# Summary of Geomorphology Assessment Results for the Middle Huron River Watershed, Section 3

## Overview

The geomorphic rapid assessment project is one part of a larger effort to update the Middle Huron River (Section 3) Watershed Management Plan (WMP). For this plan, HRWC employed a method to evaluate the stability of representative stream reaches (i.e. segments) throughout the watershed as was applied in sections 1 and 2 of the watershed. In summary, the rapid evaluation method assesses the erodibility of a stream reach's banks and the hydraulic forces impacting those banks to estimate erosion rates for each bank. These bank assessments can then be compiled into an overall erosion rate for the stream reach or average rates for all evaluated streams within a tributary creekshed. The erosion estimates individually should only be used to get a general sense of the scale of erosion relative to other streams in the system (rather than taken as precise estimates of sediment load), as the techniques are designed for a rapid and broad assessment.

The geomorphic survey effort is designed to achieve the following objectives.

**Objective 1**: To determine which representative stream reaches in the watershed are physically stable, which are actively eroding and which are aggrading. This was determined by an evaluation of Bank Assessment for Non-point source Consequences of Sediment (BANCS) model, which includes Bank Erosion Hazard Index (BEHI) and Near Bank Stress (NBS) metrics computed at stream survey locations. Specifically, observational metrics such as bank height, substrate, angle and root depth are evaluated along both banks of an assessed stream reach. The lengths of the erosive banks are then summed to estimate an overall erosion rate for the stream reach.

**Objective 2:** To develop a prioritized inventory of degraded stream reaches throughout the watershed. Stream reaches were ranked according to erosion rate estimates from the rapid BANCS assessments. Further, high-erosion potential reaches will be evaluated qualitatively for restoration potential. Reaches that are heavily altered by development (such as contained in concrete channels or heavily rip-rapped banks) will not be given high priority for stream restoration since restoration designs will be unlikely to be stable under such highly altered condition. Other physical, logistical or ownership issues may reduce the ability of watershed partners to restore a stream segment, while other factors may make a segment more desirable. Factors such as existing nutrient, pollutant, and sedimentation issues in the reach's watershed will also contribute to higher restoration potential.

HRWC assessed just under 12 miles of stream length using this method in 2022. Using the method, stream banks and lengths are evaluated to determine erosivity and site and full-length erosion rate metrics are generated. The metrics for all the stream reaches in the inventory will be compared, and from that future stream restoration targets will be prioritized. This analysis will result in a set of stream restoration recommendations for the WMP. Results can also be shared with interested land-owners by request.

## Methods

Geomorphic analysis consisted of desktop and rapid field techniques that generally follow methods outlined in Watershed Assessment of River Stability and Sediment Supply (Rosgen, 2006), specifically a slightly altered version of the BANCS model technique. The analysis focuses on reaches that may be impaired by physical or previous hydrologic alterations. Specific selection criteria are discussed below. The study teams conducted rapid assessment using the BANCS model (objective 1), with the goal of following-up with estimated bankfull dimensions of selected reaches and cross-sections to further evaluate restoration priorities (objective 2).

The study began with an initial desktop analysis to identify and assess representative reaches. All mapped streams within the study watershed were subdivided into reaches designated as reasonable lengths between branch points. A reach contributing area (RCA, or drainage area) was created for each reach. A set of statistics was generated from available GIS and aerial data for each reach, including stream length, stream slope, valley slopes, and soil erosivity. Land use characteristics were generated for each RCA such as total area and percent cover in urban, impervious, agriculture, and natural (wooded/wetland).

Reaches that are dominated by urban piping and channelization were eliminated from field analysis consideration, as such reaches have lost natural geomorphology and function and must be treated for hydrologic alteration. Remaining stream reaches were further classified by chemical (phosphorus, nitrogen, DO, TDS, TSS) and biological (bacteria, macroinvertebrate diversity) impairment from previous monitoring results. Reaches were ranked by likelihood of hydrologic or sediment impairment.

Reaches were then prioritized into three groups, based on priority for assessment: high, medium, and low priority. Criteria used for evaluation included length of open surface water, likelihood of erosion (based on land uses and slope), past observations within the area, accessibility, stream size (or drainage area), and representativeness. The number of stream reaches with initial high priority designations was small (35 total miles) compared to upstream watersheds. That is mostly because many reaches were buried under the Ford and Belleville Lake impoundments and were therefore inaccessible. The initial set of high priority reaches were classified by drainage area and stream order and then this stratified set was used to identify reaches for assessment, so that the evaluated set would be representative of the variety of stream reach types in the broader watershed. In the end, the assessment teams were able to evaluate about 1/3 of accessible reaches.

The high priority reaches were then segmented into “assessment” lengths that were between access points and between 0.5 and 1 mile in total length, which, following initial runs of the BANCS assessment methods, was determined to be a reasonable length for an assessment session. These assessments were then mapped onto Google maps along with parking and access instructions. Assessments were then assigned to teams of 3-4 assessors.

These teams made observations of erosion and alteration using BEHI and NBS metrics, and made rough estimates of bankfull width and depth, bank angle, bank slope, and bank ratios. From this analysis, a rank-order list of stream reaches for the watershed was developed for making restoration or remediation recommendations in the WMP. One important difference in method between the assessments of Section 1 and 3 streams and Section 2 streams is that HRWC developed the data collection forms into an electronic survey format using ESRI's Survey 123 platform (see Appendix A). That tool allowed data to be collected electronically in the field, including GPS coordinates and photos, and uploaded directly to the geodatabase without the need for error-prone data entry. Data from all assessment observations were recorded through the field tool and uploaded to the field geodatabase. Once data was reviewed and corrected and approved, they were transferred to the master geodatabase to be used for analysis.

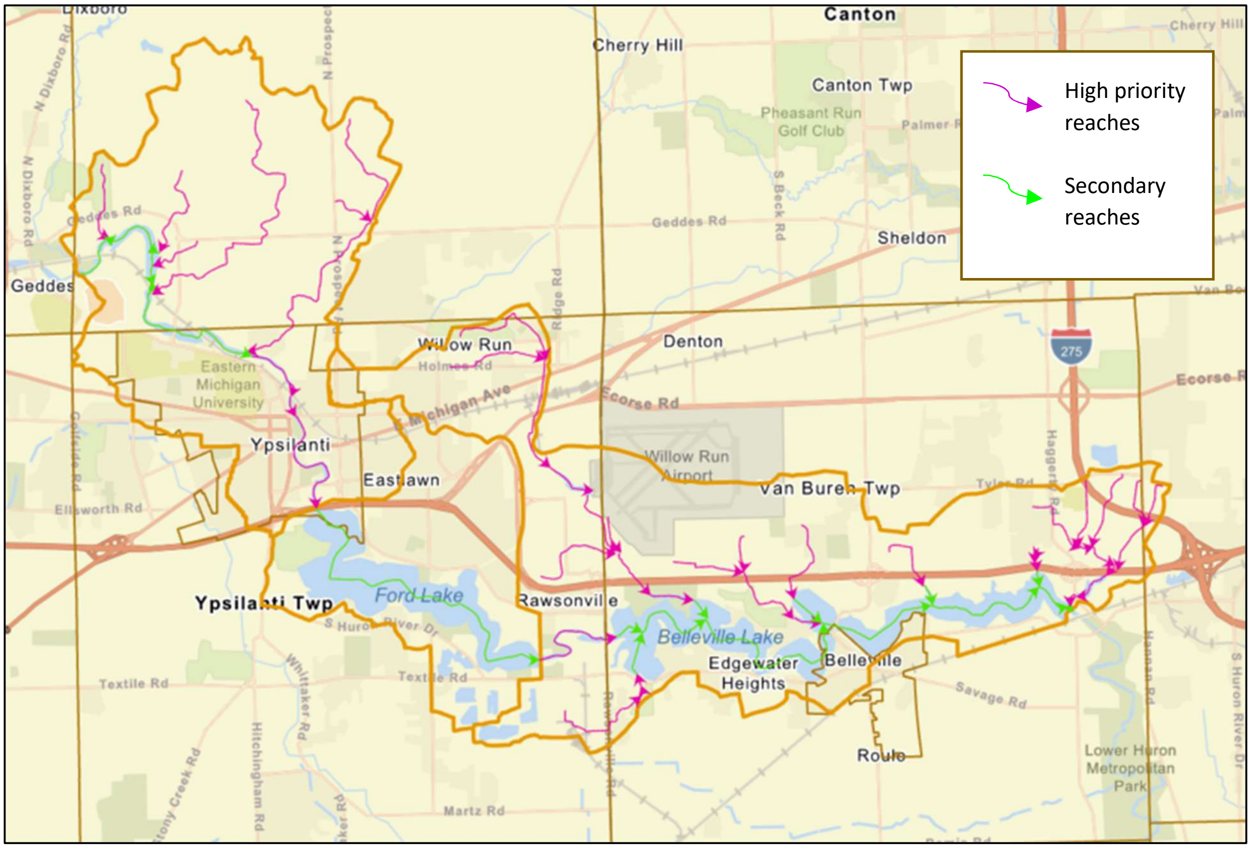
Return surveys to high priority reaches are planned to refine erosion rate calculations using more precise survey methods. Time and resources has not allowed for these surveys at this point in time. Further survey work may also be part of initial restoration project planning efforts.

More detailed methods are included in the monitoring Quality Assurance Project Plan, which can be obtained by request.

## Results

The desktop stream reach identification and segmentation generated over 66 separate reaches in the watershed (see Figure 1). Reaches were defined by connectivity, as confluence to confluence (or start point to confluence). They varied in stream length from 23 feet to 4 miles. Ultimately, 46 reaches were assessed (about 2/3 of high priority reaches) for a total of 11.78 miles of evaluated stream banks. Given the variety of reach lengths, some reaches were combined into a single assessment, while longer reaches were divided into multiple assessments.

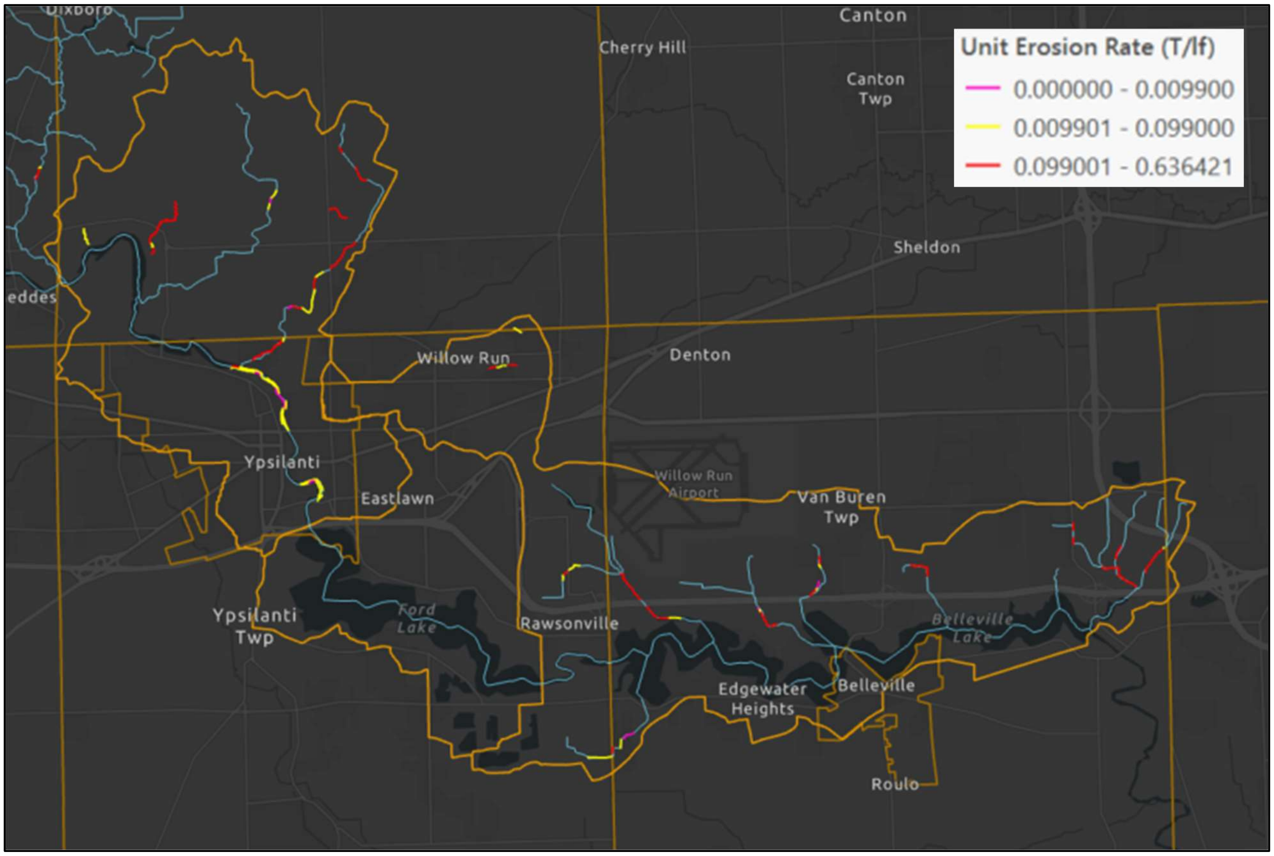
*Figure 1. Stream Reaches in the Watershed Prioritized for Assessment*




Complete data tables from the database for Reaches, Assessments, and BANCS observations are included in Appendix B (separate spreadsheet file).

Results from the geomorphic assessment can be presented in a variety of ways. First, as each bank segment is assessed, an erosion estimate can be generated such that each assessment can have many banks assessed. In most cases, one bank is eroding, while the other bank is aggrading or unaffected. However, in downcutting or widening segments, both banks may be eroding at the same time. This would result in twice the estimated erosion of a single bank impact. Many other lengths of streambank exhibit no significant observable erosion signs. Each potentially eroding bank length can be represented visually (see Figure 2) with its estimated unit erosion (in tons/yr per ft of stream length observed), and in an area the size of the study watershed patterns can be observed.

*Figure 2. Estimated Unit Erosion from Observed Stream Banks*




First, most of the stream length shown appears to be unevaluated. This is only partially true. Yes, more than half of the known stream length was not indeed assessed, but some of what was assessed (compare with Figure 1), was observed to have so little evidence of erosion that it did not merit mapping as an eroding bank. Such banks were observed, but recorded as "very low" BEHI and NBS ratings, or essentially estimated erosion rates of zero tons/year. Also, many reaches were determined to be inaccessible during field visits. This was true, for example, for a long length of stream that runs along Willow Run Airport. Access was prohibited by a locked security fence, and the airport authority refused to grant access when asked.

In general, it can also be observed that erosion rates were in the upper ranges across the watershed. Every stream assessed had at least one stretch of banks that fell in the highest unit erosion rate category. Land use in the watershed is a mix of heavy industry (like the airport), urban to suburban residential, and some small row-crop farms in the uppermost watershed. The tributary creeks in the watershed show strong evidence of channelization with high, steep banks with little protection. An exception to this general trend is the river reaches, which showed low to moderate unit erosion rates. Another important use of this fine-scale data is to isolate target lengths within a longer reach that have higher erosion potential and could serve as the best targets for restoration.

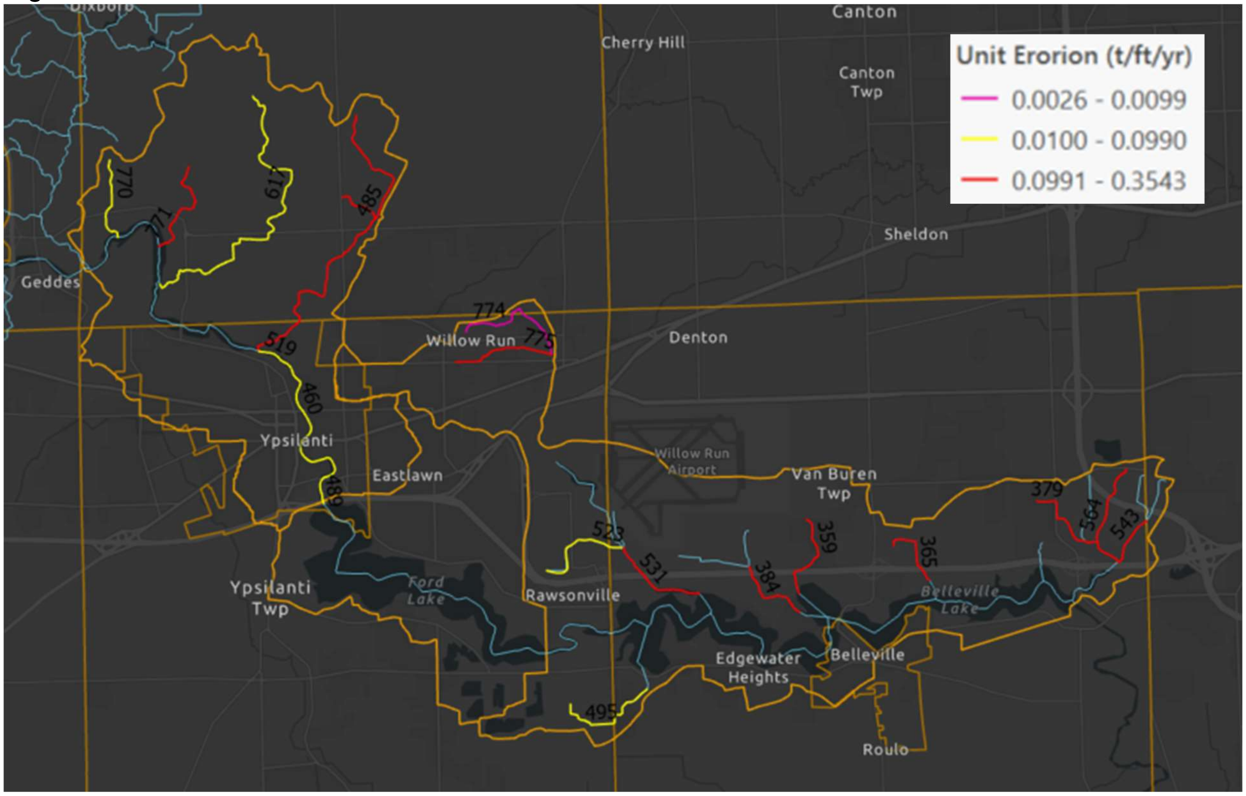
A second step in analysis is to compile assessment observations into mean erosion rates for entire reaches. Given the size of the study watershed and the total evaluated reach length, a comparative ranking of stream reaches is a good approach to identify initial restoration targets. Figure 3 shows the evaluated stream reaches and their erosion rates. Within the watershed, over half (14 of 23) of the stream reaches evaluated had high erosion rates (> 0.1 and <0.35 tons/yr/ft, marked red). Eight of the streams fall within a moderate erosion rate range of 0.01 to 0.099 tons/yr/ft, marked yellow. Only one of the reaches have stable banks with little evidence of active erosion (< 0.01 tons/yr/ft), marked pink in the Willow Run headwaters, so the majority of stream reaches evaluated showed quite a bit of evidence of active erosion. This grouping of erosion rates differs somewhat from the set evaluated in the more urbanized Section 2 of the watershed just upstream. In that watershed, there was a mix of stream reaches with high erosion rates, moderate erosion rates and low erosion rates.

Table 1 lists the stream reaches with the 20 highest erosion rates. Examining this table along with the geographic distribution high erosion reaches in Figure 3 shows that the 14 most vulnerable reaches are all tributaries to the river, with many direct tributaries to Belleville Lake. Huron River reaches showed only moderate erosion rates.

*Table 1. Stream Reaches with the 20 Highest Unit Erosion Rates*

| ReachID | Stream | Reach Length (mi) | Assessed Length (mi) | Implied Total Erosion (tons/yr) | Unit Erosion (tons/yr/ft) |
|---|---|---|---|---|---|
| 771 | Superior, unnamed | 1.31 | 0.84 | 2,451 | 0.354 |
| 365 | Belleville trib, unnamed | 0.79 | 0.30 | 1,358 | 0.324 |
| 372 | Willow Run | 0.50 | 0.44 | 763 | 0.288 |
| 531 | Willow Run | 0.62 | 0.39 | 855 | 0.260 |
| 543 | Belleville trib, unnamed | 0.60 | 0.36 | 803 | 0.253 |
| 600 | Belleville trib, unnamed | 0.34 | 0.32 | 437 | 0.241 |
| 464 | Belleville trib, unnamed | 0.15 | 0.15 | 169 | 0.210 |
| 359 | Belleville trib, unnamed | 1.06 | 0.31 | 1,003 | 0.180 |
| 564 | Belleville trib, unnamed | 0.94 | 0.29 | 786 | 0.157 |
| 384 | Belleville trib, unnamed | 0.90 | 0.35 | 676 | 0.143 |
| 775 | Willow Run | 1.15 | 0.33 | 868 | 0.142 |
| 773 | Superior #1 | 0.51 | 0.45 | 379 | 0.140 |
| 485 | Superior #1 | 3.96 | 2.38 | 2,919 | 0.140 |
| 379 | Belleville trib, unnamed | 0.88 | 0.26 | 561 | 0.121 |
| 519 | Huron River | 0.74 | 0.93 | 285 | 0.073 |
| 489 | Huron River | 1.53 | 0.42 | 560 | 0.069 |
| 495 | Belleville trib, unnamed | 1.27 | 0.69 | 432 | 0.064 |
| 460 | Huron River | 0.25 | 0.25 | 83 | 0.063 |
| 617 | Snidecar Drain | 3.70 | 0.20 | 1,100 | 0.053 |
| 523 | Belleville trib, unnamed | 1.15 | 0.31 | 314 | 0.052 |

*Figure 3. Estimated Unit Erosion Rates for Evaluated Stream Reaches*




The other observation that can be made from Table 1 is that the high erosion reaches vary in total length. While some reaches have high erosion rates for a short length, they may not generate as much total erosion as longer stream reaches with lower estimated erosion rates.

Along with erosion rates, Table 1 shows the implied *total* erosion rates for the entire reach length (including lengths that were not directly assessed). The worst reach from a total erosion perspective (reach #485, the majority of Superior Drain #1) generates almost 3,000 tons of sediment per year. The top two on the list for total erosion are both in the Superior Drain subwatershed and would appear to be the best targets for focusing restoration efforts. The length of these reaches would require that restoration be done in phases, perhaps starting upstream and working down.

Finally, the different drainage watersheds can be evaluated on the whole. There are four distinct drainage areas – Superior drains, Willow Run, direct tributaries to Belleville Lake, and the Huron River itself. Table 2 shows these drainages ranked by the mean unit erosion for all reaches within the drainage. Belleville Lake and Superior tributaries have the two highest overall averages, which are almost identical. The mean erosion rate for Willow Run reaches was only slightly lower, while the mean rate for Huron River banks was less than half that of the other drainages. Looked at by total erosion, though (see Table 3), because of its somewhat greater size, Superior tributaries generate the greatest total amount of erosion. These totals are not directly comparable, however, as not all available reaches were evaluated within each drainage. They are shown to provide a rough idea of the scale of overall erosion in each drainage area.

*Table 2. Mean Unit Erosion Rates for Drainages in the Study Watershed*

| Drainage | Unit Erosion (tons/yr/ft) |
| --- | --- |
| Belleville tributaries | 0.174 |
| Superior tributaries | 0.173 |
| Willow Run | 0.150 |
| Huron River | 0.071 |

*Table 3. Mean Total Erosion Rates for Drainages in the Study Watershed*

| Drainage | Total Erosion (tons/yr) |
| --- | --- |
| Superior tributaries | 8,659 |
| Belleville tributaries | 6,376 |
| Willow Run | 3,857 |
| Huron River | 940 |

### Potential Restoration Targets

Eight stream reaches stand out as potential high-value restoration targets, based on the results of the rapid BANCS assessment. Each reach was evaluated to have a much higher than average potential for erosion along all or part of its length. While there may be other reaches that offer potential for restoration and reduction of erosion, sedimentation and nutrient transport, these eight reaches stand out among the rest of the inventoried stream reaches. Each reach was qualitatively examined to determine the relative feasibility of addressing the potential erosion along all or parts of the stream banks. Evaluation criteria included: ease of access for equipment, willingness of landowners to support restoration work, and the potential for control of upstream hydrology. Each of the target reaches is presented on the following pages with a brief description of conditions and considerations for the reach.

**771 – Unnamed Superior tributary**

A good portion of this 1.25-mile reach was assessed, up to where tile flow ran off from farm fields (see top right photo). It appears that significant storm runoff accumulates at that point to create high velocities beyond the capacity of the stream banks to withstand.

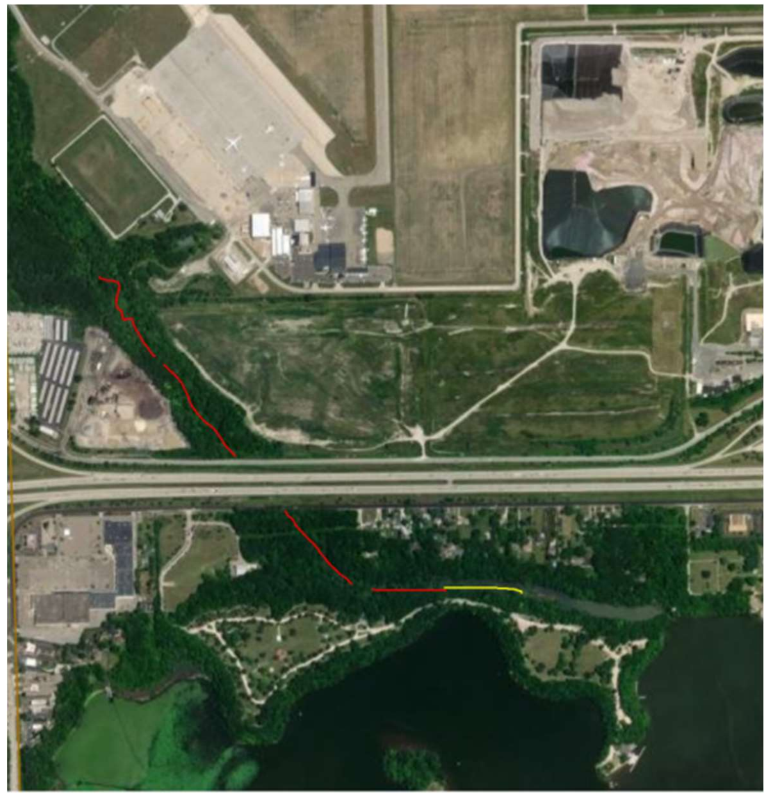
Agricultural practices, such as buffers or two-stage ditches, to slow drain flow should be the first remediation efforts.

Downstream, the riparian cover is good, but soils are sandy, unstable and erosion prone. At points, the channel has disconnected from the floodplain. Given the ample space, efforts to reshape banks and reconnect to floodplains and wetlands would be recommended. Despite forest cover, woody debris in the channel is generally absent but could be used to improve flow patterns. Land ownership is private adjoining stream, and access would require easement.

**365 – Unnamed Belleville Lake tributary**

This small reach has obviously been channelized and possibly rerouted to accommodate development. Hydrology is altered from the channelization and the recent developments. The best opportunity to improve hydrology and reduce erosion is to require stormwater improvements as the bordering industrial and commercial developments expand. If stormwater can be captured and infiltrated on-site, and a more natural hydrology returned, perhaps the banks could then be restored with a 2-stage design and native vegetation.

**372 & 531 – Willow Run**

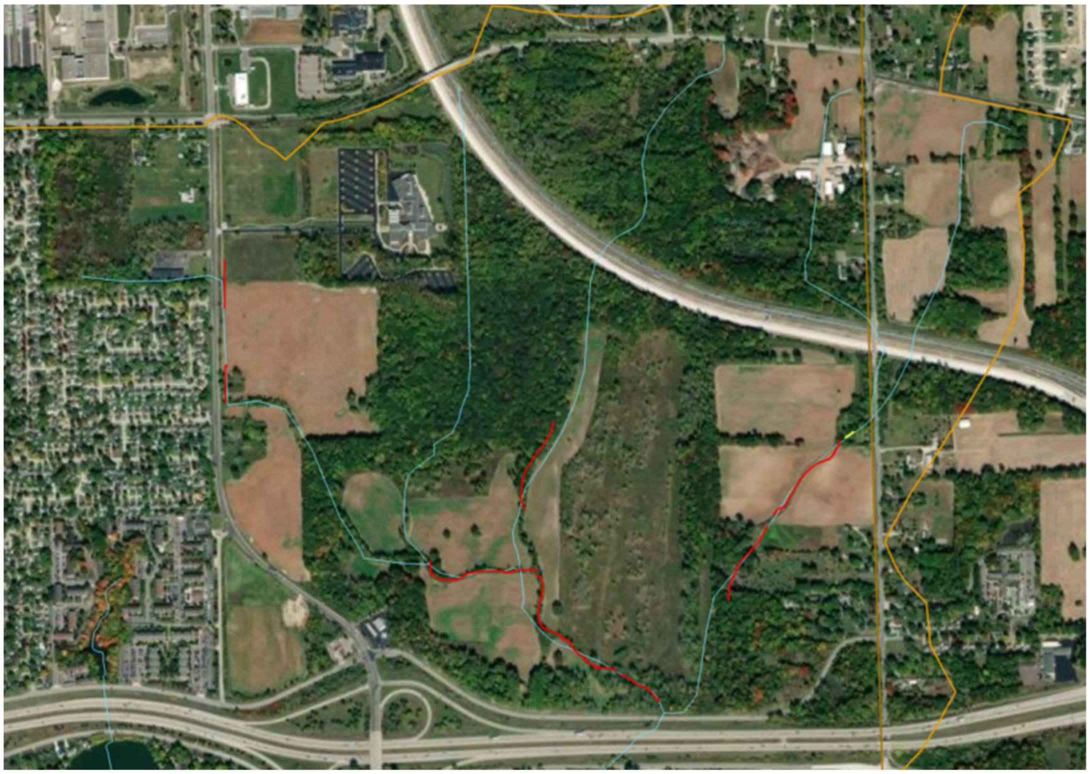


These reaches are separated by the I-94 highway and severely impacted by runoff from Willow Run airport. Rapid runoff from the airfields and related industrial lands has over-widened the creek and eroded stream banks. However, there is reasonably good riparian cover on both sides of the creek, which could offer some restoration potential, as additional development is not likely.

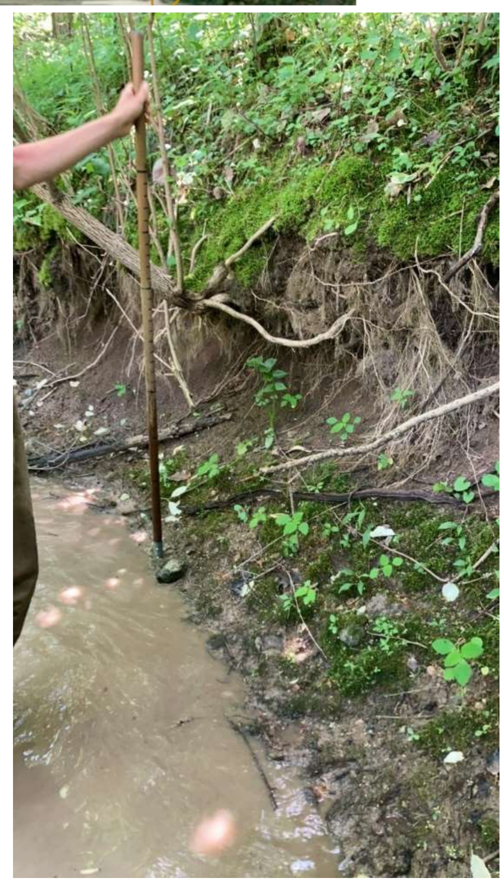
Current bankfull flows should first be determined. If flow rates allow, a low flow channel and flood flow benches could be established using ample natural materials in the riparian corridor. Additionally, the lower reach runs through Van Buren Park, where additional floodplain could be established as the creek flattens out.

Some consideration will need to be given to the quality of water in the creek, as it has a long history of contamination from past industrial operations. High slopes along the park ridge will also present a challenge, though there are still ample flat areas north of the ridge.

**543, 600, 464, 564 & 379 – Unnamed tributary network to Belleville Lake**



This cluster of tributaries at the far eastern edge of the watershed come together just prior to flowing under I-94. The channel widens and deepens into the impoundment, and is not possible to access south of the highway. The drainage area is bracketed by I-275, I-94 and Haggerty Rd. (to the west). These are the last Belleville Lake tributaries upstream of French Landing dam. The land use in between is a mix of row crop agriculture and forest and wetland cover.



The channels are general narrow in upstream headwaters, but downcut or artificially deepened throughout beyond expectations from banfull estimations. The soils are quite sandy and susceptible to erosion. The westmost channel was altered and likely moved by residential development.

Agriculture is sporadic here. Lands could be potential candidates for riparian buffer and easement purchases. There is good forest cover in some areas, so if enough buffer width could be obtained, stream banks could be brought down to create flood benches throughout. Woody debris management could also be improved to diversify habitat and flow regime.

**359 – Unnamed tributary to Belleville Lake**

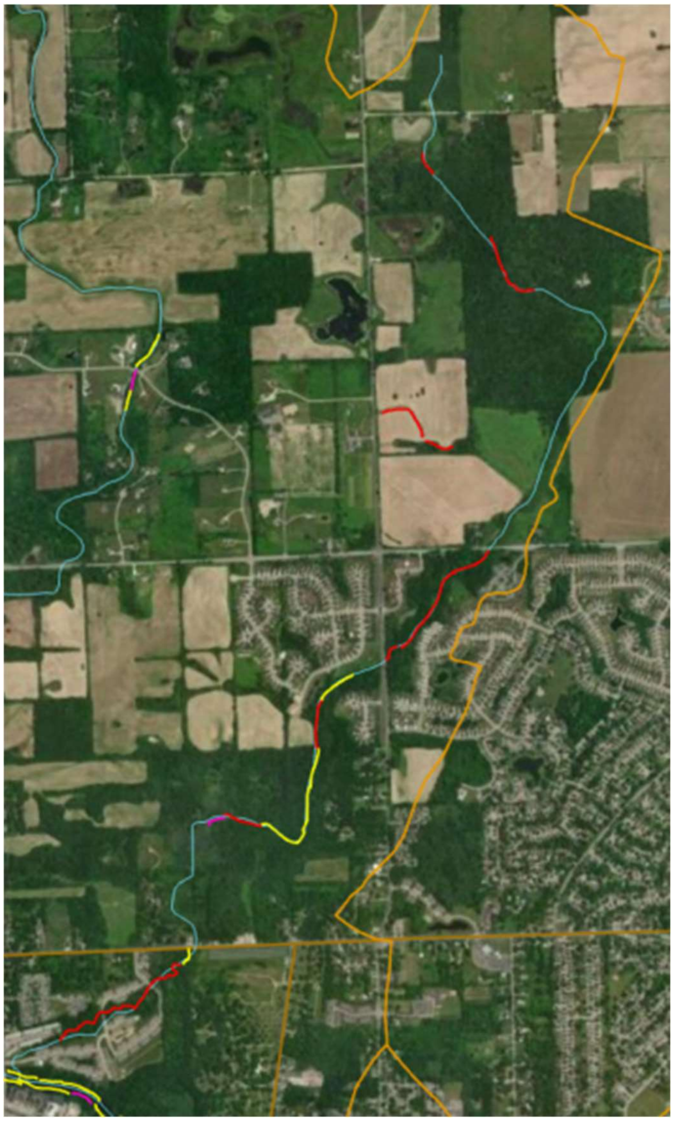
This tributary is an interesting opportunity. There are significant bank erosion issues where the stream crosses McBride Ave. and where it enters a culvert under I-94 – the top and bottom of the reach evaluation. In between the stream runs through wooded area with good riparian cover and opportunity to meander. Banks show only moderate erosion, likely from altered hydrology from upstream development. The western parcel is publicly owned by Van Buren Township, so could be a candidate for grant funding.

Culverts at both road/highway crossings should be evaluated for possible

Improvements in allowing for distribution of high storm flows. Stream banks could then be lowered to provide some amount of floodplain before the stream flows into the woods.

The downstream end could be improved by redirecting flow to properly align with the culvert entrance and providing more floodway.

**485 – Superior Drain #1**



The final reach on our recommendation list is the full Superior Drain #1. While the creek doesn't have one the highest average erosion rates, it is the longest reach recommended. Altogether, it produces the largest sediment load in the watershed. The creek passes through a mix of land covers, taking on agricultural drainage in the headwaters, through large swaths of forest cover, and splitting several recent residential developments complete with detention ponds. Evidence of erosion is periodic with long lengths of very little erosion, followed by spots of tall, highly eroded banks (see photo).

Vulnerable spots will likely need to be addressed as separate projects, but in most cases, there is ample riparian cover and space to work with. Where possible, banks could be lowered or energy redirected and sinuosity added, especially in forested areas. Wood and other natural materials are ample to use in redirecting flows. Given it's location north of Ypsilanti, new developments are likely and should be reviewed carefully to minimize further hydrologic alteration.

## Conclusions

The modified BANCS rapid geomorphic assessment applied across the lower section (section 2) of the Middle Huron Watershed proved to be useful in identifying stream erosion targets. The technique was applied with a modest amount of training and used to evaluate to a considerable proportion of available stream miles in the watershed. Despite implementation by multiple teams assessing somewhat subjective metrics, the evaluation was able to identify a short list of restoration candidates that are generating significantly more sedimentation than other streams in the watershed. While the ultimate erosion estimate values may not have a high level of accuracy taken individually, the calculations allow watershed planners to reasonably classify stream reaches into a range of categories from highly erosive to completely stable. The approach applies well across streams in different land use contexts. The BANCS surveys revealed that the majority of tributary streams in this mixed use watershed are highly sensitive and vulnerable to erosion, unlike upstream watersheds. Much of the difference may be due to a transition to lake plain soils from heavier soils found in glacial drainages upstream. Huron River banks, however, are in relatively stable shape. Finally, the compilation of a BANCS survey for a large portion of the Huron River Watershed provides a reference resource to help explain water chemistry, habitat and biological monitoring results beyond its direct use in the watershed management plan.