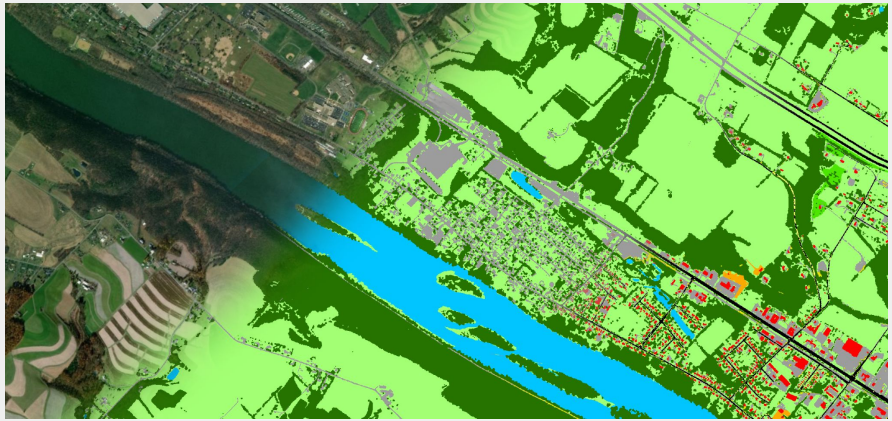
CBP Land Use/Land Cover Data Project: 1-meter 2017/18 Data Release

Chesapeake Conservancy Conservation Innovation Center
U.S. Geological Survey
University of Vermont Spatial Analysis Lab

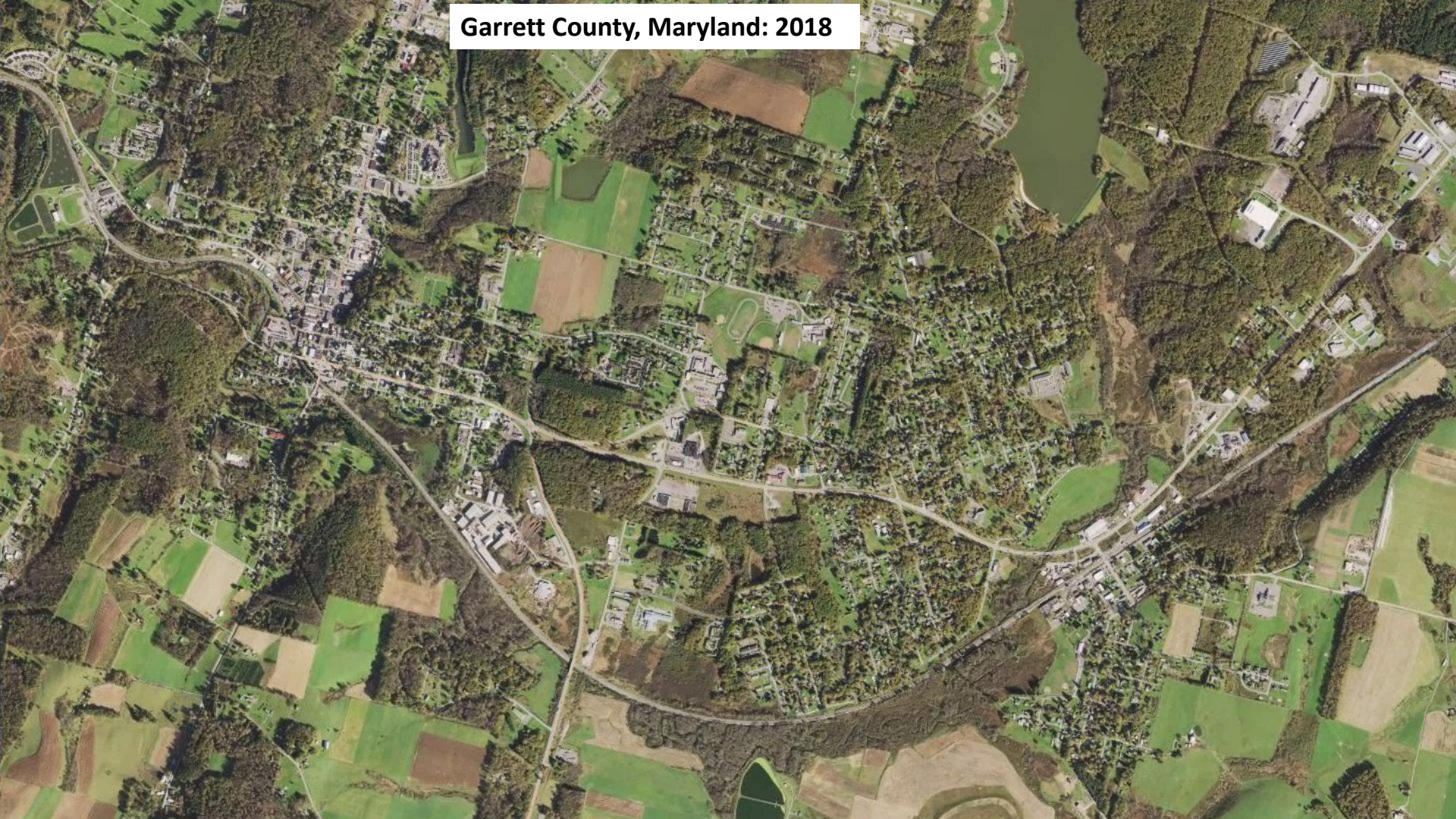
What is Land Cover?

- Land cover describes the physical land surface (e.g., tree canopy, open water, low vegetation)
- Land cover is classified using satellite/aerial imagery, digital elevation data, and building footprints. The pixels within the imagery are grouped and segmented into "objects" that get classified.
- The 2017/18 land cover data were produced by the University of Vermont team after preliminary data was reviewed by local stakeholders, Land Use Workgroup, and other Chesapeake Bay Program partners. Feedback was used to revise classification protocols and re-classify the landscape.

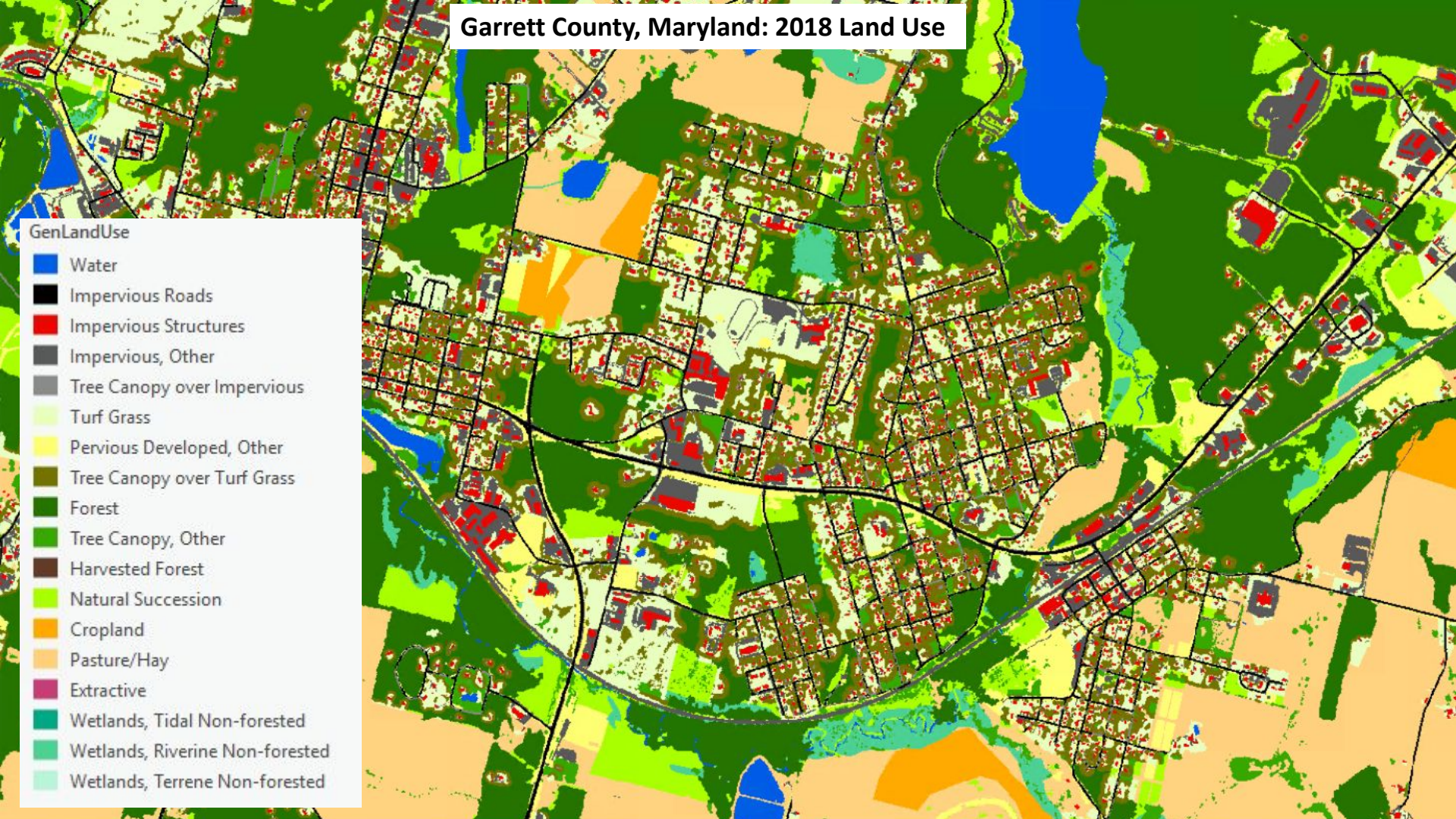


What is Land Use/Land Cover (“LULC”)?

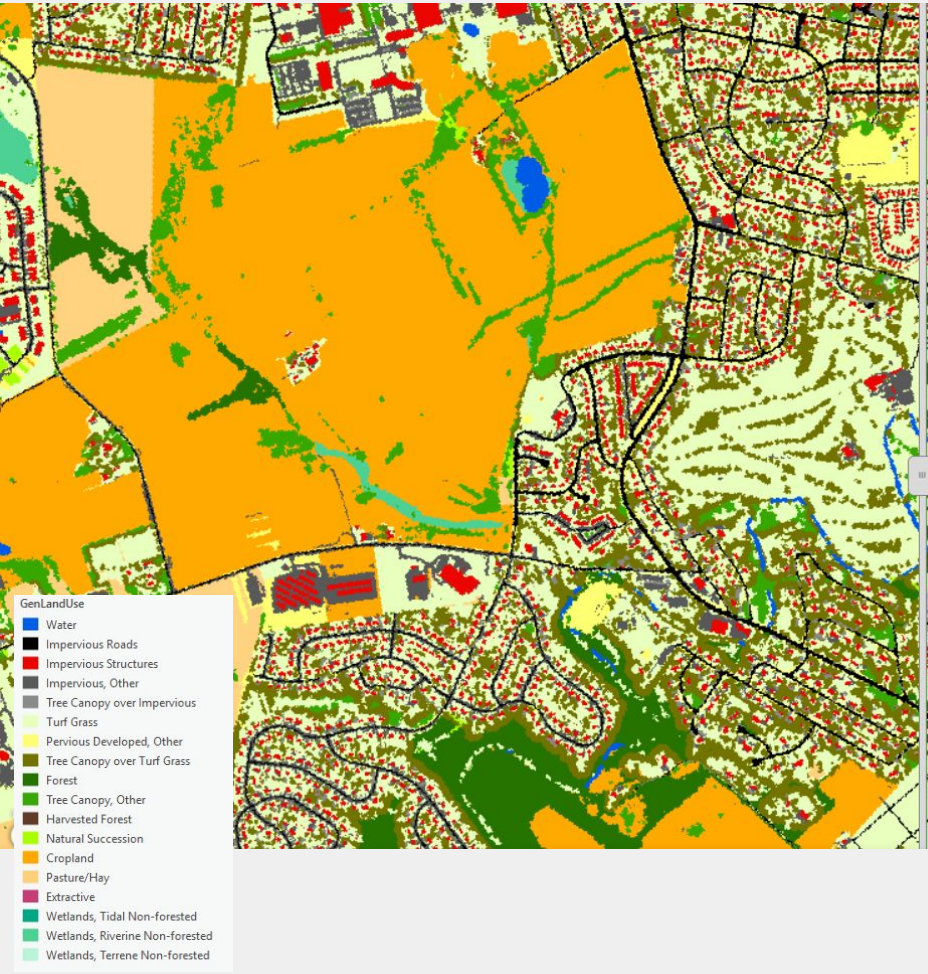
- Land use indicates how people make use of the land (e.g., cropland, recreation, solar)
- Land use is derived from land cover data using ancillary data to translate physical land features into nuanced classes indicating the type of human activities on the land.
- Land use/land cover (LULC) represents a hybrid of both use and cover, e.g., cropland-barren and cropland-herbaceous.
- The 2017/18 LULC data are being produced by Chesapeake Conservancy in partnership with staff at USGS. Preliminary data were reviewed by Chesapeake Bay Program partners; feedback was used to revise the decision rules and protocols used to produce the classification.


Garrett County, Maryland: 2018

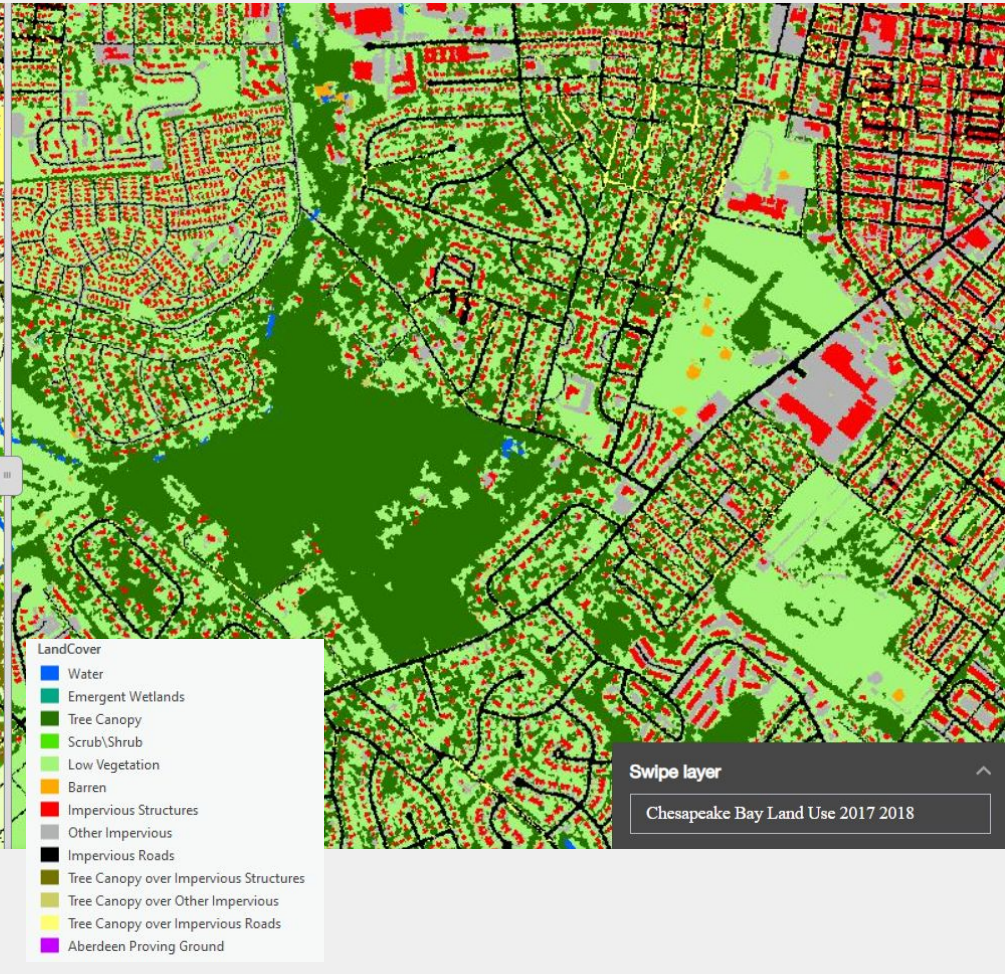
Garrett County, Maryland: 2018 Land Use



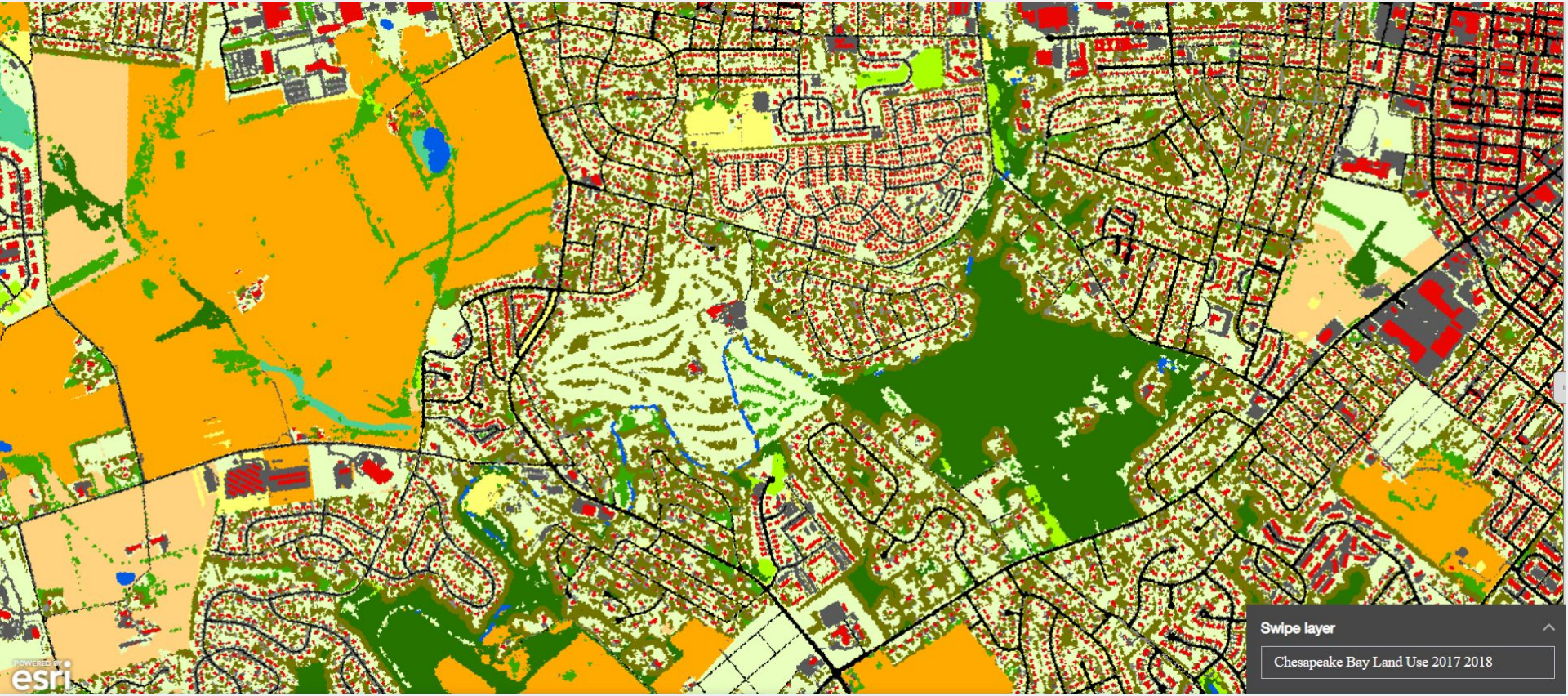
Land Use/Land Cover



Land Cover



Land Use/Land Cover



Unique Qualities of the Land Use Data

- Spatial resolution (1-meter cells)
  - ~45% more impervious identified regionally compared to 30-meter resolution NLCD data
- Categorical resolution (50+ classes)
- Iterative + Local Review
- Scale and Size of data
- Anticipated Accuracy (>90% accuracy anticipated for tree canopy and impervious surface classes)

CBP Land Use/Cover Classification (62 planned for 2021/22, 54 classes mapped for 2017/18)

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 (fresh)
  - 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. Developed (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. Forested (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: Yellow and blue classes mapped for 2017/18. Grey classes will be added to all years with the production of the 2021/22 LULC.

1. **Impervious, Roads (ROAD)**
   - 2.1 Impervious
     - 2.1.1 Roads

2. **Impervious, Structures (IMPS)**
   - 2.1 Impervious
     - 2.1.2 Structures

3. **Impervious, Other (IMPO)**
   - 2.1 Impervious
     - 2.1.3 Other Impervious
   - 4.2 Solar fields
     - 4.2.1 Impervious
   - 4.3 Extractive (active mines)
     - 4.3.2 Impervious

4. **Tree Canopy Over Impervious (TCIS)**
   - 2.1 Impervious
     - 2.1.4 Tree Canopy over Impervious

5. **Turf Grass (TURF)**
   - 2.2 Pervious, Developed
     - 2.2.1 Turf Grass

6. **Tree Canopy over Turf Grass (TCTG)**
   - 2.2 Pervious. Developed
     - 2.2.4 Tree Canopy over Turf Grass

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

8. **Forest (FORE)**
   - 3.1 Forest (non-wetland)
   - 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 (TCOT)**
   - 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 (HARF)**
    - 3.3 Harvested Forest (<= 3 years)

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

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

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

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

15. **Extractive (EXTR)**
    - 4.3 Extractive (active mines)
      - 4.3.1 Barren

16. **Cropland (CROP)**
    - 4.1 Agriculture
      - 4.1.1 Cropland
      - 4.1.3 Orchard/vineyard

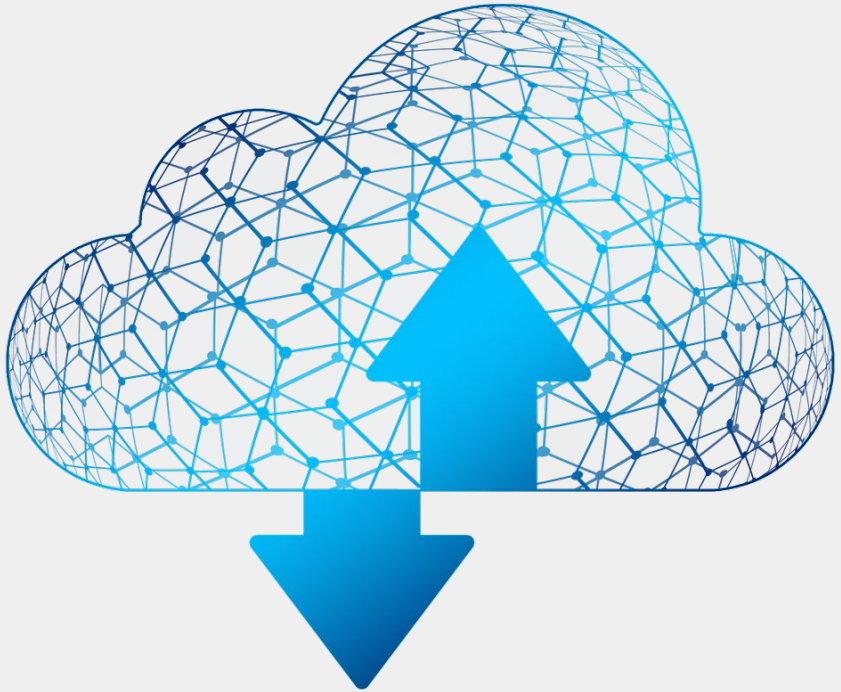
17. **Pasture/Hay (PAST)**
    - 4.1 Agriculture
      - 4.1.2 Pasture/Hay

18. **Water (WATR)**
    - 1.1 Estuarine/ Marine
    - 1.2 Lentic
    - 1.3 Lotic

Size & Scale

This data covers a 206-county region that includes areas that intersect with or are adjacent to the Chesapeake Bay watershed.

- an average of 7 million individually identified features per county (250k to 12 million range)
- 13+ TB of data processed
- Cloud computing through Microsoft Azure - 480 CPUs with 1920 GB of RAM
- 61 GB of final zipped data



Land Cover/ Land Use Change

- Land Cover Change signals where change is happening on the landscape
- Land Use Change adds context describing what the change is
- Land Cover Change contains 80 classes of observed change across the Bay Watershed
  - 12 class x 12 class = 132 potential change classes
- Land Use change contains 2,862 possible transitions for the 54 detailed classes
  - 306 possible transitions for the general 18-class schema

Land Cover and Land Use Change

Frederick, Maryland

2013/14 NAIP

2017/18 NAIP

Land Cover and Land Use Change

Frederick, Maryland

Land Cover Change

Land Use Change

Land Cover and Land Use Change

Frederick, Maryland

Land Cover Change

Land Cover no change (low vegetation)

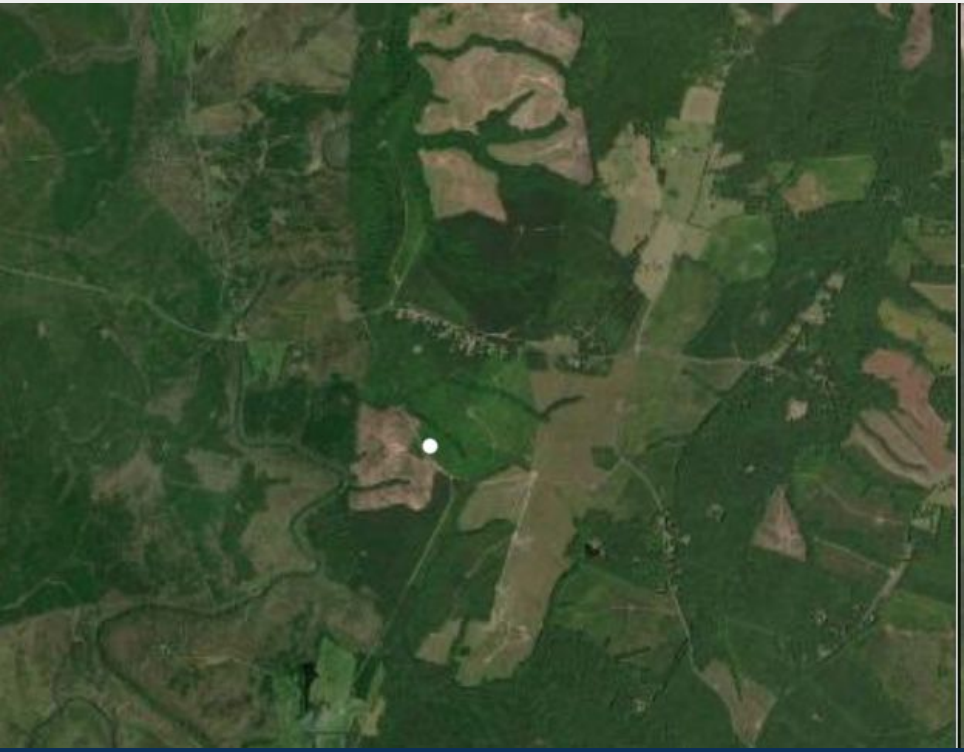
Land Use Change

Cropland to Turf Grass

Land Cover and Land Use Change

Buckingham, Virginia

2014 NAIP Imagery

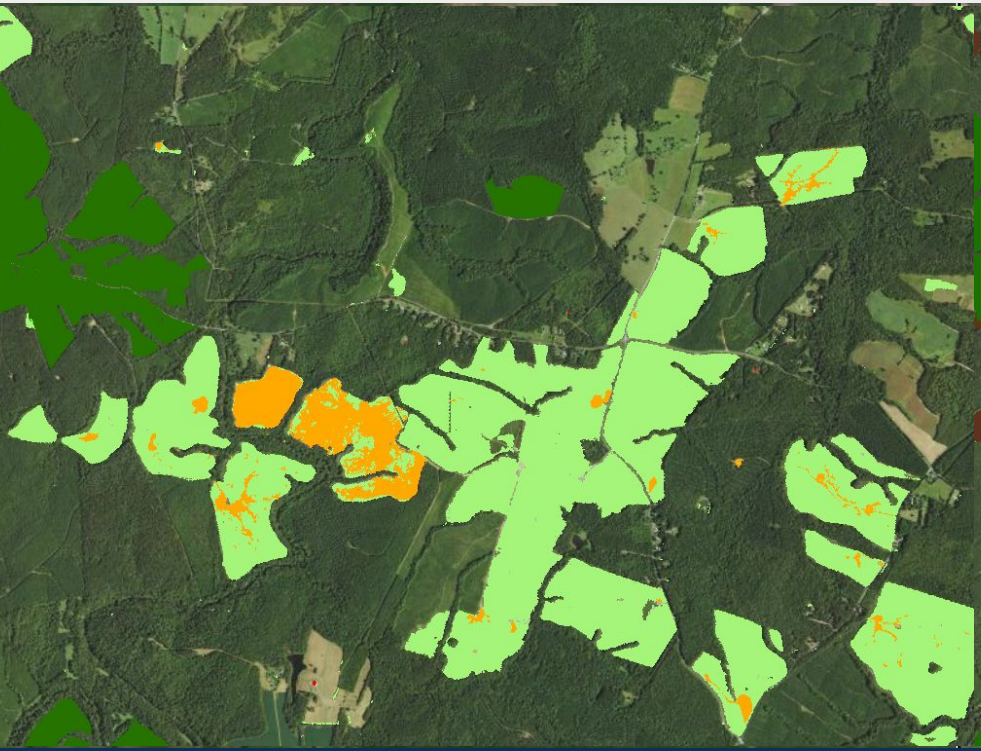


2018 NAIP Imagery

Land Cover and Land Use Change

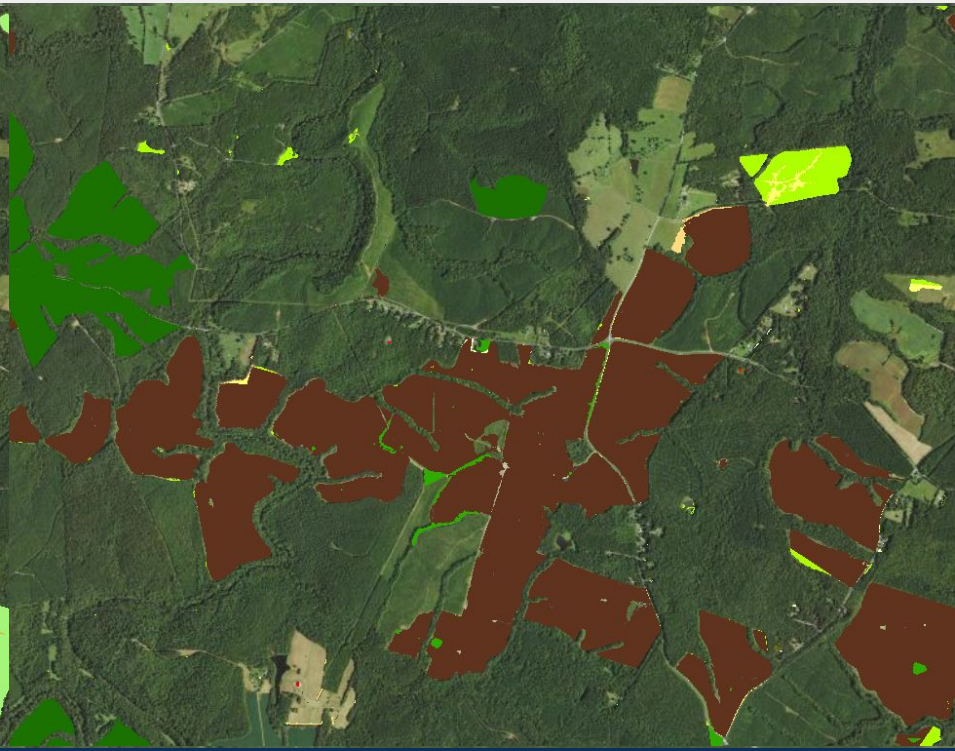
Buckingham, Virginia

Land Cover Change



Tree Canopy to Barren and Low Vegetation

Land Use Change



Forest to Harvested Forest

Land Cover and Land Use Change

Schuylkill, Pennsylvania

2013/14 NAIP

2017/18 NAIP

Land Cover and Land Use Change

Schuylkill, Pennsylvania

Land Cover Change

Tree Canopy to Barren

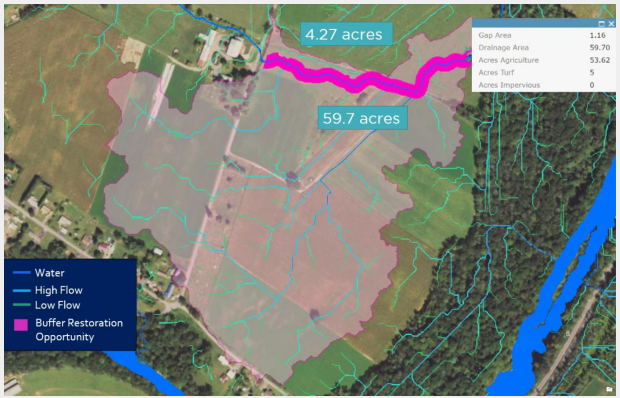
Land Use Change

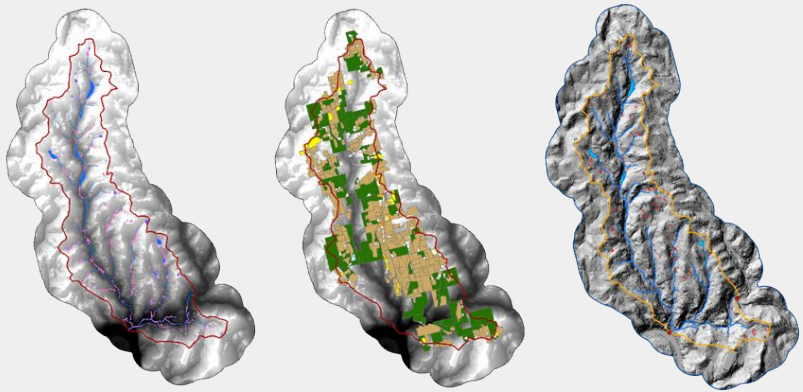
Other Tree Canopy to Extractive Barren

What can this data be used for

- Identifying BMP opportunities (e.g., riparian forest buffers, urban tree planting, stream restoration) and locating BMPs where they may be most effective (2025 WIP Outcome)
- Identifying land conservation opportunities (Protected Lands Outcome)
- Identifying potential healthy and vulnerable watersheds (Healthy Watersheds Outcome)
- Informing land use planning decisions (Land Use Methods and Metrics Outcome)
- Assessing net change in forest buffers (Forest Buffer Outcome)
- Assessing net change in tree canopy (Tree Canopy Outcome)
- Assessing extent of shaded streams (Brook Trout Outcome)
- Assessing land use conditions in areas of future marsh migration (Climate Adaptation Outcome)
- Updating stormwater management plans
- Developing management plans for watersheds that cross jurisdictional boundaries

Identifying opportunities for changing land management…





Prioritizing Conservation Opportunities…

The existence of high-resolution land cover/land use supports precision conservation at a variety of scales

- Identifying opportunities for conservation
- Monitoring and maintaining conservation easements
- Quantifying the benefits of existing and potential new easements

conservation acquisition for the Rappahannock Tribe of Virginia

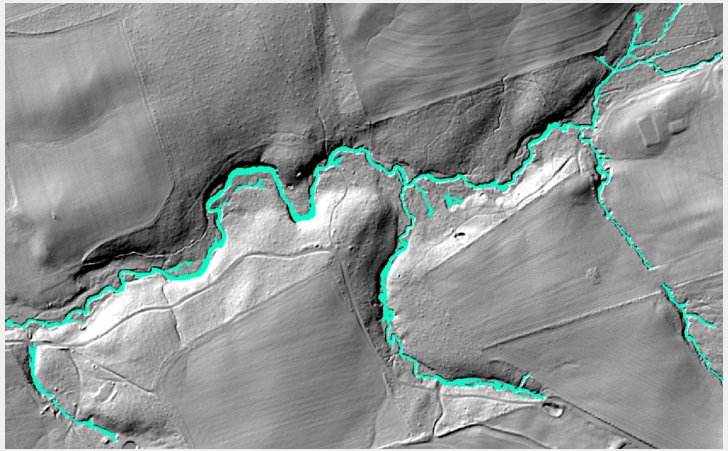
Webpage Walkthrough

Planned General Updates

- Map 2021/2022 Land Cover, Land Cover Change, Land Use and Land Use Change (2024)
- Retrospectively update 2013/14 and 2017/18 data to match updated classification
- Incorporate new ancillary data
  - 2020 parcels
  - local county/state data
- Improving quality and regional consistency of input and ancillary data
  - height/elevation models (DSM and LiDAR)
  - generalization of local land use data
  - integration of deep learning and other AI techniques for improved feature identification
- Revising model decision rules
  - Increasing quantitative decision rules - based on statistics rather than expert judgement

Planned Categorical Updates

- Agricultural Improvements
  - “Time Series” vs “Snapshot”
  - Field boundaries, pseudo field boundaries
  - Animal operations
  - Pasture/hay class
- Hydrography Improvements
  - Inclusion of CBP Objective 2 hyper-resolution (1m) hydrography
  - Streams, Ditches, and associated subclasses



Caveats

- Data will be retrospectively revised with future data releases
  - Streams, ditches, and animal operations will be added in 2021/22 data planned for release in 2024
  - Digital surface models (elevation of objects) will be added to workflow
  - Methods and ancillary data will be further refined
  - All updates will be applied to 2013/14 and 2017/18 LULC data to ensure accurate change

- A longer temporal record is needed to interpret certain types of LULC change
  - Pre-2013/14 land use data are needed to distinguish forest and farmland conversion to development
  - Post-2017/18 land use are needed to verify the end state of transitional land uses (e.g., natural succession, suspended succession)

- Potential to confuse transitional and temporary change with permanent change
  - Timber harvest is the largest change in the Bay watershed but signifies only a temporary change in tree cover, not a loss.
  - Changes from forest to tree canopy over turf grass represent a contextual change, not a loss of tree cover.
- Periods of change vary by state: 5 years for MD and DE; 4 years for DC, NY, PA, VA, and WV.

Land Use Change Matrix (Delaware)

2013-2018	ROAD	IMPS	IMPO	TCIS	TURF	TCTG	PDEV	FORE	TCOT	HARF	NATS	CROP	PAST	EXTR	TDLW	RIVW	TERW	WATR	Decrease
ROAD	0.00	0.43	5.59	19.66	2.12	0.40	2.75	1.34	0.86	0.05	0.14	0.70	0.03	0.00	0.00	0.00	0.00	0.16	34.26
IMPS	0.57	0.00	91.66	19.36	20.34	1.51	41.44	0.14	0.02	0.01	1.95	27.04	3.57	0.14	0.00	0.00	0.00	0.18	207.91
IMPO	18.86	123.79	0.00	88.71	54.97	3.00	106.50	2.27	0.75	0.04	4.43	35.88	3.22	0.04	0.44	0.04	0.96	0.51	444.42
TCIS	3.45	28.67	54.99	0.00	156.26	0.00	61.92	0.00	0.00	0.25	6.75	6.22	0.72	0.33	0.23	0.16	0.00	0.18	320.14
TURF	0.00	80.46	550.21	0.00	0.00	486.00	233.65	5.10	2.35	0.05	5.53	0.91	0.00	4.21	0.00	0.00	0.00	0.00	1,368.46
TCTG	0.87	55.93	425.33	0.47	396.32	0.00	58.51	0.00	0.00	0.52	9.71	28.60	3.31	0.00	0.00	0.00	0.00	0.72	980.29
PDEV	225.44	931.80	1,027.69	0.00	2,507.10	3.63	0.00	3.68	1.37	5.62	11.00	94.24	1.02	2.99	0.00	0.00	0.00	3.35	4,818.94
FORE	71.54	169.12	261.89	27.96	496.54	1,199.21	1,212.09	0.00	835.40	1,230.08	1,223.15	1,936.35	66.78	29.30	55.80	579.98	14.89	49.33	9,459.40
TCOT	14.84	107.07	150.70	0.00	138.34	183.24	135.34	0.00	0.00	8.01	44.17	209.48	16.72	0.26	27.85	21.76	4.69	13.13	1,075.60
HARF	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
NATS	13.05	25.18	80.59	0.00	182.73	54.23	134.64	2,255.92	267.26	24.13	0.00	167.40	2.42	1.23	0.00	0.00	0.00	112.74	3,321.52
CROP	303.37	714.92	1,858.17	0.00	873.09	8.41	608.20	454.99	154.84	3.36	172.36	0.00	6.41	66.32	0.00	0.00	0.00	294.90	5,519.33
PAST	9.27	43.47	136.00	0.00	105.77	0.89	48.44	46.63	34.14	0.78	3.69	4.00	0.00	0.00	0.00	0.00	0.00	36.66	469.74
EXTR	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
TDLW	0.08	0.07	18.75	0.00	0.00	0.00	0.00	10.34	11.05	0.00	0.01	0.00	0.00	0.00	0.00	0.00	0.00	106.83	147.14
RIVW	0.17	1.21	3.57	0.00	1.69	0.00	0.00	702.49	24.57	0.35	0.00	0.00	0.00	0.11	0.00	0.00	0.00	11.32	745.48
TERW	0.87	3.25	14.93	0.00	2.24	0.66	29.97	49.96	9.58	0.00	1.99	8.71	0.11	0.02	0.00	0.00	0.00	11.31	133.60
WATR	0.48	0.40	1.94	0.00	1.08	1.23	14.11	1.43	7.43	0.00	5.30	25.60	0.27	1.65	143.96	2.35	9.00	0.00	216.21
Increase	662.86	2,285.75	4,682.02	156.16	4,938.61	1,942.39	2,687.56	3,534.30	1,349.61	1,273.24	1,490.19	2,545.12	104.59	106.60	228.29	604.29	29.54	641.32	29,262.45
Totals																			
TotIncrease	662.86	2,285.75	4,682.02	156.16	4,938.61	1,942.39	2,687.56	3,534.30	1,349.61	1,273.24	1,490.19	2,545.12	104.59	106.60	228.29	604.29	29.54	641.32	
TotDecrease	34.26	207.91	444.42	320.14	1,368.46	980.29	4,818.94	9,459.40	1,075.60	0.00	3,321.52	5,519.33	469.74	0.00	147.14	745.48	133.60	216.21	
Net	628.61	2,077.84	4,237.60	(163.98)	3,570.15	962.11	(2,131.37)	(5,925.10)	274.01	1,273.24	(1,831.33)	(2,974.22)	(365.15)	106.60	81.15	(141.19)	(104.06)	425.11	

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IMPS	0.57	0.00	91.66	19.36	20.34	1.51	41.44	0.14	0.02	0.01	1.95	27.04	3.57	0.14	0.00	0.00	0.00	0.18	207.91
IMPO	18.86	123.79	0.00	88.71	54.97	3.00	106.50	2.27	0.75	0.04	4.43	35.88	3.22	0.04	0.44	0.04	0.96	0.51	444.42
TCIS	3.45	28.67	54.99	0.00	156.26	0.00	61.92	0.00	0.00	0.25	6.75	6.22	0.72	0.33	0.23	0.16	0.00	0.18	320.14
TURF	0.00	80.46	550.21	0.00	0.00	486.00	233.65	5.10	2.35	0.05	5.53	0.91	0.00	4.21	0.00	0.00	0.00	0.00	1,368.46
TCTG	0.87	55.93	425.33	0.47	396.32	0.00											00	0.72	980.29
PDEV	225.44	931.80	1,027.69	0.00	2,507.10	3.63											00	3.35	4,818.94
FORE	71.54	169.12	261.89	27.96	496.5	1,199.21											98	49.33	9,459.40
TCOT	14.84	107.07	150.70	0.00	138.34	183.24											76	13.13	1,075.60
HARF	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
NATS	13.05	25.18	80.59	0.00	182.73	54.23	134.64	2,255.92	267.26	24.13	0.00	167.40	2.42	1.23	0.00	0.00	0.00	112.74	3,321.52
CROP	303.37	714.92	1,858.17	0.00	873.09	8.41	608.20	454.99	154.84	3.36	172.36	0.00	6.41	66.32	0.00	0.00	0.00	294.90	5,519.33
PAST	9.27	43.47	136.00	0.00	105.77	0.89	48.44	46.63	34.14	0.78	3.69	4.00	0.00	0.00	0.00	0.00	0.00	36.66	469.74
EXTR	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
TDLW	0.08	0.07	18.75	0.00	0.00	0.00	0.00	10.34	11.05	0.00	0.01	0.00	0.00	0.00	0.00	0.00	0.00	106.83	147.14
RIVW	0.17	1.21	3.57	0.00	1.69	0.00	0.00	702.49	24.57	0.35	0.00	0.00	0.00	0.11	0.00	0.00	0.00	11.32	745.48
TERW	0.87	3.25	14.93	0.00	2.24	0.66	29.97	49.96	9.58	0.00	1.99	8.71	0.11	0.02	0.00	0.00	0.00	11.31	133.60
WATR	0.48	0.40	1.94	0.00	1.08	1.23	14.11	1.43	7.43	0.00	5.30	25.60	0.27	1.65	143.96	2.35	9.00	0.00	216.21
Increase	662.86	2,285.75	4,682.02	156.16	4,938.61	1,942.39	2,687.56	3,534.30	1,349.61	1,273.24	1,490.19	2,545.12	104.59	106.60	228.29	604.29	29.54	641.32	29,262.45
Totals																			
TotIncrease	662.86	2,285.75	4,682.02	156.16	4,938.61	1,942.39	2,687.56	3,534.30	1,349.61	1,273.24	1,490.19	2,545.12	104.59	106.60	228.29	604.29	29.54	641.32	
TotDecrease	34.26	207.91	444.42	320.14	1,368.46	980.29	4,818.94	9,459.40	1,075.60	0.00	3,321.52	5,519.33	469.74	0.00	147.14	745.48	133.60	216.21	
Net	628.61	2,077.84	4,237.60	(163.98)	3,570.15	962.11	(2,131.37)	(5,925.10)	274.01	1,273.24	(1,831.33)	(2,974.22)	(365.15)	106.60	81.15	(141.19)	(104.06)	425.11	

Forest to Tree Canopy over Turf Grass

Not a loss of tree canopy but a change in use

Land Use Change Matrix (Delaware)

2013-2018	ROAD	IMPS	IMPO	TCIS	TURF	TCTG	PDEV	FORE	TCOT	HARF	NATS	CROP	PAST	EXTR	TDLW	RIVW	TERW	WATR	Decrease
ROAD	0.00	0.43	5.59	19.66	2.12	0.40	2.75	1.34	0.86	0.05	0.14	0.70	0.03	0.00	0.00	0.00	0.00	0.16	34.26
IMPS	0.57	0.00	91.66	19.36	20.34	1.51	41.44	0.14	0.02	0.01	1.95	27.04	3.57	0.14	0.00	0.00	0.00	0.18	207.91
IMPO	18.86	123.79	0.00	88.71	54.97	3.00	106.50	2.27	0.75	0.04	4.43	35.88	3.22	0.04	0.44	0.04	0.96	0.51	444.42
TCIS	3.45	28.67	54.99	0.00	156.26	0.00	61.92	0.00	0.00	0.25	6.75	6.22	0.72	0.33	0.23	0.16	0.00	0.18	320.14
TURF	0.00	80.46	550.21	0.00	0.00	486.00	233.65	5.10	2.35	0.05	5.53	0.91	0.00	4.21	0.00	0.00	0.00	0.00	1,368.46
TCTG	0.87	55.93	425.33	0.47	396.32	0.00	58.51	0.00	0.00										
PDEV	225.44	931.80	1,027.69	0.00	2,507.10	3.63	0.00	3.68	1.37										
FORE	71.54	169.12	261.89	27.96	496.54	1,199.21	1,212.09	0.00	835.40	1.									
TCOT	14.84	107.07	150.70	0.00	138.34	183.24	135.34	0.00	0.00										
HARF	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00										
NATS	13.05	25.18	80.59	0.00	182.73	54.23	134.64	2,255.92	267.26										
CROP	303.37	714.92	1,858.17	0.00	873.09	8.41	608.20	454.99	154.84										
PAST	9.27	43.47	136.00	0.00	105.77	0.89	48.44	46.63	34.14	0.78	3.69	4.00	0.00	0.00	0.00	0.00	0.00	36.66	469.74
EXTR	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
TDLW	0.08	0.07	18.75	0.00	0.00	0.00	0.00	10.34	11.05	0.00	0.01	0.00	0.00	0.00	0.00	0.00	0.00	106.83	147.14
RIVW	0.17	1.21	3.57	0.00	1.69	0.00	0.00	702.49	24.57	0.35	0.00	0.00	0.00	0.11	0.00	0.00	0.00	11.32	745.48
TERW	0.87	3.25	14.93	0.00	2.24	0.66	29.97	49.96	9.58	0.00	1.99	8.71	0.11	0.02	0.00	0.00	0.00	11.31	133.60
WATR	0.48	0.40	1.94	0.00	1.08	1.23	14.11	1.43	7.43	0.00	5.30	25.60	0.27	1.65	143.96	2.35	9.00	0.00	216.21
Increase	662.86	2,285.75	4,682.02	156.16	4,938.61	1,942.39	2,687.56	3,534.30	1,349.61	1,273.24	1,490.19	2,545.12	104.59	106.60	228.29	604.29	29.54	641.32	29,262.45
Totals																			
TotIncrease	662.86	2,285.75	4,682.02	156.16	4,938.61	1,942.39	2,687.56	3,534.30	1,349.61	1,273.24	1,490.19	2,545.12	104.59	106.60	228.29	604.29	29.54	641.32	
TotDecrease	34.26	207.91	444.42	320.14	1,368.46	980.29	4,818.94	9,459.40	1,075.60	0.00	3,321.52	5,519.33	469.74	0.00	147.14	745.48	133.60	216.21	
Net	628.61	2,077.84	4,237.60	(163.98)	3,570.15	962.11	(2,131.37)	(5,925.10)	274.01	1,273.24	(1,831.33)	(2,974.22)	(365.15)	106.60	81.15	(141.19)	(104.06)	425.11	

Forest to Tree Canopy, Other

Shape and size of forest patch changed, no longer meeting forest requirements

Implies forest fragmentation

Land Use Change Matrix (Delaware)

2013-2018	ROAD	IMPS	IMPO	TCIS	TURF	TCTG	PDEV	FORE	TCOT	HARF	NATS	CROP	PAST	EXTR	TDLW	RIVW	TERW	WATR	Decrease
ROAD	0.00	0.43	5.59	19.66	2.12	0.40	2.75	1.34	0.86	0.05	0.14	0.70	0.03	0.00	0.00	0.00	0.00	0.16	34.26
IMPS	0.57	0.00	91.66	19.36	20.34	1.51	41.44	0.14	0.02	0.01	1.95	27.04	3.57	0.14	0.00	0.00	0.00	0.18	207.91
IMPO	18.86	123.79	0.00	88.71	54.97	3.00	106.50	2.27	0.75	0.04	4.43	35.88	3.22	0.04	0.44	0.04	0.96	0.51	444.42
TCIS	3.45	28.67	54.99	0.00	156.26	0.00	61.92	0.00	0.00	0.25	6.75	6.22	0.72	0.33	0.23	0.16	0.00	0.18	320.14
TURF	0.00	80.46	550.21	0.00	0.00	486.00	233.65	5.10	2.35	0.05	5.53	0.91	0.00	4.21	0.00	0.00	0.00	0.00	1,368.46
TCTG	0.87	55.93	425.33	0.47	396.32	0.00	58.51	0.00	0.00	0.52	9.71	28.60	3.31	0.00	0.00	0.00	0.00	0.72	980.29
PDEV	225.44	931.80	1,027.69	0.00	2,507.10	3.63	0.00	3.68	1.37	5.62	11.00	94.24	1.02	2.99	0.00	0.00	0.00	3.35	4,818.94
FORE	7											1,936.35	66.78	29.30	55.80	579.98	14.89	49.33	9,459.40
TCOT	1											209.48	16.72	0.26	27.85	21.76	4.69	13.13	1,075.60
HARF												0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
NATS	1											167.40	2.42	1.23	0.00	0.00	0.00	112.74	3,321.52
CROP	30											0.00	6.41	66.32	0.00	0.00	0.00	294.90	5,519.33
PAST	9.27	43.47	136.00	0.00	105.77	0.89	48.44	46.63	34.14	0.78	3.69	4.00	0.00	0.00	0.00	0.00	0.00	36.66	469.74
EXTR	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
TDLW	0.08	0.07	18.75	0.00	0.00	0.00	0.00	10.34	11.05	0.00	0.01	0.00	0.00	0.00	0.00	0.00	0.00	106.83	147.14
RIVW	0.17	1.21	3.57	0.00	1.69	0.00	0.00	702.49	24.57	0.35	0.00	0.00	0.00	0.11	0.00	0.00	0.00	11.32	745.48
TERW	0.87	3.25	14.93	0.00	2.24	0.66	29.97	49.96	9.58	0.00	1.99	8.71	0.11	0.02	0.00	0.00	0.00	11.31	133.60
WATR	0.48	0.40	1.94	0.00	1.08	1.23	14.11	1.43	7.43	0.00	5.30	25.60	0.27	1.65	143.96	2.35	9.00	0.00	216.21
Increase	662.86	2,285.75	4,682.02	156.16	4,938.61	1,942.39	2,687.56	3,534.30	1,349.61	1,273.24	1,490.19	2,545.12	104.59	106.60	228.29	604.29	29.54	641.32	29,262.45
Totals																			
TotIncrease	662.86	2,285.75	4,682.02	156.16	4,938.61	1,942.39	2,687.56	3,534.30	1,349.61	1,273.24	1,490.19	2,545.12	104.59	106.60	228.29	604.29	29.54	641.32	
TotDecrease	34.26	207.91	444.42	320.14	1,368.46	980.29	4,818.94	9,459.40	1,075.60	0.00	3,321.52	5,519.33	469.74	0.00	147.14	745.48	133.60	216.21	
Net	628.61	2,077.84	4,237.60	(163.98)	3,570.15	962.11	(2,131.37)	(5,925.10)	274.01	1,273.24	(1,831.33)	(2,974.22)	(365.15)	106.60	81.15	(141.19)	(104.06)	425.11	

Non-forested Wetlands to Wetland Forest and Tree Canopy

Not a change in wetland footprints

Gain in forest and tree canopy

Land Use Change Matrix (Delaware)

2013-2018	ROAD	IMPS	IMPO	TCIS	TURF	TCTG	PDEV	FORE	TCOT	HARF	NATS	CROP	PAST	EXTR	TDLW	RIVW	TERW	WATR	Decrease
ROAD	0.00	0.43	5.59	19.66	2.12	0.40	2.75	1.34	0.86	0.05	0.14	0.70	0.03	0.00	0.00	0.00	0.00	0.16	34.26
IMPS	0.57	0.00	91.66	19.36	20.34	1.51	41.44	0.14	0.02	0.01	1.95	27.04	3.57	0.14	0.00	0.00	0.00	0.18	207.91
IMPO	18.86	123.79	0.00	88.71	54.97	3.00	106.50	2.27	0.75	0.04	4.43	35.88	3.22	0.04	0.44	0.04	0.96	0.51	444.42
TCIS	3.45	28.67	54.99	0.00	156.26	0.00	61.92	0.00	0.00	0.25	6.75	6.22	0.72	0.33	0.23	0.16	0.00	0.18	320.14
TURF	0.00	80.46	550.21	0.00	0.00	486.00	233.65	5.10	2.35	0.05	5.53	0.91	0.00	4.21	0.00	0.00	0.00	0.00	1,368.46
TCTG	0.87	55.93	425.33	0.47	396.32	0.00	58.51	0.00	0.00	0.52	9.71	28.60	3.31	0.00	0.00	0.00	0.00	0.72	980.29
PDEV	225.44	931.80	1,027.69	0.00	2,507.10	3.63	0.00	3.68	1.37	5.62	11.00	94.24	1.02	2.99	0.00	0.00	0.00	3.35	4,818.94
FORE	71.54	169.12	261.89	27.96	496.54	1,199.21	1,212.09	0.00	835.40	1,230.08	1,223.15	1,936.35	66.78	29.30	55.80	579.98	14.89	49.33	9,459.40
TCOT	14.84	107.07	150.70	0.00	138.34	183.24	135.34	0.00	0.00	8.01	44.17	209.48	16.72	0.20	27.85	21.76	4.69	13.13	1,075.60
HARF	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
NATS	13.05	25.18	80.59	0.00	182.73	54.23	134.64	2,255.92	267.26	24.13	0.00	167.40	2.42	1.23	0.00	0.00	0.00	112.74	3,321.52
CROP	303.37	714.92	1,858.17	0.00	873.09	8.41	608.20	454.99	154.84	3.36	172.36	0.00	6.41	66.32	0.00	0.00	0.00	294.90	5,519.33
PAST	9.27	43.47	136.00	0.00	105.77	0.89	48.44	46.63											469.74
EXTR	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00											0.00
TDLW	0.08	0.07	18.75	0.00	0.00	0.00	0.00	10.34											147.14
RIVW	0.17	1.21	3.57	0.00	1.69	0.00	0.00	702.49											745.48
TERW	0.87	3.25	14.93	0.00	2.24	0.66	29.97	49.96											133.60
WATR	0.48	0.40	1.94	0.00	1.08	1.23	14.11	1.43	7.43	0.00	5.30	25.60	0.27	1.65	143.96	2.35	9.00	0.00	216.21
Increase	662.86	2,285.75	4,682.02	156.16	4,938.61	1,942.39	2,687.56	3,534.30	1,349.61	1,273.24	1,490.19	2,545.12	104.59	106.60	228.29	604.29	29.54	641.32	29,262.45
Totals																			
TotIncrease	662.86	2,285.75	4,682.02	156.16	4,938.61	1,942.39	2,687.56	3,534.30	1,349.61	1,273.24	1,490.19	2,545.12	104.59	106.60	228.29	604.29	29.54	641.32	
TotDecrease	34.26	207.91	444.42	320.14	1,368.46	980.29	4,818.94	9,459.40	1,075.60	0.00	3,321.52	5,519.33	469.74	0.00	147.14	745.48	133.60	216.21	
Net	628.61	2,077.84	4,237.60	(163.98)	3,570.15	962.11	(2,131.37)	(5,925.10)	274.01	1,273.24	(1,831.33)	(2,974.22)	(365.15)	106.60	81.15	(141.19)	(104.06)	425.11	

Forest and Tree Canopy to Non-forested Wetlands

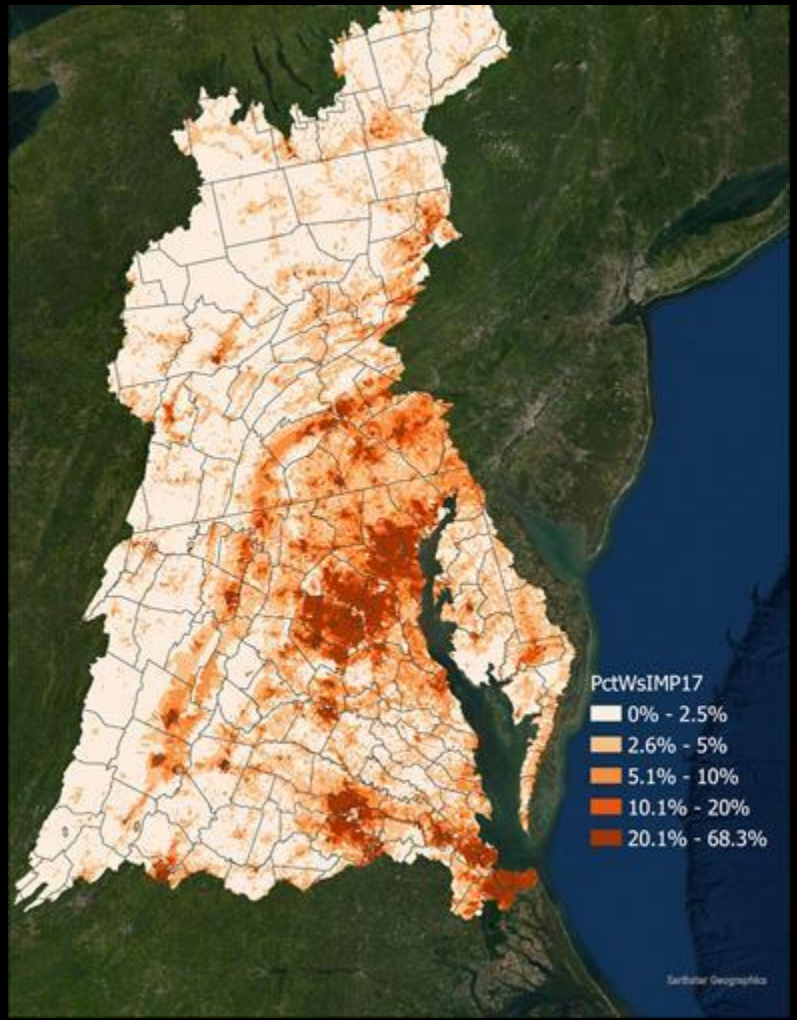
Not a change in wetland footprints

Loss of forest and tree canopy

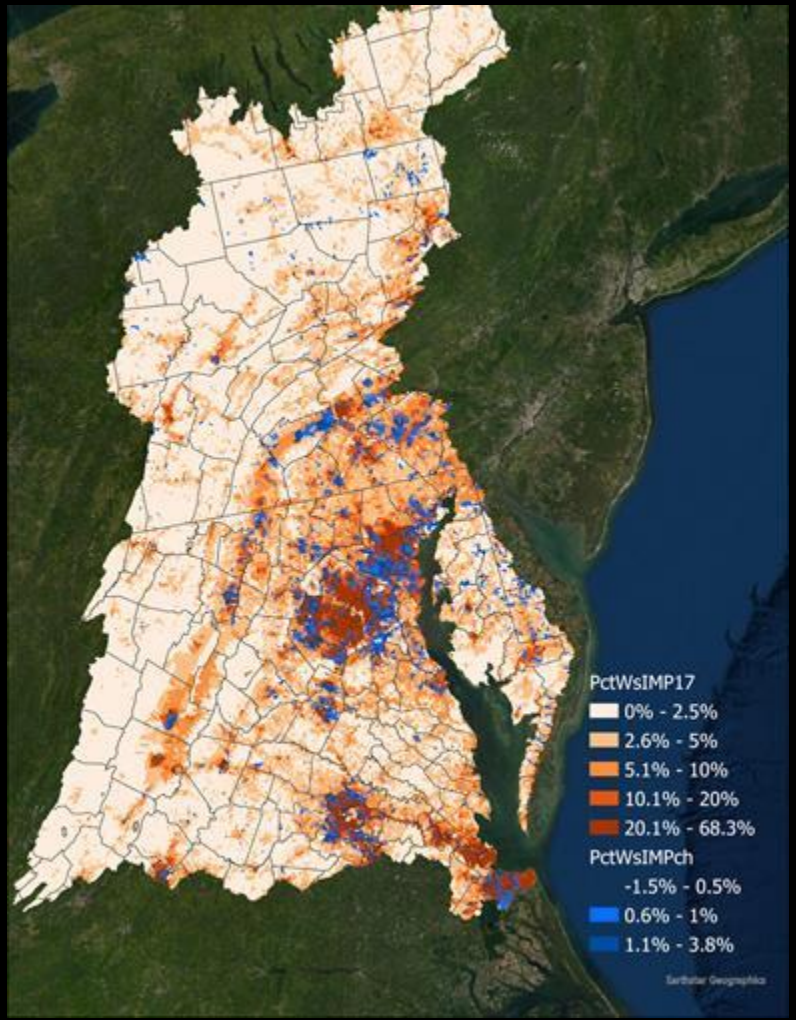
Upcoming Analyses, Reports, and Datasets

- Maryland Forest Technical Study
- Maryland Healthy Watersheds Assessment
- Maryland Department of Natural Resources Green Infrastructure Update
- Chesapeake Land Use Change Indicators (e.g., impervious cover, tree canopy)
- Scientific papers on the methods and interpretation of the 2017/18 Land Use/Land Cover dataset and the 2013/14 to 2017/18 Land Use/Land Cover Change dataset
- Chesapeake State of the Forests 2.0 Report
- US Forest Service Tree Canopy Fact Sheets (county level)
- Accuracy Assessment of the 2017/18 Land Cover and Land Cover Change data

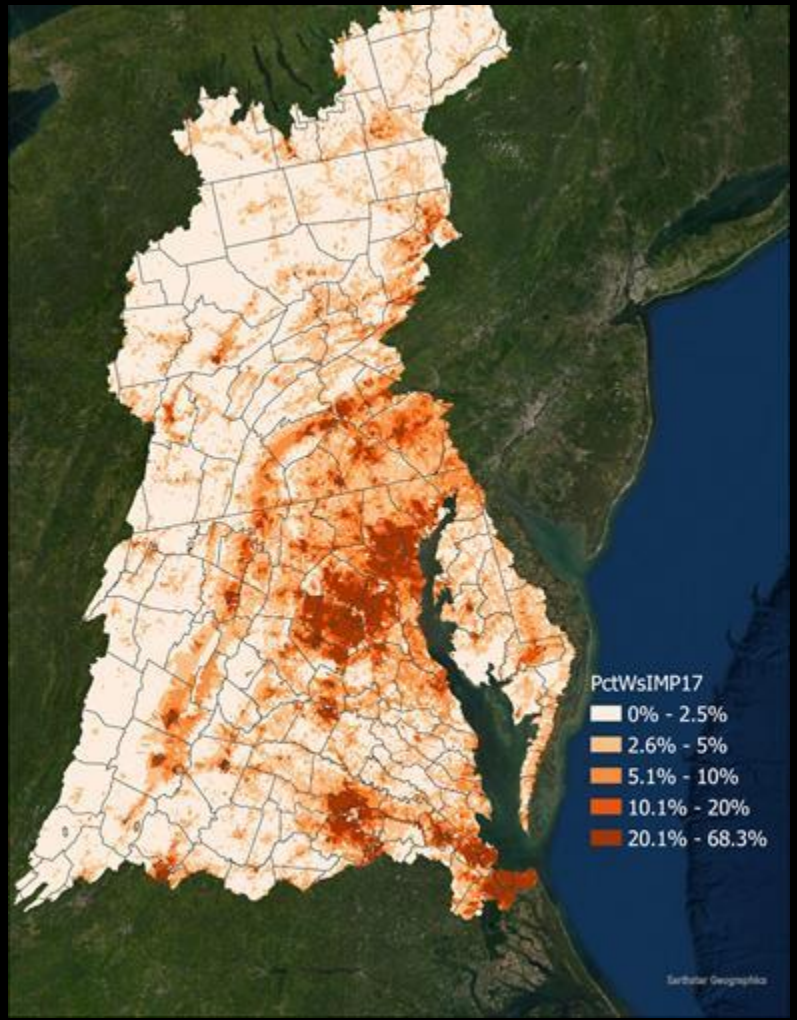
Impervious Cover, 2017/18



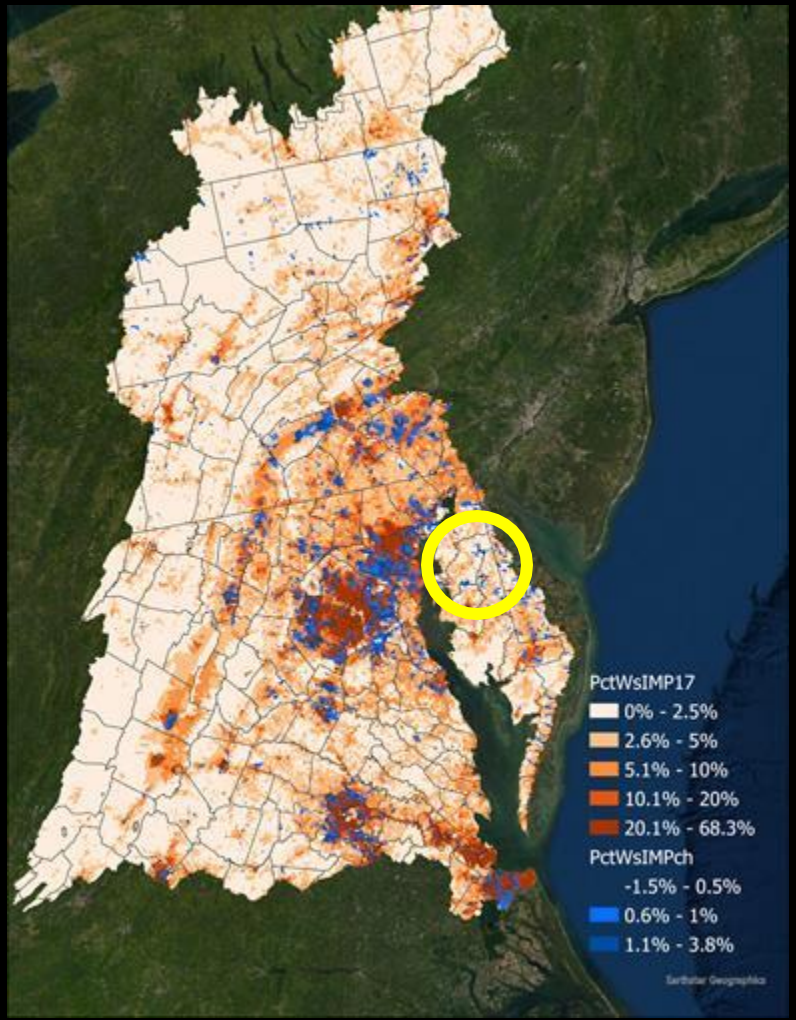
Impervious Cover Change, 2013/14 - 2017/18

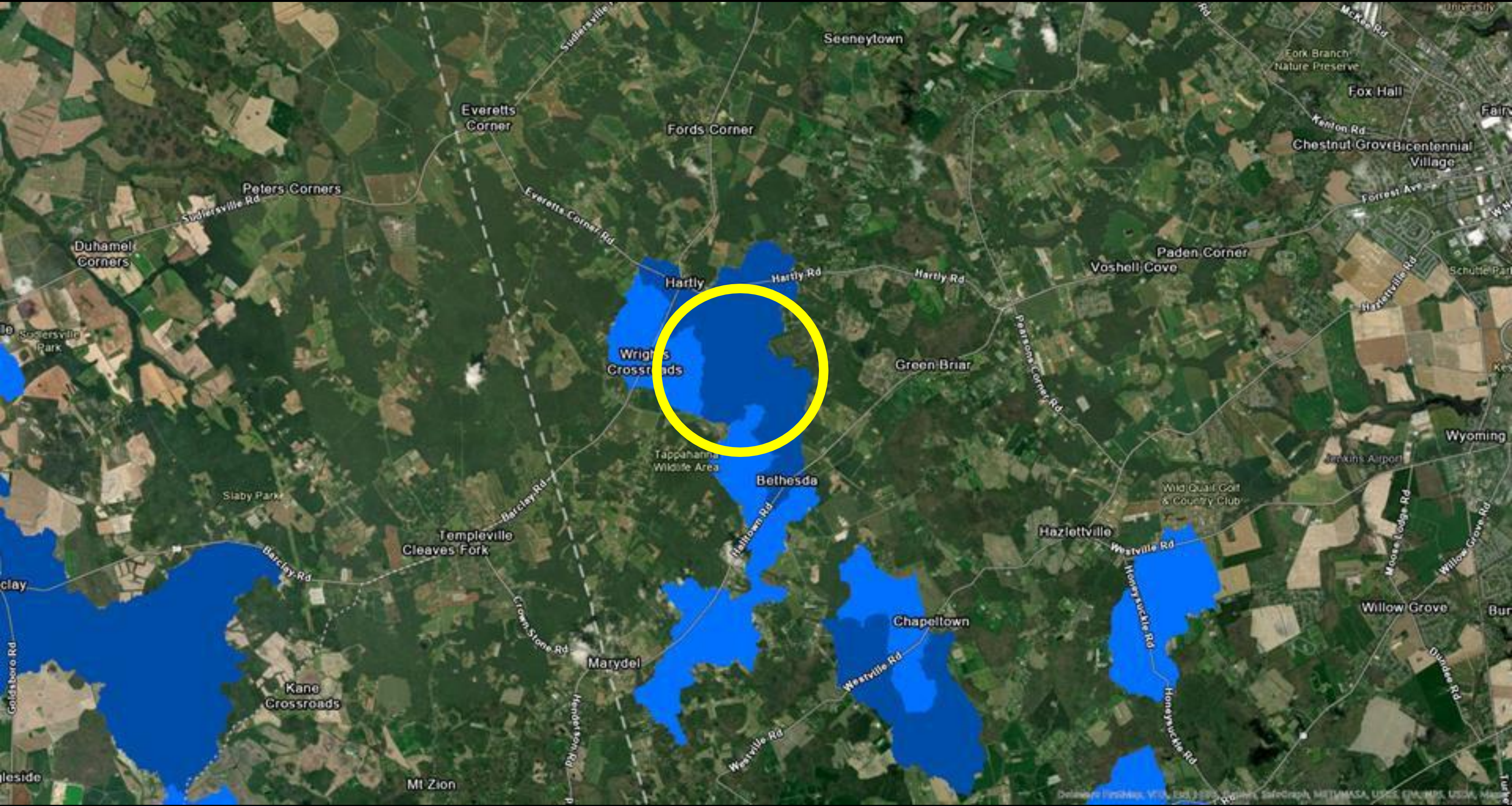


Impervious Cover, 2017/18



Impervious Cover Change, 2013/14 - 2017/18



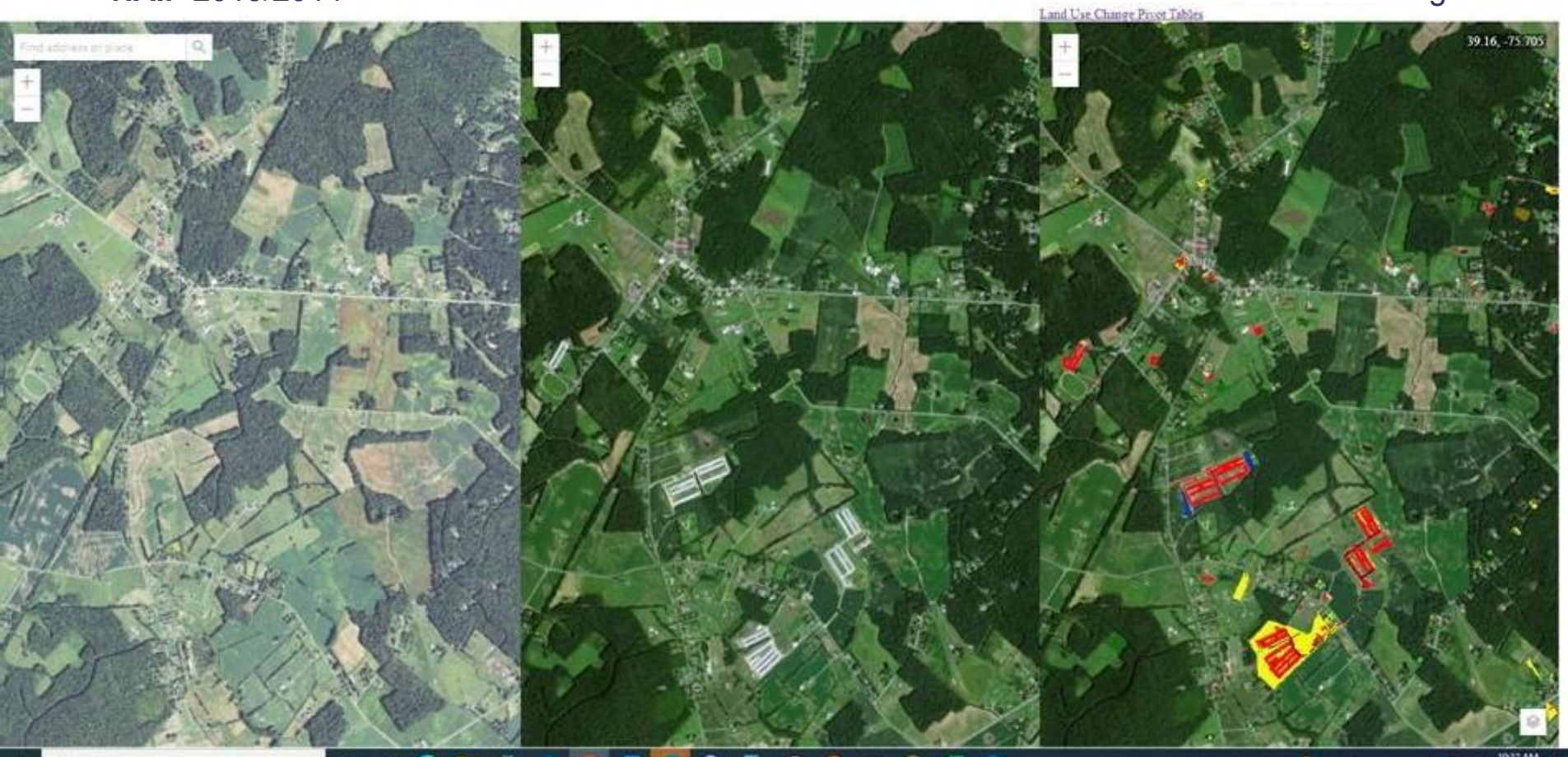


Seeneytown
Fork Branch
Nature Preserve
Fox Hall
McKee Rd
Everetts
Corner
Fords Corner
Kenton Rd
Chestnut Grove
Bicentennial
Village
Peters Corners
Sudlersville Rd
Everetts Corner Rd
Forrest Ave
Duhamel
Corners
Paden Corner
Voshell Cove
Hartly
Hartly Rd
Hartly Rd
Sudlersville
Park
Wrights
Crossroads
Green Briar
Pearsons Corner Rd
Wyoming
Tappahanna
Wildlife Area
Jenkins Airport
Bethesda
Slaby Park
Wild Quail Golf
& Country Club
Barclay Rd
Halltown Rd
Templeville
Cleaves Fork
Hazlettville
Westville Rd
Barclay Rd
Moose Lodge Rd
Willow Grove Rd
Honeysuckle Rd
Willow Grove
Chapeltown
Crown Stone Rd
Westville Rd
Marydel
Dundee Rd
Kane
Crossroads
Honeysuckle Rd
Westville Rd
Mt Zion

NAIP 2013/2014

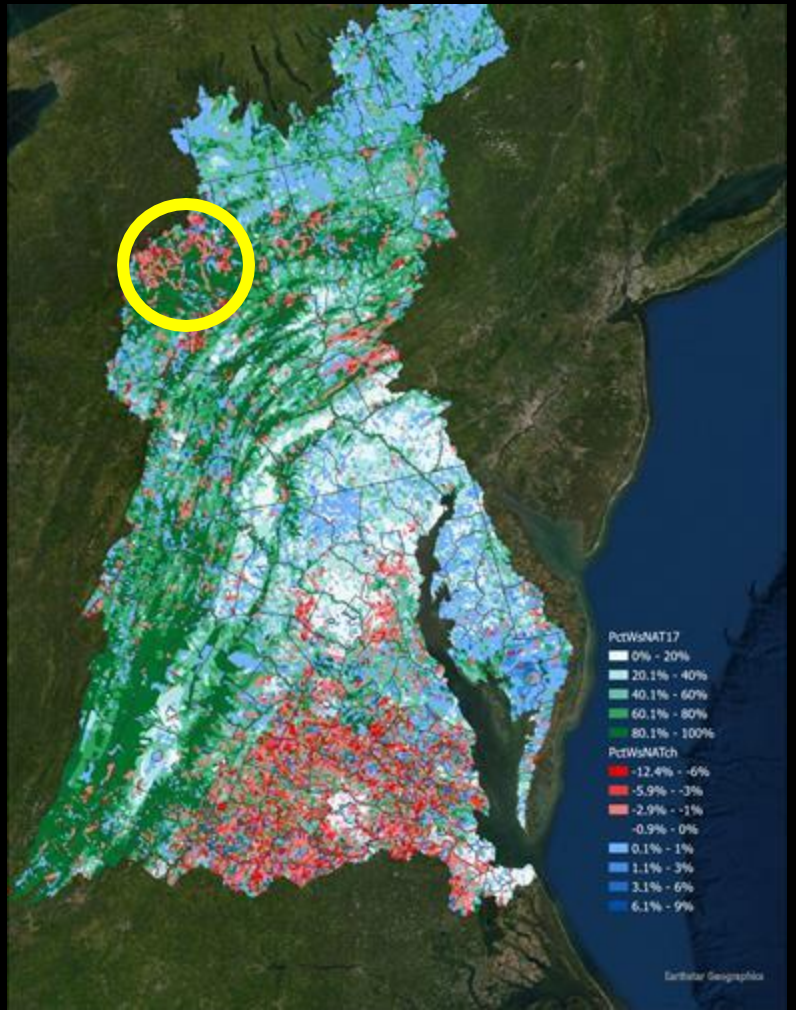
NAIP 2017/2018

Version 1 Land Use Change



Tree Cover and Wetlands, 2017/18

Tree Cover and Wetland Change, 2013/14 - 2017/18



2013 2017 Land Use Change, 2013-17

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https://www.chesapeakeconservancy.org/conservation-innovation-center/high-resolution-data/lulc-data-project-2022/

Questions? Feedback?

If you use the data, we'd love to know! We can also help determine what components of the data are most appropriate for your analysis.