



2009

Comments: Treasuring the Chesapeake: An Analysis of Climate Change and Its Impact on the Chesapeake Bay and Maryland's Surrounding Coastal Regions

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Recommended Citation

Jones, Lauren F. (2009) "Comments: Treasuring the Chesapeake: An Analysis of Climate Change and Its Impact on the Chesapeake Bay and Maryland's Surrounding Coastal Regions," *University of Baltimore Law Review*: Vol. 38: Iss. 2, Article 5.
Available at: <http://scholarworks.law.ubalt.edu/ublr/vol38/iss2/5>

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TREASURING THE CHESAPEAKE: AN ANALYSIS OF CLIMATE CHANGE AND ITS IMPACT ON THE CHESAPEAKE BAY AND MARYLAND'S SURROUNDING COASTAL REGIONS

I. INTRODUCTION

Imagine you are part of a fish species that has existed comfortably for hundreds of years.¹ Living, flourishing, and thriving with the oysters, crabs, and eelgrass as a co-dependent ecosystem in the clear waters of the Chesapeake Bay.²

Suddenly . . . well, relatively suddenly, compared to the decades of health that your population has been afforded, along comes a few generations of humans who industrialize and develop so quickly and intensely that the damage which you face as a result is seemingly irreparable. Imagine your habitat warming so quickly that you are forced to live in the cooler, deeper waters of the already shallow Bay.³ Your lifestyle is no longer about swimming freely throughout the rivers and streams, as it has become about seeking refuge from the uncomfortable and uninhabitable heat.

While you have reluctantly become accustomed to swimming in the deeper waters, each summer you can sense that even these deep waters are becoming warmer than the seventy-six degrees Fahrenheit in which you can survive.⁴ Because warmer water is less capable of holding dissolved oxygen, which is the type of oxygen that you and

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1. See Chesapeake Bay Field Office, Striped Bass, <http://www.fws.gov/chesapeakebay/striper.htm> (last visited Aug. 30, 2008) (discussing the history of the striped bass, a fish species that has lived in the Chesapeake Bay since colonial times).
 2. See CRITICAL AREA COMM'N FOR THE CHESAPEAKE AND ATL. COASTAL BAYS, MD. DEP'T OF NATURAL RES., BAY SMART: A CITIZEN'S GUIDE TO MARYLAND'S CRITICAL AREA PROGRAM 5-6 (Mary R. Owens ed., 2007), available at <http://www.dnr.state.md.us/criticalarea/download/baysmart.pdf>. The Bay's water and aquatic life are protected by trees that provide a canopy over parts of the Bay's water. This canopy improves water quality and protects the Bay from negative effects of nearby development. *Id.* at 33, 44.
 3. See CHESAPEAKE BAY FOUND., CLIMATE CHANGE AND THE CHESAPEAKE BAY: CHALLENGES, IMPACTS, AND THE MULTIPLE BENEFITS OF AGRICULTURAL CONSERVATION WORK 2 (2007), available at <http://www.cbf.org/site/DocServer/climatechange.pdf?docID=9423> [hereinafter CLIMATE CHANGE AND THE BAY].
 4. See *id.*

most sea life require for underwater survival, the dead zones in the bottom waters of the Bay are increasing in size, thus limiting the areas where you can subsist.⁵ As the amount of dissolved oxygen decreases, you face what scientists term a “temperature-dissolved oxygen squeeze,” and your prospects of surviving each year become less and less.⁶ The warmer, shallower waters force you to live farther below the surface, but the low or nonexistent levels of dissolved oxygen along the bottom of the Bay make survival in the deeper water impossible.⁷

As a result of this stressful living environment, you must change your feeding habits, which makes you more susceptible to disease.⁸ The stress and exposure of increasingly unlivable temperatures means that you and your species could face extinction in the near future.⁹

The fish described above is no figment of the author’s imagination. It is the *morone saxatilis*, more commonly known as the striped bass, and in the Chesapeake Bay region it is often referred to as the rockfish.¹⁰ It is a fish that has been heavily impacted by climate change and the consequences of pollution clouding the Chesapeake Bay.¹¹

The striped bass is also a fish that has been protected by effective legislation.¹² Record numbers of the fish rebounded from a period

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5. See *id.* Over the last forty years, the volume of water with low or no oxygen has “more than tripled.” In the summer, dead zones that do not have enough oxygen to support a healthy ecosystem can stretch for hundreds of square miles. Almost all of the sea life in the Bay depends on oxygen for survival, and the low levels of dissolved oxygen can stress or impair reproduction and growth of aquatic species. Chesapeake Bay Found., The Chesapeake Bay’s Dead Zone, http://www.cbf.org/site/PageServer?pagename=resources_facts_deadzone (last visited Aug. 30, 2008) [hereinafter Chesapeake Bay’s Dead Zone].
 6. See CLIMATE CHANGE AND THE BAY, *supra* note 3, at 2.
 7. See Chesapeake Bay’s Dead Zone, *supra* note 5.
 8. CLIMATE CHANGE AND THE BAY, *supra* note 3, at 2–3.
 9. See Chesapeake Bay’s Dead Zone, *supra* note 5.
 10. See Chesapeake Bay Field Office, Striped Bass, *supra* note 1.
 11. See CHESAPEAKE BAY FOUND., BAD WATERS: DEAD ZONES, ALGAL BLOOMS, AND FISH KILLS IN THE CHESAPEAKE BAY REGION IN 2007, at 3, 6–9 (2007), available at http://www.cbf.org/site/DocServer/CBF_BadWatersReport.pdf?docID=10003 [hereinafter BAD WATERS].
 12. See Atlantic Striped Bass Conservation Act, 16 U.S.C.A. §§ 5151–5158 (West 2008). The striped bass is protected by this federal statute, which was originally enacted as Public Law 98-613, on October 31, 1984. Atlantic Striped Bass Conservation Act, Pub. L. No. 98-613, 98 Stat. 3187 (1984). The Act recognizes that the “Atlantic striped bass are of historic commercial and recreational importance and economic benefit to the Atlantic coastal States and to the Nation.” 16 U.S.C.A. § 5151. The purpose of the Act is “to support and encourage the development, implementation,

where they were on the verge of disappearing in the Bay region.¹³ Although the population of striped bass has been restored since the early 1990s, the fish are still reported to be in poor health.¹⁴ The Chesapeake Bay Foundation has noted with concern that “[l]ow body weight, increased disease, and reduced survival have all been widely observed in Chesapeake rockfish.”¹⁵ The striped bass population faces an uphill battle for survival if the local, state, and federal governments do not act quickly in a concerted effort to combat the ever-increasing threat of climate change.

This Comment focuses on the impact of climate change on the Chesapeake Bay region and Maryland’s surrounding coastal areas. Climate change affects all aspects of the Bay, from the native species that are clinging to survival, to the landowners who are taking precautions to ensure that their waterfront properties do not end up underwater. This Comment also discusses how greenhouse gas emissions are a major contributor to ever-increasing water levels,¹⁶ and why regulating emissions on a state level will have little, if any, impact on the region.¹⁷ Countless other solutions have been proposed and explored,¹⁸ but there has yet to be much progress in improving the situation.¹⁹ Legislators must act quickly and focus their attention, money, and other resources on the Chesapeake Bay and Maryland’s coastal areas.

Part II of this Comment discusses the highly complex and multifaceted background that birthed the Chesapeake Bay’s current reality. Major contributing factors to the deterioration of the Bay’s health are byproducts of human activity, as experts point to pollution, population growth, and continual development as three causes of

and enforcement of effective interstate action regarding the conservation and management of the Atlantic striped bass.” *Id.*

13. See Karl Blankenship, *Striped Bass in Trouble? It’s Unclear*, BAY J., Dec. 1998, at 1, available at <http://www.bayjournal.com/article.cfm?article=2132>.

14. CHESAPEAKE BAY FOUND., STATE OF THE BAY 2007, at 8 (2007), available at <http://www.cbf.org/site/DocServer/2007SOTBReport.pdf?docID=1092> [hereinafter STATE OF THE BAY 2007].

15. *Id.*

16. INTERGOVERNMENTAL PANEL ON CLIMATE CHANGE, CLIMATE CHANGE 2007: SYNTHESIS REPORT 2–5 (2008), available at http://www.ipcc.ch/pdf/assessment-report/ar4/syr/ar4_syr_spm.pdf [hereinafter IPCC REPORT].

17. See discussion *infra* Part II.B.1.

18. See TOM HORTON & WILLIAM M. EICHBAUM, TURNING THE TIDE: SAVING THE CHESAPEAKE BAY 41 (1991).

19. See *infra* Part III.A–C.

decline.²⁰ The most notable effects of the crisis that will specifically impact the region include rising sea levels, sinking land, increasing water temperatures, and stronger storm threats.²¹ Combined, these consequences amount to an unfortunate loss of a healthy and prosperous habitat for the plants, animals, and sea life that live in the Bay.²² Part II also discusses the various causes of climate change, and the impact that greenhouse gas emissions and agricultural emissions have on the region.

Part III addresses the current state of Maryland's critical area laws. Although developed with well-intentioned foresight, the laws and regulations protecting the areas within one thousand feet of the tidal mean high water line have major flaws. The laws and regulations were established over two decades ago,²³ and there is an immediate need for them to be reevaluated by the legislature as the state of the Bay continues to regress.²⁴ An expansion of the one-hundred-foot buffer zone and stricter policies for land development are crucial to the maintenance of a healthy coastline.²⁵ While it was a positive start for the Maryland legislature to pass House of Delegates Bill 1253 in the 2008 legislative session, the priority remains that local jurisdictions must adhere more stringently to the critical area laws that are already in place.²⁶

20. ELIZABETH RIDLINGTON & BRAD HEAVNER, A BLUEPRINT FOR ACTION: POLICY OPTIONS TO REDUCE MARYLAND'S CONTRIBUTION TO GLOBAL WARMING 5-6, 18, 23 (2007), available at http://www.environmentmaryland.org/uploads/z1/-h/z1-hgPc9_FQ_qqcZE40y6w/blueprint-for-action.pdf.

21. See *infra* Part II.A.2-4.

22. See *infra* Parts II.A.3, II.A.5.

23. See Chesapeake Bay Critical Area Protection Act, ch. 794, 1984 Md. Laws 3744 (codified at MD. CODE ANN., NAT. RES. §§ 8-1801 to -1816 (LexisNexis 2007)). The original Critical Area Act, a "resource protection program for the Bay and its tributaries," was enacted by the General Assembly in 1984. See Critical Area Commission for the Chesapeake and Atlantic Coastal Bays, <http://www.dnr.state.md.us/criticalarea/> (last visited Aug. 30, 2008).

24. Although government officials pledged that the Chesapeake Bay cleanup would be in full force by 2010, the state of the Bay actually worsened from 2006 to 2007. See STATE OF THE BAY 2007, *supra* note 14, at 2, 11 tbl. In that time period, the Chesapeake Bay Foundation reported a one point decline in the *State of the Bay* index, from a twenty-nine in 2006 to a twenty-eight in 2007. *Id.* The Chesapeake Bay Foundation also reported that the Bay will need to reach a rating of seventy in order to be "saved." *Id.*

25. See *infra* Part III.

26. Chesapeake and Atlantic Coastal Bays Critical Area Protection Program — Administrative and Enforcement Provisions, H.D. 1253, 2008 Leg., 425th Sess. (Md. 2008).

Part IV of this Comment offers further suggestions to address how the state should handle the increasing threat of climate change and the potentially devastating effects which inevitably come with global warming. These alternatives include the construction of a dike or flood prevention system;²⁷ the implementation of water cooling plants;²⁸ and the use of renewable energy sources, including wind and solar power, as a substitute for building a third nuclear reactor at the Calvert Cliffs site.²⁹ While these options are undeniably expensive and possibly burdensome, they are necessary to prevent the economic and social costs of global warming, and the dangers of climate change to Maryland's coastal areas.

II. BACKGROUND

A. *The State of the Chesapeake Bay*

1. Generally

With over three thousand miles of "tidally influenced coastline" in the state of Maryland,³⁰ the effects of climate change on the Chesapeake Bay are readily apparent.³¹ The Chesapeake Bay area "is ranked the third most vulnerable to sea level rise, behind Louisiana and Southern Florida."³² Within the last century, the Chesapeake Bay has already experienced a sea level rise of about one foot,³³ and its rate of sea level rise nearly doubles the world average.³⁴ The Chesapeake Bay Foundation reported an expected sea level rise as high as four feet by the end of the next century if no serious efforts are made to mitigate the sources of climate change.³⁵ The rise in sea

27. See *infra* Part IV.A.1. Half of the Netherlands's territory is below sea level. Colin Woodard, *Dutch Defy Seas, but Indulge Rivers*, CHRISTIAN SCI. MONITOR, Aug. 23, 2001, at 17.

28. See *infra* Part IV.B.

29. See *infra* Part IV.C.

30. RIDLINGTON & HEAVNER, *supra* note 20, at 6.

31. David A. Fahrenthold, *Warming Poses Threats to Chesapeake, Group Says*, WASH. POST, July 20, 2007, at B1.

32. Brian Hug, *Governor O'Malley Takes Steps to Fight Climate Change in Maryland*, EMDE (Md. Dep't of the Env't, Baltimore, Md.), May 2007, <http://www.mde.state.md.us/ResearchCenter/Publications/General/eMDE/vol3no1/RGGI.asp>.

33. *Id.*

34. ZOE P. JOHNSON, MD. DEP'T OF NATURAL RES., PLANNING FOR RESILIENT COASTAL COMMUNITIES IN MARYLAND (2007), http://www.csc.noaa.gov/cz/2007/Coastal_Zone_07_Proceedings/PDFs/Tuesday_Abstracts/3221.Johnson.pdf.

35. STATE OF THE BAY 2007, *supra* note 14, at 6.

level is causing islands in the Chesapeake Bay, once a location for homes and shops, to vanish.³⁶ Maryland also faces the risk of increased damage to coastal properties and the loss of hundreds of acres of land due to stronger storm surges.³⁷

If the Chesapeake Bay watershed states do not act quickly, there is an inevitable crisis on the horizon. By the end of this century, world average temperatures could rise by three to seven degrees Fahrenheit.³⁸ The Bay provides a home to the “largest and most biologically diverse estuary” in North America,³⁹ and increasing temperatures are taking a toll on the Bay’s fragile ecosystem.⁴⁰ The change in temperature is making the Chesapeake Bay uninhabitable to many plants, and is causing a stress to numerous species of fish,⁴¹ oysters,⁴² and crabs that formerly thrived in the region.⁴³

The general consensus of the scientific community is that global warming is caused by human activity, namely the burning of fossil fuels.⁴⁴ Fossil fuels emit carbon dioxide, which traps the sun’s radiation in the atmosphere, close to the Earth’s surface.⁴⁵ In 2004, carbon dioxide emissions accounted for about 84% of the United States’ total contribution to global warming.⁴⁶ Unfortunately, even if present and future emissions of carbon dioxide from stationary and mobile sources are reduced, Maryland and the rest of the world may

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36. See CLIMATE CHANGE AND THE BAY, *supra* note 3, at 3, 5. About a dozen islands have disappeared, while others are no longer inhabitable and have been evacuated. Karl Blankenship, *Climate Change Already Affecting Bay, Experts Say*, BAY J., Nov. 2007, at 1, available at <http://www.bayjournal.com/article.cfm?article=3189>.
37. See RIDLINGTON & HEAVNER, *supra* note 20, at 10.
38. *Id.* at 5–6.
39. Maryland Department of Natural Resources, Maryland’s Coastal Program, http://www.dnr.state.md.us/Bay/czm/coastal_facts.html (last visited Aug. 30, 2008) [hereinafter Maryland’s Coastal Program].
40. Fahrenthold, *supra* note 31.
41. See *supra* notes 1–15 and accompanying text.
42. See Biology News Net, *Rising Ocean Temperatures, Pollution Have Oysters in Hot Water*, Oct. 11, 2006, http://www.biologynews.net/archives/2006/10/11/rising_ocean_temperatures_pollution_have_oysters_in_hot_water.html (last visited Aug. 30, 2008).
43. See CLIMATE CHANGE AND THE BAY, *supra* note 3, at 2, 14. The Bay is currently home to over 3600 species of plants, fish, and animals. Maryland’s Coastal Program, *supra* note 39.
44. RIDLINGTON & HEAVNER, *supra* note 20, at 5.
45. *Id.*
46. See ENERGY INFO. ADMIN., U.S. DEP’T OF ENERGY, EMISSIONS OF GREENHOUSE GASES IN THE UNITED STATES 2004: EXECUTIVE SUMMARY 2–3 (2006), [http://www.eia.doe.gov/oiaf/1605/archive/gg05rpt/summary/pdf/0573\(2004\)es.pdf](http://www.eia.doe.gov/oiaf/1605/archive/gg05rpt/summary/pdf/0573(2004)es.pdf). Methane contributed about 9%, nitrous oxide contributed about 5%, halocarbons accounted for about 2%, and sulfur hexafluoride and black carbon amounted to nominal amounts. RIDLINGTON & HEAVNER, *supra* note 20, at 16.

still suffer significant harm from climate change.⁴⁷ If concentrations of carbon dioxide in the Earth's atmosphere continue to exceed 350 parts per million, the damage is likely to be felt regardless of efforts to reduce emissions.⁴⁸ Cutting the emissions of these pollutants is, therefore, essential to protecting the Chesapeake Bay and the surrounding coastal region. The Bay itself will not be the only beneficiary. With the overall reduction of harmful emissions, the citizens of Maryland will experience a general increase in social and economic benefits.⁴⁹

Additionally, pollution, population growth, and continued development are negatively affecting the area and compounding the problem.⁵⁰ Regarding North American coastal communities and habitats, the Intergovernmental Panel on Climate Change (IPCC) projects that these areas in particular "will be increasingly stressed by climate change impacts interacting with development and pollution."⁵¹ With over 170,000 people moving to the Chesapeake Bay watershed each year,⁵² it is vital that action is taken not only at the local and state levels, but at the federal and international levels as well.

2. Rising Waters, Sinking Land

Rising sea levels, coupled with the fact that Maryland's land is subsiding,⁵³ place the state in an especially precarious position with regard to the threat of losing land. In Baltimore, "sea level already is rising by [seven] inches per century,"⁵⁴ while Maryland as a whole is sinking by more than six inches each century.⁵⁵ Rising sea levels and

47. See Bill McKibben, Op-Ed., *Remember This: 350 Parts Per Million*, WASH. POST, Dec. 28, 2007, at A21.

48. See *id.*

49. RIDLINGTON & HEAVNER, *supra* note 20, at 10.

50. See *id.* at 34, 36. "An additional 3 million people are expected to move [to] the Chesapeake Bay watershed by 2020." Maryland's Coastal Program, *supra* note 39.

51. IPCC REPORT, *supra* note 16, at 11 tbl. SPM.2.

52. David A. Fahrenthold, *Pollution Rising in Tributaries of Bay, Data Show*, WASH. POST, Dec. 5, 2007 at B1.

53. CLIMATE CHANGE AND THE BAY, *supra* note 3, at 5. Much of the shoreline in Maryland is sinking "due to a combination of sea level rise, land subsidence, and the invasive, marsh-grass eating rodent known as nutria." *Id.*

54. OFFICE OF POLICY, U.S. ENVTL. PROT. AGENCY, CLIMATE CHANGE AND MARYLAND 3 (1998), [http://yosemite.epa.gov/oar/globalwarming.nsf/uniquekeylookup/SHSU5BUSTE/\\$file/md_impct.pdf](http://yosemite.epa.gov/oar/globalwarming.nsf/uniquekeylookup/SHSU5BUSTE/$file/md_impct.pdf).

55. RIDLINGTON & HEAVNER, *supra* note 20, at 13.

subsiding land have together resulted in over one foot of land lost to the sea in the last one hundred years.⁵⁶

Included in this drastic loss of land are countless expanses of wetlands and thirteen chartered islands.⁵⁷ Only one offshore inhabited island, Smith Island, remains in the Chesapeake Bay.⁵⁸ Smith Island, however, is no exception to the threat of increasing sea levels, as it has lost 30% of its land since 1850.⁵⁹ Shore erosion has also caused almost 600 acres of Maryland's continental land to wash away,⁶⁰ and with an estimated 380,000 acres of Maryland's land less than five feet above sea level, much of the state is vulnerable to complete submersion.⁶¹

The loss of such vast amounts of land is having a negative impact on Maryland's shoreline. There is no forecasted end to this plight; in fact, just the opposite is predicted.⁶² Scientists anticipate that the sea level will rise another two to three feet on Maryland's shores before the end of the twenty-first century.⁶³

3. Rising Temperatures

Although the temperature difference—an increase of less than one degree Celsius for global surface temperatures since the beginning of the twentieth century,⁶⁴ and an increase of almost two degrees Fahrenheit in the average water temperature of the Bay since the

56. *Id.* at 13–14.

57. *An Examination of the Impacts of Global Warming on the Chesapeake Bay: Hearing Before the S. Comm. on Env't and Pub. Works*, 110th Cong. 2 (2007) [hereinafter *Hearing*] (testimony of Martin O'Malley, Governor, State of Maryland), http://epw.senate.gov/public/index.cfm?FuseAction=Files.View&FileStore_id=3b21c1a3-8433-4247-8753-cf6d3536d5d2.

58. *Id.*

59. RIDLINGTON & HEAVNER, *supra* note 20, at 14.

60. *Hearing*, *supra* note 57, at 2 (testimony of Martin O'Malley, Governor, State of Maryland).

61. ELIZABETH RIDLINGTON & BRAD HEAVNER, MARYPIRG FOUND., POWER PLANTS AND GLOBAL WARMING: IMPACTS ON MARYLAND AND STRATEGIES FOR REDUCING EMISSIONS 10 (2005), available at <http://marypirg.org/reports/ppandgw.pdf>.

62. *Id.*

63. ZOE PFAHL JOHNSON, MD. DEP'T OF NATURAL RES., A SEA LEVEL RISE RESPONSE STRATEGY FOR THE STATE OF MARYLAND 1, 1 (2000), available at http://dnrweb.dnr.state.md.us/download/bays/sea_level_strategy.pdf.

64. National Oceanic and Atmospheric Administration, Global Warming Frequently Asked Questions, Question Three, <http://www.ncdc.noaa.gov/oa/climate/globalwarming.html#Q3> (last visited Aug. 30, 2008).

1960s⁶⁵—may seem slight, the impact is anything but small for the vegetation and sea life that call the Chesapeake Bay home.

Specifically, eelgrass is one of the plants that is essential to the Bay, and has been significantly affected by rising temperatures.⁶⁶ Crabs and other underwater creatures use eelgrass as a nursery and an area to hide from predators.⁶⁷ Eelgrass, however, cannot live in water above eighty degrees Fahrenheit.⁶⁸ With much of the Bay warming to temperatures greater than eighty degrees, the eelgrass habitat is threatened and could perish altogether⁶⁹ if significant efforts are not made to restore the Bay to habitable temperatures.

Scientists have observed a similar decrease in the presence of bay grass, a plant that is essential to the underwater environment.⁷⁰ Bay grass is a critical plant that provides food and serves as a habitat for a wide range of species.⁷¹ Bay grass “also protects shorelines from erosion, removes nutrients from the water, and traps sediments that cloud bay waters.”⁷² Rising temperatures mean a reduction in the water’s capacity to hold dissolved oxygen, which is critical to most life in the Bay, including bay grass.⁷³ Algal blooms, however, survive and flourish in the oxygen depleted zones, and may grow to harmful levels when water temperatures rise.⁷⁴ The presence of these blooms is to the rest of the Bay population’s detriment, as the blooms blanket large areas and block the sunlight that is essential to the life of underwater grasses.⁷⁵

The IPCC recognized “with *high confidence*” that warming temperatures are responsible for shifts in algal production and fish abundance, as well as related changes in oxygen levels.⁷⁶ The IPCC also recognized with “*high confidence* that some hydrological

65. David A. Fahrenthold, *Kaine, O'Malley Urge Senate to Help Stem Global Warming*, WASH. POST, Sept. 27, 2007, at B6.

66. Fahrenthold, *supra* note 31.

67. Fahrenthold, *supra* note 65.

68. *Id.*

69. Fahrenthold, *supra* note 31.

70. Press Release, Md. Dep't of Natural Res., Underwater Grasses Decline in Maryland's Coastal Bays (May 3, 2007), <http://www.dnr.state.md.us/dnrnews/pressrelease2007/050307.html>.

71. *Id.*

72. *Id.*

73. See CLIMATE CHANGE AND THE BAY, *supra* note 3; Press Release, Md. Dep't of Natural Res., *supra* note 70.

74. See BAD WATERS, *supra* note 11, at 2.

75. *Id.*

76. IPCC REPORT, *supra* note 16, at 2.

systems have also been affected through increased runoff and earlier spring peak discharge in many glacier- and snow-fed rivers and through effects on thermal structure and water quality of warming rivers and lakes.”⁷⁷ The extinction of bay grass and other plants from the Bay would result in more than the loss of a species. Losing such plants would damage the Bay’s ecosystem,⁷⁸ and the fish and sea life that depend on the plants for their livelihood would also face a threat of extinction.

In addition to climate change, Maryland’s two nuclear reactors at Calvert Cliffs Nuclear Power Plant contribute considerably to the rise in Chesapeake Bay temperatures.⁷⁹ The nuclear reactors “are cooled by large amounts of water drawn from the Bay.”⁸⁰ This water is then discharged back into the Bay at a higher temperature, which damages the Bay’s fragile ecosystem.⁸¹ Not only are the fish habitats affected by the higher water temperature, but an estimated one hundred thousand small fish die each year because of the reactors.⁸² The fish swim by the reactors and become trapped in the screens that filter the water drawn into the plant.⁸³

A reduction in the dependency on coal and nuclear power, combined with an increase in the utilization of renewable energy sources, will alleviate some of the Bay’s problems with the loss of fish and other aquatic populations. Preserving the populations that make the Chesapeake Bay a unique and “iconic landscape”⁸⁴ of the Atlantic coastal region is essential to the economy and health of the area. The switch to renewable energy sources, like wind and solar power, will help keep the temperature of the Bay under control, and the ecosystem will have an increased chance at survival.⁸⁵

4. Storm Threats

Increasing temperatures, rising sea levels, and sinking land have the potential to be a catastrophic combination for Maryland. In 2003,

77. *Id.*

78. See Press Release, Md. Dep’t of Natural Res., *supra* note 70. If the Bay continues to lose its grasses, less nitrogen will be removed from the water, and the result will be more detrimental algae growth. See *id.*; BAD WATERS, *supra* note 11, at 2.

79. See RIDLINGTON & HEAVNER, *supra* note 20, at 27.

80. *Id.*

81. *Id.*

82. *Id.*

83. *Id.*

84. BAD WATERS, *supra* note 11, at 1.

85. See CLIMATE CHANGE AND THE BAY, *supra* note 3, at 2, 6; RIDLINGTON & HEAVNER, *supra* note 20, at 18–19, 28, 30.

Hurricane Isabel, a Category Two hurricane, had a similar path and approximately the same power and wind speed as an unnamed Category Two storm that struck Maryland in 1933.⁸⁶ The storm seventy years earlier, however, caused much less impact and damage to Maryland than Hurricane Isabel.⁸⁷ In fact, Isabel caused an unusual amount of flooding and damage compared to what is expected of the average Category Two hurricane.⁸⁸

Scientists hypothesize that the drastic rise in the Chesapeake Bay's sea level in the last century could have played a part in the severity of Hurricane Isabel.⁸⁹ The increased water levels in the Bay "allow water to be pushed farther inland, causing greater flooding damage, and also increase the strength of waves."⁹⁰ Because the Bay is considerably shallow, "a [one] foot increase in water level produces a 40 percent increase in wave power."⁹¹ With a continuously rising water level, storms in the future could cause devastation throughout the coastal and low-lying areas spanning the entire state of Maryland.⁹²

Additionally, British researchers at University College London found that "[a] small increase in sea temperature can lead to a big increase in hurricane activity."⁹³ The researchers found that an increase as slight as a half-degree in sea surface temperatures "can lead to a 40 percent increase in hurricane frequency."⁹⁴

In an effort to protect their land from storms and other threats of erosion, property owners in Maryland often construct storm walls.⁹⁵ The Maryland Code gives homeowners the right to do so.⁹⁶ Section 16-201 states "[a] person who is the owner of land bounding on navigable water . . . may make improvements into the water in front

86. Dr. Bill Dennison, *Hurricane Isabel and Sea Level Rise*, INTEGRATION AND APPLICATION NETWORK (IAN/Univ. of Md. Ctr. for Env'tl. Sci., Cambridge, Md.), Oct. 2003, <http://ian.umces.edu/pdfs/iannewsletter6.pdf>.

87. RIDLINGTON & HEAVNER, *supra* note 20, at 14.

88. Dennison, *supra* note 86.

89. *See id.*

90. RIDLINGTON & HEAVNER, *supra* note 20, at 14.

91. *Id.*

92. *See* Dennison, *supra* note 86.

93. *Researchers Link Hurricanes to Rising Sea Temperatures*, CBC NEWS, Jan. 30, 2008, <http://www.cbc.ca/news/story/2008/01/30/science-hurricane-temperature.html>.

94. *Id.* The research, however, contradicts a study by researchers at the U.S. National Oceanic and Atmospheric Administration (NOAA) that found that global warming "would lead to a decrease in the intensity and frequency of hurricanes." *Id.*

95. *See* RIDLINGTON & HEAVNER, *supra* note 20, at 18.

96. *See* MD. CODE ANN., ENVIR. § 16-201 (LexisNexis 2007).

of the land to preserve that person's access to the navigable water or protect the shore of that person against erosion."⁹⁷ Giving this essentially unregulated right to homeowners, who risk losing their land to erosion, storms, and sea level rise, is problematic because it grants them the power to choose any kind of erosion control mechanism they see fit.

Homeowners will often choose manufactured walls or bulkheads for their perceived strength and durability.⁹⁸ These man-made walls, however, only provide temporary relief, and will not be successful in the long term because they are designed to protect areas where shorelines and sea level are stable.⁹⁹ In the Chesapeake Bay, where the land is anything but stable, these walls end up preventing the natural inland migration of wetlands.¹⁰⁰

Wetlands improve water quality "by trapping and retaining runoff containing nitrogen, phosphorus, and sediment pollution."¹⁰¹ Wetlands also play an integral role in protecting the shoreline and nearby land "from the effects of flooding and erosion."¹⁰² When development and bulkheads prevent the natural migration of wetlands inland,¹⁰³ the Chesapeake Bay loses a valuable natural filter.¹⁰⁴

Landowners' protective barriers must be modified in the future to account for the landward migration of wetlands¹⁰⁵ and to ensure that the wetlands are not being destroyed at the expense of manufactured barriers. A possible alternative to man-made sea walls or bulkheads is the creation of fringing marshes.¹⁰⁶ Marshland not only works as a land buffer,¹⁰⁷ but can also reduce the amount of pollution entering

97. *Id.*

98. See RIDLINGTON & HEAVNER, *supra* note 20, at 18; James G. Titus, *Rising Seas, Coastal Erosion, and the Takings Clause: How to Save Wetlands and Beaches Without Hurting Property Owners*, 57 MD. L. REV. 1279, 1281-82 (1998).

99. See Titus, *supra* note 98, at 1282.

100. RIDLINGTON & HEAVNER, *supra* note 20, at 18.

101. STATE OF THE BAY 2007, *supra* note 14, at 6.

102. *Id.*

103. RIDLINGTON & HEAVNER, *supra* note 20, at 18.

104. STATE OF THE BAY 2007, *supra* note 14, at 6. Wetlands act as natural resilience and not only filter, but also cleanse water and improve water quality. HORTON & EICHBAUM, *supra* note 18, at 141.

105. U.S. ENVTL. PROT. AGENCY, ET AL., CLIMATE CHANGE, WILDLIFE, AND WILDLANDS, CHESAPEAKE BAY AND ASSATEAGUE ISLAND 2, 5 (2002), available at http://www.epa.gov/climatechange/wycd/downloads/CS_Ches.pdf.

106. See TRACY E. SKRABAL, N.C. COASTAL FED'N, EROSION CONTROL: NON-STRUCTURAL ALTERNATIVES, A SHOREFRONT PROPERTY OWNER'S GUIDE 3, <http://www.nccoast.org/publication/erosion/images/ErosionBro.pdf>.

107. *Id.* The marshes "[a]ct as a buffer from wave energy to lessen the effects of erosion."
Id.

the water,¹⁰⁸ enhance underwater habitats, and maintain a natural coastline.¹⁰⁹

Because the maintenance of a natural barrier is potentially more burdensome on a landowner, an artificial barrier may be the cheaper and less labor-intensive option. To preserve Maryland's coastline, however, landowners must start implementing the more eco-friendly and natural alternatives.

Significant changes to Maryland's current laws¹¹⁰ are essential to ensure that landowners protect their land in a way that also protects the future of the Chesapeake's coastline. A first step was initiated when the Maryland legislature passed a bill adding an additional subsection to the Natural Resources Article of the Maryland Code.¹¹¹ The new section, 8-1808.11, states "improvements to protect a person's property against erosion shall consist of nonstructural shoreline stabilization measures that preserve the natural environment, such as marsh creation, except in areas where the person can demonstrate to the satisfaction of the Department of the Environment that these measures are not feasible."¹¹² This bill will increase the amount of marshland in the area,¹¹³ and thus help to facilitate natural growth. It is unclear, however, how lenient the Department of the Environment will be with landowners who claim that natural barriers are not feasible.

5. Plant and Animal Populations

The name "Chesapeake Bay," derived from the Algonquin dialect, means "great shellfish bay."¹¹⁴ The Chesapeake Bay is arguably most well known for its oyster and blue crab populations.¹¹⁵ In the early 1600s, the explorer Captain John Smith "described oysters so plentiful that they formed a layer on the ground 'as thick as

108. *Id.* The marshes can filter upland runoff and trap sediments and nutrients that damage the water quality. *Id.*

109. *Id.*

110. See MD. CODE ANN., ENVIR. § 16-201 (LexisNexis 2007).

111. Chesapeake and Atlantic Coastal Bays Critical Area Protection Program—Administrative and Enforcement Provisions, H.D. 1253, 2008 Leg., 425th Sess. (Md. 2008); see *infra* Part III.C.

112. 2008-2 Md. Code Ann. Adv. Legis. Serv. 404 (West).

113. *Id.*

114. Sarah Brull, *An Evaluation of Nonpoint Source Pollution Regulation in the Chesapeake Bay*, 13 U. BALT. J. ENVTL. L. 221, 223 (2006).

115. See Linda R. Larson & Jessica Ferrell, *Orcinus and Oncorhynchus: Will Saving Puget Sound Orcas and Salmon Save an Ecosystem?*, NAT. RESOURCES & ENV'T, Fall 2007, at 26, 28.

stones.”¹¹⁶ Even as recent as the 1970s, local and commercial fishermen caught a combined average of twenty-five million pounds of oysters per year, “and the blue crab harvest constituted nearly a third of the nation’s catch.”¹¹⁷

Today, the oyster population is struggling, as it is approximately 2% of what it formerly was at its peak.¹¹⁸ Likewise, although stable, the blue crab population is at a level below its historic average.¹¹⁹ The decreasing population of bay grasses and the detrimentally low levels of dissolved oxygen, both a result of the rise in water temperature, are the primary factors that led to the decline in population of these essential sea creatures.¹²⁰

The loss of the oyster population is a major contributor to the decline in the Bay’s overall health.¹²¹ Oysters are vital to the ecosystem because they naturally purify the water by straining algae, and because their reefs provide shelter and food for other aquatic plants and animals.¹²² If aggressive efforts are not made to counter climate change, these populations will be no more than a distant memory.

B. Causes of Climate Change

1. Motor Vehicle Emissions

a. Greenhouse gas emissions

If Maryland were its own country, it would have ranked forty-first in the world for its carbon dioxide emissions during 2004.¹²³ Currently, Maryland’s greatest source of carbon dioxide emissions is electricity generation via “coal and natural gas-fired power plants.”¹²⁴ It is predicted, however, that in the next fifteen years, the level of emissions from transportation may increase so significantly that it

116. Brull, *supra* note 114, at 223.

117. Larson & Ferrell, *supra* note 115, at 28.

118. Chesapeake Bay Program, Oyster Harvest, <http://www.chesapeakebay.net/oysterharvest.aspx?menuitem=14701> (last visited Aug. 30, 2008).

119. Chesapeake Bay Program, Blue Crab Harvest, <http://chesapeakebay.net/crabs.aspx?menuitem=14700> (last visited Aug. 30, 2008).

120. Chesapeake Bay Program, Weather, <http://www.chesapeakebay.net/weather.aspx?menuitem=14713> (last visited Aug. 30, 2008); *see supra* notes 3–9 and Part II.A.3.

121. Larson & Ferrell, *supra* note 115, at 28.

122. *Id.* at 28–29.

123. *See* RIDLINGTON & HEAVNER, *supra* note 20, at 20.

124. *Id.* at 23. Almost 90% of carbon dioxide from power generation emissions is from coal-fired plants, even though those plants produce only a little more than 50% of power generated in Maryland. *Id.*

will trump the level of emissions from electricity sources.¹²⁵ In 2004, 38% of the state's carbon dioxide emissions came from transportation.¹²⁶ Personal vehicles were the biggest culprit, accounting for about 75% of the total carbon dioxide emissions from transportation.¹²⁷

Between 1970 and 2004, there was a 70% increase in worldwide greenhouse gas emissions, and an 80% increase in carbon dioxide emissions. Carbon dioxide in particular has somewhat uniform levels of concentration in the world's atmosphere, and therefore it presents a *global* climate change problem, as opposed to a regional one.¹²⁸ The impact of carbon dioxide is severe, as it lasts in the earth's atmosphere from about fifty to two hundred years.¹²⁹ Such a long lifespan means that the gas is well mixed throughout the entire atmosphere, almost up to the point where it reaches the lower stratosphere.¹³⁰ Regulating carbon dioxide emissions and greenhouse gases at a state level, therefore, will have little impact on the deteriorating quality of the Chesapeake Bay.¹³¹

While implementing state greenhouse gas emissions regulations will not improve the situation faced by the Chesapeake Bay region, a recent U.S. Supreme Court decision has the potential to make an impact on climate change.¹³² The Environmental Protection Agency (EPA) is the United States' federal agency tasked with developing and enforcing regulations that implement environmental laws.¹³³ In *Massachusetts v. EPA*, the petitioners argued that the EPA under President George W. Bush's administration "abdicated its responsibility under the Clean Air Act to regulate the emissions of four greenhouse gases, including carbon dioxide."¹³⁴ With the

125. *Id.* ("The number of miles traveled on Maryland's highways increased by 36 percent from 1990 to 2004, to 55 billion miles per year.").

126. *Id.*

127. *Id.*

128. See Steven G. Davison, *Regulation of Emission of Greenhouse Gases and Hazardous Air Pollutants from Motor Vehicles*, 1 PITT. J. ENVTL. & PUB. HEALTH L. 1, 51-52 (2006) (discussing Control of Emissions from New Highway Vehicles and Engines, 68 Fed. Reg. 52,922 (Sept. 8, 2003), a petitioned rule that was denied by the Environmental Protection Agency).

129. See Control of Emissions from New Highway Vehicles and Engines, 68 Fed. Reg. at 52,927.

130. *Id.*

131. See *id.*; Davison, *supra* note 128.

132. See *Massachusetts v. EPA*, 127 S. Ct. 1438 (2007).

133. See United States Environmental Protection Agency, About EPA, <http://www.epa.gov/epahome/aboutepa.htm> (last visited Aug. 30 2008).

134. *Massachusetts*, 127 S. Ct. at 1446.

decision in *Massachusetts*, however, the EPA may now have to regulate greenhouse gases pursuant to its regulatory powers under the Clean Air Act.¹³⁵ The Supreme Court held that the “EPA has the statutory authority to regulate the emission of such gases from new motor vehicles.”¹³⁶ If the EPA ultimately imposes stricter regulations, automobile makers will be forced to comply on a national level,¹³⁷ and thus be required to create more innovative and eco-friendly designs.

b. Federal resistance

While the impetus for local and state action is often strengthened by federal action, it was a step backwards for Maryland and the Chesapeake Bay when the U.S. Senate rejected a package of energy measures passed by the House of Representatives in 2007.¹³⁸ The proposed bill included “a 40 percent increase in fuel economy standards for [new] cars and light trucks.”¹³⁹ The bill could have reduced the United States’ reliance on imported oil and encouraged the use of clean energy technologies.¹⁴⁰ While the main thrust of the bill was its requirement that by 2020, all passenger vehicles sold in the United States must have an average of thirty-five miles to the gallon, the bill faced most of its opposition in two other areas.¹⁴¹ There was resistance because the bill would cost twenty-one billion dollars in taxes, mainly on oil companies, and because of a controversial mandate that electric utilities had to generate 15% of their power from alternative sources, such as wind or solar.¹⁴²

The federal government has another chance to pass legislation that could help states deal with climate change problems. A House bill¹⁴³ introduced in February 2008 seeks “to help U.S. coastal areas plan for rising sea levels and other climate-related changes” by offering grants to coastal states for climate change adaptation plans and

135. *Id.* at 1462–63. The Court found that the EPA had offered an inadequate explanation “for its refusal to decide whether greenhouse gases cause or contribute to climate change,” and therefore had to offer more grounded reasons for inaction on the statute. *Id.* at 1463.

136. *Id.* at 1462.

137. *See id.*

138. *See* John M. Broder, *Senate Blocks Energy Bill*, N.Y. TIMES, Dec. 7, 2007, <http://www.nytimes.com/2007/12/07/washington/07cnd-energy.html>.

139. *Id.*

140. *Id.*

141. *Id.*

142. *Id.*

143. Coastal State Climate Change Planning Act of 2008, H.R. 5453, 110th Cong. (2008).

capital projects.¹⁴⁴ The funds for the capital projects would only be available to “states that have developed climate change adaptation plans.”¹⁴⁵ If the bill is passed, this type of funding could greatly benefit Maryland and the Chesapeake Bay. Additionally, making funding contingent on state level planning would help force state legislatures to commit to aggressively fighting climate change.

The U.S. government, however, has demonstrated a lack of environmental commitment not only on a national level, but on a global level as well.¹⁴⁶ After Australia’s government recently ratified the Kyoto Protocol, which is set to expire in 2012, the United States became the only major industrial nation that refused to adopt the agreement.¹⁴⁷ Other nations are holding themselves accountable while President George W. Bush preferred to take “a voluntary approach” to controlling harmful emissions.¹⁴⁸ In December 2007, at the United Nations Climate Change Conference, Indonesia’s President, Susilo Bambang Yudhoyono, stated “[w]e must ensure that the United States of America, as the world’s biggest economy, the largest emitter of greenhouse gas, and the world leader in technology, is part of such a post-2012 arrangement.”¹⁴⁹

2. Agricultural Emissions

Agriculture is another factor in climate change that is particularly influential in the Chesapeake Bay watershed region.¹⁵⁰ Since there

144. See Dean Scott, *Bill Funding Coastal Adaptation Plans Welcomed at House Subcommittee Hearing*, DAILY ENV’T REP., Feb. 29, 2008, at A1.

145. *Id.*; see H.R. 5453.

146. See Charles J. Hanley, *U.S. Faces New Demand at Bali Talks*, USA TODAY, Dec. 12, 2007, http://www.usatoday.com/news/world/2007-12-12-258935157_x.htm.

147. *Id.* The Kyoto Protocol is “a treaty annex requiring 36 industrial nations to reduce greenhouse-gas emissions by an average 5 percent below 1990 levels by 2012.” *Id.*

148. *Id.* President Bush has rejected the Kyoto Protocol because he claims “it would harm the U.S. economy and cutbacks should have been imposed on much poorer but fast-developing nations such as China and India.” *Id.* U.N. Secretary-General Ban Ki-moon told reporters that he believed the roadmap developed by hundreds of delegates from over 180 nations at the “Bali [T]alks” was “too ambitious.” *Id.*

149. *Id.* The conference, which was attended by over 180 nations, was held to begin negotiations for a successor agreement to the Kyoto Protocol. *Id.* The United States continued to reject specific guidelines for reducing emissions. *Id.*

150. See HORTON & EICHBAUM, *supra* note 18, at 42–43. Agricultural pollution is a major contributor to the overall decline in the health of the Bay. *Id.* Nitrogen and phosphorus are two harmful pollutants found in commercial fertilizers and animal manure. *Id.* at 42–43. The number of farm acreage decreased in past years, yet the number of nutrients per acre of cropland doubled or even tripled in many parts of the watershed. *Id.*

are approximately twelve thousand farms just in the state of Maryland,¹⁵¹ farmers should exert greater efforts to help reduce agricultural carbon emissions into the atmosphere. One way to accomplish this goal is through agricultural conservation.¹⁵² The use of crop covers, riparian buffers,¹⁵³ rotational grazing, and no-till farming could potentially reduce carbon dioxide emissions each year by almost five million metric tons.¹⁵⁴ The IPCC suggests adjustments in planting dates and crop varieties, crop relocation, and improvement of land management practices, such as “erosion control and soil protection through tree planting.”¹⁵⁵ These recommendations will help to reduce emissions that enter the atmosphere from agricultural operations, and will help to curtail the amount of harmful chemicals contained in the agricultural runoff that pollutes the Chesapeake Bay’s waters.

III. A “CRITICAL” AREA

A. *The Critical Area Commission for the Chesapeake and Atlantic Coastal Bays*¹⁵⁶

According to the Critical Area Commission for the Chesapeake and Atlantic Coastal Bays, “[t]he Chesapeake Bay is the largest and most productive estuary in the United States.”¹⁵⁷ The Bay itself is almost 200 miles long, and is fed by 148 rivers and thousands of tiny streams

151. United States Department of Agriculture, State Fact Sheets: Maryland, <http://www.ers.usda.gov/StateFacts/MD.htm> (last visited Aug. 30, 2008). According to the 2002 Census of Agriculture, there were a combined total of 12,198 farms owned by sole proprietors, family-held corporations, partnerships, non-family corporations, and others like cooperatives, estates or trusts, and institutions. *Id.*

152. See CLIMATE CHANGE AND THE BAY, *supra* note 3, at 7.

153. “Riparian buffers are vegetated zones adjacent to streams and wetlands that represent a best management practice (BMP) for controlling nitrogen entering water bodies.” PAUL M. MAYER ET AL., U.S. ENVTL. PROT. AGENCY, RIPARIAN BUFFER WIDTH, VEGETATIVE COVER, AND NITROGEN REMOVAL EFFECTIVENESS: A REVIEW OF CURRENT SCIENCE AND REGULATIONS, at iv (2005), <http://www.epa.gov/nrmrl/pubs/600R05118/600R05118.pdf>.

154. See CLIMATE CHANGE AND THE BAY, *supra* note 3, at 8. If these practices were done for fifteen years, it would be the equivalent of taking 786,438 Hummers off the road or eliminating the entire state of Delaware’s residential electricity use. *Id.*

155. IPCC REPORT, *supra* note 16, at 15, tbl. SPM.4.

156. Included in the Atlantic Coastal Bays are Assawoman Bay, Sinepuxent Bay, Isle of Wight Bay, Newport Bay, and Chincoteague Bay. Ren Serey, *House Bill 301: Atlantic Coastal Bays Protection Act of 2002*, 10 U. BALT. J. ENVTL. L. 61, 61 n.2 (2002).

157. Critical Area Commission for the Chesapeake and Atlantic Coastal Bays, *supra* note 23.

and creeks.¹⁵⁸ The Chesapeake Bay watershed region accounts for over 64,000 square miles, spans parts of six states,¹⁵⁹ and provides a place for over fifteen million people to live, work, and recreate.¹⁶⁰

In the past, people were eager to discover and develop parts of the Chesapeake Bay area, but this growth occurred at the expense of the Bay's health. In 1984, the Maryland General Assembly addressed the progressing problem by developing and enacting the Chesapeake Bay Critical Area Protection Act (the Critical Area Act or the Act).¹⁶¹

The Act was proposed to address certain issues that plagued the Bay, such as deteriorating water quality and diminishing wildlife habitats.¹⁶² The General Assembly viewed development in the Bay area as a major contributor to the decline in the overall health of the Bay,¹⁶³ and thus sought to stave off further development around the shore. Moving forward, if Maryland's legislature does not amend these critical area laws in the near future, the growth and increased energy consumption of the United States' modern lifestyle will exacerbate the effects of the already deteriorating shoreline.

The Act called for the establishment of a one-thousand-foot-wide critical area zone (the Critical Area) along the Bay's shores and tidal tributaries, where future development would be managed.¹⁶⁴ The Critical Area included "[a]ll waters of and land under the Chesapeake Bay and its tributaries to the head of tide . . . and [a]ll land and water areas within 1,000 feet beyond the landward boundaries of State or private wetlands and the heads of tides."¹⁶⁵

Both statewide Critical Area criteria and local programs guide "[a]ll development and land-disturbing activities within the Critical

158. *Id.*

159. Chesapeake Bay Program, The Bay Watershed, <http://www.chesapeakebay.net/thebaywatershed.aspx?menuitem=13942> (last visited Aug. 30, 2008). The six states include Delaware, Maryland, New York, Pennsylvania, Virginia, and West Virginia. The District of Columbia is also included in the watershed region. *Id.*

160. Critical Area Commission for the Chesapeake and Atlantic Coastal Bays, *supra* note 23. Population in the Bay region is anticipated to increase to eighteen million by the year 2020. *Id.*

161. Chesapeake Bay Critical Area Protection Act, ch. 794, 1984 Md. Laws 3744 (codified at MD. CODE ANN., NAT. RES. §§ 8-1801 to 1816 (LexisNexis 2007)).

162. *See id.* at 3744, 3747.

163. *Id.* at 3747-48.

164. Serey, *supra* note 156, at 61.

165. MD. CODE ANN., NAT. RES. § 8-1807 (LexisNexis 2007).

Area.”¹⁶⁶ The Act also included the creation of a one-hundred-foot buffer area,¹⁶⁷ “to provide water quality benefits and an area of transition between upland habitats and aquatic habitats.”¹⁶⁸ The General Assembly’s policy behind the buffer zone states:

Human activity is harmful in these shoreline areas, where the new development of nonwater-dependent structures or the addition of impervious surfaces is presumed to be contrary to the purpose of this subtitle, because these activities may cause adverse impacts, of both an immediate and a long-term nature, to the Chesapeake and Atlantic Coastal Bays, and thus it is necessary wherever possible to maintain a buffer of at least 100 feet landward from the mean high water line of tidal waters, tributary streams, and tidal wetlands.¹⁶⁹

The Critical Area Act was the first joint effort of the local and state governments to address the growing problem of land development on the Bay.¹⁷⁰

The law also established the Critical Area Commission for the Chesapeake and Atlantic Coastal Bays (the Commission).¹⁷¹ The Commission supervises “the development and implementation of local land use programs directed towards the Critical Area.”¹⁷² Both the Commission and the local jurisdictions must operate with the goals:

- (1) To minimize adverse impacts on water quality that result from pollutants that are discharged from structures or conveyances or that have run off from surrounding lands;
- (2) To conserve fish, wildlife, and plant habitat; and
- (3) To establish land use policies for development in the Chesapeake Bay Critical Area or the Atlantic Coastal

166. Critical Area Commission for the Chesapeake and Atlantic Coastal Bays, Compliance in the Critical Area, <http://www.dnr.state.md.us/criticalarea/cca.html> (last visited Aug. 30, 2008) [hereinafter Compliance in the Critical Area].

167. NAT. RES. § 8-1801(a)(4).

168. Compliance in the Critical Area, *supra* note 166.

169. NAT. RES. § 8-1801(a)(4).

170. Critical Area Commission for the Chesapeake and Atlantic Coastal Bays, *supra* note 23.

171. NAT. RES. § 8-1803(a) (“There is a Critical Area Commission for the Chesapeake and Atlantic Coastal Bays in the Department.”).

172. Critical Area Commission for the Chesapeake and Atlantic Coastal Bays, *supra* note 23.

Bays Critical Area which accommodate growth and also address the fact that, even if pollution is controlled, the number, movement, and activities of persons in that area can create adverse environmental impacts.¹⁷³

Despite the statewide nature of the law, implementation of the Act and its criteria occurs at the local level by counties or towns, making compliance a local responsibility.¹⁷⁴ Local jurisdictions handle violators with sanctions or remedies determined either by state or local law.¹⁷⁵ In general, local jurisdictions help property owners comply with the law either through permitting procedures, such as building or grading permits, or through management plans that can include mitigation and restoration.¹⁷⁶ If property owners fail to comply, jurisdictions can issue stop work orders or fines that accumulate on a daily basis for every day that a violation remains.¹⁷⁷

B. Critical Area Laws, Anything but Flawless

The Critical Area Act requires that “[e]ach local jurisdiction *shall* review its entire program . . . at least every [six] years.”¹⁷⁸ In Talbot County, Maryland, however, a dispute arose over an enacted bill that was to change the manner in which towns regulated critical area growth allocations for lands within their borders.¹⁷⁹ Although a County ordinance from 1989 required local program reviews every four years, a 2003 bill “was the first comprehensive review and revision of the County’s local program since it was adopted in 1989.”¹⁸⁰ Almost a decade and a half elapsed before the County reevaluated its original program, despite the statutory mandate.

With the sea level expected to rise at an alarming rate in the next century,¹⁸¹ counties and towns cannot afford to let decades pass while following the same antiquated programs. As Maryland’s shoreline becomes increasingly fragile and susceptible to erosion and complete

173. NAT. RES. § 8-1808(b)(1)-(3).

174. Compliance in the Critical Area, *supra* note 166.

175. NAT. RES. § 8-1815(a).

176. Compliance in the Critical Area, *supra* note 166.

177. *Id.*

178. NAT. RES. § 8-1809(g) (emphasis added). *But see* Talbot County v. Town of Oxford, 177 Md. App. 480, 485, 936 A.2d 374, 377 (Ct. Spec. App. 2007) (indicating that the original Critical Area Act provided for local program review every four years).

179. *Talbot County*, 177 Md. App. at 487, 936 A.2d at 378.

180. *Id.*

181. JOHNSON, *supra* note 34.

submersion, the local critical area laws need constant attention in order to meet the needs of the shrinking shoreline.

In 2006, the University of Maryland's Environmental Law Clinic conducted a study on the implementation and enforcement of the Critical Area Act.¹⁸² It found major flaws such as:

- (1) Limitations on scope that allow for development within the critical area;
- (2) Concentration of main regulatory power in the hands of local jurisdictions;
- (3) Limitations on the Commission's discretion to challenge local decisions;
- (4) Problems with enforcement;¹⁸³
- (5) Failures in penalizing violators; and
- (6) Inconsistencies in granting variances.¹⁸⁴

It was also found that the people responsible for enforcing the Act often interpret the laws to protect private property owners at the expense of the environmental regulations that the Act was intended to protect.¹⁸⁵ Furthermore, there are larger issues with enforcement of the laws because the Act assigns regulatory power to local governments, and there are discrepancies in how each local jurisdiction allows for development and other activities.¹⁸⁶

The Chesapeake Bay region currently faces large problems with population growth and energy dependence.¹⁸⁷ Energy consumption and its resulting harmful levels of emissions will continue to contribute to climate change and sea level rise. With rising water levels, the critical area laws need to account for the ever-changing land structure of Maryland's coast.

182. MEGAN MOELLER ET AL., ENFORCEMENT IN MARYLAND'S CRITICAL AREA: PERCEPTION AND PRACTICE, at i (2006), http://www.law.umaryland.edu/specialty/environment/documents/Final_Critical_Area_Report.pdf.

183. *Id.* at ii. Problems with enforcement include the discretionary nature of the enforcing party's decisions, the failure to issue fines due to the cost of litigation, a lack of public understanding, enforcers' reliance upon individual complaints and the enforcers' responsive nature as opposed to proactive nature, and a lack of resources. *Id.*

184. *Id.* at i–ii.

185. *Id.* at ii.

186. *See id.* at i–ii.

187. *See* RIDLINGTON & HEAVNER, *supra* note 20, at 20–24; STATE OF THE BAY 2007, *supra* note 14, at 7.

C. Adoption of New Critical Area Laws

Maryland should reevaluate its critical area laws to address the fact that the land and waters of the Chesapeake Bay region are no longer in pristine condition. While a one-hundred-foot buffer and a one-thousand-foot management zone may have been adequate when the problem was first addressed over two decades ago,¹⁸⁸ this is no longer sufficient. The buffer needs to be extended to account for the anticipated sea level rise over the coming century.¹⁸⁹ The wetlands, marshes, trees, and natural vegetation that reside in the buffer zone are essential to maintain what is left of Maryland's shoreline.¹⁹⁰ As the General Assembly has acknowledged that human activity is harmful to the shore,¹⁹¹ preservation of the shore should mean that development be completely banned in any area within three hundred feet of the mean high water line.¹⁹² With an extended buffer area, the fragile coastal areas will be better protected from the effects of development.

While there will always be a demand for future development in tidal and coastal regions, the General Assembly must ensure that these areas are preserved for the use of future generations. Residential, commercial, and industrial developers must be denied permits and variances, and the critical area laws must be more stringent on a statewide level. Leaving permitting procedures in the hands of local governments is leaving the health of the Bay in the hands of people who may be influenced by favoritism and community pressure.

A bill passed by the General Assembly in the 2008 legislative session will hopefully solve some of the problems that occur when

188. MD. CODE ANN., NAT. RES. §§ 8-1801(a)(4), -1807 (LexisNexis 2007); MD. CODE REGS. 27.01.09.01(C)(1) (1992).

189. See CLIMATE CHANGE AND THE BAY, *supra* note 3, at 3.

190. See TIMOTHY TELLEEN-LAWTON ET AL., UNPROTECTED SHORELINE: FAILURES IN LIMITING DEVELOPMENT ALONG THE CHESAPEAKE AND COASTAL BAYS 8 (2008), available at <http://www.environmentmaryland.org/uploads/kF/Tx/kFTxuUJYXoB0nnPHLX-CPQ/Unprotected-Shoreline---Environment-Maryland-Report.pdf>; see also STATE OF THE BAY 2007, *supra* note 14, at 6 (discussing how forest buffers help reduce pollution in nearby water).

191. NAT. RES. § 8-1801(a)(4).

192. But see Chesapeake and Atlantic Coastal Bays Critical Area Protection Program — Administrative and Enforcement Provisions, H.D. 1253, 2008 Leg., 425th Sess. (Md. 2008). This bill, passed during the 2008 legislative session, originally called for a three hundred foot buffer area, but ultimately was amended to expand the buffer area to only two hundred feet in resource conservation areas. *Id.*

local governments control sanctions.¹⁹³ House Bill 1253 (the Bill) will, among other things, amend section 8-1808 of the Natural Resources Article of the Maryland Code. The Bill states that a fine not exceeding \$10,000 is applicable to "a contractor, property owner, or any other person who committed, assisted, authorized, or participated in [a] violation [of this subtitle]," and also includes other fines and civil penalties which may be administered by counting separately each violation and calendar day the violation occurred.¹⁹⁴ The Bill also contains language that holds the local jurisdictions more accountable for the variances and permits that they grant.¹⁹⁵

While these provisions are helpful, there must also be outreach at an individual level by educating people and communities about the direct impact their actions have on the welfare of the Bay.¹⁹⁶ These efforts will help to make people feel accountable for their daily actions.

IV. ALTERNATIVE SOLUTIONS FOR COMBATting SEA LEVEL RISE, STORM THREATS, TEMPERATURE INCREASES, AND EMISSIONS

A. *Storm Mitigation: Dikes, Levees, and Dams*

1. The Netherlands: A Proactive Approach

In addition to adjusting the critical area laws to account for future sea level rise, Maryland should establish a long-term water management system that controls increasing water levels and protects coastal and waterfront properties from storm damage.

The Netherlands faces similar issues as Maryland: rising waters, sinking land, and a threat of increasing storm surges.¹⁹⁷ The Netherlands, however, tackles these concerns head-on, and is spending up to twenty-five billion dollars to upgrade the water control systems already in place.¹⁹⁸ Twenty-five billion dollars is a shocking figure, but, like the Netherlands, Maryland's legislature could develop a spending plan that spreads out the cost over many

193. *Id.*; see TELLEEN-LAWTON ET AL., *supra* note 190, at 9, 16–17 (discussing problems with sanctions by local governments).

194. H.D. 1253, at 22.

195. *Id.* at 24–26.

196. MOELLER ET AL., *supra* note 182, at 52, 56.

197. Woodard, *supra* note 27.

198. *Id.*

years.¹⁹⁹ Compared to the cost of cleaning and repairing the region after another devastating storm, an effective water management system would not be such a burden on the state's budget.

The government should consider the possibility of constructing dikes or levees to control rising coastal waters. The design could be modeled after those in the Netherlands that prevent the North Sea, the Rhine River, and the Meuse River from flooding low-lying areas.²⁰⁰ While this might mean that some area residents must sacrifice their ocean-front vistas, the need for proactive measures against climate change far outweighs the desire for picturesque views.²⁰¹

2. New Orleans, Louisiana: A Reactive Lesson

Maryland could also look to New Orleans and the flood protection system that has been proposed post-Hurricane Katrina.²⁰² The estimated expenditure is over fourteen billion dollars,²⁰³ but, once again, this figure may be less than the price tag of cleaning up another catastrophic storm. Spending that sum would enable construction of "higher, tougher floodwalls and gates to seal off waterways . . . from storm surges."²⁰⁴ This type of system "would result in a widespread reduction in water levels" if massive flooding occurred.²⁰⁵ In addition, pumping stations would block surging water and protect shorefront properties.²⁰⁶

Louisiana is ranked first in the nation for its vulnerability to rising sea levels, and the Chesapeake Bay region is close behind, ranked at third most vulnerable.²⁰⁷ It is necessary for the General Assembly to act immediately²⁰⁸ and utilize the innovations that the federal

199. *See id.* John de Ronde of the National Institute for Coastal and Marine Management in The Hague claims that the country will be spreading out their spending over a period of fifty to one hundred years. *Id.*

200. *Id.*

201. Petten is a seaside village in the Netherlands that recognized the importance of the country's future, and traded its ocean view for a view of a giant seawall that measures forty-two feet tall. *Id.*

202. *See* John Schwartz, *New Orleans Flood Plan Upgrade Urged*, N.Y. TIMES, Aug. 23, 2007, <http://www.nytimes.com> (search "New Orleans Flood Plan Upgrade Urged"; then follow hyperlink) (detailing the scope of the proposed upgrade to the New Orleans flood protection system).

203. *Id.*

204. *Id.*

205. *Id.*

206. *See id.*

207. Hug, *supra* note 32.

208. *See id.*

government is designing for the benefit and protection of the Gulf region.²⁰⁹ After witnessing the destructive power, economic loss, and social impact of Hurricane Katrina, proactive measures need to be taken to construct a dike or levee system to manage storms.

Maryland's own Hurricane Isabel, with winds up to ninety-eight miles per hour,²¹⁰ was just twenty-seven miles per hour shy of Hurricane Katrina's Category Three classification.²¹¹ Maryland and the Chesapeake Bay shoreline should not be exposed to a calamity like the one that occurred with Hurricane Katrina. If other highly vulnerable regions in the United States are implementing upgraded storm management technologies, money and resources should be allocated for Maryland's coast as well.

3. The Gabčíkovo Project: A Hybrid Approach

The Danube River in Europe was known for its frequent flooding.²¹² The governments of its bordering countries decided to take action to prevent future damage.²¹³ In 1977, Czechoslovakia and Hungary entered into a treaty to create a multipurpose hydroelectric project.²¹⁴ The project, called the Gabčíkovo Project, not only protected the region from flooding, but it also generated electricity, stabilized the riverbed, secured year-round navigation, and provided improved conditions for recreational use of the water and surrounding territory.²¹⁵

Maryland's government should consider development of a similar innovative multipurpose water management system in order to account for climate change and to generate clean energy. The system on the Danube provides for approximately 10% of the Slovak Republic's annual energy consumption.²¹⁶ While there were some initial environmental concerns, the area's environment did not become any worse, but rather may have improved.²¹⁷ Adding a similar source of hydroelectric renewable energy could further reduce

209. See Schwartz, *supra* note 202.

210. Dennison, *supra* note 86.

211. National Oceanic and Atmospheric Administration, Hurricane Katrina, <http://www.katrina.noaa.gov/> (last visited Aug. 30, 2008). Hurricane Katrina's maximum wind speed on land was estimated at 125 miles per hour. *Id.*

212. See The Gabčíkovo Hydroelectric Project, [http://www.gabcikovo.gov.sk/doc/VDG\(2jaz\)/ENG_material.htm](http://www.gabcikovo.gov.sk/doc/VDG(2jaz)/ENG_material.htm) (last visited Aug. 30, 2008).

213. See *id.*

214. *Id.* The Project did have its obstacles. Hungary stopped fulfilling its treaty obligations in 1989, and tried to terminate the treaty in 1992. *Id.*

215. *Id.*

216. *Id.*

217. *Id.*

Maryland's contribution of harmful emissions, while also protecting the coastline.

B. Decreasing Water Temperatures: A Cooling System

A water temperature cooling system is another, possibly less expensive, alternative to combat the rising temperatures of the Bay's waters.²¹⁸ To lessen the man-made impact to the rising temperatures of the Bay, and to afford the Bay's plant and fish populations longer lives, a cooling system could be added to the two power plants at Calvert Cliffs.²¹⁹

The Calvert Cliffs Nuclear Power Plant was the first nuclear power plant to receive an extended license from the U.S. Nuclear Regulatory Commission.²²⁰ The extension gives Unit 1 a license to operate until 2034, and gives Unit 2 a license to operate until 2036.²²¹ While the environmental impact of nuclear power is debatable, Maryland's nuclear power will be around for at least another twenty-eight years.²²²

The inevitability that the plants will operate until at least 2036 means that they should be held accountable for the harm they do to the Bay's waters. A water cooling system is necessary because of the increase in the Bay's average water temperature, due to both the effects of climate change and the warm water discharged into the Bay from the power plants.²²³ Many other power plants in the nation have

218. See Mohamed Ahmed Salah, *Cooling Tower Blowdown Treatment Using an Inclined Plate Clarifier*, INDUSTRIAL WATERWORLD, Jan.-Feb. 2007, at 40, available at <http://www.pennet.com> (search "Cooling Tower Blowdown Treatment"; then follow "Cooling Tower Blowdown Treatment Using an Inclined Plate Clarifier" hyperlink) ("The primary use of cooling towers is to remove heat absorbed in circulating cooling water systems used in refineries, power plants, petrochemical plants and other industrial facilities. Cooling towers represent a relatively inexpensive and dependable means of removing low-grade heat from cooling water.").

219. See RIDLINGTON & HEAVNER, *supra* note 20, at 27.

220. Press Release, Constellation Energy, Constellation Energy's Calvert Cliffs' Unit 1 Refueling Outage Complete (Apr. 12, 2006), <http://ir.constellation.com/releasedetail.cfm?ReleaseID=318119>.

221. *Id.*

222. *Id.* With talks of the construction of a third reactor on-site, nuclear power will likely be around for much longer than 2036. See Press Release, Constellation Energy, UniStar Nuclear Energy Seeks Maryland Public Service Commission Approval for New Nuclear Facility at Calvert Cliffs (Nov. 15, 2007), <http://www.prnewswire.com/cgi-bin/stories.pl?ACCT=104&STORY=/www/story/11-15-2007/0004706747&EDATE=>.

223. See *supra* Part II.A.3. The water from the Bay is pumped at a rate of 2.4 million gallons per minute to cool the steam produced by the nuclear reactors, and then is

water cooling towers in place as a final step before water is emptied back into the source from which it was drawn.²²⁴ The cooling tower's sole function is to remove heat from the water used by the nuclear reactor before it is discharged back to its source.²²⁵ It is unfortunate that the plants have been operating so long without this crucial step,²²⁶ presumably at the expense of the Bay's health.

Even more advantageous than water cooling towers alone²²⁷ would be a water treatment mechanism that cools the water after being used in the condensers, and also removes from the water nitrogen and phosphorous, which are harmful nutrients increasingly found in the Bay.²²⁸ If these chemicals are removed from the water before it is returned to the Bay, there would likely be a significant increase in water quality, which would in turn increase the health of the Bay's aquatic populations.²²⁹

C. *Emissions Control: Making the Switch to Clean, Renewable Energy*

Energy and electricity usage has dramatically increased in the past few decades, and the Chesapeake Bay and surrounding regions face a major dilemma, as the demand for electricity could surpass the supply as early as 2011.²³⁰ One proposed solution to meet this demand is building a third reactor at the Calvert Cliffs site.²³¹ Such a solution raises many environmental concerns, most importantly the

returned to the Bay about ten degrees warmer. Tom Pelton, *Nuclear Power Has New Shape*, BALT. SUN, Dec. 25, 2007, at 1A. As discussed in Part II, this water temperature increase can have a major impact on the Bay's plant and animal species.

224. See American Nuclear Society, *Electricity: Operation: Cooling Towers*, http://www.aboutnuclear.org/view.cgi?fc=Electricity,Operation,Cooling_Towers (last visited Aug. 30, 2008).

225. Cooling Towers, <http://www.nucleartourist.com/systems/ct.htm> (last visited Aug. 30, 2008). Cooling towers create a decrease in plant efficiency, and the total electrical usage of the cooling tower pumps is estimated at about 5% of the electrical output of the entire power plant. *Id.*

226. Pelton, *supra* note 223. Unit 1 started generating electricity in 1975, and Unit 2 began in 1977. *Id.*

227. Cooling Towers, *supra* note 225.

228. David A. Fahrenthold, *Pollution Rising in Tributaries of Bay, Data Show*, WASH. POST, Dec. 5, 2007, at B1. Nitrogen and phosphorus can be found in manure, lawn fertilizer, and treated sewage, and they are partly responsible for the abundance of "algae blooms that create dead zones in the [B]ay." *Id.*

229. See discussion *supra* Parts I, II.A.3-5.

230. See David A. Fahrenthold, Lisa Rein, & Kristin Downey, *Threat of Power Shortages Generating New Urgency*, WASH. POST, Feb. 3, 2008, at A1. The Washington, D.C. region now uses 18% more electricity than it did in 2001. *Id.*

231. Paul Adams, *BGE Rate to Climb Higher in June*, BALT. SUN, Jan. 23, 2008, at 1A.

proposed reactor's contribution to global warming. Instead of spending over four billion dollars²³² on acquiring electricity from sources that harm the environment and hasten the effects of climate change, Maryland's government should research renewable energy alternatives. With the potential to generate 20% of its energy from renewable sources,²³³ Maryland needs to capitalize on this opportunity. This clean energy could be generated from wind farms, biomass energy technologies, and solar energy.²³⁴ The General Assembly must focus its spending in "green" areas of electricity sources, as there are available technologies to construct environmentally friendly alternatives to coal, natural gas, and nuclear power.

V. CONCLUSION

The Chesapeake Bay and its surrounding coastal areas face an increasingly uncertain future. The effects of climate change in the Chesapeake Bay are readily apparent. Rising sea levels, sinking land, increasing water temperatures, and greater storm threats have the potential to be a catastrophic combination.²³⁵ To combat the devastating consequences that could be the future of Maryland's coastal areas, the General Assembly, as well as the federal government, must act quickly. Maryland can act to save the Chesapeake Bay by reducing greenhouse gas emissions, decreasing dependence on electricity from power plants, and committing to generating electricity from renewable energy sources.²³⁶ Both the federal and state governments should commit funds towards preventing future loss throughout the region.

It is also essential for Maryland's government, and its citizens, to take responsibility for the effects that climate change is having on Maryland's shorelines. Stricter regulations and commitment to the enforcement of already existing policies will aid in curtailing any

232. Dan Morse, *Anti-Nuclear Group Fights Third Reactor*, WASH. POST, Jan. 6, 2008, at SM1.

233. RIDLINGTON & HEAVNER, *supra* note 20, at 30.

234. *Id.* For instance, nationwide, "wind farms installed almost 3,200 turbines, boosting the nation's wind energy capacity by 45 percent and cranking out an additional 5,200 megawatts, or enough electricity to power 1.5 million homes for a year." David Twiddy, *Wind Farms Need Techs to Keep Running*, USA TODAY, Feb. 2, 2008, http://www.usatoday.com/money/economy/2008-02-02-1829783981_x.htm.

235. *See supra* Part II.A.1-4.

236. *See supra* Parts II.A.3, II.B.1, IV.C.

further loss of land.²³⁷ The action of federal, state, and local governments is ultimately what will save the Chesapeake Bay.

Losing such a valuable natural resource would be losing one of the nation's treasures. The Chesapeake Bay is a source of beauty, recreation, economy, and livelihood for the eastern shore, and the problems it faces should be given more than a passing glance. While the threat of climate change is increasing, there is also more knowledge than ever about the causes of global warming. With this knowledge, the Chesapeake Bay watershed region's governments and residents need to make environmentally conscious choices for its future, today.

Lauren F. Jones

237. See *supra* Part III.