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Rouge River Benthic Monitoring Program Spring 2024 Report

This report covers benthic macroinvertebrate monitoring at 44 sites on Rouge River tributaries and branches in the spring of 2024. Most sites were sampled during the Spring Bug Hunt on April 20, 2024 where 96 attendees sampled 26 sites in 13 teams. Wayne County staff sampled 3 additional sites, FOTR and volunteers sampled 13 additional sites and Trout Unlimited sampled 2 additional sites. Team Leader training was held on April 6, 2024 and 6 attendees were trained in sampling protocols. A Bug Identification Night was held for Team Leaders on May 9 and 7 people attended. FOTR staff identified the rest of the specimens with assistance from Sue Thompson.



FRIENDS OF THE ROUGE BENTHIC MONITORING PROGRAM

FOTR's benthic monitoring program was started in 2001 to involve a large number of volunteers in monitoring the health of the watershed by sampling the creeks of the Rouge River. The types and number of benthic macroinvertebrates found can be used to assess water quality. Each team of volunteers samples two sites under the direction of a trained team leader. Samples of each organism are collected and field identifications are verified in the lab.



Understanding Benthic Scores

Stream Quality Index (SQI) is determined by weighting each type and number of organisms found by their sensitivity ratings. SQI is a measure of the degree of organic pollution that is calculated by rating and scoring organisms based on their sensitivity (sensitive, somewhat sensitive and tolerant) and frequency in the sample (rare or common). A higher proportion of sensitive organisms such as mayflies and caddisflies results in a higher **SQI**. A greater number of different organisms also results in a high **SQI**. Higher scores reflect better quality sites. The **SQI** has four different levels: **>48=EXCELLENT, 34-48=GOOD, 19-33=FAIR, <19=POOR**.

Number of taxa represents the number of different families of organisms. Like SQI, a higher number of taxa indicate a healthier site.

Number of insect taxa – insects are more sensitive than the non-insect taxa.

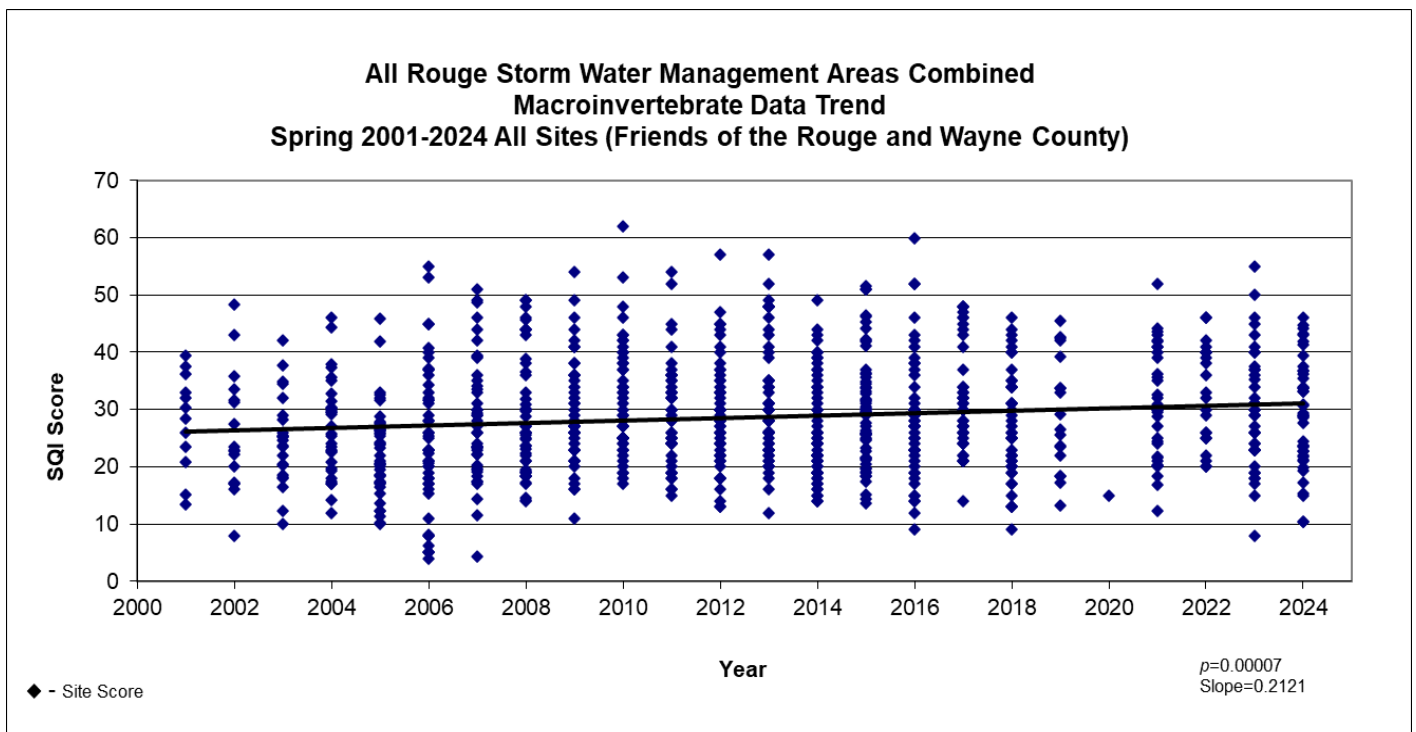
EPT refers to the number of mayfly, caddisfly and stonefly families found; these three orders contain some of the most sensitive organisms.

WQR – Water Quality Rating is a measure of the degree of organic pollution similar to SQI. Organisms are rated based on the Hilsenhoff Index of Biotic Integrity and scores are weighted by the number of individuals found. Unlike SQI, a LOWER score is indicative of less pollution. There are seven categories rather than four. 0.0-3.50=**Excellent**, 3.51-4.50=**Very Good**, 4.51-5.50=**Good**, 5.51-6.50=**Fair**, 6.51-7.50=**Fairly Poor**, 7.51-8.50=**Poor**, 8.51-10.0=**Very Poor**. WQR is calculated based on family level identification.

Overall Summary:

Stream Quality Index (SQI) averaged 29 or FAIR and the Water Quality Index (WQR) averaged 6.11 FAIR (map pg. 10-11, Table 4, and graph below). Taxa averaged 12 Families per site, EPT 2, and Chloride 169.75 (chronic level).

To compare trends over time, we analyzed the trends in SQIs. When all of the sites were compared, there was a small but significant upward trend in SQIs (see graph below).



SQI Summary:

Treated separately or together with the Middle 3 subwatershed, the Middle 1 subwatershed also had significant positive trends (Table 1, graphs pg. 22-23). No other subwatershed showed significant trends.

Table 1-FOTR and WC Spring Bug Hunt Summary 2001-2024 SQI					
Branch	slope	p-value	True trend	Subwatershed average score	Stream Quality Index (SQI)
Main 1-2	0.1674	0.0766	no trend	27	Fair
Main3-4*	-0.1351	0.7504	no trend	25	Fair
Upper	-0.0458	0.6410	no trend	24	Fair
Johnson Creek	0.0437	0.7207	no trend	38	Good
Middle 1	0.2787	0.0343	yes, positive	30	Fair
Middle 3*	0.4600	0.0218	yes, positive	20	Fair
Lower 1	0.0777	0.4749	no trend	30	Fair
Lower 2	-0.2394	0.1519	no trend	26	Fair
Middle 1 and Middle 3 combined	0.3950	0.0008	yes, positive	27	Fair

*no sites sampled in this subarea spring 2024

In addition to the trend analysis by subwatershed, a site-by-site analysis of all the sites was done (Table 2). The majority of sites had no trend. Seven sites had significant positive trends, and four sites had significant negative trends.

Table 2-Friends of the Rouge and Wayne County Spring Bug Hunt Data Trend 2001-2024 by site SQI					
Site	slope	p-value	Statistically significant trend	Site average score	Stream Quality Index (SQI)
Main1	0.6376	0.0148	yes, positive	30	Fair
Main3	0.5302	0.0158	yes, positive	31	Fair
MR-23	-1.1124	0.0427	yes, negative	30	Fair
MR-25	-1.5221	0.0235	yes, negative	39	Good
John5	0.7528	0.0264	yes, positive	30	Fair
MR-14	-0.8890	0.0469	yes, negative	27	Fair
Bish2	0.6430	0.0257	yes, positive	24	Fair
Nton	0.6449	0.0013	yes, positive	21	Fair
Wall2	0.4781	0.0040	yes, positive	22	Fair
Fel2	0.5417	0.0133	yes, positive	29	Fair
Fel5	-2.1038	0.0165	yes, negative	33	Fair

WQR Summary:

In 2021, Michigan Clean Water Corps, the organization that oversees monitoring protocols for monitoring groups like ours in Michigan, developed a new scoring system for the bugs to replace the SQI. The new system called Water Quality Rating (WQR) should better reflect the pollution tolerance of the bugs found at the site. Since there is no way to convert SQI to WQR, FOTR continues to track SQI. This was the first season where we had sites with enough data to perform trend analyses for a small number of sites. There were no statistically significant trends in the subwatersheds (Table 3), but two sites demonstrated positive trends: John2, and Sprag (Table 4). Both of these sites had a GOOD WQR score.

Table 3-FOTR and WC Spring Bug Hunt Trend Summary 2022-2024 WQR					
Branch	slope	p-value	True trend	Average score	Water Quality Rating (WQR)
Main 1/2	0.2800	0.3990	no trend	6.22	Fair
Upper	-0.5989	0.4209	no trend	7.16	Fairly Poor
Johnson Creek	0.3325	0.7445	no trend	5.63	Fair
Middle 1	-0.3450	0.2146	no trend	6.10	Fair
Lower 1	0.4125	0.4873	no trend	6.28	Fair

*No sites sampled in Main 3/4, Middle 3 in 2024

**No sites with three years of data in Lower 2

Table 4- Friends of the Rouge and Wayne County Spring Bug Hunt Data Trend 2002-2024 by site WQR					
Site	slope	p-value	Statistically significant trend	Site average score	Water Quality rating (WQR)
Evan2	0.0000	1.0000	no trend	6.59	Fairly Poor
Main1	0.6900	0.2613	no trend	6.01	Fair
Nott	-0.0400	0.3980	no trend	7.02	Fairly Poor
Sprag	0.4700	4.25x10 ⁻¹⁶	yes, positive	5.1	Good
Bell1	-0.2450	0.9061	no trend	6.92	Fairly Poor
Bell2	3.12x10 ⁻¹⁶	1.0000	no trend	9	Very Poor
Bell3	-2.1450	0.1746	no trend	7.51	Poor
Up2	-0.0050	0.8790	no trend	5.21	Good
MR-22	0.5100	0.2707	no trend	5.5	Good
MR-23	-0.3850	0.6300	no trend	6.28	Fair
John1	-0.4300	0.2797	no trend	6	Fair
John2	0.5300	0.4155	yes, positive	5.44	Good
John3	0.3500	0.1041	no trend	5.68	Fair
John8	0.5600	0.3081	no trend	4.89	Good
Ing1	-0.3800	0.1518	no trend	5.92	Fair
Nton	-0.5200	0.6595	no trend	5.99	Fair
Ton1	-0.1350	0.8373	no trend	6.4	Fair
Fowl1	0.7600	0.5732	no trend	5.67	Fair
Low2	0.0650	0.8726	no trend	6.88	Fairly Poor



Since 2020, we have been testing sites for road salt (chloride) through the Izaak Walton League’s Salt Watch program during the Stonefly Search and Bug Hunts. Salt we apply to our roads and sidewalks for snow and ice removal washes into our streams and is toxic to aquatic life when it reaches high levels. Recognizing this, the State of Michigan Department of Environment, Great Lakes and Energy (EGLE) set water quality values aiming to protect surface water from chloride, based on parts per million (ppm) concentrations.

These are:

150 ppm and above - causes long term effects to aquatic life (chronic)

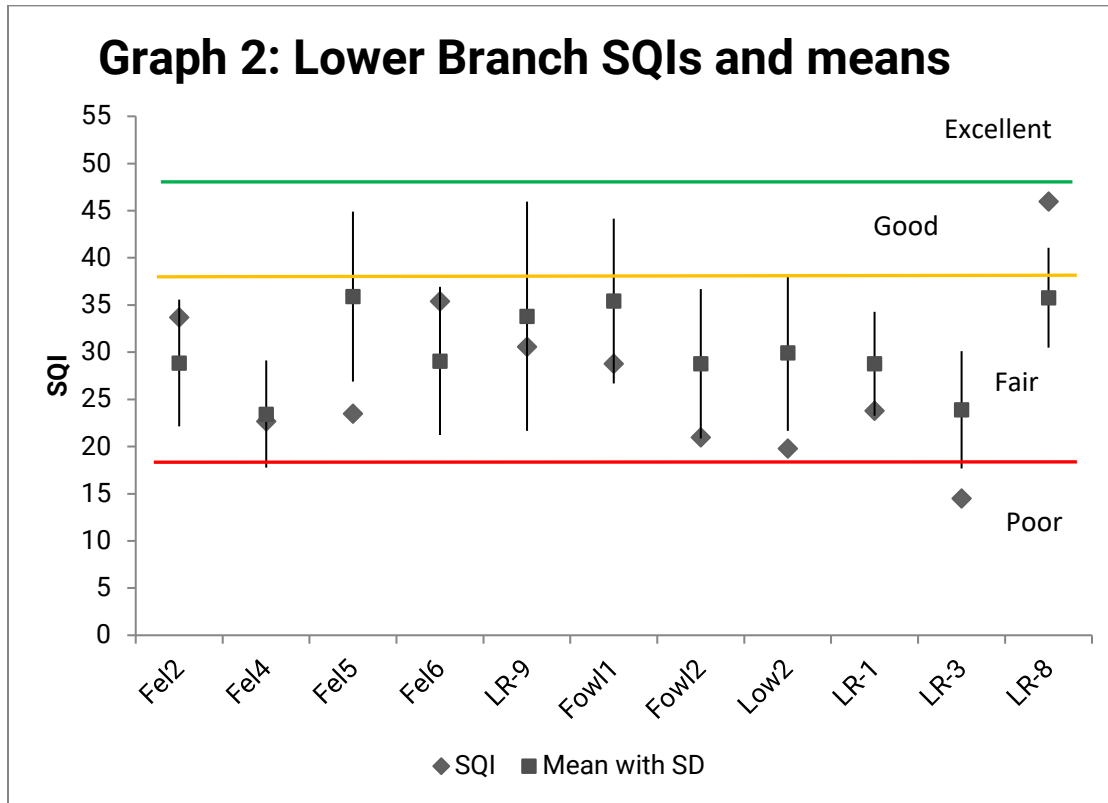
320 ppm and above - causes acute effects to aquatic life (toxic)

This spring, five site had toxic levels of chloride (table 5, map pg. 13). EGLE has already listed Bishop Creek as “impaired” due to high salt levels.

Table 5- Sites with Toxic Levels of Chloride (320 ppm and above)				
Branch	Stream Name	FIELDID	Site Description	Chloride (ppm)
Middle	Bishop Creek	Bish2	Scarborough Rd	518
Main	Evans Creek	Evan2	LTU	346
Middle	Ingersoll Creek	Ing1	Brookfarm Park	346
Middle	Tonquish Creek	MR-24	Lion's Pk	535
Middle	North Tonquish	Nton	Evergreen St	453

Last fall, we also began testing for nitrate and nitrite throughout the watershed. High levels of nitrate in the water can be due to human impacts such as fertilizer application on the land or sewage outfalls/discharge. Too much nitrate in the water can also encourage the growth of algae which could result in algal blooms. In the 1990s, the Environmental Protection Agency created a drinking water standard for nitrate at 10 mg/L (equivalent to 10 parts per million). Research suggests that prolonged exposure to nitrate levels below 10 mg/L can still lead to increased health risks. There were no sites with elevated levels of nitrate this spring.

Lower Branch



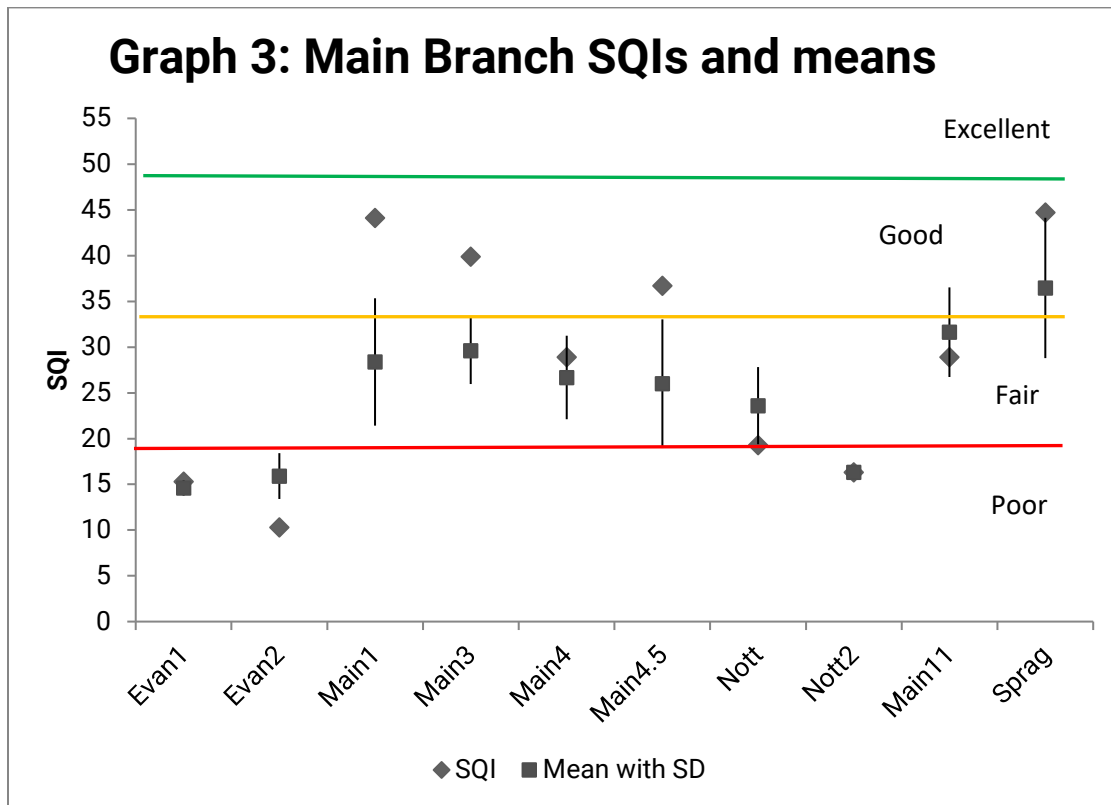
Eleven sites were sampled on the Lower Branch (Table 6, pg. 17), including two tributaries: Fellows and Fowler Creeks. SQIs averaged FAIR (27). Two sites had GOOD SQIs, eight sites had FAIR SQIs, and one site had a POOR SQI. Site scores calculated using the WQR system averaged fair (6.03). According to the WQR scoring, two sites were GOOD, six were FAIR, and three were FAIRLY POOR. Sites had an average of 12 taxa, and 2 EPT taxa.

Chloride levels ranged from a low of <31 ppm at Fel6 and Fowl1 to a high of 231 ppm at Fel5; two sites had chronic levels (Fel5 and LR-3) with no sites at the toxic level (Table 5, map pg. 13). There were no sites with elevated levels of nitrate this spring.

SQI scores were compared with past data (Graph 2). Nine were within a standard deviation of the average for the site, one was above (LR-8), and one was below (LR-3).

Long term trend analysis showed no significant trends for the Lower 1 and for all of the Lower when the subwatersheds are combined (Table 1, graphs pg. 20). Fel2 had a significant positive trend, and Fel5 had a significant negative trend (Table 2).

Main Branch

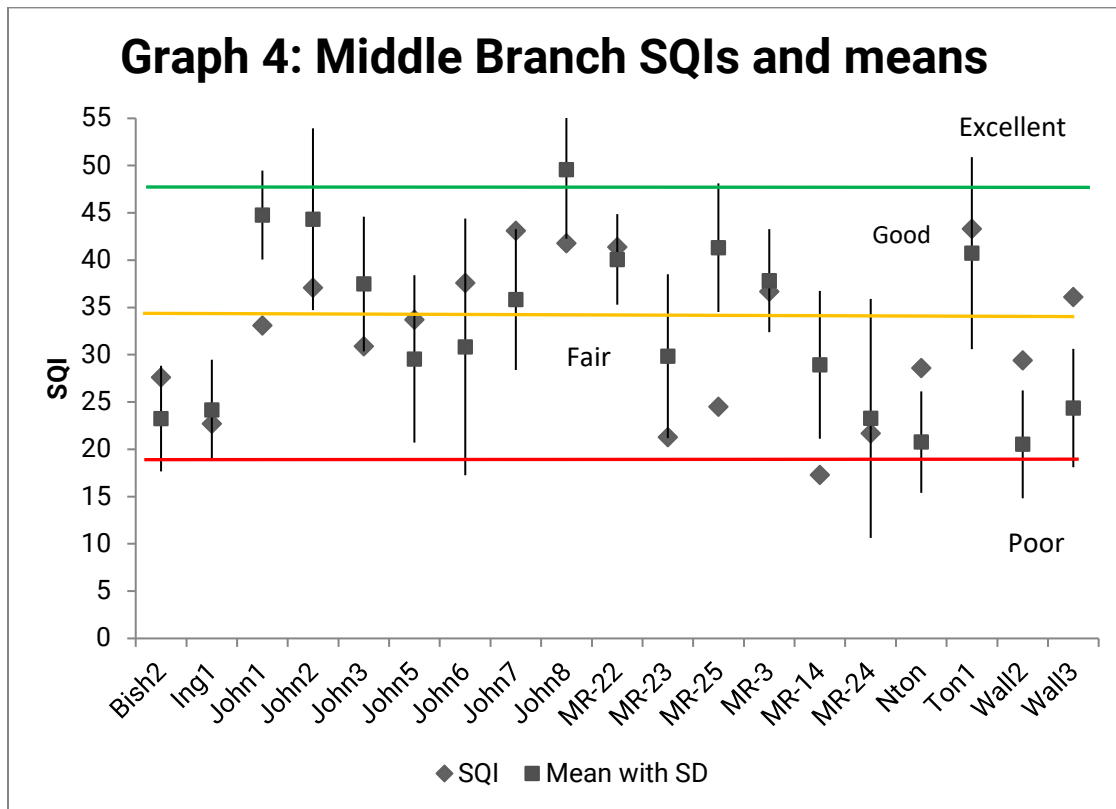


Ten sites on the Main Branch were sampled, including the following tributaries: Evans, Nottingham, Quarton, and Sprague Creek. SQIs averaged FAIR (28). Four sites rated GOOD, three FAIR, and three POOR. WQRs averaged FAIR (6.34). Five sites rated FAIR, and five sites rated FAIRLY POOR. Taxa averaged 13 and 2 EPT. Chloride levels averaged 179 ppm, and most sites were at the chronic effects level (>150 ppm), with one site at the toxic level (Evan2) (Table 5).

SQI scores were compared with past data (Graph 3). Four were within a standard deviation of the average for the site, four were above, and two were below.

Long term trend analysis shows no trends for the Main when the subwatersheds are combined (Table 1, graphs pg. 21). Main1 and Main3 had significant positive trends (Table 2).

Middle Branch

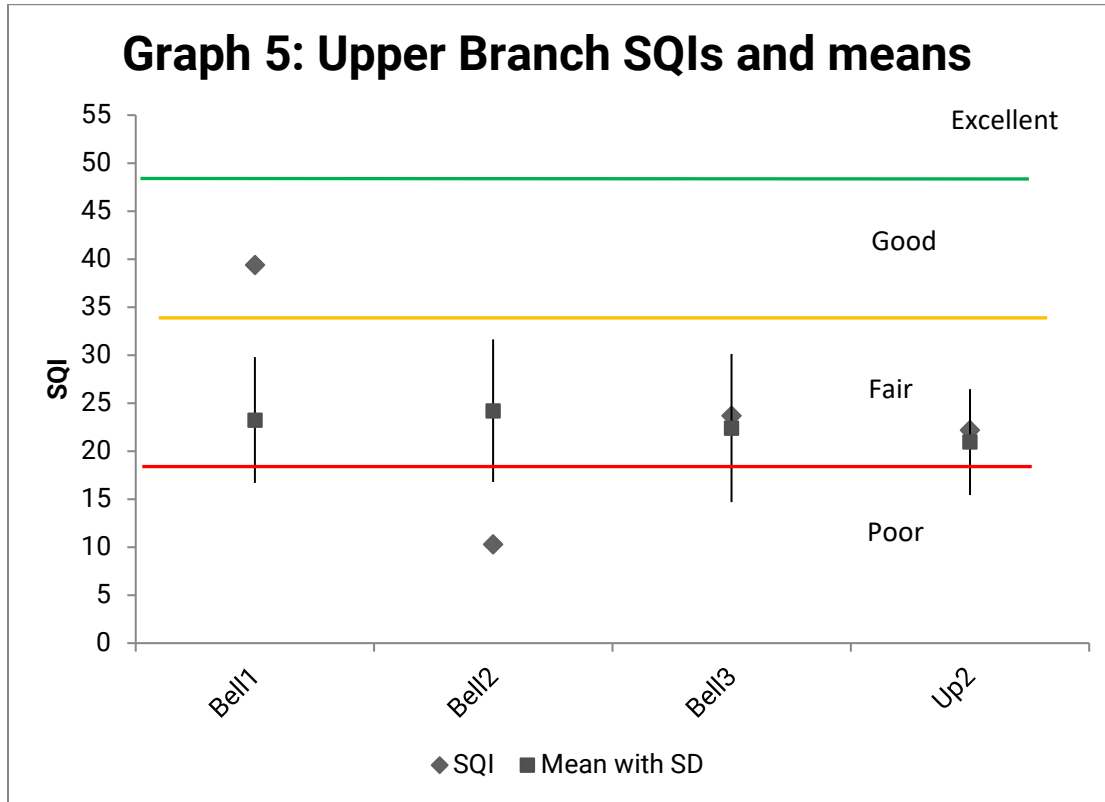


Nineteen sites were sampled on the Middle Branch and seven of its tributaries. Ten sites were sampled on Johnson Creek, one on Bishop Creek, four on Tonquish Creek, one on Ingersoll Creek, and two Walled Lake Drainage sites. The final site was in the Middle Rouge. SQI scores averaged FAIR (32). Eight site SQIs were GOOD, ten FAIR and one POOR. WQRs averaged fair (5.94). Seven sites had GOOD WQRs, 10 FAIR, one FAIRLY POOR, and one VERY POOR. Taxa averaged 14, 3 EPT.

In comparing averages and past data (Graph 4), the majority of sites (12) were within a standard deviation of the average for the sites. Three sites were above (Nton, Wall2, and Wall3) and four sites were below (John1, John8, MR-25, and MR-14). Chloride levels averaged 191 ppm (chronic) and four sites were at the toxic level (Table 5).

In long term trend analysis, the Middle 1 had a positive trend (Table 1). John5, Bish2, Nton, and Wall2 all had a positive trends when considered by site, and MR-14, MR-23, and MR-25 all had negative trends (Table 2).

Upper Branch



Four Upper branch sites were sampled including three sites on the Bell Creek tributary, and one on the Upper Rouge at Shiawasee Park. SQIs averaged FAIR (24). One site was GOOD, two were FAIR, and one was POOR. WQR averaged fairly poor (6.66). One site had a GOOD WQR, two were FAIR, and one was POOR. Taxa averaged 9, and 1 EPT.

In comparing averages and past data (Graph 5), one site was above a standard deviation of the average (Bell1), one was below (Bell2), and the rest were within the standard deviation of the average for a given site. Chloride levels averaged 271 ppm (chronic) and all four sites were at the chronic level (Table 6).

Long term trend analysis shows no trend for the Upper Branch (Table 1, graph pg. 24).

Dragonfly Diversity

Since we regularly preserve specimens, we were able to gather more information about the dragonflies. We sent some specimens to our local dragonfly expert and adjunct curator of Odonata at MSU, Darrin O'Brien. Darrin and his wife, Julie Craves, have been identifying Odonates (dragonflies and damselflies) for many years. In 2021, they identified a Hine's emerald dragonfly, a federally endangered species, in Oceana County and Julie just published a paper on it (Craves, Julie A., et al. "A new locality and unexpected haplotypes of the federally-endangered Hine's Emerald dragonfly, *Somatochlora hineana* (Odonata: Corduliidae)." *Bulletin of American Odonatology* 13.2 (2022): 7-17).

Thank you to Darrin and Julie for examining our specimens!

Darrin and Julie identified a Unicorn Clubtail (*Agricomphus villosipes*) the only dragonfly from the family Gomphidae found at our sites this spring. This organism can be found in slow moving streams with mud bottoms. This one was found at the Sprag site in Troy.



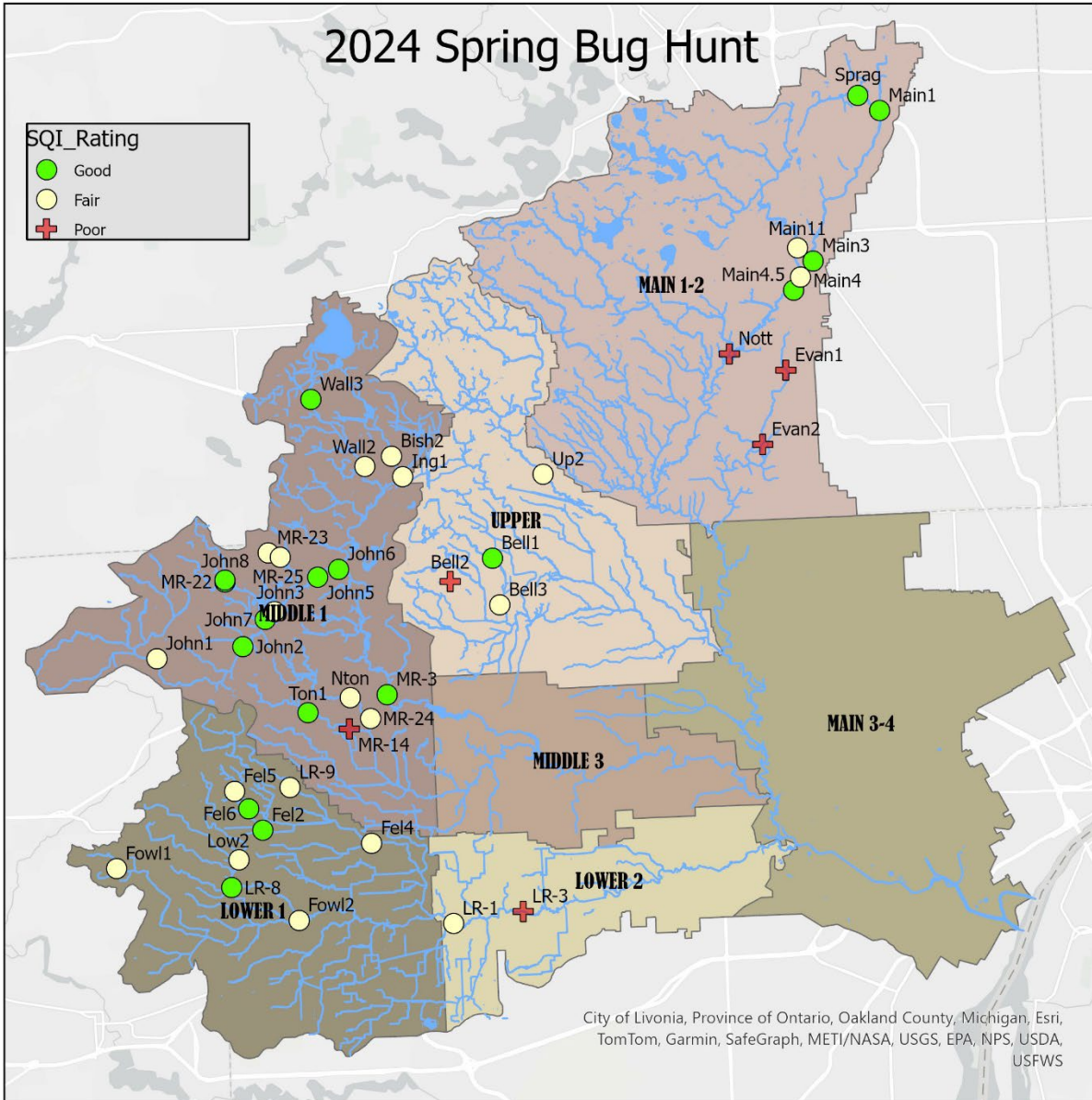
Unicorn Clubtail Dragonfly
Photo credit: Illinois DNR

They also identified a few Common Whitetail Skimmers (*Plathemis Lydia*) at the Evan1 site. Common Whitetails can tolerate degraded habitat, and are widespread throughout North America.

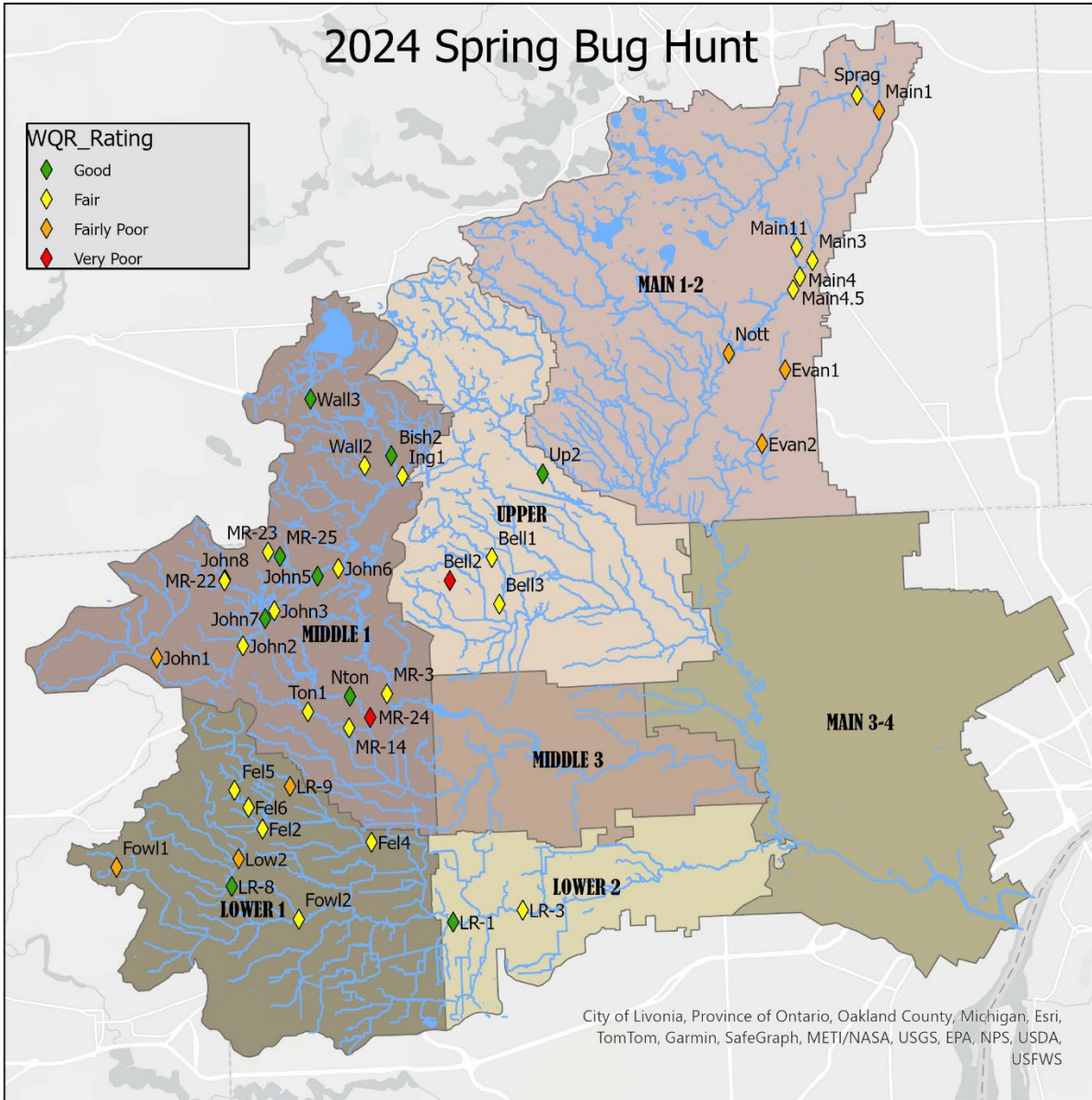


Common Whitetail Dragonfly
Photo credit: Wisconsin Odonata Survey

2024 Spring Bug Hunt



2024 Spring Bug Hunt

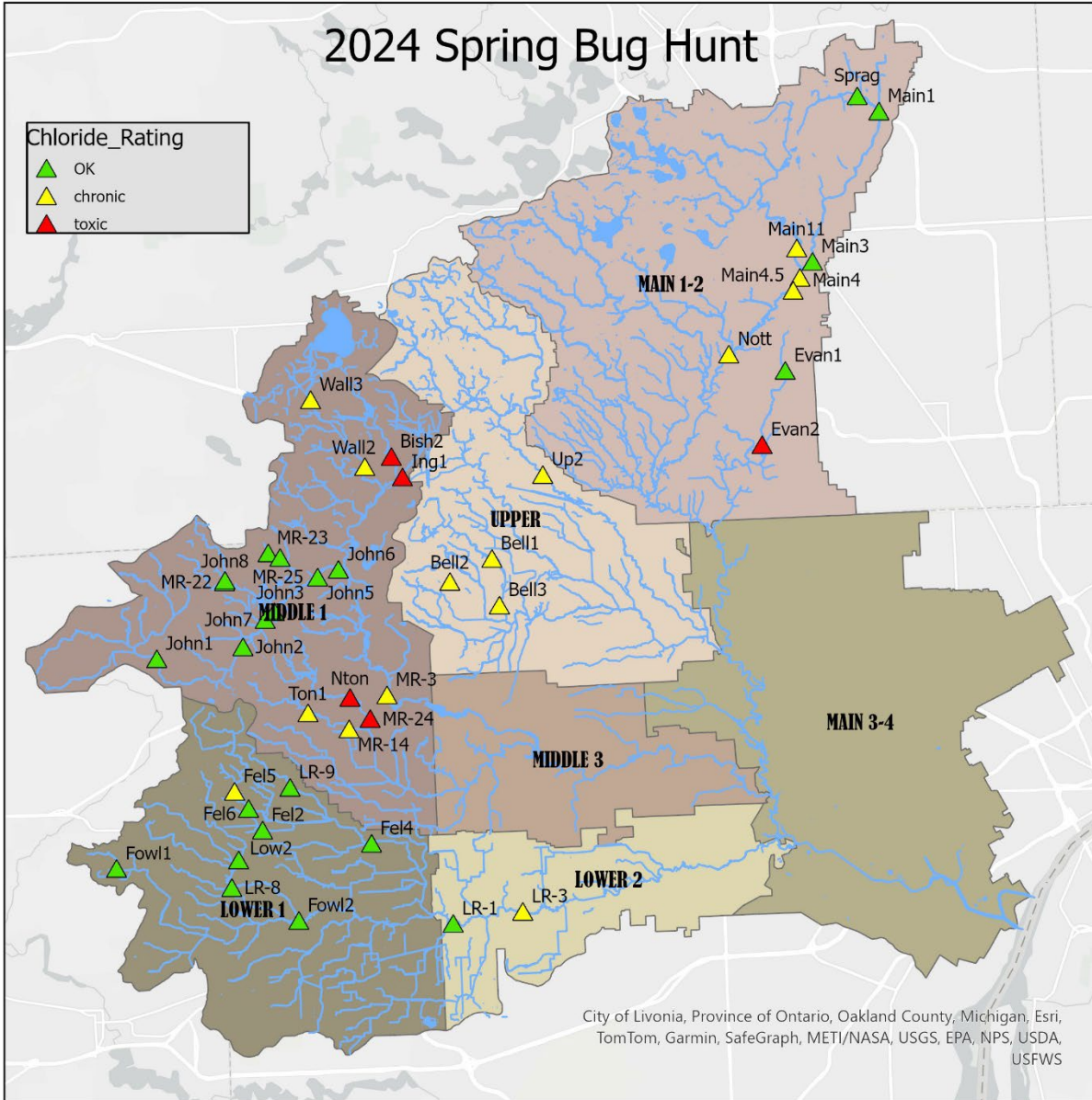


City of Livonia, Province of Ontario, Oakland County, Michigan, Esri, TomTom, Garmin, SafeGraph, METI/NASA, USGS, EPA, NPS, USDA, USFWS

2024 Spring Bug Hunt

Chloride_Rating

- ▲ OK
- ▲ chronic
- ▲ toxic



Thank you to all the **volunteers and Team Leaders, Wayne County Department of Public Services for providing bug hunt team leaders, sampling additional sites, and other technical support, Sue Thompson** for sampling additional sites and identifying difficult specimens, and **Deirdre Devlin and Schoolcraft College** students for sampling one site.

Funding for the event was provided by the communities of Beverly Hills, Canton Township, Farmington, Livonia, Northville Township, Novi, Plymouth, Plymouth Township, Southfield, Troy, Birmingham, Washtenaw County Water Resources, Michigan Department of Environment, Great Lakes, and Energy and the United States Environmental Protection Agency's Great Lakes Restoration Initiative, the Alliance of Rouge Communities, and the Michigan Clean Water Corps.



**Please join us for the Fall Bug Hunt
Oct. 12, 2024 10 am-4pm
Sign up online today (deadline Monday, September 30th, 2024)**

<https://forms.gle/vChsYYs8vPUQQ64r5>



Volunteers meet at 10am at the Plymouth Cultural Center (525 Farmer St., Plymouth). There will be an indoor welcome from 10am-11am where volunteers will have a chance to meet their team, enjoy refreshments (coffee, juice, bagels, and donuts), and watch a short presentation before heading out to two sites throughout the watershed. Ending times for each team will vary, but most teams should be able to finish by 3pm.

Holding it this way means people can meet all of the rest of the volunteers and it makes it easier for us to make adjustments so that each team has enough volunteers. For those who would rather meet in the field, that can still be arranged.



Team Leader Training



Sat. Sept. 28, 2024 9am-1pm (must have participated in a previous event)

<https://forms.gle/qLPZfKvJTQNDZftB8>



We are always in need of people willing to train and act as Team Leaders for Bug Hunts and Stonefly Searches. If you have attended an event before and would like to train to become a team leader, please sign up for the fall training.

Table 6: 2024 Spring Bug Hunt Sampling Sites

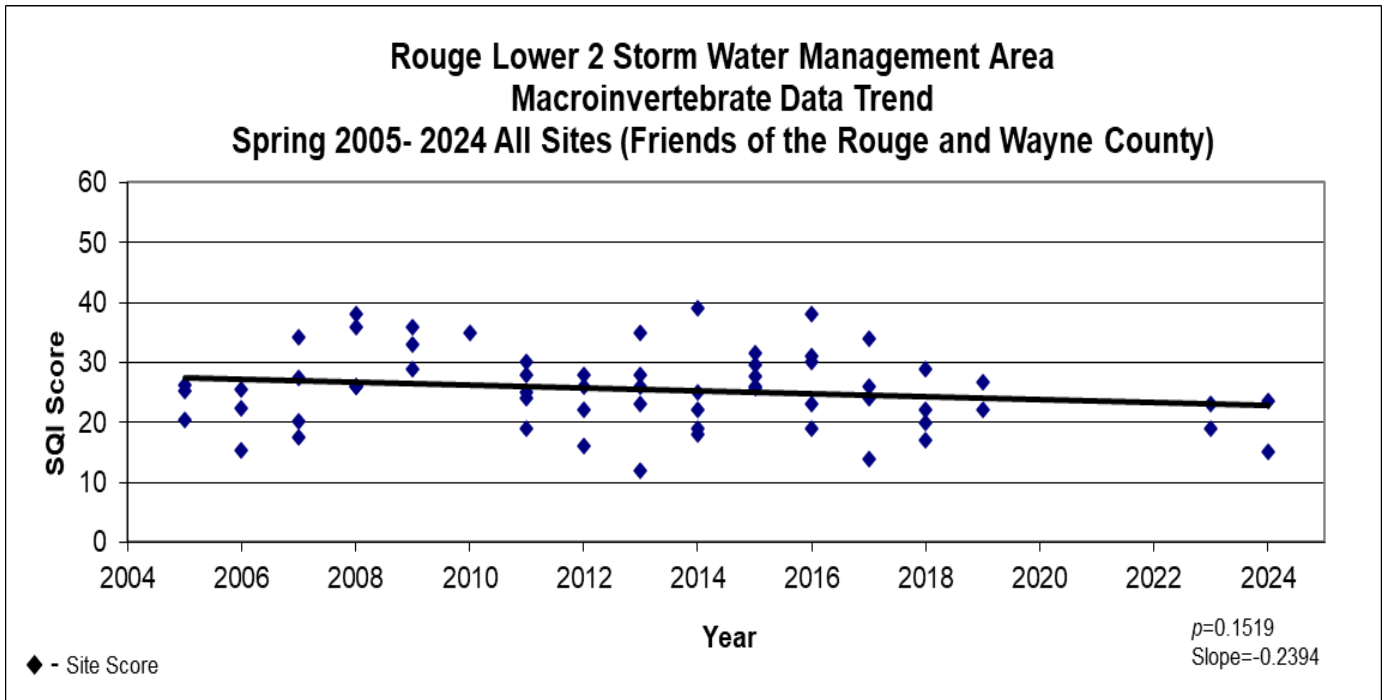
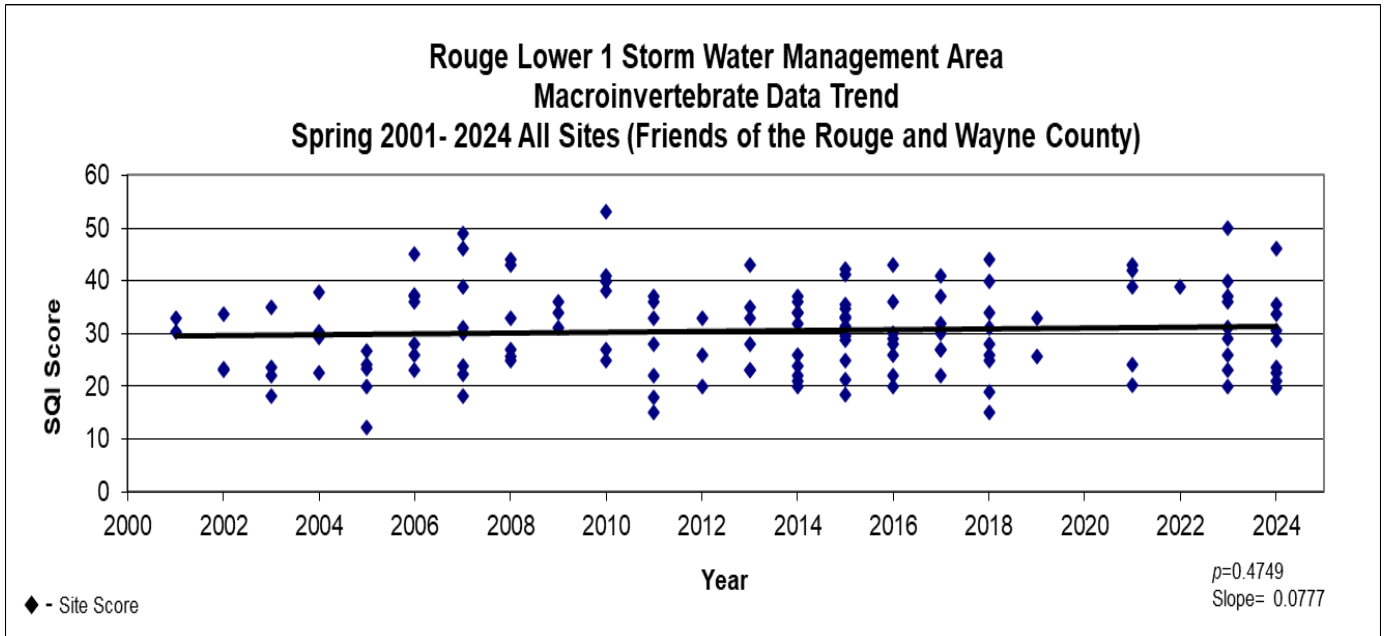
Lower Branch												
Stream Name	FIELDID	Site Description	WQR Rating	WQR	SQI	SQI Rating	Taxa	EPT	Chloride (ppm)	Chloride Rating	Nitrate (ppm)	Nitrite (ppm)
Fellows Creek	Fel2	Vintage Valley	Fair	5.51	33.7	FAIR	14	2	85	OK	1	0.15
Fellows Creek	Fel4	Flodin Pk	Fair	5.74	22.7	FAIR	11	1	119	OK	1	0.15
Fellows Creek	Fel5	Warren Ridge	Fair	5.74	23.5	FAIR	9	1	231	chronic	0	0
Fellows Creek	Fel6	Hanford	Fair	5.97	35.4	GOOD	15	2	<31	OK	0	0
Fellows Creek	LR-9	Fellows Beck Warren	Fairly Poor	6.63	30.6	FAIR	14	1	85	OK	N/A	N/A
Fowler Creek	Fowl1	Prospect	Fairly Poor	7	28.8	FAIR	14	4	<31	OK	0	0
Fowler Creek	Fowl2	Fowler Beck	Fair	5.92	21	FAIR	9	3	43	OK	2	0
Lower Rouge	Low2	Cherry Hill	Fairly Poor	7.13	19.8	FAIR	7	0	43	OK	N/A	N/A
Lower Rouge	LR-1	Commerce Ct	Good	5.44	23.8	FAIR	10	2	103	OK	4	0
Lower Rouge	LR-3	Goudy Park	Fair	5.73	14.5	POOR	6	1	151	chronic	4	0
Lower Rouge	LR-8	Ridge Proctor	Good	5.5	46	GOOD	19	3	43	OK	1	0.15
Average			FAIR	6.03	27	FAIR	12	2	87	OK	1	0
Main Branch												
Stream Name	FIELDID	Site Description	WQR Rating	WQR	SQI	SQI Rating	Taxa	EPT	Chloride	Chloride Rating	Nitrate (ppm)	Nitrite (ppm)
Evans Creek	Evan1	Evans Green Spruce	Fairly Poor	6.8	15.3	POOR	9	0	106	OK	1	0.15
Evans Creek	Evan2	LTU	Fairly Poor	7	10.3	POOR	8	0	346	toxic	2	0.15
Main Rouge	Main1	Firefighters Park	Fairly Poor	6.72	44.1	GOOD	18	3	145	OK	1	0.15
Main Rouge	Main3	Quarton at Lakeside	Fair	6.06	28.9	FAIR	14	1	233	chronic	1	0.15
Main Rouge	Main4	Booth Park	Fair	6.14	39.9	GOOD	16	3	119	OK	1	0.15
Main Rouge	Main4.5	Birmingham	Fair	5.93	28.9	FAIR	14	1	190	chronic	1	0.15
Quarton Branch	Main11	Fairway Park	Fair	5.61	36.7	GOOD	16	1	190	chronic	1	0.15
Nottingham Creek	Nott	Country Day Middle School	Fairly Poor	7	19.3	FAIR	7	1	159	chronic	1	0.3
Nottingham Creek	Nott2	Nottingham-Main	Fairly Poor	6.61	16.3	POOR	11	1	159	chronic	1.5	0.3
Sprague Creek	Sprag	Lloyd Stage Nature Center	Fair	5.57	44.7	GOOD	17	4	145	OK	1	0.15
Average			FAIR	6.34	28	FAIR	13	2	179	cronic	1	0

Table 6 continued: 2024 Spring Bug Hunt Sampling Sites

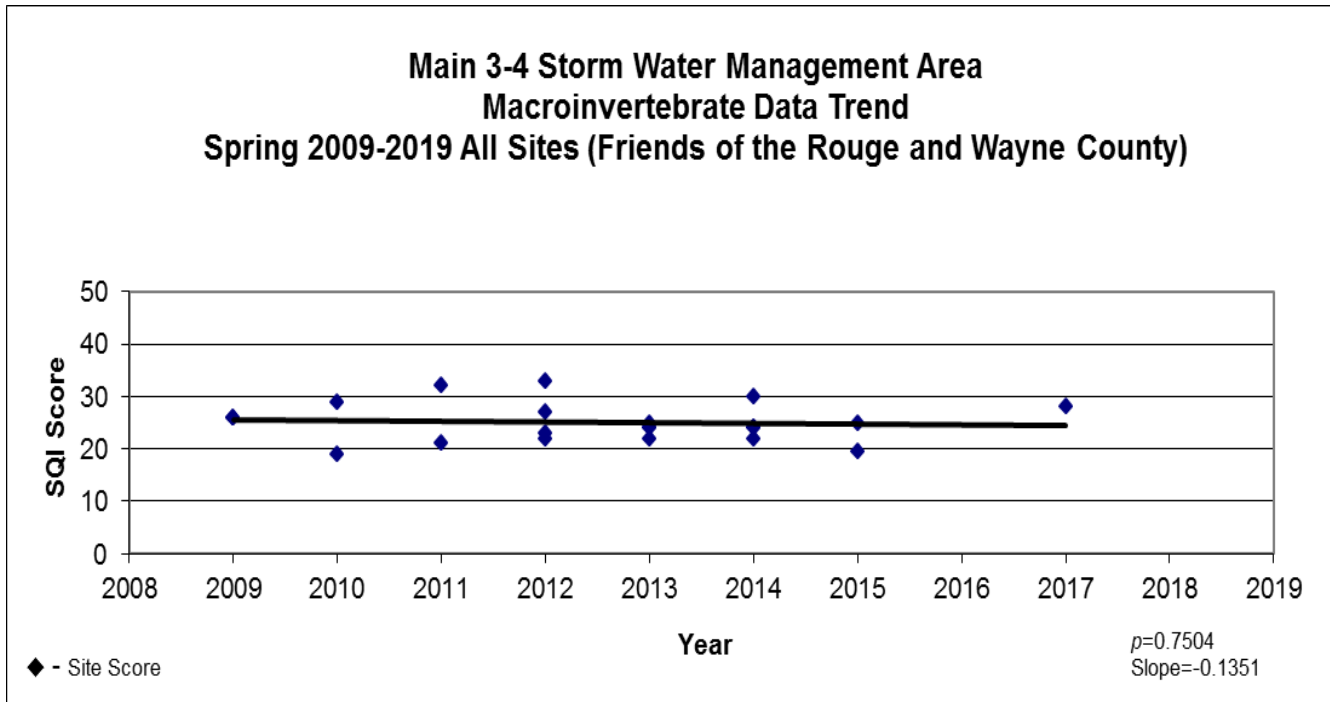
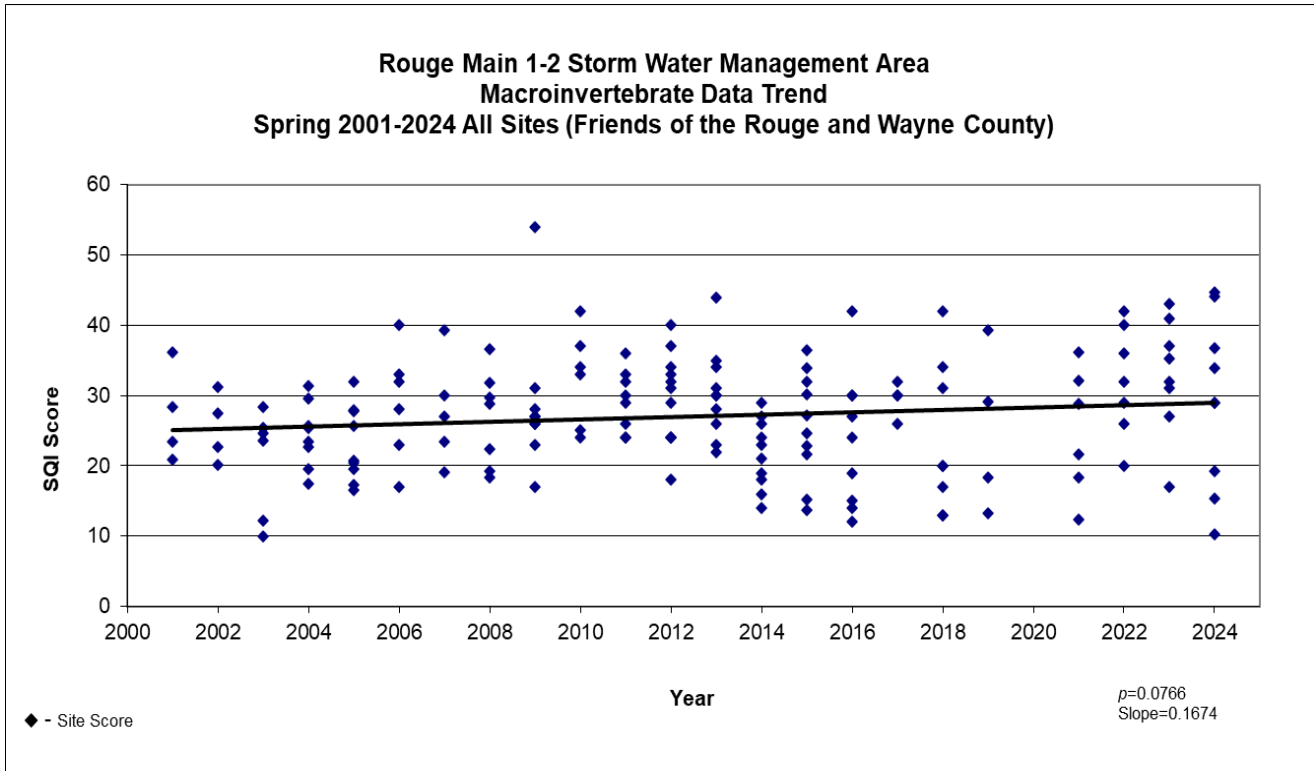
Middle Branch												
Stream Name	FIELDID	Site Description	WQR Rating	WQR	SQI	SQI Rating	Taxa	EPT	Chloride	Chloride Rating	Nitrate (ppm)	Nitrite (ppm)
Bishop Creek	Bish2	Bishop Scarborough	Good	4.64	27.6	FAIR	11	1	518	toxic	1	0.15
Ingersoll Creek	Ing1	Brookfarm Park	Fair	5.59	22.7	FAIR	10	1	346	toxic	1	0.15
Johnson Creek	John1	5M Salem	Fairly Poor	6.55	33.1	FAIR	17	5	31	OK	0	0.15
Johnson Creek	John2	5M NV	Fair	5.99	37.1	GOOD	15	5	43	OK	N/A	N/A
Johnson Creek	John3	6M NV	Fair	6	30.9	FAIR	16	4	54	OK	0	0
Johnson Creek	John5	Fish Hatchery Park	Good	5.21	33.7	FAIR	15	4	66	OK	1	0
Johnson Creek	John6	7 Mile & Hines	Fair	5.86	37.6	GOOD	14	3	66	OK	1	0
Johnson Creek	John7	Arcadia Ridge subdivision	Good	5.5	43.1	GOOD	18	5	50	OK	0	0
Johnson Creek	John8	Maybury Angell	Good	5.28	41.8	GOOD	19	3	65	OK	0	0
Johnson Creek	MR-22	Maybury south	Fair	6.15	41.4	GOOD	16	2	49	OK	0	0
Johnson Creek	MR-23	Maybury north	Fair	6.23	21.3	FAIR	10	1	92	OK	1	0.15
Johnson Creek	MR-25	Maybury East	Good	5.29	24.5	FAIR	14	2	92	OK	1	0.15
Tonquish Creek	MR-14	Smith Elem	Fair	6.2	17.3	POOR	8	1	179	chronic	1	0
Middle Rouge	MR-3	Plym Riverside	Fair	5.81	36.7	GOOD	15	4	194	chronic	2	0
Tonquish Creek	Nton	S Evergreen St	Good	4.96	28.6	FAIR	10	2	453	toxic	0	0
Tonquish Creek	Ton1	Plym Twp Pk	Fair	5.97	43.3	GOOD	19	3	242	chronic	0	0
Tonquish Creek	MR-24	Lion's Pk	Very Poor	10	21.7	FAIR	6	1	535	toxic	2	0
Walled Lake Drainage	Wall2	10 Mile	Fair	6.22	29.4	FAIR	12	1	280	chronic	5	0.15
Walled Lake Drainage	Wall3	12 Mile/Taft	Good	5.32	36.1	GOOD	14	2	280	chronic	5	0.15
Average			FAIR	5.94	32	FAIR	14	3	191	chronic	1	0
Upper Branch												
Stream Name	FIELDID	Site Description	WQR Rating	WQR	SQI	SQI Rating	Taxa	EPT	Chloride	Chloride Rating	Nitrate (ppm)	Nitrite (ppm)
Bell Branch	Bell1	Bicentennial Park	Fair	5.72	39.4	GOOD	13	3	301	chronic	1	0.15
Bell Branch	Bell2	Schoolcraft College	Very Poor	10	10.3	POOR	4	0	242	chronic	1	0.3
Bell Branch	Bell3	Livonia 6 Mile	Fair	5.71	23.7	FAIR	11	1	260	chronic	1	0.15
Upper Rouge	Up2	Shiawasee Park	Good	5.22	22.2	FAIR	8	1	280	chronic	5	0

Trend Graphs

Lower Branch



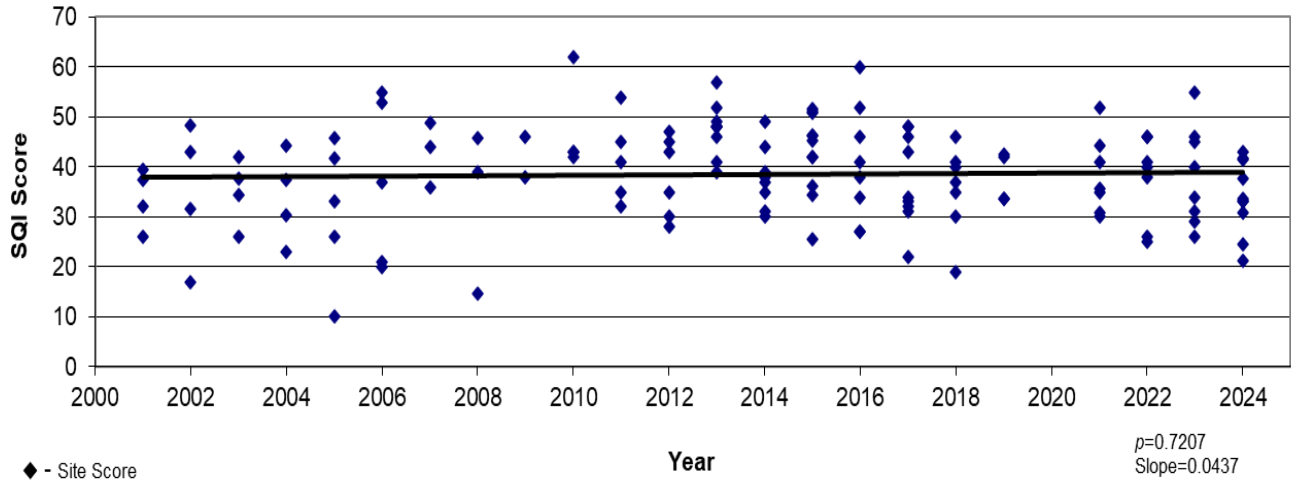
Main Branch



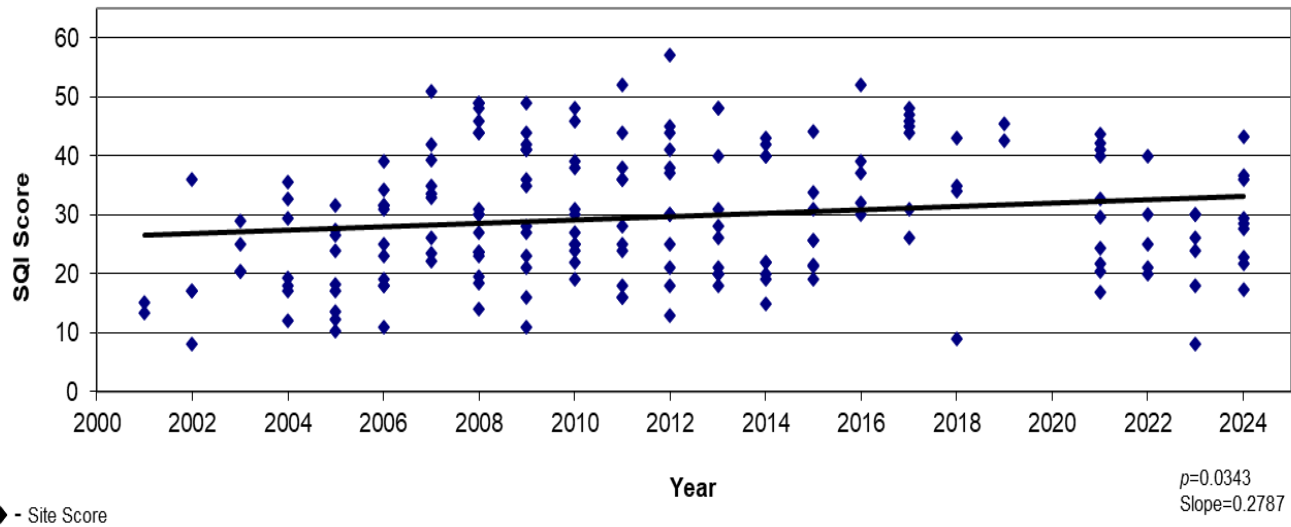
***no sites sampled in Main 3/4 in Spring 2018-2024**

Middle Branch

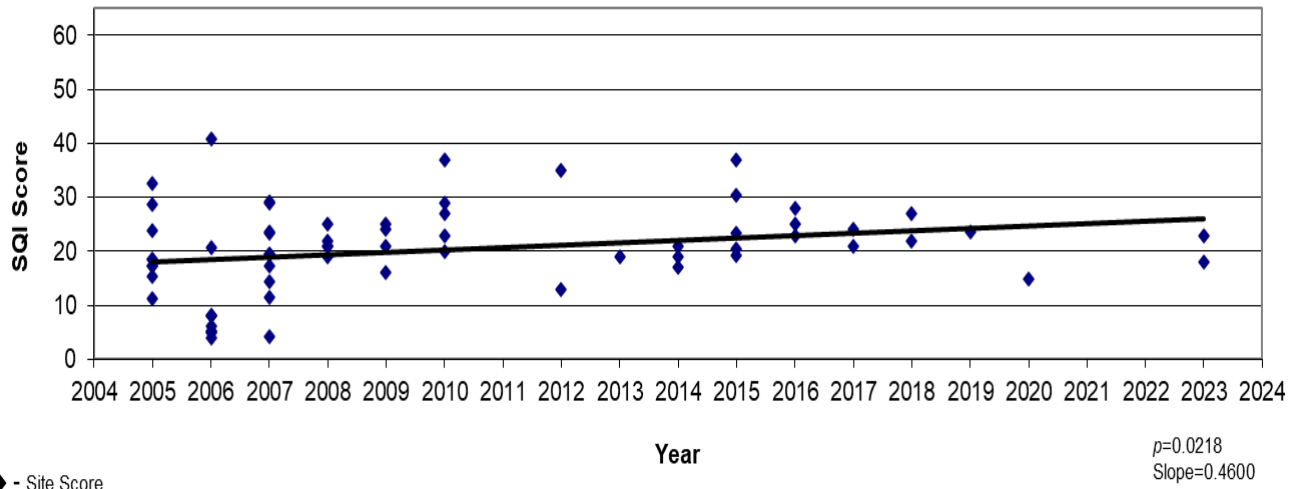
Johnson Creek
Rouge Middle 1 Storm Water Management Area
Macroinvertebrate Data Trend
Spring 2001-2024 All Sites (Friends of the Rouge and Wayne County)



Rouge Middle 1 Storm Water Management Area
Macroinvertebrate Data Trend
Spring 2001- 2024 All Sites (Friends of the Rouge and Wayne County)



Rouge Middle 3 Storm Water Management Area
Macroinvertebrate Data Trend
Spring 2005- 2023 All Sites (Friends of the Rouge and Wayne County)



***no sites sampled in Middle 3 Spring 2024**

Upper Branch

