Evaluation of First Flush Phenomena for Chemical and Microbiological Pollutants in Red Cedar River
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BACKGROUND
Michigan climate is characterized by hot humid summers, cold winters with snowfall, and wet springs. The state receives a good amount of perception throughout the year, averaging 30-40 inches annually. This climate creates a long period of pollutant build-up deposited on surfaces during dry weather (November - March) and then washed away in spring when the snow starts to melt into rivers and lakes. The initial storms of the spring season usually have higher pollutant concentrations, which create a first flush phenomenon. These pollutants can be from different sources such as de-icing salts, animal waste, manure and biosolid applications, pesticides, fertilizers, etc.

PROJECT SUMMARY
Water samples were collected from Red Cedar River, a stream flowing through farmland and receiving wastewater effluent from several municipalities in central Michigan. The samples were analyzed for fecal indicators (E.coli), human and bovine associated Bacteroides markers, DOC, sodium, potassium, chloride and nitrate. Data from 2013 are presented here. The study continues in year 2014. The objectives of the study are to:
1. Monitor water quality of Red Cedar river.
2. Evaluate first flush phenomena (spring snow melt).
3. Identify pollution sources and pollution loads discharged into Red Cedar River.
4. Study the fate and transport of contaminants.
5. Study the effect of the DOC on nutrient and contaminant release and transport.

RESULTS
The following graphs summarize 2013 sampling during spring and summer. More than 110 samples were analyzed for chemical and microbiological parameters. Rainfall and river discharge were recorded.

CONCLUSIONS
We observed high concentrations of chemical and microbiological contaminants in the Red Cedar River following first spring rainfall events and snow melt in 2013. The peak concentrations of E.coli and Bacteroides are associated with river discharge peaks.

FUTURE WORK
1. Continue sampling and analysis in 2014.
2. Describe microbial pollution and nutrient release under spring snow melt, and summer, and fall rainfall seasons.
3. Include additional sampling points to identify contribution of farms and wastewater discharge.
4. Model the release of microbial contaminants

CONCEPTUAL APPROACH