

## Human Marker Ace-K in Torch Lake Water Samples Collected in 2018

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### Brief Introduction

As part of the ongoing study of the benthic golden brown algal (GBA) bloom in Torch Lake, analysis was performed for the human marker acesulfame potassium (Ace-K) on water samples from nearshore lake water and groundwater collected in 2018. The presence of human markers in groundwater supports the hypothesis groundwater enriched with compounds from septic drainfields is entering in Torch Lake.

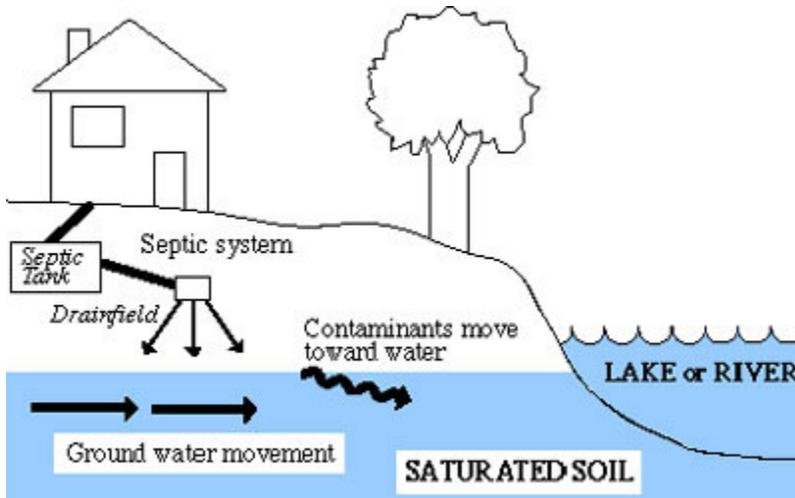


Image 1. Diagram of groundwater movement. Credit University of Minnesota Extension.

A previous Three Lakes Association study involved groundwater samples collected from 4 sites around Torch Lake was conducted in 2016, accessible at [3lakes.com](http://3lakes.com). Thirteen samples were analyzed for 4 human markers: caffeine, DEET, triclosan and benzothiazole. Every groundwater sample contained at least 2 of the human markers and 69% of the groundwater samples contained all 4 human markers.

Ace-K is a calorie-free sugar substitute discovered accidentally in 1967 by a German chemist. It is 200x sweeter than common sugar. Ace-K is not utilized by the body and is eliminated in urine. Ace-K is used exclusively in products intended for human consumption and is found in a variety of products including:

- |                                    |                                  |
|------------------------------------|----------------------------------|
| Beverages-sodas and fruit juices   | Table top sweeteners             |
| Dairy Products including ice cream | Toothpastes, mouthwashes and gum |
| Baked goods                        | Condiments                       |
| Jam, Jelly and marmalades          | Breakfast cereals.               |
| Marinades and salad Dressings      |                                  |

### Methods

The sites sampled in this study were on the east shore of Torch Lake and included Hayo-Went-Ha, a YMCA boys' summer camp; the Petty home, approximately 3 miles south of the camp; and the Gourley home, approximately two miles south of the Petty home. Groundwater collected from these same sites tested positive for the human-associated markers in the 2016 study.

Site	N Latitude	W Longitude
Gourley	44.94500	85.28130
Hayo-went-Ha	44.99150	85.28790
Petty	99142	85.28773

Table 1. Nearshore lake water and groundwater were collected from sites with these GPS coordinates.

The groundwater samples collected from the Gourley Site were collected from a temporary piezometer placed two feet into the bottom of the lake floor near shore in water 3 feet deep. The groundwater sample at the Hayo-Went-Ha and Petty sites was collected from permanent piezometers similarly placed two feet into the bottom of the lake floor at 2 feet of water depth. Surface lake water was collected nearshore in the area close to the piezometers.

Ace-K is a manmade compound. As it does not exist in nature, its presence in natural waters implies human-associated disposal via household wastewater. The University of Michigan Biological Station laboratory analyzed water samples to determine Ace-K concentrations using a PerkinElmer-Sciex API 2000 tandem quadrupole mass spectrometer. Separation was achieved using a H<sub>2</sub>O/MeOH gradient on a Phenomenex polar C18 column set. Minimum detectable level for Ace-K using this method is 0.8 µg/L

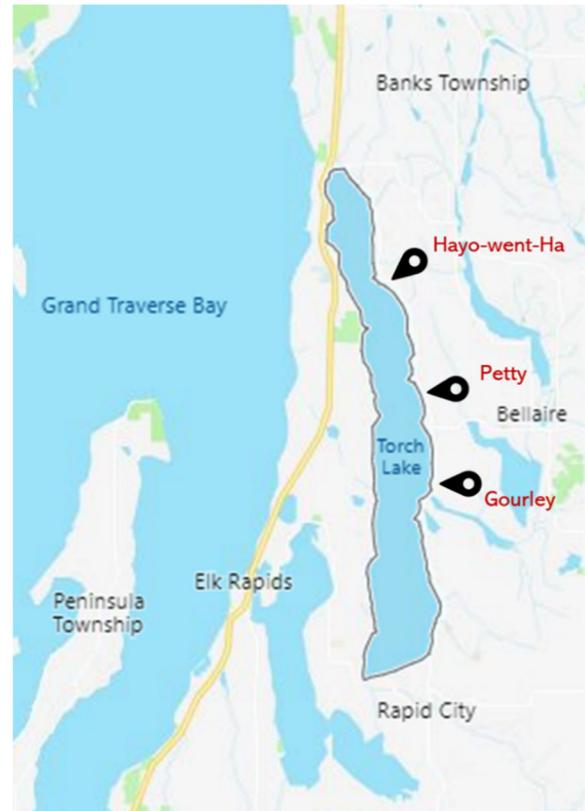


Image 2. Torch Lake Study Sites

## Results

Ace-K concentrations in the nearshore lake water (surface water) and groundwater samples from the Gourley site are listed in Table 2.

Date	Source	Ace-K µg/L
5/15/2018	Surface Water	BDL
	Groundwater	33.8
5/29/2018	Surface Water	BDL
	Groundwater	BDL
6/12/2018	Surface Water	BDL
	Groundwater	BDL
6/26/2018	Surface Water	BDL
	Groundwater	1.5
7/10/2018	Surface Water	BDL
	Groundwater	1.5
7/24/2018	Surface Water	BDL
	Groundwater	3.3

Table 2. Ace-K concentrations from nearshore surface lake water and groundwater samples collected every 2 weeks from May to July 2018 at the Gourley site. BDL means below detectable level.

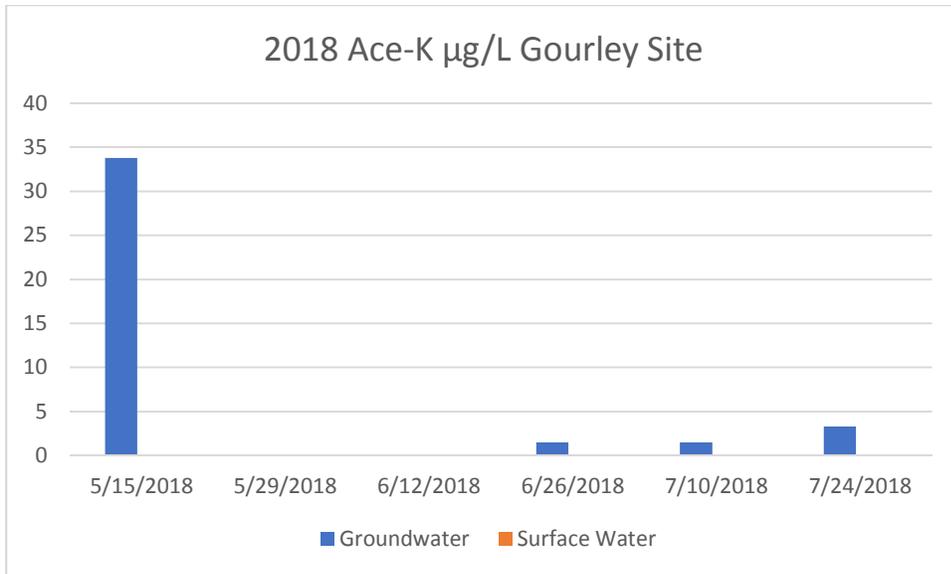


Figure 1. Ace-K concentration µg/L in groundwater and nearshore surface water at the Gourley site. Note: For graphing purposes, BDL was given the value of 0.

Ace-K was detected in 4 of the 6 groundwater samples and in none of the nearshore lake water samples at the Gourley site. The groundwater sample with the highest concentration of Ace-K during the three-month period was collected at the beginning of the summer.

#### Hayo-Went-Ha and Petty Sites

Nearshore lake water (surface water) and groundwater samples were collected on 6/25/2018 from 2 sites on the eastern shore of Torch Lake. The concentration of Ace-K in the water samples are listed in Table 3.

Date	Site	Source	Ace-K µg/L
6/25/2018	Hayo-Went-Ha	Surface Water	BDL
6/25/2018	Hayo-Went-Ha	Groundwater	7.1
6/25/2018	Petty	Surface Water	1.2
6/25/2018	Petty	Groundwater	10.1

Table 3. Comparison of water samples collected one day from 2 sites on the eastern shore of Torch Lake. Both sites are north of Clam River.

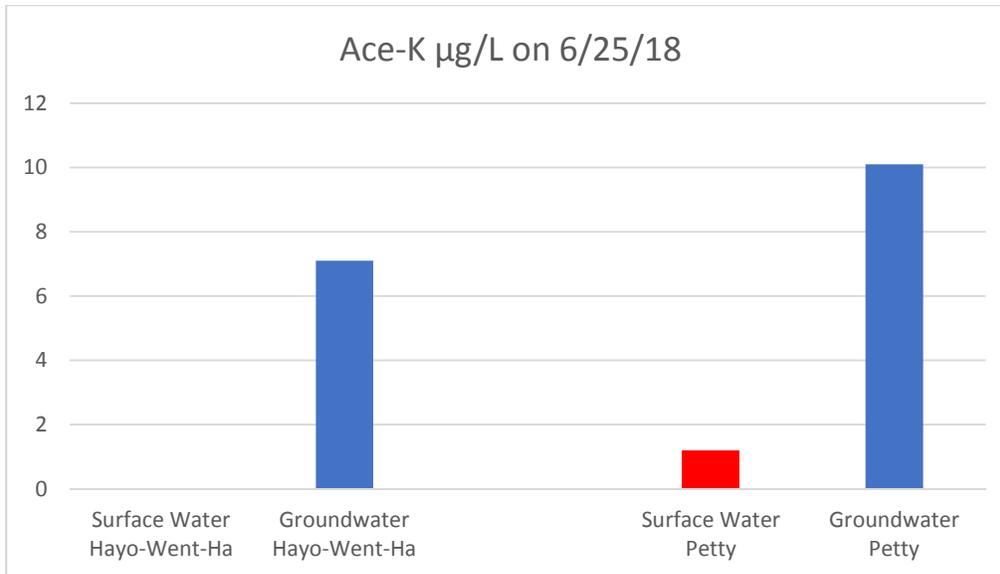


Figure 2. Comparison of Ace-K µg/L in water samples collected from 2 sites on the northeastern shore of Torch Lake in June 2018. Note: For graphing purposes, BDL was given the value of 0.

Ace-K was detected in 3 of 4 water samples collected on June 25, 2018, both groundwater samples and one of two surface water samples. Concentration of Ace-K in the groundwater samples was higher than the concentration in the corresponding nearshore surface water sample on this day.

Six of the 8 groundwater samples in this study, including at least one from each site, tested positive for Ace-K. The nearshore lake water sample collected at Hayo-went-Ha tested below detectable levels for Ace-K concentration as did all of the nearshore water samples collected at the Gourley site. Only 1 of 8 surface water samples, the single one collected at the Petty site, contained Ace-K at a concentration above the detectable level.

**Conclusions**

Based on the analysis of 16 water samples for the human marker Ace-K, 8 groundwater samples and 8 nearshore lake water (surface water) samples, groundwater does carry compounds from septic drainfield effluent from these 3 sites on Torch Lake. Groundwater carrying septic compounds is then dispersed into Torch Lake. Possibly due to dilution in lake water, the human marker, Ace-K was detected in only 1 of the 8 surface water samples.

Ace-K has a minimum detectable level of 0.8 µg/L, while the other human marker compounds studied in 2016 from the same sites, caffeine, DEET, triclosan and benzothiazole, have minimum detectable levels of 0.0009 µg/L. Based on these levels, plus the discontinuation of triclosan in consumer antiseptic washes and the temporal trend for benzothiazole to peak in early Spring sampling, caffeine and DEET remain reliable human markers for future studies.

**Acknowledgments**

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