REDUCING BACTERIA WITH BEST MANAGEMENT PRACTICES

Bacteria found in surface waters can be separated into two sources, point and non-point. Point sources can usually be directly identified, such as a discharge pipe from a sewage treatment plant. Non-point source pollution comes from many diffuse sources, making it difficult to determine the actual source(s) and even harder to control. Typically, non-point sources of bacteria result from rainfall or snowmelt moving over and through the ground. As runoff moves across surfaces, it picks up and carries bacteria, finally depositing them into lakes and rivers.

The bacteria that cause the most concern are those naturally found in the digestive tract of warm blooded animals, known as fecal bacteria. Fecal bacteria levels in water are determined by incubating a water sample for 24 hours and then counting the number of bacterial colonies that grew during that time. The unit for reporting fecal bacteria is "colony-producing units" per 100 milliliters of water (CPU/100 mL). CPUs/100 mL is used interchangeably with "organisms per 100 mL."

Listed below are examples of possible known sources that contribute to fecal bacteria contamination to our waterways:

- Livestock - cows, horses, donkeys, chickens, and sheep
- Pet wastes - dogs and cats
- Wildlife - deer, raccoons, and birds - such as geese and ducks
- Human - septic systems and wastewater treatment plants

Bacteria survival is dependent on soil moisture, temperature, pH, availability of nutrients and antagonistic organisms. Under ideal conditions the bacteria is retained near the soil surface long enough for infiltration into unsaturated soil to occur resulting in bacteria die off within the first two feet. Under less than ideal conditions, best management practices (BMPs) are the most effective and practical means of preventing or reducing bacteria from entering surface waters.

BMPs reduce bacteria levels in many different ways. Non-structural BMPs are practices that mainly control bacteria at the source. These practices include routine septic inspections and pump-outs. Septic tanks should be inspected every three years and pumped as needed, usually every three years or when the tank is about 1/3 filled. By maintaining your septic system regularly, it is less likely to fail and contaminate surface or ground water. It also extends the longevity of your septic system, saving money for costly repairs or replacements. Another very inexpensive non-structural BMP is simply being a good neighbor and managing pet waste properly. Another example is managing livestock manure.

Structural BMPs usually involve building a structure and may have a higher cost associated with it. Examples include buffers, constructed wetlands, sand filters, infiltration trenches, low impact development, and stream fencing. Dense vegetative buffers facilitate conventional bacteria removal through detention, filtration by vegetation, and infiltration into soil.

Other methods include the use of chemicals such as chlorine or even using ultraviolet lights. These methods can be costly and require considerable oversight

Constructed Wetlands

Constructed wetlands offer wildlife habitat, erosion control, surface water storage, flood control, ground water recharge, and pollutant removal. They can be useful in conjunction with other BMPs or they can function independently. It is very difficult to preserve the natural ecology of natural wetlands, which is why the use of constructed wetlands is much more prominent.

A study conducted in California (2001) indicated that a three cell constructed wetland could reduce bacteria by 90%.

Buffer Strips

Buffer strips are vegetated sections of land that are essentially flat or have low slopes designed to reduce the runoff volume. Densely vegetative cover removes pollutants through detention of runoff, filtration by the vegetation, and infiltration into soil. The effectiveness of buffers for reducing bacteria pollution, however, is dependent on the type of vegetation and the width of the buffer. Typically, the wider the buffer, the more pollution reduced. A study done in Virginia in 2003

indicated that buffers can reduce bacteria by 43 to 57%, especially in agricultural watersheds.

Sand Filters

Sand filters are a storm water treatment practice designed to remove sediment and pollutants from the first flush of runoff from pavement and impervious areas after a rain or storm event. Sand filters are very adaptable to their surroundings and tend to have a low failure rate. Sand filters require some maintenance, mainly removing trash and large debris that can clog the filter. Stormwater Best Management practices database (2001) indicated that sand filters are effective in removing from 36 to 83% of the bacteria in urban runoff.

Infiltration Trenches

An infiltration trench is an excavated trench that has been lined with filter fabric and backfilled with stone to form an underground basin. Storm water is directed into trenches through the use of grass areas or pretreatment devices. Trenches tend to be more suitable for ultra-urban situations, where the soil has low permeability. Experience suggests that if properly sited with adequate separation distance to ground water and maintained, infiltration BMPs will not result in bacteria contamination of groundwater.

Low Impact Development (LID)

LID is the integration of ecological and environmental goals and requirements into all phases of urban planning and site design from brownfields to individual residential lots to the entire watershed. LID varies from traditional stormwater practices by reducing runoff volumes as a result of attempting to recreate drainage patterns to the pre-construction state. LID practices include but are not limited to: green roofs, permeable pavers, bioretention areas, grass swales, rain gardens, and minimizing impervious areas. These practices increase runoff infiltration, storage, filtering, evaporation, and onsite detention. These examples are BMPs that can help reduce bacteria in surface water; however data is not available to determine the level of reduction that can be attributed to these practices.

Stream Fencing

Fencing livestock out of streams is a highly effective method of reducing the amount of bacteria in surface waters. A number of states have reduced bacteria contamination in impaired streams using this method. Soil and water conservation districts typically provide cost share for this practice, reducing the cost of installation.

Livestock Manure Management

Livestock manure can be a significant source of bacteria to our streams. Some studies have suggested that runoff from barnyards may have the highest potential of any agricultural operations to contaminate our streams. Runoff from manure treated fields could contain up to 25% of the bacteria applied to the field through the animal wastes. As stated above, livestock access to streams results in direct discharge of bacteria into stream. The proper collection, storage, transportation, and application of animal waste on the farm and significantly reduce bacteria loss from runoff. Some states restrict manure application during certain weather conditions. Other states, including Delaware, specify how manure must be stored, including the shape of the manure storage pile when stored outside. Long term storage (4 to 6 months) of livestock wastes can reduce bacteria numbers significantly and has been cited as the single most important BMP for livestock manures.

Pooper Scooping

Pet waste contains bacteria and parasites, as well as organic matter and nutrients, notably nitrogen and phosphorous. If not properly managed, pet wastes can contribute significant amounts of bacteria and pollutants to our waterways. Managing pet waste properly is something that everyone can do to make a difference in their respective watersheds. Individual actions result in significant water quality improvement when carried out by the majority. Unlike some forms of stormwater pollutants, pet waste can be easily and economically managed by the individual.

References

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TYPICAL BACTERIA, SUSPENDED SOLIDS, AND NUTRIENT REDUCTION FROM STORMWATER BEST MANAGEMENT PRACTICES.

BMP	Land Area Needed	Cost	Total Nitrogen % Reduction	Total Phosphorus % Reduction	Suspended Solids % Reduction	Bacteria Reduction %
Buffer Strips	Low	Medium	20 - 60	20 - 60	20 - 80	43-57
Constructed Wetlands	N/A	N/A	-103	-217	-398	78-90
Sand Filters	N/A	N/A	47	41	57	36-83
Dry Detention Pond	High	High	15	25	70	
Infiltration Trenches	Low	Medium	45 - 70	50 - 75	75 - 99	
Wet Ponds*	Medium	High	0.4	0.5	55-94	44-99
Biofiltration	N/A	N/A	25	34		>99
Bioswales	Low	Medium	25	34	70	
Storm water wetlands	N/A	N/A	30	49	N/A	78-90

*If Properly Managed

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