Title: Mapping and Characterization of Springs in Brown and Calumet Counties
Project I.D.: Wisconsin DNR PO# NME00001245
Investigators: Kevin Fermanich, Michael Zorn, Ronald Stieglitz, Christopher Waltman
Period of Contract: May 1, 2005 through September 30, 2006

Background:

Flow from groundwater springs and the associated emergent environment provide important habitat for a variety of terrestrial and aquatic plant and animal species. Springs also contribute source water to streams. Historically natural springs have provided domestic and agricultural water supplies and in some cases are still used for such purposes and for commercial water bottling operations. Under Wisconsin Act 310, high capacity wells are required to be permitted by the Wisconsin Department of Natural Resources (WDNR). The permitting process is used to determine whether high capacity wells will impact groundwater or other important water resources including natural springs. Springs discharging greater than 1 cubic feet per second (cfs) throughout 80% of the time are to be protected. The protection cutoff of 1 CFS may, however, have an undesirable effect on the ecology of small, low-discharge springs that provide critical habitat for certain species. These smaller springs will be more susceptible to groundwater depletion than larger springs. Currently, the WDNR does not have a centralized database of spring locations and there is very little information on spring flow characteristics. Spring locations appear on topographic maps, soils maps and other resource inventory maps for Brown and Calumet Counties. However, there are inconsistencies between map sources and no comprehensive natural spring survey exists for the area studied.

Objectives:

The main goal of this study was to inventory and characterize springs in Brown and Calumet Counties, Wisconsin, with an emphasis on larger springs as defined in 2003 Wisconsin Act 310. Specific objectives were to:

1. Map the location and determine the outflow characteristics of springs;
2. Quantify the flow amount and duration of springs with significant flow;
3. Measure the geochemical and water quality characteristics of springs with significant flow;
4. Determine spring outflow age and hence relative travel time through the subsurface;
5. Inventory landscape and biological characteristics of spring sites with significant flow.

Methods:

An inventory and assessment of springs was conducted between April, 2005 and August, 2006. Reconnaissance was performed to determine spring locations and discharge was qualitatively assessed. The geolocation of each spring was documented using GPS. Five springs with larger and persistent flows were chosen for detailed study—two were located in Brown County and three were located in Calumet County. Biweekly monitoring of the five selected springs began in September 29, 2005 and concluded August 28, 2006. Baseline information that was collected included pH, temperature, specific conductivity and flow. Discharge measurements were made using the volumetric measurement method, measuring stream cross section and velocity, or using a calibrated portable weir plate.
Grab-samples were collected six times at selected spring outflows and were used to determine anion (sulfate, chloride, nitrate, nitrite and phosphate) and element (Ca, Mg, Zn, Na, K, Fe) concentrations, and alkalinity. These samples were collected in September 2005, January 2006, March 2006, June 2006, July 2006 and August 2006. Apparent groundwater recharge age-dates were determined for each site on samples collected on October 1, 2005 and June 3, 2006 using ultra-trace chlorofluorocarbons (CFCs) techniques. CFC samples were analyzed and interpreted at the Trace Gas Analysis Laboratory at UW-Stevens Point.

Landscape setting, floral and fauna assessments were conducted at each of the five intensively studied spring locales. Aquatic invertebrates were sampled and inventoried in July 2006. Digital images of the sites were recorded.

Results and Discussion:

A total of 41 natural springs were mapped in Brown and Calumet counties during reconnaissance performed throughout the project. Springs found on existing maps were visited to determine if they were still flowing. Several unmapped springs were found during the reconnaissance. Outflow at several of the springs had been channelized, pooled, or capture for domestic or agricultural use. Outflow from one of the monitored springs was entirely captured for a commercial bottled water enterprise.

Precipitation in the study area was between 14 and 26% below the 30 year average from January, 2005 to the end of September, 2005. Excluding May, water-year 2006 precipitation was 12-15% below normal. A spring on the UW Green Bay campus in Brown County had an estimated discharge at or below 0.01 CFS throughout the monitoring period. Except for April and May 2006, two of the springs in Calumet County had discharge rates between 0.2 and 0.04 CFS. Peak flow occurred in mid-May 2006 in response to heavy precipitation at all three Calumet County sites. Peak discharge at one site was 3.34 CFS on June 2, 2006 and was >1 CFS from April 1 to August 1, 2006.

Temporal distribution of a cationic species show little change for all site. The samples are all bicarbonate-dominated, with sulfate and chloride concentrations varying over time. Anions show far more variability with a wide range in values. Conductivity and anion concentrations were substantially higher at the UW - Green Bay spring site than the rest of the sites.

The apparent age dates for spring water ranged were from 1966 to 1985 for the October samples and 1976 to 1986 for the June samples. The three Calumet County springs had apparent recharge times ranging between 1981 and 1986. The two Brown County springs showed 5-10 years older spring outflow water than the springs in Calumet County.

Conclusions/Implications/ Recommendations:

No springs were inventoried that had a discharge of >1 CFS for 80% of the time. The largest springs are located in association of the Niagara Escarpment. Relatively low precipitation prior to and during the project time frame likely reduced the number of flowing springs mapped and overall discharge of larger springs. Discharge of the Calumet County springs responded fairly rapidly to large rainfall events in May 2006. Most large springs have been disturbed by human activity.

This report provides baseline information on the location, flow and geochemical characteristics of major springs. This report and associated data files will be valuable for assessing future groundwater withdrawal impacts and in conducting future studies in these counties.

Related Publications: Waltman, C.S. (expected May 2007). Mapping and Characterization of Springs in Brown and Calumet Counties. MS Thesis, Environmental Science and Policy, UW-Green Bay.

Key Words: springs, Brown County, Calumet County, geochemistry, groundwater, ecology

Funding: Wisconsin Department of Natural Resources

Final Report: A final report containing more detailed information on this project is available for loan at the Water Resources Institute Library, University of Wisconsin – Madison, 1975 Willow Drive, Madison, Wisconsin 53706 (608) 262-3069.