BIENNIAL STRATEGY REVIEW SYSTEM
Chesapeake Bay Program

Narrative Analysis

LAND USE METHODS AND METRICS OUTCOME, FEBUARY 9TH, 2023

ABSTRACT: *This outcome is on course with tremendous progress made over the past two years including the finalization of a 1-meter resolution, 54-class land use/land cover (LULC) dataset for all counties within and adjacent to the Chesapeake Bay watershed for 2013/14 and 2017/18. These data are now informing the Bay watershed model (CAST-21), Chesapeake Healthy Watershed Assessment, Chesapeake Data Dashboard, the Community Tree Cover Indicator, Impervious Surface Indicator, and County Tree Cover Fact Sheets. The 1-meter LULC data are viewable and downloadable on the web[1]. These data will be used to inform additional indicators developed as part of this outcome over the coming year including metrics on the rates of land conversion (i.e., forest, wetland, and productive lands converted to development), riparian forest extent and change, and effective impervious cover extent and change. These metrics and the associated high-resolution LULC data will also inform ten other outcomes outlined in the 2014 Chesapeake Bay Agreement.*

1. Are we, as a partnership, making progress at a rate that is necessary to achieve this outcome? Would you define our **outlook** as on course, off course, uncertain, or completed? Upon what basis are you forecasting this outlook?

Yes- this outcome is on course because the metrics called for in the outcome language have mostly been developed and will be reassessed for the 2021/22 timeperiod in 2024. For the impervious surface metric, we now know that in 2017/18, there were 3,003.8 square miles of impervious cover in the Bay watershed representing 4.87% of the land area (61,681 square miles excluding Aberdeen Proving Ground). Throughout the Bay watershed over the period 2013/14 to 2017/18, impervious cover increased by 79.1 square miles representing a 2.70% relative increase and an absolute increase of 0.13% as a percentage of land area. Other impervious surfaces (e.g., driveways, parking lots) contributed to 64.25% of the net increase in impervious cover while structures contributed to 31.6% of the net increase. Roads only contributed to 4.16% of the increase.

The main gap concerns funding support to continue the monitoring of high-resolution land use/cover change through the year 2030. The current LULC data only cover an 8-year time span and have a coarse temporal resolution (4–5-year monitoring interval). This relatively short span and long interval constrain our understanding of the relationship between changes in LULC and changes in water quality, stream flow, watershed health, and communities. It limits our ability to assess long-term progress for multiple outcomes including tree canopy, forest buffers, wetlands, black ducks, healthy watersheds, and climate resiliency, land use methods and metrics, and land use options evaluation. Finally, the short span and long interval limit our understanding of the drivers of change and delay management responses to observations of change.

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

2. Looking back over the last two or more years, describe any scientific (including the impacts of climate change), fiscal, and policy-related developments that impacted your progress or may influence your work over the next two years. Have these resulted in revised needs (*e.g.*, less, more) to achieve the outcome?

The central need for continued LULC monitoring remains unchanged. A new or extended Cooperative Agreement from the USEPA is needed to continue monitoring land use/cover change through 2030. Failure to support continued LULC monitoring will hinder the ability to assess progress on multiple CBP outcomes, fail to support the land use needs of the Phase 7 model, and fail to support local and state restoration and management goals that also depend on continued production of consistent and comparable high-resolution LULC data.

Recent federal and state climate action policies are driving the transition to renewable sources of energy which, while vital for protecting the climate, will result in substantial amounts of land conversion over the coming decade. The mapping of solar fields is now included as part of CBP's LULC classification schema.

Animal operations represent one of the most concentrated sources of non-point source pollutants in the Bay watershed. Recent attempts to assess the rate of farmland conversion have been confounded by the lack of an explicit "animal operations" class that would enable the separate consideration of land intensification (e.g., new poultry houses) from conversion. Over the next year, animal operations will be included as a unique class in the 2021/22 LULC data and retrospectively added to previous years 2017/18 and 2013/14.

3. Based on the red/yellow/green analysis of the actions described in your logic and action plan, summarize what you have learned over the past two years of implementation.

While monitoring LULC change is necessary to assess rates of impervious surface increase and forest, wetland, and farm conversion to development, it assesses what has already happened on the landscape, too late to inform the development process with tools and information created via the Land Use Options Evaluation outcome.

Local governments, non-governmental organizations, and others are already using the CBP's high-resolution LULC data to inform a variety of decisions from stormwater management, land conservation, siting future development, and watershed management. Some localities have expressed reluctance to use these new data, however, because they do not want to become dependent on the data if there's no assurance they will be regularly updated.

The Land Use Methods and Metrics outcome calls for assessing the impacts of land conversion on healthy watersheds, water quality, and communities. The first two endpoints are being addressed with the high-resolution LULC data used in the Chesapeake Healthy Watershed Assessment, Maryland Healthy Watershed Assessment, and in recent updates to the Bay watershed model (CAST-21). The last endpoint, "impacts to communities", has been partially served through the production of county-level tree cover change fact sheets and through the development of a community tree cover change indicator informing the Tree Canopy Outcome. However, translating LULC change information to communities in a form that is "actionable" is a challenge and will require much closer coordination among all outcomes in the Local Action Cohort (e.g., Land Use Methods and Metrics, Land Use Options Evaluation, Local Leadership, and Tree Canopy).

Below are brief notes outlining progress on each Management Approach since 2014. Recent progress is highlighted in red.

Management Approach 1: Monitor the rate of conversion of forests, wetlands, and farmland, (and the rate of impervious surface change).

a. *Design and implement a manual, stratified sampling approach at the county level and assess land cover change from high resolution imagery circa 2009-2013.*

- *Progress: 1-meter land use/land cover data has been produced for all counties within, straddling, and adjacent to the Bay watershed for 2017/18 and the 2013/14 data were revised so that they are consistent and comparable with the 2017/18 data.*
- *Lessons Learned/Confirmed: Sampling land cover/use change with high-resolution data is not necessary when complete wall-to-wall datasets are available.*

b. *Assess land use change throughout the Bay Watershed and Bay States from the early 1980's through mid-2010's using the CBP 2013 high-res land use coupled with the Land Change Analysis and Monitoring Program Database and National Land Cover Database, the NRCS National Resources Inventory, and the USFS's Forest Inventory and Assessment data.*

i. *Progress: This has previously been attempted at 30-meter resolution to inform the Phase 6 watershed model by using the Chesapeake Bay Land Cover Data (CBLCD) series from 1984 to 2006 in combination with the 2011 National Land Cover Database (NLCD). These data are NOT consistent with the new high-resolution LULC data. Work on back casting the high-resolution LULC from 2013 to the mid-1980's at the parcel scale has begun and will continue through 2024.*
ii. *Lessons Learned/Confirmed: Moderate resolution land use/cover data varies in how it depicts developed lands and urbanization depending on the ancillary data used. This is most important when it comes to low-density residential development which is under-represented in 30-meter land use/cover datasets such as the NLCD. The implications of this can be profound because NLCD underestimates impervious cover in the watershed by over 40% compared to high-resolution LULC and because the NLCD depicts development mostly on farmland whereas the high-resolution data indicate that development occurs mostly on forested lands.*

c. *Assess difference in high resolution land cover maps at the County level.*

i. *Progress: This has been accomplished for Bay watershed counties. Summary tables, change matrices, and raster datasets are available to the public: https://www.chesapeakeconservancy.org/conservation-innovation-center/high-resolution-data/lulc-data-project-2022/*
ii. *Lessons Learned/Confirmed: Change detection has to be a specified objective at the outset of developing high-resolution data products as it is in the EPA's Cooperative Agreement with the Chesapeake Conservancy to produce comparable data for 2013, 2017, and 2021.*

d. *Investigate options for monitoring "hot spots" of land change every two years.*

i. *Progress: This was accomplished for several states in preparation for the 2019 milestone updates but proved resource intensive because it is largely a manual*

production effort that was diverting resources from producing the complete wall-to-wall land cover change products.

ii. *Lessons Learned/Confirmed: Comparisons of hot spots of tree canopy change with initial wall-to-wall tree canopy change products available for several Maryland counties illustrated the level of omissions (missed change) in the hot spot data. Comparisons of the NLCD change product for hot spot detection where the high-resolution hot spot data were unavailable illustrated significant (2x – 3x) differences, challenging the accuracy of the NLCD change products for informing the milestone updates (they were not used).*

e. *Monitor "hot spots" of change*

i. *Progress: Note yet attempted.*

ii. *Lessons/Learned/Confirmed: This task was dropped from the Management Strategy given the availability of high-resolution land use/cover change data (see 1.4).*

f. *Map and ReMap high-res land cover/use: 2013/14; 2017/18; 2021/22*

i. *Progress: 1-meter land use/land cover data have been produced for all counties within, straddling, and adjacent to the Bay watershed for 2017/18 and the 2013/14 data were revised so that they are consistent and comparable with the 2017/18 data. Preparation for mapping 2021/22 conditions is ongoing with the final data expected to be produced on schedule by June 2024.*

ii. *Lessons Learned/Confirmed: Producing comparable land cover products for 2013 and 2017 based on existing data requires a somewhat custom approach for each county based on the type, quality, and vintage of ancillary data (e.g., planimetric impervious cover, leaf-off imagery, LiDAR normalized Digital Surface Models). In addition, the high-resolution land cover product requires significant manual editing to achieve the targeted level of accuracy (90-95%). This is particularly true for LULC change because change is rare and therefore a few omissions could result in highly inaccurate result.*

Management Approach 2: Quantify the impacts of land conversion on water quality, healthy watersheds, and communities.

2.1 Quantify impact of land conversion on water quality (explaining changes in nutrient and sediment that relate to monitored and modeled land conversion).

- *Progress: This objective has been achieved to the extent practicable. The 2013 high-resolution land use and Chesapeake Bay Land Change Model informed the Phase III WIPs and were used to inform the 2019 Milestones. The 2013/14 to 2017/18 land use and land cover change data inform CAST-21 and will again inform CAST-23.*
- *Lessons Learned/Confirmed: The new 2013/14 and 2017/18 high-resolution land use/land cover data only inform CAST as a change product. Corrections to the original 2013/14 data and improvements to the classification schema which have been made will not impact CAST until after 2025.*

2.2 Quantify impact of land conversion on healthy watersheds, wildlife, and stream habitats.

- *Progress: The Chesapeake Healthy Watersheds Assessment (v1.0) has been released and relies on many metrics related to 2017/18 land use/cover conditions. Additional metrics associated with riparian conditions will be added to CHWA v2.0 in 2023. Two new GIT-funded projects will initiate in 2023 to track annual changes in vegetation condition, particularly tidal marshes, on the DelMarVa peninsula and to map potential*

non-tidal vegetated wetlands in areas where the National Wetlands Inventory is out of date.

- *Lessons Learned/Confirmed: While a 13-class dataset was sufficient to inform CAST for the Bay TMDL, it is not sufficient for communicating and understanding land use/cover change as depicted in high-resolution datasets. This is because the high-resolution data coupled with ancillary information are able detect a variety of change phenomena that require further interpretation to apply the data to habitat and healthy watershed outcomes. For example, tree fall gaps due to natural causes or timber harvests contribute to reductions in tree canopy but may not warrant a management response compared to tree loss due urban development and other practices.*

2.3 Quantify impact of land conversion on communities.

- *Progress: This has been partially served through the production of county-level tree cover change fact sheets and through the development of a community tree cover change indicator informing the Tree Canopy Outcome. The term "communities" has not been identified and community concerns/needs have not been clarified. There is potential to work with the Diversity workgroup and Climate Resiliency Workgroup to identify vulnerable communities and communities at risk. There's also potential to outreach to communities in healthy watersheds on the impacts of land use change and leverage efforts to conserve 30% of the watershed by 2030 to incentivize conservation efforts.*
- *Lessons Learned/Confirmed: Need leadership and interest in this component of the outcome for it to be further refined and addressed.*

Management Approach 3: Communicate the results to the public, elected officials, and to the Bay Program.

3.1 Link the results of the Land Use Methods and Metrics Outcome Land Use Options Evaluation Workplan.

- *Progress: Discussions have begun to integrate the Local Leadership, Land Use Methods and Metrics, and Land Use Options Evaluation outcomes into a single SRS process because they are so closely related together make up the key components of a local engagement strategy.*
- *Lessons Learned/Confirmed: A strategy is needed to communicate land change information to the public coupled with suggested actions and resources.*

3.2 Develop a Chesapeake Bay Land Change website.

- *Progress: A storymap is underdevelopment to illustrate changes in land use/cover. In addition, the USFS is producing automated tree canopy fact sheets for communities to help them understand the value of tree canopy, how it is changing and why, and what can be done to maintain/increase tree canopy.*
- *Lessons Learned/Confirmed: The impacts of land use/cover change are so broad and touch on so many different outcomes that separate communication strategies could/should be developed for each outcome.*

4. Based on what you have learned through this process and any new developments or considerations described in response to question #2, how will your work change over the next two years? If we need to accelerate progress towards achieving our outcome, what steps are needed and, in particular, what specific actions or needs are beyond the ability of your group to meet and, therefore, you need the assistance of the Management Board to achieve?

A new/extended Cooperative Agreement to monitor land use change for an additional 10 years is needed that:

- *Adapts to changes in technology and CBP needs while ensuring consistency over time;*
- *Couples monthly satellite imagery with more periodic aerial imagery;*
- *Leverages advances in computational power and artificial intelligence;*
- *Addresses the needs to monitor wetland change for black ducks and climate resiliency;*
- *Evaluates effectiveness of the data for BMP verification.*

Needs from MB:

- *Advise the USEPA that continued monitoring of high-res land use change through 2033 is needed to support the achievement of multiple outcomes and the Phase 7 model.*

- *Support a broader charge for the Land Use Workgroup to provide land use data and forecasts to serve the needs of multiple CBP outcomes and related local government actions.*

- *Support the integration of the management strategies for the Land Use Methods and Metrics Outcome and Land Use Options Evaluation Outcome.*

5. What steps are you taking, or do you recommend, to ensure your actions and work will be equitably distributed and focused in geographic areas and communities that have been underserved in the past?

The Community Tree Cover indicator developed for the Tree Canopy outcome relies on the high-resolution LULC data and is at the scale of Census Places which could approximate "communities". No attempt has yet been made to understand the LULC differences between underserved and other communities or to outreach to those communities about their concerns. A new 2023 CBP GIT-funded project will attempt to address this shortfall.