U of M and MDH Grant Project:
Contaminants of Emerging Concern – Septic System and Private Well Education and Well Testing

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Introduction

As of 2019, there were 608,720 subsurface sewage treatment systems (SSTS) processing 41.7 billion gallons of wastewater per year in Minnesota (MPCA, 2019). By design, most of this treated wastewater infiltrates into the groundwater. Residential drinking water wells draw from groundwater. In Minnesota, 75% of drinking water comes from groundwater sources (MDNR, 2021). Households that rely on onsite systems typically treat their wastewater using a septic tank, followed by a soil treatment system. Many of these homes also use a private well for their drinking water, about one fifth of Minnesotans drink water sourced from private wells (MDH, 2021). There is growing concern about new chemicals in our groundwater, drinking water, lakes, rivers, and streams. These contaminants of emerging concern (CECs) include products used every day around the home—cleaning products, over-the-counter medicines, and pharmaceuticals. CECs can present a health risk and are more likely to get into our drinking water if we do not have suitably functioning drinking water wells and/or septic systems.

Private drinking water wells and septic systems are critical to public health and the environment; and making sure they are operated properly is key to their performance. The problem is that many property owners do not understand how household products and disposal can affect our water supply. Even though CECs tend to be found in low concentrations, their prevalence is a potential health risk to humans and other biota, including endocrine disruption and antibiotic resistance (Bexfield et al., 2019).

There is the potential for CECs from products that are put into a septic system to affect drinking water wells on the same property and/or potentially down gradient at a different private or public drinking water supply well. Fortunately, if drinking water wells and septic systems are properly constructed and maintained, the risk to ground and surface water is minimized.

Project Goals

Private drinking water and septic systems are critical to public health and the environment. Just like other infrastructure around a home or business, drinking water and septic systems need regular maintenance and eventual replacement. This project focused on a state-wide effort educating SSTS owners, SSTS professionals and those managing public wells on proper maintenance and care of this infrastructure to preserve the health of Minnesota's valuable soil and water resources. The objective was to enhance their knowledge about CECs, understand why they should be involved in this aspect of groundwater protection and help them create a clear maintenance plan resulting in a reduction of CECs in the groundwater. Classes were offered to two different groups of learners:

SSTS Professionals

- Information was presented at Onsite Sewage Treatment Program (OSTP) professional continuing education classes across the state of Minnesota.
- Professional attendees included installers, maintainers/pumpers, designers, inspectors, and local government unit staff.
- They were given design and use recommendations to reduce the impacts of CECs from SSTS on groundwater.
- Professionals were provided with information and a factsheet geared towards the owners of SSTS (their clients).
- The trainings were provided as an in-kind donation from the OSTP to the project.

SSTS and Well Owners

- Classes were offered across MDH districts.
- In-person and online webinars were offered.
- SSTS owners received information on CEC use and the potential impact of their septic system on groundwater.
- Materials were posted to the U of M OSTP website, promoted in the WRC Minnegram and Confluence, and provided to MDH Source Water Protection staff for use/distribution.

During this project there were two separate grant periods, one supported state-wide SSTS owner and SSTS professional classes through February 2018 to June 2019, with a total of thirty-three classes offered. Of these, there were seventeen workshops for citizens, hosted by local partners; sixteen held in person and one provided via webinar with 700 citizens attendees total. The OSTP trained nearly 900 professionals at fifteen events cross Minnesota. Overall, the response to this first round of classes was very positive. All the sponsoring organizations expressed an interest in hosting a similar event in the future. The other grant period supported classes held across Minnesota from September 2019 through December 2020. This report will discuss the classes, survey results and well data gathered from this second grant period.

Class Outcomes

The CEC material was presented by Dave Gustafson at eight regularly scheduled OSTP professional continuing education classes throughout 2020. See **Table 1** for details. Originally, the proposal was for this information to be delivered at six OSTP workshops but two more were added.

Table 1. *SSTS Professional Class Details*

SSTS Professional Classes			
County/Organization	**Class Type**	**Number of Attendees**	**Date**
Little Falls	General CE	69	6-Nov-19
Detroit Lakes	Installer CE	40	19-Nov-19
St. Cloud	General CE	107	17-Dec-19
New Ulm	Installer CE	41	13-Jan-20
St. Cloud	Research CE	65	23-Jan-20
Willmar	Installer CE	48	27-Feb-20
Alexandria	General CE	68	4-Mar-20
Alexandria	pGeneral CE	7	9-Nov-20
Mankato	pGeneral CE	23	11-Nov-20
Brainerd	pGeneral CE	46	2-Dec-20
Brainerd	pGeneral CE	41	16-Dec-20
Total Attendees		**555**	

The material was also presented at twelve different SSTS and well homeowner classes that, due to the COVID-19 pandemic, took place as a mix of in-person and online events. See **Table 2** for details.

***Table 2**. SSTS and Well Homeowner Class Details*

SSTS and Well Homeowner Classes				
County/Organization	**Class Format**	**Region**	**Number of Attendees**	**Date**
St. Louis County	In person	North East	76	30-Sep-19
Lake County	In person	North East	30	1-Oct-19
Lake County	In person	North East	18	2-Oct-19
Lake County	In person	North East	38	3-Oct-19
Melrose Community Education	In person	Central	41	10-Oct-19
Mower County	In person	South	52	13-Jan-20
City of Ramsey	In person	Central	41	12-Mar-20
Minnesota Lakes and Rivers Advocates	Online Webinar	Statewide	87	17-Apr-20
Ottertail County	Hybrid	North West	19	6-Jun-20
Waseca County	Hybrid	South	20	5-Oct-20
St. Louis County	Online Webinar	North East	47	5-Nov-20
Redwood County	Online Webinar	South	34	8-Dec-20
Total Attendees			**503**	

The septic portion of these classes was covered by Sara Heger while the well section was covered by Jeff Grugal. The proposal was only written to deliver this information at nine classes but because of the increased ability to conduct the class online, three more classes were added. The original plan also stated that at least one class would be held at a tribal location however, because of the increased public health risk for indigenous populations due to the COVID-19 pandemic, our partners at the Leech Lake Band of Ojibwe decided against hosting a class in 2020.

***Figure 1.** Sara Heger instructing a SSTS and well homeowner class in Mower County, MN.*

A survey was distributed at some of the SSTS and well owner classes to obtain feedback. There were 120 hard copy surveys returned and 14 online surveys completed. See **Appendix A** for an example of the in-class survey.

Another component of the SSTS and well homeowner class was the distribution of well testing kits. Providing testing kits to attendees emphasized the importance of regularly testing their private drinking water system, as outlined in the class. These kits were from RMB Environmental Laboratories. If they chose to, well owners/maintainers could bring home a testing kit to test their well for nitrate as N, Arsenic, E. coli and fecal coliform. The kits were collected on a specified drop-off date and sent to the lab for processing. Results were sent to the U of M OSTP and the well owner via email. See **Appendix B** for an example of the well testing kit form and instructions that were distributed with the kits.

SSTS and well homeowner classes were primarily marketed by the local organization who hosted the event using local marketing such as press releases, newspaper ads, radio shows, social media marketing, signs, and direct mailings.

The webinar version of the course was recorded and posted to the project website along with the slide set and factsheet: https://septic.umn.edu/septic-system-owners/trainingevents.

MDH assisted with the development and review of our slides and handouts. Staff co-presented covering the well portion of the homeowner classes.

Though the official MDH events are complete, the OSTP continues to partner with local organizations. Lake County hosted two more SSTS and well homeowner classes in May and June of 2021 due to the high interest of this topic along the North Shore and newly obtained funding.

Survey Outcomes

Surveys were distributed at the Cook, Mower and Anoka County SSTS and well homeowner in-person classes, as well as some online classes for 2020. There were 134 surveys returned in total. Overall, the response to the classes was very positive. Responses showed that learners were generally satisfied with the class and most reported having gained knowledge because of attending. They also reported that they were likely to make changes around their home related to the operation of their SSTS or well because of what they had learned.

The survey included some questions about the work that is currently done in their household to insure proper maintenance of their water and wastewater systems. When asked how long it had been since their septic tank had been pumped, almost 40% of respondents reported that it had been less than one year, about 25% said 2 years and almost 15% said they did not know the last time their tank was pumped. When asked about when homeowners last had their well tested for contaminants, just under 20% said they have had their well tested in the last year and just about 25% said they have never had their well tested. Homeowners who had a recollection of having their wells tested were asked about what specific tests they had run for contaminants including:

- Arsenic
- Fluoride
- Fecal Coliform
- Lead
- Nitrate/Nitrite
- Manganese
- Iron
- Sulfate

Responses showed that the top two contaminants they remember testing for was fecal coliform and nitrate/nitrite. When asked about the top three places class attendees look for information on their well, the answers were an internet search, local government office or website and the university or county extension program. The survey results are shown in **Appendix C**.

Well Testing Outcomes

A portion of the SSTS and well homeowner class was dedicated to stressing the importance of protecting a home's private drinking water system. The MDH and OSTP recommend testing a private well for bacteria annually and nitrates at least every two years. Arsenic, Lead and Manganese tests should also be conducted at least once. If a homeowner had never tested their well or had not tested in the past year, this was a chance to have their well tested for free. Data came back from 189 wells across Minnesota because of distributing testing kits at SSTS and well homeowner classes. There were also about ten testing kits mailed out to homeowners who attended the online classes.

The state has been split into regions to better analyze the data. The twenty-three counties with wells that were tested are shown in their regional group in **Table 3**.

Table 3. *MN Counties Grouped Regionally*

Central	North East	South	West Central
Cass	Aitkin	Dodge	Becker
Chisago	Itasca	Mower	Grand Forks
Crow Wing	Lake	Redwood	Hubbard
Mille Lacs	St. Louis	Waseca	Otter Tail
Pine			Polk
Sherburne			
Stearns			
Todd			
Wright			

The number of wells tested because of this project varies across the state. The most wells tested were from the North East part of the state and the Southern part of the state had the least number of wells tested. The sample size from each region is shown below in **Table 4**.

Table 4. *Well Testing Sample Size by Region*

Sample Size	
Region	Number of Wells Tested
Central	33
North East	88
South	27
West Central	41
Total in MN	**189**

Well Testing Results

The RMB lab well testing kits analyzed for bacteria (E. coli and fecal coliform), Nitrate as N and Arsenic because, in drinking water, these contaminants pose the largest public health risk.

Learners were informed that these types of bacteria in drinking water are an indicator of contamination and advised of the steps to take in the case of a positive result. The well testing results of bacteria for this project are shown in **Figure 2**. In the central region of MN, bacteria occurred in 9% of the wells tested. In the North East region there was a 20% occurrence rate. In the southern part of the state there was bacteria present in 11% of the wells tested and in the West Central region it was found in just 2% of tested wells. Out of all 189 wells tested in the state for this project, only 13% had a positive occurrence of bacteria. Ideally, there should not be any occurrences of bacteria in drinking water wells. However, more data and resampling would be needed at these sites to make any certain determinations as it is possible that with only one sample at each site, contamination during sampling is possible.

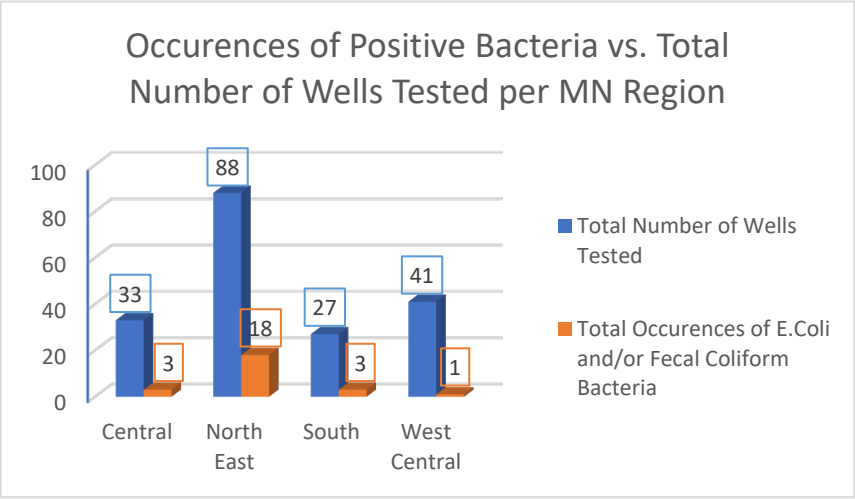
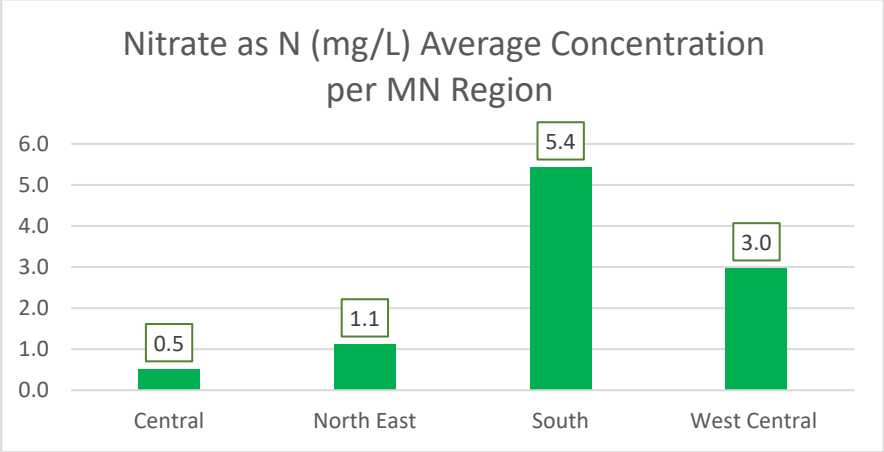


Figure 2*. Occurrences of well bacteria versus the total number of wells tested per region*.

Since nitrate is also a concern in private wells, this contaminant was also included in the testing kit. Class attendees were informed of the risks to public health and causes (runoff from fertilizer, household cleaners/chemicals, etc.) of high nitrate in drinking water and what treatment options are available if high nitrate is detected. Results from the well data show in **Figure 3** that a small amount of nitrate as N

is detected in wells from all four regions, at levels that are safe. There were two southern region wells out of the 189 tested state-wide that had nitrate as N concentrations at or over the Environmental Protection Agency's (EPA) Maximum Contaminant Level (MCL) of 10 milligrams per liter.

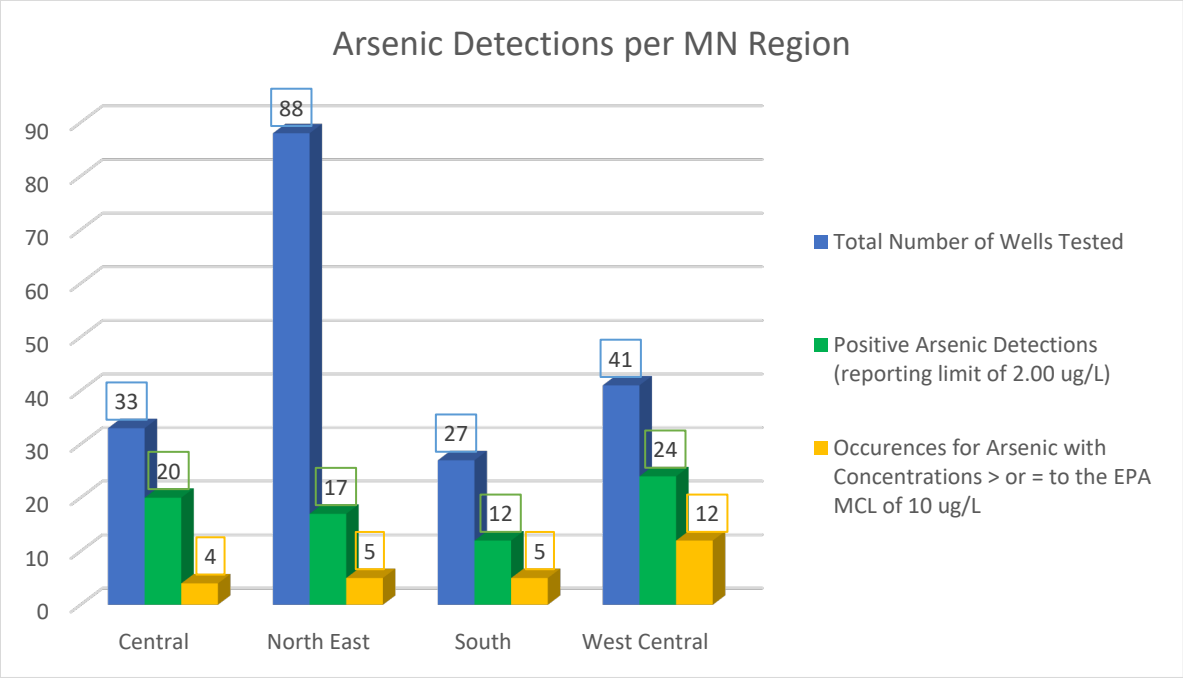
Figure 3. *Nitrate as N average concentrations per MN region*



Arsenic data from this project is shown in **Figure 4**, below. The course created for this project covered information about arsenic contamination in private wells, emphasizing that arsenic is a naturally occurring contaminant and can lead to very adverse health risks, especially if consumed over a long period of time. The MCL set by the EPA is 10 micrograms per liter. However, the EPA has set a goal of 0 micrograms of arsenic per liter of drinking water in community water systems because of the increased risk of cancer that long-term arsenic ingestion can have (MDH, 2021).

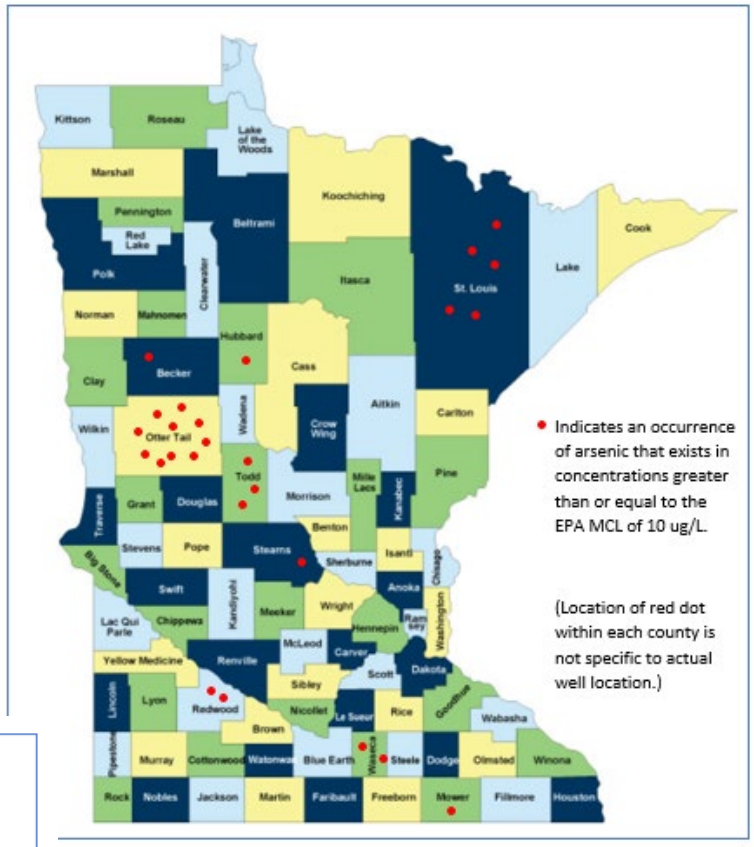
From all 189 wells tested for this project, 73 test kits came back showing an occurrence of arsenic and 26 of those occurrences are in concentrations greater than or equal to the EPA MCL of 10 ug/L. The west central region shows a 59% arsenic occurrence rate and of these occurrences, about half have concentrations greater than or equal to the EPA MCL of 10ug/L. The central region of the state has the highest overall occurrence rate of arsenic at 61% but less than 25% of those occurrences appear in concentrations greater than or equal to the EPA MCL. The northeast has the lowest occurrence rate at 19% and the southern region has the second-lowest occurrence rate at 44%. Both regions have the lowest arsenic occurrence rate above the MCL at 5% each**.**

Figure 4. *Arsenic Detections per MN Region*



Figures 5 and **6** show, respectively, occurrences of arsenic at or greater than 10ug/L by county and the locations of each class, along with how many well test kits were returned from each class location.

Figure 5. *Map of MN counties with occurrences of arsenic at or above the EPA MCL of 10 ug/L.*



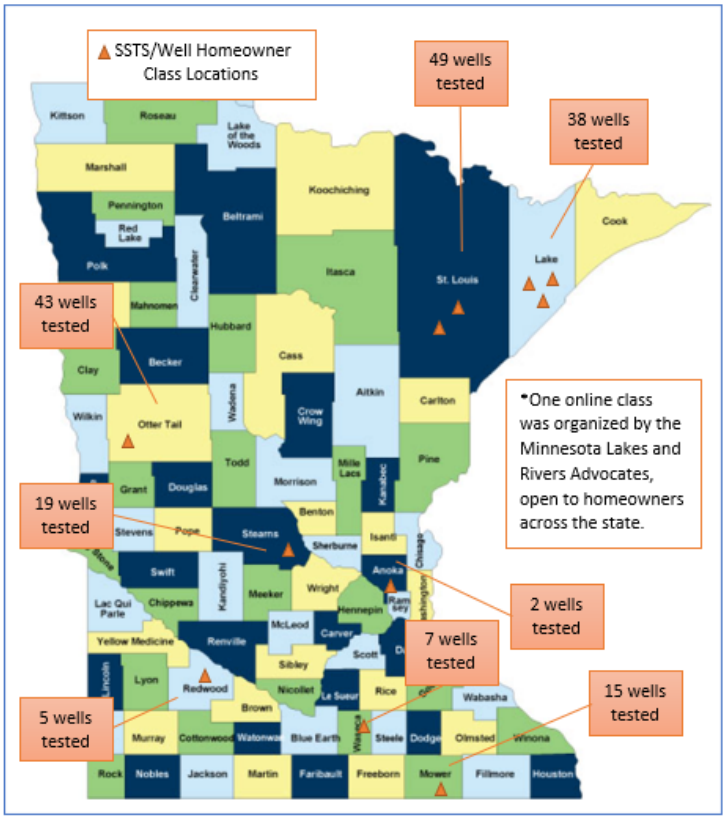


Figure 6. *Map of MN counties showing the location of each SSTS and well homeowner class and number of returned well testing kits from each location.*

Conclusion and Lessons Learned

With this project the OSTP was able to connect with septic professionals and SSTS and well owners in twenty-two counties across the state. Approximately 1,058 people were trained in total. This project was a great partnership between local units of government, lakeshore associations, MDH and the University of Minnesota. The continuation of this project would be a valuable educational tool for the state to continue partnerships with local organizations, educate through seminars and continue to build awareness around SSTS and drinking water well health by offering free well testing kits.

The key to this project being successful was local partnerships. The local partners including counties, lake associations and community education programs used various marketing approaches to get interested residents to attend both in person and virtual events. Pairing the educational events with free well tests kits was another effective method to boost participation. Adaptation to virtual events allowed the program to continue in a difficult time to provide education.

References

Bexfield, Laura M., Toccalino, Patricia L., Belitz, Kenneth, Foreman, William T., and Furlong, Edward T. (2019) Hormones and Pharmaceuticals in Groundwater Used As a Source of Drinking Water Across the United States *Environmental Science & Technology* 2019 *53* (6), 2950-2960. DOI: 10.1021/acs.est.8b05592

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Appendices

Appendix A

Septic and Private Well Workshop

Clair Nelson Community Center
October 1, 2019
Finland, MN

Please rate the following aspects of the session:	
How would you rank your overall satisfaction with the training? (1 unsatisfied, 5 very satisfied)	1 2 3 4 5
Do you feel more knowledgeable now than you did at the start of the training? (1 Learned nothing, 5 learned a lot)	1 2 3 4 5
How likely are you to make changes around your home as a result of this training? (1 very unlikely, 5 very likely)	1 2 3 4 5

1. Where do you live? (Town and/or name of lake/river)

   Finland

2. Approximately how long has it been since you had your septic tank(s) pumped?

   a) < 1 year
   b) 2 years
   c) 3 years
   d) 4 years
   e) 5 years
   f) >5 years
   g) I do not know when it was last pumped

3. If you have tested your water since construction of the well, which of the following tests did you order? (*Circle all that apply*)

   a) Arsenic
   b) Fluoride
   c) Coliform bacteria
   d) Lead
   e) Nitrate/Nitrite
   f) Manganese
   g) Iron
   h) Sulfate
   i) Other _____
   j) I have tested my well water, but don't remember the type of test
   k) N/A (Have not tested my well water)

4. Approximately when did you last test your well water for any contaminant?

   a) Within the last 12 months
   b) 1-2 years ago
   c) 3-5 years ago
   d) More than 5 years ago
   e) N/A (Have not tested for any contaminant)

5. Where do you look for information to help manage the safety and quality of your well water? (*Circle your top <u>three</u> choices*)

   a) General internet search
   b) MDH website
   c) Local/county government website or office
   d) Federal government website
   e) University or county extension service
   f) Water testing laboratory
   g) Well drilling company
   h) Health clinic
   i) Friend, relative, neighbor or co-worker
   j) Water treatment company
   k) Other

   _____

Appendix B

RMB Environmental Laboratories, Inc.

Lab Code

Detroit Lakes, MN • Bloomington, MN • Hibbing, MN
www.rmbel.info • 888-200-5770

Samples MUST BE collected the same day they are delivered.

Please read the directions on the back of this sheet before collecting your water sample. Correct sampling is critical to the accuracy of each test. If you have questions, please call (218) 846-1465 or email customerservice@rmbel.info.

Homeowner Course:

Class Location: _____ County: _____

Property Sampled:

Name: _____

Address: _____

_____

Phone: _____

***Reports will be emailed to you and the U of M.**
If email address is not provided, report will be mailed.

Results Reported To: ☐Same as Property Owner

Name: _____

Attn: _____

Address: _____

_____

Phone: _____ Fax: _____

*Email: _____

Sample Collection:

Date/Time Sample Collected: _____/_____/_____ at _____ : _____ (am / pm) Collected by: _____

Sampling Point: (well, kitchen...) _____ Depth of well: _____

Well Type: *(circle one)* □ Sandpoint □ Drilled □ Unknown □ New Other: _____

Water Type: *(circle one)* □ Conditioned □ Raw □ Unknown Other: _____

Sample Submission: Return samples and completed form on this date:

Thursday, March 19th, 2020 8:00am-12:30pm

To this location:

Anoka County Government Center
Environmental Services
2100 3rd Ave, Suite 600 Anoka, MN 55303

Lab Use Only Rev 09/11/18

☐ Rcvd same day as collected ☐ Rcvd in good condition ☐ Rcvd on Ice Temp Blank _____°C LTG _____ Chlorine Check: Absent Present

Sample Received on : _____ at _____ Rcvd by: _____ Check $ _____ # _____ Cash $ _____ CC Type_____ $ _____

NO_3:	TC ☐ CT ☐ CS	Arsenic ☐ Lab Pres HNO_3	Lead ☐ Lab Pres HNO_3	Other:
_____/_____/_____ Date Time Analyst	_____/_____/_____ Date Time Analyst	_____/_____/_____ Date Time Analyst	_____/_____/_____ Date Time Analyst	
_____mg/L Dilut:_____	Coliform: Absent _____ Present _____	_____µg/L	_____µg/L	Notes:
N+N_____	E. coli: Absent _____ Present _____	Dilution:_____	Dilution:_____	
NO_2 _____				

Water Sample Collection Instructions

Collect the samples the same day as delivery to the designated location. Samples collected early will be outside the required holding time and be considered void.

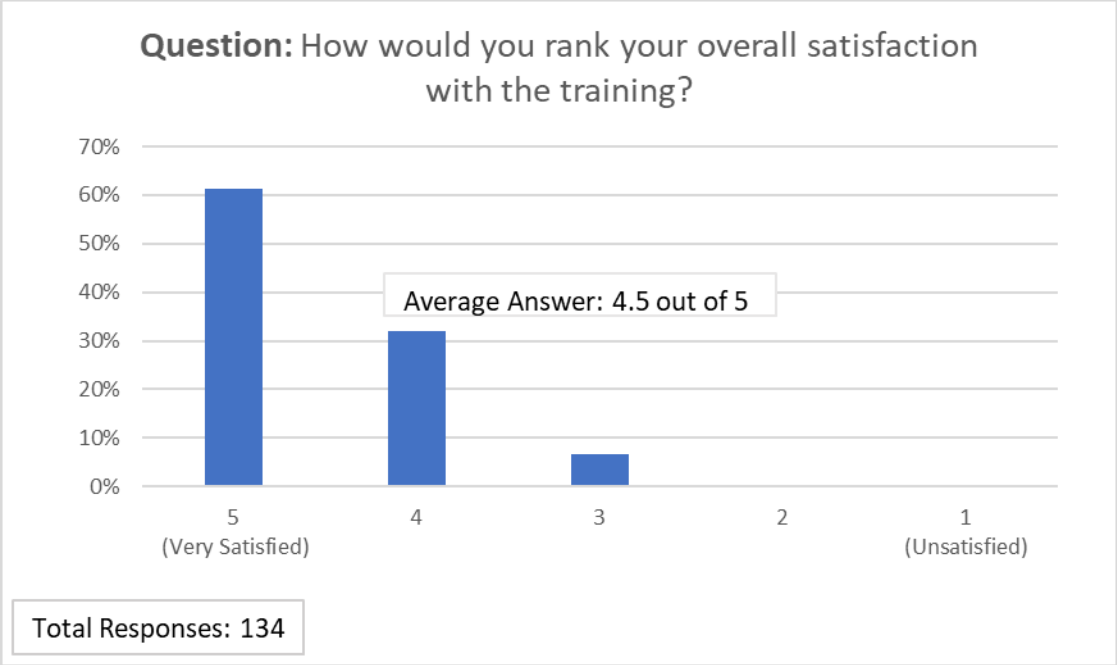
Sample Collection Instructions:

1. Water sample collection should occur as close to the well as possible, using a point in the water system that is regularly used.
2. To ensure the sample best represents the groundwater source, the sample should be collected at a location before the water is treated by a water softener, iron filtration unit, or water heater. If this is not possible, bypass the water softener.
3. Remove all aeration devices (screen) and rubber washer(s) from the faucet.
4. Flame the faucet (only if it is solid metal) until thoroughly heated (approx. 30 seconds) by using a small propane torch, a butane cigarette lighter, or a candle (do not use matches to heat faucet). If you are not able to flame the faucet, thoroughly disinfect the faucet opening with rubbing alcohol. (Do not use chlorine)
5. Run the cold-water tap for a minimum of 5 minutes.
6. **BACTERIA:** Collect the water sample using the sterile bottle provided. The bacteria bottle is sterile until opened. Take great care not to touch the inside of the bottle or cap of the sterile bacteria bottle. **Fill the sterile bacteria bottle slightly above the 100 ml fill line.**
7. **NITRATES:** Completely fill the nitrate bottle and close tightly.
8. **ARSENIC:** Completely fill the arsenic bottle and close tightly.
9. Fill out the information form (on front) and place in the box with the filled sample bottles.
10. Return kit box with completed form and collected samples to the designated location on the designated date.

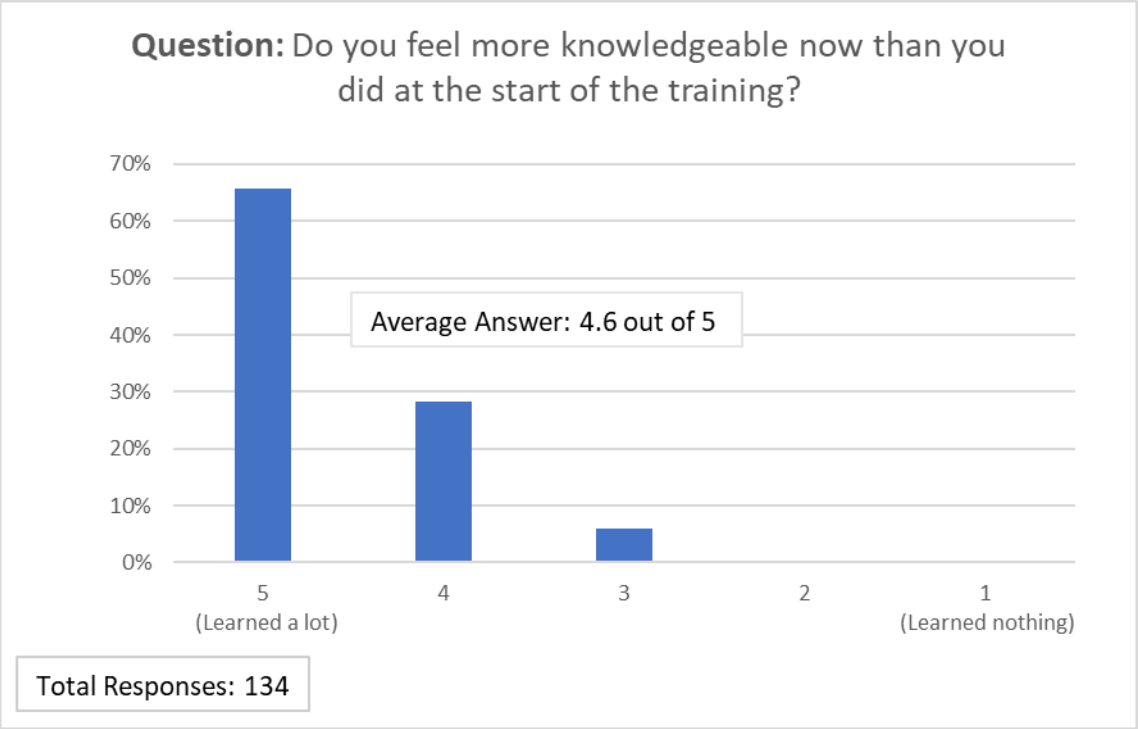
Appendix C

Septic and Private Well Workshop Survey Results

Question 1



Question 2



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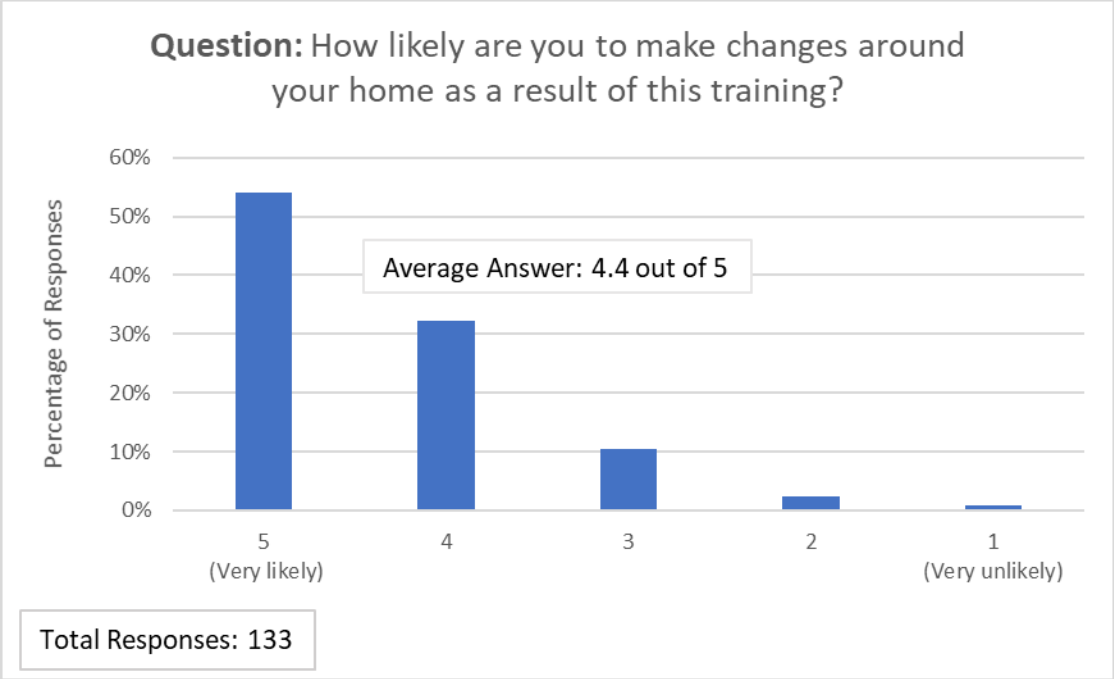
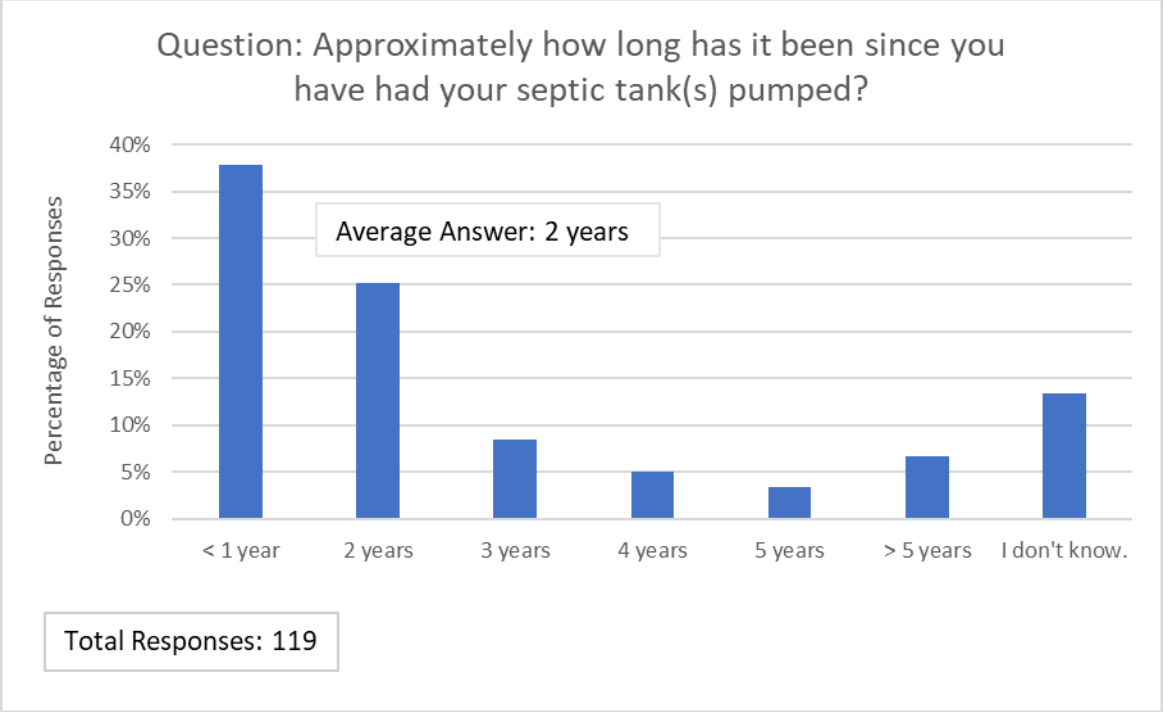
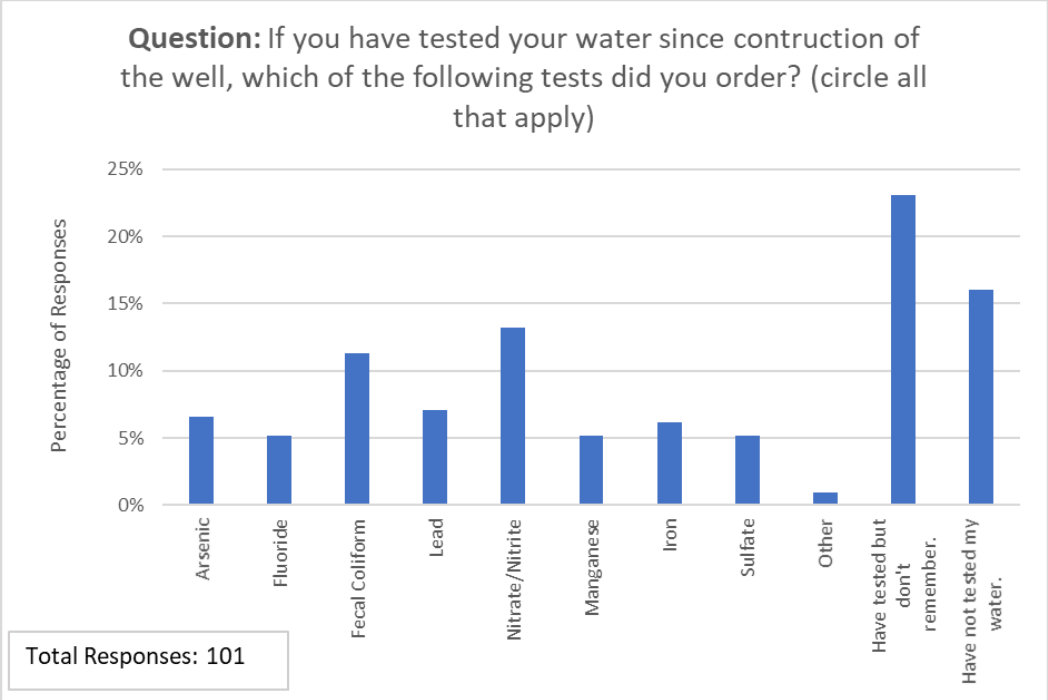


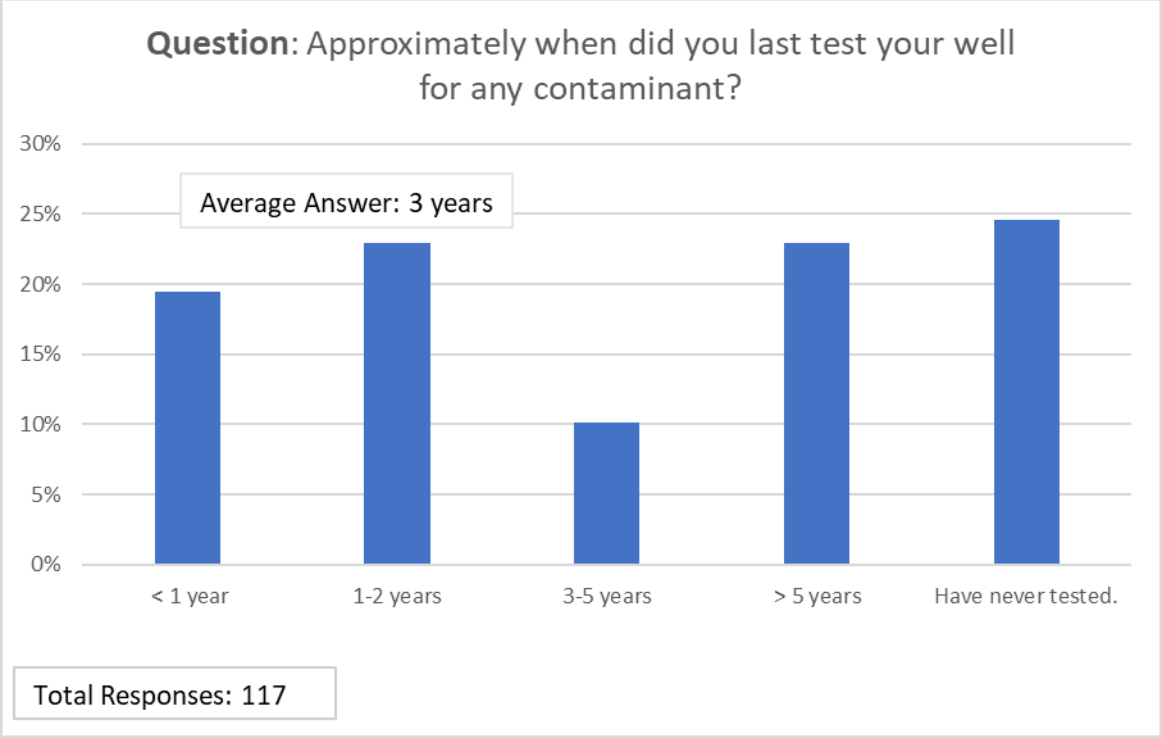
Question 4



Question 5



Question 6



Question 7