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Enviro Science 102
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Why can't we swim in the Pequabuck?

Abstract:

The Pequabuck River in the Farmington Valley of CT. has been off limits to swimmers for a number of years now, and this project investigated why. Samples were taken from a number of sites along the river and analyzed in lab for a number of contaminants that would make swimming unhealthful to bathers.

Objective:

To discover if there are unusually high or unsafe levels of fecal coliform, sodium, potassium, chloride, flouride, sulfate and nitrate in the waters of the Pequabuck and to figure out what is causing these high readings.

Background:

The Farmington River is a tributary of the Connecticut River which runs from Canada to the Hudson. It is an unusual river, in the fact that it appears to have a turn around- looking at it on a map, one finds that it runs south, then suddenly turns and runs north up into the Connecticut, the result

Do you mean till? Surely no glacier now!

of glacial blocking of its flow- a natural dam of sorts. The Farmington has long been a source of recreation and livelihood for residents of the Farmington Valley, and it is worrisome that in many spots, recreation must

be prohibited for health reasons.

One such spot is the Pequabuck river, running from Tarriffille through Bristol and Plainville to Farmington, where it empties into the Farmington River. Samples were taken at seven sites, from the source up in Tarriffille to the point where it meets the Farmington, and on the Farmington, just before the Pequabuck empties into it. A picturesque river, it was disturbing to discover so much wrong with it.

The Farmington Watershed Commission, formed in 1952 to restore the river and its surroundings, in association with the U.S. Geological Survey, has kept a record of water quality of the Farmington from 1981 to 1989, testing for conductivity, pH, dissolved oxygen, fecal coliform and streptococcus, as well as a variety of specific ions and heavy metals. These findings are compiled yearly and utilized in reports on the overall health of the river.

The Pequabuck consistently had unusually high readings of fecal coliform in the site where the researchers sampled, the result of which is the prohibition of swimming, much less drinking from the river. These results can be found in the graphs of figures 6 and 7. Water bodies are classified as A, B, C, and D, A being of drinking quality, with two fecal coliforms per 100 milliliters or less; B being suitable for swimming, but not drinking, with 200 coliforms or fewer; C being good for industrial use only; and D, unsafe for all of the above. Commonly, the Pequabuck has levels of fecal coliform hundreds of times higher than those that are safe for swimming.

The causes for the pollution of the Pequabuck are painfully obvious- Connecticut has a long history of unregulated dumping into its rivers. In the middle of the nineteenth century the Connecticut River itself was known as an open sewer, and the fishing industry was all but obliterated (the shad catch dropped from 28,000 shad per day to 11,000 shad per season). A number of sewage treatment plants and industries were allowed until just recently to dump untreated water into many rivers of the Connecticut Valley, including the Pequabuck. Since 1985 measures have been taken to upgrade these facilities, with the initiation of construction projects for advanced treatment plants.

It will be discovered in the following pages whether or not the effects of these improvements are yet apparent.

ABOUT THE WATER IN THE PEQUABUCK:

It was discovered that the Pequabuck's water was used by a number of industries that resided along it. A number of metalworking factories (springs, plating, etc.) use the water for cooling and waste disposal, undoubtedly depositing many heavy metals in the water, sediment and plant and animal life, though this was not studied. Another study, however, confirmed the fact that discharges from these factories had considerable amounts of heavy metals. Two sewage treatment plants also use the river, dumping treated domestic wastewater into the Pequabuck. Treatment at these plants consists of surface skimming, settling and clarification, chlorination, and biological oxidation, according to a survey done on companies and municipal industries. These studies also discovered that there is nutrient loading near the discharges of these plants.

CONNECTICUT WATER QUALITY POLICY:

Researchers in Connecticut seemed to have spent a good deal of time studying the pollution of area rivers, bringing up a great deal of legislation. Connecticut has put forth a statement that supports their continued efforts to "protect public health and welfare and promote the economic development of the State; to preserve and enhance the quality of the waters of the State for present and future use for public water supplies, propagation of fish, aquatic life and wildlife, recreational purposes, and agricultural, industrial, and other legitimate uses." In addition, the Federal Clean Water Act states its own purposes, that "the objective of this Act is to restore and maintain the chemical, physical, and biological integrity of the Nation's waters." This is a boon for the state of Connecticut, as under this law it may petition for federal funds with which to restore the Pequabuck.

METHODS:

Water samples were taken on April 1, 1991 between 10:30 a.m. and 12:30 p.m, it was a clear day and about 60°F. A sterile bottle was bound to a dowel and was dipped into the river for collection. The samples were refrigerated for twenty-seven hours, then fecal coliforms were cultured and the remaining water was filtered. The filtered water in the two weeks ensuing was tested for anions (Flouride, Chloride, Sulfate, and Nitrate) as well as cations (Potassium and Sodium) on the Ion Chromatograph and Atomic Absorption Spectrometer, respectively.

DATA:

Description of sites:

Site 1: Marked on the map with a 1, this site is on the Farmington river just before the water from the Pequabuck enters into it. The water was clear, and the layer of sediment on the bottom was thin and very mushy; the width at this point was approximately 50 feet. There was little vegetation on the banks- a few large trees, grasses and shrubs, and one bank was a lawn on private property whose grasses had been recently mowed. About 200 feet upstream of the site was a small dam, next to a defunct mill that now houses shops. A small amount of white water was seen on the dam.

Site 2: Marked with a 2. This site is at the very end of the Pequabuck, at a pool. The water was extremely slow moving and cloudy, fed by a number of small tributaries from under a bridge that all joined together again upstream. The stream where I sampled was about 25 feet wide, and was bounded by sharp banks that were vegetated with grasses.

Site 3: A fast moving stream about 30 feet wide, adjacent to a foundry and an old spring factory. There was a dam about 200 feet upstream, and many trees and grasses along the steep banks. The water was relatively clear.

Site 4: The stream was about 20 feet wide, with steep banks vegetated primarily by shrubs. The water, moving more slowly than at site 3, was shallow and slightly cloudy and green.

Site 5: The water here was a bit clearer, though there was a good deal of algae growing on the large pebbles (about 4 inches in diameter) that made up the bottom of the stream. This site was just downstream of a large brass company, and the width was about 30 feet.

Site 6: The stream ran along a long town green here; it was fast-moving, shallow and clear. It was about 30 feet wide and had a few trees and grasses on the banks. A spring company was just upstream.

Site 7: It took a good deal of driving through hilly terrain to get this site, the source of the Pequabuck. A large pool above a waterfall had very slow moving water that was a murky brown and about 3 feet deep. There were many grasses and trees in the area.

Fecal Coliform:

The seven samples were diluted 100 and 1000 times, as it was known that previous samples from the Pequabuck had produced too many colonies to be counted if they were cultured without dilution. Samples 1 and 2 were cultured with 1: 10, 1: 100, and 1: 1000 dilutions; samples 3 through 7 were diluted 1:100 and 1: 1000. The numbers were adjusted from the dilution that contained the most sample. Table 1 lists the findings.

The U.S.G.S study on the Pequabuck also tested for fecal coliform- graphs of their findings from 1981 to 1989 are in figures 6 and 7. At certain times in the year coliform counts were as high170,00/ 100ml water (Jan 1984), though they also went as low as 24/ml (May 86).

Sodium and Potassium:

The samples were diluted 1: 10, and run through the atomic absorption spectrometer. Table 2 lists the adjusted numbers.

Flourine, Chloride, Nitrate, Sulfate:

Samples were run through the ion chromatograph straight and diluted by 1:10. Table 3 lists the results.

DISCUSSION OF DATA:

It is obvious in looking at the data that the water of the Pequabuck is not healthy. The lowest coliform count is just at the allowable level for swimming; the others are extremely dangerous for bathers, with counts as high as 1700 and 2500. The levels of sodium are also unusually high, with normal levels of river water being 4 mg/L or less- these samples yielded levels as much as five times as great. Potassium levels, too, were high. Normal levels of potassium are between 0.2 and 1.5 mg/L; levels for the Pequabuck ranged from 0.8 to 2.5. In addition, chloride readings were unusually high, with the normal being between 0.3 and 0.4 mg/L- readings from the Pequabuck went as high as 18.3. Nitrate readings were also well above the 1.0 mg/l level, with a high of 5.89, and considering the lack of vegetation at the sites, these readings are worrisome. A number of the sulfate readings also exceeded the normal high of 12 mg/L, reaching as high as 29.9, though that reading was taken from a diluted sample and may possibly be suspect. All these unusually high readings are signs of pollution and sewage disposal- the incoming sewage has much coliform, sodium and chloride, and whatever else people let go down their drains, and they are showing up in samples taken downstream of a sewage treatment plant. The nitrate readings are probably a result of nitrogen containing substances being dumped into the river, and the lack of vegetation to take them up. It is possible that since samples were taken in early spring, vegetation that usually takes care of the nitrate had not yet grown. In any case, it is clear that treatment at the sewage plants is not successfully taking care of these elements and the administrators of the plants are causing the deterioration of the Pequabuck.

It is interesting to note that the sites 2 through 6 follow consistent patterns, as do 1 and 7. Site 1 is located before the Pequabuck empties into the Farmington, and thus does not show the same signs of pollution as the waters of the Pequabuck. Site 7 is at the head of the Pequabuck, before it has passed by all the industrial parks who utilize and dump into the water, and shows very similar readings to those of the Farmington. Sites 2 through 5 all have similar readings for chloride and nitrate, all extremely high, though there is more variation in the readings for these five samples for sulfate, which are also unnaturally high. A look at the graphs confirms these facts, with the lowest readings for all the ions and the coliform in the first and last sampling, the untainted samples, and the highest in the middle four or five, reflecting the way the water is used by the towns along the Pequabuck.

The U.S. Geologic survey along the Pequabuck has discovered amazing amounts of coliform bacteria, which are graphed for the years 1981 to 1990 in figures 6 and 7. May, June and July are consistently the months with the lowest levels of coliform, the highest levels being in November, December and January, and October of 1988. Temperature certainly has something to do with this, but the opposite of what one might expect is true. Warmer temperatures should culture a greater number of bacteria, and colder temperatures should inhibit their growth. Perhaps it is just this fact that the sewage treatment plant takes into account, and disposes of its wastewater elsewhere. In any case, it is noteable that in most years, in the summer months, the months a river might be used for bathing, the levels of coliform were acceptable under health regulations. It is only during the winter months that the outrageously high levels were found.

? They don't chlorinate the effluent in the winter

It also appears looking at U.S.G.S findings that the levels at their highest are finally going down. The highest reading for 1989 was 1400 in December- compared with the December readings previous, 80,000 in 1982, 50,000 in 1983, 380,000 in 1985, 110,000 in 1986, and 29,000 in 1988, the levels have dropped appreciably. However, at their worst, the levels are still completely unacceptable, and Connecticut must put stricter regulations on the sewage treatment centers, because these amounts of coliform do not belong in a river.

a graph of this would be nice

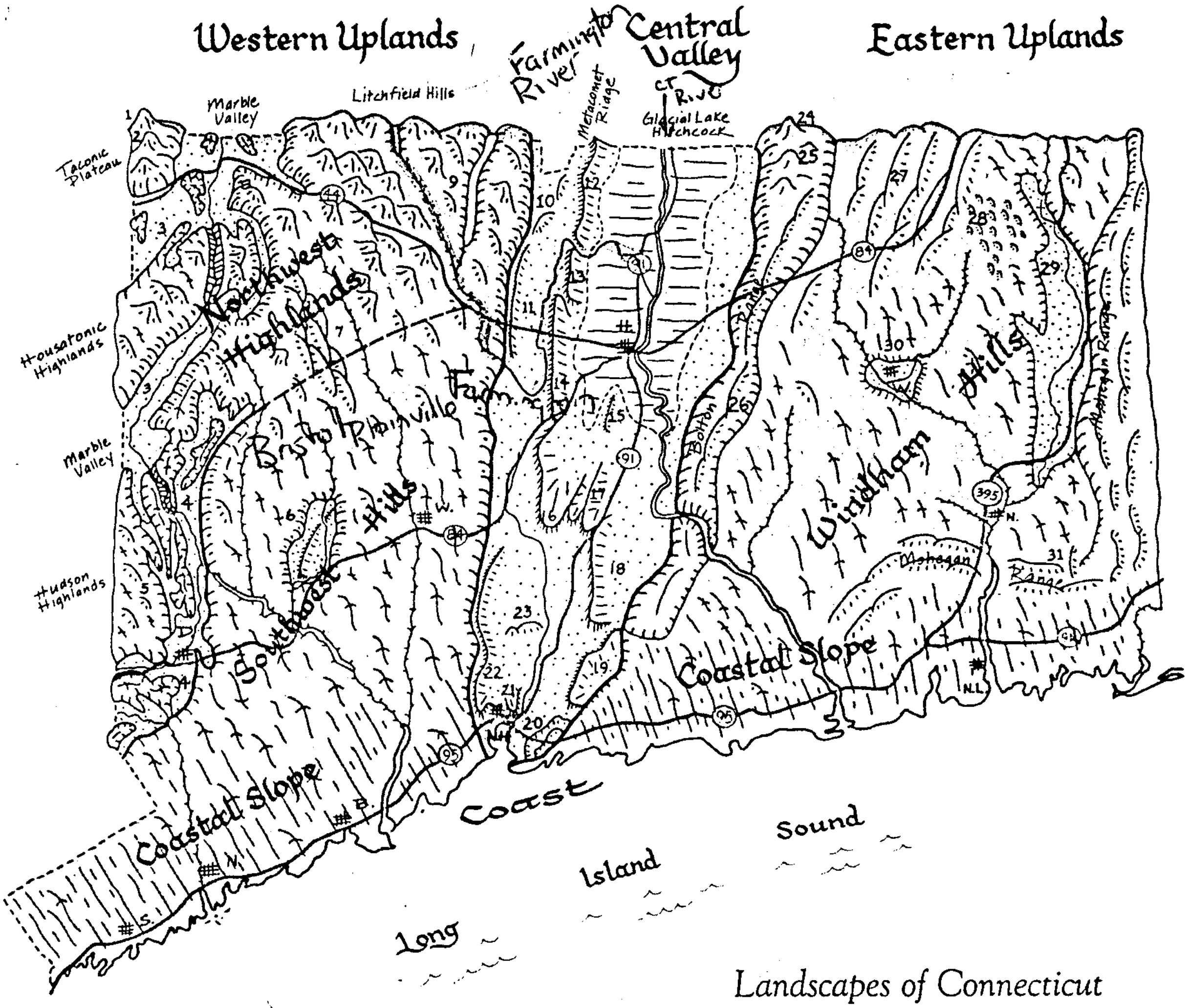
SUGGESTIONS FOR IMPROVEMENT:

It has clearly been shown that the Pequabuck is in dire need of cleaning up. The first step is the immediate installation of tertiary treatment in all the sewage treatment centers along the river. The coliform

now in the river will take care of itself, dying out if it is not replaced. The water that is discharged into the river must be regulated to make certain that adequate numbers of coliform are being killed so they don't wind up in the swimming water of Connecticut bathers.

or washed downstream

Fig. 1. Map of Connecticut



Landscapes of Connecticut

Fig 2a - Path of the Pequabuck - line up right side of b w/ left side of a

Fig 2b - Path of the Pequabuck - line up rt. side of c w/ lt. side of b.

Fig 2c - Path of the Pequabuck - line up right side w/ lt side of 6

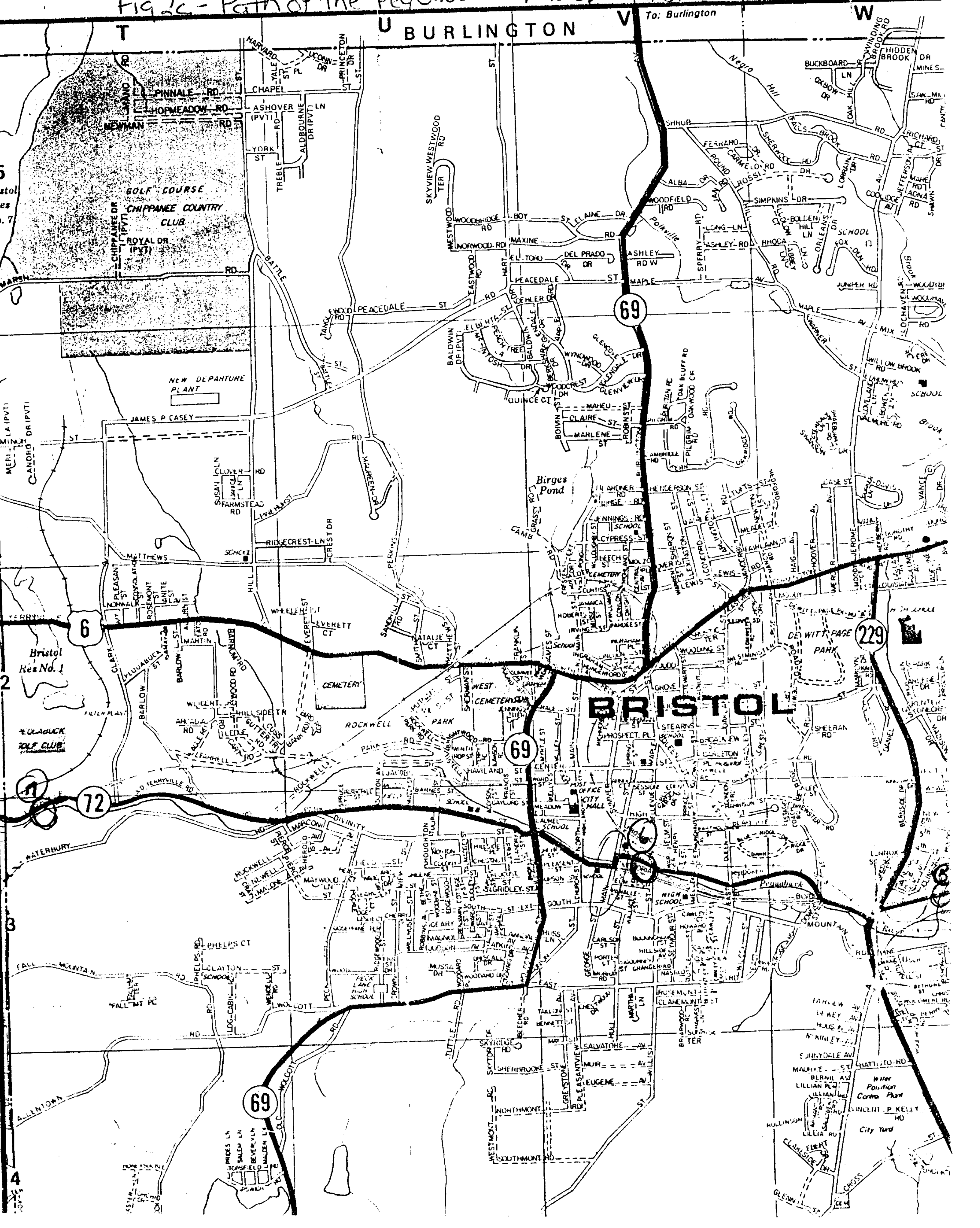
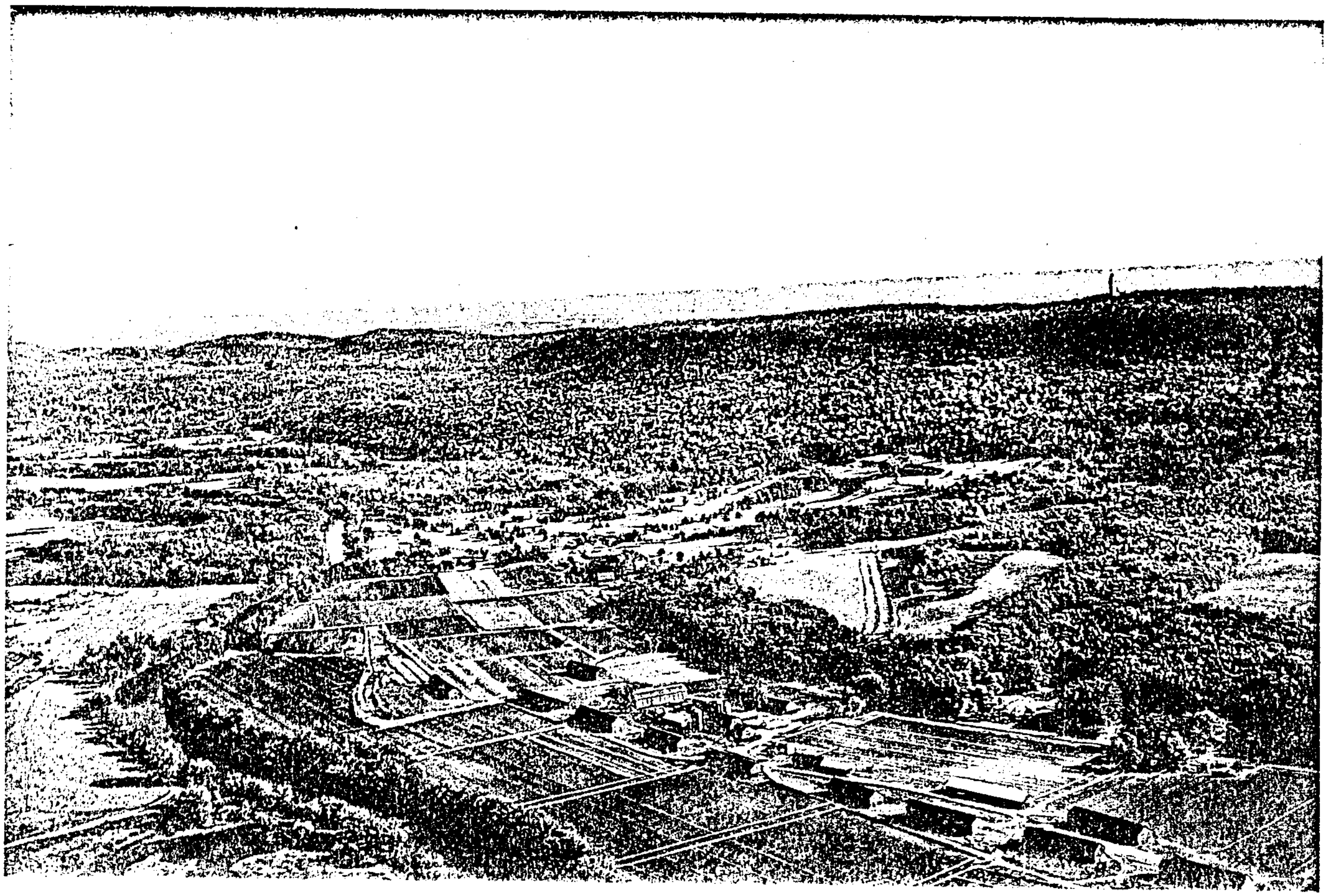


Fig 3. A view of the Farmington River



Landscapes of the Central Valley

The Central Valley is a broad region of level land in the midst of New England's hills. Through this lowland runs the 75-mile long Metacomet Ridge, an abrupt wall of rock rising from the valley floor. Pictured here is the Talcott Mountain section of the Metacomet Ridge, in Avon. Beneath the west-facing cliffs, tobacco barns line the fertile floodplain of the Farmington River.

Table 1. Right column lists fecal coliform count/ 100 ml

site	10x	100x	1000x	adjusted numbers
	(number of colonies counted on plate)			bacteria/100 ml
1	47	10	1	470
2	22	10	1	220
3	--	12	2	1200
4	--	28	1	2800
5	--	15	4	1500
6	--	17	1	1700
7	--	2	2	200

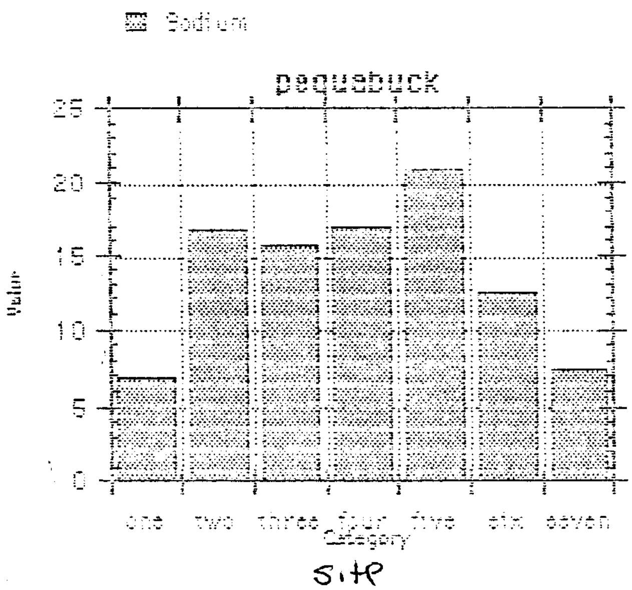
Table 2. Mg/L Sodium and Potassium

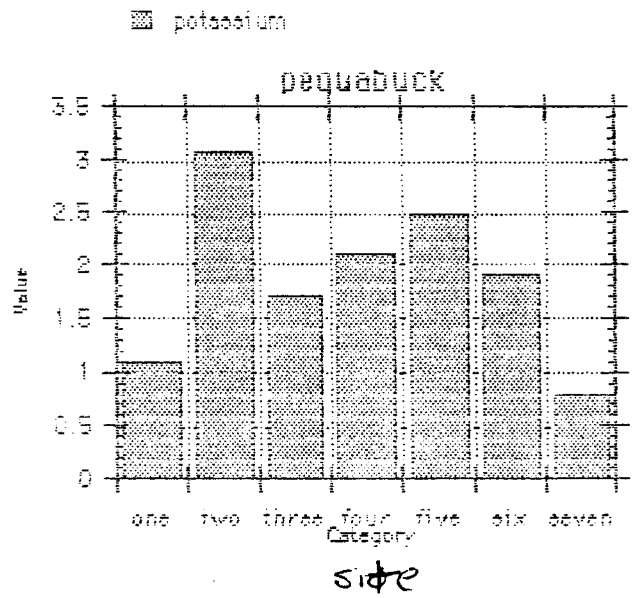
Site	Sodium, Mg/L	Potassium, Mg/L
1	7.10	1.10
2	16.90	3.10
3	15.90	1.70
4	17.00	2.10
5	21.00	2.50
6	12.50	1.90
7	7.60	0.80

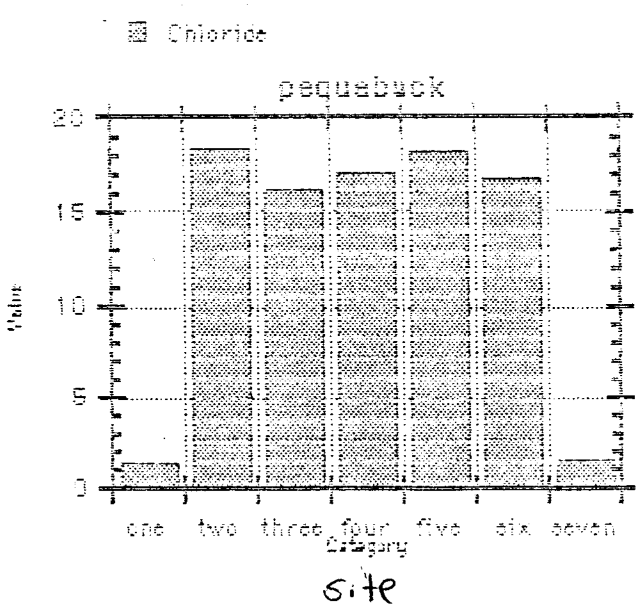
Table 3. Flouride, Chloride, Nitrate, and Sulfate, mg/L

site	Flouride	Chloride	Nitrate	Sulfate
1	0.00	1.39	1.17	8.15
2	0.00	18.3	5.89	29.9
3	0.03	16.2	4.84	14.63
4	0.04	17.0	4.36	14.85
5	0.07	18.2	4.52	17.13
6	0.00	16.8	4.85	11.85
7	0.01	1.53	1.78	8.74

Fig 4. Graphs of Na^+, K^+, Cl^-, F^- ions at each site sampled







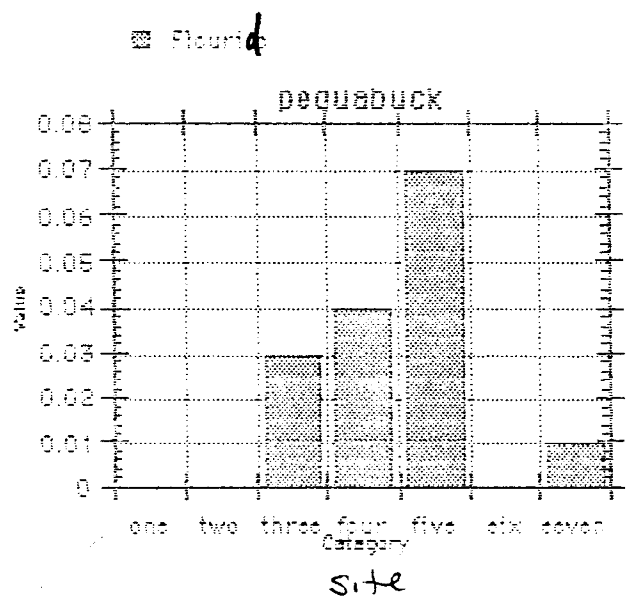
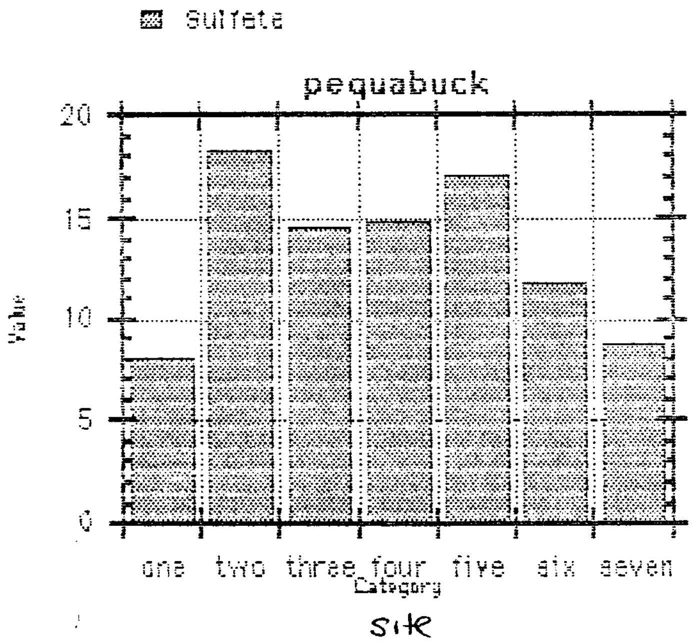
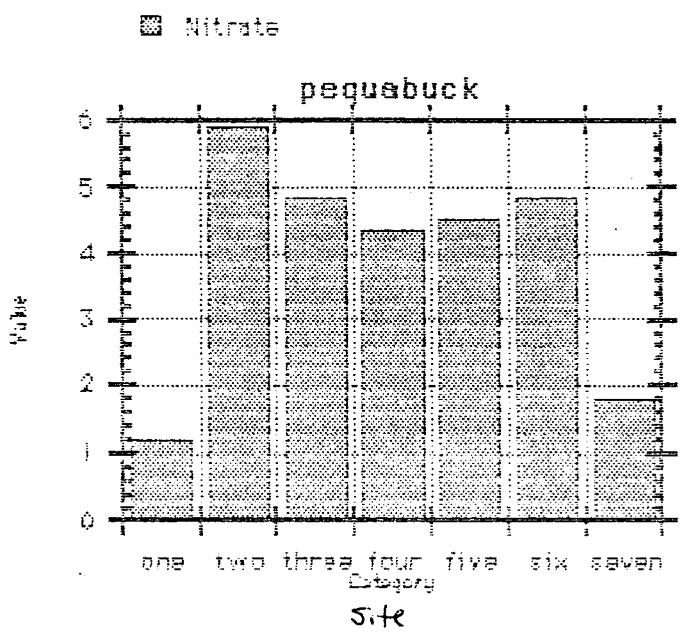


Fig 5. Graphs of SO_4^{2-}, NO_3^-, fecal coliform at each site sampled





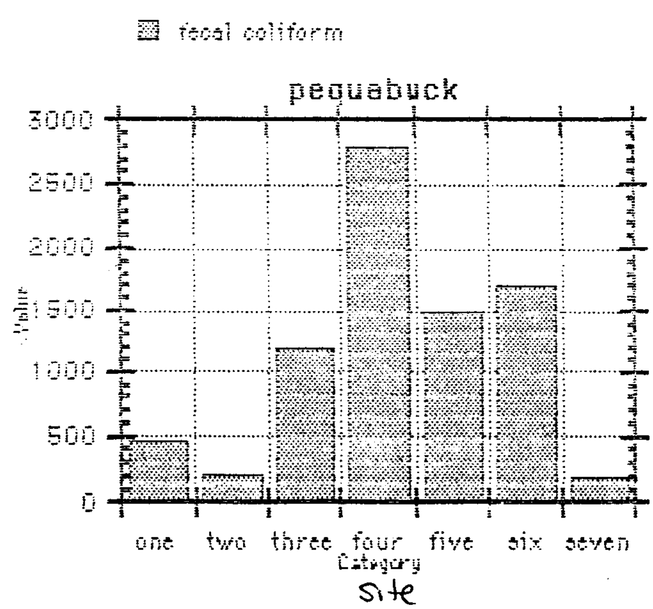
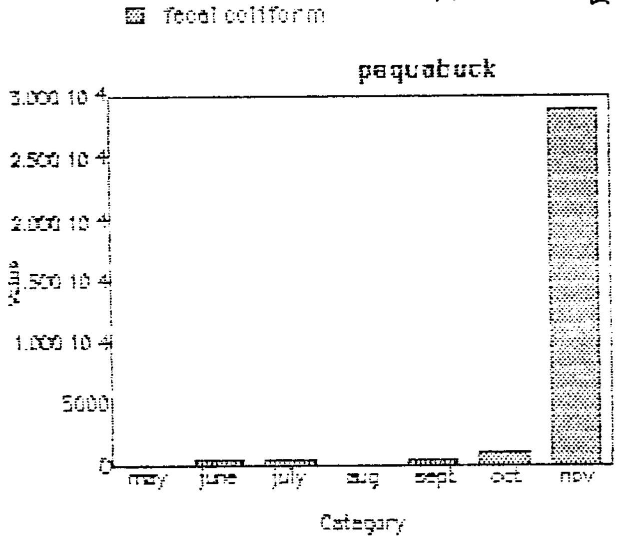
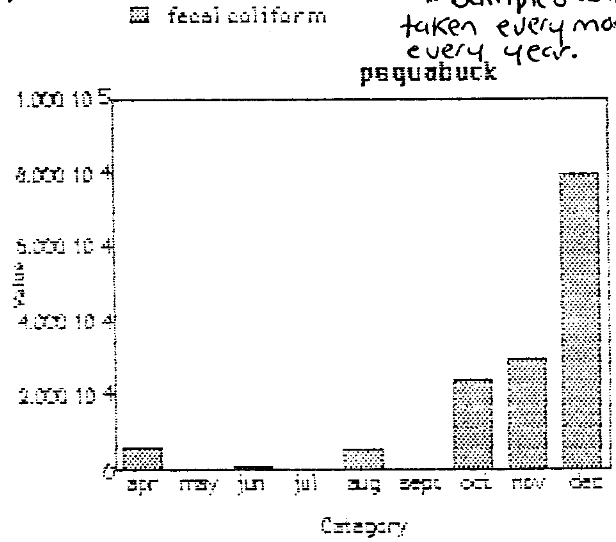


Fig 6. U.S. Geo. Survey of fecal coliform levels in the Pequabuck, 1981-1985*

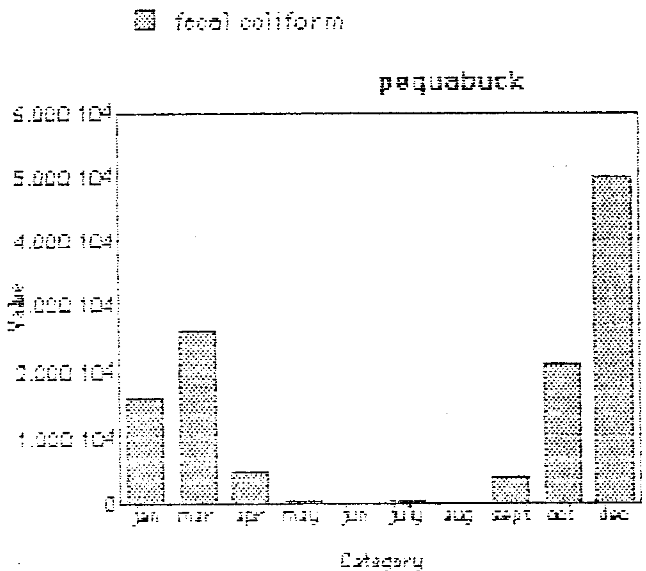
* samples were not taken every month of every year.



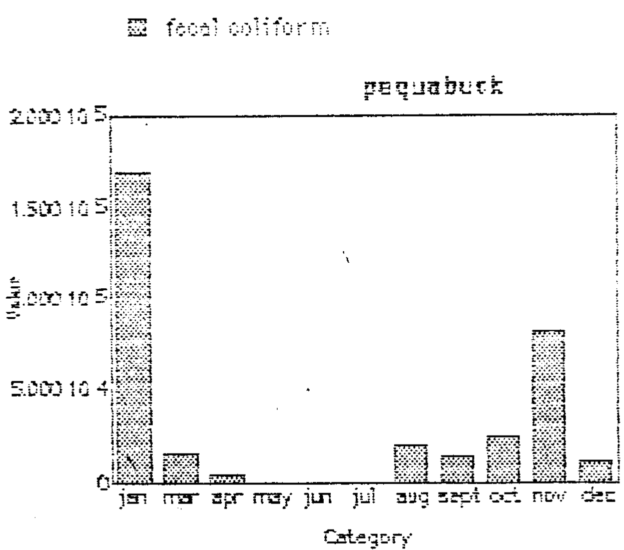
1981



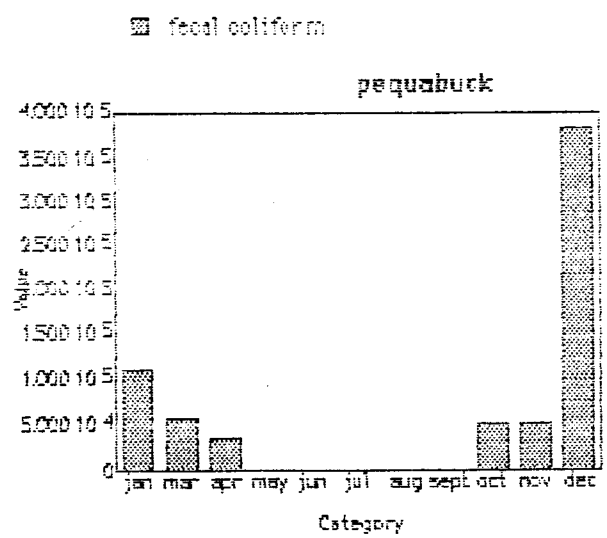
1982



1983



1984



1985

Fig 7. U.S.G.S. fecal coliform levels in the Pequabuck, 1986-1989