Snow Sampling

PROCEDURE

Effective Date: 11/1/13	**Document Number:** ENV	**Version:**1

PURPOSE

Potential water pollution associated with spring snow melt is a concern for watersheds in northern climates. The intent of this study is to gather baseline snow chemistry data from locations near the mine and mill as well as reference locations outside the influence of these two facilities. This procedure will provide guidance on the sampling methodology to be utilized for this project.

SCOPE

This procedure applies to the Eagle Mine and Humboldt Mill snow sampling program.

RESPONSIBILITIES

It is the responsibility of all individuals working for or on behalf of Eagle Mine to comply with this procedure. Sampling will be completed by an Eagle Mine environmental representative and analysis performed by Trimatrix Laboratory located in Grand Rapids, MI.

PROCEDURE

Eagle Mine is committed to protecting the environment and minimizing the potential impacts associated with our mining and milling operations. Potential water pollution associated with spring melt is a concern for watersheds. In an effort to better understand these potential impacts, Eagle Mine is sampling snow pack at various locations near the mine and mill as well as reference locations which are not influenced by our operations. Program duties include location identification, sampling procedures, and analytical data review.

Sampling Locations

A total of eight locations were selected for the snow sampling program. Three locations were selected at both the mine and mill and an additional two reference locations. All locations are tentative and are dependent upon accessibility. In general, the locations will likely require the use of snowshoes in order to access.

Eagle Mine

The Eagle Mine is situated on the Yellow Dog Plains near the Salmon Trout Main Branch. Three sampling locations were selected near the mine site (see Appendix A).

1. Southwest of the mine site near the potable well.
2. Northwest of the mine site near the Triple A Road at surface water sampling location STRM002.
3. On the mine site near the treated water infiltration system.

Humboldt Mill

The Humboldt Mill is located in Humboldt Township approximately 24 miles west of the city of Marquette. Three sampling locations were selected near the mill site (see Appendix A).

1. Southeast of the mine site along County Road 601
2. West of the mine site along County Road 601, near the Hwy 95 intersection
3. North of the WTP across HWY 41

Reference Locations

Four areas were selected at locations away from Eagle Mine operations and therefore should not be influenced by mining or milling activities (see Appendix A).

1. County Road 510 near the Yellow Dog river crossing
2. Near the SWP's meteorological station located at Cram's General Store in Big Bay.
3. Northwest Road near Triple A
4. Soccer complex on 550 in City of Marquette

Sampling Procedure

Samples will be collected prior to snowmelt in late February or early March.

Sample bottles should be requested at least two weeks in advance of sampling to ensure they arrive in time. Sample bottles can be requested from Jennifer Rice at Trimatrix Laboratories located in Grand Rapids Michigan. Bottle requests can be made via email or phone. Email: ricejl@trimatrixlabs.com; Phone: 616-975-4500

Table 1. below outlines the equipment needed in order to complete the sampling effort.

Table 1. Required Equipment

Winter weather clothing	Sampling logbook
Backpack	GPS
Snowshoes	Sampling jar
Gallon Size Ziploc bags	De-ionized water (available in the WTP)
Sharpie marker	Snow tube (must be constructed prior to sampling – see attached instructions)
Ink pens/pencils	Radio
Nitrile gloves (large enough to fit over winter glove	Camera
Cooler & Ice	Paper towels

Prior to the initial sampling event, the snow tube must be constructed. Instructions can be found in Appendix B or on the National Weather Service – Eastern Region Headquarter website http://www.erh.noaa.gov/btv/html/snowtubeinstr.htm.

Due to the cold weather environment and somewhat remote locations, samplers should work in pairs (buddy system) for added safety. The sampling team will drive as close to the sampling location as possible and then snowshoe the remainder of the way, if necessary.

The sampling location chosen should be untouched in order to obtain the most representative sample.

Once the samplers arrive and select the sampling location, a GPS reading should be recorded so the location can be duplicated in the future. A photograph of the sampling location should also be taken to document the conditions of the area prior to sampling.

Two samples will be collected from each location; the top one inch of snow and a composite sample of the snow column.

LABELING CONVENTION – Samples will use the following naming convention: Samples collected near the Eagle Mine will begin with "EM"; those collected by the Humboldt Mill will start with "HM"; and the two reference locations "RL." The second number will be associated with the sample location; the first location at each area will be "01" the second "02", etc. The next identifier will be "SNOW" for all locations and either "01" if it is the top one inch of snow, or "02" if it is the composite sample. The last part of the sample name is the date (mmddyy). Example: EM01-SNOW01-020713 this would be the top one inch of snow collected from the first Eagle Mine location on November 7, 2013.

Sample 1 – Top one inch of snow

- Write the sample name, date, and sampling time on the Ziploc bag
- Don the nitrile gloves
- Using the sample jar collect the top one inch layer of snow and place in a gallon size Ziploc bag. Repeat until the sample bag is at least ¾ of the way full
- Seal the bag
- Remove and dispose of the gloves
- Enter the sample information in the Sampling Logbook

Sample 2 – Composite Sample

- Write the sample name, date, and sampling time on the Ziploc bag
- Don the nitrile gloves
- Select a location to sample where you didn't remove the top one inch of snow.
- Push the snow tube straight into the snow and rotate until the tube reaches the ground level. There may be levels of ice or hardened snow that you will have to push through in order to reach the bottom.
- Pull the snow tube up at a slight angle to help keep the snow in the tube.
- Discard the lower 2.5-3 inches of sample to eliminate the possibility of contamination from the underlying soil.

- Have the second individual hold the sample bag, while the sampler empties the contents of the snow tube into the bag. Depending on the level of snow, more than one bag may be required. (label each bag).
- Seal the bag
- Remove and dispose of the gloves
- Enter the sample information in the Sampling Logbook

Once all sampling is complete, exit the sampling location and place the samples in the cooler on ice.

Sampler Decontamination

In between sampling locations, the snow tube and sampling jar, must be cleaned in order to eliminate the chance of cross-contamination between locations.

- Rinse the equipment once with de-ionized (DI) water
- Wet a paper towel and add a few drops of Liquinox soap to the towel
- Wipe down the inside and rim of the sampler and jar with the paper towel
- Rinse the equipment with DI water, repeat three times
- All rinse water can be disposed on the ground

Sample Preparation

To ensure uniform handling of all samples, the melting and bottling process should follow the same protocol.

- Remove the samples from the cooler and allow approximately 90% of the sample to thaw at room temperature.
- Once 90% of the sample has melted, place in the refrigerator to complete the melting process. This procedure allows the sample to completely melt without raising the temperature above 4^{o}C (39.3^{o}F).
- Immediately following the thawing process the sample should be bottled.
    - If more than one Ziploc bag of snow was collected from the snow tube, the contents of the bags shall be combined. This can be accomplished by pouring one bag into the other or if necessary using a clean non-metallic container to make a composite sample. Stir or mix the samples to ensure homogeneity.
    - Transfer the sample name, date, and time listed on the Ziploc bag to the sample bottle(s).
    - Remove the cap, and pour the contents from the bag into the sample bottles of the same name.
    - Replace the cap on the sample bottle and return to the refrigerator or cooler with ice.
- Samples will be analyzed for the quarterly mining permit parameter list plus a few additional parameters recommended in other snow sampling procedures.

Table 2. Snow Sampling Parameter list

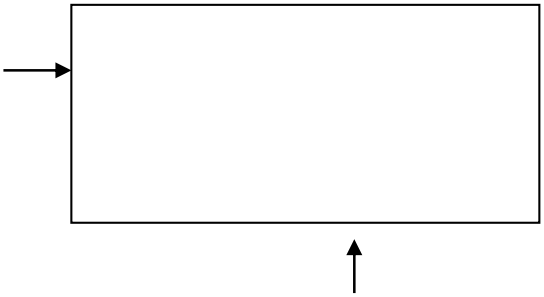
Parameter	Analytical Method	Method Reporting Limits	Units
Ammonia Nitrogen	SM 4500-NH3	1.0	mg/L
Arsenic	EPA 6020	1.0	µg/L
Boron	EPA 6020	50	µg/L
Calcium	EPA 6010B	0.50	mg/L
Chloride	SM 4500-Cl	1.0	mg/L
Copper	EPA 6020	1.0	µg/L
Iron	EPA 6010B	20	µg/L
Lead	EPA 6020	1.0	µg/L
Manganese	EPA 6020	10	µg/L
Mercury	EPA 1631E	0.5	ng/L
Nickel	EPA 6020	1.0	µg/L
Nitrate	SM 4500-NO3	0.05	mg/L
Nitrite	SM 4500-NO2	0.05	mg/L
Phosphorus	SM 4500-P	0.01	µg/L
Potassium	EPA 6010B	0.50	mg/L
Selenium	EPA 6020	2.0	µg/L
Sulfate	EPA 9056	1.0	mg/L
Zinc	EPA 6020	10	µg/L
pH	Field	NA	pH units
Specific Conductance	Field	NA	µS/cm

Chain of Custody/Shipping

All samples, regardless of their chemical preservation, are to be placed on ice in coolers from the time they are sampled through the duration of their shipment to the laboratory. Ice is available in the water treatment plant. Guidelines for sample management are as follows:

- If time permits, labels on bottles should be protected with clear packaging tape to prevent water from obscuring the sample label.
- Coolers should be lined with bubble wrap to prevent glass bottles from breaking in transit.
- Ice shall be packaged in Ziploc bags and positioned under and around the sample bottles, so that there isn't any space for bottles to shift during transport.
- If the cooler has a drain port, use duct tape to ensure the port does not open in transit and allow water to drain (this will alert the shipper and cause unwanted delay of the package).
- Complete the chain of custody (COC) provided by the laboratory and keep a copy for our records. Email a copy of the COC to the laboratory as a courtesy and they will know to notify you if the sample does not arrive.

- Place the original COC in a Ziploc bag and tape it to the inside lid of the cooler.
- Close the cooler and use packaging tape to secure the cooler for transport. If the cooler has a handle, tape the handle down so it cannot be used to toss the cooler during shipment.
- Place signed custody seals in the following orientation, and use packaging tape to secure the custody seal to the cooler.



Plan view of cooler with custody seal orientation denoted with arrows.

- Complete a UPS shipping label and drop the shipment off at either the UPS store located near Target in Marquette or the UPS receiving center located near Midway Rental in Negaunee Township.
- The UPS representative will weigh the package, affix the label, and provide a copy of the shipping label to you for your records.
- Track the package to ensure timely arrival at the laboratory.

REFERENCES

Hansen, Greg. (April 1, 2003). Low Cost Snow Tube Fabrication. National Oceanic and Atmospheric Administration – National Weather Service Eastern Region Headquarters. http://www.erh.noaa.gov/btv/html/snowtubeinstr.htm

REVISIONS

Version:	Date:	Prepared by:	Approved by:	Reason for Change:
1	11/20/13	Amanda Zeidler		

Appendix A

Sampling Location Maps


Big Bay
Two additional sampling points - one off of the Northwest Road and the second near the city of Marquette possibly by soccer complex on 550
Powell
Big Bay
Perkins County Park
Lake Independence
510
550
510
KL
510
Saux Head Lake

NOTES

1. Orthophotography supplied by Aero-Metric Engineering, Sheboygan, Wisconsin. Date of photography: April 27, 2006.
2. Horizontal datum based on NAD 83/96. Horizontal coordinates based on Michigan State Plane North.
3. Humboldt Mill Project located within Sections 2 and 11, T47N, R29W, Humboldt Township, Marquette County, Michigan.

LEGEND

- Existing Background Monitoring Wells upgradient of HTDF
- Proposed HTDF Leachate Monitoring Wells per R425.406(5)(a)
- Proposed HTDF Compliance Monitoring Wells per R425.406(5)(b)
- Downgradient Containment Wall/Compliance Boundary
- KEMC Project Location
- Sampling Locations

Foth Infrastructure & Environment, LLC

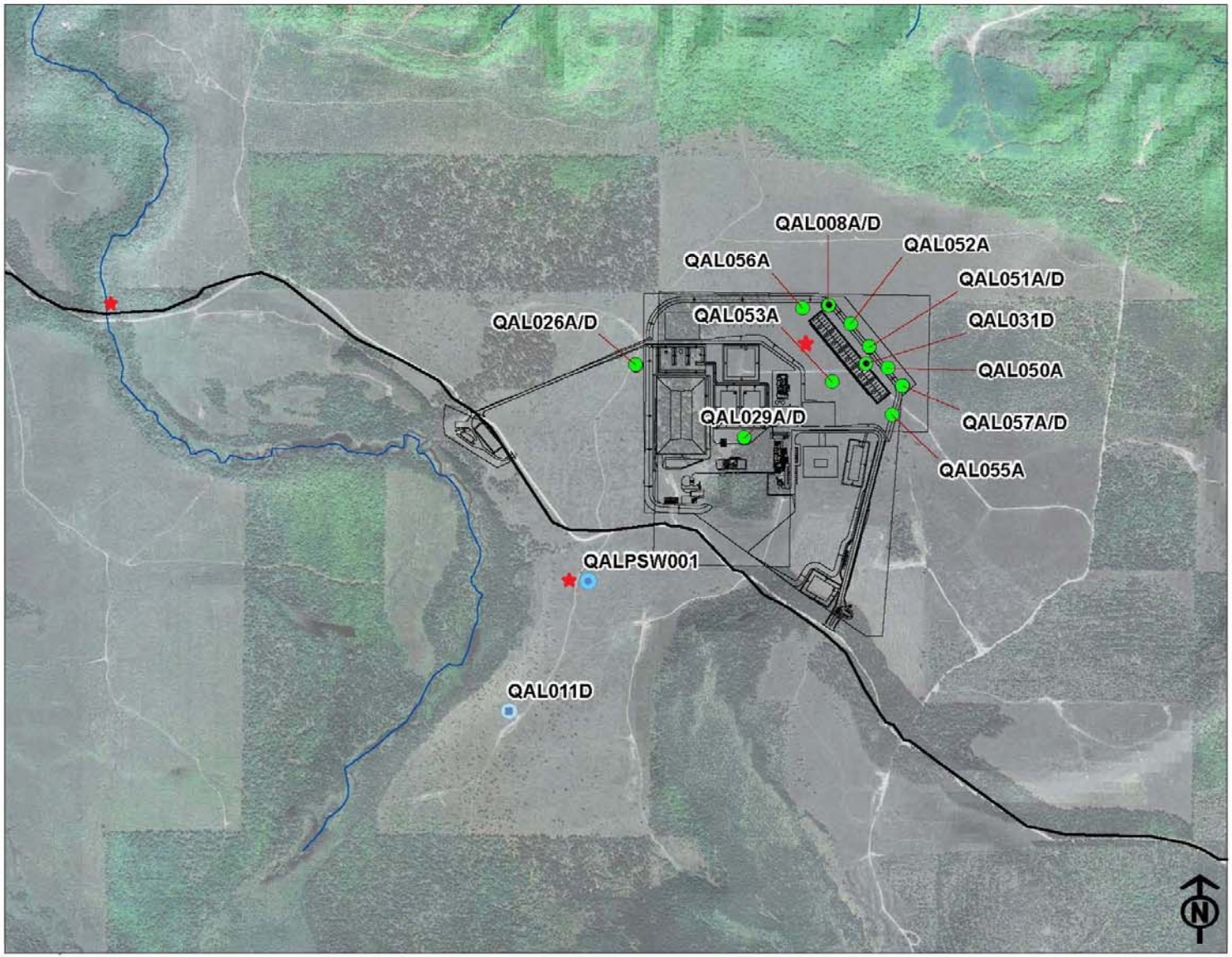
REVISED	DATE	BY	DESCRIPTION

CHECKED BY:	JGL	DATE: AUG '08
APPROVED BY:	SVD1	DATE: AUG '08
APPROVED BY:		DATE

Kennecott Eagle Minerals

FIGURE 5-1
HUMBOLDT MILL PROJECT
GROUNDWATER MONITORING WELL LOCATIONS

Scale: 1" = 300' | Date: AUGUST, 2008
Prepared by: DAT | Project No: 06W003



GROUNDWATER DISCHARGE PERMIT MONITORING LOCATIONS
Project View

- ROAD
- HYDROGRAPHY
- PROPOSED MINE FACILITY
- GROUNDWATER QUALITY MONITORING WELL
  - *Instrumented for continuous monitoring*
- NON - POTABLE WATER SUPPLY WELL
- POTABLE WATER SUPPLY WELL
- SNOW SAMPLING LOCATIONS

Reference

Data provided by: Kennecott Eagle Minerals, North Jackson Company
Projection & Datum: UTM NAD 83 Zone 16N

0 2,000 Feet

Scale: 1:12,000

Kennecott Eagle Minerals

North Jackson Company
ENVIRONMENTAL SCIENCE & ENGINEERING

Figure: XX

Appendix B

Snow Tube Instructions

APPENDIX B

Low Cost Snow Tube Fabrication

Greg Hanson, Service Hydrologist, WFO Burlington, VT

http://www.erh.noaa.gov/btv/html/snowtubeinstr.htm

(First posted 11/30/00, Updated 04/01/03)

This is an alternative to the commonly used, but expensive, Adirondack Snow Tube. The low cost method uses PVC pipe, with serrated teeth cut directly into the pipe. The PVC teeth may not prove to be as durable as the metal teeth fitted to the Adirondack Snow Tube, but at $9.00 PVC pipe is cheap to replace.

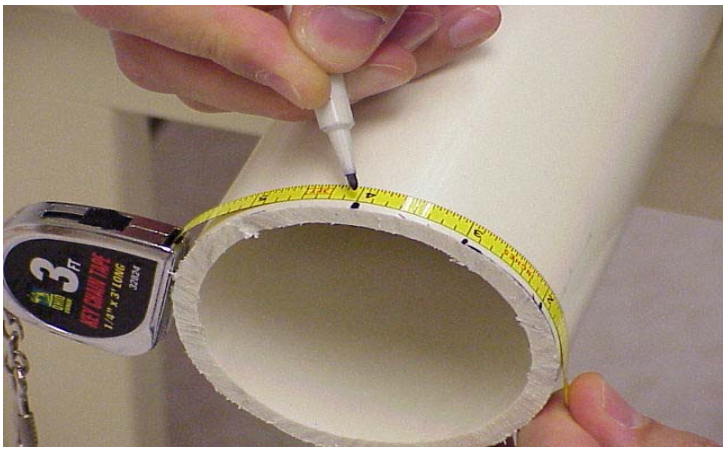
Materials	Tools
10' x 3" inside diameter schedule 40 PVC pipe	Safety glasses
3/4 inch diameter dowel rod	Tape Measure
	Jig saw or hack saw
	Coarse file or rasp
	Permanent marker
	Drill w/ ¾" bit
	Bench vise

Step 1: Cut the pipe

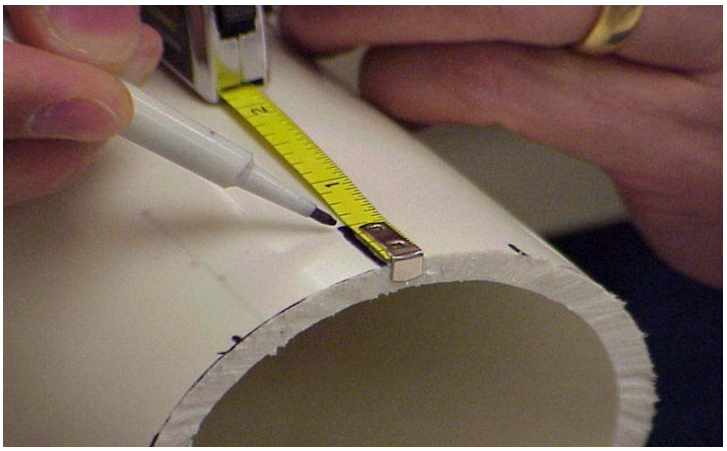
Using a hack saw or jig saw, cut the pipe to length, depending on your application. The length of an Adirondack snow tube is 5 feet, if the snow depth in your area is greater make the tube longer.

Step 2: Lay out the teeth.

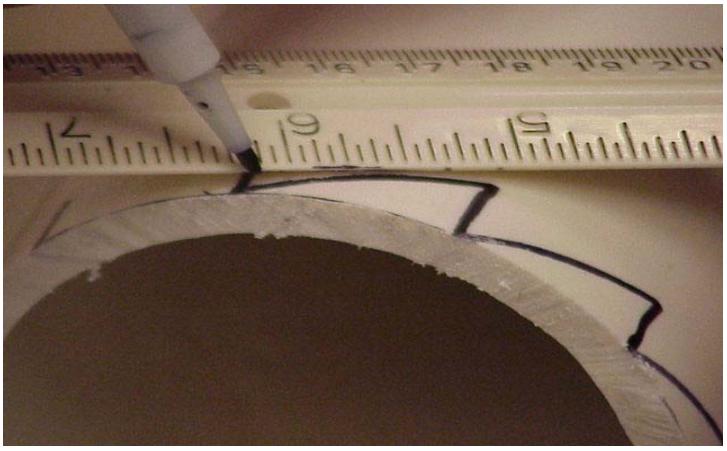
Use a sawtooth pattern, 1/2 inch deep, and spaced 1 inch apart. At one end of the tube, draw marks at one inch intervals around the end of the tube.



At each mark, draw a line 1/2 inch down the tube (picture 2). This will be the depth of the teeth.



Draw a diagonal line from the end of one line to the bottom of the adjacent line.

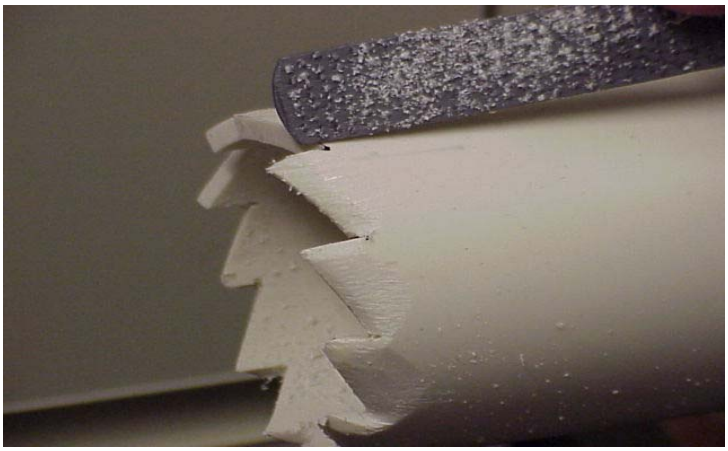


Step 3: Cut the teeth

With a jig saw or hack saw, cut the teeth. Don't forget your eye protection!

Step 4: Sharpen the teeth

With a file or rasp, sharpen the outside edge of the teeth.



Step 5: Make the handle

Drill two 3/4 inch holes in the other end of the tube to accept the handle. Cut a piece of 3/4 dowel to 1 foot length. Insert the dowel into the holes.

Step 6: Mark outside of tube

Using a waterproof marker, mark the outside of the tube for snow depth. This example is the steel automotive exhaust pipe, with the end flared to an inside diameter of 3 inches.

SNOW SAMPLING - MARCH 2014

Location	Mercury (ng/L)	Copper (ug/L)	Ammonia (mg/L)	Phosphorus (mg/L)	Nitrate (mg/L)	Iron (ug/L)	Zinc (ug/L)	Chloride (mg/L)	Calcium (mg/L)	Manganese (ug/L)	Lead (ug/L)	Nickel (ug/L)	Potassium (mg/L)
Domestic Well A	**4.2**	**1.6**	**0.24**	**0.0182**	**0.19**	10	5	0.5	0.25	5	0.5	0.5	0.25
Domestic Well B	**1.31**	0.5	**0.14**	**0.0112**	**0.18**	**31**	5	0.5	0.25	5	0.5	0.5	0.25
West Gate A	**1.64**	0.5	**0.22**	0.005	**0.18**	10	**10**	0.5	0.25	5	0.5	0.5	0.25
West Gate B	**0.929**	0.5	**0.15**	0.005	**0.22**	10	5	**1.1**	0.25	5	0.5	0.5	0.25
Salmon Trout A	**2.37**	0.5	**0.22**	0.005	**0.18**	**37**	**12**	**1.1**	0.25	5	0.5	0.5	0.25
Salmon Trout B	**1.24**	0.5	**0.096**	0.005	**0.19**	**47**	5	0.5	0.25	5	0.5	0.5	0.25
Northwest Road A	**1.54**	0.5	**0.23**	**0.0111**	**0.17**	10	5	0.5	0.25	5	0.5	0.5	0.25
Northwest Road B *	**8.88**	**5.2**	**0.11**	**0.107**	**0.18**	**2500**	**22**	**1.0**	**1.4**	**93**	**2.0**	**2.6**	**0.73**
Yellow Dog A	**2.78**	0.5	**0.31**	**0.0124**	**0.25**	**50**	**10**	0.5	0.25	5	0.5	0.5	0.25
Yellow Dog B	**1.31**	0.5	**0.11**	**0.0155**	**0.19**	**140**	5	0.5	0.25	**14**	0.5	0.5	0.25
Big Bay A	**1.67**	0.5	**0.34**	**0.0110**	**0.25**	**90**	**14**	**1.1**	0.25	5	0.5	0.5	0.25
Big Bay B	**0.95**	0.5	**0.25**	**0.0126**	**0.26**	**110**	5	**2.8**	0.25	5	0.5	0.5	0.25
Marquette A	0.25	0.5	**0.21**	0.005	**0.21**	**130**	**17**	0.5	**0.61**	5	0.5	0.5	0.25
Marquette B	**1.09**	**1.3**	**0.20**	**0.0151**	**0.23**	**480**	5	**6.6**	**0.76**	**11**	0.5	0.5	0.25
CR FX A	**1.52**	0.5	**0.16**	0.005	**0.28**	**35**	5	**1.2**	0.25	5	0.5	0.5	0.25
CR FX B	**1.17**	0.5	**0.16**	**0.0250**	**0.24**	**140**	5	**6.4**	0.25	5	0.5	0.5	0.25
CR601 A	**1.90**	**1.3**	**0.20**	**0.0160**	**0.24**	**510**	5	**2.4**	**0.54**	5	0.5	0.5	0.25
CR601 B	**1.37**	**1.2**	**0.15**	**0.0140**	**0.29**	**380**	**10**	**14**	**0.72**	5	0.5	0.5	0.25
Mill Septic A	**1.90**	0.5	**0.18**	0.005	**0.24**	**71**	**12**	**1.1**	0.25	5	0.5	0.5	0.25
Mill Septic B	**0.716**	0.5	**0.14**	0.005	**0.22**	**140**	5	0.5	0.25	5	0.5	0.5	0.25

Minimum	0.25	0.5	**0.096**	0.005	**0.17**	10	5	0.5	0.25	5	0.5	0.5	0.25
Maximum	**8.88**	**5.2**	**0.34**	**0.107**	**0.29**	**2500**	**22**	**14**	**1.4**	**93**	**2**	**2.6**	**0.73**
Average	1.94	0.91	0.19	0.02	0.22	246.55	8.35	2.17	0.39	10.15	0.58	0.61	0.27
Standard Deviation	1.83	1.07	0.06	0.02	0.04	551.49	4.93	3.32	0.29	19.64	0.34	0.47	0.11

Notes:

"A" location is the top one inch of snow, "B" location is a core composite sample

Results in **bold** were detected; results in standard type were not detected and are reported at half the reporting limit in order to perform calculations.

Additional parameters were analyzed, but were all reported as non-detect and therefore not listed in this table.

* The Northwest Road "B" sample contained some sand and gravel which may have contributed to the higher results