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Non-Point Source Pollution Water Quality Assessment of Southern Manitowoc County Creeks

Summer 2013

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LAKESHORE NATURAL RESOURCE PARTNERSHIP, INC.
LNRP

Friends of Hika Bay
Calvin, Pine, Point, Fischer, Centerville Creeks

Partners

The stream assessment research is supported by the UW-Manitowoc Biology Department, Lakeshore Natural Resource Partnership, and Friends of Hika Bay. This partnership formed in 2010 to develop a science-based water quality monitoring and assessment program involving Centerville Creek in southern Manitowoc County.

Background

In 2012, University of Wisconsin-Manitowoc began research on Point, Fischer, Pine, and Calvin Creeks which flow through Southern Manitowoc County into Lake Michigan. This is an expansion of the research started in 2010 on Centerville Creek, also in Southern Manitowoc County. These four creeks were added to increase the amount of data available for local land owners, community-based programs and wildlife management organizations. In summer of 2013, two sampling points were designated for each of the four creeks, allowing readings from upstream and downstream locations, creating a better understanding of physical, nutrient, and biological parameters throughout the watershed. The main focus of the research was to understand the ecology and health of the creeks based on land use and how this impacts Lake Michigan. Specifically, our objectives were to collect water quality data by taking weekly samples of physical, nutrient, and biological parameters of the creeks. In addition, when rain events occurred (accumulating one or more inch of rain), 24 and 48 hour samplings took place. Physical data collected included: temperature, turbidity, pH, conductivity and dissolved oxygen. Nutrient data collected included: total phosphate, dissolved phosphate and ammonia nitrogen (NH3, NH4). Finally, *E.coli* levels were monitored as a biological parameter of stream health.

Major Findings

When compared to the data collected in 2012, both Pine and Calvin creeks showed a decrease in total phosphate and *E. coli* numbers, but an increase in dissolved phosphate. While comparing data from Point creek and Fischer creek to data from 2012, there was a decrease in the levels of both total and dissolved phosphates as well as *E.coli*. In Point Creek, *E. coli* tended to increase downstream rather than decrease. Fischer Creek's *E. coli* trends were also consistent with those of summer 2012 by increasing downstream. All four creeks sampled showed unacceptably high levels of *E. coli* and phosphate which are large indicators of high levels of runoff and represent potential health concerns in the watershed. The runoff is believed to occur from multiple source points along the creeks. Research has shown that phosphate is a contributor to *Cladophora* growth. High phosphates levels are postulated to have led to large amounts of *Cladophora* at the mouths of the creeks on the Lake. This increase of *Cladophora* may be connected to the inverse of the normal trend of phosphates decreasing downstream which may be caused from large amounts of runoff.

Sampling Methodologies

Water Quality Parameter	Method	Units
Water Temperature	Thermometer	°C
pH	Meter	1-12 scale
Stream Velocity	Flow meter	Feet per second
Turbidity	Meter	NTU (Nephelometric Turbidity Units)
Ammonia nitrogen	Hach test kit	mg/L
Phosphate	Colorimetric method using a Spectrophotometer	mg/L
Conductivity	Meter	µS (microsiemen)
Dissolved oxygen	Dissolved oxygen meter	mg/L
E. coli	Colilert method	MPN/100 ml (Most Probable Number)

Suggestions For Future Research

The addition of sample sites to the creeks with a stronger emphasis on sampling farther inland to assess land use would allow us to assess in greater detail where the pollution is entering the water system.

Another change we recommend would be to reduce the standard for a “rain event” of 1.0 inch, to 0.5 inches or more. This change would help the fact that the qualification of a “rain event” needing to be 1.0 in. or greater limited our abilities to collect rain event data, especially when the average rainfall, even on testing days, rarely met the 1.0 in standard. Changes in data recorded on days with less than one inch of rain leads us to think it is necessary to lower the standard to 0.5 inches.

Discussion

Pine Creek:

P107	S. Gass Lake Road
P106	Highway U

Agreeing with data from summer 2012, phosphate levels did not follow the general trends seen in other streams of increasing downstream, but rather decreased downstream. This reverse of the trend line may indicate a pollution source farther inland than our testing sites. A difference in the data of summer 2013, to the data of summer 2012**,** was that *E. coli* increased downstream which follows the general trend line. Even with phosphate not following the general trend line, it was still above acceptable levels.

Also agreeing with the data of summer 2012, most physical parameters followed trends of decreasing downstream in summer 2013. However, in 2012, turbidity was observed to increase instead of decrease whereas in 2013 there was less turbidity which may have contributed to the lack of rainfall.

Differences Between Averages of Data Collected in 2012 and 2013 – Pine Creek

Averages for All Creek Sample Points	Summer 2012	Summer 2013	Difference
Water temperature (°C)	17.50	16.82	-0.68
pH	8.31	8.50	+0.19
Turbidity (NTU)	10.35	11.85	+1.5
Stream flow (M/sec)	0.3	0.5	+0.2
Conductivity (µS)	841	858	+17
Dissolved oxygen (mg/L)	7.34295	8.76923	+1.42628
Total Dissolved Phosphate (mg/L)	0.01695	0.03197	+0.01502
Total Phosphate (mg/L)	0.08541	0.07344	-0.01197
Ammonia nitrogen (NH3) (mg/L)	0.01901	0.02548	+0.00679
Ammonia nitrogen (NH4) (mg/L)	0.23933	0.22241	-0.01692
E. coli (MPN/100 ml)	770.975	722.204	-48.771

Test	Standard Acceptable Ranges During Summer
Water Temperature	10-19°C
pH	5.8 to 8.5
Turbidity	1 to 5 NTU
Dissolved Oxygen	>5.0 ppm
Total Phosphate	0.01 to 0.03 ppm and <0.1 ppm maximum
Un-ionized Ammonia (NH_3)	<0.1 mg/l
Total Ammonia, Nitrogen (NH_4)	<0.5 mg/l
E coli	Advisory: >235 Closed: >1000

Calvin Creek:

CA02	Northeim Road
CA01	S. 26th Street

The data from 2013 shows turbidity, phosphate levels and *E.coli* counts were above the normal range. *E. coli*, dissolved oxygen, and turbidity increased downstream. Normally high *E. coli* levels would lead to lower dissolved oxygen, however, the dramatic increase of stream flow and decrease of temperature between CA02 and CA01 may explain the high levels of dissolved oxygen and turbidity. This increase in *E.coli*, phosphates and turbidity also matches a trend found in the data of 2012

Because ammonium nitrogen and phosphate did not follow the general trend lines of increasing downstream, they indicate a pollution source farther inland then our testing sites.

Differences Between Averages of Data Collected in 2012 and 2013 – Calvin Creek

Averages for All Creek Sample Points	Summer 2012	Summer 2013	Difference
Water temperature (°C)	18.55	18.30	-0.25
pH	8.37	8.57	+0.2
Turbidity (NTU)	12.46	17.18	+4.72
Stream flow (M/sec)	0.1	0.6	+0.5
Conductivity (µS)	674	695	+21
Dissolved oxygen (mg/L)	6.77061	8.09961	+1.32900
Total Dissolved Phosphate (mg/L)	0.03873	0.04292	+0.00419
Total Phosphate (mg/L)	0.10408	0.09352	-0.01056
Ammonia nitrogen (NH3) (mg/L)	0.02850	0.03748	+0.00898
Ammonia nitrogen (NH4) (mg/L)	0.39064	0.28440	-0.10624
E. coli (MPN/100 ml)	1396.349	1279.581	-116.768

Test	Standard Acceptable Ranges During Summer
Water Temperature	10-19°C
pH	5.8 to 8.5
Turbidity	1 to 5 NTU
Dissolved Oxygen	>5.0 ppm
Total Phosphate	0.01 to 0.03 ppm and <0.1 ppm maximum
Un-ionized Ammonia (NH_3)	<0.1 mg/l
Total Ammonia, Nitrogen (NH_4)	<0.5 mg/l
E coli	Advisory: >235 Closed: >1000

Point Creek:

PO03	S. Gass Lake Road
PO02	Schutte's Property

Much like Calvin Creek, Point Creek appeared to follow the same trends of phosphates decreasing downstream whereas *E. coli* and dissolved oxygen increasing downstream. The increase of dissolved oxygen maybe linked to the increase of stream flow and decrease of temperature between PO03 and PO02.

Phosphate levels continue to be above what is considered the acceptable range. Because of the phosphate levels decreasing downstream, we are inclined to believe there is a source of pollution farther upstream from our sampling sites.

Differences Between Averages of Data Collected in 2012 and 2013 – Point Creek

Averages for All Creek Sample Points	Summer 2012	Summer 2013	Difference
Water temperature (°C)	19.21	18.15	-1.06
pH	8.51	8.69	+0.18
Turbidity (NTU)	14.14	6.61	-7.53
Stream flow (M/sec)	0.4	1.3	+0.9
Conductivity (µS)	717.2	748.1	+30.9
Dissolved oxygen (mg/L)	7.86765	8.48153	+0.61388
Total Dissolved Phosphate (mg/L)	0.03407	0.03182	-0.00225
Total Phosphate (mg/L)	0.08035	0.05895	-0.0214
Ammonia nitrogen (NH3) (mg/L)	0.03275	0.03081	-0.00194
Ammonia nitrogen (NH4) (mg/L)	0.27734	0.17162	-0.10572
E. coli (MPN/100 ml)	841.665	706.062	-136.603

Test	**Standard Acceptable Ranges During Summer**
Water Temperature	10-19^{o}C
pH	5.8 to 8.5
Turbidity	1 to 5 NTU
Dissolved Oxygen	>5.0 ppm
Total Phosphate	0.01 to 0.03 ppm and <0.1 ppm maximum
Un-ionized Ammonia (NH_3)	<0.1 mg/l
Total Ammonia, Nitrogen (NH_4)	<0.5 mg/l
E coli	Advisory: >235 Closed: >1000

Fischer Creek:

FI03	Dairyland Drive
FI02	County Road LS

Following general trend lines, dissolved oxygen should increase when stream flow increases and water temperature decreases. However, the data shows a decrease in dissolved oxygen from FI03 to FI02, even with an increase in stream flow and decrease in water temperature. This could be linked to the increase of *E. coli* downstream, as a result of the bacteria using up the available oxygen in the water.

The data also showed phosphate and *E. coli* levels were well above acceptable standards.

Differences Between Averages of Data Collected in 2012 and 2013 – Fischer Creek

Averages for All Creek Sample Points	Summer 2012	Summer 2013	Difference
Water temperature (°C)	17.33	15.63	-1.7
pH	8.43	8.63	+0.2
Turbidity (NTU)	9.27	3.48	-5.79
Stream flow (M/sec)	0.4	0.5	+0.1
Conductivity (µS)	792.5	793.4	+.09
Dissolved oxygen (mg/L)	8.38853	9.06231	+0.67378
Total Dissolved Phosphate (mg/L)	0.03289	0.03195	-0.00094
Total Phosphate (mg/L)	0.08765	0.06307	-0.02458
Ammonia nitrogen (NH3) (mg/L)	0.03489	0.01756	-0.01733
Ammonia nitrogen (NH4) (mg/L)	0.30705	0.14098	-0.16607
E. coli (MPN/100 ml)	940.363	635.646	-304.717

Test	**Standard Acceptable Ranges During Summer**
Water Temperature	10-19^{o}C
pH	5.8 to 8.5
Turbidity	1 to 5 NTU
Dissolved Oxygen	>5.0 ppm
Total Phosphate	0.01 to 0.03 ppm and <0.1 ppm maximum
Un-ionized Ammonia (NH_3)	<0.1 mg/l
Total Ammonia, Nitrogen (NH_4)	<0.5 mg/l
E coli	Advisory: >235 Closed: >1000