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CHESAPEAKE BAY FOUNDATION
Saving a National Treasure

January 14, 2021

Department of Environmental Protection
Policy Office
Rachel Carson State Office Building
P.O. Box 2063
Harrisburg, PA 17105
Via eComment: http://www.ahs.dep.pa.gov/eComment
e-mail: RegComments@pa.gov

RE: Proposed Rulemaking for Carbon Dioxide Budget Trading Program; Amending 25 Pa. Code Chapter 145, Subchapter E (#7-559).

To Whom It May Concern,

On behalf of the Chesapeake Bay Foundation (CBF) and its more than 300,000 members and e-subscribers, please accept these comments, along with our December 14, 2020 public hearing testimony, pertaining to the proposed Carbon Dioxide (CO_2) Budget Trading Program (CDBTP) regulations. This proposed rulemaking was noticed in Pa. Bulletin on Saturday, November 7, 2020 (50 Pa.B. 6212). These regulations propose to amend 25 Pa. Code Chapter 145 (relating to interstate pollution transport reduction) by adding Subchapter E (relating to CDBTP). This subchapter would establish a program to limit the emissions of carbon dioxide from fossil fuel-fired electric generating units (EGUs), with a nameplate capacity equal to or greater than 25 megawatts (MWe).

CBF is a 501(c)(3) non-profit organization, founded in 1967. The organization's mission—carried out from offices in Maryland, Virginia, Pennsylvania (PA) and the District of Columbia—is to restore and protect the ecological health of the Chesapeake Bay, the nation's largest and one of its most vital estuaries. As such, and on behalf of our members, we are interested in matters that will impact the health of the Chesapeake Bay, the waters that feed into it, and the health of those who live and work within the Bay watershed.

According to the United States Energy Information Administration, Pennsylvania generates the fifth most CO_2 emissions from EGUs in the country.[1] CO_2 emissions are a major greenhouse gas (GHG) that is a catalyst for local, regional, and global climate change-related impacts. The myriad of current and projected deleterious impacts to the health and well-being of

[1] U.S. Energy Information Administration. (2020, May 20). *State carbon dioxide emissions data*. U.S. Energy Information Administration (EIA). https://www.eia.gov/environment/emissions/state/

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Pennsylvania’s economy, citizens, and environment are well documented. Of core concern to CBF’s mission is the projected 13 percent increase in heavy precipitation events by 2050.[2] Unless climate change impacts are arrested, or new and retrofitted conservation practices and water infrastructure are implemented, the impact of this precipitation will very likely further stress Pennsylvania's rivers and streams with increased nutrient and sediment-laden runoff, streambed and bank erosion, and incidences of combined sewer overflows; to cite just a few of the impacts.

Furthermore, these impacts will make it even more challenging for Pennsylvania to meet its obligations to help restore the Chesapeake Bay. Recently the Chesapeake Bay Program Water Quality Goal Implementation Team (WQGIT) projected that due to climate change related impacts, by 2025 Pennsylvania’s pollution loads to the Chesapeake Bay will increase by 1.8 million pounds of nitrogen and 95,000 pounds of phosphorus annually. By 2035, preliminary estimates suggest these loads could double. As a result, the WQGIT stated that the impacts of climate change on the Bay as *“...a significant and increasing concern.”*[3]

However, according to a 2014 peer reviewed study commissioned by CBF, Pennsylvania successfully implementing the Blueprint will have a significant, positive benefit for Pennsylvania’s economy. Once fully implemented, and the natural benefits[4] fully realized, **the economic value of these benefits would increase by $6.2 billion annually, from $32.6 to $38.8 billion, in the Commonwealth**.[5]

To that end, **CBF strongly supports this proposed rulemaking.** This proposed regulation and program would help reduce CO_2 emissions greatly, and by doing so, ultimately help this Commonwealth in terms of human health, environmental impacts and our economy.

Critically, **implementation of this rulemaking offers the Commonwealth an unprecedented opportunity to simultaneously address climate change while significantly accelerating implementation of key components of Pennsylvania’s Phase 3 Chesapeake Bay Watershed Implementation Plan (WIP3)**.[6] Specifically, revenue generated from the CDBTP could be used to providing funding for agricultural systems to enhance soil health, and riparian and upland tree plantings in rural, suburban, and urban landscapes that will simultaneously improve water quality and sequester atmospheric CO_2.

As detailed below, soil health practices and tree plantings are widely recognized as powerful tools in sequestering atmospheric CO_2. They are also critical towards restoring the over 10,200

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[2] Pennsylvania Department of Environmental Protection. (2020). *Pennsylvania Climate Action Plan 2021*. https://files.dep.state.pa.us/Energy/Office%20of%20Energy%20and%20Technology/OETDPortalFiles/Climate%20Change%20Advisory%20Committee/2020/12-22-20/2021_PA_CAP_Initial_Draft_12-15-20.pdf
[3] Martin J., & Dunne E. (2020, December 17). *Requesting Final Partnership Decisions on 2025 Climate Change Impacts* [PDF]. Chesapeake Bay Program. https://www.chesapeakebay.net/channel_files/41853/climatechangefinaldecisions_psc
[4] Defined as life-supporting processes such as water and air purification and flood protection, and life-enhancing assets such as beautiful places to recreate and live.
[5] Phillips, S., & McGee, B. (2014). *The Economic Benefits of Cleaning Up the Chesapeake--A Valuation of the Natural Benefits Gained by Implementing the Chesapeake Bay Clean Water Blueprint*. Chesapeake Bay Foundation. https://www.cbf.org/document-library/cbf-reports/the-economic-benefits-of-cleaning-up-the-chesapeake.pdf
[6] Pennsylvania Department of Environmental Protection. 2019. Pennsylvania Phase 3 Chesapeake Bay Watershed Implementation Plan.

miles of sediment-impaired and roughly 2,600 miles of nutrient-impaired streams in the state[7], and meeting the majority of Pennsylvania's pollutant load reductions in the WIP3.

The WIP3 includes the implementation of various conservation practices on approximately 2,775,000 acres of cropland, 495,000 acres of pasture, 5,050 acres of tree and shrub establishment, and 85,650 acres of riparian forest buffers in the Chesapeake Bay watershed in Pennsylvania that could sequester approximately 1.2 metric tons of CO_2 per year.

Approximate Carbon Sequestration of WIP3 goals[8]

	Average CO_2 sequestered (Metric ton/acre/year)	**WIP3 goal**	**Acreage in WIP3**	**CO_2 Sequestered (Metric ton/acre/year)**
Cover Crops	0.32	33-50% of cropland	1,137,750	364,080
Conventional tillage to no-till cultivation	0.42	47% of cropland	1,304,250	547,785
Conventional tillage to conservation tillage	0.13	20% of cropland	555,000	72,150
Managed Grazing	0.26	50% of pastures	247,500	64,350
Tree/Shrub Establishment	1.98		5,050	9,999
Riparian Forest Buffer Establishment	2.19		85,650	187,574
Total				**1,245,938**

But a plan is only as good as it's implemented. And the Commonwealth has a substantial self-identified funding shortfall of $324 million a year to support the design, implementation, and maintenance of the conservation practices the committed to in the WIP3. Viable sustainable options to address this shortfall are extremely limited.

The CDBTP, however, should play a significant role in supporting the implementation of the WIP3. **The Commonwealth would be remiss in not prioritizing CDBTP resources towards conservation practices that simultaneously reduce atmospheric CO_2 and mitigate a myriad of the impacts of climate change**, specifically agricultural soil health techniques and riparian and upland tree plantings.

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[7] Pennsylvania Department of Environmental Protection, P. (2020). *2020 Pennsylvania Integrated Water Quality Monitoring and Assessment Report*. https://www.depgis.state.pa.us/2020_Integrated_Report/

[8] Swan, A., Williams, S.A., Brown, K., Chambers, A., Creque, J., Wick, J., Paustian, K. 2015. *COMET-Planner: Carbon and greenhouse evaluation for NRCS conservation practice planning.* USDA Natural Resources Conservation Service, Colorado State University.

In order to enhance the value of these regulations, we offer the following comments:

I. Agricultural Conservation and Soil Health Benefits

By changing the trajectory of climate change, we can strengthen both our agricultural community and food security in the Commonwealth. Climate change is upending normal weather patterns, leading to erratic temperature fluctuations and periods of both intense precipitation and drought, all of which pose great difficulties for Pennsylvania farmers, such as challenges in planting and harvesting crops, lower yields, loss of topsoil through erosion, and increased damage due to pests and plant disease.

Climate change projections suggest an increased variability of temperature and precipitation in the future. Extreme climate conditions, such as sustained drought, excessive rainfall, and heat waves can significantly impact crops and livestock.

Excess precipitation can be as damaging as too little precipitation due to increased flooding events, greater erosion, and decreased soil quality. Extreme precipitation events may increase soil erosion, which is the result of inadequate infiltration rates and excessive rainfall that exceeds the soil's capacity to absorb water. Livestock and dairy production may be more affected by increases in the number of days of extreme heat or cold, than by shifts in average temperature. Likewise, crop production may be more affected by extreme events, especially if they occur at critical developmental stages such as flowering or interfere with the timing of planting or harvest operations or applications of fertilizers or pesticides. The trend toward wetter springs has resulted in fewer workable field days during the planting season. Farm financial vulnerability and resilience may depend more upon the magnitude and timing of extreme events than the effects of mean growing season changes due to climate change.[9]

More frequent droughts will require an increase in irrigation to sustain crops and may lead to a large decrease in water quantity throughout the Commonwealth. In contrast, increased intense rainfall events will also cause more runoff, erosion and flooding. The stress of higher temperatures on livestock and poultry will decrease meat, milk and egg production. To mitigate, farmers may need to install irrigation systems, surmount challenges with planting and harvesting in a timely manner, cope with soil loss from erosion, and purchase potentially expensive cooling systems to protect the animals.

Regenerative agricultural practices and soil health

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[9] Walthall, C.L., J. Hatfield, P. Backlund, L. Lengnick, E. Marshall, M. Walsh, S. Adkins, M. Aillery, E.A. Ainsworth, C. Ammann, C.J. Anderson, I. Bartomeus, L.H. Baumgard, F. Booker, B. Bradley, D.M. Blumenthal, J. Bunce, K. Burkey, S.M. Dabney, J.A. Delgado, J. Dukes, A. Funk, K. Garrett, M. Glenn, D.A. Grantz, D. Goodrich, S. Hu, R.C. Izaurralde, R.A.C. Jones, S-H. Kim, A.D.B. Leaky, K. Lewers, T.L. Mader, A. McClung, J. Morgan, D.J. Muth, M. Nearing, D.M. Oosterhuis, D. Ort, C. Parmesan, W.T. Pettigrew, W. Polley, R. Rader, C. Rice, M. Rivington, E. Rosskopf, W.A. Salas, L.E. Sollenberger, R. Srygley, C. Stöckle, E.S. Takle, D. Timlin, J.W. White, R. Winfree, L. Wright-Morton, L.H. Ziska. 2012. *Climate Change and Agriculture in the United States: Effects and Adaptation.* USDA Technical Bulletin 1935. Washington, DC.

Pennsylvania's WIP3 relies on the 33,500 farms, spanning almost three million acres of farmland in the Chesapeake Bay Watershed, adopting many practices to reduce sediment loss from erosion and nutrient loss from runoff on approximately 40 percent of this farmland. These same practices are widely recognized for their ability to sequester carbon and reduce greenhouse gas (GHG) emissions. Regenerative agricultural practices keep soil and nutrients on the land and out of our rivers and streams with no-till cultivation, biodiversity, perennial crops, minimal soil disturbance, livestock grazing healthy forages, and soil vegetative coverage and living root systems throughout the year.

These practices also help sequester large amounts of carbon and reduce GHG emissions, while helping farms to mitigate the problems resulting from climate change with increased resilience to extreme weather events. The Rodale Institute estimates that global adoption of regenerative practices could sequester more than 100 percent of current anthropogenic emissions of CO_2, and that stable soil carbon can rapidly draw down atmospheric carbon dioxide.[10] Soils constitute the largest terrestrial organic carbon pool, which is three times the amount of CO_2 currently in the atmosphere and 240 times the current annual fossil fuel emissions. Thus, even slight increases in soil carbon storage represent a substantial carbon sink potential. Because soil carbon sequestration is a strategy that may be applied at a large scale, the French government proposed to increase soil carbon concentration in a substantial portion of agricultural soils globally, by 0.4 percent per year, in conjunction with the Conference of the Parties to the UN Framework Convention on Climate Change (UNFCCC) negotiations in December 2015.[11] **These practices should be embraced as eligible offset categories in the CDBTP.**

"Soil health is the continued capacity of soil to function as a living ecosystem that sustains plants, animals, and humans… If the soil is healthy, it is teeming with large and small organisms that live together in a dynamic, complex web of relationships."[12] Strong natural communities of microbes, fungi and insects break down dead vegetative material, producing sticky substances that hold soil structure together. "Soil carbon sequestration works with biodiversity above and below ground—in plant and soil life—to capture carbon dioxide with photosynthesis, drawing it down underground as soil carbon, and locking it in soil organic matter through microorganism and mineral associations."[13] Deep root systems and earthworms create channels to transport water and nutrients throughout the soil. Improved water infiltration helps to minimize runoff during storms, reduce flood risk, and store water for periods drought.

Conservation tillage and other practices to improve soil health will modify the entire soil profile. The soil matrix is firm and yet the soil is perforated with thousands of pores created by roots, fungal hyphae, surface and deep-dwelling earthworms, and many other types of organisms. Root

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[10] Moyer, J., Smith, A., Rui, Y., Hayden, J. 2020. Regenerative agriculture and the soil carbon solution. Rodale Institute. https://rodaleinstitute.org/wp-content/uploads/Rodale-Soil-Carbon-White-Paper_v11-compressed.pdf.

[11] Paustian, K., Lehmann, J., Ogle, S., Reay, D., Robertson, G., and Smith, P. 2016. "Climate-smart soils." *Nature*. 7 April 2016: 49-57.

[12] Duiker, S.W., Myers, J.C., and Blazure, L.C. 2017. Soil Health in Field and Forage Production. USDA Natural Resources Conservation Service, Penn State University Extension, Capital Resource Conservation & Development, and Clinton County Conservation District. https://extension.psu.edu/soil-health-in-field-and-forage-crop-production.

[13] Moyer, J., Smith, A., Rui, Y., Hayden, J. 2020. Regenerative agriculture and the soil carbon solution. Rodale Institute. https://rodaleinstitute.org/wp-content/uploads/Rodale-Soil-Carbon-White-Paper_v11-compressed.pdf.

channels and earthworm burrows leave pores that are continuous from the surface deep into the subsoil, to enhance aeration, water movement, and nutrient availability.[14]

Conservation practices that sequester soil carbon provide many additional ecosystem services:

- Crop diversity and soil health improvement increase the number of beneficial organisms, that keep destructive diseases and pests in check, with reduced need for pesticides that carry inherent risks, and their fuel-intensive application.[15]
- Cover crops often help suppress weeds, with ground cover and the release of allelopathic compounds that inhibit weed seedling germination and growth, thereby reducing the need for synthetic herbicides, fuel for tillage and cultivation, and soil disturbance.[16]
- Regenerative agricultural systems improve the soil and agroecosystem resilience under increasing climatic fluctuations. These will help soils dry out in wet weather, retain available water during drought, moderate soil temperature fluctuations, so the farm may be more resilient to extreme weather events.[17]
- Cover crops may reduce vulnerability to erosion from extreme rain events, increased soil water retention during droughts, and maintenance of nitrogen mineralized due to warming.[18]
- Flooding risks are reduced when rain can infiltrate through soils rather than run off, during the intense storms that are becoming more common.
- Legume cover crops grow in a symbiotic relationship with soil bacteria that convert gaseous nitrogen in soil's air pockets to ammonia (accumulating 5 to 30 g N/m2 between fall planting and spring termination[19]), that the cash crop can use. This decreases the need for synthetic nitrogen fertilizer (the production of which is the single largest energy use in agricultural production). This stored nitrogen is so significant that Pennsylvania's nutrient management guidelines require accounting for nitrogen contributions from legumes to subsequent crops.[20] The decreased fertilizer usage in turn reduces nutrient loading to the waterways and helps reduce fossil fuel and nitrous oxide emissions from fertilizer production and application.[21]

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[14] Duiker, S.W., J.C. Myers, and L.C. Blazure. 2017. Soil Health in Field and Forage Production. USDA Natural Resources Conservation Service, Penn State University Extension, Capital Resource Conservation & Development, and Clinton County Conservation District. https://extension.psu.edu/soil-health-in-field-and-forage-crop-production.

[15] Duiker, S.W., J.C. Myers, and L.C. Blazure. 2017. Soil Health in Field and Forage Production. USDA Natural Resources Conservation Service, Penn State University Extension, Capital Resource Conservation & Development, and Clinton County Conservation District. https://extension.psu.edu/soil-health-in-field-and-forage-crop-production.

[16] Schipanski, M.E., Barbercheck, M., Douglas, M.R., Finney, D.M., Haider, K., Kaye, J.P., Kemanian, A.R., Mortensen, Ryan, M.R., Tooker, J., White, C. 2014. A framework for evaluating ecosystem services provided by cover crops in agroecosystems. *Agricultural Systems.* 125 (2014) 12–22.

[17] Blanco-Canqui, H., and C. Francis. 2016. Building resilient soils through agroecosystem redesign under fluctuating climatic regimes. *Journal of Soil and Water Conservation*. Nov/Dec 2016—Vol. 71, No. 6; pages 127A-133A.

[18] Kaye, Jason & Quemada, M.. 2017. Using cover crops to mitigate and adapt to climate change. A review. *Agronomy for Sustainable Development*. 37. 10.1007/s13593-016-0410-x.

[19] Kaye, Jason & Quemada, M.. 2017. Using cover crops to mitigate and adapt to climate change. A review. *Agronomy for Sustainable Development*. 37. 10.1007/s13593-016-0410-x.

[20] Pennsylvania State Conservation Commission. 2019. Pennsylvania's Nutrient Management Act Program Technical Manual. Version 11.0.

[21] U.S. Department of Agriculture. May 2016. USDA Building Blocks for Climate-Smart Agriculture and Forestry: Implementation Plan and Progress Report.

- Cover crops with significant biomass reduce erosion, and also leaching losses of manure and fertilizers. The increased carbon also usually increases soil aggregate stability, so that the benefits of cover crops for erosion control may extend to extreme rain events that fall outside the period when cover crops are actually growing.[22]
- Cover crops protect bare ground during the winter to reduce nutrient leaching, increase soil organic matter, improve soil structure, reduce erosion, and decrease pest damage.
- No-till cultivation maintains residue cover and improves soil structure, to reduce compaction from the weight of grazing animals and farm equipment.[23]
- Managed grazing keeps healthy vegetative cover on the soil at all times, with livestock grazing only a portion of a plant at a time, and then leaving it to rest and regenerate both vegetative and root material. It also evenly distributes manure, increasing manure management effectiveness and efficiency.[24]
- Cover crops often provide habitat for soil organisms, to help control various insect pests and disease.[25]
- Increased diversity of plants and coverage of the ground throughout the year provide habitat for pollinators, birds and other wildlife.
- Reduced soil erosion and nutrient and pesticide runoff will improve water quality in local streams and rivers, as well as the Chesapeake Bay.
- Drinking water protection through enhanced groundwater infiltration and filtering of precipitation through the soil column.

Soil carbon sequestration practices also provide benefits to the agricultural economy:

- Cover crops can decrease the need for fertilizer, insecticide and herbicide applications, and while profitability may increase through gradual accrual of soil carbon and risk management.[26]
- Cover crops may also provide livestock forage to reduce the need for purchased feed inputs.[27]
- Fertilizer purchases and application costs may be reduced with higher organic nitrogen in soil.

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[22] Kaye, Jason & Quemada, M.. (2017). Using cover crops to mitigate and adapt to climate change. A review. *Agronomy for Sustainable Development*. 37. 10.1007/s13593-016-0410-x.
[23] Duiker, S.W., Myers, J.C., and Blazure, L.C. 2017. Soil Health in Field and Forage Production. USDA Natural Resources Conservation Service, Penn State University Extension, Capital Resource Conservation & Development, and Clinton County Conservation District. https://extension.psu.edu/soil-health-in-field-and-forage-crop-production.
[24] U.S. Department of Agriculture Climate Hubs, "Managing Grazing to Improve Climate Resilience," www.climatehubs.usda.gov/hubs/northeast/topic/managing-grazing-improve-climate-resilience. Accessed June 2020.
[25] Blanco-Canqui, H., and C. Francis. 2016. Building resilient soils through agroecosystem redesign under fluctuating climatic regimes. *Journal of Soil and Water Conservation*. Nov/Dec 2016—Vol. 71, No. 6; pages 127A-133A.
[26] Schipanski, M.E., Barbercheck, M., Douglas, M.R., Finney, D.M., Haider, K., Kaye, J.P., Kemanian, A.R., Mortensen, Ryan, M.R., Tooker, J., White, C. 2014. A framework for evaluating ecosystem services provided by cover crops in agroecosystems. *Agricultural Systems.* 125 (2014) 12–22.
[27] Duiker, S.W., and Pant, D. 2020. Intensive Grazing Management of Cover Crops for Soil Health. Penn State Extension. https://extension.psu.edu/intensive-grazing-management-of-cover-crops-for-soil-health

- With cover crops, soils warm more quickly to allow planting earlier in the spring,[28] a very important consideration when the available timeframe for planting can be very tight.
- Under managed grazing, livestock do most of their own harvesting and manure spreading, without labor, fuel and equipment expenses.
- Farms with high levels of soil health may experience greater resilience to extreme weather events, such as drought, heavy rain, and high temperatures.[29]
- Cover crops, especially brassica species with deep taproots that break through compacted soil to allow greater access to deep water, may increase adaptive capacity to maintain yields and prevent nitrogen losses during drought.
- With beneficial organisms keeping destructive diseases and pests in check, costs for pesticides and their application costs, and crop damages are reduced.[30]
- Veterinary expenses and cull rates also often drop, due to fewer herd health problems, when livestock more active and outside under grazing systems.[31]

Regenerative agricultural systems also help secure a healthy food system:

A food system's vulnerability to climate change is a function of its exposure to specific climate effects, the system's sensitivity to those effects, and its capacity to adapt to those effects. Climate change, with increased weather variability and more frequent and intense weather extremes, is already causing disruptions throughout the US food system, and increasing costs and the complexity of food production. The interaction between regional climate change effects and the geographic specialization and concentration of agricultural production increases the US food system's vulnerability to climate change.[32] As discussed above, regenerative agricultural practices help increase the crop and livestock production's resiliency to extreme weather events.

Preliminary research suggests that healthy soil in a regenerative agricultural system, with deep root systems and high levels of microbial diversity facilitate nutrient delivery to plants, leading to foods that contain more nutrients.[33]

Livestock grazing on landscapes with high levels of biodiversity have enhanced health, which is subsequently linked to the health of humans consuming meat and dairy products from these animals. Products from these animals have improved ratios of omega-3 to omega-6 fatty acids,

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[28] Duiker, S.W., J.C. Myers, and L.C. Blazure. 2017. Soil Health in Field and Forage Production. USDA Natural Resources Conservation Service, Penn State University Extension, Capital Resource Conservation & Development, and Clinton County Conservation District. https://extension.psu.edu/soil-health-in-field-and-forage-crop-production.

[29] Blanco-Canqui, H., and C. Francis. 2016. Building resilient soils through agroecosystem redesign under fluctuating climatic regimes. *Journal of Soil and Water Conservation*. Nov/Dec 2016—Vol. 71, No. 6; pages 127A-133A.

[30] Duiker, S.W., J.C. Myers, and L.C. Blazure. 2017. Soil Health in Field and Forage Production. USDA Natural Resources Conservation Service, Penn State University Extension, Capital Resource Conservation & Development, and Clinton County Conservation District. https://extension.psu.edu/soil-health-in-field-and-forage-crop-production.

[31] Hanson, J.C., Johnson, D.M., Lichtenberg, E., and Minegishi, K. 2013. Competitiveness of management-intensive grazing dairies in the mid-Atlantic region from 1995 to 2009. *Journal of Dairy Science:* 96:1894–1904 http://dx.doi.org/10.3168/jds.2011-5234.

[32] Lengnick, L. 2015. The vulnerability of the US food system to climate change. *Journal of Environmental Studies and Sciences.* Vol. 5, 348–361. https://doi.org/10.1007/s13412-015-0290-4.

[33] Moyer, J., Stoll, S., Schaeffer, Z., Smith, A., Grega, M., Weiss, R., Fuhrman, J. 2020. *The Power of the Plate: The case for regenerative organic agriculture in improving human health*. https://rodaleinstitute.org/wp-content/uploads/Rodale-Institute-The-Power-of-the-Plate-The-Case-for-Regenerative-Organic-Agriculture-in-Improving-Human-Health.pdf

that may reduce the incidence of heart disease, cancer, rheumatoid arthritis, autoimmune, and neurodegenerative diseases thought to stem from inflammation.[34]

Pasture-based systems can improve the nutritional value of milk, with greater levels of vitamins B2, B7 and E, and conjugated linoleic acid, that confers reduced cardiovascular and metabolic disease risks. They also had improved ratios of omega-3 to omega-6 fatty acids.[35]

II. Trees—benefits of riparian and upland forests and canopy

A large and growing array of studies have demonstrated the "mind blowing"[36] potential planting trees has on sequestering carbon from the atmosphere and mitigating a myriad of the impacts of climate change.[37]

In the WIP3, Pennsylvania committed to implementing over 85,000 new acres of streamside forests, commonly referred to as forest riparian buffers, 5,000 acres of lawn converted to woods, and 50 acres of new urban tree canopy. This equates to planting approximately 17 million new trees alongside streams that flow to the Bay. **Collectively, tree-based conservation practices are the class of practices the state is relying upon the most to meet nitrogen reduction commitments at over 7.5 million pounds of reduction annually.**

These trees have the potential to not only substantially advance Pennsylvania's efforts to 'save the bay' but also a myriad of other benefits:

Carbon sequestration

It is estimated that forests in the United States store roughly 14 percent of all annual CO_2 emissions emitted nationally.[38] They do this via a complex interrelationship that includes the active sequestering of carbon into the woody material of trees via photosynthesis and even the root structure and organic soil matrix as part of the forest floor as part of the forest carbon cycle.[39]

Although various methodologies exist, utilizing an approach by the U.S. Forest Service[40] suggests that **WIP3 acres of new forested buffers, woods, and tree canopy could sequester**

[34] Provenza, F.D., Kronberg, S.L., and Gregorini, P. 2019. Is Grassfed Meat and Dairy Better for Human and Environmental Health? Frontiers in Nutrition: 6:26. https://www.frontiersin.org/articles/10.3389/fnut.2019.00026/full
[35] Kerry Health and Nutrition Institute. 2019. Nutrition Benefits of Grass-Fed Dairy. https://khni.kerry.com/news/blog/nutrition-benefits-of-grass-fed-dairy/
[36] Carrington, D. (2019, December 16). *Tree planting 'has mind-blowing potential' to tackle climate crisis*. the Guardian. https://www.theguardian.com/environment/2019/jul/04/planting-billions-trees-best-tackle-climate-crisis-scientists-canopy-emissions
[37] Bastin, J., Finegold, Y., Garcia, C., Mollicone, D., Rezende, M., Routh, D., Zohner, C. M., & Crowther, T. W. (2019). The global tree restoration potential. *Science*, *365*(6448), 76-79. https://doi.org/10.1126/science.aax0848
[38] Melillo, Jerry M., Terese (T.C.) Richmond, and Gary W. Yohe, Eds., 2014: Climate Change Impacts in the United States: The Third National Climate Assessment. U.S. Global Change Research Program, 841 pp. doi:10.7930/J0Z31WJ2.
[39] American Forests. (2019, October 3). Forests as carbon sinks. https://www.americanforests.org/blog/forests-carbon-sinks/
[40] Smith, J. E., Heath, L. S., Skog, K. E., & Birdsey, R. A. (2005). Methods for Calculating Forest Ecosystem and Harvested Carbon with Standard Estimates for Forest Types of the United States (General Technical Report NE-343). U.S. Department of Agriculture Forest Service. https://www.fs.fed.us/ecosystemservices/pdf/estimates-forest-types.pdf

roughly 28,000,000 metric tons CO_2e (carbon dioxide equivalent) over the life of the roughly 17 million trees to be planted to meet Pennsylvania's Chesapeake Bay obligations.

Local stream pollution reductions

A 2005 literature review conducted by the U.S. Environmental Protection Agency (USEPA)[41] concluded that based on the over 100 studies reviewed, nitrogen removal from overland surface flows and shallow subsurface groundwater discharges to streams reached peak capacity when the width of the buffer exceeded 328 feet (100 meters). Seventy-five percent removal of nitrogen, however, was found at widths of approximately 92 feet (about 28 meters).

According to the same USEPA review, **forested riparian buffers, when compared to riparian buffers of other vegetation, provided the most effective and consistent removal of nitrogen**, whether it is from overland surface flows or shallow subsurface groundwater discharges to adjacent streams.

In addition to capturing and treating pollution from runoff, research by the Stroud Water Research Center on Pennsylvania streams has concluded that forested buffer systems, compared to grassed systems, provide enhanced *in situ* (in-stream) contaminant sequestration and degradation primarily due to increased biological activity. The researchers noted that increased nitrogen attenuation and pesticide degradation were particularly associated with **forested stream buffers, with these streams attenuating 200 to 800% more than non-forested streams**.[42] The ability of forested buffers to enhance the in-stream processing of both nonpoint and point source pollutants reduces their impact on downstream rivers and estuaries.

Important game fisheries and aquatic life

Streamside forests also enhance habitat for fish and other aquatic organisms—a vital component for maintaining stream ecological health. Woody debris and decaying leaves add organic food and support biological abundance, diversity, and productivity in streams. **In small upland streams, as much as 75 percent of the organic food base in a stream may be supplied by dissolved organic materials or detritus from the adjacent forest canopy**.[43] Benthic organisms feed on this material, forming the basis of the aquatic food chain,[44] therefore, supporting ecologically important game species like Pennsylvania's native brook trout.

The tree canopy created by a streamside buffer contributes to the health of the stream by maintaining cooler water temperatures and by providing healthier habitats for economically and environmentally important fish species, like brook trout and brown trout, and other important aquatic and game species. Collectively, the **economic contributions generated by outdoor recreational activities (e.g., fishing and hunting) in Pennsylvania annually account for**

[41] Chow, Leeanne. 2012. A literature review of riparian buffer widths for sediments, nutrients and large woody debris. University of British Columbia, Forestry Undergraduate Essays/Theses, 2011 winter session, FRST 497.
[42] Sweeney, B, T.L. Bott, J. K. Jackson, L. A. Kaplan, J. D. Newbold, L. J. Standley, W. C. Hession, and R. J. Horwitz. 2004. Riparian deforestation, stream narrowing, and loss of stream ecosystem services. PNAS, September 2004; 101: 14132–14137
[43] Welsch, D. J. 1991. Riparian Forest Buffers - Function for Protection and Enhancement of Water Resources. NA-PR-07-91. [Broomall, PA:] U.S. Dept. of Agriculture, Forest Service, Northern Area State & Private Forestry.
[44] Semlitsch, R,, J. Russell Bodie. 2003. Biological Criteria for Buffer Zones around Wetlands and Riparian Habitats for Amphibians and Reptiles. Conservation Biology, Volume 17, Issue 5, pages 1219–1228, October 2003.

almost $17 billion in salaries and wages and over $300 million in federal, state, and local tax revenue.[45] Forested riparian buffers, by providing fundamental habitat and maintaining cool waters, play a significant role in supporting such economic activity. The warming of a stream reduces the oxygen carrying capacity of the waterway, harming stream life that is temperature sensitive. The enhanced habitat and cool water temperatures that forested buffers provide to streams establish the framework for sustainable, economically productive fisheries as well as a host of other aquatic species, many of which brook trout depend on.

While the presence of buffers clearly improves fish habitat measures, the lack of a sufficient buffer can lead to severe losses of important game species. A study of Pennsylvania streams found increases of 4 to 9°F when forested buffers are lost, which is the equivalent of moving the stream over 400 miles south.[46] Klapproth and Johnson (2000) also noted water temperatures are important in regulating phosphorus concentrations, as when water reaches above 60°F, phosphorus is more readily released from its sediment hosts and dissolved into the stream as a pollutant. Increased water temperatures also produce heavy growth of filamentous algae (from increases of 9°F), encourage the growth of parasitic bacteria, and can adversely affect benthic organisms.

Meyer et al. (2005)[47] noted that not only the presence but also the size of forested stream buffers has a profound impact on a stream's ability to support trout populations. Researchers found that when forested buffer widths were reduced from 100 feet to 50 feet, stream temperatures increased 2.9°F to 4.2°F while fine sediments increased 11 percent. Although these changes may appear small, they resulted in an 81-88 percent reduction in young trout populations.

Source water protection

Forested buffers also reduce the costs of treating drinking water.[48] According to Penn State University, 56 percent of Pennsylvanians get their drinking water from surface waters, including 43,000 miles of streams, 2,300 reservoirs, and 76 natural lakes.[49] Research has indicated that trees play a vital role in maintaining the quality of the water entering drinking water treatment plants and, therefore, reduce the costs of treatment. In fact, on average **for every 10 percent decrease in forest cover in a watershed, treatment costs increase approximately 20 percent**.[50] The USEPA estimates that the treatment cost to source water protection ratio, which includes forest buffer preservation/restoration, on average, is 27:1. Thus, for every $1 spent on

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45 Southwick Associates. (2018). *The Power of Outdoor Recreation Spending in Pennsylvania: How hunting, fishing, and outdoor activities help support a healthy state economy*. Theodore Roosevelt Conservation Partnership. https://www.trcp.org/wp-content/uploads/2018/12/TRCP-and-Southwick-PA-Economic-Analysis-12-6-18.pdf
46 Klapproth, J. and J. Johnson. 2000. Understanding the Science Behind Riparian Forest Buffers: Effects on Plant and Animal Communities. Virginia Cooperative Extension, Virginia State University, Charlottesville, VA. Publication No 420-152.
47 Meyer, J. M., et al. 2005. Implications of Changes in Riparian Buffer Protection for Georgia's Trout Streams. Institute of Ecology, The University of Georgia, Athens, GA.
48 Pennsylvania Source Water Protection. Role of Forests and Drinking Water. http://www.sourcewaterpa.org/?page_id=3066
49 Penn State University. Pennsylvania Impact: Cleaner Water for Pennsylvania. Website: http://paimpact.cas.psu.edu/agr9973.html
50 Ernst, C., R. Gullick, K Nixon. .2004. Protecting the Source: Conserving Forests to Protect Drinking Water. American Water Works Association Optflow Vol. 30, No. 5, May 2004.

source water protection, $27 is saved in treatment costs. An analysis of the Gettysburg source water protection program yielded a ratio of 178:1.[51]

So critical are trees to clean and healthy drinking water sources, that David Cassells, a World Bank forest specialist says, *"Protecting forests around water catchment areas is no longer a luxury but a necessity. When they are gone, the costs of providing clean and safe drinking water to urban areas will increase dramatically."*[52]

Nuisance flood mitigation

Collectively, Pennsylvania's existing tree canopy in eight urbanized areas[53] is estimated to avoid creating 32.3 billion gallons of stormwater runoff a year, according to Climate Central, an independent nonprofit of scientists and communicators.[54] This natural capital represents an avoided expense and loss of property that is not borne by taxpayers.

Forested riparian buffers and upland forest soils provide a significant stormwater function because they **capture, absorb, and store amounts of rainfall up to 40 times greater than disturbed soils, like construction sites, and 15 times more than turf grass.**[55] Research has consistently concluded that because of these benefits, those projects which preserve and restore forest buffer systems often require less or smaller-sized stormwater infrastructure.[56] This fact is widely recognized, and many state and local stormwater management programs, including Maryland's, allow for the "crediting" for the volume and rate of runoff from built areas as long as it is discharged by sheet flow to intact buffer systems. Tree plantings, as defined in the WIP3 and throughout the state, promise to further avoid the creation and enhance the mitigation of polluted stormwater runoff, particularly in urban and suburban communities.

Air pollution reduction

Trees play a vital role in ameliorating a large array of air pollutants to the benefit of human health and the environment. In the atmosphere, nitrogen dioxides (NO_x) is converted to nitric acid, which trees absorb through their pores, or stomata; thus, reducing the amount of low-level ozone formed.[57] **Trees also remove particulate matter from the atmosphere, particularly**

[51] Gartner, Todd & Mehan, G. & Mulligan, James & Roberson, Alan & Stangel, Peter & Qin, Yiyuan. (2014). Protecting forested watersheds is smart economics for water utilities. Journal - American Water Works Association. 106. 54-64. 10.5942/jawwa.2014.106.0132

[52] Trust for Public Land and American Water Works Association. 2004. Protecting the Source: Land Conservation and the Future of America's Drinking Water. San Francisco, CA

[53] Allentown, Altoona, Erie, Harrisburg, Philadelphia, Pittsburgh, State College, and Wilkes-Barre areas.

[54] *Runoff avoided by trees*. (2019, October 23). Climate Central: A Science & News Organization. https://www.climatecentral.org/gallery/maps/runoff-avoided-by-trees-2019#

[55] Palone, R.S. and A.H. Todd (editors.) 1997. Chesapeake Bay riparian handbook: a guide for establishing and maintaining riparian forest buffers. USDA Forest Service. NA-TP-02-97. Radnor, PA.

[56] Miller, A.E. and A. Sutherland. 1999. Reducing the Impacts of Storm Water Runoff through Alternative Development Practices. Office of Public Service & Outreach, Institute of Ecology, University of Georgia, Athens, GA.

[57] U.S. Environmental Protection Agency. (2015). *Nitrogen Dioxide Removed Annually by Tree Cover*. U.S. Environmental Protection Agency EnviroAtlas. https://enviroatlas.epa.gov/enviroatlas/DataFactSheets/pdf/ESC/NitrogenDioxideremovedannuallybytreecover.pdf

small particles which are a major health hazard in air pollution.[58] Both contaminants are widely recognized as significant contributors to acute and chronic human health impacts.

Climate Central concludes that the current tree canopy in eight urban/suburban Pennsylvania communities ameliorates 1.3 billion pounds of air pollution a year.[59] Nowak et al. (2013) concluded that trees and forests in the contiguous United States removed 38.4 billion pounds of air pollution in 2010 that resulted in $6.8 billion in benefits to human health.[60]

By adding roughly 15 million new trees as called for in the WIP3, it is more than reasonable to conclude that air pollution will be reduced further and human health improved throughout much of the Commonwealth.

III. Other Considerations

Environmental Rights

Of significant importance, these proposed regulations would be directly in line with our state Constitution, specifically, Article I, Section 27 by ensuring that Pennsylvanians are receiving their fundamental right to clean air and pure water.[61] **These types of regulations are exactly how the Commonwealth acts as a trustee in accordance with the Constitution.** Keeping our citizen's interests in mind and acting with prudence and loyalty by proposing and approving regulations that reduce CO2 will help to conserve and maintain our air and waters for generations yet to come as required by the state Constitution.

Equity and Environmental Justice

It is a well-established fact that powerplants and other facilities are more likely to be sited in low-income communities and communities of color. For purposes of regulation, the Pennsylvania Department of Environmental Protection (DEP) has developed Environmental Justice Areas (EJ Areas). An EJ Area is defined as "any census tract where 20% or more individuals live at or below the federal poverty line, and/or 30% of more of the population identified as a non-white minority, based on data from the U.S. Census Bureau and the federal guidelines for poverty."[62] As of 2018, EJ Areas were twice as likely to be within three miles of

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[58] U.S. Environmental Protection Agency. (2015). *Percent Particulate Matter (PM10) Removed Annually by Tree Cover*. U.S. Environmental Protection Agency EnviroAtlas. https://enviroatlas.epa.gov/enviroatlas/DataFactSheets/pdf/ESC/PercentparticulatematterPM10removedannuallybytreecover.pdf
[59] Climate Central. (2019, June 4). *The power of trees*. Climate Matters Media Library | Climate Matters. https://medialibrary.climatecentral.org/resources/the-power-of-trees
[60] Nowak, D. J., Hirabayashi, S., Bodine, A., & Greenfield, E. (2014). Tree and forest effects on air quality and human health in the United States. *Environmental Pollution*, *193*, 119-129. https://doi.org/10.1016/j.envpol.2014.05.028
[61] The people have a right to clean air, pure water, and to the preservation of the natural, scenic, historic and esthetic values of the environment. Pennsylvania's public natural resources are the common property of all the people, including generations yet to come. As trustee of these resources, the Commonwealth shall conserve and maintain them for the benefit of all the people. Article I, Section 27 of the Pennsylvania Constitution. See also, *Pa. Envtl. Def. Found. v. Cmwlth*, 161 A.3d 911 2017 Pa. LEXIS 1393 (Pa. 2017).
[62] *PA Environmental Justice Areas*, Department of Environmental Protection, https://www.dep.pa.gov/PublicParticipation/OfficeofEnvironmentalJustice/Pages/PA-Environmental-Justice-Areas.aspx

an existing power plant and three times as likely to be near two or more plants.[63] In addition to carbon dioxide, fossil-fueled plants emit a variety of other air pollutants, or co-pollutants. Co-pollutants include particulate matter, ozone, sulfur dioxides and nitrogen oxides, all of which pose significant risks to human health.[64] **While these co-pollutants are not the focus of cap-and-trade programs, localized implementation may lead to their reduction and have resulting benefits for environmental justice communities.**

The efficacy of carbon trading programs in reducing pollution disparities in disadvantaged communities has been a source of great debate. In many instances, the broad mandate of carbon trading programs is considered unlikely to translate to localized reductions of carbon dioxide or its co-pollutants. However, **regulators have the potential to create localized impacts by incorporating DEP's EJ Areas and the accompanying datasets into its CDBTP regulations and utilizing the resources it accumulates to benefit environmental justice communities.**

In order for a carbon trading programs like CDBTP to provide benefits to environmental justice communities, the unique characteristics of the locality must be incorporated into its implementation. For example, if facilities in overburdened communities are allowed to rely on offsets and trades, a cap-and-trade program may inadvertently create GHG "hotspots"[65] where emissions are increased, thereby worsening the impacts of power plants on surrounding communities. **Regulators might avoid this unfortunate effect by placing limitations on the ability of facilities located in EJ Areas to use offsets and by prohibiting trades to facilities in EJ Areas.** Facilities in EJ Areas should be encouraged to reduce their own emissions through participation in CDBTP.

Regulators might also alleviate pollution burdens in environmental justice communities by utilizing auction proceeds to invest in pollution reduction projects in EJ Areas. By investing these funds into communities who have borne the brunt of the harm from fossil-fuel pollution, regulators ensure that local communities benefit from the implementation of CBDTP. Such an initiative also creates opportunities to work with communities to develop supplementary programs and provide avenues for public engagement that are traditionally absent in carbon trading programs. Auction revenue might also be used for the development of job training programs that assist communities relying on power plants for jobs and other economic benefits in the transition to a green economy.[66] In California, revenue raised from allowances is directed

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[63] *Pernicious Placement of Pennsylvania Power Plants: Natural Gas-Fired Power Plant Boom Reinforces Environmental Justice,* Food & Water Watch at 9 (Jun. 2018), https://www.foodandwaterwatch.org/sites/default/files/rpt_1806_pagasplants_web3.pdf

[64] *Electric Utilities,* American Lung Association, https://www.lung.org/clean-air/outdoors/what-makes-air-unhealthy/electric-utilities.

[65] Alice Kaswan, *CPR Perspective: Envirionmental Justice and Climate Change: Incorporating Environmental Justice into Greenhouse Gas Cap-and-Trade Programs,* The Center for Porgressive Reform, July 2009, http://progressivereform.org/our-work/energy-environment/perspejandcc/

[66] Jonah Kruman-Faber, *Carbon Pricing in a Just Transition; A Policy Framework and Case Study of California Cap-and-Trade,* ClimateXchange (Sep. 2019), https://climate-xchange.org/wp-content/uploads/2018/08/Carbon-Pricing-in-a-Just-Transition-Final-Website.pdf.

toward the states climate investments in order to administer climate specific programs.[67] A recent study suggested that this, along with other regulatory mechanisms implemented along with the State's cap-and-trade program narrowed California's "EJ Gap"[68] by 21-30%.[69] **If the mechanisms discussed above are incorporated into the CDBTP, the Commonwealth has the potential to make significant strides in the pursuit of environmental justice.**

In conclusion, CBF strongly supports the passage of this rulemaking. We emphatically encourage the Commonwealth to direct resources collected by the CDBTP to EJ Areas as well as towards conservation practices that sequester CO_2 while improving and protecting local rivers and streams and the Chesapeake Bay. Our health, well-being, and quality of life depend on it.

Thank you for your consideration of these comments.

Sincerely,

Shannon Gority
Pennsylvania Executive Director
Chesapeake Bay Foundation

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[67] *Regional Cap and Trade: Lessons from Regional Greenhouse Gas Initiative and Western Climate Initiative*, Climate Xchange, at 21 (Oct. 2108) https://climate-xchange.org/wp-content/uploads/2018/08/Cap-and-Trade-Report-10.03.2018-compressed.pdf.

[68] A term coined by researchers to describe the pollution disparities in California's communities. Duane Hernandez-Cortez, Kyle C. Meng, *Do Environmental Markets Cause Environmental Injustice? Evidence from California's Carbon Market* (May 2020), https://hernandezcortes.github.io/assets/pdf/HCM_manuscript.pdf.

[69] Duane Hernandez-Cortez, Kyle C. Meng, *Do Environmental Markets Cause Environmental Injustice? Evidence from California's Carbon Market* (May 2020), https://hernandezcortes.github.io/assets/pdf/HCM_manuscript.pdf.