

Crystal Creek, Fillmore County Dye Tracing 2010

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Introduction

Dye tracing was conducted at sinkholes in and around the Crystal Creek watershed in Bristol & Carimona Townships in Fillmore County. These traces were done as part of a cooperative effort between DNR, MDA and Fillmore County. The county and the MDA are working with landowners in the Crystal Creek watershed to study land management impacts on water resources. This area is underlain by Ordovician Galena limestone and is characterized by surface karst features. The predominant karst features are sinkholes and springs. The traces were done to begin to delineate the ground water basins (springsheds) that feed the springs that are the water sources for Crystal Creek. In karst areas like the Crystal Creek watershed, it is common for the ground water watershed to have different boundaries than the surface water watershed.

Dye tracing entails using fluorescent dyes to track groundwater flow directions and travel times. The dye is poured into a sinkhole or sinking stream; from there, it flows through the karst conduit system until it re-emerges at a spring or springs. For this project, the dyes used were Uranine C (Color Index # 45350, Chem. Abs. # 518-47-8), Eosine Y (Color Index # 45380, Chem. Abs. # 17372-87-1) and Rhodamine WT (Acid Red 388, Chem. Abs.# 37299-86-8). Both direct water samples and passive dye detectors were used and all the samples were analyzed at the University of Minnesota Geology Department using a scanning spectrofluorophotometer. The traces were designed and executed by Jeff Green of MNDNR Waters and Kevin Kuehner of the Minnesota Dept. of Agriculture. E. Calvin Alexander, Jr., Andrew Luhmann, and Scott Alexander of the University of Minnesota Geology Department performed the sample analysis and interpretation. Numerous landowners in the Crystal Creek watershed gave permission for access to their properties.

Results

MDA staff had secured access to the springs feeding Crystal Creek and Willow Creek in the project area. These sites were monitored using passive charcoal detectors (bugs). Five separate traces were run at three different times. Table 1 summarizes the results and Figure 1 is a map of the dye traces.

The March 2010 traces were recovered at a spring feeding Willow Creek. The runoff entering these sinkholes is discharged out of the Crystal Creek watershed. The July traces were run from two sinkholes that are outside of the surface watershed of Crystal creek. Water flowing into those sinkholes discharges at Spring A323, which is an important coldwater source for Crystal Creek. These four traces demonstrate that the ground water watershed has different boundaries than the surface water watershed. The November 2010 trace was the first race recovered at spring A0059. That trace is the beginning of the process of mapping the contribution area (springshed) of the spring. Ground water flow rates based on direct water samples taken during these traces were 12 to 24 hours from the point of introduction (sinkholes) to the springs where the dye was recovered. These values are consistent with other traces done in the Galena karst by DNR & U of M staff.

Dye Input Point NAD_1983_UTM_Zone_15N	Dye Type & Quantity	Date/Time	Water Source	Dye Detection Points NAD_1983_UTM_Zone_15N
Sinkhole MN23:D5643 571271E/4825668N	Eosine 1037.23 gm. Chromatint Red 0143 Lot 020706	3/11/2010 1740	Snowmelt runoff est. @ 100+ gpm	“Big Pond Spring” 572000E/4825569N
Sinkhole MN23:D6487 Scheevel 571089E/4825344N	Uranine HS 787.83 gm. Chromatint Lot 092508	3/11/2010 1653	Snowmelt runoff .25-.5 CFS	“Big Pond Spring” 572000E/4825569N
Sinkhole MN23:D5526 571084E/4827791N	Uranine HS 324.12 gm. Chromatint Lot 092508/039922	7/20/2010 1625	550 gal DNR tank	Spring MN23:A0323 570694E/4826707N
Sinkhole (Kruegel) 570482E/4827675N	Eosine 310.15 gm. Chromatint Red 0143 Lot 12207	7/20/2010 1756	550 gal DNR tank	Spring MN23:A0323 570694E/4826707N
Sinkhole MN23:D5251 Dornink 569597E/4824672N	Uranine HS 313.36 gm. Chromatint Lot 092508	11/15/2010 1532	550 gal DNR tank	Spring MN23:A0059 570073E/4826011N

Table 1. Dye Input and Detection Points

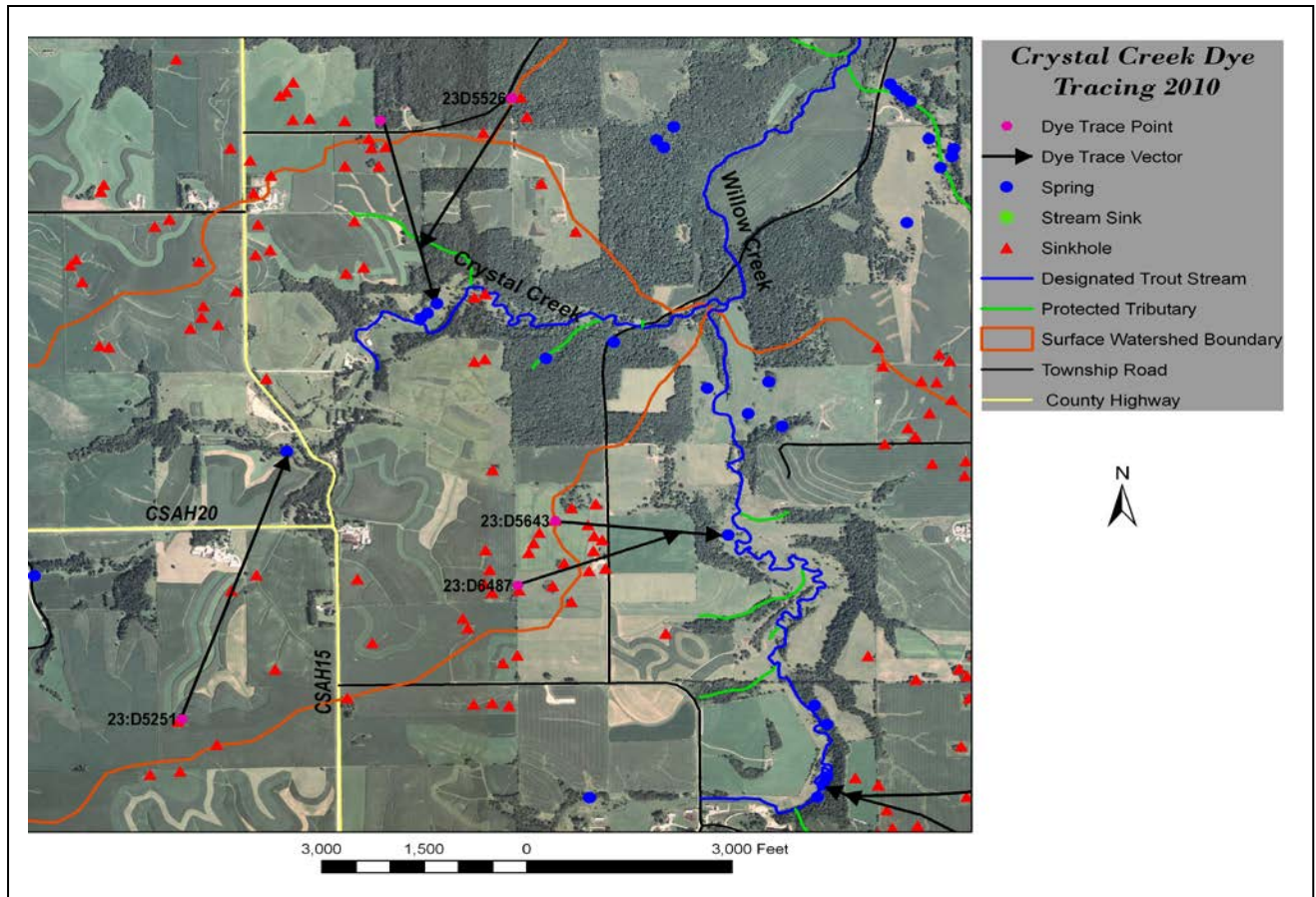


Figure 1. Dye Trace Map