MEMORANDUM

To: Groundwater Advisory Council
From: H. Bokuniewicz
Re: Minutes of the meeting of 24 November 2008
Date: December 1, 2008

PRESENT	**REGRETS**
N. Bartilucci	M. Alarcon
H. Bokuniewicz	R. Alvey
S. Colabufo	L. Koppelman
G. Hanson	R. Liebe
S. Jones	R. Mazza
M. Nofi	D. Paquette
W. Spitz	A. Rapiejko
S. Terracciano	K. Roberts
C. Young	K. Willis

1. There were no comments on the minutes of the last meeting.

2. I had given the presentation on emerging contaminants to the Cornell-Breast-Cancer-and Environmental-Risk-Factors meeting. This was not a technical group, so my talk was a general one. Based on the response, I think I got the right message across (at least I don't think I did any damage).

- Gil Hanson talked about the evolution of nitrogen in Long Island groundwater based mostly on the work done under his supervision by Patti Bliefus, Caitlin Young and Jennie Munster. The latest hypothesis is that the depth to the water table in the recharge area controls the extent of denitrification in the aquifer. Briefly, the deeper the water table, the more oxidation of dissolved organic carbon (DOC) in the vadose zone where oxygen is continually being added from the atmosphere, which allows the infiltrating water in the vadose zone and the resulting groundwater to have a high oxygen concentration. As a result, nitrate in groundwater derived from recharge areas with a deep water table undergoes limited denitrification because of its low DOC and high oxygen concentrations.

  It has long been known that about 50% of the total nitrogen source is lost before it reaches the water table. Speculation on the reasons for this include denitrification around cesspool leaching fields (Porter et al, 1980), ammonium sorbtion near cess pools (Hanson et al, 1999), 61% denitrification in the vadose zone and 35% in groundwater (LISS 2007) or somewhere (Munster et al, in preparation).

  Recently two new types of data have become available. These are the measurements of the concentration of dissolved organic carbon (DOC) and nitrogen/argon ratios in

groundwater on Long Island. The nitrogen/argon ratios measure the extent of denitrification by the extent of increase in the ratio of nitrogen to argon above the atmospheric value in the aquifer. These parameters are easily measured to one ppm. Two sites were examined, one in Northport where the recharge area has a relatively deep water table and one on Fire Island where the recharge area has a relatively shallow water table.

In Northport, levels of DOC in the groundwater were about 0.5 ppm and the nitrogen/argon ratios show that 10 to 15% of the nitrogen had been denitrified in the aquifer. On Fire Island, DOC was as high as 18 ppm in the groundwater and the nitrogen/argon ratios show that 100% of the nitrate had been denitrified in the groundwater.

The conceptual model has ammonium from the septic system being sorbed onto organic and particulate matter in the vadose zone. Oxygen available in the vadose zone converts ammonium to nitrite and then to nitrate. In addition, bacteria use the oxygen to react with DOC which is converted to carbon dioxide which then escapes as a gas. If the water table is shallow there is less time for the bacteria to react with DOC in the vadose zone leaving low oxygen and relatively high DOC concentrations. As a result in the aquifer there are low oxygen and relatively high DOC concentrations. Due to the low oxygen and the presence of DOC the bacteria oxidize only some of the DOC using the nitrate which results in the formation of nitrogen gas (denitrification) and carbon dioxide. Both the nitrogen gas and carbon dioxide dissolve in the groundwater.

This model helps to explain some of the earlier results from Northport which had both high concentrations of nitrate (approaching 10 ppm or higher) and high oxygen (up to 11 ppm). Based on Jennie Munster's measurements of nitrate, chloride, sulfate and bromide 10 to 15% of the water is sewage derived. Modeling suggests that about 50% of the nitrogen associated with sewage has been lost from the system. Patti Bliefus' isotopic measurements on nitrogen and oxygen isotopes on nitrate in Northport groundwater suggested no significant denitrification. The nitrogen/argon ratios and the nitrogen and oxygen isotope data are consistent in showing that the loss of nitrogen in the groundwater by denitrification is not adequate to explain the data. The loss has to be somewhere other than in the groundwater

The average value of nitrate for rain of 0.4 ppm was discussed as possibly being to low, but the values used here were from rain actually collected at the sites of studies.

There was discussion of whether the high oxygen values found in the supply wells at Northport were introduced at the well sites. Opinions of professionals in California suggested that the introduction of oxygen in supply wells was not a problem when sampling, but it was suggested that there are several ways that this could be happening in Long Island wells. It might be advisable to test some of these processes if possible. If the well's check valve leaks, water can trickle backwards into the well, perhaps at a rate high enough to cause splashing to oxygenate the water. There might also be vertical movement of oxygenated water along the annular space between the well casing and the aquifer, especially in large-diameter, older wells that do not have cement along the casing. Oxygenated water may also get down into the active well through a damaged well casing, especially in older wells with no grout.

The issue of modeling was also raised. Data suggest that essentially all the nitrate in Northport wells is from sewage. The SWAP model suggests a 50 year travel time from the recharge areas; the concern is that the model results were based on 1994 pumpage. Higher or lower pumpage could change the travel time and 50 years ago, or 1958, is about the horizon for the major shift from agriculture to suburban land use in the area. Bleifuss et al (2000) and Munster et al (in preparation) use geochemical data and historic maps and air photos to show that the capture zones for the Northport municipal supply wells were in suburban land use during the expected time of recharge.

On Fire Island, nitrate values were low (less than 0.02 ppm) and dissolved oxygen concentrations were also low (0.4 to 3 ppm). There was 100% denitrification in the aquifer, but the water table was shallow and DOC was high enough to support denitrification. In discussion, it was pointed out that there is a strong seasonal use in Fire Island. Could dilution during periods of low use be influencing the results?

Such data might be applicable to the Forks.

So, it seems that nitrate is often not denitrified in Long Island aquifers. Where water table in the recharge area is deep the DOC in the vadose zone and the groundwater as a result has too high of an oxygen content for denitrification of nitrate to be a major process. The lost nitrogen might be in the form of ammonium sorbed on the soil near cesspools. Soil chemical composition near leach fields should be examined.

An enhanced satellite image showed possible algal blooms all along the LI coast perhaps, supported by nitrate from groundwater seepage at the coast.

The water table at the Forge River is shallow so we should expect high denitrification in the aquifer there, though, perhaps, not as high as that at Fire Island. Samples have been collected but not completely analyzed yet. DOC appears to be high.

P.S. This hypothesis is based on data from two sites. Data from more sites are required to test and refine or refute this model. If the depth to the water table is indeed the controlling parameter of denitrification a map of this depth could be a surrogate for denitrification. With EPA support through the Interagency Agreement, USGS has prepared a map depicting the estimated depth to the water table on Long Island. It is going through final review before publication as a Scientific Investigation Map, and should be available on-line in a few months.

3. I am still interested in assembling a technical workshop on nitrogen. This would not be to redo any particular sediment budget but to discuss the various assumptions and values for general processes like denitrification and rainfall. It was pointed out that other workshops like this, like TNC meeting on marsh management, were, perhaps, not as productive as hoped.

4. The EPA ruling not to regulate perchlorate was discussed briefly. There is some concern that, in the absence of an EPA standard, the Federal legislature may take on their own regulation by law. Bethpage has a perchlorate treatment in place perhaps financed by the Navy and/or Grumman.

5. A pharmaceuticals take-back program is being planned for Stony Brook on April 14, 2009. SCWA is also working with CVS and Walgreens for an educational program. The DEC has a web site for the disposal of waste drugs at:

   http://www.dec.ny.gov/chemical/45083.html?showprintstyles#pagecontent

6. We will try to do something on lawn care in the spring. We would want to target homeowners and landscapers but attracting this audience is difficult. It was suggested that some sort of technical meeting might be appropriate where the audience on-site might be small we could hope to get publicity out through the media (somehow). Topics might include the "tadpole guy" from the Pine Barrens Research Forum who showed complicated impacts due to surfactants rather than the active ingredient in herbicides, something on drip irrigation or low-volume subsurface irrigation, the availability of other-than-blue-grass sod, Jennie's organic/inorganic fertilizer comparisons.

7. We will try to get Cheryle Webber to meet with us next time for a further discussion of water reuse.

8. Doug Feldman has replaced Paul Ponturo at the Suffolk County Department of Health Services.

9. The next meeting will be on **Monday, December 15, 2008** at the offices of Dvirka and Bartilucci in Woodbury from 9:30 to 11 AM.

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