Chesapeake Bay Program | Indicator Analysis and Methods Document
Tree Canopy | DRAFT VERSION 10/9/18

Indicator Title: Tree Canopy

Relevant Outcome(s): Tree Canopy

Relevant Goal(s): Vital Habitats

Location within Framework (i.e., Influencing Factor, Output or Performance): Performance

A. Data Set and Source

(1) Describe the data set. What parameters are measured? What parameters are obtained by calculation? For what purpose(s) are the data used?

The proposed Tree Canopy Indicator has two components: 1) urban tree planting BMPs reported by states annually to track progress towards meeting the Bay TMDL; and 2) remotely-sensed changes in tree canopy updated every five years. Both of these components combined represent the annual extent of tree canopy in the Bay watershed, used as our best available estimate for tracking progress for the Tree Canopy Outcome.

1) Reported Tree Plantings

To track real-time progress that jurisdictions and partners are making in planting trees to increase canopy, we will use annual BMP progress data that are reported for the Chesapeake Bay TMDL. We will use the combined reported acres of Urban Tree Canopy Expansion, Urban Forest Planting, and Urban Forest Buffer BMPs to summarize progress in each state, wherever they are reported in the watershed. The only geographic constraint for reporting these BMPs is that they must be reported on developed land uses (e.g. turf, impervious surfaces), not on agricultural land uses. The Forestry Workgroup proposes to count BMP progress data starting from 2010 when the TMDL went into effect and jurisdictions began implementing urban tree BMPs as part of WIP efforts. This aligns with the indicator reporting approach used by the Wetlands Outcome.

The annual BMP data provide our best real-time estimate of tree canopy expansion. However, this measure only captures gains, not the losses in tree canopy that we know are occurring across the landscape every day due to development, storms, rising sea levels, invasive pests such as Emerald Ash Borer, and other factors. To track overall net changes in tree canopy, remotely-sensed land cover data are needed to supplement the annual BMP data.

2) Remotely-sensed Changes in Tree Canopy

Thanks to the Chesapeake Bay Program Partner's investment in high-resolution land cover and land use data with tree canopy coverage, we have a remotely-sensed estimate of tree canopy throughout the watershed for year 2013/14. Using these data, the current extent of tree canopy in the watershed includes all tree planting BMPs reported from 2010 to present plus all mapped "tree canopy over turf grass" and "tree canopy over impervious surfaces" in the watershed, plus all "forest" found within 2010 Census Urban Areas/Clusters. (*see rationale in background section below) These data will be updated annually based on reported BMPs and every five years based on the combination of reported BMPs and updated high-resolution land cover and land use data.

The first planned update of the high-resolution land cover/use data is scheduled for release in 2021 based on 2018/19 imagery. Using these new land cover data, all newly emergent "tree canopy over turf grass" and "tree canopy over impervious surfaces" that fall outside areas classed as forest in 2013/14 will be added to the total tree canopy extent along with all urban tree BMPs reported since 2010. Formerly forested lands that convert to tree canopy land uses in the updated land cover will be tracked separately and will not be used to count for tree canopy expansion. Newly emergent tree canopy on agricultural lands that have been converted to development will be counted as "gains" in community tree canopy. Emergent tree canopy on active crop and pasture lands will not be counted towards gains, since agricultural lands fall outside of our definition of community tree canopy. A summary table of 2013 state baseline information for the Tree Canopy Indicator is provided below.

The second update of high-resolution land cover and land use data based on 2023/2024 imagery is scheduled for release in 2025. Because it is estimated to take approximately 10 years for new tree plantings to be detected in high-resolution land cover data, only tree planting BMPs reported since 2014 will be included in it.

(2) List the source(s) of the data set, the custodian of the source data, and the relevant contact at the Chesapeake Bay Program.
- Source: 1) NEIEN BMP progress data and 2) Chesapeake Bay Land Cover Dataset (CBP/Chesapeake Conservancy), further analyzed/filtered by CBP GIS team
- Custodian: 1) Sucharith Ravi, CBP/UMCES; 2) Peter Claggett, CBP/USGS,
- Chesapeake Bay Program Contact – Julie Mawhorter, jmawhorter@fs.fed.us, 570-296-9626

(3) Please provide a link to the location of the data set. Are metadata, data-dictionaries and embedded definitions included?

Dataset will be posted once Indicator is approved

B. Temporal Considerations

(4) Data collection date(s): 1) BMP data – 2010-present (beginning with 2018 BMP progress/history update to NEIEN) 2) CBP Land Cover data – 2013 baseline

(5) Planned update frequency (e.g., annual, biannual, etc.):
- Source Data: 1) BMP data - annual 2) land cover – every 5 years, approximately
- Indicator: annual

(6) Date (month and year) next data set is expected to be available for reporting: May 2019

C. Spatial Considerations

(7) What is the ideal level of spatial aggregation (e.g., watershed-wide, river basin, state, county, hydrologic unit code)? Watershed-wide and state

(8) Is there geographic (GIS) data associated with this data set? If so, indicate its format (e.g., point, line polygon). Yes, raster

(9) Are there geographic areas that are missing data? If so, list the areas. No

(10) Please submit any appropriate examples of how this information has been mapped or otherwise portrayed geographically in the past. N/A

D. Communicating the Data

(11) What is the goal, target, threshold or expected outcome for this indicator? How was it established?

The Tree Canopy Outcome was established in the CB Watershed Agreement (2014).

Tree Canopy Outcome: *Continually increase urban tree canopy capacity to provide air quality, water quality and habitat benefits throughout the watershed.* ***Expand urban tree canopy by 2,400 acres by 2025.***

The 2,400 acre goal was set during the drafting of the Watershed Agreement based on estimates provided by each jurisdiction on how much annual progress was an ambitious yet hopefully reasonable target:

Jurisdiction	Annual Target (New Acres)	2025 Target (New Acres)
Delaware	5	60
DC	40	480
Maryland	45	540
New York	5	60
Pennsylvania	60	720
Virginia	40	480
West Virginia	10	120
TOTAL	**205**	**2460**

(12) What is the current status in relation to the goal, target, threshold or expected outcome? Not available until May 2019, when 2018 BMP progress/history are approved

(13) Has a new goal, target, threshold or expected outcome been established since the last reporting period? Why? – No, this is a new outcome, and we will not have a comprehensive update on progress until the next land cover update is available.

(14) Has the methodology of data collection or analysis changed since the last reporting period? How? Why? No

(15) What is the long-term data trend (since the start of data collection)? Not available until May 2019

(16) What change(s) does the most recent data show compared to the last reporting period? To what do you attribute the change? Is this actual cause or educated speculation? Not available until May 2019

(17) What is the key story told by this indicator? Not available until May 2019

E. Adaptive Management

(18) What factors influence progress toward the goal, target, threshold or expected outcome?

From Tree Canopy Outcome Logic Table/Workplan:

- Funding and Finances

- Federal and State Government Agency Engagement
- Local Government Agency Engagement
- Legislative Engagement at State and Local Level: Policies and Ordinances
- Partner Coordination
- Scientific and Technical Understanding: Technical Capacity and Knowledge
- Public and Landowner Engagement: Education and Outreach
- Environmental Factors Challenging Tree Canopy progress:
    - Population Growth (Development);
    - Climate Change (storms, pests, invasive species, drought, etc.)
    - Biota (pests, invasive species, etc.)
    - Habitat Condition (poor soils, utility/infrastructure conflicts, etc. impacting urban tree plantings)

(19) What are the current gaps in existing management efforts?

Gaps generally are related to limitations in 1) adequate funding/partnerships, 2) effective policy and ordinances, 3) technical capacity and knowledge, including tracking/reporting tools to capture progress, and 4) education and outreach capacity See Tree Canopy Management Strategy and Logic Table/Workplan for more details

(20) What are the current overlaps in existing management efforts?

State urban forestry programs, CB-wide coordination through Forestry Workgroup, local government management of the urban forest (county and/or city/town), TMDL/WIP planning efforts for urban BMPs

(21) According to the management strategy written for the outcome associated with this indicator, how will we (a) assess our performance in making progress toward the goal, target, threshold or expected outcome, and (b) ensure the adaptive management of our work?

The biennial Strategy Review System (SRS) process by the CBP Management Board for each outcome is the primary process we will use to assess our performance in making progress toward the Tree Canopy outcome. This review is being held in November 2018, and the Tree Canopy 2-year workplan will be adapted shortly after based on what we learn from the review, including Management Board and stakeholder input. A more robust assessment and adaptation period will occur when we have the next updated land cover data analyzed, to help us understand the changes actually happening in tree canopy gains and losses across the landscape.

F. Analysis and Interpretation

Please provide appropriate references and location(s) of documentation if hard to find.

(22) What method is used to transform raw data into the information presented in this indicator? Please cite methods and/or modeling programs.

1) NEIEN database queries are used to pull BMP progress data reported annually from 2010 to present for 3 urban tree BMPs: urban tree planting, urban forest planting, and urban forest buffers; these are added together at the state level to provide the annual indicator of progress
2) GIS analysis is used to filter and summarize the appropriate land cover data layers for the Tree Canopy Indicator (tree canopy over impervious, tree canopy over turf, and urban forest, i.e. forest occuring within 2010 Census urban areas/urban clusters)

(23)Is the method used to transform raw data into the information presented in this indicator accepted as scientifically sound? If not, what are its limitations? yes

(24) How well does the indicator represent the environmental condition being assessed?

The biggest limitation in the Indicator is that the annual BMP progress data are 1) incomplete, not capturing all the plantings going on, and more importantly 2) only reflect reported gains, and do not capture losses we know are occurring on the landscape every day through development, storms, pests/diseases, removals and natural mortality. This limitation is substantially addressed through the land cover updates every 5 years, but there will always be challenging time lags between tree plantings reported and when they show up in the land cover data (approximately 10 years after planting).

(25) Are there established reference points, thresholds, ranges or values for this indicator that unambiguously reflect the desired state of the environment? No

(26) How far can the data be extrapolated? Have appropriate statistical methods been used to generalize or portray data beyond the time or spatial locations where measurements were made (e.g., statistical survey inference, no generalization is possible)?

There are land cover projections used for the TMDL. For tree canopy, we will have a somewhat better ability to extrapolate trends over time when we have the next land cover update.

G. Quality - will be completing this section soon, with help from partners

Please provide appropriate references and location(s) of documentation if hard to find.

(27) Were the data collected and processed according to a U.S. Environmental Protection Agency-approved Quality Assurance Project Plan? If so, please provide a link to the QAPP and indicate when the plan was last reviewed and approved. **If not, please complete questions 29-31.**

(28) *If applicable:* Are the sampling, analytical and data processing procedures accepted as scientifically and technically valid?

(29) *If applicable:* What documentation describes the sampling and analytical procedures used?

(30) *If applicable:* To what extent are procedures for quality assurance and quality control of the data documented and accessible?

(31) Are descriptions of the study design clear, complete and sufficient to enable the study to be reproduced?

(32) Were the sampling, analytical and data processing procedures performed consistently throughout the data record?

(33) If data sets from two or more sources have been merged, are the sampling designs, methods and results comparable? If not, what are the limitations?

(34) Are levels of uncertainty available for the indicator and/or the underlying data set? If so, do the uncertainty and variability impact the conclusions drawn from the data or the utility of the indicator?

(35) For chemical data reporting: How are data below the MDL reported (i.e., reported as 0, censored, or as < MDL)? If parameter substitutions are made (e.g., using orthophosphate instead of total phosphorus), how are data normalized? How does this impact the indicator?

(36) Are there noteworthy limitations or gaps in the data record?

H. Additional Information (*Optional)*

(37) Please provide any further information you believe is necessary to aid in communication and prevent any potential misrepresentation of this indicator.