Report

On Water Quality of Franklin Township Streams

Prepared for

Department of Environmental Protection, State of New Jersey

Franklin Township Council

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The water quality of the streams of Franklin Township has long been a concern of the Franklin Township Environmental Commission. Pollution of these waters can negatively affect human health, natural systems, recreation, and commerce. It was with these concerns in mind that the Environmental Commission applied for and was awarded a grant from the New Jersey Department of Environmental Protection (NJDEP) to do a baseline water quality sampling of most of the streams in the township.

This report presents the findings of our study. The most striking finding is that *all* township streams sampled exceeded the State of New Jersey Surface Water Quality Standards (SWQS: NJAC 7:9B) limit for fecal coliforms (bacteria indicating contamination with fecal matter), many (13 of 23 tested) at ten to a hundred times the standard, in two or three samplings. Also, most streams were above the SWQS for phosphorus, but by relatively little; six had a phosphorus level as much as twice the SWQS. Turbidity and total solids were problems at some sites, notably in Sim's (Zarephath) Brook, where it may be attributed to ongoing construction of the Canal Walk senior village. Total nitrogen, and its components nitrate and nitrite, did not exceed SWQS at any site, though it came close in the brook near the Griggstown Quail Farm. Dissolved oxygen, pH and temperature were not a problem in any stream. The few streams tested for oil and grease, measures of direct run-off from streets and parking lots, showed no problems.

We recommend the following:

• Further study is necessary to determine the cause of the fecal coliform pollution. Procedures are known for tentatively assigning the source of fecal coliform pollution to human, animal (deer, cows), or avian (geese, chickens, pheasants) waste. We hope to pursue such investigations in collaboration with Cook College, Rutgers University.

• One of the most polluted brooks was Sims' (Zarephath) Brook, which drains the area of Canal Walk. It appears that even careful placement of silt fences etc. is not sufficient to protect streams from run-off due to exposed earth during construction. Developers should be required to monitor streams for turbidity and take additional protective measures if there is excessive suspended matter.

• Another highly polluted brook is in the vicinity of the Griggstown Quail Farm, and it is possible that the problem emanates from the high-density poultry raising and processing activity there (though there are also ducks on a pond upstream). The owner of the farm applied to have this area added to the sewer service area and connected to the township sewer system, which would lessen contribution from the farm to stream pollution. This application has not been carried through. The township should pursue, more strongly, approval for the extension of the service area and the connection to the sewer system.

• Advice is needed from the NJDEP and the New Jersey Water Supply Authority on general approaches to reducing stream pollution. Greater protection of riparian corridors, with abundant riparian vegetation, is an important approach. Grants are available to farm owners for establishment of riparian buffers, but when, as is the case for the Six Mile Run watershed, the landowner is the State of New Jersey, this approach is not readily available.

• Conservative planning, especially with respect to impervious surface which prevents water sinking into the ground where contaminants will be filtered out, is needed.

Details concerning sampling and sites are presented in Attachment 1. The results are tabulated in Attachment 2. Attachment 3 describes the test criteria and terms used, and attachment 4 presents the test results in graphic forms and discusses them.

Attachment 1. Sites and Sampling

Initially, samples were collected, and field measurements carried out, by members of the Environmental Commission at twenty-seven sites, on Sept. 28 and 29, 2003. Because analyses indicated fecal coliform bacteria as the most widespread pollutant, exceeding allowable limits at most sites, follow-up samples were collected at most of these sites, and two additional sites, on August 2, 2004. Samples were also collected at some sites on April 20 and 21, 2004 for analysis by the Applied Microbiology class at Cook College, Rutgers University.

The location of the sampling sites is shown in Fig. 1 (attached), and names and more details concerning the sites given in the legend to the figure. In some cases the stream was sampled at slightly different locations in 2003 and 2004. Streams were fairly high, but not in flood, on both occasions. The weather was overcast, with some very light rain in 2003.

Cedar Grove Brook, the brooks sampled at sites 9 and 10, 'Lisa's Brook', 'Spencer Brook', 'Knowlton Brook', Dirty Brook and 'Flemer Brook' flow into the Delaware and Raritan Canal; the others pass under the canal and into the Millstone or Raritan River (or into Six Mile Run, which empties into the Millstone River). Both the Delaware and Raritan Canal and the Millstone River (at its confluence with the Raritan) are sources of drinking water for residents of central New Jersey.

All of the streams sampled are classified as Fresh Water 2-Non Trout (FW2-NT) in accordance with the State of New Jersey Water Quality Standards N.J.A.C. 7:9B (SWQS). This is a general classification for waters that are not designated as Pineland waters or waters that are set-aside for posterity [Fresh Water 1(FW1)] and are not designated trout production or maintenance waters (although we have been informed that trout have been seen in Nine Mile Run). Streams within the Six Mile Run Reserve have now been designated Category 1, a higher category of stream quality and protection.

The streams visited on Sept. 28-29, 2003 were field tested for pH, conductivity (a measure of dissolved ionic compounds such as salt), turbidity, dissolved oxygen and temperature, using Horiba U-10 multi-meters.. Samples collected then were submitted to Accutest Laboratories, Dayton, NJ, a certified testing laboratory, for measurement of nitrates, phosphorus, total solids, fecal coliforms (from rural non-sewered areas) and oil and grease (from developed areas with many roads and parking). Samples for fecal coliform testing were collected on the morning of Sept. 29, since the allowed holding time before analysis is only 6 hours.

Attachment 2. Test Results.

Table 1. Results from Stream Survey, Sept. 28-29, 2003

site	location	Fecal coliforms /100 ml	Nitrogen, nitrate + nitrate	Nitrogen, nitrate, mg/L	Nitrogen, nitrite, mg/L	Total phos-phorus, mg/L	Total suspended solids, mg/L	pH	Conduct-ivity, mS/cm	Turbidity NTU	Dissolved O_2, mg/L	T, °C
1	Meadows Brook		1.4	1.4	<0.01	0.12	<4	7.12	0.271	5	6.99	20.1
2	Mile Run		2.7	2.7	<0.01	0.14	13	7.04	0.289	0	7.66	19.7
3	Seeley's Brook		2.2	2.2	<0.01	0.10	<4	7.23	0.251	4	8.18	19.7
4	Cedar Grove Brook		1.1	1.1	<0.01	0.15	32	6.83	0.19	70	7.5	19.9
5	Raritan Brook	720	1.0	1.0	<0.01	0.15	20	N/A	N/A	N/A	N/A	N/A
6	Randolph Brook		0.7	0.7	<0.01	0.2	58	7.06	0.174	131	7.93	20.2
7	Sim's (Zarephath) Brook		1.1	1.1	0.012	0.53	**520**	6.6	0.104	**999**	7.5	20.1
8	Spooky Brook		0.72	0.7	0.017	0.16	21	6.5	0.13	70	6.8	20.7
9	'Miller Farm Brook'		2.2	2.2	<0.01	0.22	**405**	7.02	0.137	29	7.55	18.6
10	North of Blackwells Mills		2	2	0.049	0.25	17	6.87	0.193	26	7.3	19.7
11	Six Mile Run at Canal Rd	**TNTC***	1.5	1.5	<0.01	0.3	18	7.06	0.17	40	7.6	19.7
12	Cross Brook		0.81	0.81	<0.01	0.14	8	6.91	0.126	214	7,84	19.0
13	Middlebush Brook	**TNTC**	2.6	2.6	<0.01	0.21	54	6.56	0.22	146	7.5	19.1
14	Steep Hill Brook	1920	2.7	2.7	<0.01	0.16	17	6.92	0.213	33	8.13	19.4
15	Simonson's Brook	2160	0.82	0.82	<0.01	0.17	32	6.5	0.11	152	9.17	19.6
16	'Spencer Brook'		0.33	0.33	<0.01	0.072	<4	6.88	0.86	13	8.0	19.0
17	'Three Brooks'		0.73	0.73	<0.01	0.15	12	6.7	0.116	34	8.15	19.6
18	'Knowlton Brook'		0.66	0.66	<0.01	0.083	12	6.9	0.096	25	7.8	19.8
19	Dirty Brook		<0.10	<0.10	<0.01	0.14	54	7.07	0.1	120	8.3	20.6
20	'Flemer Brook'		0.13	0.13	<0.01	0.059	4	7.0	0.123	0	8.55	19.8
21	Nine Mile Run at Rte. 27		0.88	0.88	<0.01	0.11	19	6.79	0.185	18	6.1	19.8
22	Ten Mile Run at Rte. 27		1.4	1.4	<0.01	0.15	4	6.3	0.19	18	6.1	19.8
23	Griggstown Quail Farm Brook	**TNTC**	7.4	7.4	0.036	0.33	56	6.62	0.288	93	7.62	20.9
24	Nine Mile Run at 6 Mile Run	900	0.95	0.95	<0.01	0.14	11	7	0.126	20	8.2	20.1
25	Clyde Brook	1220	0.8	0.8	<0.01	0.12	11	6.84	0.121	18	8.44	19.8
26	Six Mile Run at Clyde Brook		0.66	0.66	<0.01	0.11	11	6.9	0.138	11	8.2	20.7
27	Ten Mile Run at Canal Rd.	1080	1.1	1.1	<0.01	0.18	26	6.15	0.111	55	8.15	20

Values exceeding SWQS are shown in red. Extreme values are **boldfaced.** *TNTC, too numerous to count. N/A, not available.
Samples from sites 1-6, 21 and 22 were also assayed for oil and grease. All had levels less than 5 mg/L.

The results of all tests on samples collected on Sept. 28-29, 2003 are presented in Table 1. The results of fecal coliform tests from all sampling dates are shown in Table 2. The Lakeview Ranch sample was also tested for volatile organic compounds, because of concern about possible dumping there, but none were found.

Table 2. Fecal Coliform Counts

Site	Site name	Coliforms/100 ml		
		9/29/03	4/20-1/04	8/2/04
4	Cedar Grove Brook			2160
5	Raritan Brook	720		2440
6	Randolph Brook			3900
7	Sim's (Zarephath) Brook			>4000 (est. 24000)
8	Spooky Brook			440
9	Miller Farm Brook			420
10	North of Blackwells Mills			420
11	Six Mile Run at Canal Rd.	TNTC	150	1760
13A	Middlebush Brook, East Branch	TNTC	4300	>4000 (est. 12,000)
13B	Middlebush Brook, West Branch		2300	>4000 (est. 5600)
14	Steep Hill Brook	1920	400	480
15	Simonson's Brook	2160	4000	2320
17	'Three Brooks'		<1000	1420
18	'Knowlton Brook'		400	3800
21	Franklin Park Brook at Rte. 27			2540
22	Ten Mile Run at Rte. 27			2400
23	Griggstown Quail Farm Brook	TNTC	9000	3780
24	Nine Mile Run near confluence	900	<100	960
25	Clyde Brook	1220	3000	640
26	Six Mile Run at Rte 27			2120
27	Ten Mile Run at Canal Rd	1080	900	1500
28	'Lisa's Brook' near Bunker Hill Rd		15,000	>4000 (est. 12,000)
29	Lakeview Ranch			480

TNTC = too numerous to count. As in Table 1, values exceeding the SWQS are shown in red.

Attachment 3: Criteria and Glossary of Tests

Fecal coliform bacteria are an indicator of fecal pollution, whether from human sources (poorly functioning septic systems, leaking sewers), animal (livestock, deer) or bird (poultry raising, geese). The surface water criteria (SWQS, state water quality standard) for fecal coliforms states that samples taken from FW2-NT waters should not exceed a geometric average of 200/100ml.

Nitrogen, generally as the two oxidized states **nitrate** and **nitrite**, is a nutrient for algal and plant growth in streams; it can be deleterious, especially to infants, when present at high levels in drinking water. Excess nitrogen generally results from over-fertilization of agricultural lands or lawns, or from livestock or poultry raising. The SWQS for surface waters is 10 mg/ml.

Phosphorus is a nutrient for bacterial, algal and plant growth in streams, usually the limiting nutrient. Excess phosphorus, generally resulting from over-fertilization or over-use of phosphate-containing detergents, leads to heavy algal growth in bodies of water and eutrophication, filling in of ponds which become marshes. The level of phosphorus should not exceed 0.1mg/l in any stream, unless it can be demonstrated that it is not a limiting nutrient and will not render the water unsuitable for designated uses. Phosphorus is currently a contaminant of concern in the Millstone and Raritan Rivers; Total Maximum Daily Loads are under study.

Total suspended solids and **turbidity** both describe the amount of suspended material carried by the stream, total suspended solids as the weight of material suspended and turbidity as the cloudiness of the stream. The SWQS standard for total suspended solids is 40mg/l. Turbidity is measured in nephelometric turbidity units (NTU) and should not exceed the maximum of 50 NTU at any one time. High turbidity is both esthetically undesirable ('muddy waters') and unhealthy for stream organisms; it indicates that much material is being eroded and transported to downstream waters.

pH is a measure of the acidity or basicity of the stream (pH 7 is neutral; lower pH values show increasing acidity, higher pH values increasing basicity). An acceptable range for pH is 6.5-8.5.

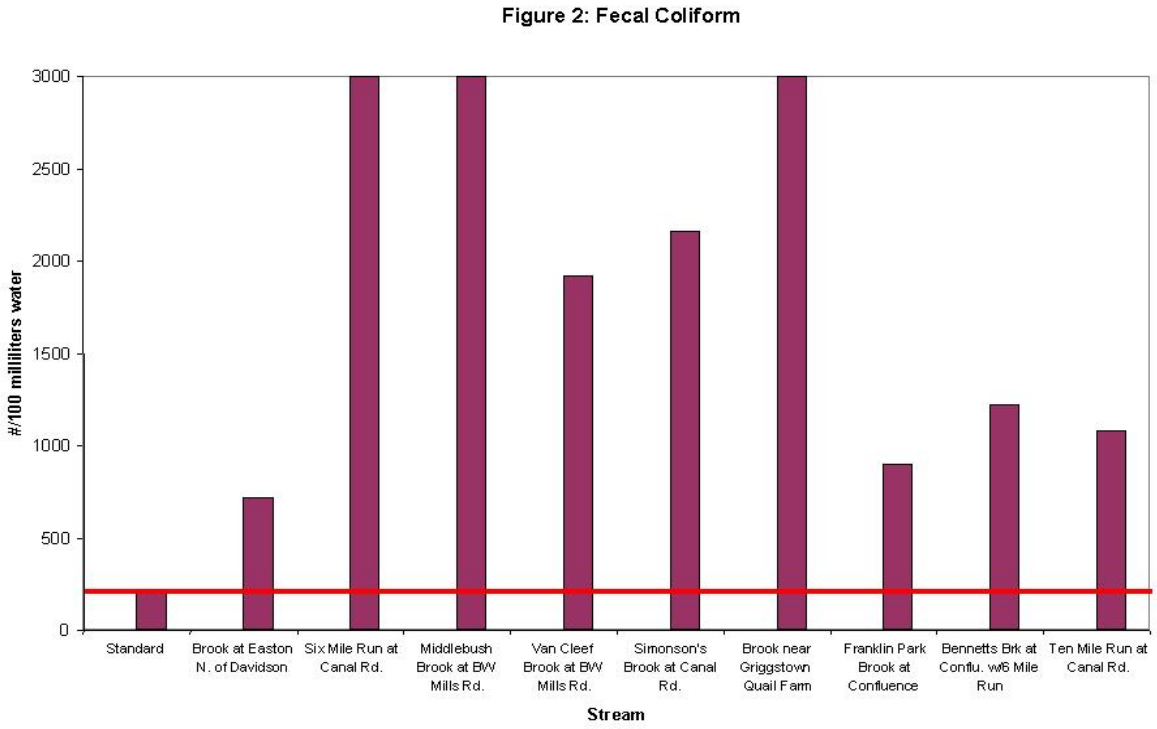
Conductivity is a measure of dissolved ionic compounds, essentially the saltiness of the stream.

Dissolved oxygen is necessary for stream animal life; a low level of dissolved oxygen indicates excessive algal growth in the stream and can kill off fish, etc. The acceptable minimum for Dissolved Oxygen is 4.0 milligrams per liter (mg/l).

The **temperature** of the stream (20°C = 68° F) should not be excessively high, as can occur when all riparian vegetation is removed.

Attachment 4. Detailed description of Test Results

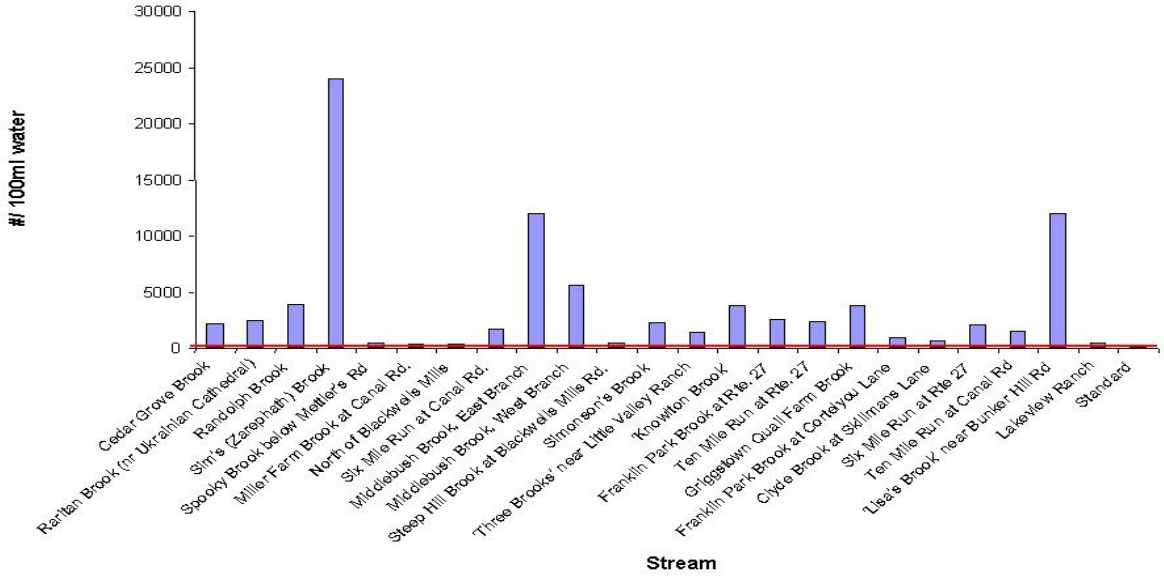
High levels of fecal coliforms, an indicator of fecal pollution, were the most striking finding of the study (Table 2, Figure 2a). These samples were collected within the short ≥6 hour holding time for the samples, from time of collection to laboratory analysis. All of the streams sampled for fecal coliforms were found to be above the standard count of 200 per 100 milliliters of water. The April samples were analyzed by the Applied Microbiology class using the less precise Most Probable Number method, but generally support the other results.



In all these figures the red bar indicates the SWQS maximum allowable level.

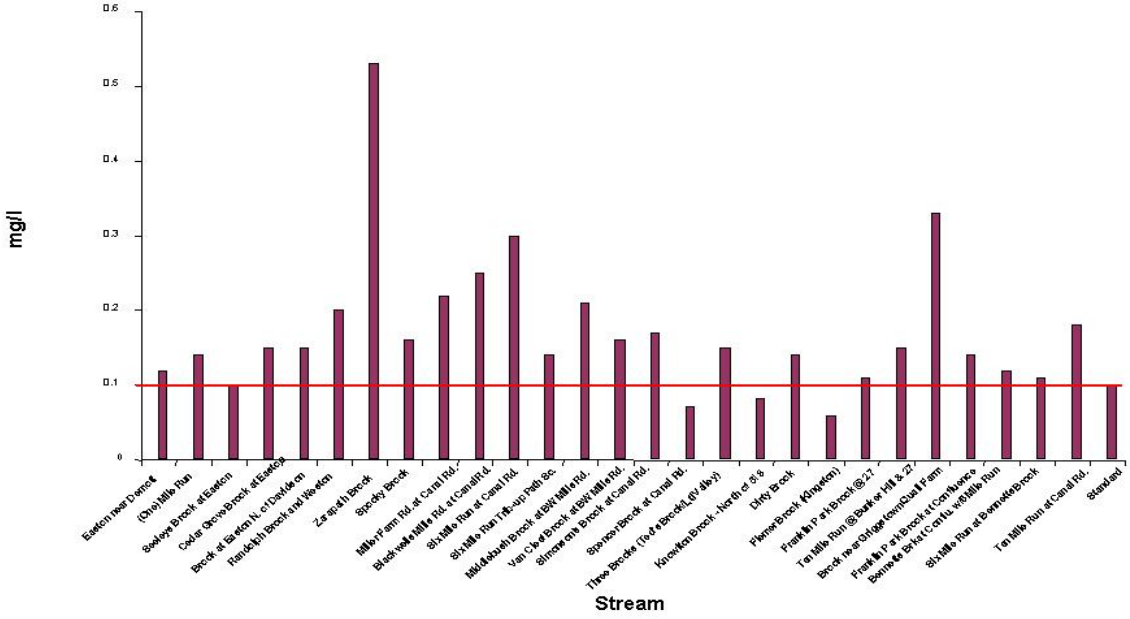
Because of these alarming results, a second expanded round of sampling for fecal coliforms was carried out on August 2, 2004. Results (again analyzed by Accutest) are shown in figure 2b. Again all streams sampled were above the standard count of 200/100ml water, many more than ten times the standard.

Figure 2b: Fecal Coliform Round 2



The SWQS states that phosphorus should not exceed 0.1mg/l in any stream unless it can be demonstrated that it is not a limiting nutrient and will not render the water unsuitable for designated uses. Therefore all the twenty-seven streams sampled except Flemer, Knowlton, Seeley and Spencer Brooks failed to meet this criterion (Fig. 3), although the level was more than twice this limit in only six streams.

Figure 3: Total Phosphorus



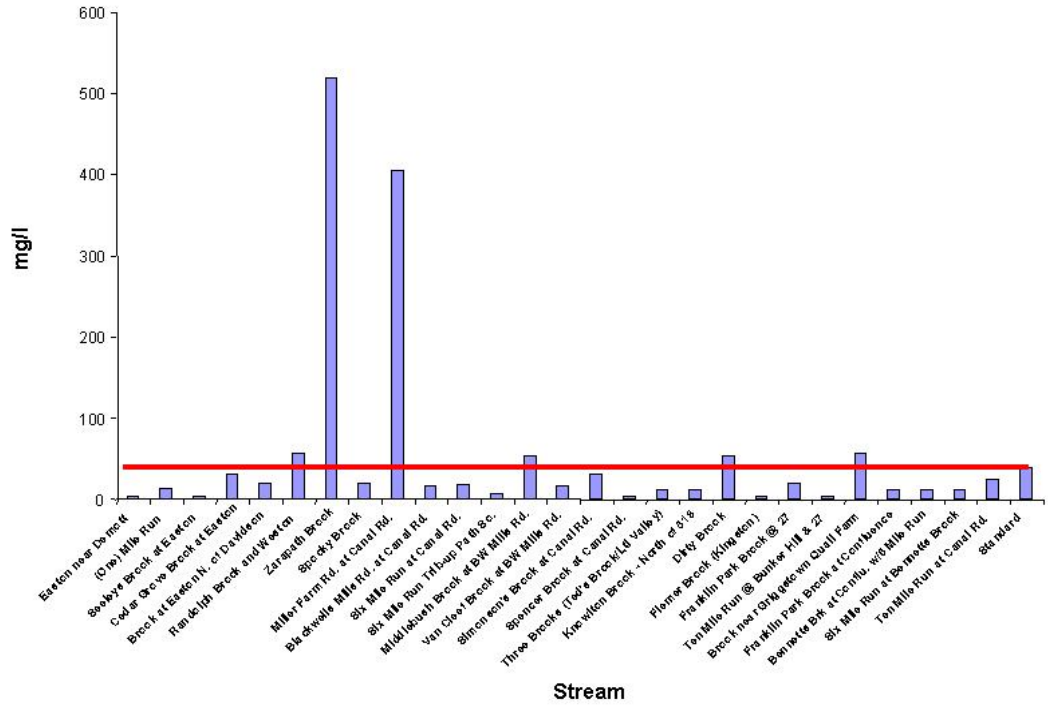
The SWQS regulates Nitrate (as N) under toxic substances. It states that the maximum concentration of nitrate permitted is 10,000µg/l (10 mg/l) This is based on noncarcinogenic effect-based human criteria as a 30 day

average. Cropland and pasture are the most widespread land uses that may affect nitrate concentrations in most river basins. None of our streams exceed this limit, though Griggstown Quail Farm Brook comes close.

Nitrogen and phosphorus are both essential nutrients and high concentrations can cause eutrophication, a condition that can affect aquatic life in the local streams. Nonpoint sources of nutrients from residential and agricultural land uses can potentially supply large quantities of nutrients through stream flow and ground water inflow, resulting in large nutrient accumulations downstream and extensive eutrophication.

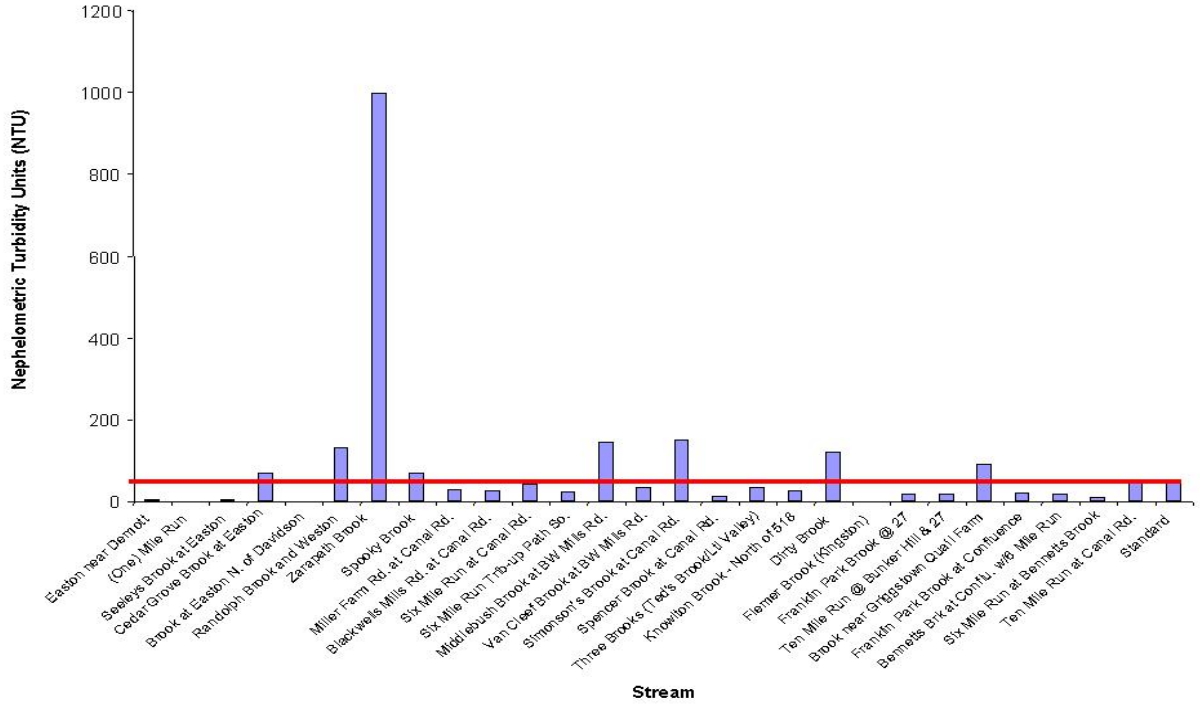
The SWQS for total suspended solids is 40mg/l. The streams at Sim's (Zarephath) Brook, Miller Farm, Middlebush, Dirty Brook, and the Griggstown Quail Farm are all above the standard. Zarephath and Miller Farm Brooks had the highest concentrations, at 520 mg/l and 405 mg/l respectively (Fig. 4).

Figure 4: Total Suspended Solids



Turbidity should not exceed the maximum of 50 NTU at any one time. Ten samples exceed the SWQC; Cedar Grove Brook, Randolph Brook, Zarephath Brook, Spooky Brook, Cross Brook, Middlebush Brook, Simonson's Brook, Dirty Brook, Quail Farm Brook and Ten Mile Run at Canal Rd. The Zarephath Brook sample was the highest at 999 NTU, essentially off scale (Fig. 5). This is probably attributable to construction at Canal Walk, near the headwaters of the stream.

Figure 5: Turbidity



The pH of the samples all fell into the acceptable range of 6.5-8.5. Stream waters usually range from a pH of 6.5 to a pH of 8.5. Rainwater is naturally acidic (≈5.6), and in some areas may be even more acidic (4.0-5.0) due to atmospheric pollutants. The more acidic the water, the greater its ability to dissolve and carry substances. The dissolved oxygen levels were also acceptable, since no samples fell below the 4.0mg/l standard. Dissolved oxygen is vital to fish and other aquatic life living in a given water body.

The results of this study confirm the commission's concerns over the state of the surface waters in Franklin Township. Source apportionment studies to locate the cause of the pollution are needed. This may be beyond the capabilities of this Commission and may require input and services from other sources and agencies. Procedures are known for tentatively assigning the source of fecal coliform pollution to human, animal (deer, cows), or avian (geese, chickens) waste. We hope to pursue such investigations in collaboration with Cook College, Rutgers University. It should be noted that levels far above acceptable in some streams, such as high turbidity at Zarephath Brook, may be the direct result of construction in that area, and the commission recommends taking immediate action to curtail this problem. Some high levels, such as fecal coliforms in Middlebush Brook East, Griggstown Quail Farm Brook and 'Lisa's Brook', may result from past contamination now alleviated by inclusion in sewer service.

Figure 1. Sites where streams were sampled.

We have used brook names from a map in the Somerset County Engineering meeting room, Somerville, and from names used by the Franklin Township Engineer's Office. Because many of these names are not widely known, and indeed we have applied tentative names to some otherwise unnamed streams (shown in inverted commas), the locations are summarized here:

1. 'Meadows Brook' crossing Easton Ave. at DeMott Lane.
2. Mile Run, at Landing Lane near Easton Ave.
3. Seeley's Brook at Easton Ave. (by Rutgers Plaza)
4. Cedar Grove Brook, at Easton Ave. by McAteer's Restaurant.
5. Raritan Brook, at Easton Ave. at the South Bound Brook Borough border.
6. Randolph Brook, at Weston Canal Rd.
7. Sim's Brook/Zarephath Brook, at Weston Canal Rd. near Zarephath.
8. Spooky Brook, in Colonial Park below the lower dam.
9. 'Miller Farm Brook' at Canal Rd. near Miller Farm Rd.
10. Unnamed brook at Canal Rd. just north of Blackwells Mills.
11. Six Mile Run at Canal Rd.
12. Cross Brook, a southern tributary of Six Mile Run, sampled at confluence with that stream.
13. Middlebush Brook. In 2003 this was sampled at Blackwells Mills Rd; in 2004 the east and west branches were sampled separately just above their confluence at South Middlebush Rd (13A is the eastern branch, 13B the western).
14. Steep Hill Brook at Blackwells Mills Rd. This is a northern tributary of Six Mile Run from the Wildflower Ridge area.
15. Simonson's Brook at Canal Rd in Griggstown.
16. 'Spencer Brook' at Canal Rd. This drains township-owned open space southeast of Griggstown.
17. 'Three Brooks' below the D&R Canal near Little Valley. Three brooks from the area between Canal Rd. and Rte 518 join and flow under the D&R Canal in a single aqueduct.
18. 'Knowlton Brook' at Canal Rd., just north of Old Georgetown Rd.
19. Dirty Brook, which drains from the Trap Rock Quarry, at new Laurel Ave.
20. 'Flemer Brook' at Laurel Ave. nearer Kingston
21. Franklin Park Brook/Nine Mile Run at Rte. 27.
22. Ten Mile Run at Rte. 27.
23. Brook just north of Griggstown Quail Farm, at Canal Rd.
24. Franklin Park Brook/Nine Mile Run: in 2003 sampled at its confluence with Six Mile Run, in 2004 at Cortelyou Lane.
25. Clyde Brook: in 2003 sampled at confluence with Six Mile Run, in 2004 at Skillmans Lane.
26. Six Mile Run: in 2003 sampled at its confluence with Clyde Brook, in 2004 at Rte. 27.
27. Ten Mile Run at Canal Rd.
28. 'Lisa's Brook' crossing Canal Rd. just south of Bunker Hill Rd.
29. Brook flowing out of "Lakeview Ranch", 90 Old Georgetown Rd., where various animals (mostly horses) are kept and dumping of transported materials has been reported by neighbors.