

## **Review of the Assessment by Tompkins County Department of Health of the Water Supply for Taughannock State Park**

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Motivation for this review and approach taken: On May 11, 2005, Alice Cole of the Tompkins County Department of Health (DOH) wrote to Taughannock Falls State Park notifying the Park that their water supply was a “ground water under the direct influence of surface water” (GWUDI). This determination became one of the prime factors in the proposal for water district #5 in the Town of Ulysses, as described in the “Engineering Report for Water District #5, November 2005 DRAFT report. On August 8, 2006, the Tompkins County Board of Health ordered the Park to join the new water district as it became available, and abandon all other sources of water. As an interested resident of the Town of Ulysses as well as an expert in how scientific information is used in environmental decision-making, I wanted to understand the basis for the GWUDI determination. I also wanted to know more about the true public health risk posed by the Park’s water system. The GWUDI regulations have been developed by the State of New York with guidance from the US EPA in response to an outbreak of the disease-causing protozoan *Cryptosporidium* in Milwaukee in 1993. Does potential contamination of the Park’s well with water from Cayuga Lake pose a risk from this organism? If so, had the Department of Health considered the risks to households that directly use Cayuga Lake water for their drinking water, and of recreational use of the Lake? What procedures and analyses did the Department of Health use in their analysis of public health risk?

I am also motivated by my concern over a large expansion of a water district in Ulysses into an area predominantly zoned for agriculture and in a State agricultural district. Town regulation of land use in such agricultural lands is severely restricted by the State. Over the past 2 years, federal policy and financial incentives have called for a massive increase in ethanol production as a fuel. One local ramification of that is the proposal for a large ethanol plant at the former Seneca Army Depot. The “brewers grain” produced as a waste product from such a facility has a high likelihood of being sold as a feedstock for new large dairy and beef facilities within 20 miles of the plant, perhaps with up to 40,000 head (Simpson, T. W., A. N. Sharpley, R. W. Howarth, H. W. Paerl, and K. R. Mankin. 2008. The new gold rush: Fueling ethanol production while protecting water quality. *J. Env. Qual.*, in press). In 2007, I was a member of an advisory panel to the US EPA warning about this issue in the Mississippi River basin. I would like to see it considered locally by governmental agencies here as well. The ready availability of a water supply in an agricultural district increases the likelihood of large animal facilities, and this in turn may provide a significant challenge to local environmental quality, including increased *Cryptosporidium* contamination in Cayuga Lake.

My review is based on materials received from DOH and from the NY State Office of Parks, Recreation and Historic Preservation in response to freedom of information act requests I filed on October 22 and November 13, 2007. In addition to my own review, I asked for an independent assessment by Dr. Michael Wilson, a professor at SUNY Fredonia and a consultant to the NY State Department of Health in the development of the GWUDI regulations. A statement by Dr. Wilson to me (based on materials I received from DOH and passed along to him) is included at the end of this report.

My background as a reviewer: I am a biogeochemist and aquatic ecosystem scientist with more than 30 years of experience in water quality issues and in environmental assessment and review of assessments. I undertook this review as a private effort and paid for all expenses with my own funds. The review should not be construed as a position of Cornell University or any other group with which I am associated. For identification purposes, I have been a professor at Cornell since 1985 and I am an adjunct staff scientist at the Ecosystems Center of the Marine Biological Lab in Woods Hole, MA. I direct the Agricultural Ecosystems Program at Cornell, a program that focuses on agriculture and water quality. I am the president of the Coastal & Estuarine Research Federation, the world's largest professional society dealing with research and environmental management in coastal areas. Under the auspices of the International Council of Science, I chair a United Nations-funded project to evaluate the environmental impacts of biofuel technologies. I represent the State of New York on the Science and Technical Advisory Committee of the Chesapeake Bay Program. I have given several briefings to Congressional committees and federal and state agencies on water quality issues. I also gave a briefing on water quality to President Bush's environmental and economic staff at the White House in the fall of 2006.

### Major conclusions:

[\[Note that more detail and documentation follow below in the "Detailed findings" section\].](#)

There is no evidence of a significant public health threat from *Cryptosporidium* to the Taughannock State Park's water system. *Cryptosporidium* has not been studied in Cayuga Lake, as far as I can discern, but the organism is probably present at times and places due to inputs from sewage and runoff from dairy farms in the watershed. This may pose a small risk to recreational users of the Lake, and to households that directly use the Lake for their water. It may also pose a very much smaller (and quite acceptable) risk to users of the Bolton Point water supply. The current risk to users of the Park's water is unlikely to be much greater than that to users of water from Bolton Point, and may be less.

In any case, the risk from *Cryptosporidium* to all water users in our community is low, and a serious public health threat is posed only to those with greatly impaired immune systems, such as AIDS patients. The best available evidence shows that the large majority of Americans have at some time been exposed to *Cryptosporidium*, with most exposure coming through contaminated food and through handling of toddler wastes at

daycare centers. The disease is not serious, except to those with impaired immune systems. The DOH may wish to consider advisories to this at-risk population, suggesting appropriate measures for their protection from exposure from all sources.

The Park's well does suffer from contamination by coliform bacteria (including *E. coli*), although this poses no significant public health risk, as the numbers are low, and the water supply is chlorinated. The coliform contamination most likely comes from the nearby septic tank that serves the public rest rooms of the Park and/or to poor venting and sealing of the Park's water system. The Park could consider closing their current public rest rooms and associated septic system, and replacing them with composting toilets or other closed systems. This step together with fixing vents, seals, and leaks in the storage system for the Park's water is likely to solve the coliform contamination.

There is no conclusive evidence that Cayuga Lake water influences the Park's water system, although some contribution of Lake water to the well is a distinct possibility, perhaps probable. However, available evidence suggests that if Lake water is moving to the well, the travel time is such that there is sufficient filtering of the water as it moves through soils and sediments to remove *Cryptosporidium* and other potentially harmful organisms such as *Giardia*. Therefore, there is little public health risk from these organisms. The Park could greatly lower the already low risk by drilling a new well, with proper casing, to a depth of perhaps 200 feet. This should receive further study, but as a first cut, seems likely to solve any potential water quality issues, even if the well were drilled near the current one. Currently, this is forbidden by the Tompkins County Board of Health. The Board of Health should be asked to reverse their order to the Park to connect to municipal supplies and abandon other options, as a new well may best meet the needs of the Park in a cost-effective way, with perhaps the lowest public health risk of any option.

Should a water district in Ulysses provide water to the agricultural area where local zoning can exercise little or no control on agricultural activities, there is a significant risk of the growth of animal feedlot operations and processing plants, using brewer's grain from the ethanol plant in Seneca County. This could pose large challenges to environmental quality in our area, both in terms of air quality, but also water quality, and might well increase the risk of *Cryptosporidium* infection in users of water from Cayuga Lake (as well as increasing phosphorus input to the Lake, which is already impaired by phosphorus). The greatest threat would be to homes using the Lake as their direct source of drinking water, and to recreational users of the Lake. The US Center for Disease Control recommends that swimming be prohibited in lakes where the *Cryptosporidium* risk is high.

The GWUDI analysis by the Tompkins County Department of Health appears shallow, somewhat flawed, and possibly biased. It is also extremely poorly documented. The Tompkins County Legislature should review the processes and procedures used by County DOH. I suggest that DOH should have better guidelines for keeping records, and for fully complying with requests for information under the freedom of information act. Greater public transparency is highly advisable. Also advisable is the better use of

outside expert opinion and consults. Decisions such as the 2005 GWUDI determination can potentially cost local communities and entities such as the State Park a great deal of money, and should not be released without far better documentation and analysis than is apparent in this case.

Detailed findings:

1. There is no evidence that DOH has analyzed the public health risk from *Cryptosporidium* in the Park drinking water supply, or to users of Cayuga Lake for drinking water or recreation. In a public meeting of the Ulysses Town Board in March 2006, Eric Pond of the engineering firm of Barton and Loguidice, raised the risk of the *Cryptosporidium* in the Park water supply as one major public health concern addressed by the newly proposed water district #5. However, to date no evidence of this risk has been presented by him or his firm or by DOH.
2. I am aware of no studies of *Cryptosporidium* in Cayuga Lake. However, this protozoan is commonly found in the fecal wastes of both humans and animals, and so is frequently present in lakes that receive sewage inputs or runoff from animal farming operations in their watersheds ([http://hosts.cce.cornell.edu/wq-fact-sheets/Fspdf/Factsheet15\\_RS.pdf](http://hosts.cce.cornell.edu/wq-fact-sheets/Fspdf/Factsheet15_RS.pdf)). Consequently, it is reasonable to believe *Cryptosporidium* may be in Cayuga Lake, at least at some times and places. However, the Lake is big and deeply mixed, which provides huge dilution potential, lowering any risks.
3. Those who drink untreated water contaminated by *Cryptosporidium* or who swallow such water while swimming are at risk of getting intestinal ailments such as diarrhea. The resulting disease is seldom serious in otherwise healthy individuals, but can be fatal in those with impaired immune systems (such as individuals with AIDS). Reported cases of the disease are rare, but the US Food and Drug Administration believes most Americans have at some time during their life been infected. Exposure in daycare centers and to fecal-contaminated foods (and not drinking water) are probably the major exposure routes (<http://www.cfsan.fda.gov/~mow/chap24.html>).
4. The risk of exposure to *Cryptosporidium* in the Park drinking water system due to pulling in water from Cayuga Lake is extremely small, and poses no significant public health danger. If there is a significant influence of Cayuga Lake water on the Park's well (see point #6 below), the water is essentially filtered as it moves through soil and sediment before reaching the well (see report on pages 8-9 from Dr. Wilson). The microbiological data from DOH clearly indicate that the large array of microorganisms found in the Lake are not present in the Park's well. *Cryptosporidium* cells are 3 microns in size (<http://www.cfsan.fda.gov/~mow/chap24.html>). Cells of this size would be expected to be filtered out by movement of water through the soil and sediment.
5. If *Cryptosporidium* is in Cayuga Lake, this poses a very small risk of exposure through the public drinking water supply at Bolton Point. This risk is quite small and should not alarm anyone. However, it may be as large or greater than the risk from the Park's water supply. Filtration at the Bolton Point plant is designed to

remove the vast majority – but not all – of the *Cryptosporidium* cells. However, outbreaks of *Cryptosporidium* have occurred in water treatment systems elsewhere, including the 1993 Milwaukee outbreak. These prior outbreaks occurred when the plants were in full compliance with EPA standards (<http://biology.kenyon.edu/slouc/bio38/hannahs/crypto.htm>). Anyone with a compromised immune system is well advised to use home micro-filtration systems, because of the low risk associated with *Cryptosporidium* in water supplies such as that at Bolton Point ([http://www.cdc.gov/NCIDOD/DPD/parasites/cryptosporidiosis/factsheet\\_crypto\\_pr\\_event\\_water](http://www.cdc.gov/NCIDOD/DPD/parasites/cryptosporidiosis/factsheet_crypto_pr_event_water)).

6. The DOH issued a determination of groundwater under the direct influence of surface waters (GWUDI) for the Park's well. Dr. Wilson also believes there is evidence of GWUDI, as noted in his report to me, presented on pages 8-9. However, the major part of his opinion is based on finding coliform bacteria in the well. The coliforms are not detected in the nearby water from Cayuga Lake, and likely come either from a nearby septic system or from seepage through inadequate seals, etc., on the water storage system in the Park (see point #7 below). That is, the surface waters influencing the well may not be from Cayuga Lake but rather from extremely local sources. This should be addressed and solved. However, the chlorination of the Park water is largely adequate to solve any major public health risk from the coliform contamination.
7. In a report and a letter dated July 14 and July 28, 2003, from Steven Maybee of DOH to the Park, the DOH notes that the infiltration gallery for the Park water system was not adequately sealed and the vent for the storage was not turned down and screened. These deficiencies provide a ready source of bacterial contamination to the water system, and may be the cause of the coliform contamination sometimes observed. Maybee noted that "improvements need to be made before samples [for GWUDI analysis] can be taken." Apparently, the deficiencies have still not been fixed (they were noted again in a letter from Steve Maybee at DOH to the Park dated August 25, 2007, which also noted "the valve pit next to the tank is underwater and there appears to be a crack in the top of the tank..."). At some point between July of 2003 and the issuance of the GWUDI determination in May of 2005, DOH apparently changed their minds and decided that the deficiencies with the storage system were not a problem with assessing GWUDI. There are no notes or documents that discuss this change of opinion and the reasons for it. I believe that Maybee was correct in his original statement from 2003 saying that deficiencies with the storage system make it impossible to determine conclusively if there is an influence of surface water from Cayuga Lake on the well.
8. The GWUDI determination letter of July 2005 to the Park from Alice Cole as well as a letter to me dated December 20, 2007 from Liz Cameron (the current Director of Environmental Health of DOH) stress the "microscopic particulate analysis" as strong evidence for GWUDI in the Park's water system. Two analyses were conducted, in September 2003 and July 2004. The microorganisms present in water from Cayuga Lake (many different types of algae, etc.) were compared with what is present in the Park's water system. The interpretation of

- these data by DOH simply does not hold up to scrutiny. In 2003, the only organism present in the Park's water system which might possibly have come from the Lake was an unidentified "spherical cell." The 14 different types of identifiable microbes in the Lake water were simply not observed in the Park water system. For the 2004 sampling, no organisms of potential lake origin were found in the Park water system. The GWUDI determination letter from Alice Cole of July 2005 says "the identification of algae, diatoms, rotifers, plant debris, or insects that are characteristics of surface water, would indicate surface water contamination of the source; the results of 9/30/03 did. A recently received result of a 7/28/04 sample was less conclusive." In my professional opinion, this statement is wrong, and neither sampling shows contamination with water from Cayuga Lake. Quite the contrary: these samplings should reassure the public that if Lake water is reaching the Park's well, the microbes from the Lake are being filtered out enroute.
9. In addition to the coliform contamination and the "microscopic particulate analysis," the DOH's GWUDI determination relied on "analyses of physical parameters (pH, temperature, and turbidity)," comparing the Park's water with Cayuga Lake water over time with 38 samplings between December 2002 and September 2003. There are absolutely no notes or documents regarding how DOH interpreted these data. In his consultation to me (report below), Dr. Wilson wrote: "The amplitude of the groundwater turbidity peaks suggest GWUDI, but with the exception of one peak, suggest a moderate or better degree of natural filtration." So perhaps the DOH is correct in using these data to suggest GWUDI, although the filtration suggests GWUDI may not be a concern for *Cryptosporidium*. I believe there is an alternative explanation for the physical data: some correspondence between physical/chemical parameters in the Park's well and in the waters of Cayuga Lake might be expected, if groundwater inputs to the Lake are large and having a large local influence in the near-shore area. This might well be expected for the Lake waters near the Park, given the large elevation drop and resulting head in groundwater across the Park. The physical data are not in themselves convincing (and are not even noted as evidence by Liz Cameron in her December 20, 2007 letter to me).
  10. The Park's well is apparently shallow (although no one seems to know the exact depth), is near the Lake, and has a casing that may allow significant contamination by near-surface groundwater. It may be quite likely, therefore, that Lake water is drawn into the well. However, as noted Dr. Wilson, a determination of this would demand much more knowledge on such factors as hydrologic conductivity in the soils and sediments. Whether or not the well is drawing in Lake water is determined by the balance of pumping from the well and re-supply from groundwater flows compared to potential water flows from the Lake. These factors have simply not been studied, and apparently were not considered by DOH in their analysis.
  11. There is no evidence that the DOH used outside experts or consultants. This is surprising, as GWUDI determinations and risk assessment are difficult and still relatively recent. *Cryptosporidium* was not identified as a disease agent until 1976, and through the mid 1980s, this disease seemed limited to AIDS patients (<http://waterandhealth.org/newsletter/old/03-01-1995.html>). Only with a major outbreak in Milwaukee in 1993 was this viewed as a drinking water issue

[http://en.wikipedia.org/wiki/Milwaukee\\_Cryptosporidium\\_outbreak](http://en.wikipedia.org/wiki/Milwaukee_Cryptosporidium_outbreak)). This is what led to the GWUDI regulations, which are still relatively new. The science and engineering behind them remain quite uncertain. Do County DOH staff have the necessary training and experience for this issue? The only evidence of any outside consultation whatsoever comes in the December 20, 2007 letter from Liz Cameron to me; there she states that the DOH “GWUDI determination was made in consultation with the NYSDOH...” However, this must have been done orally and without any notes, as there are absolutely no documents or communications showing such consultation.

12. On August 9, 2002, John Anderson who was then the head of Environmental Health Services for Tompkins County DOH wrote to the Park and strongly urged them to work with the Town of Ulysses on a new water district. At that time, he stressed the need for a second source of water for the Park, and there was no mention of GWUDI or any risk of microbial contamination of the well. Regarding the second source for the Park, the Anderson letter specifically stated “providing this capacity is not only a responsible thing to do, it is necessary.” There is no other mention of this in any other records or documents from DOH. Was the word “necessary” a statement of legal regulation, or Anderson’s personal opinion of good engineering practice? There is no documentation on this issue. Given this very strong stance by the head of the Division of Health Services for TC DOH early in the analysis, it seems likely that DOH staff may have been biased to find other reasons (such as GWUDI) to continue to push the Park into water district #5. Solving a GWUDI problem gives a municipal water project 100 points under the State Drinking Water Revolving fund scoring system. The cutoff for hardship financing consideration when the WD5 project was submitted (August 2005, 3 months after the DOH GWUDI determination) was 130 points.
13. My requests to DOH under the freedom of information act (dated October 22 and November 13, 2007) resulted in some data, many letters, and almost no other types of information (despite a specific request for all information, using the State web site for guidance in phrasing the request). There were no notes from meetings, no analyses or notes in support of analyses, and no e-mails. In response to an e-mail from me expressing doubt that all information had in fact been provided, Liz Cameron wrote to me on December 20, 2007. There she told me that there were indeed 10 e-mails between Steve Maybee and staff at the Park between July and November 2007, and that those would be forwarded to me (they were). She went on to say she knew of no other information withheld. She confirmed this again in an e-mail sent to me on January 22, 2008. However, in response to my FOI request to the Park, I received other communications between the Park and DOH, including a series of pertinent e-mails in 2003. Perhaps DOH simply lost these due to poor record keeping. In any case, I am struck by the lack of notes and analyses in support of the GWUDI determination. When one considers how this determination was used – with active participation by DOH at public meetings – to argue for a multi-million dollar water district, I find this absence inexcusable.

## Report Discussing GWUDI Determination for Taughannock Falls Well

Dear Dr. Howarth,

January 15, 2008

I am in receipt of several data sets for a well of unknown hydrogeologic setting at Taughannock Falls State Park. You asked for my opinion on whether this well is GWUDI.

Below is a discussion of GWUDI decision making, the character of existing data sets for the site in question, and conclusions.

### Overview of GWUDI:

Bacteria in natural waters are small and thus resist natural filtration, but they can be easily treated with chlorine and often decay or are consumed in the ground. Viruses usually travel attached to clays or other tiny particles and so are trapped by natural filtration, as are protozoa. Protozoa such as Giardia and Crypto present great risk even when in small quantities (low concentrations), but finding them in small quantities in natural water is technologically difficult. Thus they may be present in risky quantities but not detectable. Decisions about GWUDI suffer from a lack of simple surrogate indicators. Further complicating the GWUDI issue is that there is often ample evidence for risk reduction by natural filtration. Also, warmer water and longer times of travel tend to decrease durability (infectivity) of cysts, etc. Quantifying these and other variables has been elusive for the scientific community. We are left to make a judgment based on multiple lines of mutually supportive qualitative and quantitative evidence.

### Analysis of Contaminant Transport for the Taughannock Falls site:

- 1) Does the aquifer geometry allow for connection of source to receiver? Critical information regarding geologic well logs and surface maps is lacking. A thin zone of permeable material could serve as an unwanted connector while a small amount of impermeable sediment could be a barrier. The letter of 5-11-05 from Ms. Cole argues for risk because it describes circumstantial evidence for geometric connection (her paragraphs 1 and 2).
- 2) Is there evidence of hydraulic connection through pressure responses? Observations of wells or other water pressure detectors in response to pump tests or other phenomena are lacking for the Taughannock Falls well.
- 3) Is the well in a hydrogeologic setting especially conducive to GWUDI? No, this well is not in cavernous limestone, basalt lava, etc.; thus it likely has some natural filtration.
- 4) Is the kind of construction of the well helpful to natural filtration? No, this well was listed (item #3 on a printed draft form by the County Health Department) as a susceptible type of construction.
- 5) Do the physical indicators relate reasonably to the well and what is the temporal correspondence of indicators? The ground water conductivity at the site is higher than surface water and the ground water turbidity is lower than surface water, which is generally to be expected. The three sets of paired curves (graphs) were re-plotted adjacent to each other; the weekly paired data show temporal correspondence that argues for GWUDI. The amplitude of the groundwater turbidity peaks suggest GWUDI, but with the exception of one peak, suggest a moderate or better degree of natural filtration.

- 6) What is the time of travel (TOT)? There's no hydrogeologic information to use to calculate TOT but the correspondence of physical parameters suggests TOT of a few days to a few weeks which is reasonable for a distance of 50 ft. to surface source (assuming a sand or gravel aquifer).
- 7) What are the MPA test results or bacterial results? Source water always begins as surface water (eg. rain, snow, lake, or stream). The water is filtered as it passes through soil or rock (eg. greatly through sand but little through a limestone cave). Various microbiological tests are conducted to help evaluate natural filtration. Bacteria tests measure indicators of the impact of warm blooded animals that could be sources of Giardia or other unwanted pathogens. Bacteria test results are often problematic, as in this case. While the results are clearly positive and indicate GWUDI, they may be simply the result of poor sanitary seals at the collection device, rather than a lack of natural filtration within the aquifer. A common problem is any openings to the atmosphere (such as loose well caps or tank vents) can allow bacteria to enter (including coli-form, etc.) Surface water entering the well annulus is another common bacteria source. The Taughannock bacterial results support GWUDI, but the solution could be as simple as plugging the old well and drilling a new well near the first. The MPA results are less helpful than the bacteria. MPA indicators could be either from in-situ aquifer sediments or from poor sanitary seals or from GWUDI. MPA might be more useful if concentrations of organisms in certain categories were listed for likely source water (Cayuga Lake and/or other nearby stream, etc.) and compared to raw water to get a perception of reduction by natural filtration.

Conclusions;

- 1) There is no doubt that this collection device (well) is GWUDI; there is plenty of evidence for a GWUDI determination.
- 2) However, a different collection device (new well, better tank, etc.) at the same location subject to new investigation (including hydrogeologic, quantitative MPA, and temperature) might yield a non-GWUDI determination, if the regulatory agency was convinced that there was significant natural filtration. This should be discussed with the agency at an early date.
- 3) You will have to weigh the logistical, economic, and other trade-offs among choices; such as:
  - a) Improve sanitary seals and retest.
  - b) Use the criteria on the County Health Department Source-Screening Form to guide new well location and construction.
  - c) Build a treatment system.

Sincerely,

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