

State of Vermont
Department of Environmental Conservation
Waste Management & Prevention Division
1 National Life Drive - Davis 1
Montpelier, VT 05620-3704
(802) 249-5186
tami.wuestenberg@state.vt.us

March 11, 2015

Town of Thetford
Attn: Stuart Rogers
PO Box 126
Thetford Center, VT, 05075-0126

RE: Upper Valley Fish & Game Club, Thetford Town Forest
Thetford, Vermont

Dear Stuart:

The Vermont Department of Environmental Conservation (VTDEC) was asked by the Town of Thetford to obtain water samples from a stream and pond located in the Thetford Town Forest, which is owned by the Town of Thetford. The Town has leased a small portion of property off of Five Corners Road, to the Upper Valley Fish & Game Club (UVF&GC) since the late 1970s. Members from the Watershed Management Division (WSMD) and the Waste Management and Prevention Division (WMPD) visited the site on October 23, 2014, conducted a site reconnaissance and obtained 5 samples that were analyzed for total metals via EPA Method 6020A. Three samples were taken from the small tributary that runs through the shooting area (01-03), one sample was taken from the pond (04), and one sample was taken from a drainage ditch (05). The Memo detailing the site visit activities is included with this letter.

Water quality samples obtained from the stream reported slightly elevated levels of lead above the Chronic Water Quality Criteria expressed in the Vermont Water Quality Standards (VTWQS). However, with the current data, the stream is not out of compliance with the VTWQS chronic criteria for lead, because it is a duration-frequency based criteria. As expected, lead levels were reported higher near the shot fall zones and decrease further downstream. Total lead was detected at the stream's outfall into the pond, however below the Chronic and Acute Water Quality Criteria. A sample was not obtained from the outfall of the pond across Five Corners Road.

It is the WMPD's understanding that the UVF&GC is working with the Vermont Department of Fish & Wildlife on the development of an Environmental Stewardship Plan (ESP) to help them implement the Environmental Protection Agency's Best Management Practices. The ESP needs to address issues such as erosion, lead leaching and lead reclamation. No lead shot in any form is permitted to land in waters of the state. Lead was not observed in the stream during the site visit, therefore the lead found in the water quality results is most likely the result of lead eroding from the soils into the stream.

Once this document is created, and enhancement work is completed on the site, the WMPD and the WSMD will conduct another water quality sampling event at the site. In the



preparation of its Tactical Basin Plan (www.vtwaterquality.org/wqd_mgtplan/swms_ch4.htm) for waters in the Waits, Wells, and Ompompanoosuc Rivers, WSMD will include an action item to conduct this sampling post-implementation. The goal of this inclusion is simply to present notification to interested public that the VTDEC is working collaboratively with UVF&GC to preclude lead contamination of the subject streams.

Please feel free to call me with any questions you may have. I can be reached at (802) 249-5186.

Sincerely,



Tami Wuestenberg
Environmental Analyst V
Sites Management Section
Waste Management and Prevention Division

c: Al Stone, Upper Valley Fish & Game Club
Rhett Scruggs, Upper Valley Fish & Game Club (*email*)
Daneil Pieterse, VDF&W
Rick Levey, WSMD

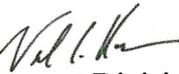
**Agency of Natural Resources
Department of Environmental Conservation**

**Watershed Management Division
Building 10 North
802-338-4816**

MEMORANDUM

To: Pete LaFlamme, Director, WSMD

From: Richard Levey, Monitoring, Assessment and Planning Program (MAPP)

Cc: Neil Kamman, Manager, MAPP 
Tami Wuestenberg, Waste Management Division

Date: January 26, 2015

Subject: Environmental assessment conducted on Unnamed Stream at the Upper Valley Fish & Game Club, Thetford, Vermont

On October 23, 2014, in response to information brought to the attention of DEC by concerned citizens regarding potential risks to adjacent waters, DEC collected surface water samples for chemical analysis on a small stream and pond at the Upper Valley Fish & Game Club, Thetford, Vermont.

Contaminants of primary concern were lead (Pb) and arsenic (As) which are known to be associated with gunpowder residue and shot. The goal of this environmental monitoring was to determine the following: 1) are levels of lead and arsenic in the tributary and pond surface water elevated as a result of activities at the shooting range, and if so 2) do those levels exceed current water quality criteria for surface waters? This investigation was conducted in cooperation with the DEC Waste Management Division.

Site Location

The Upper Valley Fish & Game Club is located on Five Corners Road in Thetford, Vermont. The club is located within the Thetford Town Forest, a 176 acre town owned parcel with little surrounding development. The shooting range encompasses approximately 2.5 acres, shooting is directed into a hillside on the east side. A small stream is running through the range at the 55 yard mark and originates from the hillside on the east, and runs in a northwestern direction for approximately 150 meters before entering a 1.0 acre pond. The pond drains to a tributary below Gillette Swamp which drains to the Ompompanoosuc River approximately 1 mile downstream.

The eastern boundary of the shooting range is located in close proximity to the headwaters of the stream that runs through the range. The stream is managed as Class “B” waters ([VT Water Quality Standards \(October 2014\)](#)). The site is in VT planning sub-basin VT14-03, the drainage area of this stream is < 1 km². The location and site descriptions are shown in **Figure 1 and Table 1**. Surface water samples were collected from five sites, representing three samples from the stream, one sample from the pond and one sample from a drainage ditch that flows to the stream.

Water Analysis

Water samples were submitted to the Vermont DEC Environmental Laboratory, located in Burlington, Vermont on the University of Vermont Campus. Water samples were analyzed for total lead, total arsenic, total Hardness (CaCO₃) and turbidity. The practical quantitation limits (PQL) for lead (Pb) and Arsenic (As) analyses at the VTDEC Laboratory are 1 µg/L for Pb and As. Field measurements included pH, conductivity and temperature. Sampling was conducted in accordance with DEC’s quality assurance project plan for the Ambient Biomonitoring Network (ABN) and in accordance with applicable field standard operating procedures described in the [Water Quality Division Field Method Manual](#) (May 2012) and ABN Quality Assurance Project Plan (August 2010). All chemical analyses were conducted in accordance with the [VTDEC Laboratory’s Quality Assurance Plan](#) (January 2013).

Table 2 summarizes the results for these parameters.

Table 1. Location of chemical assessments conducted on the Unnamed Stream, pond and drainage ditch at the Upper Valley Fish & Game Club, Thetford, Vermont.

Location	Site	Description	Lat/Long (DD, NAD83)
Thetford Stream 0.3	1	Upper-Stream site, above confluence with drainage ditch. Approx.10 meters above cleared range area.	43.85716 72.24332
Thetford Stream 0.2	2	Mid-Stream site, below confluence with drainage ditch. Approx. 15 meters below Upper Stream site	43.85714 72.24326
Thetford Stream 0.1	3	Lower-Stream site, approx.30 meters below Mid-Stream site. Also below 200 yard target range.	43.85740 72.24332
Thetford Drainage Ditch	4	Located at eastern most portion of cleared range at approx.50 meters out, runs parallel with cleared range and drains to Stream.	43.85687 72.24364
Pond	5	Stream flows to the pond; down gradient of shooting range.	43.85799 72.24361

Figure 1. 1:1,122 Scale Map showing approximate locations of surface water chemical assessments conducted at the Upper Valley Fish & Game Club, Thetford, Vermont (Arrows indicate shooting directions).



Table 2. Water Chemistry Results for Unnamed Stream at the Upper Valley Fish & Game Club, Thetford Vermont, collected on October 23, 2014. Bolded values exceed Vermont Water Quality Standards Pb chronic values.

Parameter	Site 1 Thetford Stream 0.3 (Upstream from F&G Club)	Site 2 Thetford Stream 0.2	Site 3 Thetford Stream 0.1	Site 4 Thetford Drainage Ditch	Site 5 Pond
Total Pb (µg/L)	2.2	5.0	8.0	18	1.0
Total As (µg/L)	<1	<1	<1	<1	<1
Turbidity (NTU)	3	2.6	2.6	1.5	3.9
Hardness (mg/L-CaCO ₃)	21	24	28	71	52
pH	7.92	7.76	7.66	7.83	7.9
Conductivity (umhos)	58	48	54	124	94
Temperature (C°)	10.6	10	10.1	11	10.7

Results

Lead (Pb) concentrations were detected in the water at all of the sites, from the reporting limit of 1.0 µg/L-Pb at the Pond (Site 5), to a high of 18 µg/L-Pb at the drainage ditch site (Site 4). Arsenic was not detected at any of the sites above the PQL of 1 µg/L-As. Water sampling results were related to applicable criteria contained within Appendix C of the [VT Water Quality Standards \(October 2014\)](#). Lead is a hardness-dependent toxic metal, as such criteria are adjusted to the site specific hardness (CaCO₃). The site specific hardness value of 25 mg/L-CaCO₃ represents the hardness for 3 of the 5 sites sampled; tributary sites 1 - 3. Ambient water quality criteria for total Pb at a hardness of 25 mg/L-CaCO₃ are 0.54 µg/L for chronic and 13.9 µg/L for acute. Lead concentrations at the stream sites did not exceed the acute criteria, but did exceed the chronic criteria value of 0.54 µg/L-Pb at all three sites. Additional monitoring data would be required to determine compliance or non-compliance with the VT WQS chronic criteria for Pb which is a duration-frequency based criteria, “4-day average not to be exceeded more than once every three years.”

Stream Site 1 was the furthest upstream site sampled and was chosen as a “control,” although this site had the lowest concentration (2.2 µg/L-Pb) it was not an adequate “control,” as it was not sufficiently above the influence of shooting range activity. Stream Site 2, was below the confluence with the “drainage ditch” which was likely a source of Pb from the shooting range and this was reflected in the higher observed concentration (5.0 µg/L-Pb). The highest Pb concentration observed was at the Stream Site 3 which was below the drainage ditch and also below the 200 yard shooting range; the Pb

concentration at this site was 8.0 µg/L-Pb. The drainage ditch, was sampled to assess the likelihood that lead from the range was a source of lead to the stream sites, and had the highest observed Pb concentration (18.0 µg/L-Pb).

The pond had the lowest Pb concentration observed, just at the reporting limit of 1.0 µg/L-Pb, and did not exceed the acute or chronic criteria for Pb. The hardness of the pond was 52 mg/L-CaCO₃, adjusting the Pb criteria to this site specific hardness, ambient water quality criteria for total Pb are 1.38 µg/L for chronic and 35.5 µg/L for acute.

Discussion:

The water chemistry data collected during this study are indicative of lead contamination from the shooting range activities. The Pb concentrations observed at the three stream sites are consistent with the proximity and activities of the Upper Valley Fish & Game Club shooting range.

The solubility of lead is dependent on the pH and alkalinity of the soil and water, the lower the pH the more soluble the lead. Lead from the shooting range oxidizes when exposed to air and dissolves when exposed to acidic water and soil. Normal clean rain has a pH value of between 5.0 and 5.5, which is slightly acidic, annual precipitation and prolonged rains, increase the potential risk of lead migration off-site in solution. It is extremely rare to detect Pb in surface waters in Vermont not associated with high turbidity or other anthropogenic activity (i.e. landfill, stormwater runoff from developed lands, shooting range).

Summary:

The weight of evidence from this investigation suggests that levels of lead in the Unnamed Stream surface waters are elevated as a result of activities at the Upper Valley Fish & Game Club and these levels exceed chronic criteria values expressed in the VTWQS. However additional data is necessary to determine compliance or non-compliance with the VTWQS chronic criteria for Pb which is a duration-frequency based criteria, “4-day average not to be exceeded more than once every three years.”

The current shooting range practices do not prevent lead pellets from entering the headwaters of the Unnamed Tributary. An evaluation of current management practices should be undertaken to prevent future discharges of lead pellets to surface waters in this area. Stabilization of lead shot in the soil should be considered to reduce the availability of lead that can migrate off site.