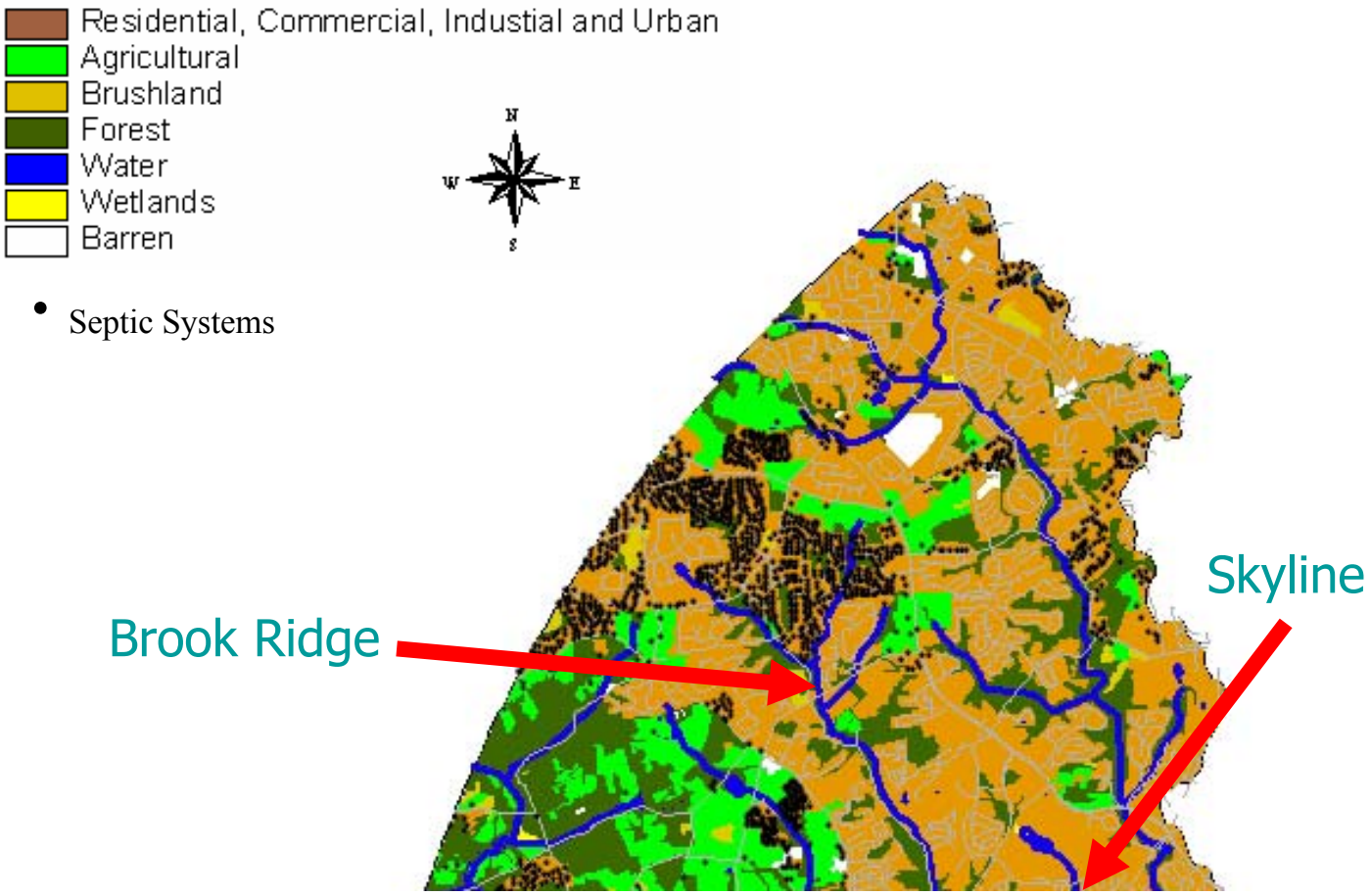
BACTERIA SOURCE TRACKING & BACTERIA TMDLs



DEFINTION
Bacteria Source Tracking is a method used to determine the sources of fecal bacteria contamination found in surface and/or ground waters. There are currently four Bacteria Source Tracking methods that are being developed and utilized: Biochemical, Molecular, Chemical, and Immunological. The Molecular based method compares "fingerprints" of isolated bacteria from known sources with "fingerprints" of unknown origin found in waterways. The "fingerprint" is created using a method called Ribotyping, which generates a band pattern or "fingerprint" of a bacteria isolate.

METHOD
Water ways are impaired due to fecal contamination to the point that the risk levels are greater than they were first evaluated by the fecal indicator bacteria concentration, which is why we use source tracking. Source tracking begins with the collection of fecal samples from known sources. Indicator bacteria from these sources (E. coli and Enterocci) are ribotyped to generate patterns for the resource library. Environmental samples are then acquired and the fecal indicator bacteria are isolated from those samples. Next, the samples are ribotyped to generate "fingerprints". After the samples are ribotyped, they are compared to known library samples which are then matched to their indicated sources.

DIFFERENT SOURCES OF BACTERIA
The bacteria found in surface waters come from many different sources. Bacteria can come from both point and non-point sources. 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). Typically, non-point sources result from rainfall or snowmelt moving over and through the ground. As the runoff moves, it picks up and carries away natural and human sources of bacteria, finally depositing them into lakes and rivers.

We use the E.coli and Enterococcus bacteria as our indicator organism, which are naturally found in the digestive tract of warm blooded animals. Listed below are examples of possible known sources that contribute to fecal bacteria contamination:

- Livestock - cows, horses, donkeys, chickens, and sheep

- Pet wastes - dogs and cats
- Wildlife - deer, raccoons, and birds
- Human - septic systems and wastewater treatment plants

Thus, scientists use source tracking to determine the origin of the fecal bacteria. For example, if a septic tank is leaking effluent directly into a stream, source tracking would enable a scientist to determine that the bacteria is coming from the septic tank by matching the bacteria fingerprint(s) that was found in the water with the bacteria fingerprint(s) found in the septic tank. Scientists also have to take into consideration the amount of fecal bacteria wildlife is contributing to a waterway. The fecal bacteria from wildlife are considered to be naturally occurring because there is not an easy way to prevent wildlife from defecating in a waterway.

Bacteria Source Tracking was used in a Pike Creek study to determine the source of bacteria found in the Creek (Table 1). Over a five day period, eleven water samples were collected from a subdivision, called Brookridge. Older communities containing onsite septic systems including cesspool are located upstream of Brookridge. Brookridge is situated one mile from Pike Creek. The Skyline area which was also included in these samples are served by sewer systems.

Table 1. Bacteria sources, as a percentage, in two small creeks flowing through one subdivision served by onsite systems, some containing cesspools and one subdivision served by a sewer district.

Bacterial Source	Brookridge-Cesspool	Skyline-Sewer
Horse	0	20
Waterfowl	0	7
Deer	5	2
Raccoon	6	9
Rodent	8	15
Birds	26	24
Dog	8	12
Cat	2	0
Human	22	1
Sewage	5	1
Unknown	18	9

This study concluded the area influenced by onsite systems contained 27% bacteria from human/sewage sources and the sewer systems study contained 2% bacteria from human/sewage sources.

A Total Maximum Daily Load (TMDL) or pollution limit can be determined for bacteria. TMDLs determine a maximum amount of bacteria which is allowed in a stream so that the stream can still be used for its intended uses, such as drinking water, swimming, and fishing. Significant portions of the Christina River are listed as impaired due to high bacteria levels. Consequently, these polluted streams and rivers must have reductions in bacteria loads in order to meet their intended uses. TMDLs help determine the unknown sources of fecal bacteria in the waterways, which in turn help with the reduction of fecal bacteria.

Reference:

1. http://www.wvu.edu/~agexten/landrec/TMDL.htm
2. http://www.epa.gov/owow/nps/qa.html
3. http://www.epa.gov/gmpo/presentations/bacterial.pdf
4. http://water.usgs.gov/nrp/proj.bib/microbiology/sourcetracking.html
5. http://www.epa.gov/gmpo/cac/bacterial_source_tracking_ellender.pdf
6. http://www.epa.gov/gmpo/presentations/bacterial.pdf

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