# Section 3:

# Shoreline Analysis Methodology and Results

**Details of the Buffalo Niagara Shoreline Digitization Project**
**(September – December 2012)**

Aaron M. Feeney

In order to better assess fish habitats and erosion potentials within the Niagara River Greenway, it was determined that it would be useful to symbolize shoreline attributes. The better understanding of current conditions also helps to inform the RAP delisting criteria of 25% of shoreline in the AOC that has habitat value. The assessment completed specifies whether a given section of shoreline is considered hard or soft, and if hardened, what material is present. Alternately, for sections of soft shoreline, an assessment of vegetation present is indicated. As part of a GIS internship through SUNY Erie Community College (ECC), Aaron M. Feeney took on the task of digitizing all shorelines within the study area and assigning such attributes. This project was carried out primarily at the Buffalo Niagara Riverkeeper office, and was overseen by Lisa Casey from Ecology and Environment and Lisa Matthies-Wiza of SUNY ECC.

Lisa Casey provided over 11 gigabytes of satellite imagery with a spatial resolution of one pixel per foot, as well as a number of key shapefiles. One shapefile included, titled "NHDFlowline," displayed approximately where the streams, creeks, tributaries, and rivers should be found. Another shapefile presented the municipal boundaries to delineate the study area, and a third showed the watershed. The shapefile to which shoreline features were added was titled "erosion_shore_nypa." This shapefile, originally begun by the New York Power Authority (NYPA), digitized features such as the perimeter of Grand Island and all shorelines along the US side of the Niagara River. The NYPA data was inaccurate, in some places missing the shoreline depicted in the satellite imagery by 20 to 50 feet. This was likely an artifact of digitizing features at too small a map scale on the part of the original GIS operator. All data listed as originating with NYPA were corrected for spatial accuracy by moving and adding vertices where needed, but most attributes of this data were not altered. In several rare cases along the Tonnawanda River reassessments of hardened versus soft shoreline were made and the attribute table was changed accordingly.

**Assessment Process Summary**

Shoreline Assessment:

- Aerial imagery supplied by Ecology & Environment under contract with Buffalo Niagara Riverkeeper was used in the shoreline assessment. Google maps and Bing Maps provided additional information, as these services provide a higher resolution, different seasons, and multiple angles.
- The main classification consideration was whether a given length of shoreline is hardened or soft.
- Hardened shorelines were classified by the type of building material used:
    - Concrete
    - Steel
    - Riprap (usually a building material, but is sometimes naturally present)
    - Timber
    - Stone (differentiated from riprap embankments)
    - Bridge (Bridges are generally accompanied by hardened shoreline, so it is important to capture this in our data. However, since aerial imagery is largely unable to reveal what type of construction is found underneath a bridge, the bridge category of hardened shoreline was created.
    - Artificial path (created to encode underground paths of hardened "shoreline" which were apparent from the flowline)
- Soft (natural) shorelines were classified according to the degree of vegetation cover, primarily for purposes of assessing shade availability for fish habitat analyses. The four categories include:

- None (beach or a normal lawn up to the edge, with no vegetation overhang)
- Sparse (minimal vegetation overhang, sometimes in the form of long grasses, small shrubs or small trees)
- Medium (presence of larger shrubs and trees that are loosely grouped such that medium overhang areas of variable shade are present)
- Dense (largest and densest grouping of trees which ensures that large overhang areas of consistent shade are present)

**Shapefile Attributes**

| | | |
|---|---|---|
| erosion_shore_nypa.PROTECTION | HARD | SOFT |
| erosion_shore_nypa.Class | type of hardened features | |
| erosion_shore_nypa.Shore_veg | degree and type of vegetation | |
| erosion_shore_nypa.L_R_status, alias: "shoreline(s)" | 1 | 2 |
| erosion_shore_nypa.sh_length | length of encoded features | |
| erosion_shore_nypa.Source | indicates NYPA original features | |

The rest of the fields in the "erosion_shore_nypa" shapefile are either self-explanatory or can be omitted. The attribute "erosion_shore_nypa.L_R_status" with the alias "shoreline(s)" was the result of an innovation which vastly reduced the amount of work required to achieve digitization of all features in the study area. Many creeks and intermittent streams are too narrow to justify the use of two lines in digitization, in a one-line-per-shoreline fashion. The "erosion_shore_nypa.L_R_status" field was added to enable digitization of two shorelines at once using one line with the attribute 2 in this field. Regular lines (i.e., one-shoreline-per-line lines) were given an attribute of 1 in this field. In order to use this field to assist in measurement of the total shoreline lengths of all segments, the GIS analyst must add a new field and use the field calculator to define its values as the product of "erosion_shore_nypa.L_R_status" times "erosion_shore_nypa.sh_length."

**Positional and Attribute Accuracy**

As stated in Appendix C. of the U.S. Environmental Protection Agency document, *Guidance for Geospatial Data Quality Assurance Project Plans (QA/G-5G)* (EPA/240/R-03/003), published by the Office of Environmental Information, "there are two kinds of geospatial data accuracy":

- **Positional Accuracy** is the closeness of the locations of the geospatial features to their true position.
- **Attribute Accuracy** is the closeness of attribute values (characteristics at the location) to their true values. This applies to accuracy of continuous attributes such as elevation and accuracy of categorical attributes such as soil types.

Great care was taken to ensure attribute accuracy over the course of the three-month project. However, there was no ground truthing (unless some field work was carried out by NYPA), so future studies may well augment the attribute accuracy of the project shapefile.

| RIVER, CREEK, OR TRIBUTARY | SOFT | HARD | TOTAL | SOFT % | HARD % | MUNICIPALITY |
|---|---|---|---|---|---|---|
| Big Sixmile creek | 25 miles | 1.5 miles | 26.5 miles | 94 | 6 | Grand Island |
| Bergholtz creek | 29.4 miles | 1.4 miles | 30.8 miles | 96 | 4 | Niagara Falls, Wheatfield |
| Black creek | 17.8 miles | 4.2 miles | 22.0 miles | 81 | 19 | Niagara Falls, Wheatfield, North Tonawanda |
| Buffalo river | 10.1 miles | 9.3 miles | 19.4 miles | 52 | 48 | Buffalo |
| Bull creek | 20.7 miles | 0.6 miles | 21.2 miles | 97 | 3 | Wheatfield |
| Burnt Ship creek | 2.3 miles | 0.1 miles | 2.4 miles | 97 | 3 | Grand Island |
| Cayuga creek | 32.5 miles | 3.0 miles | 35.4 miles | 92 | 8 | Niagara Falls, Niagara, Wheatfield, Tuscarora Indian Reservation, Lewiston |
| Cazenovia creek | 2.4 miles | 1.7 miles | 4.1 miles | 59 | 41 | Buffalo |
| Ellicott creek | 7.9 miles | 5.9 miles | 13.7 miles | 57 | 43 | Tonawanda (town), Tonawanda (city) |
| Fish creek | 18.5 miles | 1.3 miles | 19.8 miles | 94 | 6 | Lewiston, Tuscarora Indian Reservation |
| Gill creek | 26.9 miles | 5 miles | 31.9 miles | 84 | 16 | Tuscarora Indian Reservation, Niagara Falls, Niagara, Lewiston |
| Grand Island Perimeter | 13.9 miles | 13.7 miles | 27.5 miles | 50 | 50 | Grand Island |
| Gun creek | 16.5 miles | 0.5 miles | 17 miles | 97 | 3 | Grand Island |
| Little Sixmile creek | 2.7 miles | 0.2 miles | 2.9 miles | 94 | 6 | Grand Island |
| Niagara River | 21 miles | 37.7 miles | 58.7 miles | 36 | 64 | Porter, Lewiston, Lewiston (villiage), Niagara Falls, Wheatfield, North Tonawanda, Tonawanda (town), Tonawanda (city), Buffalo, Lackawanna |
| Sawyer creek | 22.4 miles | 3.6 miles | 26 miles | 86 | 14 | Wheatfield, North Tonawanda |
| Scajaquada creek | 5.4 miles | 6.9 miles | 12.2 miles | 44 | 56 | Buffalo |
| Smokes creek | 2.7 miles | 0.2 miles | 2.9 miles | 93 | 7 | Lackawanna |
| Spicer creek | 10.4 miles | 0.4 miles | 10.8 miles | 96 | 4 | Grand Island |
| Tonawanda creek | 10.3 miles | 8.6 miles | 18.9 miles | 55 | 45 | North Tonawanda, Tonawanda (town), Tonawanda (city) |
| Twomile creek | 7.9 miles | 1 mile | 8.9 miles | 89 | 11 | Tonawanda (town), Tonawanda (city) |
| Unnamed Grand Island 1 | 0.5 miles | 0.2 miles | 0.7 miles | 75 | 25 | Grand Island |
| Unnamed Grand Island 2 | 1.1 miles | 0.1 miles | 1.3 miles | 91 | 9 | Grand Island |
| Unnamed Grand Island 3 | 2.1 miles | 0.2 miles | 2.3 miles | 91 | 9 | Grand Island |
| Unnamed Grand Island 4 | 1 mile | 0.1 miles | 1.1 miles | 89 | 11 | Grand Island |
| Unnamed Grand Island 5 | 1.5 miles | 0.02 miles | 1.5 miles | 99 | 1 | Grand Island |
| Unnamed Grand Island 6 | 2.7 miles | 0.1 miles | 2.8 miles | 95 | 5 | Grand Island |
| Unnamed Grand Island 7 | 0.9 miles | 0.1 miles | 1 mile | 90 | 10 | Grand Island |
| Unnamed Grand Island 8 | 0.9 miles | 0.1 miles | 1 mile | 86 | 14 | Grand Island |
| Unnamed Grand Island 9 | 0.7 miles | 0.2 miles | 0.8 miles | 81 | 19 | Grand Island |
| Unnamed Grand Island 10 | 0.7 miles | 0.1 miles | 0.8 miles | 83 | 17 | Grand Island |
| Unnamed Grand Island 11 | 0.6 miles | 0.2 miles | 0.9 miles | 73 | 27 | Grand Island |
| Unnamed Grand Island 12 | 6.3 miles | 0.7 miles | 7 miles | 90 | 10 | Grand Island |
| Unnamed Porter | 3.7 miles | 0.1 miles | 3.8 miles | 97 | 3 | Youngstown, Porter |
| Unnamed Tonawanda | 1.4 miles | 0.7 miles | 2 miles | 67 | 33 | Tonawanda (town) |
| Woods creek | 30.8 miles | 1.6 miles | 32.5 miles | 95 | 5 | Grand Island |
| **Totals** | **361.5 miles** | **111.2 miles** | **472.7 miles** | **76** | **24** | |