

Cass River Water Quality Monitoring Project

Year Two Project Summary

Prepared by: Environmental Science Solutions, LLC

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Project Background and Goals

The *Cass River Greenway* (CRG) organization contracted *Environmental Science Solutions* (ESS) to assist with fulfillment of its obligations pursuant to the Cass River Water Quality Monitoring Project grant (Project # 2011-0501) issued by the State of Michigan Department of Environmental Quality – Water Resources Division – Office of Surface Water Assessment.

The main goal of the project is to provide current baseline information to help determine watershed conditions along the main channel of the Cass River. Data and information from this project will be used to complement the current Cass River Watershed Management Plan and provide community members and stakeholders information about water quality within the study area.

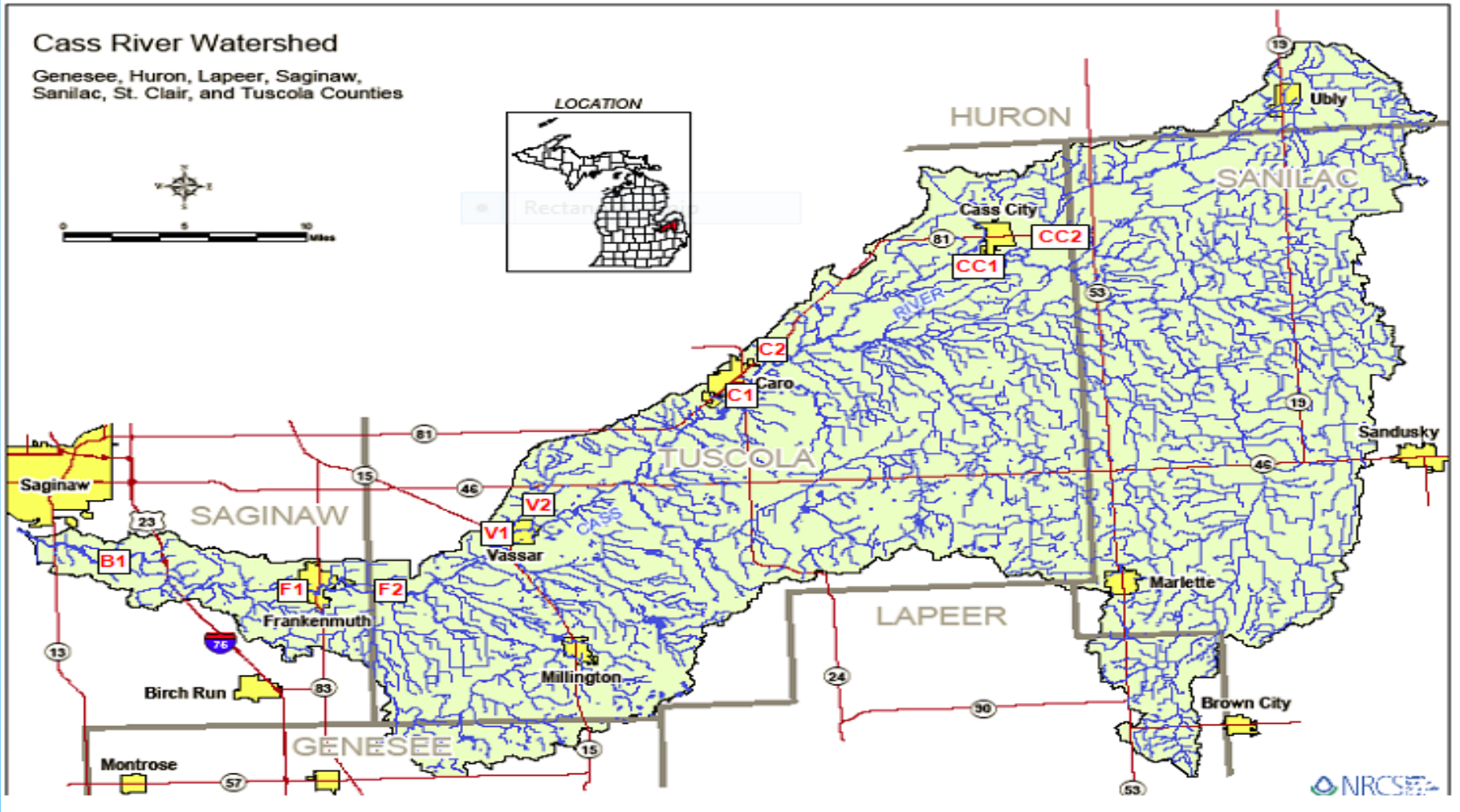
Project Study Area

The study area for the project is the main channel of the Cass River on the northern boundary of the Cass River Watershed from Cass City in the northeast to Bridgeport in the southwest in east central lower Michigan. Nine sampling sites are located near the municipalities of Cass City, Caro, Vassar, Frankenmuth and Bridgeport in Tuscola and Saginaw counties. (See site map on next slide).

Project Study Area

Cass River Watershed

Genesee, Huron, Lapeer, Saginaw, Sanilac, St. Clair, and Tuscola Counties



Sample Sites

Site Name	Site ID	Municipality	County	Latitude	Longitude	Watershed
Cemetery Rd.	CC2	Cass City	Tuscola	43.5847	-83.1736	Cass River
Dodge Rd.	CC1	Cass City	Tuscola	43.5698	-83.2321	Cass River
Dayton Rd.	C2	Caro	Tuscola	43.4901	-83.3765	Cass River
Wells Rd.	C1	Caro	Tuscola	43.4503	-83.4401	Cass River
Caine Rd.	V2	Vassar	Tuscola	43.3924	-83.5222	Cass River
Huron Rd.	V1	Vassar	Tuscola	43.3712	-83.5803	Cass River
Bray Rd.	F2	Frankenmuth	Tuscola	43.3244	-83.6572	Cass River
Beyer Rd.	F1	Frankenmuth	Saginaw	43.3287	-83.7584	Cass River
Fort Rd.	B1	Bridgeport	Saginaw	43.3486	-83.8844	Cass River

Sample Parameters

Total Phosphorus

Total Suspended Solids

Fecal Coliform Bacteria

Nitrates

Turbidity

Temperature

pH

Dissolved Oxygen

Biological Oxygen Demand

Year Two Sampling Summary Highlights

2013 Sampling season began about 3 weeks earlier than 2012 (Early- April vs. May)

2013 was a bit cooler and wetter sampling season. More significant rain events.

Variation from 2012 to 2013 includes:

Increased Phosphorus levels in the upper and lower reaches of the sampling area.

pH Values were lower throughout the sample area.

Nitrate Values were down throughout the sample area. Elevated values occurred throughout the sample area on the 4/24 sample date.

Total Suspended solids and Turbidity values were elevated in all but the Fort Rd. site (B1).

Biological Oxygen Demand values were increased at all sites

Sample Results – Year Two

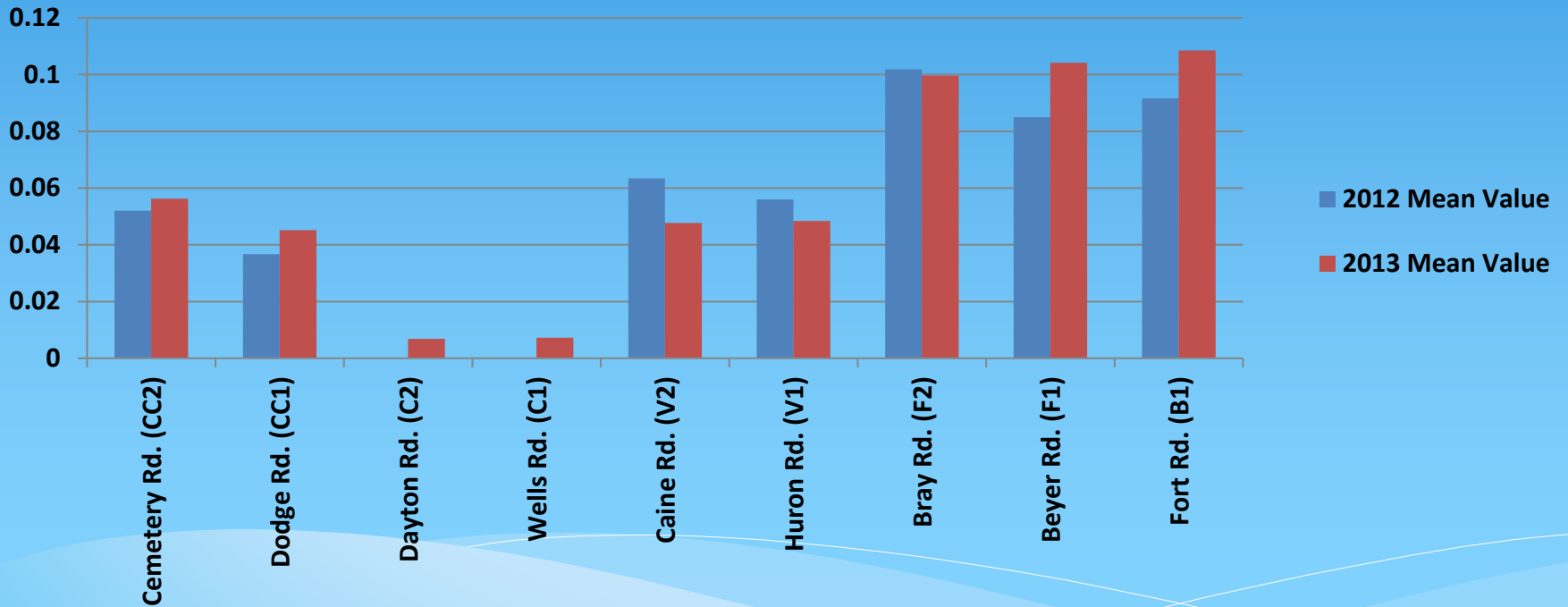
Site Name	Phosphorous	Total Suspended Solids	Fecal Coliform Bacteria	Nitrates	Turbidity	Temperature	pH	Dissolved Oxygen	Biochemical Oxygen Demand
Geometric Mean	mg/L	mg/L	Col / 100 ml	mg/L	NTU	° F	Units	mg/L	mg/L
Cemetery Rd. (CC2)	0.06	11.6	129	2.79	10.2	62.5	7.9	6.47	2.15
Dodge Rd. (CC1)	0.05	9.0	175	2.55	9.1	62.6	7.9	6.57	2.44
Dayton Rd. (C2)	0.007	14.5	94	2.63	14.9	63.5	8.0	6.23	2.38
Wells Rd. (C1)	0.01	23.3	90	2.80	26.2	64.1	8.0	6.38	2.05
Caine Rd. (V2)	0.05	13.6	55	2.71	13.9	63.2	8.0	6.49	2.16
Huron Rd. (V1)	0.05	13.3	58	2.99	13.5	64.2	8.1	6.12	1.81
Bray Rd. (F2)	0.10	13.9	189	2.10	10.2	64.3	8.1	6.24	1.96
Beyer Rd. (F1)	0.10	20.2	163	2.11	13.5	64.6	8.0	6.20	2.03
Fort Rd. (B1)	0.11	15.6	83	2.62	15.8	66.2	8.1	6.21	1.71
Study Area Geometric Mean	0.04	14.46	105	2.57	13.50	63.90	8.00	6.32	2.06

Annual Comparison

Percent Change From 2012 to 2013 Sampling Season									
Site Name	Phosphorous	Total Suspended Solids	Fecal Coliform Bacteria	Nitrates	Turbidity	Temperature	pH	Dissolved Oxygen	Biochemical Oxygen Demand
Geometric Mean	mg/L	mg/L	Col / 100 ml	mg/L	NTU	° F	Units	mg/L	mg/L
Cemetery Rd. (CC2)	7.6%	46.6%	26.1%	-8.6%	33.0%	-0.7%	-3.6%	7.6%	30.9%
Dodge Rd. (CC1)	18.8%	45.8%	52.7%	-29.2%	49.3%	-0.5%	-4.1%	6.5%	33.2%
Dayton Rd. (C2)	99.7%	9.5%	56.7%	-40.8%	27.0%	-4.4%	-3.8%	1.3%	34.3%
Wells Rd. (C1)	99.5%	26.2%	34.6%	-41.8%	45.9%	-2.7%	-3.3%	8.5%	28.5%
Caine Rd. (V2)	-33.1%	13.4%	-2.7%	-38.4%	27.6%	-4.2%	-3.4%	9.0%	30.2%
Huron Rd. (V1)	-15.7%	7.3%	5.5%	-27.2%	13.8%	-3.2%	-2.4%	4.6%	24.3%
Bray Rd. (F2)	-2.2%	22.8%	29.2%	-57.0%	20.6%	-2.9%	-1.8%	7.8%	30.3%
Beyer Rd. (F1)	18.4%	35.2%	13.9%	-68.4%	29.1%	-5.0%	-2.8%	11.7%	40.9%
Fort Rd. (B1)	15.6%	-46.9%	-56.7%	-61.3%	-21.6%	-4.6%	-2.8%	3.3%	5.8%
Percent Change (Total Mean)	71%	21%	23%	-40%	27%	-3%	-3%	7%	29%

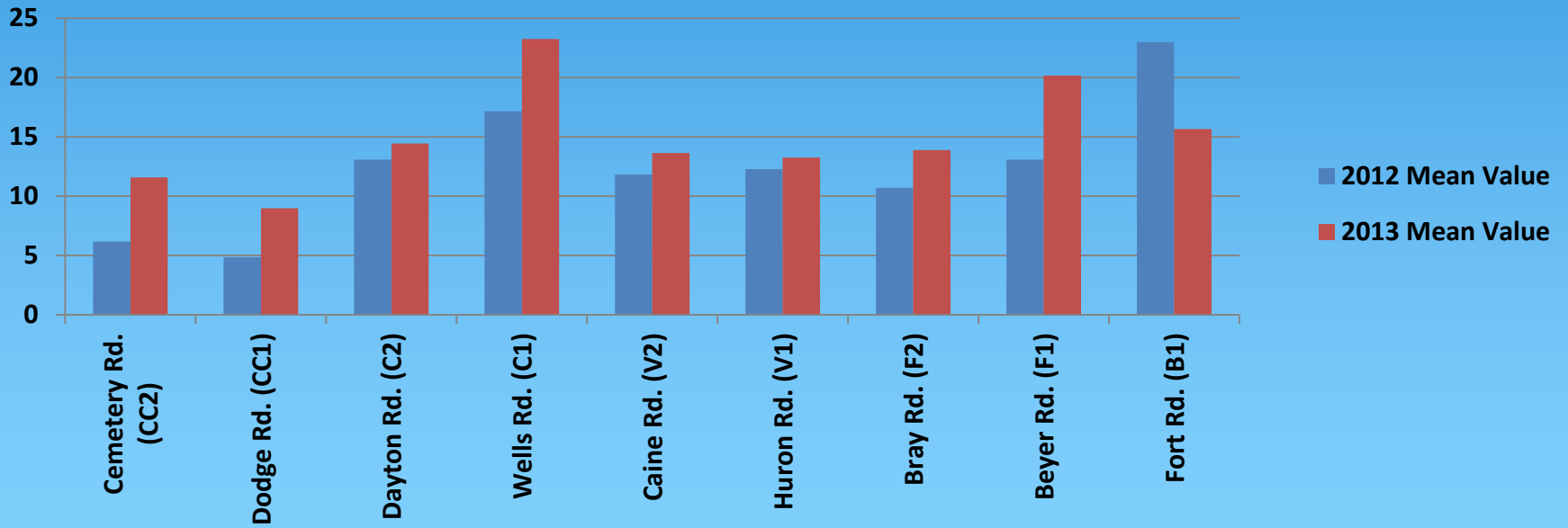
Mean Value Comparison - Phosphorous

Phosphorous Mean Site Values (mg/L)



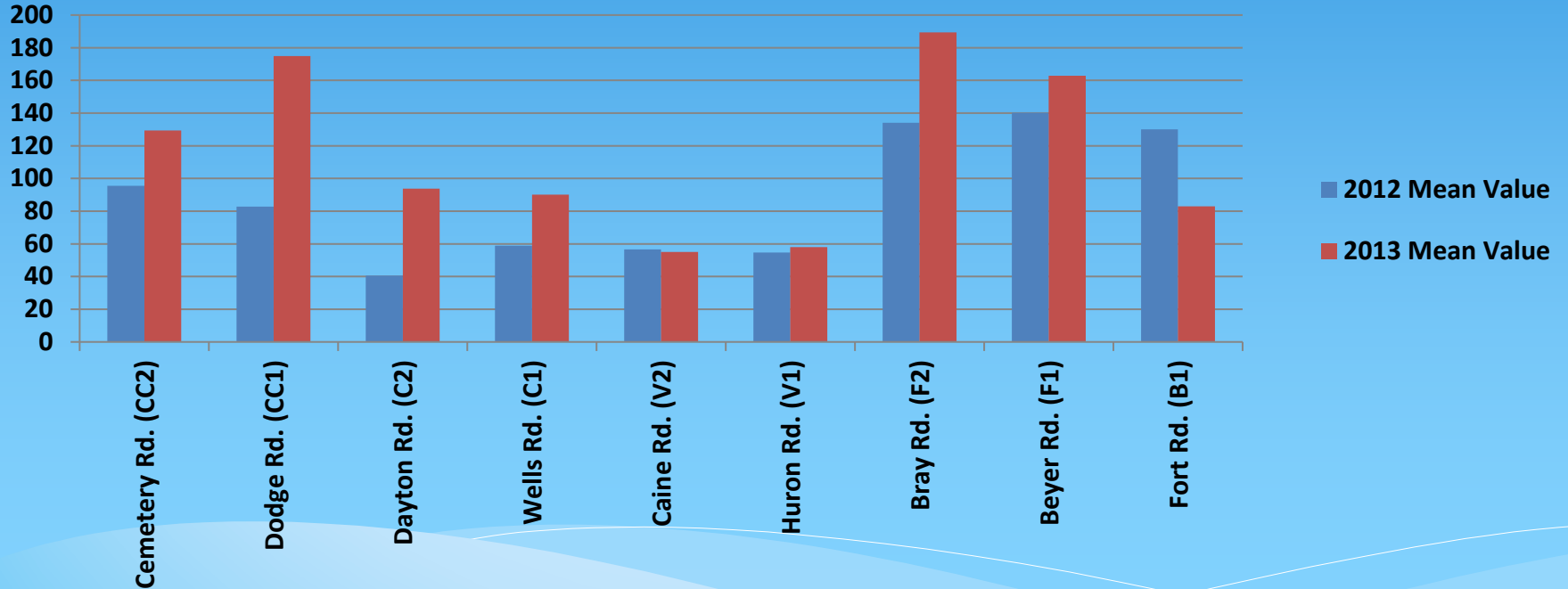
Mean Value Comparison - TSS

Total Suspended Solids Mean Site Values (mg/L)



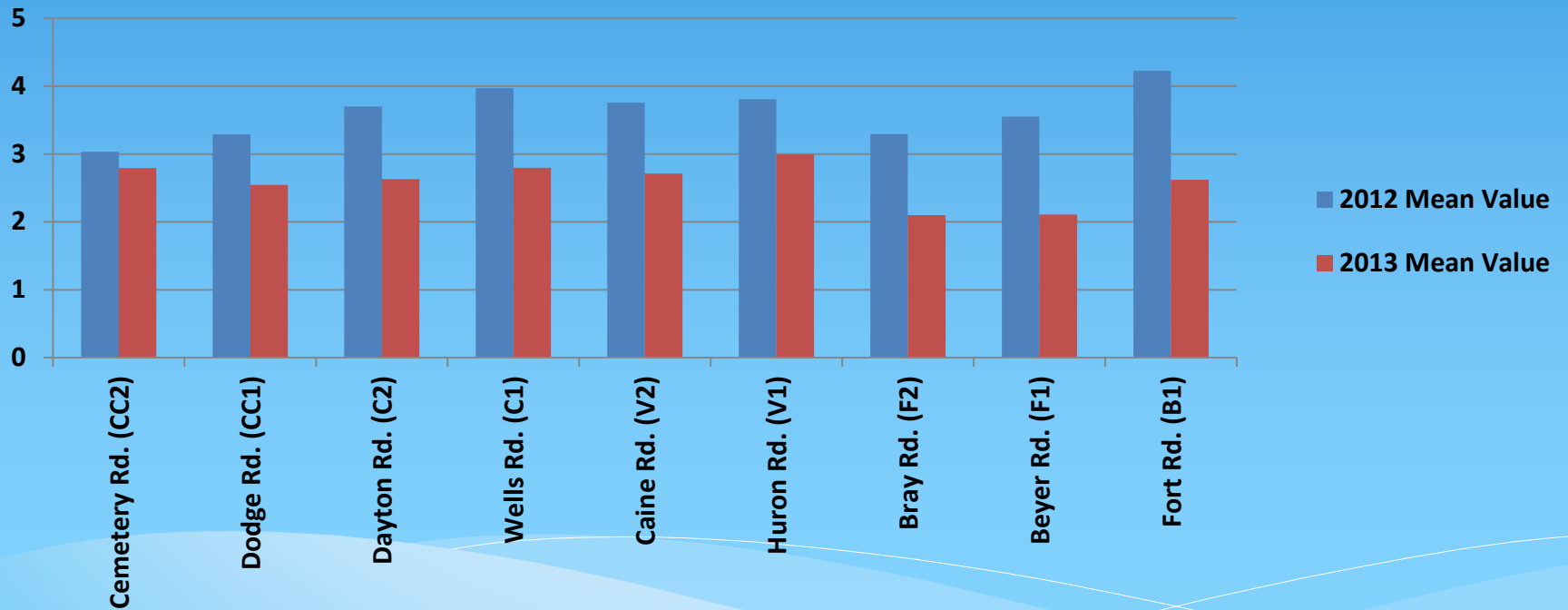
Mean Value Comparison – Fecal Coliform

Fecal Coliform Bacteria (Colonies/ 100 ml)



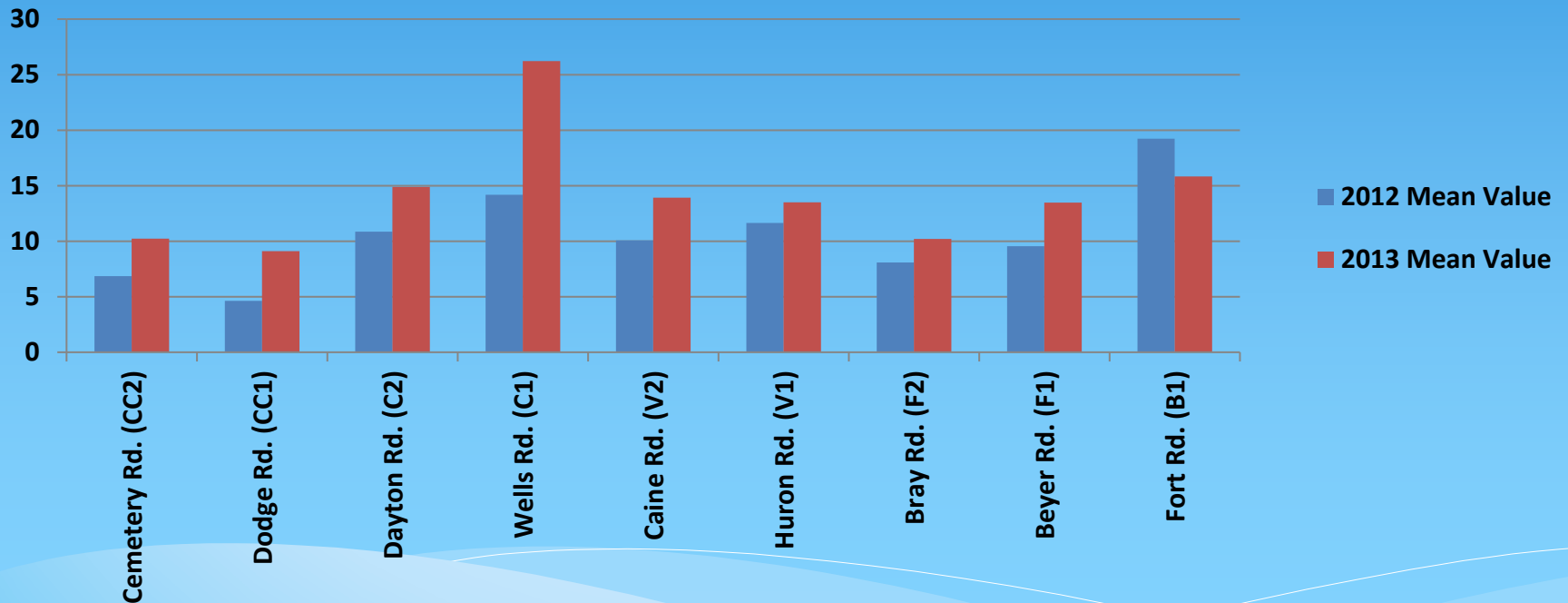
Mean Value Comparison – Nitrates

Nitrates (mg/L)



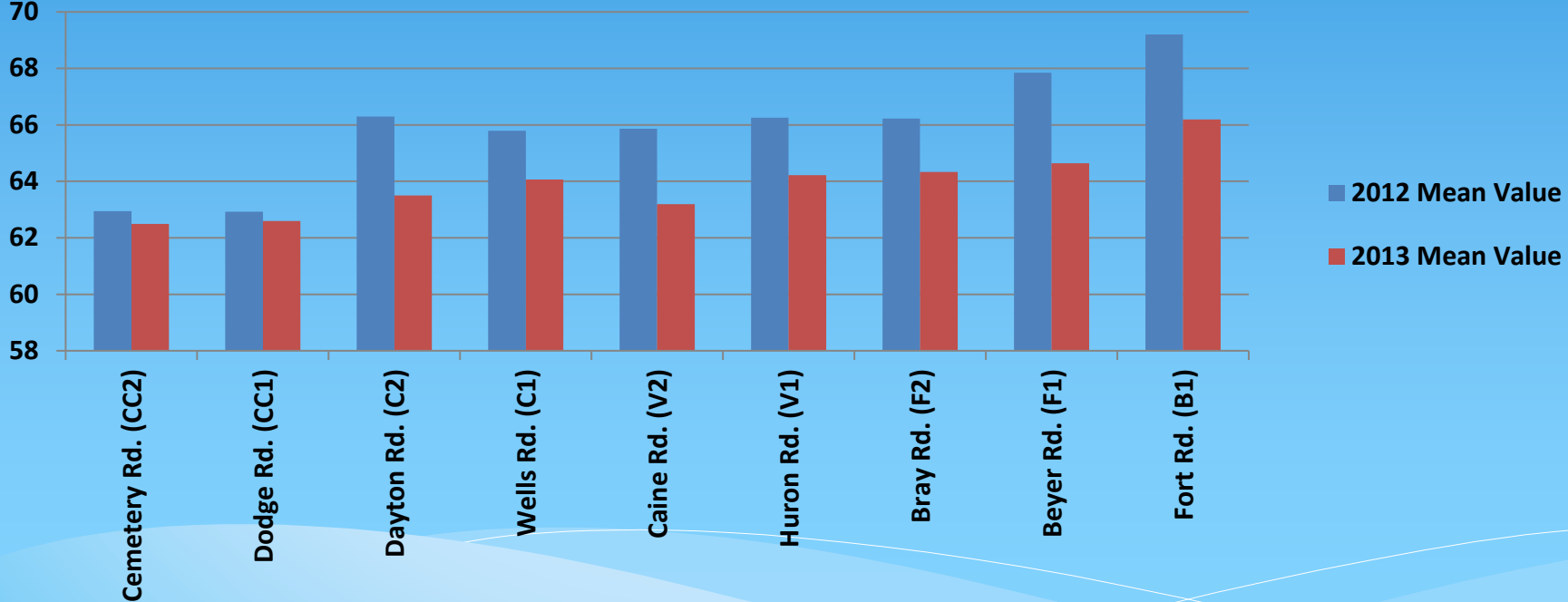
Mean Value Comparison – Turbidity

Turbidity (NTU's)



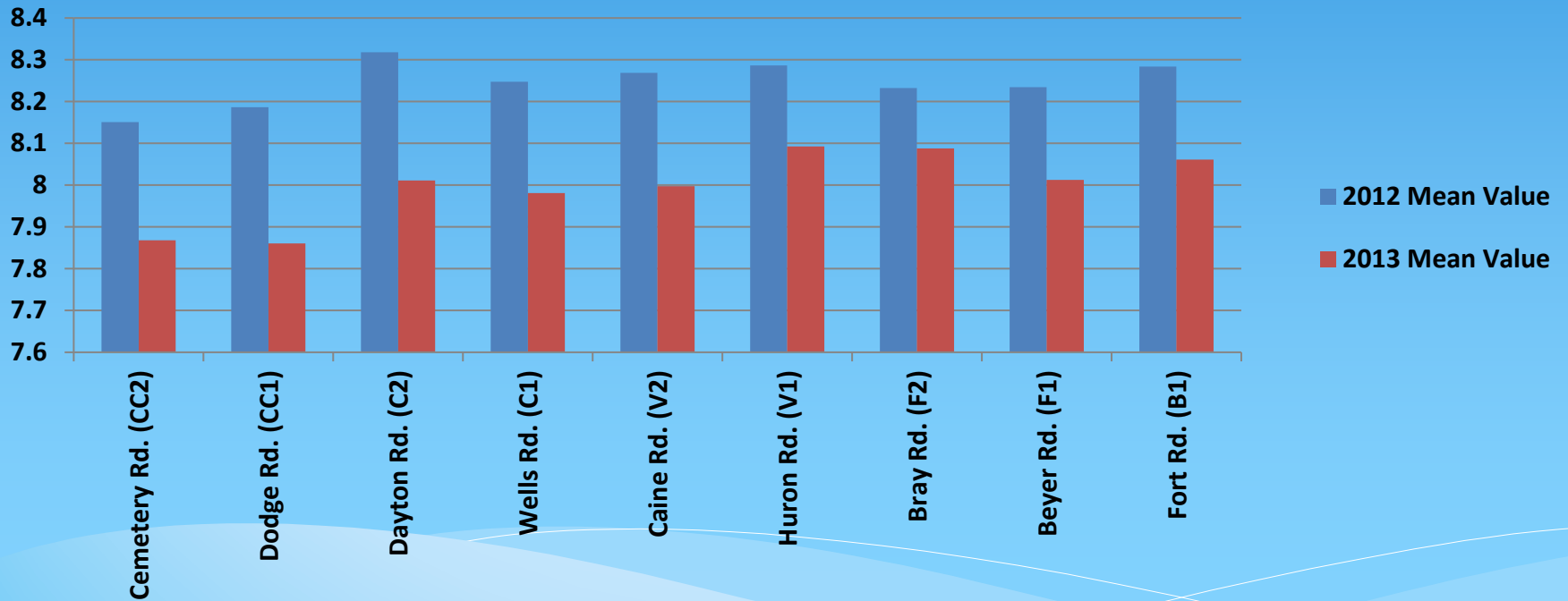
Mean Value Comparison – Temperature

Temperature (°F)



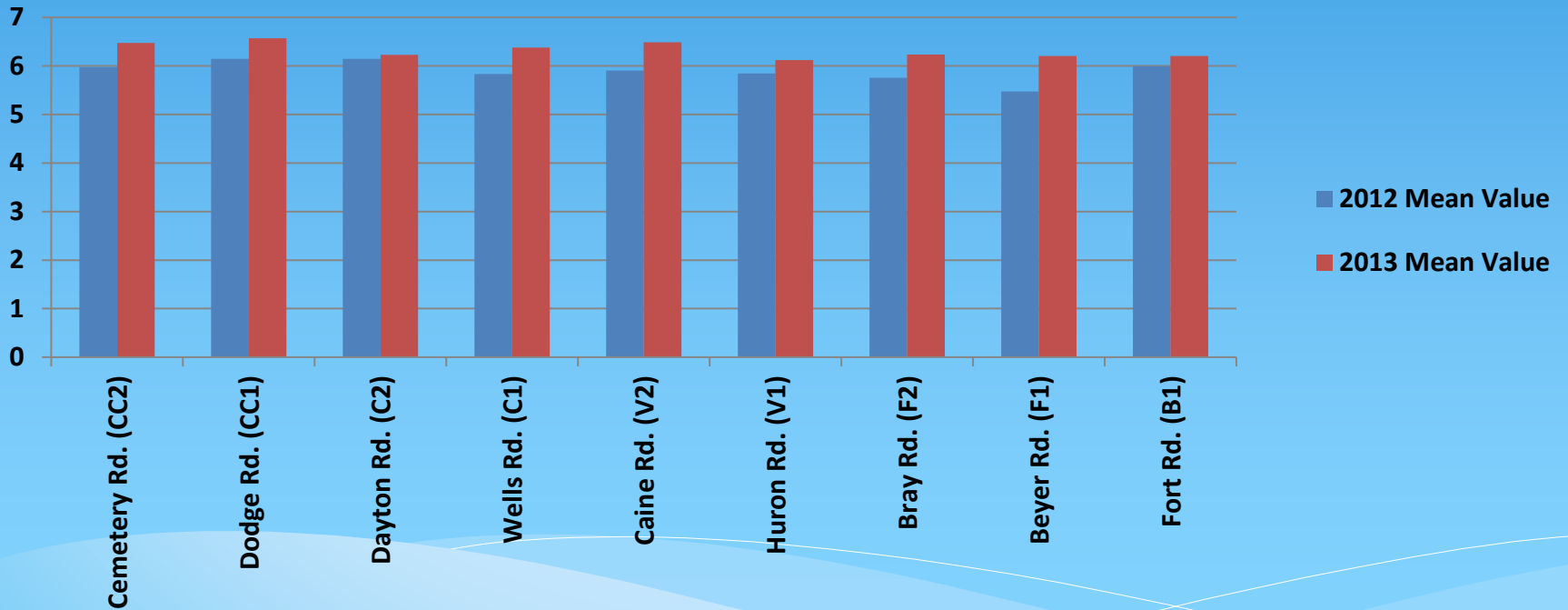
Mean Value Comparison – pH

pH (pH Units)



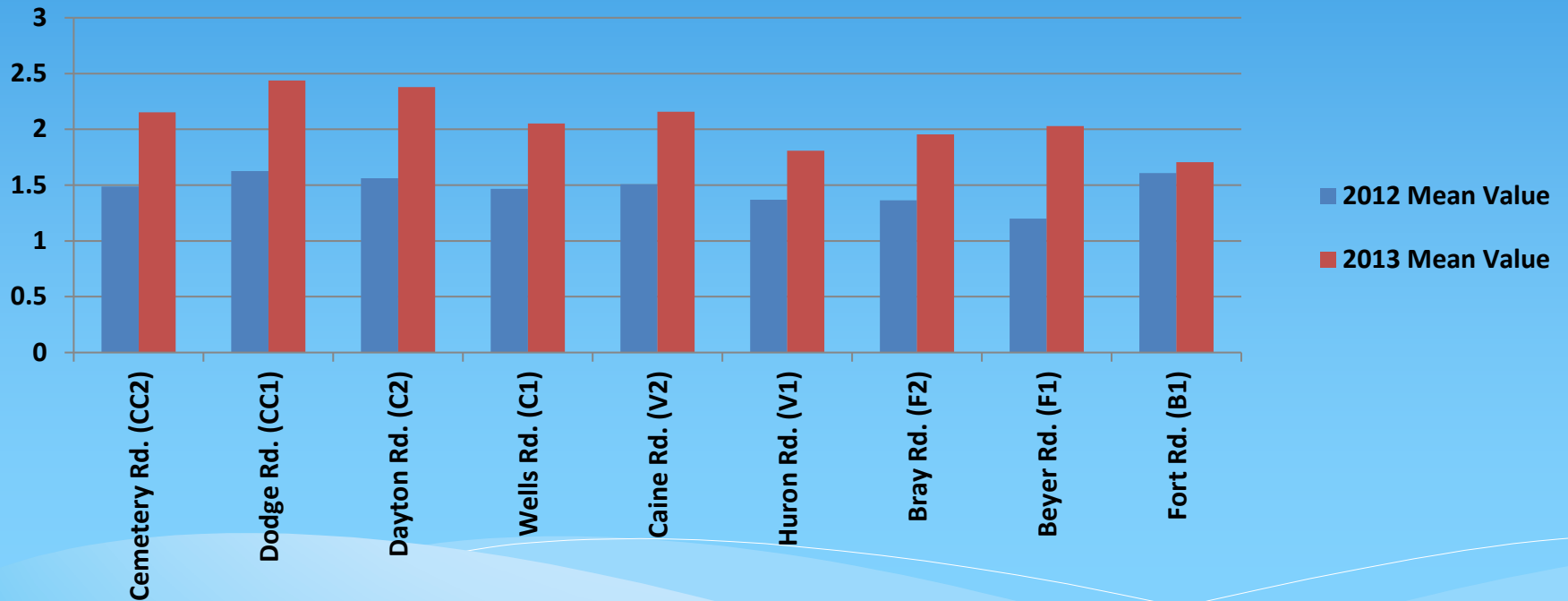
Mean Value Comparison – Dissolved Oxygen

Dissolved Oxygen (mg/L)



Mean Value Comparison– Biochemical Oxygen Demand

Biochemical Oxygen Demand (mg/L)



Water Quality Index (WQI) Summary

Water Quality Index Range

WQI Value

90 - 100

70 - 90

50 - 70

25 - 50

0 - 25

Rating

Excellent

Good

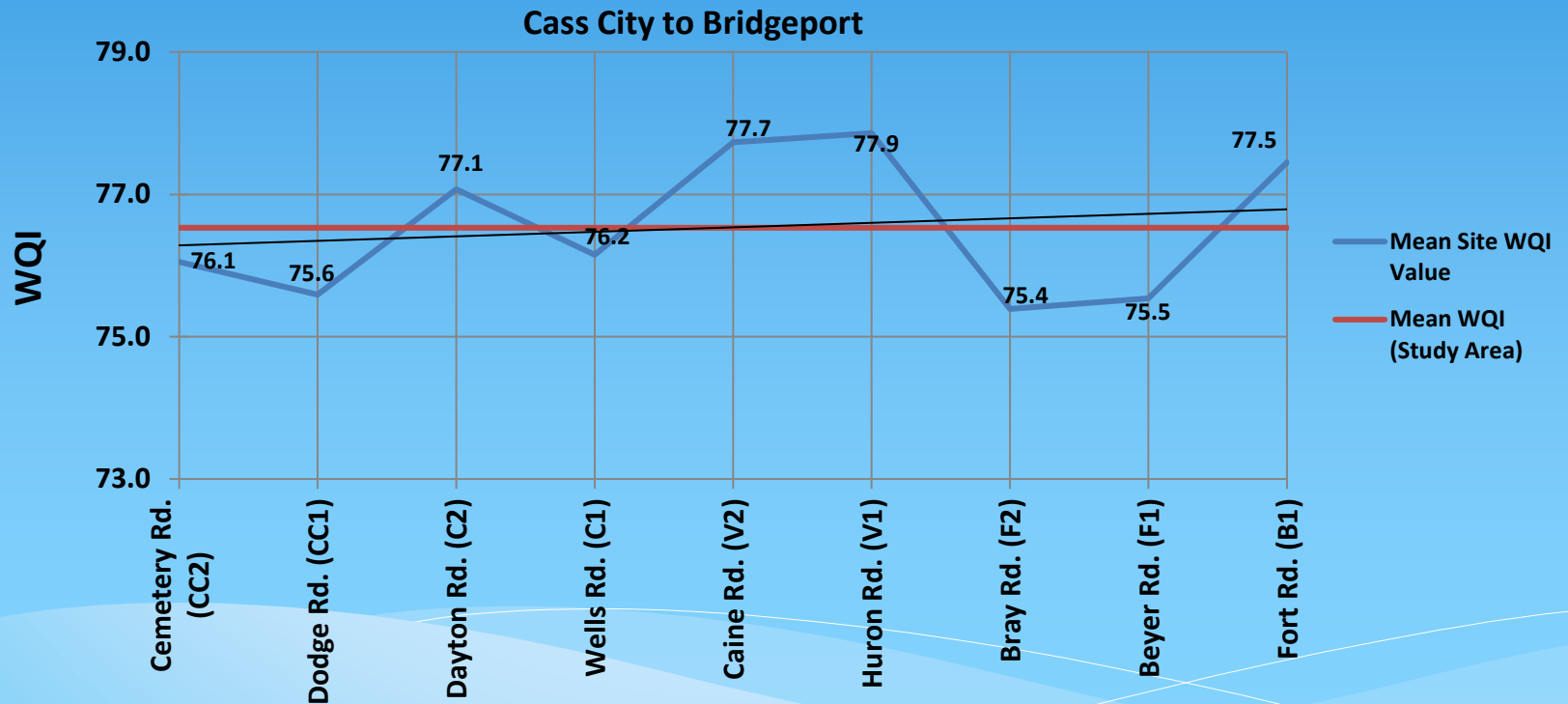
Medium

Poor

Very Poor

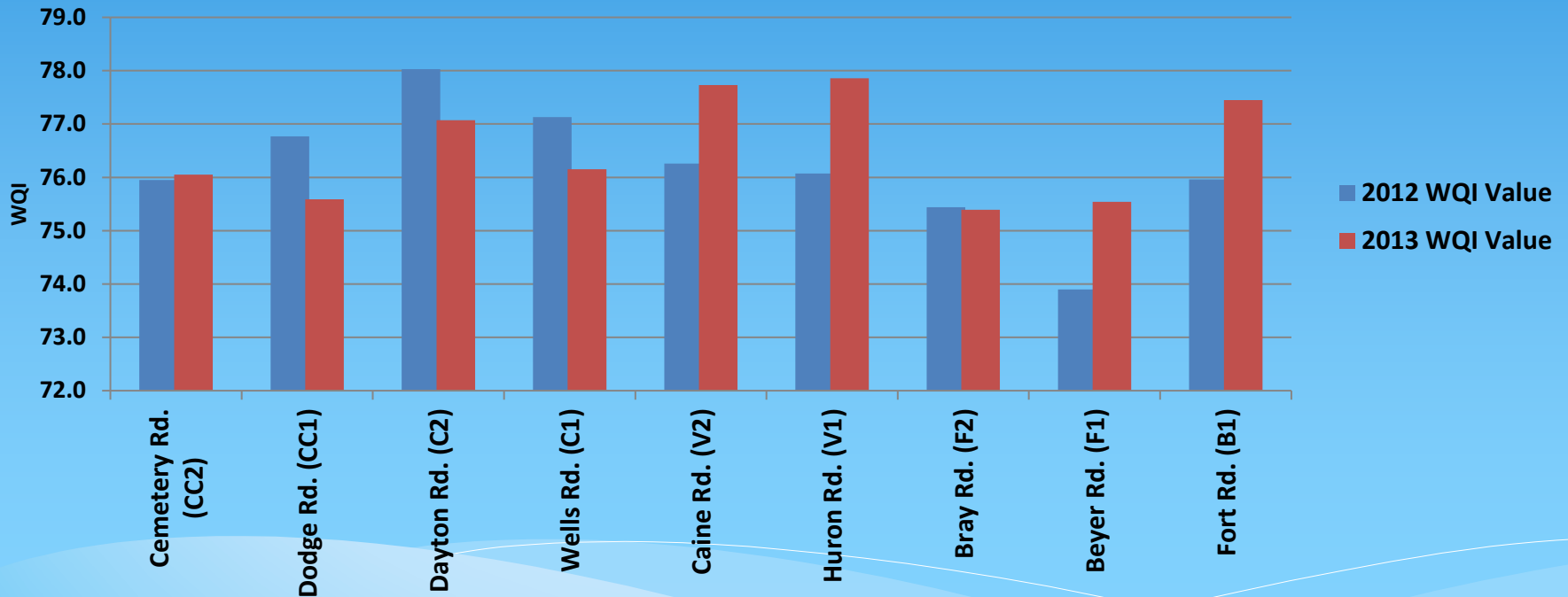
Water Quality Index (WQI) Summary

Cass River Water Quality Index Values



Water Quality Index (WQI) Summary

WQI Annual Comparison 2012 and 2013 Sampling Seasons



Water Quality Index (WQI) Summary

Site Name	2012 Site WQI	2013 Site WQI	Percent Change	2013 WQI Rank	2012 WQI Rank	Net Rank Change
Cemetery Rd. (CC2)	76.0	76.1	0.13%	6	7	-1
Dodge Rd. (CC1)	76.8	75.6	-1.6%	7	3	-4
Dayton Rd. (C2)	78.0	77.1	-1.2%	4	1	-3
Wells Rd. (C1)	77.1	76.2	-1.3%	5	2	-3
Caine Rd. (V2)	76.3	77.7	1.9%	2	4	2
Huron Rd. (V1)	76.1	77.9	2.3%	1	5	4
Bray Rd. (F2)	75.4	75.4	-0.1%	9	8	-1
Beyer Rd. (F1)	73.9	75.5	2.2%	8	9	1
Fort Rd. (B1)	76.0	77.5	1.9%	3	6	3
Mean Value	76.2	76.5	0.5%			

Water Quality Standard (WQS) Summary

Under weather conditions encountered, all sites met all statutory and generally accepted water quality standards. However, analysis indicated that heavy rain events and high temperatures can adversely affect bacteria levels.

All parameters for all sample all sites met state and EPA standards and scored in the good to excellent range in developed Water Quality Index standards.

Total suspended solids, nitrates, turbidity and Biochemical Oxygen Demand fall into the non-regulated category. Standards for these parameters are developed based on generally accepted water quality monitoring principles and practices.

Locally and Developed standards apply to E. Coli. This project measured fecal coliform. E. Coli is a subset of fecal coliform. Generally fecal coliform levels were below any thresholds that are a cause for public health concerns.

Observations and Conclusions

The overall increase in solids, turbidity, phosphorous and fecal in year two is likely due to the timing and intensity of precipitation throughout the study area. Second year sampling saw more and heavier rainfall events during sampling days.

The decline in temperature in year two can largely be attributed to the earlier sampling season start date. Water temperature was significantly cooler during the April sampling events.

The decline in pH in year two can likely be attributed mainly to the earlier sampling season start date. Research shows that pH increases with water temperature. Additionally, early season runoff may contain snow melt which can be lower in pH than ambient river water. pH was lower throughout the watershed throughout the sampling season.

Increased DO and BOD levels in year two also follow from increased flow. Again, the timing and intensity of precipitation supports the increase in these parameters during year two.

Recommendations

Extend sample season from early spring through late fall to capture seasonal variations in water chemistry.

Vary sample times within sample days to capture diurnal variation in sample parameters.

Conduct additional testing after rain events and during high temperatures to determine changes from steady state conditions

Investigate seasonal variation in pH – lower pH in early spring sample events.

Reducing flow rates from overland runoff during major rain events is key to slowing flow and reducing phosphorous and sediment loading levels.

Remain aware of DEQ's potential action regarding tributary stream E. Coli standards (possible tributary studies including E. Coli and benthic monitoring) (Grant Opportunities).

Project Partners

Cass River Greenway

Michigan Department of Environmental Quality

Cass City Municipal Wastewater Treatment Facility

Caro Municipal Wastewater Treatment Facility

Vassar Municipal Wastewater Treatment Facility

Frankenmuth Municipal Wastewater Treatment Facility

Saginaw Valley State University

Environmental Science Solutions, LLC

References

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EPA 440/5-86-001, Quality Criteria for Water 1986.

**Michigan Administrative Code, Part 4. Water Quality Standards.
Rule 323.1041**