

Introduction:

Contaminants are constantly flowing through creeks and rivers in the Metropolitan area, which can sometimes impact the environment in harmful ways. Best Management Practices, or BMPs, can help diminish these contaminants, such as settling small particles (turbidity) out of the water.

Minnehaha and Shingle Creeks have BMPs along them. Wireless sensors were placed upstream and downstream from the BMPs, and conductivity and turbidity data was taken every minute for several months to evaluate how well the BMPs were performing.

Outfalls flowing into the Mississippi River from road runoff or other sources were also monitored. These outfalls were monitored and compared to water quality standards, in order to see if their pollutant concentration largely impacted the river's quality over time.

Why is this important?

What are BMPs?

- Best Management Practices is a term used to describe practices that can be implemented on a region to protect water quality and promote soil conservation.
- Other than retention ponds and swamp lands, other examples of BMPs are runoff diversions, silt fences, and vegetation on bare soil.

What does chloride do to ecosystems?

- It inhibits water absorption through plant roots.
- Since chloride ions are less reactive, they can accumulate and get into the air, soil, and water, either from snowmelt, soil, or spray off the wind. It can eventually infiltrate into our groundwater.
- It inhibits bacteria in soil, which has long-term impacts such as corrosion. It also means that potentially fewer bacteria will be in the water to eat DO (dissolved oxygen).

What does turbidity do to you?

- Turbidity is a measure of the clarity of water. If a water body has excess soil erosion, dissolved solids, or excess microorganisms, less light penetrates through the water. Without light, plants and fish are harmed.
- Turbidity doesn't hurt the body unless the colloids (particles) are dangerous themselves. Many times, the colloids are pieces of organic matter. Microorganisms in the water break down this organic matter, with the concomitant use of oxygen. A water body that has low DO as a result is unhealthy for fish and plants living in it.

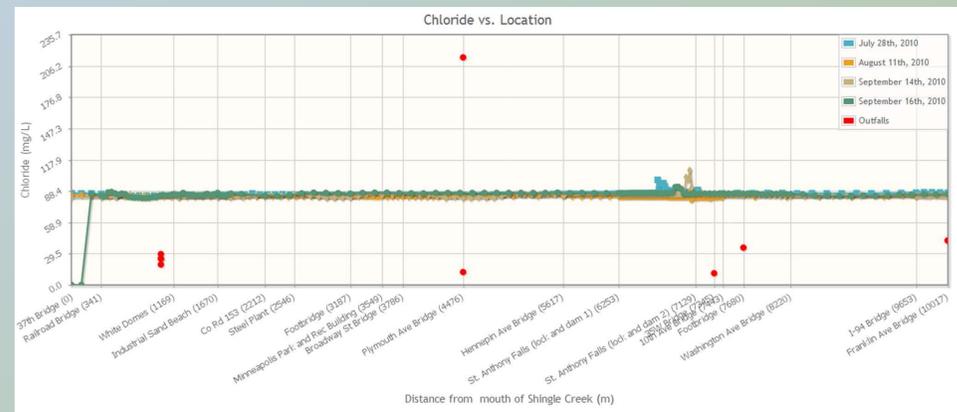
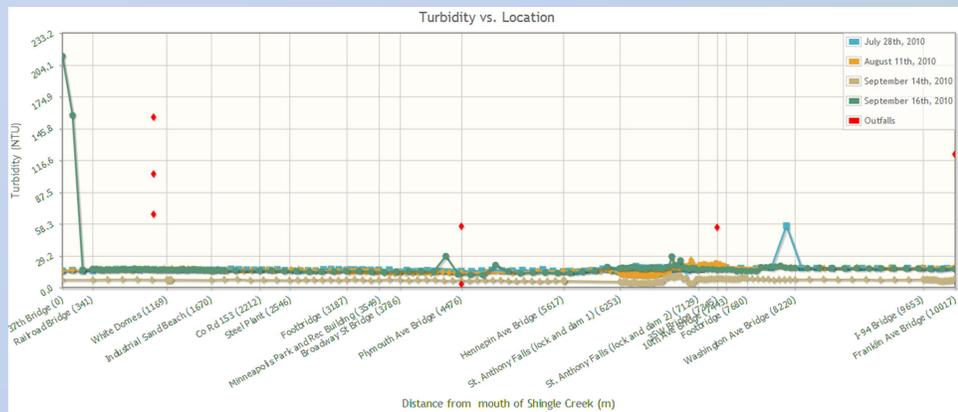
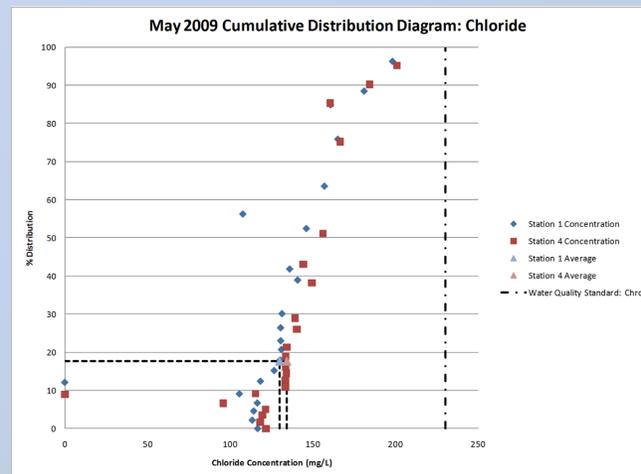
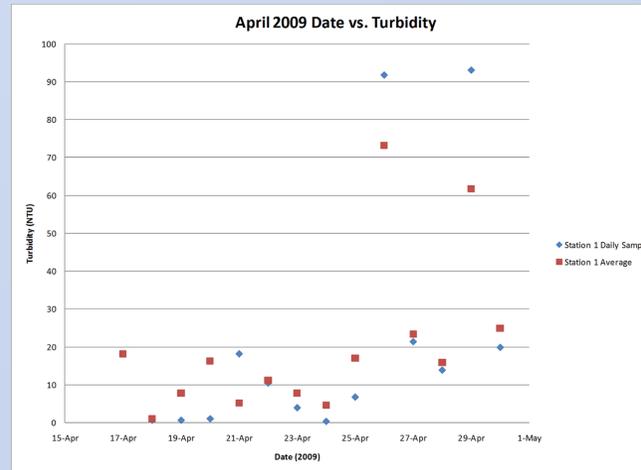
Evaluating and Monitoring BMPs with Networked Wireless Sensors

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Results:



Results and Conclusions:

Are BMPs working?

- Looking strictly at the turbidity in April, May, and June of 2009, the upstream turbidity, measured in NTU (Nephelometric Turbidity Units), has a significantly higher average than downstream, which implies that the BMPs are filtering out some suspended solids.
- Neither upstream or downstream turbidity data exceeds water quality standards. There is very little difference between upstream and downstream chloride concentrations. The BMPs are not significantly impacting chloride concentrations. The water quality standards were exceeded in April, but not May or June.

What is the difference between taking data every minute verses once a day every day?

- As one can see in the top figure, there is a difference in the average values obtained from sampling once a day verses every minute.
- At some points in time, there is as little as 7% difference between these values; at other points, there is as high as a 175% difference.

Is it worth it to clean our streams with BMPs, or do other measures need to be taken?

- Although the water quality standards were not exceeded in either May or June, they were in April, so the BMPs are not completely removing all of the turbidity that needs to be removed in order for the streams to stay healthy. More measures should be taken to ensure that the turbidity is controlled year-round.

Should outfall water be treated before it is released into the Mississippi?

- There were five outfalls that were monitored. The DO water quality standards are known for the Mississippi, and each outfall was analyzed to see if it met these standards. All of the outfalls met the standards except one, called 1NE. This is the outfall that is nearest to where Shingle Creek flows into the Mississippi.
- 25% of the measurements did not meet the chronic-level water quality standards. Those 25% only exceeded standards by 13.2%, so according to DO standards, it is not necessary to treat outfall water.
- 67% of the time, for all outfalls, the water quality standard for turbidity is exceeded.

References:

- Arnold, William. *Evaluating and Monitoring BMPs with Networked Wireless Sensors*. JWRG Proposal 2007, 2006.
- "How Does Chlorine in Water Affect My Health?" *Global Healing Center Health Products & Information*. Web. 10 Apr. 2011.
- "Impaired Waters and Total Maximum Daily Loads." EPA Office of Water. 9 July 2010. Web. 01 Oct. 2010.
- "Water Quality Monitoring." *Southwest Florida Water Management District*. Web. 10 Apr. 2011.
- "What Are BMPs?" *North Carolina Department of Environment and Natural Resources*. 1 May 2008. Web. 10 Apr. 2011.

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