Phase 7 Land Use

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Water Quality Goal Implementation Team Meeting
April 25, 2022

Land Use History for Phase 7

LCMAP: Land Change Monitoring, Assessment, and Projection; CBLCD: Chesapeake Bay Land Cover Data series;
NLCD: National Land Cover Database
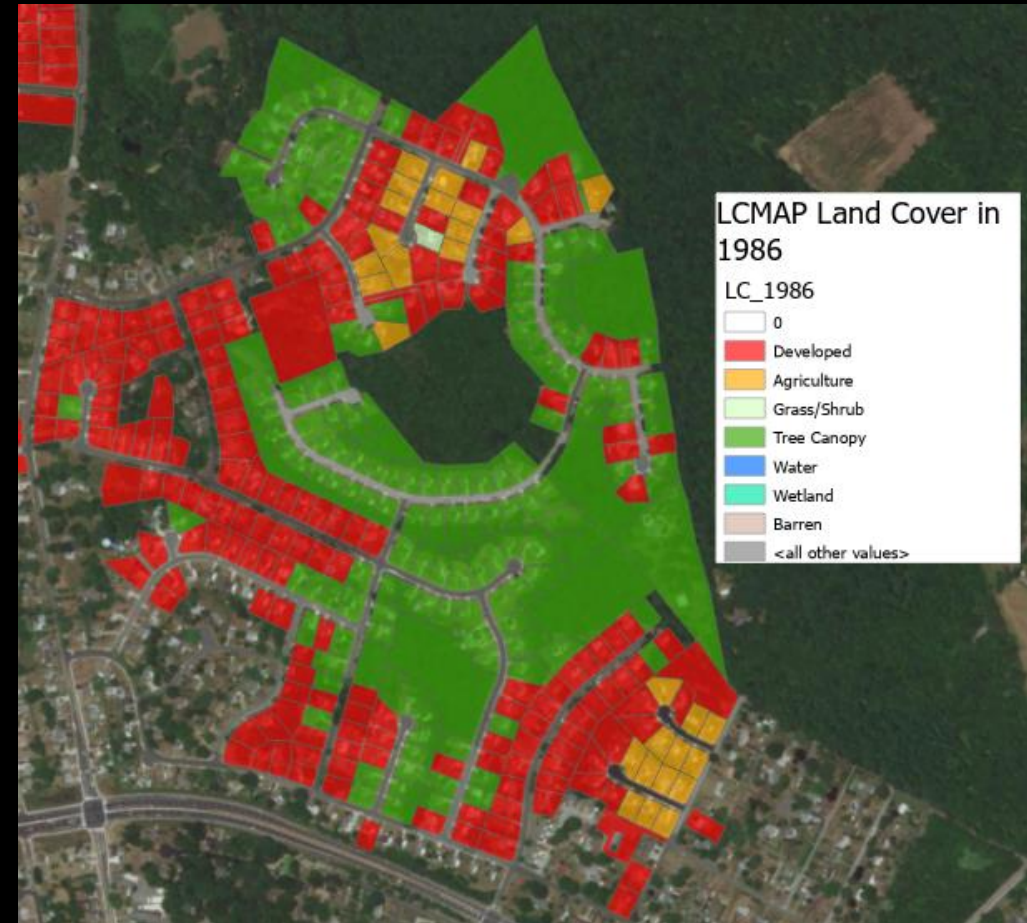
Back-Casting Development Example

Year Developed (LCMAP)
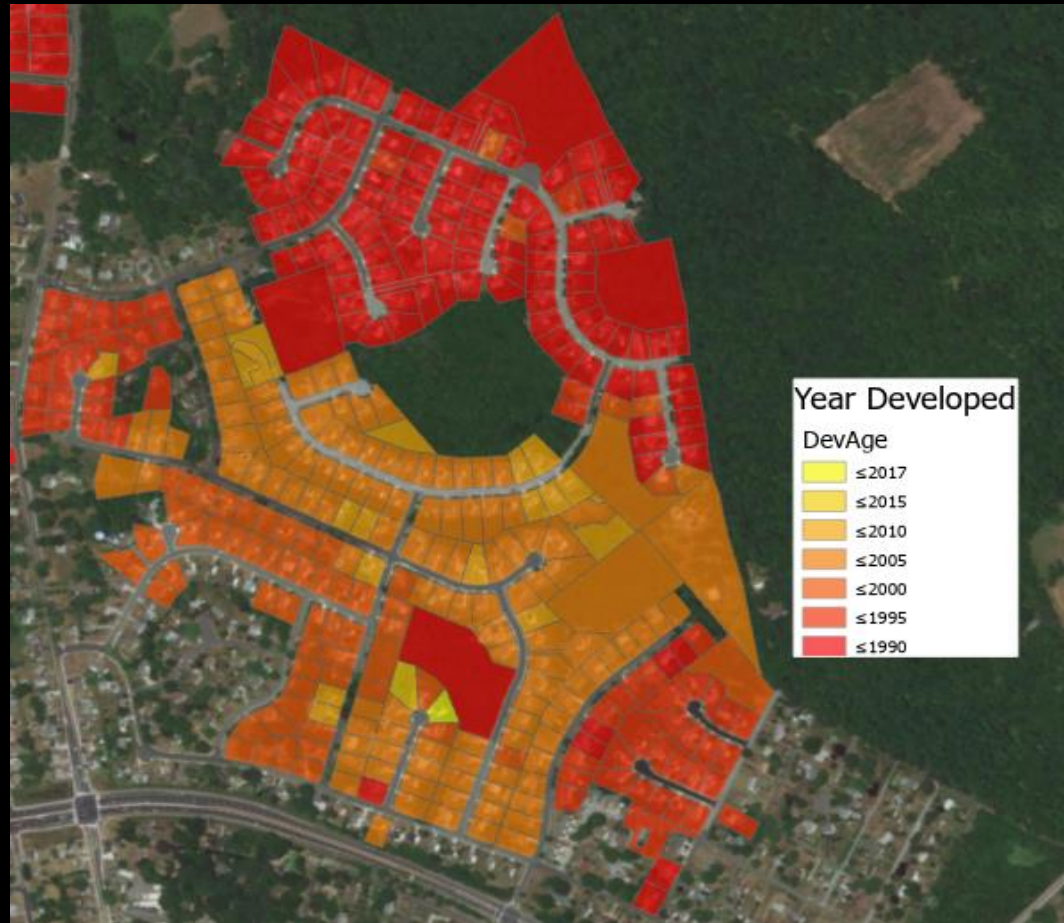
Land Cover 1986 (LCMAP)

CBP Complete Land Use/Cover Classification (62 classes)

1. Water (11)
    1.1 Estuarine/ Marine
    1.2 Lentic (fresh)
        1.2.1 Lakes and reservoirs
        1.2.2 Riverine ponds
        1.2.3 Terrene ponds
    1.3 Lotic
        1.3.1 Channels
            1.3.1.1 Open Channel
            1.3.1.2 Tree Canopy over Channel
            1.3.1.3 Culverted
        1.3.2.Ditches
            1.3.2.1 Open Ditch
            1.3.2.2 Tree Canopy over Ditch
            1.3.2.3 Culverted

2. Development (12)
    2.1 Impervious
        2.1.1 Roads
        2.1.2 Structures
        2.1.3 Other Impervious
        2.1.4 Tree Canopy (TC) over Impervious
            2.1.4.1 TC over Roads
            2.1.4.2 TC over Structures
            2.1.4.3 TC over Other Impervious
    2.2 Pervious
        2.2.1 Turf Grass
        2.2.2 Transitional- barren

        2.2.3 Suspended Succession
            2.2.3.1 Barren
            2.2.3.2 Herbaceous
            2.2.3.3 Scrub-shrub
        2.2.4 Tree Canopy over Turf Grass

3. Natural (forest-related) (7)
    3.1 Forest (>= 1 acre, 240-ft width)
    3.2 Other Tree Canopy
    3.3 Harvested Forest (<= 3 years)
        3.3.1 Barren
        3.3.2 Herbaceous
    3.4 Natural Succession (> 3 years)
        3.4.1 Barren
        3.4.2 Herbaceous
        3.4.3 Scrub-shrub

4. Production (17)
    4.1 Agriculture
        4.1.1 Cropland
            4.1.1.1 Barren
            4.1.1.2 Herbaceous
        4.1.2 Pasture/Hay
            4.1.2.1 Barren
            4.1.2.2 Herbaceous
            4.1.2.3 Scrub-shrub
        4.1.3 Orchard/vineyard
            4.1.3.1 Barren
            4.1.3.2 Herbaceous
            4.1.3.3 Scrub-shrub

        4.1.4 Animal Operations
            4.1.4.1 Impervious
            4.1.4.2 Barren
            4.1.4.3 Herbaceous
    4.2 Solar fields
        4.2.1 Impervious
        4.2.2 Pervious
            4.2.2.1 Barren
            4.2.2.2 Herbaceous
            4.2.2.3 Scrub-shrub
    4.3 Extractive (active mines)
        4.3.1 Barren
        4.3.2 Impervious

5. Wetlands and Water Margins (16)
    5.1 Tidal
        5.1.1 Barren
        5.1.2 Herbaceous
        5.1.3 Scrub-shrub
        5.1.4 Other Tree Canopy
        5.1.5 Forest
    5.2 Riverine (Non-tidal)
        5.2.1 Barren
        5.2.2 Herbaceous
        5.2.3 Scrub-shrub
        5.2.4 Other Tree Canopy
        5.2.5 Forest
    5.3 Terrene/Isolated (Non-tidal)
        5.3.1 Barren
        5.3.2 Herbaceous
        5.3.3 Scrub-shrub
        5.3.4 Other Tree Canopy
        5.3.5 Forest
    5.4 Bare shore

Note: White, yellow, and blue classes are mapped for 2017/18. Grey classes will be added to all years with the production of the 2021/22 LULC.

Phase 7 Land Use Classes (TBD)

1. Impervious, Roads
2.1 Impervious
    2.1.1 Roads

2. Impervious, Structures
2.1 Impervious
    2.1.2 Structures

3. Impervious, Other
2.1 Impervious
    2.1.3 Other Impervious
4.2 Solar fields
4.2.1 Impervious

4. Tree Canopy Over Impervious
2.1 Impervious
    2.1.4 Tree Canopy over Impervious

5. Turf Grass
2.2 Pervious, Developed
    2.2.1 Turf Grass

6. Tree Canopy over Turf Grass
2.2 Pervious. Developed
    2.2.4 Tree Canopy over Turf Grass

7. Pervious Developed, Other
2.2 Pervious. Developed
    2.2.2 Transitional- barren
    2.2.3 Suspended Succession
4.2 Solar fields
    4.2.2 Pervious

8. Forest
3.1 Forest (>= 1 acre, 240-ft width)
5.1 Tidal
    5.1.5 Forest (>= 1 acre, 240-ft width)
5.2 Riverine (Non-tidal)
    5.2.5 Forest (>= 1 acre, 240-ft width)
5.3 Terrene/Isolated (Non-tidal)
    5.3.5 Forest (>= 1 acre, 240-ft width)

9. Tree Canopy, Other
3.2 Other Tree Canopy
5.1 Tidal
    5.1.4 Other Tree Canopy
5.2 Riverine (Non-tidal)
    5.2.4 Other Tree Canopy
5.3 Terrene/Isolated (Non-tidal)
    5.3.4 Other Tree Canopy

10. Harvested Forest
3.3 Harvested Forest (<= 3 years)

11. Natural Succession
3.4 Natural Succession (> 3 years)
5.4 Bare shore, Water Margins

12. Wetlands, Tidal non-forested
5.1 Tidal Wetlands
    5.1.1 Barren
    5.1.2 Herbaceous
    5.1.3 Scrub-shrub

13. Wetlands, Riverine Non-forested
5.2 Riverine Wetlands (Non-tidal)
    5.1.1 Barren
    5.1.2 Herbaceous
    5.1.3 Scrub-shrub

14. Wetlands, Terrene Non-forested
5.3 Terrene/Isolated Wetlands (Non-tidal)
    5.1.1 Barren
    5.1.2 Herbaceous
    5.1.3 Scrub-shrub

15. Extractive
4.3 Extractive (active mines)
    4.3.1 Barren
    4.3.2 Impervious

16. Cropland
4.1 Agriculture
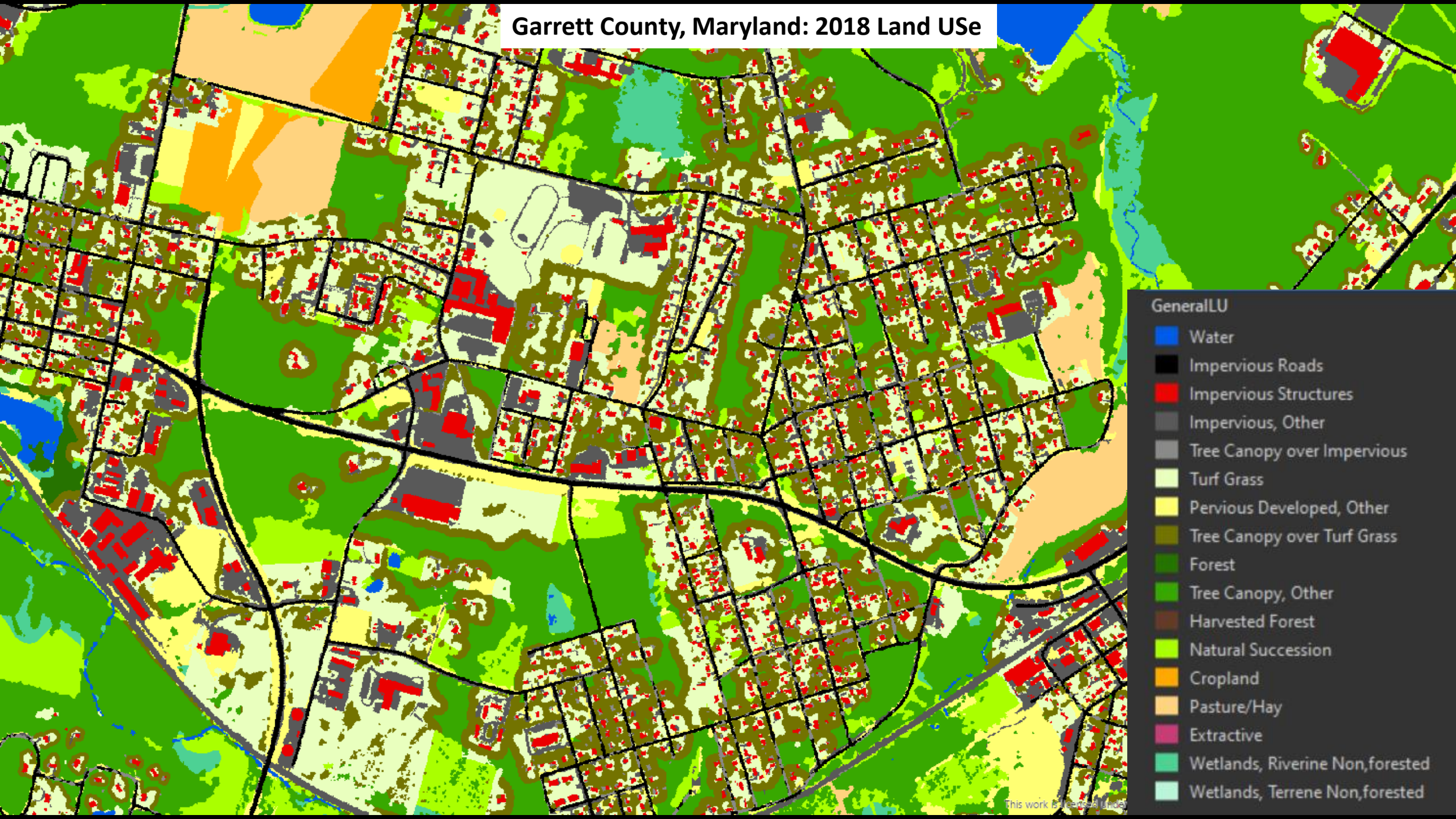   4.1.1 Cropland
    4.1.3 Orchard/vineyard

17. Pasture/Hay
4.1 Agriculture
    4.1.2 Pasture/Hay

18. Water
1.1 Estuarine/ Marine
1.2 Lentic
1.3 Lotic

Garrett County, Maryland: 2018 Land USe

GeneralLU
- Water
- Impervious Roads
- Impervious Structures
- Impervious, Other
- Tree Canopy over Impervious
- Turf Grass
- Pervious Developed, Other
- Tree Canopy over Turf Grass
- Forest
- Tree Canopy, Other
- Harvested Forest
- Natural Succession
- Cropland
- Pasture/Hay
- Extractive
- Wetlands, Riverine Non,forested
- Wetlands, Terrene Non,forested

Phase 7 Hydrography
Lower Susquehanna Example

CBP Hyper-Resolution Streams, 1:2000
(Lower Susquehanna Example)
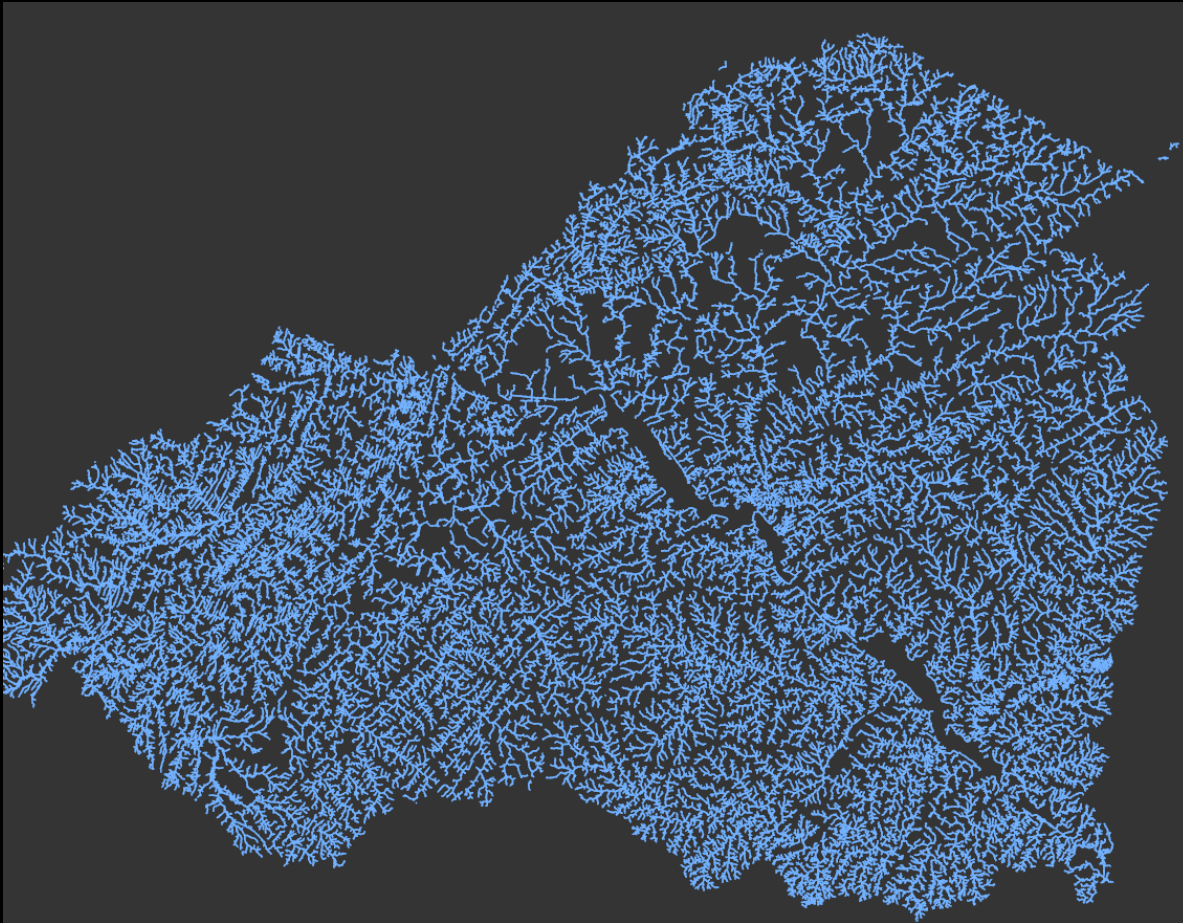
Attributes:
- Channel type (gully, ditch, stream, etc.)
- Bank height
- Channel width
- Floodplain width
- Entrenchment ratio
- Flow permanence probability
- Stream order
- Drainage area

2017 High-res Land Use +
Hyper-res Hydrography (2K)
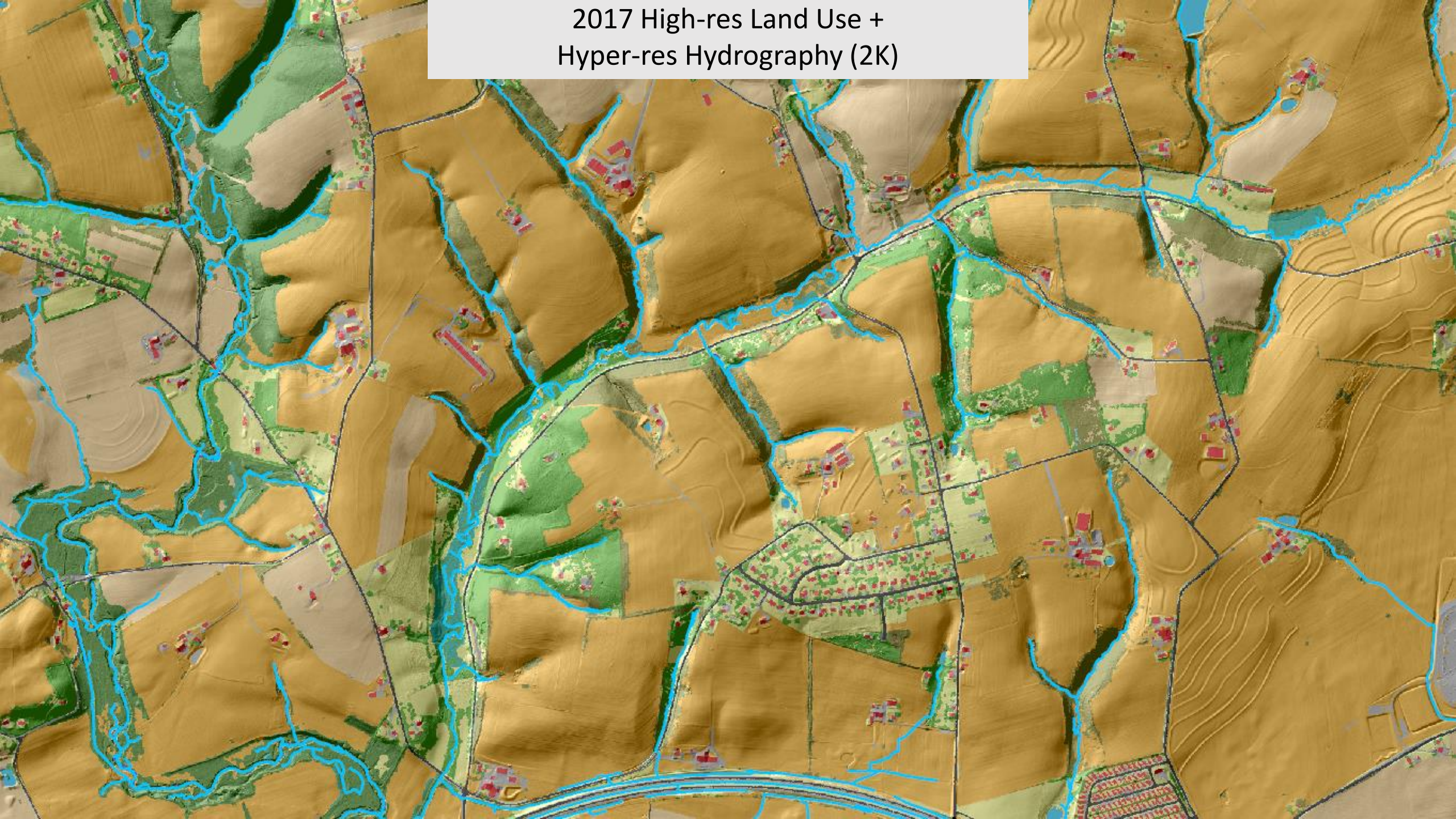
2x difference in stream density (2K vs 24K hydrography)

Added Tributaries

Increased Complexity

Extended headwaters
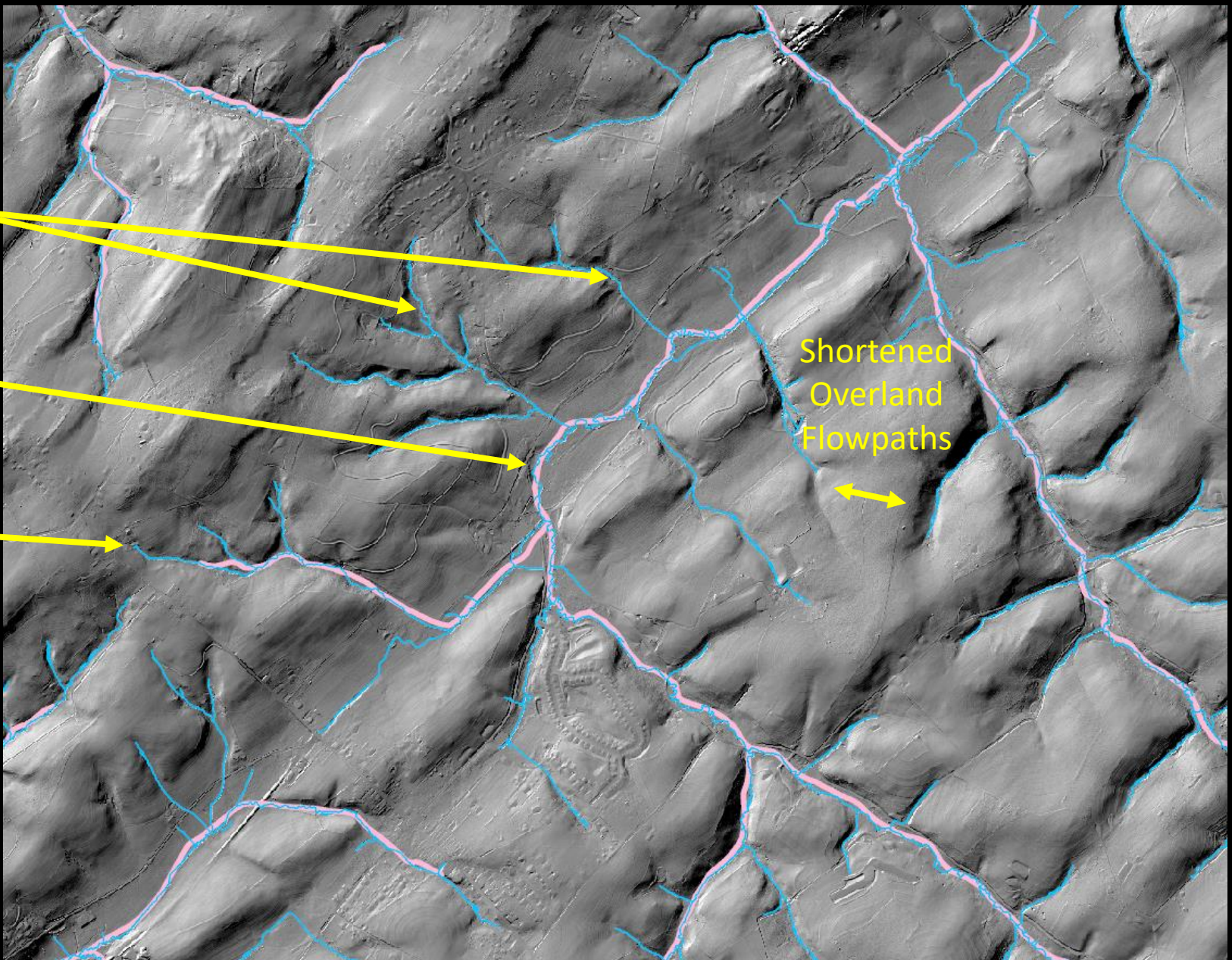
Shortened Overland Flowpaths

NHD24K
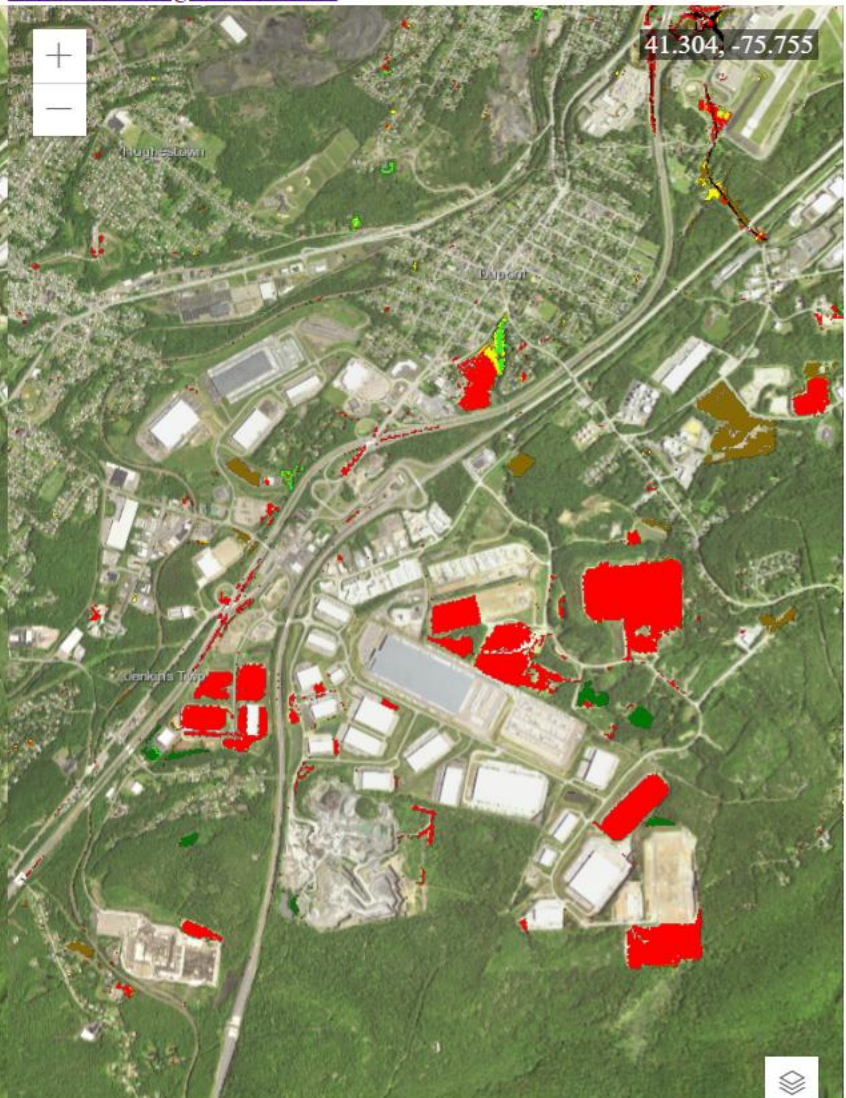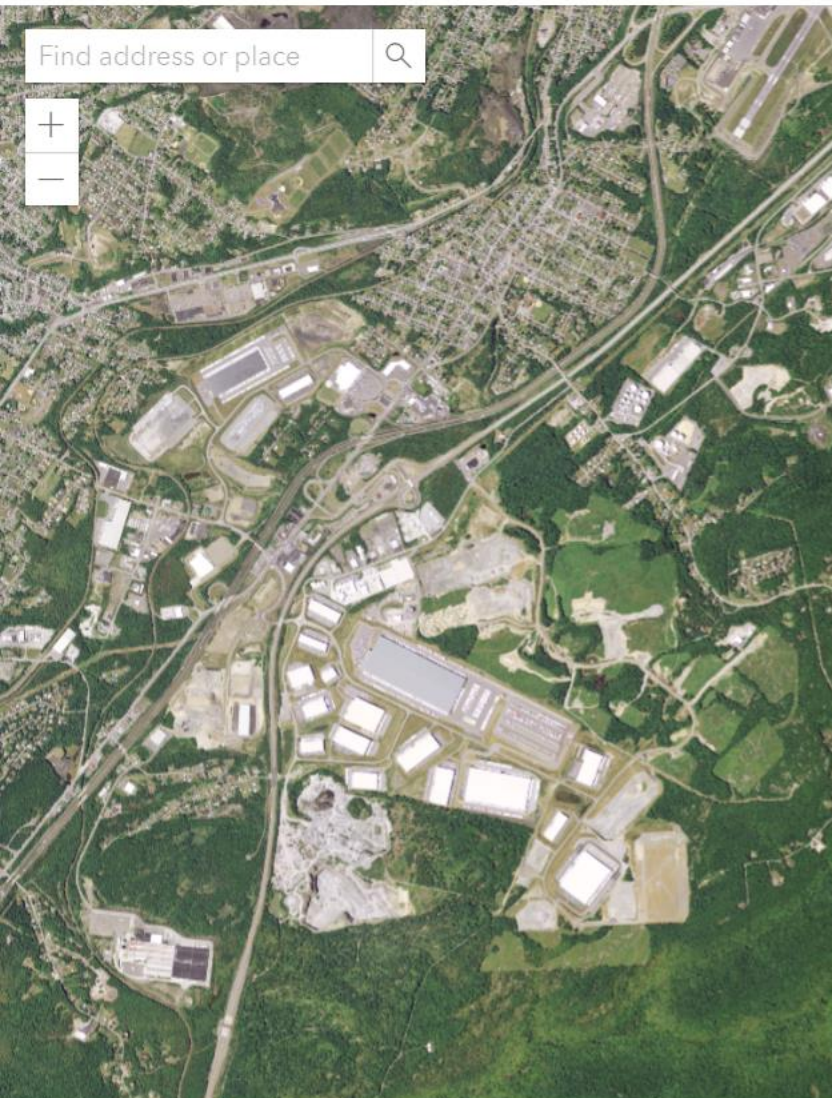
HyperRes
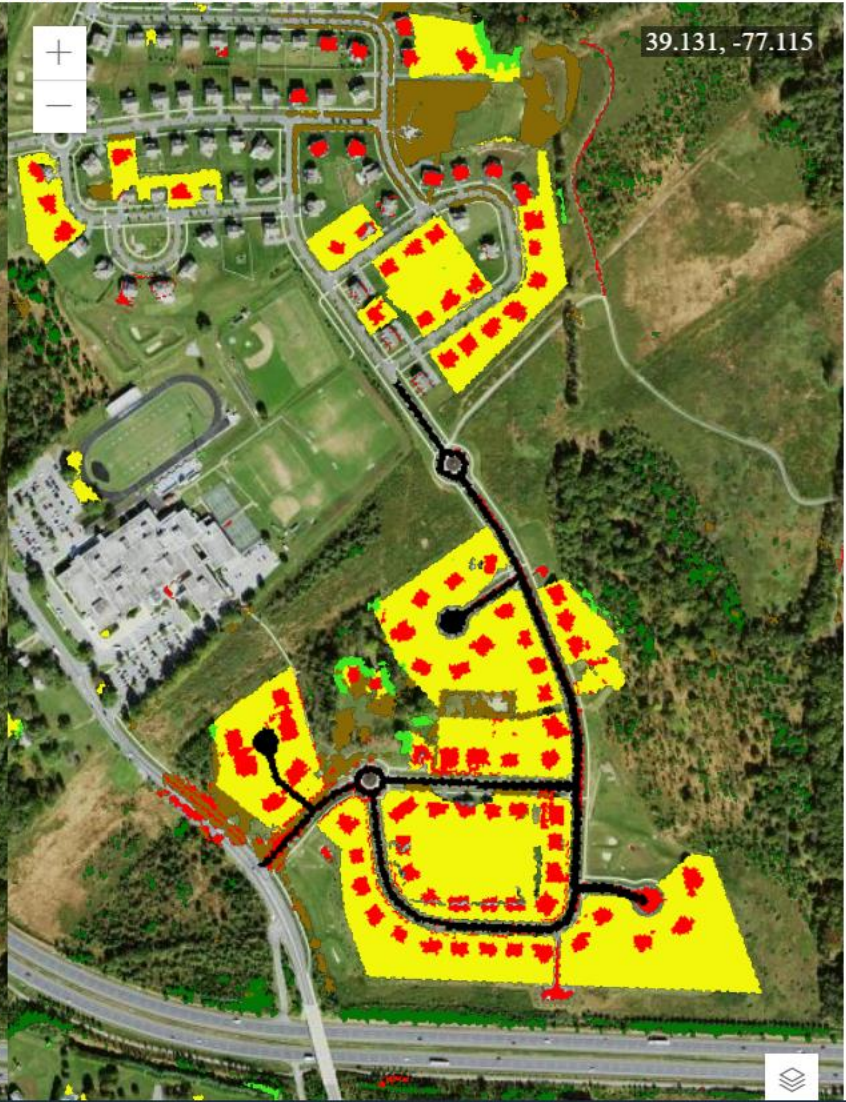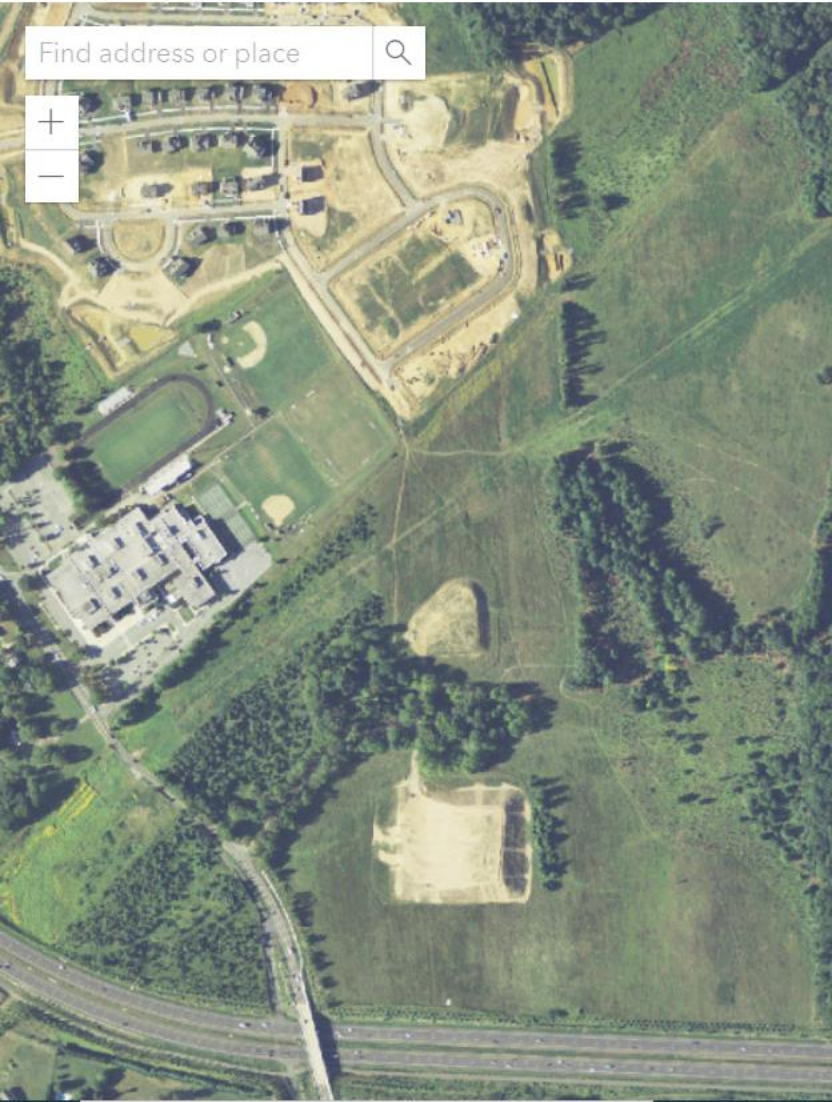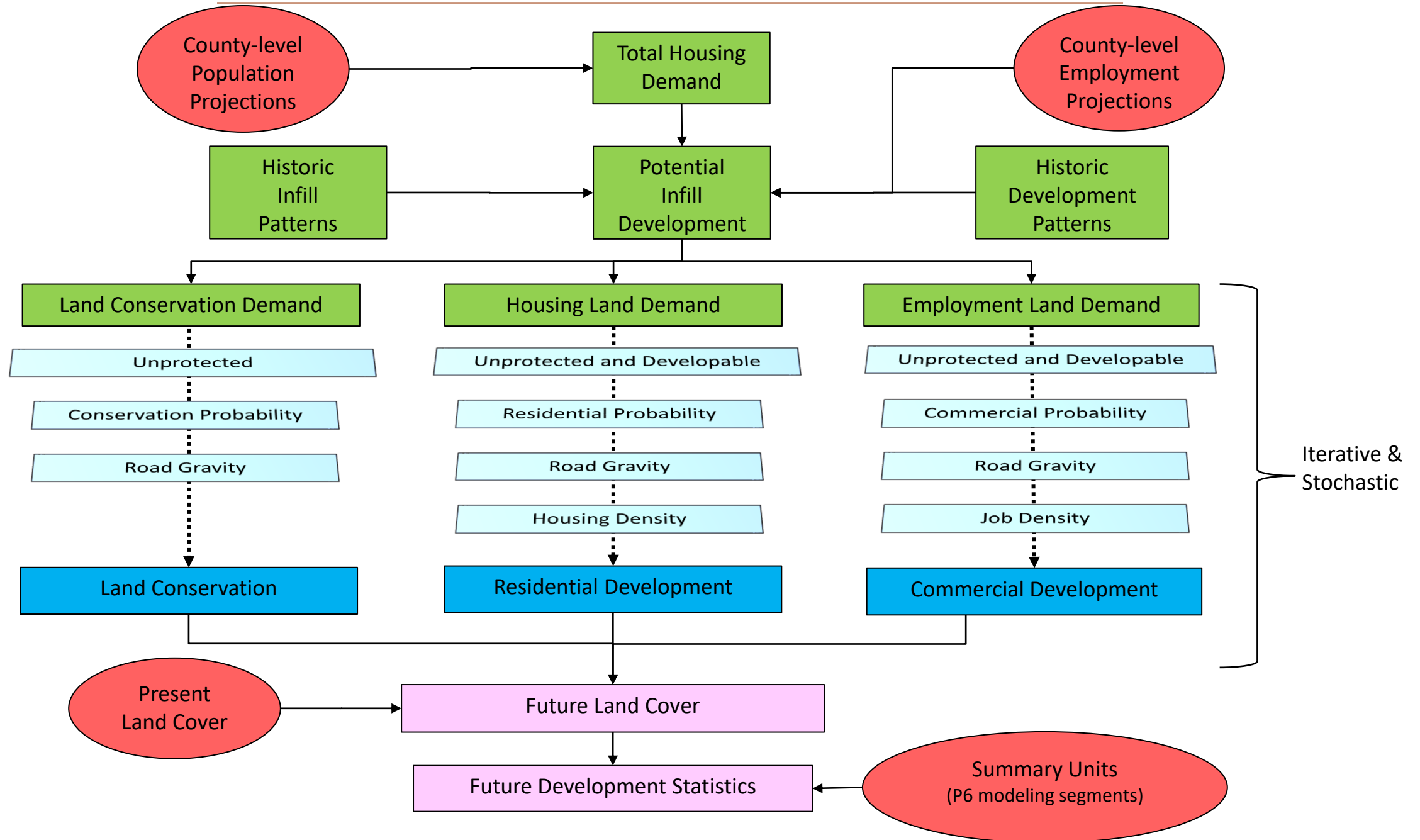
Evaluating the environmental significance of high-resolution data

- CalCAST
- SPARROW
- Maryland Healthy Watershed Assessment
- Various ongoing USGS studies relating landscape condition to macro-benthic and fish community composition, stream temperature, and stream conductivity.

Forecasting Future Changes in Land Use: Chesapeake Bay Land Change Model v5

Multiple Stochastic Iterations
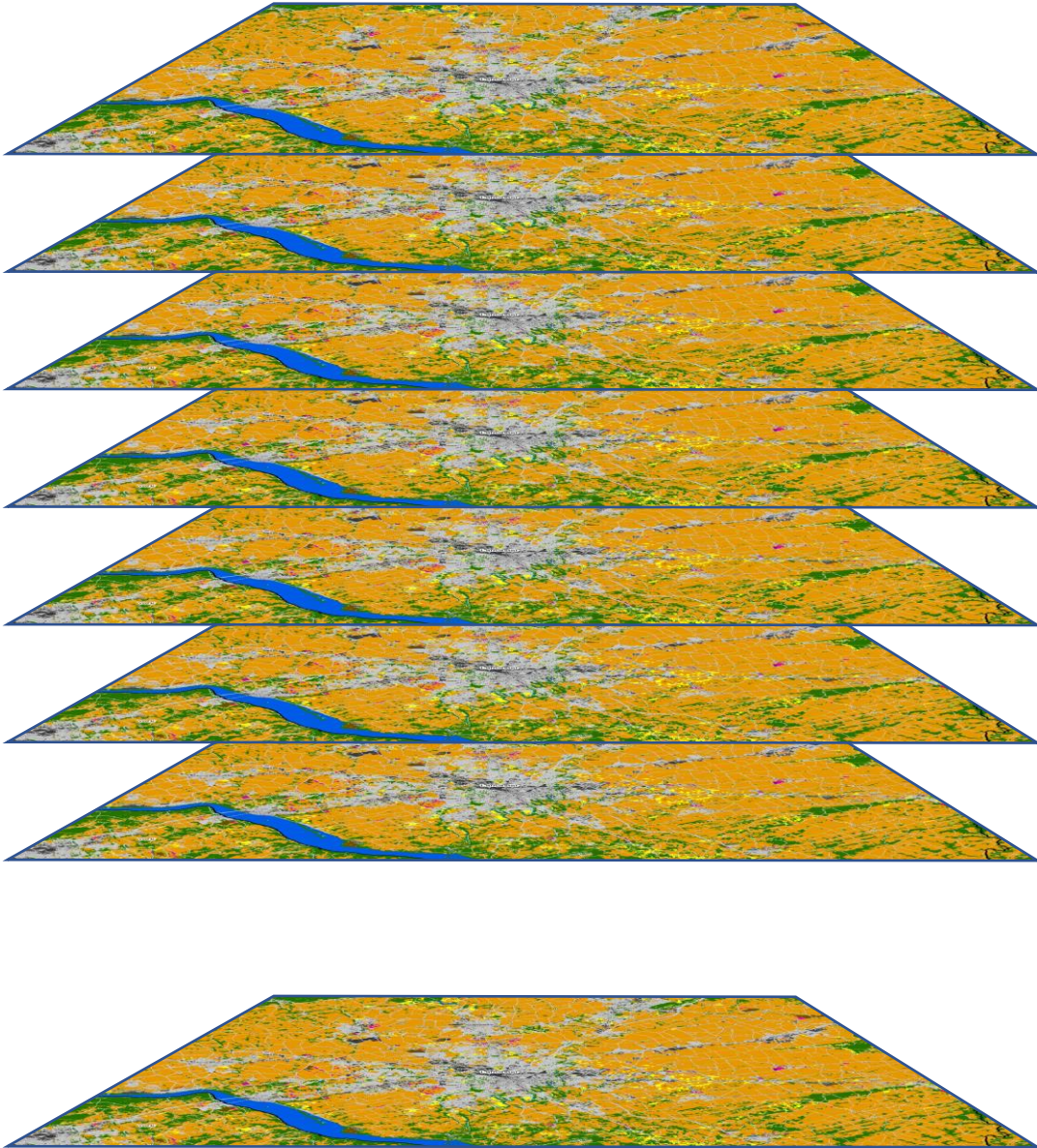
Every county is simulated 101 times for each scenario and target year, i.e., 2025.

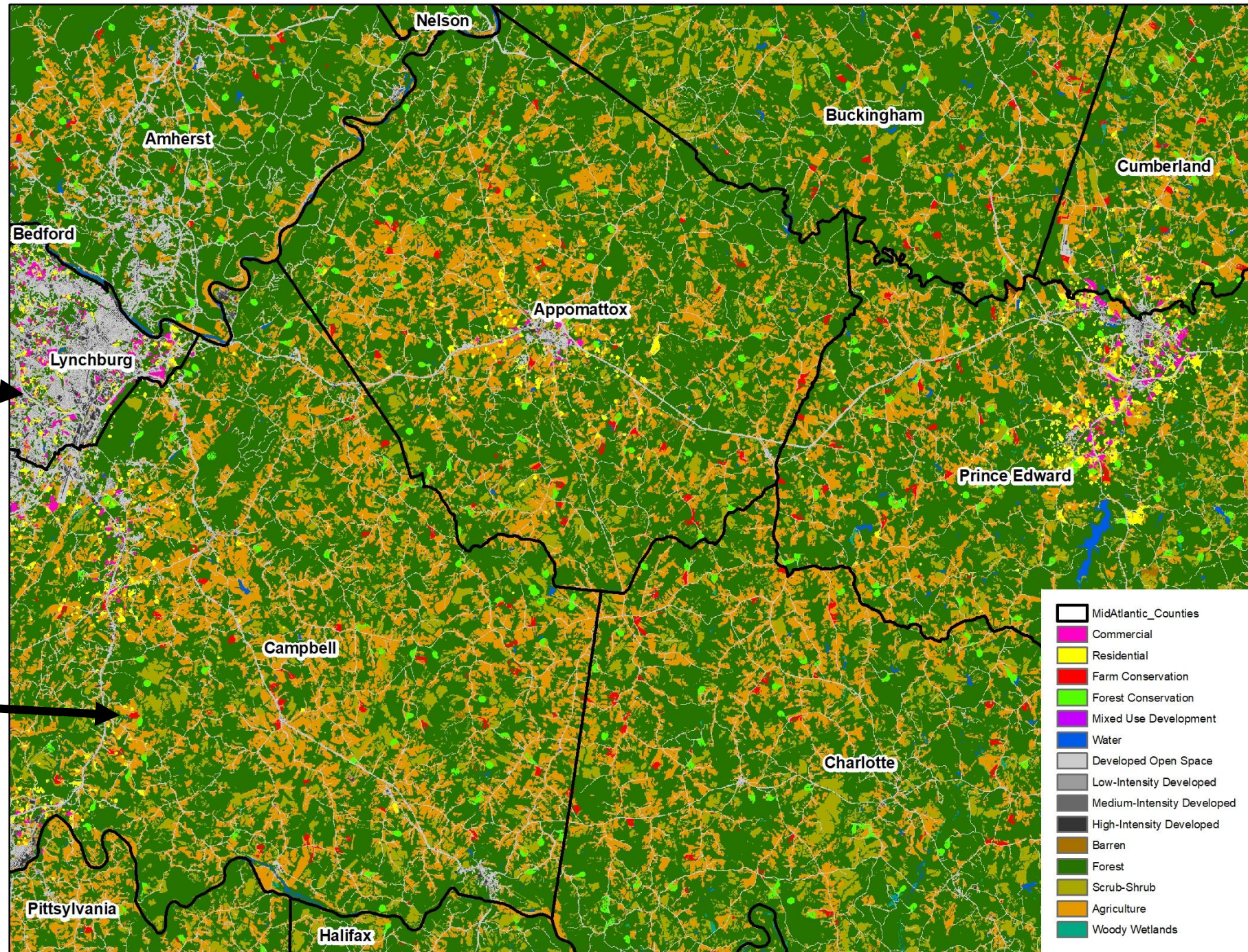Average of simulations by summary unit = future development

Relative Standard Deviation = estimate of uncertainty

Land Change Model Outputs
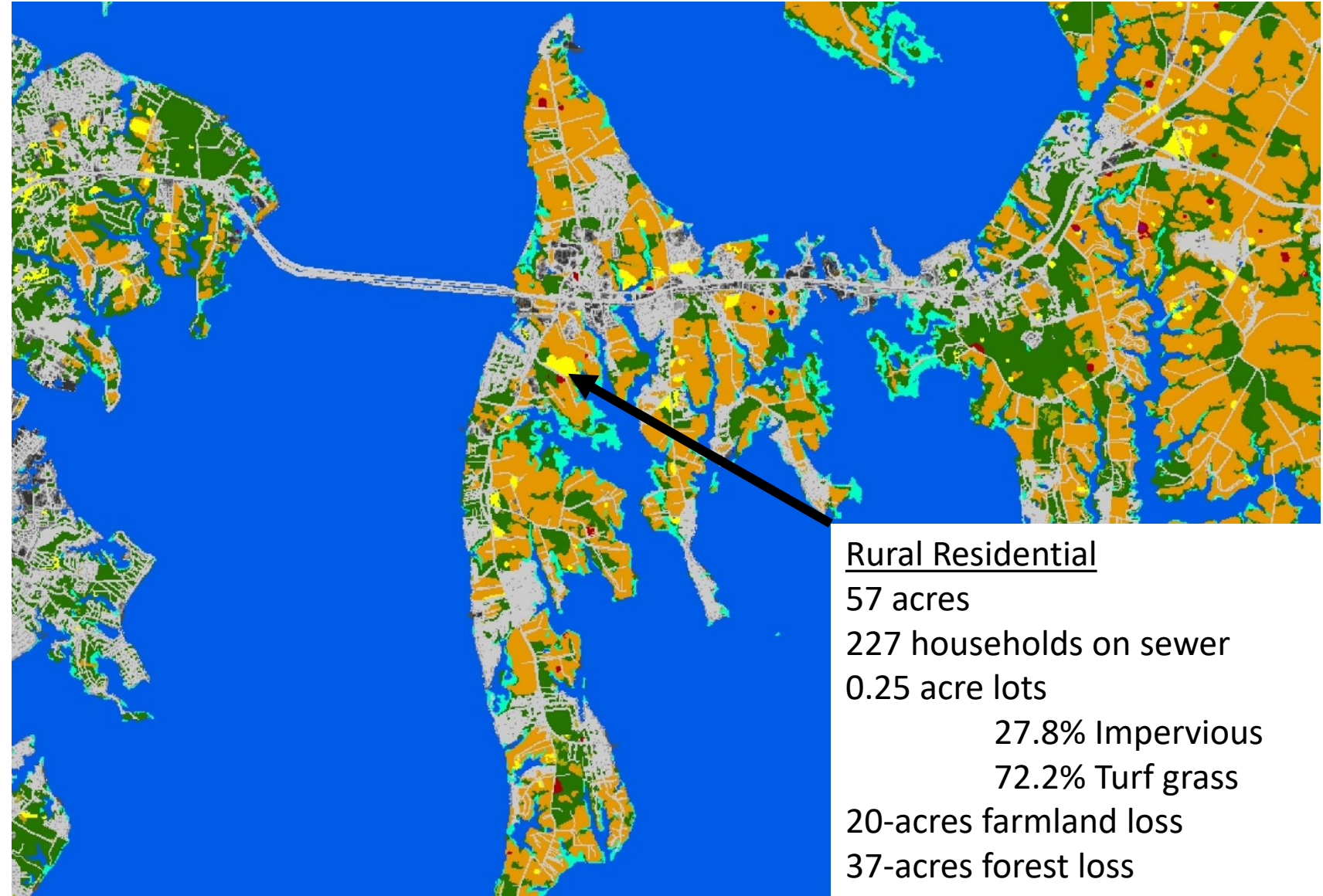
Commercial ▮ and Residential ▮ Growth

Farmland ▮ and Forest ▮ Conservation

MidAtlantic_Counties
Commercial
Residential
Farm Conservation
Forest Conservation
Mixed Use Development
Water
Developed Open Space
Low-Intensity Developed
Medium-Intensity Developed
High-Intensity Developed
Barren
Forest
Scrub-Shrub
Agriculture
Woody Wetlands

Nelson
Buckingham
Cumberland
Amherst
Bedford
Appomattox
Lynchburg
Prince Edward
Campbell
Charlotte
Pittsylvania
Halifax

Land Change Model Outputs: Summary Statistics

- Impervious surface and turf grass expansion

- Forest conversion to development

- Farmland conversion to development

- Future population on sewer and septic

Rural Residential
57 acres
227 households on sewer
0.25 acre lots
     27.8% Impervious
     72.2% Turf grass
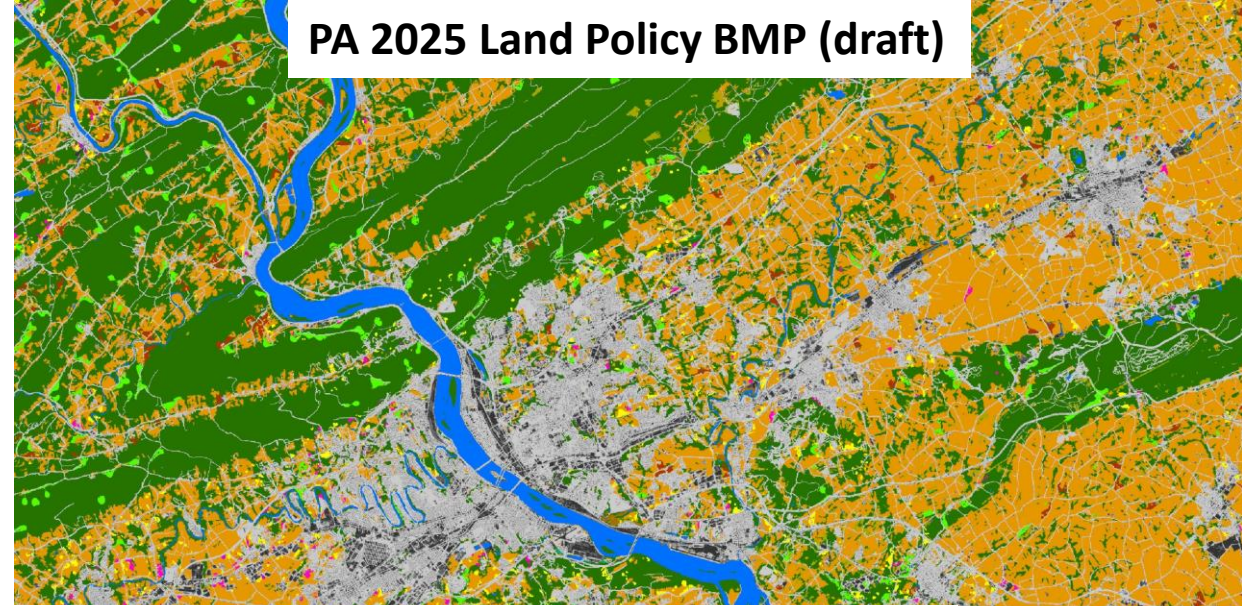20-acres farmland loss
37-acres forest loss

Crediting Land Conservation and Planning towards Water Quality Improvement
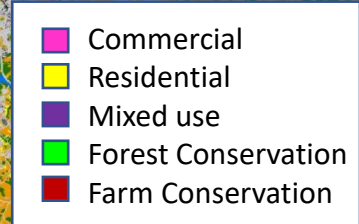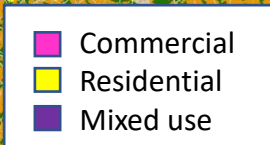

PA 2025 Baseline Condition
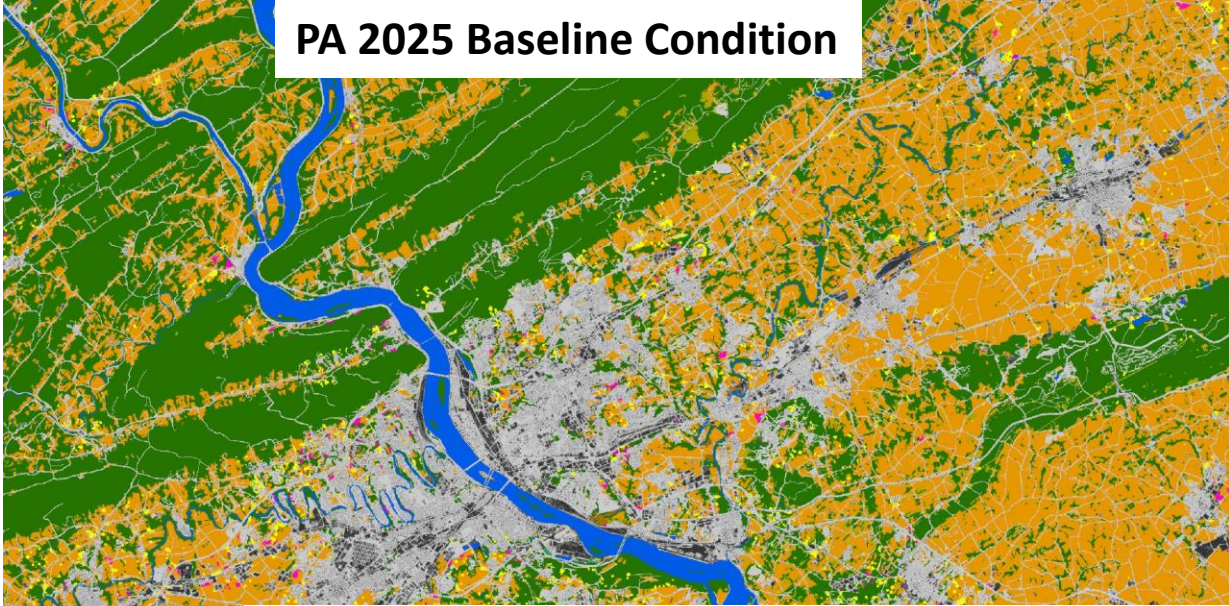
PA 2025 Land Policy BMP (draft)

Difference in land use translated into a change in pollutant loads = Water quality credit afforded to land conservation and land use planning

LandPolicyBMP	TN (lbs/yr)	TP (lbs/yr)	TSS (lbs/yr)
PA Custom (draft)	(158,146)	(943)	(1,080,715)

Commercial
Residential
Mixed use

Commercial
Residential
Mixed use
Forest Conservation
Farm Conservation

Forecasting Future Changes in Land Use

CBLCM v5 (current version)

- Simulates residential, commercial, and mixed-use development and forest and farmland conservation.

- Simulates change in patches of cells.

- Estimates infill/redevelopment by county.

- Relies on Capiella and Brown (2001) impervious surface coefficients.

- Derives commercial and residential densities from Decennial Census and NLCD.

- Parameterized using 30-meter resolution NLCD: 2001-2011.

CBLCM v6 (supporting Phase 7)

- Same as v5 plus solar fields and timber harvests.

- Simulates infill/redevelopment by parcel.

- Derives impervious surface coefficients for residential and commercial growth from high-res land use data.

- Derives commercial and residential densities from parcel data, high-res land use, and ancillary data.

- Parameterized using 1-meter resolution land use change: 2013-2021 high res and 1987 – 2012 from revised land use backcast.

- Tracks development capacity, age of housing stock, and successional stage of vegetation.

- Implements method for Smart Sewer expansion and improves estimation of septic systems.

Other Land-Use Related Phase 7 Tasks

- Update RUSLE erosion estimates with updated LiDAR and Land Use

- Investigate the pollution loads from potential new land uses (e.g., 2022 STAC workshop on solar fields)

- Investigate issues associated with BMPs and Land Use (e.g., BMP expiration, backout, insufficient acres)

- Consider the impact of increased stream resolution and density on how we parameterize and model hydrology and water quality

- Consider the replacement of timber harvest and construction reporting with high-resolution mapped changes in land use.

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