Identification of Sediment Sources in the Tributaries of Marion County Park & Lake to Develop Future Erosion Management Plan

Chuck Balkenbusch, Lucas Linder, Tessa Zee

KANSAS STATE UNIVERSITY

Purpose

- Channel cross sections, soil samples for particle size measurement, water samples for suspended sediment measurements collected
- Erosion hotspots and stream bends identified
- To identify sources of sedimentation to assess the sediment's erosion potential and downstream impact on lake bed fill in the tributaries of Marion County Lake

Study Area & Sample Locations

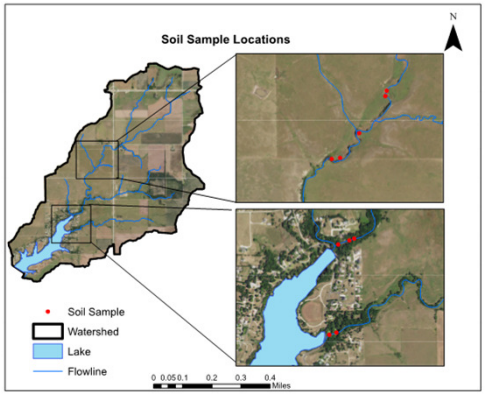

Figure 1: Map of site and soil sample locations along the two tributaries of Marion County Lake. The top right figure is Northern Stream Site A. The bottom right figure shows Northern Stream Site B north of the lake and the Northeast Stream Site towards the bottom of the figure.

Site Name	Sample/ Measurement ID	Site Description
Northern Stream Site A	N1-S, A-1	Dry stream bed, lighter and less clayey soils, bends in stream/sites of erosion, few trees on stream bank
	N2-S, A-1	
	N3-S, A-2	
	N4-S, A-3	
	N5-S, A-3	
Northern Stream Site B	N6-S, N6-W	Water flowing, lighter and less clayey soils, bends in stream/sites of erosion, slightly forested
	N7-S, N7-W	
	N8-S, N8-W	
Northeast Stream Site	NE1-S	Water in some parts of stream, darker & clayier soils, bends in stream/sites of erosion, slightly forested
	NE2-S	
	NE3-W	

Table 1: Site name, sample and measurement ID, and site description of each point where data was collected.

- 4,000 acre watershed
- 300 acre park with 153 acre lake
- Two largest tributaries of Marion County Lake
- Dominant soil types: Labette-Sogn silty clay loam and Sogn silty clay loam
- Some sections of these tributaries not sampled due to landowners not allowing access
- Future semesters could try to gain access to these areas to expand dataset

Materials and Methodology

- Ten soil samples from three locations
- Four water samples from two locations on March 29th, 2018 and April 10th, 2018
- Mastersizer 3000 used to sample particle size
- KSU Soil Testing Lab ran water samples for Total Suspended Solids (TSS), Total Dissolved Solids (TDS), Electrical Conductivity (EC), Total Nitrogen, and Total Phosphorus.

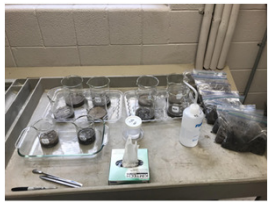

Image 1: Samples settling before decanting, a crucial step before being tested for particle size in the Mastersizer 3000.

Image 2: Sampling soil sample N6-S at Northern Stream Site B.

Image 3: Sampling water sample N7-W at Northern Stream Site B.

Results: Particle Size & Water Data

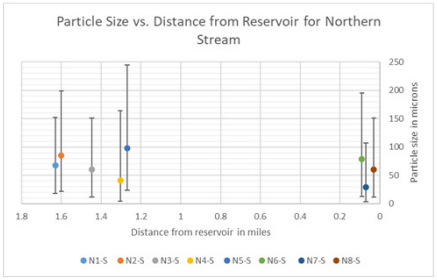

Figure 2: Particle Size Data for all Northern Stream samples in relation to distance from reservoir. The bottom tick mark in each box represents the Dx10 size, the dot in the middle represents the Dx50 size and the top tick mark represents the Dx90 size.

Image 4: : Site of sample NE2-S. Standing water right before a large curve in the stream. Tree roots exposed on stream bank on left side of photo. Picture taken looking upstream.

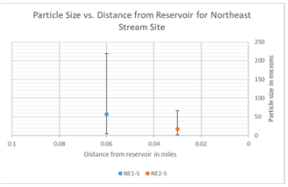

Figure 3: Particle Size Data from the Northeast Stream in relation to distance from the reservoir. The bottom tick mark in each box represents the Dx10 size, the dot in the middle represents the Dx50 size and the top tick mark represents the Dx90 size.

- No significant correlation between particle size as sites move closer to the lake or with depth of sample from soil surface
- Particle size results showed less clay particles than expected from Web Soil Survey data of typical characteristics of Labette-Sogn and Sogn silty clay loam.
- Average Dx50 results show that greatest composition of soil is sand sized particles (>50 microns)
- Samples may have not been given adequate time to settle in between decanting, therefore some silt and clay particles were discarded.
- Adequate settling time should be emphasized in future semesters

Sample Name	Sample Date	TSS mg/L	TDS mg/L	EC mS/ cm	Total N ppm	Total P ppm
N6-W	3/29/18	84	451	0.64	1.93	0.14
	4/10/18	38	433	0.62	1.37	0.08
N7-W	3/29/18	50	449	0.64	2.08	0.13
	4/10/18	288	438	0.63	3.90	0.40
N8-W	3/29/18	12	441	0.63	1.63	0.10
	4/10/18	517	414	0.59	3.62	0.49
NE3-W	3/29/18	167	332	0.48	2.02	0.41
	4/10/18	95	280	0.40	1.57	0.16

Table 2: TSS, TDS, EC, Total N, and Total P results from water analysis

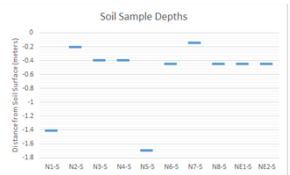

Figure 4: Depth of soil samples collected from the soil surface. Average sample depth of 45 cm was chosen to represent the comprehensive soil profile on exposed banks. Soil samples taken at sites of erosion were taken at varying depths. Measurements are in meters.

- 0.13 inches of precipitation occurred between March 29th and April 10th in Marion
- Did not cause significant flow in parts of stream with running water
- Nitrogen and phosphorus at lowest concentration because of time of year
- Likely a lot higher during late summer and early fall after agricultural application
- TSS results may have element of human error from sampling technique
- TDS and EC did not vary much from each sampling site

Results: Stream Profile & Physical Erosion Observations

Image 5: Site A-1. Downstream look at steep cut bank exposed at the horizon of the picture. Two stream paths have formed from variable stream discharge. Tabular blocks at stream bottom.

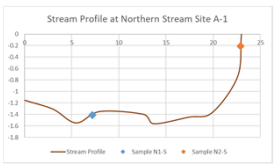

Figure 5: Stream profile with soil sample locations for the Northern Stream Site A-1. Profile done looking downstream. Both axes in meters, Y axis origin is from the height of the sight.

Image 6: : Site A-2. Evidence of bank slumping and detachment in the grass clumps moving downward on the left bank. Flood debris can be seen caught in the tree on the right. Picture taken looking downstream.

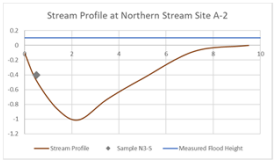

Figure 6: Stream profile with soil sample locations for the Northern Stream Site A-2. Profile done looking downstream. Both axes in meters, Y axis origin is from the height of the sight.

Image 7: Slump and undercut erosion with two concrete slabs placed by landowner to slow flow at site A-3. Pictured slab is 2.85 m. Another smaller slab is not shown in picture, but measures 1.2 m.

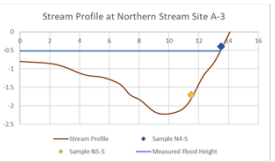

Figure 7: Stream profile with soil sample location for the Northern Stream Site A-3. Profile done looking upstream. Both axes in meters, Y axis origin is from the height of the sight.

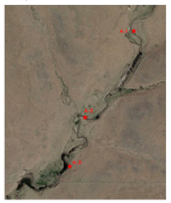

Image 8: Aerial photo of stream profile measurements A-1, A-2, and A-3 at Northern Stream Site A.

- A-1 stream exhibits more horizontal erosion due to more gradual curvature and flatter floodplain
- A-2 and A-3 exhibit for vertical erosion and channeling. The curvature of these areas had a smaller radius and are more susceptible to erosion
- Height of flood debris should be monitored to structure erosion management plan around max flow of stream
- Long-term focus on the bends of these tributaries to help monitor stream bank conditions

Conclusions & Acknowledgements

- This project provided great field work experience
- Practice with different kinds of scientific implementation
- This project should be continued in future semesters to collect larger dataset
- Latitude and longitude of each sample point provided in paper so that measurements can be consistent in future semesters
- Long-term bank lowering and channel bends should be monitored over time

- We would like to thank Matt Meyerhoff, Lisa Suderman, and Isaac Hett for their correspondence during this project, Rickey Roberts of KSU Research and Extension for providing funding to run our water samples, and Abby Langston for providing guidance as our advisor.