Report on Nutrient and Biotic Synoptic Surveys in The Bush River Watershed, Harford County, Maryland, March 2002 as part of the Watershed Restoration Action Strategy.

Maryland Department of Natural Resources
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This work supports Department of Natural Resources Outcomes –
#2 Healthy Maryland watershed lands, streams, and non-tidal rivers.
#3 A natural resources stewardship ethic for Marylanders.
#4 Vibrant local communities in balance with natural systems.

Significant field collection assistance was provided by Beth Habic, Jennifer Jaber, Kevin R. Coyne, and John McCoy of MD Dept of Natural Resources, Chesapeake and Coastal Watershed Services, Watershed Restoration Division, Watershed Evaluation Section.

Comments or questions about this report can be directed to :
Niles L. Primrose
MD Dept of Natural Resources
Chesapeake and Coastal Watershed Services
Watershed Restoration Division
Watershed Evaluation Section.
nprimrose@dnr.state.md.us
410-260-8804

Executive Summary

The Bush River watershed was subdivided into 81 subwatersheds based on road crossings. Grab samples for dissolved nutrient analysis were collected at 75 sites. Benthic samples were collected at a subset of 18 sites and fish at 9 sites. Six subwatersheds where not sampled due to access problems or no flowing water at the time of sampling in March, 2002. Nutrient loads and yields within the Bush River watershed where generally low as compared to other watersheds around the state. The highest nitrate/nitrite concentrations were in the high range in 18 subwatersheds, with apparent clustering in West Branch watershed (7 subwatersheds), the middle portion of Bynum Run (3 subwatersheds), and upper James Run/Broad Run (3 subwatersheds). The remaining five subwatersheds where headwater streams above the reservoir, Bread and Cheese Branch, Long Branch, Hoops Branch, and an unnamed tributary to Elbow Branch. Thirty-nine of the 75 sites sampled had moderate nitrate/nitrite concentrations. The majority of the subwatersheds had baseline orthophosphate concentrations. Two subwatersheds had excessive concentrations, one in Broad Run and one a small headwater stream in Bynum. Five other subwatersheds scattered throughout the watershed had high concentrations. No subwatersheds had orthophosphate yields above baseline. The in situ Hydrolab readings from all sites found few significant anomalies in the constituents measured. The macroinvertebrate communities found at the18 sites sampled ranged from ‘very poor’ to ‘good’ IBI categories. Habitat assessments that accompanied the macroinvertebrate sampling ranged from ‘fair to ‘excellent’. The major habitat problems were stream bank erosion and excessive sediment in the prime macroinvertebrate habitat areas such as riffles. In situ measurements of temperature, dissolved oxygen, conductivity and pH taken at the time of water sample collection showed no significant anomalies. Fish sampling at 9 sites found expected number of species except at 2 sites.

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Introduction

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 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 bench mark, 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. For ease of discussion, the four divisions within the concentration and yield ranges will be considered *background, moderate, high,* and *excessive* (Table 1.).

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.*

Biological (macroinvertebrates and fish) sampling and habitat condition information are collected on a limited basis within the WRAS watersheds. Analysis of the biological data in conjunction with the nutrient and Stream Corridor Assessment information can provide good insight into the location, severity, and causes of water quality problems within a watershed.

Additional analysis that draws in existing and planned land use, and tax map information, can be a useful watershed planning tool to determine what areas might be targeted for protection or remediation.

METHODS

Water Chemistry Sampling

Synoptic water chemistry samples were collected in early spring throughout the watershed. 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 the time of all 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.

Benthic Macroinvertebrate Sampling

Aquatic macroinvertebrates were collected at the time of water chemistry samples during the spring to be within the MBSS spring index period. Macroinvertebrate collections were made over a $2m^2$ area of the best available habitat using a 0.3m wide dip net with a mesh size of 500 microns. The best available habitats include: gravel riffles, snags, submerged vegetation and root mats. Habitats were sampled in the proportion to their occurrence at the station. Samples were composited in a sieve bucket, fine sediments washed out, and large debris rinsed and discarded. The remaining sample was preserved in 70% ethanol and returned to the laboratory for subsampling. Subsampling was done using a gridded tray. Grids were chosen at random until the grid with the 100th organism had been completed. Organisms were identified to genus, recorded on a bench sheet, and archived future reference. Insitu water quality data (dissolved oxygen, pH, conductivity, temperature) were collected during each sampling episode with a

Hydrolab Surveyor II. A macroinvertebrate index of biotic integrity (IBI)(MD DNR, 1998) was calculated to facilitate ranking of site quality.

Macroinvertebrate Habitat Assessment

A habitat assessment was completed at the time of the macroinvertebrate collections to provide a qualitative measure of the in stream and riparian habitat quality. The assessment, modified from Plafkin et al. (1989) to focus on macroinvertebrate habitat, rates the in stream structure, channel and lower bank morphology, and the upper bank and riparian zone using a series of metrics. The metrics are weighted to provide more scoring potential to the parameters more directly influencing the in stream macroinvertebrate community. The macroinvertebrate habitat score is weighted by the number of equally scored metrics in each category.

The primary metrics rate in stream habitat quality and quantity available for use by the macroinvertebrate community. This includes the amount and type of woody debris, prevalence of undercut banks, degree of embeddedness (siltation) in riffles, pool depth, and water velocity and flow. These metrics are given the most weight because of their direct importance to the health and diversity of the in stream macroinvertebrate communities. Secondary metrics assess channel morphology, rating the quality of the lower stream bank and the structure of the channel. These metrics include relative measures of riffle extent, channel sinuosity, and extent of channel alterations caused by high flow events. These metrics are weighted less than the primary because of their less direct impact on the in stream macroinvertebrate communities. The tertiary metrics rate the quality of the upper banks and adjacent riparian areas. These metrics include scoring of the type and amount of bank vegetation, amount and frequency of bank erosion, and land use in the riparian area. These characteristics of the watershed are given the least weight because they are less important to the in stream macroinvertebrate community.

Fish Sampling

Fish were sampled during the summer to coincide with the MBSS index period for fish sampling. Backpack electroshockers were used for two passes through a 75 meter reach of stream with block nets at each end of the reach. All species were enumerated and weighed to obtain taxa richness and biomass estimates.

Results and Discussion

A total of 81 sampling sites were identified in the Bush River watershed. Station locations are noted in Table 2, and subwatersheds are shown in Figure 1. Grab samples for dissolved nutrient analysis were collected at 75 sites. Benthic samples were collected at a subset of 18 sites and fish at 9 site. Six subwatersheds where not sampled due to access problems, map discrepancies, or stream blockages at the time of sampling in March, 2002.

Nitrate/nitrite and orthophosphate concentrations and yields within the Bush River watershed are noted in Table 3.. The watershed average concentration for these constituents is compared to other watersheds around the state in Table 4, and found to be at the low end of these values. The subwatershed nitrate/nitrite concentration results are mapped in Figure 2, and the yields are mapped in Figure 3. No subwatersheds were found to have an excessive concentration of nitrate/nitrite. High concentrations were

Table 2.Bush Watershed Synoptic Sampling Sites

Station	Road Crossing	Latitude	Longitude	Sample Type*
0	Cranberry Run at Spesutie Rd.	39.47650	-76.20325	N
1	Cranberry Run at Rt 7.	39.48781	-76.19258	N
2	Grays Run at Union (Lieskes) Rd.	39.50256	-76.21258	N
3	U T** to Grays Run at Union (Lieskes) Rd.	39.50258	-76.21250	N
4	UT to Grays Run above Rt 7 (west).	39.48939	-76.21553	N
5	Grays Run at Rt 7.	39.48944	-76.21539	N.B.
6	UT to Grays Run above Rt 7 (east).	39.49189	-76.21125	N
7	UT to Bush at Rt 40 (east)	39.47458	-76.22792	N
8	UT to Bush at Rt 40 (west)	.	.	.
9	James Run at Rt 7.	39.47633	-76.26067	N.B.F
10	James Run at Creswell (Rt 543).	39.49206	-76.25908	N
11	James Run at Nova Scotia Rd.	39.50450	-76.25903	N
12	James Run at James Run Rd.	39.52506	-76.25633	N
13	Broad Run off Rt 136	39.53042	-76.26297	N.B
14	UT to Broad Run off Rt 136	.	.	N
15	Broad Run at Edwards La. (confluence with UT 16)	39.53694	-76.27681	N
16	UT to Broad Run nr Edwards Rd.	39.53692	-76.27681	N
17	Bynum Run at Rt 7.	39.47178	-76.26689	N.B.F
18	Bynum Run at Hookers Mill Rd.	39.47881	-76.27944	N
19	UT to Bynum at confluence w/ Bynum	39.48747	-76.28261	N
20	Bynum above confluence w/ UT 19	39.48756	-76.28325	N
21	UT to UT above Cedar La. (east)	39.50500	-76.28353	N.F
22	UT to UT above Cedar La. (west)	.	.	N
23	Bynum run at Wheel Rd.	.	.	N
24	Bynum Run at MacPhail Rd.	.	.	N
25	Bynum Run at Churchville Rd. (Rt 22)	.	.	N
26	Bynum Run at confluence w/ UT 27 above Moores Mill	.	.	N
27	UT to Bynum Run above Moores Mill Rd.	.	.	N
28	Bynum Run at Rt 1 Bussiness	.	.	N
29	UT to Otter Pt. Cr. At Perry Ave.	39.39583	-76.29125	N
30	UT to Otter Pt Cr. At Rt 24	39.43011	-76.30847	N
31	Ha Ha Br. At Rt 7	39.45161	-76.28908	N.B
32	Ha Ha Br. At Red Maple Dr.	.	.	.
33	U T to Winters at Chipper Dr.	.	.	.
34	Winters Run at Rt 7	39.44322	-76.31594	N.B.F
35	UT to Winters Run at Fashion Way	39.44883	-76.32133	N
36	UT to Winters nr New Cut Rd	39.45958	-76.32453	N
37	UT to east side of Winters downstream of Station 36	39.45881	-76.32325	N
38	UT to east side of Winters	.	.	N
39	UT to Winters at Winters Run Rd.	.	.	N
40	Mountain Br. At Winters Run rd.	39.47394	-76.33672	N
41	Winters Run at Singer Rd.	.	.	N.B
42	Mountain Br. At Clayton Rd.	39.47244	-76.35044	N

43	UT to Mountain Br. Nr Clayton Rd.	39.47250	-76.35028	N
44	UT to Atkisson Res. east side	39.48711	-76.33378	N
45	Plumtree Run at Plumtree Rd.	39.49650	-76.34783	N.B
46	UT to Winters at Ring Factory Rd.	39.50108	-76.35925	N
47	Winters at Ring Factory Rd.	39.49775	-76.35356	N
48	High Bridge Run at Old Joppa Rd.	39.49881	-76.37292	N
49	Plumtree Run at Tollgate Rd.	39.50422	-76.33861	N.B.F
50	Plumtree at Ring Factory Rd.	39.51139	-76.34261	N
51	Plumtree at Atwood Rd.	39.52781	-76.34839	N.B
52	Winters Run at Rt 1 bypass	39.51983	-76.37278	N
53	Heavenly Waters off Rt 1 bypass	39.51997	-76.37106	N.B
54	UT to Winters at Tollgate Rd. (west)	39.52989	-76.38325	N
55	Elbow Br at confluence with Winters	39.52333	-76.38697	N.B
56	Winters Run above confluence with Elbow Br.	39.52228	-76.41889	N
57	UT to Elbow Br at Waterville Rd.	39.51928	-76.40261	N
58	Bear Cabib Br. at Carrs Mill rd.	39.53644	-76.39411	N.B
59	Bread & Cheese Br at Angleside Rd.	39.53875	-76.40992	N.B.F
60	Bread & Cheese at Ryan Rd.	39.53236	-76.41483	N
61	Bear Cabin Br. at Bernadette Dr.	39.55494	-76.38561	N.B.F
62	Long Br. at Boggs Rd.	39.55622	-76.40892	N.B.F
63	Hoops Br. at Pleasantville Rd.	39.55219	-76.43467	N
64	Winters Run at Putnam Rd.	39.55094	-76.44628	N.B
65	East Br. at Cosner Rd	.	.	.
66	UT to East Br off Phillips Mill Rd	39.52019	-76.44264	N
67	UT to East Br at 2nd left off Phillips Mill Rd	.	.	.
68	East Br. at PhillipsMill Rd.	39.57706	-72.43956	N
69	UT to West Br. at Baldwin Mill Rd.	39.55581	-76.46514	N
70	West br. at Ba;dwin Mill Rd.	39.55700	-76.46433	N.B
71	UT to West Br. nr 3000 blk Charles Rd.	39.56286	-76.47153	N
72	UT to West Br nr Engle Rd. off Charles Rd.	.	.	.
73	West Br. at Durham Rd.	39.57264	-76.48706	N
74	UT to West Br. at Furnace Rd south	39.58167	-76.48397	N
75	West Br. at Furnace Rd.	39.58406	-76.49347	N
76	West Br. at Schuster Rd.	39.59583	-76.50728	N
77	UT to West Br. at Furnace Rd. north.	39.59714	-76.48997	N
78	East Br. at Federal Hill Rd.	39.60603	-76.44561	N
79	East br at Jarretsville Rd.	39.60817	-76.47825	N
80	Burnt Oak Ct.	39.47958	-76.29825	N.B.F
81	Merrick Way	39.48522	-76.30453	N.B.F
				*(Benthic, Nutrient, Fish)

** UT = unnamed tributary

Figure 1.
Bush River Watershed WRAS, March, 2002
Synoptic Sampling Sites

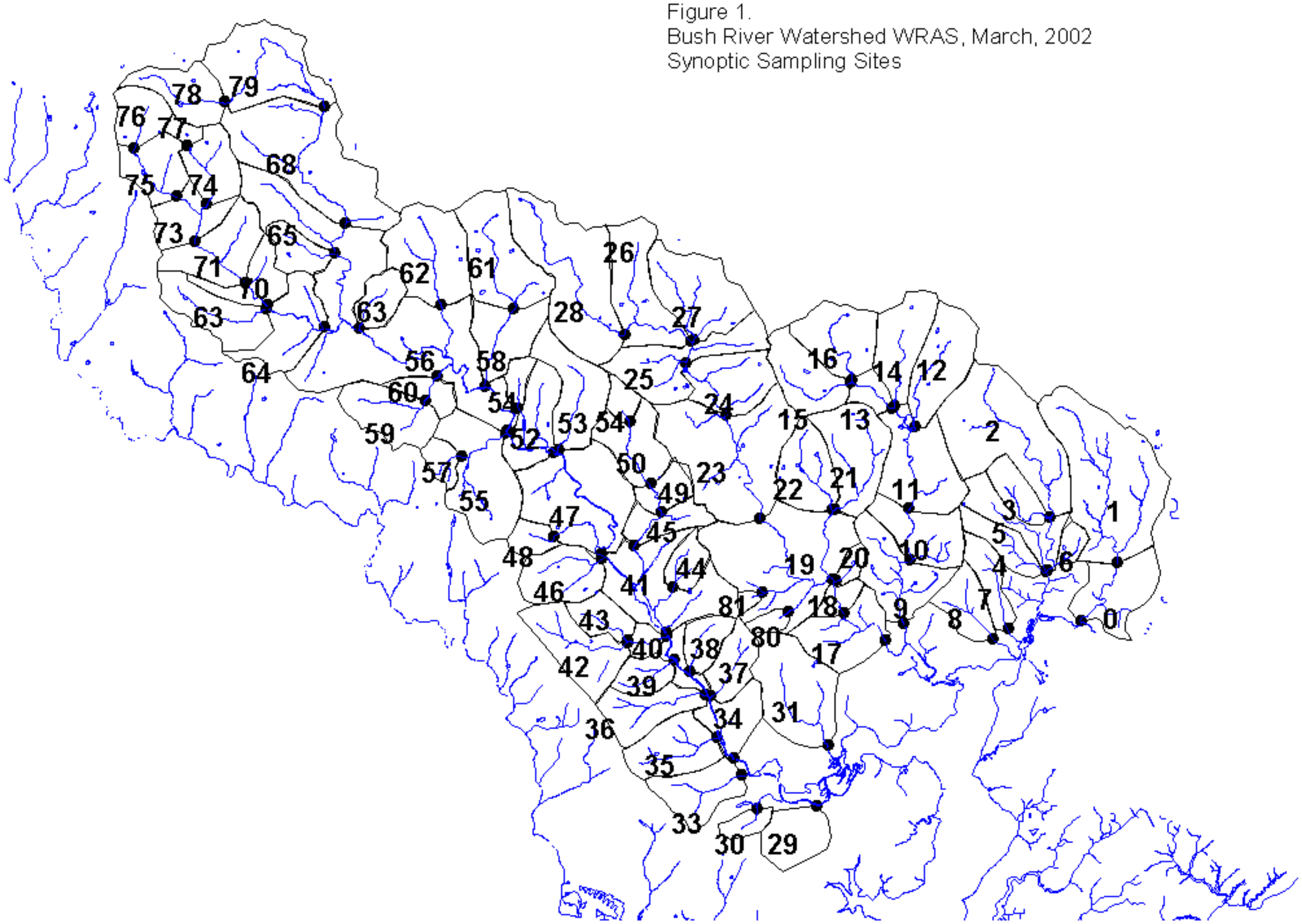


Table 3. Bush River Watershed WRAS Nutrient Synoptic Results, March, 2002

		Concentration			Daily Loads		Area	Nutrient Yields/Hectare	
DATE	STATION	PO4 (mg P/L)	NO23 (mg N/L)	Discharge (L/s)	PO4 (kg/day)	NO23 (kg/day)	Hectares	PO4 (lb/day/hec)	NO23 (lb/yr/hec)
03/19/02	0	0.011	0.45	103.54	0.10	4.03	1382	0.000071	0.002912
03/19/02	1	0.004	0.35	71.29	0.02	2.16	1020	0.000024	0.002114
03/28/02	2	0.015	0.30	144.47	0.19	3.74	845	0.000222	0.004431
03/28/02	3	0.001	0.12	3.79	0.00	0.04	168	0.000002	0.000235
03/19/02	4	0.004	0.01	0.12	0.00	0.00	177	0.000000	0.000001
03/19/02	5	0.003	0.06	11.16	0.00	0.06	1332	0.000002	0.000043
03/19/02	6	0.006	0.06	5.16	0.00	0.03	70	0.000038	0.000380
03/19/02	7	0.004	0.24	1.63	0.00	0.03	184	0.000003	0.000183
03/19/02	8	.	.	0.00	.	.	.	.	.
03/19/02	9	0.008	1.90	276.11	0.19	45.33	2730	0.000070	0.016600
03/19/02	10	0.008	1.96	191.99	0.13	32.51	2331	0.000057	0.013951
03/19/02	11	0.007	2.14	147.97	0.09	27.36	2006	0.000045	0.013641
03/19/02	12	0.008	4.42	29.65	0.02	11.32	392	0.000052	0.028905
03/18/02	13	0.034	3.11	93.21	0.27	25.05	771	0.000355	0.032505
03/18/02	14	0.004	2.48	53.86	0.02	11.54	344	0.000054	0.033509
03/18/02	15	0.004	3.06	73.02	0.03	19.30	315	0.000080	0.061313
03/18/02	16	0.007	1.28	55.61	0.03	6.15	362	0.000093	0.016999
03/19/02	17	0.003	1.14	471.75	0.12	46.47	5689	0.000021	0.008168
03/19/02	18	0.007	1.23	470.39	0.28	49.99	5334	0.000053	0.009372
03/28/02	19	0.015	3.99	16.31	0.02	5.62	58	0.000363	0.096509
03/28/02	20	0.004	1.36	901.31	0.31	105.91	5250	0.000059	0.020175
03/26/02	21	0.005	4.31	19.54	0.01	7.28	436	0.000019	0.016677
03/26/02	22	0.003	3.15	11.51	0.00	3.13	328	0.000009	0.009554
03/25/02	23	0.004	1.74	261.48	0.09	39.31	3470	0.000026	0.011329
03/25/02	24	0.005	1.75	185.81	0.08	28.09	2541	0.000032	0.011054
03/25/02	25	0.004	1.92	185.14	0.06	30.71	2202	0.000029	0.013948
03/25/02	26	0.004	1.77	138.61	0.05	21.20	1281	0.000037	0.016545
03/25/02	27	0.006	2.03	40.85	0.02	7.16	482	0.000044	0.014852
03/25/02	28	0.006	1.81	59.23	0.03	9.26	830	0.000037	0.011154
03/21/02	29	0.003	0.94	8.79	0.00	0.71	259	0.000009	0.002753
03/21/02	30	0.004	0.29	4.96	0.00	0.12	83	0.000021	0.001499
03/25/02	31	0.004	0.16	9.11	0.00	0.13	552	0.000006	0.000228
03/25/02	32	.	.	.	.	.	.	.	.
03/25/02	33	.	.	.	.	.	288	.	.
03/25/02	34	0.003	2.02	857.71	0.22	149.69	.	.	.
03/22/02	35	0.004	0.10	20.62	0.01	0.18	334	0.000021	0.000533
03/22/02	36	0.004	0.21	26.55	0.01	0.48	281	0.000033	0.001713
03/28/02	37	0.007	0.58	51.16	0.03	2.56	201	0.000154	0.012748
03/25/02	38	0.012	0.23	40.16	0.04	0.80	158	0.000263	0.005044
03/25/02	39	0.004	2.37	0.21	0.00	0.04	143	0.000001	0.000301
03/22/02	40	0.007	1.14	87.54	0.05	8.62	614	0.000086	0.014036
03/25/02	41	0.004	2.31	669.54	0.23	133.63	8903	0.000026	0.015009
03/22/02	42	0.007	1.02	44.62	0.03	3.93	384	0.000070	0.010229

03/22/02	43	0.004	1.31	11.98	0.00	1.36	159	0.000026	0.008546
03/26/02	44	0.003	2.04	11.04	0.00	1.95	134	0.000021	0.014527
03/25/02	45	0.003	2.73	143.62	0.04	33.88	688	0.000054	0.049240
03/26/02	46	0.005	1.66	8.72	0.00	1.25	310	0.000012	0.004039
03/25/02	47	0.004	2.58	662.21	0.23	147.61	7167	0.000032	0.020595
03/21/02	48	0.003	0.63	35.78	0.01	1.95	103	0.000090	0.018873
03/26/02	49	0.004	2.14	29.76	0.01	5.50	504	0.000020	0.010912
03/26/02	50	0.003	1.81	18.76	0.00	2.93	369	0.000013	0.007940
03/25/02	51	0.059	1.47	0.41	0.00	0.05	77	0.000027	0.000667
03/25/02	52	0.004	2.78	497.46	0.17	119.49	6031	0.000029	0.019812
03/25/02	53	0.004	0.70	5.59	0.00	0.34	325	0.000006	0.001041
03/26/02	54	0.003	1.23	3.95	0.00	0.42	76	0.000013	0.005522
03/25/02	55	0.006	2.61	23.46	0.01	5.29	645	0.000019	0.008206
03/25/02	56	0.005	2.82	506.07	0.22	123.30	5013	0.000044	0.024597
03/26/02	57	0.014	3.06	6.12	0.01	1.62	96	0.000077	0.016796
03/22/02	58	0.006	2.20	91.16	0.05	17.33	837	0.000056	0.020695
03/22/02	59	0.007	3.71	29.28	0.02	9.38	325	0.000054	0.028844
03/22/02	60	0.008	4.24	27.33	0.02	10.01	444	0.000043	0.022552
03/22/02	61	0.010	2.82	60.31	0.05	14.69	525	0.000099	0.027972
03/22/02	62	0.010	3.54	110.31	0.10	33.74	518	0.000184	0.065182
03/21/02	63	0.003	3.03	9.34	0.00	2.44	161	0.000015	0.015178
03/14/02	64	0.001	3.14	139.36	0.01	37.81	1172	0.000010	0.032272
03/14/02	65	.	.	.	.	.	.	.	.
03/14/02	66	0.002	2.96	14.21	0.00	3.63	166	0.000015	0.021950
03/14/02	67	.	.	.	.	.	.	.	.
03/14/02	68	0.002	2.50	226.03	0.04	48.82	1802	0.000022	0.027092
03/14/02	69	0.002	4.98	23.08	0.00	9.93	355	0.000011	0.028014
03/14/02	70	0.001	2.80	85.86	0.01	20.77	820	0.000009	0.025321
03/14/02	71	0.001	2.97	78.92	0.01	20.25	613	0.000011	0.033032
03/14/02	72	.	.	.	.	.	.	.	.
03/14/02	73	0.004	3.33	55.59	0.02	15.99	438	0.000044	0.036490
03/14/02	74	0.002	3.56	18.23	0.00	5.61	299	0.000011	0.018770
03/14/02	75	0.001	3.01	36.12	0.00	9.39	463	0.000007	0.020309
03/14/02	76	0.001	3.50	15.61	0.00	4.72	202	0.000007	0.023327
03/14/02	77	0.003	3.98	0.90	0.00	0.31	49	0.000005	0.006373
03/14/02	78	0.002	2.13	100.12	0.02	18.43	290	0.000060	0.063588
03/14/02	79	0.002	2.65	7.15	0.00	1.64	871	0.000001	0.001879
03/28/02	80	0.003	0.74	5.47	0.00	0.35	43	0.000033	0.008080
03/28/02	81	0.020	0.80	5.38	0.01	0.37	50	0.000187	0.007472

Table 4. Annual & Spring Nutrient Concentration Averages from Other Nutrient Synoptic Surveys

	Piney	German Br.	Pocomoke	Bush	Breton Bay	Patuxent	Choptank	Liberty
NO23 Spring	3.742	3.832	3.734	1.944	0.223	0.439	2.892	3.410
NO23 Annual	4.823	4.704	2.384					
PO4 Spring	0.800	0.043	0.028	0.006	0.004	0.012	0.023	0.004
PO4 Annual	1.177	0.067	0.022					

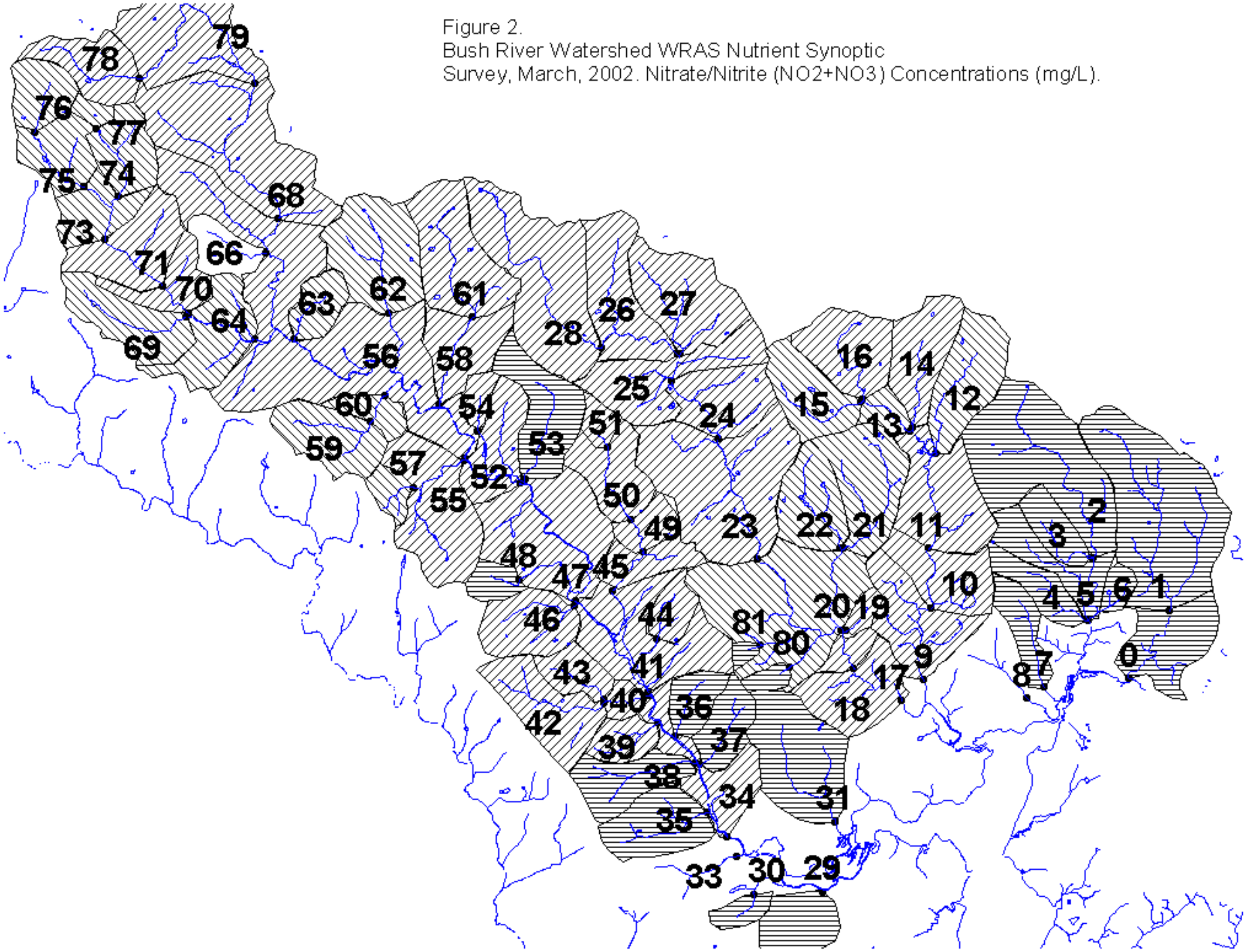
found in 18 subwatersheds, with apparent clustering in West Branch watershed (7 subwatersheds), the middle portion of Bynum Run (3 subwatersheds), and upper James Run/Broad Run (3 subwatersheds). The remaining five subwatersheds where headwater streams above the reservoir, Bread and Cheese Branch, Long Branch, Hoops Branch, and an unnamed tributary to Elbow Branch. Thirty-nine of the 75 sites sampled had moderate nitrate/nitrite concentrations. These sites included the outlet sites of Winters, Bynum, and James. Cranberry and Grays Run and a number of the small tributaries of lower Winters Run had baseline concentrations.

Six subwatersheds with high concentrations translated to excessive yields. Four subwatersheds with moderate concentrations translated into excessive yields. These subwatersheds were concentrated in the West Branch, middle Bynum and upper James. Yields at the outlets were baseline with the exception of a moderate yield from James Run.

The majority of the subwatersheds had baseline orthophosphate concentrations (Figure 4). Two subwatersheds had excessive concentrations, one in Broad Run and one a small headwater stream in Bynum. The Broad Run site had considerable suspended sediment coming from the LaFarge facility near the site due to rain at the time of sampling. Five other subwatersheds scattered throughout the watershed had high concentrations. One of these five, Long Branch, had cows in the stream upstream of the sampling site, and Bear Cabin Branch had significant construction upstream that would have contributed to elevated suspended sediment and thus elevated orthophosphate concentrations. No subwatersheds had orthophosphate yields above baseline (Figure 5).

The in situ Hydrolab readings from all sites (Table 5) found few significant anomalies in the constituents measured. Elevated conductivity was noted at all four sites in Plumtree Branch. The highest being at the upstream site very close to downtown Bel Air. This upstream site also had an elevated pH level. The site on Elbow Branch also had an elevated pH, but with normal conductivity. Temperatures varied according to time of day and amount of stream shading. Dissolve oxygen was more than adequate at all sites. The lowest reading of 8.72 mg/L was at the pond spillway at site 79.

Figure 2.
Bush River Watershed WRAS Nutrient Synoptic
Survey, March, 2002. Nitrate/Nitrite (NO2+NO3) Concentrations (mg/L).



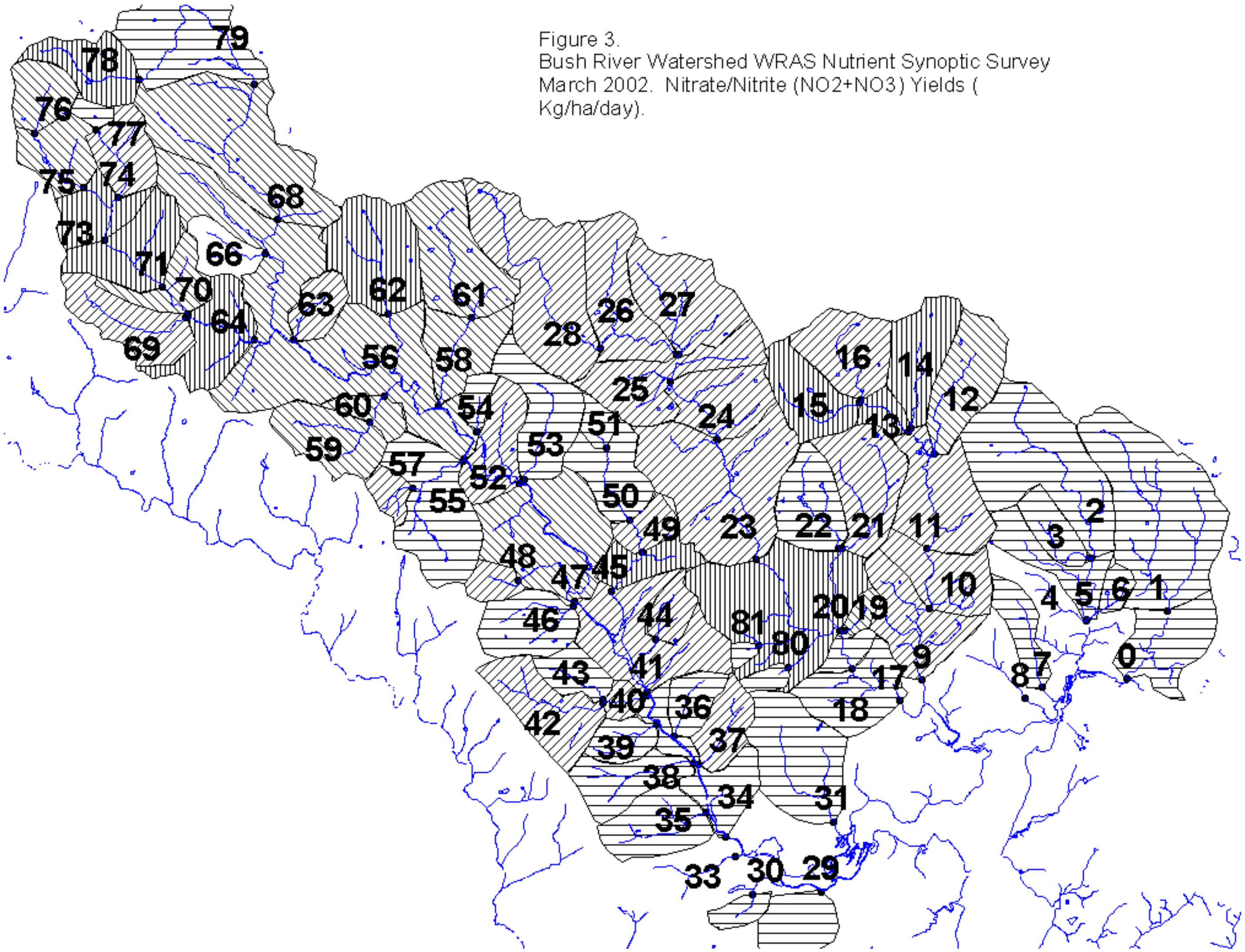


Figure 3.
Bush River Watershed WRAS Nutrient Synoptic Survey
March 2002. Nitrate/Nitrite (NO2+NO3) Yields (
Kg/ha/day).

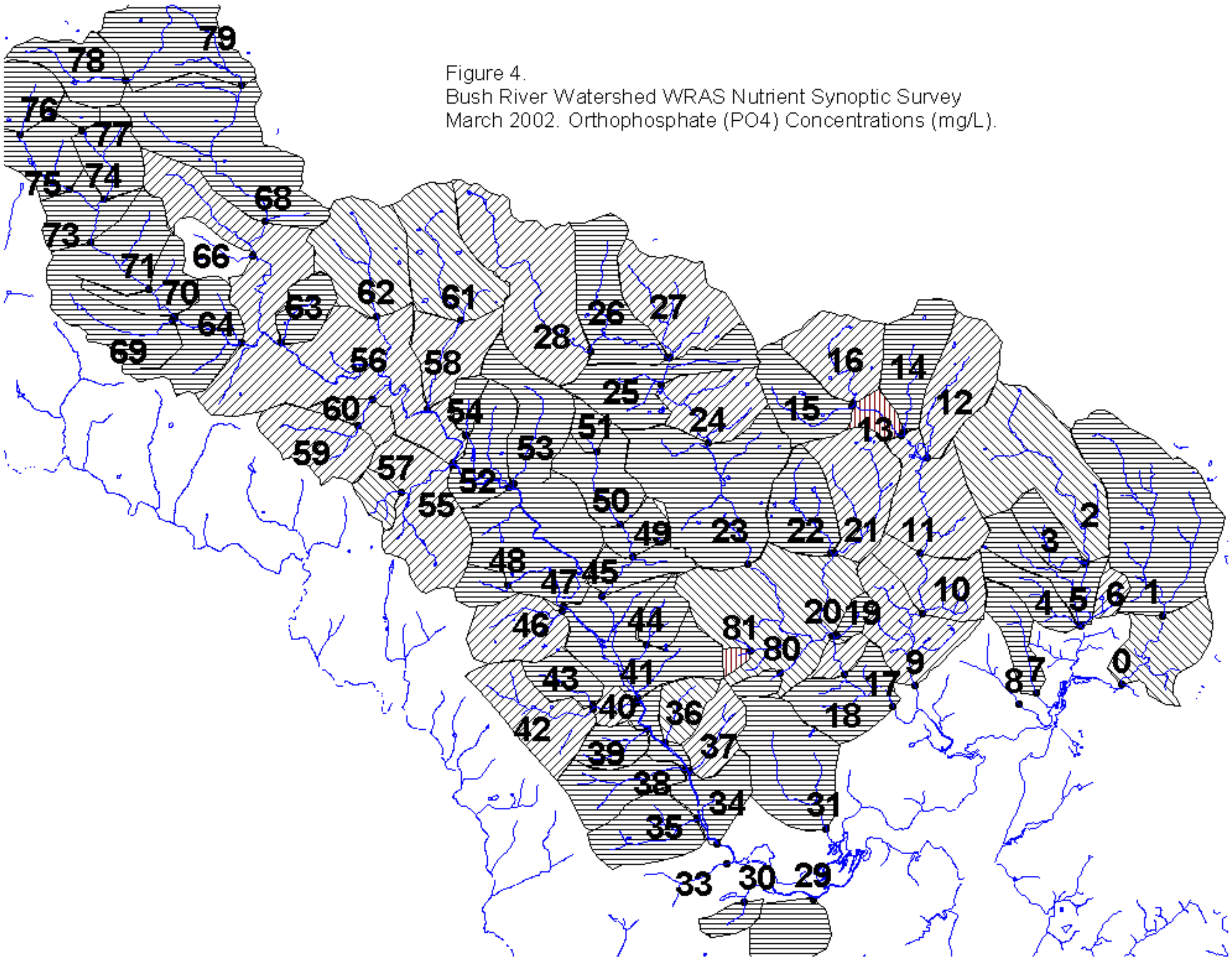


Figure 4.
Bush River Watershed WRAS Nutrient Synoptic Survey
March 2002. Orthophosphate (PO4) Concentrations (mg/L).

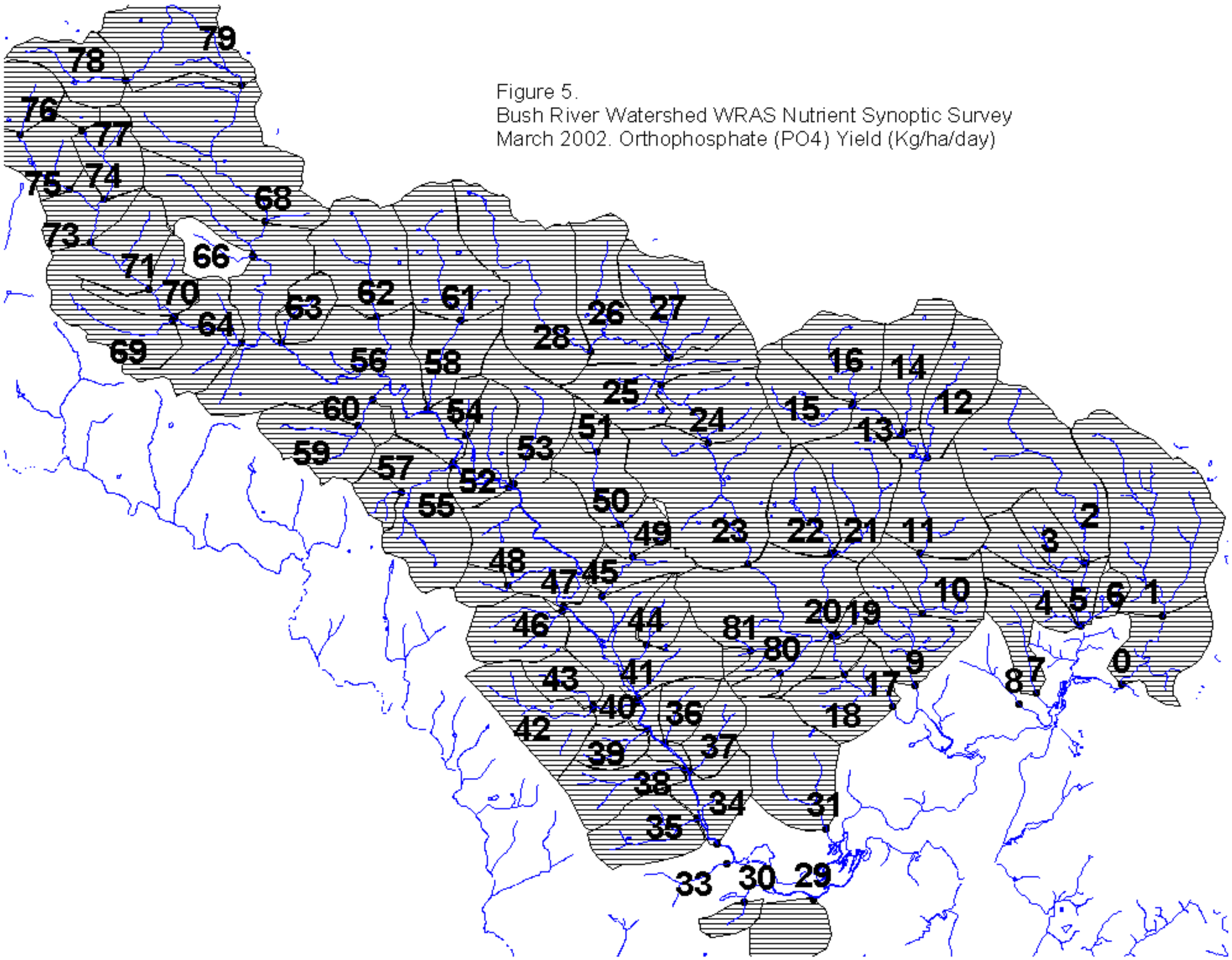


Figure 5.
Bush River Watershed WRAS Nutrient Synoptic Survey
March 2002. Orthophosphate (PO4) Yield (Kg/ha/day)

Table 5. Bush River Watershed Insitu Water Quality

			InSitu Hydrolab Readings			
DATE	STATION	TIME	Temp.	pH	Cond.	DO
03/19/02	0	910	7.06	6.76	0.319	10.87
03/19/02	1	940	7.01	7.01	0.319	10.52
03/28/02	2	925	6.25	6.97	0.166	10.97
03/28/02	3	945	5.70	6.70	0.195	9.79
03/19/02	4	1030	8.07	6.79	0.289	10.21
03/19/02	5	1032	7.83	7.08	0.312	11.44
03/19/02	6	1005	7.14	7.01	0.109	11.09
03/19/02	7	1105	6.89	6.73	0.087	11.44
03/19/02	8	.	.	.	.	.
03/19/02	9	1205	8.15	7.09	0.252	11.97
03/19/02	10	1340	9.61	7.94	0.219	11.06
03/19/02	11	1310	9.16	7.84	0.223	11.63
03/19/02	12	1250	9.27	8.06	0.344	12.12
03/18/02	13	935	5.91	7.29	0.150	12.00
03/18/02	14	950	6.07	7.22	0.199	12.00
03/18/02	15	1015	6.14	7.35	0.150	11.01
03/18/02	16	1030	6.29	7.30	0.127	10.85
03/19/02	17	1430	9.86	7.83	0.229	11.60
03/19/02	18	1400	9.56	7.74	0.222	11.79
03/28/02	19	1045	7.28	7.19	0.179	10.44
03/28/02	20	1100	8.23	7.47	0.201	11.56
03/26/02	21	1445	7.05	7.63	0.214	10.88
03/26/02	22	1455	7.50	7.52	0.127	11.06
03/25/02	23	940	7.01	7.57	0.256	11.53
03/25/02	24	1040	7.36	7.33	0.265	11.53
03/25/02	25	1105	7.83	7.83	0.282	11.32
03/25/02	26	1145	8.43	.	0.259	11.07
03/25/02	27	1205	8.53	.	0.277	10.94
03/25/02	28	1320	10.67	.	0.247	10.77
03/21/02	29	1000	9.15	7.11	0.278	10.46
03/21/02	30	1100	14.07	7.43	0.247	11.71
03/25/02	31	910	6.29	6.67	0.195	10.15
03/25/02	32	.	.	.	.	.
03/25/02	33	.	.	.	.	.
03/25/02	34	935	7.26	6.95	0.185	12.01
03/22/02	35	900	3.95	6.76	0.302	11.47
03/22/02	36	921	3.91	7.15	0.129	11.97
03/28/02	37	1310	11.34	7.27	0.182	10.42
03/25/02	38	1455	11.34	.	0.152	13.19
03/25/02	39	1430	12.34	.	0.124	10.05
03/22/02	40	940	3.78	7.13	0.183	12.73
03/25/02	41	1025	7.49	7.34	0.183	11.91
03/22/02	42	1015	4.15	7.12	0.200	12.09
03/22/02	43	1035	4.34	7.02	0.117	11.91
03/26/02	44	1415	7.64	7.44	0.316	10.90

03/26/02	45	1125	8.32	7.84	0.376	12.27
03/26/02	46	1150	6.70	7.39	0.214	11.23
03/25/02	47	1125	6.96	7.47	0.179	11.67
03/21/02	48	1300	10.83	7.30	0.169	9.70
03/26/02	49	1320	7.58	7.69	0.399	11.20
03/26/02	50	1345	7.94	7.56	0.442	11.70
03/25/02	51	1320	10.82	8.12	0.630	14.70
03/25/02	52	1255	8.86	7.78	0.160	11.54
03/25/02	53	1230	9.30	7.78	0.324	10.80
03/26/02	54	1250	7.18	7.85	0.180	11.40
03/25/02	55	1400	10.00	8.19	0.171	10.20
03/25/02	56	1440	10.52	7.89	0.155	11.17
03/26/02	57	1215	7.30	7.42	0.267	11.00
03/22/02	58	1125	5.62	7.07	0.165	12.19
03/22/02	59	1400	6.76	7.25	0.172	9.94
03/22/02	60	1340	6.72	7.01	0.185	11.20
03/22/02	61	1230	6.28	7.11	0.168	11.72
03/22/02	62	1250	7.01	7.08	0.157	11.04
03/21/02	63	1400	11.88	7.04	0.158	9.83
03/14/02	64	1345	12.08	7.17	0.139	9.99
03/14/02	65	.	.	.	.	.
03/14/02	66	1445	11.37	.	0.105	9.44
03/14/02	67	.	.	.	.	.
03/14/02	68	1420	12.30	.	0.132	9.59
03/14/02	69	1320	12.60	.	0.194	9.43
03/14/02	70	1300	11.25	.	0.131	10.56
03/14/02	71	1230	9.86	.	0.131	10.39
03/14/02	72	.	.	.	.	.
03/14/02	73	1140	10.47	.	0.137	10.42
03/14/02	74	1115	9.16	.	0.116	9.94
03/14/02	75	1055	8.84	.	0.152	10.13
03/14/02	76	1035	8.22	.	0.117	10.44
03/14/02	77	1020	10.44	.	0.138	9.33
03/14/02	78	925	7.80	.	0.138	10.36
03/14/02	79	955	7.75	.	0.129	8.72
03/28/02	80	1200	9.01	7.21	0.253	11.71
03/28/02	81	1230	11.31	6.76	0.123	10.30

One of the 18 benthic samples, Long Branch, had an IBI score of ‘good’ (Table 6, Figure 6). As noted above, this site also had elevated orthophosphate concentrations, indicating a possible enhancement of the macroinvertebrate community. This same process could be occurring at the 2 West Branch and 1 Broad Creek sites that had ‘fair’ IBI scores and elevated nutrients. The 5 sites with “poor” IBI scores, and the 3 sites with “very poor’ IBI scores, had marginal to poor instream macroinvertebrate habitat. High quality riffle habitat was missing or very degraded due to imbeddedness. The apparent inconsistency between IBI score and habitat score has to do with the habitat metrics. In general, the out of stream characteristics such as bank and riparian vegetation were good, but instream characteristics most significant to the benthic community were in poor condition.

Fish communities where sampled at 9 sites. Table 7 provides a species list for the sampled sites, and Figure 7 shows the locations in the watershed. Six of the sites are associated with stream restoration projects or storm water retrofit projects. The 3 remaining sites were chosen because of 'good' or 'fair' benthic IBI scores. The three storm water retrofit sites (80, 81, 81A) are very small headwater streams where a good fish community would be expected to have a limited number of species present, up to 5, due to physical limitations of water volume and habitat. Site 81A is not shown on the map because it was above a storm water pond nested in the site 81 watershed and had no fish. The remaining sites with the exception of site 80 met expectations for species numbers. Mottled sculpins , a sediment intolerant species, were a significant portion of the fish community in the smaller streams that were sampled.

Table 6. Bush River Watershed Benthic IBI Calculations

site	# Taxa/ score	# EPT taxa score	#Ephem taxa score	# Ditpera taxa score	% Ephem score	% Tanytarsini of total chir score	intolerant taxa score	% tolerant score	% collecters score	total score	IBI score/#metrics	IBI rating	Habitat Rating
55	29/5	8/3	3/3	14/5	12/3	8/5	8/3	24/3	52/5	35	3.89	fair	excellent
53	22/3	4/1	1/1	12/5	1/1	3/3	5/3	31/3	56/5	25	2.78	poor	fair
9	15/1	4/1	1/1	8/3	2/1	1/1	2/1	36/3	59/5	17	1.89	very poor	good
31	10/1	1/1	0/1	8/3	0/1	18/5	0/1	12/3	35/5	21	2.33	poor	fair
40	14/1	5/3	3/3	7/3	65/5	2/3	1/1	19/3	66/5	27	3.00	fair	excellent
17	17/3	2/1	1/1	14/5	2/1	4/3	0/1	22/3	58/5	23	2.56	poor	fair
70	25/5	9/3	3/3	14/5	10/3	5/5	7/3	23/3	46/5	35	3.89	fair	fair
58	20/3	6/3	3/3	10/5	22/5	0/1	4/3	23/3	39/5	31	3.44	fair	good
51	12/1	2/1	0/1	7/3	0/1	0/1	1/1	47/3	45/5	17	1.89	very poor	fair
59	17/3	6/3	1/1	10/5	53/5	1/1	5/3	19/3	61/5	29	3.22	fair	good
80	11/1	2/1	0/1	7/3	0/1	0/1	0/1	51/1	44/5	15	1.67	very poor	fair
34	21/3	6/3	2/3	10/5	15/3	1/3	5/3	15/3	28/5	31	3.44	fair	good
45	13/1	1/1	0/1	8/3	0/1	0/1	2/1	34/3	47/5	17	1.89	very poor	good
41	22/3	9/3	2/3	9/3	10/3	8/5	3/1	16/3	22/5	26	2.89	poor	excellent
62	28/5	8/3	3/3	16/5	34/5	2/3	7/3	11/5	50/5	37	4.11	Good	fair
64	24/5	11/3	3/3	10/5	11/3	1/3	9/5	27/3	32/5	35	3.89	fair	excellent
5	13/3	4/1	0/1	5/3	0/1	0/1	5/3	24/3	38/5	21	2.33	poor	good
81	16/3	3/1	1/1	9/3	1/1	0/1	1/1	48/3	54/5	19	2.11	poor	fair
13	23/5	6/3	2/3	12/5	8/3	7/5	3/3	30/3	35/5	35	3.89	fair	good

Table 7. Bush River Watershed, Fish Communities at Selected 75 meter reach **Sites**

site #		34	34	9	62	59	21	80	81	81A
		Rt 7	Rt 95							
Species	commnon name									
Lepomis auritus	red breast sunfish	254	176							
Lepomis macrochirus	bluegill	51	4	65						
Lepomis gibbosus	pumpkinseed	8		881						
Lepomis cyanellus	green sunfish			6			1		1	
Micropterus dolomieu	smallmouth bass	42	25							
Micropterus salmoides	large mouth bass	3	11	2						
Nocomis micropogon	River Chub	15	17							
Metromyzon marinus	sea lamprey	2	12							
Anguilla rostrata	american eel	103	101	22			10		9	
Notropus procne	swallowtail shiner	1	67	17						
Pimiphales notatus	bluntnose minnow		24							
Etheostoma olmstedi	tessellated darter	49	24	4			1			
Simotilus corporalis	fallfish	37	6		6	8				
Semotilus atromaculatus	creek chub	1		23	142	78	55	226	94	
Catostomus commerconi	white sucker	3	8	32	2	1	7			
Hypentolium nigricans	northern hogsucker	13	1	2						
Rhinichthys cataractae	longnose dace	13	7		19	28	2			
Notropus rubellus	rosyface shiner		15							
Luxilus cornutus	common Shiner	39	12	18		1	4			
Cyprinella analostana	satin fin shiner	11	51	12						
Noturus insignis	margined madtom	2	18							
Rhinichthys atratulus	blacknose dace				135	115	63	132		
Clinostomus funduloides	rosyside dace			3	146		67		50	
Exoglossum maxillingua	cutlips minnow			1	4	2	5			
Cottus bairdi	mottled sculpin			2	373	256	96		54	
Nocomis migropogon	river chub					1				
Ameiurus nebulosus	brown bullhead			8						
Gambusia holbrooki	mosquito fish			2						
Fundulus diaphanus	banded killifish			3						
Erimyzon oblongus	creek chub sucker			27						
	total # species	18	18	19	8	9	11	2	5	0

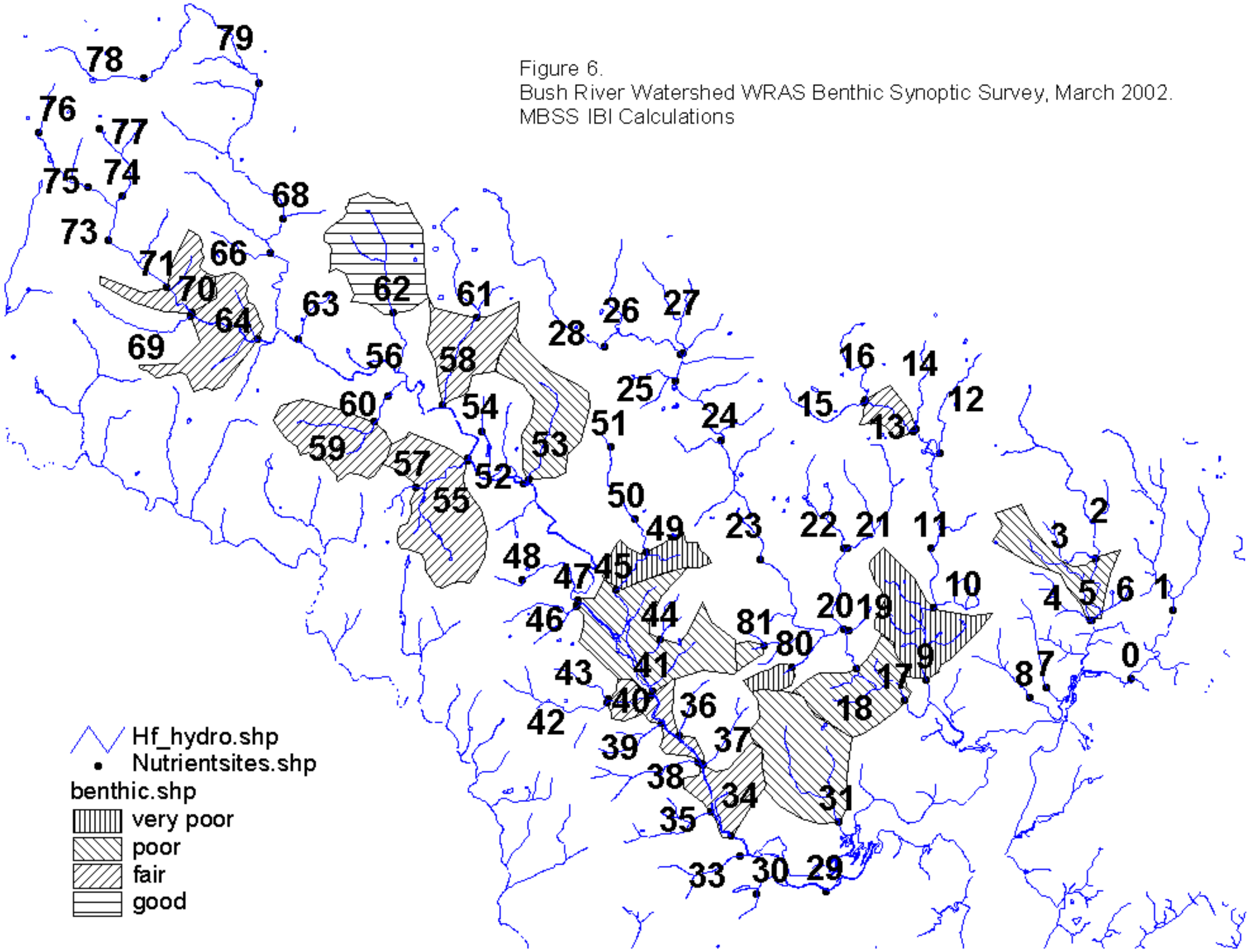


Figure 6.
Bush River Watershed WRAS Benthic Synoptic Survey, March 2002.
MBSS IBI Calculations

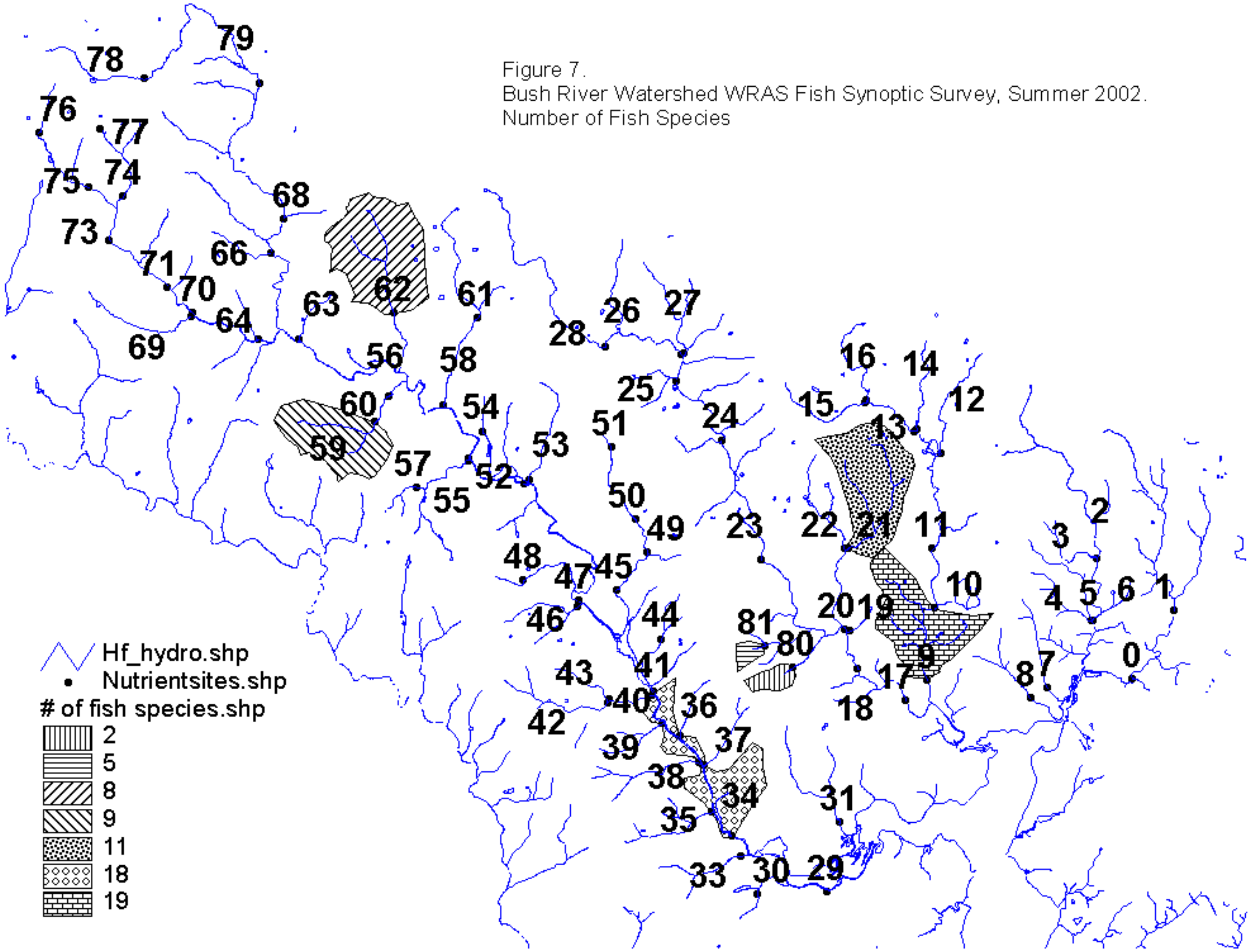


Figure 7.
Bush River Watershed WRAS Fish Synoptic Survey, Summer 2002.
Number of Fish Species

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