Missisquoi River Basin Association
Water Quality Monitoring Program
Summary of Results 2005-2014

Submitted for the Missisquoi River Basin Association
2839 VT Route 105, East Berkshire, VT 05447
by Alisha Sawyer
(original document created by: Jeremy Deeds and Shana Stewart Deeds)

to the Vermont Department of Environmental Conservation
1 National Life Dr., Main 2, Montpelier, VT 05620

Missisquoi River Basin Overview:

The Missisquoi River runs across the northwestern part of Vermont and into southern Quebec. The river begins in Lowell and flows approximately 80 miles into the Missisquoi Bay. The Missisquoi River watershed is comprised of forests, agricultural land, and some urban and suburban developments. At 25%, agriculture is the dominant non-forested land use land cover. The water quality in Missisquoi Bay is at risk due to the enrichment of nutrients from surrounding lands in the watershed and the toxic algae blooms that may result. The Missisquoi River watershed is currently the focus of several monitoring and restoration efforts by local, state and regional groups to identify nutrient sources and minimize nutrient input to the Missisquoi River and Bay.

Program Overview:

The Missisquoi River Basin Association (MRBA) is a non-profit organization focused on the restoration of the Missisquoi River and its tributaries. The Water Quality Monitoring program is a volunteer-run sampling program that takes place each summer throughout the Basin. Through partnership with the Vermont Department of Environmental Conservation's LaRosa Analytical Services Partnership Program, the MRBA has access to the State of Vermont's analytical laboratory to process and analyze the water samples taken in the field.

The goal of the monitoring project is multifaceted. This volunteer program allows community members to learn about the environment of the Missisquoi River Basin, conservation and restoration of this environment, and water quality sample collection with interpretation of the results. In addition, the program collects valuable data that may aid in the determination of specific problem areas on which to focus restoration efforts, and of whether past restoration efforts are working.

Methods:

Trained citizen volunteers collect water samples biweekly at between 19 and 23 sites depending on the year. These sites are located throughout the Missisquoi River Basin, along the mainstem of the Missisquoi River and its tributaries. Refer to Table 1 for a list of sample sites, their corresponding site codes and the years they were sampled. Figures 1-3 show the location of each site labeled by their corresponding site code.

Table 1. List of MRBA sampling sites with site codes and sampling years.

Mainstem Sites	Code	Years
Westfield - Loop Rd - Below Mineral Springs Brook	M-WL	2005, 2006, 2007, 2008, 2009, 2010, 2011, 2012, 2013, ***2014***
Troy - Citizens Dam	M-TCD	2005, 2006, 2007
North Troy - Below Big Falls	M-NTBF	2005, 2006, 2007, 2008, 2009, 2010, 2011, 2012, 2013, ***2014***
East Richford - Near QC Border	M-ER	2005, 2006, 2007, 2008, 2009, 2010, 2011, 2012, 2013, ***2014***
Richford – below town, Davis Park	M-RDP	2005
Richford - Below North Branch Marvin Rd	M-RM	2006, 2007
East Berkshire - Below Trout River	M-EB	2005, 2006, 2007
Enosburg Falls - Lawyers Landing	M-ELL	2005
Enosburg Falls - Below Town	M-EF	2005, 2006, 2007, 2008, 2009, 2010, 2011, 2012, 2013, ***2014***
N.Sheldon - Above Black Creek - Kane Road	M-NS	2005, 2006, 2007
Sheldon Junction – Bridge	M-SJ	2005
Highgate - Dam at Highgate Falls	M-HD	2005, 2006, 2007
Swanton – above town Johns Bridge	M-SJB	2005
Swanton - Marble Mill - Below Dam	M-SMM	2005
Swanton - Monument Road	M-SMR	2005, 2006, 2007, 2008, 2009, 2010, 2011, 2012, 2013, ***2014***

Tributary Sites	Code	Years
Lowell - Burgess Branch Route 58	T-LBB	2005, 2006, 2007, 2008, 2009, 2010, 2011, 2012, 2013, ***2014***
Troy - Jay Branch - Vielleux Road	T-TJB	2006, 2007, 2008, 2009, 2010, 2011, 2012, 2013, ***2014***
Newport Center - Mud Creek - Route 105	T-NCMC	2006, 2007, 2008, 2009, 2010, 2011, 2012, 2013, ***2014***
Newport Center – trib. to Mud Creek	T-NCTM	2008, 2009, 2010
North Troy - Mud Creek - Bear Mountain Road	T-NTMC	2005, 2006, 2007, 2008, 2009, 2010, 2011, 2012, 2013, ***2014***
Richford - North Branch - Pinnacle Road	T-RNB	2006, 2007, 2008, 2009, 2010, 2011, 2012, 2013, ***2014***
East Berkshire - Trout River - Near Mouth - Route 118	T-EBTR	2005, 2006, 2007, 2008, 2009, 2010, 2011, 2012, 2013, ***2014***
Enosburgh - Tyler Branch, Duffy Hill Road	T-ETBDH	2006, 2007, 2008, 2009, 2010, 2011, 2012, 2013, ***2014***
Enosburgh – Tyler Branch, Boston Post Rd.	T-ETYB	2008, 2009, 2010, 2011, 2012, 2013, ***2014***
Enosburgh – below Tyler Branch	T-EBTB	2005
Enosburgh – The Branch (Rt. 108)	T-ETB	2008, 2009, 2010, 2011, 2012, 2013, ***2014***
East Fairfield - Black Creek Ryan Rd.	T-EFBC	2007, 2008, 2009, 2010, 2011, 2012, 2013, ***2014***
Fairfield – Wanzer Brook	T-FFWZ	2008, 2009, 2010, 2011, 2012, 2013, ***2014***
Sheldon - Mouth of Black Creek - Bouchard Road	T-SBC	2005, 2006, 2007, 2008, 2009, 2010, 2011, 2012, 2013, ***2014***
Highgate - Hungerford Brook Route 207	T-HHB	2006, 2007
Sheldon – trib to Hungerford Bk Cook Rd.	T-SHCR	2008, 2009, 2010, 2011, 2012, 2013, ***2014***
Swanton – trib to Hungerford Woods Hill Rd.	T-THBW	2008, 2009, 2010, 2011, 2012, 2011, 2012, 2013, ***2014***
Swanton – Hungerford Bk Woods Hill Rd.	T-HBW	2008, 2009, 2010, 2013, ***2014***
Berkshire - Godin Brk Godin Rd	T-BGB	2011, 2012, 2013, ***2014***
Berkshire – Godin Brk - West (01)	T-GBG01	2013, ***2014***
Berkshire – Godin Brk – East (02)	T-GBG02	2013, ***2014***

Sites in blue averaged below 25 µg/L Phosphorus in 2014

Sites in green had the highest average concentrations of Phosphorus in 2014 (greater than 50 µg/L)

Contact: Alisha Sawyer, MRBA (802) 827-3360

Volunteers received training in accordance with the Quality Assurance Project Plan (QAPP) for taking grab samples for total phosphorus, total nitrogen, total suspended solids, and turbidity. Samples were kept cold, both during transport and storage, prior to analysis. Samplers also completed a field data sheet at each site noting not only who took the sample and where and when the sample was taken, but also parameters such as water flow and weather observations. In order to interpret the results from the State laboratory it was necessary to organize and manage the data using Microsoft Access® and Microsoft Excel®, which allowed for further geographic analysis in ESRI ArcGIS®.

Results and Discussion:

Figures 1-3 show sampling locations and results of the three water quality parameters measured (total phosphorus, total nitrogen and turbidity). The raw data for each parameter and sample event are presented in Appendix A. Figures 4-6 present mean values for the three parameters at each site ±1 standard error of the mean.

Mainstem total phosphorus (TP) data from 2014 was generally higher than levels observed in 2013, though there is a decrease noted at site M-SMR. The site M-EF showed the highest average phosphorus concentration of mainstem sites, with an average value of 74.4 µg/L. None of the mainstem sites were below the Vermont ANR water quality standard of 25 µg/L TP for Missisquoi Bay of Lake Champlain. The average 2014 TP value observed at location (M-WL - Loop Road crossing in Westfield, VT) was 32.83 µg/L, the lowest of the mainstem sites.

In 2013, seven tributary sites showed an average phosphorus value below 25 µg/L, the Vermont Water Quality Standard for Missisquoi Bay. In 2014 only four were below this threshold; this shows degrade in the watershed but not to the levels observed in the especially high phosphorus year of 2012. Once again, the tributary sites with the lowest average TP concentrations were in the upper, pre-Canada section of the mainstem (T-LBB, T-TJB), along with two newer sampling sites (T-BGB01, T-BGB02) which were the last tributary site that showed an average TP value of less than 25 µg/L in 2014.

The Missisquoi watershed is approximately 25% agricultural land, and, among the all the Lake's watersheds, the Missisquoi Basin is the largest contributor of phosphorus to Lake Champlain (Troy et al., 2007). The 2014 (as well as 2012) data show that large amounts of TP in the basin originate mainly in the sub-watersheds of Mud Creek (T-NCMC, T-NTMC), Hungerford Brook (T-SHCR, T-THBW, T-HBW), and Black Creek (T-EFBC, T-SBC).

There is no State water quality standard for total nitrogen (only for nitrate nitrogen: 5 mg/L NO_3^- in most state waters), so comparing these Missisquoi nitrogen data to established criteria is not possible. In general, portions of the watershed showing increased concentrations of total nitrogen coincide with locations showing increased levels of phosphorus (Figs. 1, 2). This result of both nutrients increasing proportionately seems to indicate that the source of nutrient enrichment in the watershed is likely agricultural runoff, rather than urban development or wastewater treatment plant effluent alone, because these point sources tend to increase nitrogen dramatically more than phosphorous alone. In 2014 Nitrogen levels seemed to increase overall both in the tributaries and the mainstem with the exception of tributary sites (T-HBW, T-SHCR, T-THBW) and mainstem site (M-SMR) where there was a slight decrease. The largest increase was seen in tributary sites T-BGB and T-ETYB.

As with nutrients, average turbidity values (the degree to which light is scattered by particles suspended in the water) in the watershed were found to be generally higher in 2014 than in 2013. High values in 2012 were likely due to significant rain events – which was observed again during the 2014 sampling season. All mainstem sites had higher average turbidity values in 2014 except for one: M-SMR (Monument Road in Swanton), which was slightly lower this year. In 2013 all tributaries showed average turbidity values less than 10 NTU in 2013, which is the standard for cold water fisheries. In 2014 three mainstem sites (M-EF, M-ER, M-NTBF) and nine tributary sites (T-ETBDH, **T-NCMC**, T-RNB, T-EFBC, T-ETYB, T-SHCR, T-THBW, **T-HBW**, **T-BGB**) exceeded that standard – the ones in bold saw the most dramatic increase. The Missisquoi River mainstem below Enosburg Falls is a designated warm-water fishery, but no sites along this stretch of river exceeded the 25 NTU standard for this designation.

Figures 4-6 show the overall averages of all samples taken in the previous three years. The graphs represent mean values for each parameter at each site ±1 standard error of the mean. These figures show that, for many sites, water quality has remained relatively stable in the mainstem, but the tributaries show more susceptibility to yearly fluctuations in nutrient concentrations.

Often the median value (mid-point) of a set of data is described because it is less susceptible to being skewed towards one or two outliers in a dataset (i.e. being pulled one way or another by results from extreme sampling conditions such as data from the September 5th sampling event of 2012). In order to look at the MRBA data in this slightly different way, the yearly median TP values for all sites with data from the last nine years are presented in Figure 7. These graphs show the central tendency (represented by the data point) of TP values in each sampling year, with bars that show the extent of the 25th (low) and 75th (high) percentile values from each year. This way of looking at results may be helpful for identifying long-term trends in data with high variability such as the field measurements of water quality. It can be seen in the Figure 7 graphs that many of the long-term sampling sites are generally stable over time, despite some year-to year variability (M-ER, M-NTBF, M-WL, T-ETBDH, T-LBB, T-TJB, T-EBTR). Other sites show potentially increasing TP levels within the last couple of years (M-EF, T-NCMC). Further statistical analyses should be performed to draw additional conclusions about data trends over the past several years.

Conclusion:

The MRBA sampling program has proven to be a great success over the past eleven years not only with data collection but also with education and outreach. Numerous samples have been collected and analyzed by over two dozen volunteers who sample every two weeks from late spring into early fall. These data have been very useful to MRBA and other organizations that target sites in need of water quality improvement projects due to high concentrations of nutrients and sediment. Some of these projects are already underway (or have been completed) in the Missisquoi River Basin. The MRBA Water Quality Monitoring Program hopes to continue collaboration with the Vermont DEC in 2015 to produce useful information for both entities and for all those working on the protection of water quality in the Basin.

References:

Troy, A., D. Wang, D. Capen, J. O'Neil-Dunne and S. MacFaden. 2007. Updating the Lake Champlain Basin Land Use Data to Improve Prediction of Phosphorus Loading Lake Champlain Basin Program. Lake Champlain Basin Program, Grand Isle, VT.

Vermont Department of Environmental Concentration. Biomonitoring database. Accessed February 24, 2011.

Vermont Water Quality Standards; Vt. Code R. 12 004 052; State of Vermont Natural Resources Board, Water Resources Panel. Effective March 17th, 2014. http://www.nrb.state.vt.us/wrp/publications/wqs.pdf

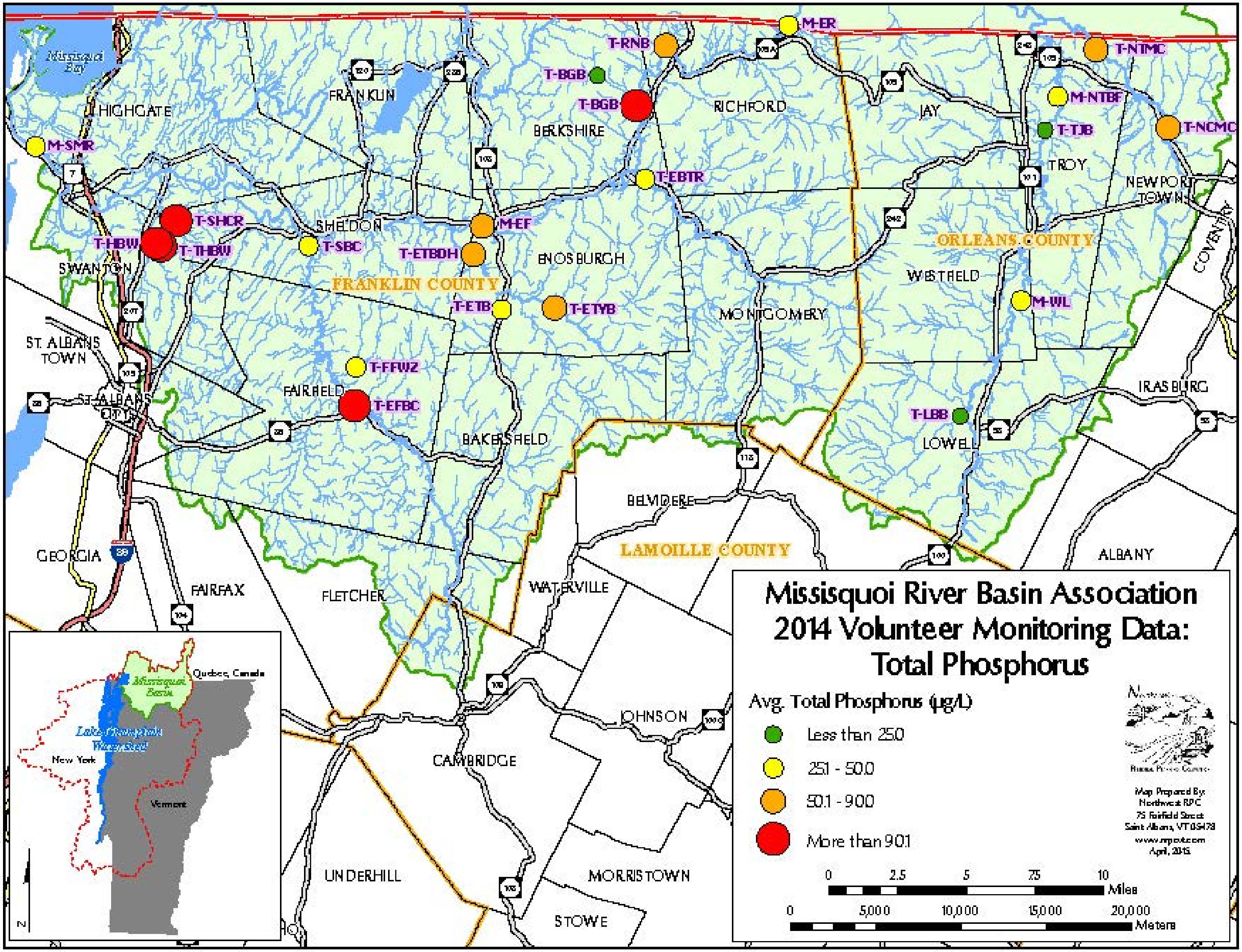

Figure 1: 2014 averages for total phosphorus (µg/L) at each sampling site. Larger dots and changes in color indicate higher levels of nutrients. See Table 1 for site code names.

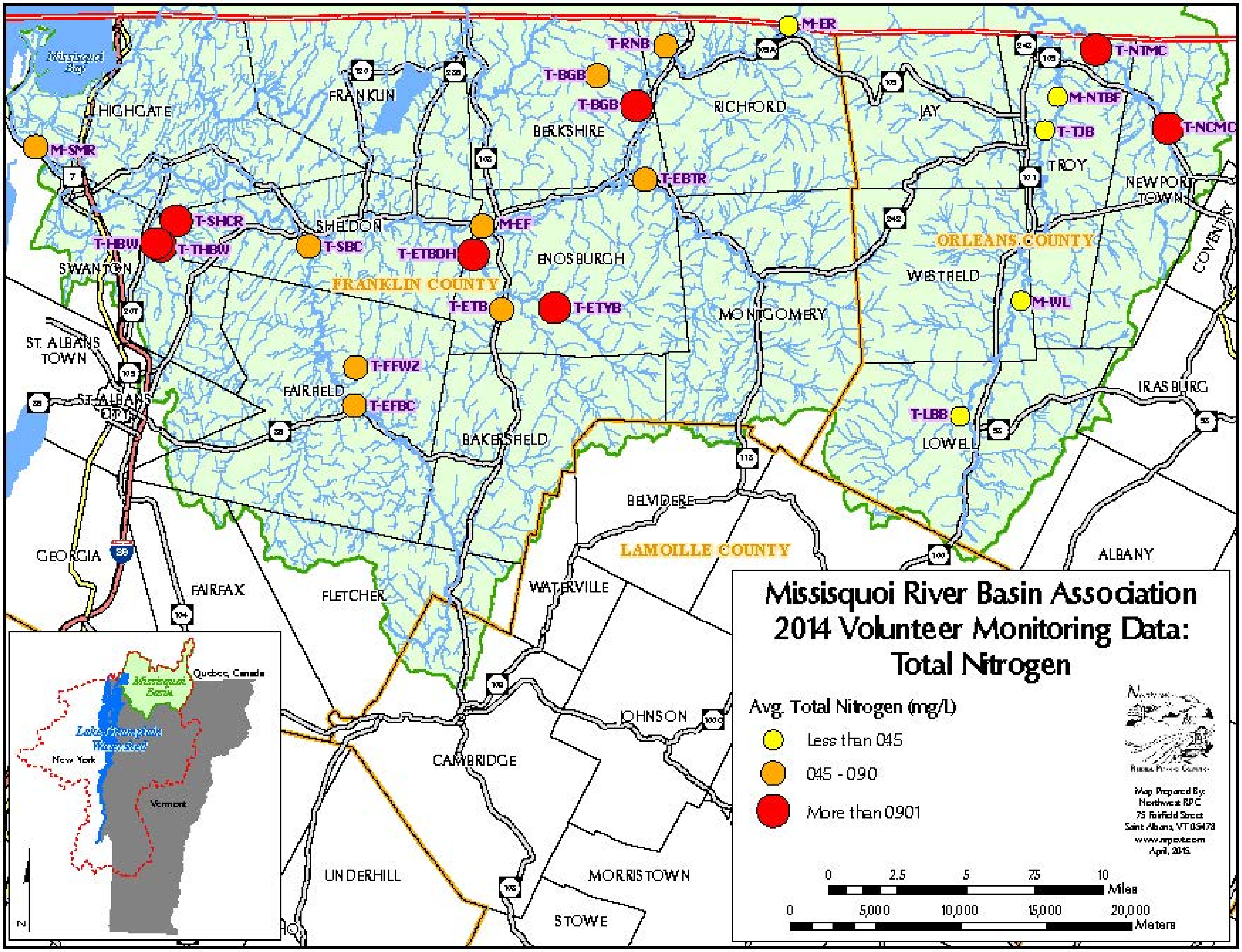

Figure 2: 2014 averages for total nitrogen (mg/L) at each sampling site. Larger dots and color changes indicate higher levels of nutrients. See Table 1 for site code names.

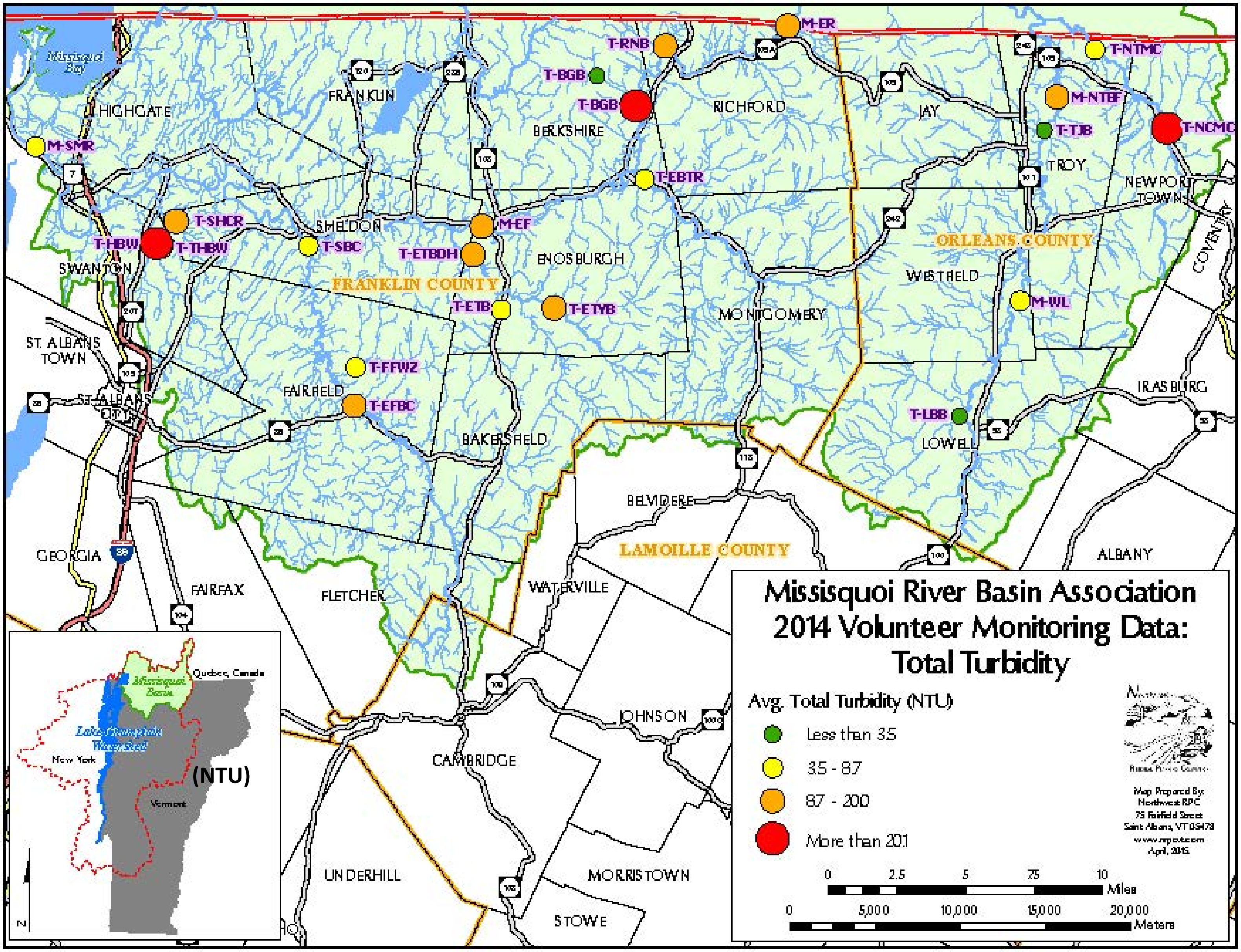

Figure 3: 2014 turbidity averages (Nephelometric Turbidity Units - NTU) at each sampling site. Larger dots and color change indicate higher levels of turbidity. See Table 1 for site code names.

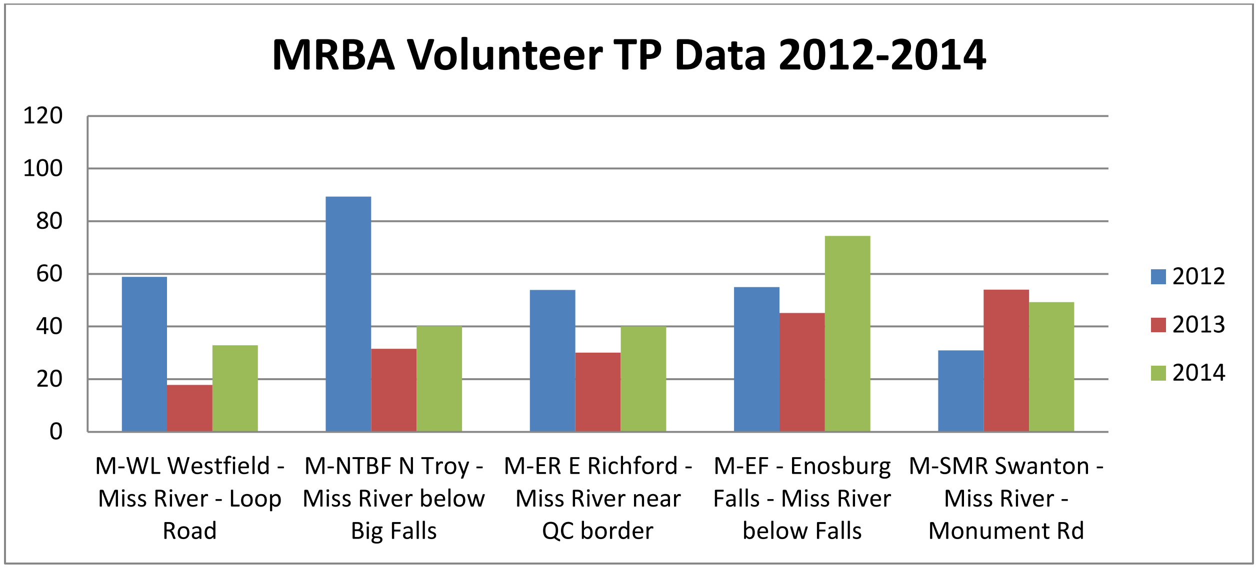

Figure 4a: Mainstem Missisquoi River averages for total phosphorus concentration in µg/L from 2012 to 2014.

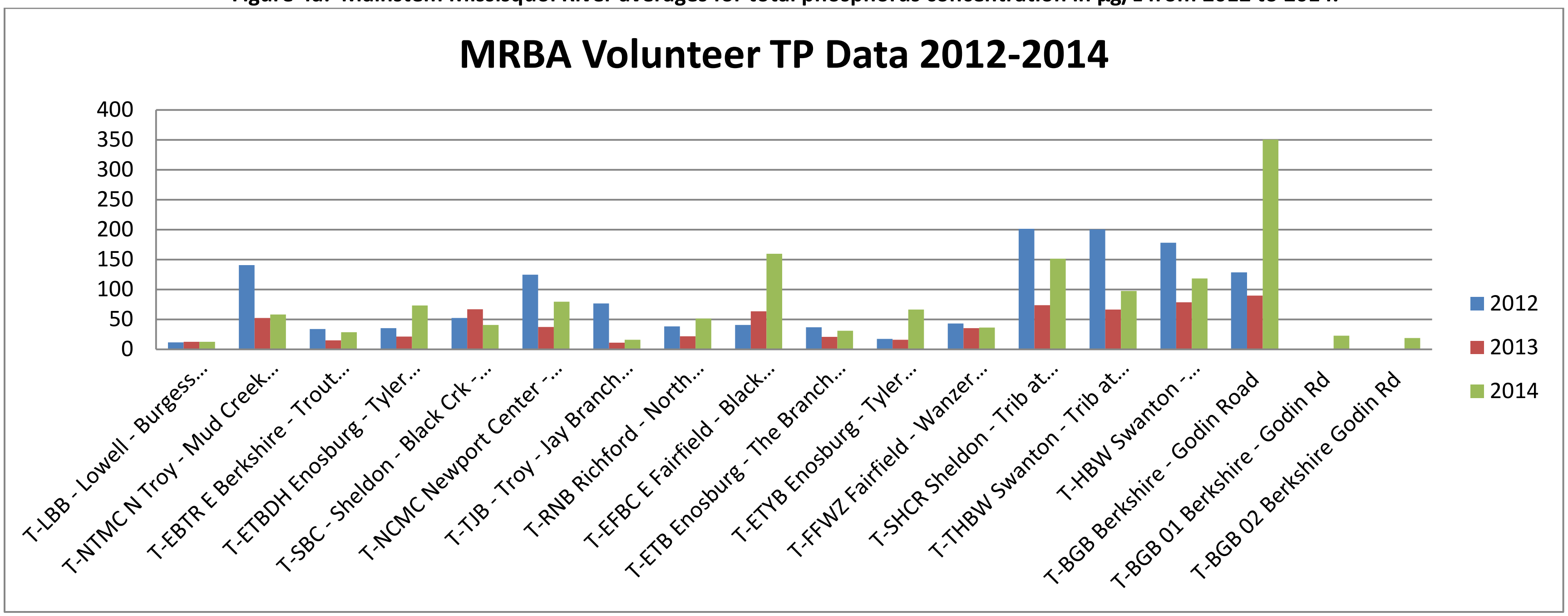

Figure 4b: Missisquoi River Tributary averages for total phosphorus concentration in µg/L from 2012-2014.

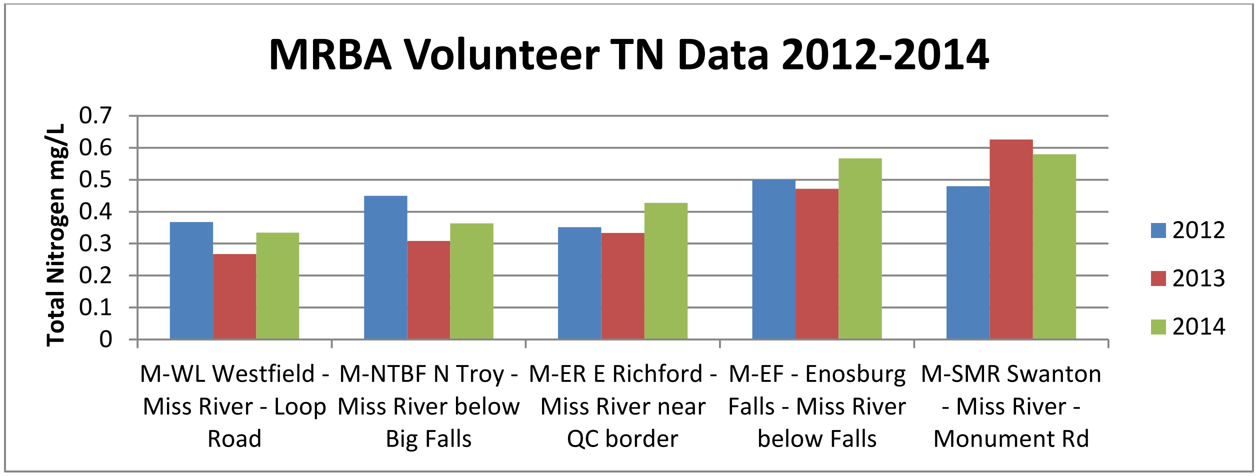

Figure 5a: Mainstem Missisquoi River averages for total nitrogen concentration in mg/L from 2012 to 2014.

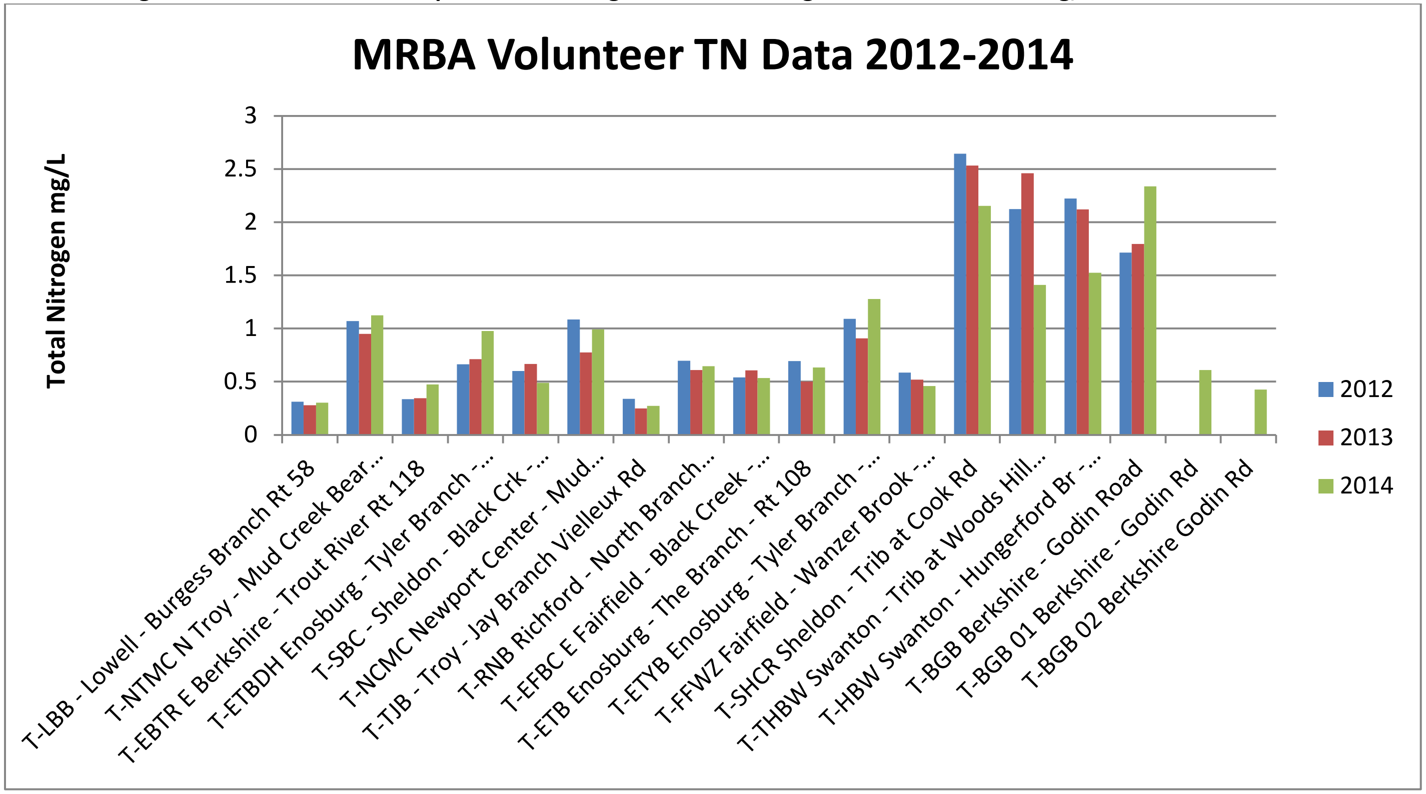

Figure 5b: Missisquoi River Tributary averages for total nitrogen concentration in mg/L from 2012 to 2014.

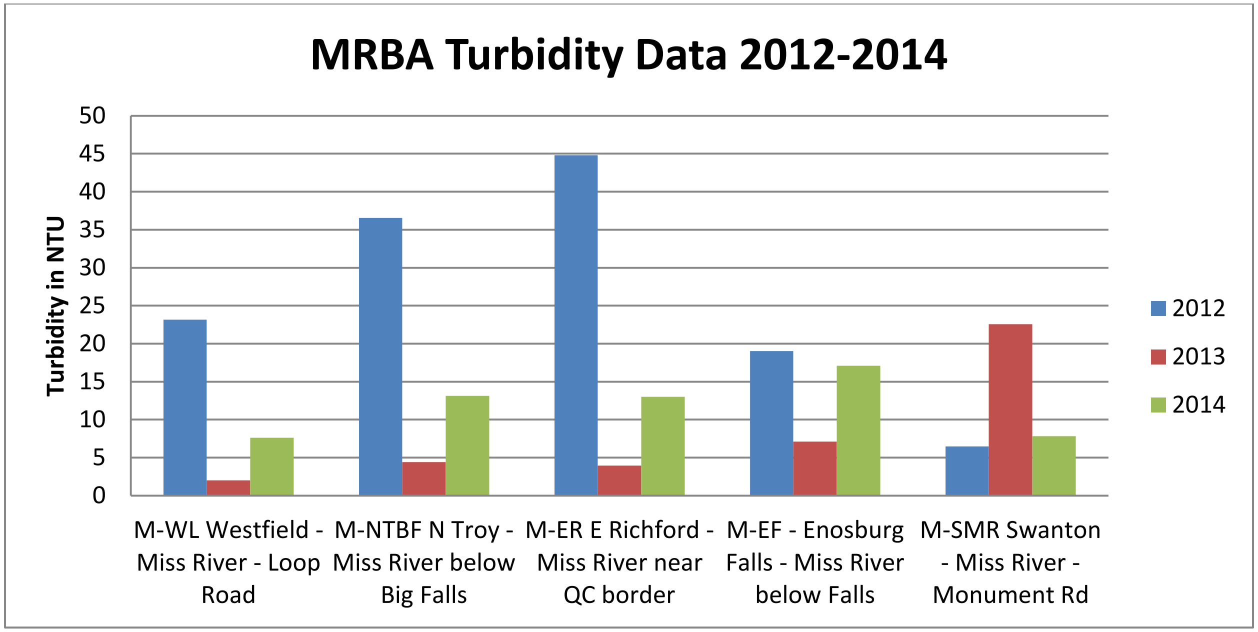

Figure 6a: Mainstem Missisquoi River averages for turbidity in NTU from 2012 to 2014.

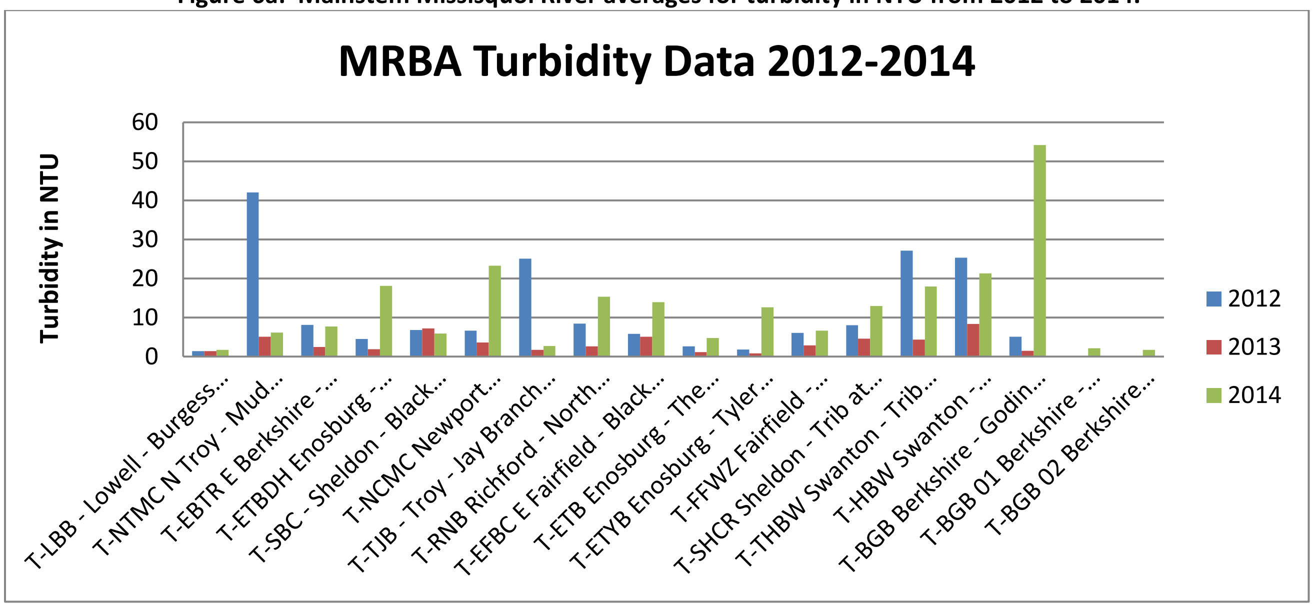

Figure 6b: Missisquoi River Tributary averages for turbidity in NTU from 2012 to 2014.

Figure 7 (a-m). Yearly median total phosphorus values for the 13 MRBA volunteer water quality monitoring sites with at least 9 years of data. Error bars indicate the 25th and 75th percentile distribution of the yearly data. "M" sites are mainstem and "T" sites are tributaries; see Table 1 for full site descriptions. Note that the scales vary between each graph.

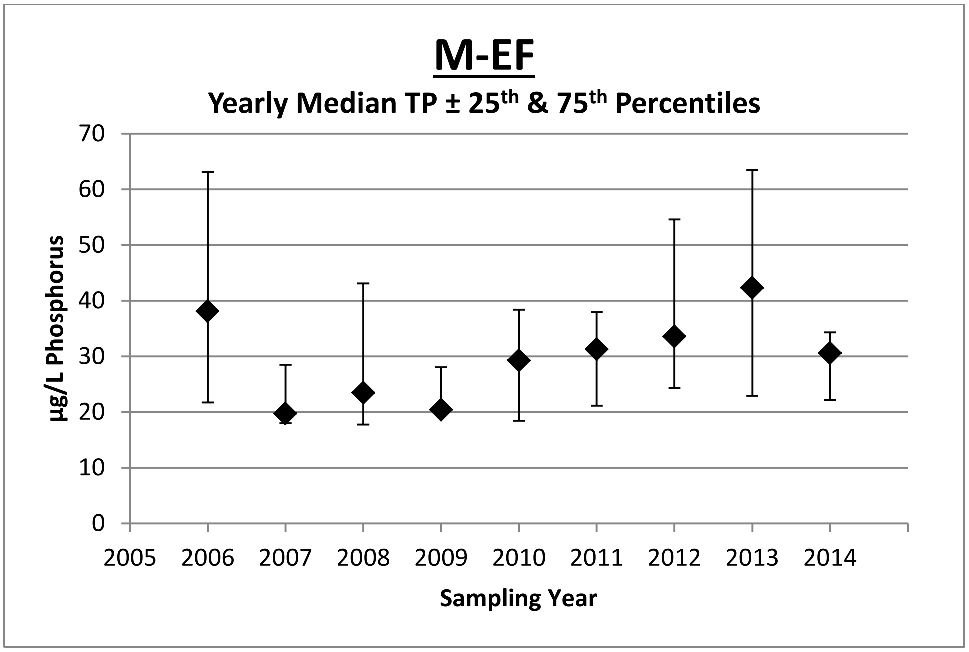

Fig 7a. Phosphorus (µg/L) by year.

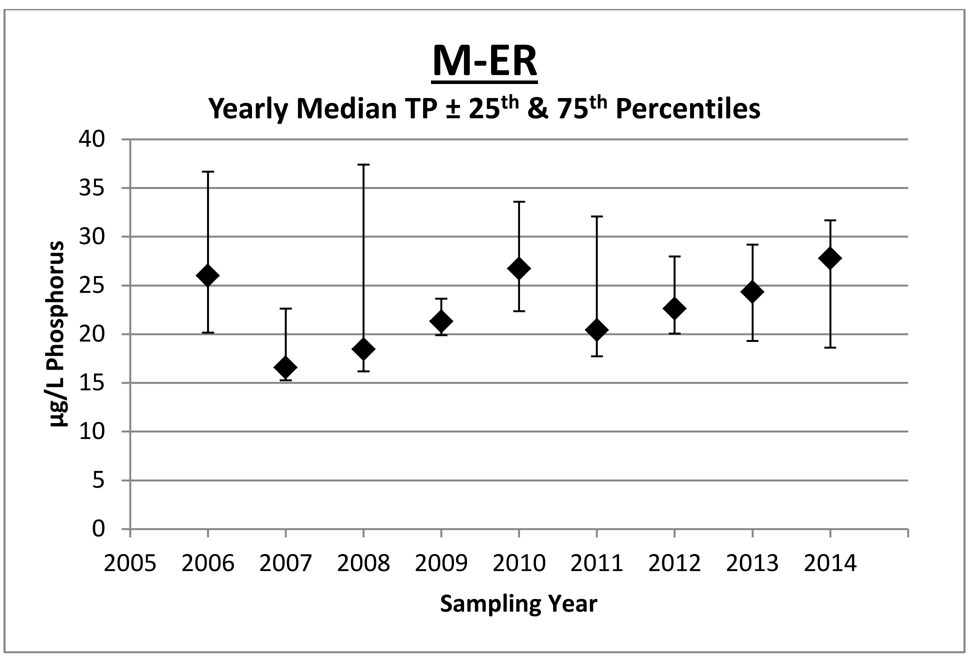

Fig 7b. Phosphorus (µg/L) by year.

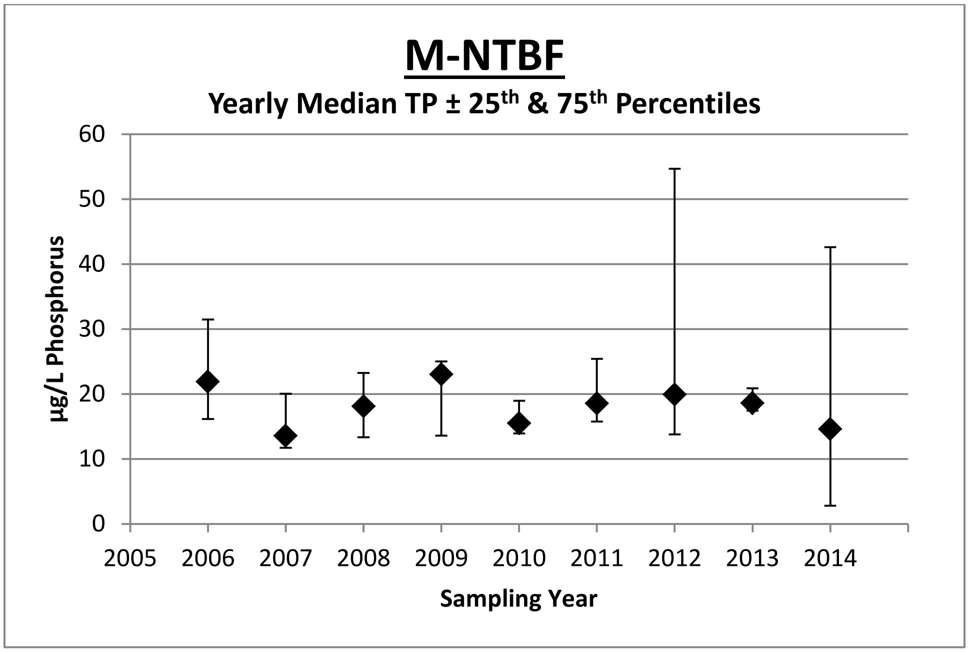

Fig 7c. Phosphorus (µg/L) by year.

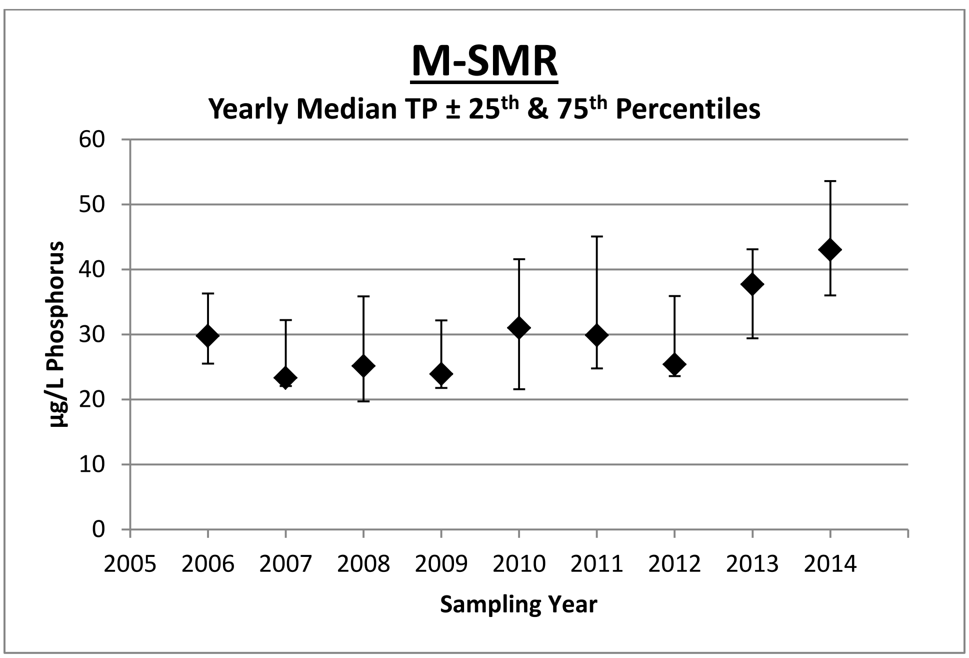

Fig 7d. Phosphorus (µg/L) by year.

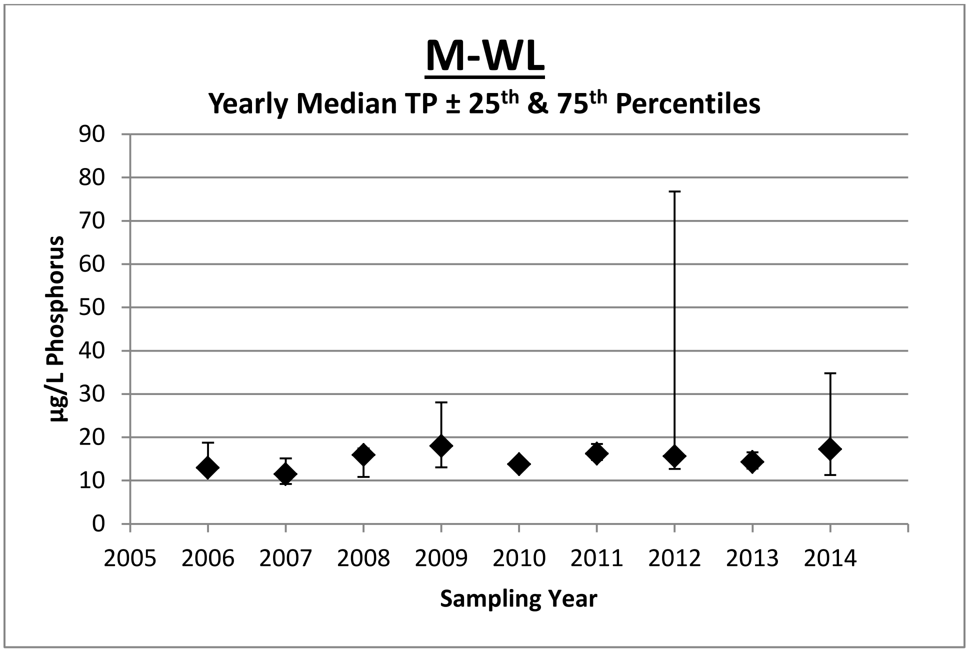

Fig 7e. Phosphorus (µg/L) by year.

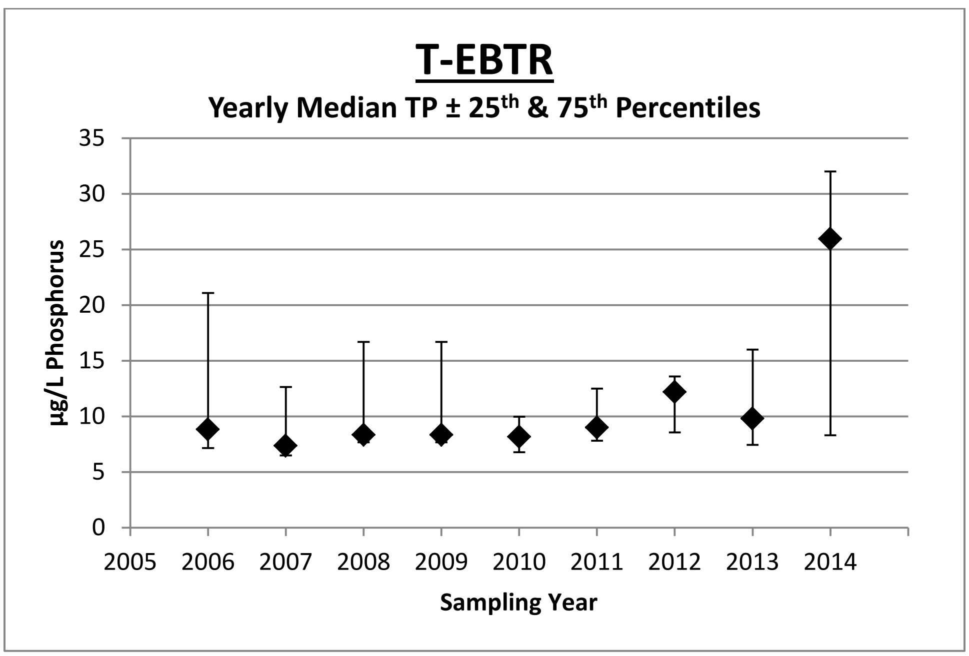

Fig 7f. Phosphorus (µg/L) by year.

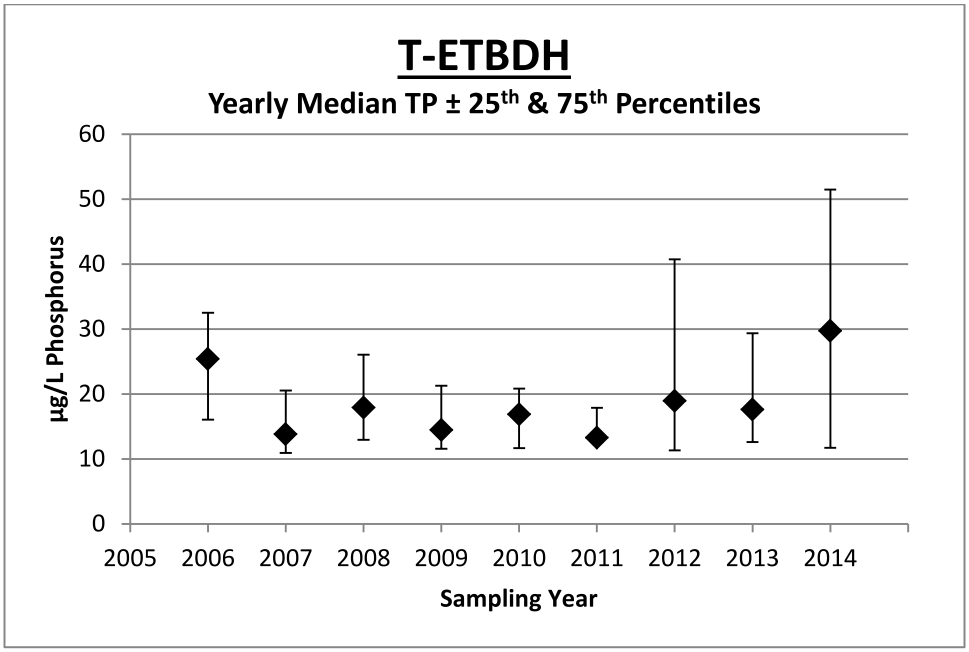

Fig 7g. Phosphorus (µg/L) by year.

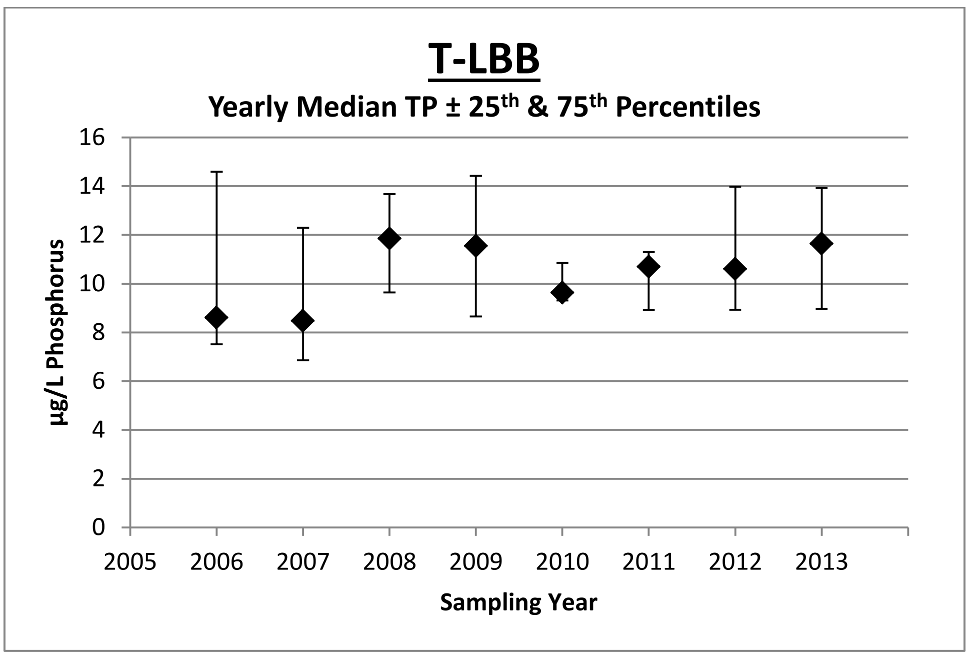

Fig 7h. Phosphorus (µg/L) by year.

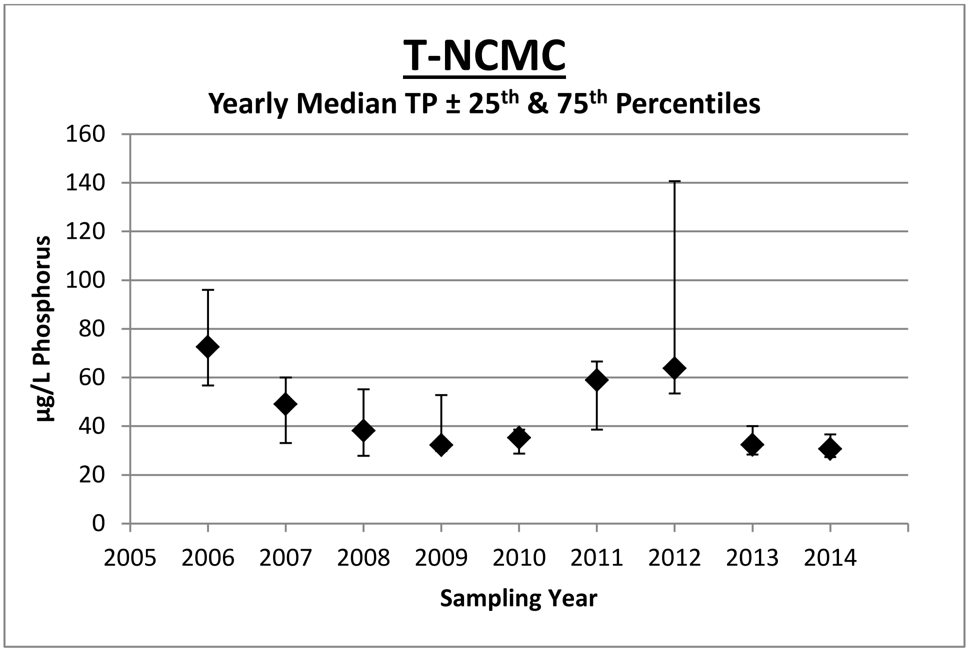

Fig 7i. Phosphorus (µg/L) by year.

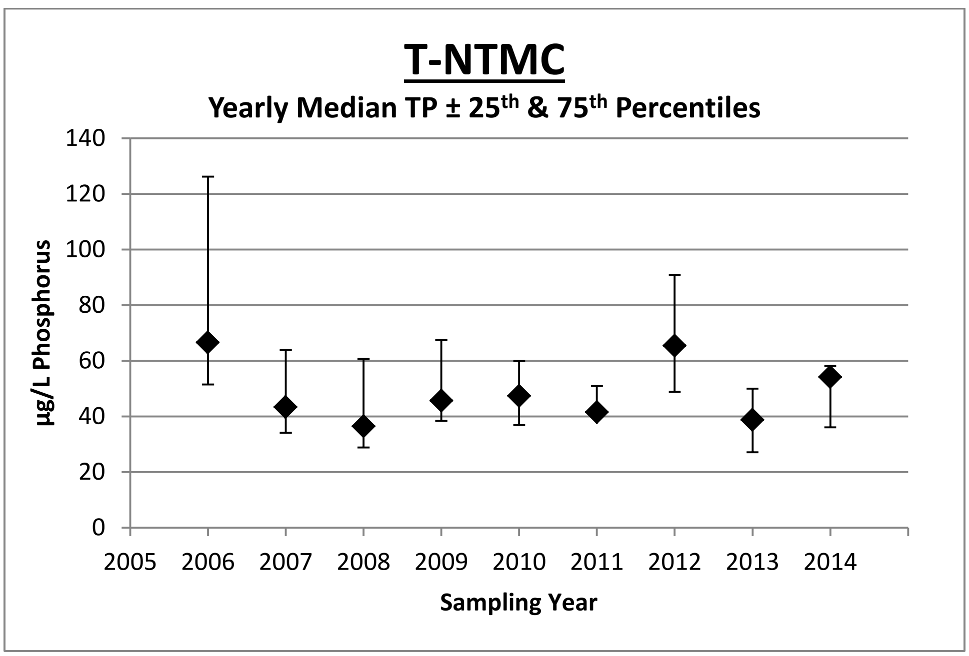

Fig 7j. Phosphorus (µg/L) by year.

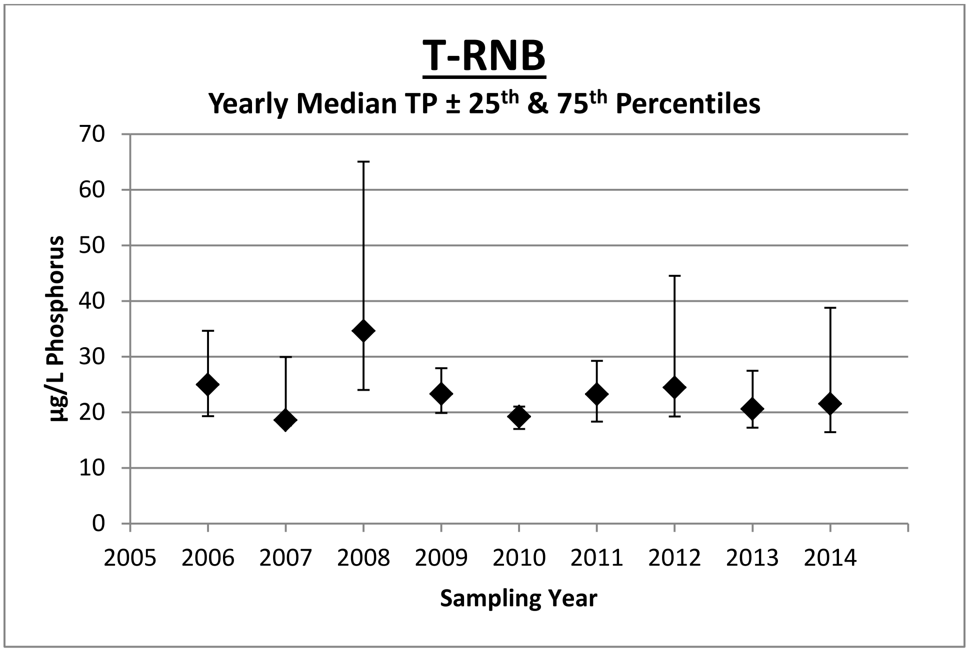

Fig 7k. Phosphorus (µg/L) by year.

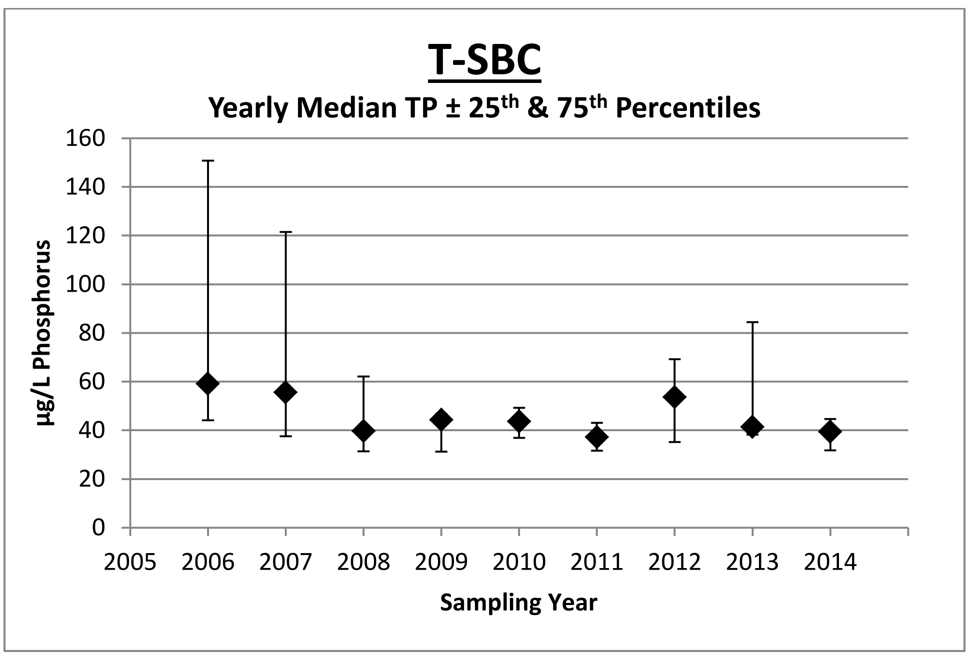

Fig 7l. Phosphorus (µg/L) by year.

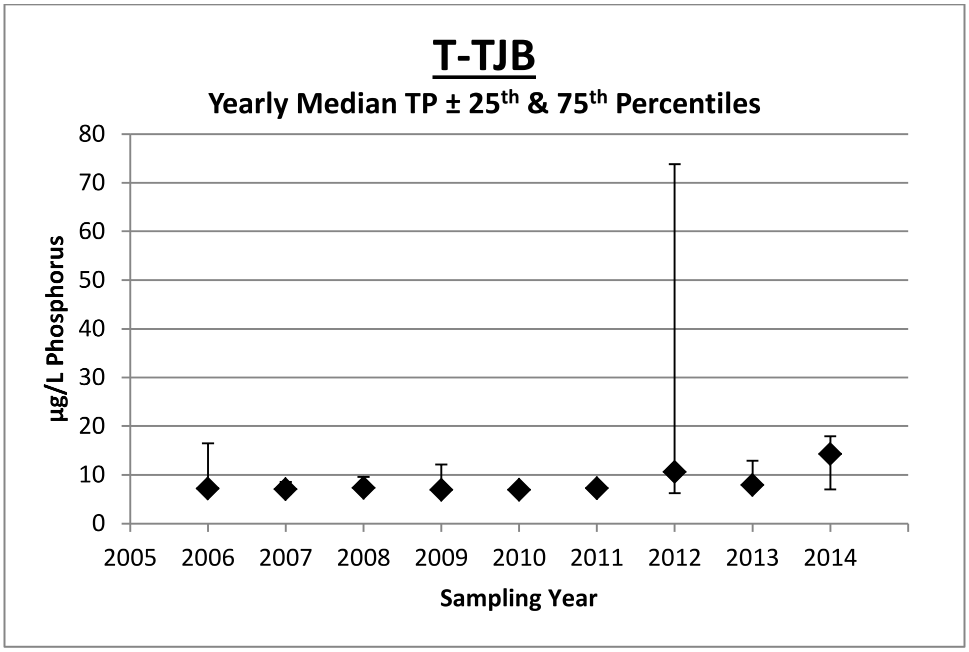

Fig 7m. Phosphorus (µg/L) by year.

Appendix A. 2014 MRBA Volunteer Water Quality Data

Total Phosphorus (µg/L)

Site Code	28-May	11-Jun	25-Jun	9-Jul	23-Jul	06-Aug	20-Aug	03-Sep	17-Sep	01-Oct	15-Oct	*Site Averages*
M-EF	142	34.3	25.9	81.7	17.9	30.6	33.8	468.5	41.5	22.2	18.5	***74.4***
M-ER	169	20.2	24.1	31.7		31.4	31.8	18.6	36.4	20.7	16.4	***40.03***
M-NTBF	96.3	12.4	14.9	197	13.1	28	5.8	36.3	11.8	14.6	11.8	***40.18***
M-SMR	38.6	36	26.1	115	53.6	66.8	42.9	53.8	42	29.5	43.6	***49.26***
M-WL	57.4	11.4	14.3	119	20.2	34.8	11.3	56.2	10.4	13.1	11.1	***32.83***
T-BGB	95.9	71.9	1090	270.6	1400	76.5	85.1	208	59.9	36	53.7	***350.54***
T-BGB01				35.4		22.1	14.7	29.6	16.6	18	16	***22.46***
T-BGB02				30.8		21.7	16.8	24.8	13.5	12.1	12.7	***18.91***
T-EBTR	26	32	25.2	37.8	25.9	90.2	18.1	29.1	7.33	7.94	8.31	***28.48***
T-EFBC	37.8	959	190	60.3	67.7	61.4	54	39.9	28.3	95.6	37.8	***159.4***
T-ETB	51.3	10.6	115	22.7	12.4	57	9.45	34.4	9.57	9.37	8.46	***30.93***
T-ETBDH	46.5	12.9	218.4	47.3	51.6	321	11.3	121	11.7	11.8	11.2	***73.03***
T-ETYB	25.8	11.6	427	15.8	8.28	218	8.21	38.4	8.7	8.09	8.41	***66.12***
T-FFWZ	21.3		146	52.7			17.7	23.4	14.6	19	16.5	***36.19***
T-HBW	159	75.5	92.7	151	92	64.1	52.1	125	131	141	216	***118.13***
T-LBB	23.8	8.36		25.1	7.28		7.3	17.8	8.16	8.15	7.81	***12.64***
T-NCMC	100	30.3	36.6	456	27.4		31.1	26.5	27.3	31.4	100	***79.19***
T-NTMC		59.7	45.5	116	54.2	58.2	31.5	107	36.1	45.6	27	***58.08***
T-RNB	38.8	23	262.2	26.8		20	14.5	79.2	18	16.4	38.8	***51.51***
T-SBC	32.3	31.7	54.3	60.3	43.4	39.4	24.5	49.5	30.6	44.6	32.3	***40.62***
T-SHCR	368.4	61.6	714	152	74	49.1	43.9	86.4	70.3	62.1	60	***151.19***
T-THBW	138	56.4	87.4	142	74.5	65.6	58.2	98.3	86.6	118	149	***97.48***
T-TJB	41.5	5.98	27.1	17.9	5.16	14.3	22.8	11.1	7.06	6.99	41.5	***15.84***
Averages:												
Mainstem	**100.66**	**22.86**	**21.06**	**108.88**	**26.2**	**24.28**	**25.12**	**110.26**	**28.42**	**20.02**	**20.28**	***47.34***
Tributaries	**80.43**	**96.70**	**235.43**	**95.58**	**138.84**	**78.57**	**28.96**	**63.86**	**32.52**	**38.45**	**46.97**	***84.56***

Total Nitrogen (mg/L)

Site Code	28-May	11-Jun	25-Jun	9-Jul	23-Jul	06-Aug	20-Aug	03-Sep	17-Sep	01-Oct	15-Oct	*Site Averages*
M-EF	0.59	0.5	0.5	0.7	0.46	0.55	0.37	1.79	0.44	0.35	0.26	***0.59***
M-ER	0.73	0.3	0.32	0.36		0.46	0.33	0.39		0.19	0.29	***0.37***
M-NTBF	0.5	0.26	0.37	0.95	0.32	0.37	0.26	0.37	0.27	0.17	0.15	***0.36***
M-SMR	0.58	0.44	0.76	0.94	0.77	0.62	0.64	0.46	0.56	0.42	0.38	***0.60***
M-WL	0.38	0.25	0.32	0.77	0.3	0.36	0.25	0.49	0.22	0.12	0.15	***0.33***
T-BGB	1.29	1.3	4.74	3.38	4.22	1.47	1.75	1.92	1.65	1.38	0.91	***2.18***
T-BGB01				0.73		0.46	0.28	0.66	0.93	0.6	0.4	***0.58***
T-BGB02				0.37		0.52	1.01	0.36	0.26	0.26	0.21	***0.43***
T-EBTR	0.27	0.55	0.42	0.71	0.91	0.57	0.45	0.4	0.35	0.27	0.17	***0.46***
T-EFBC	0.39	0.42	1.13	0.57		0.52	0.43	0.51	0.56	0.42	0.4	***0.54***
T-ETB	0.49	0.58	0.91	0.54	0.75	0.59	0.61	0.71	0.73	0.67	0.62	***0.65***
T-ETBDH	0.55	1.2	1.47	1	1.08	1.4	0.73	1.03	0.88	0.85	0.67	***0.99***
T-ETYB	0.59	0.76	2.25	1.1	2.09	1.31	0.98	0.97	1.56	1.51	1.09	***1.29***
T-FFWZ	0.36		1.43	0.8			0.36	0.36	0.22	0.17	0.19	***0.49***
T-HBW	3.14	1.78	2.79	2.4	0.84	0.85	1.02	0.89	0.98	0.9	1.18	***1.52***
T-LBB	0.32	0.33		0.38	0.33		0.29	0.36	0.28	0.22	0.21	***0.30***
T-NCMC	0.92	0.43	0.6	5.31	0.45		0.46		0.34	0.32	0.78	***1.06***
T-NTMC		0.88	1.02	3.34	0.89	0.94	0.71	1.79	0.78	0.77	0.35	***1.15***
T-RNB	0.47	0.52	1.03	0.66		0.53	0.53	0.68		0.8	0.63	***0.65***
T-SBC	0.4	0.45	0.61	0.76		0.47	0.5	0.48	0.59	0.33	0.37	***0.50***
T-SHCR	2.08	2.41	4.51	2.82	2.25	1.68	2.19	1.62	1.53	1.56	1	***2.15***
T-THBW	2.94	1.91	2.61	2.68	0.85	0.96	1.3	0.77	0.53	0.51	0.44	***1.41***
T-TJB	0.36	0.25	0.35	0.38	0.36		0.27		0.28	0.1	0.1	***0.27***
Averages:												
Mainstem	**0.56**	**0.35**	**0.45**	**0.74**	**0.46**	**0.47**	**0.37**	**0.7**	**0.37**	**0.25**	**0.25**	***0.45***
Tributaries	**0.97**	**0.92**	**1.72**	**1.55**	**1.25**	**0.88**	**0.77**	**0.84**	**0.73**	**0.65**	**0.54**	***0.92***

Turbidity (NTU)

Site Code	28-May	11-Jun	25-Jun	9-Jul	23-Jul	6-Aug	20-Aug	3-Sep	17-Sep	1-Oct	15-Oct	*Site Averages*
M-EF	50.2	2.1	4.84	10.9	2.45	6.38	4.33	111	12.8	4.04	3.34	***19.31***
M-ER	78.6	3.37	5.61	6.99		6.14	4.2	11.5		4.3	2.79	***13.72***
M-NTBF	33.8	0.8	2.22	84.3	1.02	4.98	0.37	12.1	1.63	1.51	1.86	***13.14***
M-SMR	14.5	2.98	4.87	9.03	8.33	9.21	3.54	4.71	4.34	9.89	10.1	***7.41***
M-WL	19.2	0.87	2.1	34.3	1.73	7.76	1.63	12.5	1.02	1.17	1.25	***7.59***
T-BGB	3.98	1.06	13.5	186.4	2.25	1.37	3.42	0.55	0.49	0.85	246	***41.81***
T-BGB01				3.39		2.03	1.16	2.19	2.15	2.46	1.65	***2.15***
T-BGB02				1.93		1.89	1.69	1.67	1.68	1.68	1.61	***1.74***
T-EBTR	6.79	2.09	6.71	7.02	6.55	45.8	2.09	5.18	0.51	0.47	0.86	***7.64***
T-EFBC	2.56	5.65	35.4	8.25		13.7	36.7	4.35	6.65	4.93	21.4	***13.96***
T-ETB	10.5	0.88	21.9	2.98	1.1	11.8	1.06	3.21	0.54	0.56	0.48	***5.00***
T-ETBDH	9.29	0.49	22	7.74	2.53	148.4	2.31	19.5	1.53	1.17	1.02	***19.63***
T-ETYB	3.14	0.89	84.5	0.68	0.39	56.6	0.58	2.83	0.52	0.22	0.24	***13.69***
T-FFWZ	3.08		48.5	4.84			1.12	0.39	0.4	0.49	1.05	***7.48***
T-HBW	19.8	11.2	27.8	12.5	18.6	8.54	4.77	41.1	64.3	8.32	17.4	***21.30***
T-LBB	6.18	0.42		3.97	0.55		0.64	1.84	0.75	0.56	0.62	***1.73***
T-NCMC	16.3	3.72	3.62	188	2.13		4.8		3.46	2.33	5.79	***25.57***
T-NTMC		2.75	3.09	15.2	3.39	7.75	4.49	10.7	7.22	7.71	3.22	***6.55***
T-RNB	7.07	1.69	90.6	3.92		1.99	1.9	37.6		3.39	1.54	***16.63***
T-SBC	6.16	3.22	7.08	15.5		7.19	6.39	2.56	5.41	2.81	5.79	***6.21***
T-SHCR	42.5	6.29	55.3	12.6	7.5	5.89	4.03	2.74	3.8	4.06	3.35	***13.46***
T-THBW	27.8	6.57	19.7	16.5	6.76	10.9	13.2	15.5	12.5	13	52.7	***17.74***
T-TJB	11.3	0.33	2.55	2.94	0.48		2.17	5.24	0.2	0.29	0.45	***2.60***
Averages:												
Mainstem	**39.26**	**2.02**	**3.93**	**29.10**	**3.38**	**6.89**	**2.81**	**30.36**	**4.95**	**4.18**	**3.87**	**12.24**
Tributaries	**11.76**	**3.15**	**29.48**	**27.46**	**4.35**	**23.13**	**5.14**	**9.24**	**6.59**	**3.07**	**20.29**	**12.49**