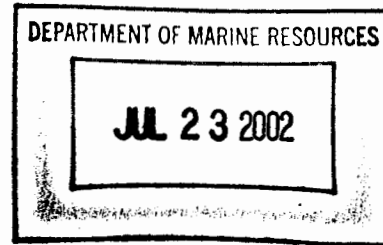




July 16, 2002

Ms. Amy M. Fitzpatrick, Director
Public Health Division
Maine Department of Marine Resources
P.O. Box 8
West Boothbay Harbor, ME 04575



Dear Ms. Fitzpatrick:

Enclosed is the final copy of the FDA report on the review of the Spruce Creek shellfish growing area. The review was conducted in response to a request by the Interstate Shellfish Conference (ISSC) to investigate concerns raised by Spinney Creek Shellfish, Incorporation regarding Maine's approach to shellfish growing water classification.

The support provided by you and your staff to the Food and Drug Administration (FDA) team is greatly appreciated. Our review indicates that the data and information were not adequate to relate the effects from actual and potential sources of contamination to water quality in Spruce Creek. More specifically, impacts from nonpoint runoff from the Spruce Creek watershed and water entering from Portsmouth Harbor needed to be further assessed. Most of the water samples were taken at high tidal stages, and not adequate for determining the effects of tidal stage on water quality. The determination of water quality at near low tide will require the addition of new sampling stations near the main flow of the river.

Please forward any comments or questions you may have regarding the findings and recommendations to us.

Our address is: Food and Drug Administration, Center for Food Safety and Applied Nutrition, Division of Cooperative Programs, Shellfish Safety Team, HFS-628, 5100 Paint Branch Parkway, College Park, MD 20740.

Sincerely,

A handwritten signature in cursive script that reads "Virgil E. Carr".

Virgil E. Carr, Ph.D., P.E.
Shellfish Safety Team
Division of Cooperative Programs

Enclosure

**GROWING AREA CLASSIFICATION REVIEW OF SPRUCE CREEK
RELATED TO TIDAL STAGES
AUGUST 21-25, 2000**

Introduction

FDA, in cooperation with the Maine Department of Marine Resources (DMR), completed a file and field review of Spruce Creek, Maine shellfish growing area during August 21-25, 2000. This review was conducted in response to a request by the Interstate Shellfish Sanitation Conference (ISSC) for FDA to examine the methods used by DMR to classify shellfish growing waters for consistency with the requirements of the National Shellfish Sanitation Program (NSSP) Model Ordinance Chapter IV.02. In fulfilling this request, Spruce Creek was one of four Maine growing areas visited. This report pertains only to the classification of Spruce Creek shellfish growing area.

FDA representatives Ira Somerset, NE Regional Shellfish Specialist, Paul DiStefano, Office of Seafood, and Virgil Carr, Office of Field Programs, conducted the review. Maine Department of Marine Resources (DMR) personnel assisting FDA during the review included Amy Fitzpatrick, Laura Livingston, Jan Barter, and Bob Goodwin.

FDA's review was based on information obtained during a field visit and data obtained from the water quality database furnished by DMR. Information assessed from the database in this review comprises about an 8-year period, from May 1993 – July 2000. Information reviewed includes the dates and times of sample collections, tidal stage at the times of collections, corresponding fecal coliform MPN levels, salinities, and cumulative amounts of rainfalls occurring 0, 1, 2, and 3 days before collection dates.

The shellfish resource in Spruce Creek is comprised of soft shell clams (*Mya arenaria*) growing in the intertidal mud flats. The shellfish growing waters in Spruce Creek can receive fecal contamination from non-point sources within the drainage basin and also from the adjoining waters from Portsmouth Harbor. In particular, the waters in Spruce Creek shellfish areas can be impacted by rainfall related runoff discharges on ebb tides, and by waters from Portsmouth Harbor on flood tides. Pollution impacts on Spruce Creek are expected to be runoff related, except for the wastewater treatment plants discharging to the Piscataqua River. This report provides a description and an analysis of the influence that hydrologic and hydrographic factors exert on water quality in Spruce Creek, and an assessment of the need to consider these factors when determining adverse pollution conditions in the classification of Spruce Creek.

Spruce Creek Shellfish Classification

In the spring of 2000, the portion of Spruce Creek from the highway bridge at its mouth to about 1.25 nautical miles upstream was re-classified on a year round basis from restricted to conditionally approved based on 3 inches of rainfall in 24 hours. The rest of

Spruce Creek, about 0.75 nautical miles in length, remains classified as restricted. A map of the Spruce Creek is shown as **Figure 1** (NOAA Chart 13283).

Time of Sample Collection Relative to High Tide

Tidal stage can exert a significant influence on water quality determinations. Ordinarily, waters occurring around low tides are sampled to capture the effects occurring from pollution sources upstream and to represent the least amount of dilution occurring during the tidal cycle. Thus, the time of sampling can be an important factor in determining shellfish area classifications. **Table 1** shows the total numbers of samples collected at nine separate sampling stations and the numbers of samples collected two or more hours before and after the occurrence of high tide. The exact times of sample collections relative to high tide were determined by comparing the actual collection times with tide tables for Kittery Point (43°05' North Latitude by 70°42' West Longitude). These data demonstrate that most (61-90%) of the results obtained from the DMR database and used in this review derived from samples that had been collected within two hours before or two hours after the occurrence of high tide, a 4-hour period in the tidal cycle when the maximum dilution of contamination inputs might be expected. Few samples were collected during tidal stages representative of low water. A comparison of water quality between higher tidal stages and lower tidal stages was not made because the database was not related to adverse pollution conditions caused by point and non-point pollution sources. It is quite possible under adverse pollution conditions that the waters in Spruce Creek will contain more fecal contamination during the lower tidal stages than during higher tidal stages. This is commonly seen in riverine systems.

DMR describes the 12-hour tidal cycle in terms of the time intervals depicted in **Figure 2**. One-hour intervals represent the occurrences of high and low tides, and on either side of these respectively, 1-hour intervals also are allotted to represent high flood, high ebb, low ebb, and low flood waters. The two remaining 3-hour intervals represent flood and ebb tide waters. FDA's review specifically related the times of sample collection to the occurrence of high tide. These data for nine separate sampling stations are shown graphically in **Figures 3A-3I**. Water quality data (fecal coliform MPN's/100 ml) for each sample station are plotted according the times of sample collection relative to the number of hours before or after the occurrence of high tide. Viewed individually or collectively, the graphs further illustrate that water quality monitoring over the 8-year period assessed occurred predominantly within 1.5 hours before or after high tide, a 3-hour period in the tidal cycle when dilution of contamination would likely be maximal. This 3-hour interval corresponds to the total time covered by the three separate 1-hour intervals designated for high tide, high flood and high ebb waters in **Figure 2**.

Sanitary Survey

Spruce Creek adjoins Portsmouth Harbor (*see Figure 1*), a downstream area that is classified as prohibited. Thus, the water entering Spruce Creek on flood tides derives from a prohibited area. Spruce Creek is about 1.4 nautical miles below the Route 1 Bridge connecting Portsmouth, New Hampshire and Kittery, Maine. The Piscataqua River, the Squamscott River, and other smaller tributaries feed into Portsmouth Harbor

waters. These sources are not large rivers, and they are extensively tidal. The mean tide range is about 8.7 feet. The drainage area for these rivers and tributaries can result in runoff following rainfall. The effects of that runoff on the Portsmouth Harbor water quality, and on Spruce Creek as it enters on flood tide, need to be investigated.

The cities of Portsmouth and Kittery both have wastewater treatment facilities with effluents that enter Portsmouth Harbor. These contribute pollution to Portsmouth Harbor, most especially when treatment is stressed or during breakdown conditions. Effects from these wastewater treatment plants need to be included in the sanitary survey.

In addition to the polluted water from Portsmouth Harbor entering Spruce Creek on flood tides, there exists the potential for contamination to occur from sources originating within the drainage area for Spruce Creek. Most of the potential sources within the Spruce Creek watershed are expected to be non-point, and these plus those entering with tidal flood tide water would be expected to occur following rainfall and runoff events.

Samples Taken After Rainfall-Runoff Conditions

The water quality database consists mainly of results derived from water samples collected during periods of dry weather. This is illustrated by examining data from the 45 samples obtained from Station 24 at the mouth of Spruce Creek, shown in **Table 2**.

Precipitation data are presented as daily rainfall amounts for the day of sampling, for each of the 3 preceding days, and also as cumulative rainfall amounts. A total of 10 of the 45 collections occurred on days when rainfalls of 0.5 inches or greater fell either on the day of collection or on any of the preceding 3 days. The data from these 10 dates indicate that pollution impacts stemming from rainfall should be considered when assessing water quality in Spruce Creek. The following points are observed:

- Only 1 of the 45 samples was obtained when a rainfall of greater than 0.5 inches (0.52) had occurred on the day prior to sampling. That sample had an elevated fecal coliform level, even though sampling had occurred at high ebb tide. Fecal coliform levels determined for other sampling stations (data not shown) on that day were not elevated.
- Three of the 45 samples were collected when rainfalls greater than 0.5” had occurred two days prior to sampling. The one sample collected on ebb tide showed an elevated fecal coliform level.
- One of the 45 samples was collected when a rainfall greater than 0.5” had occurred 3 days prior to sampling. No impact on fecal coliform levels was evident from this sample, collected at low flood tide.
- Six of the 45 samples collected were obtained when 0.5 inches or greater rainfall occurred on the date that sampling occurred. None of these six showed an elevated fecal coliform level, but it is uncertain from the database whether the rainfalls preceded the times of sampling and, if so, how much rain fell before the times of sampling. This is a relevant matter to consider because pollution impacts from rain falling after sample collection would not be reflected in the water quality data determined, even though the database still reflects that rainfall occurred.

In order to accurately establish adverse pollution conditions, it seems clear that additional samples are needed to determine the impacts from non-point pollution sources on Spruce Creek water quality. For this purpose, and also to assess the appropriate tidal stage for sampling, sampling should be conducted during lower tidal stages.

For growing area classification of Spruce Creek, data showing the effects from rainfall derived runoff within the watershed and that from Portsmouth Harbor waters also are needed in the water quality analysis. Conditionally approved management of shellfishing in Spruce Creek may depend on non-point pollution effects as contributing factors. Sufficient sample data must be collected at lower tidal stages to evaluate the impact of non-point pollution.

Summary and Conclusions

- DMR has not related the effects from actual and potential sources of contamination to water quality in Spruce Creek. Impacts on water quality in Spruce Creek from Portsmouth Harbor water that includes the effluents from two wastewater treatment plants and from nonpoint pollution contributions based on rainfall and runoff need to be more fully determined.
- DMR's assessment of water quality in Spruce Creek is based on a systematic random sampling (SRS) program as provided for in the National Shellfish Sanitation Program (NSSP) Model Ordinance. Samples are not taken at all stations on the same day. The approximate station locations are shown in **Figure 1**. This sampling approach is not adequate for the classification of Spruce Creek because it appears fairly certain that adverse pollution conditions affect the area's water quality. Impacts from water entering from Portsmouth Harbor and from non-point runoff in the watershed of Spruce Creek are factors that must be considered in classification and management of shellfish resources in Spruce Creek.
- Most of the samples analyzed to determine water quality were collected at high tidal stages. These samples are not adequate for determining the effects of tidal stage on water quality in Spruce Creek. The greatest potential for contaminated water to move over mud flats where soft clams grow occurs during 1.5 hours on either side of low tide. The determination of water quality at near low tide will require the addition of new sample stations near the main flow of the river. To fully determine the effects of pollution sources on Spruce Creek water quality at lower flood and lower ebb tide stages, a means of access to the river at low tide will be required.

Recommendations

- FDA evaluation determined that there is not enough data to reliably assess the effects of non-point pollution triggered by watershed runoff on water quality in Spruce Creek. Further work needs to be conducted to determine if there are critical runoff conditions that cause deterioration of water quality.
- Sampling should be conducted at lower tidal stages to define the impact of non-point runoff originating from the Spruce Creek watershed and carried in with Portsmouth Harbor water.

- New sampling stations need to be established nearer the main flow of the river at lower tidal stages. Monitoring should be conducted by boat to ensure access to key stations.

Table 1. Numbers of Samples Taken Two or More Hours Before and After High Tide During the Period May 1993 to July 2000.

Station Number	Total Samples	No. Samples taken 2 or more hours before high tide	No. Samples taken 2 or more hours after high tide
24	45	6	4
29.1	44	9	8
30	48	1	8
31	49	2	10
32	52	1	6
33*	14	0	2
34	51	2	3
35	51	1	4
36	51	1	5

*Note: Last sample taken at Station 33 was on 10/16/94. The location of Station 33 is not shown on **Figure 1**.

Table 2. Database Information for Sample Station 24: Sample Collection Date, Tidal Stage, Hours Before/After High Tide, Fecal coliform MPN, Accumulative and Daily Rainfall
Rainfall/Tide/Fecal Coliform Analysis for Station 24
Area A

ColDate	Cat	Tide	Hours	Fecal Coli	TC	HTP	DS	ACCUMULATIVE RAINFALL								RAINFALL ON SPECIFIC DAY				
								Rain-0	Rain-1	Rain-2	Rain-3	Rain-4	Temp	Salin	0-day	1-day	2-day	3-day		
03/25/93	A	HE	0:30	2.9		12:13		0.000	0.220	0.220	0.220	0.220	0.220	0.220	11.5	30	0.000	0.220	0.000	0.000
05/09/93	A	HE	0:30	3.6			14:22	0.000	0.010	0.010	0.050	0.050	0.050	0.050	13.0	28	0.000	0.010	0.000	0.040
05/26/93	A	F	1:21	2.9	14:00		15:21	0.000	0.060	0.060	0.060	0.060	0.060	9.5	31	0.000	0.060	0.000	0.000	0.000
06/06/93	A	E	1:35	3.6	14:50		13:15	0.500	0.510	0.510	0.510	0.510	0.860	1.0	30	0.500	0.010	0.000	0.000	0.000
03/14/94	A	HF	0:30	9.1		12:17		0.000	0.000	0.000	0.480	1.520	4.5	29	0.000	0.000	0.000	0.000	0.000	0.480
04/10/94	A	HE	0:30	93.0			11:45	0.020	0.020	0.150	0.360	0.360	9.9	26	0.020	0.000	0.000	0.000	0.000	0.130
05/08/94	R	H	0:00	15.0			10:41	0.800	0.820	1.470	1.920	1.920	9.9	29	0.800	0.020	0.000	0.020	0.000	0.450
06/12/94	A	HE	0:30	7.3			13:56	0.200	0.200	0.200	0.200	0.200	12.0	30	0.200	0.000	0.000	0.000	0.000	0.000
07/10/94	A	HE	0:30	3.6			12:52	0.000	0.030	0.140	0.310	0.310	17.0	32	0.000	0.000	0.000	0.030	0.000	0.170
08/14/94	R	HE	0:30	3.6			17:15	0.150	0.150	0.150	0.150	0.150	15.0	32	0.150	0.000	0.000	0.000	0.000	0.000
09/11/94	A	HE	0:30	43.0			15:58	0.000	0.520	0.520	0.530	0.530	14.0	33	0.000	0.520	0.000	0.520	0.000	0.010
10/16/94	R	HE	0:30	2.9			9:40	0.000	0.000	0.000	0.000	0.000	10.5	33	0.000	0.000	0.000	0.000	0.000	0.000
04/30/95	R	E	2:54	2.9	15:25		12:31	0.100	0.150	0.151	0.152	0.152	8.0	30	0.100	0.000	0.050	0.050	0.001	0.001
06/25/95	R	E	2:55	2.9	13:20		10:25	0.000	0.000	0.000	0.000	0.000	14.5	33	0.000	0.000	0.000	0.000	0.000	0.000
08/13/95	R	E	1:09	3.6	14:50		13:41	0.000	0.040	0.040	0.040	0.040	17.0	32	0.000	0.040	0.000	0.040	0.000	0.000
09/10/95	R	E	1:41	43.0	14:10		12:29	0.001	0.031	0.701	0.702	0.702	14.0	31	0.001	0.030	0.000	0.030	0.000	0.001
10/15/95	R	F	2:01	43.0	14:15		16:16	0.060	0.060	0.080	0.080	0.080	13.0	32	0.060	0.000	0.000	0.000	0.020	0.000
04/21/96	R	H	0:00	9.1			14:23	0.000	0.000	0.000	0.020	3.660	7.5	21	0.000	0.000	0.000	0.000	0.000	0.020
05/19/96	R	H	0:00	7.3			13:19	0.340	0.360	1.080	1.080	1.081	10.0	28	0.340	0.020	0.000	0.020	0.000	0.000
06/23/96	R	L	6:00	7.3			16:55	0.910	1.240	1.370	1.370	1.371	6.0	31	0.910	0.330	0.130	0.330	0.000	0.000
07/28/96	R	E	3:40	9.1	13:10		9:30	0.000	0.310	0.320	0.321	0.551	15.0	30	0.000	0.310	0.010	0.310	0.001	0.001
09/08/96	R	HE	0:30	3.6			8:49	0.050	0.050	0.050	0.070	0.070	15.0	31	0.050	0.000	0.000	0.000	0.000	0.020
10/06/96	R	HE	0:30	2.9			7:13	0.000	0.000	0.000	0.270	0.270	10.5	30	0.000	0.000	0.000	0.000	0.000	0.270

Table 2 (Continued). Database Information for Sample Station 24: Sample Collection Date, Tidal Stage, Hours Before/After High Tide, Fecal coliform MPN, Accumulative and Daily Rainfall

ColDate	Cat	Tide	Hours	Fecal Coli	TC	HTP	DS	ACCUMULATIVE RAINFALL							RAINFALL ON SPECIFIC DAY				
								Rain-0	Rain-1	Rain-2	Rain-3	Rain-4	Temp	Salin	0-day	1-day	2-day	3-day	
04/13/97	R	F	2:45	3.6	14:05		16:50	0.970	0.970	0.970	0.970	0.970	0.971	5.0	28	0.970	0.000	0.000	0.000
05/11/97	R	F	1:26	2.9	14:00		15:26	0.100	0.350	0.350	0.350	0.470	7.0	30	0.100	0.250	0.000	0.000	0.000
06/29/97	R	LF	4:30	2.9			19:30	0.000	0.000	0.000	0.000	0.000	18.5	30	0.000	0.000	0.000	0.000	0.000
07/13/97	R	LF	4:30	3.6			18:00	0.000	0.000	0.001	1.621	1.861	18.0	31	0.000	0.000	0.001	0.000	1.620
08/10/97	R	HF	0:30	3.6			16:26	0.030	0.150	0.150	0.150	0.150	16.0	33	0.030	0.120	0.000	0.000	0.000
09/21/97	R	E	2:53	9.1	18:10		15:17	0.050	0.070	0.070	0.170	0.170	14.5	31	0.050	0.020	0.000	0.000	0.100
05/17/98	R	F	1:00	2.9	15:00		16:00	0.000	0.000	0.000	0.000	0.000	n/a	30	0.000	0.000	0.000	0.000	0.000
07/12/98	R	HE	0:30	3.6			13:46	0.000	0.010	0.010	0.010	0.010	15.0	30	0.000	0.010	0.000	0.000	0.000
07/26/98	R	H	0:00	2.9			13:56	0.000	0.000	0.180	0.180	0.180	14.0	31	0.000	0.000	0.000	0.180	0.000
08/09/98	R	HE	0:30	3.6			12:36	0.000	0.000	0.140	0.140	0.140	17.0	30	0.000	0.000	0.000	0.140	0.000
08/30/98	R	F	3:58	2.9	13:35		17:33	0.090	0.090	0.090	0.090	0.090	17.0	31	0.090	0.000	0.000	0.000	0.000
09/27/98	R	F	2:50	9.1	13:10		16:00	0.260	0.260	0.260	0.260	0.790	14.5	31	0.260	0.000	0.000	0.000	0.000
05/02/99	R	H	0:00	2.9			13:14	0.000	0.000	0.000	0.260	0.000	10.0	30	0.000	0.000	0.000	0.000	0.260
06/20/99	R	HF	0:30	2.9			17:43	0.000	0.000	0.001	0.001	0.001	15.0	32	0.000	0.000	0.001	0.001	0.000
07/18/99	R	F	1:35	3.6	14:35		16:10	0.000	0.000	0.000	0.000	0.000	18.0	32	0.000	0.000	0.000	0.000	0.000
08/15/99	R	F	1:35	3.6	13:10		14:45	0.500	0.600	0.600	0.890	0.890	16.0	33	0.500	0.100	0.000	0.000	0.290
08/29/99	R	HF	0:30	3.6			13:20	0.000	0.020	0.040	0.040	0.040	n/a	31	0.000	0.020	0.020	0.000	0.000
09/26/99	R	HE	0:30	9.1			12:08	0.000	0.000	0.000	0.070	0.100	15.0	31	0.000	0.000	0.000	0.000	0.070
04/09/00	R	H	0:00	2.9			15:27	0.500	0.501	0.501	0.501	0.611	6.0	29	0.500	0.001	0.001	0.000	0.000
05/07/00	R	H	0:00	2.9			14:21	0.000	0.000	0.050	0.050	0.100	11.0	20	0.000	0.000	0.000	0.050	0.000
06/04/00	R	H	0:00	3.6			13:13	0.000	0.030	0.030	0.030	0.030	13.0	29	0.000	0.030	0.000	0.000	0.000
07/23/00	R	HF	0:30	2.9			16:30	0.040	0.041	0.041	0.041	0.811	17.0	31	0.040	0.001	0.000	0.000	0.000

TC =Time of Collection
 HTP=High Tide Prediction
 DS=Daylight Savings High Tide
 Hours = Time Before or After HTP or DS

Figure 1. Map of the Area for Spruce Creek, Maine
 [Source: NOAA Chart 13283]

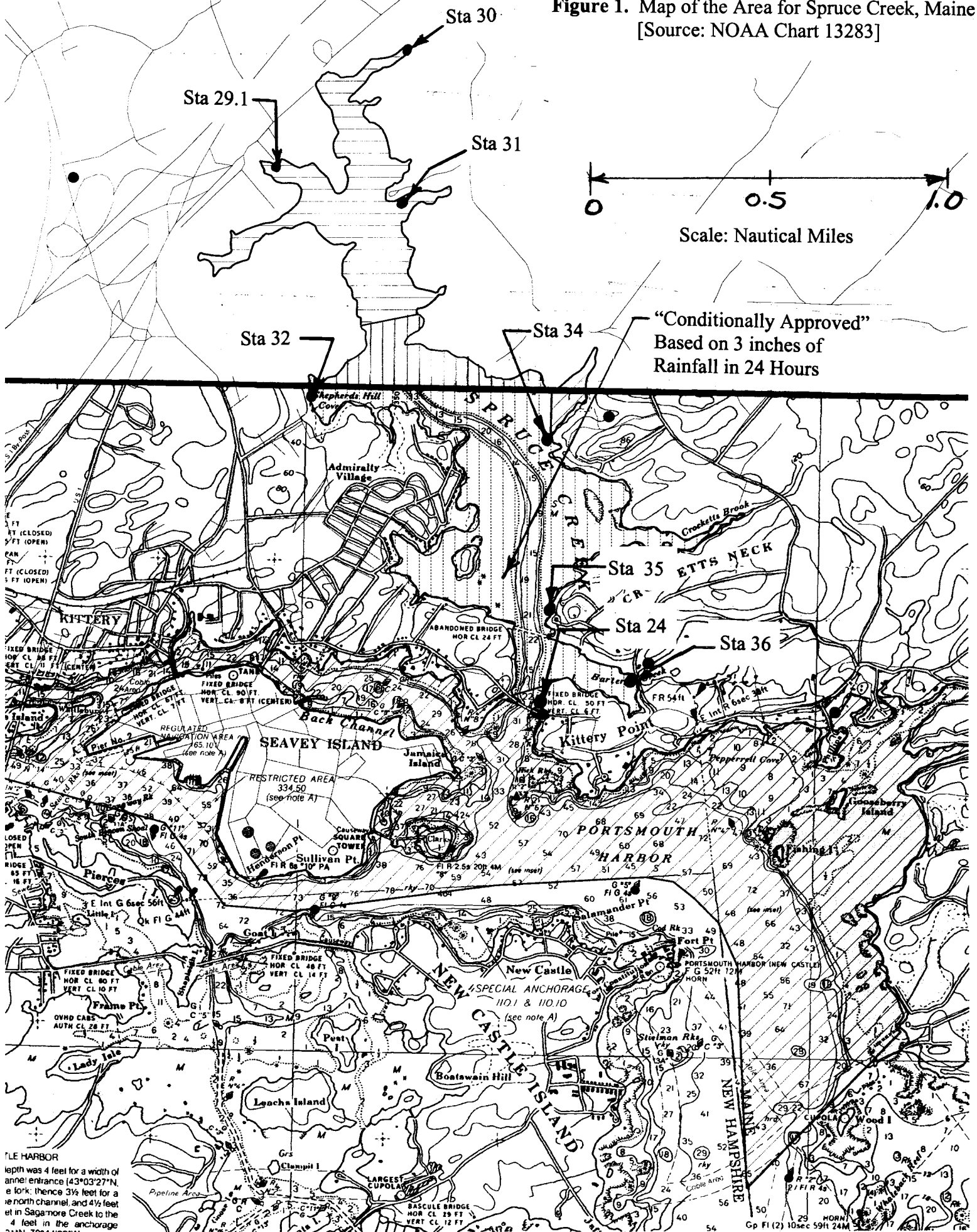
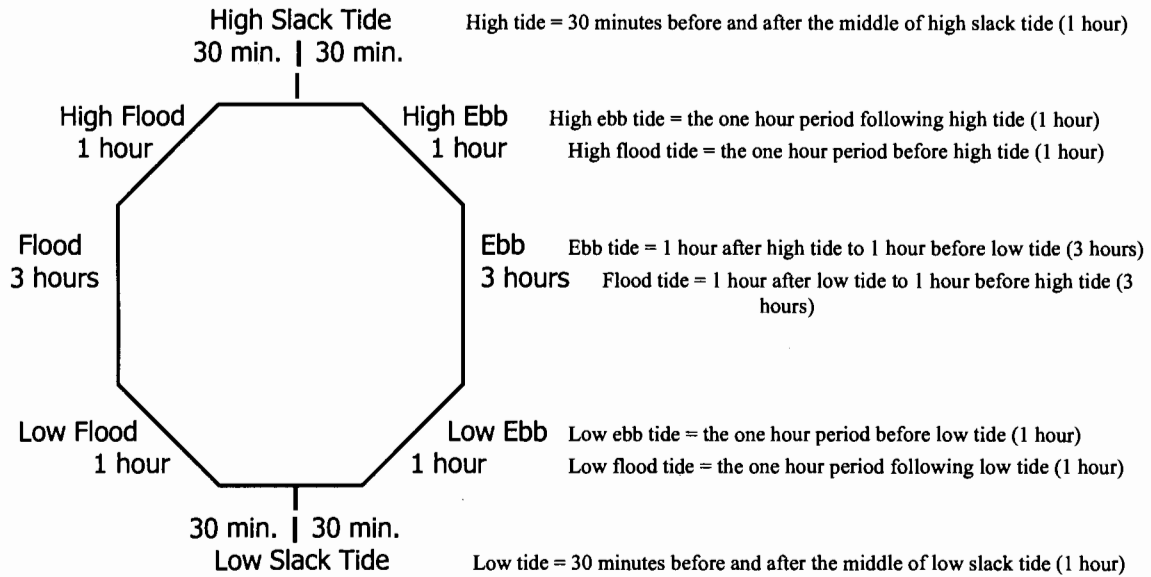


Figure 2. Schematic Time Intervals For 12-Hour Tidal Cycle [Source: DMR, Maine].

The DMR data system assigns each sample a tidal stage based on predicted times for high and low tide. DMR uses 8 tidal stage designations. They are described and represented below.



Spruce Creek Sample Station 24 (May 1993 - July 2000):

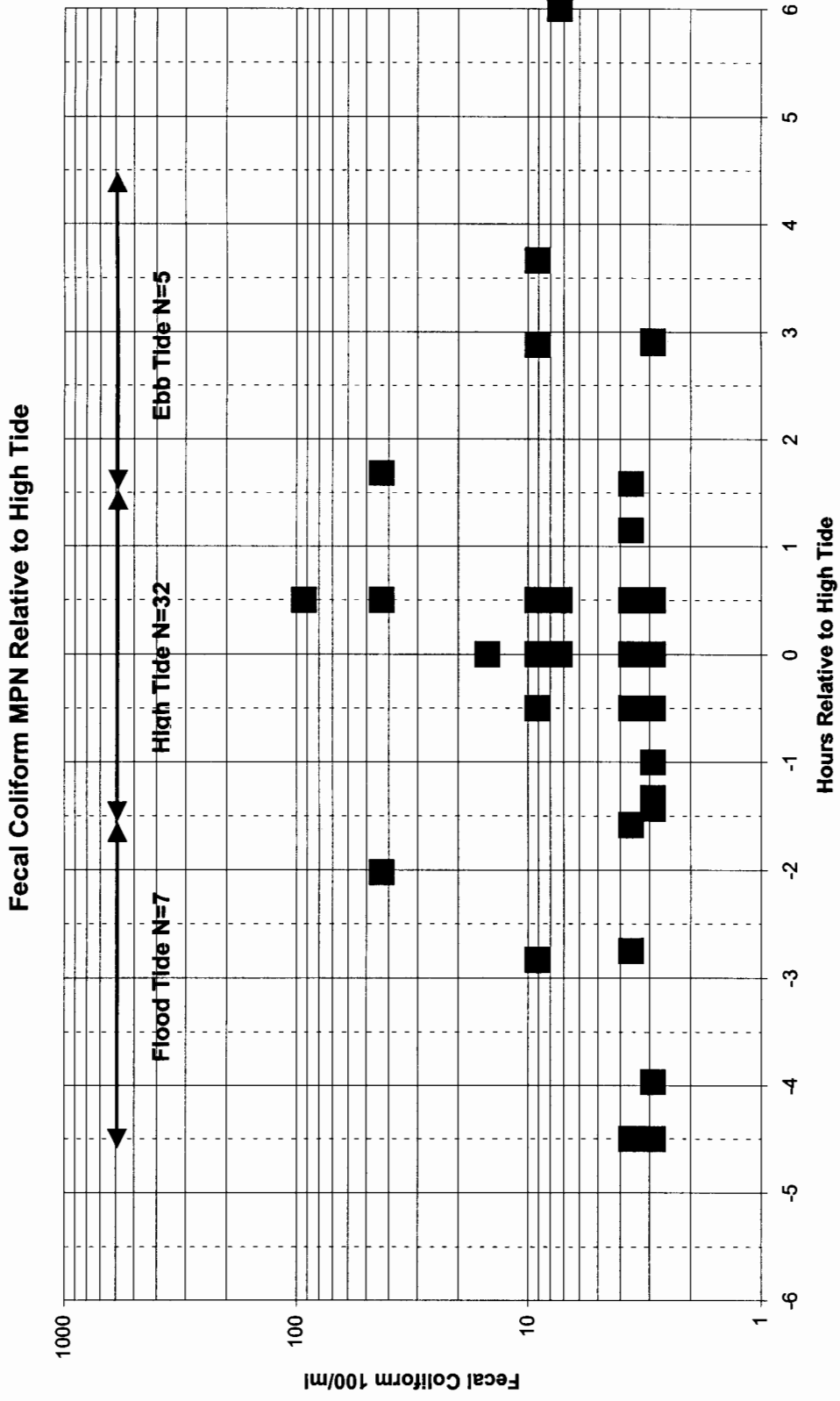


Figure 3A.

Spruce Creek Sample Station 29.10 (May 1993 - July 2000):

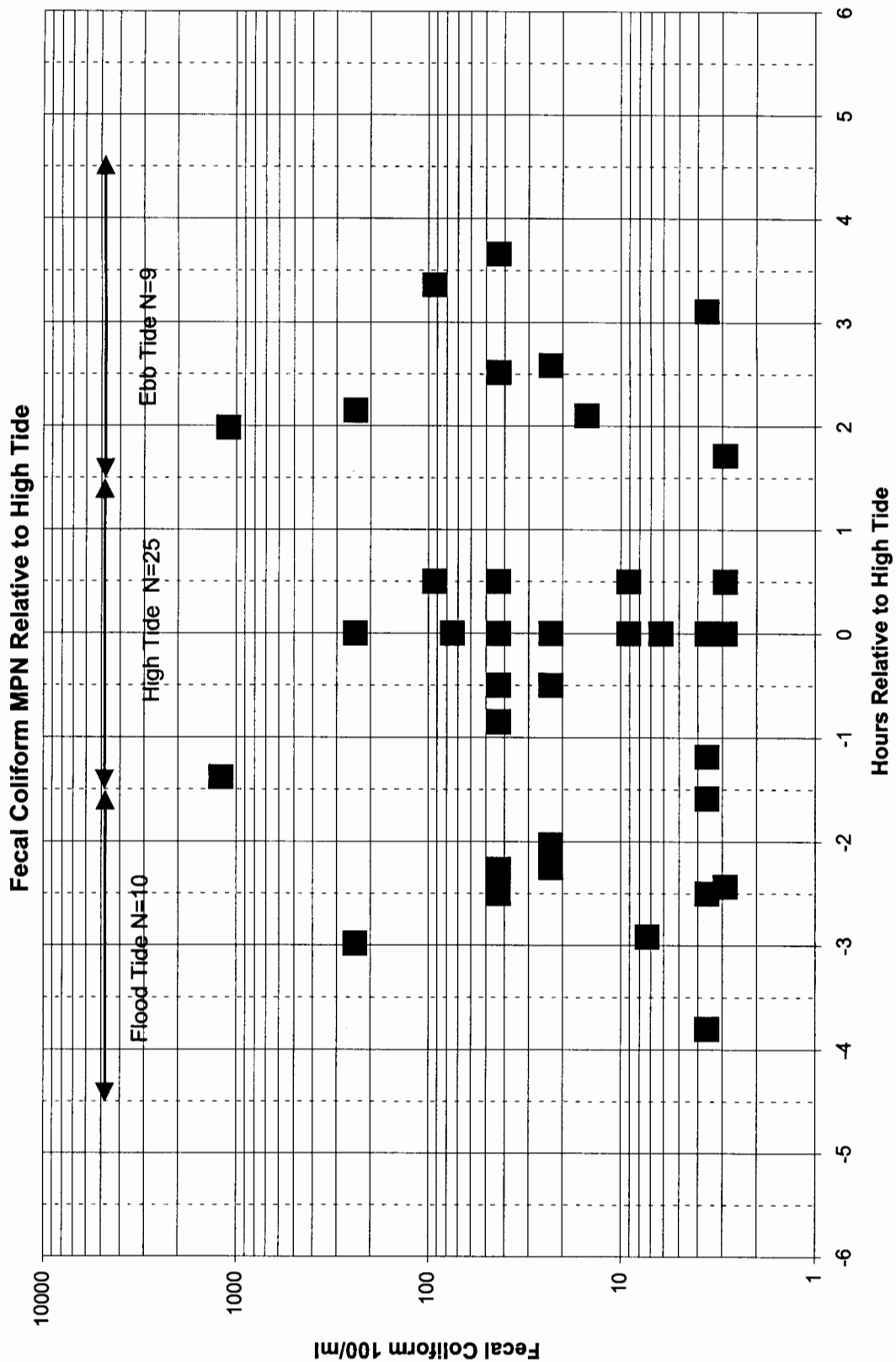


Figure 3B.

Spruce Creek Sample Station 30 (May 1993 - July 2000):

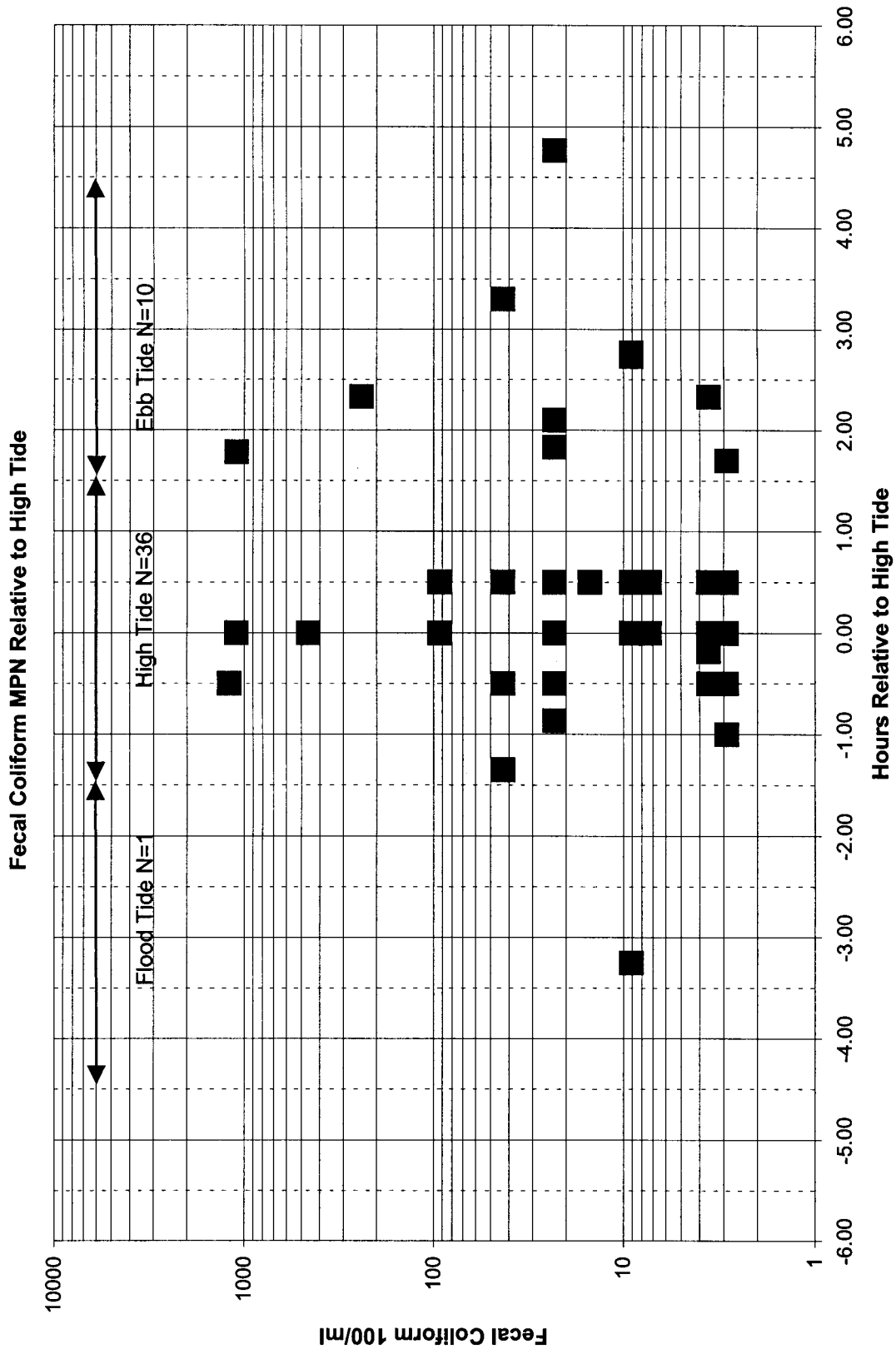


Figure 3C.

Spruce Creek Sample Station 31 (May 1993 - July 2000):

Fecal Coliform MPN Relative to High Tide

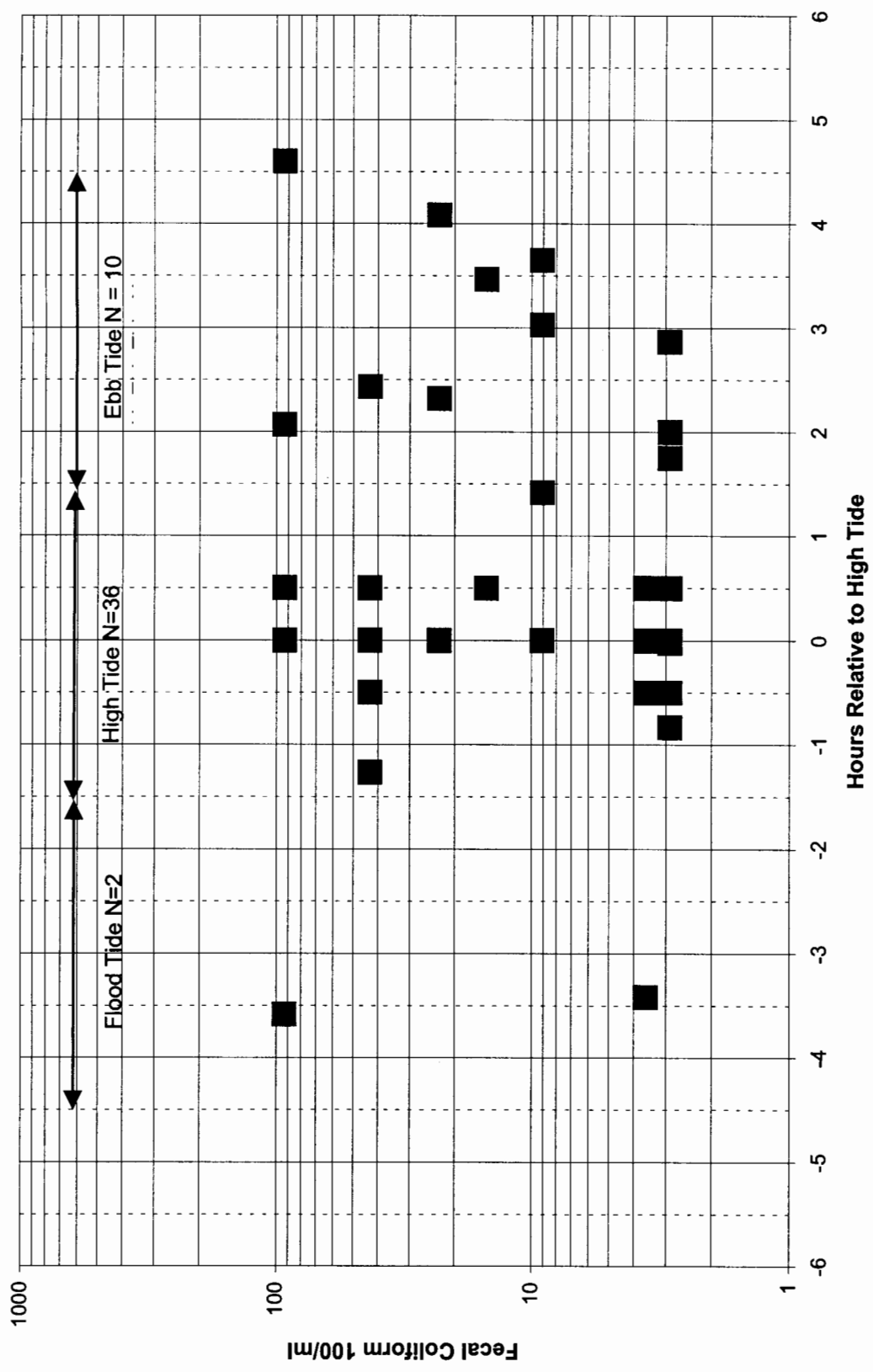


Figure 3D.

Spruce Creek Sample Station 32 (May 1993 - July 2000):

Fecal Coliform MPN Relative to High Tide

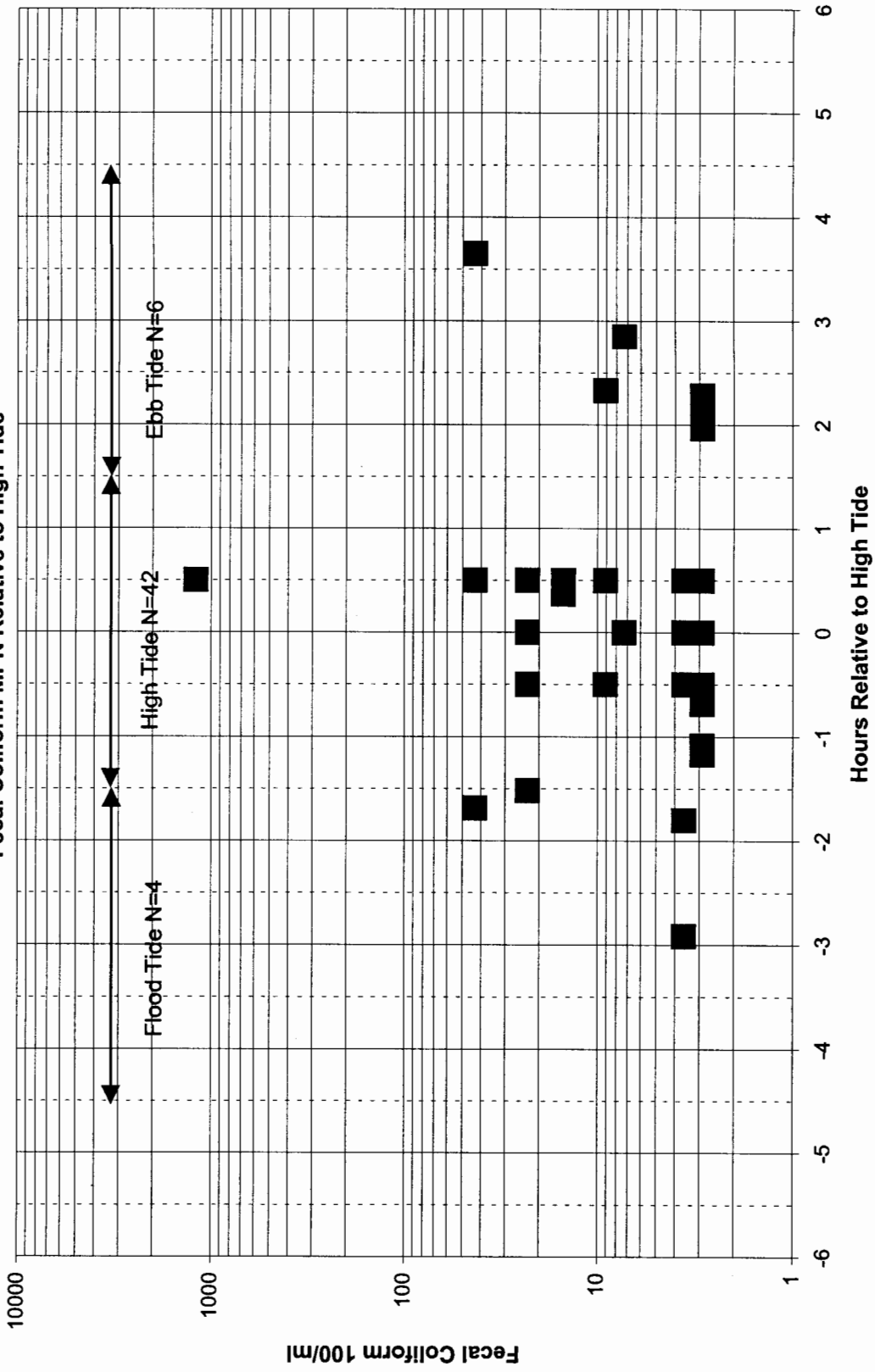


Figure 3E.

Spruce Creek Sample Station 33 (May 1993 - July 2000):

Fecal Coliform MPN Relative to High Tide

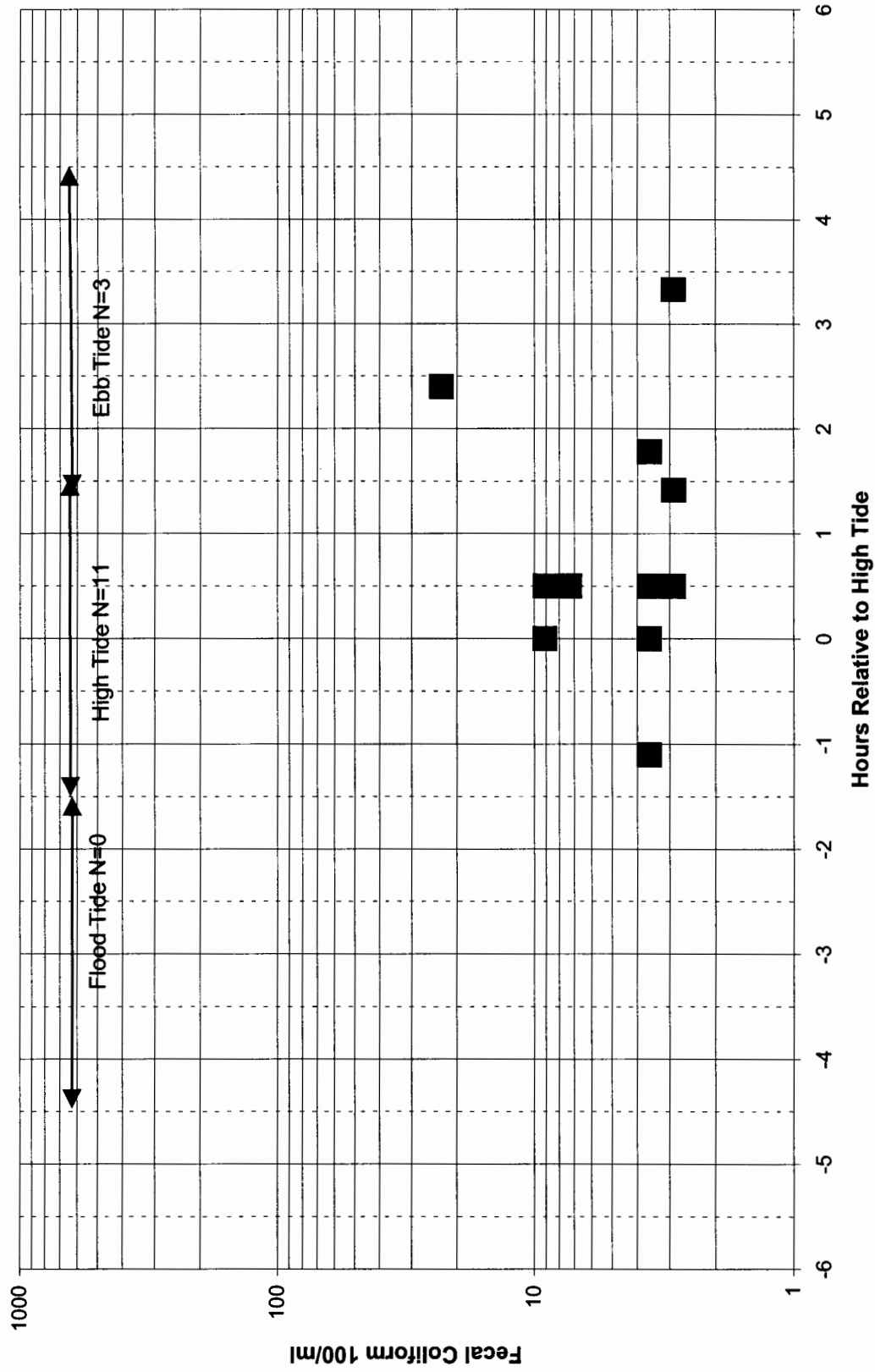


Figure 3F.

Spruce Creek Sample Station 34 (May 1993 - July 2000):

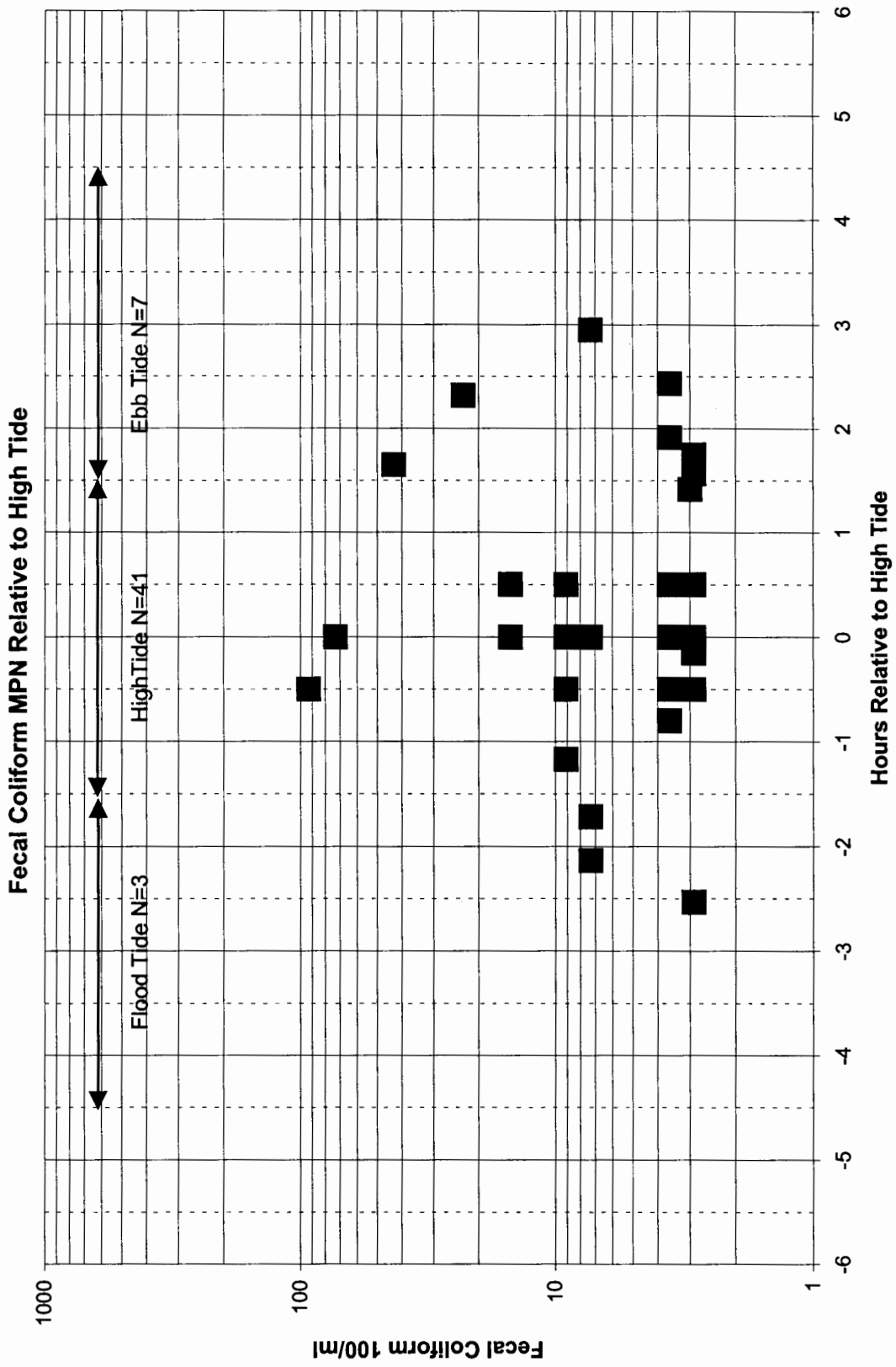


Figure 3G.

Spruce Creek Sample Station 35 (May 1993 - July 2000):

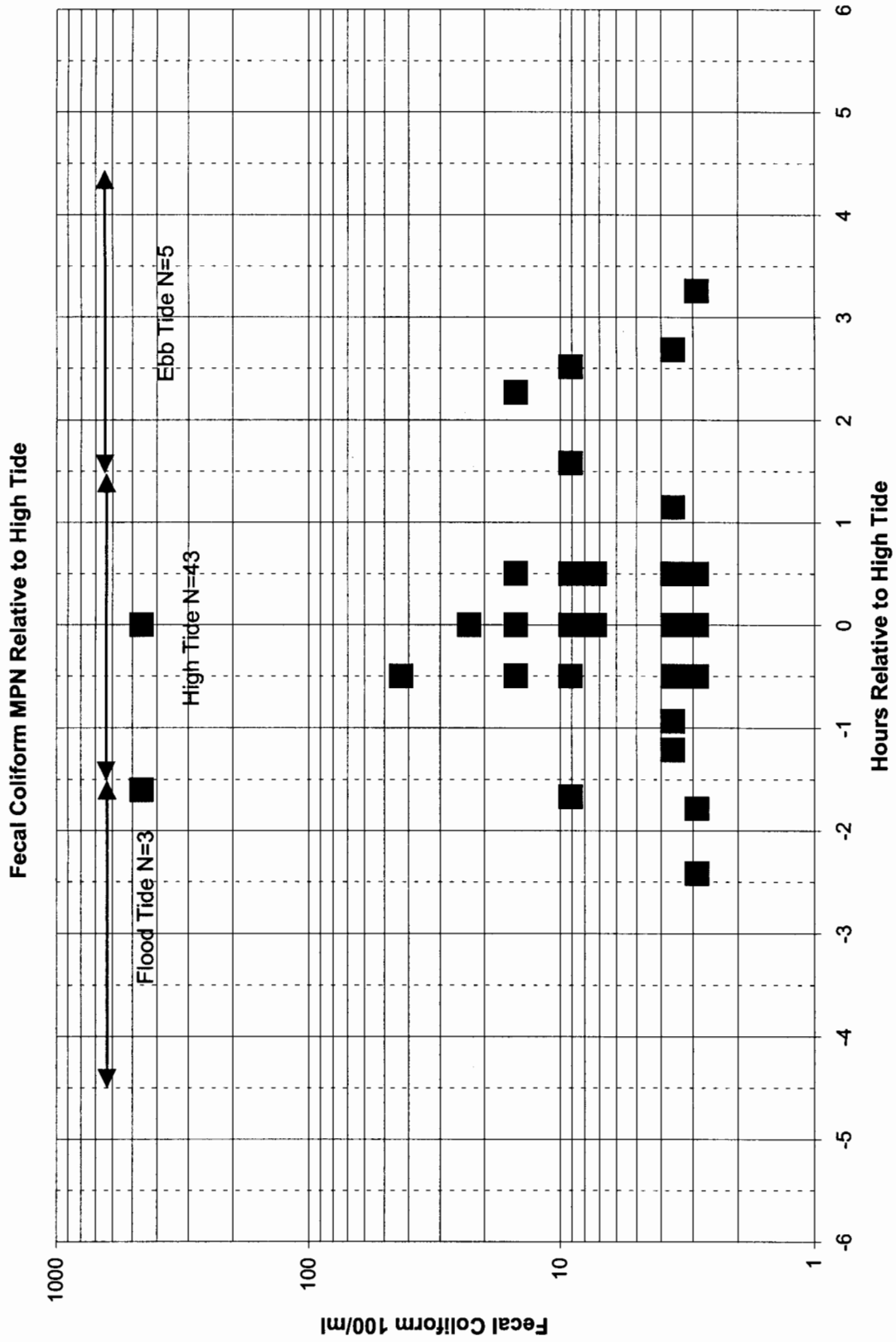


Figure 3H.

Spruce Creek Sta 36 (May 1993 - July 2000):

Fecal Coliform MPN Relative to High Tide

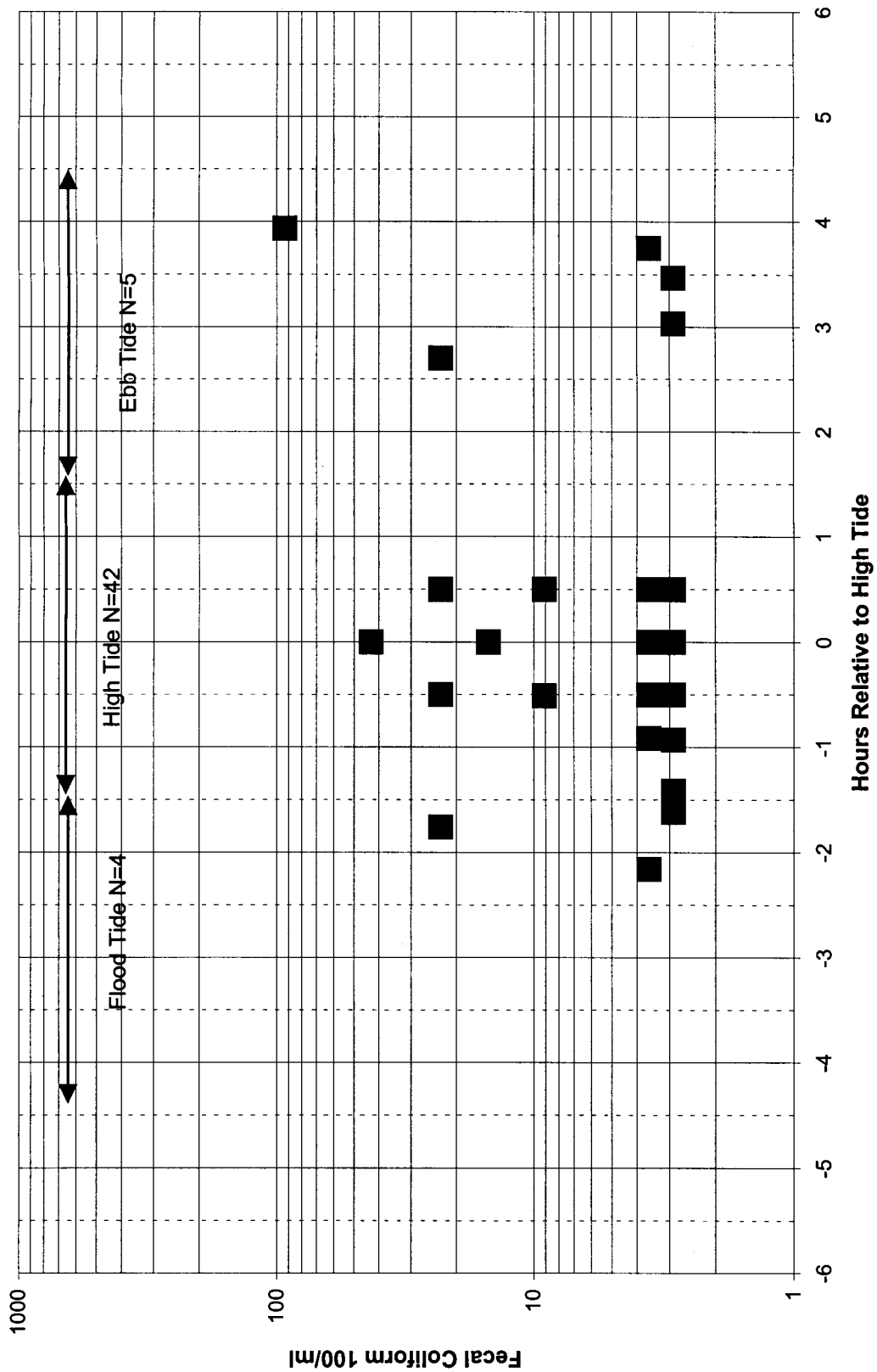


Figure 31.