After It Rains…

A Citizens Guide to Understanding Stormwater BMP

CITY OF SUFFOLK DEPARTMENT OF PUBLIC WORKS–STORMWATER DIVISION

Forward

The purpose of this booklet is to provide a resource for the general public to learn about the importance of stormwater best management practices (BMPs) and their role in water conservation. This can also be a useful resource for property managers and owners associations who have general questions about stormwater facilities and their functionality, as well as routine maintenance suggestions and guidelines.

More technical information for best management practices can be found at the Virginia Stormwater BMP Clearinghouse (http://vwrrc.vt.edu/swc/); a website created by the Virginia Department of Conservation and Recreation (DCR) in conjunction with the Virginia Water Resources Research Center for the purpose of stormwater education and guidelines. We also encourage you to visit the Virginia Department of Environmental Quality (DEQ) website at www.deq.state.va.us to learn more about the ways that our state is taking action in the preservation of our most precious natural resources.

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Why BMPs?

"It is not necessarily those lands which are the most fertile or most favored climate that seem to me the happiest, but those in which a long stroke of adaptation between man and his environment has brought out the best qualities of both."
- T. S. Eliot

What exactly is a BMP? The term BMP is an acronym for "Best Management Practice". This is defined as any scheduled activity, physical structure, facility, or maintenance procedure intended to prevent or reduce the discharge of pollutants to our waterways. BMPs can be either an activity, such as limiting the use of fertilizers, or a structure, such as a stormwater facility. BMPs are used to counteract the impacts of development on the natural environment.

So what does that mean exactly?

After it rains, stormwater naturally drains into the ground. During this process, the water is naturally filtered. Grass, trees, and other plants also help aid in this process. The rain water continues its descent until it becomes part of the ground water where it eventually makes its way back into rivers and streams. After something is built, such as a road or parking lot for example, this natural process is blocked, causing the water to take a different path. The surfaces that prevent water from being absorbed and block filtering are known as impervious surfaces. Concrete, asphalt, gravel, and buildings are typical examples.

So where does this water go then, if not into the ground?

Some water enters the ground in other areas. Most however runs across lots, enters gutters, and flows down streets and through yards where it picks up dirt, debris, fertilizer, animal wastes and harmful chemicals along the way. This "soup" of pollutants would eventually run directly into the nearest river or stream if it were left unchecked. This is where BMPs come into play.

I think I understand. So BMPs help keep pollution out of the waterways?

Yes, and much more. Some BMPs help control both water quality and quantity. Through the use of stormwater facilities, the run-off has a place to gather before it makes its way to the nearest stream. Here the stormwater run-off can be detained, giving pollutants and other harmful substances time to sink and filter out, allowing cleaner water to be slowly released back into the waterways. Aquatic plants and beneficial bacteria further this process by absorbing excess nutrients. This minimizes the negative effects of pollutants going into a stream all at once, and helps prevent damage to the environment. Because stormwater run-off is often channeled through ditches, pipes, and gutters and diverted to a stormwater facility where it is "collected", flood control can also be achieved.

It may be said that the goal of a best management practice is effectively minimizing the impact of development and in essence recreating the natural order of the land as much as possible.

"In nature there are neither rewards nor punishments, there are consequences."
- Robert G. Ingersoll

The effects of urbanization on our local waterways has always been a major area of concern. The *Federal Water Pollution Control Act* of 1948 was the first major U.S. law to address this concern. Growing public awareness led to sweeping amendments, until the law became commonly known as the *Clean Water Act* in 1972.

States like Virginia began to get involved creating laws to supplement the act. In 1988, the Virginia General Assembly enacted the *Chesapeake Bay Preservation Act* (CBPA) which required all Tidewater localities to establish local programs to protect and improve water quality in the Chesapeake Bay watershed and its tributaries. Each locality was required to define its Chesapeake Bay Preservation Areas and establish enforcement procedures to ensure compliance with state regulations.

On May 12, 2009, the president signed the *Chesapeake Bay Protection and Restoration Executive Order* recognizing the Chesapeake Bay as a national treasure and calling on the federal government to lead a renewed effort to restore and protect the nation's largest estuary and its watershed. The Environmental Protection Agency (EPA) has developed the *Chesapeake Bay Compliance and Enforcement Strategy*; a multi-year and multi-state strategy combining our water, air and waste enforcement authorities to address violations of federal environmental laws resulting in nutrient, sediment and other pollution in the Bay.

Presently the City of Suffolk is working under these guidelines to comply with current regulations by conducting public outreach and education, and performing annual BMP inspections, stormwater management, Illicit discharge investigations, and developing pollution prevention standards to help protect our state and local waterways, which will help aid in the overall restoration of the Chesapeake Bay.

"Yesterday is not ours to recover, but tomorrow is ours to win or lose."- Lyndon B. Johnson

After It Rains

There is a lot that happens during a rain storm that usually goes unnoticed. From a pollutant standpoint, the worst part of a rain shower is the beginning. This is often referred to as the "first flush". It is during this time that the majority of harmful pollutants and nutrients remaining on the surface are washed away. Let's take a look at the illustrations below…

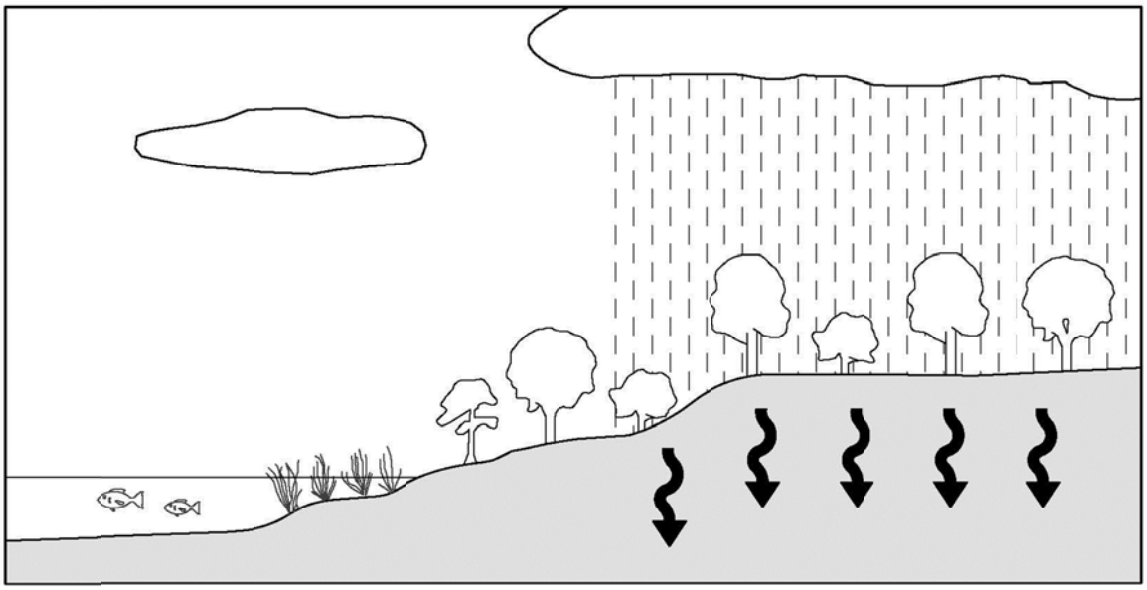


Illustration showing the natural process of stormwater being filtered by the ground after a rainfall.

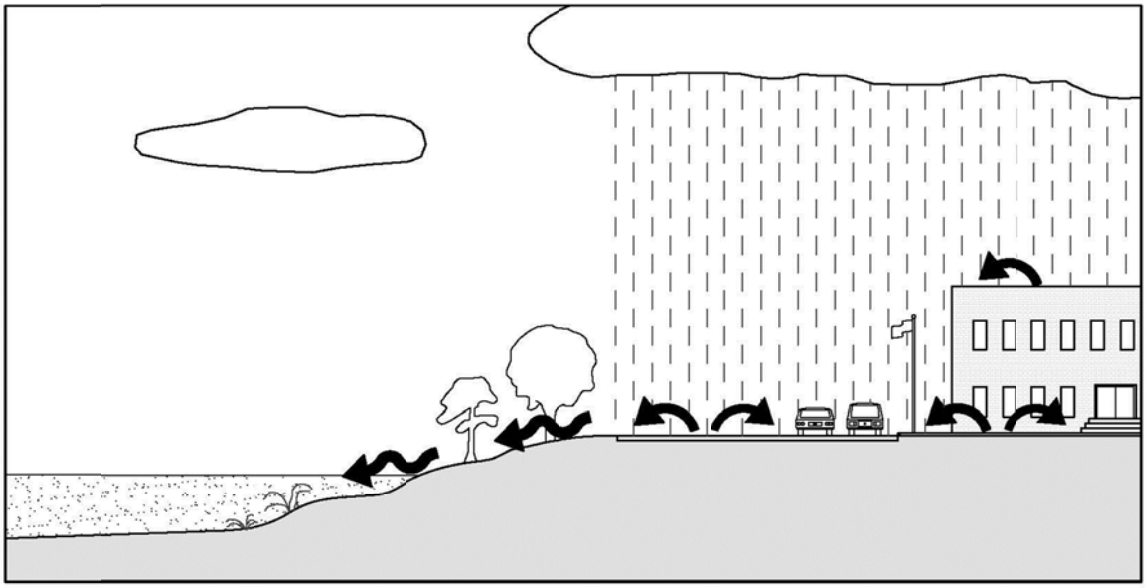


Illustration showing the natural filtration process being blocked by development. The stormwater washes directly into the river carrying pollutants from the surface and contaminating the water.

It's easy to see where rain water goes after it hits the ground. Just take a look outside and observe the flow of water the next time it rains.

As discussed earlier, certain BMPs help control stormwater runoff by applying certain control measures. For example, a stormwater facility that can detain the water before it goes into the river as shown in the illustration below…

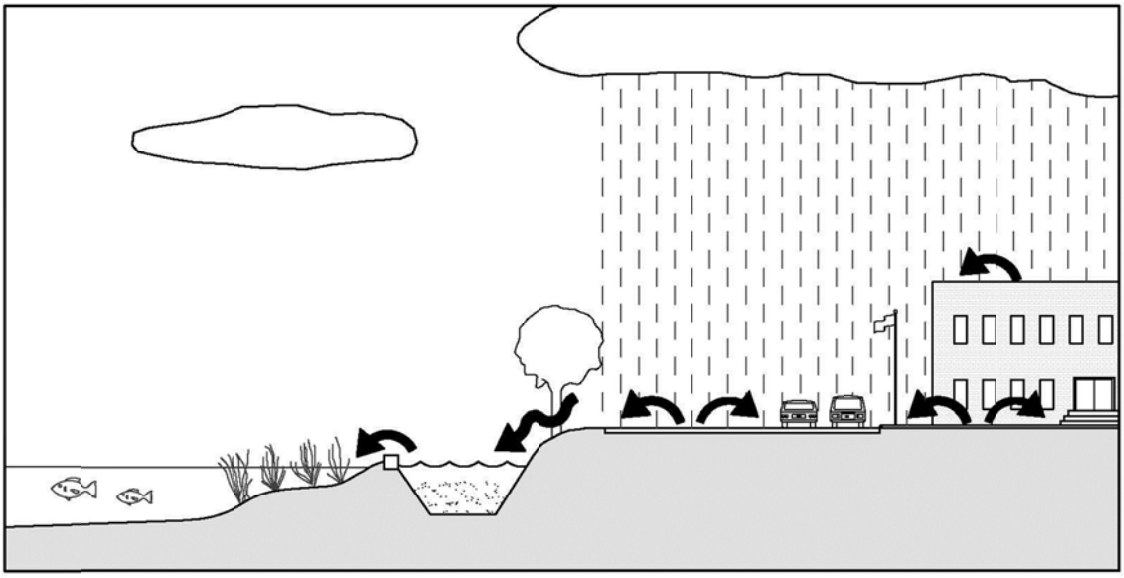


Illustration showing developed area utilizing BMP. Polluted water is gathered in a stormwater facility effectively allowing particles to settle out before being released into the nearby river.

This is just one example of a best management practice. Storm inlets, underground pipes, vegetated areas, and ditches can all be part of a BMP. These man-made devices can help divert runoff into a stormwater facility where it can be properly treated before being released back into local water ways. The next chapter contains a brief look at some common types of stormwater facilities.

Different Types of Stormwater Facilities

While there are many different types of stormwater facilities, the important thing to remember is that they are all designed for specific criteria and are custom built for each site. Some are more effective at removing pollutants than others. Some retain water and some do not. In addition, some BMPs in areas such as neighborhoods, may have one very large facility or several smaller ones to effectively treat stormwater. Having a basic understanding of how a stormwater facility functions can be of great value, especially where care and maintenance are concerned. The following are some common types of stormwater facilities and how they function. *(More detailed information for stormwater facilities can be found at the Virginia Stormwater BMP Clearinghouse at http://vwrrc.vt.edu/swc/.)*

Detention Basins "Dry Ponds"

A detention basin is a stormwater facility that temporarily stores runoff for a specified period of time and discharges it gradually through an outlet structure. It improves the quality of stormwater runoff through gravitational settling. However, pollutants can become re-suspended during heavy rainfalls. Detention basins are usually dry during non-rainfall periods.

Retention Basins "Wet Ponds"

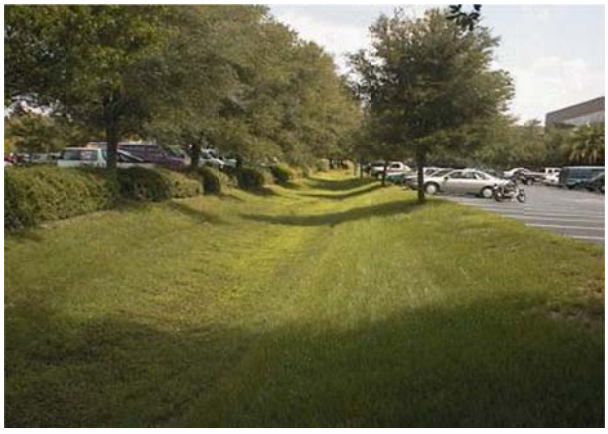
A retention basin is a stormwater facility which includes a permanent impoundment, or pool of water, and is normally wet during non-rainfall periods. A retention basin is considered one of the most reliable and versatile stormwater facilities available. The advantages of a wet pond over a dry pond are higher pollutant removal and less chance that pollutants will be re-suspended during a storm. Wet ponds can also serve as an aesthetic amenity as well as a habitat for wildlife.

Bioretention

Bioretention facilities (also referred to as "Rain Gardens") are planting areas installed in shallow basins in which stormwater runoff is treated by filtering through bed components (mulch, sand, etc.) Harmful pollutants are then absorbed by the plants installed in the system. Properly constructed bioretention areas replicate the ecosystem of an upland forest floor, and can be quite effective if properly maintained.

Grassed Swales

A grassed swale is a broad and shallow channel vegetated with erosion resistant and flood tolerant grasses. The purpose of grassed swales is to convey stormwater runoff at a non-erosive velocity in order to enhance its water quality through infiltration. Check dams may be used within the swale to slow the flow rate and create small, temporary ponding areas. A water quality swale is appropriate where greater pollutant removal efficiency is desired.



Manufactured BMP Systems

A Manufactured BMP system is a structural measure which is specifically designed and sized by a manufacturer to intercept stormwater runoff and prevent the transfer of pollutants downstream. Manufactured BMP systems are used solely for water quality enhancement in urban areas where surface stormwater facilities are not feasible. They typically do not store water, but filter the water as it passes through. Manufactured BMP systems require regular inspections and maintenance to maximize their effectiveness.

Maintenance Responsibilities

Things break. It's just a common fact of life. Just as routine maintenance can prolong the life of an automobile, the same is true with stormwater facilities. While some can, and will fail due to unforeseen circumstances, it is estimated that 50 percent of the stormwater facilities that fail within the first 5 years do so from lack of proper maintenance.

But who is responsible for this maintenance? The answer is the property owner or any party that utilizes the BMP. Typically for residential areas, homeowner associations are charged with carrying out required maintenance. Commercial properties are usually cared for by a property manager or facilities operator. Before a new development is constructed, certain agreements must be signed and recorded by all parties involved guaranteeing that stormwater facility maintenance will be carried out. This is usually outlined in the form of a deed of easement or an agreement. If you are unsure who is responsible for maintenance, or are unable to locate your maintenance agreement or have general questions, you can contact the City of Suffolk Department of Public Works, Engineering/Stormwater Division at (757) 514-7725 or visit us on the web at www.suffolkva.us/pub_wks/engineering-stormwater for assistance.

Develop a Maintenance Program

A good way to stay on top of maintenance and help to minimize costs is to develop a maintenance program. This can be anything from regularly scheduled visual inspections that are performed by a property manager or other personnel, or a regular routine with a groundskeeper, such as vegetation removal. Some homeowner associations set aside funds specifically for more expensive non-routine tasks, such as dredging and removing sediment from wet ponds. Whatever the case may be, a solid plan helps to keep things on track and makes sure that a stormwater facility is kept functioning at its best.

General Maintenance Elements

The following are some basic key elements that should be noted when conducting visual inspections. However, this is not a checklist. As stated previously, all BMPs are site specific and can vary in their maintenance requirements. Always refer to the original maintenance documentation for details regarding facility care and maintenance.

Accessibility - Access to and from a stormwater facility is always required to perform inspections and maintenance. This includes access around the facility, as well as structures such as pipes and outlet devices.

Vegetation - While plants are usually a good thing for stormwater facilities, they can get out of control very quickly if left unattended. This is in part because of the large amount of nutrients that can gather in a stormwater facility, like nitrogen and phosphorus. Plants in and near these facilities have all the food and water they could ever need! Aquatic weeds can also be difficult to control. Excessive vegetation blocks access and prevents visual inspections from being conducted properly. Organic debris from plants clogs up pipe drains and blocks the flow of water. Worse yet, roots from larger plants like trees and shrubs can cause embankments to fail, create erosion problems, and damage underground pipes, leading to costly repairs and system failure.

Denuded Areas - While too much vegetation can be bad if not maintained, too little also poses its own set of problems. Grasses and ground cover helps strengthen banks and side slopes by stabilizing the ground with root systems. These roots prevent loose dirt from washing away and help guard against erosion damage. Vegetation also helps absorb some of the water and can provide a buffer to protect the stormwater facility. One of the first steps for erosion control on a construction site is to "stabilize with vegetation".

Debris/Sedimentation - Over time, dirt and debris washes into stormwater facilities and accumulates in the basin bottom and near pipe openings. This can be accelerated by erosion, denuded areas washing down into the facility, or from other sources nearby. Accumulated sediment can clog pipes and hinder water flow. If enough sediment gets into the facility, it will need to be removed and the system restored to its original design specifications. Care should always be taken when doing any new site work where soil disturbance may be involved to prevent damage to stormwater facilities. The removal of sediment from a stormwater facility may require the use of heavy equipment and the associated costs can be significant.

Structural Components - Most stormwater facilities use structures such as underground pipes to channel water. Other components may include weirs (dams), flumes/ditches, and outlet devices that should be kept clean to prevent clogging and system backups. Over time these structures can crack or separate, and need to be repaired. Trees allowed to thrive on or near structural components can also move and/or rupture concrete pipes with their roots.

Aquatic Environment - A healthy ecosystem is a good indicator of a well-balanced stormwater facility. Aquatic vegetation helps break down nutrients and increases pollutant removal value. Excessive algae, discolored water and unsightly odors are often signs that something is wrong. Overuse of fertilizers, clogged pipes and excessive vegetation often contribute to these problems.

Common Problems

Below are some examples of common problems that can be seen frequently during routine inspections. Some of these problems can occur very quickly without proper maintenance.

Facilities overgrown with vegetation make inspections nearly impossible to conduct.

Trees can grow very quickly in stormwater facilities and cause major structural damage.

Denuded areas can cause major erosion problems that only worsen over time.

Loose dirt and sediment can wash down into a stormwater pond and damage the system. This can be controlled by properly stabilizing banks and side slopes with vegetative cover.

Erosion underneath pipes a.k.a. "undermining" can cause pipes to crack and separate.

Improper use of herbicides can destroy an ecosystem. If using chemicals, make sure that care is being conducted by properly trained personnel and always follow state and local codes.

Manufactured systems can become clogged up quickly with litter and should be cleaned out often.

Drains should be checked and cleaned often to prevent backups and flooding.

Closing

So now you should have a better understanding of stormwater best management practices and their importance in our everyday lives. So what's next? Why not take a look out the window next time you're driving down the street through your neighborhood or on your way to the supermarket. Stormwater BMPs are everywhere, working hard in the background of our lives to help keep our environment cleaner and protecting our local waterways. For more ideas on how you can help make a difference in your community, please visit some of our local partners below to help get started today.

Partners/Acknowledgments:

- Virginia Department of Conservation and Recreation, Division of Soil and Water Conservation. 1999. Virginia Stormwater Management Handbook. First Edition, Volumes One and Two.
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- The Chesapeake Bay Journal http://ceds.org/audit/ChesaBaySWMBMPAudit.pdf
- EPA Bay Enforcement Strategy http://www.epa.gov/enforcement/water/chesapeakebay.html
- City of Suffolk Stormwater Division www.suffolkva.us/pub_wks/engineering-stormwater

Interesting Facts About Water

Amazing Stuff? What is it?

Here's a hint. Even though it has the most unique properties of any substance on Earth, it's pretty easy to find. In fact, it's the most common substance on the planet. We are surrounded by it. It's in everything that lives; all living beings are made up mostly of it.

So what are we talking about?

WATER.

Facts

· Every living thing (organism) on Earth is *mostly* water. An elephant is 70 percent water; a tomato is 90 percent water; of mice and men, water is 65 percent.

· The quantity of water on Earth is static – 326 million cubic miles. One cubic mile contains 1,000,000,000,000 (one trillion) gallons of water.

· About 70 percent of Earth's surface is covered by water.

· Ninety-seven percent of Earth's water is in oceans. The remaining three percent is freshwater. Two of that three percent is held in ice caps or glaciers; .5 percent is groundwater; .02 percent is in lakes and rivers; .001 percent is in the atmosphere.

· Half the world's fish come from .001 percent of the ocean, along coastal areas.

· Eighty-five percent of the water vapor in the atmosphere evaporates from our oceans. Plant transpiration also adds much water to the air. Most trees give off about 70 gallons of water a day. One acre of corn transpires 4,000 gallons per day.

· From 20 to 50 percent of the water in streams comes from groundwater.

Properties

· Water is the only substance on Earth that exists naturally in three forms: solid (ice), liquid, and gas (water vapor or steam).

· Water moderates Earth's climate because it absorbs and releases heat slowly.

· It's called the *universal solvent* because, given time, it can dissolve anything except a few man-made compounds.

· Like most liquids, water becomes more dense as it gets cooler until it reaches 39 degrees F. Once it reaches 32 degrees, it expands instead and, because of this, floats. If it didn't, the sun couldn't melt it and bodies of water would only have a thin layer of water (the rest would be ice) on their surface and, even then, only in the summer. Aquatic life would not exist – no life would.

· Water weighs 62.4 lbs. per cubic foot.

· Water has very high surface tension. That's why water bugs can walk on it.

· Only ammonia absorbs heat better than water.

· It is the only *common* substance that exists as a liquid at normal temperatures. It freezes at 32 degrees and boils at 212 degrees F.

Human Use

· Factories use more water than any other material.

· *Per capita* use of water in the United States is about 1,600 gallons per person per day. Of that, about 70 gallons are for domestic use, 650 for irrigation and 820 for industry.

· Precipitation ends up in the following places: Municipalities, .42 percent; Irrigation, 2.46 percent; Industry, 3.12

- more

percent; Oceans, 24 percent; Evaporation 70 percent.

· America has more faucets and toilets than any other country. Flushing a toilet uses about three gallons of water. Running a shower uses five gallons *a minute;* a bath takes about 35 gallons. Washing dishes by hand takes about five gallons; an automatic dishwasher uses about 30 gallons.

· It takes about 150 gallons of water to produce a newspaper.

· In the United States, water costs about 45¢ per 1,000 gallons.

· Public water utilities supply about 80 percent of the U.S. population. Most cities use groundwater, but most *large* cities depend mainly on surface water sources.

· Why can't we live off sea water? Our kidneys can't handle the salt. Sea water has about seven times the acceptable salt level. We would die of dehydration because our kidneys could not expel the excessive salt.

· The water in your body is billions of years old. It has been *recycled* millions of times.

Pollution

· Not all pollution is man-made. Volcanic ash, for example, can kill aquatic life. Some sediment pollution is caused by natural erosion, without which there would be no Grand Canyon. Man can do little to control natural pollution.

· According to the Federal Water Quality Administration, the United States' southeastern region, which includes Virginia, has the lowest percentage of polluted stream miles. Here's how all regions of the country fare: Southeast, 8 percent; Pacific States, 25 percent; Southern Plains, 29 percent; Northeast, 40 percent; Northern Plains, 42 percent.

· Nearby waterways had the following percentages of polluted miles: Susquehanna, 20 percent; Upper Chesapeake Bay, 10 percent; Potomac River, 15 percent.

· Water pollution originates from three major sources: industry, sewage and agriculture.

· By the year 2020, the United States will produce three times the sewage it did in 1970. Four-fifths is treated, 10 percent goes through septic systems and 10 percent goes untreated.

· Cholera, typhoid fever and dysentery are transmitted through water. Chlorination eliminates these diseases.

· The following are *not* eliminated by chlorine: Polychlorinated biphenyls (PCBs), chloroform, arsenic, lead and mercury pollution. All have been found in groundwater and municipal drinking water supplies.

· By volume, sediment (suspended soil particles) is the greatest pollutant.

· Pollutants from farmland include animal waste, excess nutrients (from fertilizer), sediment and pesticides. In the United States, waste from farm animals is estimated to be 20 times that produced by humans.

· Fertilizer and nutrients from farmland, household detergents and sewage stimulate excess algae growth in waterways. The algae die, respire and decay. If water has too much organic waste, such as dead algae, bacteria use more dissolved oxygen than usual. Most aquatic life does well in water with oxygen concentrations of nine parts per million. Concentrations less than five parts per million will asphyxiate some species.

· Some industries, such as steel mills, require good water quality for production. Others, such as tourism and commercial fisheries, suffer because of polluted water.

· Because water pollution can curtail economic growth, lower worker health standards and income can result.

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