

A Sustainable Chesapeake

BETTER MODELS FOR CONSERVATION

Edited by David G. Burke and Joel E. Dunn

THE CONSERVATION FUND



The case study you have downloaded is highlighted below. Other case studies from this Chapter of *A Sustainable Chesapeake: Better Models for Conservation* can be individually downloaded. The editors encourage readers to explore the entire Chapter to understand the context and sustainability principles involved with this and other featured case studies. The full publication contains 6 Chapters in total: Climate Change Solutions, Stream Restoration, Green Infrastructure, Incentive Driven Conservation, Watershed Protection and Stewardship.

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A Carbon Footprint Analysis and Forest Carbon Sequestration Pilot Program

Climate Leadership by the Maryland Department of Natural Resources

The Maryland Department of Natural Resources evaluated its carbon footprint, identified ways to reduce it, and implemented a pilot forest carbon sequestration program to offset a portion of the greenhouse gas emissions.

CASE STUDY SUMMARY

The climate in the Chesapeake Bay region is warming.^{1,2,3,4} Manmade greenhouse gases have been identified as the primary cause of these increasing temperatures.⁵ The associated environmental changes are happening so rapidly that residents of the Bay watershed will likely perceive the effects within their lifetimes. Immediate impacts will be felt along the coasts due to rising sea levels and strong storms.⁶ The combination of predicted environmental changes due to climate change will make Bay restoration efforts more difficult.⁷

Minimizing climate change will require the reduction and stabilization of greenhouse gas concentrations in the atmosphere. This very serious and very difficult challenge requires that our society become carbon neutral – which means that individuals, corporations, and governments must collectively reduce their carbon emissions, and sequester as much carbon as they produce. In an effort to lead by example, the Maryland Department of Natural Resources (DNR) has evaluated its carbon footprint, identified ways to reduce it, and implemented a pilot forest carbon sequestration

program to offset a portion of the greenhouse gas emissions that cannot be immediately eliminated.

DNR estimated that its fiscal 2006 baseline carbon footprint was approximately 17,284 metric tons of carbon dioxide equivalents (CO₂e) – an amount approximately equal to emissions from 40,195 barrels of oil or the annual electricity use of 2,289 households. The results of the carbon footprint calculation provided a baseline for DNR to set greenhouse gas emission reduction benchmarks and to determine the level of carbon sequestration activities needed to move towards carbon neutrality. The DNR calculation led the way to a larger effort to calculate the environmental footprint of the entire Maryland State Government.

DNR designed and implemented a plan to plant 171.4 acres of forest on non-forested land, which would offset a significant portion of the Department's greenhouse gas emissions for one year. The planting also complements DNR's effort to accelerate progress towards pending forest protection goals associated with the Chesapeake Bay Agreement and subsequent commitments.

RESOURCE MANAGEMENT CHALLENGE

The earth's atmosphere is remarkably thin compared to the overall size of the planet, which makes it extremely vulnerable to changes in chemical composition from human activities. Over the last two centuries, humans have added significant amounts of greenhouse gases to the atmosphere, including: carbon dioxide (CO₂), methane (CH₄), nitrous oxide (N₂O), hydrofluorocarbons (HFCs), perfluorocarbons (PFCs), and sulfur hexafluoride (SF₆). Even though the other gases have higher global warming potential coefficients, CO₂ is the most important of the greenhouse gases because of its abundance. Higher CO₂ concentrations have essentially thickened the atmosphere, which has enabled it to hold more heat on the earth's surface. These atmospheric changes will likely raise temperature and sea level, and cause changes in precipitation regimes in the Bay region, all significant challenges for an already stressed ecosystem.⁸

Maryland DNR manages 467,340 acres of land across the State. The Department's mission is to lead Maryland in securing a sustainable



The Department owns, operates or leases 1,923 buildings, which total over 3 million square feet. Stationary combustion at these facilities is responsible for 8,296 metric tons of CO₂ a year.



Governor O'Malley signs executive order establishing the Maryland Climate Change Commission.

future for our environment, society, and economy by preserving, protecting, restoring, and enhancing the State's natural resources. To support its mission, the Agency uses 1,941 vehicles, and owns, operates or leases 1,923 buildings (3,141,711 square feet). The resultant use of vehicle fuels,

electricity, and heating/cooling fuels gives the Department a significant carbon footprint. A carbon footprint is defined here as a measure of the amount of carbon dioxide equivalents, in metric tons, emitted directly or indirectly because of activities under the DNR's operational control.

State agencies across the watershed do not typically have systems in place that allow for quick tabulation of statistics on greenhouse gas emissions. Data on energy use is divided among 14 units within the Department, with numerous locations throughout the State. Posing an additional challenge, some of this data is available only from other State agencies. Coordination of such information has not been expected or required until now. Lastly, no State agency has laid out a process for sequestering carbon using forests that includes guidance on site selection, planting and management plans, monitoring protocols, or registry protocols.

CONSERVATION VISION

On April 20, 2007, Governor Martin O'Malley signed an Executive Order establishing the Maryland Climate Change Commission (MCCC) charged with collectively developing an action plan to address the causes of climate change, prepare for the likely consequences and impacts of climate change to Maryland, and establish firm benchmarks and timetables for implementing the Commission's recommendations. The resulting Climate Action Plan details the effects of climate change and recommends specific policies to reduce carbon emissions and protect Maryland's people and property from rising sea levels and changing weather patterns.⁹ The Plan recommends that DNR "lead by example" by calculating its carbon footprint and implementing innovative carbon reduction strategies, including offsetting a portion of the Agency's footprint through forest carbon sequestration.

The long-term vision for the program is to devise a carbon management blueprint involving emission reductions and voluntary offsets that all other State agencies, private corporations and individuals can replicate.



With strong leadership, fairly simple methods and a bigger scale effort, Maryland can begin to address its overall contribution to the larger challenge of stabilizing greenhouse gases and combating climate change. This can simultaneously accomplish other objectives, such as green infrastructure corridor conservation and restoration, no-net-loss of forest cover and water quality improvement through buffer plantings. This type of program will necessarily involve a suite of partners, including government, nonprofits and corporations working together to accomplish the carbon management objective.

IMPLEMENTATION RESOURCES

Based upon the findings of the Climate Change Commission, John Griffin, Secretary of Natural Resources, asked DNR agency staff to conduct a carbon footprint analysis and a pilot CO₂ sequestration project to offset emissions. The DNR hired David Palange, a graduate student from the Nicholas School of the Environment at Duke University, as a summer intern to conduct the analysis. The funding for the internship came from the National Oceanic and Atmospheric Administration and DNR's Chesapeake and Coastal Program.

The State of Maryland's Program Open Space (POS) was designed to offset development trends by conserving open space and building recreational infrastructure. Funded through a 0.5% real estate transfer tax, POS revenues now support additional conservation programs. The State used POS funds to purchase a site south of Cambridge, Maryland, to prevent an unwanted development, to improve water quality and enhance wildlife habitat on the property. Approximately 588 acres of the 728 acre site were in agriculture production prior to restoration. The

entire property was purchased for \$10,321,000 (\$14,177/acre). Terms of the sale stipulated that over \$1.9 million was to be provided by the sellers for site restoration. To date, approximately \$1,430,000 has been spent on site restoration. The primary goal of the overall restoration project was to improve water quality of on-site runoff and stormwater flowing into and from the site. A secondary goal was to improve habitat for the federally endangered Delmarva fox squirrel, migratory waterfowl, and songbirds. Subsequently, in planning for the restoration of the property, DNR determined that 171.4 acres of it were well suited to be a forest carbon sequestration site. Of the 171.4 acres, 30 acres will be intensively monitored for carbon. DNR's Power Plant Research Program is funding the monitoring effort associated with the sequestration project. The initial cost of monitoring is \$10,000.

CONSERVATION STRATEGY

The DNR's carbon management strategy involves three main components: a carbon footprint analysis, emission cutting strategies, and a forest carbon sequestration demonstration project.

Carbon Footprint Analysis: To calculate its carbon footprint. The DNR used the Climate Registry's General Reporting Protocol (TCRGP), which is an amalgamation of various well respected greenhouse gas programs and protocols.¹⁰ The analysis focused mainly on direct emissions, such as stationary and mobile combustion sources, and indirect emissions, such as the consumption of purchased electricity. Only emissions from DNR vehicles or buildings were considered, so leased buildings and personal commuting were not included in the analysis. Some data had to be estimated or extrapolated to complete the carbon footprint estimate within the available time. The DNR analy-

sis did not include data on HFCs and PFCs and does not produce SF₆.

The carbon footprint calculation focuses primarily on DNR's vehicle fleet (highway, aircraft, marine, off-road, heavy truck and equipment) and its mobile combustion (natural gas, ethanol, gasoline, jet fuel, biodiesel and diesel), and facilities combustion (fuel oil #2, propane, natural gas, biomass, electricity). Greenhouse gas emissions were calculated by multiplying the total gallons of each fuel type used by the emission factor for each fuel type and adding up all the emissions. CH₄ and N₂O emissions were calculated based on default CH₄ and N₂O emission factors for vehicle model year or for fuel type and converted to units of CO₂e. Total CO₂e emissions were categorized as mobile combustion, indirect combustion (i.e. purchased electricity) and stationary combustion (i.e. heating fuels and biomass).

Carbon Cutting Strategies: DNR staff examined the emissions generated by its vehicles and facilities and determined various ways to promote efficiency, substitution, and carbon capture. Efficiency actions are those that use fewer resources to achieve the same result. The main ways to improve efficiency are through technology and behavioral changes. Substitution actions are those that replace high emission fuels and energy sources with renewable sources and/or low emission fuels. A series of short and long term efficiency and substitution actions that could be taken to reduce the Department's carbon footprint were subsequently identified. To supplement the carbon footprint reduction efforts, it was determined that a carbon capture project would also be needed.

Forest Carbon Sequestration:

Forests cover 44% of Maryland and offer significant opportunities for

THE CLIMATE REGISTRY VOLUNTARY REPORTING PROTOCOL

The goal of the Climate Registry is to standardize greenhouse gas accounting and reporting rules across multiple jurisdictions and to provide guidance on the production of a comprehensive, consistent and comparable report. The Climate Registry is the first multinational effort to standardize greenhouse gas accounting and reporting.

carbon sequestration.¹¹ Forests are also the most beneficial land use for restoring and maintaining water quality.¹² In 2000, Maryland forests absorbed an estimated 11.5 million metric tons more of CO₂ than they emitted.¹³ DNR determined that the three most important components to the sequestration project were site selection, a planting plan and a monitoring strategy.

Site Selection: After reviewing several recent POS purchases, DNR identified a 171.4 acre area called the Little Blackwater property, south of Cambridge, Maryland, as the forest carbon sequestration pilot project demonstration site.

Planting Plan: Three forest management scenarios were selected for planting and future carbon sequestration monitoring.

- ▶ **Low Management (100% Hardwoods):** 37.1 acres – A mixture of oaks were planted in this area on 10' X 10' spacing. Oaks planted include red oak (*Quercus rubra*), swamp white oak (*Quercus bicolor*) and willow oak (*Quercus phellos*). This stand will be allowed to mature in excess of 80 years with minimal management activity.

Little Blackwater Forest Carbon Sequestration Pilot	
Forest Type	Acres
Mixed oaks	37.1
Mixed pine-hardwood	97.5
Loblolly	36.8

- ▶ **Moderate Management (50-70% Pine & 30 – 50% Oaks):** 97.5 acres – A mixed pine-hardwood forest was planted in this area on 10' X 10' spacing. This stand represents a typical natural mixed stand on the Delmarva Peninsula. Loblolly pine (*Pinus taeda*), red oak, swamp white oak and willow oak were planted. Rotation length of this stand will be 60 to 80 years in age.
- ▶ **High Management (100 % Pine):** 36.8 acres – A loblolly pine plantation was planted in this area on 10' X 10' spacing. This stand represents the intensively managed pine plantations on the Delmarva. Rotation length of this stand will be 40 to 60 years of age.

Monitoring Strategy:

There are two parts to the monitoring plan. The first establishes the baseline condition of the parcel. The second tracks the accumulation of carbon over time. The difference between the carbon accumulated some time after planting minus the baseline condition is the amount sequestered. Carbon occurs in several “pools” including at least above-ground biomass, below-ground biomass, forest litter and soil carbon. Protocols for monitoring these pools have been

developed and are currently being reviewed.

The Maryland Geological Survey (MGS), a component of DNR, developed a monitoring plan to measure carbon sequestration below-ground as forest growth occurs on three, 10 acre plots within each separate planting regimes. MGS will develop a random sampling protocol for selecting the below ground soil sampling sites and a suitable sampling methodology, and will produce a



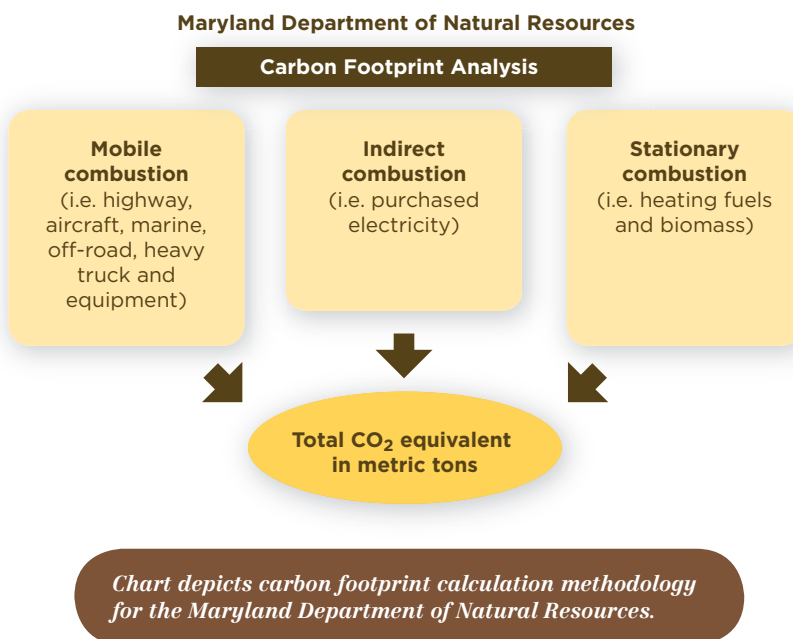
Photo showing swamp white oak seedling planted in 2009 at the Little Blackwater site. This wetlands adapted species is tolerant of the saturated soil conditions often found on the Delmarva Peninsula.

sampling procedure that can be used by the Department of Public Safety and Correctional Services inmates to collect the soil samples.

At each sampling location, subsamples will be collected from identified soil horizons A, B, and C, with appropriate subsampling within each horizon as necessary to fully characterize the belowground carbon. It is anticipated that the samples should be collected yearly to determine the increase in belowground carbon over time within each soil horizon. Samples will be returned to the MGS laboratory for analysis of total Carbon, Nitrogen and Sulfur using a Carlo-Erba NCS Analyzer. Results will be reported for each forest management scenario plot and for each soil horizon within the plots. Anticipated increases in carbon over time will also be evaluated.

RESULTS

Carbon Footprint Analysis: In the Fiscal Year 2006 baseline year, Maryland DNR produced approximately 17,284 metric tons of CO₂e. Carbon dioxide was responsible for 99% of the total greenhouse gas emissions. The remaining 1% was due to CH₄ and N₂O emissions. The total CO₂e emissions are comparable to 3,166 passenger cars, 40,196 barrels of oil, 2,289 households' annual electricity use, or 196 acres of deforestation. DNR's vehicle fleets are responsible for 52% of the agency's emissions and indirect emissions, and stationary combustion at DNR's facilities is responsible for the remaining 48%. The Agency's



highway vehicle fleet, made up of cars, trucks, SUVs and vans, is responsible for 74% of the mobile combustion emissions.

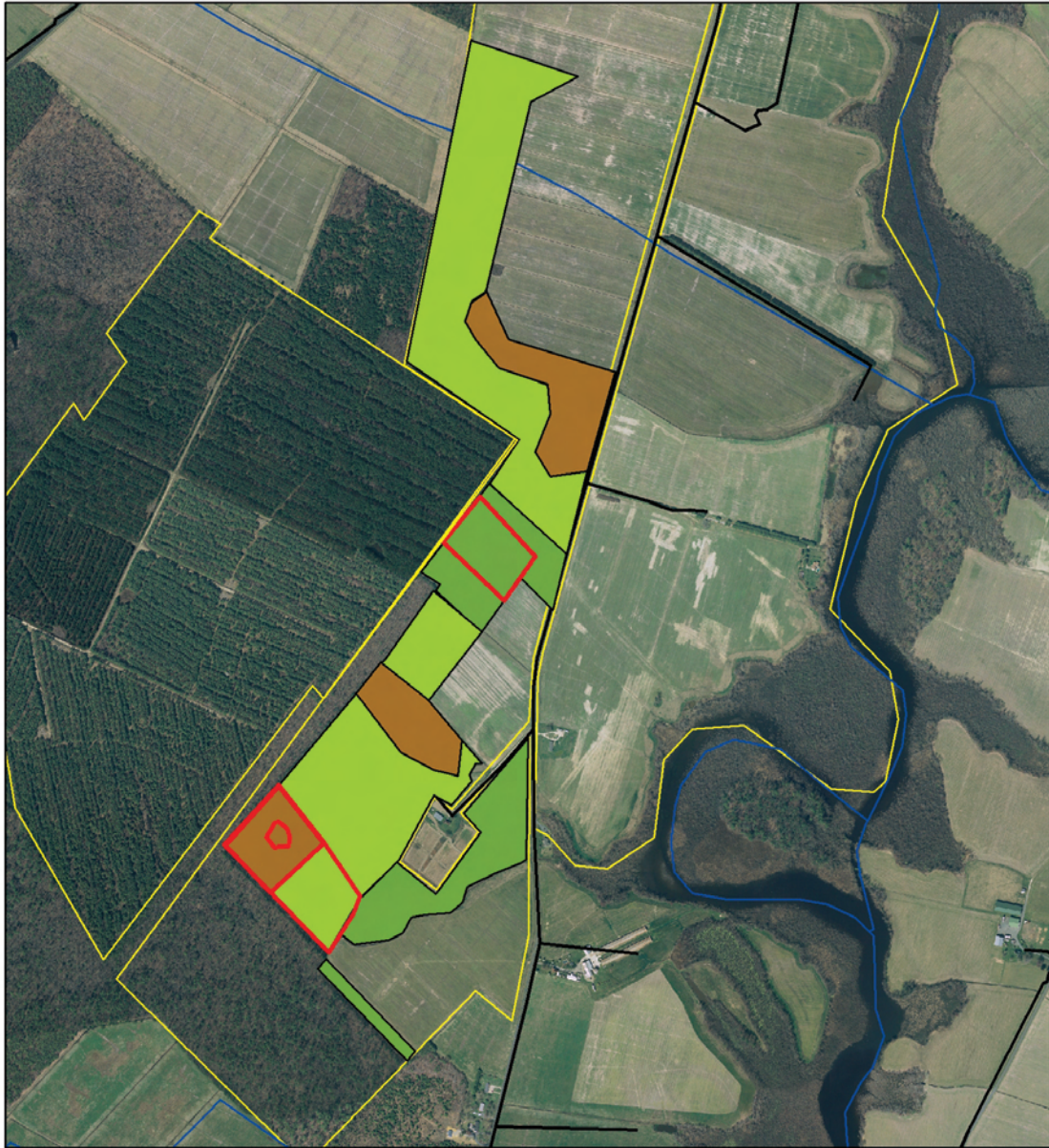
The Carbon Footprint analysis has led to a larger statewide effort to calculate the entire Maryland State government's environmental footprint. In addition to the carbon footprint and its components, the State is measuring each agency's water usage and waste reduction, reuse and recycling. The progress each agency has made towards specific reduction goals will be tracked and updated at regular intervals to maintain momentum and accountability. Once the initial data-gathering is complete, as much of the detailed information as possible will be made available to the public via the internet.

Carbon Cutting Strategies: Upon completion of the carbon footprint analysis, the DNR project team recommended strategies to reduce carbon emissions coming from transportation and facilities. For transportation, recommendations included the implementation of several policies and training to decrease annual miles driven by the highway vehicle fleet and improve the fuel economy of the fleet, such as reducing vehicle gallons bought by tightening the commuting policy; clearly communicating that necessary vehicles will not be taken away if driven less than 10,000 miles; training DNR staff in vehicle maintenance; and downsizing the fleet where necessary. For facilities, recommendations included using new or upgraded building standards, performing energy upgrades at

PROTECTING THE FORESTS OF THE CHESAPEAKE WATERSHED

In 2007, following The Conservation Fund's landmark report, *The State of Chesapeake Forests*, the Chesapeake Executive Council adopted a commitment to identify, protect and expand forests in the Chesapeake Bay watershed through Directive No. 06-01.¹⁴ Subsequently, Maryland made a commitment to protect 250,000 acres of forest by 2050. Along with sequestering carbon, these forests also improve air and water quality and provide critical wildlife habitat.

▶ Little Blackwater Property Forest Carbon Sequestration Plan



Legend

-  Streams
-  Roads
-  CFL Boundary
-  10 acre Carbon Sequestration Plots
-  Low Management (100% Hardwoods) 37.1 acres
-  Moderate Management (50-70% Pine & 30-50% Oaks) 97.5 acres
-  High Management (100% Pine) 36.8 acres





Maryland Department of Natural Resources staff monitors survival of loblolly pine trees planted as part of the carbon sequestration project. This species grows rapidly and has great potential to sequester atmospheric carbon.

small and large-scale buildings, and committing to renewable energy projects. Implementation of electricity upgrades can be accomplished in a cost effective manner and have significant education potential, e.g., compact fluorescent light bulbs, light sensors, power-saving software, and insulation.

Forest Carbon Sequestration: In accordance with the conservation strategy, 171.4 acres were planted at the Little Blackwater site. This new forest will offset a significant amount of the DNR's greenhouse gas emissions for one year. MGS will provide annual reporting of the belowground carbon sequestration and changes through time and will report those results to DNR forest management team members. This will assist in the determination of improved methods and forest management practice for carbon capture. These results demonstrate that forest carbon sequestration activities can be quickly implemented and offer a cost-effective greenhouse gas mitigation option that provides additional environmental benefits.

KEYS TO SUCCESS

- **Leadership:** Governor Martin O'Malley signed the Maryland Commission on Climate Change into action early in his inaugural year, thus sending a clear message that under his leadership the State was committed to mitigating the drivers of climate change.
- **Scientific and public review:** The foundation for this project was

established by the MCCC in its Interim Report and final Climate Action Plan.

- **Site acquisition:** Maryland's Program Open Space enabled the Department to purchase the Little Blackwater site, which prevented an unwanted development, improved water quality, enhanced wildlife habitat and sequestered carbon.
- **Internal collaboration:** The Secretary of DNR, John R. Griffin, created an Office for a Sustainable Future to assist the Agency with achieving a new mission, to secure a sustainable future for our environment, society, and economy by preserving, protecting, restoring, and enhancing the State's natural resources. This new office served as the project lead and worked across the Agency's many Units and Programs, including the Chesapeake & Coastal Program, the Maryland Forest Service, Maryland Parks Service, the Power Plant Research Program, Maryland Geological Survey, Program Open Space, Watershed Restoration, Financial & Administrative Services, Engineering and Construction, as well as many others, to conduct the overall project.



The Maryland Department of Natural Resources has reconfigured their vehicle fleet to improve fuel economy and reduce emissions of carbon dioxide and other greenhouse gases.

► **External collaboration:** The Conservation Fund and Burke Environmental Associates provided the original request that DNR consider doing this project as an element of the Commission on Climate Change's work. These partners worked with DNR to develop the scope of the carbon footprint and carbon sequestration project components, as well as to assist with development of this profile.

PHOTOS AND FIGURES

All photos by Joel Dunn; except page 14 (bottom), Maryland Department of the Environment

Page 17: Figure, Joel Dunn

Page 18: Figure, Maryland Department of Natural Resources

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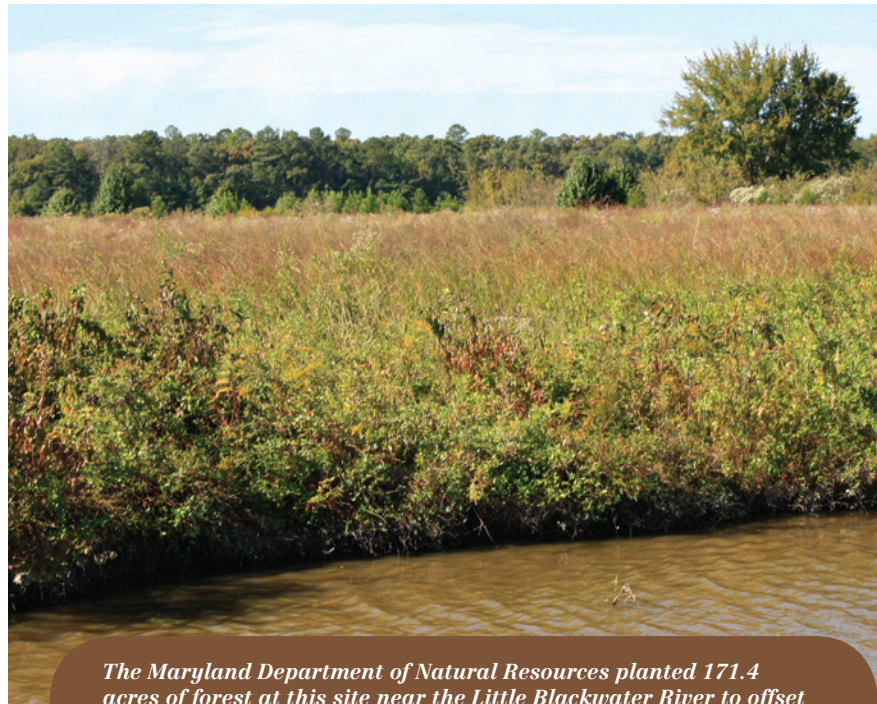
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The Maryland Department of Natural Resources planted 171.4 acres of forest at this site near the Little Blackwater River to offset a portion of their greenhouse gas emissions for one year.



FOR MORE INFORMATION

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