

Phil Fiore
19 Cardinal Ln.
Gales Ferry, Ct.

To: Elizabeth Burdick
Director of Land Use and Planning
Town of Ledyard

From: Phil Fiore
Date: 11-27-24

Subject: Requested Arsenic Reference Data and New Arsenic and Lead Calculations

Special Use Permit

[PZ#24-8SUP & PZ#24-9CAM – 1737 and 1761 Connecticut Route 12 (Parcel IDs: 76-2120-1737 & 61-2120-1761)] GFI, LLC.

Arsenic Testing (Exhibit 138-1 & -2) and References

In response to Beth Ribe's request for the reference of arsenic concentrations in private wells, I had made copies of the relevant pages that I have previously discussed from exhibit number 122, reference number 2, pages 1 and 5 inclusive in this report (USGS, Arsenic and Uranium in Private Wells in Connecticut. 2013-15, May2017). The two geological maps attached confirm that Mount Decatur is labeled as Hope Valley Alaskite Gneiss terrane present in the Avalonia (Continental) terrane.

The USGS reference describes Connecticut's arsenic concentrations exceeding EPA guidelines originating from minerals and bedrock that exceed EPA guidelines of 10 ug/L that are present in the Hope Valley Alaskite Gneiss formations of 20% of the wells tested.¹ Therefore, the arsenic levels are not zero and have not been tested to the proper sensitivity level of ug/L (ppb) by the analytical instrument ICP-MS as described in method EPA 6020 from exhibit 138-2. The ICP-MS instrument would also be used for arsenic determinations in private well samples [(Method EPA 200.8, Rv. 5.4 (1994))] at the 1 ug/L or ppb concentration level of detection for regulatory monitoring as described in the attached reference by the USGS.

Exhibit number 138-1 from Attorney Heller explains a more sensitive arsenic test that gave results less than 1.84 ppm. The concentration and level of sensitivity was only reduced by a factor of 10. The method was tested from an initial result of < 20 ppm to a new result of < 1.84 ppm when the level of toxicity is at an EPA guideline concentration of 10 ug/L (ppb) maximum contaminant level (MCL), which is 100 times less (1ppm = 1000ppb) than reported. Arsenic is a widely dispersed metal that is present in the environmental terranes and bedrock. An acid rock environment does not need to be present to initiate mobilization.

Prepared in cooperation with the Connecticut Department of Public Health

Arsenic and Uranium in Private Wells in Connecticut, 2013–15

Major Findings

- Nearly 1 out of 15 (7 percent) water samples from 674 private wells tested in Connecticut contained either arsenic or uranium at concentrations that exceed the U.S. Environmental Protection Agency's (EPA) maximum contaminant levels (MCLs) enforceable for drinking-water supplies of 10 micrograms per liter ($\mu\text{g/L}$) for arsenic or 30 $\mu\text{g/L}$ for uranium.
- Of the 81 geologic units studied, 19 had at least one sample with arsenic or uranium concentrations that exceeded the MCL.

Introduction

The occurrence of arsenic and uranium in groundwater at concentrations that exceed drinking-water standards is a concern because of the potential adverse effects on human health. Some early studies of arsenic occurrence in groundwater considered anthropogenic causes, but more recent studies have focused on sources of naturally occurring arsenic to groundwater, such as minerals within aquifer materials that are in contact with groundwater. Arsenic and uranium in groundwater in New England have been shown to have a strong association to the geologic setting (Ayotte and others, 2003, 2006) and nearby streambed sediment concentrations (Robinson and Ayotte, 2006). In New Hampshire and Massachusetts, arsenic and uranium concentrations greater than human-health benchmarks have shown distinct spatial patterns when related to the bedrock units mapped at the local scale (Montgomery and others, 2003; Colman, 2011; Flanagan and others, 2014).

The Connecticut Department of Public Health (DPH; 2016) reported that there are about 322,600 private wells in Connecticut serving approximately 823,000 people, or 23 percent of the State's population. The State does not require that existing private wells be routinely tested for arsenic, uranium, or other contaminants; consequently, private wells are only sampled at the well owner's discretion or when they are newly constructed. The U.S. Geological Survey (USGS), in cooperation with the DPH, completed an assessment in 2016 on the distribution of concentrations of arsenic and uranium in groundwater from bedrock in Connecticut (fig. 1). This report presents the major findings for arsenic and uranium concentrations from water samples collected from 2013 to 2015 from private wells.

Sources of Data on Arsenic and Uranium Concentrations

The main objective of this study was to compile and analyze arsenic and uranium concentrations from private wells

throughout Connecticut (fig. 1). In cooperation with the DPH, local health departments and districts used volunteers to visit randomly selected houses in their districts and collect an unfiltered water sample from an untreated source in the home. Staff from DPH also distributed bottles to homeowners at four agricultural fairs in Bethlehem, Durham, Goshen, and Woodstock; at water fair events in East Hampton and Colchester; and one home show in Hartford. These homeowners were instructed to collect an unfiltered water sample prior to any existing treatment system. The water samples, collected from 2013 to 2015, were submitted to the DPH Laboratory in Hartford for trace-element analysis according to EPA method 200.8 (U.S. Environmental Protection Agency, 1994).

The towns of Stamford, Weston, and Wilton have substantially more water samples and wells than the other studied towns. On average, 7 wells were sampled in most towns, whereas, 81 wells were sampled in Wilton; 110 wells, in Weston; and 732 wells, in Stamford, resulting in an unbalanced distribution of water samples in the State. To balance the distribution for the purposes of this study, 7 to 14 wells from Stamford, Weston, and Wilton were randomly selected for inclusion in the statewide dataset. This subset of samples represented less than 5 percent of the final statewide dataset, which consisted of 660 arsenic samples and 589 uranium samples collected from 674 wells. Data for these 674 wells are available in Flanagan and Brown (2017). All available data from these three towns are discussed in the "Comparison of Arsenic and Uranium Exceedance Rates in Three Towns" section.

As part of the quality assurance plan for this study, the USGS submitted six standard reference samples to the DPH Laboratory with concentrations of arsenic and uranium spanning the range of expected environmental values. These samples were supplied by the USGS Branch of Quality Systems (U.S. Geological Survey, 2016) in Denver, Colo., and provided an independent analysis of measurable bias. Results from the analysis of the standard reference samples (table 1) indicated no measurable bias.

Table 3. Arsenic and uranium concentrations that exceed maximum contaminant levels from 674 private wells in Connecticut, by geologic unit and major bedrock category, 2013–15.

[Geologic unit names are the Connecticut Department of Energy and Environmental Protection preferred names as modified from Rodgers (1985). Bedrock categories (subheadings) are modified from Robinson and Kapo (2003). Color shadings indicate the percentage of wells with exceedances above concentration thresholds in ranges of: —, no data (—); 0, less than (<) 1 percent; 1, 1 to 10 percent; 10, more than (>) 10 to 20 percent; 20, >20 to 30 percent; and 30, >30 percent. MCL, U.S. Environmental Protection Agency maximum contaminant level enforceable for public water supplies; µg/L, microgram per liter; NA, not available]

Geologic unit name	Geologic unit code	Number of samples		MCL percentage ^a of water samples with concentrations, in micrograms per liter		Percentage of study area underlain by geologic unit ^b
		Arsenic	Uranium	Arsenic >10 µg/L	Uranium >30 µg/L	
Avalon granite						
"Scituate" Granite Gneiss	Zss	1	1	0	0	0.7
Hope Valley Alaskite Gneiss	Zsh	5	3	20.0	0	2.1
Plainfield Formation	Zp	3	2	0	0	1.4
porphyritic phase of Potter Hill Granite Gneiss	Zspp	1	1	0	0	<0.2
Potter Hill Granite Gneiss	Zspb	2	2	0	0	1.3
Potter Hill Granite Gneiss and Narragansett Pier Granite undivided	Zsph + Pn	1	1	0	0	<0.2
Rope Ferry Gneiss of the "Waterford Group"	Zwr	5	5	0	0	1.1
Calcgranofels						
Fly Pond (calc-silicate) member of Tatnic Hill Formation	Otaf	1	—	0	—	0.4
Hebron Gneiss	SOh	45	24	17.8	4.2	4.7
lower member of Bigelow Brook Formation	SObl	2	2	0	0	0.6
Southbridge Formation	SOs	5	2	0	0	1.0
Carbonate-bearing metasedimentary rocks						
basal marble member of Walloomsac Schist	Owm	4	4	0	0	0.5
Stockbridge Marble	OCs	3	2	0	0	0.8
unit b of Stockbridge Marble	Csb	6	6	0	0	0.4
unit c of Stockbridge Marble	Csc	3	3	0	0	0.5
units e and d of Stockbridge Marble	Ose	1	1	0	0	<0.2
Granite, other						
"Eastford gneiss phase" of Canterbury Gneiss	Dce	2	1	0	0	0.5
Canterbury Gneiss	De	2	1	0	0	1.2
Glastonbury Gneiss	Ogl	22	20	4.5	25.0	1.7
lower member of Middletown Formation	Oml	3	3	0	0	<0.2
Middletown Formation	Otm	10	11	0	0	1.0
Monson Gneiss	Omo	47	45	0	4.4	2.4
Nonewaug Granite	Dng	10	10	0	10.0	0.6
Ordovician granitic gneiss	Og	56	41	14.3	9.8	2.1
Trap Falls Formation and Ordovician granitic gneiss undivided	Otf + Og	3	9	0	11.1	1.0
upper member of Middletown Formation	Omu	9	9	0	11.1	0.2
Waterbury Gneiss	Cwb	1	—	0	—	0.8
Waterford Group	Zw	26	25	0	4.0	0.8
Granville granite						
Gneiss of Highlands massifs	Yg	4	4	0	0	0.6
pink granitic gneiss	Ygr	2	2	0	0	1.1
Mafic rocks						
amphibolite-bearing unit of Manhattan Schist	Cma	3	3	0	0	0.4
Beardsley Member of Harrison Gneiss	Obb	9	8	0	0	0.5
Brookfield Gneiss	Ob	14	12	0	0	1.2
dioritic phase of Lebanon Gabbro	Did	1	1	0	0	<0.2
gneiss (metavolcanic) member of Brimfield Schist	Obrg	5	5	0	0	0.3
Harrison Gneiss	Oh	3	3	0	33.3	0.9

Based on the new arsenic results as described in exhibit 138-2, the amount of arsenic will be recalculated to reflect the total excavation. A computer aided model design from the topography of Mt. Decatur is a more accurate representation of the total bedrock in the proposed 40-acre excavation and has been calculated at approximately 5,000,000 yd³. This number was calculated considering the overburden, bedrock waste that will not be sold, and over excavation. In either case, toxic metals as identified as arsenic will be exposed to the environment and will be a hazard to both the workers and residents.

The applicant environmental professional should identify the closest drinking water wells within a 1000-foot radius. "DEEP recommends a minimum of annual monitoring of water levels and water quality of the closest drinking water well until the development project is completed and the site has been stabilized." ² This government regulated monitoring procedure was not described in the application.

In addition, based on the article from Northeastern Geoscience, volume 32, written by Brown and Thomas, they described that there are risks to human health from arsenic soil exposure resulting from ingestion, dermal contact, or inhalation.³ Even though Mount Decatur might not be an acid rock drainage (ARD) site, arsenic molecules are still mobile under neutral and basic conditions. Therefore, arsenic can make its way faster into wells, aquifer or Thames River by increasing the surface area of the bedrock when blasted, crushed, and transported. The below calculations approximate total arsenic from the excavation and quarry operations as provided by a new arsenic result from exhibit number 138-2. The total arsenic of 6 kg was calculated from a 10-year operation.

- ~ 500,000 Yd³ / Yr (10-year operation ~5,000,000 yd³)
- 1 ppm* As = 0.0001%
- 1 Yd³ Bedrock = 1200 kg [1000kg (1 metric ton) = 2204 lbs].
- 1200 kg = 1.2 gms (0.000001 x 1200)
- 500,000 Yd³ x 1.2 gms = 0.60 kg / Year
- 0.60 kg (40 acres) 10 years = 6.0 kg Total
- Well Testing (As) EPA: (ICP-MS) Analysis Method 200.8, Rv.5.4 [1ppb]
(*EX 138-2 - Result of <1.84 ppm As)

There are 25 metals listed that are present in the Mount Decatur sample from exhibit 77, slide 16 as noted in the bedrock mineralogy and chemistry slide from the GFI presentation. Each metal has their own level of toxicity; however, arsenic is the most toxic at 10 ppb exposure from either inhalation or ingestion as discussed in exhibit 121 and 122. The OSHA guidelines are 10 ug/m³/ 8hr period. These results translate to workers not being exposed to more than 2 ug/m³/15-minute period. No PPE and safety plan present in the application would fail to prevent arsenic dust to come in contact with eyes, mouths, and skin of the workers plus there is a possibility of dust leaving the site and onto neighboring residents' properties.

Lead is described as one other metals present in Mount Decatur as tested from Adirondack Geological Services DPC. Lead had a positive test result of 27 ppm verses being at the limit of detection from analytical instrumentation. As 40 acres of Mount Decatur is excavated, lead salts can be exposed to the environment from blasting, crushing, and transporting. Even though there is supposedly no ARD for Mount Decatur, exposure to lead from ingestion, dermal contact, and inhalation can pose a serious health risk not only to the workers, but to the residents as dust particles that can leave the property on any one day depending on the wind speed and direction. The below calculations approximate total lead from the excavation and quarry operations totaling 160 kg from a 10-year operation. The sheer size of this operation over 10 years is a major health concern due to no engineering controls or safety plans in place as discussed by GFI experts or PPE provided for the workers.

- ~ 500,000 Yd³ / Yr (10-year operation ~5,000,000 yd³)
 - 27 ppm (Pb)* = 0.0027%
 - 1 Yd³ Bedrock = 1200 kg [1000kg (1 metric ton) = 2204 lbs].
 - 1200 kg = 32 gms. Pb (0.000027 x 1200)
 - 500,000 Yd³ x 32 gms. = 16 kg / Year
 - 10 Years = 160 kg Total
- (*GFI Presentation: EX #77. pg. 16.)

The environmental protection agency (EPA) has guidelines for lead exposure. They are the following: *

- Ground Dust: 10 ug/ft²
 - Water: 15 ug/L or 15 ppb
 - Air: 0.15 ug/m³ / calendar quarter
- (* 1986 Safe Drinking Water Act, no lead solder)
(<https://www.EPA.gov/Lead>)

There are health concerns from lead exposure that have a wide range of health issues. They are the following:

- Brain Damage: Damage of the brain, nervous system, and kidneys
- Development Delays: Hearing and speech issues, difficulty learning, and paying attention.
- Anemia: fatigue
- High Blood Pressure:
- Cancer: Lung, brain, stomach, kidney
- Miscarriage and Premature Birth

In conclusion, based on the article from the USGS Department of the Interior, arsenic is present in the Hope Valley Alaskite Gneiss terrane which encompasses Mount Decatur bedrock and minerals. In addition, based on the analysis by Harris Miller & Hanson Inc. (HMMH), a peer review of exhibit number 121, the experts review on

(exhibit #130) concluded Fiore's report to be technically accurate. Therefore, the methodology used in this report is also accurate when considering the new arsenic calculations and health issues of lead as an additional toxic metal at the ppb level. It is not the responsibility of the residents to provide detailed solutions to issues of the applicants' operations, but the applicant is required to provide the burden of proof that there will be no toxic metals and toxic dust generated.

References

1. USGS, Arsenic and Uranium in Private Wells in Connecticut, 2013-15, May 2017.
2. Department of Energy & Environmental Protection (DEEP) Ct., Guidance Document for Evaluating Potential Hydrogeologic Impacts Associated with Blasting & Development Activities, 12-2019.
3. Northeastern Geoscience; Major and Trace Element Geochemistry and Background Concentrations for Soils in Connecticut; Craig J. Brown and Margaret A. Thomas, Volume 32, Pgs. 1-37.

Analytical Instrumentation References

- (XRF) X-Ray Florescence:
Elemental Composition and Concentration
- (XRD) X-Ray Diffraction: 0.1 – 1 wt.%
(crystal structure, orientation, oxidation states)
- ICP-OES: Inductively Coupled Plasma / Optical Emission Spectroscopy:
Agilent 5800 [ppb]
- (ICP-MS) Analysis 200.8, Rv.5.4 (MS), 1 ppb
Inductively Coupled Plasma / Mass Spectrometry (ppt)
Well Testing (As) EPA: (Analysis 200.8, Rv.5.4)