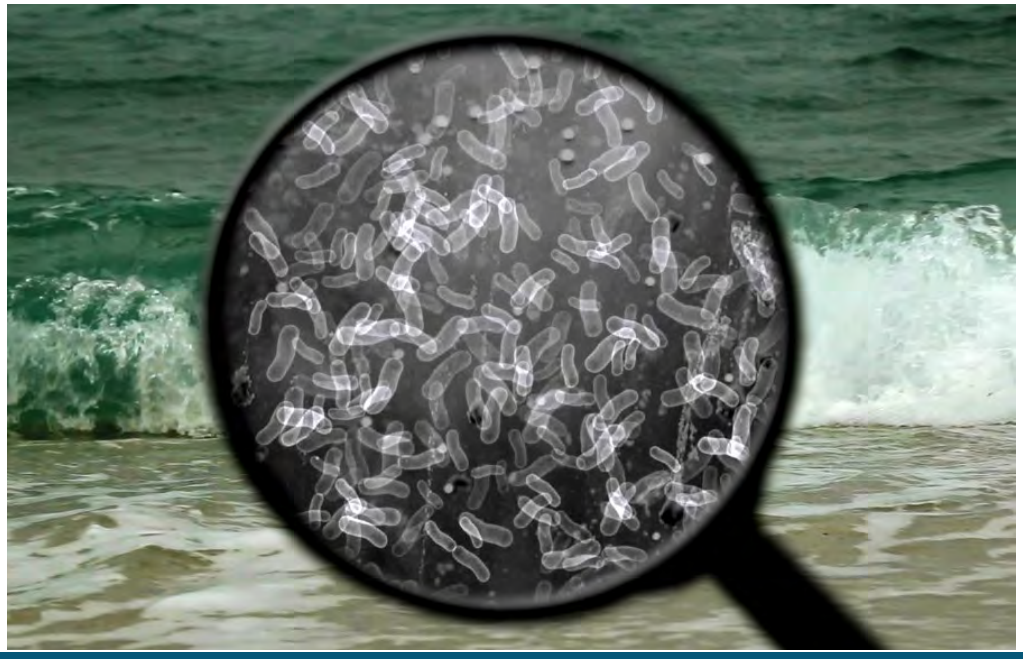
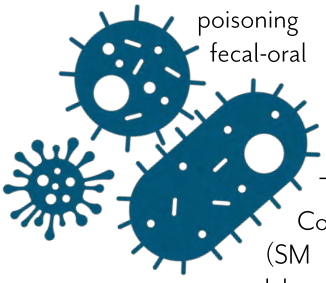
Pathogens. The sneakiest of pollutants which often get overlooked when it comes to monitoring are probably the biggest biological concern for water quality. Pathogens can render serious health issues for people with compromised immune systems and be extremely detrimental for certain species of fish and wildlife. In this month's edition of **The Rain Events,** we are going to be taking a look at these microbe pollutants which are on the TMDL and 303(d) lists of impairments. We will also identify some industrial potential sources, and learn how to prevent pathogen pollution.

Otherwise known as micropollutants.

So, what are pathogens? The term "pathogen" comes from two Greek words: *pathos*, meaning "suffering," and *genus*, meaning "origin." Thus, pathogens are literally microorganisms that are the "*origin of suffering*" - or, as we might say, they can cause disease. Pathogens include some types of bacteria, viruses, protozoans, fungi, and other microbes. Let's clarify that statement a little further. ***A pathogen is a microorganism that has the potential to cause disease.*** An infection is the invasion and multiplication of pathogenic microbes in an individual or population. A disease is when the infection causes damage to the individual's vital functions or systems. ***An infection does not always result in a disease.*** And we must make a distinction between non-infectious microorganisms and infectious pathogens. ***Keep in mind that while all pathogens are infectious microorganisms, very few microorganisms are infectious pathogens.*** Some estimate that as little as 1% of bacterial species are pathogenic. Many microbes such as viruses are pathogenic to some species but not others. And as anyone who has ever eaten yogurt, cheese, sauerkraut, or kombucha knows, some microorganisms are perfectly safe to ingest and actually help the body maintain a healthy microbiota or bacterial flora. Hence the popular craze about eating probiotic foods. Interestingly, many of the microbes that storm water professionals refer to as "pathogens" are not necessarily pathogens, but actually ***indicator organisms***. It's tremendously difficult to count and identify all species of microorganisms in a sample and determine which are pathogenic, so ***scientists utilize indicator organisms – harmless bacteria that indicate the potential presence of pathogenic bacteria or viruses***. And since many pathogens follow the fecal-oral route of infection, fecal coliform bacteria are used to indicate the presence of sewage or fecal matter in the water column, which could be a potential source of pathogens. Fecal coliform bacteria include a handful of bacteria genera, such as: *Escherichia, Enterobacter, Klebsiella,* and *Citrobacter*. You probably recognize the sometimes-pathogenic *Escherichia coli*, or *E. coli*, for its common association with food





poisoning (remember the fecal-oral contamination route? Yeah, disgusting!). If you request a Total Fecal Coliform analysis (SM 9223B) from your storm water laboratory, you will get one of two results: either an unquantified present/absent report, or a Most Probable Number (MPN) report which provides essentially an educated guess on the amount of fecal coliform bacteria present per 100ml of water sampled. If fecal coliform bacteria are detected in a water column, it likely indicates the water has come into contact with fecal material, either through raw sewage, wild animal or bird feces, or pet and livestock feces. Strictly speaking, fecal coliform bacteria are ***"opportunistic pathogens,"*** which means that given the right circumstances and environments they can be pathogenic, but generally they are harmless. So, referring to the 303(d) list of biological impairments as "pathogens" is not always true. Enteric viruses are pathogenic, as are some serotypes of fecal coliform bacteria such as *E. coli O157:H7*. So, despite the title of this month's article, a more appropriate term for these potential pollutants could be ***"biohazards,"*** which refers to the CDC's classification system that ranks biological substances and microorganisms on a scale that ranges from non-infectious to pathogens.

But, let's tie this all together. **When we're talking about the 303(d) and TMDL impairment lists, it isn't a question of whether a microbe is pathogenic or not. Rather, it's a question of whether a particular water body is impaired for a particular microbe.** Most of the microbes listed on the 303(d) and TMDL lists are fecal coliform bacteria, which are not necessarily pathogenic, and are easy to test for in an analytical laboratory. However, there are a few water bodies in California which are impaired for enteroviruses, which are pathogenic viruses that infect the gastrointestinal tract. But since we know that fecal coliform bacteria are indicator organisms, in the unlikely case that you need to sample for enteroviruses, you can use the SM 2993B fecal coliform analytical test as an indicator for the potential presence of enteroviruses.

Grossed out yet? Well, hang in there! You need to find out whether you need to test for pathogens. Testing for pathogens depends on whether your facility has an industrial source of fecal contamination. Generally speaking, pathogens infect storm water by sanitary sewer overflows, the improper disposal of pet waste, and soil contaminated with solid waste. But there are also some industries which may have an actual identifiable industrial source of contamination. Those being:

- Animal feedlots (SIC Codes 02XX)
- Slaughterhouses and Meat Products (SIC Codes 2011-2015)
- Sewage or Wastewater Treatment Works (see IGP Attachment A, Category 9)

Even if your facility has industrial sources of fecal bacteria, remember that fecal bacteria is an indicator organism itself—so before you add Total Fecal Coliform to your list of sampling parameters, check to see if there is another activity indicator parameter that you can use. **Fecal bacteria is so widespread and uncontrollable (bird poop, for example), that it's not very useful in determining if your facility is actually discharging fecal-contaminated storm water, or if it's just background pollution.** For slaughterhouses and meat product facilities, a better test would be Biochemical Oxygen Demand (BOD), which will not only detect offal and fecal matter, but other organic pollutants such as blood. For animal feedlots, BOD would work as well, or Total Ammonia as N, which would target waste products such as urine and fecal material. Keep in mind that BOD and Ammonia both have NAL values, so they may not be as desirable as other indicator parameters without NALs. However, this is assuming your facility's receiving water is not listed on the 303 (d) or TMDL lists as impaired for fecal bacteria or enteroviruses. If your facility has an industrial source of fecal bacteria or enteroviruses **AND** your receiving water is listed on the 303(d) list, **OR** if your receiving water has a TMDL impairment for fecal bacteria you'll need to include the appropriate analytical test(s) in your sampling parameters. Depending on the impairments listed in the 303(d) or TMDL lists, you might need to add a couple different sampling parameters (such as Total Fecal Coliform, E. coli, and Enterococci) - talk to your analytical laboratory to determine the best approach for your situation.

Now that we've completely ruined lunch for you, how do you prevent the spread of pathogens or reduce the bacteria levels in storm water runoff? According to Allison Boyer an Environmental Control Specialist, "BMPs reduce bacteria levels in many different ways." She highlights a couple of examples of best management practices for pathogen minimization which include removing or controlling the source, making sure potential pathogen sources are periodically maintained and removed from the premise by professionals, and the use of buffers, constructed wetlands, sand filters, infiltration trenches, low impact development, and stream fencing.

Using naturally dense vegetative swales and buffers and retention areas facilitate bacteria removal through detention, filtration by vegetation, and infiltration into soil. If the pathogen pollutant load is still too high, other methods of sanitation include the use of chemicals such as chlorine or ultraviolet lights. However, these methods can be costly and high maintenance. Depending on the amount of pathogens on your facility and your ability to control the initial source, you may be able to go the natural route, and if not, the more scientific and effective route.

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Storm Water Contest...

Each month, we invite our readers to participate in a contest to test their knowledge of the Industrial General Permit and show their storm water compliance program. We enter all submittals to our monthly newsletter question into a drawing and one person is selected at random to receive a $25 gift card. Last month's contest question was:

What are some of the duties of a QISP?

Congratulations to Trieu who answered our contest question - *"A QISP's responsibilities include implementing the SWPPP, performing the Annual Comprehensive Facility Compliance Evaluation (Annual Evaluation), assisting in the preparation of Annual Reports, performing ERAs, and training appropriate Pollution Prevention Team members."* Trieu, we hope you enjoy some delicious chocolate on us!

...This Month's Contest

What type of industrial activity can be potential sources of pathogens?

We need industrial storm water sleuths to help us with this month's question. Submit your answers by Friday, May 13th. Email your answer to jteravskis@wgr-sw.com. One winner will be selected by a random drawing to receive a $25 gift card to Five Guys.

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