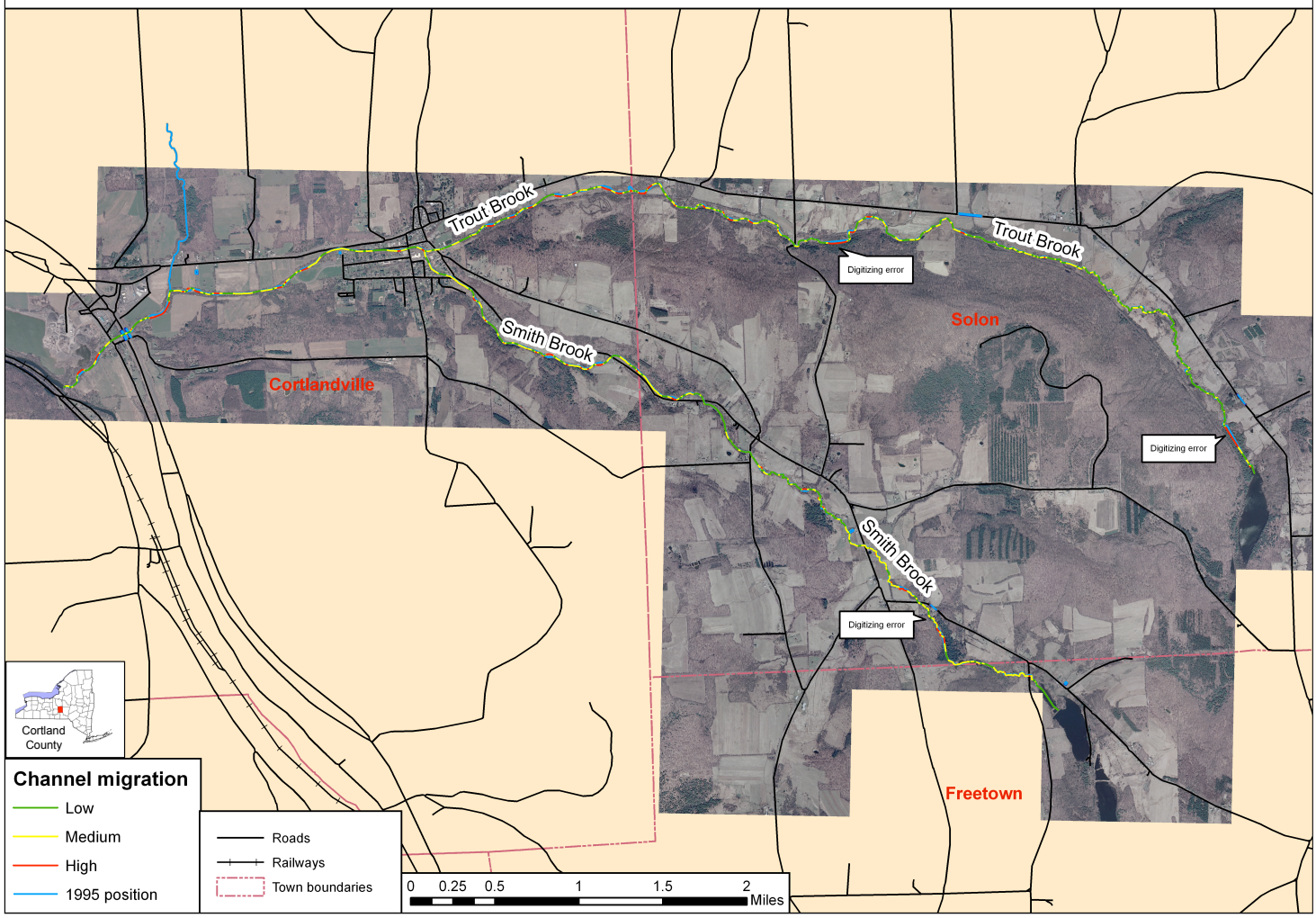
Channel migration of Trout Brook & Smith Brook in Cortland County, NY, between 1995 & 2006



INTRODUCTION

Stream channel migration is a significant problem that can cause damage to roads, buildings and other infrastructure (Fig. 1). The usual societal response to migrating channels is to use expensive hard engineering solutions to stabilize channels after they begin to damage or threaten structures. There are other potentially cheaper and less invasive options, such as not building in areas where channels are migrating or using soft buffers such as tree planting to slow migration, but such measures depend on knowledge of how channels are migrating now and how channels may migrate in the future.

The goal of this project was to use orthophotographs in a Geographic Information System (GIS) to determine areas of active channel migration along Trout Brook and Smith Brook in eastern Cortland County. Essentially this was a proof-of-concept project: could reaches of unstable channel be detected by using these freely available digital aerial photographs?

Fig. 1. Gas pipelines exposed by migration of Smith Brook. A flash flood in July 2006 caused substantial bank erosion and enabled the stream to outflank the hard engineering structures that had previously protected these buried pipes.

METHODS

Orthophotographs of the study area taken in March and April 1995 and 2006 were downloaded from the NYS Geographic Information Systems Clearinghouse. The 1995 images have a one meter (3.3 ft.) resolution while the 2006 images (shown above) have a 0.6 meter (2 ft.) resolution. These images were then loaded into ArcGIS 9.2 for analysis.

With just the 1995 images visible, the centerlines of Trout Brook and Smith Brook were traced, along with some tributaries, from their respective sources to the Tioughnioga River (blue lines above). The channel in three areas could not be resolved and so was traced as straight segments ("Digitizing error" labels above). The channel centerline tracing was then repeated with just the 2006 images visible.

Offsets of the 1995 and 2006 channel traces could be due to either actual channel migration or be artifacts due image distortion (orthorectification errors). To assess the latter, distinctive road junctions in several locations were traced on the 1995 and 2006 images and the apparent positions of these fixed points compared; this showed that between two and four meters (6.6 to 13.1 ft.) of offset between the 1995 and 2006 images could be due to image distortion. Up to two meters (6.6 ft.) of additional apparent offset could have arisen due to the resolutions of the orthophoto images.

Explicit differences between the 1995 and 2006 channel traces were determined using the buffer tool in ArcGIS. Stream reaches where the 1995 and 2006 centerlines were within two meters (6.6 ft.) or less of each other were classified as "Low" migration. Reaches where the traces were between two and seven meters (6.6 to 23 ft.) of each other were classified as "Medium" migration, while reaches where the traces were more than seven meters (23 ft.) apart were classified as "High" migration.

RESULTS & CONCLUSION

The analysis (above) shows that there are multiple reaches of Trout Brook and Smith Brook that fall into the "High" channel migration classification (> 7m or 23 ft. offset between 1995 and 2006). In most cases these are bends in the channel where erosion of the outer bank, and thus channel migration, would be expected (Fig. 2).

These results suggest that careful orthophotograph analysis can reveal areas of migrating channels. This type of analysis may prove useful for wise land use planning and for mitigating unstable channels before they become an expensive problem.

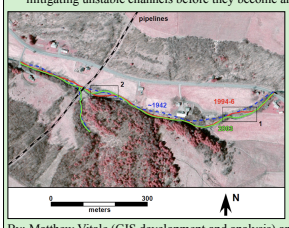


Fig. 2. Detail showing two areas of channel migration on Smith Brook, based on an analysis of 1942 (map) and 1994-6 and 2003 (orthophoto) images. The downstream area of instability (#2) is the one that reached the pipelines during the July 2006 flash flood.

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