

Understanding Historic use of the Huron Creek Watershed through GIS and Archive Analysis

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Background

The Huron Creek watershed, located in Houghton County, Michigan, is positioned over what once was one of the richest deposits of native copper in the world (Greer, 2007). In 1852, mining began in the watershed at the Isle Royale mine, and the Huron Mine (see Figure 1). In order to process local mine rock into copper ingots the Huron Stamp Mill was opened in 1865. The stamp mill utilized hydropower generated by damming Huron Creek with a thirteen-foot earthen dam (Greer, 2007). In addition to the damming, the creek itself was often rerouted for industrial or agricultural activities. Rapid deforestation occurred in the region due to the mining companies need for raw construction materials and space. The mining activities caused an increase in soil erosion, which changed the appearance and location of the creek as a result of bed or bank deposition.

Today, the Huron Creek watershed continues as an essential natural resource and amenity for Houghton County. The creek flows through the commercial district of Houghton and discharges into the Portage Canal at the city of Houghton's waterfront residential park. The development in the commercial district has eliminated natural riparian zones, an essential buffer for protecting the health of the creek from hazardous run off. The commercial development has replaced forested land with impermeable surfaces, resulting in increased stream flows during rain and snowmelt events and reduced infiltration to underlying ground water. The stream channel also has been modified severely as a result of development. It is critical that we understand more about the physical and spatial changes of the creek, as well as how humans have interacted with creek in the past and present. This knowledge will inform how we approach the long-term management and protection of the watershed for the residents of Houghton County and for those who visit the creek for years to come.

Research Goals

Today there are efforts to restore the creek, guided by the Huron Creek Watershed Management plan (Center for Water and Society, 2009). However, the management plan contains limited information about the history of the watershed, which is critical for to informing restoration efforts. The management plan currently includes recent aerial photographs that are limited to only the creek's path and locations observable from the coarse resolution of an air photo. These photos do not show the physical and environmental features and dimensions of the creek. As well, during the period of heavy industrial and mining use, aerial photographs do not exist. The goal of this research is to create a working model that depicts the physical and environmental characteristics of the creek and surrounding watershed, as well as its use by the community over time.

Methods

Traditionally, the efforts of recreating a stream's natural state or physical and environmental features is through quantitative analysis of geomorphology. Geomorphology is the study of physical features of the surface of the Earth and its relation to its geological structures. Through techniques of analyzing sediment

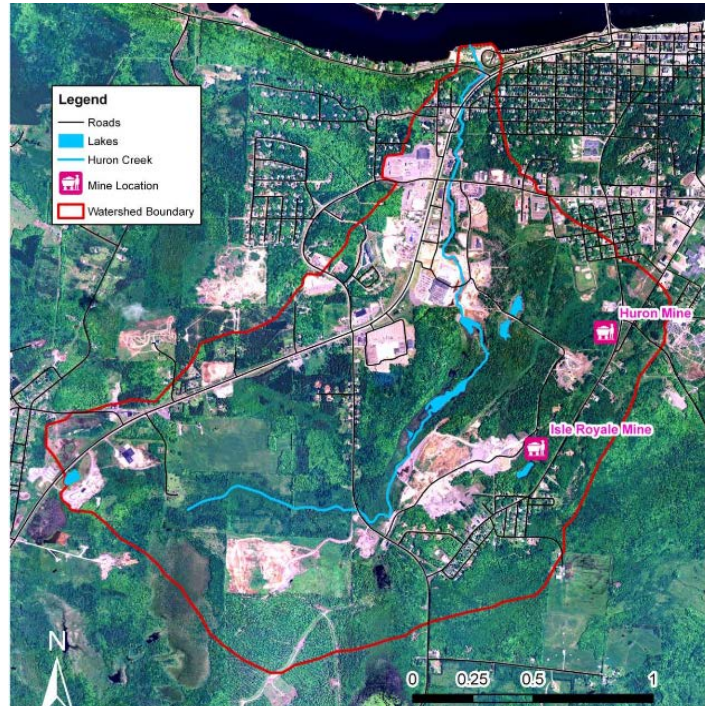


Figure 1: Isle Royale and Huron Mine locations. Created by Linda Kersten

samples, geomorphologists define stream order, bifurcation ratios, distribution frequencies, drainage basin density, side slopes, hypsometric cross sections, sediment loss, and land-use (Strahler, 1957). This process was used on a watershed study in the Central Spanish Pyrenees where researchers tracked human activities at different spatial and temporal scales to determine the most important periods of soil erosion over thousands of years (García-Ruiz, 1998). The study demonstrates the great importance of human activities as triggering factors for hydraulic consequences. However, these geomorphology studies require large amounts of data, usually collected with specialized laboratory and field instrumentation that is beyond the scope of most researchers.

The advancement of geospatial technologies has allowed for new ways to interrogate and uncover the histories of physical and environmental features, known as historical geographic information systems, or historical GIS. By combining a set of disparate sources in a geospatial environment, including archival records, historical maps, demographic data, climate data, and a set of oral histories with local residents who have a long relationship with the watershed, we can recreate the historical landscape of the creek. (See Figure 2 of GIS example) This method of recreating the past has been shown to reveal a unique perspective on historical landscapes, patterns, and processes (Lafreniere & Gilliland 2015).

Following other models in historical GIS, ESRI's ArcGIS will be the tool of choice as it allows for a seamless integration of spatial and temporary data, and the analysis of data overtime. The unique contribution of this research will be to add a temporal scale, in order to create a geospatial model of the past urban creek over time. To add to existing research in historic landscape reconstruction this research will attempt, for the first time, to represent a historic landscape in four dimensions. The 3D ArcGIS virtual model will be converted into a physical 4D model using 3D printing technologies (example shown in Figure 3). The advantage of creating a physical model is to convey the research to the public through interaction, and aid in the visualization of the final research. The 4th dimension represents the temporal element, with different colors and symbology signifying significant time periods in the history of the watershed.



Figure 2: GIS spatial model of 1883 flood in London, Canada

Schedule/Project Timeline

In spring semester of 2015 I enrolled in a 4000 level GIS project course to build my GIS knowledge base and to refine historical GIS techniques needed for this proposed project. I am also working on the Keweenaw Historical Spatial Data Infrastructure project to gain the archival skills and to begin collecting some of the sources needed in this project. I will begin this project on May 11th, spending the bulk of May and June on further data collection, digitalization, and integration into the historical GIS. In July, I will move to the analysis stage, harmonizing the qualitative and quantitative sources and creating the geospatial 3D model of the watershed. Late July and early August will be spent building the 4D physical model and writing up the results of my research.

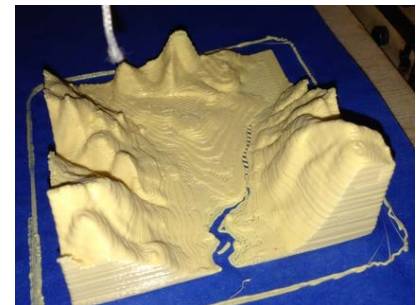


Figure 3: Example model of a 3D printed riverbed in Adirondack Park in New York State

Deliverables

With the inter-disciplinary linkage between historical geography and environmental science, the outcome would be to write a final report of the research, and submit a paper to a scientific and/or historical journal (e.g. Environmental History, Social Science History, Water History, Journal of Hydrology). The 4D physical model of the creek's bed and presentation of research will be created for a public and professional presentation for the interested community. My mentors have set aside funding for the research to be presented at either an environmental or historical conference (Association of American Geographers, Social Science History, Society for Social Studies of Science Conference, American Geophysical Union).

References

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