PROJECT REVIEW

Key findings of the Little Plover River groundwater flow modeling project in Wisconsin's Central Sands region

Wisconsin Geological and Natural History Survey | 2016

Summary

A state-of-the-art groundwater flow model was developed as a tool for understanding the interactions between groundwater withdrawals and streamflow in the Little Plover River basin in Wisconsin's Central Sands region.

Background

Wisconsin's Central Sands region is home to abundant streams, rivers, and lakes as well as a thriving agricultural industry. In 2013, in response to concerns about the growing number of high-capacity wells and their impacts on surface waters, the Wisconsin Department of Natural Resources funded a project to construct a groundwater flow model for the Little Plover River basin in Portage County. The project was carried out jointly by the Wisconsin Geological and Natural History Survey and the U.S. Geological Survey.

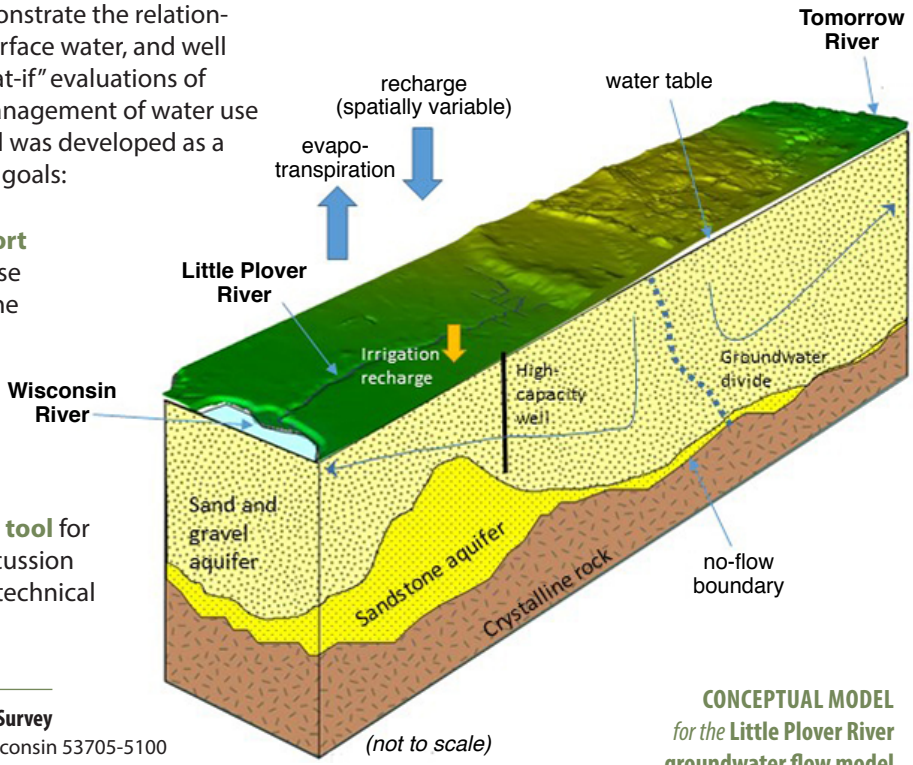
The model can be used to demonstrate the relationships between groundwater, surface water, and well withdrawals. Models allow "what-if" evaluations of possible decisions involving management of water use or land-use changes. The model was developed as a pilot project with the following goals:

1. **To provide scientific support** for future water- and land-use management decisions in the Little Plover River basin.
2. **To evaluate modeling techniques** that might later be expanded to the entire Central Sands region.
3. **To serve as an educational tool** for fostering science-based discussion for both the public and the technical community.

Model construction

The groundwater system in the Little Plover River basin is simulated using a three-dimensional groundwater flow model. The model incorporates knowledge about the area's geology, wells, and surface water locations, and is calibrated (adjusted) so that simulated groundwater levels and stream flows closely match measured values. In this model, horizontal layers represent the sand and gravel aquifer and the underlying sandstone bedrock.

A soil-water balance model was used to estimate groundwater recharge by calculating the amount of precipitation and irrigation that infiltrate through the soil to replenish the groundwater system. This estimated recharge, that varies both in space and time, provided data for the groundwater flow model.



CONCEPTUAL MODEL *for the* **Little Plover River groundwater flow model**

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The model simulates high-capacity wells, with pumping rates varying monthly. Base flow, the groundwater component of streamflow, is simulated for the Little Plover River. The model can simulate both long-term average conditions ("steady-state") as well as how seasonal variations in pumping and recharge affect water levels and base flow throughout the year ("transient").

Key findings

- The Little Plover River is closely connected to the groundwater system, making it vulnerable to impacts from nearby pumping.
- Water use in the basin varies through the year. About 80% of the total annual water use comes from irrigation pumping, which occurs primarily during the growing season.
- Land use and crop patterns affect recharge rates, which in turn impact groundwater levels and stream flows. The model can be used to evaluate the effects of changing land use.
- Pumping and land-use changes have altered the natural groundwater flow pattern. The area of the landscape contributing groundwater to the river (the capture zone) is smaller now than it was before human settlement.
- Wells outside the capture zone can still have a major impact on base flow.
- There can be a delay of weeks to months between changes in pumping and impacts on the river, depending on the distance between the pumping well and the river.
- A well's impact on the river depends primarily on its proximity to the river. For example, removing about 15 wells nearest the river would increase base flow substantially in an average year.
- The concept of depletion potential, the percentage of pumped groundwater that otherwise would have supplied flow to a river or lake, can help evaluate the relative impact of each well. This analysis method shows promise as a guide for balancing water use with environmental needs.

What is the project status?

The model and report have undergone extensive peer review and are currently being revised. We anticipate making the model and an accompanying user's manual publicly available later this year and the report documenting the model construction will follow. Once the model is available, we will host a workshop or webinar demonstrating how to use it.

What's next?

The model can be used to evaluate the potential impact of proposed wells and to simulate different management scenarios to support future decision making in the Little Plover River basin. Potential uses of the model include evaluating the hydrologic impacts of changing pumping rates, land use, crop types, or irrigation practices in specific areas.

The modeling techniques evaluated for this pilot project are readily transferrable to model construction in the remainder of Wisconsin's Central Sand Plains, although significant data collection would be needed to extend the model to a larger area.

Who can I contact for more information?

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See also **http://fyi.uwex.edu/littleplovermodel/**