THE ECONOMIC BENEFITS OF CLEANING UP THE CHESAPEAKE

A VALUATION OF THE NATURAL BENEFITS GAINED BY IMPLEMENTING THE CHESAPEAKE CLEAN WATER BLUEPRINT
The Chesapeake Bay Foundation gratefully acknowledges the generosity of Albert H. Williams for underwriting this report.
Executive Summary

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The Chesapeake Bay is a national treasure. Its forests, wetlands, and waters provide many natural benefits to the 17 million people and associated plants and animals that call this 64,000-square-mile region home. But those benefits have been greatly reduced by agricultural, urban and suburban, sewage treatment, and air pollution.

In 2010, the six Bay states, the District of Columbia, and the federal government began a renewed effort to restore the health of the Bay and its vast network of rivers and streams. That effort—the Chesapeake Clean Water Blueprint1—is designed to substantially reduce the amount of nitrogen, phosphorus, and sediment pollution that enters local waters and the Bay. Its goal: to restore the Bay’s ecological health. In doing so, implementing the Blueprint will reduce risks to our health, provide a legacy of clean water for our children and grandchildren, and increase economic benefits to the region.

Fully implementing the Blueprint is a big job. It requires the commitment, time, and resources of all sectors of our society and every individual in the watershed.

So, what will be the return? According to the peer-reviewed economic report, The Economic Benefits of Cleaning Up the Chesapeake, it will be tremendous. The report’s findings include the following:

1. In 2009 (before the Blueprint), the lands and waters of the Chesapeake Bay region provided economic benefits totaling $107.2 billion annually. This serves as the baseline for our study. These benefits include air and water filtration, agricultural and seafood production, property valuation, and flood and hurricane protection.

2. The value of these same benefits will increase by $22.5 billion to $129.7 billion annually if the Blueprint is fully implemented. Once realized, those benefits would be enjoyed year after year.

3. If the Blueprint is not fully implemented, pollution loads will increase, and the value of the natural benefits will decline by $5.6 billion annually to $101.5 billion. The value of the Bay region’s natural benefits will decline further after 2025 as additional pollution continues to degrade our natural resources.

1 The Blueprint includes the science-based pollution limits established by the Chesapeake Bay Total Maximum Daily Load and the state-specific implementation plans designed to achieve those limits. EPA and the Bay jurisdictions agreed to implement practices to achieve 60 percent of the necessary pollution reductions by 2017, and 100 percent of those practices in place by 2025.
What Are Natural Benefits?

Our lands, waters, and associated plants and animals provide natural benefits that economists call ecosystem services. People depend on these services to sustain and enhance human life. In addition to the production of goods such as food and timber, these benefits from nature include life-supporting processes such as water and air purification and flood protection, and life-enhancing assets such as beautiful places to recreate and live. Despite their vital importance, these natural benefits are often taken for granted, their value not quantified. Over the past decade, however, the acceptance of forests, wetlands, and other ecosystems as vital economic assets has led to an increase in studies calculating these natural benefits in regions including the Everglades, the Mississippi Delta, the Puget Sound—and now the Chesapeake.

**CLIMATE STABILITY**
Influence of land cover and biologically mediated processes on maintaining a favorable climate, promoting human health, crop productivity, recreation, and other services.

Chesapeake land uses that provide this benefit:
- Forest
- Urban
- Open
- Wetland

**FOOD PRODUCTION**
The harvest of agricultural produce, including crops, livestock, and livestock by-products; the food value of hunting, fishing, etc.; and the value of wild-caught and aquaculture-produced fin fish and shellfish.

Chesapeake land uses that provide this benefit:
- Agriculture
- Open Water
- Wetland

**WATER FLOW REGULATION**
Modulation by land cover of the timing of runoff and river discharge, resulting in less severe drought, flooding, and other consequences of too much or too little water available at the wrong time or place.

Chesapeake land uses that provide this benefit:
- Forest
- Urban
- Open
- Urban Other
- Wetland

**WATER SUPPLY**
Filtering, retention, storage, and delivery of fresh water—both quality and quantity—for drinking, irrigation, industrial processes, and other uses.

Chesapeake land uses that provide this benefit:
- Forest
- Open Water
- Wetland

**AIR POLLUTION TREATMENT**
Purification of air through the absorption and filtering of airborne pollutants by trees and other vegetation, yielding cleaner, more breathable air (reduction of NOx, SOx, CO2), reduced illness, and an improved quality of life. (Note: Economists more commonly call this “Gas Regulation.”)

Chesapeake land uses that provide this benefit:
- Forest
- Urban
- Open
- Wetland

**WASTE TREATMENT**
Removal or breakdown of nutrient pollution and other chemicals by vegetation, microbes, and other organisms, resulting in fewer, less toxic, and/or lower volumes of pollutants in the system.

Chesapeake land uses that provide this benefit:
- Forest
- Open Water
- Wetland

**RECREATION**
The availability of a variety of safe and pleasant landscapes—such as clean water and healthy shorelines—that encourage ecotourism, outdoor sports, fishing, wildlife watching, etc.

Chesapeake land uses that provide this benefit:
- Agriculture
- Forest
- Open Water
- Urban Open
- Wetland
- Other

**AESTHETIC VALUE**
The role that beautiful, healthy natural areas play in attracting people to live, work, and recreate in a region; often reflected in property values.

Chesapeake land uses that provide this benefit:
- Agriculture
- Forest
- Open Water
- Urban Open
- Wetland
- Other
The Methods

To analyze the benefits that the Chesapeake Bay's watershed (a six-state drainage area) provides, the authors first established a 2009 baseline. They considered the environmental condition of seven types of land use: agriculture, forest, wetland, open water, urban open space, urban other (e.g., paved areas), and other (mostly barren land). These land uses were derived from data from the Chesapeake Bay Program and the National Land Cover Database.

Next, they calculated how the amount and productivity of these land uses would change if the Chesapeake Clean Water Blueprint were fully implemented or, alternatively, not implemented, Business as Usual.

The authors then drew from existing economic studies to calculate the dollar value of eight benefits that we enjoy and that are supplied by these land uses. The eight are: climate stability, food production, water regulation, water supply, air pollution treatment, waste treatment, recreation, and aesthetic value.

Finally, for each land use they calculated the total value of the natural benefits under the three scenarios (Baseline, Blueprint, Business as Usual) by multiplying the acres and condition of each land-use type by the dollar value of the applicable eight natural benefits.

(The methodology is fully explained on pages 8 through 12 of the report, The Economic Benefits of Cleaning Up the Chesapeake.)

The Results

When we implement the Blueprint, some highly polluting land uses will be converted to uses that produce more natural benefits. For example, agricultural fields that use proven conservation practices and urban spaces that incorporate common sense development solutions (rain gardens and paving that soaks in rain) will pollute less and provide increased benefits. In addition, the conversion of land from forests and wetlands to uses that produce fewer natural benefits (like parking lots and subdivisions) will occur at a slower pace. As we reduce the amount of nitrogen, phosphorus, and sediment pollution, that flows to our waters, the ecosystems on all the various land uses will become healthier, more capable of providing benefits.

If we fail to implement the Blueprint, we can expect to lose more forests and wetlands to development. Fewer pollution controls will be implemented on urban and suburban streets and agricultural fields. Increases in pollution will degrade ecosystems and as a result they will produce fewer natural benefits.

The report indicates that the benefits provided by the 64,000-square-mile Chesapeake Bay watershed, including its tidal areas, can be valued at more than $107 billion annually. Furthermore, when the Blueprint is fully implemented, the region will generate more than $22 billion in additional annual benefits. The report cites a decline in value of $5.6 billion (in 2013 dollars) annually if the Blueprint is not fully implemented.

The authors found that the majority of the benefits of implementing the Blueprint will be generated by upstream land uses, rather than by the open water land use of the Chesapeake Bay and the tidal portion of its tributaries.

Each of the states in the watershed will see substantially enhanced benefits. Virginia, more than $8.3 billion annually; Pennsylvania, $6.2 billion annually; and Maryland $4.6 billion annually. In all cases, forests generated the largest benefits, because more than half (55 percent) of the watershed is forested and because the services they provide—filtering drinking water, reducing flooding, providing recreation and beauty—are highly valued. Open water, however, had the largest percentage increase associated with implementing the Blueprint.

The Costs

CBF's study addressed only benefits, not costs.

There are no recent estimates of the total costs of implementation, but an earlier estimate put costs in the range of roughly six billion per year.²

Considering federal, state, and local investments in clean water in the 10 years since that time, we estimate the current number is closer to five billion annually. And once capital investments are made, the long-term annual operations and maintenance costs will be much lower.

The Blueprint will return benefits to the region each year at a rate of more than four times the cost of the clean-up plan.

² Chesapeake Bay Watershed Blue Ribbon Finance Panel. 2004. Saving a National Treasure. Financing the Clean-up of the Chesapeake Bay. www.chesapeakebay.net/content/publications/cbp_12881.pdf
The tables below summarize the study’s findings. In all cases, the values are expressed in terms of 2013 dollars.

### SUMMARY OF BENEFIT VALUE (ECOSYSTEM SERVICE VALUES) FOR SEVEN LAND USES, BY SCENARIO

<table>
<thead>
<tr>
<th>Land Use</th>
<th>Baseline</th>
<th>Blueprint</th>
<th>Change from Baseline</th>
<th>Business as Usual</th>
<th>Change from Baseline</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>Benefit Value (billions)</td>
<td>Benefit Value (billions)</td>
<td>Benefit Value (billions)</td>
<td>Benefit Value (billions)</td>
<td>Benefit Value (billions)</td>
</tr>
<tr>
<td>Agriculture</td>
<td>$12.258</td>
<td>$13.434</td>
<td>$10.949</td>
<td>-11%</td>
<td></td>
</tr>
<tr>
<td>Forest</td>
<td>73.960</td>
<td>86.406</td>
<td>69.639</td>
<td>-6%</td>
<td></td>
</tr>
<tr>
<td>Open Water</td>
<td>16.721</td>
<td>24.301</td>
<td>16.549</td>
<td>-1%</td>
<td></td>
</tr>
<tr>
<td>Other</td>
<td>.467</td>
<td>.508</td>
<td>.386</td>
<td>-17%</td>
<td></td>
</tr>
<tr>
<td>Urban Open</td>
<td>3.403</td>
<td>4.706</td>
<td>3.727</td>
<td>10%</td>
<td></td>
</tr>
<tr>
<td>Urban Other</td>
<td>.011</td>
<td>.014</td>
<td>.012</td>
<td>7%</td>
<td></td>
</tr>
<tr>
<td>Wetland</td>
<td>.356</td>
<td>.364</td>
<td>.270</td>
<td>-24%</td>
<td></td>
</tr>
<tr>
<td>Total</td>
<td>$107.176</td>
<td>$129.732</td>
<td>$101.531</td>
<td>-5%</td>
<td></td>
</tr>
</tbody>
</table>

### SUMMARY OF BENEFIT VALUES, BY SCENARIO

<table>
<thead>
<tr>
<th>Natural Benefit</th>
<th>Baseline</th>
<th>Blueprint</th>
<th>Change from Baseline</th>
<th>Business as Usual</th>
<th>Change from Baseline</th>
</tr>
</thead>
<tbody>
<tr>
<td>Aesthetic Value</td>
<td>$38.446</td>
<td>$47.407</td>
<td>$36.653</td>
<td>-5%</td>
<td></td>
</tr>
<tr>
<td>Climate Stability</td>
<td>5.498</td>
<td>6.508</td>
<td>5.237</td>
<td>-5%</td>
<td></td>
</tr>
<tr>
<td>Food Production</td>
<td>12.129</td>
<td>13.313</td>
<td>10.839</td>
<td>-11%</td>
<td></td>
</tr>
<tr>
<td>Air Pollution Treatment</td>
<td>3.471</td>
<td>4.061</td>
<td>3.271</td>
<td>-6%</td>
<td></td>
</tr>
<tr>
<td>Recreation</td>
<td>3.071</td>
<td>4.099</td>
<td>3.227</td>
<td>5%</td>
<td></td>
</tr>
<tr>
<td>Waste Treatment</td>
<td>12.155</td>
<td>16.470</td>
<td>11.827</td>
<td>-3%</td>
<td></td>
</tr>
<tr>
<td>Water Regulation</td>
<td>12.386</td>
<td>14.448</td>
<td>11.634</td>
<td>-6%</td>
<td></td>
</tr>
<tr>
<td>Water Supply</td>
<td>20.019</td>
<td>23.427</td>
<td>18.843</td>
<td>-6%</td>
<td></td>
</tr>
<tr>
<td>Total</td>
<td>$107.176</td>
<td>$129.732</td>
<td>$101.531</td>
<td>-5%</td>
<td></td>
</tr>
</tbody>
</table>

### SUMMARY OF BENEFIT VALUE FOR CHESAPEAKE BAY JURISDICTIONS, BY SCENARIO

<table>
<thead>
<tr>
<th>Jurisdiction</th>
<th>Baseline</th>
<th>Blueprint</th>
<th>Change from Baseline</th>
<th>Business as Usual</th>
<th>Change from Baseline</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>Benefit Value (billions)</td>
<td>Benefit Value (billions)</td>
<td>Benefit Value (billions)</td>
<td>Benefit Value (billions)</td>
<td>Benefit Value (billions)</td>
</tr>
<tr>
<td>Virginia</td>
<td>$41.195</td>
<td>$49.540</td>
<td>$38.066</td>
<td>-8%</td>
<td></td>
</tr>
<tr>
<td>Pennsylvania</td>
<td>32.637</td>
<td>38.828</td>
<td>30.810</td>
<td>-6%</td>
<td></td>
</tr>
<tr>
<td>Maryland</td>
<td>15.892</td>
<td>20.449</td>
<td>15.209</td>
<td>-4%</td>
<td></td>
</tr>
<tr>
<td>New York</td>
<td>10.361</td>
<td>12.276</td>
<td>10.363</td>
<td>0%</td>
<td></td>
</tr>
<tr>
<td>West Virginia</td>
<td>6.330</td>
<td>7.668</td>
<td>6.458</td>
<td>2%</td>
<td></td>
</tr>
<tr>
<td>Delaware</td>
<td>.735</td>
<td>.941</td>
<td>.659</td>
<td>10%</td>
<td></td>
</tr>
<tr>
<td>District of Columbia</td>
<td>.025</td>
<td>.029</td>
<td>.027</td>
<td>5%</td>
<td></td>
</tr>
<tr>
<td>Total</td>
<td>$107.176</td>
<td>$129.732</td>
<td>$101.531</td>
<td>-5%</td>
<td></td>
</tr>
</tbody>
</table>
The conclusions are clear.

1 The Chesapeake region currently provides natural benefits of at least $107.2 billion annually. (Baseline Scenario)
The lands and waters of the Chesapeake Bay drainage basin provide economically valuable benefits, including flood protection, water supply and filtration, food, waste treatment, climate regulation, recreation, and aesthetic value. A conservative estimate of these benefits shows economic value of at least $107.2 billion per year in 2013 dollars, grounded in baseline conditions of 2009, prior to initiation of the Blueprint.

For comparison, this sum is approximately one-fourth the size of the gross product of the states that contain the Chesapeake Bay watershed and about one-sixth the size of the total labor earnings of all the residents of the Bay region’s 207 counties.

2 Post Blueprint benefits are nearly $130 billion annually, an increase of more than $22 billion per year. (Blueprint Scenario)
The value of these benefits when the Chesapeake Clean Water Blueprint has been fully implemented and made effective is roughly $129.7 billion per year, measured in 2013 dollars, or more than $22 billion in additional annual benefits when compared to the baseline.

3 Without the Blueprint, benefits decline to $101.5 billion annually, a loss of $5.6 billion from the baseline. (Business as Usual Scenario)
A “business-as-usual” scenario—which calculates the natural benefits generated by a Chesapeake Bay ecosystem that has not profited from the restoration activities associated with a fully implemented Blueprint—shows an annual value of $101.5 billion, in 2013 dollars. It is worth noting that the “business-as-usual” scenario includes many prescribed practices that were already underway as of 2014 and will continue to be implemented, including upgrading sewage treatment plants and reducing some urban and suburban polluted runoff. Post 2025, however, this decrease in value will only get larger as the population and associated pollution increase and the Chesapeake region’s environment—absent the resiliency provided by the Blueprint’s restoration projects—continues to degrade.

4 Benefits are enjoyed throughout the entire Chesapeake Bay watershed.
The Blueprint will improve the ecological health of the Chesapeake Bay and its rivers and streams, as well as the land that drains into those waterways. The states will see increased annual benefits. Virginia will realize benefits of more than $8.3 billion, Pennsylvania $6.2 billion, and Maryland $4.6 billion annually. As percentages of the overall benefits, the states’ increased benefits from the Blueprint are generally proportional to their land-area percentage of the Bay watershed, although Virginia, the second largest, has the greatest natural assets owing to the large amount of tidal wetlands and waterways.

Full implementation of the Blueprint makes good economic and environmental sense.
The report, commissioned by the Chesapeake Bay Foundation, was developed by Spencer Phillips, Ph.D., with scientific assistance from Beth McGee, Ph.D., and peer reviewed by Dr. Gerald Kaufman of University of Delaware, Dr. Valerie Esposito of Champlain College, Dr. Tania Briceno of Earth Economics, and Mr. Dan Nees of the University of Maryland.

**Dr. Spencer Phillips** is a natural resource economist with more than 20 years of experience researching the relationships between ecosystems and economic well-being. Currently the Principal of Key-Log Economics, LLC, based in Charlottesville, Virginia, he has been an economist at the White House Council on Environmental Quality, Senior Economist and Vice President for Ecology and Economics Research at The Wilderness Society, and Executive Director of the Northwoods Stewardship Center. Phillips received his doctorate from Virginia Polytechnic Institute and State University and his B.A. from the University of Virginia. He lectures at The University of Virginia and Goucher College in microeconomics, ecological economics, and public policy.

**Dr. Beth McGee** is the Senior Water Quality Scientist at the Chesapeake Bay Foundation, where she has worked since 2003. She has a B.A. in Biology from the University of Virginia, a M.S. in Ecology from the University of Delaware, and a Ph.D. in Environmental Science from the University of Maryland. She has more than 20 years of experience in Chesapeake Bay water-quality issues, published numerous peer-reviewed papers, and served on multiple technical committees and advisory groups. Prior to CBF, she worked for the U.S. Fish and Wildlife Service, U.S. Environmental Protection Agency, and the Maryland Department of the Environment.