



To: The Bethlehem Board of Selectmen

From: The Bethlehem Conservation Commission

Date: September 17, 2007

Subject: Summary of report from William McDowell, Professor of Water Resources Management, Department of Natural Resources Director, NH Water Resources Research Center, University of New Hampshire

Dear members of the Selectboard:

Attached is a copy of the report the town commissioned to evaluate the April 2007 water-quality report based on samples taken from test wells at the North Country Environmental Services facility on Trudeau Road.

As you know that report found some higher-than-normal levels of volatile organic compounds (VOC) as well as VOCs where they had not been found before. The New Hampshire Department of Environmental Services was concerned enough that on July 31st it sent a letter to NCES informing the company that a remediation plan was necessary.

The conservation commission thought it would be a good idea to have an outside expert evaluate the April report and provide an independent opinion on the seriousness of the problem. As you know the board approved that.

Here is a summary of Professor McDowell's conclusions:

- 1) There should be no expansion of the dump until the current source of contamination is "understood and resolved."
- 2) The overall concentrations are "not exceedingly high" but "the worry, however, is that these hits in the monitoring wells represent the tip of the iceberg, and that more contamination will follow unless action is taken."
- 3) These compounds found in the tests "have significant or potentially significant health implications at moderate to high concentrations." Health

(Over)

issues range from liver, kidney and lung problems to neurological disorders.

4) "The present level of contamination is not alarming but is (obviously) sufficient to warrant action by DES. No compounds exceed the MCL (maximum contaminant level), but only one compound actually has an MCL, so that is not too reassuring or meaningful a standard for safety."

5) The greatest danger posed by these contaminants is the huge aquifer below the Trudeau Road facility. "Contamination of the aquifer is more of a concern than contamination of surface waters. Many of these compounds are quite volatile (e.g. ether) and would quickly be lost to the atmosphere once they enter surface waters. Thus, I do not think this poses an imminent threat to the Ammonoosuc or local wetlands. They are not quickly lost from aquifers, however."

The commission would like to note that the town's Natural Resource Inventory and Master Plan lists that aquifer as an incredibly important resource to the town for current use and future growth.

6) Professor McDowell had praise for the action taken by the Department of Environmental Services and said the tests conducted by the lab hired by North Country Environmental Services appeared to have been professionally done.

However, he suggested it would be valuable to have some additional tests added to cover "inorganics and total dissolved organic matter." He suggests adding sodium, potassium, calcium, magnesium, ammonium, sulfate, and dissolved organic carbon and nitrogen.

7) The cost of this evaluation of the 73-page April report was \$1,000, the maximum amount estimated.

The commission appreciates the board's help with this matter. Professor McDowell could meet with the board to answer specific questions or a conference call could be arranged with interested members.

Sincerely,

Cheryl Jensen
Chair, Bethlehem Conservation Commission

Report on Groundwater contamination issues – NCES Bethlehem solid waste facility

Overview and Background This brief report assesses the significance of the findings made by the MSW operator and DES response. The most critical piece of information, already widely appreciated in the town, is that DES has required a remediation plan to deal with the recent occurrence of organic contaminants in groundwater. The occurrence of these compounds in a well that was previously clean suggests the possibility that leakage from the landfill has occurred and organic contaminants may be moving off-site in groundwater. The exact source of contamination is uncertain at present. DES response has been rapid and decisive, requiring remediation. Overall, the compounds present have significant or potentially significant health implications at moderate to high concentrations. Only one contaminant (see Table 1) has an MCL (maximum contaminant level), and the groundwater is below that value. Public drinking water supplies must not exceed the MCL, and they are widely interpreted as a threshold for “safe” drinking water in private and public water supplies. Lack of an MCL does not mean that any level of a compound in drinking water is OK to drink. It simply means that no legally binding threshold has been established. As per my telephone conversation with the Jensens, I have spent most of my effort on assessing the dangers posed by these compounds and implications for the future water resources of the town.

Information on Contaminants of Concern

Table 1. Contaminants found in Well MW 402U, their Maximum Contaminant Level, and comments on sources and possible health effects. All concentrations µg/L.

Contaminant	Observed conc.	MCL ()=related compound	Comments
1,1-Dichloroethane	5.4	(5)	Solvent; liver problems, cancer; MCL for 1,2-DCE, not 1,1-DCE
Cis-1,2-dichloroethene	1.7	70	Solvent; liver problems, cancer
Diethyl ether	11.3	--	Ether, ethyl ether; “starting fluid” for gasoline engines
MTBE	2.1	No MCL yet - pending	20-40 µg/L recommended allowable level (gas octane booster)
tetrahydrofuran	13.9	--	Suspected neuro, respiratory, and endocrine toxicant

Health Effects Summaries of Contaminants – edited excerpts from epa.gov except as noted

1,1-Dichloroethane – not listed by EPA, the closely related 1,2-dichloroethane has the following effects

Short-term: EPA has found 1,2-dichloroethane to potentially cause the following health effects when people are exposed to it at levels above the MCL for relatively short periods of time: central nervous system disorders, and adverse lung, kidney, liver circulatory and gastrointestinal effects.

Long-term: 1,2-Dichloroethane has the potential to cause the following effects from a lifetime exposure at levels above the MCL: cancer.

Cis-1,2-dichloroethene = Cis-1,2-dichloroethylene

Acute: EPA has found cis- and trans- 1,2-dichloroethylene to potentially cause central nervous system depression from short-term exposures at levels above the MCL.

Short-term exposures in drinking water which are considered "safe" for a 10-kg (22 lb.) child consuming 1 liter of water per day: for the cis form- a one-day exposure of 4 mg/L or up to a 7-year exposure to 3 mg/L. For the trans isomer: a one-day exposure of 20 mg/L or up to a 7-year exposure to 2 mg/L.

Chronic: Both cis- and trans-1,2-DCE have the potential to cause liver, circulatory and nervous system damage from long-term exposure at levels above the MCL. The trans isomer is approximately twice as potent as the cis- isomer in its ability to depress the central nervous system.

Cancer: There is inadequate evidence to state whether or not either cis- or trans-1,2-DCE have the potential to cause liver cancer from a lifetime exposure in drinking water.

Diethyl ether (OSHA.gov)

Effects on Humans: Ethyl ether has been used to produce surgical anesthesia in humans; the concentration that is needed to induce anesthesia in humans ranges from 100,000 to 150,000 ppm. After anesthesia has been induced, it is maintained at about 50,000 ppm because respiratory arrest may occur at higher concentrations. At 200 ppm, mild nasal irritation occurs, and at 2,000 ppm, dizziness may be experienced. Brief exposures of the eyes to the liquid or to high vapor concentrations produced burning but no injury. Prolonged exposure may cause temporary corneal epithelial injury. Prolonged skin contact can cause burns. Ethyl ether is also a defatting agent, and repeated exposure may cause skin drying and cracking. NOTE that these data refer to airborne concentrations and exposure.

MTBE

This Advisory recommends that keeping levels of contamination in the range of 20 to 40 µg/L or below to protect consumer acceptance of the water resource (taste and smell) would also provide a large margin of exposure (safety) from toxic effects.

There are no studies of effects on humans of long-term exposure to MtBE. All of the studies available for hazard assessment are laboratory animal studies. There are studies in rodents of the carcinogenicity of MtBE, as well as its metabolites, *tertiary*-butyl alcohol (TBA) and formaldehyde. Exposure caused a dose-related increase in the incidence of combined leukemia and lymphomas in the female rats and an increase in Leydig cell adenomas (benign testicular tumors) in the high-dose male rat. Applicability to humans is uncertain.

Tetrahydrofuran (OSHA.gov)

Effects on Humans: Tetrahydrofuran is a central nervous system depressant in humans; based on effects seen in animals, it may also cause irritation of the mucous membranes and upper respiratory tract and liver and kidney damage. There are no reports of chronic effects in humans. However, investigators exposed to unknown concentrations while testing tetrahydrofuran's pharmacological properties developed severe occipital headaches. Researchers engaged in the experimental spinning of synthetic fibers showed a marked decrease in white blood cell count that is believed to have been caused by exposure to tetrahydrofuran, which was used as a solvent; these individuals recovered after 2 years of treatment.

Answers to specific questions raised in e-mail of 8/29:

Many of these questions are related, and thus I will try to answer them in a few paragraphs.

The present level of contamination is not alarming but is (obviously) sufficient to warrant action by DES. No compounds exceed the MCL, but only one compound actually has an MCL, so that is not too reassuring or meaningful a standard for safety. Overall concentrations are not exceedingly high (really contaminated sites I saw in the literature had up to 1000 higher concentrations of related VOCs). The worry, however, is that these "hits" in the monitoring wells represent the tip of the iceberg, and that more contamination will follow unless action is taken.

Contamination of the aquifer is more of a concern than contamination of surface waters. Many of these compounds are quite volatile (e.g. ether) and would quickly be lost to the atmosphere once they enter surface waters. Thus, I do not think this poses an imminent threat to the Ammonoosuc or local wetlands. They are not quickly lost from aquifers, however.

If local aquifers become contaminated, remediation is feasible but expensive. Groundwater can be pumped to the surface, stripped of its volatiles by sparging, passed through activated carbon for remaining organics, and returned. For individual homeowners, activated carbon filters will remove these organics.

I believe that adding an expansion to the dump is unwarranted until this situation is understood and resolved. I am not certain that I have the whole story (I am inferring

some things based on a sentence here and there and your letter) but it appears that the old unlined landfill was somehow lined and incorporated into the new landfill. If correct, this scenario makes it more complicated to trace the source of a contaminant problem and fix it. It also makes it harder to assess whether the current design and operation of the "new" part of the landfill are sufficient to protect groundwater quality.

Apparently bromide salts were added to the new landfill in an effort to "tag" any leachate that might escape from that portion of the landfill. This would be a good idea, but to be most effective would require a good understanding of the bromide levels in the old landfill leachate. Getting a thorough understanding of the construction, siting, and remediation of the landfill, and the current excavation of a potential spill site, would be necessary for me to better assess the quality of the work being done at the site. I have not been able to do this within my allotted time.

Based on what I have read, the quality of the work being done for NCES seems good. I can not assess the accuracy of the analytical results without comparison tests, but the lab certification process should provide that assurance for the town. The field notes and chain of custody were all easy to follow and understand. The detection limits that are shown are state of the art to the best of my knowledge for the organics. For analyses that I am personally familiar with and run routinely, bromide detection limits are appropriate, but nitrate detection limits are not particularly good. I do not see this as a big problem, the limits are appropriate for the method used, though other more sensitive methods are available and widely used. The letter from SHA to DES dated 17 May describes the results obtained in a forthright manner, and highlights how they might indicate a problem with groundwater contamination.

The one area where I see that more work might be done is a broad scan of the inorganics and total dissolved organic matter in selected wells. The electrical conductivity value of MW 402U is much higher than the others. This means that it has a lot more material dissolved in the water than the others. The chloride data show this, and I am suggesting adding sodium, potassium, calcium, magnesium, ammonium, sulfate, and dissolved organic carbon and nitrogen. It is not that I fear the water may be grossly contaminated to the point of posing a threat to water supplies or the river. Rather, I would like to see these analyses be used as a forensic tool to help understand the nature of the contamination with trace organics. This is an approach that is widely used in studies of elemental cycling in watersheds to try to understand sources of various ions in surface waters. It might help to understand where the hits of trace organics are coming from. In a certain sense, focusing on the more esoteric trace compounds limits your understanding of the hydrogeology as a whole.

Comments on July sampling:

The results obtained from SW 04, the spring called S-108, are striking. The data presented (very high iron and manganese, high TKN, no nitrate) suggest that this spring is discharging very old, oxygen-poor water, or that it is discharging oxygen-poor landfill leachate that for whatever reason does not have concentrations of trace organics above

detection limits. Again, the less esoteric list of water quality parameters described above, particularly dissolved organic carbon (DOC), would be very helpful in assessing why this site has such high iron and manganese and whether it is of concern.

Additional input:

Should the town require additional input, I am happy to come to Bethlehem to a public meeting to discuss my findings.