Report on Nutrient Synoptic Survey in the Miles River Watershed, Talbot County Maryland March, 2005 as part of a Watershed Restoration Action Strategy.

Maryland Department of The Environment
Technical and Regulatory Services Administration
April, 2006

DEPARTMENT OF THE ENVIRONMENT

Montgomery Business Park Center
1800 Washington Boulevard, Suite 540
Baltimore MD 21230-1718

Acknowledgements

This work was supported by the 2005 319(h) grant from U.S. Environmental Protection Agency # C9-00-3497-02-0.

Cover photo: Unnamed tributary to Potts Mill Cr at Pleasant Valley Rd. by Niles Primrose

Comments or questions about this report can be directed to:
Niles L. Primrose
MD Dept of the Environment
Technical and Regulatory Services Admin

nprimrose@mde.state.md.us
443- 482- 2705
410-537-4228

Executive Summary

A nutrient synoptic survey was conducted during March, 2005 in the Miles River watershed as part of the Miles River Watershed Restoration Action Strategy (WRAS). Water samples were analyzed from 24 fresh water free flowing sites throughout the watershed. Nitrate/nitrite concentrations were found to be excessive (>5 mg/L) in two subwatersheds, high (3 – 5 mg/L) in three, moderately elevated (1-3 mg/L) in eight, and baseline (<1 mg/L) in the remaining eleven subwatersheds. Instantaneous nitrate/nitrite yields were found to be excessive (>.03 Kg/Hectare/day) in two subwatersheds, high (.02-.03 Kg/Hectare/day) in two, moderate (.01-.02 Kg/Hectare/day) in one, and baseline (<.01 Kg/Hectare/day) in the remaining nineteen. Excessive concentrations (>.015 mg/L) of orthophosphate were found in fourteen subwatersheds, high concentrations (.01-.015 mg/L) in 1, moderate concentrations (.005 -.01 mg/L) in five, and the remaining four below baseline (<.005 mg/L). Orthophosphate yields were found to be moderate (.0005-.001) Kg/Hectare/day) in one watershed, and baseline (<.0005 Kg/Hectare/day) in the remaining twenty-three. The elevated nitrate/nitrite concentrations and yields may be associated with row crop agriculture and communities on well and septic. The elevated orthophosphate concentrations found throughout the Miles watershed may be associated with suspended sediment in water draining from numerous ponds. The average nutrient concentration from the Miles watershed was low compared to other WRAS watersheds. No significant anomalies were found in the insitu measurements of temperature or dissolved oxygen. One subwatershed in the Miles had relatively high conductivity (>500 mS/cm) that was attributed to deposition of dredge spoils upstream. This same subwatershed had a very low pH that could also be related to the dredge spoils.

Table of Contents

List of Tables Page

List of Figures

Introduction

A nutrient synoptic survey was conducted during March, 2005 in the Miles watershed as part of the Miles Watershed Restoration Action Strategy (WRAS).

Nutrient synoptic sampling was scheduled for early spring to coincide with the period of maximum nitrogen concentrations in the free flowing fresh water streams. The major proportion of the nitrogen compounds are carried dissolved in the ground water rather than in surface runoff. The higher nitrogen concentrations in the late winter and early spring reflect the higher proportion of nitrogen rich shallow ground water present in the base flow at this time of year. Nitrogen concentrations are reduced in summer as the proportion of shallow ground water is reduced through plant uptake, and replaced by deeper ground water that may have lower nitrate concentrations, or has been denitrified through interaction with anoxic conditions in the soils below the streambed. Point sources can also contribute to in stream nitrate concentrations.

Orthophosphate is generally transported bound to suspended sediments in the water column. In stream orthophosphate concentrations can also be produced through mobilization of sediment bound phosphorus in anoxic water column and/or sediment conditions, sediment in surface runoff from areas having had surface applied phosphorus, ground water from phosphorus saturated soils, and point source discharges.

Ranges used for nutrient concentrations and yields (Table 1) were derived from work done by Frink (1991). The low end values are based on estimated nutrient exports from forested watersheds, and the high end values are based on estimated nutrient exports from intensively agricultural watersheds. As an additional benchmark, the Chesapeake Bay Program uses 1 mg/L total nitrogen as a threshold for indicating anthropogenic impact. The dissolved nitrogen fraction looked at in these synoptic surveys constitutes approximately 50% to 70% of the total nitrogen.

Table 1. Nutrient Ranges and Rating

Rating	NO2+NO3 Concentration mg/L	NO2+NO3 Yield Kg/ha/day	PO4 Concentration mg/L	PO4 Yield Kg/ha/day
Baseline	<1	<.01	<.005	<.0005
Moderate	1 to 3	.01 to .02	.005 to .01	.0005 to .001
High	3 to 5	.02 to .03	.01 to .015	.001 to .002
Excessive	>5	>.03	>.015	>.002

A Note of Caution

Estimates of annual dissolved nitrogen loads/yields from spring samples will result in inflated load estimates, but the relative contributions of subwatersheds should remain reasonably stable. More accurate nitrate/nitrite load/yield estimates need to include sampling during the growing season to account for potential lower concentrations and discharges. Storm flows can also significantly impact loads delivered to a watershed outlet.

The tendency of orthophosphate to be transported bound to sediments makes any estimates of annual orthophosphate loads/yields derived from base flow conditions very conservative. More accurate estimates of orthophosphate loads/yields in a watershed

must include samples from storm flows that carry the vast majority of the sediment load of a watershed. Residual suspended sediments from recent rains, or instream activities of livestock or construction can produce apparently elevated orthophosphate concentrations and yields at base flow.

METHODS

Synoptic water chemistry samples were collected in early spring throughout the watershed. Sampling was halted for a minimum of 24 hours after rainfall events totaling more than .25 inches. Grab samples of whole water (500 ml) were collected just below the water surface at mid-stream and filtered using a 0.45 micron pore size (Gelman GF/C) filter. The samples were stored on ice and frozen on the day of collection. Filtered samples were analyzed by the Nutrient Analytical Services Laboratory at the University of Maryland's Chesapeake Biological Laboratory (CBL) for dissolved inorganic nitrogen (NO_3, NO_2), and dissolved inorganic phosphorus (PO_4). All analyses were conducted in accordance with U.S. Environmental Protection Agency (EPA) protocols. Stream discharge measurements were taken at the time of all water chemistry samples. Water temperature, dissolved oxygen, pH, and conductivity were measured in the field with a Hydrolab Surveyor II at selected sites at the time of water quality collections. Watershed areas used to calculate nutrient yields per unit area were determined from a digitized watershed map using Arcview software.

Where sites are nested in a watershed the mapped concentration data for the downstream site is shown only for the area between the sites. Yield calculations for a downstream site are based on the entire area upstream of the site, but are mapped showing just the area between sites. The downstream sites therefore illustrate the cumulative impact from all upstream activities.

RESULTS

A nutrient synoptic survey was conducted during March, 2005 in the Miles River watershed as part of the Miles River WRAS. Water samples were collected and analyzed from 24 fresh water free flowing sites throughout the watershed. The proximity to tidewater and paucity of road crossings limited the number of accessible free flowing sites. Sampling site locations are noted in Table 2 and mapped with subwatersheds in Figure 1. Dissolved nutrient concentrations and yields from all sites are noted in Table 3. Nitrate/nitrite concentrations were found to be excessive (>5 mg/L) in two subwatersheds, high (3 – 5 mg/L) in three, moderately elevated (1-3 mg/L) in eight, and baseline (<1 mg/L) in the remaining eleven subwatersheds (Figure 2). Instantaneous nitrate/nitrite yields were found to be excessive (>.03 Kg/Hectare/day) in two subwatersheds, high (.02-.03 Kg/Hectare/day) in two, moderate (.01-.02 Kg/Hectare/day) in one, and baseline (<.01 Kg/Hectare/day) in the remaining nineteen (Figure 3). Excessive concentrations (>.015 mg/L) of orthophosphate were found in fourteen subwatersheds, high concentrations (.01-.015 mg/L) in one, moderate concentrations (.005 -.01 mg/L) in five, and the remaining four below baseline (<.005 mg/L) (Figure 4). Orthophosphate yields were found to be moderate (.0005-.001) Kg/Hectare/day) in one watershed, and baseline (<.0005 Kg/Hectare/day) in the remaining twenty-three (Figure 5).

Table 2. Miles River WRAS Nutrient Synoptic Survey March, 2005
Sampling Site Locations

Station	Location	Lat	Long
0	UT to Glebe Cr at Glebe Rd (w)	38.78974	76.10286
2	Glebe Cr at Goldsborough Neck Rd	38.79581	75.08531
3	UT to Glebe Cr off Bryan Dr	38.79699	76.08058
4	Glebe Cr off Bryan Dr	38.79757	76.08079
5	UT to Glebe Cr off Bryan Dr	38.79757	76.08079
6	UT to Glebe Cr at Villa Dr	38.79929	75.09007
7	UT to Goldsborough Cr at Goldsborough Neck Rd	38.81429	75.08035
8	UT to Goldsborough Cr at Goldsborough Neck Rd	38.81689	76.08049
9	UT to Goldsborough Cr at Goldsborough Neck Rd	38.82117	76.08824
10	UT to Goldsborough Cr at Goldsborough Neck Rd	38.82098	76.09068
11	UT to Potts Mill Cr at Pleasant Valley (W)	38.83618	76.09409
14	UT to Potts Mill Cr off landfill off Rt 662	38.84013	76.06857
15	UT to Potts Mill Cr off landfill off Rt 662	38.84019	76.06903
16	UT to Potts Mill Cr at Rt 50	38.83804	76.06069
17	UT to Potts Mill Cr at Hog Neck G.C.	38.83169	76.05099
18	UT to Potts Mill Cr at Hog Neck G.C.	38.83075	76.05390
19	Potts Mill Cr at Rabbit Hill Rd	38.85204	75.06211
20	UT to Potts Mill Cr at Hiners La	38.84652	76.05539
21	UT to Potts Mill Cr at Rt 50	38.85013	76.06052
22	UT to Potts Mill Cr at Rabbit Hill Rd	38.85204	75.06211
23	UT to Potts Mill Cr at Sharp Rd	38.85161	76.09564
24	UT to Potts Mill Cr at Forrest Landing Rd	38.85600	76.09430
25	UT to Potts Mill Cr at Wye Heights Rd	38.86396	76.08037
48	UT to Potts Mill Cr at Rabbit Hill Rd (W)	38.85459	76.07422

Figure 1. Miles River WRAS Nutrient Synoptic Survey March, 2005
Synoptic Sites and Subwatersheds

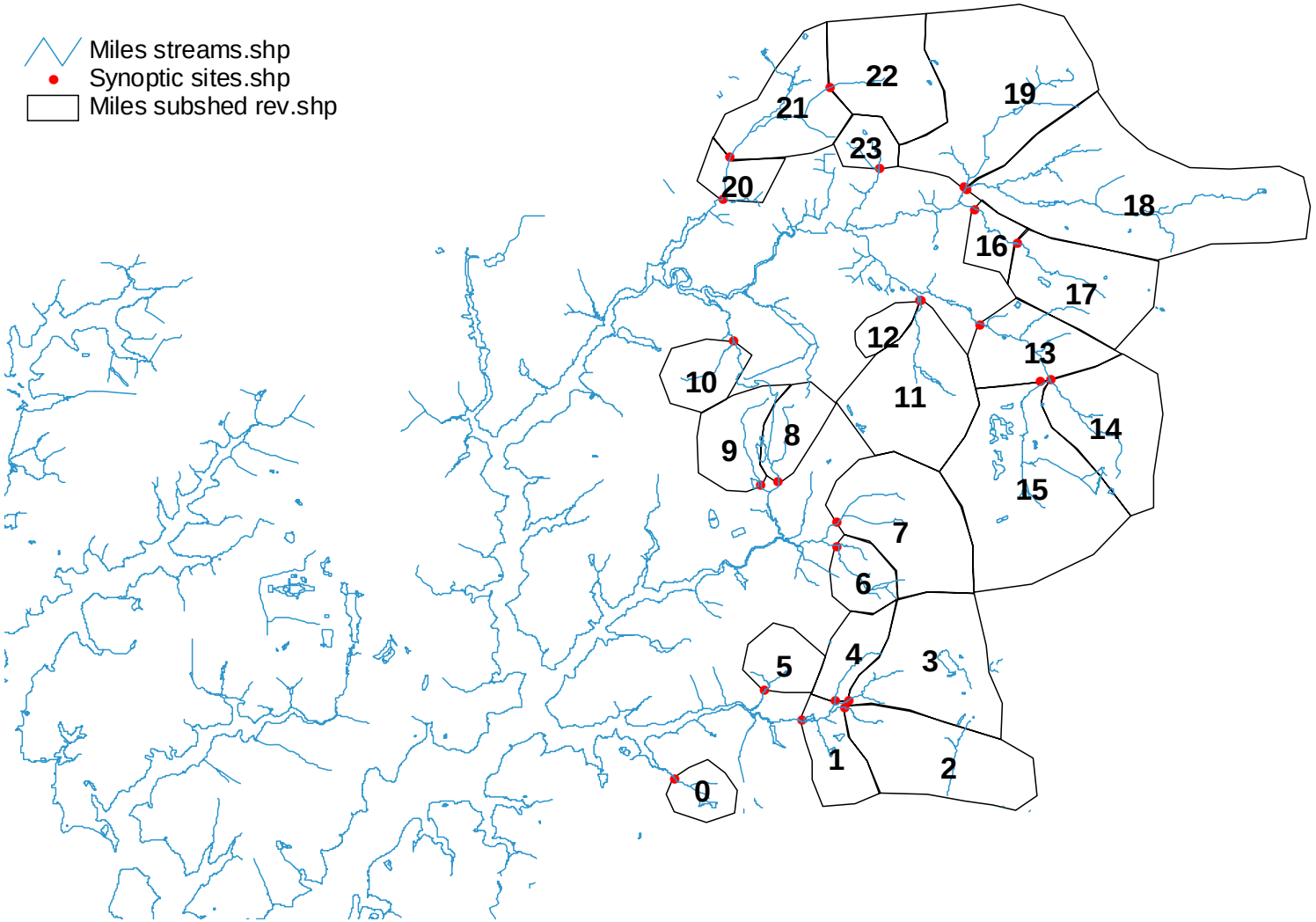


Table 3. Miles River WRAS Nutrient Synoptic Survey March, 2005
Dissolved Nutrient Concentrations and Yields.

Subshed	Date	Time	PO4 mg/L	NO2+NO3 mg/L	Discharge L/sec	Area hectares	PO4 yield Kg/H/day	NO2+NO3 yield Kg/H/day
0	03/14/05	1000	0.003	0.77	4.1	43	0.000025	0.006310
2	03/14/05	1030	0.022	0.76	19.6	516	0.000072	0.002493
3	03/14/05	0940	0.028	0.55	4.6	184	0.000061	0.001197
4	03/14/05	0915	0.009	1.24	8.2	199	0.000032	0.004394
5	03/14/05	0900	0.023	1.10	0.2	59	0.000008	0.000400
6	03/14/05	1050	0.044	0.08	4.7	58	0.000305	0.000555
7	03/14/05	1115	0.006	0.45	32.5	56	0.000301	0.022553
8	03/14/05	1135	0.005	9.20	9.8	198	0.000021	0.039425
9	03/14/05	1205	0.027	0.24	3.3	64	0.000121	0.001075
10	03/14/05	1155	0.053	0.04	4.6	86	0.000246	0.000185
11	03/25/05	0930	0.021	0.25	10.4	65	0.000290	0.003456
14	03/14/05	1310	0.004	4.97	12.1	199	0.000021	0.026150
15	03/14/05	1255	0.001	2.41	0.6	29	0.000002	0.004103
16	03/14/05	1440	0.009	3.32	31.2	645	0.000038	0.013870
17	03/25/05	0835	0.024	1.81	5.2	170	0.000064	0.004810
18	03/25/05	0850	0.025	1.97	15.8	333	0.000102	0.008069
19	03/14/05	1410	0.010	1.70	9.9	429	0.000020	0.003403
20	03/14/05	1420	0.006	5.23	3.2	159	0.000010	0.009035
21	03/25/05	0815	0.135	2.63	5.1	200	0.000298	0.005802
22	03/14/05	1350	0.016	2.24	12.2	316	0.000053	0.007473
23	03/09/05	1340	0.038	0.58	39.2	344	0.000374	0.005710
24	03/09/05	1500	0.042	0.59	26.5	299	0.000322	0.004520
25	03/09/05	1440	0.092	0.32	15.7	158	0.000789	0.002743
48	03/10/05	1400	0.004	4.69	8.2	39	0.000073	0.085443

Figure 2. Miles River WRAS Nutrient Synoptic Survey March, 2005
Nitrate/Nitrite (NO2+NO3) Concentration mg/L

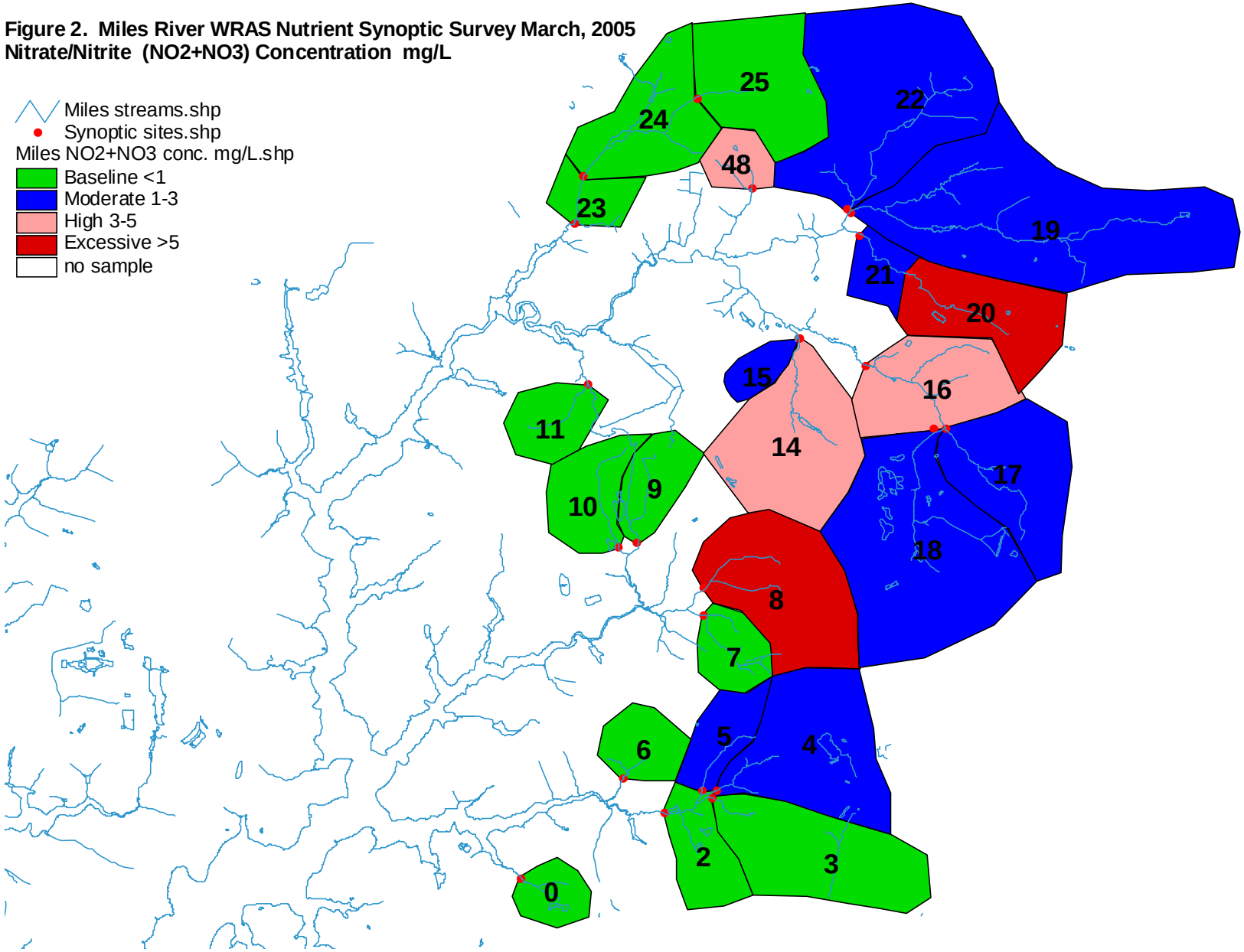


Figure 3. Miles River WRAS Nutrient Synoptic Survey March, 2005
Nitrate/Nitrite (NO2+NO3) Yield Kg/H/day

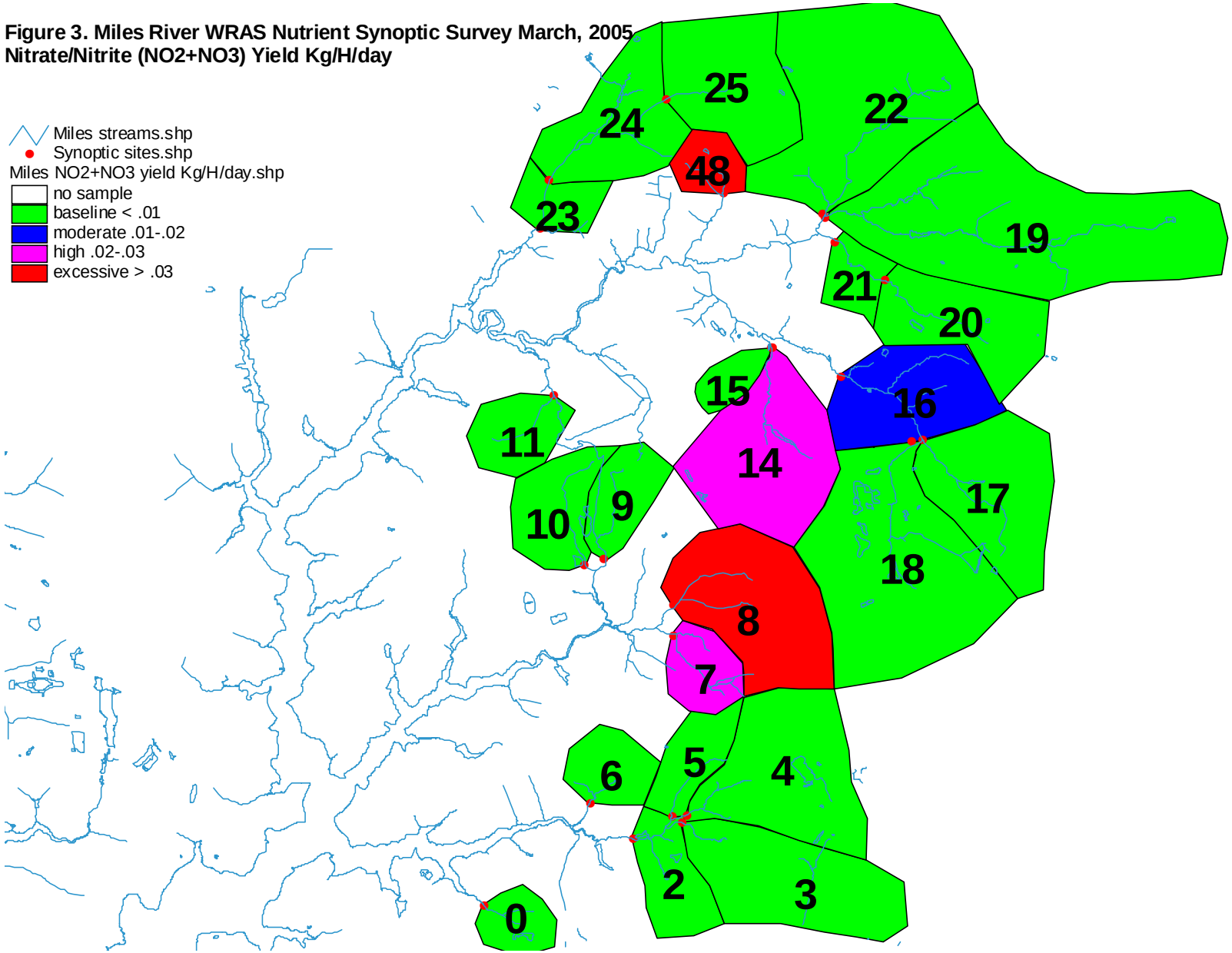


Figure 4. Miles River WRAS Nutrient Synoptic Survey March, 2005.
Orthophosphate (PO4) Conc. mg/L

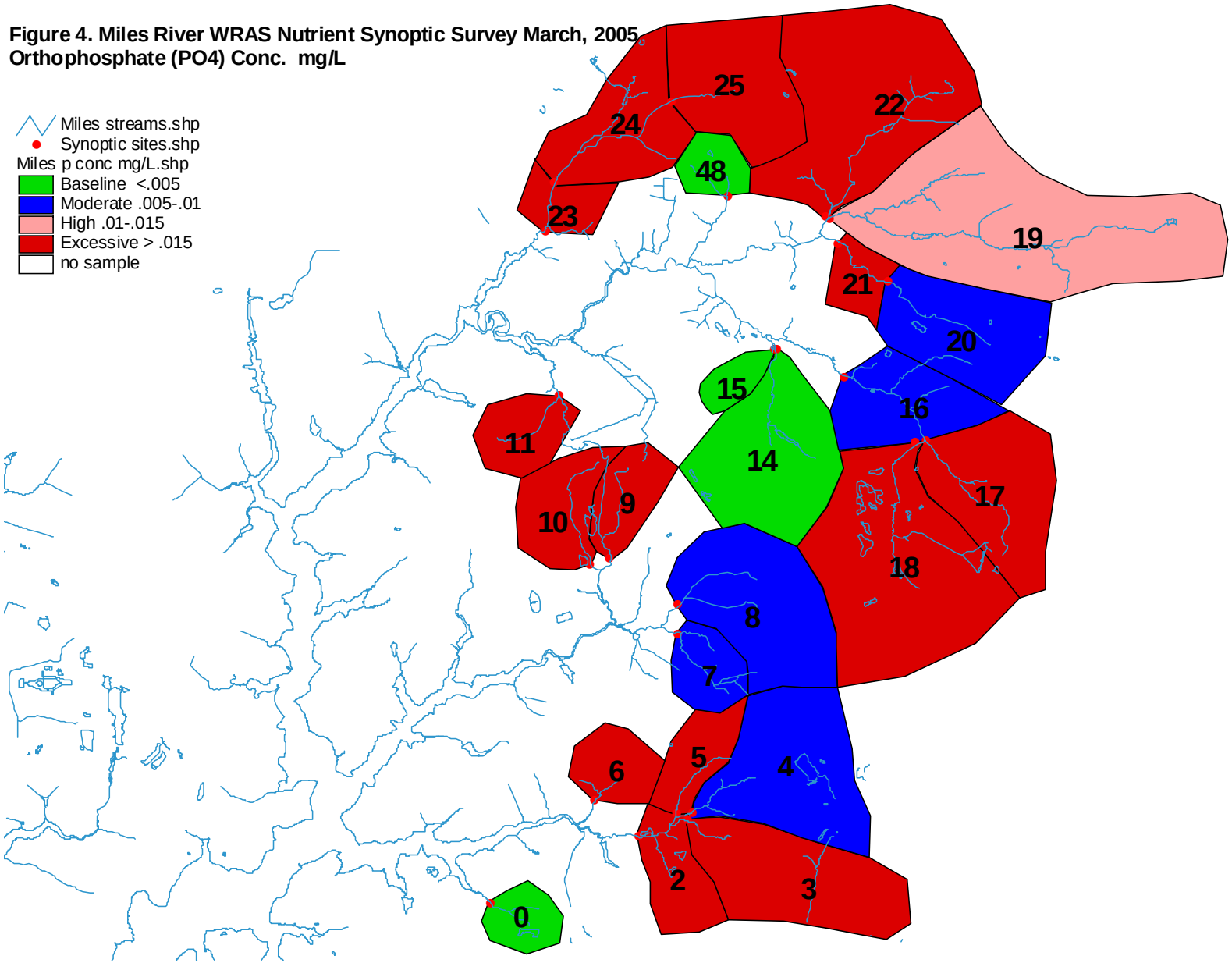
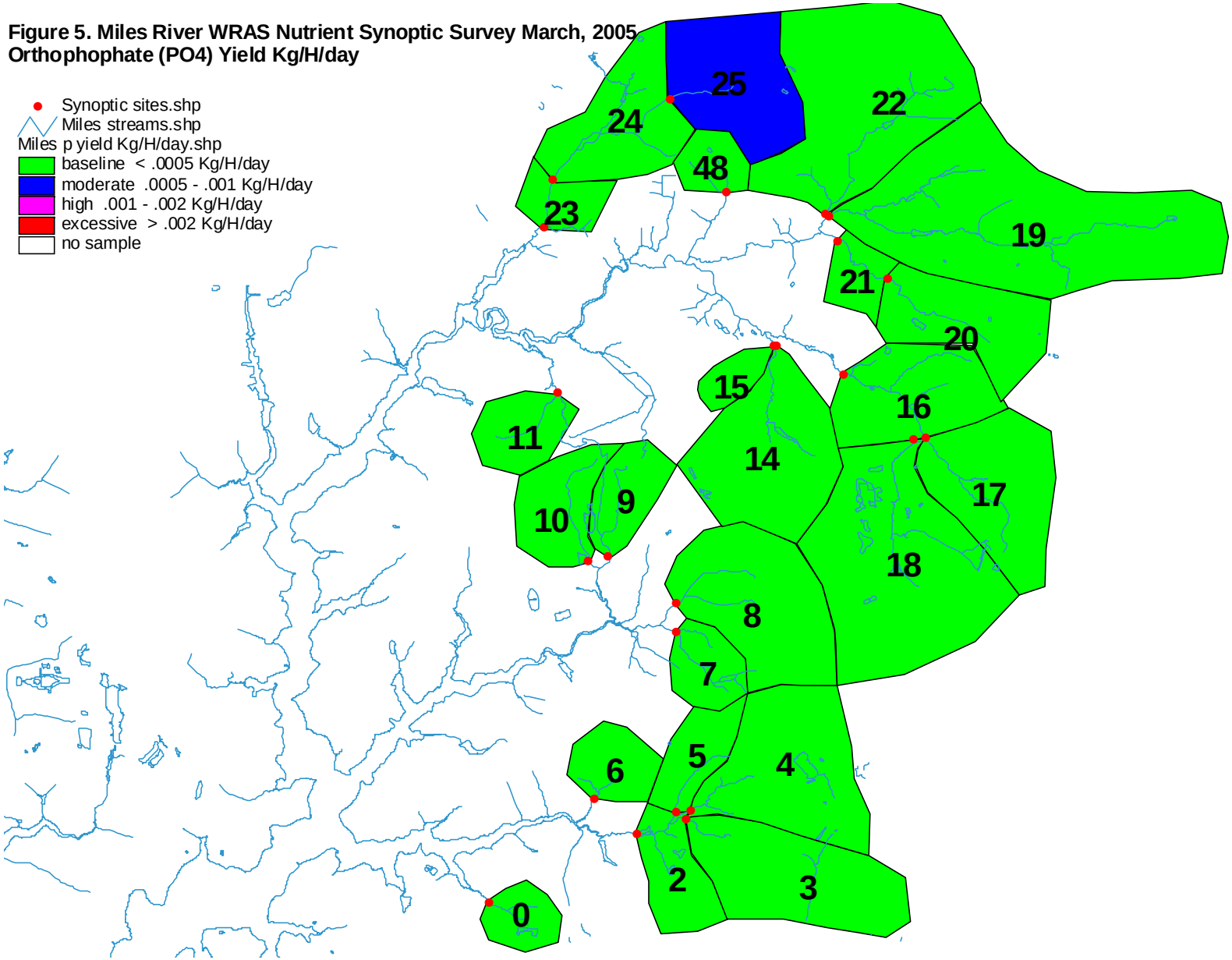


Figure 5. Miles River WRAS Nutrient Synoptic Survey March, 2005
Orthophophate (PO4) Yield Kg/H/day



Temperature, dissolved oxygen, pH, and specific conductivity values are noted for all sites in Table 4. No significant anomalies were found in the insitu measurements of dissolved oxygen, or temperature. Depressed ph values (<5.5) were found in only one subwatershed (Figure 6). Only one Miles subwatershed had relatively high specific conductivity (>500 mS/cm) (Figure 7). Six other subwatersheds in this drainage had moderately elevated specific conductivity (300 to 500 mS/cm).

Table 4. Miles River WRAS Nutrient Synoptic Survey March, 2005
Insitu Water Quality Parameters

Station	Date	Time	Temp oC	pH	DO mg/L	Specific Conductivity mS/cm
0	14-Mar-05	1000	5.18	3.56	9.26	524
2	14-Mar-05	1020	5.86	6.55	11.65	394
3	14-Mar-05	940	3.77	7.29	12.64	375
4	14-Mar-05	915	4.90	7.20	10.91	384
5	14-Mar-05	900	4.04	6.73	11.65	180
6	14-Mar-05	1050	8.87	7.22	16.25	267
7	14-Mar-05	1115	7.73	7.20	11.86	167
8	14-Mar-05	1135	8.21	6.53	10.53	232
9	14-Mar-05	1205	8.34	7.35	12.97	278
10	14-Mar-05	1155	10.56	7.15	11.58	258
11	25-Mar-05	930	6.88	6.66	9.10	166
14	14-Mar-05	1310	9.93	7.16	10.62	326
15	14-Mar-05	1255	6.67	7.73	14.67	334
16	14-Mar-05	1440	9.03	7.01	11.67	205
17	25-Mar-05	835	7.15	6.02	9.85	132
18	25-Mar-05	850	7.63	6.25	9.46	219
19	14-Mar-05	1410	8.98	7.17	11.55	173
20	14-Mar-05	1420	9.24	7.21	10.89	171
21	25-Mar-05	815	6.73	6.59	10.15	168
22	14-Mar-05	1350	9.58	7.37	11.70	301
23	9-Mar-05	1535	4.32	6.55	8.79	217
24	9-Mar-05	1500	4.57	6.48	8.55	206
25	9-Mar-05	1440	5.15	5.78	7.71	256
48	9-Mar-05	1400	6.07	5.54	10.61	167

Figure 6. Miles River WRAS Nutrient Synoptic Survey March, 2005
pH

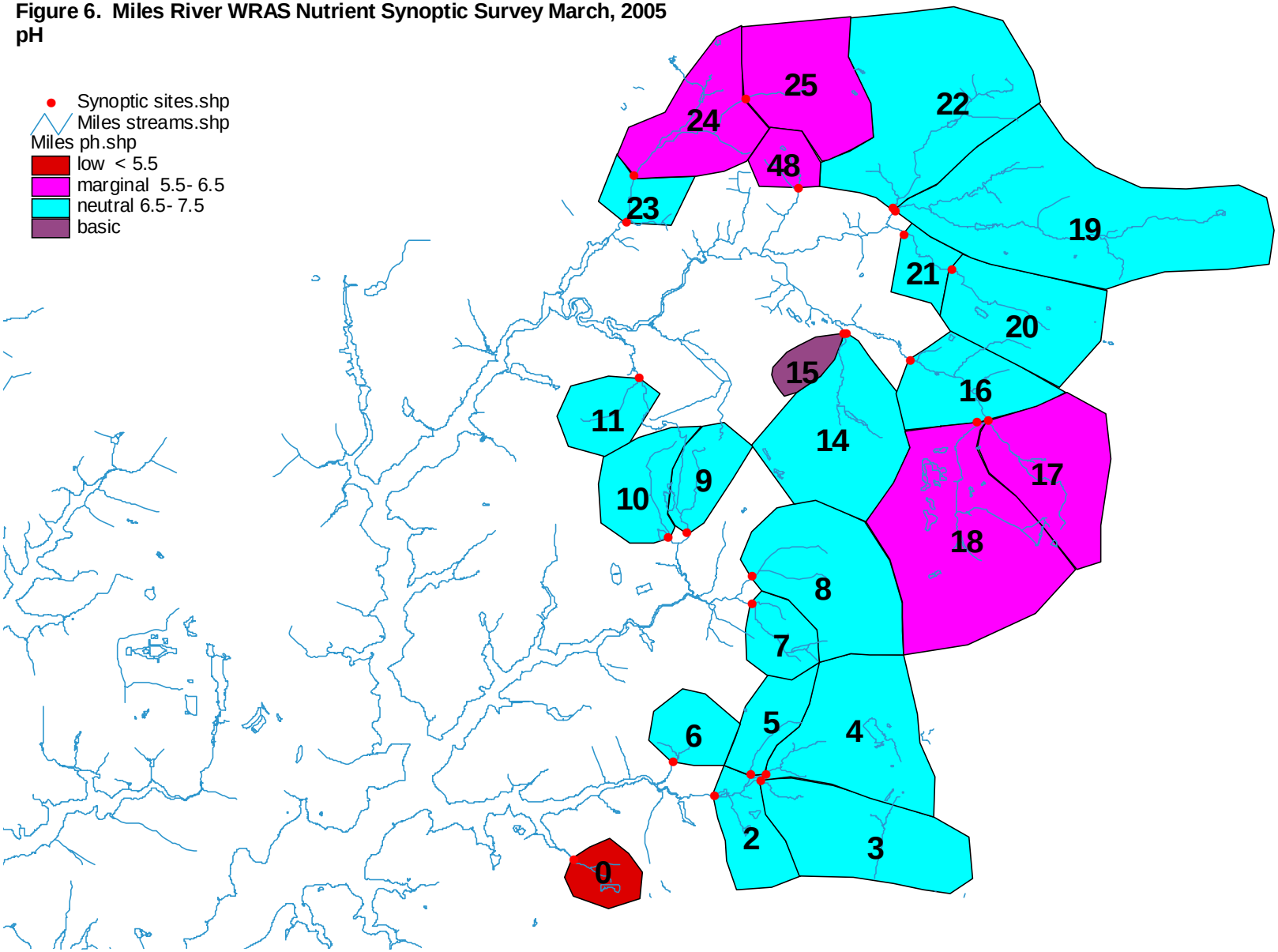
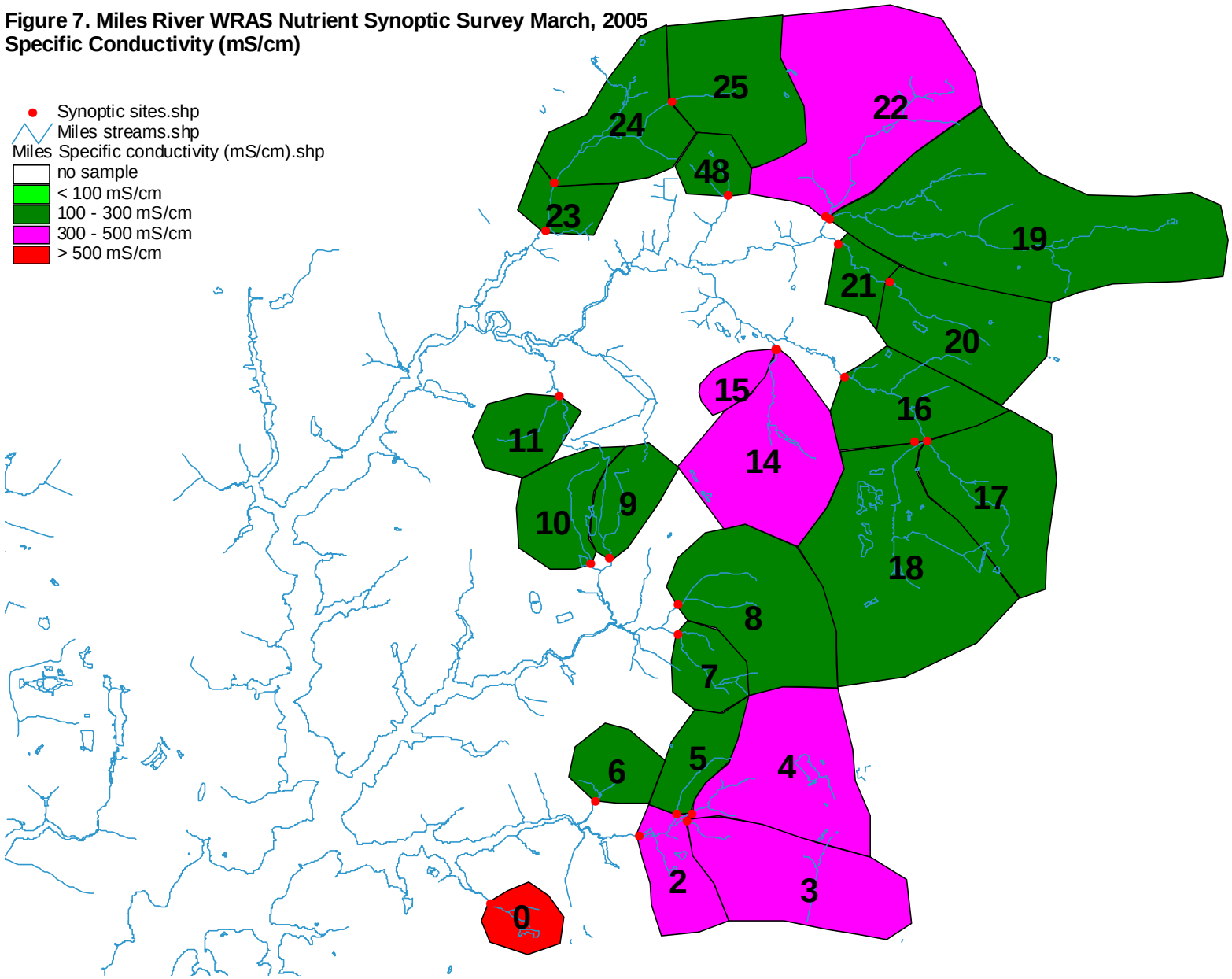


Figure 7. Miles River WRAS Nutrient Synoptic Survey March, 2005
Specific Conductivity (mS/cm)



Discussion

The elevated nitrate/nitrite concentrations and yields may be associated with row crop agriculture and communities on well and septic. Further investigations in those subwatersheds with high concentrations and yields could provide additional information that could help clarify the nutrient source. The elevated orthophosphate yields found throughout the Miles watershed may be associated with sediment in water draining from numerous ponds. Many farm ponds in the Miles watershed act as sediment control ponds especially during winter and early spring before crops are growing. The relatively wet spring of 2005 would have produced elevated discharges from these ponds that would have included suspended sediment, the transport agent for phosphorus. While nutrient concentrations ranged from below baseline to excessive, the average nutrient concentration from the Miles watershed was low compared to most other WRAS watersheds (Table 5). No significant anomalies were found in the insitu measurements of temperature or dissolved oxygen. One subwatershed in the Miles (site 0) had very low pH (3.56) and relatively high conductivity (>500 mS/cm) that was attributed to salt leaching from estuarine dredge spoils deposited upstream of the sampling site. The elevated pH (>7.5) and moderately elevated specific conductivity (300 and 500 mS/cm) at site 15 may be due to concrete in the ruble fill within this subwatershed. Moderately elevated specific conductivity (300 and 500 mS/cm) at sites 2, 3 and 4, could be associated with snow removal activities at the Easton airport. Salt applications on Route 50 could also be contributing to the moderately elevated specific conductivity at sites 14 and 22.

Table 5. Annual & Spring Nutrient Concentration Averages from Other Nutrient Synoptic Surveys

Mg/L	Piney	German Br.	Pocomoke	Talbot Choptank	Middle Chester	Newport Sinepuxent	**Miles**
NO2+NO3 Spring	3.742	3.832	3.734	3.538	4.87	1.93	**1.96**
NO2+NO3 Annual	4.823	4.704	2.384				
PO4 Spring	0.800	0.043	0.028	0.007	0.012	.03	**0.026**
PO4 Annual	1.177	0.067	0.022				

Literature Cited

Frink, Charles R.. 1991. *Estimating Nutrient Exports to Estuaries*. Journal of Environmental Quality. 20:717-724.