



UNIVERSITY OF WISCONSIN
OSHKOSH

Door County Well Monitoring Program - Spring 2025 Summary

UW OSHKOSH

ENVIRONMENTAL RESEARCH AND INNOVATION CENTER

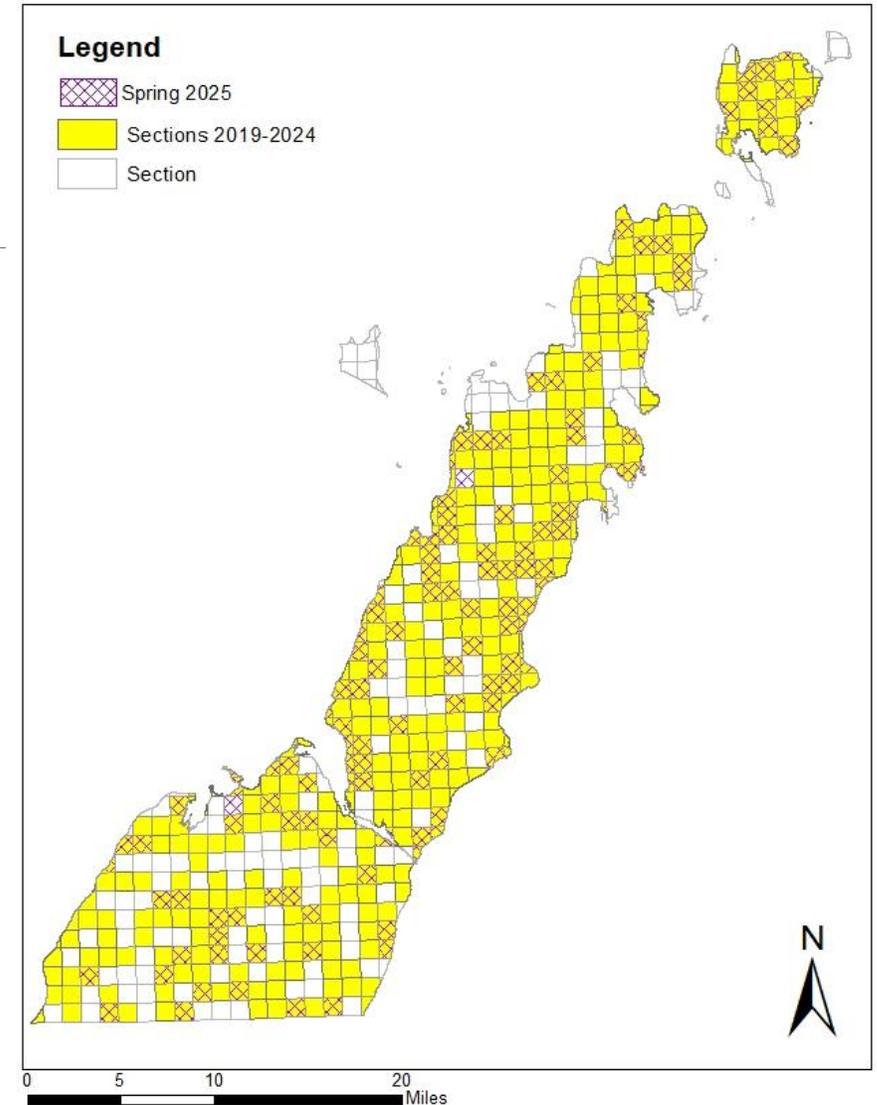
JUNE 18, 2025

Program Goals

- Provide continued education on water resources in Door County, WI
- Provide avenue for residents and guests to have the most accurate information on their drinking water quality
- Provide reliable information to guide county resources for the protection and maintenance of drinking water resources
- Be proactive with respect to drinking water resources, rather than reactive
- Create a groundwater water quality database for Door County
- Establish trends in groundwater data over time

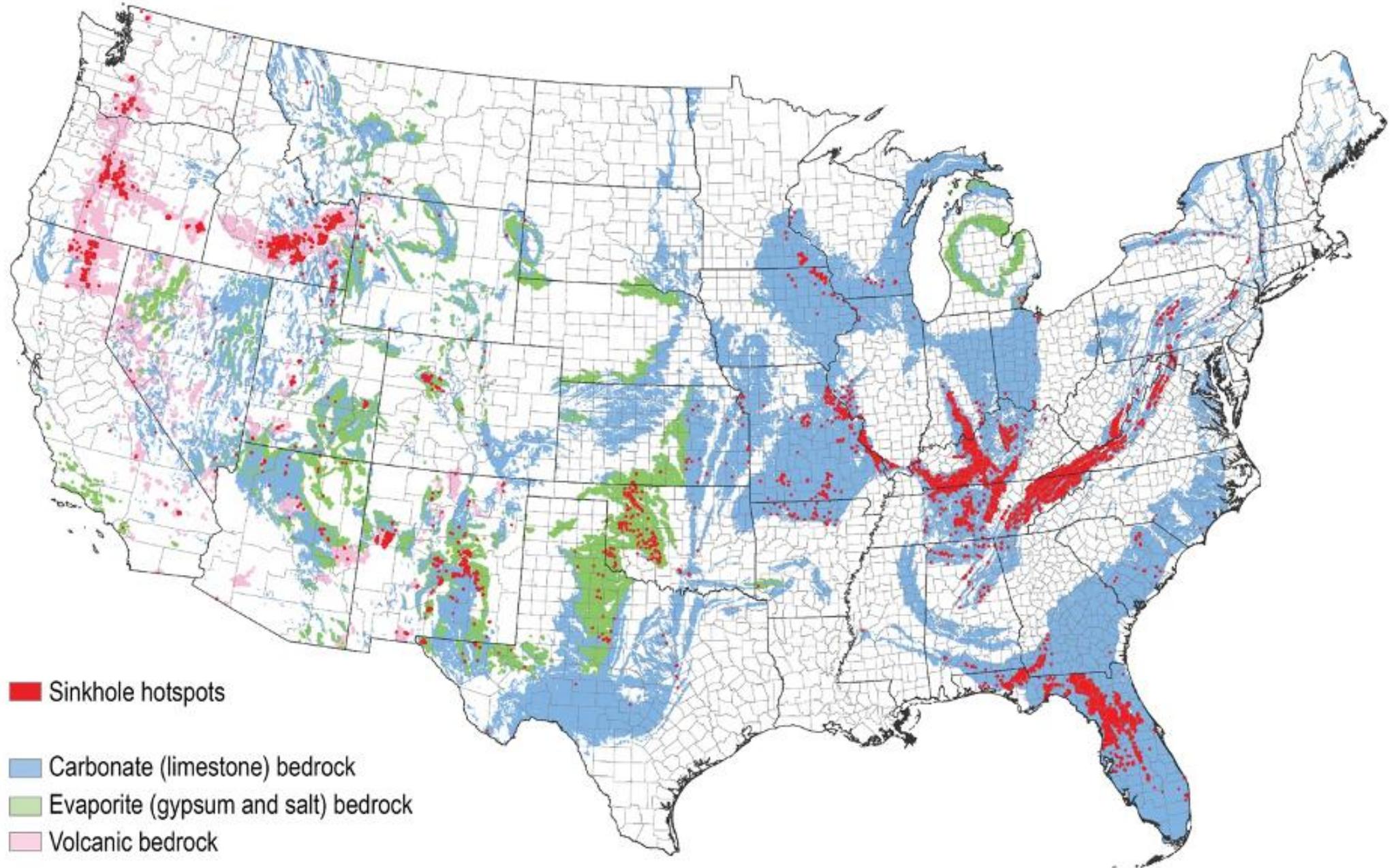
Program Goals

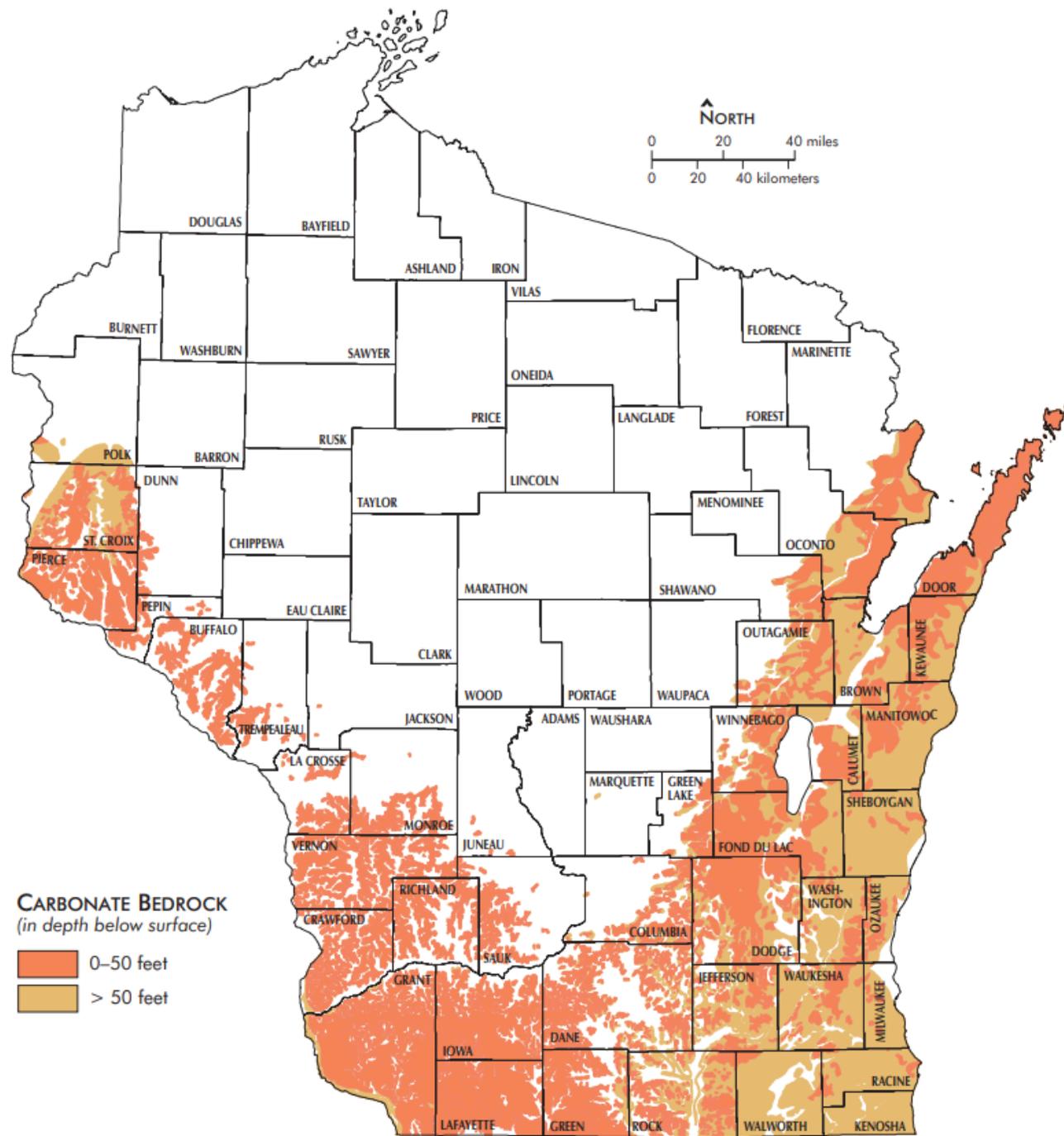
- Target is at least one well per section (square mile) of Door County
 - 2 new sections added in 2025!
 - 406 sections covered since 2019 – that's 62% of the county!
- Spatially distributed data to look for trends and relationships
 - Soil type
 - Depth to bedrock
 - Water table depth
 - Land use
- Samples collected to date:
 - Bacteria samples = 2,093
 - Nitrate sample = 2,057
 - Arsenic samples = 1,588



Karst Geology & Groundwater Susceptibility

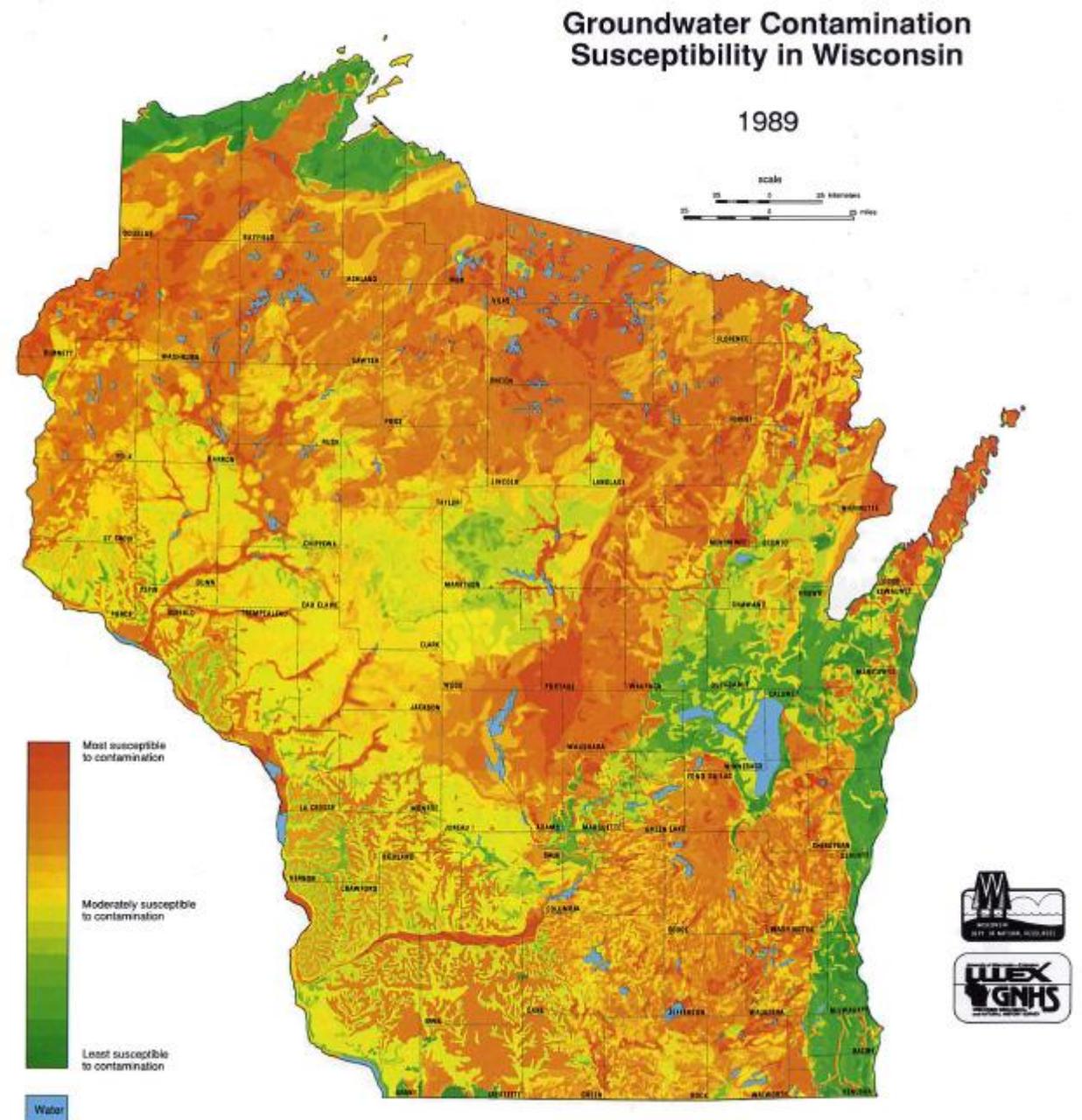
US Karst Map of the US



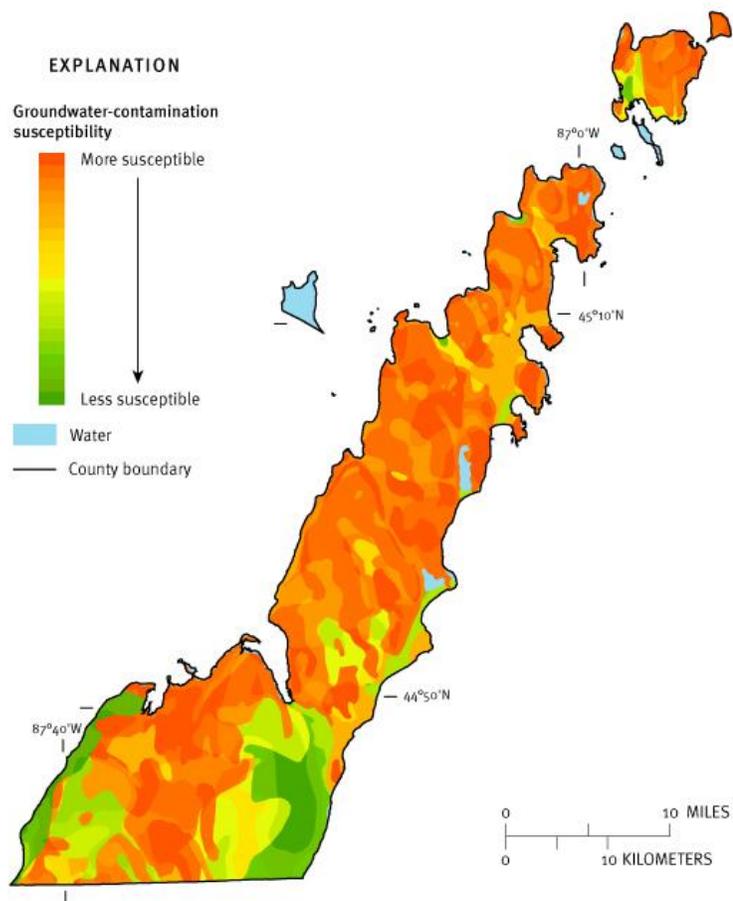


Susceptibility

- Based on factors such as:
 - Bedrock depth
 - Soil type
 - Depth to water table



Door County – Groundwater-Contamination Susceptibility Analysis

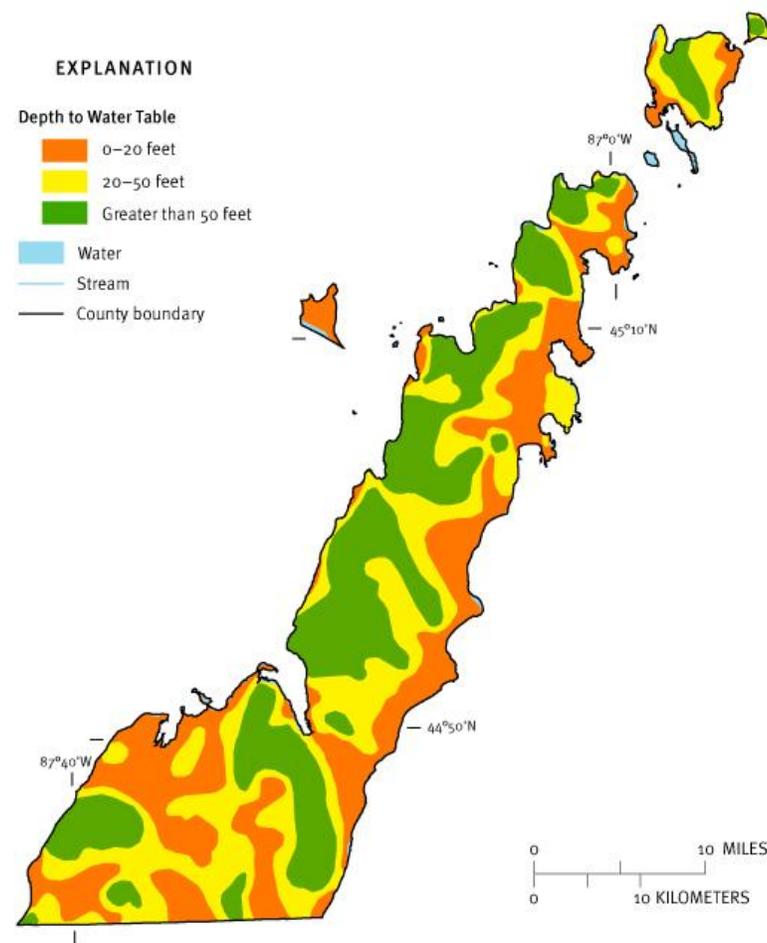


This groundwater-contamination susceptibility map is a composite of five resource characteristic maps, each of which was derived from generalized statewide information at small scales, and cannot be used for any site-specific purposes.

Map source: Schmidt, R.R., 1987, Groundwater contamination susceptibility map and evaluation: Wisconsin Department of Natural Resources, Wisconsin's Groundwater Management Plan Report 5, PUBL-WR-177-87, 27 p.

Figure created for the "Protecting Wisconsin's Groundwater Through Comprehensive Planning" web site, 2007, <http://wi.water.usgs.gov/gwcomp/>

Door County – Depth to Water Table



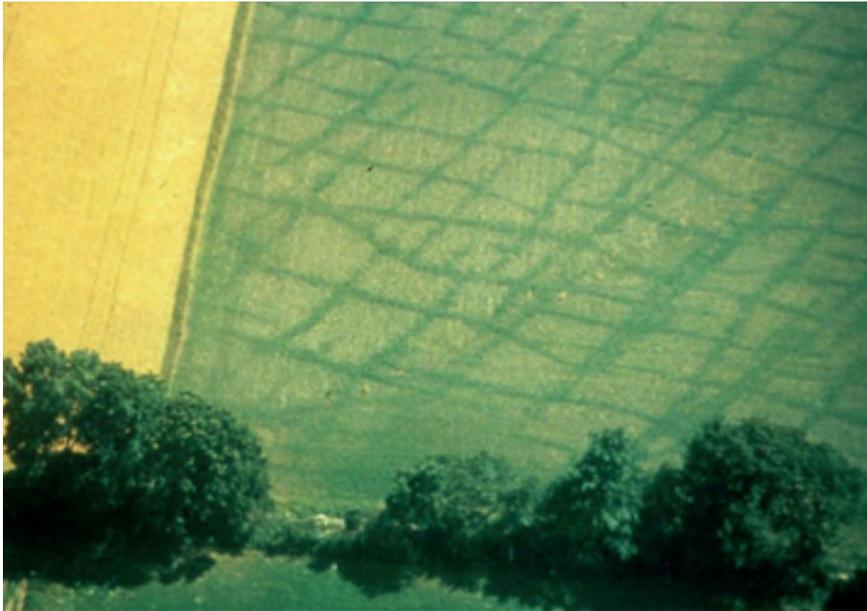
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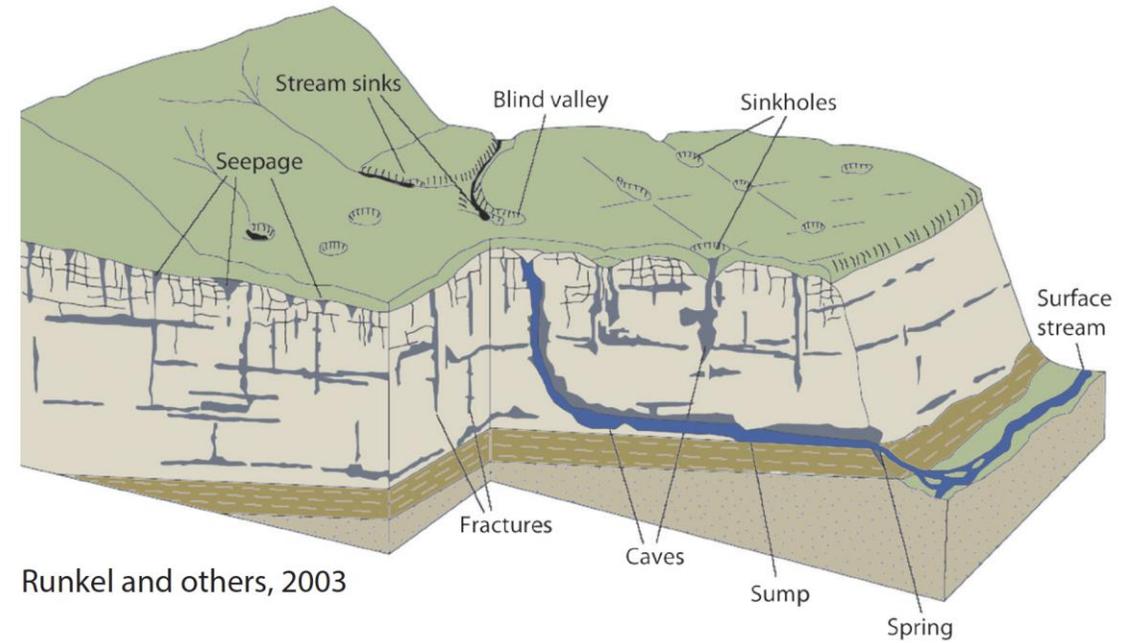
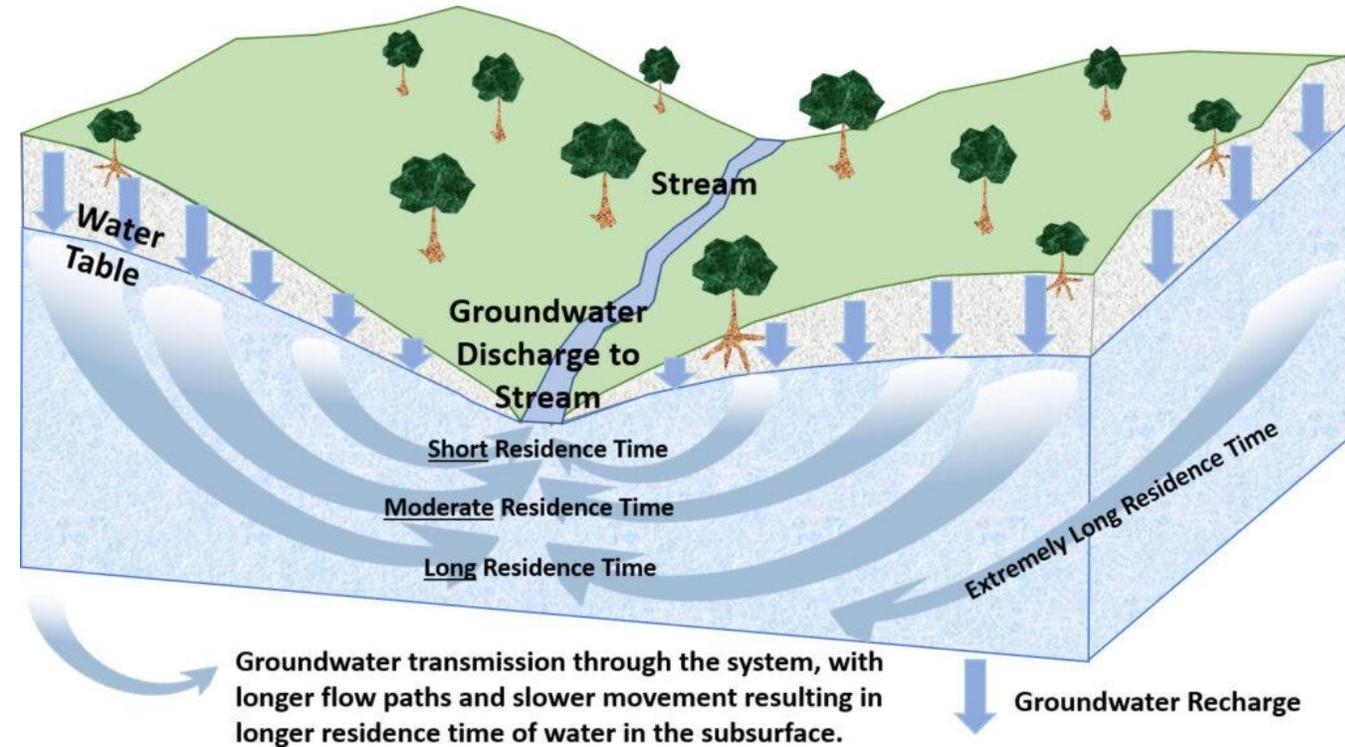
What is Karst Geology?

- A landscape created when water dissolves rocks
- Made of dolomite and limestone



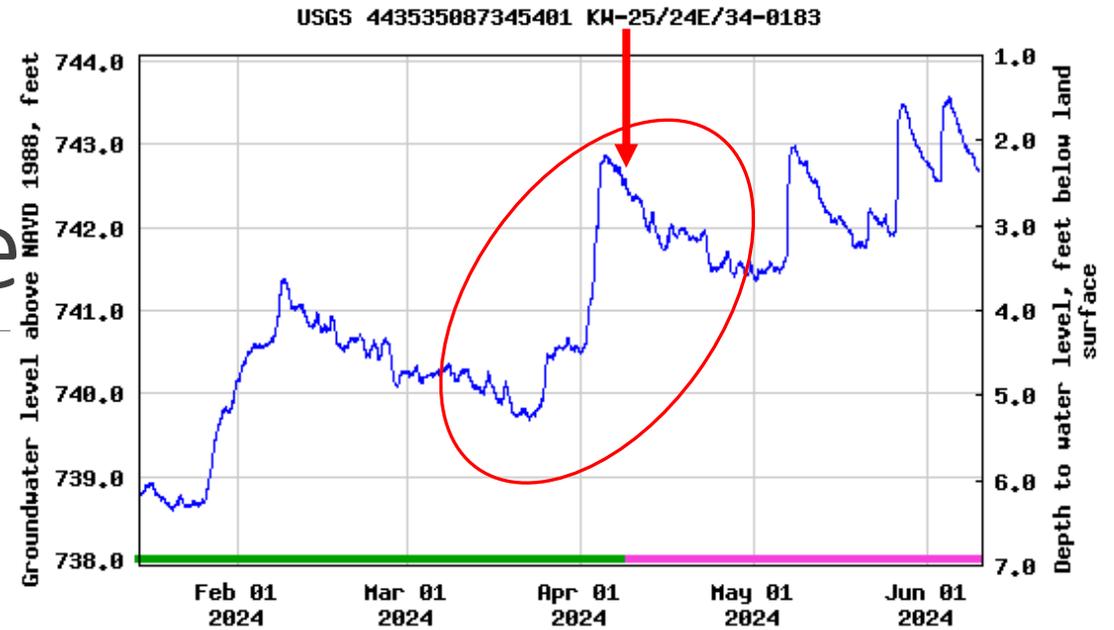


How fast does groundwater move?

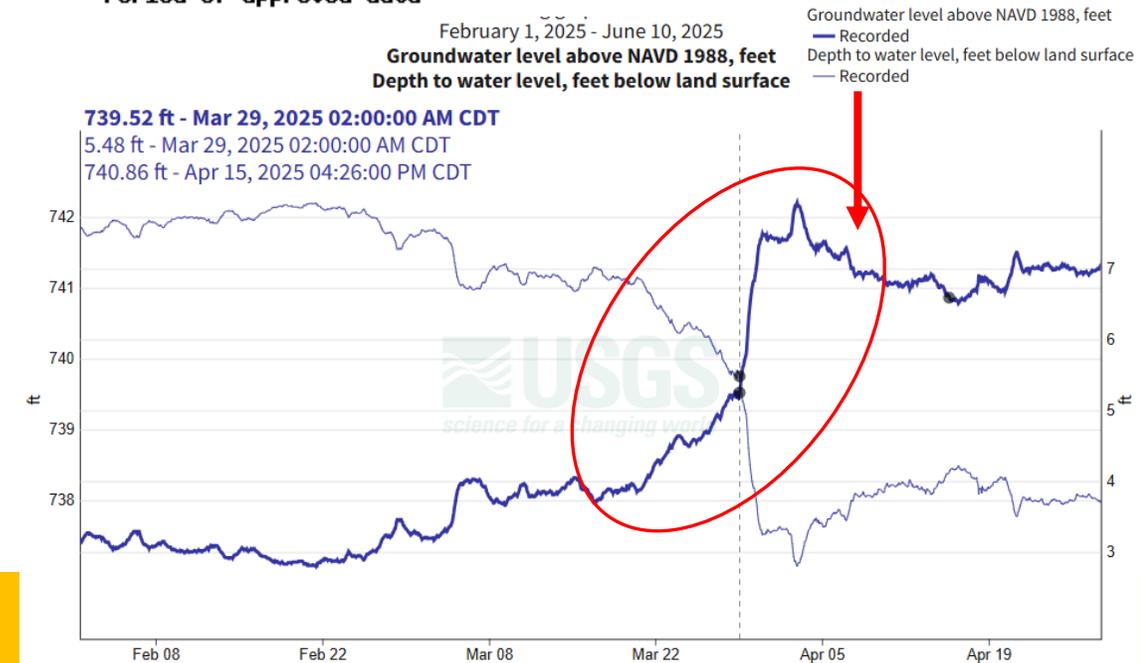


Groundwater Recharge

- Study design requires samples to be collected in a narrow window of time (within ~30 hours) – **but why?**
 - Reduce any variables in groundwater quality
 - Weather conditions
 - Groundwater conditions – dry period or recharge period
 - Greater effects with karst geology



— Groundwater level above navd 1988 — Period of provisional data
 — Period of approved data



Testing Parameters



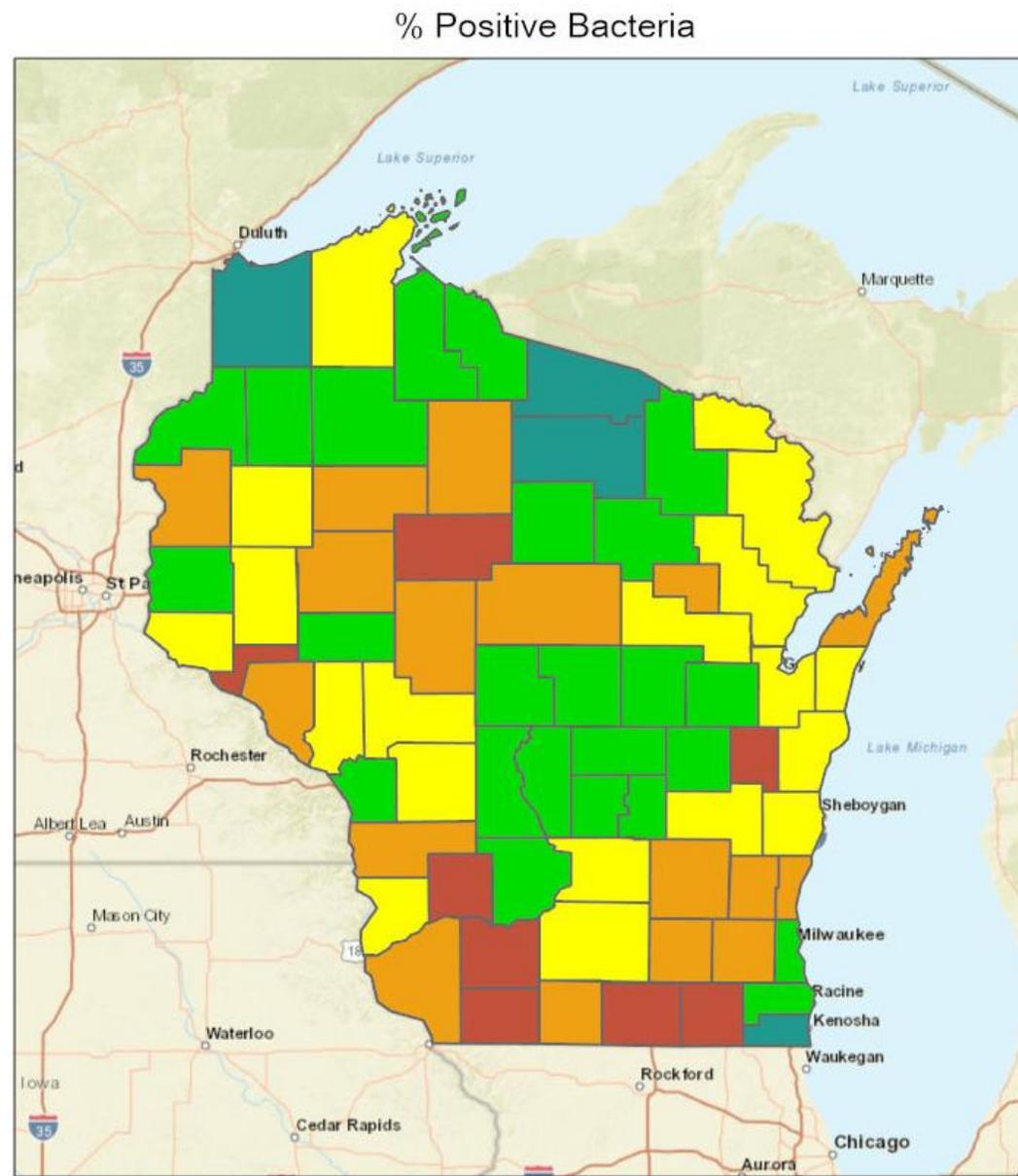
Bacteria

- Feces contain millions of microorganisms/gram
- Pathogens (disease-causing) usually found in low numbers
- Pathogens are more difficult than indicator organisms to recover and identify in the lab
- Pathogens can be bacteria (*E.coli*), viruses (Norovirus), or protozoans (*Cryptosporidium*)
- We look for fecal indicator organisms that “indicate” that a recent contamination has occurred (which suggests that pathogens also are likely present)



Bacteriological contamination in private wells throughout Wisconsin – percent positive by county

-Can be caused by several factors



November 26, 2019

Bacteria - Percent - Positive by County

5.1% - 10%

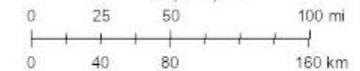
10.1% - 15%

15.1% - 20%

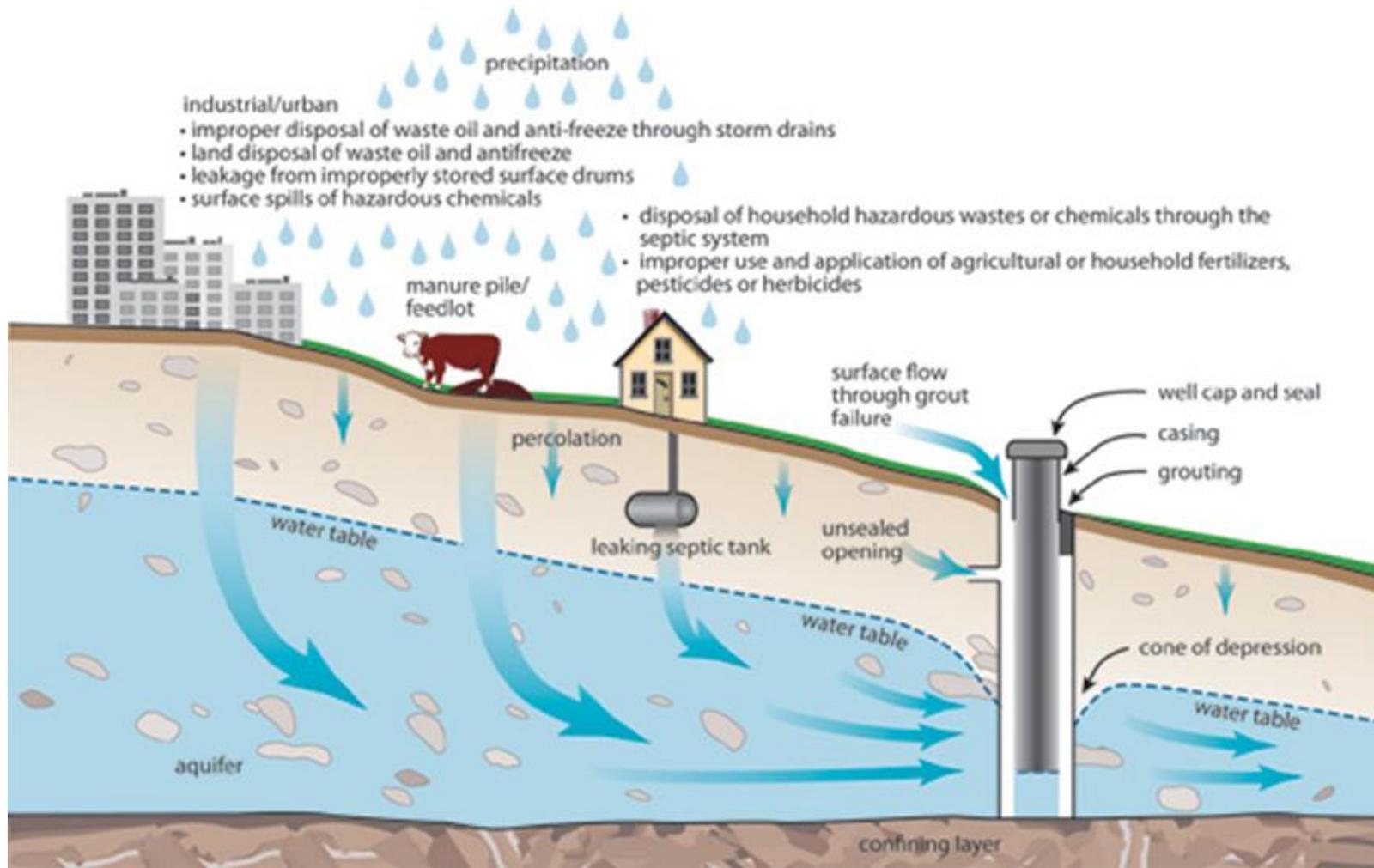
20.1% - 25%

25.1% ...

1:4,622,324



Sources: Esri, HERE, Garmin, USGS, Intermap, INCREMENT P, ...

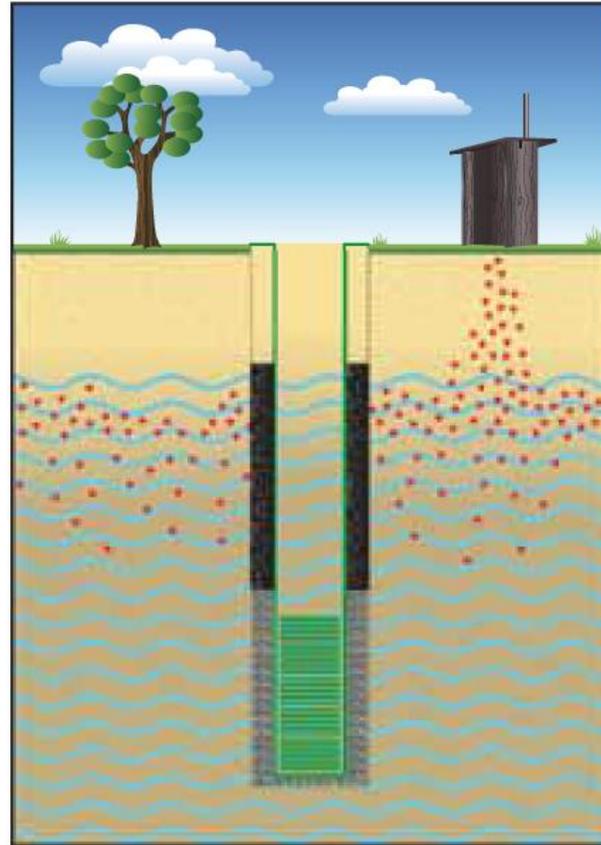


Sources of Bacteria

Sources of Bacteria

- Sources

- Improperly constructed well
- Older or damaged well
- Distribution system issue (cracked pipe, dead end, etc)
- Outside source of bacteria (agriculture, animal waste, human waste)

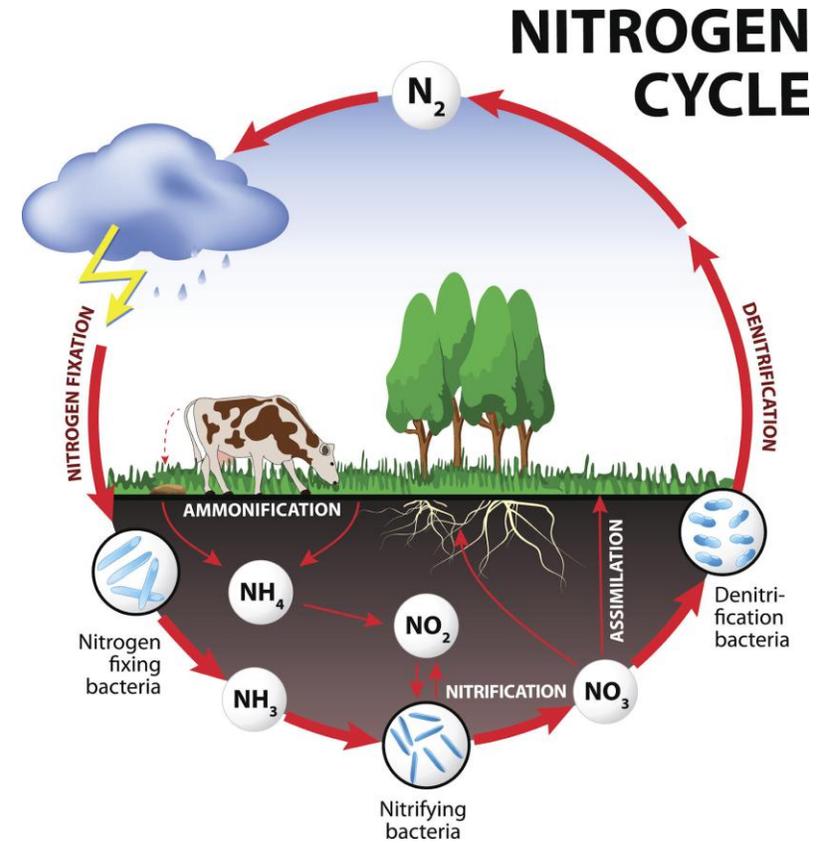


Sanitary Well



Nitrate

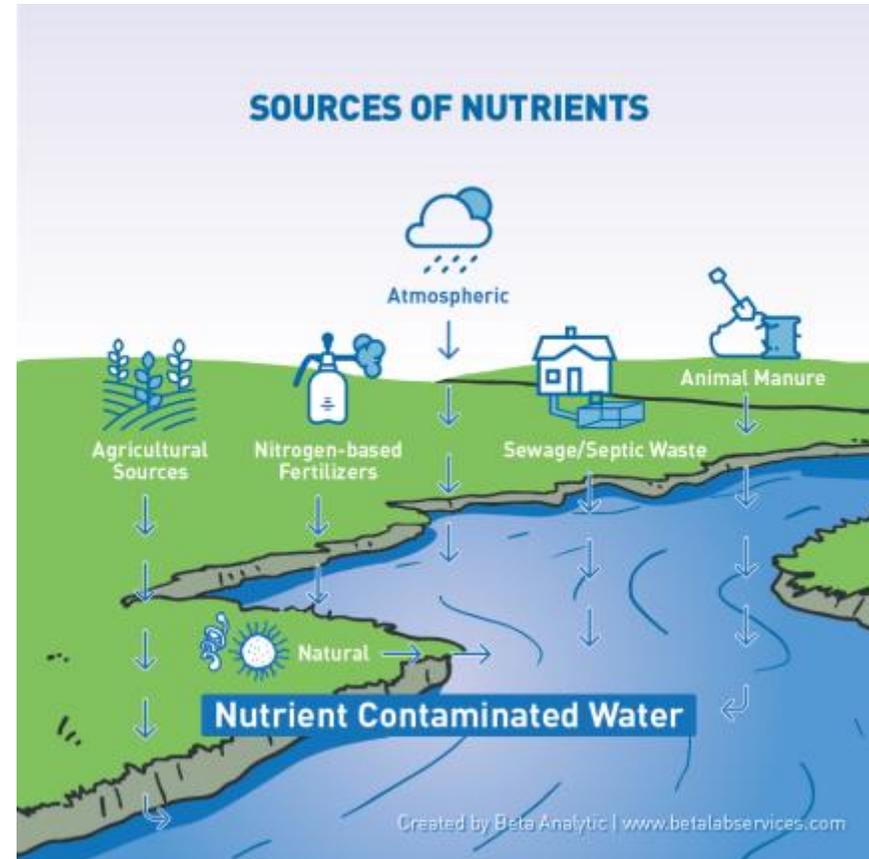
- Formed when nitrogen combines with oxygen in water
- Soluble – commonly found in runoff



Nitrate

- Sources

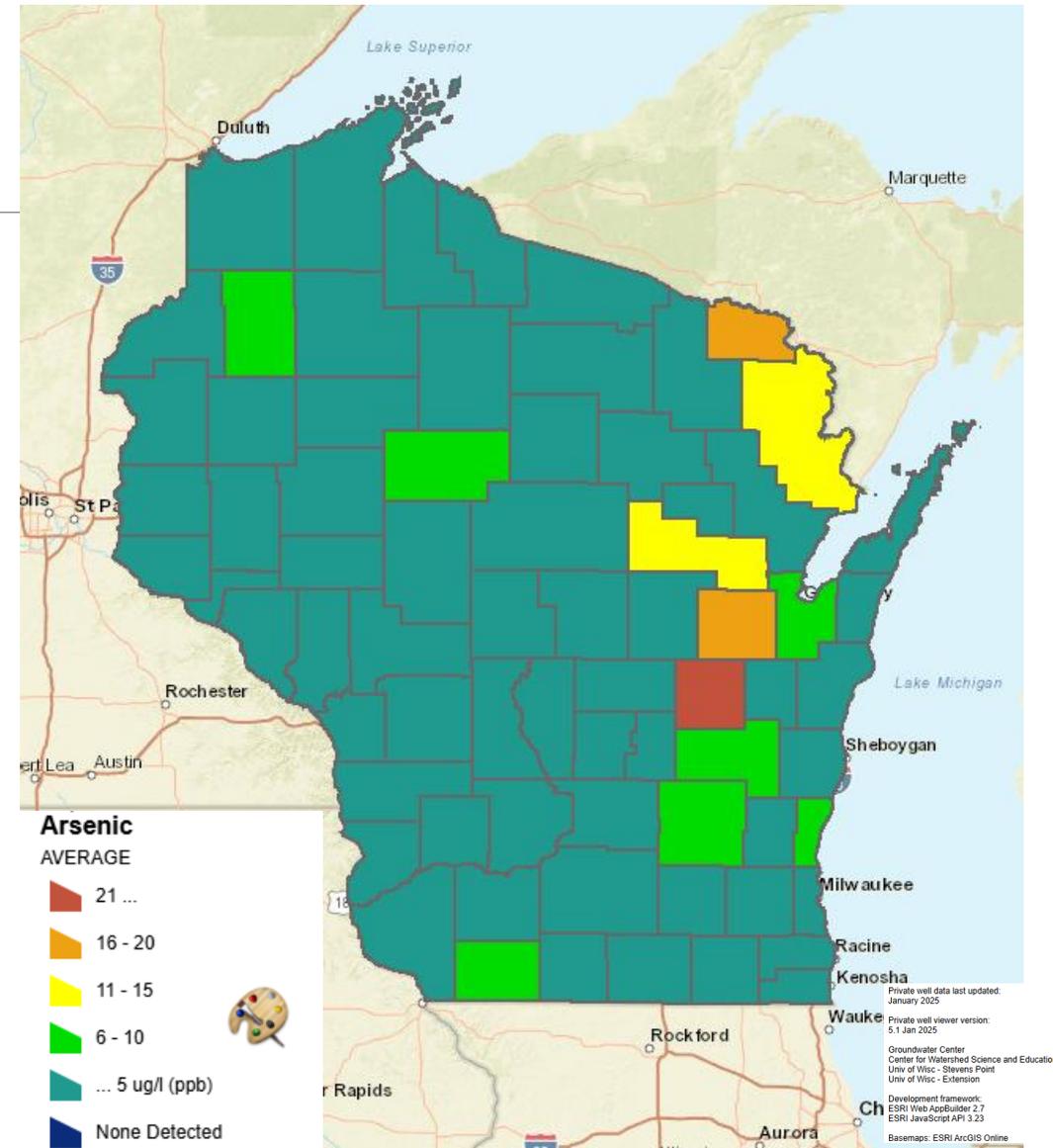
- Agriculture (manure and/or fertilizer)
- Sewage/Septic
- Animal waste
- Atmospheric (trace amounts)
- Lawn care (fertilizer)
- Very low naturally occurring nitrate



Arsenic

- Sources

- Most naturally occurring in bedrock
- Lead arsenate pesticides were used in orchards from 1890s-1960s (binds to soil, does not usually migrate into groundwater)



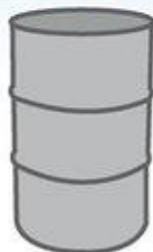
Interpreting Results



How much is one part per ...

million (ppm)

milligrams/liter (mg/L)



= three drops added to a
42-gallon barrel

billion (ppb)

micrograms/liter ($\mu\text{g/L}$)



length = 35 feet, diameter = 8 feet

= one drop added to
a large tanker truck

quadrillion (ppq)

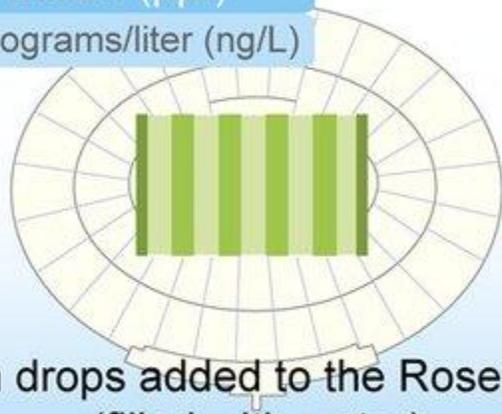
picograms/liter (pg/L)



*Area = 1000 sq mi
Average depth = 13 ft*

trillion (ppt)

nanograms/liter (ng/L)



= ten drops added to the Rose Bowl
(filled with water)

= two teaspoons added to the
Great Salt Lake of Utah

What's considered unsafe?

Parameter	Maximum Contaminant Level (MCL)	"Unsafe" Levels*
Total Coliform	0 MPN/100 mL	> 0 MPN/100 mL
<i>E. coli</i>	0 MPN/100 mL	> 0 MPN/100 mL
Nitrate	10 mg/L	> 10 mg/L
Arsenic	10 µg/L	> 10 µg/L
* "Unsafe" Levels refers to samples that exceed the MCL		

Safe Drinking Water Act (SDWA) sets these thresholds for public health.

Interpreting Results

BACTERIA

- Tested for presence of Coliform and *E. coli* bacteria
- A negative or “0” result: there is no bacteria present in the sample and it is safe to drink
- A positive or any number: bacteria is present in the sample, and it is unsafe to drink

NITRATE

- “ND”: nitrate was not detected in the sample; water is safe to drink
- Between 0-9.9 mg/L: nitrate was detected in the “safe” range
- Over 10 mg/L: nitrate was detected over the “safe” range, water is unsafe to drink

Interpreting Results

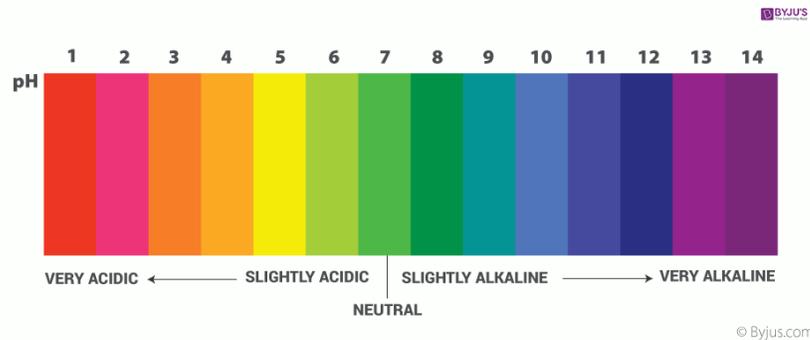
ARSENIC

- ND: arsenic was not detected in the sample
- Between 0-10 $\mu\text{g}/\text{L}$: arsenic was detected in the “safe” range
- Over 10 $\mu\text{g}/\text{L}$: arsenic was detected over the “safe” range

Interpreting Results

CUMULATIVE

pH: measure of the acid-base balance. Carbon dioxide concentration & increase in temperature can decrease pH of water.



Iron: a metal element that makes up 5% of the earth's crust. Iron is not considered hazardous to health. Recommended level is less than 0.3 mg/L

Hardness: water's ability to react with soap and produce a lather. Caused by ions such as calcium and magnesium. Not considered hazardous to health. Hard water can cause lime buildup/scaling on plumbing fixtures.

Water Hardness Scale		
Grains/Gal	mg/L & ppm	Classification
Less than 1	Less than 17.1	Soft
1 – 3.5	17.1 - 60	Slightly Hard
3.5 - 7	60 - 120	Moderately Hard
7 - 10	120 - 180	Hard
Over 10	Over 180	Very Hard

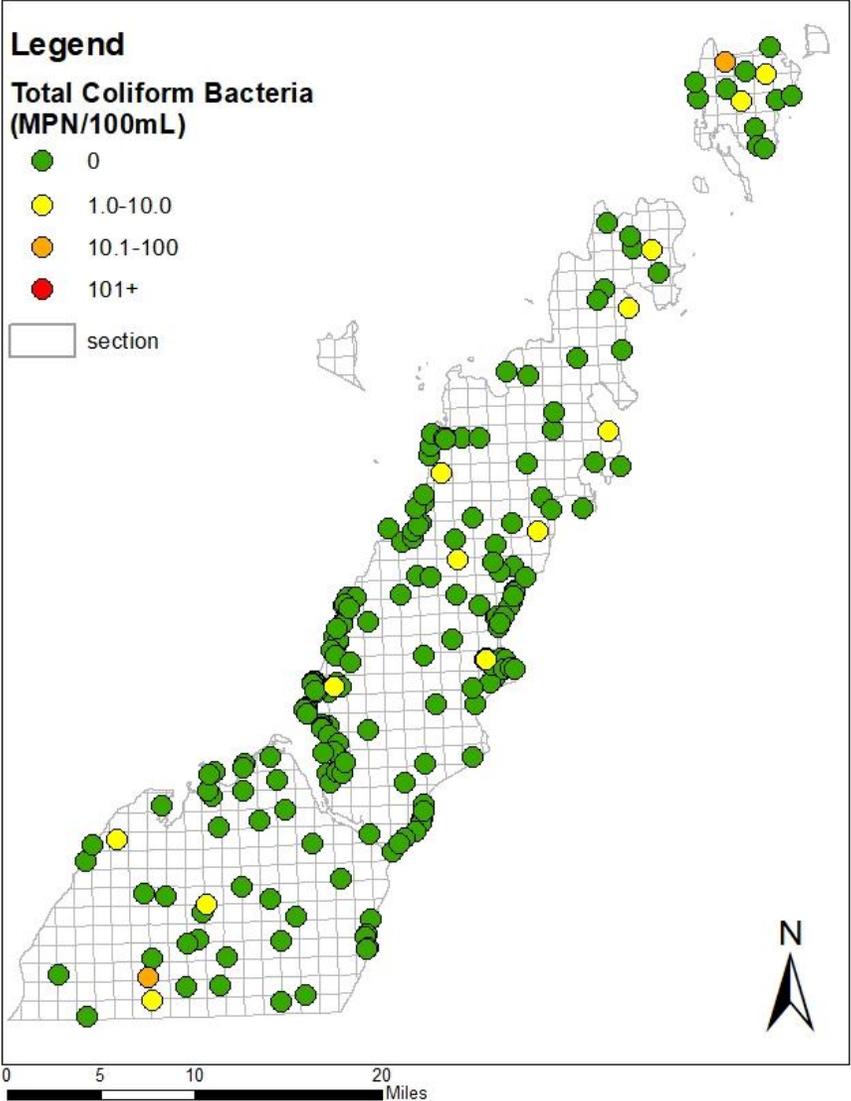
Alkalinity: water's ability to neutralize acids. Can be affected by natural deposits in the earth and industrial practices. It is not considered to be hazardous to health. Recommended level is between 75-200 mg/L

Spring 2025 Results



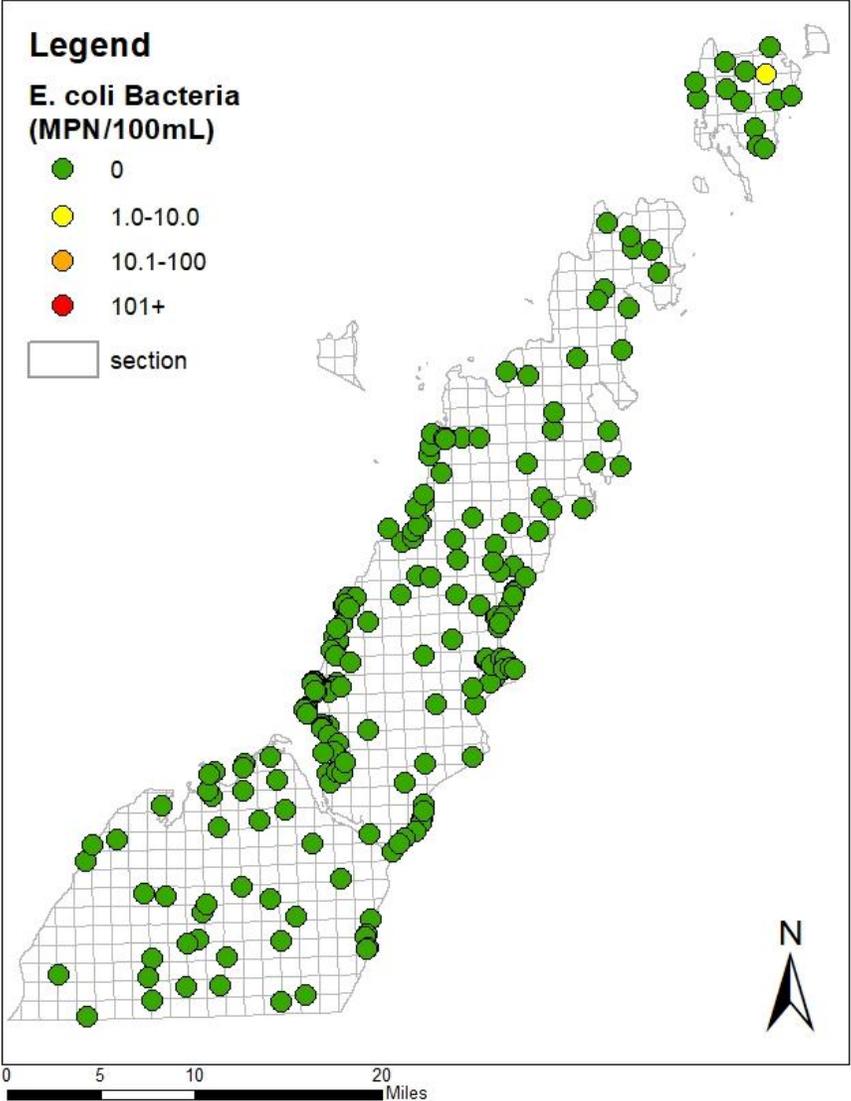
Coliform Bacteria

Spring 2025		
Coliform Result (MPN/100 mL)	# Samples	% Samples
0	199	93
1-10	13	6
10-100	2	1
100+	0	0
n=214		



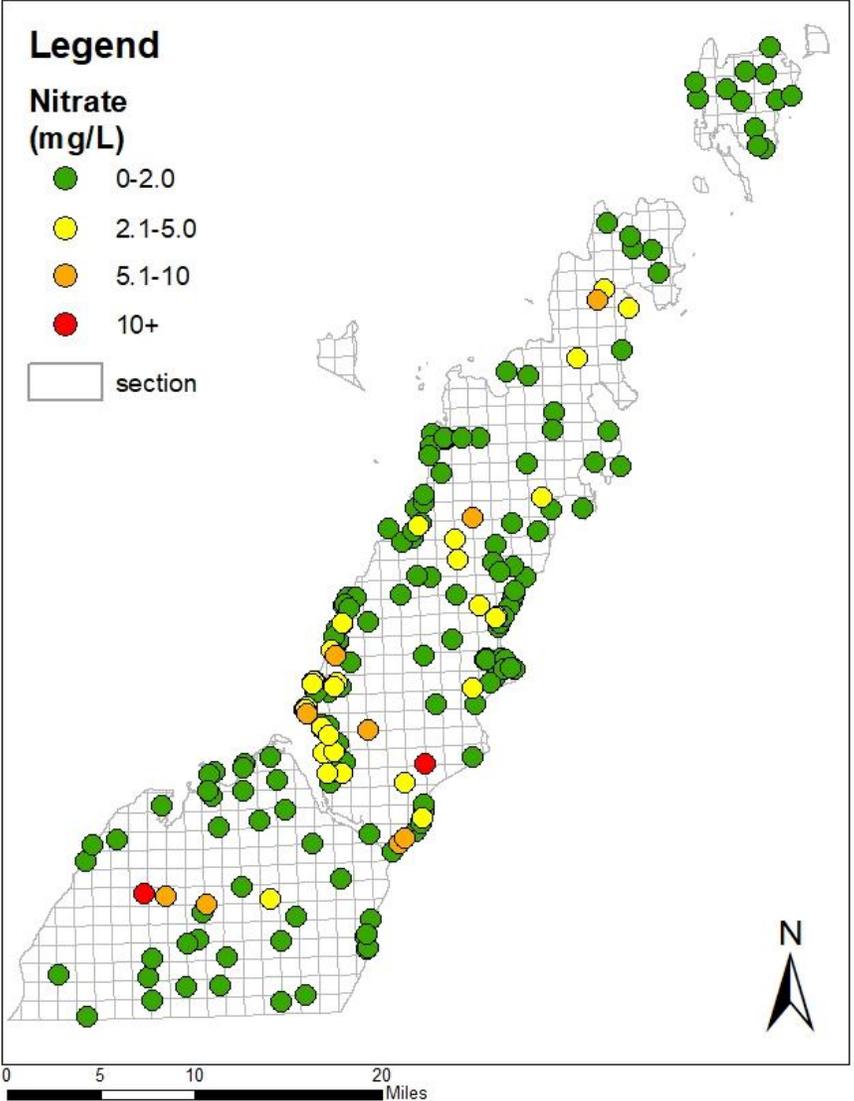
E. coli Bacteria

Spring 2025		
<i>E coli</i> Result (MPN/100 mL)	# Samples	% Samples
0	213	100
1-10	1	0
10-100	0	0
100+	0	0
n=214		



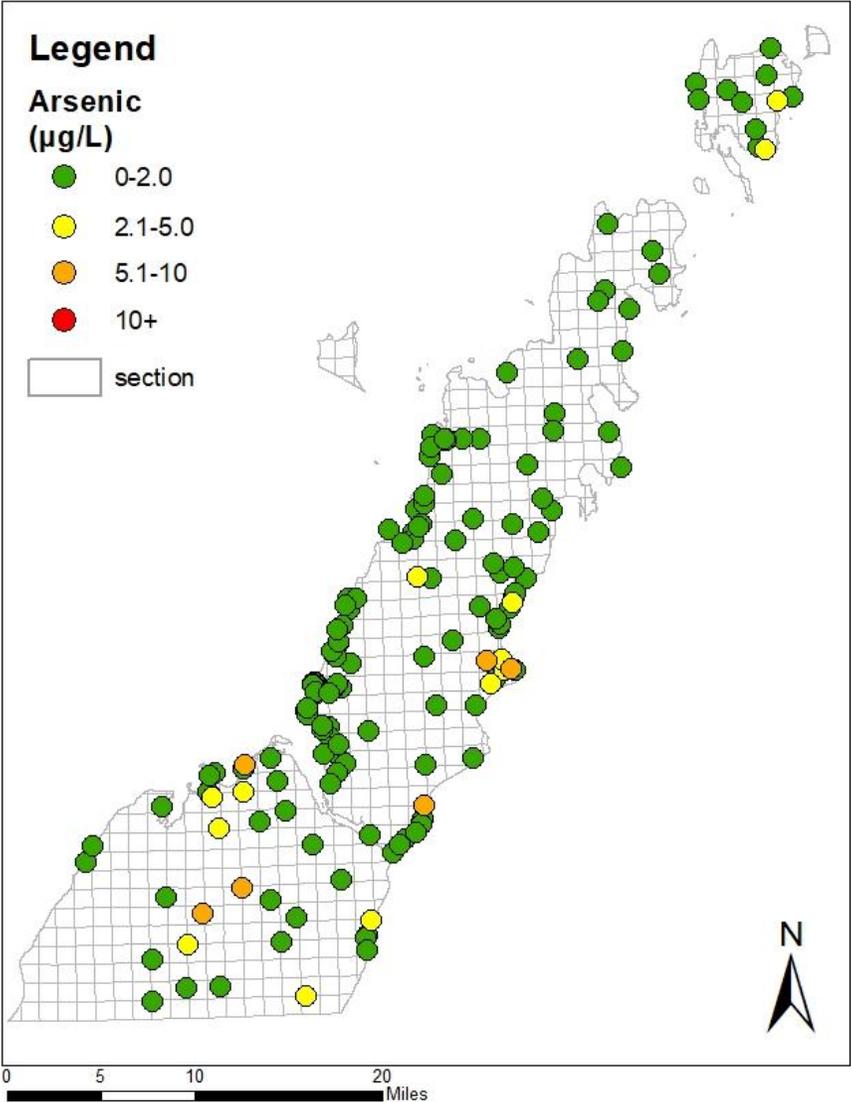
Nitrate

Spring 2025		
Nitrate Result (mg/L)	# Samples	% Samples
Less than 2	166	78
2-5	34	16
5-10	12	6
10+	2	1
n=214		



Arsenic

Spring 2025		
Arsenic Result (µg/L)	# Samples	% Samples
Less than 2	151	88
2-5	14	8
5-10	6	4
10+	0	0
n=171		



Previous Data - Coliform





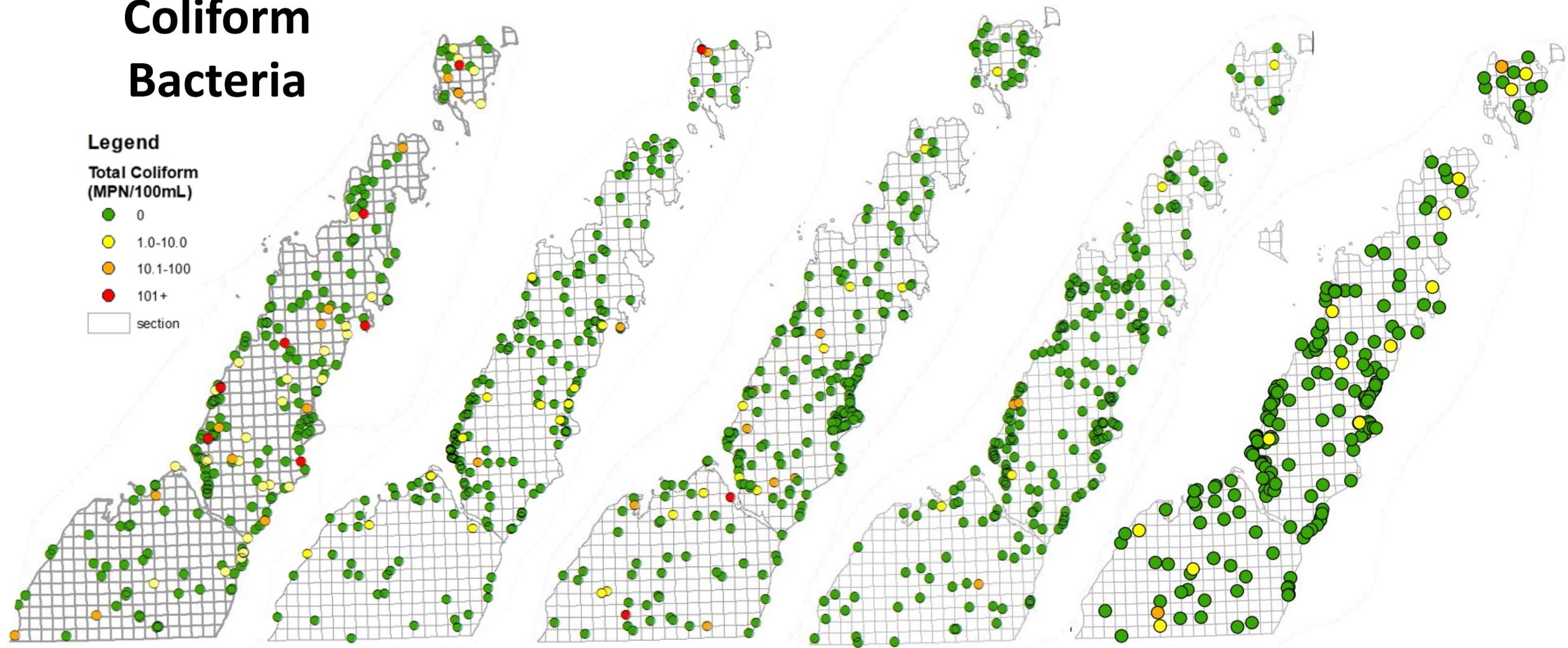
Spring 2021-2025 Coliform Bacteria

Legend

Total Coliform
(MPN/100mL)

- 0
- 1.0-10.0
- 10.1-100
- 101+

□ section



2021

2022

2023

2024

2025

Coliform Bacteria

2019			2020			2021			2022 (Spring + Fall)			2023 (Spring + Fall)		
Coliform Result (MPN/100 mL)	# Samples	% Samples	Coliform Result (MPN/100 mL)	# Samples	% Samples	Coliform Result (MPN/100 mL)	# Samples	% Samples	Coliform Result (MPN/100 mL)	# Samples	% Samples	Coliform Result (MPN/100 mL)	# Samples	% Samples
0	125	84	0	254	86	0	166	76	0	414	91	0	328	92
1-10	15	10	1-10	28	9	1-10	30	14	1-10	28	6	1-10	18	5
10-100	6	4	10-100	9	3	10-100	14	6	10-100	11	2	10-100	7	2
100+	2	1	100+	4	1	100+	7	3	100+	2	0.4	100+	4	1
n=148			n=295			n=217			n=456			n=357		

2024 (Spring + Fall)			Spring 2025		
Coliform Result (MPN/100 mL)	# Samples	% Samples	Coliform Result (MPN/100 mL)	# Samples	% Samples
0	377	93	0	199	93
1-10	22	5	1-10	13	6
10-100	6	1	10-100	2	1
100+	1	0	100+	0	0
n=406			n=214		

Potential sampling errors? (Sample faucets must be properly disinfected)

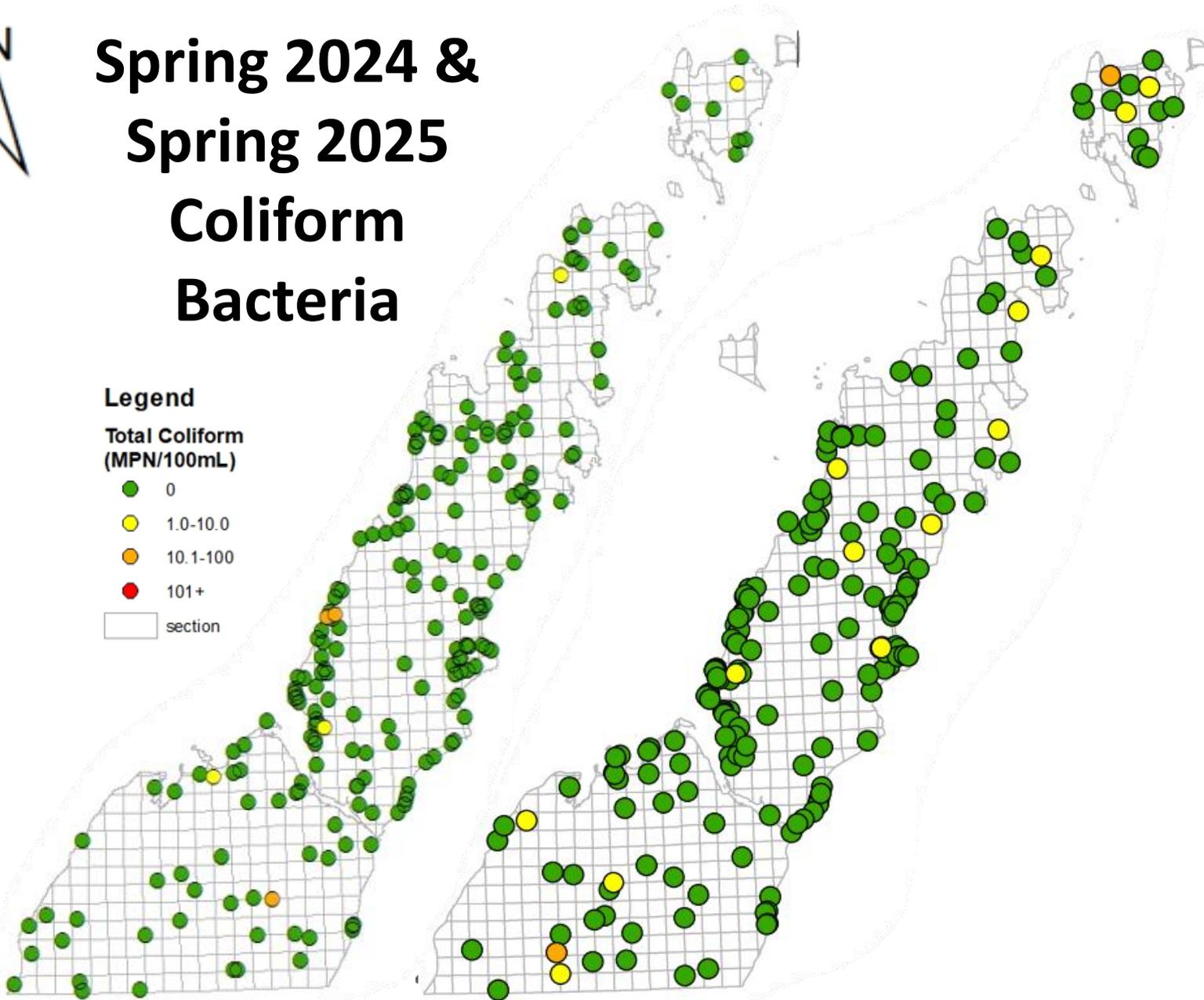


Spring 2024 & Spring 2025 Coliform Bacteria

Legend

Total Coliform
(MPN/100mL)

- 0
- 1.0-10.0
- 10.1-100
- 101+
- section



Spring 2024		
Coliform Result (MPN/100 mL)	# Samples	% Samples
0	216	96
1-10	5	2
10-100	3	1
100+	0	0
n=224		

Spring 2025		
Coliform Result (MPN/100 mL)	# Samples	% Samples
0	199	93
1-10	13	6
10-100	2	1
100+	0	0
n=214		

Spring 2024

Spring 2025

Previous Data – *E. coli*



Spring
2021-2025

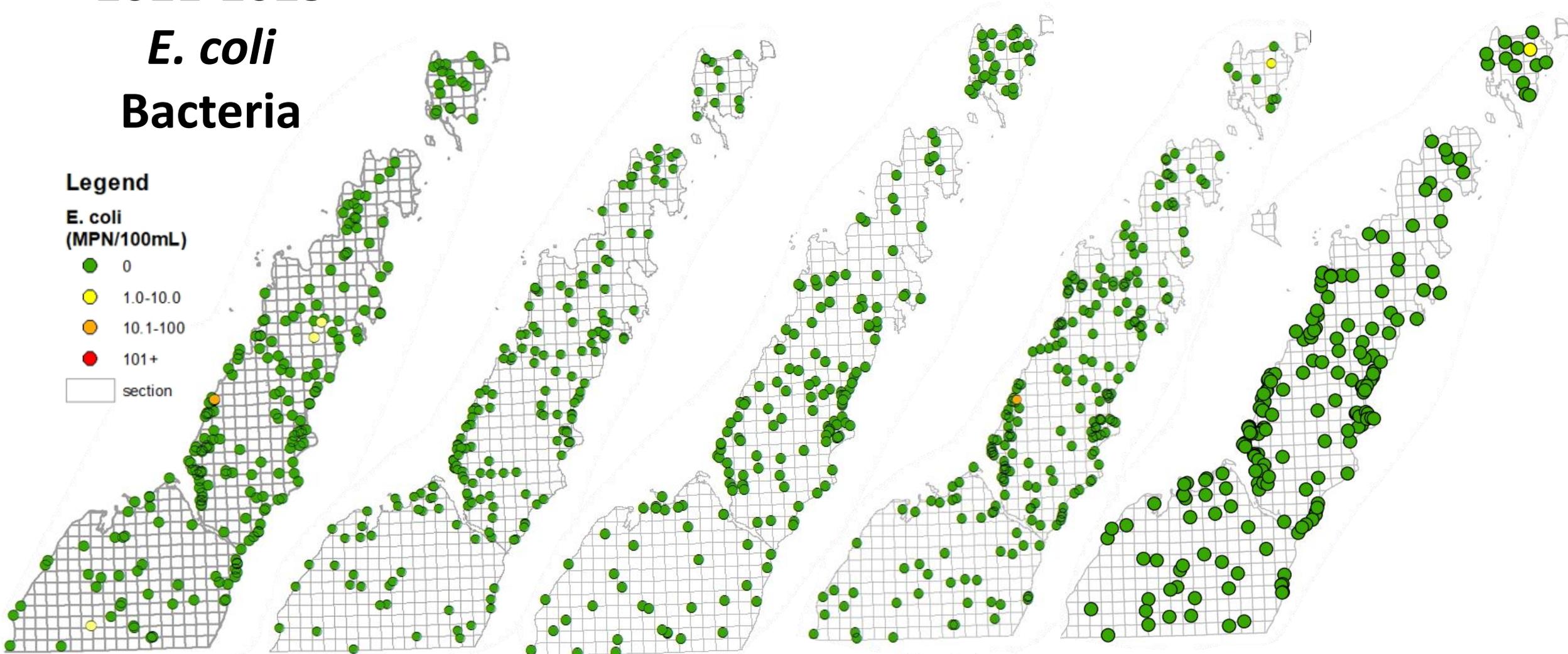
E. coli
Bacteria

Legend

E. coli
(MPN/100mL)

- 0
- 1.0-10.0
- 10.1-100
- 101+

□ section



2021

2022

2023

2024

2025

E. coli Bacteria

2019			2020			2021			2022 (Spring + Fall)			2023 (Spring + Fall)		
<i>E coli</i> Result (MPN/100 mL)	# Samples	% Samples	<i>E coli</i> Result (MPN/100 mL)	# Samples	% Samples	<i>E coli</i> Result (MPN/100 mL)	# Samples	% Samples	<i>E coli</i> Result (MPN/100 mL)	# Samples	% Samples	<i>E coli</i> Result (MPN/100 mL)	# Samples	% Samples
0	148	100	0	293	99	0	213	98	0	454	100	0	354	99
1-10	0	0	1-10	2	1	1-10	3	1	1-10	2	0.4	1-10	2	1
10-100	0	0	10-100	0	0	10-100	1	<1	10-100	0	0	10-100	1	<1
100+	0	0	100+	0	0	100+	0	0	100+	0	0	100+	0	0
n=148			n=295			n=217			n=456			n=357		

2024 (Spring + Fall)			Spring 2025		
<i>E coli</i> Result (MPN/100 mL)	# Samples	% Samples	<i>E coli</i> Result (MPN/100 mL)	# Samples	% Samples
0	404	100	0	213	100
1-10	1	0	1-10	1	0
10-100	1	0	10-100	0	0
100+	0	0	100+	0	0
n=406			n=214		



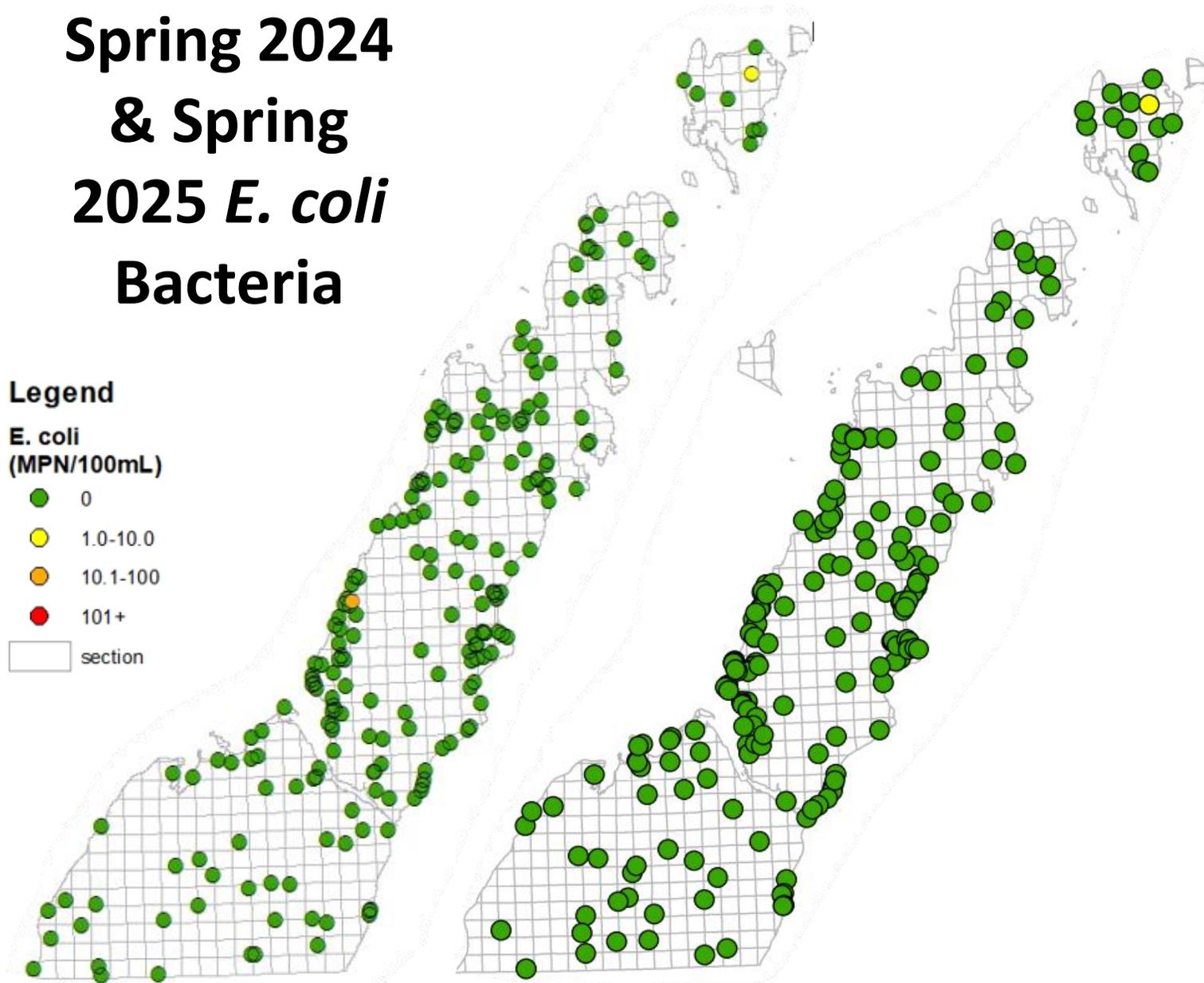
Spring 2024 & Spring 2025 *E. coli* Bacteria

Legend

E. coli
(MPN/100mL)

- 0
- 1.0-10.0
- 10.1-100
- 101+

section



Spring 2024		
<i>E. coli</i> Result (MPN/100 mL)	# Samples	% Samples
0	222	99
1-10	1	0
10-100	1	0
100+	0	0
n=224		

Spring 2025		
<i>E. coli</i> Result (MPN/100 mL)	# Samples	% Samples
0	213	100
1-10	1	0
10-100	0	0
100+	0	0
n=214		

Spring 2024

Spring 2025

Previous Data – Nitrate



Spring 2021-2025

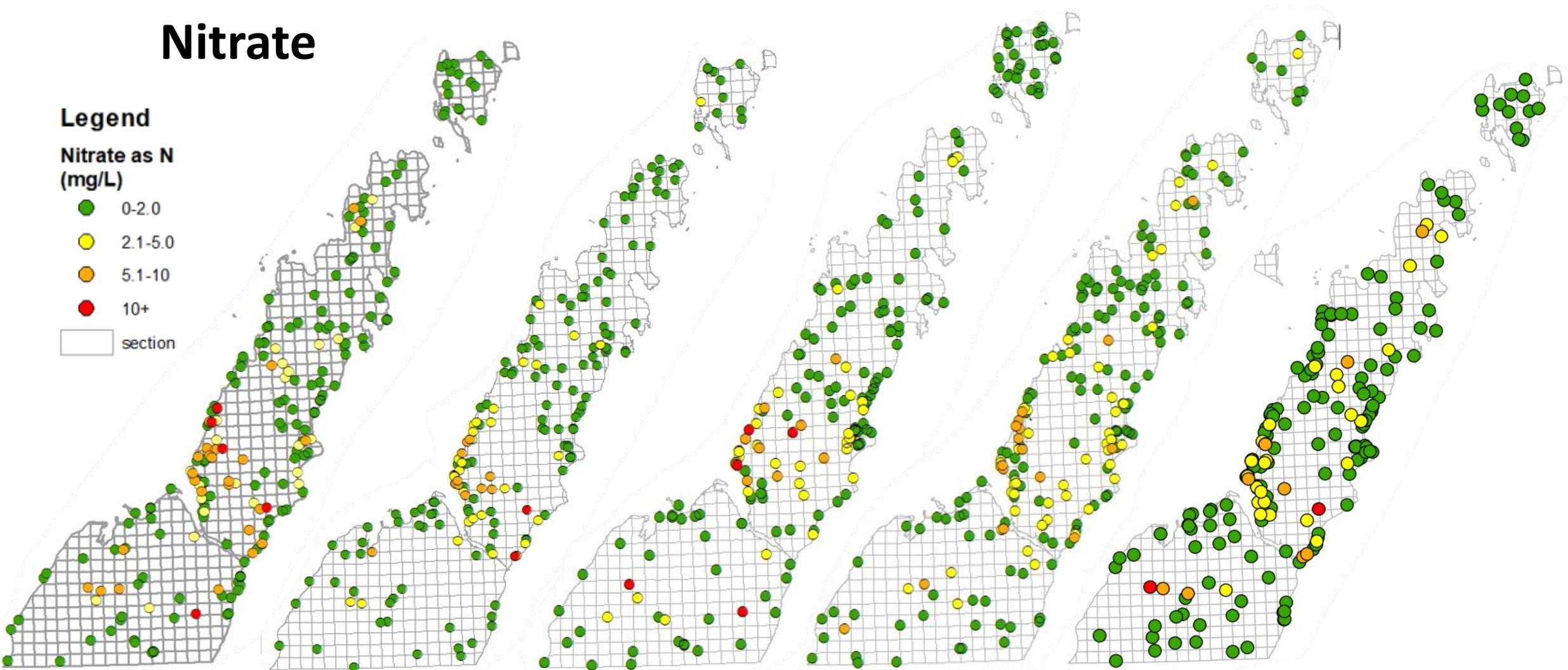
Nitrate

Legend

Nitrate as N
(mg/L)

- 0-2.0
- 2.1-5.0
- 5.1-10
- 10+

section



2021

2022

2023

2024

2025

Nitrate

2019			2020			2021			2022 (Spring + Fall)			2023 (Spring + Fall)		
Nitrate Result (mg/L)	# Samples	% Samples	Nitrate Result (mg/L)	# Samples	% Samples	Nitrate Result (mg/L)	# Samples	% Samples	Nitrate Result (mg/L)	# Samples	% Samples	Nitrate Result (mg/L)	# Samples	% Samples
Less than 2	104	71	Less than 2	206	72	Less than 2	157	75	Less than 2	347	77	Less than 2	261	75
2-5	23	16	2-5	46	16	2-5	23	11	2-5	76	17	2-5	58	17
5-10	16	11	5-10	34	12	5-10	25	12	5-10	25	6	5-10	23	7
10+	3	2	10+	2	1	10+	5	2	10+	2	<1	10+	8	2
n=146			n=288			n=210			n=450			n=350		

2024 (Spring + Fall)			Spring 2025		
Nitrate Result (mg/L)	# Samples	% Samples	Nitrate Result (mg/L)	# Samples	% Samples
Less than 2	287	72	Less than 2	166	78
2-5	82	21	2-5	34	16
5-10	29	7	5-10	12	6
10+	1	0	10+	2	1
n=399			n=214		

Concentrations of nitrate greater than 3 mg/l generally indicate contamination.



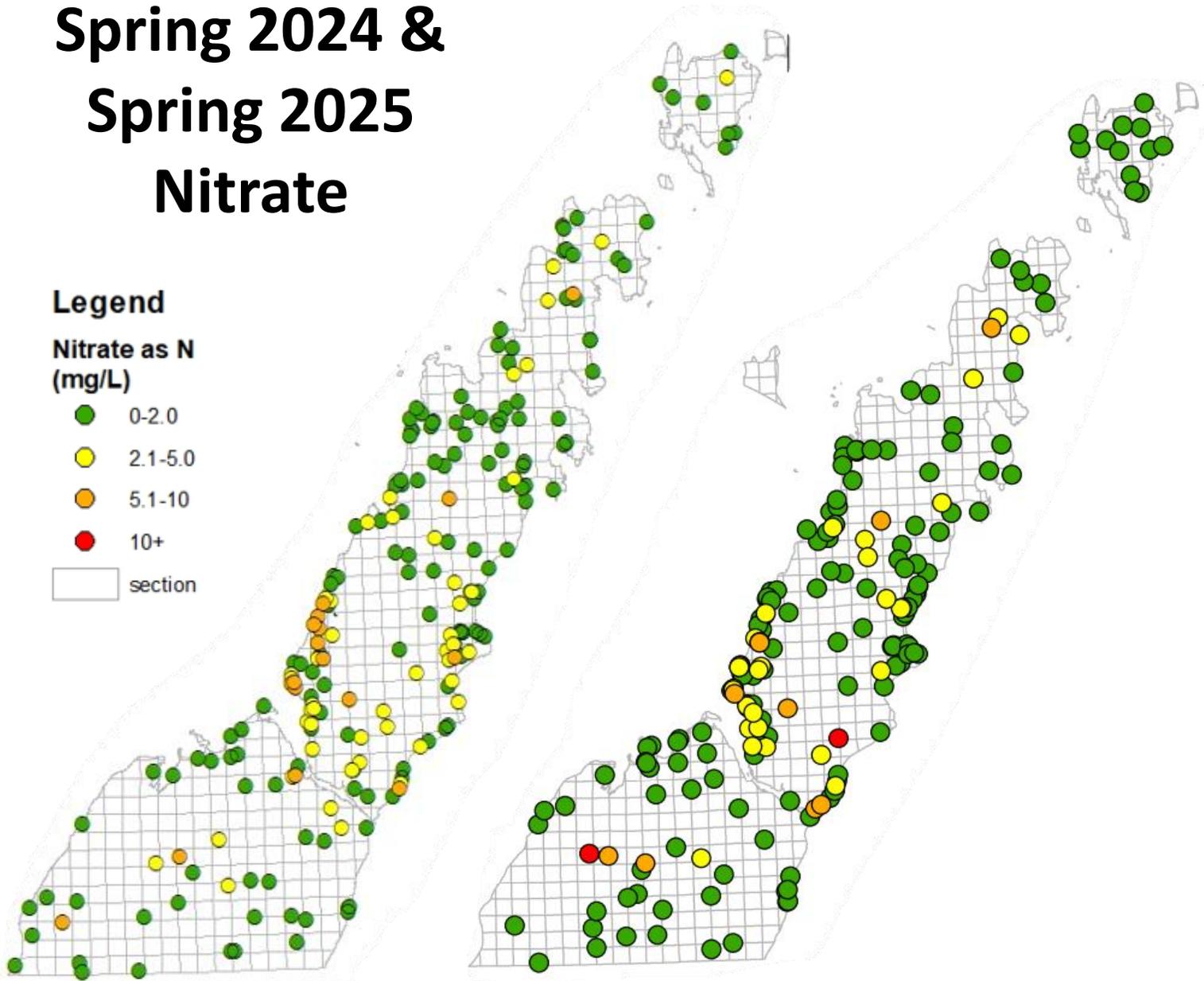
Spring 2024 & Spring 2025 Nitrate

Legend

Nitrate as N
(mg/L)

- 0-2.0
- 2.1-5.0
- 5.1-10
- 10+

□ section



Spring 2024

Spring 2025

Spring 2024		
Nitrate Result (mg/L)	# Samples	% Samples
Less than 2	151	69
2-5	51	23
5-10	17	8
10+	0	0
n=219		

Spring 2025		
Nitrate Result (mg/L)	# Samples	% Samples
Less than 2	166	78
2-5	34	16
5-10	12	6
10+	2	1
n=214		

Previous Data – Arsenic



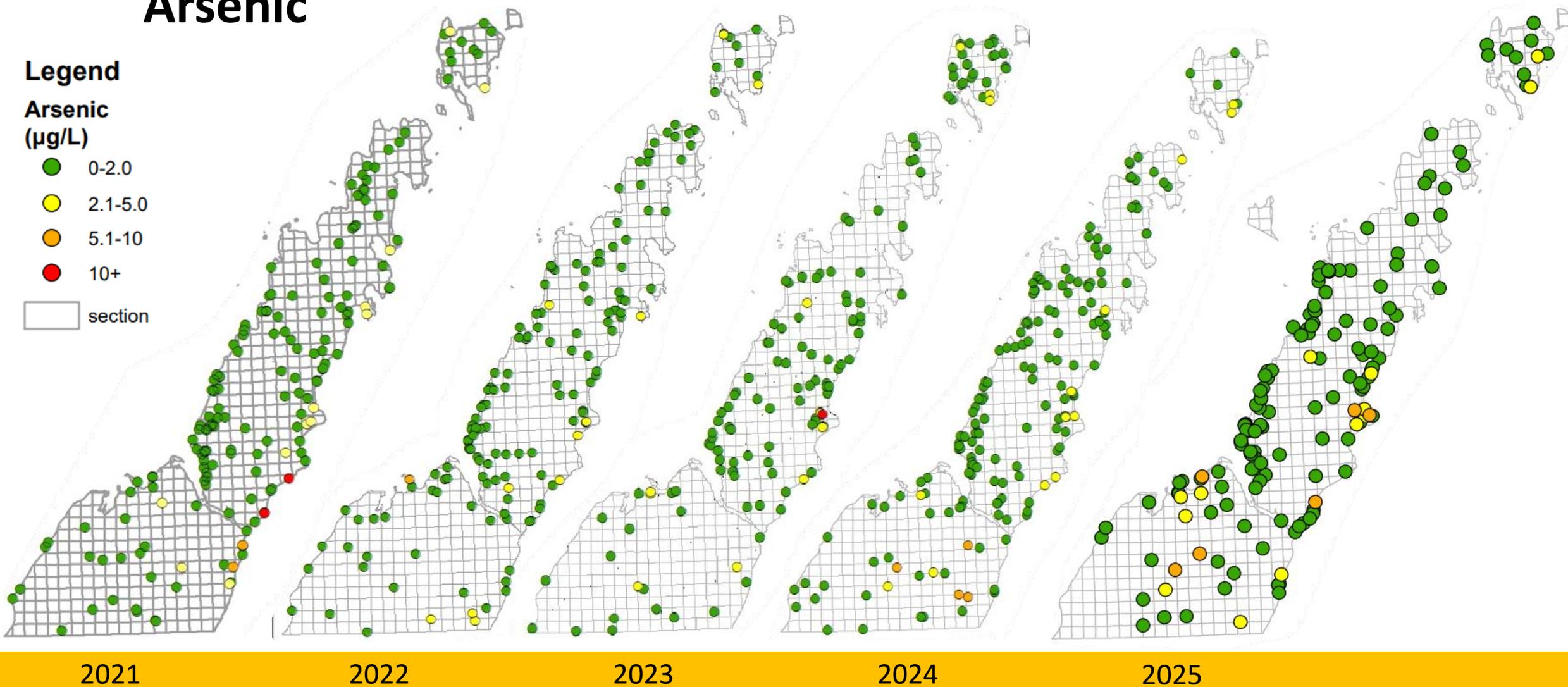
Spring 2021-2025 Arsenic

Legend

Arsenic
($\mu\text{g/L}$)

- 0-2.0
- 2.1-5.0
- 5.1-10
- 10+

□ section



Arsenic

2019			2020			2021			2022 (Spring + Fall)			2023 (Spring + Fall)		
Arsenic Result (µg/L)	# Samples	% Samples	Arsenic Result (µg/L)	# Samples	% Samples	Arsenic Result (µg/L)	# Samples	% Samples	Arsenic Result (µg/L)	# Samples	% Samples	Arsenic Result (µg/L)	# Samples	% Samples
Less than 2	70	99	Less than 2	214	90	Less than 2	149	89	Less than 2	328	90	Less than 2	235	90
2-5	1	1	2-5	15	6	2-5	15	9	2-5	33	9	2-5	20	8
5-10	0	0	5-10	7	3	5-10	2	1	5-10	4	1	5-10	5	2
10+	0	0	10+	1	<1	10+	2	1	10+	1	0.3	10+	1	0
n=71			n=237			n=168			n=366			n=261		

2024 (Spring + Fall)			Spring 2025		
Arsenic Result (µg/L)	# Samples	% Samples	Arsenic Result (µg/L)	# Samples	% Samples
Less than 2	282	90	Less than 2	151	88
2-5	27	9	2-5	14	8
5-10	5	2	5-10	6	4
10+	0	0	10+	0	0
n=314			n=171		

Generally low arsenic concentrations from sampling events.



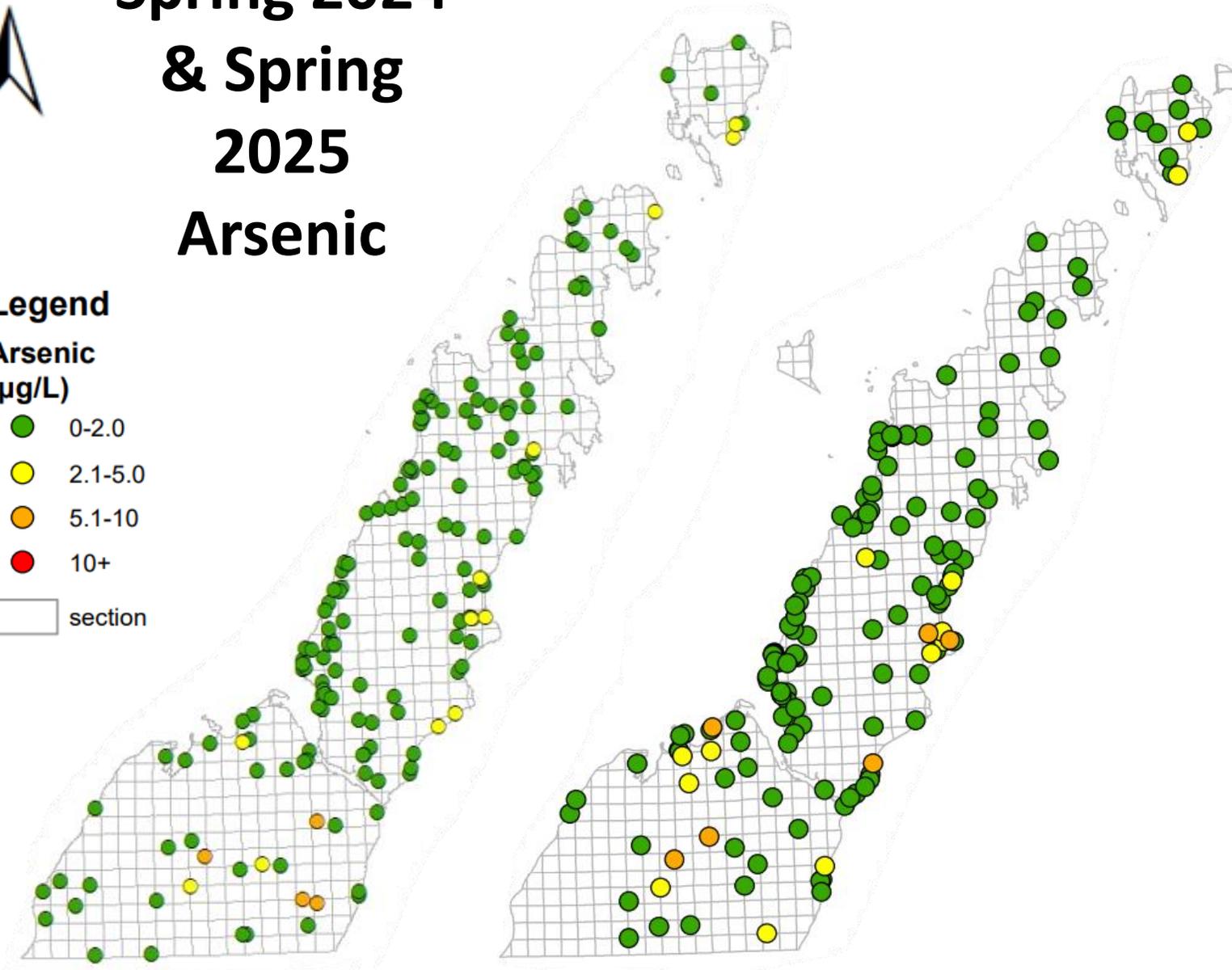
Spring 2024 & Spring 2025 Arsenic

Legend

Arsenic ($\mu\text{g/L}$)

- 0-2.0
- 2.1-5.0
- 5.1-10
- 10+

□ section



Spring 2024		
Arsenic Result ($\mu\text{g/L}$)	# Samples	% Samples
Less than 2	156	91
2-5	12	7
5-10	4	2
10+	0	0
n=172		

Spring 2025		
Arsenic Result ($\mu\text{g/L}$)	# Samples	% Samples
Less than 2	151	88
2-5	14	8
5-10	6	4
10+	0	0
n=171		

Spring 2024

Spring 2025

County-Wide Sampling Efforts

Percentage Exceeding Safe Water Quality Standards

Water Quality Standard	Spring 2025 Door County Results	Fall 2024 Door County Results	Spring 2024 Door County Results	Fall 2023 Door County Results	Spring 2023 Door County Results	Fall 2022 Door County Results	Spring 2022 Door County Results	Fall 2021 Door County Results	Fall 2020 Door County Results	Fall 2019 Door County Results	Door County Results* (Average)	Wisconsin**
Total Coliform (> 0 MPN/100 ml)	7%	12%	4%	12%	5%	8%	10%	24%	14%	16%	18%	17%
<i>E. coli</i> (> 0 MPN/100 ml)	<1%	0%	1%	2%	0%	0%	1%	2%	1%	0%	6%	5%
Nitrate (> 10 mg/L)	<1%	1%	0%	3%	3%	1%	0%	2%	1%	2%	2%	8%
Arsenic (> 10 µg/L)	0%	0%	0%	0%	<1%	0%	<1%	1%	<1%	0%	3%	5%

*Data derived from UWSP Well Viewer, UWO 2015 (480 samples) & 2016 (392 samples) community program, 2011-2015 UWEx Private Well Program (582 samples)

**Data derived from the Wisconsin Groundwater Coordinating Council Report & UWSP Well Viewer

County-Wide Nitrate

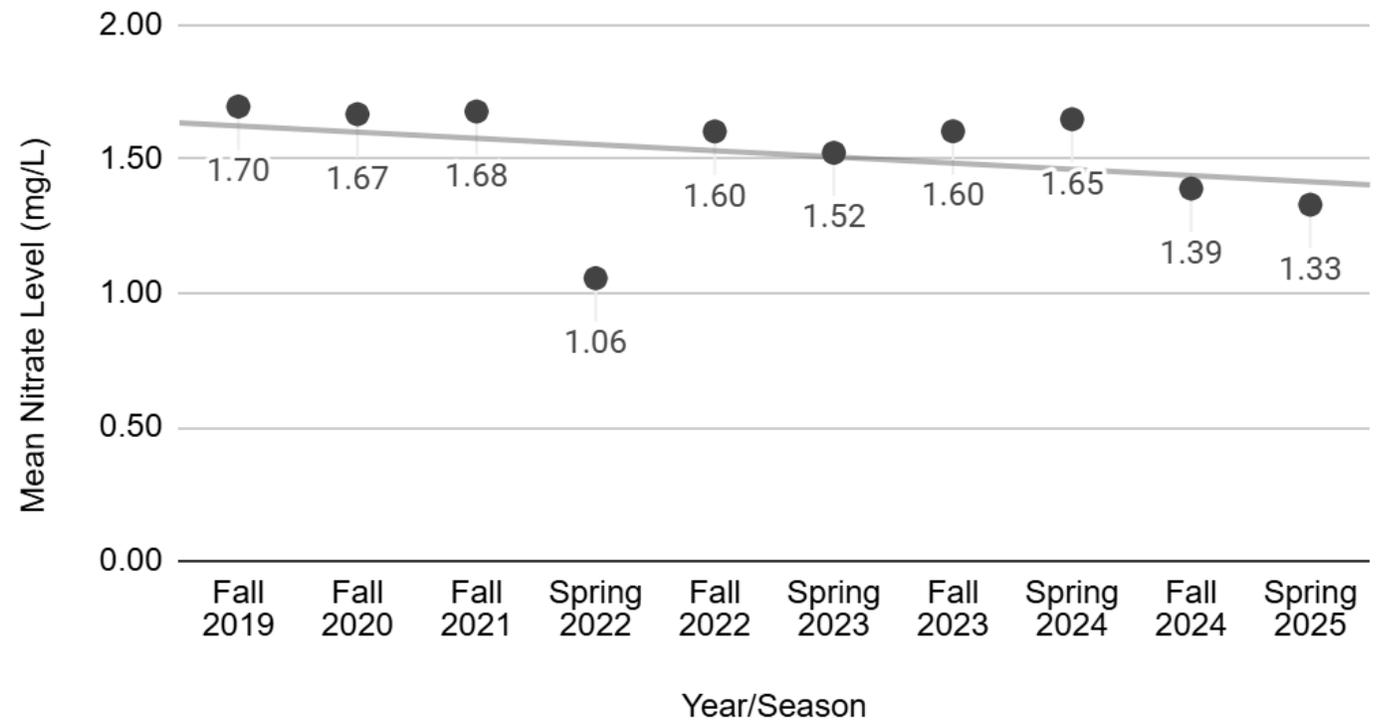


County-Wide Mean Nitrate Levels

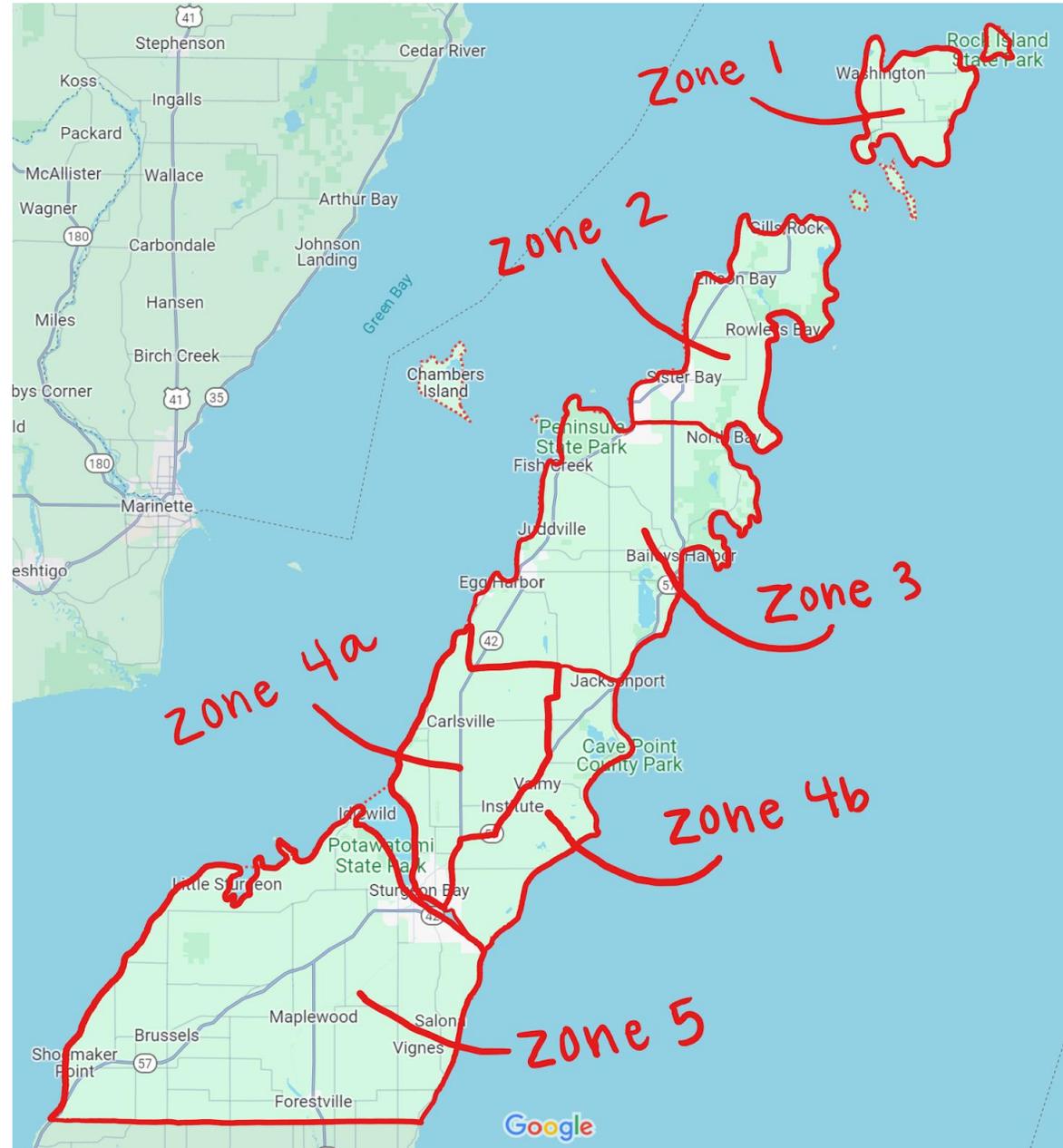
County-Wide Mean Nitrate Levels		
Sampling Season	Mean Nitrate Level (mg/L)	Number of Samples
Fall 2019	1.70	n = 145
Fall 2020	1.67	n = 288
Fall 2021	1.68	n = 211
Spring 2022	1.06	n = 256
Fall 2022	1.60	n = 194
Spring 2023	1.52	n = 193
Fall 2023	1.60	n = 157
Spring 2024	1.65	n = 217
Fall 2024	1.39	n = 180
Spring 2025	1.33	n = 214

- County nitrate concentrations are consistently below the MCL.

Door County Mean Nitrate Levels



The nitrate analysis uses the following zone boundaries to distinguish the sample locations:

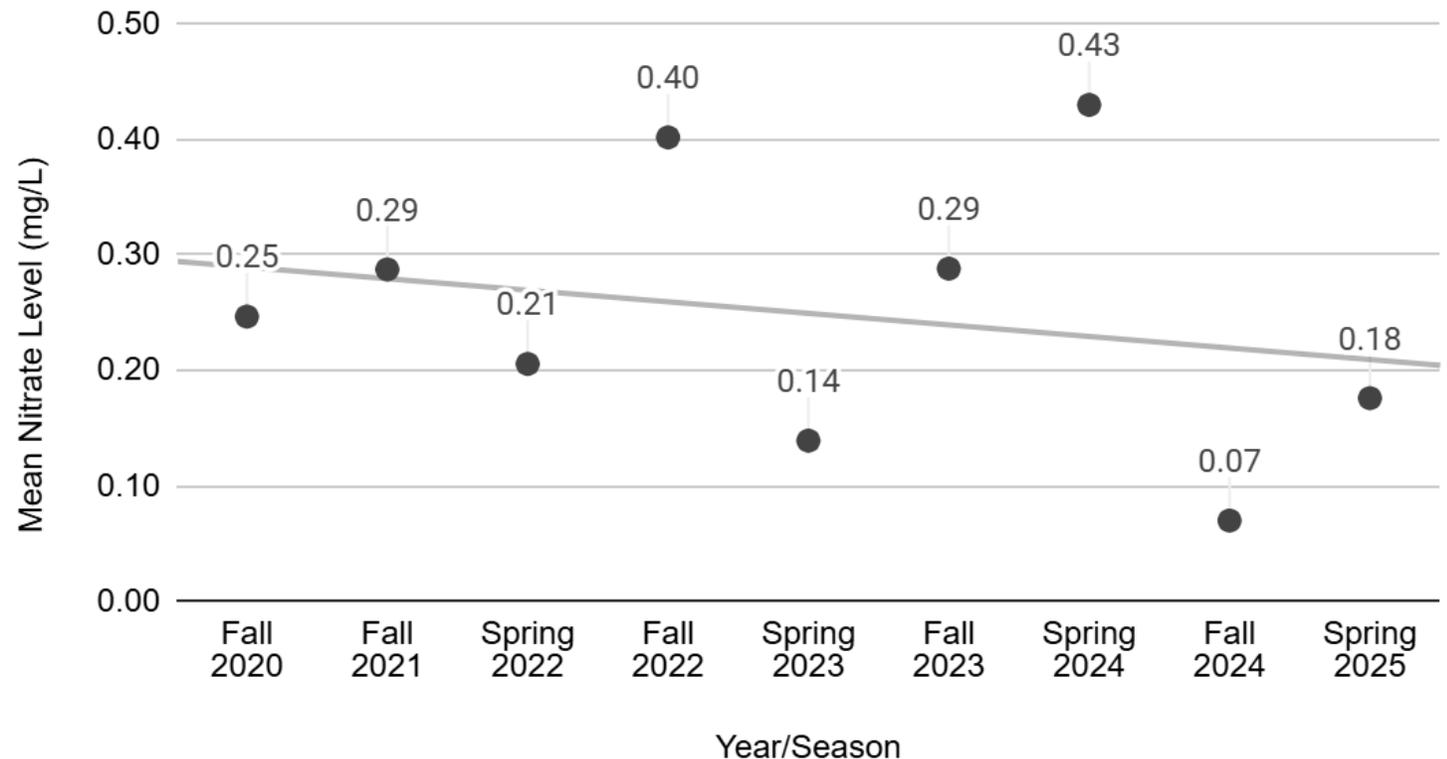


Zone 1 Mean Nitrate Levels

Zone 1 Mean Nitrate Levels		
Sampling Season	Mean Nitrate Level (mg/L)	Number of Samples
Fall 2020	0.25	n = 15
Fall 2021	0.29	n = 17
Spring 2022	0.21	n = 23
Fall 2022	0.40	n = 11
Spring 2023	0.14	n = 15
Fall 2023	0.29	n = 10
Spring 2024	0.43	n = 8
Fall 2024	0.07	n = 15
Spring 2025	0.18	n = 14

- No samples were received from this zone in Fall 2019
- Consistently has the lowest nitrate concentrations in the county
- Smallest range of values out of all zones.

Door County Mean Nitrate Levels - Zone 1

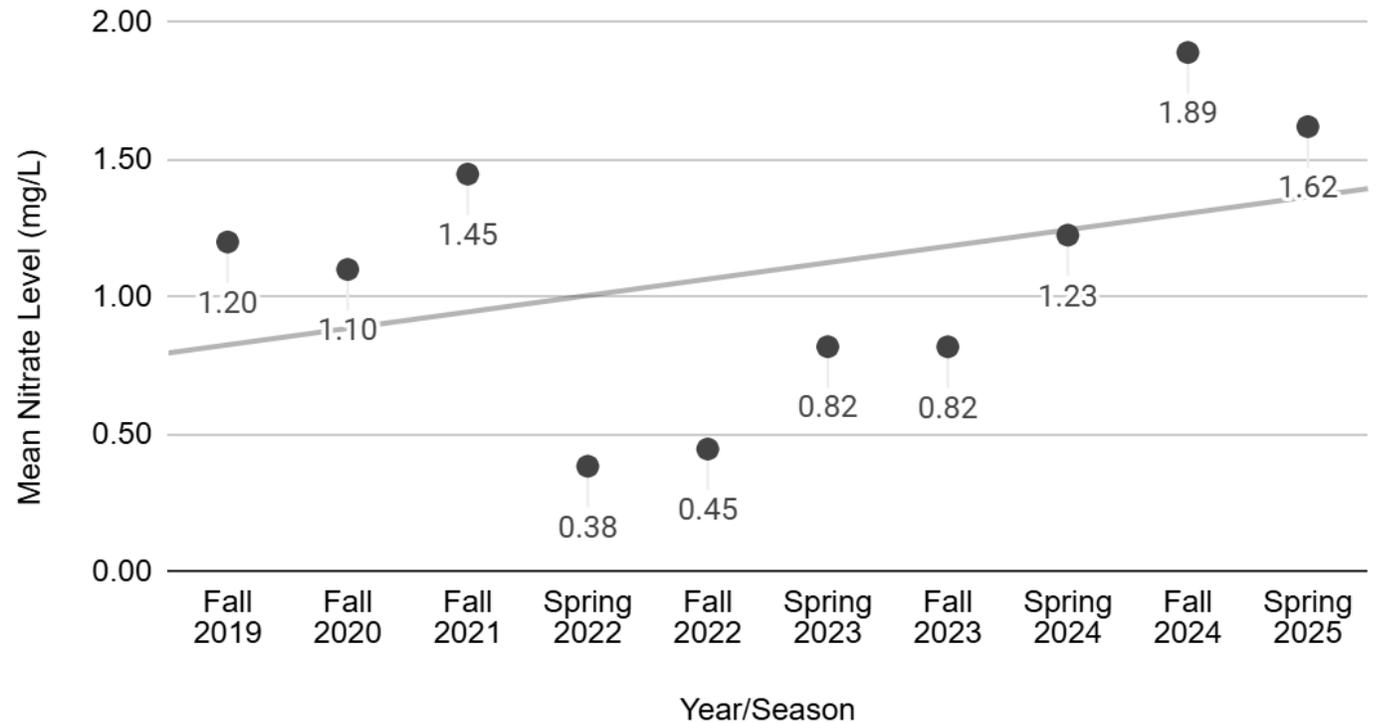


Zone 2 Mean Nitrate Levels

Zone 2 Mean Nitrate Levels		
Sampling Season	Mean Nitrate Level (mg/L)	Number of Samples
Fall 2019	1.20	n = 13
Fall 2020	1.10	n = 17
Fall 2021	1.45	n = 21
Spring 2022	0.38	n = 18
Fall 2022	0.45	n = 20
Spring 2023	0.82	n = 16
Fall 2023	0.82	n = 13
Spring 2024	1.23	n = 24
Fall 2024	1.89	n = 17
Spring 2025	1.62	n = 13

- Decrease from Fall 2021 to Spring 2022 likely contributes to the dip observed in the county-wide trends

Door County Mean Nitrate Levels - Zone 2

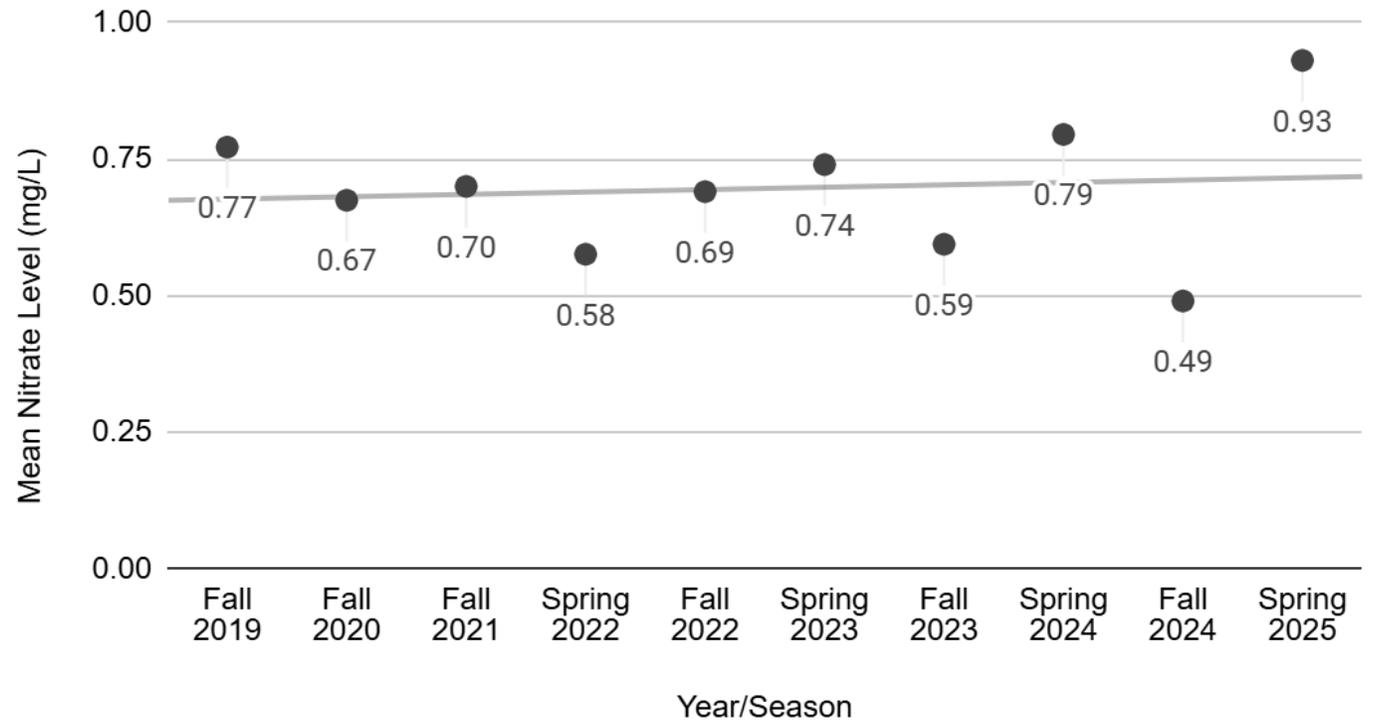


Zone 3 Mean Nitrate Levels

Zone 3 Mean Nitrate Levels		
Sampling Season	Mean Nitrate Level (mg/L)	Number of Samples
Fall 2019	0.77	n = 42
Fall 2020	0.67	n = 57
Fall 2021	0.70	n = 51
Spring 2022	0.58	n = 51
Fall 2022	0.69	n = 56
Spring 2023	0.74	n = 42
Fall 2023	0.59	n = 29
Spring 2024	0.79	n = 60
Fall 2024	0.49	n = 45
Spring 2025	0.93	n = 57

- Fairly stable trend with low nitrate concentrations.

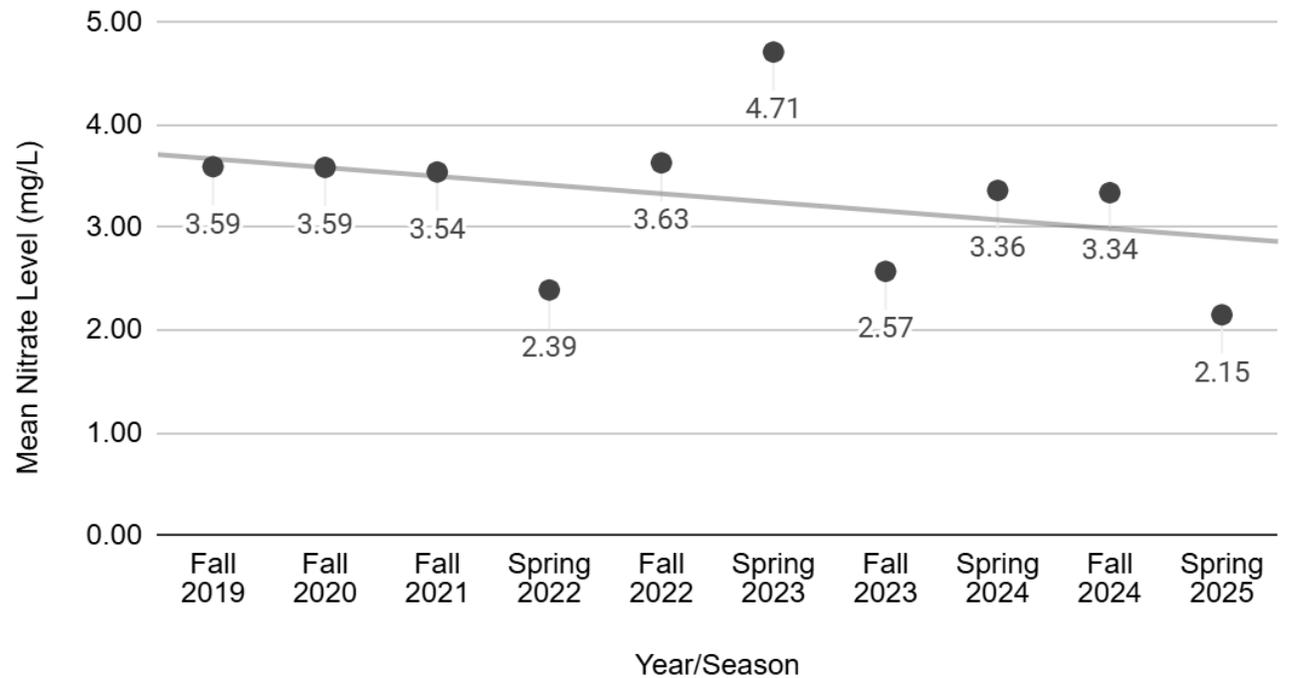
Door County Mean Nitrate Levels - Zone 3



Zone 4a Mean Nitrate Levels

Zone 4a Mean Nitrate Levels		
Sampling Season	Mean Nitrate Level (mg/L)	Number of Samples
Fall 2019	3.59	n = 14
Fall 2020	3.59	n = 78
Fall 2021	3.54	n = 40
Spring 2022	2.39	n = 37
Fall 2022	3.63	n = 41
Spring 2023	4.71	n = 30
Fall 2023	2.57	n = 29
Spring 2024	3.36	n = 35
Fall 2024	3.34	n = 29
Spring 2025	2.15	n = 52

Door County Mean Nitrate Levels - Zone 4a

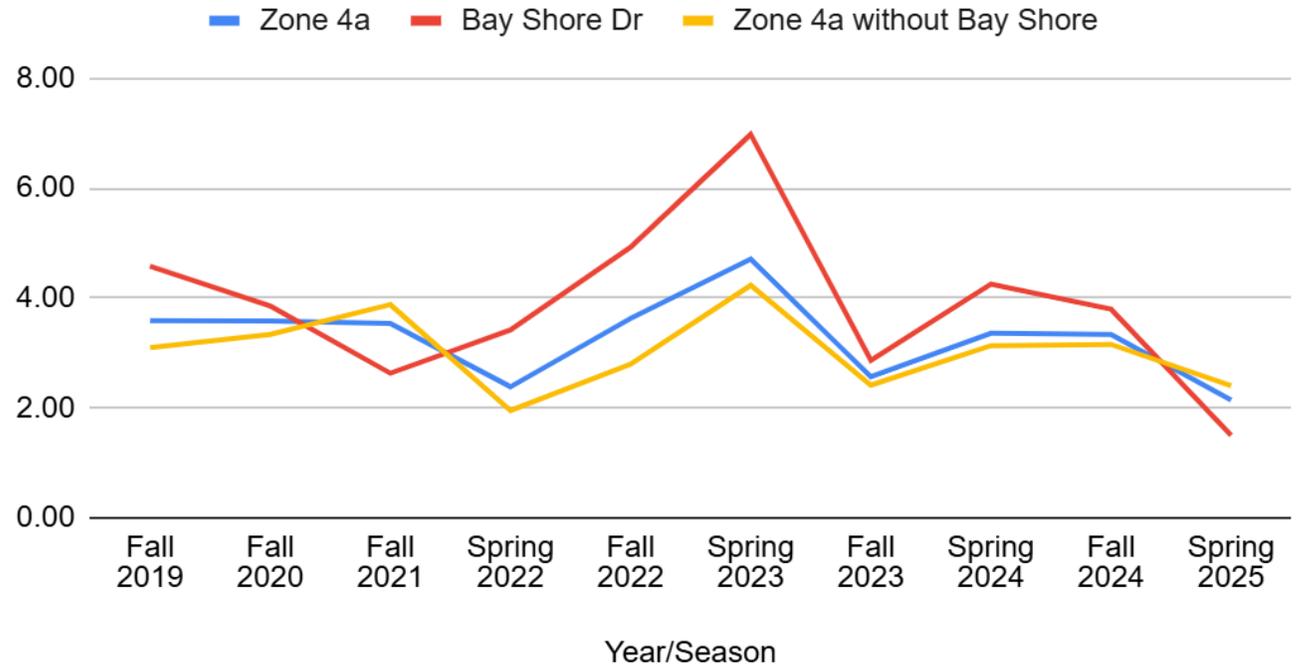


- Highest nitrate concentrations in the county

Zone 4a Comparison

Zone 4a Mean Nitrate Level Comparison			
Sampling Season	Zone 4a	Bay Shore Dr	Zone 4a without Bay Shore Dr
Fall 2019	3.59	4.58	3.10
Fall 2020	3.59	3.86	3.34
Fall 2021	3.54	2.64	3.89
Spring 2022	2.39	3.42	1.96
Fall 2022	3.63	4.93	2.80
Spring 2023	4.71	6.98	4.24
Fall 2023	2.57	2.87	2.42
Spring 2024	3.36	4.26	3.14
Fall 2024	3.34	3.80	3.16
Spring 2025	2.15	1.51	2.41

Door County Mean Nitrate Levels - Zone 4a Comparison

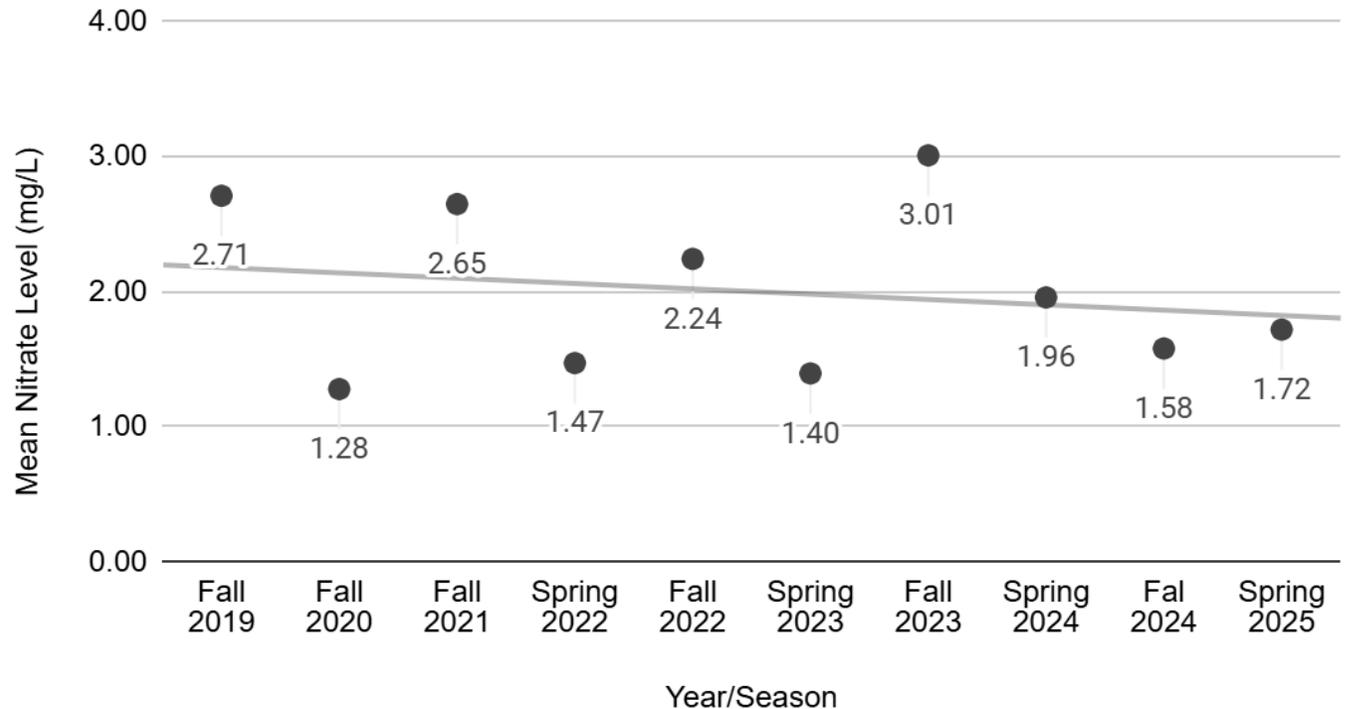


- Many of the Zone 4a samples were from Bay Shore Dr, and so these nitrate means aim to show how samples from that street contribute to the overall concentration of that zone

Zone 4b Mean Nitrate Levels

Zone 4b Mean Nitrate Levels		
Sampling Season	Mean Nitrate Level (mg/L)	Number of Samples
Fall 2019	2.71	n = 28
Fall 2020	1.28	n = 58
Fall 2021	2.65	n = 33
Spring 2022	1.47	n = 67
Fall 2022	2.24	n = 25
Spring 2023	1.40	n = 37
Fall 2023	3.01	n = 25
Spring 2024	1.96	n = 44
Fall 2024	1.58	n = 33
Spring 2025	1.72	n = 33

Door County Mean Nitrate Levels - Zone 4b

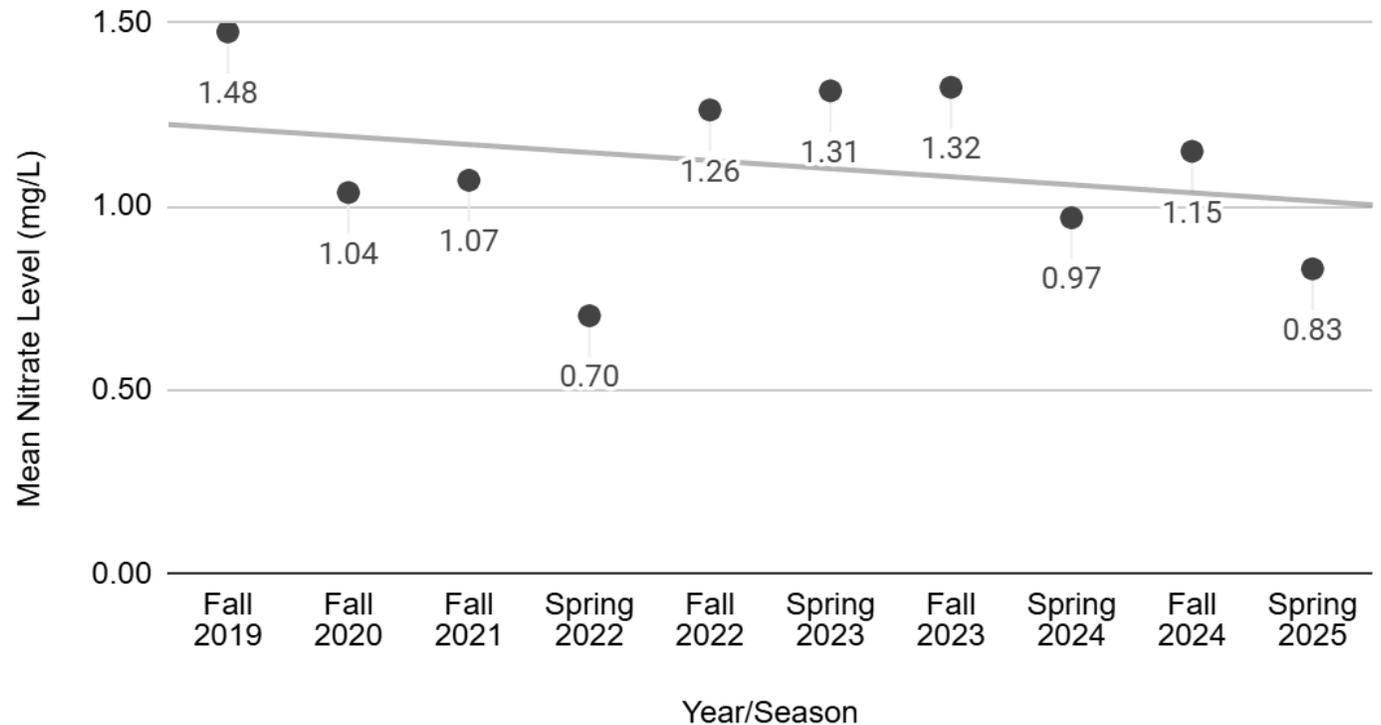


Zone 5 Mean Nitrate Levels

Zone 5 Mean Nitrate Levels		
Sampling Season	Mean Nitrate Level (mg/L)	Number of Samples
Fall 2019	1.48	n = 48
Fall 2020	1.04	n = 63
Fall 2021	1.07	n = 49
Spring 2022	0.70	n = 53
Fall 2022	1.26	n = 45
Spring 2023	1.31	n = 42
Fall 2023	1.32	n = 48
Spring 2024	0.97	n = 46
Fall 2024	1.15	n = 41
Spring 2025	0.83	n = 46

- Decrease from Fall 2021 to Spring 2022 likely contributes to the dip seen in the county-wide trends
- Zone 5 is the largest geographic zone

Door County Mean Nitrate Levels - Zone 5

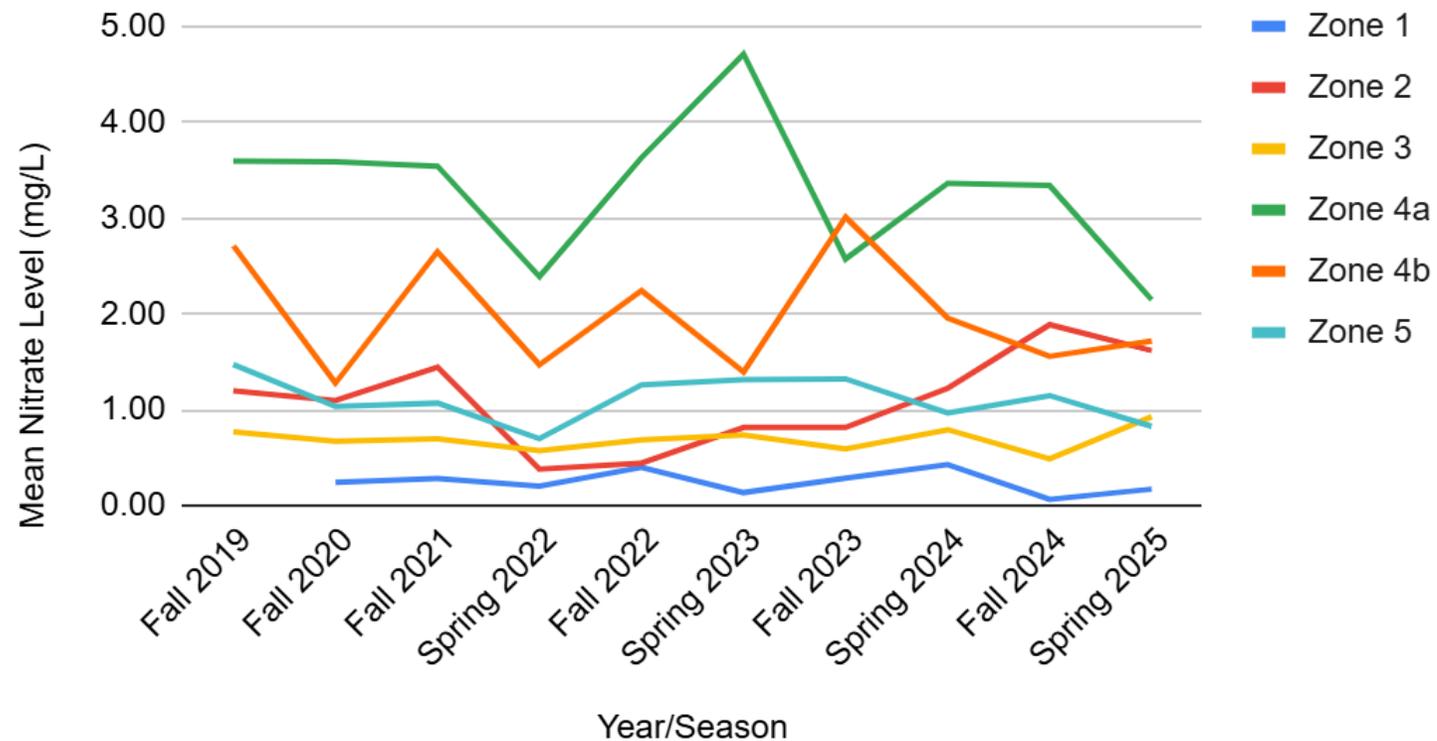


Zone Comparison

Mean Nitrate Levels by Zone						
Sampling Season	Zone 1	Zone 2	Zone 3	Zone 4a	Zone 4b	Zone 5
Fall 2019	--	1.2	0.77	3.59	2.71	1.48
Fall 2020	0.25	1.1	0.67	3.59	1.28	1.04
Fall 2021	0.29	1.45	0.7	3.54	2.65	1.07
Spring 2022	0.21	0.38	0.58	2.39	1.47	0.7
Fall 2022	0.4	0.45	0.69	3.63	2.24	1.26
Spring 2023	0.14	0.82	0.74	4.71	1.4	1.31
Fall 2023	0.29	0.82	0.59	2.57	3.01	1.32
Spring 2024	0.43	1.23	1.27	3.36	1.96	0.97
Fall 2024	0.07	1.89	0.49	3.34	1.56	1.15
Spring 2025	0.18	1.62	0.93	2.15	1.72	0.83

Zone Comparison

Door County Mean Nitrate Levels - All Zones



Zone Comparison

Mean Nitrate Levels (mg/L) from All Sampling Seasons (2019-2025)

Zone 1	Zone 2	Zone 3	Zone 4a	Zone 4b	Zone 5
0.25	1.09	0.70	3.29	2.00	1.11

- Combines the individual means from all sampling seasons to find an overall nitrate level for each zone since the beginning of the Well Monitoring Program

Septic Tracer Study



Overall Project Objectives

Project Objective:

Evaluate septic system tracers of contamination in groundwater near high densities of septic system installations.

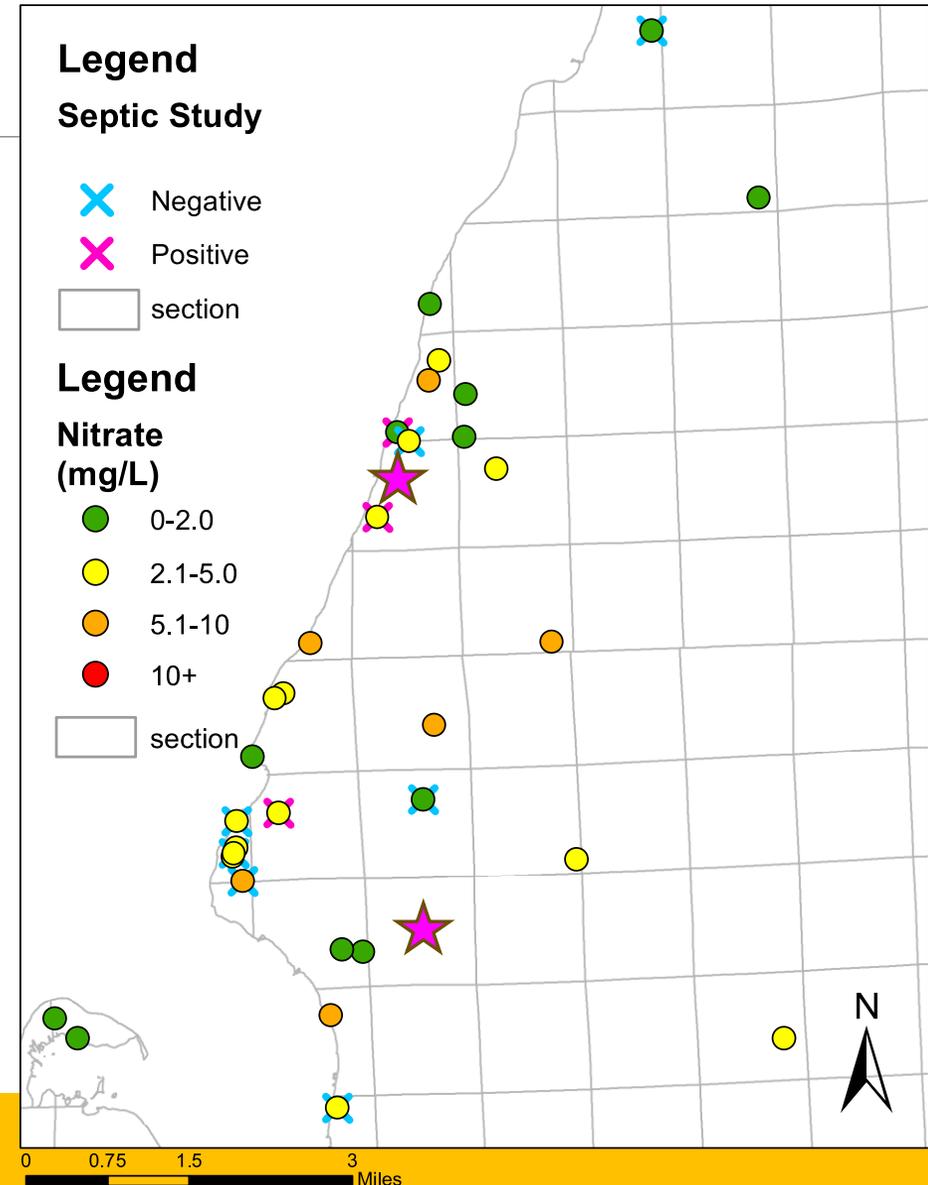
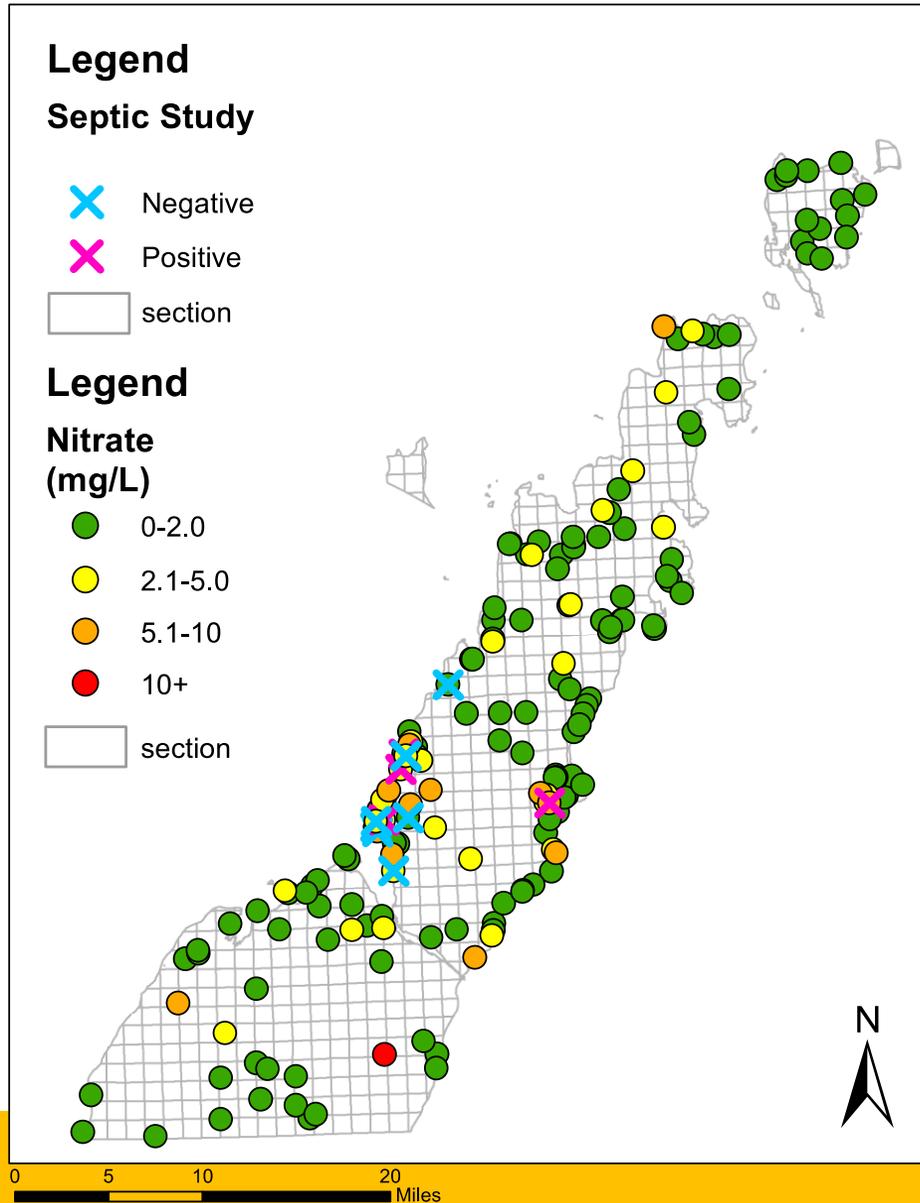
Where:

- 2 Locations that are defined by significant year around usage. Sites TBD.
- 2 Locations that are defined by a majority of seasonal usage. Sites TBD.

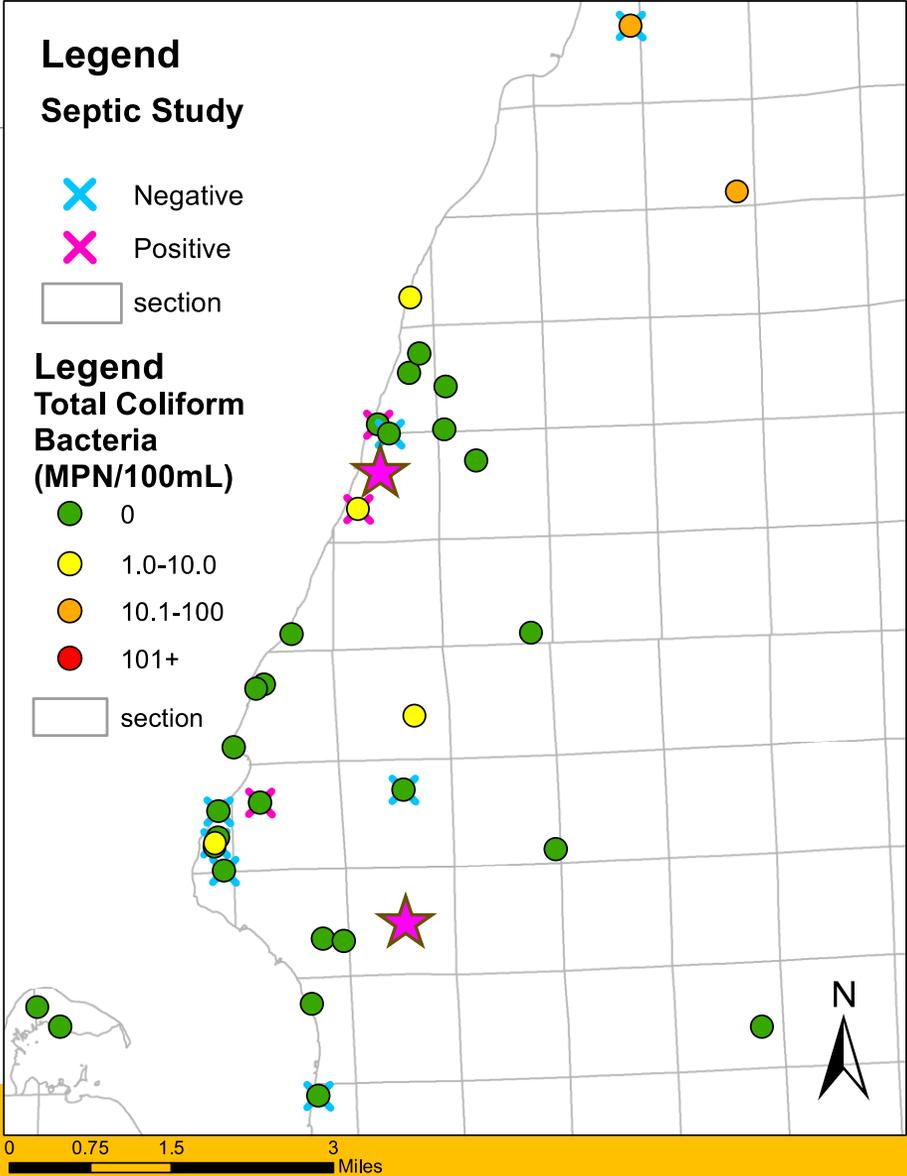
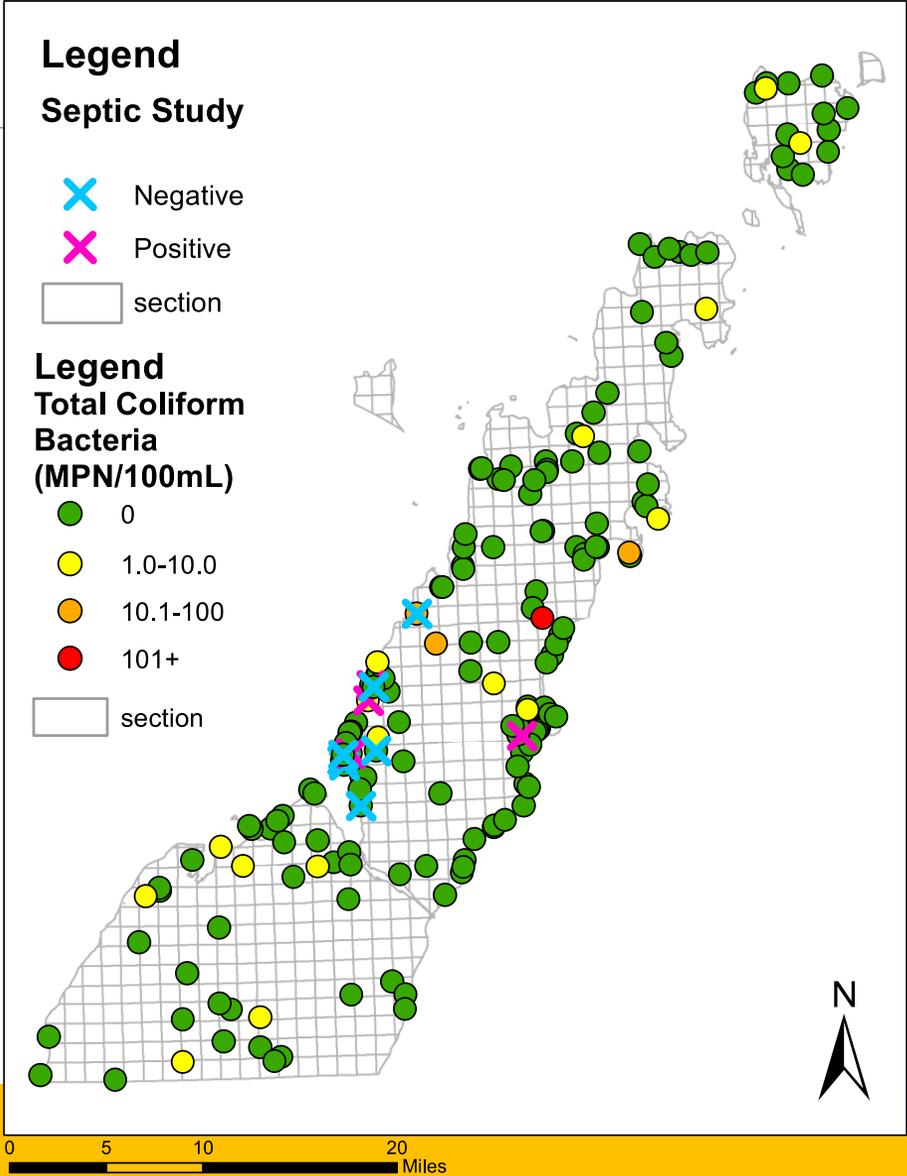
When:

- Spring or Fall (10-20 samples per location) x 2 locations x 2 events = ~80 samples
- Summer (10-20 samples per location) x 2 locations x 2 events = ~60 samples

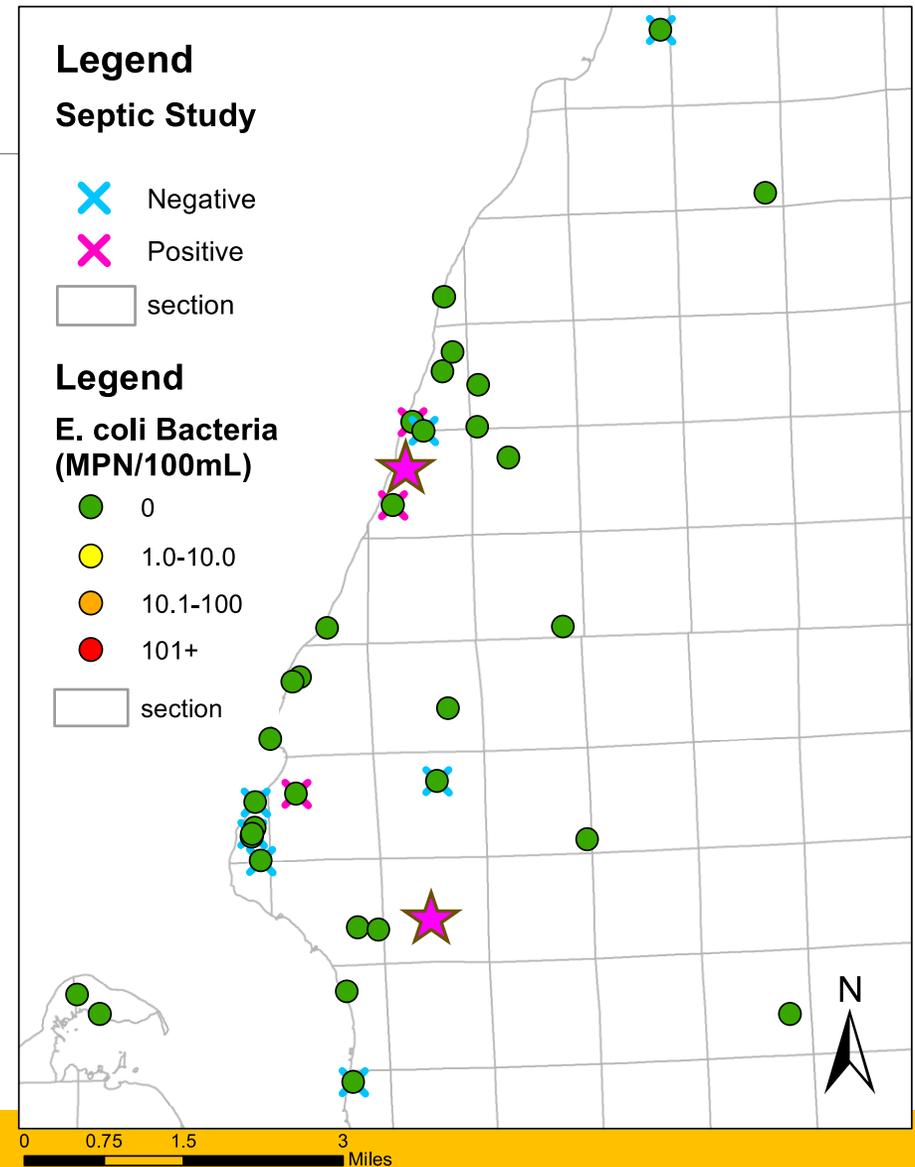
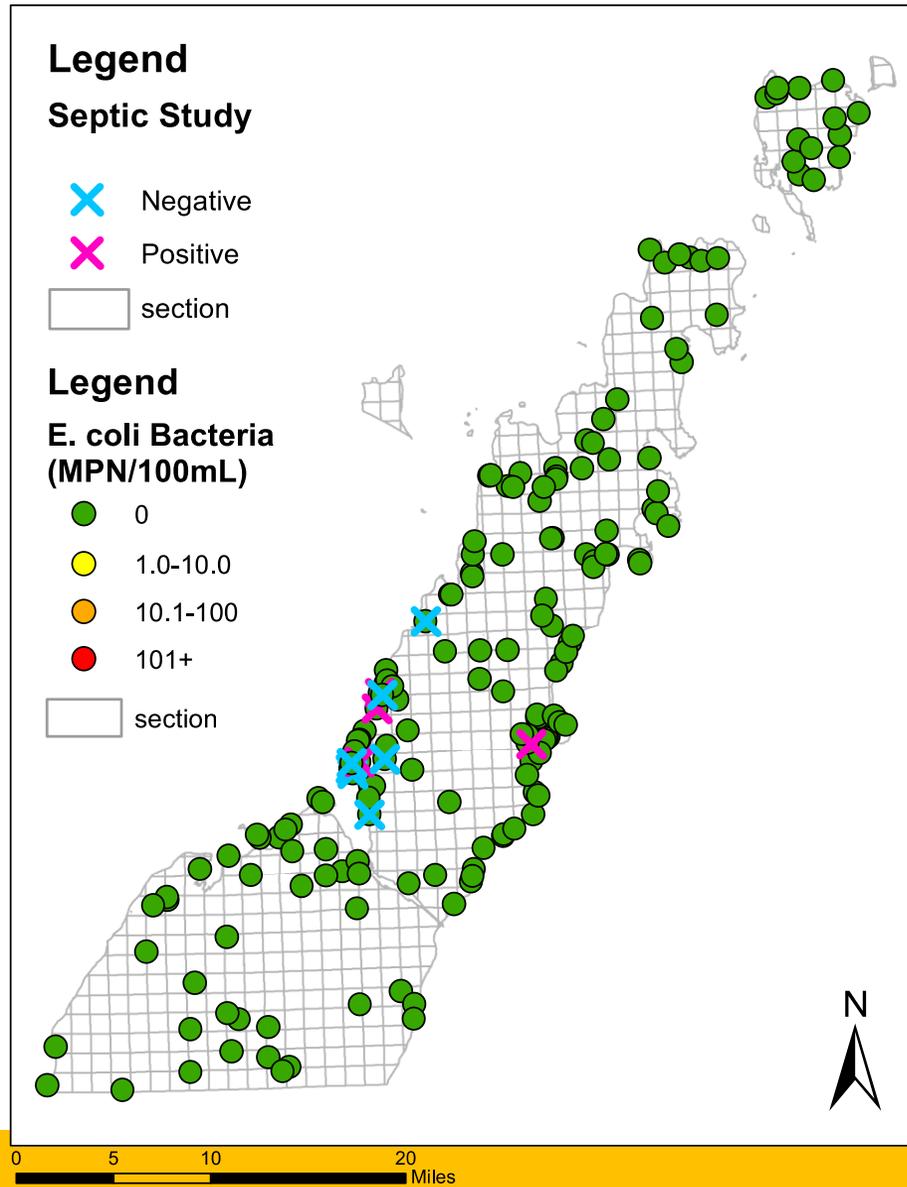
Initial Septic Tracer Results with Nitrate Results Fall 2024



Initial Septic Tracer Results with Coliform Results Fall 2024



Initial Septic Tracer Results with *E.coli* Results Fall 2024



Initial Fall 2024 Septic Tracer Study Results

- **Acesulfame** (artificial sweetener) – **1 present out of 10**
- **Sucralose** (artificial sweetener) – **3* positive of 10**
- **Caffeine** (do I need to say more?) – **1* positive of 10**
- **Paraxanthine** (metabolite of caffeine) – **All non-detect**
- **Sulfamethoxazole** (antibiotic) – **All non-detect**
- **Carbamazepine** (prescription medication) – **All non-detect**
- **Coliform** (fecal indicator of septic and ag) – **1 positive of 10 of above**
- ***E.coli*** (fecal indicator of septic and ag) - **0**
- **Nitrate** (fecal indicator of septic and ag) – **4, 5, 6.1 (mg/L)**

Note: The 10 samples were nine physical locations with one location before and after RO treatment.

Second Set of Septic Tracer Study Results – Spring 2025

- **Acesulfame** (artificial sweetener) – **2* present out of 21**
- **Sucralose** (artificial sweetener) – **1* positive of 21**
- **Caffeine** (do I need to say more?) – **All non-detect**
- **Paraxanthine** (metabolite of caffeine) – **All non-detect**
- **Sulfamethoxazole** (antibiotic) – **All non-detect**
- **Carbamazepine** (prescription medication) – **All non-detect**
- **Coliform** (fecal indicator of septic and ag) – **All non-detect**
- ***E.coli*** (fecal indicator of septic and ag) – **All non-detect**
- **Nitrate** (fecal indicator of septic and ag) – **Avg. 3.24 ppm (2.18 for + homes)**

*Note: * indicates one well was positive for both constituents.*

Second Set of Septic Tracer Study Results

Sample #	COLIFORM	E COLI	NITRATE	ARSENIC	ALKALINITY	HARDNESS	IRON	PH
1	ND	ND	3.6	ND	180	250	ND	7
2	ND	ND	2.6	ND	240	350	ND	7
3	ND	ND	7.25	ND	40	50	ND	6
4	ND	ND	ND	5.87	180	425	ND	7
5	ND	ND	3.2	ND	240	350	ND	8
6	ND	ND	1.5	ND	240	425	ND	7
7	ND	ND	ND	1.83	180	300	ND	7
8	ND	ND	2.3					
9	ND	ND	4.3					
10	ND	ND	1.6	ND	180	150	1	7
11	ND	ND	ND	ND	180	25	ND	8
12	ND	ND	1.3					
13	ND	ND	4.49	ND	180	425	0.1	8
14	ND	ND	2	ND	180	250	ND	7
15	ND	ND	6.7	ND	180	425	ND	7
16	ND	ND	1	ND	240	350	0.6	7
17	ND	ND	2.8	ND	180	250	ND	7
18	ND	ND	0.75	ND	80	15	ND	7
19	ND	ND	ND	4.58	180	250	ND	7
20	ND	ND	6.5					
21	ND	ND	ND					

1 chemical present

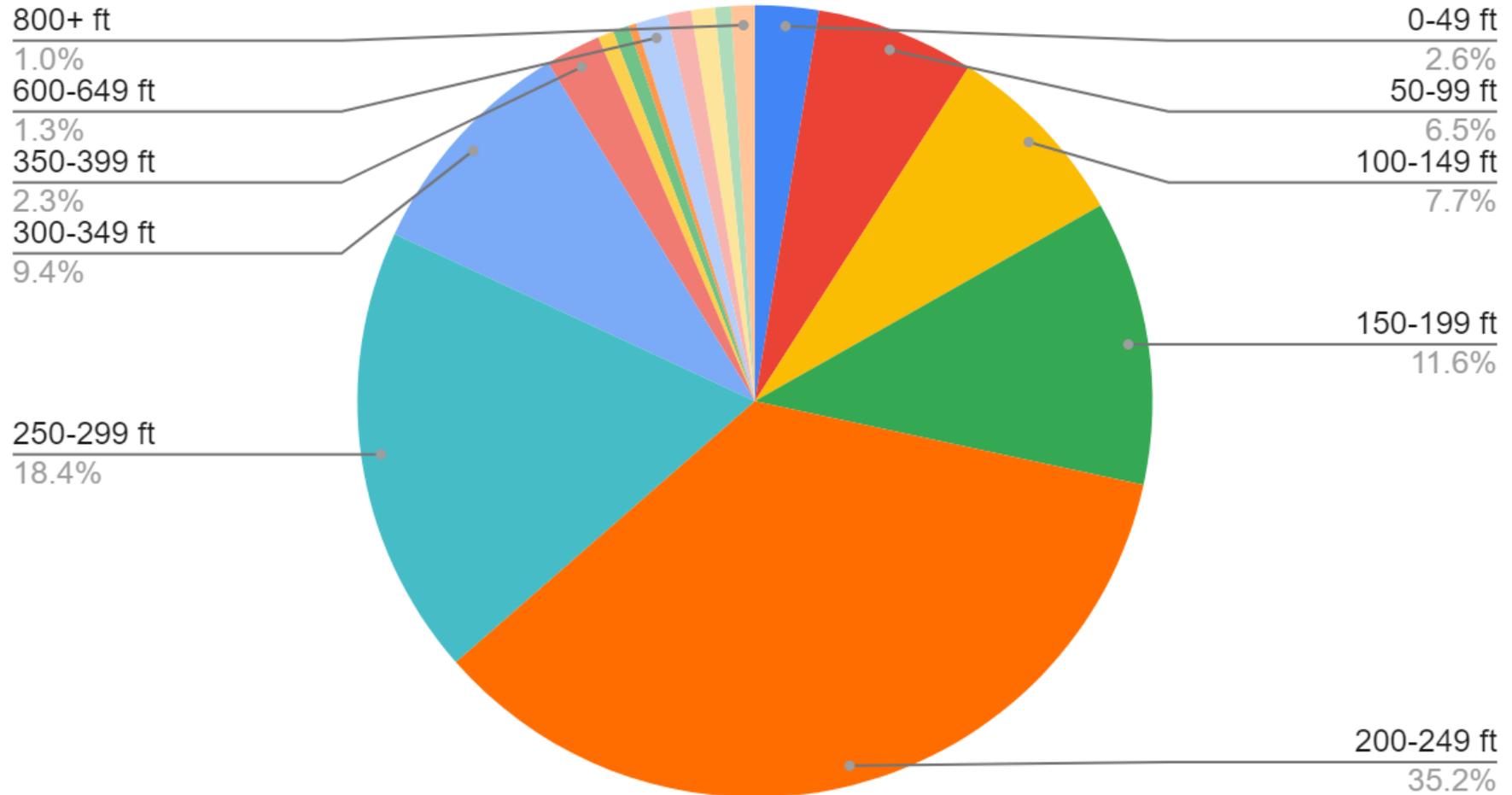
2 chemicals present

Additional Data

The Door County Well Monitoring Program asks that participants provide some pieces of qualitative data along with their water sample if they are known. These include:

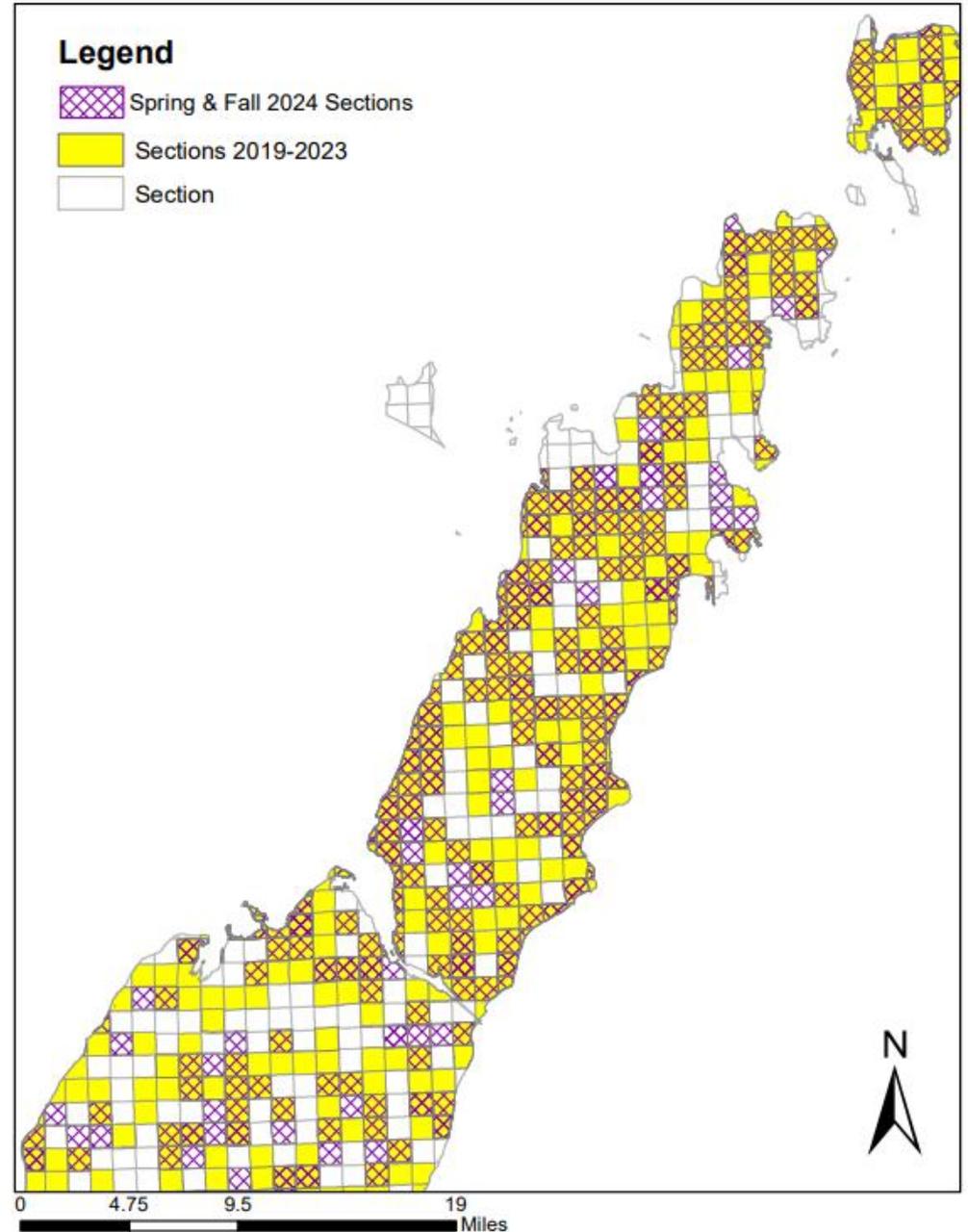
- Well Type
 - Only 7 respondents have driven/sand point wells, while the rest that responded all have drilled wells. Considering the geography of Door County, these results are to be expected.
- Well Construction Date
- Well Depth
 - From the people that provided the depth of their well, we have modelled the range of well depths across the entire county here:

Range of Well Depths



Further Research & Plans

- Continue targeted sampling in spring, summer, and/or fall (seasonal)
- Recruiting same volunteers from previous years plus additional wells in other sections across county
- Continuation as a long-term study (ongoing annual program)



Take Home Messages

- Karst geology makes Door County groundwater highly vulnerable to contamination and causes high variability in water quality results
- Sample your well at least annually for bacteria and nitrate, or more often if changes or problems observed (recommended)
- Do not hesitate to use your resources if you have questions or concerns about Door County groundwater quality
 - Wisconsin DNR
 - Door County Soil & Water Conservation Department
 - Door County Public Health

Special Thanks

Thank you to **Crossroads at Big Creek, Door County Soil & Water Department, Door County Public Health, Door County Community Foundation (and others)** for their support throughout the last 20+ years of water work in the county!

QUESTIONS? CONTACT
US AT
ERIC@UWOSH.EDU OR
(920) 424-3148

PRESENTATION &
RECORDING AVAILABLE
ONLINE

**Thank you – we
can't do this
without you!**