

The Effect of Stormwater on Wastewater Treatability: A study of targeted Emerging Contaminants at a Wastewater Treatment Plant

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Bio on Presenter

- From Tuscaloosa, AL
- Graduated with Bachelor of Science in Chemistry from Stillman College (Tuscaloosa, AL)
- Obtained Master of Science in Environmental Management from Samford University (Birmingham, AL)
- Worked for four years for the Alabama Department of Public Health as a Public Health Environmentalist (Tuscaloosa, AL)
- currently pursuing a PhD in Environmental Engineering from the University of Alabama (2012)



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Outline

- Introduction
- History and importance
- Chemistry of targeted pollutants
- Site description/parameters for treatment plant
- Description of weather conditions
- Methodology
- Results
- Discussion

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Emerging Contaminants

- "Emerging contaminants" can be broadly defined as any synthetic or naturally occurring chemical or any microorganism that is not commonly monitored in the environment but has the potential to enter the environment and cause known or suspected adverse ecological and(or) human health effects. **USGS**

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History of Emerging Contaminants Research

- Pharmaceuticals were first reported in surface waters during the investigation of U.S. waterways in the 1970s, although they were not regulated as legacy pollutants such as PCBs and DDTs (Snyder 2006)
- Since the first reported occurrence of several antibiotics in river water samples there have been many investigations of antibiotics and publications documenting their presence in groundwater, surface water, wastewater and landfill leachate, including the National Reconnaissance study sponsored by the U.S. EPA and the U.S Geological Survey (Xu 2007, Kolpin 2003)

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Importance of Emerging Contaminants Research

- Fate and transport
- Potential effect on aquatic wildlife and potential risk to humans
- Knowing the effect of concentration levels and formulating adequate maximum concentration limits
- Finding method to reduce emission into waterways.

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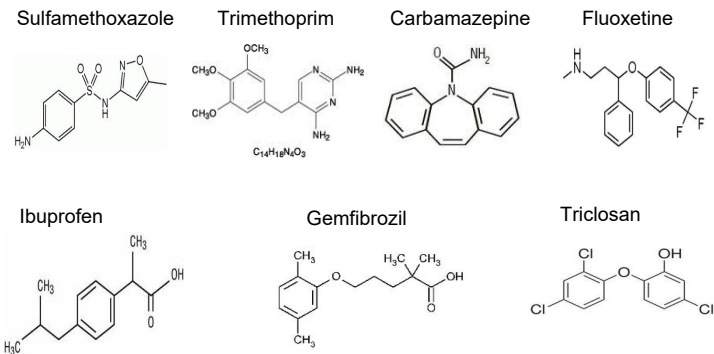
Types of Emerging Contaminants

- Pharmaceuticals and Personal Care Products (PPCPs)
- Estrogens
- Pesticides
- Microbial
- Heavy metals
- Polycyclic aromatic hydrocarbons (PAHs)

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Targeted Compounds

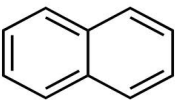
- Pharmaceuticals



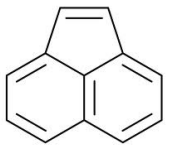
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Targeted Compounds

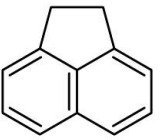
- PAHs



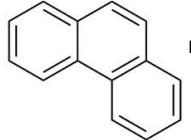
Naphthalene



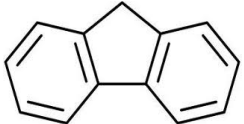
Acenaphthylene



Acenaphthene



Phenanthrene

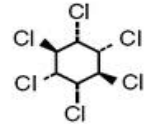


Fluorene

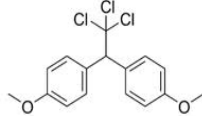
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Targeted Compounds

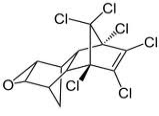
- Pesticides



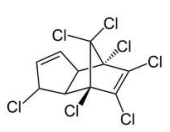
Lindane



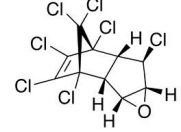
Methoxychlor



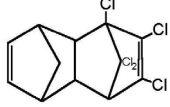
Dieldrin



Heptachlor



Heptachlor epoxide



Aldrin

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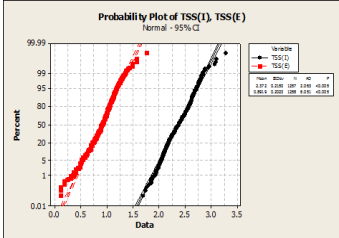
- Earl Hilliard Wastewater Treatment Plant**
 - A secondary treatment system with a pretreatment phase, a primary clarifier, an aeration tank, a secondary clarifier and UV disinfection system.
 - Capacity up to 24 MGD

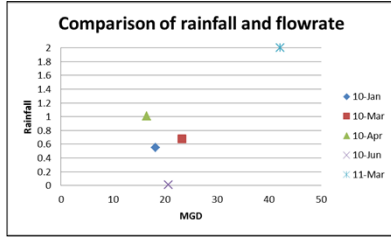


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Parameters





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Operation conditions (dry weather)

	Date	Rainfall (mm)	MGD	cfs
	10/24/10	0	15.7	24.3
	05/11/11	0	13.5	20.9
	05/14/11	0	30.7	47.5
	10/10/11	0	16.9	26.1
	12/05/11	0	18.0	27.8

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Operation Conditions (wet weather)

	Rainfall (in)	Rainfall (mm)	Flow rate (MGD)	Flow rate (cfs)
01/16/10	0.55	14.0	18.2	27.8
03/02/10	0.68	17.3	23.3	35.7
04/24/10	1.01	25.7	16.5	25.3
06/25/10	trace	0	20.7	31.2
10/24/10	trace	0	15.7	24.3
11/02/10	trace	0	20.5	31.7
03/09/11	2.7	68.6	42.2	63.4
09/20/11	2.2	55.9	26.5	41.0

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Sample schedule

- Four composite one liter samples
 - Inlet
 - Primary Clarifier
 - Secondary Clarifier
 - Disinfection
- Seven wet weather samples and seven dry weather samples
 - pharmaceuticals
 - PAHs
 - Pesticides

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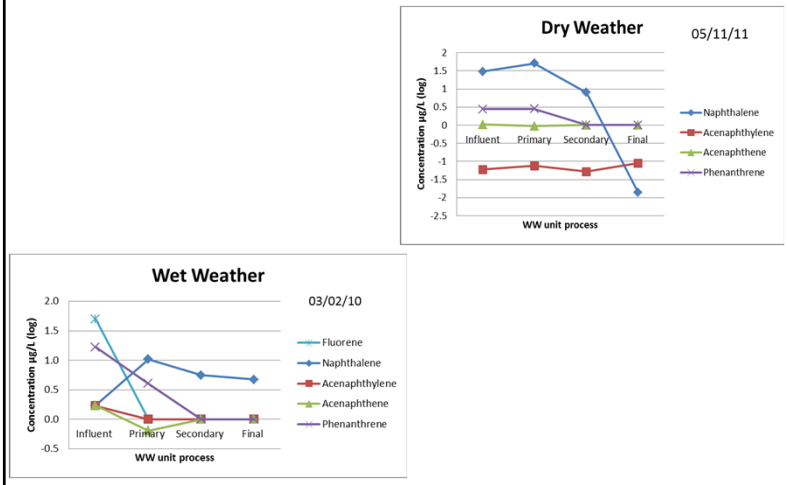
Analysis

- Acidic and basic pharmaceuticals
 - SPE
 - HPLC analysis
- PAHs
 - Separation flask with KD concentrations
 - GC-MS
- Pesticides
 - Separation flask with KD concentrations
 - GC-ECD

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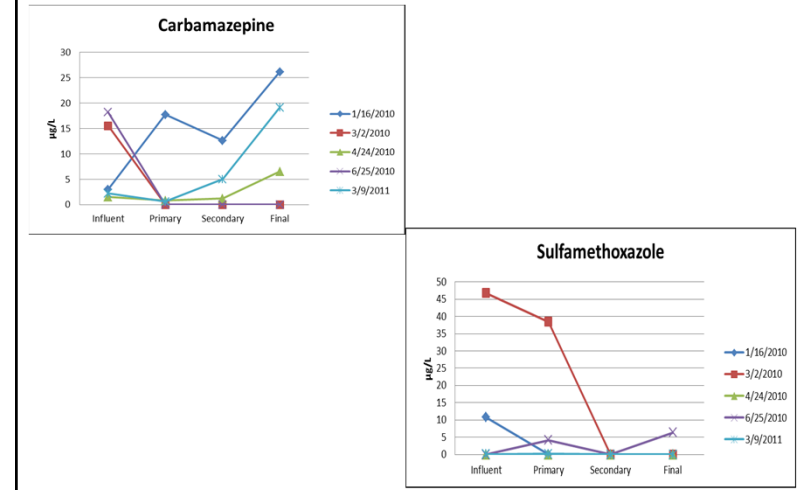
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Results



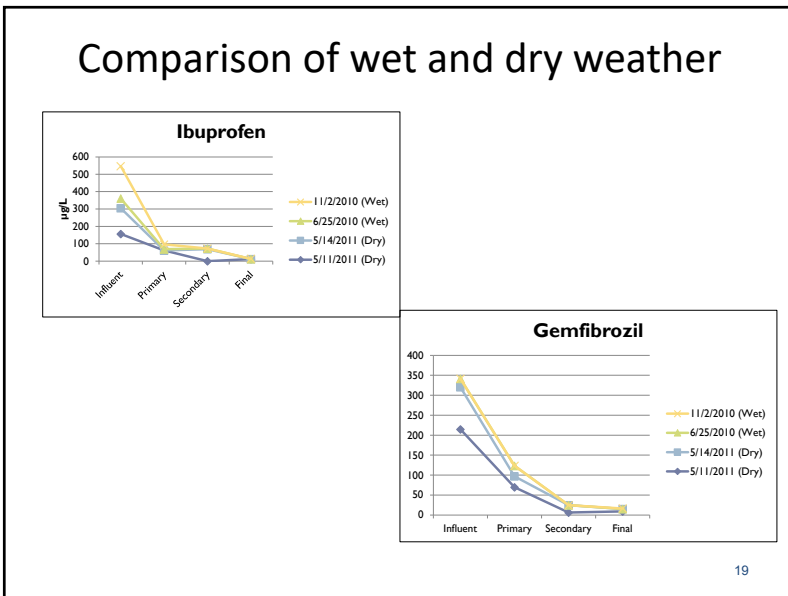
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Wet Weather example



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Comparison of wet and dry weather



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Mass of Pollutants (dry weather)

Pollutant	Rainfall (mm)	g/day (05/11/11)
Sulfamethoxazole	0	25.6
Trimethoprim	0	308.6
Carbamazepine	0	0.0
Fluoxetine	0	0.0
Acenaphthylene	0	3.0
Acenaphthene	0	53.1
Phenanthrene	0	140.5

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Mass of pollutants(wet weather)

Pollutant	Rainfall (mm)	g/day (03/02/10)
Sulfamethoxazole	17.3	4125.1
Trimethoprim	17.3	1258.1
Carbamazepine	17.3	1366.0
Fluoxetine	17.3	357.6
Acenaphthylene	17.3	149.6
Acenaphthene	17.3	151.5
Phenanthrene	17.3	108.0

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Discussion

- There is an increase of flow rate during high rain events
- PAHs show an increase in g/day during wet weather
- Wet weather concentrations are more variable than dry weather
- There are some results that show effluent concentrations are higher than influent concentration

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Conclusions for PAHs

- Stormwater is a contributor to some emerging contaminants, such as PAHs, into the wastewater treatment plant.
- There is some matrix interference that is causing some effluent concentrations to be higher than the influent concentrations.
- Although, higher concentrations of contaminants enter the wastewater treatment, secondary and final treatment has been shown to adequately remove the analytes.

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Conclusions for Pharmaceuticals

- There was an increase in mass for pharmaceuticals for the wet weather samples
- The reduction rates varied with each constituent
- Some pharmaceuticals had higher effluent concentrations than the influent concentration

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Acknowledgements

- U.S. Environmental Protection Agency
- University of Alabama
- Penn State University-Harrisburg
- Miles College, Birmingham, AL
- Dr. Robert Pitt

References

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- Xu W, Zhang G, Li X, Zou S, Li P, Hu Z, Li J. Occurrence and elimination of antibiotics at four sewage treatment plants in the pearl river delta (PRD), south china. *Water Res* 2007 11;41(19):4526-34.
- U.S. Geological Survey; Emerging Contaminants; <http://toxics.usgs.gov/regional/emc/index.html>

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Questions?



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