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National Regional Sediment Management Program Detroit District (LRE) & Coastal and Hydraulics Laboratory (CHL)

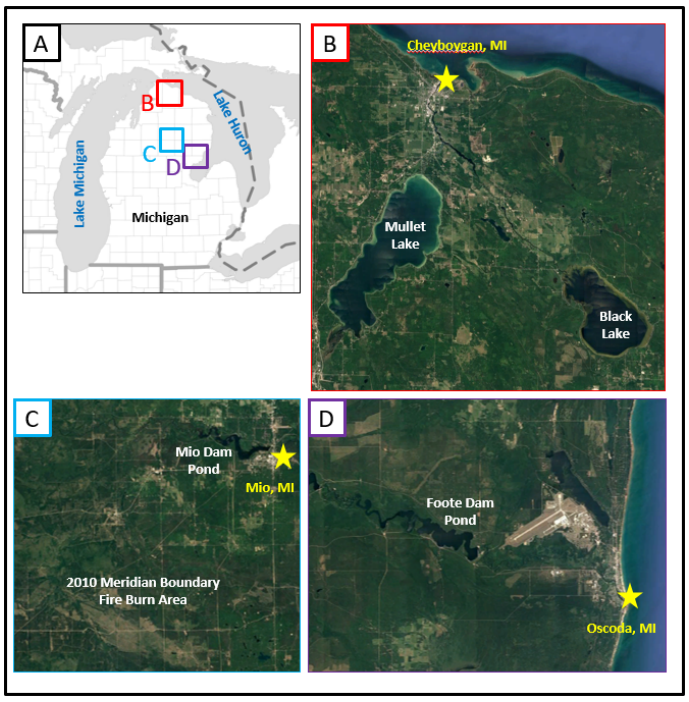
Sediment Source to Sink Lag Time

Description (

In the Great Lakes region as well as other watersheds, sediment eroded from upland catchments and transported downstream has long been considered the primary source of sediment causing shoaling in federal navigation channels and harbors. Despite changing to land use practices that seek to reduce upland erosion rates, the need for dredging has not noticeably decreased, suggesting either the sediment sources are not properly identified, or that there is significant lag time in the transport of previously eroded catchment sediment to the downstream sinks. LRE and CHL will use sedimentary geochemical markers to not only more completely identify the sources of sediment in-filling the navigation channels and harbors, but also to quantify the lag time between erosion of sediment in the upland catchment and subsequent deposition due to temporary storage within the tributary.

Issue/Challenge To Address

Over the last several decades, federal funding through the Farm Bill has sought to reduce soil erosion in agricultural watersheds in the Great Lakes through changes in farming practices. Despite beneficial changes in land use practices, there has been no noticeable reduction in the amount of sediment in-filling federal navigation channels at the far downstream end of these catchments. Given that the likely source of these shoaling sediments is erosion of the upper catchment and subsequent transport downstream via the tributary, this suggests that there a significant lag time between the erosion of sediment particle, and its ultimate deposition in a harbor or channel. This lag storage is likely found within the tributaries themselves, in actively accumulating, and likely stable, point bars or similar features that only erode during significant flow events.



In FY17, researchers from LRE and CHL collected several sediment cores at two study areas: along the Cheyboygan & Black Rivers, which converge just south of Lake Huron near Cheyboygan, MI, and the Au Sable River, which empties into Lake Huron at Oscoda, MI. These cores were analyzed in FY18 for a suite of geochemical markers including physical characteristics, organic content, stable isotopes, and radioisotopes. Based on preliminary results, it was determined that additional samples were necessary to clarify sediment transport rates and potential lag time. Additional sampling in FY18 incorporated strategic locations near the headwaters of the Au Sable River to capture the runoff from a recent forest fire burn area for analysis of coarse-grained black carbon distribution as another sediment transport tracer. In FY19, the storage time, and thus lag time, along each tributary will be quantified in order to better refine the regional sediment budget for each system. These data will be critical for assessing future dredging needs, as well as providing a quantification of the relative success of the erosion abatement efforts in each catchment.

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Successes Lessons Learned

The partnership between CHL and LRE has demonstrated great success during the initial years of this study; pairing technical expertise with regional knowledge has fostered efficient field data collection to target sampling locations to yield results most pertinent to addressing the study objectives.

Expected Products

- Geochemical analyses identifying storage times and sources for sediment along each tributary and in the harbors (lab report)
- Analysis of sediment physical characteristics including gradation, shape indices, and coarse-grained black carbon distribution (tabulated lab data)
- Final Report/Journal Article and Presentation

Stakeholders/Users

This study represents a collaboration between the sediment source tracking expertise at the at CHL. LRE will provide vessels, samplers and a crew for collecting samples and will be mentored by lab staff in the application of these sediment tracking techniques.

Projected Benefits Value Added

This study will refine our understanding of lag times between sediment erosion and ultimately delivery to a navigation channel or harbor, allowing improved planning of future dredging needs. It will also lead to improved management of stakeholder expectations with respect to land use practices and the resulting influence downstream. In addition to the obvious navigation benefits, this study will allow improved prediction of future flood risks, as the risk along any one tributary may be altered as the sediment currently stored in the tributaries is reduced via continued transport downstream, resulting in geomorphic changes that reshape cross sectional geometries and longitudinal profiles. Lastly, both fluvial and littoral ecosystems are affected by changes in the sediment supply. The knowledge gained from this study will thus span all three business lines and both inland and coastal settings.

Leveraging Opportunities

This study began in FY17 as part of the Great Lakes Tributary Modeling Program (Sec 516(e)) and was intended to be conducted over multiple years. The Tributary Modeling Program has contributed $75k in FY17 and $25k in FY18 with carry over funds. These funds were used to conduct the literature review and collect the initial sediment cores, greatly reducing RSM costs for this project. Additionally, DOTS funding was secured to contribute towards the FY18 effort for the coarse-grained black carbon field sample collection to provide the study with an alternative short-term tracer for sediment transport.

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Participating Partners (

N/A