

Title: A Survey of Baseflow Discharges in the Western Fox-Wolf Watershed

Project I.D.: DNR project # 186

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Period of Contract: May 5 2005 through June 30 2007

Background/Need: Wisconsin's 2003 Act 310 expanded the State's authority to manage the environmental impacts of high capacity wells. Implementation of Act 310 represents a formidable challenge for WDNR staff, both in terms of the complexity of making a "no significant adverse environmental impact" determination and in having a sufficient decision-making knowledge base. WDNR staff identified among other knowledge needs a priority for baseflow information in the GPAs (Groundwater Protection Areas) of the western Fox-Wolf watershed. GPAs in the western Fox-Wolf contain about 1800 km of high quality streams and 10 lakes.

Objectives: The objective of this study was to survey baseflows for the headwater streams lying within GPAs in the western Fox-Wolf watershed. The scope of work included the following:

1. Compiling and interpreting USGS daily discharge information. We examined the daily discharge record for the Upper Fox and Wolf basins, determined which stations might be useful, inferred baseflows, and compared water years 2005 and 2006 against the long term record at each station.
2. Compiling USGS miscellaneous stream discharge measurements from the Upper Fox and Wolf basins and comparing to those measured in this study.
3. Measuring stream discharges during baseflow periods on headwater streams.
4. Regressing baseflows against potentially explanatory variables suitable for use by WDNR review staff.
5. Comparing project baseflows against those previously measured by USGS.

Methods: Stream discharge measurements were made by velocity-discharge methods.

Results and Discussion: Baseflow discharge measurements made during the project period (2005-6) reflected drier than average conditions. Though annual precipitation was near normal to moderately dry, summers tended to be drier than the years as a whole. Long-term active USGS daily discharge gauges in 2005 and 2006 averaged the 21st and 9th percentiles of annual averages, respectively.

Discharge measurements were taken at 304 sites during baseflow conditions, at least once at each site during the summer of 2005. Forty sites were selected from 17 sub-watersheds for repetitive measurements that continued until October 2006. On average repetitive measurements were made 14 times per site.

Stream discharges during baseflow periods correlated well with the cumulative amount of stream channel occurring upstream from a measurement point. In a watershed-by-watershed analysis, streams gained baseflow by an average 1.5 cfs per cumulative stream mile (range of 0.26 to 10.6 cfs per mile). Further, an average 17.1 cumulative stream miles (range of 0.98 to 38.13) was required to generate 10 cfs of baseflow.

Repetitive measurements made at select sites indicated that baseflow variability is small near headwater streams, but increases greatly in the lower reaches of a system. This suggests that efforts to quantify baseflow variability are better spent in larger stream reaches.

Comparisons of baseflows measured in this study agreed well with low flow measurements at 35 collocated sites used by the USGS from the 1930s until 2006, bolstering confidence in both data sets. Large-scale USGS daily discharge gauges further suggest a baseflow of 11.2" per unit of watershed.

Baseflow measurements made for this project as well as summary statistics of USGS daily discharge sites and miscellaneous discharge sites have been forwarded with this report as ArcGIS map document and geodatabase files.

**Conclusions/
Implications/**

Recommendations: This study provides measured baseflow discharges for many headwater streams of the western Fox Wolf watershed. These measurements should be useful to WDNR staff for evaluating applications for high capacity well approvals. Furthermore, the study provides tools for estimating baseflow discharges at locations where estimates do not exist.

Related

Publications: None at this time.

Key Words: Baseflow discharge, Fox-Wolf watershed, high capacity wells

Funding: Wisconsin Department of Natural Resources

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