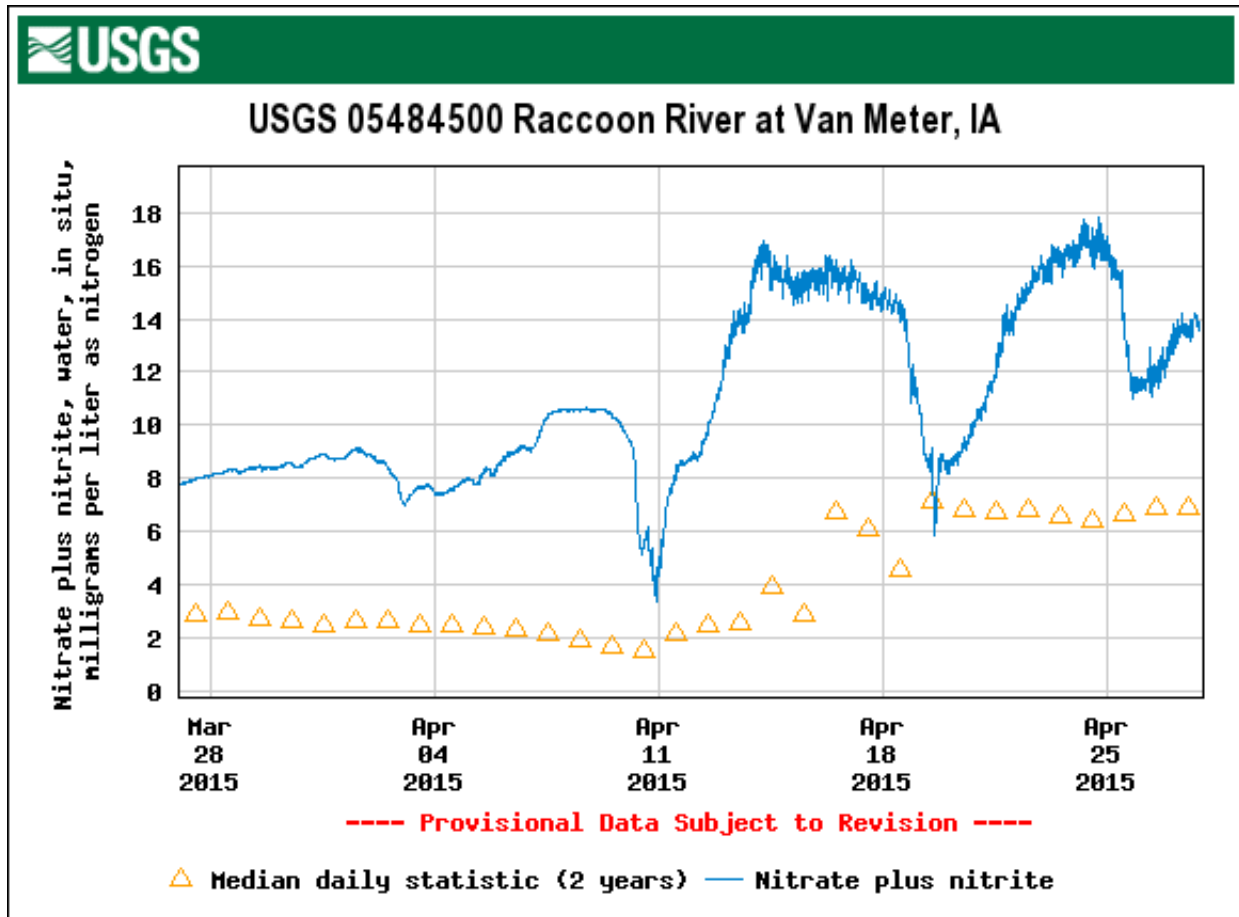


Numerical Nitrates

The Raccoon River in Iowa has significant levels of nitrates and nitrites coming from surrounding farm fields. The Environmental Protection Agency requires nitrate levels be under 10 milligrams per liter for drinking water. At levels higher than this, “blue baby syndrome” and possible links with cancer and endocrine disruption become a danger to people who drink the water. This means that the Des Moines Water Works must remove nitrates from the water coming from the Raccoon River to make sure it is safe to drink.

The US Geological Survey keeps track of nitrate and nitrite levels at several spots along the Raccoon River. Here is data from the Van Meter monitoring station in Iowa for one month in 2015, from March 27 to April 27:



1. How many days were nitrate levels above EPA standards for drinking water? Estimate!

Numerical Nitrates

2. The Des Moines Water Works processes ten million gallons of water a day. Convert this to liters per day.
3. Use numerical integration to estimate how much nitrate passed through the water processing plant in the month shown, assuming the plant operated at full capacity. (What are your units?)
4. The previous question gave a maximum for how much nitrate passed through the processing plant in the month shown. Refine your estimate of nitrate removed: assume that the nitrate removal process was only turned on when nitrate levels were higher than 10 milligrams per liter, and that the plant removed enough nitrogen to get the water to EPA-mandated levels but not lower. If so, estimate how much nitrate was removed in the month for which you have data.
5. What was the cost of operating the nitrate removal equipment if the cost is \$7,000 per day of operation?