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The Chesapeake Bay was first settled by the Paleoindians 15,000 years ago; it is the largest natural watershed in North America. It extends for 200 miles over New York, Virginia, Delaware, Maryland, Washington D.C. and West Virginia. The Bay is home to over 3,600 species of plants and animals (cacaponinstitute.org). The great significance of the Chesapeake has been prominent for thousands of years. Due to development, increased population and pollution around the bay, it has been facing many problems. With the increased population, there is declining household sizes, “Nationwide, there was an average of 3.11 persons per household in 1970 but only 2.63 persons per household by 1990, a drop over 15%” (McConnell, 2004), and the average household is demanding more land per person. From development of homes, fertilization, car emissions, pet waste, impervious surfaces and other everyday activities, “17 percent of phosphorus, 11 percent of nitrogen and 9 percent of sediment loads to the Bay come from stormwater,” (<http://www.chesapeakebay.net/stormwater.htm>). This surface runoff from homes and farmlands, contain hazardous chemicals such as; petroleum soil contaminants, fertilizers and pesticides. Runoff often causes erosion that causes sediment to collect in the bay, however surface runoff is not the only source; development may cause this as well. “Agricultural runoff and municipal water treatment were fingered long ago as major culprits in the nitrogen buildup that chokes out aquatic life in the Bay. Only quite recently, however, did researchers discover that airborne nitrogen-oxide emissions—from utilities that generate electricity and from cars and trucks on the highways—can do the same kind of damage” (Resources, 1998). These negative impacts on the bay are quite visible; there is discoloration and bad smell to the water, dying species, lack of vegetation and increased algae growth. Contaminants and pollution to the

bay outnumber and outweigh the efforts that are being put in to restore it, thus the problem is progressively getting worse.

In order to decrease the amount of contamination affecting the Bay, state and local governments are implementing various tactics to help decrease pollution and raise money to get rid of it. To address the nitrogen and phosphorus nutrient pollution problem, there are tradable permits. Nitrogen and phosphorus are necessary to help plants grow, however when dumped into the Chesapeake Bay in large amounts because of its use in fertilizer and prominence in sewage it causes increased algae growth. When there is too much algae in the water, it devours the oxygen which in turn causes fish to die. The Chesapeake Bay Program's goal is to reduce pollution levels by 40%. These permits allow only a certain amount of pollution to be produced by a certain company, factory or person. Then if a point or non-point source decides that they do not need the entire permit, they can sell it off, and vice versa. "Each trade should result in net reduction in nutrient loading and also maintain the tributary nutrient cap. No local water quality impacts are allowed to result from trading. A source may receive credits for reductions in nutrients, through the operation of a facility or the implementation of a BMP," (Kraemer, 2004).

Another way to reduce fertilizer and pesticide usage is with increased taxes on them. Within the U.S., Iowa, Nebraska and Wisconsin tax fertilizer and/or pesticides. In Iowa, the Groundwater Protection Act states that, "pesticide manufacturing registration fees, pesticide dealer licensing fees, and fertilizer taxes. Among other provisions, retailers of nitrogen-based fertilizers must pay an additional \$.75 per ton sold based on an 82 percent solution and prorated for different solutions. Pesticide dealers, before selling or offering for sale any pesticide, must pay an annual registration fee of one-fifth of one percent of gross sales within this state with a minimum fee of two hundred fifty dollars and a maximum fee of three thousand dollars for each

and every brand and grade to be offered for sale in this state except as otherwise provided. Fifty dollars of each fee collected shall be deposited in the general fund of the state and the remainder of each fee collected shall be placed in the agriculture management account of the groundwater protection fund,” (<http://www.newrules.org/environment/iaground.html>). Nebraska has implemented the tax on solely fertilizers; “four dollars per ton upon the gross tonnage of all sales, use, or other consumption,” (<http://www.newrules.org/environment/nebfert.html>). The state will also reimburse anyone who paid more than the required tax.

Then there are Tradable Development Rights, or TDR, which helps prevent against sprawl and preserves the land. With a TDR, it “will move new development toward designated growth areas and help landowners permanently preserve their land. It allows residential development rights on valuable resource land such as farmland to be purchased and transferred to increase the density of homes that can be built in areas already designated and suitable for growth. This way, developers could purchase development rights from farmers, which would allow them to keep farming while providing another option to realize the value of their working lands. And, in the unlikely event of a reduced property value related to down zoning, a TDR program will ensure reasonable compensation for any affected landowner,” (Lefebvre, 2006).

Subsidies can also help prevent against polluting the Bay; however there has been some discrepancy about them due to conflicting other subsidies. “The most recent setback for the existing system of federal payments designed to boost the income of producers of feed grains, rice, cotton and milk is a ruling that cotton subsidies violate a 1994 trade agreement that places limits on different kinds of subsidies,” (Faber, 2004). However, people would be more inclined to help lessen their negative effects on the Bay if there was financial help. The aspect of financial help may arise some discrepancy due to the large national deficit the government is

currently in. Many people may find that raising revenue to help environmental problems should not be a priority for the government currently.

One policy option that has received relatively little attention, but could make a significant impact to the Bay's pollution problem is rain gardens. The creation of at least one rain garden for every new neighborhood that is built or home(s), buildings or even campuses that are built on an acre of land or more. Rain gardens are somewhat similar to sediment ponds in that they collect sediment, runoff and storm water and holds it in the pond, then slowly releases it back into the ground. This slow release of clean water into the ground helps re-nourish and provide moist soil for plants to grow in. Also, rain gardens help prevent soil erosion. If constructed correctly, rain gardens can help reduce runoff by 25 percent. A rain garden is approximately 6 percent of the land it holds the runoff for. "A 180 ft rain garden traps 8000+ gallons of water per year. [And] there is 9 times more runoff from a city block than from a forest of the same size. These are two extremes on a runoff continuum, in which lawns are somewhere in the middle. Rain gardens improve the performance of lawns on this runoff scale," (Calumet Conserver, 2005). Other than just filtering run-off, rain gardens have many benefits; they recharge ground water, can reduce risk of home flooding, conserve water, remove standing yard water, increase beneficial insects that eliminate pest insects, will survive drought season, improve water quality and can enhance landscapes (<http://www.raingardennetwork.com/benefits.htm>). By mandating rain gardens in new developments, it will ensure that people and communities will help decrease the impact of their runoff. A downside to mandating is that since people must have rain gardens now; builders may not properly construct them due to a lack of budgeting or knowledge.

Constructing a rain garden is fairly simple for a single home. If constructing one for a bigger area, such as a school or building, it may take professional consultation. Ideally, rain

gardens are built in permeable soil so that the soil does not stay saturated for too long. To determine the size of a rain garden, it should be one-fourth the size of the roof area plus the driveway area all divided by twenty. The depth of a typical rain garden is four to six inches with a minor depression in the center. After planting the various types of trees or plants in the garden, there should be two to three inches of hard wood mulch placed on top. Location of the garden “should ideally be located between the source of runoff (roofs and driveways) and the runoff destination (drains, streams, low spots, etc.).” When choosing a location, it should also be at least 10 feet away from the house foundation, at least 25 feet away from a septic system drain field, should receive much sunlight and avoid underground utility lines (<http://www.bae.ncsu.edu/topic/raingarden/Building.htm>).

Benefits of rain gardens are not limited to just decreasing run off, but they also look very nice in a yard and grow flowers. Various types of trees, shrubs, vines and plants can go in a rain garden. Generally speaking, the type of plant to use should be “native and resistant to the stress from both brief periods of pooling as well as dry periods between rainfall events,” (<http://www.uri.edu/ce/healthylandscapes/raingarden.htm#plants>). These plants should also be able to withstand larger than usual amounts of sediment, fertilizer and pesticides. Popular trees that are used, but are not limited to, include; Red Maple, Red Cedar, Green Ash, Gray Birch, Pin Oak and Red Oak. Shrubs and Vines that can be used are the Red Chokeberry, Black Chokeberry, Red Twig Dogwood, Black Huckleberry, American Holly, Virginia Creeper, Northern Bayberry, Trumpet Honeysuckle, Mountain-laurel, Late Lowbush Blueberry, Highbush Blueberry and Nannyberry. Plants that are often used are perennials and herbaceous plants that include; Nothern Maidenhair Fern, Jack-in-the-pulpit, Wild Columbine, Sweet Joe-Pye Weed, Switchgrass, Wingergreen, Bushy Aster, Heath Aster, New England Aster, Carolina Lovegrass,

various Mountain Mints, and New York Fern. There has been question of rain gardens attracting mosquitoes, however if one is built correctly then the water should drain within a few hour or at most a day. For mosquitoes to lay and hatch eggs it would take a minimum of seven days, thus there would be no additional mosquito problem. If certain plants are used, it can often attract hummingbirds and butterflies.

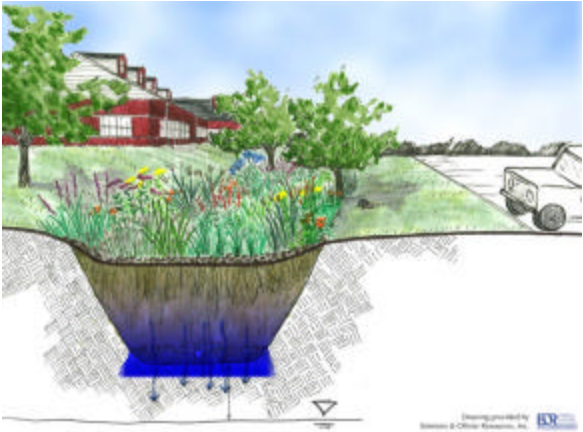
To implement the requirement of rain gardens for every newly developed neighborhood or yard there would have to be new policies made to require these and also help bear the cost of creating rain gardens. “Right now, New Jersey is looking at implementing rain gardens to prevent polluted rainwater from further damages waterways including the Atlantic Ocean. West Michigan Environmental Action Council started their rain garden initiative to help reduce West Nile Virus. In the town of Maplewood Minnesota, communities have come together to plan and create rain gardens in neighborhood. Kansas City Missouri started the 10,000 Rain Garden plan in the KC metro area in the hopes that residents will eventually plant 10,000 of these gardens,” (Utendorf, 2008).

Rain garden requirements would mean better grading analysis for irrigation and storm water runoff in the new and upcoming developments. Houses may have their own individual rain gardens or several houses may share one, all depending on the landscape of their yards. This policy will also be in effect to buildings and even campuses being built; not necessarily preexisting ones. If homeowners, land lords or owners of buildings want to create a rain garden, there will be a tax return and government grants that will help with bearing the costs. Financing will be dependent upon the state government and how much money people are allotted to have or get in return. The federal government should also create subsidies to promote and help pay for rain gardens.

The upkeep of rain gardens will be necessary to ensure that they are still effective and not harming more than helping. These costs will vary due to the type of plants in the garden, but can be as low as \$62.00 per year. For residential areas, the homeowners association will be responsible, and to those that do not have these community programs, it will be up to the individual. There is no regulations as to what is made up or consisting of the rain gardens—what kinds of flowers or plants are being used. If the rain gardens are planted with suitable grass, then the upkeep would be just to mow them. To those who do not have enough funds for the upkeep can apply for funding from their state government. The state this policy will be effective in is Virginia, especially the areas outside of Northern Virginia, seeing as though there is going to be the most development there.

The Chesapeake Bay will hopefully be cleaner and less polluted due to the establishment of rain gardens. Rain gardens will highly benefit all areas that are in effect of this policy and will help to a less polluted environment.

Pictures of rain gardens:



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