In the Shadow of John Muir

Will groundwater withdrawals at Bluff Point threaten the Kilmarnock water supply?

Unintended Consequences

John Muir, writer, conservationist, and founder of the Sierra Club, famously wrote, " Tug on anything at all and you'll find it connected to everything else in the universe." This observation explains, I believe, why we find ourselves so frequently in environmental messes and why it is so difficult to get out of them. Nature's web is complex. Too often, we have blundered into some province of nature before we fully understand the consequences of our actions. For proof, we have to look no farther than the mess we have made of the Chesapeake Bay.

At least we can see much of the damage to the Chesapeake Bay. Our groundwater problems develop out of sight. This is the problem with groundwater; it's--well, *underground*. A leaking petroleum tank can pollute an aquifer before we know it. With little warning, reckless pumping can dry up neighboring wells and deplete an aquifer beyond restoration. By now, it is a familiar story; recognition of the threat comes too late to prevent serious harm.

In Northumberland County (Virginia) the developer of Bluff Point, an 898 acre resort and residential development, is proposing to pump more than 200,000 gallons of groundwater a day from the Potomac aquifer. Troubled by this prospect, the town manager of Kilmarnock, a community just over the county line in Lancaster County, persuaded the town council to call on Northumberland County officials for assistance. Groundwater flow displays very little respect for political boundaries. In light of "the potential negative impact on the town's wells and water system," the council asked for aquifer tests in order to define the hydrologic consequences of Bluff Point's groundwater withdrawals. "There is no scientific data to base a projection," the town manager told the *Rappahannock Record*. "We just don't know, but we would like to get ahead of this rather than wait until problems occur."

Getting Ahead of the Problem

If Northumberland and Lancaster Counties, along with the rest of Northern Neck, were now included in the Eastern Virginia Groundwater Management Area, then state law would require a thorough assessment of the potential impact of the water withdrawals on the groundwater system and on other water users. A groundwater withdrawal permit is issued by the State Water Control Board only after the board is satisfied that "the maximum safe supply of ground water will be preserved and protected for all other beneficial uses and that the applicant's proposed withdrawal will have no significant unmitigated impact on existing ground water users or the ground-water resource" (9VAC25-610-110). But because the Eastern Virginia Groundwater Management does not currently extend to the Northern Neck (or Middle Peninsula), the developer of Bluff Point has no legal obligation to conduct such a hydrologic assessment.

A well-conducted hydrologic assessment would give answer to Kilmarnock's concerns that groundwater withdrawals at Bluff Point might reduce or otherwise harm the town water supply. It would include a pump test or aquifer test, in which a prospect well is pumped at a specified rate for a specified period of time (commonly 72 hours) and measurements of the amount of drawdown in observations wells are made and recorded. (In a confined aquifer such as the Potomac aquifer, drawdown is the distance that the artesian water level is lowered by pumping. For an illustrated

explanation of confined aquifers and drawdown of artesian water levels, see: http://groundwatervirginia.org/files/Chapter_1_Groundwater_System.pdf). The relationship between pumping rate and drawdown varies from one aquifer to another and depends on the unique hydraulic properties of an aquifer. For example, pumping a well in one aquifer at 100 gallons per minute may produce 10 feet of drawdown in the vicinity of the well, whereas pumping a well in another aquifer at the same rate may produce 50 feet of drawdown or more.

Two key hydraulic properties influence this aquifer behavior. The first aquifer property is called *transmissivity*. Put simply (if not precisely), transmissivity describes the permeability of an aquifer and is a measure of the volume of groundwater flowing through a strip of an aquifer in a given time. All other factors being equal, an aquifer having a high value of transmissivity is a better water producer than an aquifer with a low value of transmissivity. The second hydraulic property is *storativity*. Storativity refers to the ability of a aquifer to store water. (Technically, it is the volume of water released from an aquifer per 1 foot surface area per 1 foot change in head, which is a definition only a groundwater wonk could love.) What's important for this discussion is that the analytical results of an aquifer test define the values of transmissivity and storativity of the aquifer being pumped.

Let's examine how an aquifer test and knowledge of transmissivity and storativity of the Potomac aquifer beneath Bluff Point can tip off the citizens of Kilmarnock to potential damage to their water supply. Employing any one of several hydrologic techniques, a groundwater scientist can use the values of the aquifer properties to define the area of impact (AOI) of the proposed withdrawal (in this case, equivalent to approximately 200,000 gallons per day) and predict the amount of drawdown at any location within the AOI. Thus, this kind of assessment would reveal if Kilmarnock's water wells lie within the area of impact of the groundwater withdrawals at Bluff Point and how much well interference, if any, is likely. The worst case scenario would be that groundwater withdrawals at Bluff Point would draw down the regional artesian water level so much that the pumping water level in a Kilmarnock supply well would drop below the pump intake, causing the well to "go dry."

Preventive Medicine

The large groundwater withdrawals planned for Bluff Point are precisely the kind of actions that the members of the Lancaster County Board of Supervisors hoped to see regulated when they petitioned the State Water Board for inclusion in the Eastern Virginia Groundwater Management Area. New groundwater withdrawal regulations, including expansion of the GWMA to the Northern Neck and Middle Peninsula, are working their way through the halls of state government in Richmond. If all the pieces fall into place, the new regulations will go into effect by the Spring or Summer of 2011. At that time, the law will be on the side of the citizens of Kilmarnock who want their water supply protected. I think that John Muir would've understood.

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April 27, 2010