

CAST Land Use Change: 2013-2017

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**Water Quality Goal Implementation Team Call
July 26, 2021**

2013 - 2017 Land Use Change Review for CAST-21

July – September 2021

July 26th: WQGIT is presented with CAST-19 and CAST-21 data depicting 2017 land use conditions for all full counties in the watershed.

August 4th: LUWG endorses use of the high-res land use change data as the “best available data” to inform CAST-21.

August 23rd: WQGIT decides to approve use of the high-res land use change data in CAST-21.

September 1st: USGS delivers land use data to CAST team.

Generalized Land Use Changes: 2013 – 2017

CAST-21 (pre-BMP) vs CAST-19 (pre-BMP)

Change: 2013 - 2017	CAST-21				CAST-19			
Land Use	DEV	NAT	AG	MO	DEV	NAT	AG	MO
Gains	120,486	4,562	37,978	235,949	116,785	237,171	172,142	25,095
Losses	-	(354,277)	(4,453)	(40,245)	(0)	(147,455)	(345,875)	(57,864)
Net Change	120,486	(349,715)	33,524	195,704	116,785	89,716	(173,733)	(32,769)

Why the differences:

CAST-21 relies on direct measures of land cover change from aerial imagery interpreted as changes in land use based on rules and ancillary data. The data are transparent, verifiable, and logical.

CAST-19 reconciles modeled urban development (from the CBLCM) with surveyed changes in cropland and pasture (from the Census of Agriculture). Modeled urban growth is only as accurate as the assumptions and input data. Surveyed estimates of agriculture represent land in production- not land use- and have inherent reporting errors. The reconciliation process, aka “true up”, results in non-transparent and unverifiable changes in all land uses, some of which are illogical.

DEV = Developed (impervious surfaces and turf grass); NAT = Natural (forest, wetlands, and water), AG = Agriculture (cropland and pasture), MO = Mixed Open (natural and suspended succession, bare developed)

Generalized Land Use Changes: 2013 – 2017

CAST-21 (pre-BMP) vs CAST-19 (pre-BMP)

FIPS	ST	CountyName	IMP	PERV	CRP	PAS	NAT	MO
10001	de	Kent	1,857	938	(136)	(47)	(513)	(2,099)
42033	pa	Clearfield	417	132	24	211	(3,883)	3,098
51101	va	King William	20	195	1,585	678	(4,251)	1,773

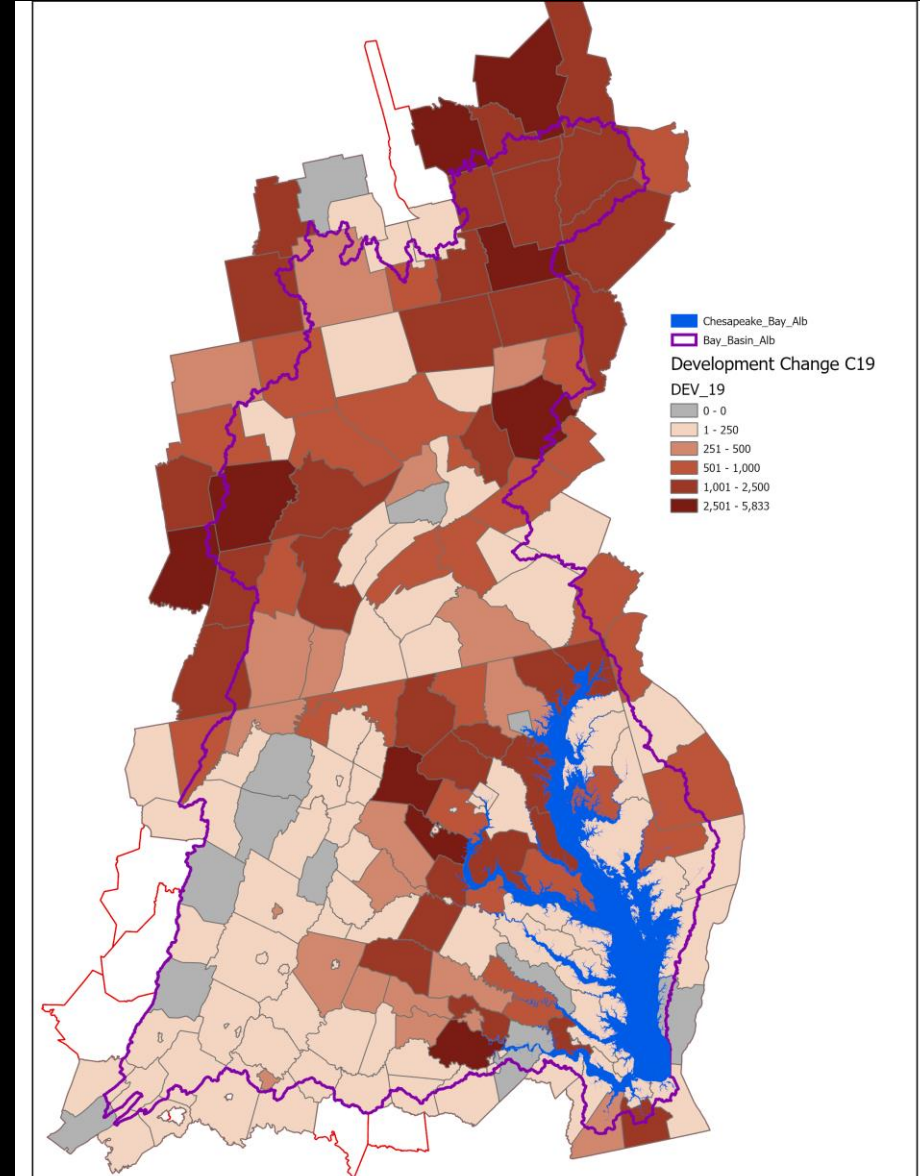
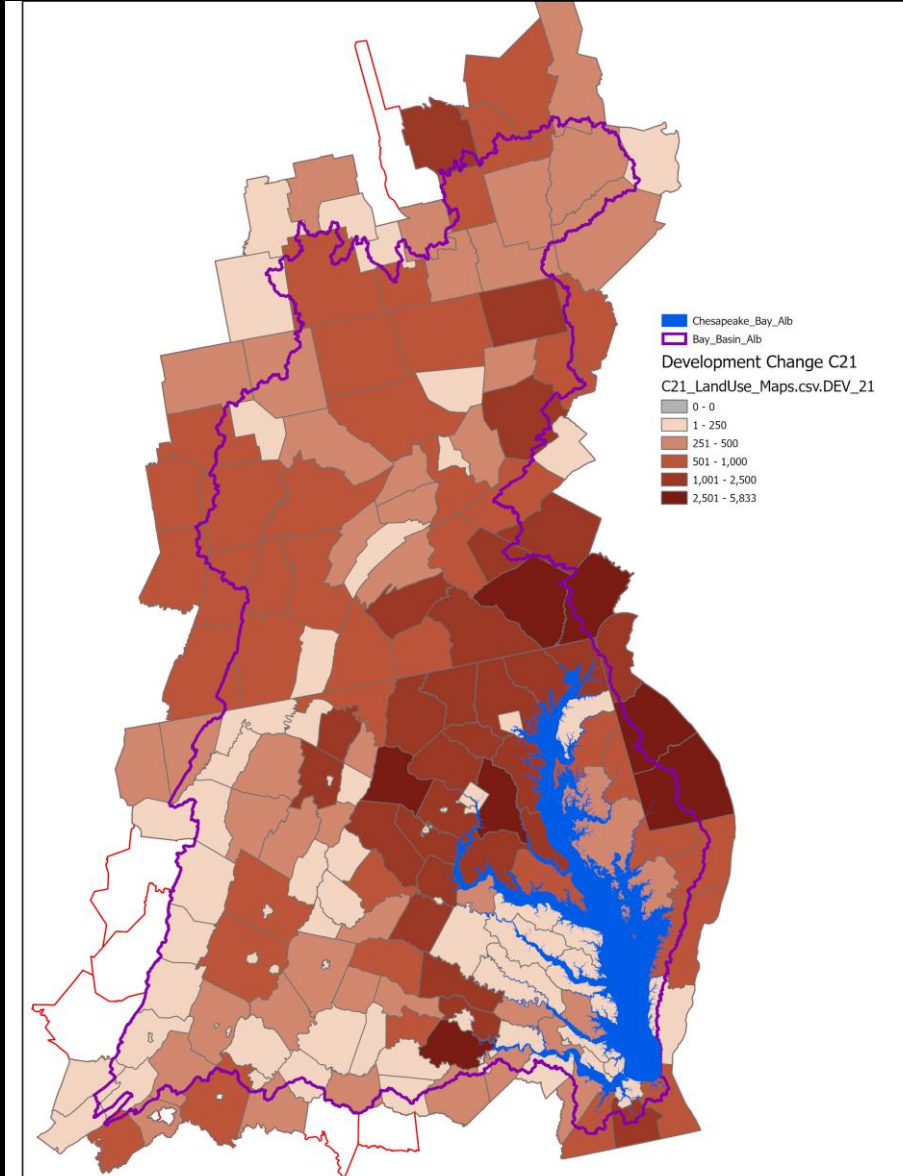
FIPS	ST	CountyName	IMP	PERV	CRP	PAS	NAT	MO
10001	de	Kent	630	(630)	5,726	(1,401)	(1,641)	(2,684)
42033	pa	Clearfield	946	2,495	(6,067)	(12,945)	11,743	3,827
51101	va	King William	115	398	(1,025)	142	345	25

CAST-19 Issues:

- Kent: illogical loss of turf grass despite growing population and increase in impervious surfaces
- Clearfield: large decline in farmland and associated increase in natural lands despite mapped evidence to the contrary
- King William: no recognition of the dominant change in the county: timber harvest

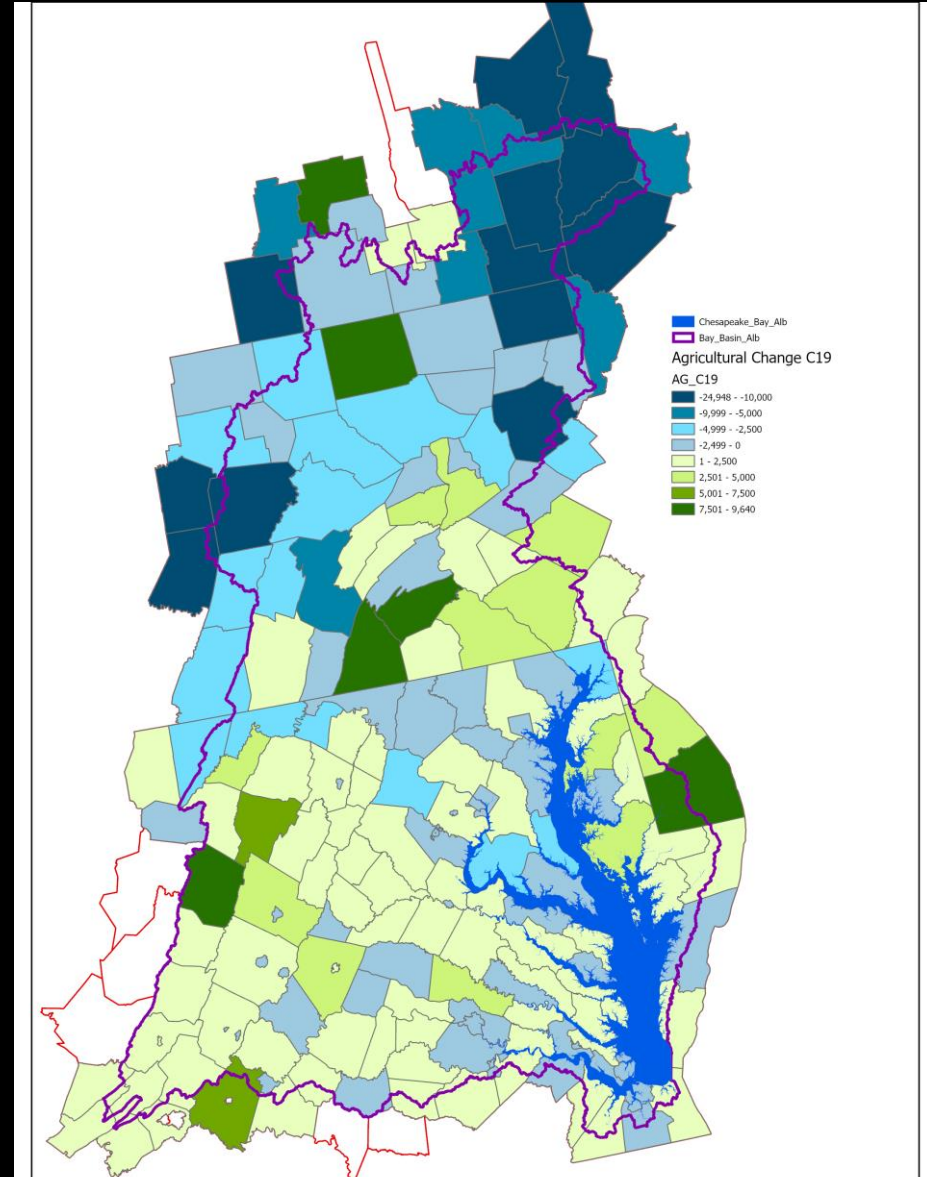
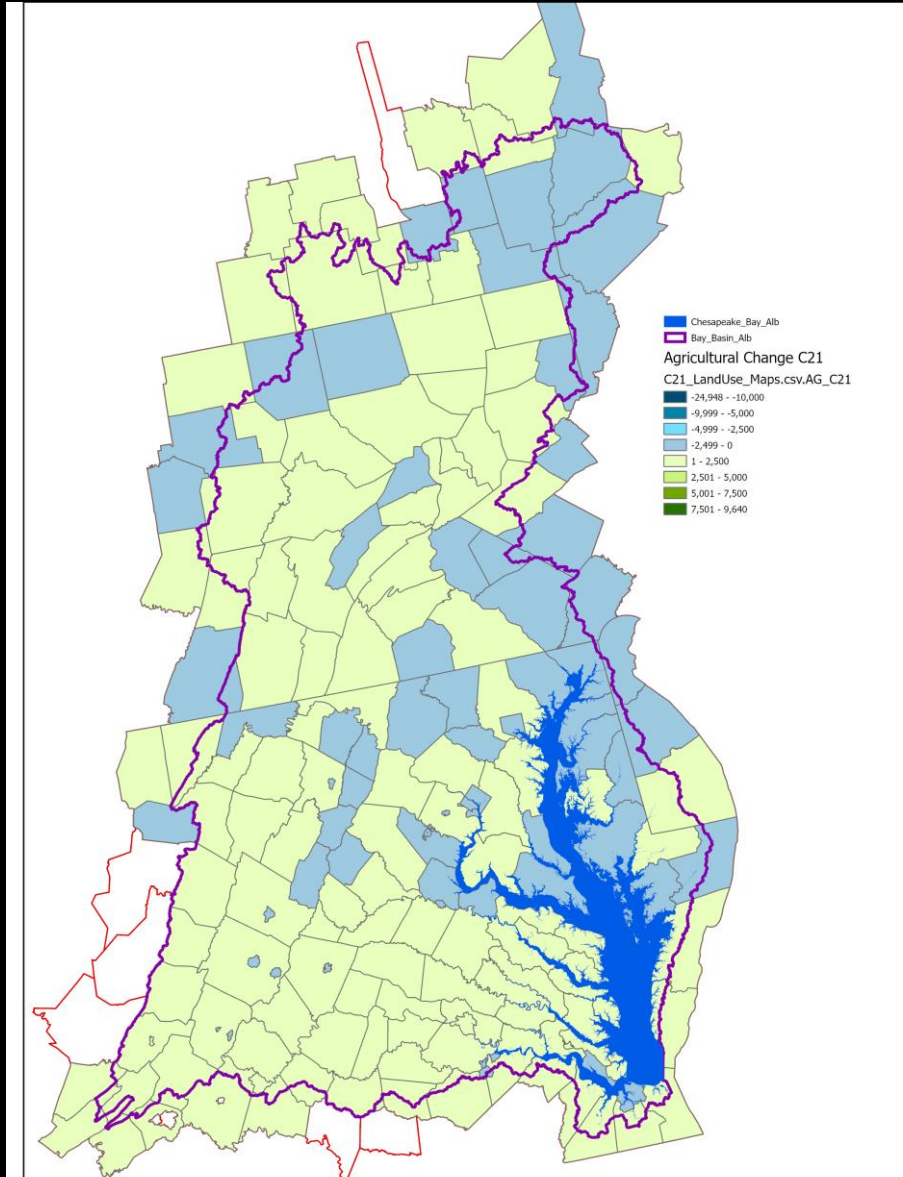
Generalized Development Changes: 2013 – 2017

CAST-21 (pre-BMP) vs CAST-19 (pre-BMP)



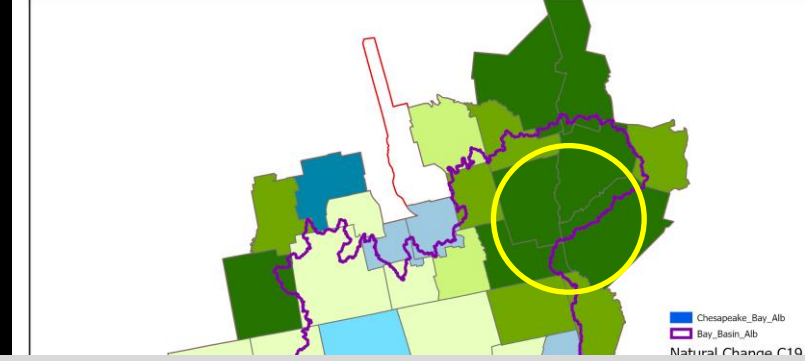
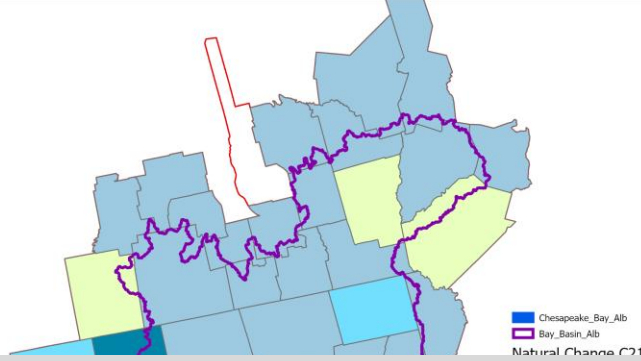
Generalized Agriculture Changes: 2013 – 2017

CAST-21 (pre-BMP) vs CAST-19 (pre-BMP)



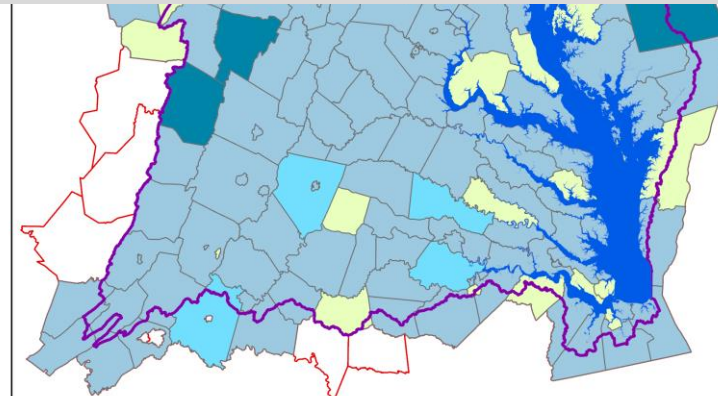
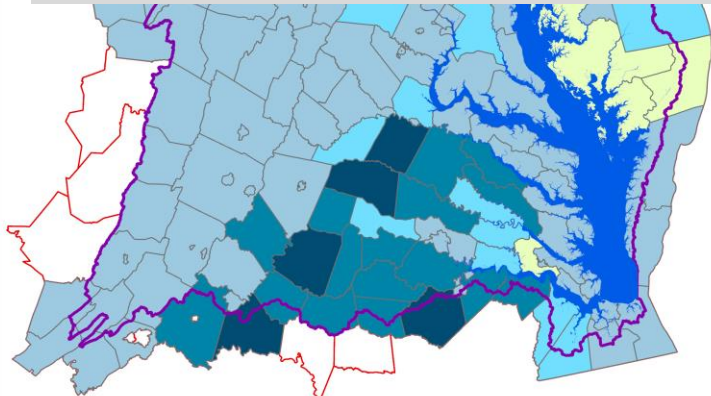
Generalized Natural Changes: 2013 – 2017

CAST-21 (pre-BMP) vs CAST-19 (pre-BMP)



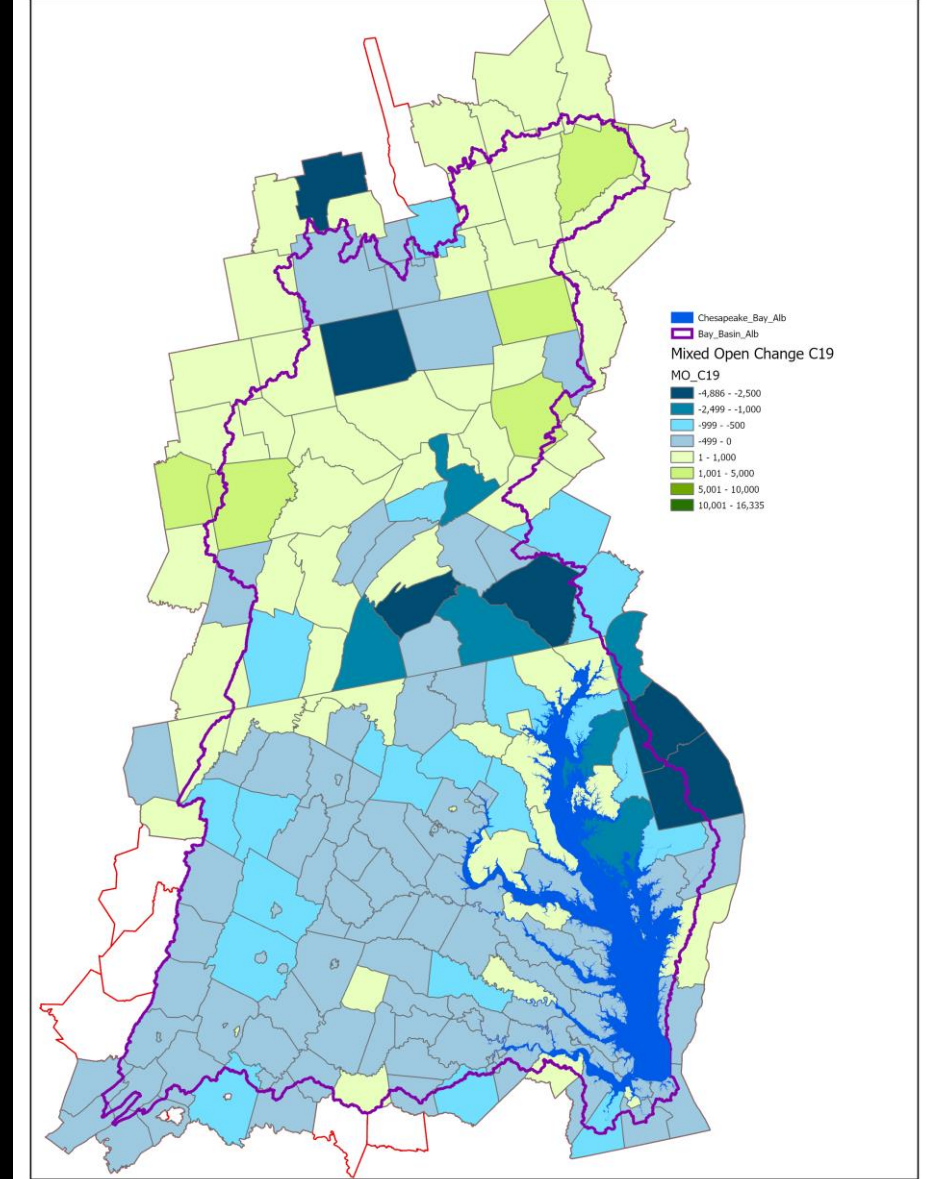
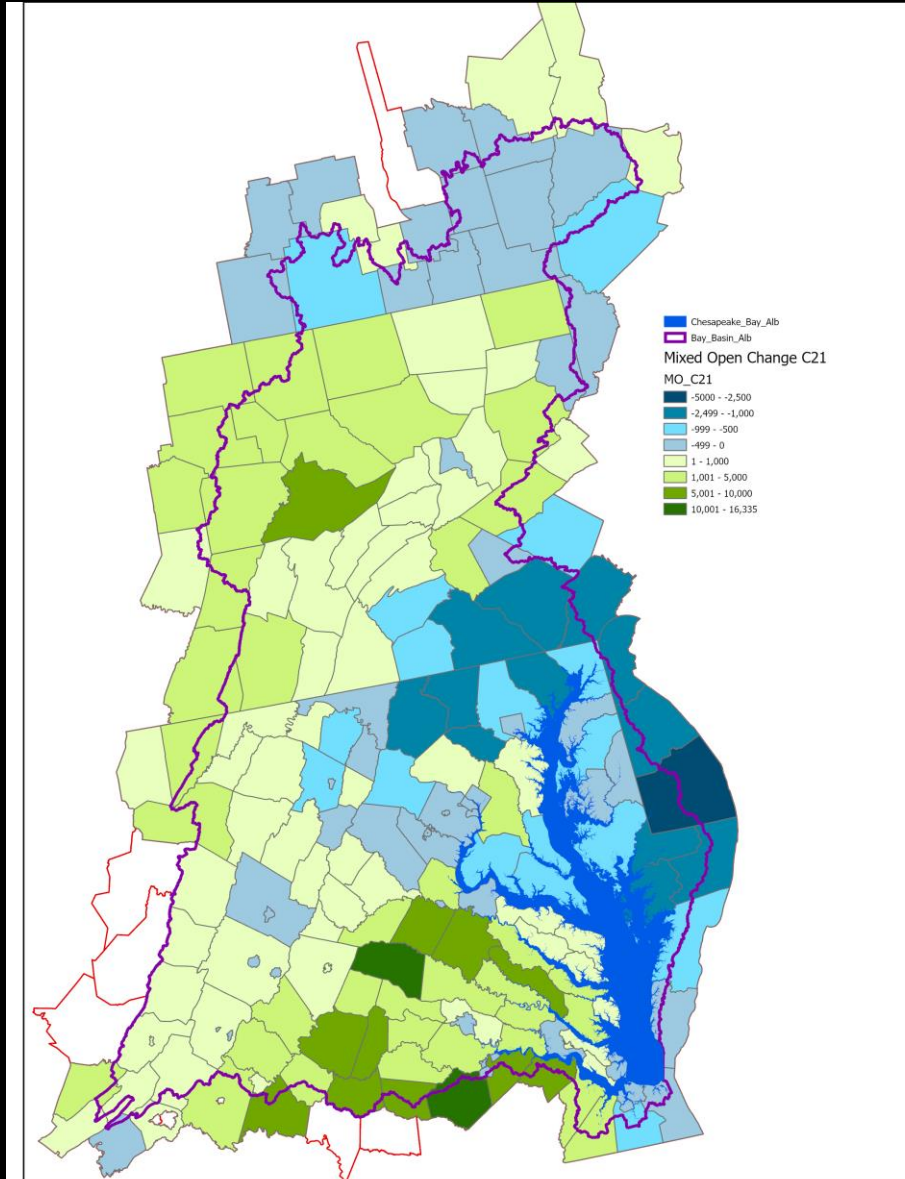
CAST-19 indicates a net increase of +12,000 acres of natural land (trees) in Broome County, NY while the high-res land use data, CAST-21, indicate a net decrease of -164 acres.

The estimated decrease in farmland from the Census (2012-2017) exceeds that which is associated with modeled urbanization, resulting in an increase in forested area as a result of the “true-up” process. This change is not observed in aerial imagery.



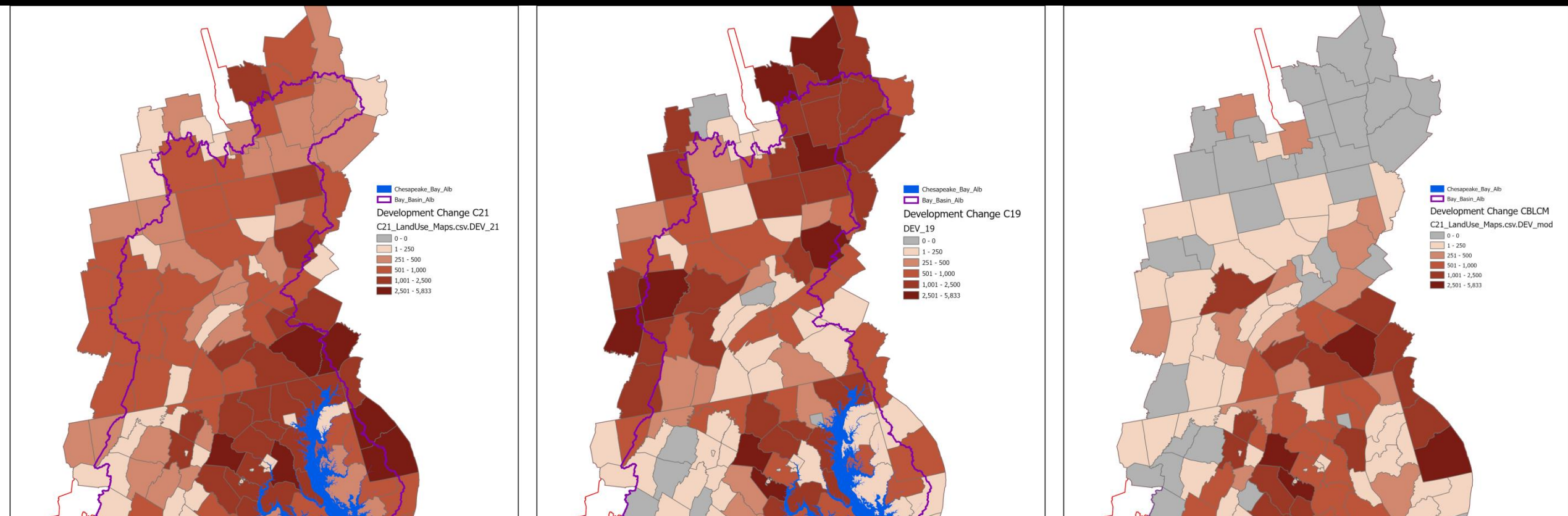
Generalized Mixed Open Changes: 2013 – 2017

CAST-21 (pre-BMP) vs CAST-19 (pre-BMP)



Generalized Development Changes: 2013 – 2017

CAST-21 (pre-BMP) vs CAST-19 (pre-BMP) vs CBLCM



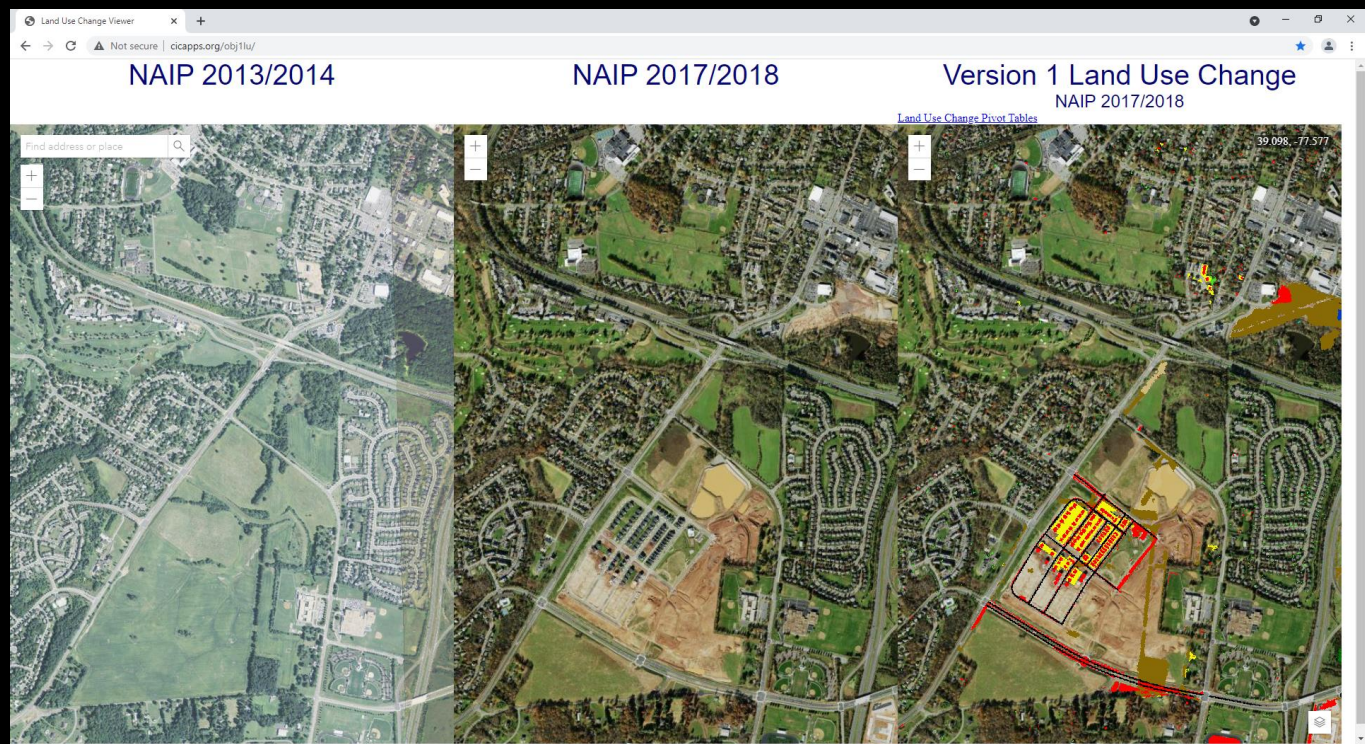
Change: 2013 - 2017	CAST-21				CAST-19				CBLCM			
Land Use	DEV	NAT	AG	MO	DEV	NAT	AG	MO	DEV	NAT	AG	MO
Gains	120,486	4,562	37,978	235,949	116,785	237,171	172,142	25,095	86,947	-	-	2,952
Losses	-	(354,277)	(4,453)	(40,245)	(0)	(147,455)	(345,875)	(57,864)	-	(42,512)	(47,387)	-
Net Change	120,486	(349,715)	33,524	195,704	116,785	89,716	(173,733)	(32,769)	86,947	(42,512)	(47,387)	2,952

Benefits of High-resolution Land Use Data for CAST

1. Transparent

2. Verifiable

3. Logical



T1-T2 LU	IR	INR	TCI	TG	TCT	FORE	WLF	WLO	WLT	MO	CRP	PAS	WAT	Loss
IR	0	3.15	33.35	0	4.86	8.83	0	0	0	1	0	0	0	51.19
INR	140.14	0	82.57	105.78	24.72	2.03	0.12	0	0	123.01	1.25	6.09	1.48	487.19
TCI	3.25	68.33	0	11.1	0	0	0.09	0	0	26.2	0.43	1.52	0	110.92
TG	31.53	168.39	0	0	227.02	3.51	1.21	0.03	0	176.44	1.04	0.43	0	609.59
TCT	9.38	157.63	0.06	107.96	0	4.98	0	0	0	73.62	2.78	3.76	0	360.16
FORE	95.21	854.04	0.6	337.13	427.37	0	0	0	0	1806.96	43.56	110.74	2.65	3678.25
WLF	0	0	0	0	0	0	0	0	0	0	0	0	0	0
WLO	0	0	0	0	0	0	0	0	0	0	0	0	0	0
WLT	0	0	0	0	0	0	0	0	0	0	0	0	0	0
MO	198.73	1236.4	0.02	1199.79	16.13	524.14	0	0	0	0	34.35	16.99	8.7	3235.24
CRP	1.14	13.73	0	1.4	0	1.42	0	0	0	13.48	0	0	0.95	32.12
PAS	4.01	50.28	0	7.16	0.06	10.08	0	0	0	16.65	0	0	0.27	88.5
WAT	0	0	0	0	0.36	1.5	0	0	0	0.55	4.03	0	0	6.44
Gain	483.38	2551.95	116.6	1770.31	700.51	556.49	1.42	0.03	0	2237.89	87.43	139.53	14.05	8659.59
TotGain	483.38	2551.95	116.6	1770.31	700.51	556.49	1.42	0.03	0	2237.89	87.43	139.53	14.05	
TotLoss	51.19	487.19	110.92	609.59	360.16	3678.25	0	0	0	3235.24	32.12	88.5	6.44	
Net	432.19	2064.76	5.68	1160.72	340.35	-3121.76	1.42	0.03	0	-997.35	55.31	51.03	7.61	

NAIP 2013/2014

NAIP 2017/2018

Version 1 Land Use Change NAIP 2017/2018



Did this large forest clearing occur?
CAST-21 says "yes", CAST-19 says "no"

FIPS	ST	CountyName	DEV	NAT	AG	MO	DEV	NAT	AG	MO
51177	va	Spotsylvania	1,801	(10,930)	399	8,730	2,235	(2,080)	114	(270)

Errors in the High-resolution Land Use Data for CAST

Localized errors in the high-resolution land use data are inevitable. Causes for errors vary and include:

- Differences in NAIP image quality (e.g., seasonality, sun angle, atmospheric haze) for 2013/14 vs 2017/18
- Issues with 2013/14 land cover data (e.g., Virginia)
- Poor quality or temporally-offset LiDAR imagery (e.g., 2012 LiDAR + 2018 NAIP)
- Poor quality ancillary data (e.g., local land use, parcels, Microsoft buildings)
- Lack of ancillary data (e.g., timber harvest, abandoned mines, landfills)
- Over-generalized land use decision rules

A preliminary accuracy assessment of the high-resolution data will be conducted in the fall of 2021.

Two errors identified at the July 14th Land Use Workshop are expected to be systematic:

1. Under-classification of timberland from forest to cropland or pasture.
2. Mis-interpretation of post-fire successional forest as cropland or pasture.

**Both will be fixed for Version 1 Land
Use Change data by July 30th - not
impacting data delivery for CAST-21!**

Example Fix: King William County, VA

Version 1 (July 9th) Data

3616 acres of new mixed open (from forest)

1647 acres of new cropland (from forest)

691 acres of new pasture (from forest)



Preliminary Fix (July 21st)

5739 acres of new mixed open (from forest)

176 acres of new cropland (from forest)

38 acres of new pasture (from forest)



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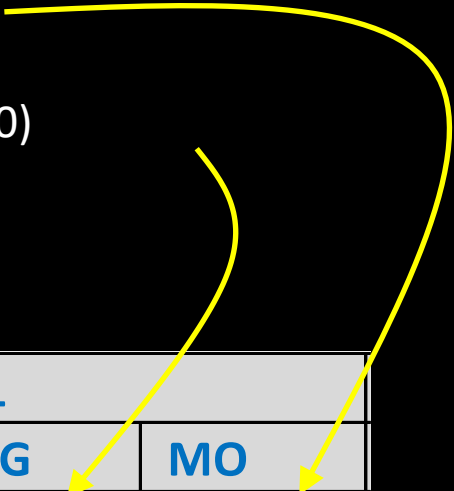
Estimated Impact of Fix on Land Use Changes: 2013 – 2017

CAST-21

Estimated Impact:

- Increase in new mixed open: : ~30,000 acres (+/- 5,000)
- Decrease in new cropland and pasture: ~30,000 acres (+/- 5,000)

Change: 2013 - 2017	CAST-21			
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Gains	120,486	4,562	37,978	235,949
Losses	-	(354,277)	(4,453)	(40,245)
Net Change	120,486	(349,715)	33,524	195,704



CAST-21 Land Use Production

July – September 2021

July 30th: Complete fix for all 206 counties. Repost land use change spatial data and pivot tables.

August 4th: LUWG endorses use of the high-res land use change data as the “best available data” to inform CAST-21.

August 23rd: WQGIT decides to approve use of the high-res land use change data in CAST-21.

September 1st: USGS delivers land use data to CAST team: 2013-2017 land use change and updated 2025 land use forecast.

High-resolution Land Use Data for CAST-21

Summary

The 2013-2017 high-resolution land use change data are transparent, verifiable, and logical. Comparatively, the modeled land use change data are not transparent, challenging to verify, and sometimes illogical.

The accuracy of the 2013-2017 high-resolution land use change data is quantifiable (TBD late 2021).



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