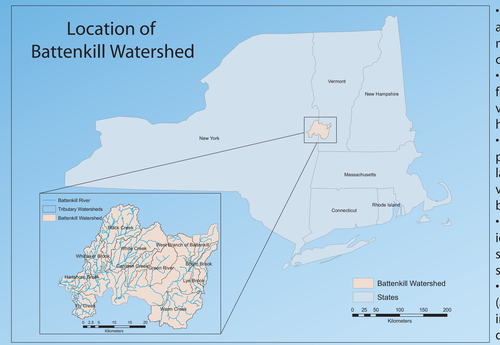
BUFFERS ON THE BATTENKILL: MAPPING RIPARIAN BUFFERS USING GIS

Megan Chadwick and Kyle Nichols
Department of Geosciences, Skidmore College, Saratoga Springs, NY

Abstract

The presence and location of riparian buffers play a critical role in water quality. Therefore, identifying and predicting locations where riparian buffers are absent is vital for watershed sustainability. Like most rivers, the Battenkill River watershed (~1150 km^2) has a patchwork of buffers, leaving many sections of the river vulnerable to pollutants. For this research, we used Geographical Information Systems (GIS) to map the current distribution of the buffers along the Battenkill River and its tributaries and locate the most viable locations for buffer restoration projects on behalf of the Battenkill Conservancy. For base maps we used 2 foot resolution orthophotography taken in 2004 for New York and 1 meter resolution digital orthophotography taken in 2003 for Vermont. Existing hydrography coverages did not accurately overlay stream locations on the orthophotographs so we re-digitized the main stem Battenkill and all visible tributaries. We overlaid 10 meter buffers on the base maps to determine zones without riparian buffers. The location of riparian buffers and coverages of land use, soil type, slope, and access points were used to identify areas of greatest concern for further protection of the Battenkill watershed. As a result, this research provides a comprehensive look at the current state of buffers along the Battenkill River as well as a database of accurate information for future use.

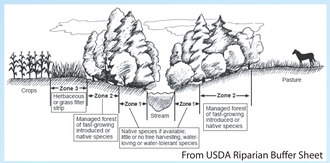
Introduction



- Buffers help prevent non-point source pollutant inputs such as oil, lead, pesticides, fertilizers, manure, and soils, derived from urban and agricultural lands
- The large amount of high runoff potential surfaces coupled with the high percentage of cultivated land leads to higher runoff velocity with a high capacity for sediment and pollutants
- The greatest impact on watershed quality is pollutant input, which can be elevated due to lack of buffers, high runoff potential soils, cultivation or development of land, and proximity to bridges.
- Used GIS to map riparian buffer zones and to identify areas of potential concern for non-point source pollution input in the Battenkill watershed
- Provided data for the Battenkill Conservancy (a not-for-profit organization aimed at improving the quality of the Battenkill Watershed) to develop buffer restoration projects

Why are Buffers Important?

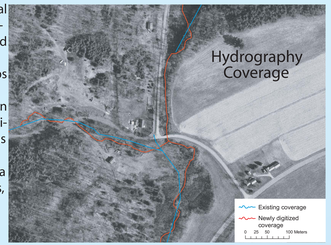
- increase bank stability
- create wildlife habitat
- slow runoff
- increase evapotranspiration
- trap sediment and pollutants giving microorganisms and organic matter in the buffer time to breakdown pollutants before they enter the river (USDA, At Water's Edge).

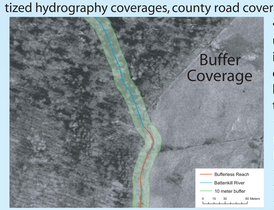


From USDA Riparian Buffer Sheet

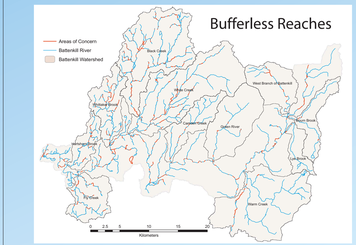
Methods

- Acquired USGS 1992 land use data and digital elevation models, surficial geology data for New York, soil data for Vermont, and 2 foot per pixel ortho-rectified aerial photographs for New York and 1 foot per pixel ortho-rectified aerial photographs for Vermont
- Re-digitized Battenkill and visible tributaries from aerial photo base maps because existing hydrography coverage was too coarse
- Overlaid 10 meter buffers and digitized the bufferless reaches based on aerial photographs and land cover and digitized bridges using the newly digitized hydrography coverages, county road coverages, and aerial photographs

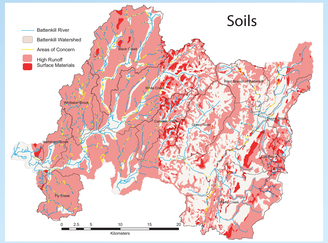




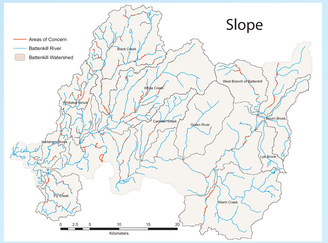
- Delineated watershed using DEMs and divided area into 11 tributary watersheds, demarcating the drainage boundaries of the major tributaries of the Battenkill
- Calculated slope using DEMs, river length, number of bridges, access points, land use percentage, distribution of hydrologic soil groups, and bufferless reaches for the Battenkill Watershed and 11 tributary watersheds
- Isolated areas of concern using an algorithm to identify bufferless reaches located within 200 m of high runoff potential soils, with a slope greater than 0.01 degree, with developed or cultivated land use, and within 200 m of a bridge or access point



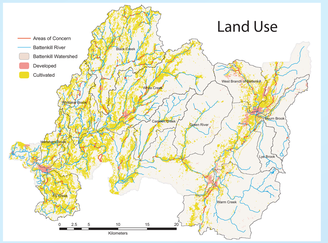
1. The first step is to map the locations along the river that lack a vegetative buffer of at least 10 meters.



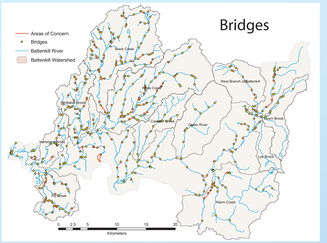
2. Next, the bufferless reaches are narrowed down to the locations within 200 meters of high runoff potential soils or surface materials (shown in red and pink).



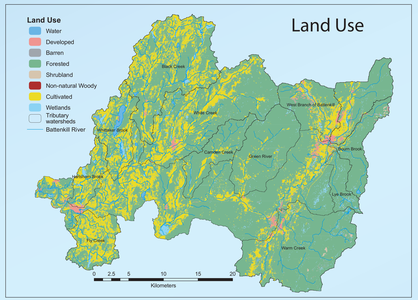
3. Then locations with a slope greater than 0.01 degree were selected.



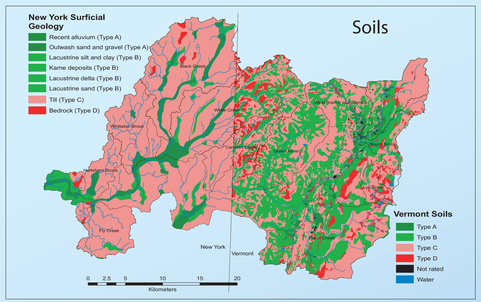
4. The data was narrowed down further by selecting locations within developed or cultivated land use categories.



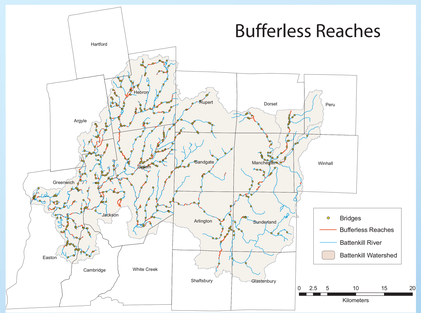
5. Finally, the locations within a 200 meter distance of a bridge were selected to show the areas of highest concern.



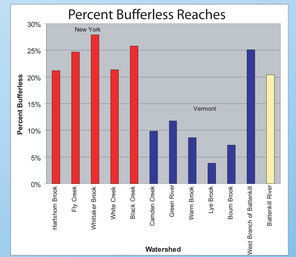
Land use in the watershed is 74% forested, 22% cultivated, and 2% developed. Cultivation is the greatest of the human impacts on the watershed quality because there are 249 km^2 of land on which fertilizers and pesticides are used and eventually runoff into the Battenkill River.



The soil coverage is 53% high runoff potential in Vermont and surficial geology coverage is 82% high runoff potential in New York, leading to higher runoff rates as well as faster runoff. The Vermont soil data is based off of hydrologic soil groups, whereas the New York data groups are based on surficial geology. There is no digital soil data for Washington County, New York at this time.



- The Battenkill River and its tributaries total 831 km in length and the watershed is 1150 km^2
- There are 983 bufferless reaches, totaling a length of 170 km or 20% of river length
- There are 455 bridges or access points on the river
- The tributary watersheds in New York generally have a higher percentage of bufferless reaches than the tributary watersheds in Vermont

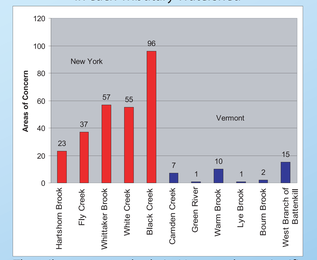


Areas of Concern

The areas of potential concern for non-point source pollution input are identified based on five factors: lack of riparian buffers, proximity to high runoff potential soils, a slope of at least 0.01 degree, cultivation or development of land, and proximity to bridges. Out of the 983 bufferless reaches on the Battenkill River and its tributaries, 397 have been identified as areas of concern.

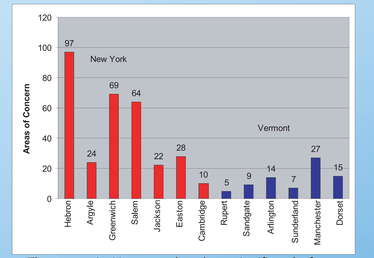
Areas of Highest Concern

Number of Areas of Highest Concern in each Tributary Watershed



The tributary watersheds in Vermont have significantly fewer areas of concern than the tributary watershed in New York.

Number of Areas of Highest Concern in each Town



The towns in Vermont also show significantly fewer areas of concern than the towns in New York. The town boundaries cover an area greater than the watershed boundary, thus town data are not directly comparable.

Conclusions

- Created an inventory of bufferless reaches on the Battenkill River and its tributaries
- Identified 397 out of 983 bufferless reaches as areas of concern
- Established a detailed database of features in the Battenkill watershed, including bridges, bufferless reaches, accurate hydrography coverage, and a division of sub-watersheds indicating the main tributaries of the Battenkill
- Cultivated land is responsible for the highest number of bufferless reaches in the Battenkill Watershed

Acknowledgements

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