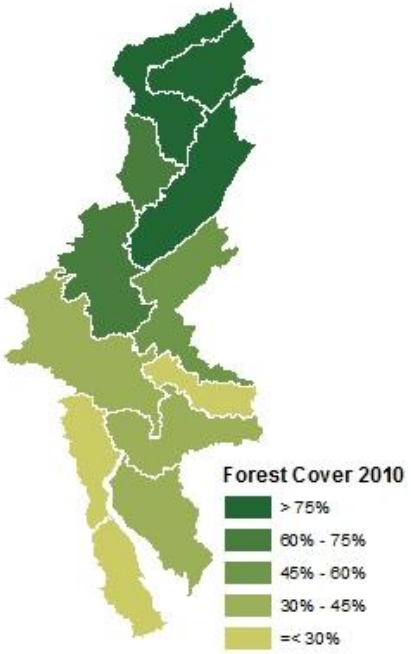

TOTAL FOREST COVER
54.6%
54.4%
54.1%
53.7%
1996
2001
2006
2010


TOTAL AGRICULTURE AREA
21.6%
21.5%
21.0%
20.9%
1996
2001
2006
2010

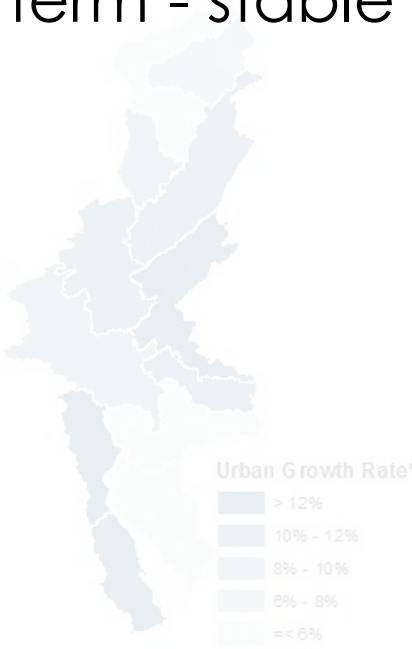

TOTAL URBAN AREA
14.8%
15.1%
15.8%
16.3%
1996
2001
2006
2010



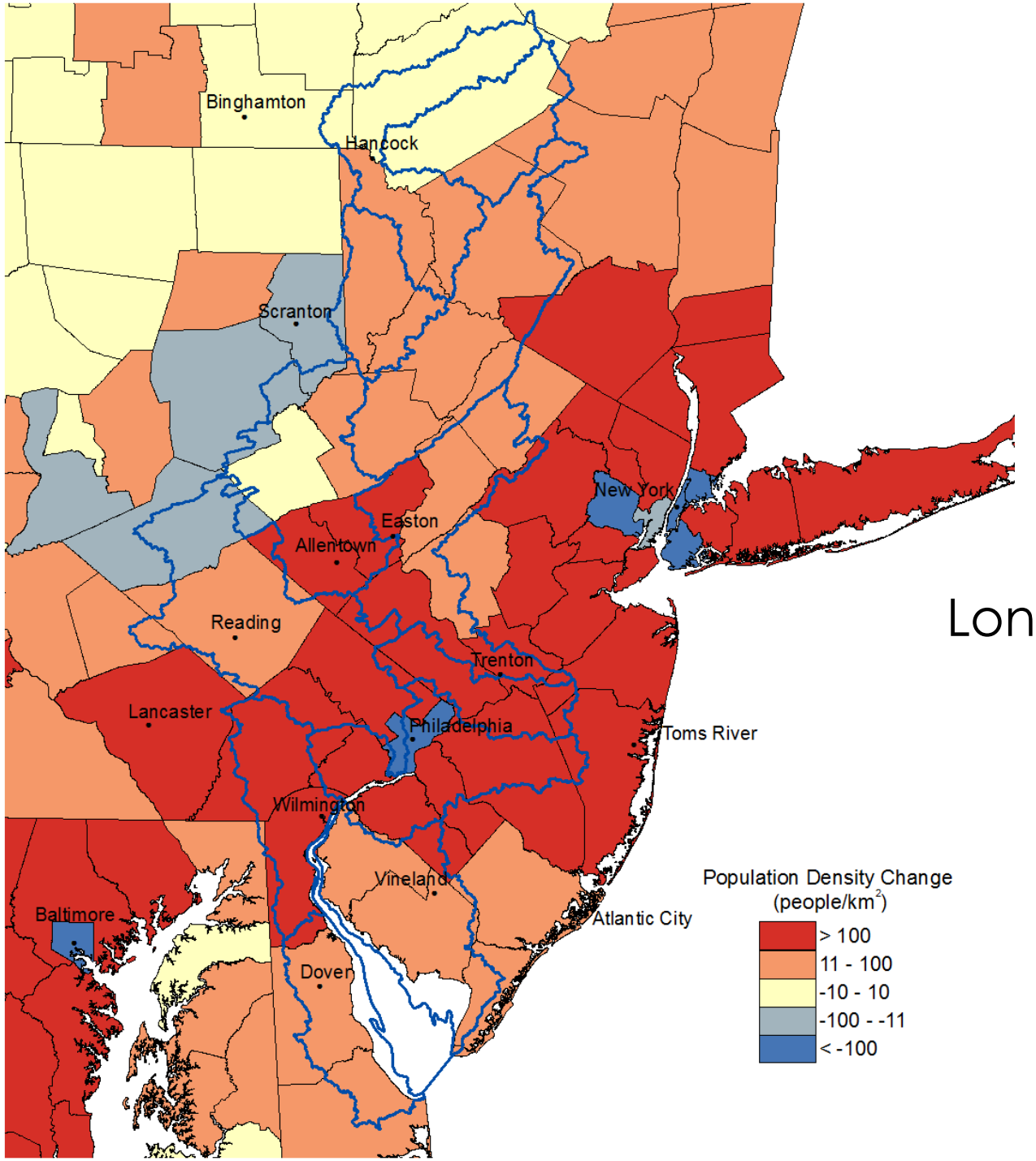




Short term - stable



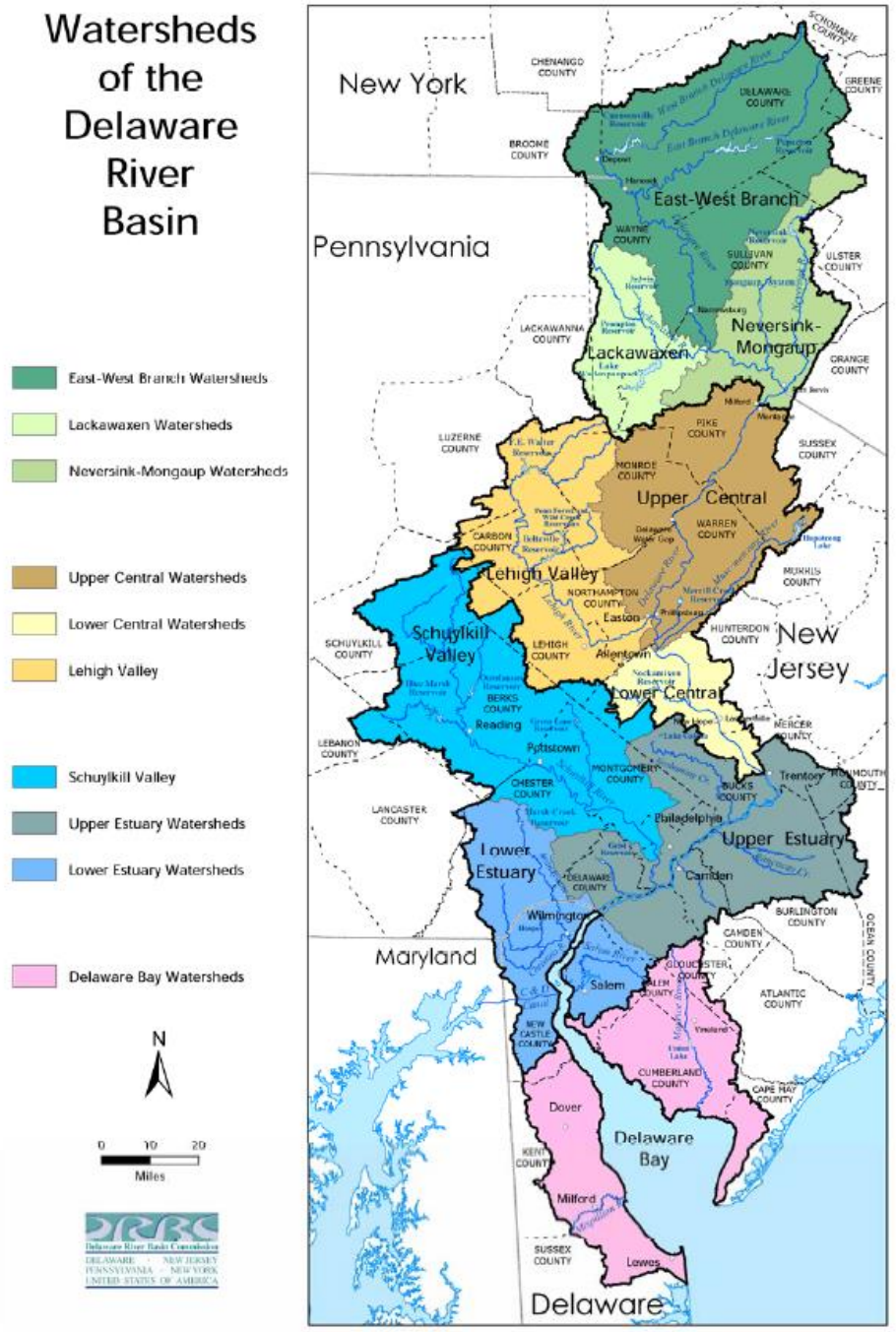
*period of analysis from1996 to 2010



Long term - dynamic

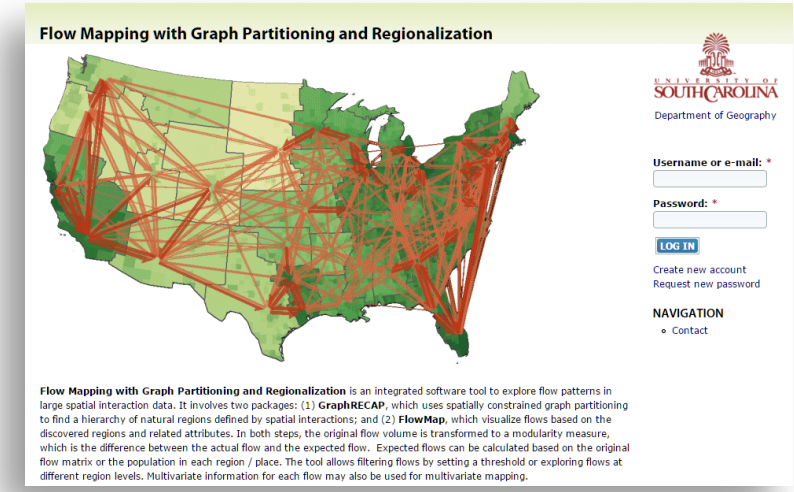
Watershed planning

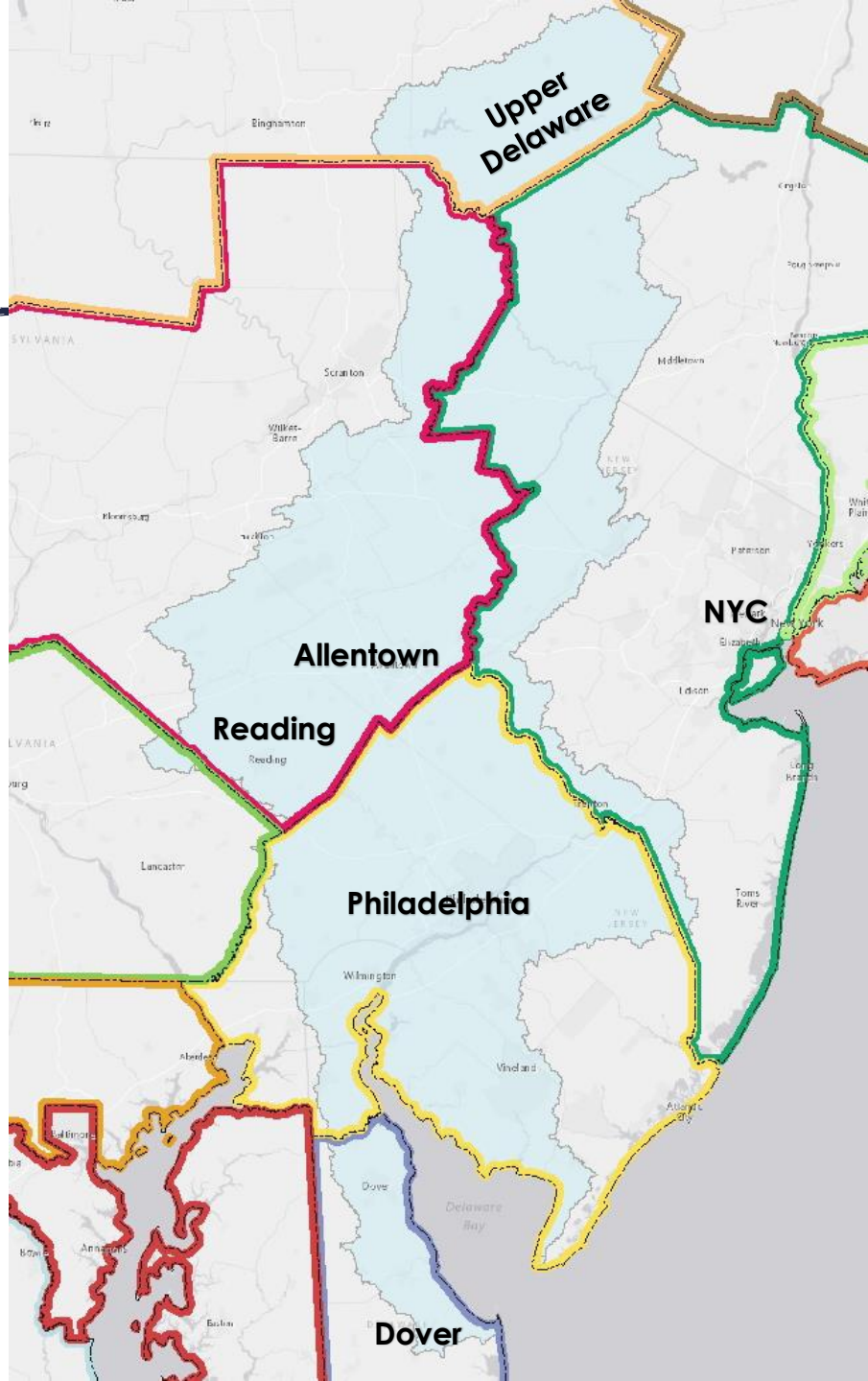
How important is it to plan for the future by thinking about the whole watershed?



Watershed identity

Does the DRB have a cohesive regional identity or many fragmented identities?





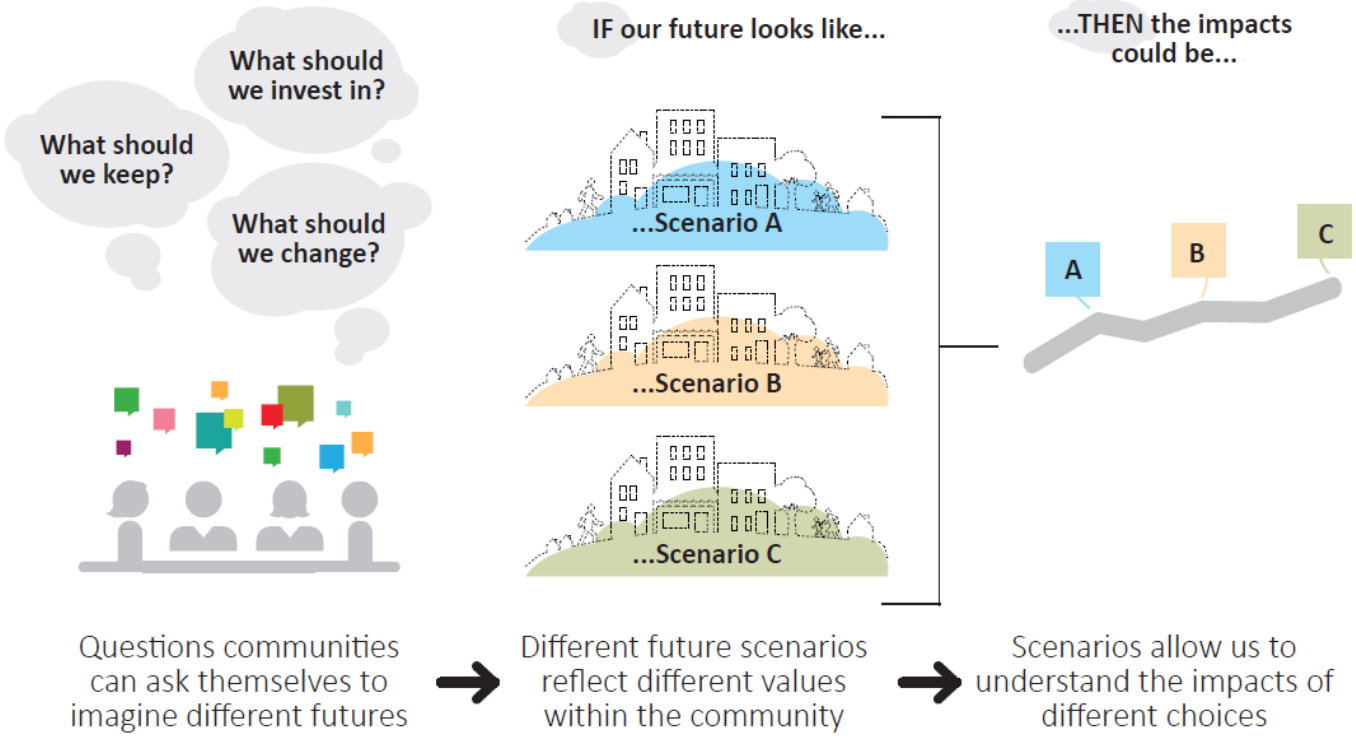
The Watershed in 2070

Our approach to forecasting land use change

- Community driven
  - What do you value?
  - Iterative
- Data driven
  - Reflect current trends
  - Best available forecast data
- Use scenarios

The Watershed in 2070

Scenarios are plausible stories about the possible futures and range of changes that could occur



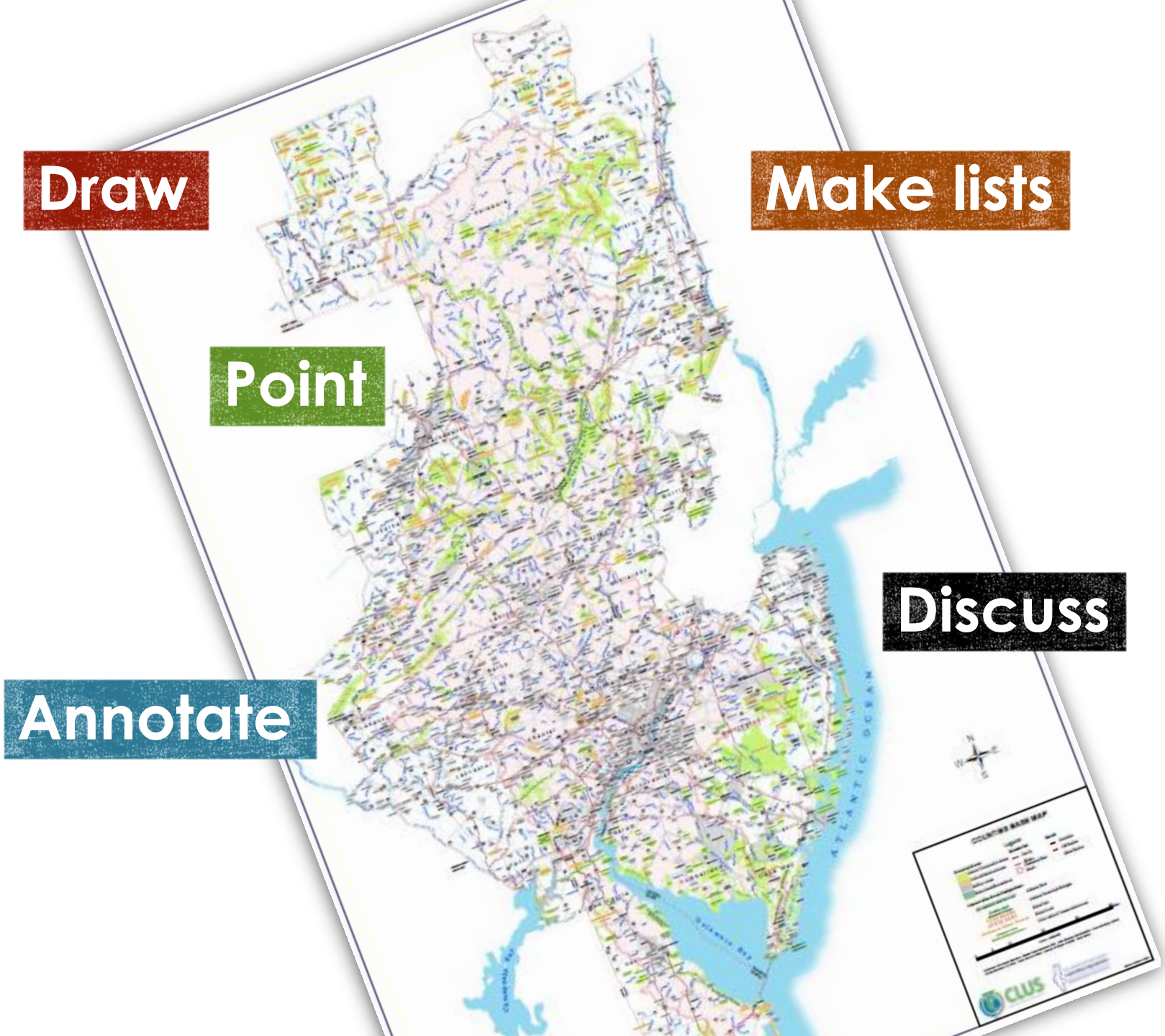
Let's get to work

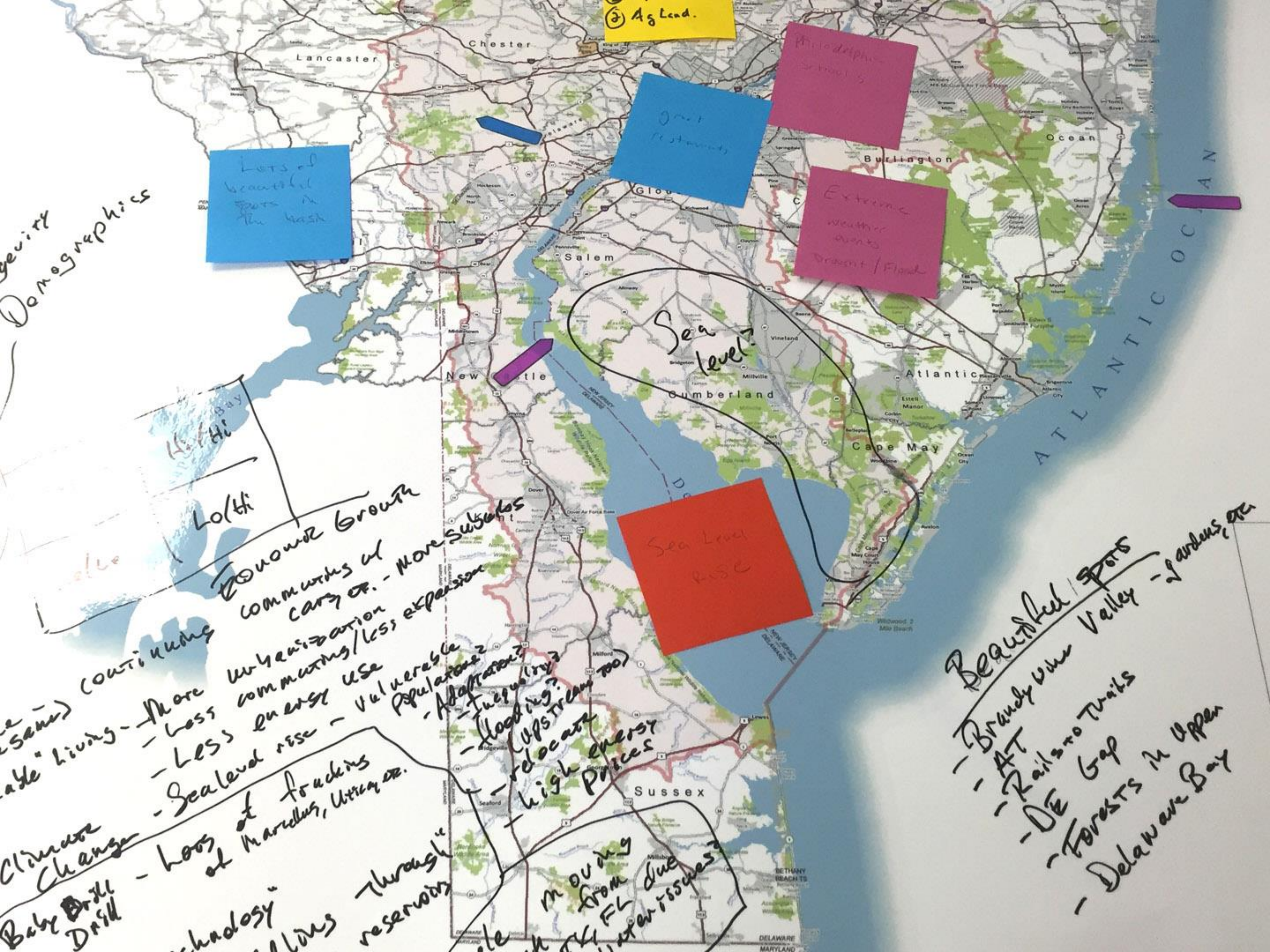
Session 1

- What do you value? What would you like to preserve? What are the current challenges & opportunities?
- Report back

Session 2

- What would you like to change? What are future challenges & opportunities?
- Report back


Draw
Make lists
Point
Discuss
Annotate


Ag Land.
Chester
Lancaster
Philadelphia Schools
great restaurants
Burlington
Ocean
Extreme weather events Drought / Flood
Demographics
Salem
Sea level?
Vineland
Cumberland
Atlantic
Cape May
ATLANTIC OCEAN
Lo/Hi
Economic Growth
- more suburbs
Sea Level Rise
Less energy use
Sealevel rise - vulnerable populations?
- Adaptation?
- Inequality?
- flooding? upstream too?
- relocate
- high energy prices
Climate Change
Loss of fracking of Marcellus, Utica etc.
Sussex
Beautiful spots
Brandywine Valley - gardens, etc.
- AT
- Rails to Trails
- DE Gap
- Forests in Upper
- Delaware Bay

What's next?

Philadelphia, PA	Oct. 29, 2015
Narrowsburg, NY	Nov. 10, 2015
Reading, PA	Jan. 13, 2016
Washington, NJ	Feb. 16, 2016
Dover, DE	Feb. 18, 2016

What's next?

On-line survey (coming in winter 2016)

- A chance for you to contribute individually
- A chance for others to contribute

Draft scenario storylines (coming in spring 2016)

- Incorporate best data and findings from workshops and survey
- We'll be asking for your feedback

Final scenario storylines (summer 2016)

Scenario forecasts (fall/winter 2016)

Preliminary Findings- 2015 Workshops

http://drbproject.org

DELAWARE RIVER BASIN
Land Use Dynamics
SHIPPENSBURG UNIVERSITY

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Funding for this project comes from the William Penn Foundation.

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Welcome to the Delaware River Basin Project!

A watershed of over 13,000 square miles, the Delaware River Basin (DRB) provides water resources for roughly 5% of the US population. This 2-year project based at Shippensburg University aims to develop a land cover mapping, modeling, and monitoring system for the Delaware River Basin in support of maintaining and restoring water resources.

Thank you for your interest!

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The Delaware River Basin Project

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Antonia Price	Project coordinator
Joshua Barth	Student fellow

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