Chesapeake Bay Program
A Watershed Partnership

The Chesapeake Bay Land Change Model: Trend Scenario

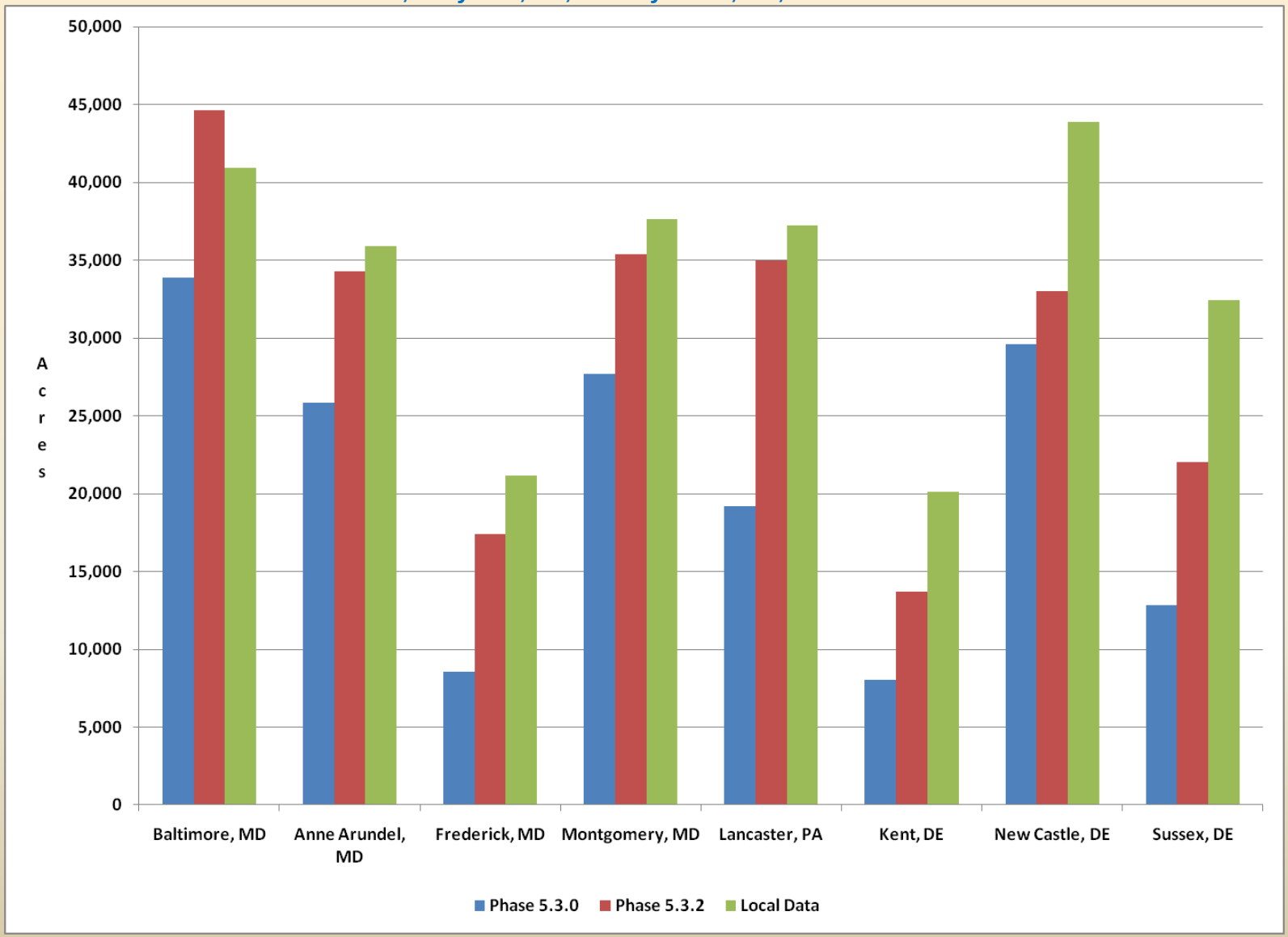
Peter R. Claggett

Research Geographer, USGS

Chesapeake Bay Program

September 15, 2011

County-level Impervious Surface Estimates
(Phase 5.3.0, Phase 5.3.2, and Local Data)
MD, Maryland; PA, Pennsylvania; DE, Delaware



USGS

Why was the CBLCM* created?

1. To generate spatially and temporally consistent developed land use data for calibrating the Chesapeake Bay watershed model and for simulating alternative future scenarios.

2. A new model was needed to address the specific data input needs of the Watershed Model and to accommodate the best available regional data.

*Chesapeake Bay Land Change Model

What does the CBLCM do?

1. Estimates extent of historic and future development in rural, suburban, and urban areas.

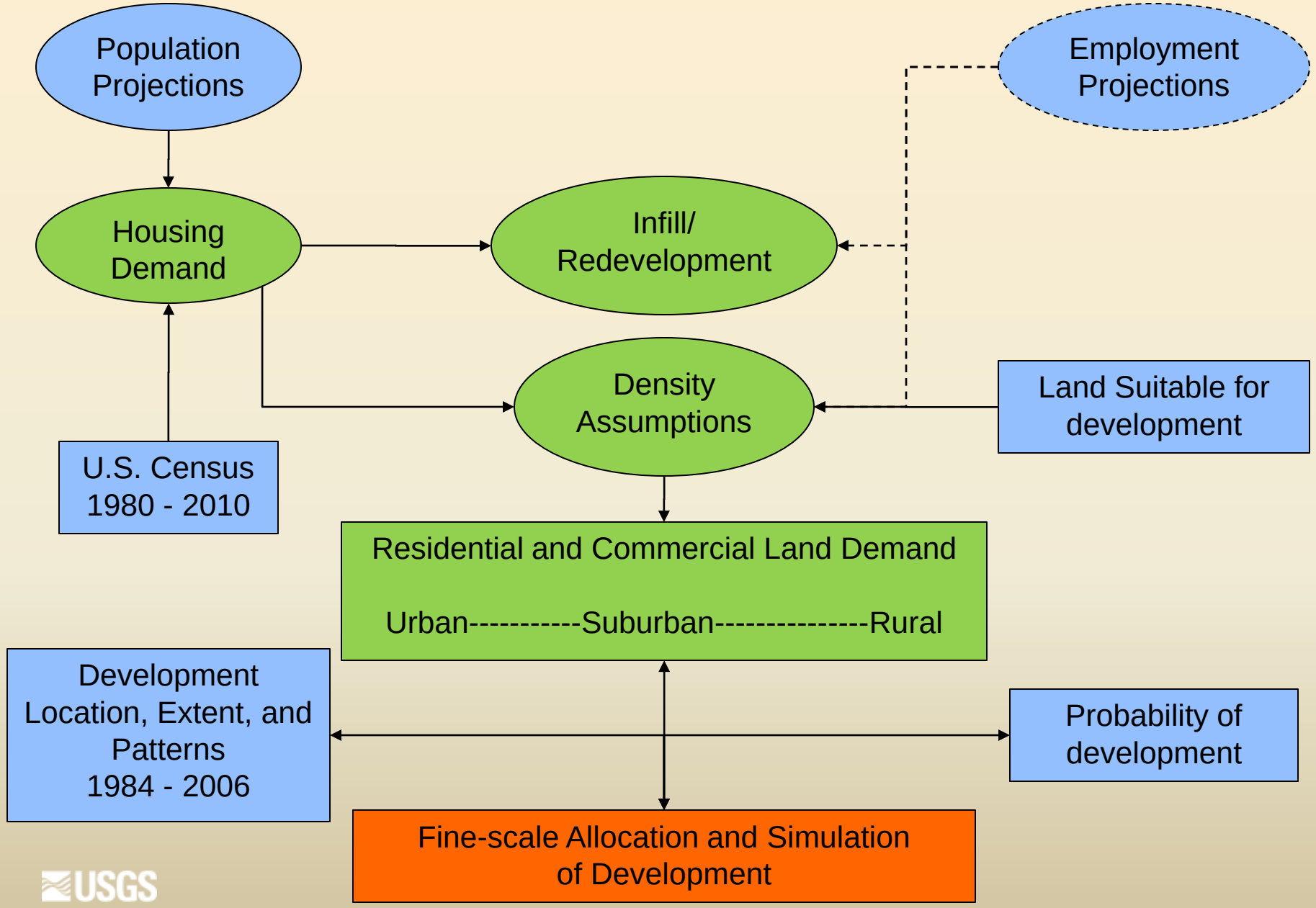
2. Estimates historic and future population and households on sewer and septic.

3. Estimates future conversion of forest and farmland.

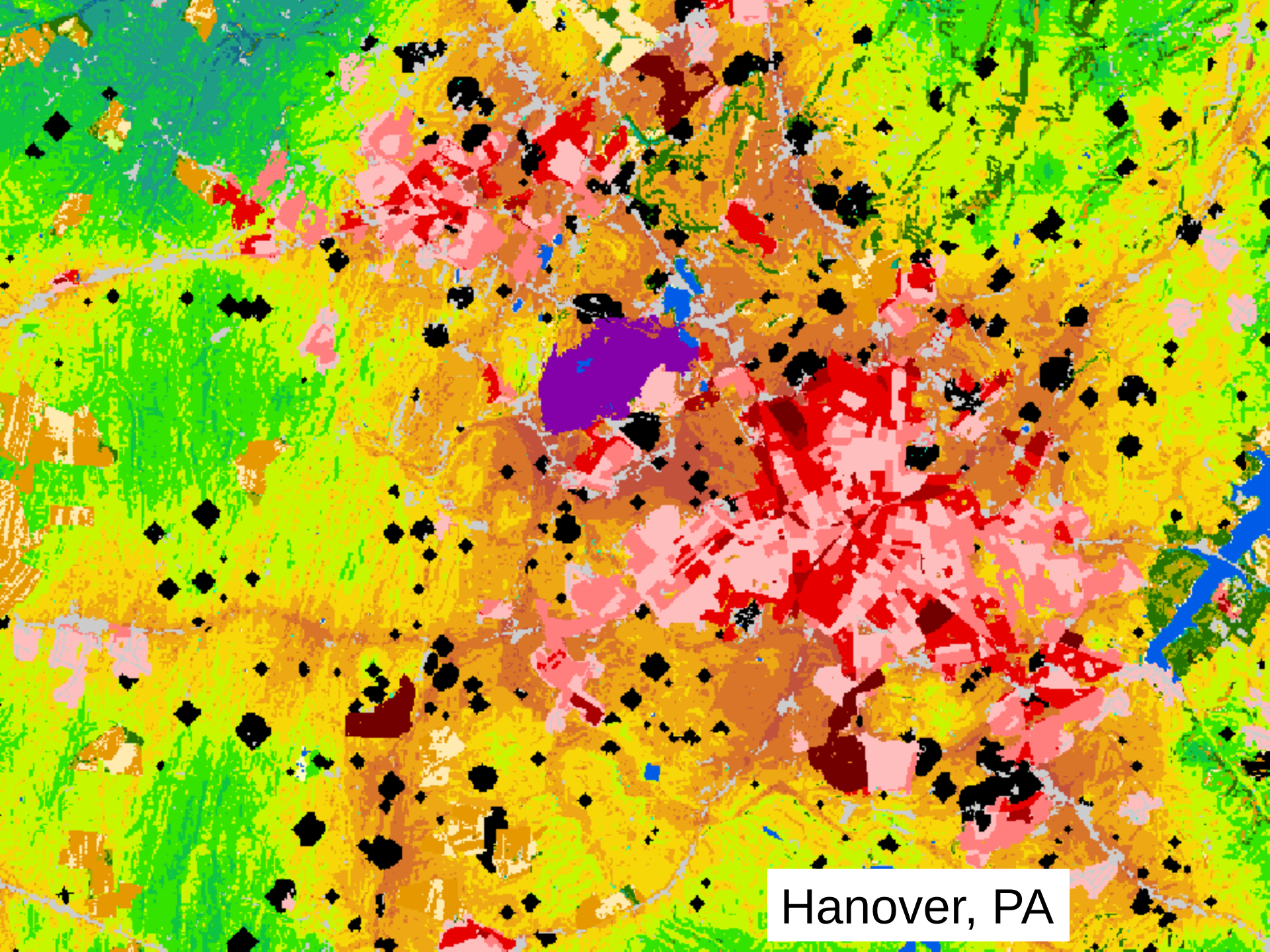
CBLCM Data Inputs

- Land cover (1984, 1992, 2001, 2006)
- Census population and housing (1990, 2000, 2010)
- Census population estimates (2001 – 2010)
- County population projections (2010 – 2025)
- Roads (2006 NAVTEQ)
- Institutions (2006 NAVTEQ)
- Slope (National Elevation Dataset)
- Public and protected lands (Federal, State, Local, and Nongovernmental Organization data)
- Sewer service areas (Tetra Tech survey)
- Estimated rural and suburban residential lot sizes (Chesapeake Bay Program Office - CBPO)
- Estimated impervious surface coefficient for residential lots (CBPO)
- Estimated future average household size (CBPO)

How does the CBLCM work?

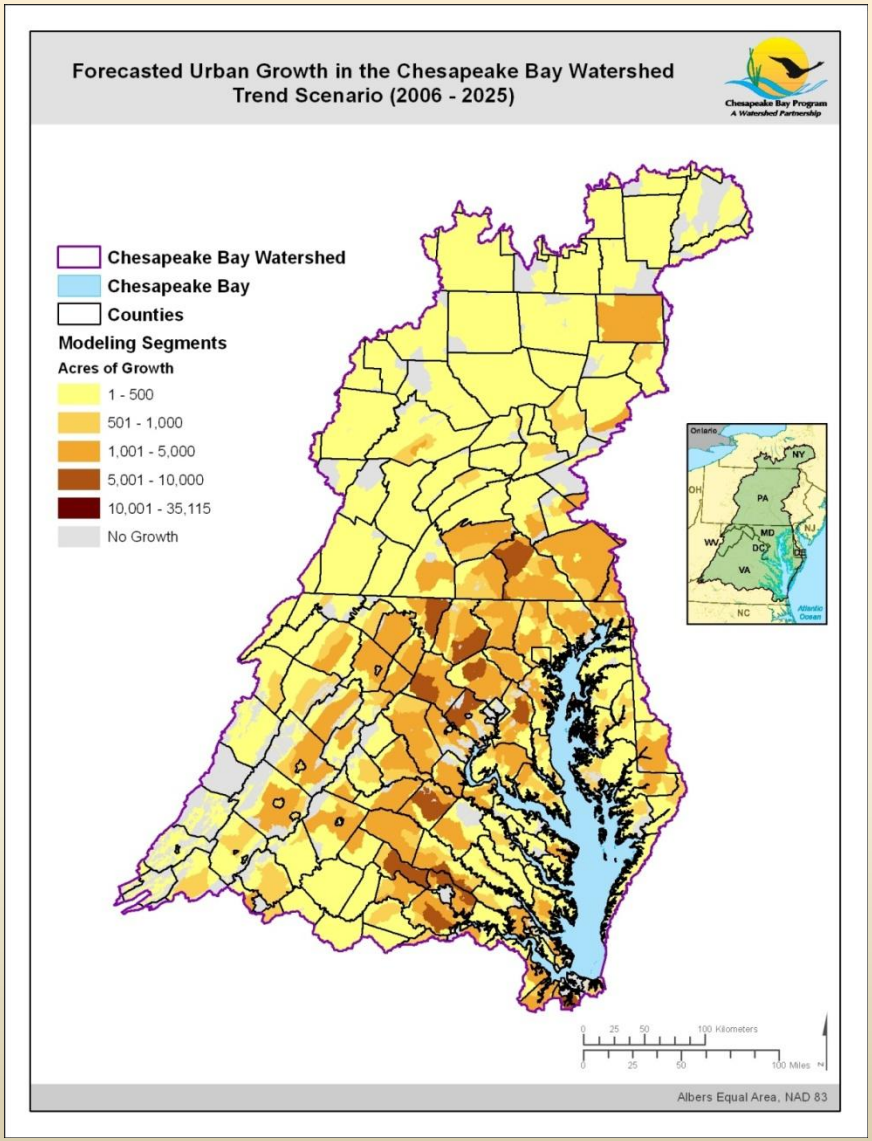


USGS


Hanover, PA

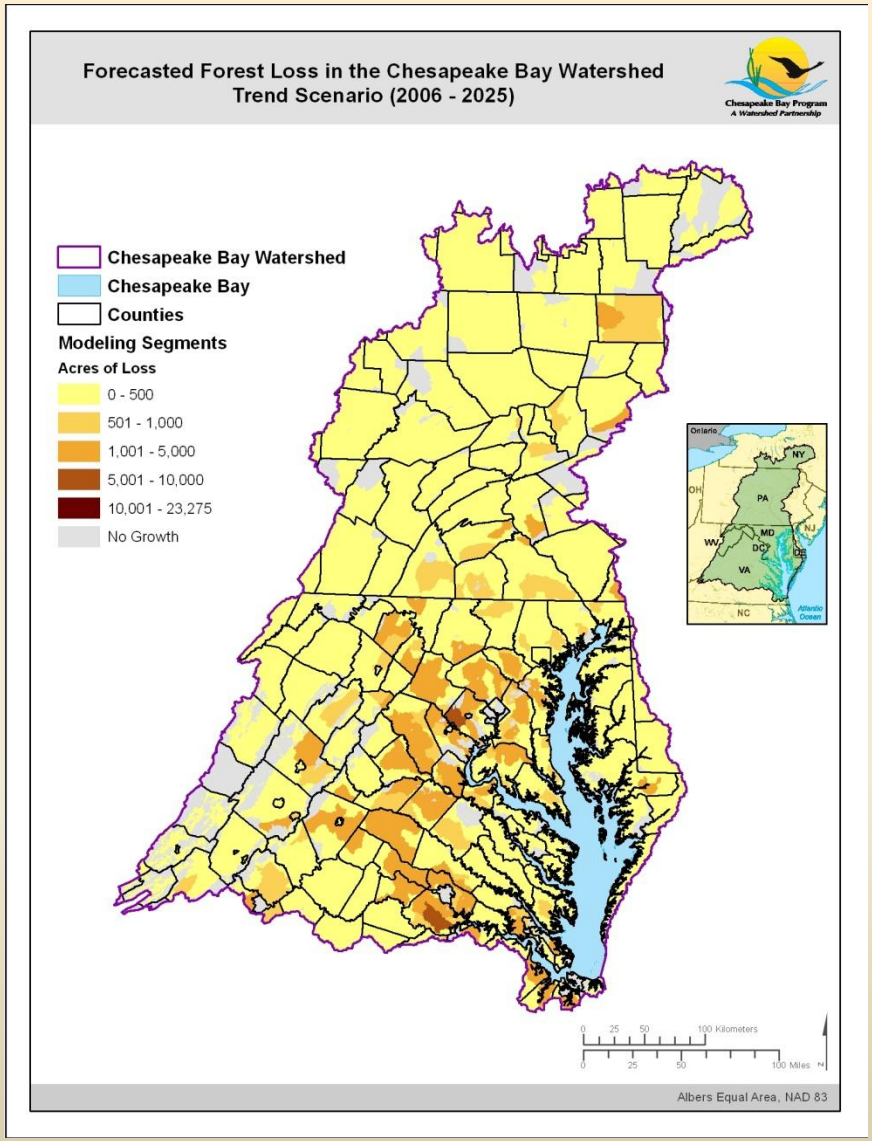
Forecasted Urban Growth in the Chesapeake Bay Watershed

2006 - 2025

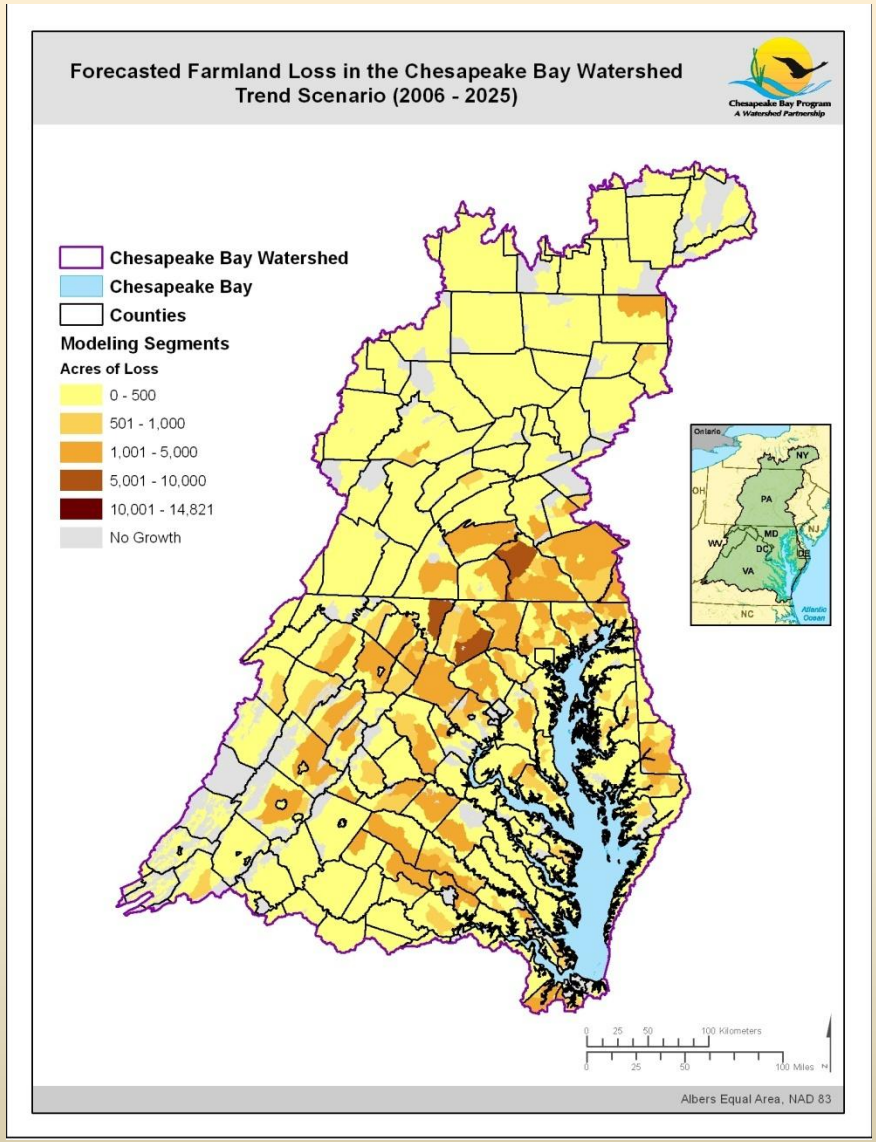


USGS

Forest Loss (2006 – 2025)



Farmland Loss (2006 – 2025)



USGS

Phase 5.3.2 Trend Scenario (2006 – 2025)

- Developed lands may increase an additional 15 percent (~ 37,800 acres per year).
- Impervious surfaces may increase by 122,000 acres.
- Pervious surfaces (lawns) may increase by 596,000 acres.
- 85 percent of future population growth expected to be on sewer.
- Onsite septic systems may increase by 15 percent (236,000 systems) and population on sewer may increase by 17 percent (2,160,000).
- Approximately 328,000 acres of forests (tree canopy) and 390,000 acres of farmland may be converted to development.

Trend Scenario Impacts to Nitrogen Loads

Phase 5.3.2 Median No Action Edge-Of-Stream Load Coefficients

Impervious	**12.5 lbs. TN/acre/yr**
Pervious (lawns)	**10.5 lbs. TN/acre/yr**
Septic	**4.5 – 11.2 lbs. TN/hh/yr**
Sewer	**1.8 - 4.9 lbs. TN/hh/yr**

Abbreviations: lbs., pounds; TN/acre/yr, total nitrogen per acre per year; TN/hh/yr, total nitrogen per household per year

Trend Scenario Impacts to Nitrogen Loads

Impervious surface:
122,000 acres: + 1.5 million lbs. TN/yr

Pervious surfaces (lawns):
596,000 acres: + 6.3 million lbs. TN/yr

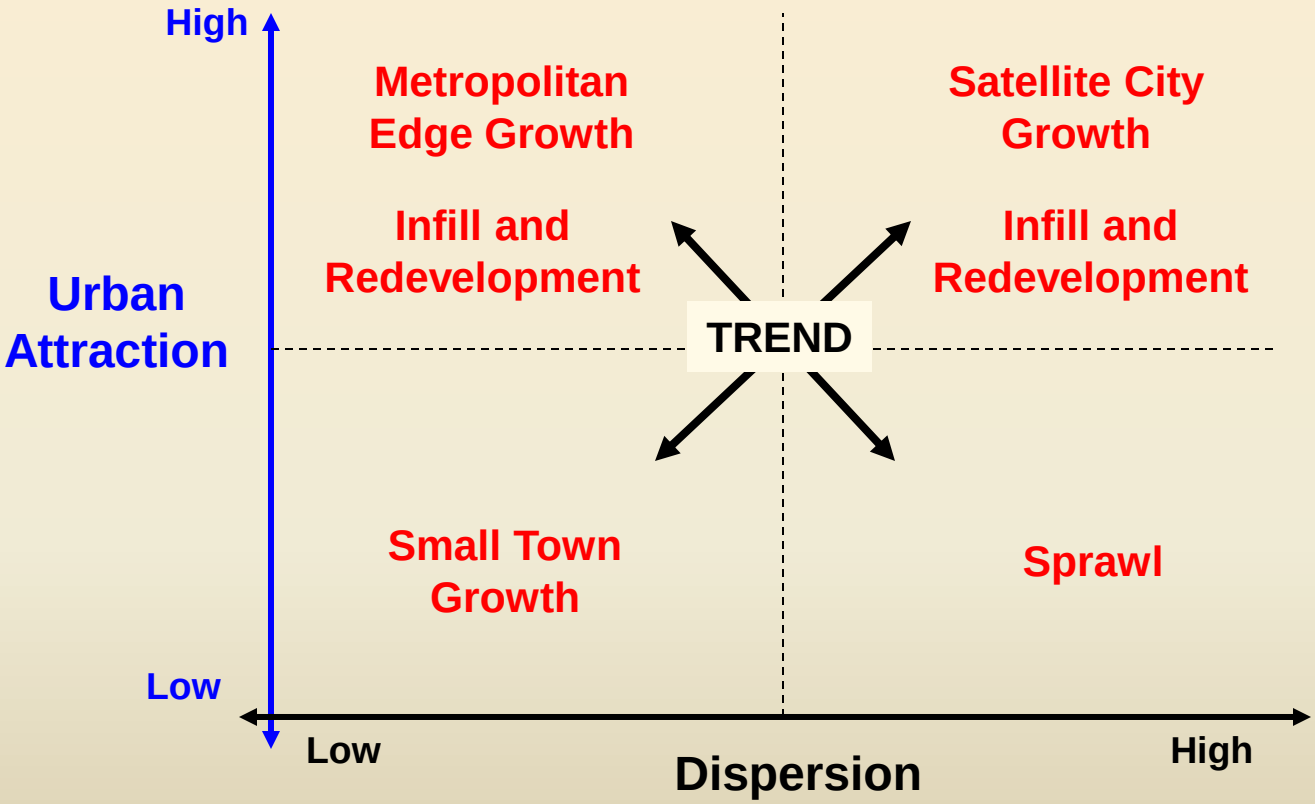
Sewer:
2,160,000 people: + 1.5 – 4.2 million lbs. TN/yr

Septic:
236,000 systems: + 0.9 – 2.6 lbs. TN/yr

Total Impact:
+ 10.2 – 14.6 million lbs. TN/yr

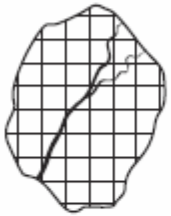
Abbreviations: lbs., pounds; TN/yr, total nitrogen per year

Conceptual Alternative Future Development Scenarios



Alternative Future Development Scenarios

EXHIBIT 5: 10,000-Acre Watershed Accommodating 10,000 Houses

Scenario A	Scenario B	Scenario C
		
10,000 houses built on 10,000 acres produce: 10,000 acres x 1 house x 18,700 ft^3/yr of runoff = **187 million ft^3/yr of stormwater runoff** **Site: 20% impervious cover** **Watershed: 20% impervious cover**	10,000 houses built on 2,500 acres produce: 2,500 acres x 4 houses x 6,200 ft^3/yr of runoff = **62 million ft^3/yr of stormwater runoff** **Site: 38% impervious cover** **Watershed: 9.5% impervious cover**	10,000 houses built on 1,250 acres produce: 1,250 acres x 8 houses x 4,950 ft^3/yr of runoff = **49.5 million ft^3/yr of stormwater runoff** **Site: 65% impervious cover** **Watershed: 8.1% impervious cover**

USEPA, 2006. Protecting Water Resources with Higher-Density Development, 231-R-06-001.

USGS

Crafting Alternative Future Scenarios

Exclusion

- Wetlands and riparian zones
- Riparian buffers
- Critical areas
- Steep slopes
- Easements and protected lands
- Zoning and ordinances

Accessibility

- Travel time
- Proximity to major road intersections

Densification

- Zoning and ordinances
- Lot size (percent impervious, percent pervious)
- Percent single-unit, percent multi-unit houses
- Population and housing density
- Priority funding areas

Demand adjustment

- Population projection
- Average household size
- Vacancy rate

Amenity attraction (proximity to…)

- Transit stations
- Parks, lakes, and golf courses
- Employment centers
- Activity centers
- Bay shoreline
- High performing schools
- Public water and sewer
- Zoning and ordinances

Disamenity repulsion

- Industrial areas
- Airports
- Landfills
- High-crime areas

USGS

Contact Information:

Peter Claggett

Research Geographer

U.S. Geological Survey

410-267-5771

pclaggett@usgs.gov

USGS