**Title:** Information Support for Groundwater Management in the Wisconsin Central Sands, 2009-2011

**Project I.D.:** NMA00000253

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**Period of Contract:** July 1 2010 through June 30 2012

**Background/Need:** The levels of groundwater, lakes, and wetlands and the baseflows of streams in the Wisconsin Central Sands are substantially affected by groundwater pumping. The issue requires gathering and interpreting relevant hydrologic data, creating analysis tools, and assembling knowledge as to hydrologic causes and effects.

**Objectives:** **C**ontinue information support for management activities concerning groundwater pumping and its impacts on surface waters in the Wisconsin Central Sands.

**Methods:** Baseflows were measured at 31 stations and groundwater elevations were measured at three sites at monthly to bimonthly frequencies. A historic monitoring well at Amherst Junction was reconstructed. Groundwater and lake level data were compiled from various sources and evaluated for trends. A groundwater flow model was extended to a broader area of the Central Sands. Irrigation rates were estimated for years 2008-2010. Precipitation, stream discharge, and water elevation data were summarized and interpreted.

**Results and Discussion:**

Hydrologic information availability. Much of the hydrologic data gathered or compiled for this study have been forwarded to the Department of Natural Resources (WDNR) and uploaded to the United States Geological Survey data archives.

Extended groundwater flow model. The extended model resides at the Watershed Center and is available for WDNR and other needs.

Weather conditions, 2009-2011. Year 2009 precipitation was about average, but 2010 was notably wetter than average by 6.5 to 10.6 in, depending on station. Year 2011 was also mostly wetter than average. The greater precipitation amounts in 2010 and 2011 raised water levels and streamflows through the region by suppressing irrigation pumping and increasing recharge.

Hydrologic conditions, 2009-2011. Discharges in reference (relatively unaffected by pumping) streams were below average in 2005-2009, but increased substantially in 2010 and exceeded the 90 percentile in 2011. Reference groundwater levels that were previously somewhat low to average rose to 72 percentile at Amherst Junction and 91 percentile at Wautoma in the same period.

Groundwater levels in pumping affected areas. Groundwater levels in these areas reached record lows in the late 2000s, during a period of average to modestly dry weather, a signal consistent with a pumping impact. The wet conditions of 2010-2011 eased pumping declines somewhat in areas with many high capacity wells.

Lake levels. Lake level measurement in 2011 increased substantially from 2007 lows by an average 2.6 feet, presumably due to the large rains of 2010-2011. The levels of four lakes previously shown to have large and significant pumping declines were revisited. Maximum pumping declines in the four reached 3.3 to 8 feet in 2007-2010, depending on lake, and showed a partial rebound in 2011.

Little Plover River. Little Plover discharges during 2005 through mid 2010 were mainly less than the one-day low of the entire historic period, and the stream experienced dry-ups in stretches during 2005-2009. The extreme wet period that began in mid 2010 increased discharges above the historic one-day low and even the historic average for much of 2010 and 2011. Groundwater pumping diversions, using 2005-2007 as a reference period, averaged 4.5 cfs. Implemented and planned diversion reduction strategies, and the unplanned closure of the New Page paper mill, may in a decade or two reduce diversions by 25%, assuming no increases in Plover pumping or repurposing of New Page pumpage. However, this may only be sufficient to reduce "unhealthy" flow days from 77% to 66% of the time.

Irrigation rates, 2008-2010. Irrigation rates for the Central Sands had medians of 9.5 in, 7.6 in, and 4.2 in in 2008, 2009, and 2010, respectively. Yellow field corn, potato, and sweet corn received the greatest amounts of irrigation.

**Conclusions/ Implications/ Recommendations:**

Pumping impacts on water levels and streamflows in the Wisconsin Central Sands continued through 2011, but were moderated somewhat beginning in mid-2010 by very large precipitation amounts and somewhat wet conditions in 2011. Wet conditions increase natural recharge, and suppress the need for extracting water from aquifers for irrigation. Compiled hydrologic data and groundwater modeling tools are available for management agencies, scientists, and outreach educators.

**Related Publications:**

Kraft, G.J., K. Clancy, D.J. Mechenich, and J. Haucke. 2012. Irrigation Effects in the Northern Lake States: Wisconsin Central Sands Revisited. Ground Water Journal. V. 50 (2): 308-318.

Kraft, G.J., D.J. Mechenich, K. Clancy, and J. Haucke. 2010. Groundwater Pumping Effects on Groundwater Levels, Lake Levels, and Streamflows in the Wisconsin Central Sands. Center for Watershed Science and Education, University of Wisconsin, Stevens Point, WI.

Clancy, K., G.J. Kraft, and D.J. Mechenich. 2009. Knowledge Development for Groundwater Withdrawal Management around the Little Plover River, Portage County Wisconsin. Center for Watershed Science and Education, University of Wisconsin, Stevens Point, WI.

**Key Words:** Central Sands, groundwater pumping, irrigation, Little Plover

**Funding:** WDNR Groundwater Monitoring funds.

**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.