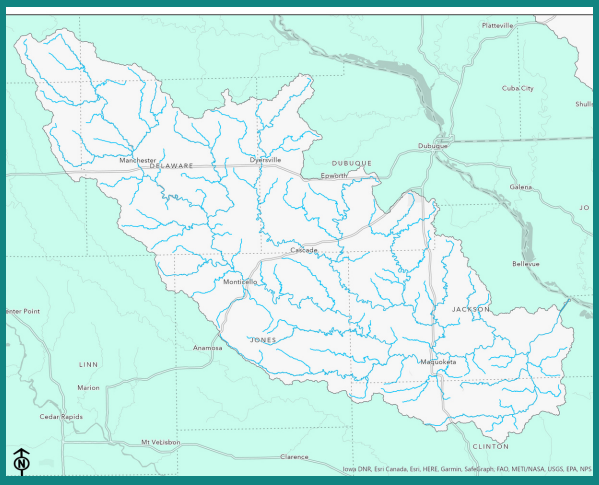
Maquoketa River Watershed Water Quality Results from 2019-2022

The Maquoketa River Watershed Management Authority formed in 2017 to improve water quality, reduce flooding, and protect local drinking water in the Maquoketa River watershed. The Maquoketa watershed drains land covering 1,870 square miles. across nine counties (Buchanan, Clayton, Clinton, Delaware, Dubuque, Fayette, Jackson, Jones, and Linn).



The purpose of monitoring is to understand water quality throughout the entire watershed during different times of the year. To accomplish this goal, sites were established near the outlet of subwatersheds which drain to either the North Fork of the Maquoketa River (the North Fork flows through Dyersville, Cascade, and Maquoketa) or the South Fork of the Maquoketa River (the South Fork flows through Manchester, Lake Delhi, and Monticello before joining the North fork at Maquoketa). A total of 34 sites were monitored in 2019, two new sites were included in 2020 bringing the total to 36 sites, and nine additional sites were included in 2021 (seven sites in and around Lake Delhi as well as sites near the outlets of both the North and South Forks of the Maquoketa River near Maquoketa) bringing the total sites monitored in 2021 and 2022 to 45.

Monitoring Design...

Sample Design

- For each sampling event, sites throughout the watershed were sampled the same day within a three-hour window.
- Each sampling provided a “snapshot” of water quality in the watershed.
- Sites were sampled three times each year (May, June and August; in 2020, the August sampling was delayed to September due to the derecho).
- With a snapshot, sites can be compared to each to each other to determine where concentrations are similar and where high or low values occurred.

Sites

- Sampling groups visited their assigned sites, made observations of stream conditions, and collected samples that were then delivered to a lab for analyses.
- Water from all sites were analyzed for turbidity, dissolved reactive phosphorus, nitrate-nitrogen, and *E. coli* bacteria, common parameters used to evaluate water quality for streams in Iowa.
- The Iowa DNR Fisheries in Manchester analyzed samples for turbidity while the other lab analyses were performed by Dr. Marty St. Clair at Coe College.

Parameter

TURBIDITY

What is it? Turbidity measures the clarity of water. Clear water has low turbidity while murky or cloudy water has high turbidity. Elevated turbidity can be caused by sediment, algae, and organic matter. High turbidity can be harmful for fish and aquatic life. Water flow and rainfall can impact turbidity levels. Turbidity is measured in NTUs. The median turbidity for streams statewide is 16 NTU (Iowa DNR, 2017).

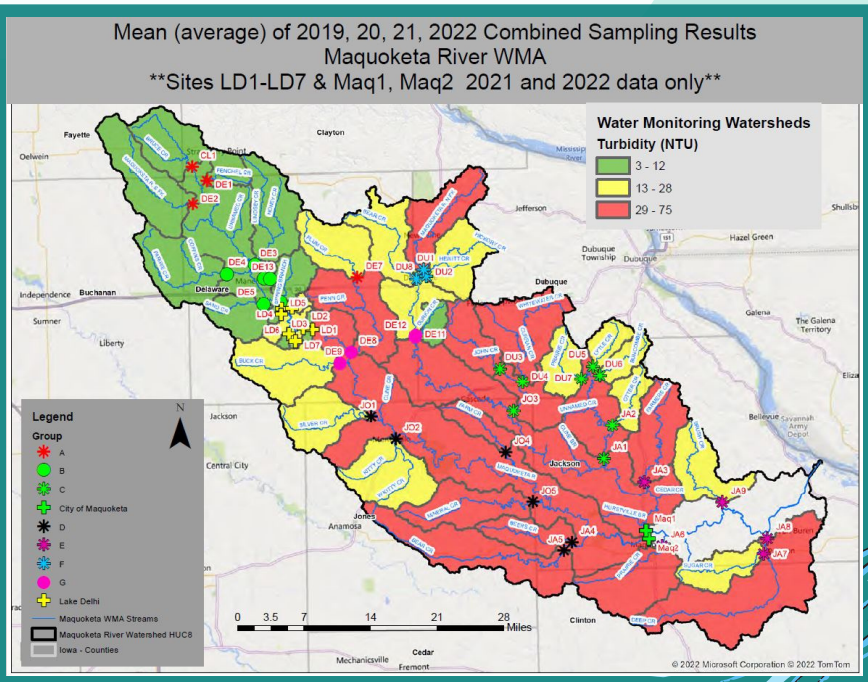
RESULTS

Higher turbidity levels occurred in the lower portion of the Maquoketa River Watershed (Figure 1) with levels ranging from 29 to 75 NTU. The lowest turbidity levels, ranging from 3 to 12 NTU, were measured in subwatersheds located near the upper or headwaters of the watershed. The highest single sample turbidity was 529 NTU and occurred June 2020 at Deep Creek (JA8) following recent rain in the area.

Water Quality Units of Measure

- NTU – Nephelometric Turbidity Units; unit used to measure the turbidity of water
- mg/L – milligrams per liter; unit used to measure dissolved reactive phosphorus and nitrate-nitrogen
- CFU/100 ml – Colony Forming Units per 100 milliliters of water; unit used to measure *E. coli* bacteria.

Figure 1



Parameter

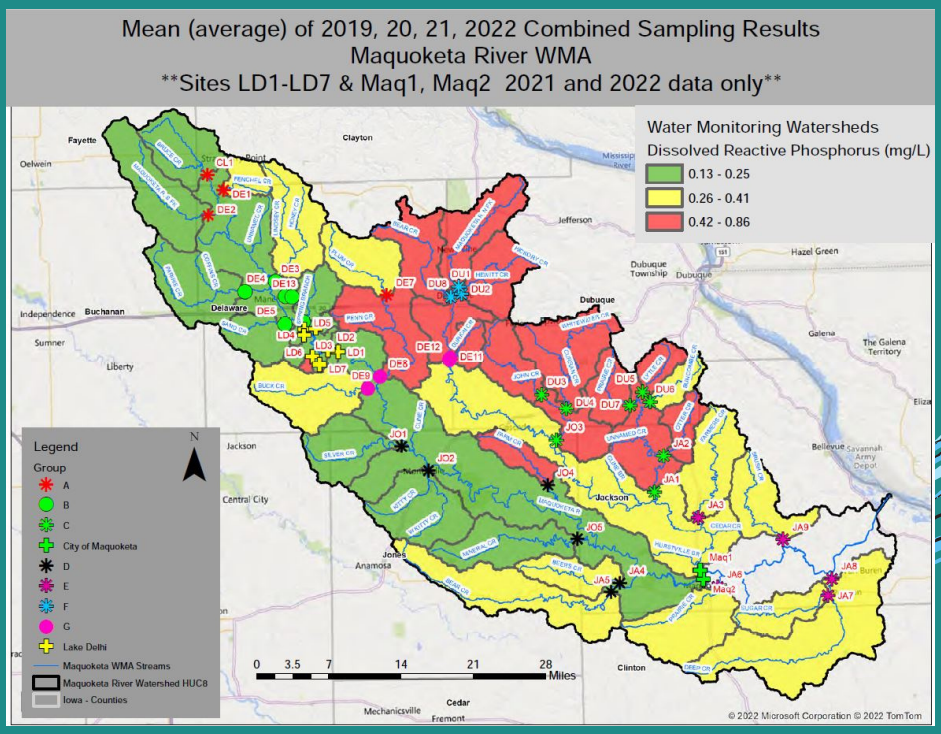
DISSOLVED REACTIVE PHOSPHORUS

What is it? Phosphorus is an essential nutrient for plants and animals. However, an overabundance of nutrients in water can result in increased plant growth and algal blooms which can cause lower dissolved oxygen in the water and have negative impacts on fish and aquatic life. Phosphorus sources include human, animal and industrial wastes fertilizers, and certain soils and rocks. Phosphorus is measured in mg/L. Dissolved (soluble) reactive phosphorus is the form of phosphorus available for use by plants and algae and is the form measured at the streams monitored in the Maquoketa watershed. Median dissolved reactive phosphorus concentrations for streams statewide is <0.1 mg/L (Iowa DNR, 2017).

RESULTS

Higher dissolved reactive phosphorus levels occurred primarily at sites which drain to the North Fork of the Maquoketa River (Figure 2). The higher levels ranged from 0.42 to 0.86 mg/L. Lower levels, ranging from 0.13 to 0.25 mg/L, occurred at tributaries draining to the South Fork of the Maquoketa River. Highest single sample turbidity was 529 NTU and occurred June 2020 at Deep Creek (JA8) following recent rains. The two highest single sample dissolved reactive phosphorus concentration were 2.78 mg/L (DU1 – North Fork Maquoketa River) and 2.00 mg/L (DU3 – John Creek); both occurred August 2022.

Figure 2



Parameter

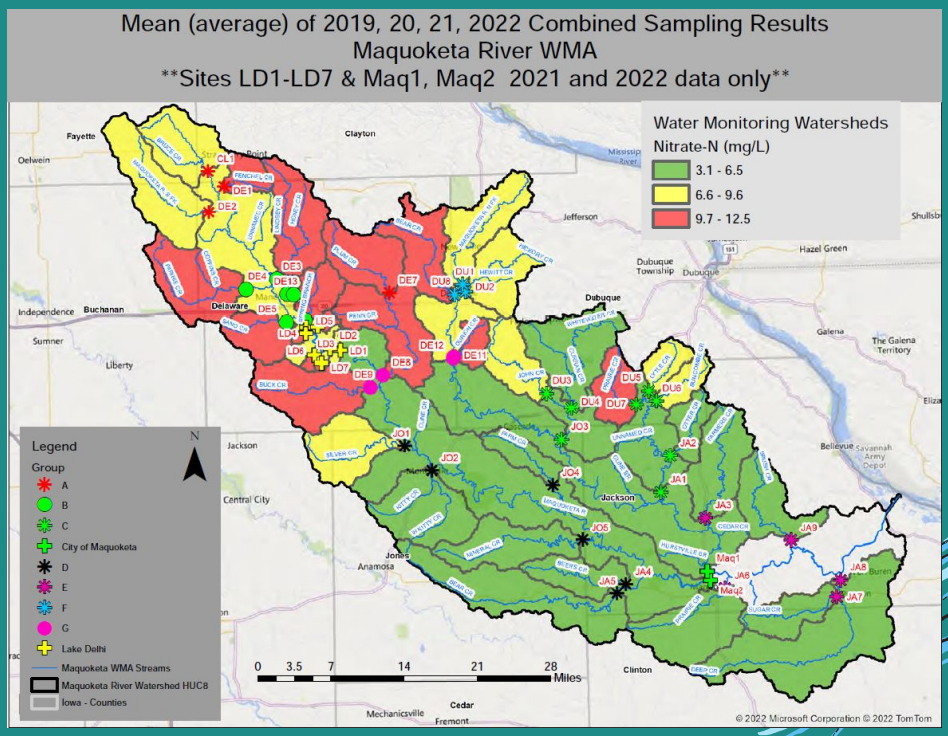
NITRATE-NITROGEN

What is it? Nitrogen is essential for plant growth. Elevated nitrogen levels in water, however, can cause nutrient enrichment and increased plant and algal growth, as well as other water quality problems. There are various forms of nitrogen, including nitrate, ammonia, and organic. Sources of nitrogen include soil organic matter, animal waste, fertilizer, sewage, and decomposing plants. Stream sites in the Maquoketa WMA were monitored for nitrate-nitrogen, a form that is water soluble. Nitrate-nitrogen (nitrate-N) is measured in mg/L. Nitrate-N concentrations display a seasonal trend with higher concentrations occurring late spring/early summer. The median nitrate-N for streams statewide is 5.5 mg/L (Iowa DNR, 2017).

RESULTS

The higher nitrate-N concentrations (9.7 to 12.5 mg/L) occurred primarily at tributaries in the upper portion of the South Fork of the Maquoketa River (Figure 3). Lower concentrations (3.1 to 6.5 mg/L) occurred in the lower portion of both the South and North Forks of the Maquoketa River. The highest single sample nitrate-N concentration was 24.3 mg/L and occurred June 2022 at Coffins Creek (DE4).

Figure 3



Parameter

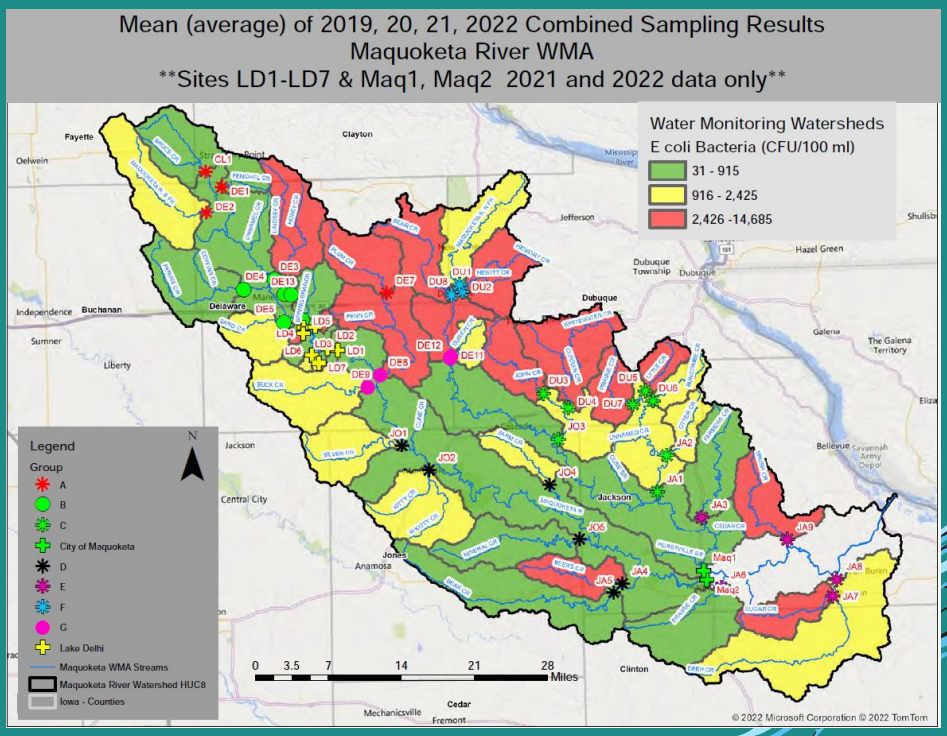
E.COLI BACTERIA

What is it? *E. coli* bacteria is a type of fecal coliform bacteria found in the intestines of warm-blooded organisms such as humans, livestock, and wildlife. The presence of *E. coli* bacteria in rivers indicates contamination by animal waste or sewage and a greater risk that pathogens (disease-causing organisms) may also be present. Many factors impact *E. coli* bacteria levels in rivers including bacteria sources present, rainfall, time of year, nutrient levels in the water, and sediment and water temperature. Bacteria levels can be quite variable and vary by orders of magnitude. The median *E. coli* bacteria for streams statewide is 120 CFU/100 ml (Iowa DNR, 2017).

RESULTS

Based on four years of monitoring, *E. coli* bacteria levels varied throughout the watershed (Figure 4). Sites LD5, a tributary to Lake Delhi in Delaware County, and DE8, Plum Creek in Delaware County, had the highest levels overall during the monitoring. The highest single sample *E. coli* bacteria measured was >24,196 CFU/100 ml) and occurred 62 times at a variety of sites and sample dates.

Figure 4



MAQUOKETA WATERSHED RESULTS COMPARED TO STREAMS STATEWIDE

How do water quality results from the Maquoketa River watershed compare to streams statewide? To answer this question, the Maquoketa watershed results were compared to the Iowa Department of Natural Resources (DNR) network of 60 streams statewide which are monitored on a monthly basis. The DNR network provides the best data set to which to compare the Maquoketa Watershed results. Figure 5 shows annually the median turbidity, dissolved reactive phosphorus, nitrate-N, and *E. coli* bacteria results for streams sampled statewide during the same three months during which the Maquoketa watershed sites were sampled.

Overall, turbidity levels for the Maquoketa watershed sites were similar to levels in streams statewide. The exception was in 2022 when turbidity results for rivers statewide were higher than those in the Maquoketa watershed. The difference in 2022 may have been caused by differing rainfall conditions.

Dissolved reactive phosphorus and *E. coli* bacteria levels were significantly higher for sites monitored in the Maquoketa watershed compared to streams statewide. While the difference was not as great, nitrate-N concentrations were also higher for the Maquoketa sites when compared to streams statewide.

Figure 5

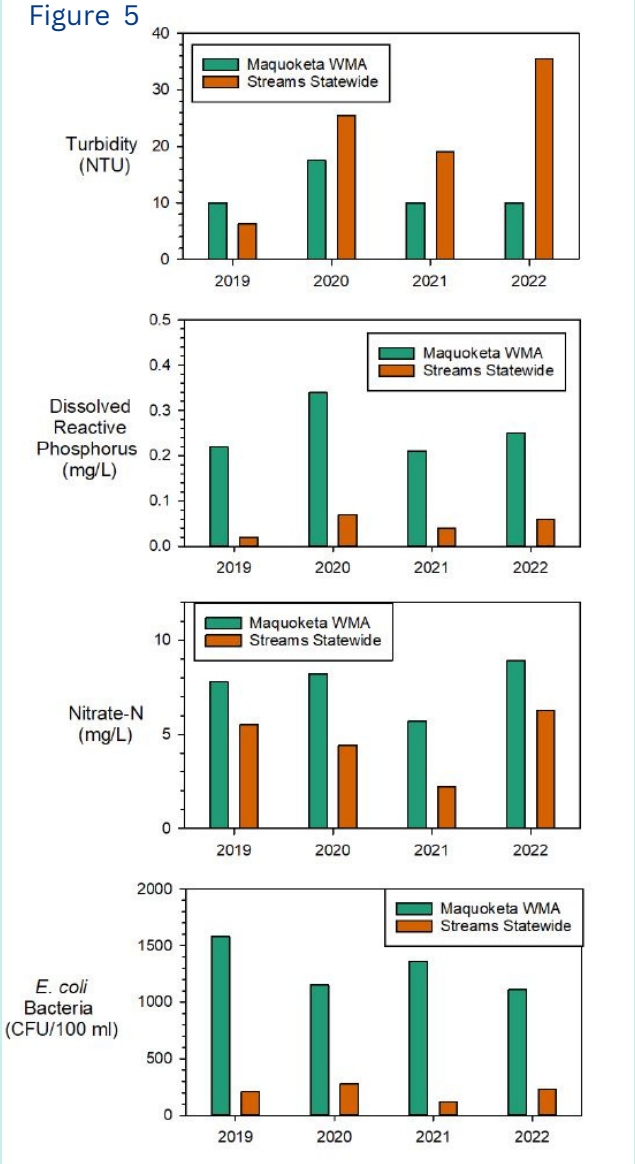


TABLE OF MEANS FOR ALL SITES

Maquoketa WMA - Means based on twelve sampling events in 2019 -2022.

(Note: median was calculated for E. coli bacteria)

Site ID	Stream	County	Turbidity (NTU)	Dissolved Reactive Phosphorus (mg/L)	Nitrate-N (mg/L)	*E. coli* Bacteria (CFU/100 ml)
CL1	Maquoketa River	Clayton	5	0.18	9.6	234
DE1	Fenchel Creek	Delaware	3	0.32	11.2	373
DE2	Maquoketa River	Delaware	6	0.18	7.3	921
DE3	Honey Creek	Delaware	12	0.27	10.4	2561
DE4	Coffins Creek	Delaware	9	0.20	10.1	520
DE5	Sand Creek	Delaware	7	0.15	10.0	1476
DE6	Spring Branch	Delaware	4	0.17	12.5	835
DE7	Plum Creek	Delaware	14	0.29	12.2	3094
DE8	Plum Creek	Delaware	30	0.43	10.0	6646
DE9	Buck Creek	Delaware	18	0.30	10.6	1790
DE11	Durion Creek	Delaware	10	0.68	11.0	1141
DE12	North Fork Maquoketa River	Delaware	25	0.67	9.8	2757
DE13*	Manchester wetland US	Delaware	3	0.26	7.6	201
DE14*	Manchester wetland DS	Delaware	3	0.26	8.0	909
DU1	North Fork Maquoketa River	Dubuque	20	0.81	7.1	1516
DU2	Hewitt Creek	Dubuque	18	0.55	8.7	2801
DU3	John Creek	Dubuque	88	0.86	8.8	2929
DU4	Whitewater Creek	Dubuque	56	0.51	5.8	2545
DU5	Lytle Creek	Dubuque	28	0.46	7.2	3233
DU6	Buncombe Creek	Dubuque	14	0.37	7.4	2420
DU7	Prairie Creek	Dubuque	27	0.44	9.7	2819
DU8	Bear Creek	Dubuque	22	0.56	10.1	2806
JA1	Lytle Creek	Jackson	89	0.47	6.2	1973
JA2	Otter Creek	Jackson	23	0.43	5.7	1110
JA3	Farmers Creek	Jackson	33	0.27	5.3	873
JA4	Beers Creek	Jackson	47	0.27	3.5	2783
JA5	Bear Creek	Jackson	58	0.27	8.7	786
JA6	Prairie Creek	Jackson	86	0.80	4.4	878
JA7	Sugar Creek	Jackson	22	0.34	3.1	3125
JA8	Deep Creek	Jackson	75	0.41	5.0	1464
JA9	Brush Creek	Jackson	27	0.30	4.6	3048
JO1	Silver Creek	Jones	14	0.20	8.3	1384
JO2	Kitty Creek	Jones	14	0.18	6.2	1247
JO3	Whitewater Creek	Jones	74	0.55	6.4	1236
JO4	Farm Creek	Jones	34	0.49	6.5	2117
JO5	Mineral Creek	Jones	34	0.24	4.8	606
LD1**	Maquoketa River DS Dam	Delaware	8	0.13	6.6	58
LD2**	Maquoketa River Hartwick Bridge	Delaware	14	0.20	6.8	31
LD3**	Unnamed Creek (240th St)	Delaware	13	0.16	9.7	3564
LD4**	Maquoketa River Bailey's Ford Bridge	Delaware	9	0.23	7.7	342
LD5**	Unnamed Creek (197th Ave)	Delaware	12	0.19	11.4	14684
LD6**	Unnamed Creek (267th St)	Delaware	3	0.61	10.1	1010
LD7**	Turtle Creek (275th St)	Delaware	4	0.18	11.1	1127
Maq1**	North Fork Maquoketa River	Jackson	74	0.38	4.6	420
Maq2**	Maquoketa River	Jackson	55	0.16	4.7	41

* Site sampled only in 2020, 2021, and 2022

** Site sampled only in 2021 and 2022

Protecting Local Drinking Water

Improving overall water quality

Reducing Flooding

Supporting Positive Soil Health Practices

Promoting Recreation

Standardized Levels Table

Standardized Levels based on Class A1 Primary Contact Recreation and Class BWW2 warm water aquatic life designated use	
E. coli bacteria (CFU=Colony Forming Units)	235 CFU/100 ml (Statewide Stream average is 120 CFU/100ml)
Chloride (Milligrams per liter)	Has both an acute (629 mg/L) and chronic (389 mg/L) standard. (Statewide stream average is 21 mg/L)
Turbidity (NTU= Nephelometric Turbidity Units)	There is no turbidity standard. Except point source discharge streams "The turbidity of the receiving water shall not be increased by more than 25 Nephelometric turbidity units by any point source discharge. (Statewide stream average is 16 NTU)
Sulfate (Milligrams per liter)	no stream standard (Statewide median is 34 mg/L)
Dissolved reactive phosphorus (Milligrams per liter)	no stream standard (Statewide stream average <0.1 mg/L)
Nitrate-N (Milligrams per liter)	If a stream is designated Class C, meaning it is used as a source for drinking water, then there is a drinking water standard of 10 mg/L for nitrate-N. Otherwise there is no stream standard for nitrate-N. (Statewide stream average 5.5 mg/L)

Acknowledgements

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Created December 2022

References:

Stream Water Quality Summary 2000-2016, Iowa DNR, Water Fact Sheet 2017-02, 2017, 7 p.