

## Clarification of Accounting for Growth Expectations for the Phase III Watershed Implementation Plans (WIPs)

### Highlights:

1. The Bay TMDL assumes that jurisdictions offset net increases in nutrient and sediment loads across all sectors at the state-basin scale based on sector growth from year 2017 to 2025.
2. Actions included in Land Policy BMPs can reduce future growth in loads and thereby contribute quantitatively towards accounting for growth in a jurisdiction's Phase III WIP.
3. Verification of Land Policy BMPs warrants narrative, programmatic, and numeric reporting of actions implemented each year to ensure that the jurisdictions are on track towards achieving the 2025 targets. Examples: acres of forest and farmland conserved by county, investments to expand wastewater infrastructure, issuance of new subdivision ordinances, implementation of new zoning regulations, or state programs to protect riparian zones from development.
4. Jurisdictions should clearly state in their Phase III WIP whether, and how much, nutrient and sediment load reductions from land use change in one sector will be used to offset growth in loads from other sectors.
5. Jurisdictions may assess and offset growth sector-by-sector and at finer-scale geographies (e.g., counties or smaller watersheds) so long as overall net increases in loads at the state-basin scale are fully offset.

### Chesapeake Bay Program (CBP) Partnership Decisions on Accounting for Growth

In December 2017, the CBP partnership's Principals' Staff Committee (PSC) approved the jurisdictions' use of the 2025 projected "Current Zoning" baseline scenario to account for growth (e.g., future change in land uses and animal and human populations) in the development and implementation of the jurisdictions' Phase III Watershed Implementation Plans (WIPs) and two-year milestones. The PSC further decided that the future growth forecasts be updated every two years using the best available data to coincide with the development of the two-year milestones. Accordingly, the EPA's Chesapeake Bay Program Office (CBPO) will run each jurisdiction's respective Phase III WIP input deck of approved Best Management Practices (BMPs) on forecasted conditions at the state, state-basin, and source sector level using "Current Zoning" as the 2025 baseline land use condition. When developing their WIPs, jurisdictions will have the opportunity to use the Chesapeake Assessment Scenario Tool (CAST)<sup>1</sup> to select one or more alternative representations of 2025 land use conditions (i.e., "Land Policy BMPs"<sup>2</sup>) which reflect potential combinations of actions focused on growth management, forest conservation, and/or agricultural conservation.

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<sup>1</sup> The CAST tool is available for use by the public following registration on the site and it has excellent documentation and help screens.

For more information, see: <https://cast.chesapeakebay.net/> and <http://www.chesapeakeconservation.org/index.php/our-work/current-initiatives/conservation-plus/>

<sup>2</sup> Note that Land Policy BMPs have been referenced in previous documents as "Conservation Plus BMPs".

**US Environmental Protection Agency (EPA) Expectations about Accounting for Growth<sup>3</sup>**

The EPA expects that new or increased loadings of nitrogen, phosphorus, and sediment in the Chesapeake Bay watershed that are not specifically accounted for in the Chesapeake Bay TMDL's Wasteload Allocation or Load Allocation will be offset by loading reductions and credits generated by other sources under programs that are consistent with the definitions and common elements described in the TMDL's Appendix S. This includes National Pollutant Discharge Elimination System (NPDES) permits that are new or not covered by the Bay TMDL and NPDES permits that are expanding and/or have increased discharges of nitrogen, phosphorus and sediment, including those NPDES permits adding septic hookups and general stormwater and construction permits where land is converted to development from another use. EPA expects each jurisdiction to account for and describe how it will offset sector or state-basin growth in its Phase III WIP, which is consistent with the expectation outlined in the 2010 Bay TMDL (e.g., describing programs and regulations that will be implemented to maintain existing land use/cover, including high-quality beneficial land use/cover such as forests).

The EPA expects that any planned or proposed offsets should not adversely affect local water quality (e.g., installing BMPs in a rural area to compensate for increased urban pollution should not allow for water quality degradation in the urban area). More specifically, jurisdictions should identify the amount of certain BMPs (and associated load reductions) that will be used as "offsets" to account for growth, specify which growth sectors (e.g., urban, agriculture, septic) are being accounted for by these offsets, and determine that the specific growth is not adversely affecting local water quality and local TMDLs.

The EPA strongly encourages jurisdictions to utilize Partnership-approved approaches, data, and decision support tools, e.g., Chesapeake Bay Land Change Model (CBLCM) and CAST for forecasting conditions to fully account for projected growth at the appropriate geographic scales and for each source sector. Jurisdictions can review current forecasts and data informing those forecasts via the Phase 6 Land Use Viewer (<https://chesapeake.usgs.gov/phase6/map>). As part of the development of their two-year milestones from 2018-2025 during every odd year, jurisdictions have an opportunity to provide the CBPO with new and updated information pertaining to future urban growth forecasts. These data include county-level population and employment projections, zoning (classed as residential, commercial, both, and no-growth areas), percentage of county residential and commercial growth expected to occur as infill or redevelopment, MS4 and/or CSO regulated stormwater areas, and sewer service areas. These data must be provided to the CBPO through either the jurisdictional representatives on the CBP Land Use Workgroup or through the state WIP coordinators in the spring of every odd year (due this year by April 28<sup>th</sup>). These new or updated data will be used to update the Current Zoning baseline 2025 condition and the Land Policy BMPs and will increase the accuracy of the forecasts.

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<sup>3</sup> This information was taken directly from EPA's Phase III WIP Expectations and follow-up correspondence between EPA Region 3 and individual jurisdictions in support of their 2016-2017 and 2018-2019 milestones and progress evaluations, dated 7/12/2018:

<https://www.epa.gov/chesapeake-bay-tmdl/epa-oversight-watershed-implementation-Plans>

Accounting for growth strategies outlined in the jurisdictions' Phase III WIPs should also address gaps in programmatic capacity and approaches to facilitate local engagement. Gaps in programmatic capacity include: building, staffing, and implementing the programs and programmatic infrastructure, tracking systems, BMP verification programs, policies, legislation, and regulations necessary to fully account for growth and offset all resultant new or increased pollutant loads through 2025. Local engagement approaches should include a clear description of local, regional, and federal involvement in each jurisdiction's strategy to account for growth (e.g., provisions for maintaining up-to-date communications with stakeholders and the public about progress on Phase III WIP implementation and articulation of the roles that other stakeholders will play in implementation).

### **Land Policy BMPs**

To support the jurisdictions' efforts to account for growth in loads due to changes in land use, the CBP partnership and the jurisdictions have developed a suite of future land use scenarios that are referred to as "Land Policy BMPs" are available in CAST for optional inclusion in each jurisdiction's Phase III WIP. The Land Policy BMPs currently in CAST include three developed for illustrative purposes ("Forest Conservation", "Growth Management", and "Agricultural Conservation") and will include at least one custom Land Policy BMP for jurisdictions that expressed interest in developing one (i.e., District of Columbia, Delaware, Maryland, Pennsylvania, Virginia, and West Virginia). Currently proposed custom Land Policy BMPs include a balanced mixture of forest and farmland conservation and growth management. New York has expressed interest in developing one but has not yet done so.

Land Policy BMPs represent aggregations of a variety of policy and programmatic actions implemented by a variety of organizations. The CBPO only has resources to simulate Land Policy BMPs in CAST that have been drafted by one or more of the Bay jurisdictions. The WIP leadership in each jurisdiction determines the policy and programmatic elements to be included in their Land Policy BMPs with input solicited from private industry, NGOs, academia, and others via the WIP development process. Jurisdictions can choose and/or design land conservation and growth management actions to include in their custom Land Policy BMPs. The proposed actions can reflect state-wide policies, programs, regulations, and investments or vary by county (i.e., a statewide dataset of zoning restrictions which includes data for select counties and relies on default values for all other counties). If a jurisdiction is interested in the effects of a single policy or program- like a cluster housing subdivision ordinance- they can develop a unique Land Policy BMP reflecting just that single practice to the CBPO under the condition that they also provide guidance on how the ordinance is expected to affect future land use conditions. For example, the CBPO would need to know how the ordinance is presumed to impact development densities and the geographic areas affected by it. Once finalized and approved by the jurisdictions that developed them, custom Land Policy BMPs will be included in CAST. While the custom Land Policy BMPs will be available to all users, their effects on land use will only apply to the jurisdiction for which they were developed.

When designing Land Policy BMPs, it's important to briefly consider how the CBLCM functions. The CBLCM simulates future residential and commercial development resulting from population growth. Projected growth for a county or city MUST be accommodated within that jurisdiction. No leapfrog development or migration is allowed because these phenomena are assumed to be already accounted for in each

jurisdictions' demographic projection. Growth can be accommodated through infill/redevelopment or greenfield development, the latter resulting in the conversion of forests and/or farmland to development. All infill/redevelopment is assumed to be served by sewer and result in no additional increase in developed land. Actions that increase infill/redevelopment directly reduce the footprint of future growth and reduce impacts to both forests and farmlands. Actions that increase development densities in high-probability residential or commercial areas have similar effects, but they are less direct compared to infill/redevelopment. Actions that prevent future development on a parcel of land serve to deflect growth to other areas, assuming there is enough suitable land remaining to accommodate growth. For example, protecting lands currently served by sewer could increase future nutrient loads if growth is deflected into areas served by septic. Land protection actions will have the greatest impact on the future footprint of development if they occur within jurisdictions with high population growth and limited land available for development.

### **Calculating Load Reductions from Land Policy BMPs**

The effects of land use planning and land conservation actions on future development and septic systems and associated conversions of forests, cropland, and pasture are simulated by the CBPO using the CBLCM. Future estimates of developed land and land use conversions are combined in CAST with extrapolated trends in crops, hay, pasture, and animal populations from the Census of Agriculture<sup>4</sup> (1982 -2012), state-reported acres of harvested forest, and land under construction to form the final 2025 land use datasets associated with the 2025 Current Zoning baseline and each Land Policy BMP. Adjustments are made to the developed land use acres to accommodate reported construction acres, to the forest acres to accommodate harvested forest, and to both the mixed open land use and acreages reported in the Census of Agriculture to accommodate the Census of Agriculture.

Pollutant loads (pounds of nitrogen, phosphorus, and sediment) from Land Policy BMPs are estimated using CAST which has been designed to help jurisdictions develop their Phase III WIPs and estimate pollutant loads from all BMPs, including Land Policy BMPs. Pollutant loads resulting from Land Policy BMPs can be estimated on one of two base conditions: Historic Trends or Current Zoning. Because the "Current Zoning" base condition was accepted as the official 2025 baseline used by the CBP partnership to evaluate the effects of Land Policy BMPs on 2025 conditions, it is recommended that this baseline be chosen to estimate pollutant load reductions from Land Policy BMPs. When a jurisdiction develops its Phase III WIP with a specific Land Policy BMP, the net pollutant load reductions associated with that Land Policy BMP (compared to Current Zoning) count towards the jurisdiction's required reductions under its Phase III WIP planning targets. When counting reductions from Land Policy BMPs, it is important to remember that these reductions are derived from forecasted future conditions. The actual reductions associated with a Land Policy BMP may change over time as land use conditions are updated in CAST every two years.

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<sup>4</sup> The 2017 Census of Agriculture is scheduled for release on April 11, 2019 and will be incorporated into the CBP's extrapolations of trends in crops, hay, pasture, and animal populations in all 2025 projections produced from the summer of 2019 onward.

Expected changes in nitrogen, phosphorus, and sediment loads for each jurisdiction's custom Land Policy BMP compared to 2025 Current Zoning baseline loads are shown in Table 1. These custom, jurisdiction-specific, Land Policy BMPs may include unique mixtures of growth management, forest conservation, and farmland conservation actions. The effects of these collective actions on future land use conditions and septic systems were simulated using the CBLCM and then input to CAST to estimate their effects on pollutant loads. Negative values, i.e., reductions compared to the Current Zoning baseline, are in parentheses. As a percentage of the total needed load reductions required from 2018 – 2025 across all jurisdictions, Land Policy BMPs reduce nitrogen and phosphorus loads by <1% of what is required to meet the 2025 targets. While this contribution is relatively small, it is a contribution that is occurring and has not previously been accounted for in Watershed Implementation Plans. Moreover, Land Policy BMPs should be evaluated with the recognition that the impact of planning and land conversion actions will only increase over time as the population of the watershed continues to grow. This fact becomes increasingly relevant post-2025 when the pollution reduction targets must be maintained to prevent future water quality degradation.

The effects of Land Policy BMPs on nutrient loads are complex and can be counter-intuitive. Increases in pollutant loads may result from a Land Policy BMP with more, higher-loading land use acres (e.g., cropland) or fewer, lower-loading land use acres (e.g., forest) compared to the Current Zoning baseline. Land Policy BMPs may also decrease loads from one pollutant, e.g., phosphorus, while increasing loads from another, e.g., nitrogen. This occurs in the draft custom Land Policy BMP for Delaware because extrapolated changes in crop types from the Census of Agriculture lead to relatively large increases in nitrogen that counter the decreases in the developed sector due to growth management actions. These changes in crop type, however, cause only minor increases in phosphorus relative to the changes expected due to growth management actions, which is why the net change in phosphorus remains negative. Because the effects of Land Policy BMPs are complex, jurisdictions are encouraged to evaluate the effects and refine their Land Policy BMPs in ways that generate greater pollutant reductions while remaining realistic.

**Table 1. Change in Total Pollutant Loads (Edge-of-Tide pounds of TN, TP, and TSS) associated with jurisdiction-specific Land Policy BMPs compared to the 2025 Current Zoning baseline.**

<b>Jurisdiction</b>	<b>TN</b>	<b>TP</b>	<b>TSS</b>
<b>District of Columbia</b>	551	39	119,646
<b>Delaware</b>	30,365	(2,822)	(118,038)
<b>Maryland</b>	(69,433)	(4,949)	(3,494,531)
<b>New York</b>	-	-	-
<b>Pennsylvania</b>	(20,816)	(425)	(434,900)
<b>Virginia</b>	(283,782)	(14,159)	(10,231,241)
<b>West Virginia</b>	(890)	(146)	(74,279)

#### **Updating Observations of Land Use Change and 2025 “Current Zoning” baseline**

Regular updates to the Chesapeake Bay land use data will inform an adaptive management approach to achieve pollutant reduction targets and will constitute an important part of the process to verify the effects of Land Policy BMPs. Coarse-scale, “hot spots” of land cover change (approx.  $\geq 10$  acres) for major land cover types (e.g., impervious cover, tree cover, scrub-shrub, herbaceous, and water) will be derived from satellite data every two years (with a 1 to 2-year lag). Land cover change hot spots will be overlaid on the 2013 high-resolution land use dataset to translate land cover change into changes in land use. Fine-scale changes in land use (approx.  $\geq 1$  acre) will be observed from aerial imagery every four years (with a 2 to 3-year lag). When available, these data will be provided to the jurisdictions to inform their two-year milestones and annual progress narratives, indicating the need for greater or lesser emphasis on BMPs for different sectors. The data will also be useful for verifying the effects of Land Policy BMPs and jurisdictions will have the option to update actions included in their Land Policy BMPs every milestone period. For example, jurisdictions may want to place a greater emphasis on infill/redevelopment or land conservation given recently observed changes in land use. Regular updates will occur every odd year, coinciding with the two-year milestones, using the best available data (e.g., population and employment projections, protected lands, Census of Agriculture, and potentially new observed patterns of land use change). For example, updating the Current Zoning baseline in the summer of 2019 will inform 2019 and 2020 Progress and the 2021-2022 Milestones.

### **Annual Progress Reporting Recommendations**

Every year, the Bay jurisdictions must report progress towards achieving the goals outlined in their WIPs and two-year milestones. Reporting annual progress has a narrative programmatic component and a quantitative component consisting of a table of approved BMPs that were implemented over the previous year. For annual progress, implemented BMPs are combined with expected land use conditions in CAST to quantify their expected nutrient and sediment reductions against land use conditions interpolated from the latest mapped land uses (i.e., 2013) and the 2025 Current Zoning baseline. While this is the agreed-upon CBP Partnership approach for evaluating progress, jurisdictions may choose to evaluate their progress against land use conditions interpolated from the latest mapped land uses (i.e., 2013) and their 2025 Land Policy BMP in addition to the official approach. This latter method will enable jurisdictions to consider the expected effects of land use planning and land protection actions on their progress.

Actions specified in the Phase III WIPs to achieve the Land Policy BMPs adopted by each jurisdiction should not be included in the tables of implemented structural BMPs reported for annual progress. However, verification of the Land Policy BMPs warrants narrative, programmatic, and numeric reporting of actions implemented each year to ensure that the jurisdictions are on track towards achieving them. For example, annual progress reporting might include documentation of acres of forest and farmland conserved by county, investments to expand wastewater infrastructure, issuance of new subdivision ordinances, or implementation of zoning regulations that protect riparian zones from development. Annual reporting of activities along with monitored changes in land use will help verify Land Policy BMP actions intended to reduce and minimize potential future increases in pollutant loads due to land use activities. The Land Use Workgroup, Water Quality Goal Implementation Team, and Management Board will be asked to clarify CBP partnership expectations about the level of detail needed to verify Land Policy BMP actions in annual progress narratives.

### **Guidance for Local Review and Interpretation of Changes in Land Use**

Changes in pollutant loads associated with Land Policy BMPs result from estimated changes in land use and septic systems due to increases in population and employment, trends in agriculture, and reported annual estimates of acres under construction and harvested for timber. Because these data are combined in CAST, it is challenging to identify the land use changes that are mainly responsible for changes in pollutant loads. One can isolate the specific drivers of changes in pollutant loads for each source sector by comparing changes in land use simulated by the CBLCM with those produced from CAST and the associated changes in loads. The CBPO will provide jurisdictions with data on changes in land use and nutrient and sediment loads for each Land Policy BMP by land use category. These data will be available through the CBP partnership's Land Use Workgroup website: [https://www.chesapeakebay.net/who/group/land\\_use\\_workgroup](https://www.chesapeakebay.net/who/group/land_use_workgroup). This information can be used by the jurisdictions to determine how best to account for growth. For example, increasing loads due to growth may, in some jurisdictions, be counter-balanced by a net decrease in nutrient and sediment loads due to the conversion of farmland. Jurisdictions should clearly state in their Phase 3 WIP whether, and how much, nutrient and sediment load reductions from land use changes in one sector will be used to offset new loads from increased land coverage and septic discharges from developed uses.

Because the CBPO estimates future changes in land use through a sequential modeling process, to fully understand the causes of future changes in nutrient loads, it is important to examine the data at each stage of the process.

### **Stage 1: Review baseline data and update it**

The first step in understanding future estimates of land use change is to review the baseline data used by the CBPO to represent land use, urban areas, sewer service areas, federal facilities, regulated stormwater areas, residential and commercial development suitability (e.g., land available and eligible for development)<sup>5</sup>, and residential and commercial development densities. These data are available to view, review, and download through the Phase 6 Land Use Viewer. Any discrepancies between local data and those shown in the Viewer will propagate through the final Phase 6 land use datasets for all years after 2013. The CBPO will solicit and accept updates to these data in the spring of each odd year (i.e., spring 2019, 2021, 2023, and 2025) as discussed previously.

### **Stage 2: Review estimates of population, employment, and infill development rates and provide updates**

In addition to reviewing the baseline spatial data, jurisdictions are welcome to review the county-level future population, employment, and infill estimates and associated metadata available for download via the “Data and Metadata Download” menu on the Phase 6 Viewer website. While the population projections for each county/city were developed by state agencies or contractors, employment projection data was only available for Maryland and Delaware and for counties in the Washington Metropolitan Council of Governments’ region. Elsewhere, future employment was derived by multiplying estimates of future-year total housing units (derived directly from the population projections) by the ratio of total employment estimates for 2015 from the Bureau of Economic Analysis divided by 2015 total housing unit estimates derived from the Bureau of Census Annual Population Estimates.

In the CBLCM, net positive changes in population drives new development. The demographic components of population change include births, deaths, and domestic and international migration. Net positive changes in population occur when births plus migration exceed deaths plus outmigration. The relationship between changes in population and new development is complex and depends on many factors such as consumer preferences, household characteristics, housing prices and quality, accessibility, school quality, and taxes to name a few. Data on these factors is scarce and therefore simplifying assumptions had to be made to consistently simulate growth throughout the Bay watershed. If future population is projected to decline, no growth in development is forecasted by the CBLCM (except in the potentially rare case where locally-provided employment projections indicate growth in employment despite declines in

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<sup>5</sup> Note that for the Current Zoning baseline conditions, the development suitability datasets incorporate zoning, protected lands, floodways, impervious surfaces, tidal wetlands, and steep slopes. The Land Policy BMPs may include additional factors that exclude land from future growth.



population). The CBLCM does not simulate growth in roads (e.g., lane additions or new alignments). Future estimates of impervious surfaces are restricted to those associated with buildings, driveways, and parking lots.

The main purpose of the CBLCM is to stochastically simulate a plausible future development footprint resulting from projected population and employment growth. Estimated residential and commercial infill/redevelopment rates and development densities are critical elements in the footprint estimation process. Residential and commercial infill/redevelopment rates are estimated for every county and independent city in the Bay watershed based on the ratio of expected-to-observed residential and commercial development in modeled urban areas. Observed development is based on impervious surface changes from 2001-2011 derived from the National Land Cover Datasets. Expected development is derived from estimated changes in housing or jobs at the Block Group scale multiplied by the highest-expected neighborhood residential or commercial development densities. If expected development is greater than observed development, the difference is assumed to be infill and/or redevelopment and therefore does not result in the conversion of forests or farms. Adding up this hidden amount of growth in urban housing or jobs and dividing it by the total change in housing or jobs for each jurisdiction results in jurisdiction-specific residential and commercial infill/redevelopment rates. If jurisdictions have their own estimates of infill/redevelopment rates for counties or independent cities, they can provide them to the CBPO for incorporation into the biennial updates.

### **Stage 3: Review changes in land use from the CBLCM**

The 101 stochastic estimates of future residential and commercial development on sewer and septic produced by the CBLCM are averaged for each unique combination of land-river segment, federal agency, and regulated area (4,296 of these unique areas exist throughout the Bay watershed). These data are then post-processed into estimates of the twelve mapped Phase 6 land uses (see Phase 6 Viewer for land use definitions). Note that neither the CBLCM nor CAST simulate future changes to federal agency or regulated area footprints (e.g., MS4 and CSO areas). MS4 footprints may contain a substantial amount of undeveloped land, particularly in states that have classified entire counties as Phase II MS4s (e.g., Maryland) or others that exclusively rely on the 2010 Census Urban Area boundaries (e.g., Pennsylvania) to define MS4 areas. Only the developed portion of MS4s are classed as “regulated” in CAST. If future growth is simulated in undeveloped portions of a MS4, these lands will be reclassified from mixed open, forest, cropland, or pasture into one of the five MS4 developed classes, increasing the total acres of developed MS4 lands while not affecting the overall MS4 footprint. The extent of MS4 areas can be reviewed in the Phase 6 Viewer. The CBPO can accommodate changes to these areas every two years.

The following chart illustrates forecasted changes in land use for the Current Zoning baseline from 2013 to 2025 for the three counties in Delaware (Figure 1). Most of the new greenfield development in the state is forecasted to occur in Sussex county because it has the highest projected growth in population and a relatively low infill rate (19%). The large amount of growth in turf grass (“TG”) is indicative of dispersed low-density development patterns associated with the conversion of farmland.

#### **Stage 4: Review changes in land use from CAST**

CAST combines output from the CBLCM with extrapolated trends in agriculture from the Census of Agriculture and reported annual estimates of acres under construction and harvested for timber. These additional data are needed because the CBLCM currently does not simulate changes in crop types, farmland abandonment, silviculture, or the initial construction stage of development, all of which are important for estimating future nutrient and sediment loads to the Bay. Land use data from CAST are available by running baseline condition reports on the Current Zoning baseline or on any of the Land Policy BMPs. In addition to information on land use, the baseline reports include information on wastewater and farm animal populations.

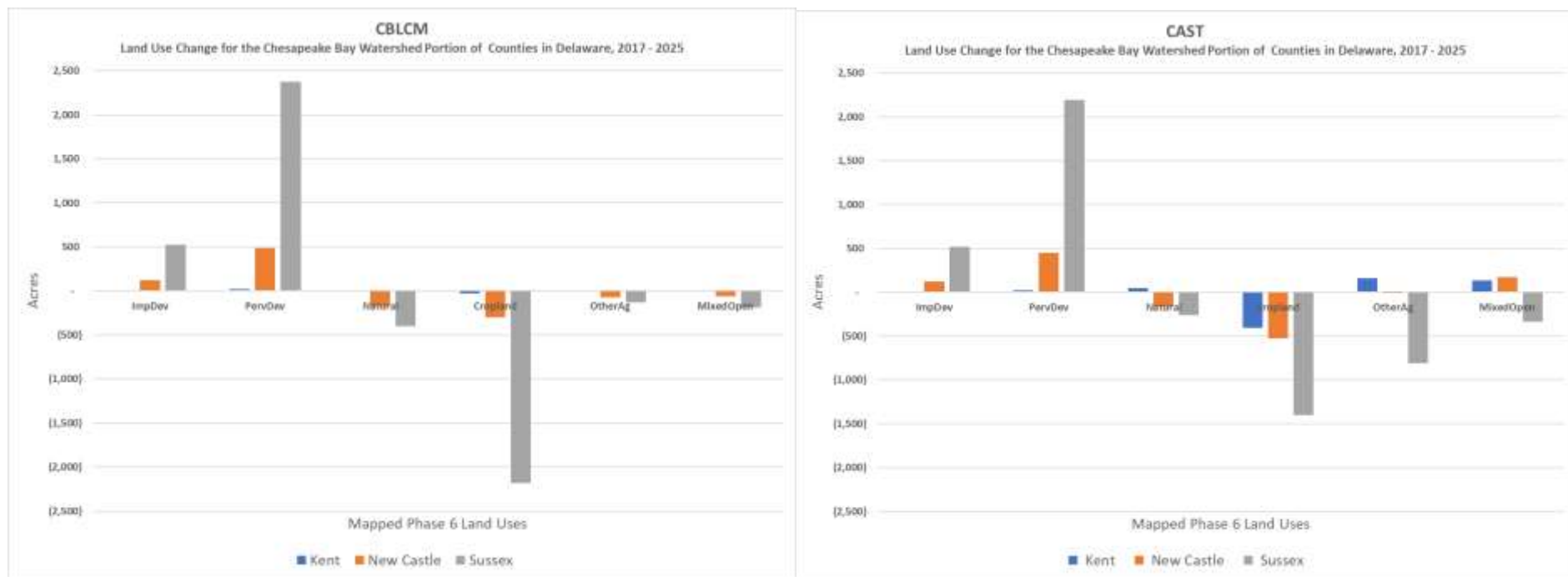
#### **Stage 5: Comparing and interpreting CBLCM and CAST land use change data**

By comparing CBLCM and CAST output, jurisdictions will have the information needed to make more informed decisions on how best to account for growth. The Current Zoning 2025 land use data from CAST for counties in Delaware are illustrated below (Figures 1 and 2). In these charts one can see that in Sussex County, for example, CAST shows less future cropland loss but more “other ag” (e.g., pasture, hay, ag open space, and feeding space) and “mixed open” loss compared to the CBLCM. These differences are caused by incorporating extrapolated trends from the Census of Agriculture. In addition, one can see less growth in turf grass in CAST compared to the CBLCM which is caused by the incorporation of state reported construction acres. The incorporation of annual reported harvested acres results in changes to the forest class which is included in the “Natural” category. Analyses such as this have already been run for all states to facilitate understanding the effects of land use change on water quality. They can be accessed through the CBP Land Use Workgroup website.

To produce these figures, much care was taken to aggregate CBLCM and CAST land uses into more general categories so that the data are comparable. In addition, care was taken to ensure that Edge-of-Tide land uses (only those in the Bay watershed) are used to compare with Edge-of-Tide loads. Edge-of-Stream loads are affected by full-county information. In Delaware counties, this is particularly relevant because none of them lie solely within the Bay watershed boundary.

As mentioned above, annually reported construction and harvested forest data are helpful because they represent land disturbances that are not simulated by the CBLCM and both are high-loading land uses. Any presumed future change in these land uses and their loads, however, should be ignored when accounting for growth because such changes are the result of reporting irregularities and are completely disconnected from trends and simulated future development. Discussions are ongoing with the Land Use Workgroup, Urban Stormwater Workgroup, and Water Quality Goal Implementation Team to keep the acres of construction and harvested forest in CAST constant from present through 2025. If not held constant, presumed reductions in construction loads may offset increases associated

with new development even though the reductions arise from data anomalies rather than as a result of informed efforts to estimate future lands under construction.



Figures 1 and 2. Output from the CBLCM and CAST for Delaware Counties under the Current Zoning baseline scenario.

### Stage 6: Interpreting Changes in Nutrient and Sediment Loads Associated with Land Use Change

To evaluate the effects of Land Policy BMPs on pollutant loads in CAST, users should compute pollutant loads for a 2025 Current Zoning baseline and from the same 2025 base condition with the addition of a Land Policy BMP. To be comparable, these CAST scenarios should include the same wastewater and BMP datasets (e.g., “2017 Wastewater” and “2017 Progress v9”) and be computed for full-county extents to ensure consistent spatial allocation of BMPs. Once these two scenarios are produced, comparative reports can be generated in CAST showing the differences in Edge-of-Tide pollutant loads associated with the selected Land Policy BMP.

To facilitate the interpretation of changes in nutrient and sediment loads from CAST for accounting for growth purposes, the load source data from CAST can be generalized into fewer categories (Table 2) so that changes in loads associated with changes in land use can be easily visualized (Figure 3). For the three Delaware counties, these data show mostly intuitive changes in loads due to changes in land use. They also show, however, that despite a net reduction in cropland acres, loads from cropland are expected to increase in Kent and Sussex county. This is due partly from a shift from low loading to high loading crop types but is also associated with growth in poultry and associated manure as expected from Ag Census trends. Additional data on changes in animal numbers and changes in stream bank/bed erosion will be provided to the jurisdictions to help them decipher the water quality implications from changes in land use.

**Table 2. Aggregated Land Use Categories.**

Ag Open Space	Construction	CropLow	CropHigh	PervDev	ImpDev	FeedSpace	MixedOpen	Natural	Other	Pasture
AOS	CNS	CPL	CPH	PRV	IMP	FDS	MO	NAT	OTH	PAS
AOSpace	Regulated Construction	Full Season Soybeans	Double Cropped Land	Non-Regulated Turf Grass	MS4 Tree Canopy over Impervious	Permitted Feeding Space	Mixed Open	True Forest	Stream Bed and Bank	Pasture
	CSS Construction	Other Agronomic Crops	Specialty Crop High	Non-Regulated Tree Canopy over Turf Grass	MS4 Roads	Non-Permitted Feeding Space	CSS Mixed Open	Non-tidal Floodplain Wetland	Shoreline	Other Hay
		Small Grains and Grains	Silage with Manure	MS4 Turf Grass	MS4 Buildings and Other			Headwater or Isolated Wetland		Legume Hay
		Specialty Crop Low	Grain without Manure	MS4 Tree Canopy over Turf Grass	CSS Tree Canopy over Impervious			Harvested Forest		Riparian Pasture Deposition
			Grain with Manure	CSS Turf Grass	CSS Roads			CSS Forest		
			Silage without Manure	CSS Tree Canopy over Turf Grass	CSS Buildings and Other					
					Non-Regulated Tree Canopy over Impervious					
					Non-Regulated Roads					
					Non-Regulated Buildings and Other					

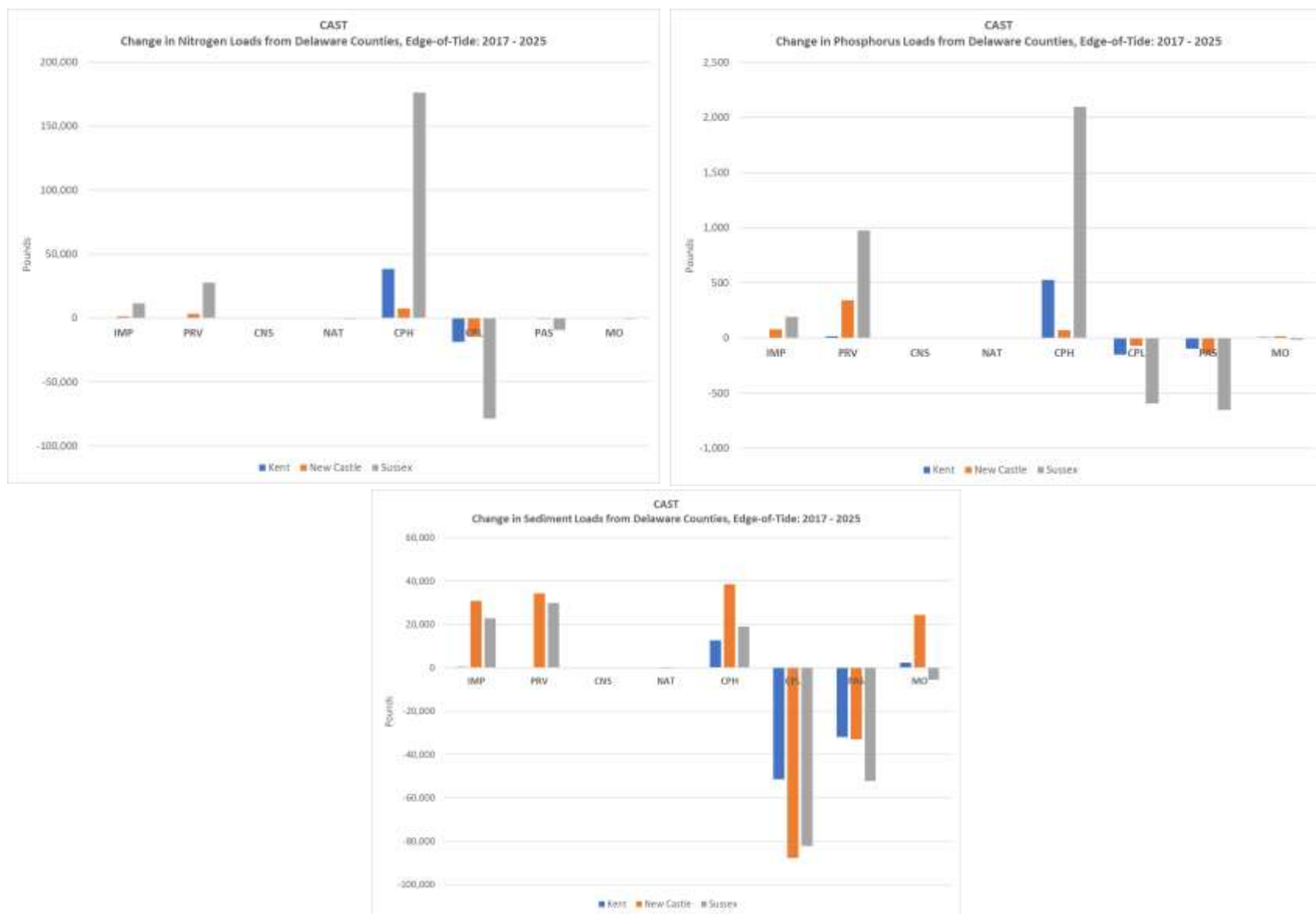


Figure 3. Output from CAST illustrating the change in nutrient and sediment loads associated with changes in land use.