Impervious Surfaces and Change in the Chesapeake Bay Watershed

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Metropolitan Washington Council of Governments, Water Resources Technical Committee
October 30, 2023

U.S. Department of the Interior
U.S. Geological Survey

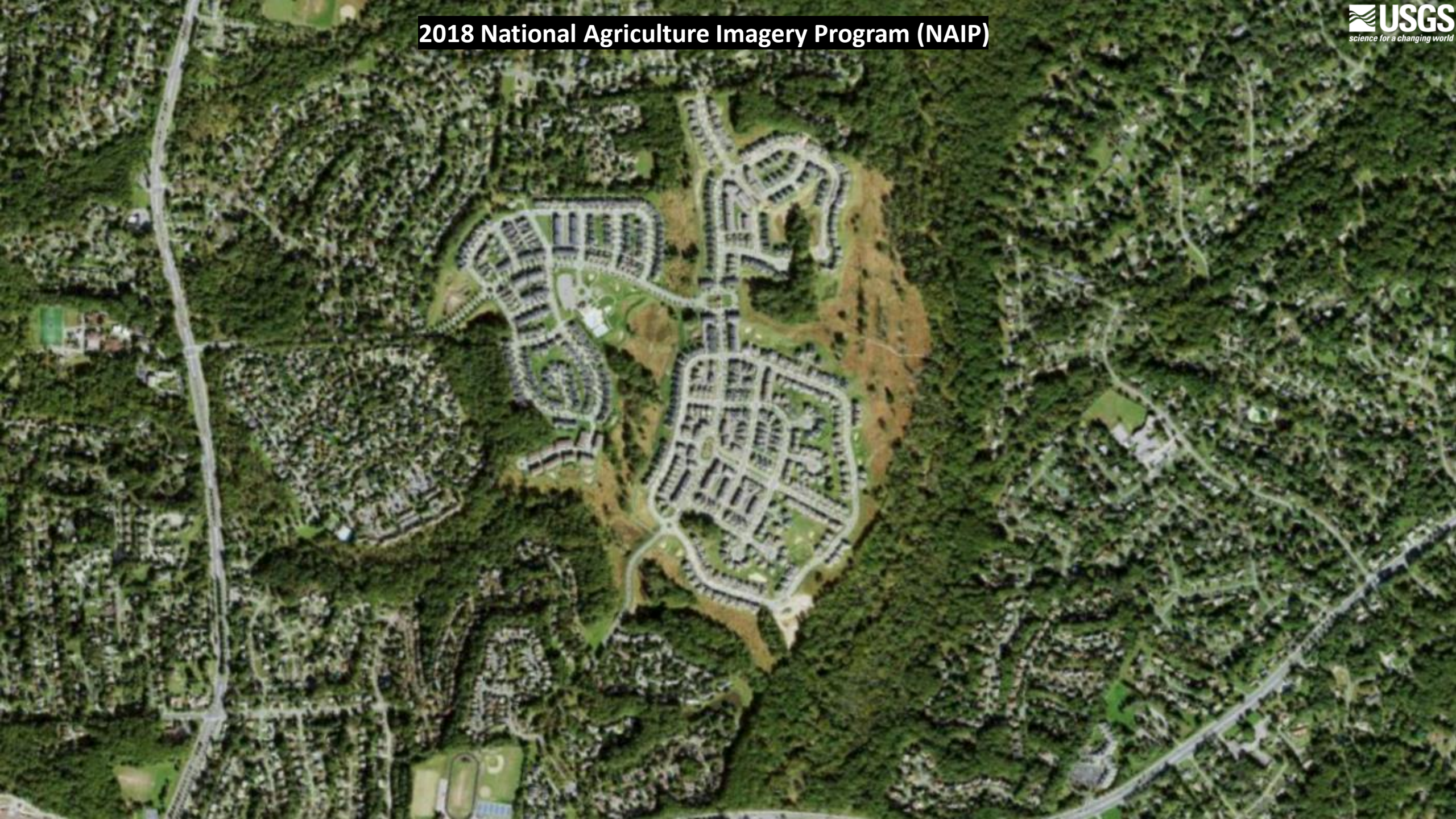
Completed LULC Products for a 99,000 mi^2 Region

Land Cover & Land Cover change (12-classes, 1-meter): 2013/14 and 2017/18

Land Use and Land Use Change (54-classes, 1-meter): 2013/14 and 2017/18

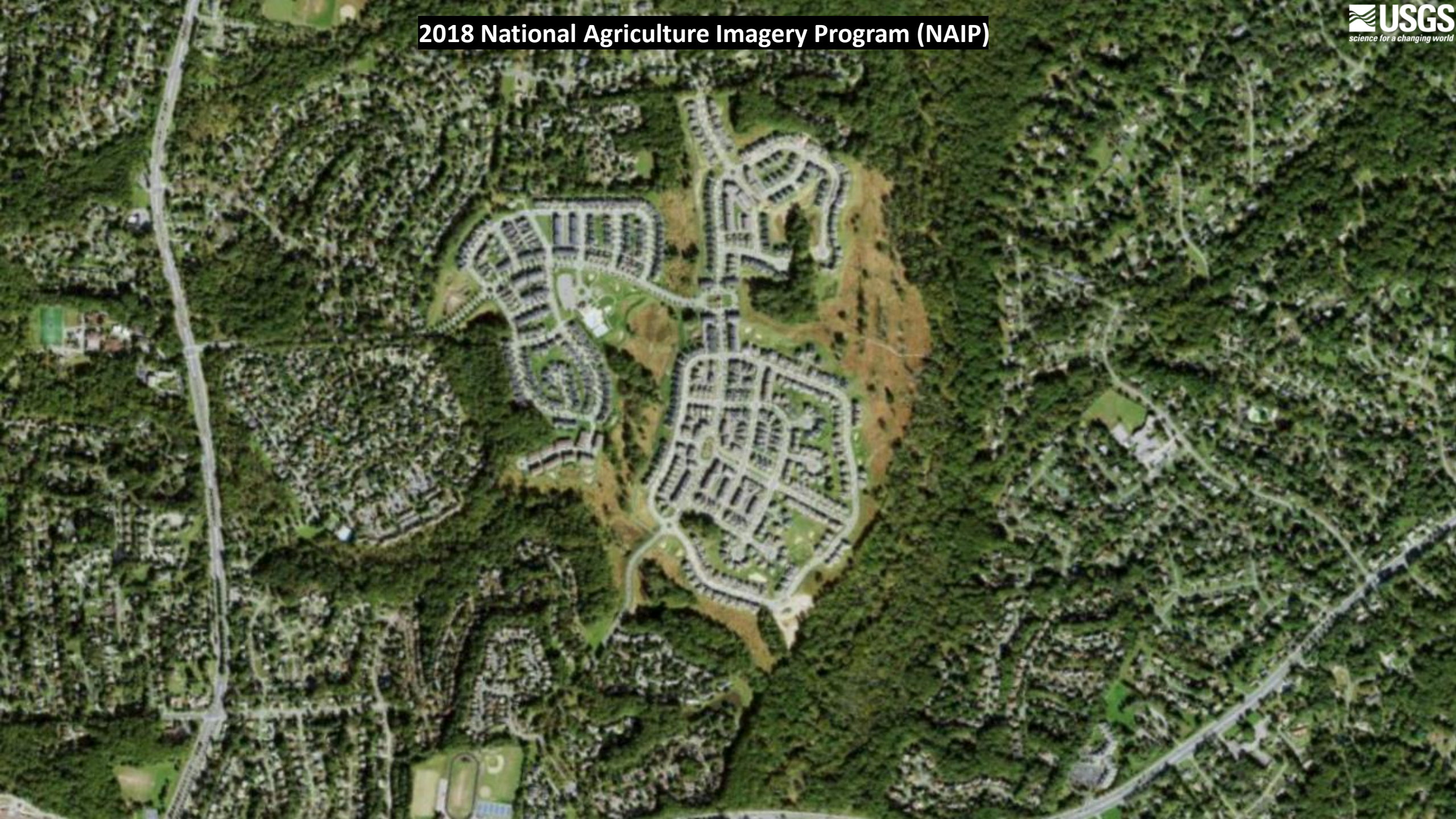
Land Use and Land Use Change (18-classes, 10-meter)

- Tabular summaries by county, NHD+ catchment (accumulated), 24K NHD catchment (accumulated)


2018 National Agriculture Imagery Program (NAIP)
USGS
science for a changing world

2018 Land Use
USGS
science for a changing world
Riparian Zone
FACET Streams (1:100k)
GenLandUse
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, Tidal Non-forested
Wetlands, Riverine Non-forested
Wetlands, Terrene Non-forested

2012 Google Earth Imagery
USGS
science for a changing world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Chesapeake Bay 1-meter Land Use/Cover Classification (64 classes)

Water and Water Margins (6)

- 10 Tidal Waters
- Lentic
  - 11 Lakes & Reservoirs
  - 12 Riverine Ponds
  - 13 Terrene Ponds
- Lotic
  - 14 Streams and Rivers (visible water)
- 15 Bare Shore

Development (18)

- Impervious
  - 20 Roads
  - 21 Structures
  - 22 Other Impervious (Parking lots, driveways)
  - 23 TC over Roads
  - 24 TC over Structures
  - 25 TC over Other Impervious
  - 31 Extractive Impervious
  - 32 Solar Field Panel Arrays
- Pervious
  - 26 Tree Canopy over Turf Grass
  - 27 Turf Grass
  - 28 Bare Developed
  - 30 Extractive Barren
  - 33 Solar Field Barren
  - 34 Solar Field Herbaceous
  - 35 Solar Field Shrubland
  - 36 Suspended Succession Barren
  - 37 Suspended Succession Herbaceous
  - 38 Suspended Succession Shrubland

Natural Lands (25)

- Tree Canopy
  - 40 Forest
  - 41 Tree Canopy, Other
- Open Space
  - 42 Natural Succession Barren
  - 43 Natural Succession Herbaceous
  - 44 Natural Succession Shrubland
  - 45 Harvested Forest Barren
  - 46 Harvested Forest Herbaceous
- Riverine Wetlands
  - 50 Riverine Wetlands Barren
  - 51 Riverine Wetlands Herbaceous
  - 52 Riverine Wetlands Shrubland
  - 53 Riverine Wetlands Tree Canopy
  - 54 Riverine Wetlands Forest
  - 55 Riverine Wetlands Harvested Forest
- Terrene Wetlands (isolated)
  - 60 Terrene Wetlands Barren
  - 61 Terrene Wetlands Herbaceous
  - 62 Terrene Wetlands Shrubland
  - 63 Terrene Wetlands Tree Canopy
  - 64 Terrene Wetlands Forest
  - 65 Terrene Wetlands Harvested Forest
- Tidal Wetlands
  - 70 Tidal Wetlands Barren
  - 71 Tidal Wetlands Herbaceous
  - 72 Tidal Wetlands Shrubland
  - 73 Tidal Wetlands Tree Canopy
  - 74 Tidal Wetlands Forest
  - 75 Tidal Wetlands Harvested Forest

Agriculture (15)

- Productive Lands
  - 80 Cropland Barren
  - 81 Cropland Herbaceous
  - 82 Orchards and Vineyards Barren
  - 83 Orchards and Vineyards Herbaceous
  - 84 Orchards and Vineyards Shrubland
  - 85 Pasture Barren
  - 86 Pasture Herbaceous
  - 87 Hay Barren
  - 88 Hay Herbaceous
- Agricultural Facilities
  - 90 Agricultural Structures
  - 91 Animal Operation Impervious
  - 92 Animal Operation Barren
  - 93 Animal Operation Herbaceous
  - 94 TC over Agricultural Structure
  - 95 TC over Animal Operation Impervious

Grey classes planned for 2021/22 data released in June 2024

How many CBP Outcomes mention land use change or land conversion as an important metric or factor influencing progress?

20 of 31 Outcomes

taken from survey results and/or identified from individual LAPs, management strategies, or science needs lists

Themes (5 of 5)	Goals (8 of 10)	Outcomes (20 of 31)
Abundant Life	Sustainable Fisheries	Blue Crab Abundance
		Blue Crab Management
		Oysters
		Forage Fish
		Fish Habitat
	Vital Habitats	**Wetlands**
		Black Duck
		Stream Health
		Brook Trout
		Fish Passage
		Submerged Aquatic Vegetation
		Forest Buffers
		Tree Canopy
Clean Water	Water Quality	**2017 Watershed Implementation Plan (WIP)**
		2025 Watershed Implementation Plan (WIP)
		WQ Standards Attainment & Monitoring
	Toxic Contaminants	Toxic Contaminants Research
		Toxic Contaminants Policy & Prevention
	Healthy Watersheds	**Healthy Watersheds**
Conserved Lands	Land Conservation	**Protected Lands**
		Land Use Methods and Metrics Development
		Land Use Options Evaluation
Engaged Communities	Stewardship	Citizen Stewardship
		Local Leadership
		Diversity
	Public Access	**Public Access Site Development**
	Environmental Literacy	Student
		Sustainable Schools
		Environmental Literacy Planning
Climate Change	Climate Resiliency	**Climate Monitoring & Assessment**
		Climate Adaptation

CHESAPEAKE PROGRESS

Search

Abundant Life | Clean Water | Conserved Lands | Engaged Communities | Climate Change | About Us

Home > Conserved Lands > Land Conservation

Land Use Methods and Metrics Development

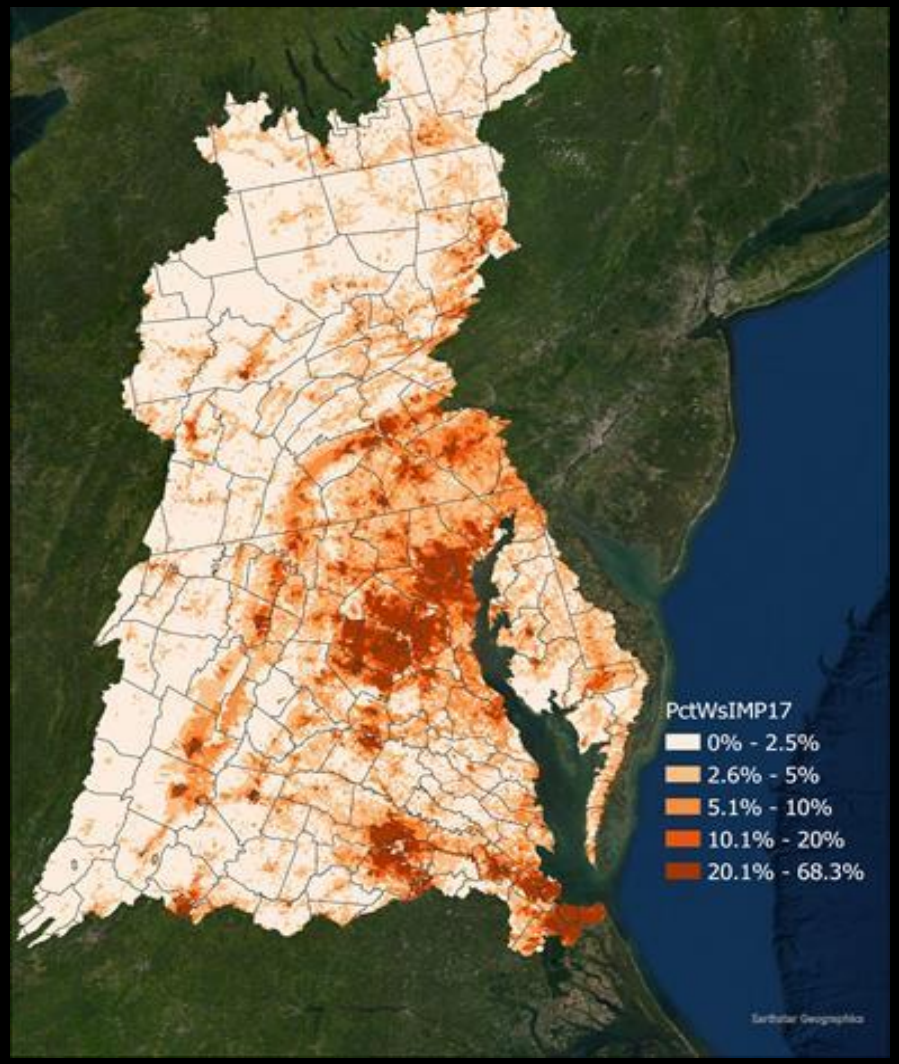
RECENT PROGRESS **INCREASE** | OUTLOOK **ON COURSE**

Continually improve our knowledge of land conversion and the associated impacts throughout the watershed. By December 2021, develop a watershed-wide methodology and local-level metrics for characterizing the rate of farmland, forest and wetland conversion, measuring the extent and rate of change in impervious surface coverage and quantifying the potential impacts of land conversion to water quality, healthy watersheds and communities. Launch a public awareness campaign to share this information with local governments, elected officials and stakeholders.*

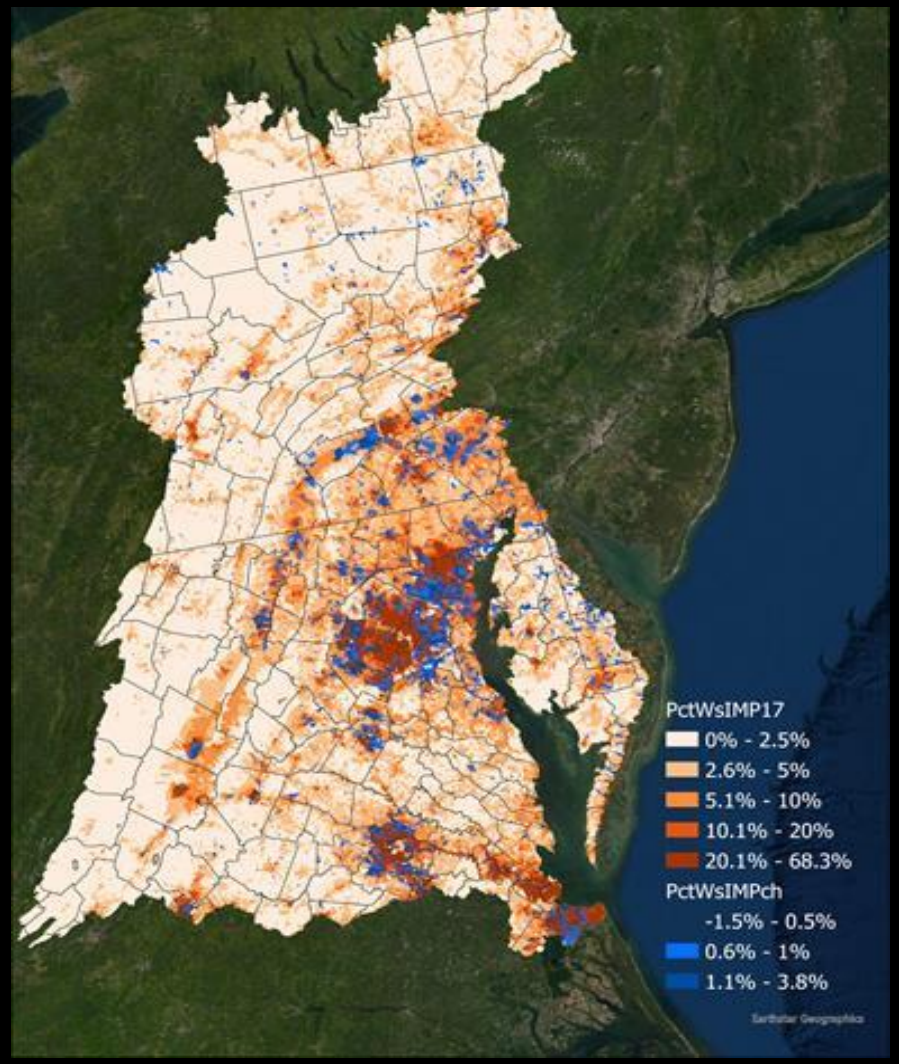
**In January 2020, the outcome was modified from the original language.*

https://www.chesapeakeprogress.com/

Impervious Cover and Impervious Change Indicator: Chesapeake Progress



Impervious Cover, 2017/18,
4.75% of the watershed

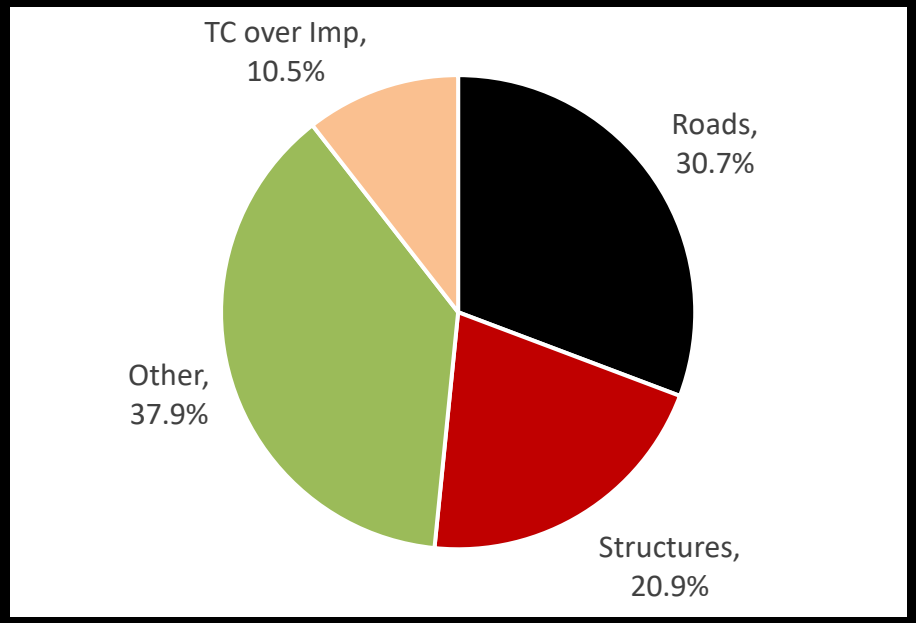


Impervious Cover Change, 2013/14 - 2017/18,
2.6% (79.1 mi^2) relative increase

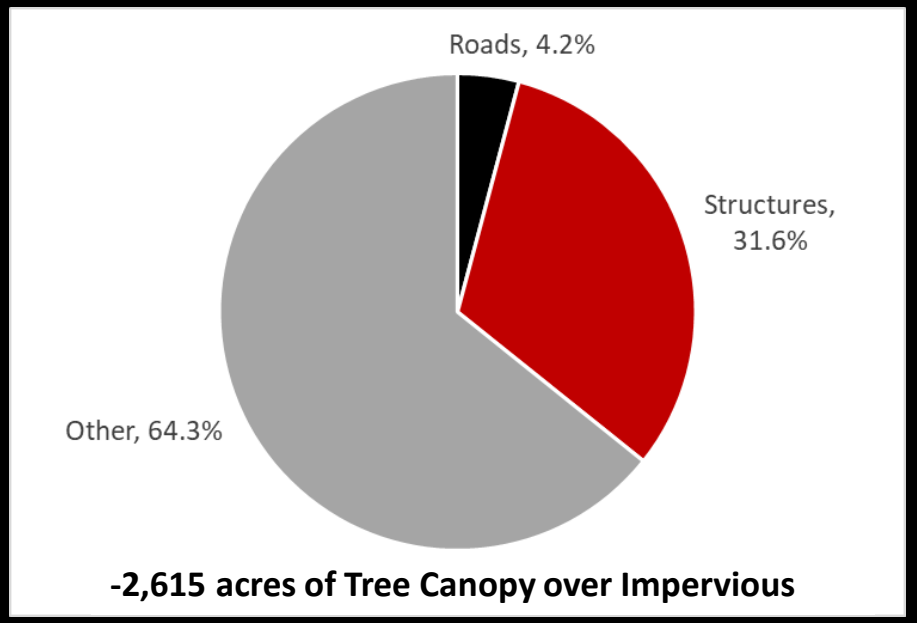
Land Use Composition in the Chesapeake Bay Watershed

	Impervious	Pervious Developed	Forested Extent	Agriculture	Extractive	Wetlands
Delaware	18,280	35,346	195,020	198,721	81	2,875
District of Columbia	20,272	12,648	6,366	11	-	39
Maryland	476,973	897,860	2,588,501	1,587,519	9,711	213,529
New York	115,198	235,801	2,520,808	1,052,199	2,061	35,447
Pennsylvania	517,412	981,516	9,366,290	3,343,970	28,543	50,717
Virginia	732,476	1,191,997	9,111,059	2,571,516	11,603	142,557
West Virginia	48,898	109,452	1,754,101	360,881	2,153	4,433
Total	1,929,508	3,464,620	25,542,144	9,114,818	54,151	449,597
CBW Proportions	4.76%	8.54%	62.98%	22.48%	0.13%	1.11%

Impervious Surface Composition 2017/18



Impervious Surface Change Composition 2013/14 - 2017/18



-2,615 acres of Tree Canopy over Impervious

Land Use/Land Cover Change Viewer

2013/2014 NAIP

2017/2018 NAIP

Land Use / Land Cover Change, 2013-2018

https://lulc-1718.cicapps.org/

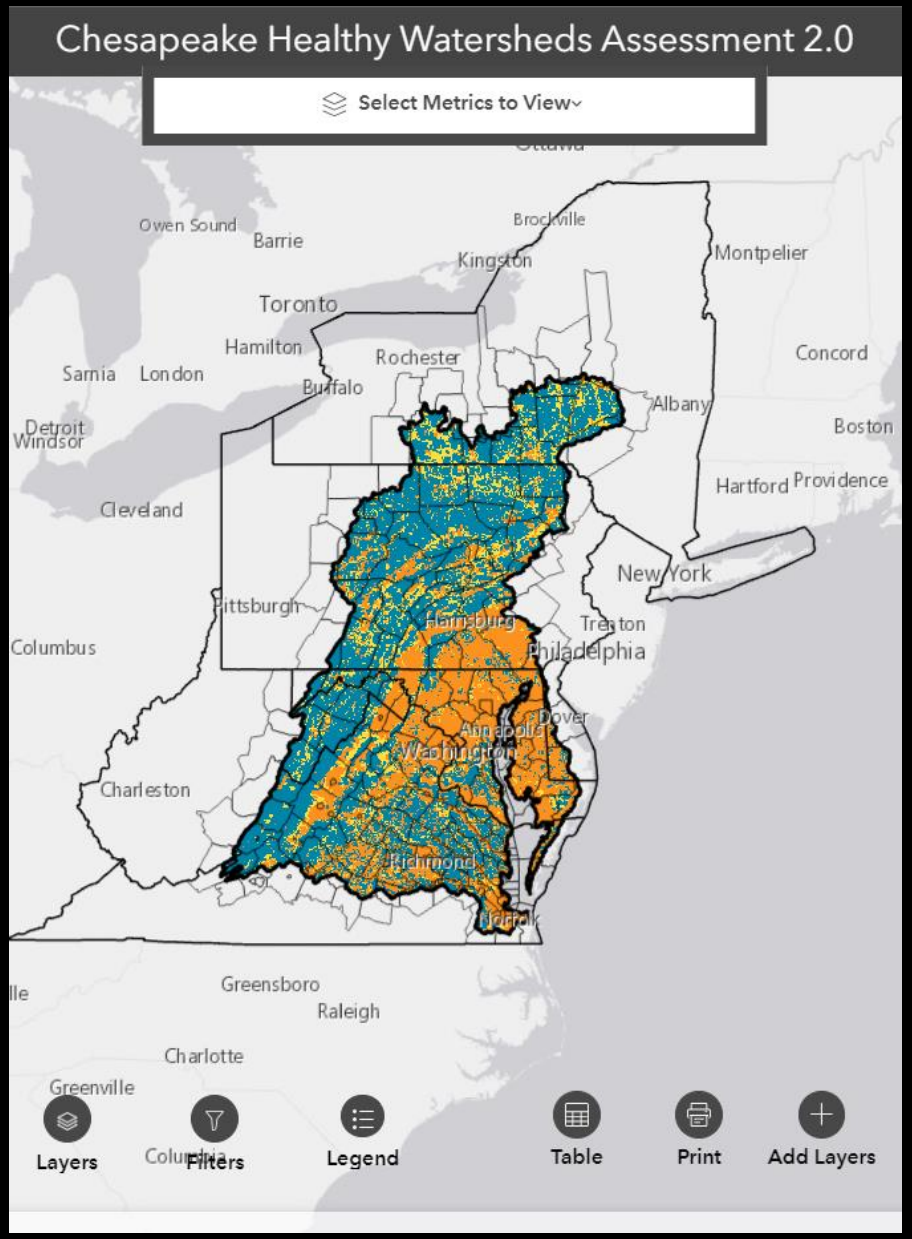
Land Use/Land Cover Change Viewer

2013-2018	ROAD	IMPS	IMPO	TCIS	TURF	TCTG	PDEV	FORE	TCOT	HARF	NATS	CROP	PAST	EXTR	TDLW	RIVW	TERW	WATR	Decrease
ROAD	-	2	47	0	20	8	44	0	6	-	5	1	5	0	-	0	0	-	140
IMPS	0	-	33	0	8	9	10	-	0	-	0	0	4	-	-	-	-	-	65
IMPO	5	74	-	0	96	38	27	0	4	-	2	2	14	0	-	0	0	0	264
TCIS	1	6	19	-	422	-	243	-	-	-	13	2	9	0	-	1	0	-	715
TURF	0	22	213	0	-	126	27	1	2	-	0	-	0	2	-	-	-	-	393
TCTG	0	22	308	0	2,356	-	128	-	-	0	38	3	25	0	-	-	-	0	2,881
PDEV	44	190	219	-	374	2	-	-	0	-	6	0	1	6	-	-	-	1	843
FORE	15	39	119	4	248	943	241	-	884	0	655	95	218	1	0	87	1	-	3,552
TCOT	5	30	93	0	276	34	168	-	-	0	167	68	217	1	0	28	1	0	1,087
HARF	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
NATS	0	0	2	0	80	3	9	32	70	-	-	0	14	0	-	-	-	2	212
CROP	39	16	66	-	48	1	15	18	27	-	1	-	2	-	-	-	-	0	234
PAST	20	31	214	-	90	1	70	51	170	-	21	1	-	0	-	-	-	2	672
EXTR	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
TDLW	-	-	0	-	-	-	-	0	0	-	-	-	-	-	-	-	-	-	0
RIVW	0	0	1	-	1	-	-	3	5	-	-	-	-	-	-	-	-	-	11
TERW	-	0	0	-	-	-	-	0	0	-	-	-	-	-	-	-	-	0	1
WATR	-	0	0	-	3	0	1	2	5	-	1	-	0	15	-	0	-	-	28
Increase	131	431	1,335	4	4,024	1,165	984	108	1,174	0	909	172	510	26	0	116	2	6	11,097
Totals																			
TotIncreas	**131**	**431**	**1,335**	**4**	**4,024**	**1,165**	**984**	**108**	**1,174**	**0**	**909**	**172**	**510**	**26**	**0**	**116**	**2**	**6**	
TotDecreas	**140**	**65**	**264**	**715**	**393**	**2,881**	**843**	**3,552**	**1,087**	**-**	**212**	**234**	**672**	**-**	**0**	**11**	**1**	**28**	
Net	**(10)**	**367**	**1,071**	**(711)**	**3,631**	**(1,716)**	**141**	**(3,444)**	**87**	**0**	**697**	**(62)**	**(162)**	**26**	**0**	**105**	**1**	**(21)**	

https://lulc-1718.cicapps.org/

Use of LULC in the Chesapeake Healthy Watersheds Assessment 2.0

% Impervious Cover
% Tree Cover
% Natural land in the riparian zone



County-level Tree Canopy Fact Sheets (fully automated for 206 counties)

Tree Cover Status & Change
FOR JEFFERSON COUNTY, WV

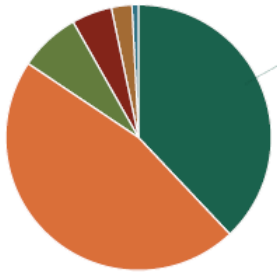
37.9%
Total Percent of County with Tree Cover

$11.2 Million
Annual Benefits provided by Tree Cover (in reduced air pollution, stormwater, & carbon dioxide)

-73 Acres
Net Loss of Tree Cover on Developed Lands, 2014 to 2018

What is the land use/land cover breakdown in your county?

133,537 ACRES OF LAND AREA IN JEFFERSON COUNTY



37.9%	Tree Cover [1] 50,648 acres	4.9%	Impervious (Buildings/Pavement) 6,562 acres
46.4%	Agriculture 61,985 acres	2.5%	Other [2] 3,362 acres
7.4%	Turf Grass (Lawns) 9,939 acres	0.8%	Non-Forested Wetlands 1,041 acres

1 . Tree cover includes all trees occurring on all land uses, such as individual trees found over turf, impervious, agricultural, wetlands, or other lands. It also includes areas of "forest," defined in this dataset as patches of tree cover 1 acre or greater, with a minimum patch width of 240 feet.

2 . Other includes a mixture of non-treed land uses not captured in the main pie chart categories. See the *Data Guide* for detailed definitions of "other" and all the land use categories.

Land use/land cover statistics were generated based on 2018 imagery using the 2022 edition of the *Chesapeake Bay Land Use and Land Cover Database*.

Where does tree cover occur in your county?

77.5% is in forest (39,242 acres)

1.3% is over impervious (657 acres)

10.5% is over turf grass (5,326 acres)

10.7% is other tree cover (5,423 acres)

What are some benefits of tree cover in your county?

Total Air Pollution Removal Value
2.9 Million lbs removed annually
$1.3 Million saved annually
Total air pollution removal includes CO, NO_2, O_3, SO_2, and Particulate Matter (PM2.5, PM10).

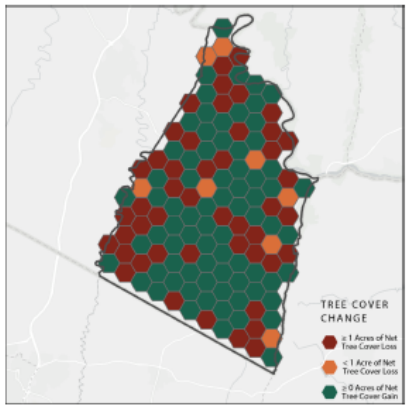
Gallons of Reduced Stormwater Runoff Value
70.7 million gallons reduced annually
$631,900 saved annually

Carbon Sequestered Value
50,000 tons removed annually
$9.3 million saved annually

Calculated based on 2018 tree cover data using: *landscape.treetools.org*

CHESAPEAKETREES.NET
PUBLISHED FEBRUARY 2023

How is tree cover changing on developed and developing lands?



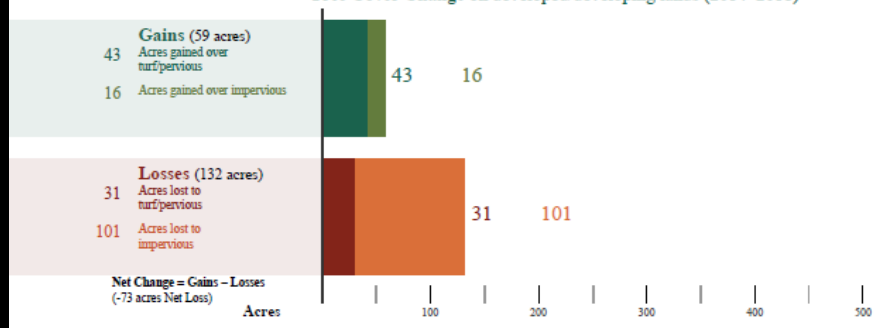
Understanding how your tree cover changes over time can inform the sustainable management of forests and community trees. The map to the left shows where your county has lost and gained tree cover from 2014 to 2018, focusing on land that is already or newly developed.

Tree cover can be lost quickly due to human activities (e.g., construction) or natural events (e.g., severe weather).

Tree cover can be gradually increased through tree planting and natural regrowth, but these gains may take 10-15 years to be detected in high resolution imagery.

Since mature, healthy trees provide significantly greater community benefits than newly planted trees, it is important to both preserve existing tree cover and seek opportunities to grow new trees and forests. Local land use planning, ordinances, and tree programs play a critical role!

Tree Cover Change on developed/developing lands (2014–2018)



Learn More:

Chesapeake Tree Canopy Network
Links to county fact sheets, user guides, map viewers, datasets, and more

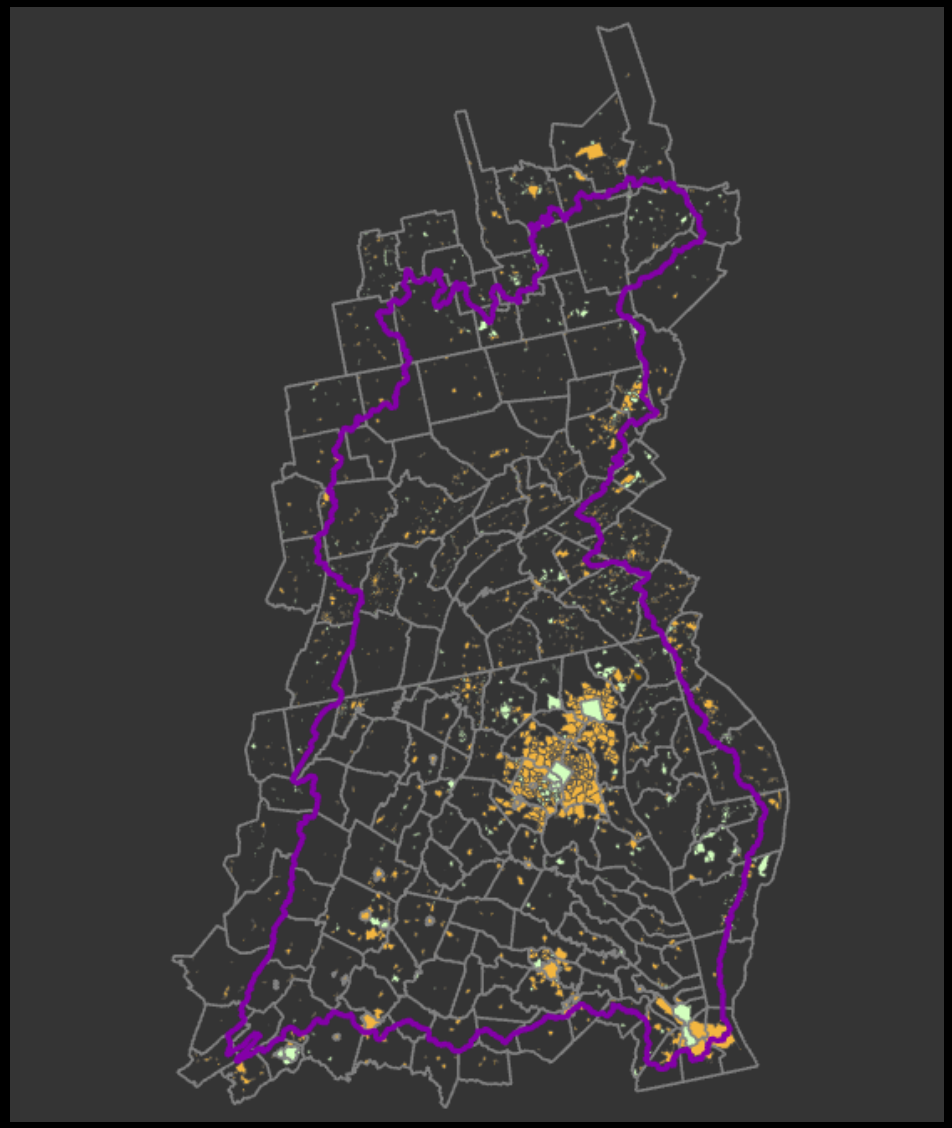
Tree Equity Score
Explore maps of how tree benefits are distributed across communities

Capitalizing on the Benefits of Trees
A slideshow for local leaders featuring tree benefits, case studies and resources

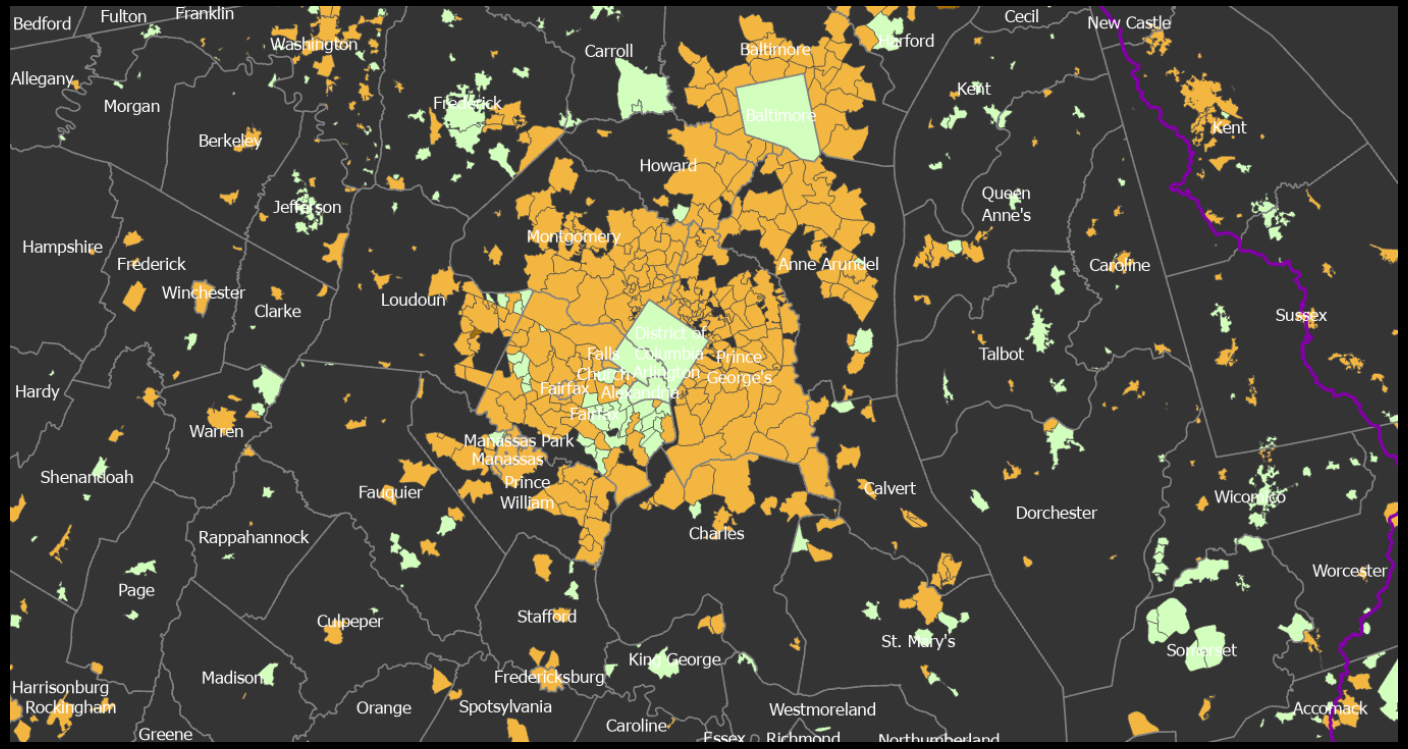
State Urban and Community Forestry Assistance
(Frank Rodgers, West Virginia Website)

Fact sheets produced through a grant from the USDA Forest Service. USDA is an equal opportunity provider, employer and lender.

Community Tree Cover Indicator: Chesapeake Progress



Community Tree Cover, 2013/14 - 2017/18



Community Tree Cover, 2013/14 - 2017/18

Decline, 2013/14 - 2017/18

Increase, 2013/14 - 2017/18

Other Documented Use Cases

MS4 analysis required for the Chesapeake Bay Pollutant Reduction Plan update

Regional green infrastructure work.

Create local land use and local planning or County Comprehensive plans

Long range planning updates by forest resources management agencies, which is required by the latest USDA Farm Bill. The updates are known as State Forest Action Plans.

Create tree canopy percentages for every town, park, and HOA community in DE.

Audubon used the land cover as a reference layer in their Christmas Bird Count by dashboard

Estimating forest, targeting tree plantings, estimating tree planting opportunities on various ownerships, riparian buffer potential, etc.

Prioritize and direct conservation efforts and work for long term Brook Trout benefits

Map potential community garden sites in cities

Tributary Reports

Explain drivers of water quality trends

Check and balance on “Accounting for Growth”

Land use is linked to distribution, abundance and resiliency of SAV

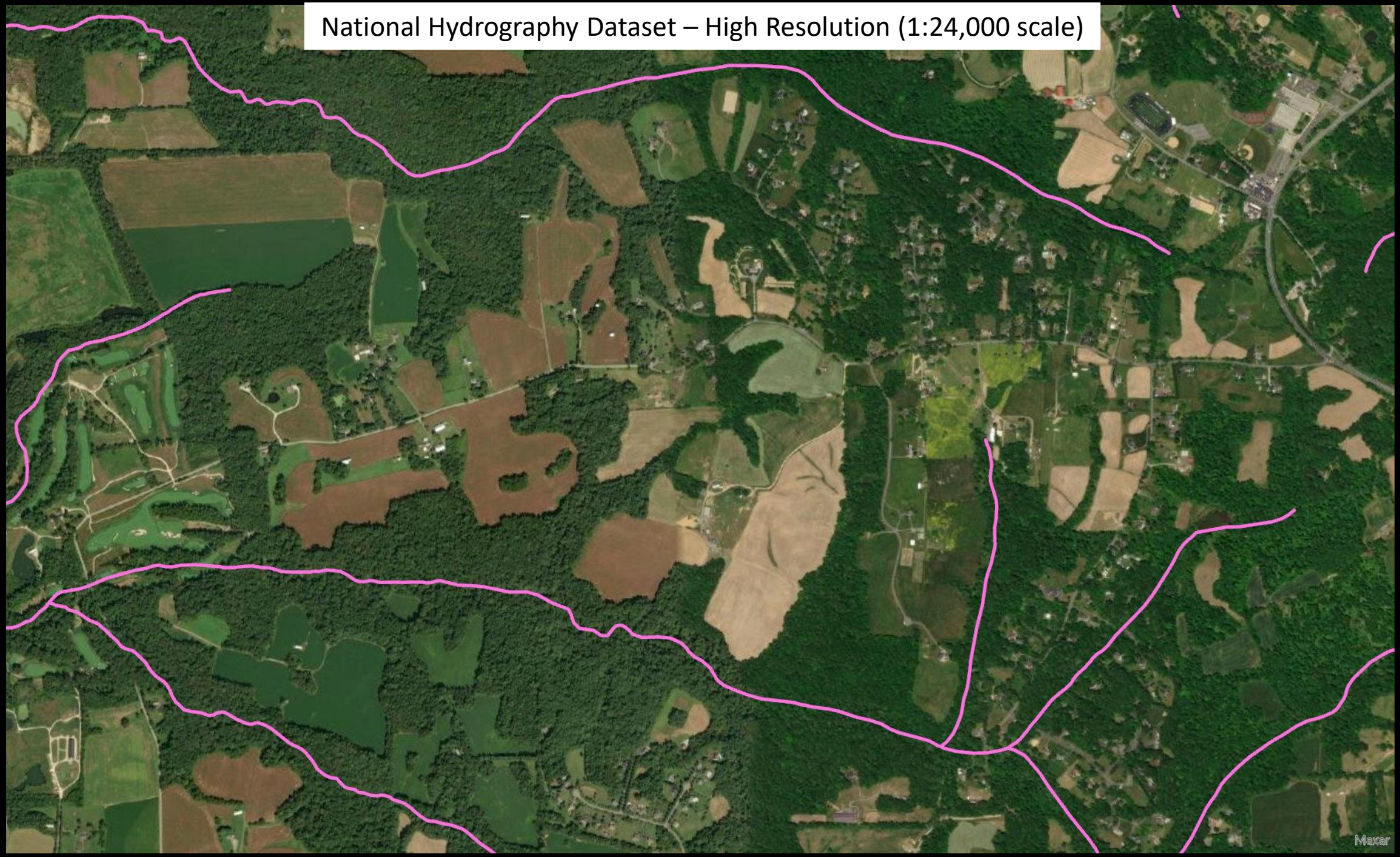
Targeting conservation

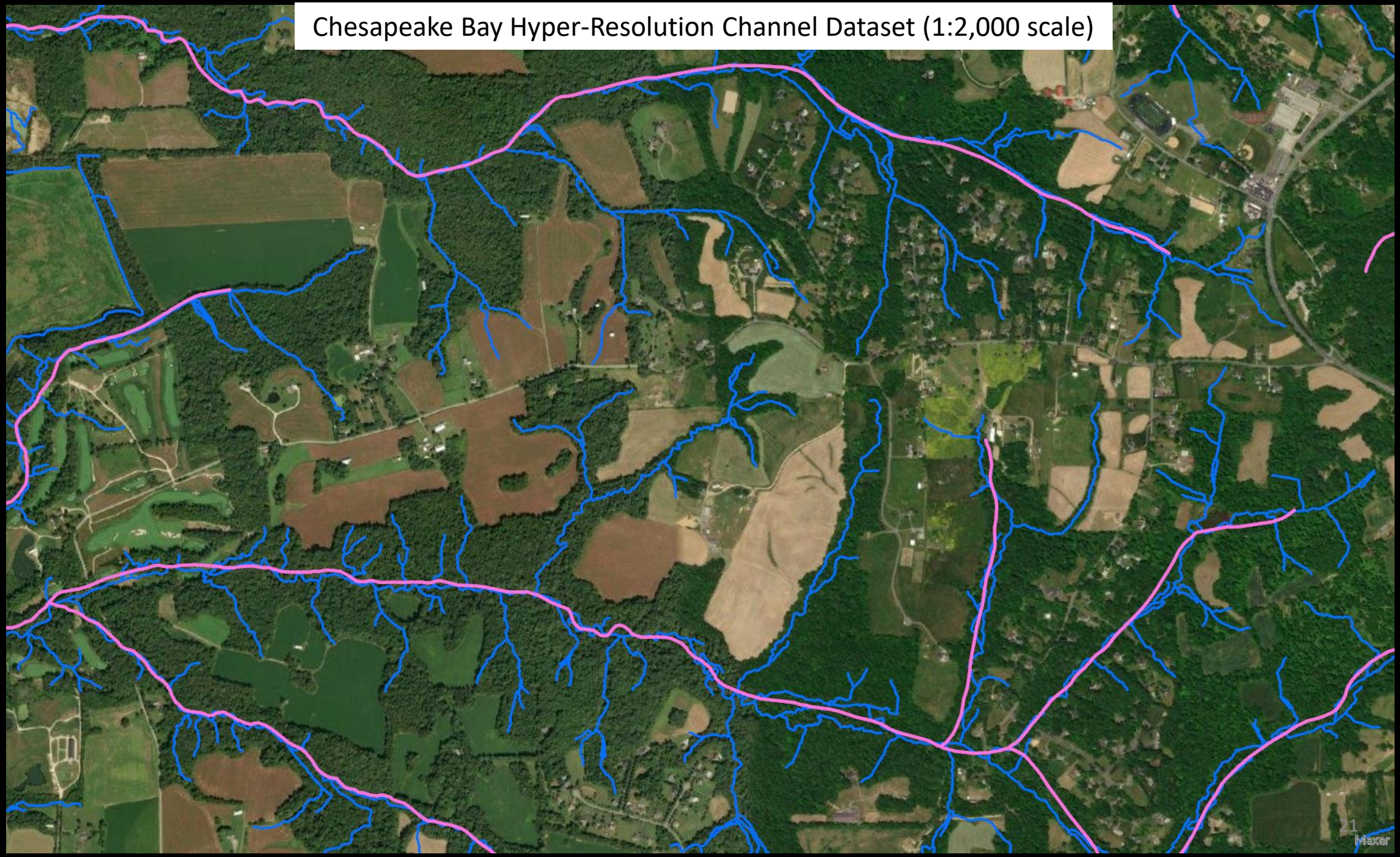
Understanding watershed trends and vulnerability

Informs trends in forest and riparian areas

USGS Chesapeake Regional Assessments

National Hydrography Dataset – High Resolution (1:24,000 scale)




Chesapeake Bay Hyper-Resolution Channel Dataset (1:2,000 scale)

USGS
science for a changing world