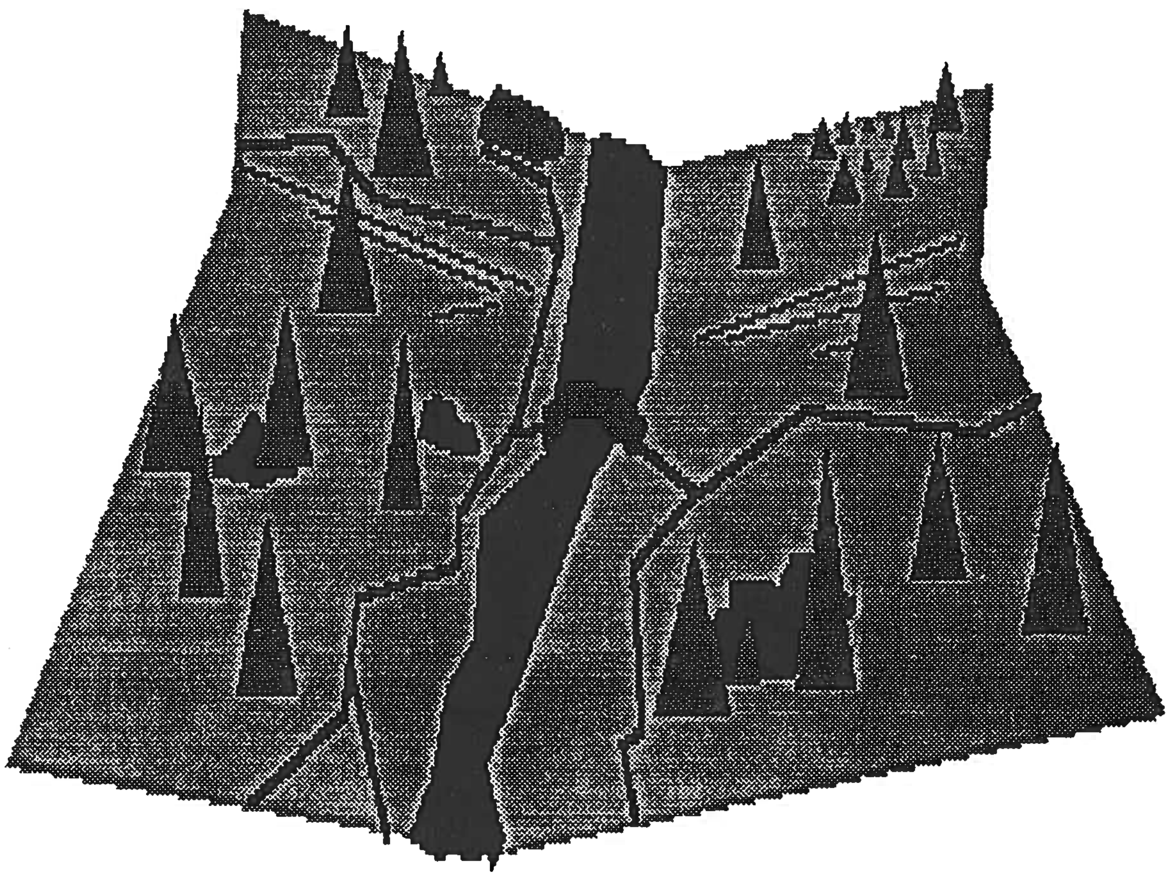
Katherine Groves

Royal River Monitoring Project



First Annual Report

May, 1994

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Introduction

This report is intended to be the first in a series of annual "State of the Royal River" reports. As such, it represents a work in progress and is in no way intended to be a definitive description of the condition of the Royal River. Rather, it is hoped that this be viewed as a jumping off point from which all future monitoring data can be based and the foundation from which the identification of long-term trends can be made.

Over the summer of 1993, volunteers from the "Friends of the Royal River" organization took water samples from 20 different sites in the watershed on eight different days at two week intervals from June 9 to September 15. These sites included locations on the main stem of the river from its source at Sabbathday Lake to the Lower Falls in Yarmouth where it joins the tidal basin in Yarmouth's harbor. Samples were also taken from the tributaries of Collyer Brook, Chandler River (Brook), Moose Brook, and Eddy Brook. The samples were taken to a science laboratory at Yarmouth High School where the water was tested for Dissolved Oxygen (DO) content and Tubidity. From the temperature data gathered at the time the samples were taken, Percent Saturation was also calculated. Samples were also taken to the Yarmouth Pollution Control facility where technicians ran tests to determine the Total Fecal Coliform (bacteria found in the intestines of warm-blooded animals) counts present in the samples.

In addition, macro-invertebrates (bottom dwelling creatures) were collected in the fall on two different occassions at two different sites. These were indentified in the biology lab at the high school by resource personnel from the University of Maine at Orono, a specialist from the River Watch Network based in Vermont, volunteers from the "Friends of the Royal River," and students in the Accelerated Biology course.

All of the data was then turned over to the students of the Environmental Science class for collation, display, interpretation, and analysis. In addition, it was felt that it would be interesting and helpful to included sections in this report on the history of the Royal River and an overview of the general physical and human-made characteristics of the watershed.

This report is the result of the students' efforts to present the gathered data and to draw some preliminary conclusions about the health and welfare of what the State of Maine has determined should be a Class B river.

Credit must be given to the following who played a key role in the 1993 chapter of this monitoring project.

John Jemison, Dave Lytle, and Kirk Stanley of the University of Maine Extension Service at Orono were the initiators and prime movers behind the whole effort and arranged for everything from funding to publicity.

It was the "Friends of the Royal River" that provided the volunteers who gathered the samples and took them to the lab. Particularly involved in coordination and implementation were Jim Barker and Dan Emery. And Mary Holman from the "Friends" spent many hours in the lab over the summer analyzing the samples as they came in from the field.

Geoff Dates from the River Watch Network in Vermont came to Yarmouth numerous times to serve as technical expert, workshop leader, and supervisor of monitoring procedures as well as the identification of the macro-invertebrates.

John Sowles from the State of Maine Department of Environmental Protection came to the high school and worked with the class to provide information and advise on the State regulations and the display and interpretation of data.

Julie Raines and students from the Accelerated Biology class assisted in the collection of the macro-invertebrate samples and helped identify them in the lab.

Finally, Ken Larrabee of the Shopping Notes was instrumental early on in encouraging me to do this, generously offered assistance, and strongly reaffirmed for me the need to get students involved in a study which focuses on a real-life issue and which results in a product that has value and practical implications for the community in which they live. This, we hope, this report begins to do.

These students of the Environmental Science class are responsible for the following sections of the report:

Chris Lord, Stanley Warren, David White = History

Carrie Gillis, Kara Swartz = Watershed Description

Lynn-Ann Hilton, Shawna Hitchcock, Michelle Lester, Jess Roberge = Dissolved Oxygen

Jason Loring, Niels Mank, Bobby Olivadoti = Turbidity

Chad Morrison, Brenda Mumma, Sunithi Simmons, Colleen Slaughter, = Total Coliform Bacteria

Katie Cardone, Ryan Willette = Weather Profiles and Related Data

There are much more data on file than are contained in this report. Time constraints required that we conclude our efforts for this year with the following information. We hope it is helpful. Wes Willink 5/12/94

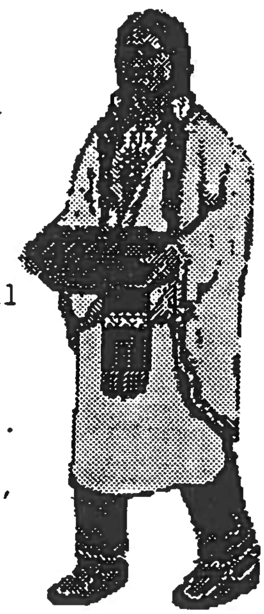
HISTORY

History of The Royal River

Several hundred million years ago, the bedrock of what is now the state of Maine, was formed by earthquakes, volcanic action, and sedimentary pressure. All this action formed what is now the Appalachian Mountains. As these mountains wore away, they formed the basins of what are now Maine's rivers. One of these basins outlines the watershed of what is the Royal River. When the Ice Age came along, glaciers, snow, and ice altered the course of the Royal River and covered it with a new layer of clay and gravel. Once this occurred, it started the young life of the Royal River.

Compared to other Maine rivers, the Royal River is rather small at 26 miles long. It winds both southerly and easterly from its source at Sabbathday Lake. It runs through six Maine towns; New Gloucester, Gray, Auburn, Poland, Yarmouth, and North Yarmouth. It has 23 tributaries and 100 miles of streams altogether.

Man first came into the region between 8,000 and 10,000 B.C. Around that time, the glaciers started to melt and the climate grew warmer. The food supply became scarce, as the Paleo-Indians, became extinct. Centuries passed before the next group of people appeared along the Royal River. These people established a colony here around 2,000 B.C. They used the Royal River and other Maine rivers for means of transportation, hunting, and fishing. By 1,000 A.D., a more advanced Indian culture, called the Ceramic Culture, came to the Royal River region and its surounding areas. This tribe was here when the first European settlers came to Maine in the 16th and 17th centuries. Around this time the Pejepscots, a sub-tribe of the Anasagunticooks, controlled the Royal River tributaries. These people used the Royal River and other Maine rivers for a seasonal migration route. History tells us that these people used Lane's Island, which is at the mouth of the Royal River, as its headquarters for their seacoast existence.



To these Indians, the Royal River was known as "Wescustogo," meaning the "gullied river banks."

The first falls were called "Pumgustuck" meaning "the falls river." This indicated that the Royal River enters the salty harbor waters with a considerable fall at the mouth

. The European settlers looked at the river and the surrounding lands as marketable real estate. These people used the river in n indirect way, as a source of power to produce shelter and food.

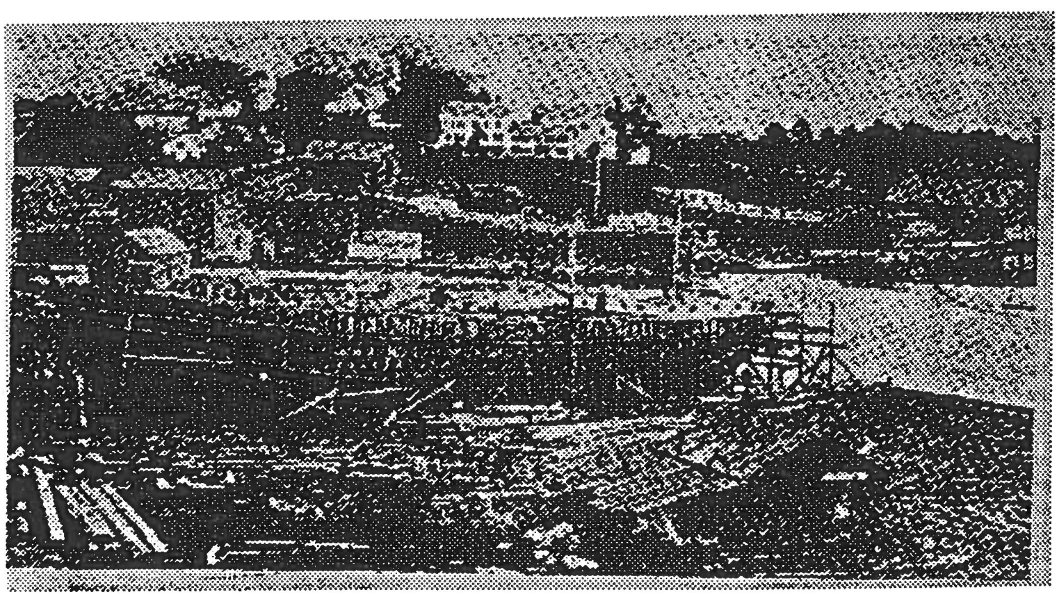
These European settlers, settled at the mouth of the Royal River for five different reasons: (1) the river valley provided lumber and fertile soil for agriculture, (2) the falls provided a unique opportunity for water power, (3) the advantages of a sheltered harbor were numerous, (4) water was always available for personal use, and (5) transportation by waterway was always there.

The first permanent colonist in the Royal River region settled in 1640. Some received land grants from agent Sir Ferdinando Gorges. Others purchased huge amounts of land from Indians. Settlement in the basin was a slow process.

The first permanent colonists and the namesake of the river, arrived in 1636 by the name of William Royall. By 1639, he had established himself on his plantation at Browns Point. It wasn't until the spring of 1643 that Gorges allowed him to own his own land outright.

After the Civil War in England, Alexander Rigby claimed a large part of Maine. The Royal River province was named by him, and it was called Lygonia. Along with Rigby, George Felt and John Cousins also played a big part in exploring the Royal River province. Over the next thirty years many settlements appeared along the Royal River. By the 1670's at least twenty families had settled here. In 1675, many of these families were driven away because of King Philip's War. It wasn't until 1678 when the people started returning. By the mid-1680's, the Wescustago community was called North Yarmouth and started to flourish. Thirty-six families were living here, including planters. Many new mills had been built in this area.

Throughout the early 1700's, the community of North Yarmouth suffered many problems. There began to be many land disputes from grantees from Gorges. Most of the problems were land related. In 1739, a small group from Massachusetts travelled many miles up the Royal River in order to create a community around its source. These people were driven away within a year, but returned with their families to found the town of New Gloucester. Today New Gloucester is mainly a farming and lumbering town. At the turn of the 19th Century, the Royal River's economical use, by man, peaked. Goods were poled up river to other settlements. Logs floated downstream to saw mills and pulp mills. They were then taken to the harbor and shipped to different ports.



In 1820, the profitable era of shipbuilding began at the harbor in North Yarmouth. From 1874-1878 about 4,618 tons of vessels were launched from Yarmouth shipyards.Factories and mills grew in size and numbers throughout the 1800's. At this point, the river was used mainly for economical purposes. At the end of the 1800's many new factories began to be built. These factories included The Forest Paper Company, Hodsdon Shoe Factory, and L.L. Shaw's Cotton Factory. During the forty year period from 1870 to 1910, the population steadily increased from 1,900 to 2,400.

With the opening of a new century came the beginning of a new life for the Royal River waters. Most industries came to end by the 1920's. The presence of the Royal River became unimportant to the surrounding communities. The Royal River is no longer an economic necessity. Today the Royal River serves mainly as recreational enjoyment for people. Many people canoe, fish, picnic, and hike along the trails of the Royal River. The river still floods every now and then, but still flows from Sabathday Lake to Casco Bay.

WATERSHED DESCRIPTION

Royal River Watershed

Description

The Royal River watershed encompasses two-hundred forty-two square miles in the Cumberland and Androscoggin Counties. A watershed is the geographic region within which water drains into a particular body of water, and includes hills, lowlands, and the body of water in which the land drains. The water can come from numerous sources including rain, snow, and groundwater. The boundaries of a watershed are defined by the ridges of land separating watersheds. The Royal River watershed includes eleven towns and is inhabited by nearly 55,000 people. The river is twenty-six miles long starting at Sabbathday lake and ending in Casco Bay.

The water feeding the river can pick up several pollutants in many areas on its way to Casco Bay. Old septic systems, eroded camp roads and stream banks, sanded and salted roads, and old mill sites are just a few examples of the possible pollutants threatening the Royal River. These pollutants can destroy fishing and agricultural industries, wildlife, recreation, and the health of the river.

Auburn

The total amount of land that Auburn occupies in 42,709 acres. Of this land 4,015 acres are commercial and industrial. The residential population of Auburn uses 2,936 acres. 24,000 people receive their water from a district source. The number of municipal accounts of waste water is 5,700, and combined sewer overflow is 9 (there is no reported overboard discharge). Their surface water comes from ponds, lakes, rivers, and streams. Their solid waste sites include two landfills, which serves 22,379 people, including one transfer station.

Durham

Durham occupies 24,890 acres of land. Of this land 124 acres is commercial and industrial, and 6,098 is residential. The population mainly receives its water supply from a non-community organization, few receive it from the community supplier. Waste water is taken care of through municipal accounts, they also have no solid waste sites. Their surface water includes ponds and lakes at 94 acres, rivers and streams at 50 miles, and wetlands inside the watershed boundaries at 120 acres.

Gray

Gray occupies 29,080 acres. Of that, 150 acres is commercial and industrial, and 2,752 is residential. They also have the most dairy farms of the watershed. The population mainly receives their water supply from district, but some get it from a non-community organization. Wastewater is taken care of through municipal accounts. Gray has one landfill, has one transfer station, and it serves 4,760 people. Their surface water supply comes from ponds and lakes at 1,587 acres, rivers and streams at 39 miles, and wetlands within the watershed is 2,222 acres.

New Gloucester

New Gloucester occupies 31,104 acres of land, and of that land 735 acres is commercial and industrial, and 2,361 acres is residential. New Gloucester also has the most beef livestock farms in the watershed. The population mainly receives their water supply from a non-community organization, but some receive it from the community. Their solid waste sites serve 3,488 people and their surface water supply comes from ponds and lakes at 409 acres, rivers and streams at 50 miles and wetlands within the watershed is 504 acres.

North Yarmouth

North Yarmouth covers 14,780 acres of land. Of that land 200 acres is commercial and industrial, and 1,840 acres is residential. The population mainly receives its water supply from a community supplier, but some receive it from district, plus they have one land fill. Their surface water includes 1 acre of lakes and ponds, 33 miles of rivers and streams, and 135 acres of wetlands within the watershed boundaries.

Poland

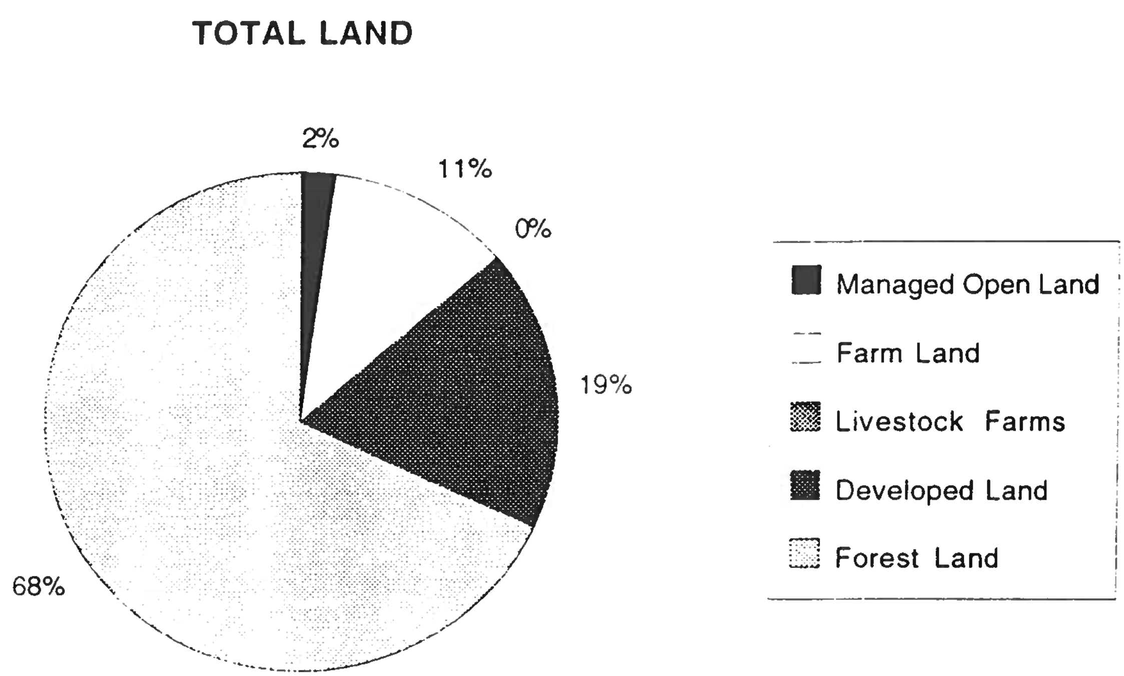
Poland occupies 31,799 acres of land. Of that land 1,431 acres is commercial and industrial, and 11,000 is residential. The population receives its water supply from a non-community organization, but some receive it from the community, they also have one landfill. Their surface water includes 2,949 acres of ponds and lakes, 25 miles of rivers and streams, and 2,084 acres of wetlands within the watershed boundaries.

Pownal

Pownal occupies 15,528 acres of land. Of that land 18 acres is commercial and industrial, and 835 acres is residential. The town receives its water supply from a non-community organization. Their surface water includes 1 acre of ponds and lakes, 35 miles of rivers and streams, and 27 acres of wetlands within the watershed boundaries.

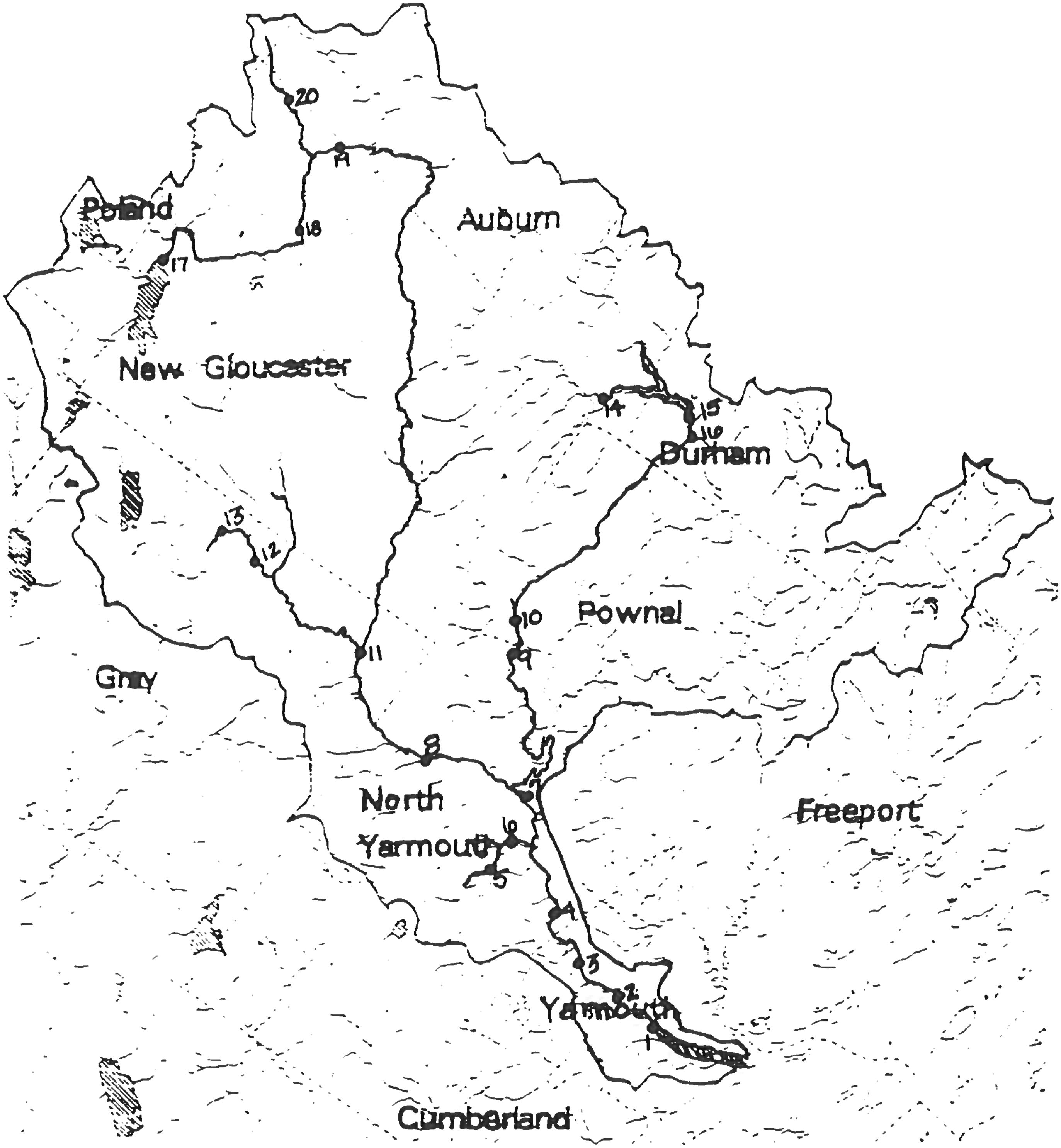
Yarmouth

Yarmouth occupies 8,651 acres of land. Of this land 730 acres is commercial and industrial, and 7,947 acres is residential. They mainly receive their water supply from district, but some comes from a non-community organization. Their wastewater is taken care of through municipal accounts, and they have one landfill. Their surface water is 0 acres of ponds and lakes, 17 miles of rivers and streams, and 21 acres of wetlands within the watershed boundaries.


TOTAL LAND
2%
11%
0%
19%
68%
Managed Open Land
Farm Land
Livestock Farms
Developed Land
Forest Land

TESTING SITES

Testing Sites in the Watershed



Main Stem Sites and Their Miles From the Source

Mile	Site
0	17
2.5	18
5	19
13	11
16	8
18.5	7
22	4
23	3
24.5	2
26	1

ROYAL RIVER CLASSIFICATION

Water Classification Program
Maine Revised Statutes Annotated
Title 38
Article 4-A

Royal River Basin
(p. 24)

A. Royal River, main stem.
(1) From the outlet of Sabbathday Pond to tidewater - Class B

B. Royal River, tributaries - Class B

38 § 465. Standards for classification of fresh surface waters

3. Class B waters. Class B shall be the 3rd highest classification

A. Class B waters shall be of such quality that they are suitable for the designated uses of drinking water supply after treatment; fishing; recreation in and on the water; industrial process and cooling water supply; hydroelectric power generation, except as prohibited under Title 12, section 403; and navigation; and as habitat for fish and other aquatic life. The habitat shall be characterized as unimpaired.

B. The dissolved oxygen content of Class B waters shall be not less than 7 parts per million or 75% saturation, whichever is higher, except that for the period from October 1st to May 14th, in order to ensure spawning and egg incubation of indigenous fish species, the 7-day mean dissolved oxygen concentration shall not be less than 9.5 parts per million and the 1-day minimum dissolved oxygen concentration shall not be less than 8.0 parts per million in identified fish spawning areas. Between May 15th and September 30th, the number of *Escherichia coli* bacteria of human origin in these waters may not exceed the geometric mean of 64 per 100 milliliters or an instantaneous level of 427 per 100 milliliters.

C. Discharges to Class B waters shall not cause adverse impact to aquatic life in that the receiving waters shall be of sufficient quality to support all aquatic species indigenous to the receiving water without detrimental changes in the resident biological community.

WEATHER PROFILES

June 9th

SITE#	AIR TEMP.	WATER TEMP.	OBSERVATION CODES	CURRENT WEATHER	PREVIOUS 3 DAYS WEATHER	OTHER COMMENTS
1	66	59	C, J, P/O	very light rain	rain; clear; clear	several birds in river, up stream
				cloudy		from sample site
2	73	65	O, (light) C	overcast and drizzl	rain; sunny; sunny and	
				changing to sunny	warm	
3	67	61	B, O, P	overcast w/	warm sunny days w/ occ.	
				showers	rain, cool nights	
4	59	60	D, J, O, R,T	drizzle	warm; hard rain; warm	
5	56	58	C, J, Q	drizzle	sunny; windy; rain	significant current- 20 yds. dow
						stream from elevated culvert
6	70	60	C, J, P	overcast- threating	rain; sunny; sunny	sample closer to mouth than
				rain		fork
7	70	62	C, J, P	overcast- threating	rain; sunny; sunny	sample close to shore
				rain		
8	62	61	C, J, Q	drizzle- no wind	sunny; windy; moderate rair	near rapids
9	58	61	C, J, O	slightly overcast,	clear & sunny	significant water movement
				drizzly		
10	74	64	C, K, Q	overcast	sunny, windy, highs in 60's	sample taken 15 ft. downstream
						of culvert
11	62	54	C, J, Q	overcast, still	sun, heavy rain; Mon.&Tues.	
					-clear	
12	63	59	C, J, O	cloudy	sunny	
13	60	51	C, J, O, U	cloudy	rain/ sunny	
14	70	65	C, J, O	heavy overcast	sunny	
15	62	66	C, J, O/Q	overcast/drizzle	sunny, rain (3 days ago)	below dam
16	62	66	C, J, O/Q	overcast/drizzle	sunny, rain (3 days ago)	difficult bushwack to reach site

June 9th

SITE#	AIR TEMP.	WATER TEMP.	OBSERVATION CODES	CURRENT WEATHER	PREVIOUS 3 DAYS WEATHER	OTHER COMMENTS
17	65	62	B, J, Q, R, S, T	overcast; semi-	dry; cool; winds	near Outlet Beach: public beach
				humid; little rain		
18	67	66	C, H, P/Q, S	cloudy, humid	sunny, dry	
				sprinkling		
19	61	62	C, J, Q, S	partly sunny	warm, partly sunny	
20	61	58	C, J, Q	partly sunny	warm, partly sunny	

June 23rd

SITE #	AIR TEMP	WATER TEMP.	OBSERVATION CODES	CURRENT WEATHER	PREVIOUS 3 DAYS WEATHER	OTHER COMMENTS
1	60	66	C-B, J, O	clear & breezy	humid-warm heavy showers	
2	66	71	Q to O, B	windy & sunny	1)sunny 2)overcast, rainy	
					3)sunny, T-storms	
3	60	59	C, O	partly sunny & windy	overcast w/ occasional	
					wind and rain	
4	56	67	D, J, Q, R, T	cool & clear	hot, dry, rainy, T-storms	
5	61	56	C, J, Q	clear & windy	rain showers, heavy at	
					times	
6	62	60	C, J, P	clear & windy	T-storms mixed w/ clouds	dust and leaves on surface
					and rain	
7	62	66	C, J, P	clear & windy	T-storms mixed w/ clouds	wave action on surface, patches
					and rain	of pollen
8	61	63	C, J, Q	clear & windy	rain showers, heavy at	litter on rocks, construction
					times	begining on bridge
9	60	63	C, J, O	sunny & windy	sunny	small fish and minnows
						present
10	70	68	C, J, Q	clear and windy	humid, T-showers	small minnows observed
11	56	60	C, J, Q	clear, windy, dry	1) clear 2) clear 3) rainy	
12	59	54	A, J, O	sunny and windy	sunny w/ T-showers	
13	63	54	A, J, O	sunny, windy	sunny w/ T-showers	
14	not returned					
15	58	64	B, J, Q-O	clear	hot and humid w/ occ.	
					T-showers	
16	58	64	B-C, J, O	clear	hot and humid w/ occ.	
					T-showers	

June 23rd

SITE #	AIR TEMP	WATER TEMP.	OBSERVATION CODES	CURRENT WEATHER	PREVIOUS 3 DAYS WEATHER	OTHER COMMENTS
17	60	65	B, J , Q, R, S, T	windy & clear	rain; windy	
18	62	68	D, H, Q	sunny, windy, cool	sunny, showers, hot &	
				nice*	humid	
19	52	63	C, J, Q	windy, bright, not	periodic rain & showers	leaf chaff in river, trash;
				totally clear day	mixed w/ sun	fish line, bottles, paper
20	52	60	C, J, Q	windy, bright, not	periodic rain & showers	wind riffling surface- some
				totally clear day	mixed w/ sun	floating leaf debris

July 7th

SITE#	AIR TEMP.	WATER TEMP.	OBSERVATION CODES	CURRENT WEATHER	PREVIOUS 3 DAYS WEATHER	OTHER COMMENTS
1	77	74	B, J, O, U	hazy-humid-hot	clear,dry and windy to warm then hot and humid	
2	81	79	J, Q, A/B	hazy sunshine	sunny and warm	ducks and ducklings, lots of water bugs, no current
3	80	68	B, L, H	hot	hot, humid, and hazy	deer tracks nearby
4	77	77	C, J, O, R, T	hot, overcast	hot and dry (all 3)	
5	75	61	B, J, Q	hot, sunny	sunny, breezy, high 80's	
6	80	76	B, J, Q	extremely humid, hot still	sunny and hot	patches of oily film on surface
7	80	77	B, J, P	extremely humid, hot still	sunny and hot	oily film on surface, dead carp down river
8	83	72	C, J, P	hot, sunny	sunny, breezy, high 80's	
9	78	74	B, J, O	hot, humid	hot, humid	many small minnows and fish
10	84	76	C, J, Q	hot, humid, clear	hot, humid -highs 80's-90's	
11	78	70	B, K, Q	hazy, warm	hot and clear	
12	80	60	Q, J, O	hot - humid	hot	
13	82	58	C, J, O	hot - humid	hot and sunny	
14	80	76	A, J, O	very warm and sunny	sunny and warm	water becoming plant-choked
15	71	77	B, J, O/P	hot and sunny	hot and sunny	
16	70	73	C/B, F, O	hot and sunny	hot and sunny	F noticed after stepping into brook

July 7th

SITE#	AIR TEMP.	WATER TEMP.	OBSERVATION CODES	CURRENT WEATHER	PREVIOUS 3 DAYS WEATHER	OTHER COMMENTS
17	86	80	B, J, Q, R, S, T	hot and humid	hot and humid	
18	80	77	B, J, Q, R, S	warm, humid, some	1-muggy,hot 2&3-pleasant	
				clouds		
19	72	70	B, J, L/M	pt. cloudy, hot &	pt. cloudy, hot and humid	
				humid		
20	72	74	B, J, M/N	pt.cloudy, hot &	pt. cloudy, hot and humid	
				humid		

July 21st

SITE#	AIR TEMP.	WATER TEMP.	OBSERVATION CODES	CURRENT WEATHER	PREVIOUS 3 DAYS WEATHER	OTHER COMMENTS
1	62	69	C, J, OtoQ	fog and clear over-head	clear &dry 1st day, light rain following	
2	76	77	J, A-B, Q-P, T	fair, light breeze, warm	fair, cool,rain	minnoust water bugs, ducks
3	65	65	C, J, O	overcast	sunny, rain, drizzle	
4	66	69	C, J,O, R, T	overcast	sunny, rain, drizzle	
5	64	57	C, J, O	overcast	sunny, rain, drizzle	
6	68	60	B, J, P	humid,fog, still	mixed clouds/sun.; rain yesterday	muddy to the eye, clear in bottle
7	68	68	B, J, Q	humid, fog, still	mixed clouds/sun.; rain yesterday	surface clean- detectable flow
8	not returned					
9	69	71	B, J, O	foggy, overcast, drizzly	2 days; sunny/ yesterday; rainy	minnows,waterbugs,small mass of fish or frog eggs
10	72	74	C, J, L	foggy, overcast, drizzly	2 days; sunny/ yesterday rainy	2-3" minnows, LARGE mass of eggs
11	64	59	B, J, Q	clear	rain	
12	66	56	C, J, O	sunny	sunny, sunny, rain	
13	66	56	C, J, O	sunny	sunny, sunny, rain	
14	not returned					
15	61	67	C, F, O(weak)	clear, misty, cool	rainy, dry, dry	F only after stepping in
16	61	69	B, J, O(very light)	clear, misty, cool	rainy, dry, dry	

July 21st

SITE#	AIR TEMP.	WATER TEMP.	OBSERVATION CODES	CURRENT WEATHER	PREVIOUS 3 DAYS WEATHER	OTHER COMMENTS
17	71	72	A, J, Q, R, S, T	sunny & clear	rain & cloudy	
18	65	70	C, J, Q, U	sunny & clear	rain & cloudy	great deal of algae, turnover-
						looks "terrible"
19	75	64	B, J, N		2 days nice, 1 day rain	
20	75	62	C, J, O(weak)		2days nice, 1 day rain	

August 4th

SITE#	AIR TEMP.	WATER TEMP.	OBSERVATION CODES	CURRENT WEATHER	PREVIOUS 3 DAYS WEATHER	OTHER COMMENTS
1	72	72	Q to O none	clear	clear showers foggy	
2	76	76	A to B,J,Q cloudy	sunny	sun showers warm	lots of duck droppings, no visible current, lots of plant growth
3	68	67	A,F,L,N	hazy no breeze	80's humid t storms	oily film on bank
4	70	74	D,F,O,R,T	over cast	cloudy hot showers hot	
5	70	60	B,J,Q	hazy no breeze	80's t storms	
6		68	B,J,Q	humid sunny	mix sun clouds t storms	
7	74	76	B,J,Q	humid sunny	mix sun clouds t storms	
8	66	65	B,C,J,P,Q,T	hazy no breeze	80's t storms	
9	72	76	C,J,O	sunny clear	rainy humid sunny	many small clumes of eggs
10	72	75		clear hot humid	humid hot 80's	hundreds of 1"-4" fish, new plant growth in river
11			B,J,Q	hazy warm	warm rain	
12	74	58		hazy	sunny fogy sunny	
13	70	56		hazy	sunny foggy sun	
14	72	72	B,J,O	warm, hazy	rain, cool; hot hazy	
15	62	75	B,J,Q	over cast warm	warm sunny t storms	
16	62	72	B/C, J, light O	over cast warm	warm sun t storms	F after stepping in mud

August 4th

SITE#	AIR TEMP.	WATER TEMP.	OBSERVATION CODES	CURRENT WEATHER	PREVIOUS 3 DAYS WEATHER	OTHER COMMENTS
17	70	76	B,J,Q,P,S,T	cool somewhat	hot humid, rain at night	
				overcast		
18	67	73	C,J,N,Q	humid warm no	cool night hot days	floating algae
				breeze		
19	63	70	B,Q	overcast		broken glass along streamside
20	63	70	D	clouds breaking		water not moving, chaff on
						surface, lots of trash

AUGUST 18th

Site#	Air temp	H2O temp	Obser. codes	Current weather	Previous 3 days	Other comentes
1	68	70		light rain	mostly overcast	c,j,q birds
2	70	72	A,J,G,P	overcast	sunny clouds	ducks minnows geese
3	68	63	D,O,L	scatt. showers	overcast	
4	67	70	D,F,O,R,T	drizzle	warm hot cloudy	
5	72	58	B,J,Q	light rain	70s 80s humid	
6			B,H,M	raining	mix clouds sun humid	silt suspended
7			B,J,P	raining	mix.clouds+sun	
8	68	68	B,J,Q	lt. rain overcast	70-80 humid	
9	67	71	O	overcast	hazy warm prt sunny	
10	67	71		67	hazy warm prt sunny	
11	70		C,J,P	overcast/drizzle	sunny/partly cloudy	
12	72	57	B,J,O	showery	sun,sun,cloudy	
13	70	56	B,J,O	showery	sun,sun,cloudy	

AUGUST 18th

14	66	67	B,J,O	rain	o.k.	2 dead eels in water
15	67	72	D,J,O	drizzle	warm,hot,cloudy	
16	70	71	D,F,L	drizzle	warm,hot,cloudy	
17		72	A,J,Q,R,S,T	rain and clouds	overcast	
18	67	71	E,J,Q	fog, sprinkles	cool	floating debris
19	60	68		fog and drizzle	cloudy	floating debris
20	60	65		heavy skies	clear	brown water

September 1st

Site#	Air temp	H2O temp	Obser. codes	Current weather	Previous 3 days	Other comentes
1	74	72	b.c.q	overcast mild	sun dry windy	cloudy j.
2	78	73	b.j.p	overcast warm light bre	warm clear L. wind	minnows plant growth
3	69	64	b.f.l	warm partly cloudy	warm clear	
4	72	72	c.f.u.r.t	warm cloudy	warm clear	
5	74	59	B,J,Q	cloudy no wind	80s veriable winds clear	
6	76	66	a.k.p.	humid hot overcast	sunny warm humid muggy	milk color distinct from river
7	76	72	a.k.p.	humid hot overcast	sunny warm humid	lots of plant growth on banks
8	70	69	B,J,Q	cloudy no wind	80's veriable wind clear	ducks
9	70	76	c.j.l	overcast	hot muggy	large minnows
10	70	78	b.j.o	overcast	hot muggy	large minnows
11	0		r.j.q	cloudy	clear warm	
12	70	60	B,J,O	overcast	sunny	
13	74	56	B,J,O	overcast	sunny	
14	68	70	c.j.o	warm partly cloudy	warm partly clear	
15	67	72	B, J,O	cloudy, occasional	fair and sunny	
				drizzle		
16	67	70	B, J, O(light	cloudy, occasional	fair and sunny	
				drizzle		

September 1st

17		74	A,J,Q,R,S,T	overcast, sprinkles	hot and humid	
18	72	74	B, C, J, Q, L	cloudy, humid	cool nights, dry warm days	lake full of algae and growth
19	60	68	B, P	fog and drizzle	hot and humid	much chaff& floating debris
20	60	65	D, L	heavy skies	hot and humid	vegative growth around perimeter

September 15th

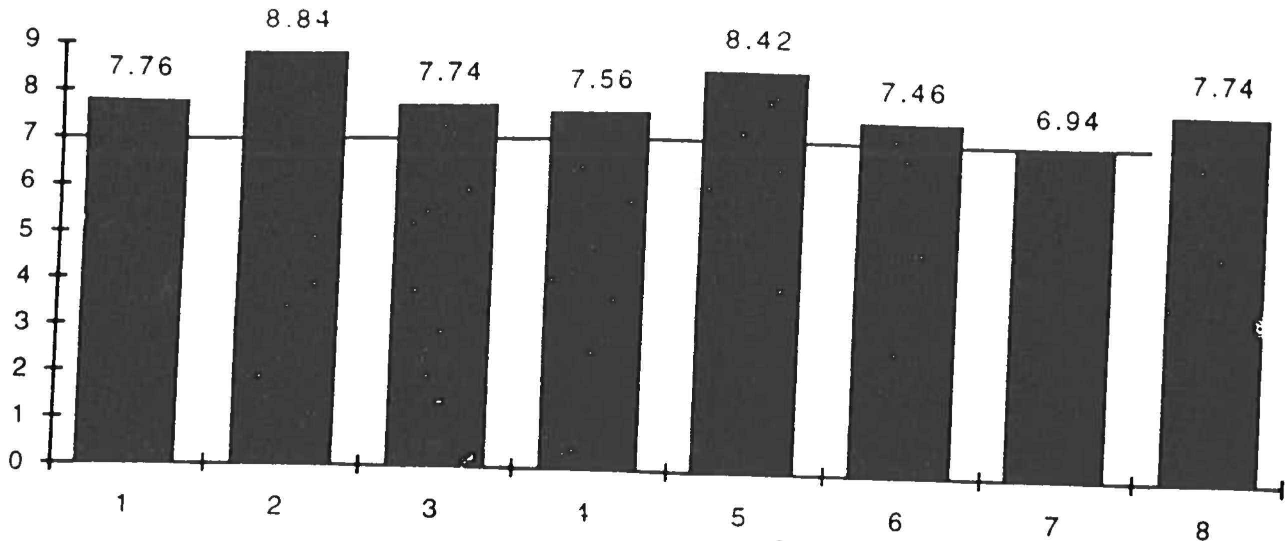
SITE#	AIR TEMP.	WATER TEMP.	OBSERVATION CODES	CURRENT WEATHER	PREVIOUS 3 DAYS WEATHER	OTHER COMMENTS
1	65	68	C, J, Q	partly cloudy,misty	cool Sun./ warm-muggy,	
				warm, muggy	clear to overcast	
2						
3	68	64	C, F, O	cool	cool, warm, hot	
4	70	69	D, J, O, R,T	warm	cool, warm, hot	
5	75	60	B, J, Q	clear, slight breeze	clear, 80's w/ breeze	
6	74	64	A, J, M	humid	sunny	
7	74	64	A, J, P	humid	sunny	
8	69	65	B, J, Q	clear, slight breeze	clear, 80's w/ breeze	
9	70	67	C, J, O	clear, slight breeze	clear, 80's w/ breeze	raccoon tracks
10	68	67		high clouds, breezy	warm, 80-90's, sunny, windy	
11			B, J, Q	clear	warm, clear	
12	73	57	B, J, O	sunny	sunny	
13	73	59	B, J, O	sunny	sunny	
14	72	68	C, J, L, U	muggy, cooler	hot	
15	68	70	A/B, J, Q	clear, warm	fair, warm after cool	
16	67	65	B, J, O(light)	clear, warm	fair, warm after cool	

September 15th

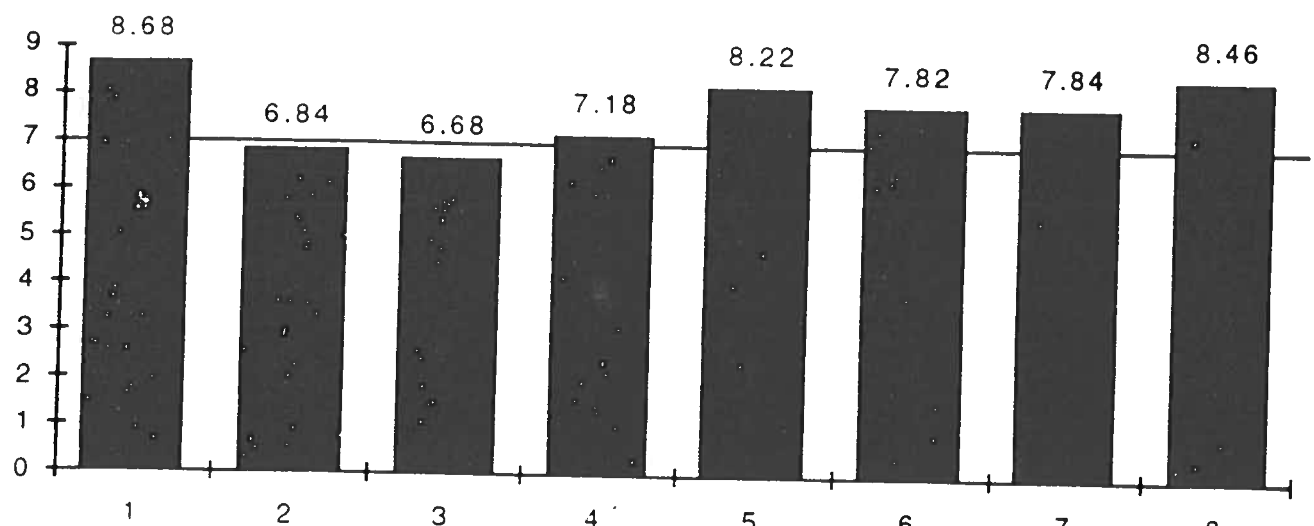
SITE#	AIR TEMP.	WATER TEMP.	OBSERVATION CODES	CURRENT WEATHER	PREVIOUS 3 DAYS WEATHER	OTHER COMMENTS
17	74	70	A, J, Q, R, S, T	cooler,breezy	hot, breezy	
18	68	68	C, J, P	muggy, partially	cool to hot	
				clear		
19	70	66	B, Q/N	warm, partly cloud	warm, sunny	
20	70	64	D, Q/L	warm, partly cloud	warm, sunny	

DISSOLVED OXYGEN

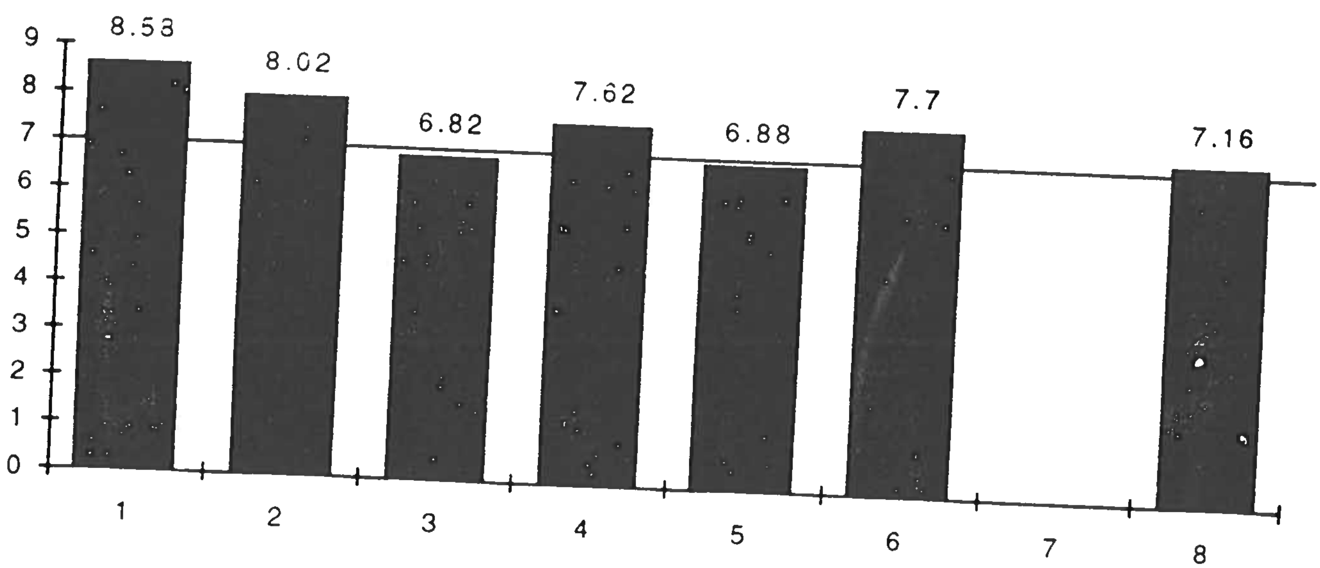
SITE #17
mg/l (ppm)



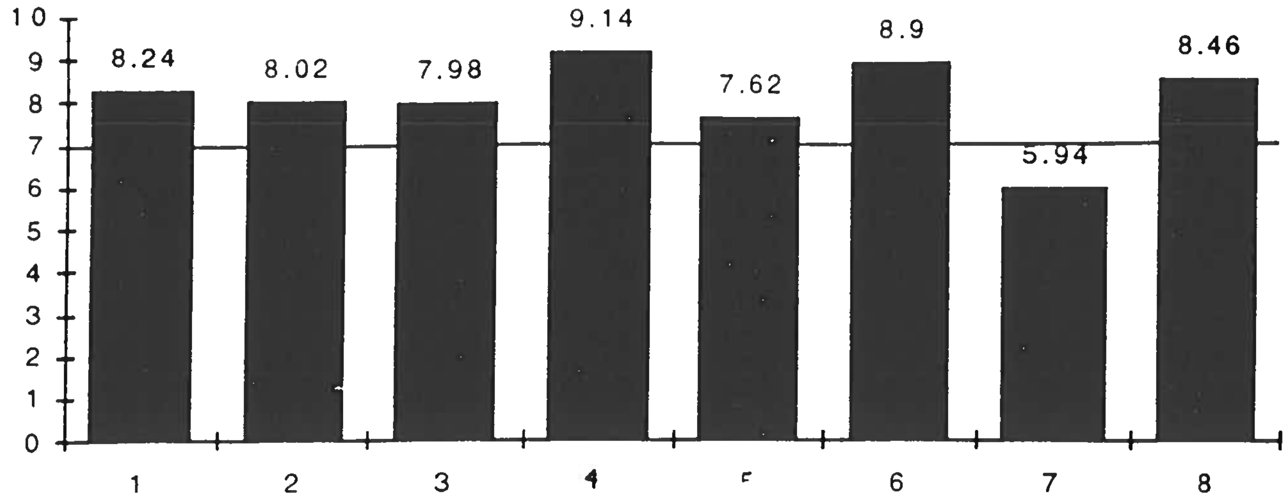
SITE #18
mg/l (ppm)



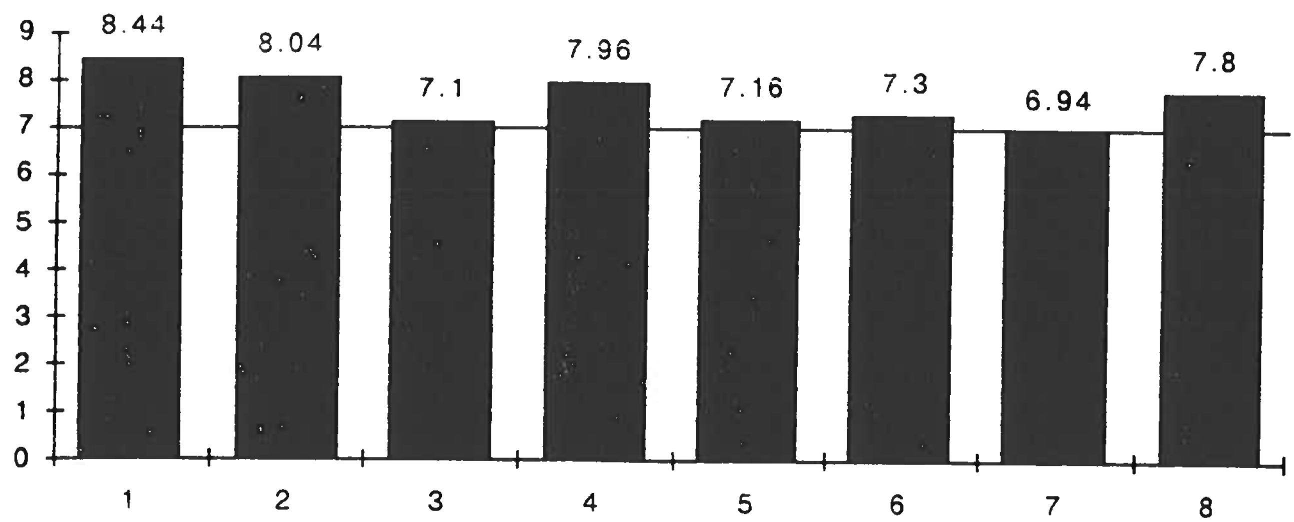
SITE #19
mg/l (ppm)



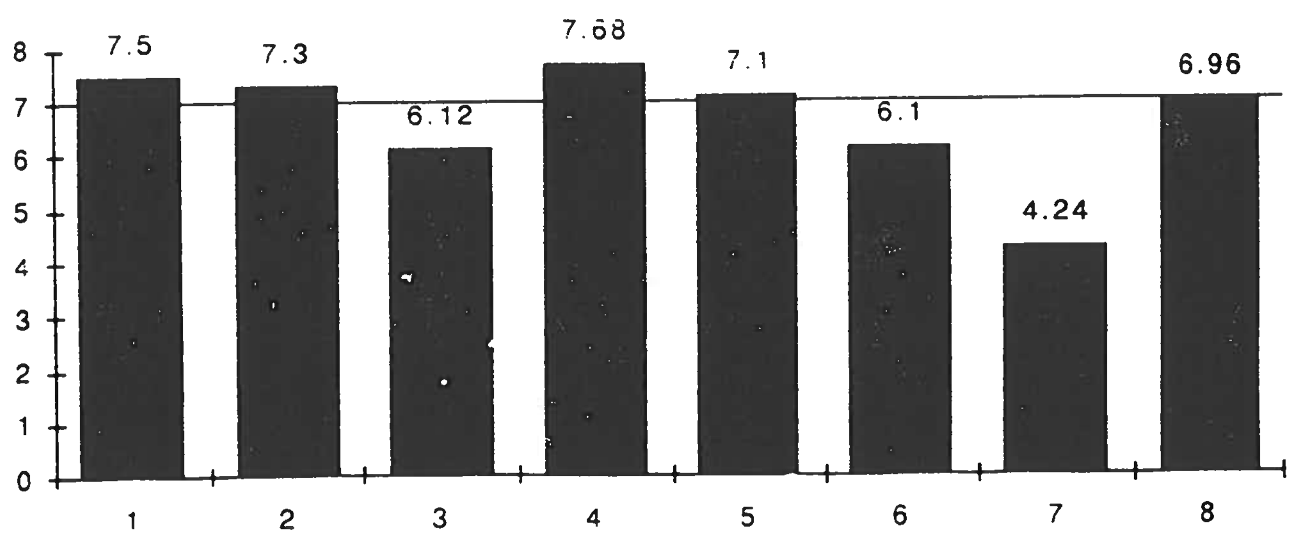
SITE #11
mg/l (ppm)

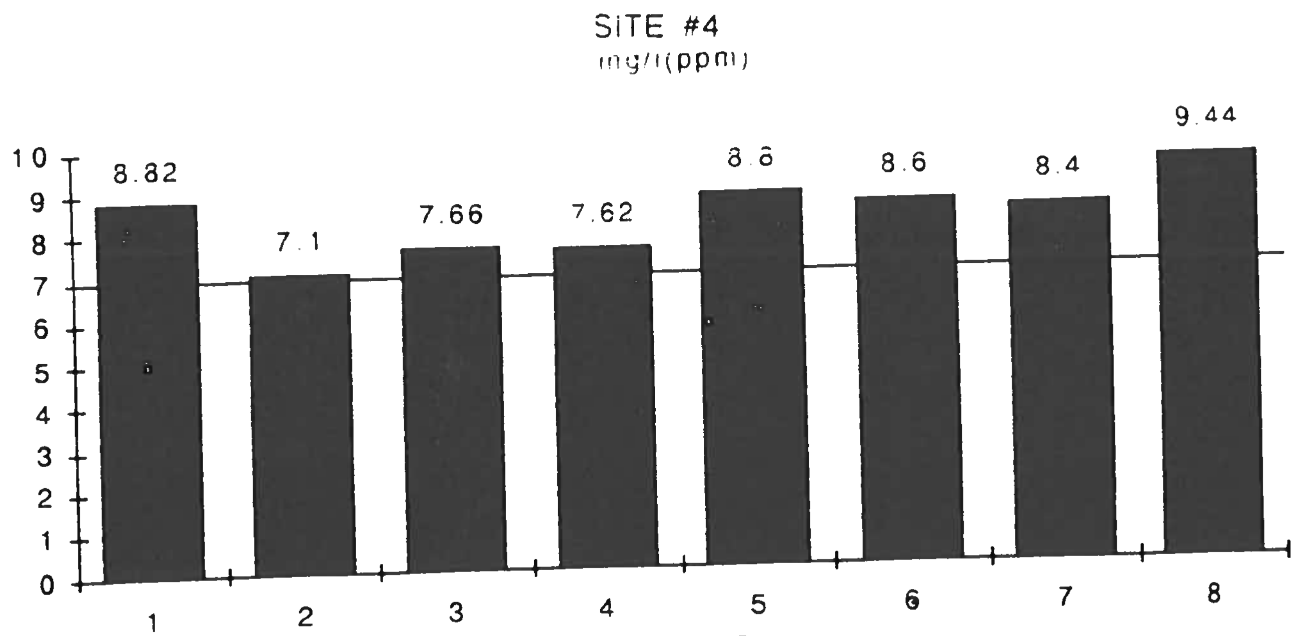


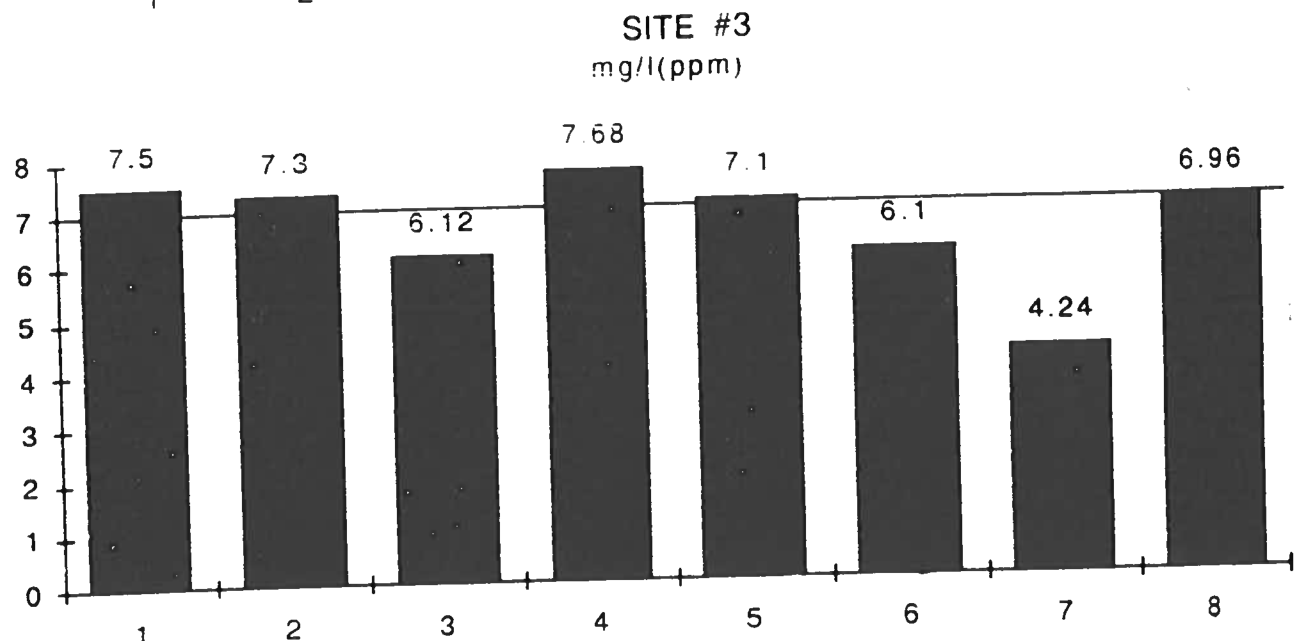
SITE #8
mg/l(ppm)

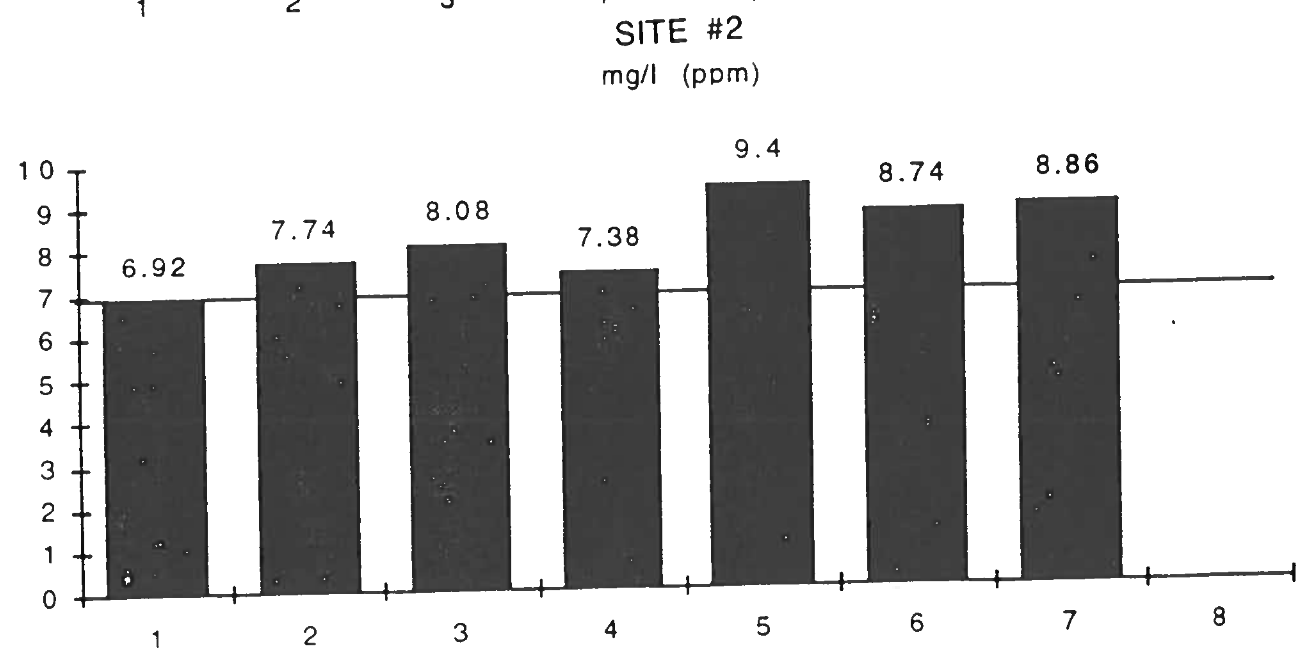


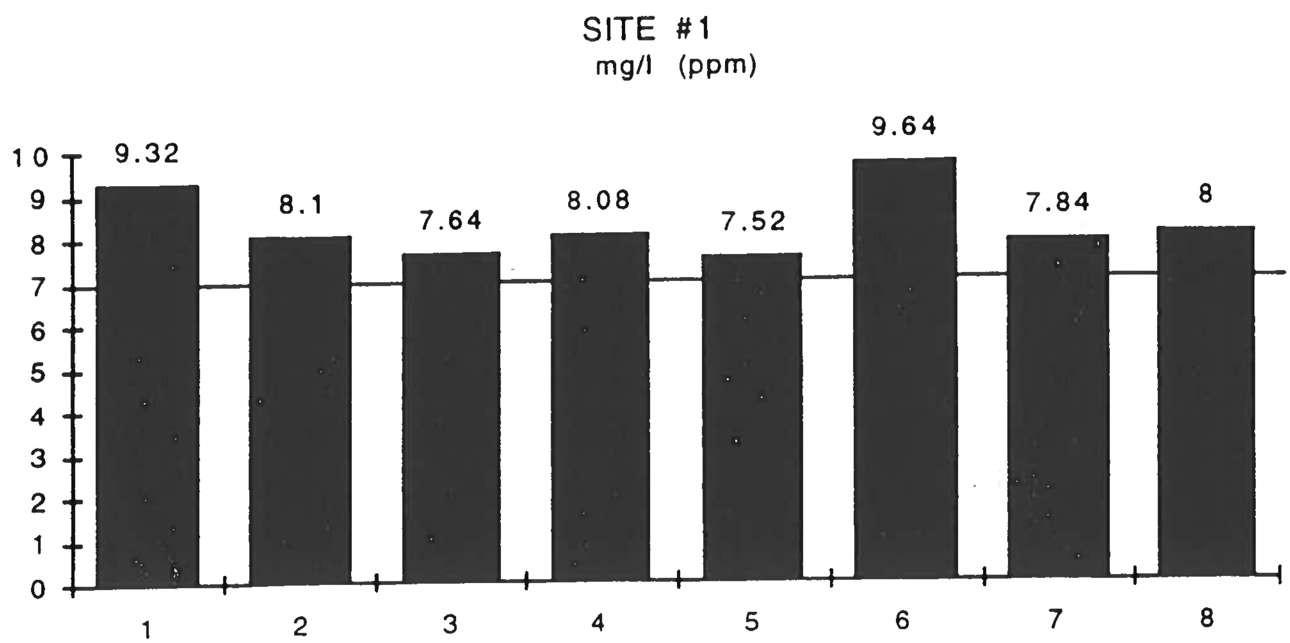
SITE #7
mg/l(ppm)



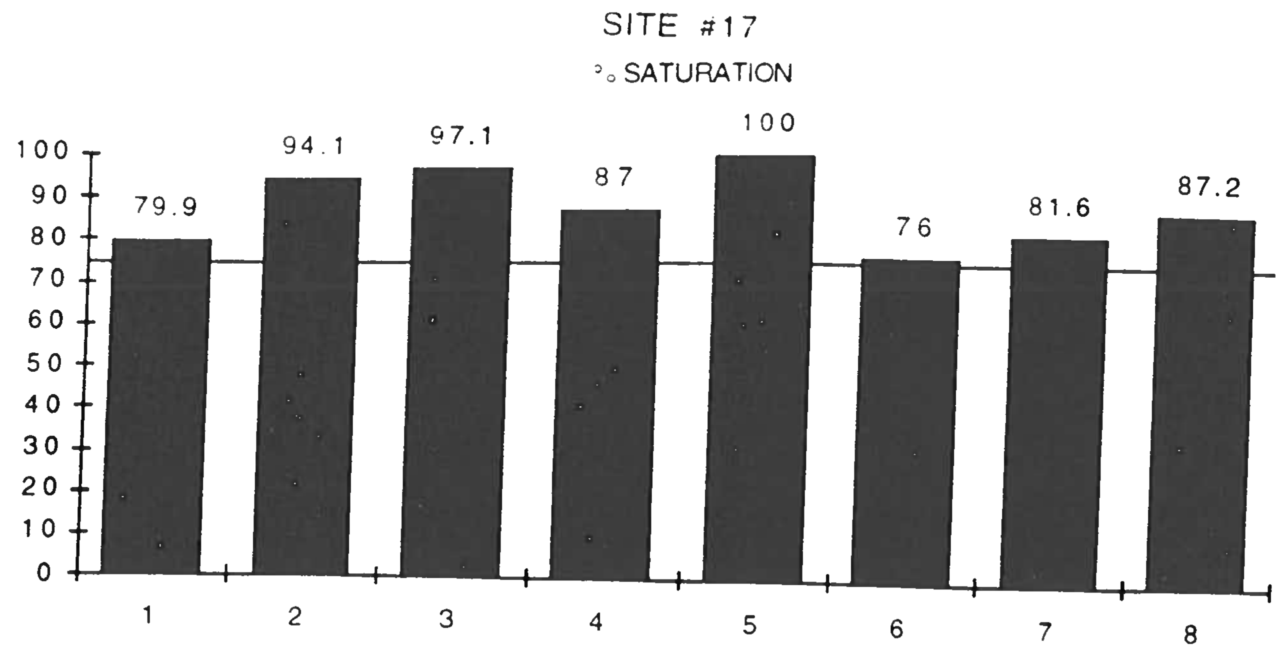

SITE #4
mg/l(ppm)
8.82
7.1
7.66
7.62
8.8
8.6
8.4
9.44
0 1 2 3 4 5 6 7 8 9 10
1 2 3 4 5 6 7 8


SITE #3
mg/l(ppm)
7.5
7.3
6.12
7.68
7.1
6.1
4.24
6.96
0 1 2 3 4 5 6 7 8
1 2 3 4 5 6 7 8


SITE #2
mg/l (ppm)
6.92
7.74
8.08
7.38
9.4
8.74
8.86
0 1 2 3 4 5 6 7 8 9 10
1 2 3 4 5 6 7 8



SITE #1
mg/l (ppm)
10
9
8
7
6
5
4
3
2
1
0
9.32
8.1
7.64
8.08
7.52
9.64
7.84
8
1
2
3
4
5
6
7
8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90
80
70
60
50
40
30
20
10
0
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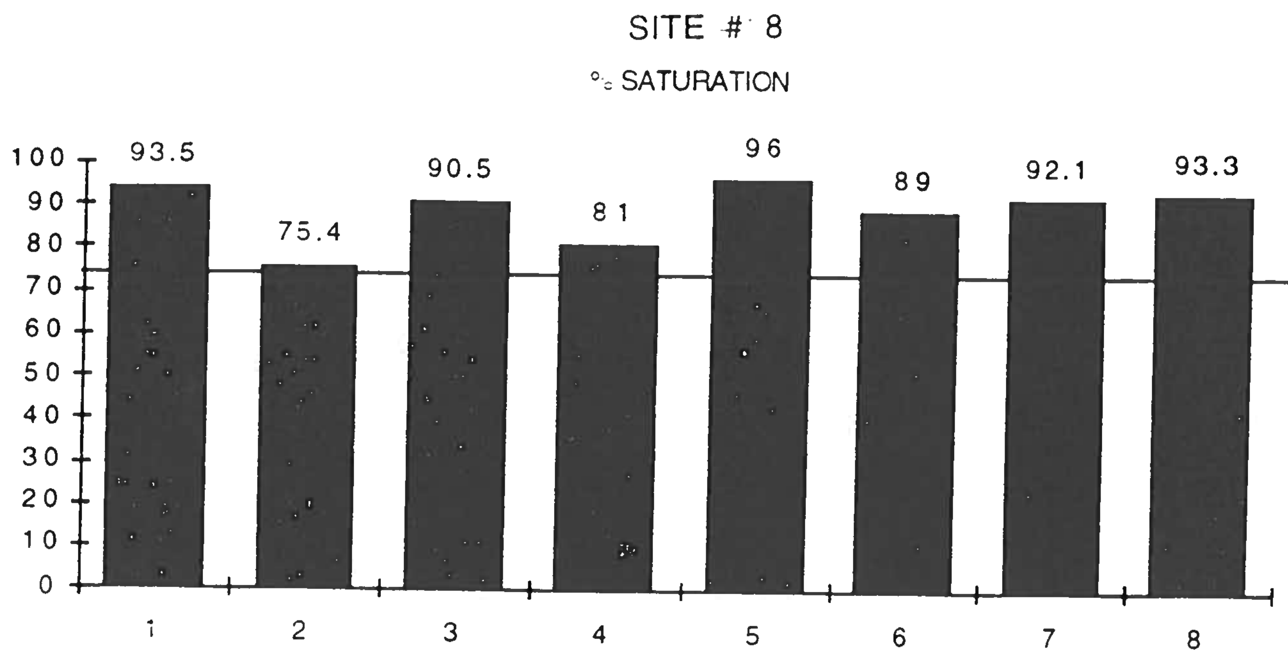
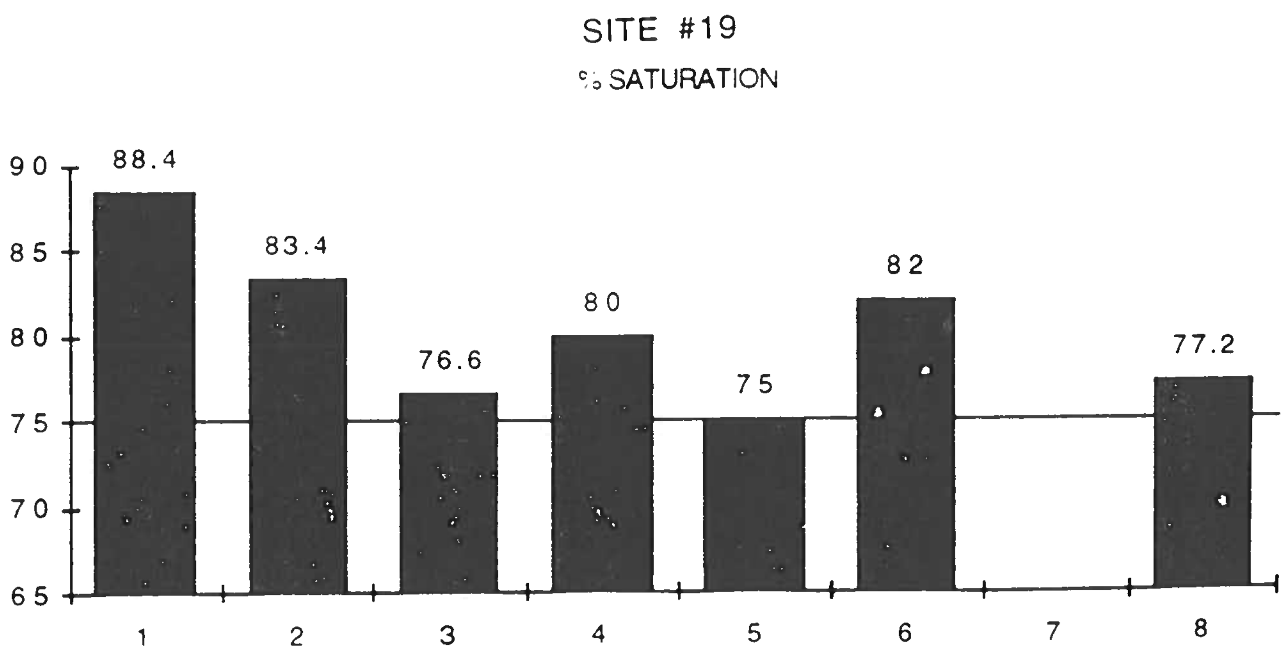
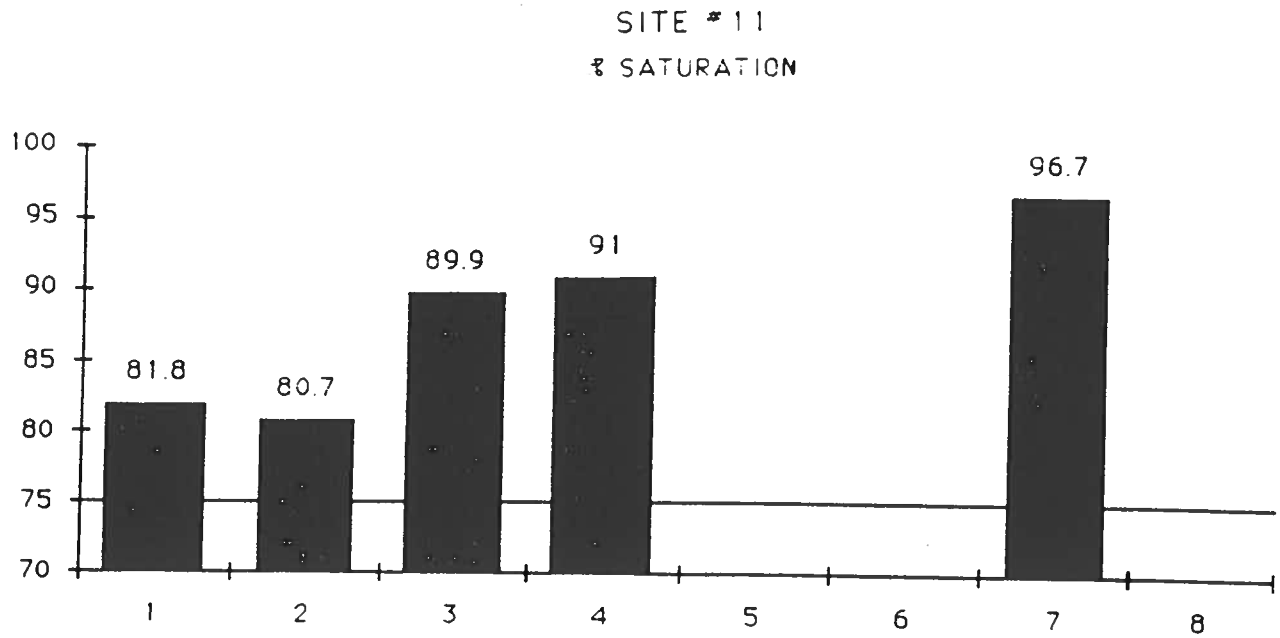
94.1
97.1
87
100
76
81.6
87.2
1
2
3
4
5
6
7
8


SITE # 8
% SATURATION
100
90
80
70
60
50
40
30
20
10
0
93.5
75.4
90.5
81
96
89
92.1
93.3
1
2
3
4
5
6
7
8


SITE #19
% SATURATION
90
85
80
75
70
65
88.4
83.4
76.6
80
75
82
77.2
1
2
3
4
5
6
7
8


SITE #11
% SATURATION
100
95
90
85
80
75
70
81.8
80.7
89.9
91
96.7
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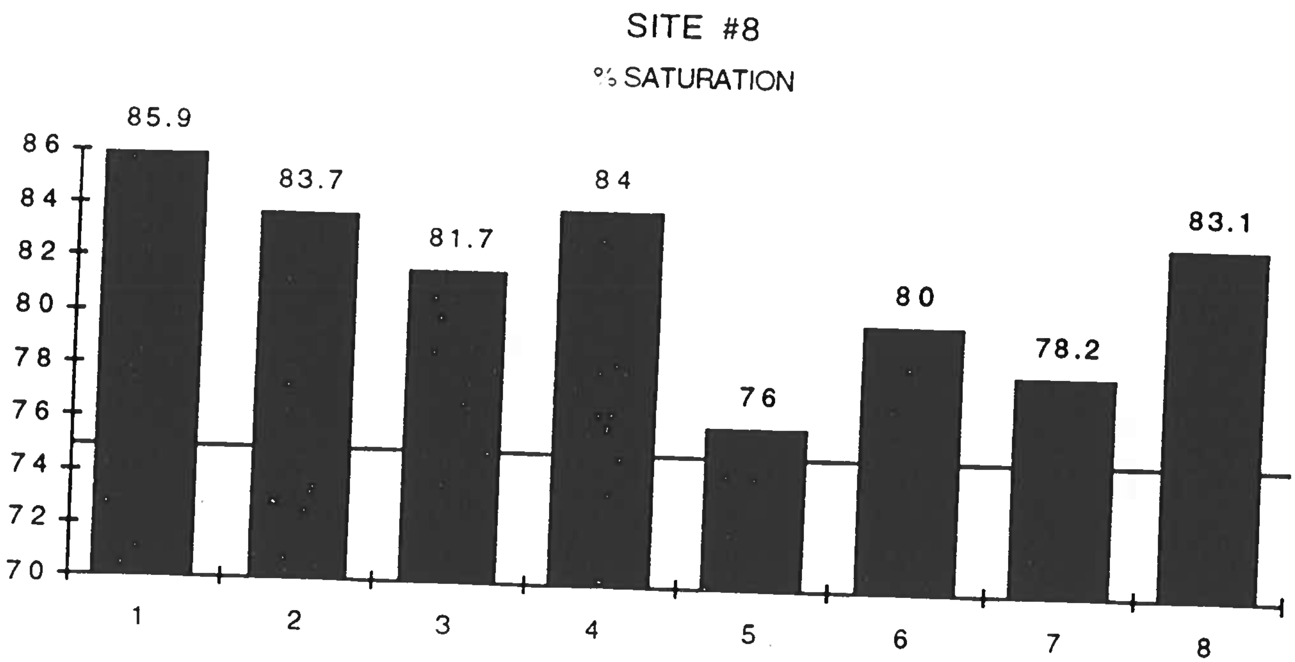
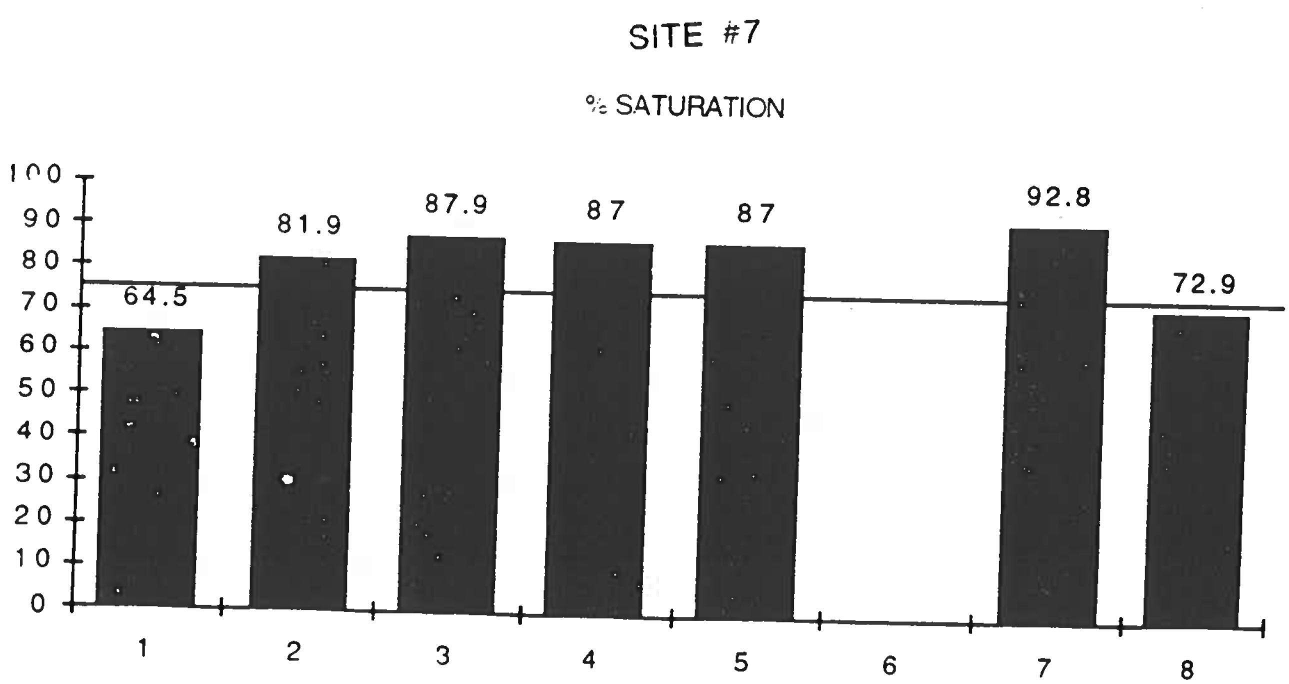
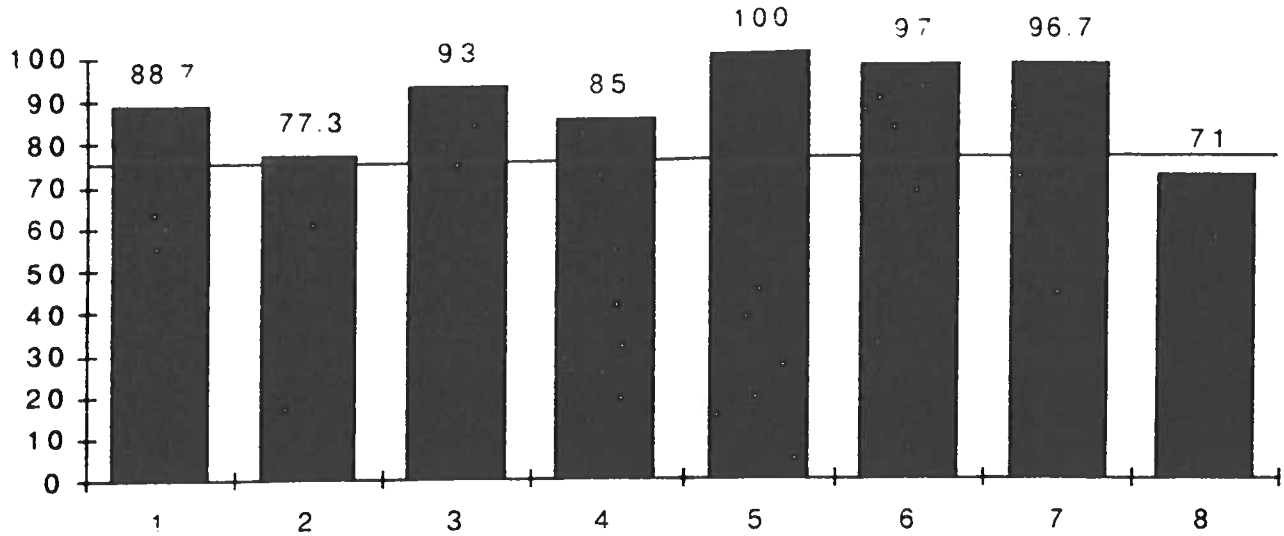
2
3
4
5
6
7
8


SITE #8
% SATURATION
86
84
82
80
78
76
74
72
70
85.9
83.7
81.7
84
76
80
78.2
83.1
1
2
3
4
5
6
7
8


SITE #7
% SATURATION
100
90
80
70
60
50
40
30
20
10
0
64.5
81.9
87.9
87
87
92.8
72.9
1
2
3
4
5
6
7
8

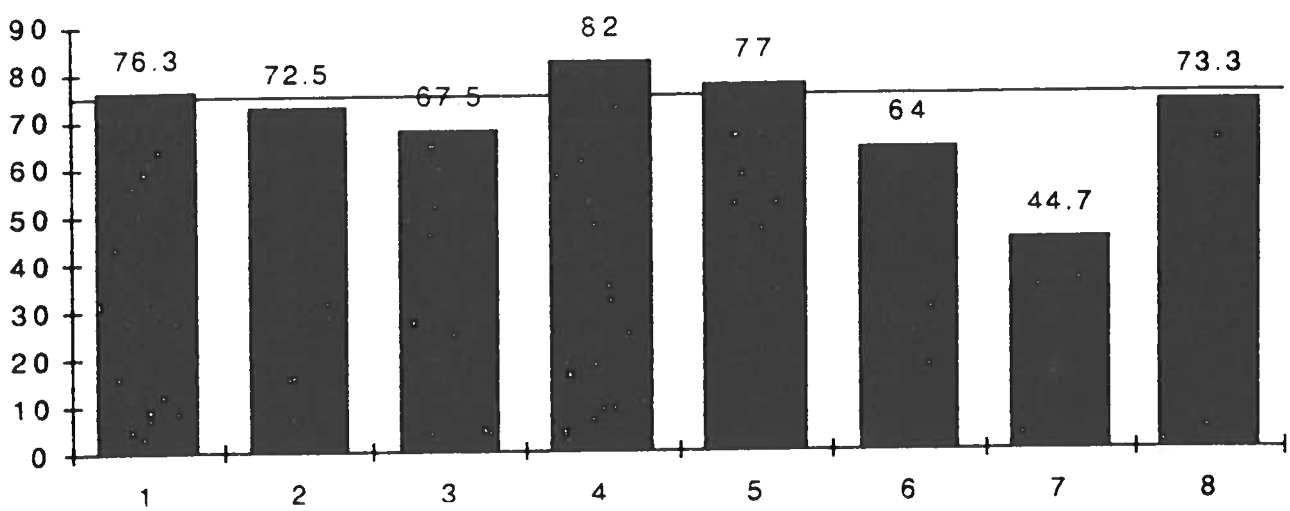
SITE #[illegible]

% SATURATION



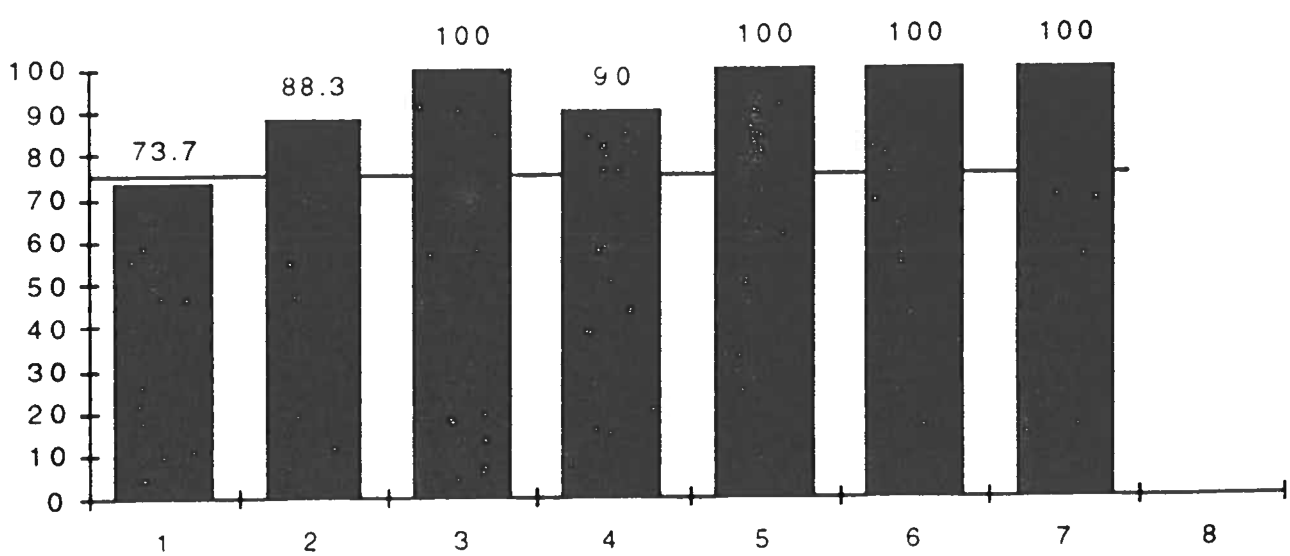
SITE #3

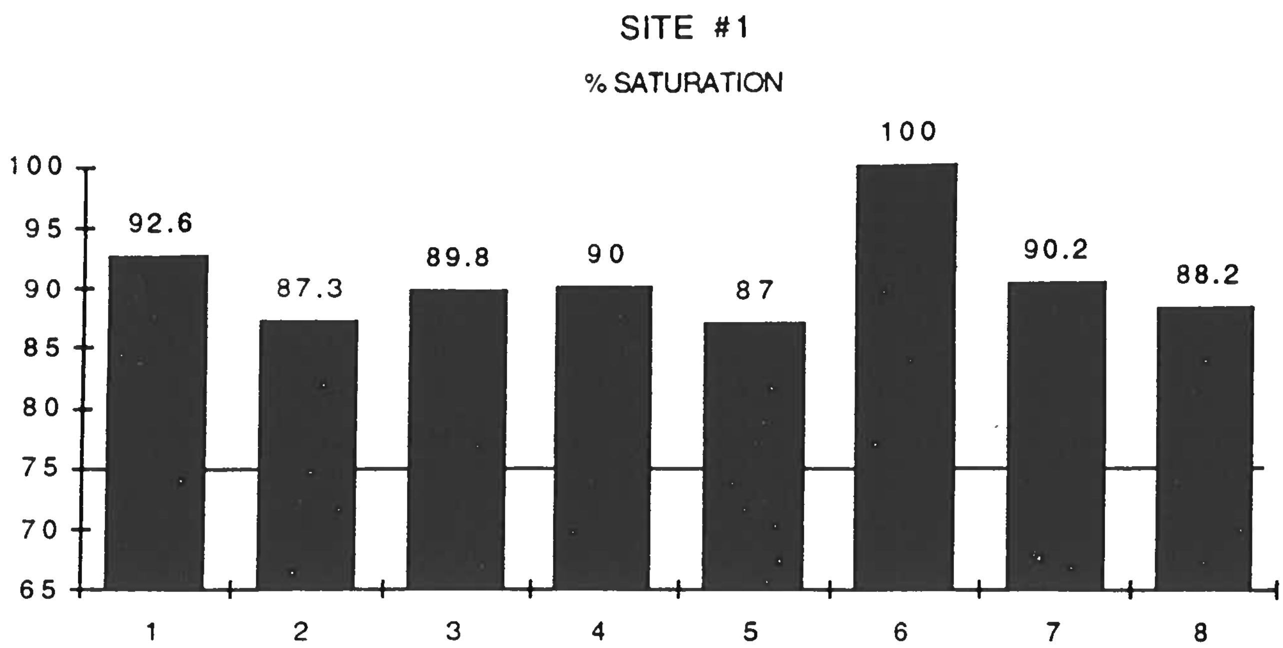
% SATURATION



SITE #2

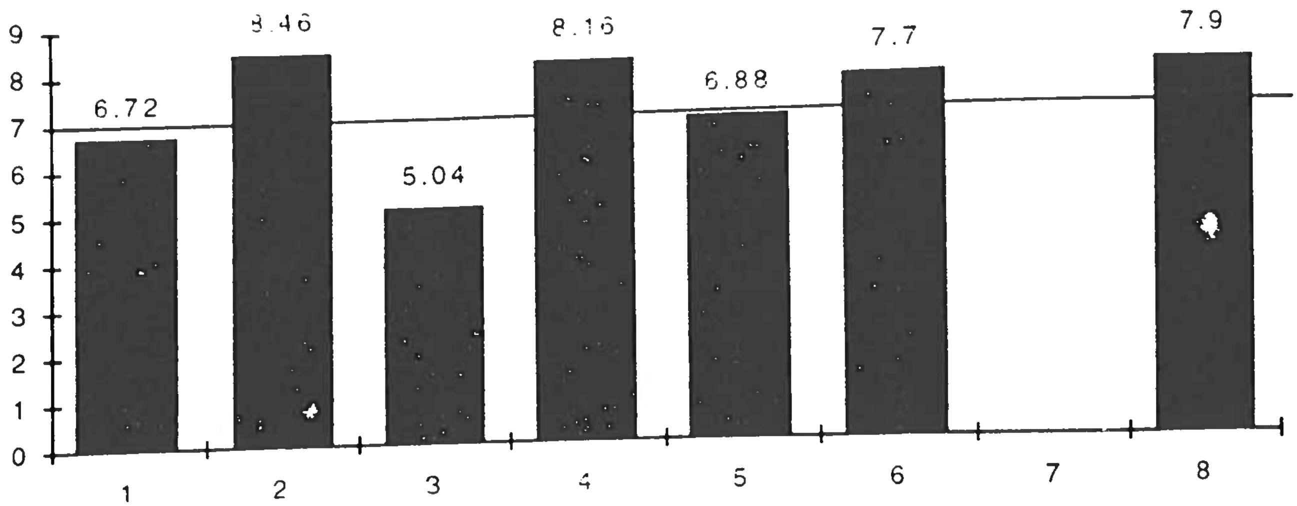
% SATURATION



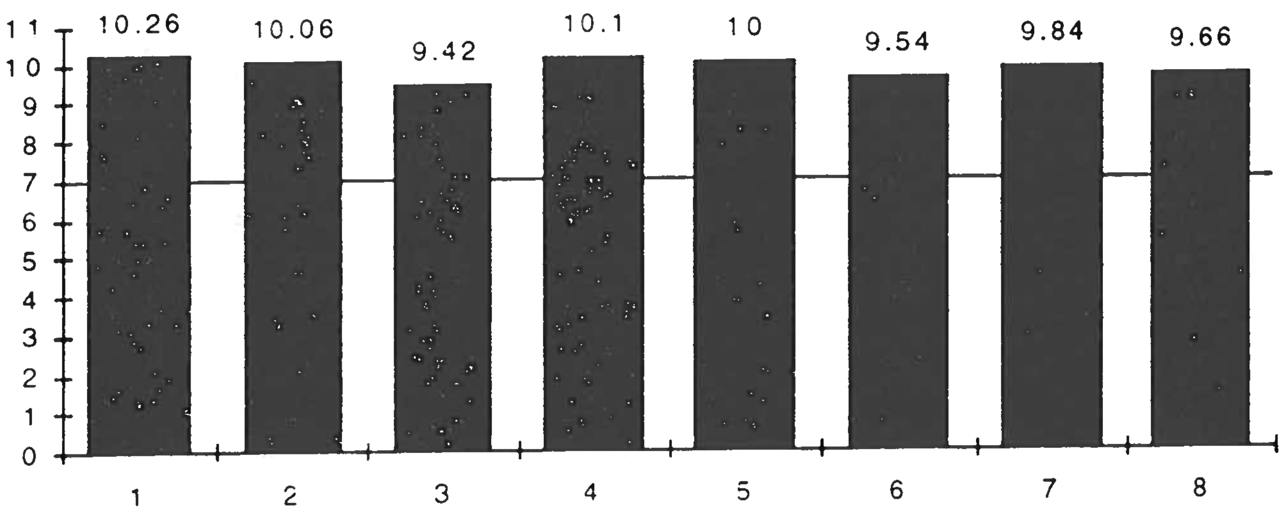


SITE #1
% SATURATION
100
95
90
85
80
75
70
65
92.6
87.3
89.8
90
87
100
90.2
88.2
1
2
3
4
5
6
7
8

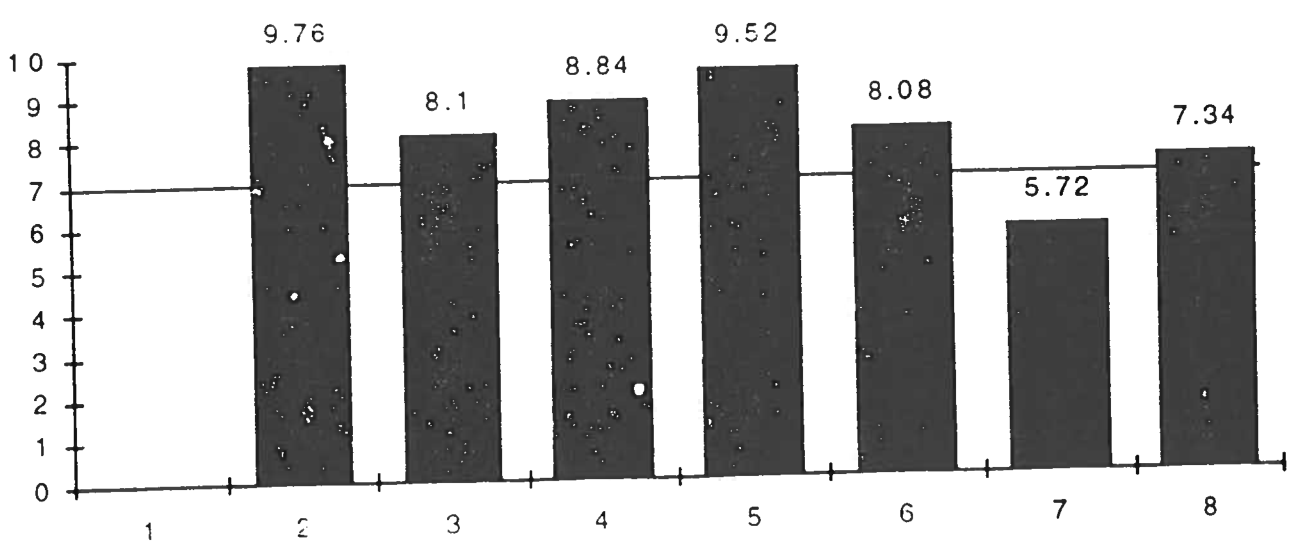
SITE #20
mg/l (ppm)

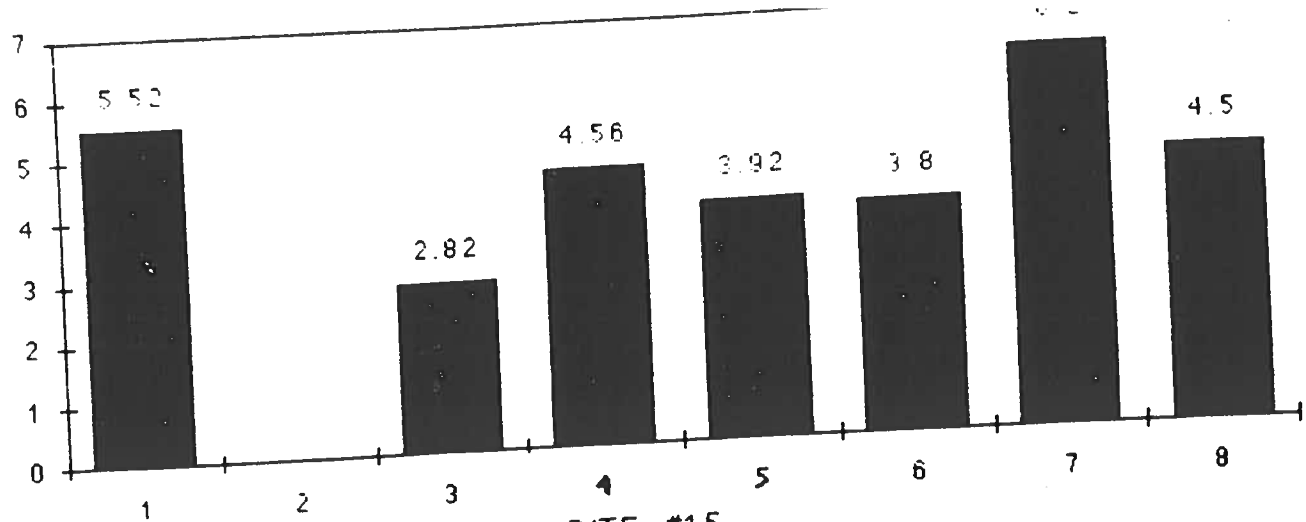


SITE #13
mg/l(ppm)

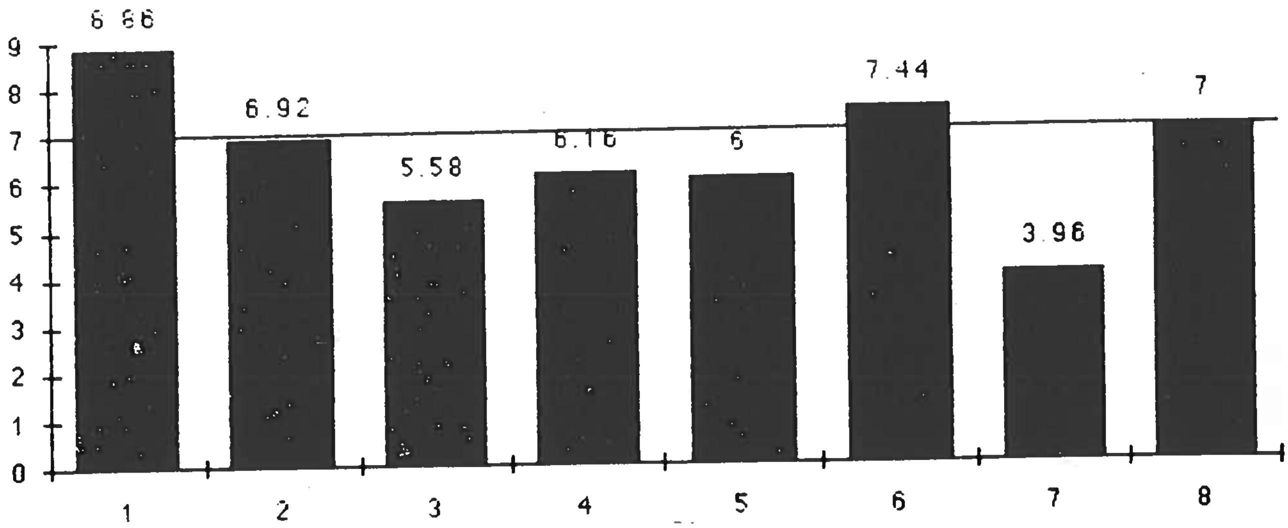


SITE #12
mg/l (ppm)

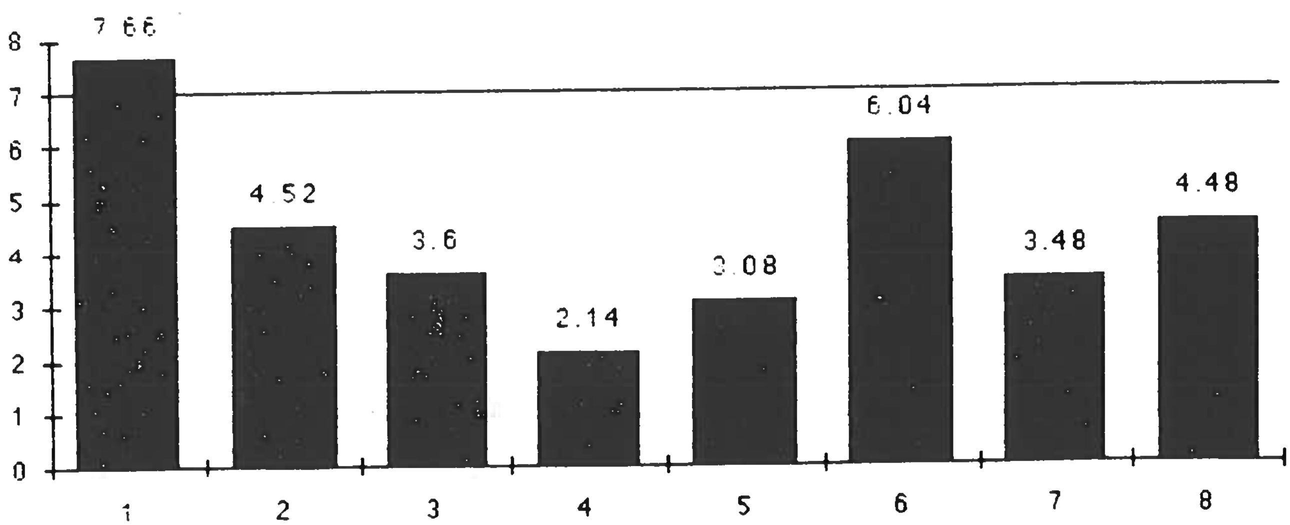




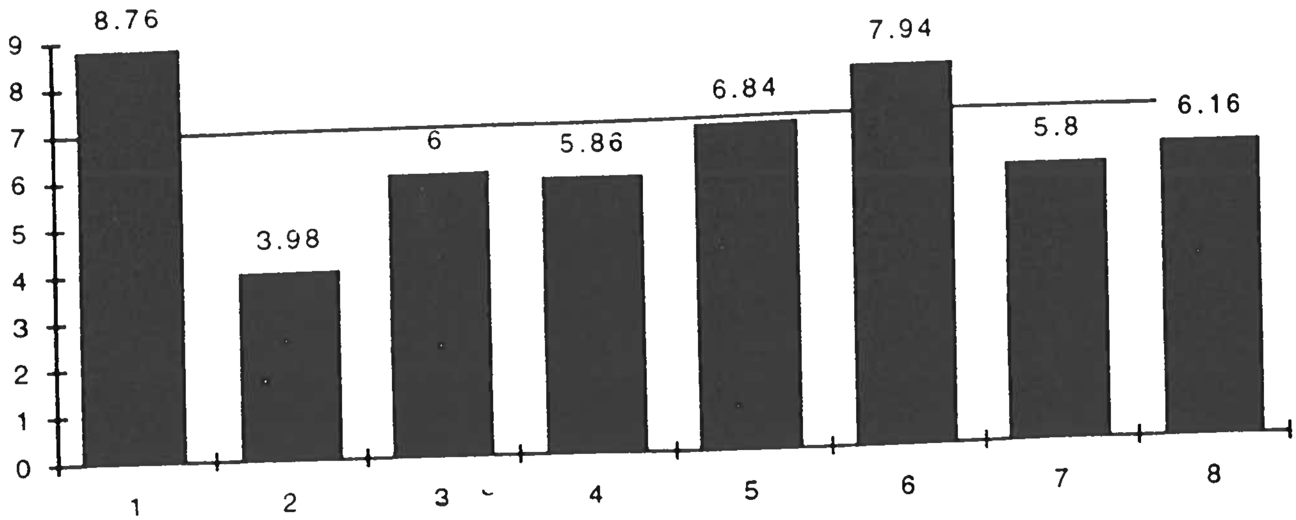
SITE #15
mg/l (ppm)



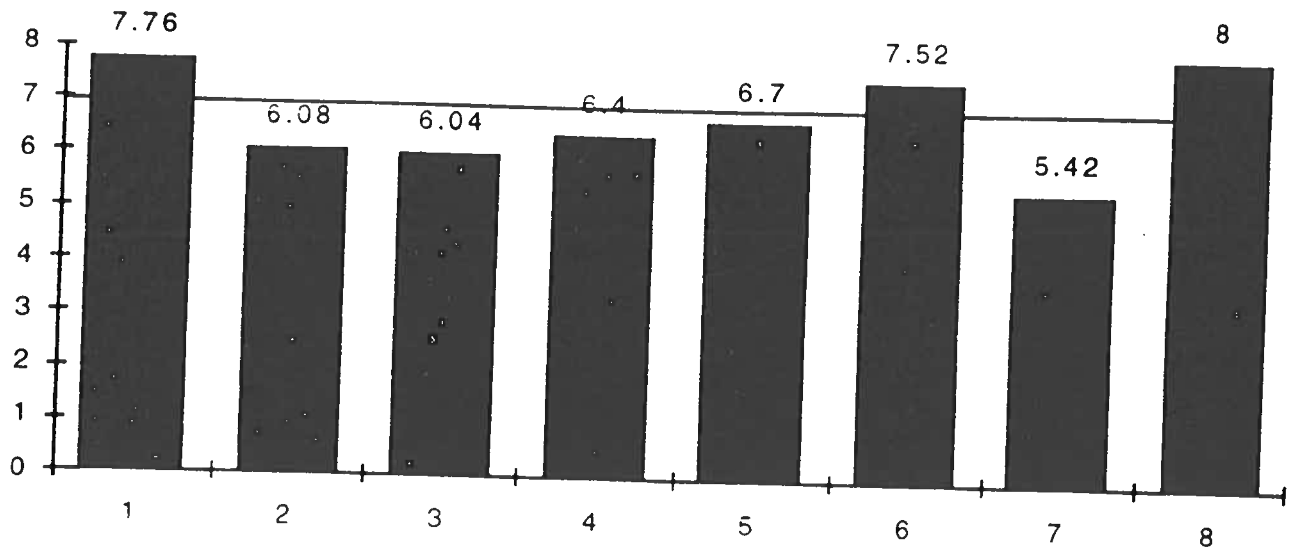
SITE #16
mg/l (ppm)



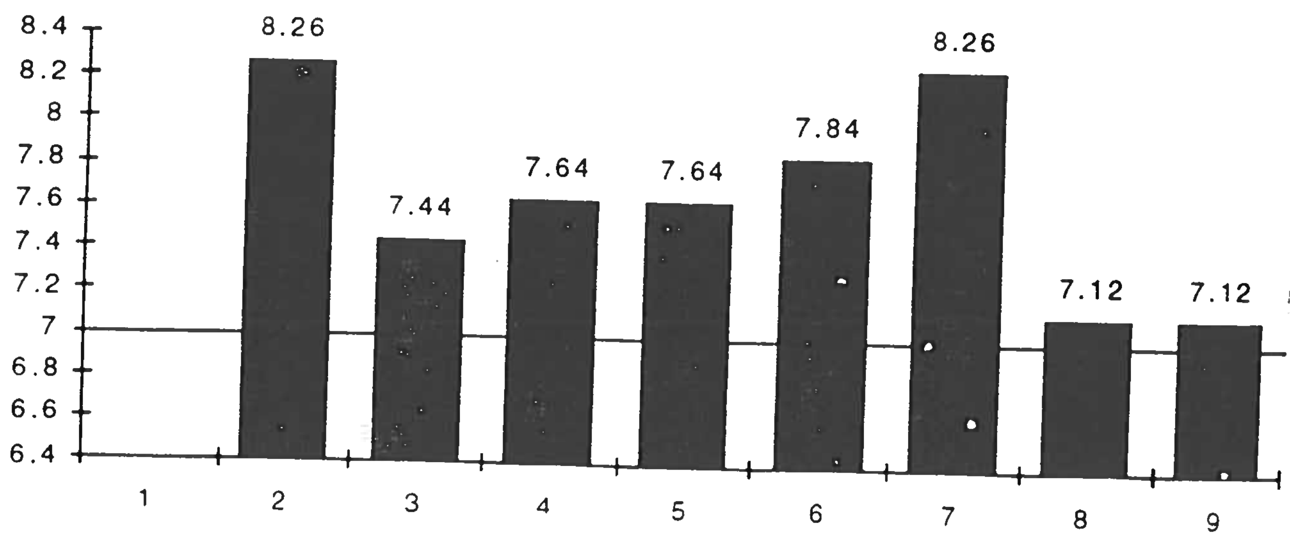
SITE #9
mg/l (ppm)



SITE #10
mg/l (ppm)

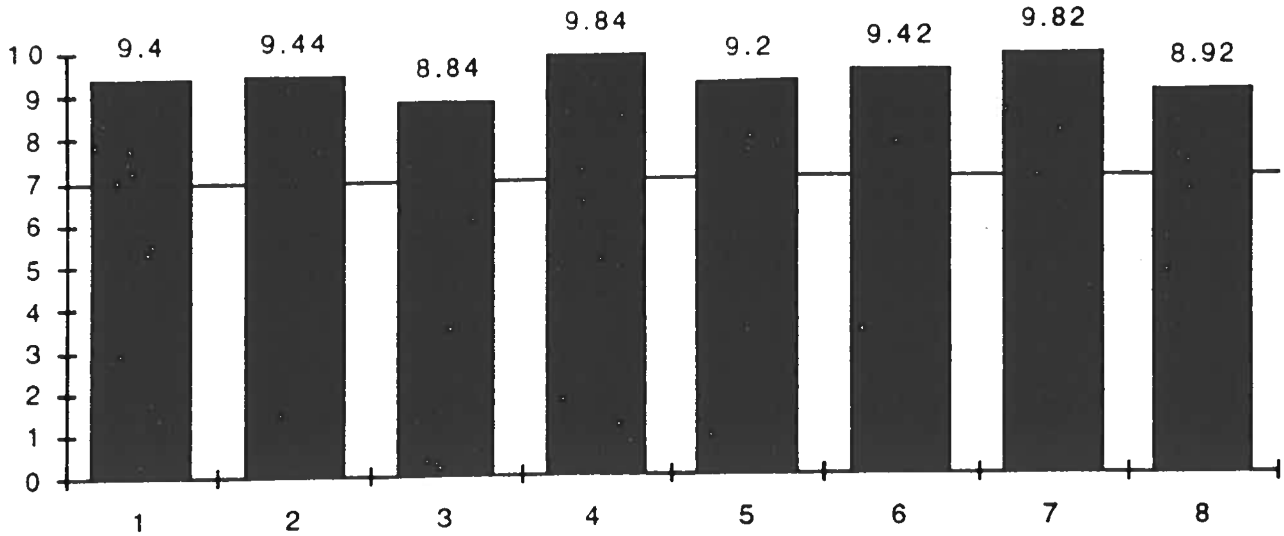


SITE #6
mg/l (ppm)

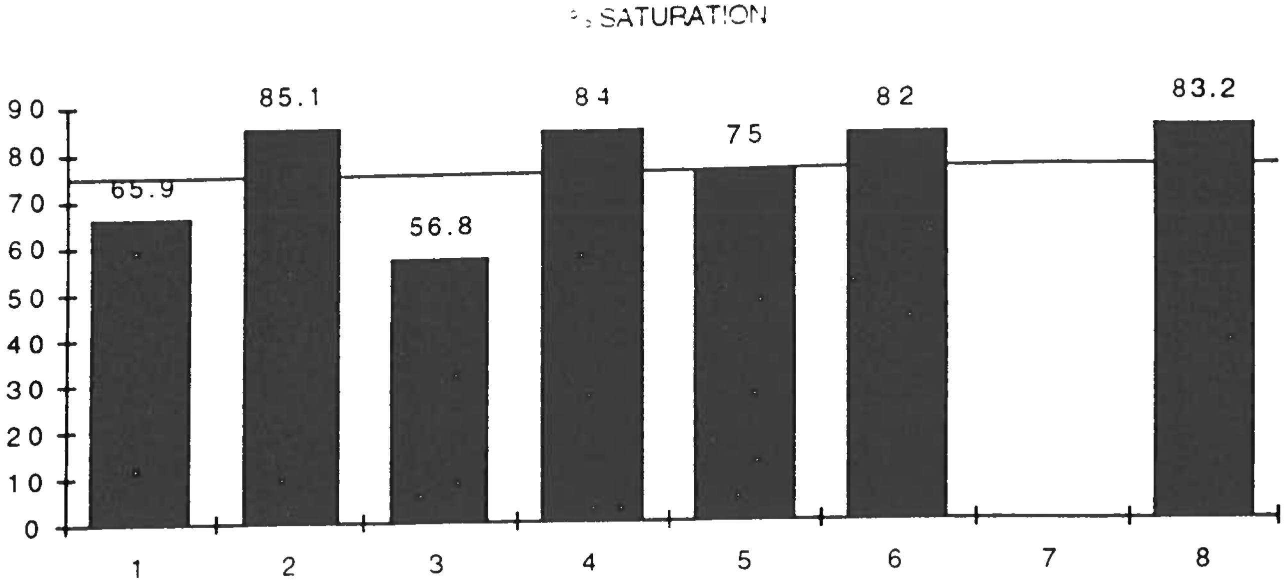


SITE #5

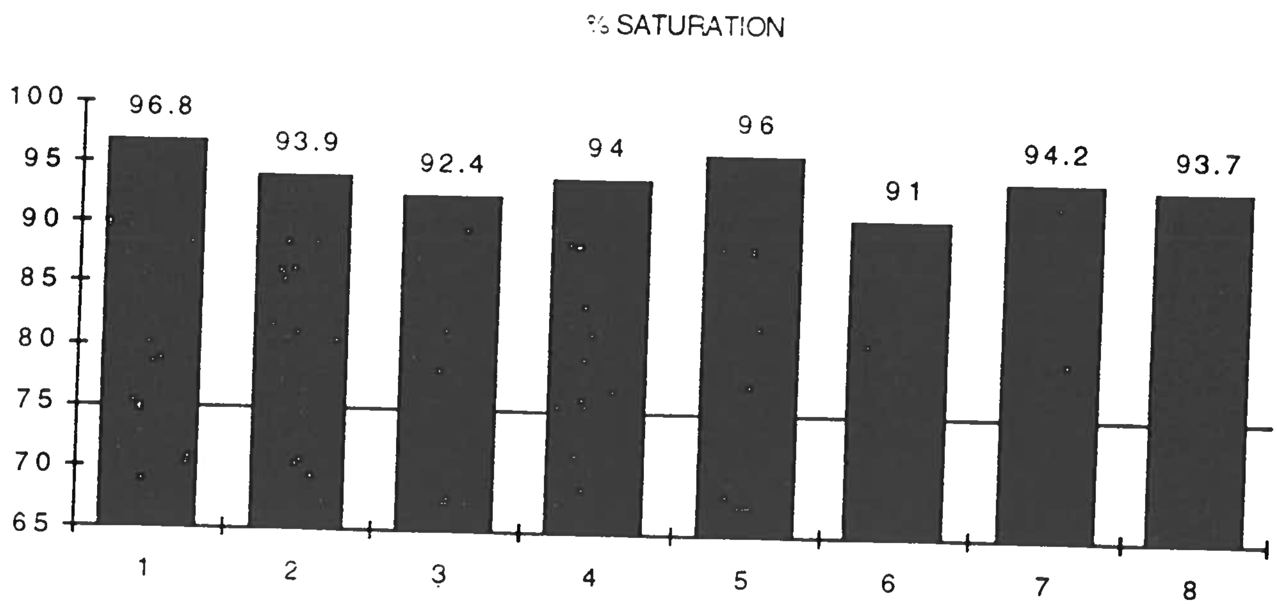
mg/l (ppm)



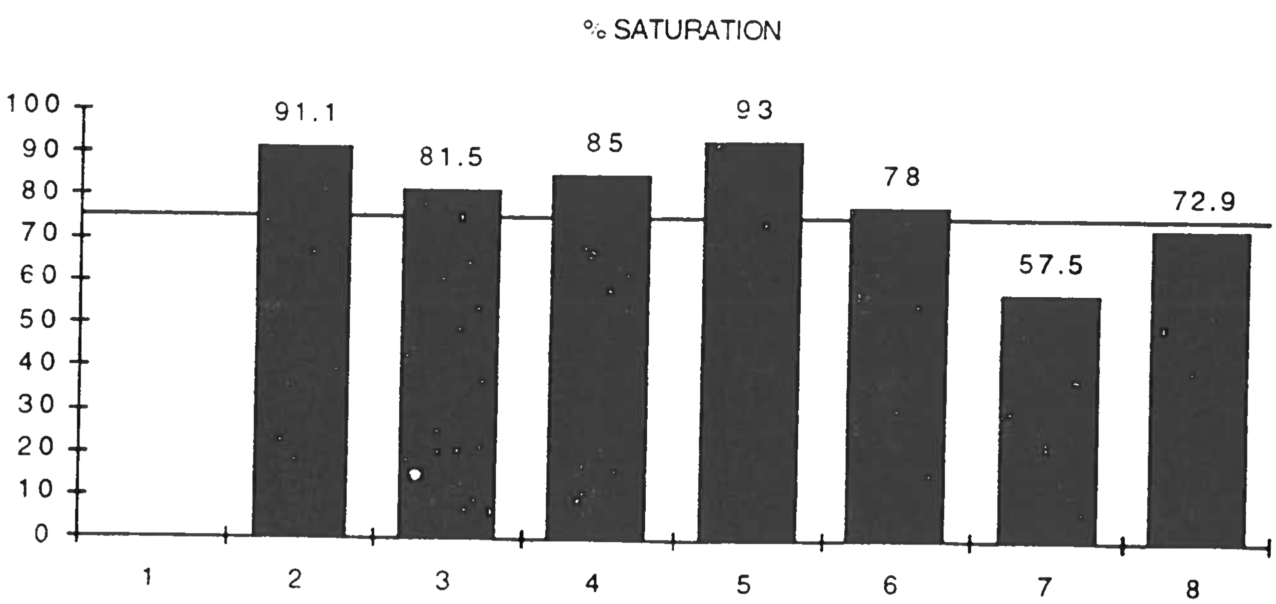
SITE #20



SITE #13

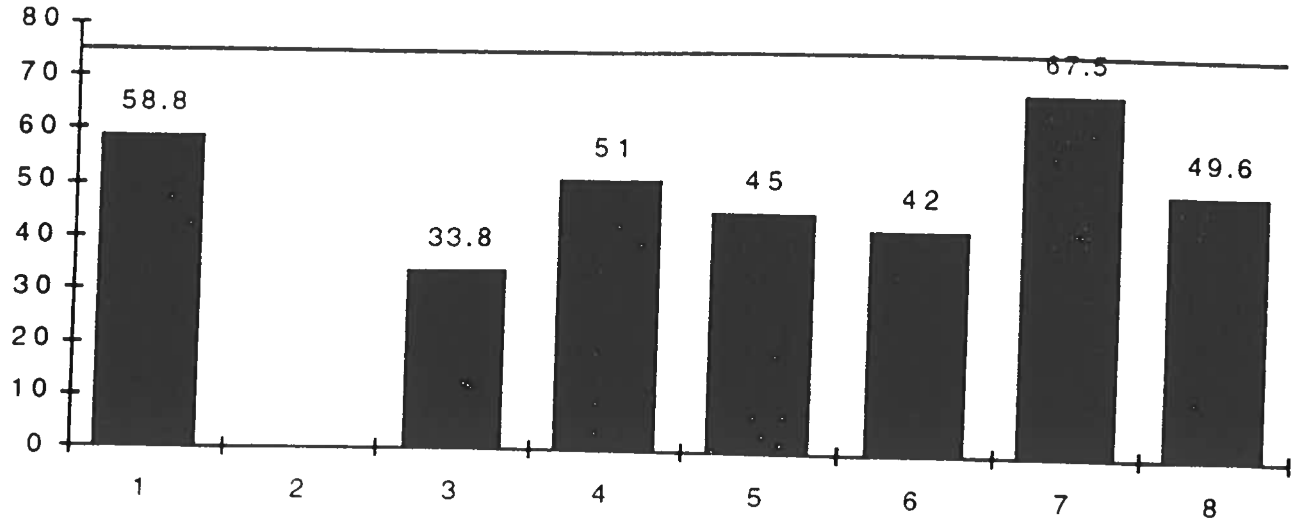


SITE #12



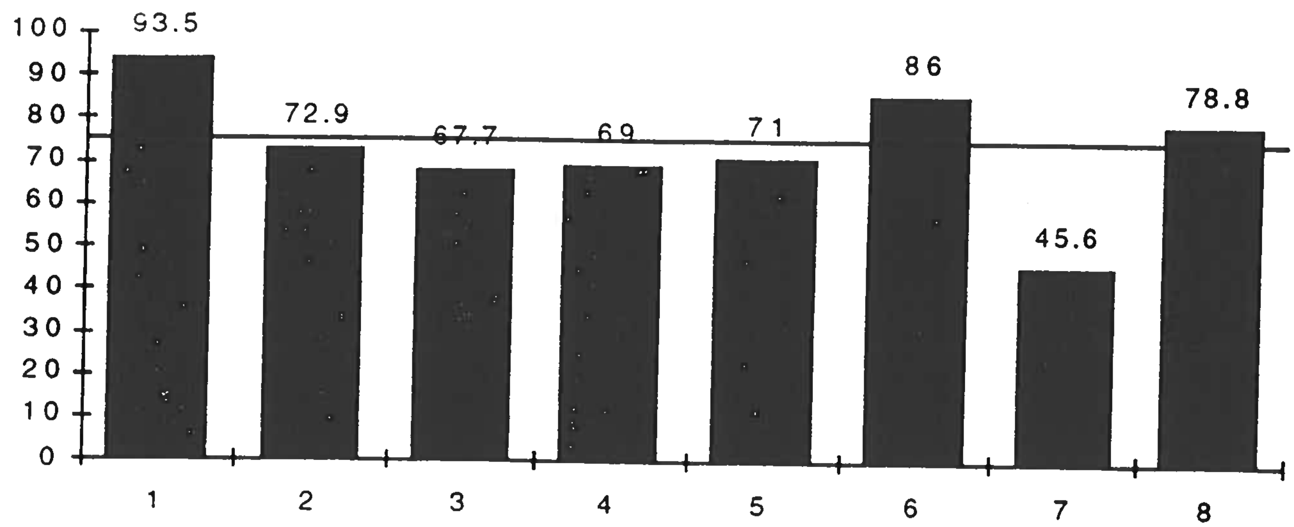
SITE #14

% SATURATION



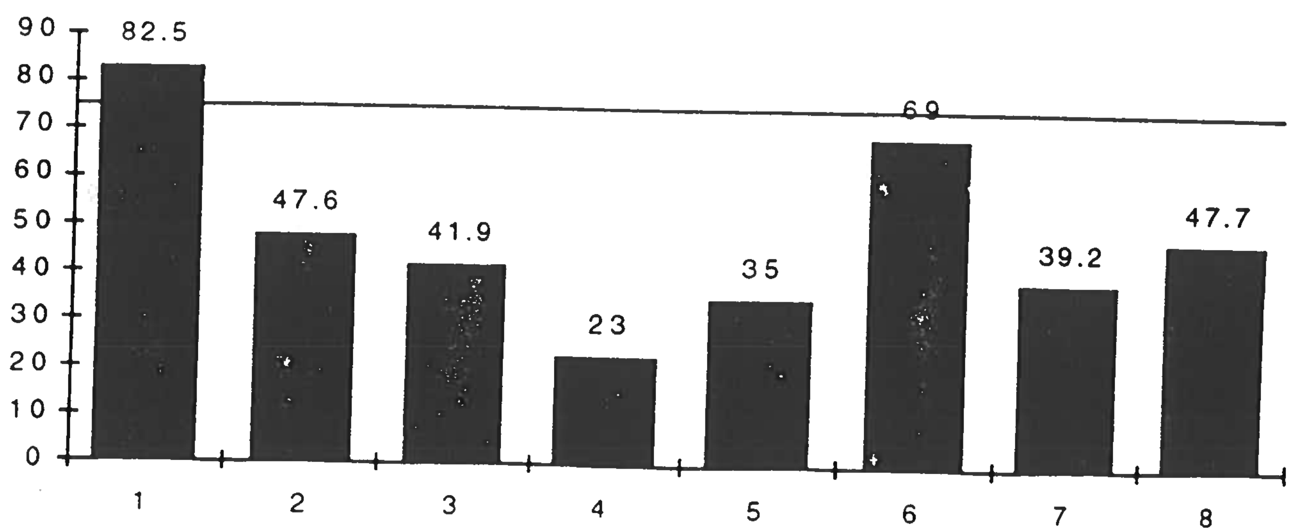
SITE #15

% SATURATION



SITE #16

%SATURATION



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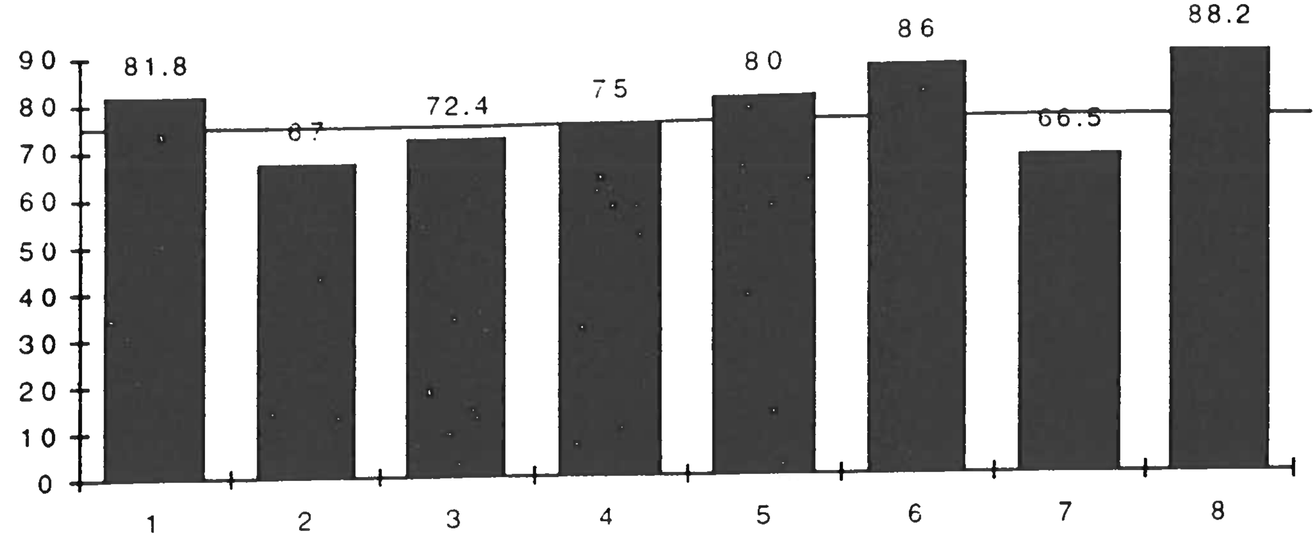
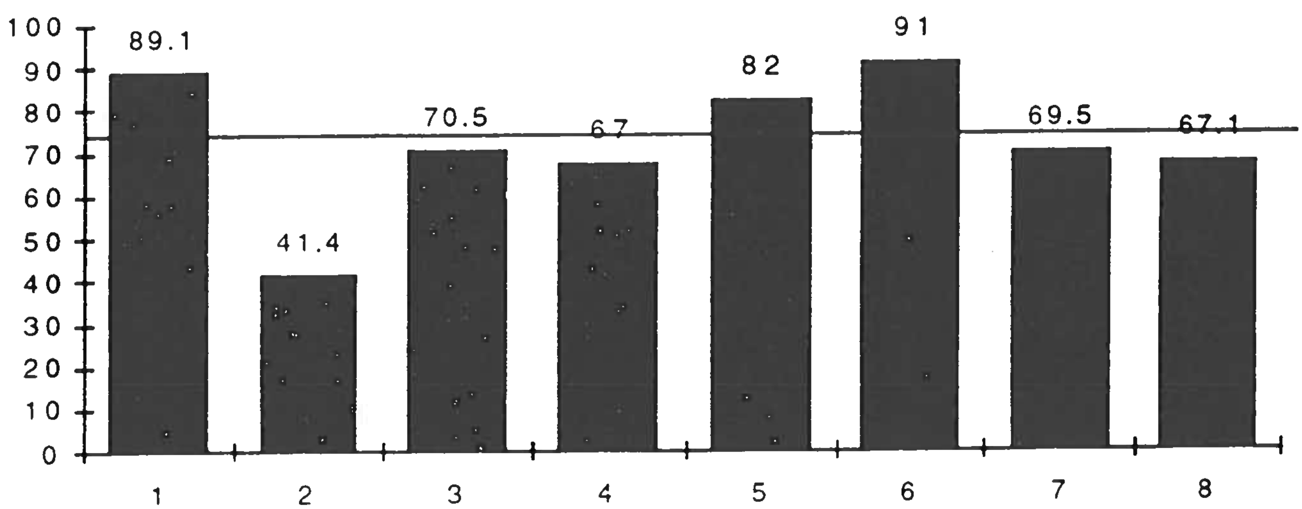
% SATURATION



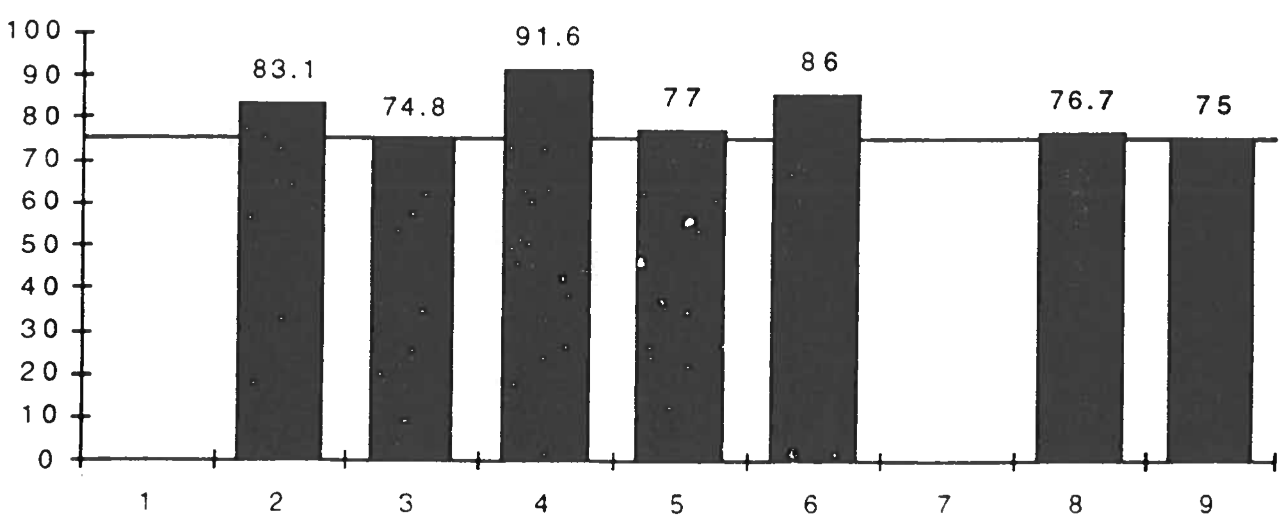
SITE #9

% SATURATION

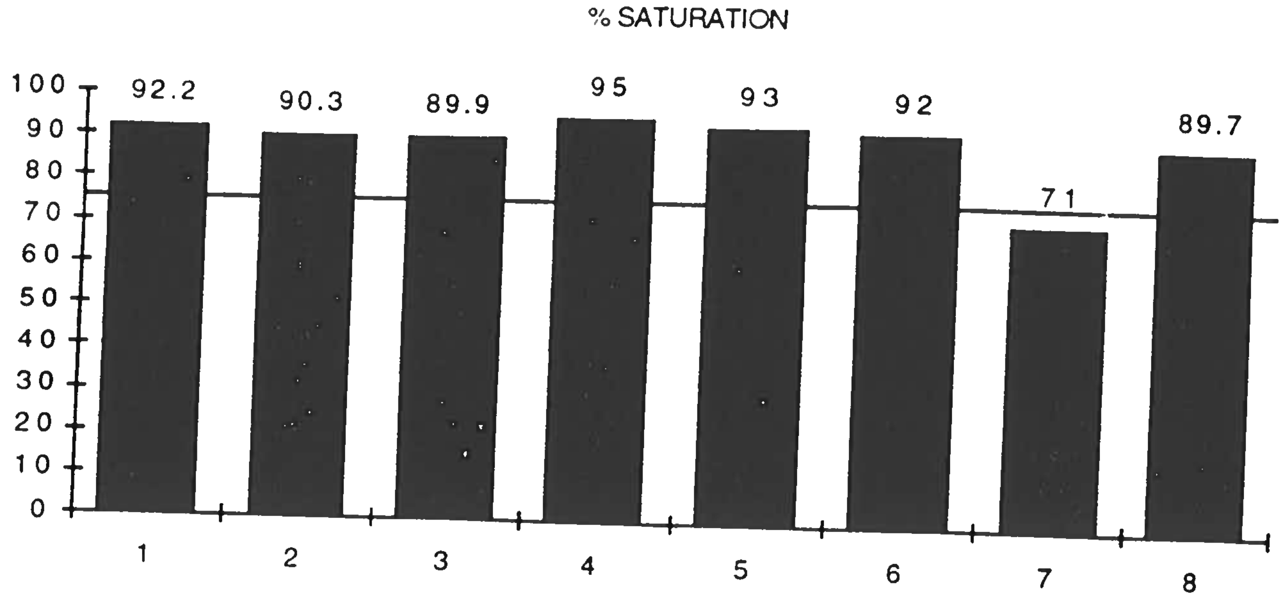


SITE #6

% SATURATION



SITE #5


% SATURATION
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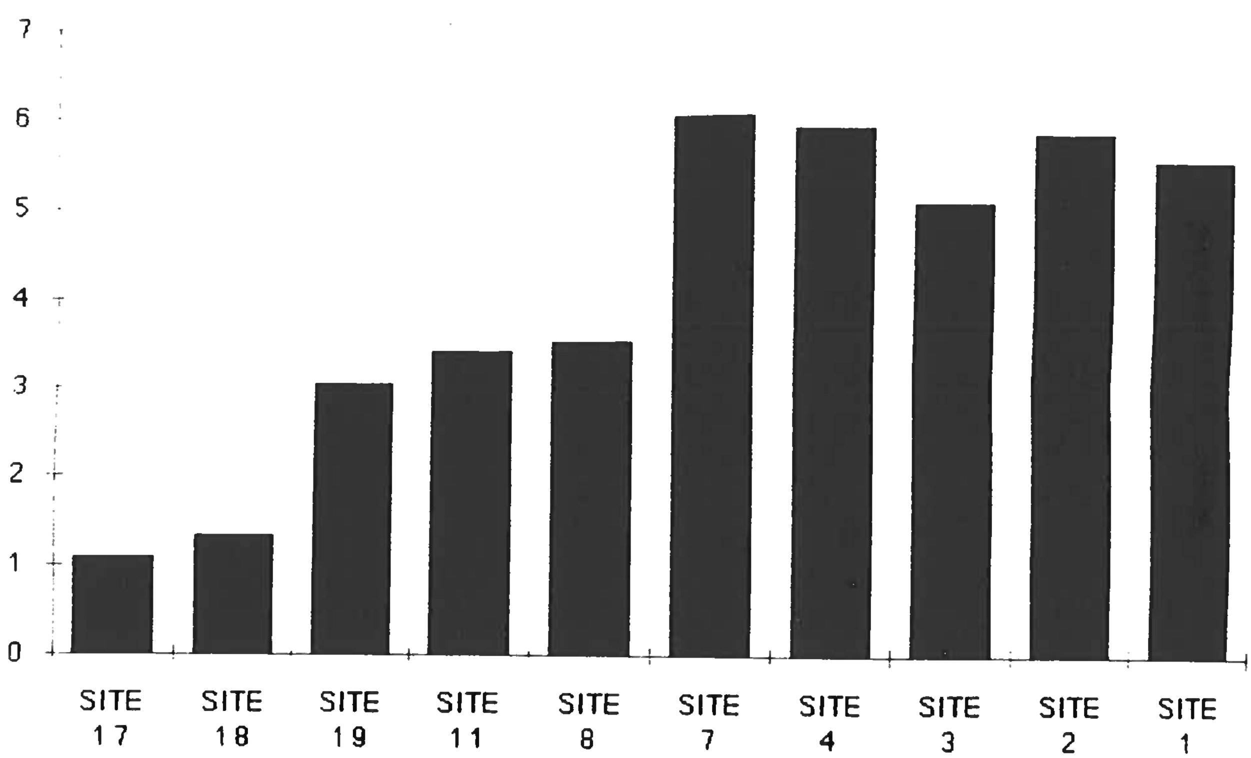
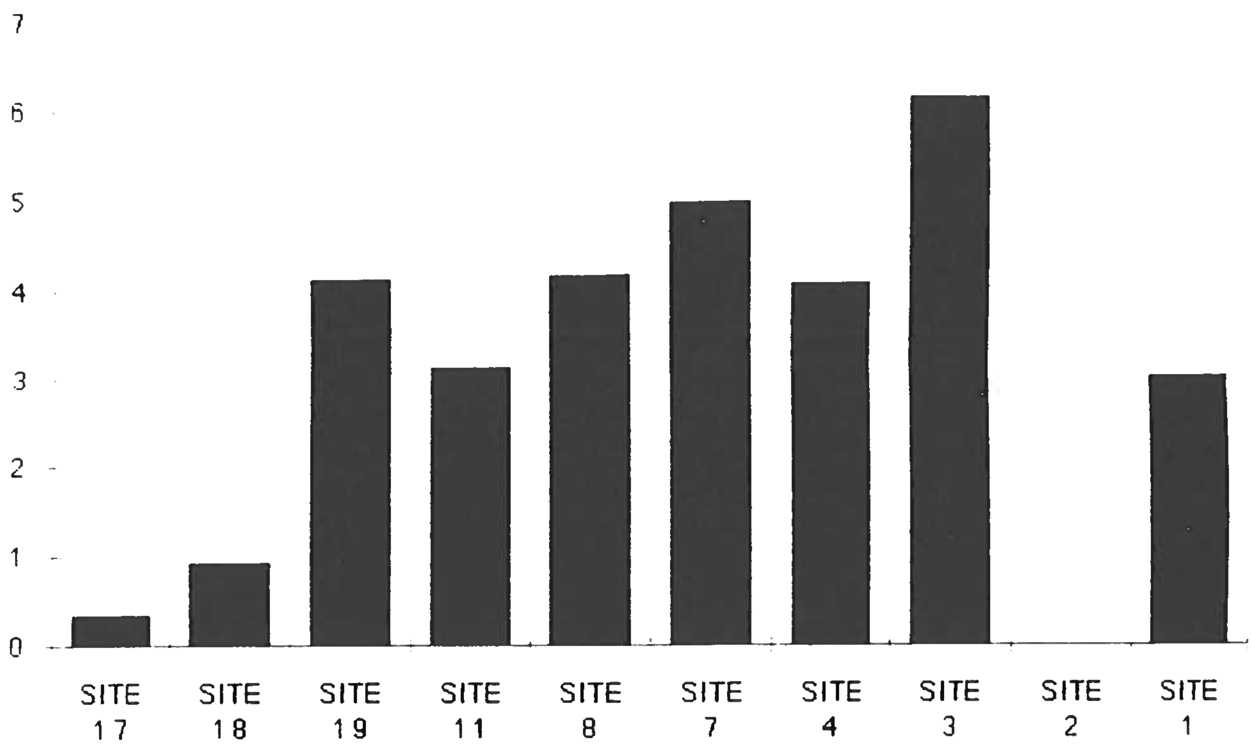
50
40
30
20
10
0
92.2
90.3
89.9
95
93
92
71
89.7
1
2
3
4
5
6
7
8

TURBIDITIY

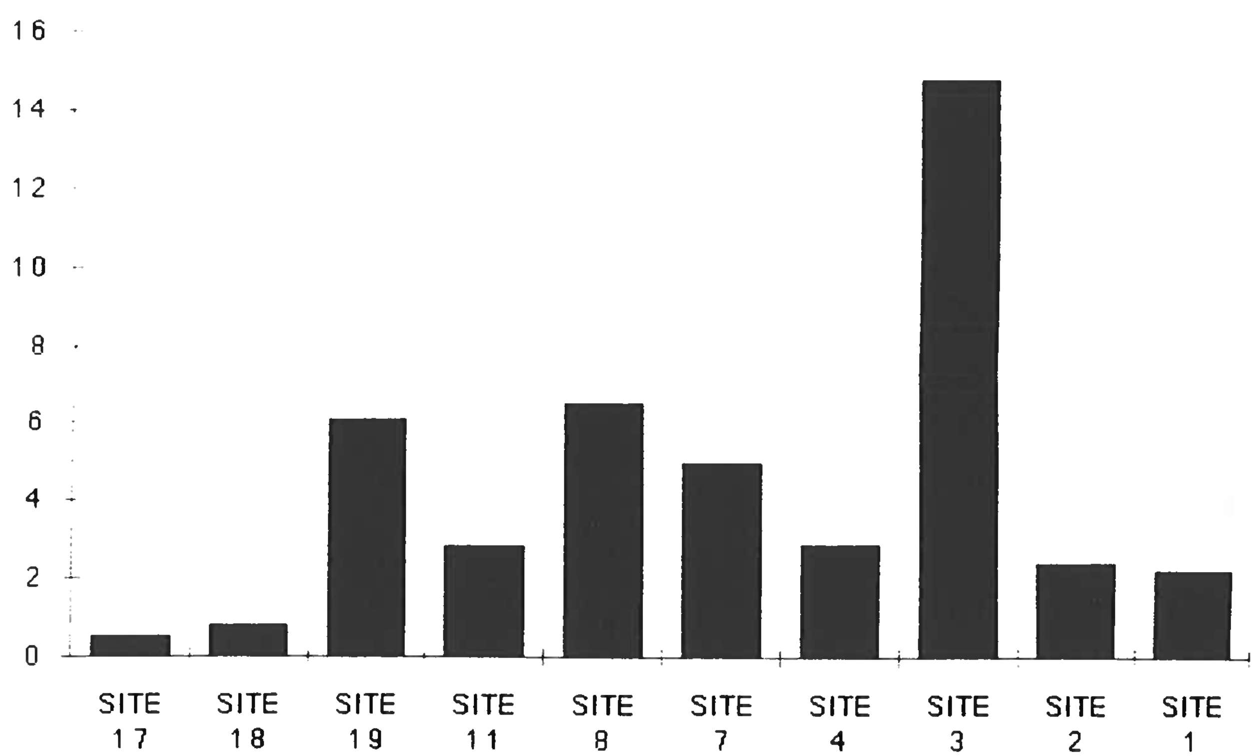
6/9/93 GRAPH 2



7
6
5
4
3
2
1
0
SITE 17
SITE 18
SITE 19
SITE 11
SITE 8
SITE 7
SITE 4
SITE 3
SITE 2
SITE 1

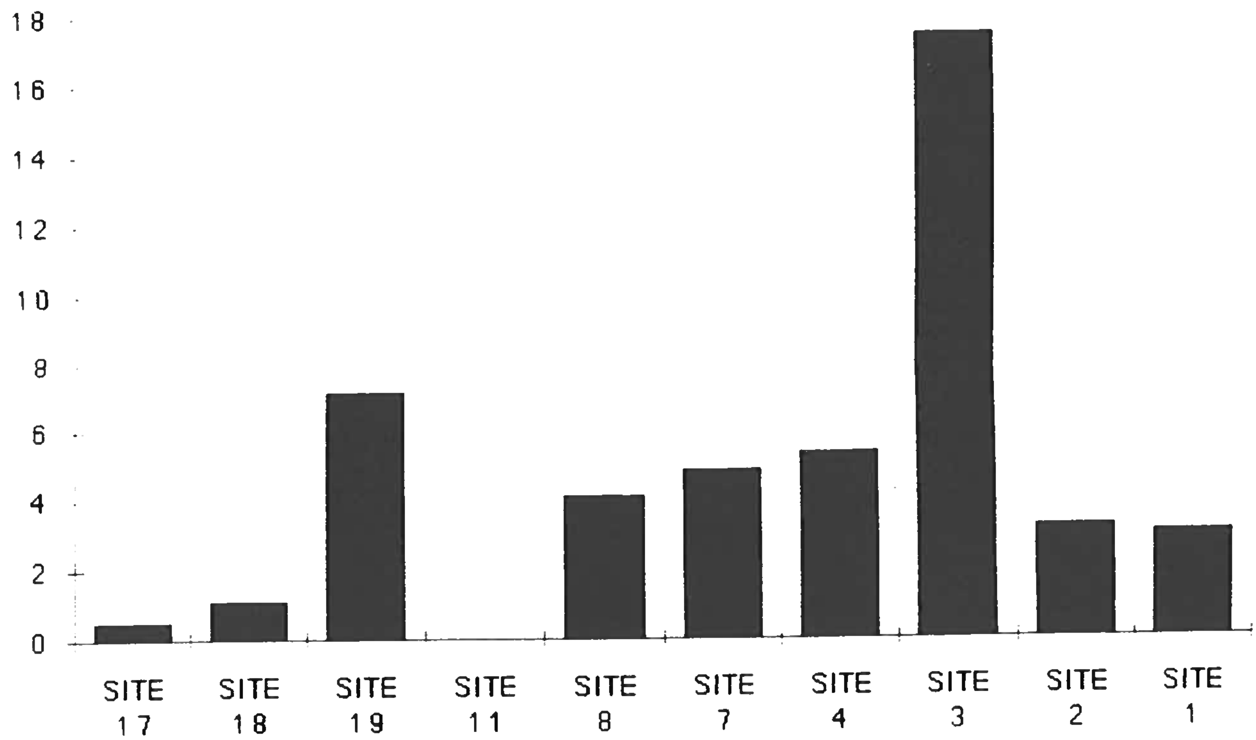

7
6
5
4
3
2
1
0
SITE 17
SITE 18
SITE 19
SITE 11
SITE 8
SITE 7
SITE 4
SITE 3
SITE 2
SITE 1

7/7/93 GRAPH 2

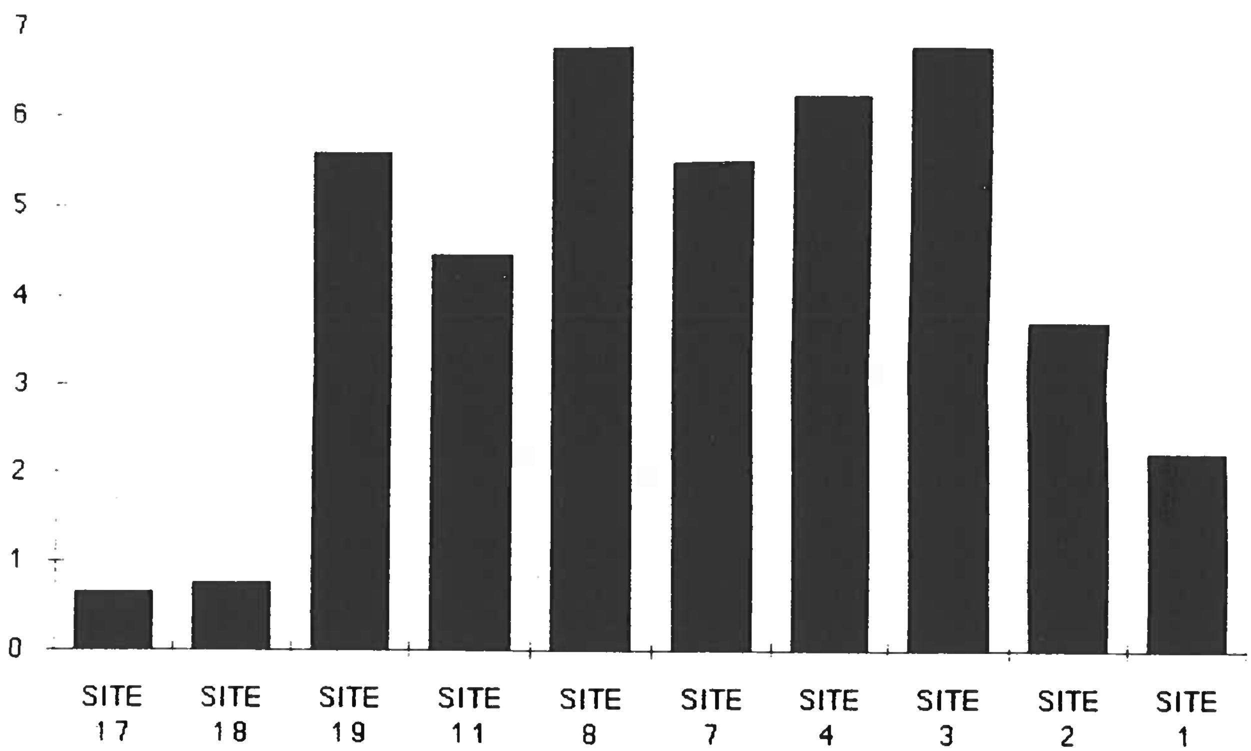


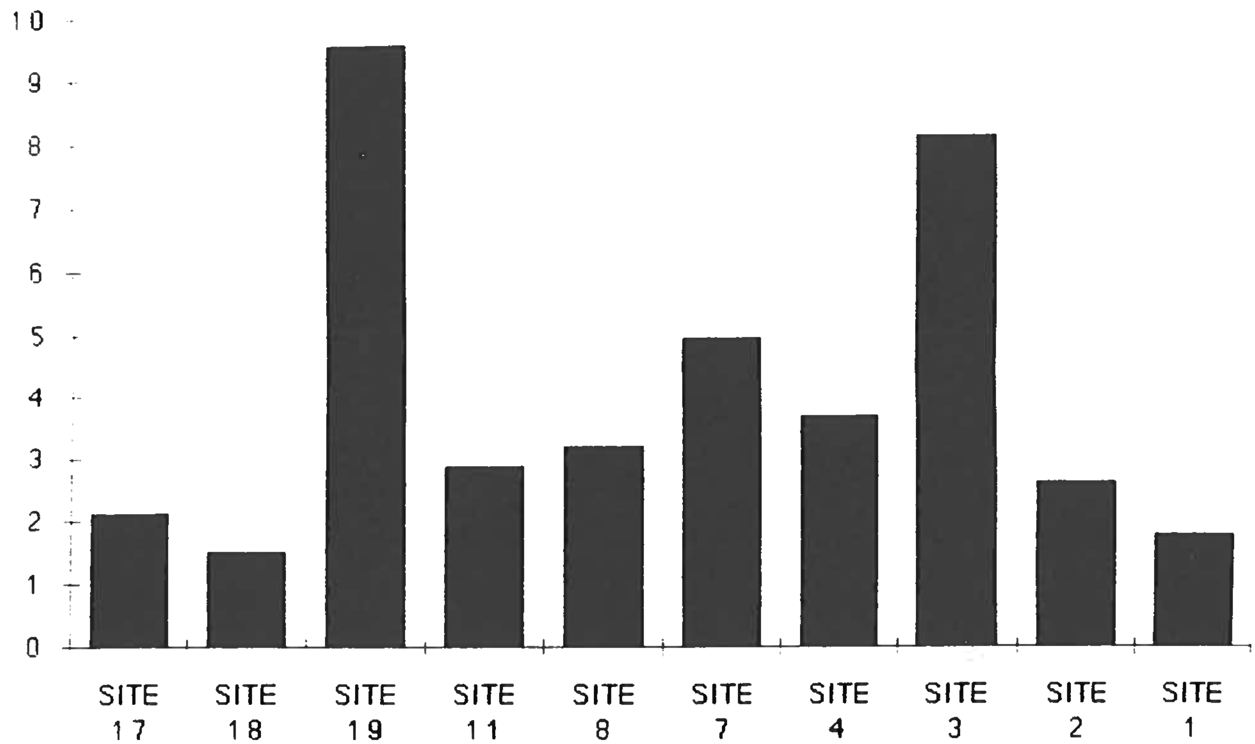
16
14
12
10
8
6
4
2
0
SITE 17
SITE 18
SITE 19
SITE 11
SITE 8
SITE 7
SITE 4
SITE 3
SITE 2
SITE 1

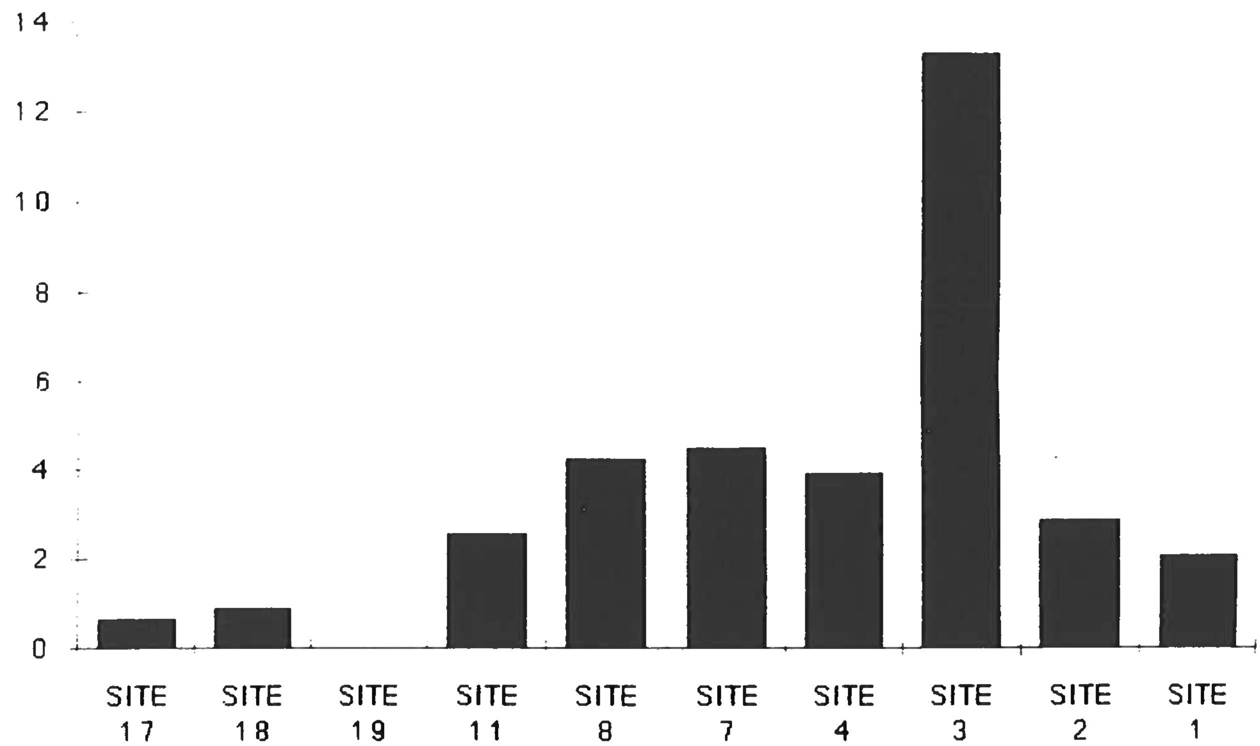
7/23/93 GRAPH 2



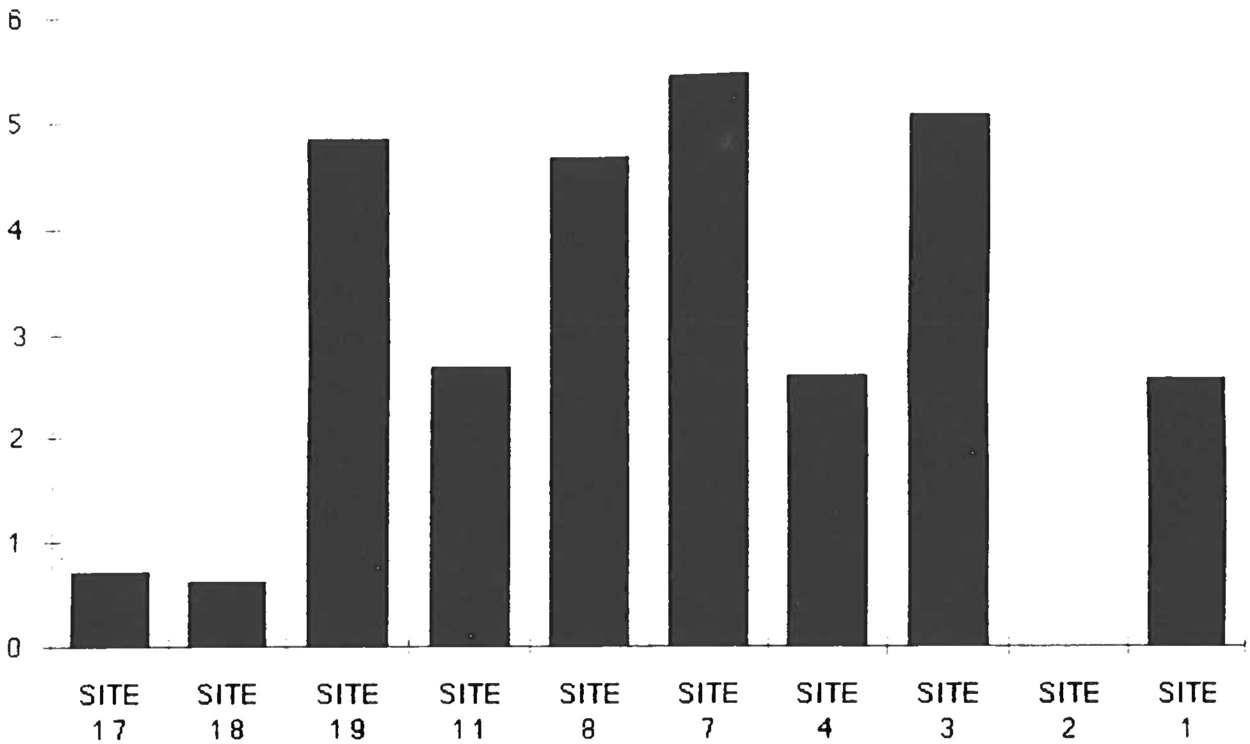
8/4/93 GRAPH 2


7
6
5
4
3
2
1
0
SITE 17
SITE 18
SITE 19
SITE 11
SITE 8
SITE 7
SITE 4
SITE 3
SITE 2
SITE 1

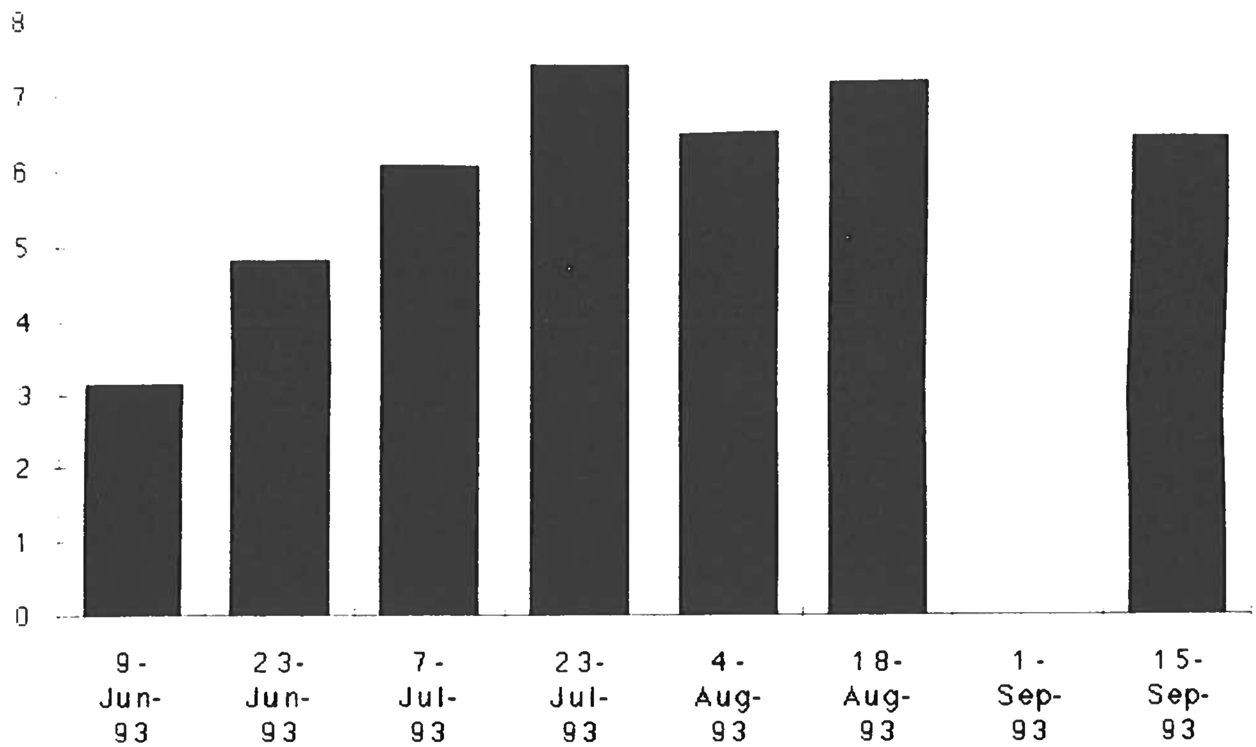

10
9
8
7
6
5
4
3
2
1
0
SITE 17
SITE 18
SITE 19
SITE 11
SITE 8
SITE 7
SITE 4
SITE 3
SITE 2
SITE 1


14
12
10
8
6
4
2
0
SITE 17
SITE 18
SITE 19
SITE 11
SITE 8
SITE 7
SITE 4
SITE 3
SITE 2
SITE 1

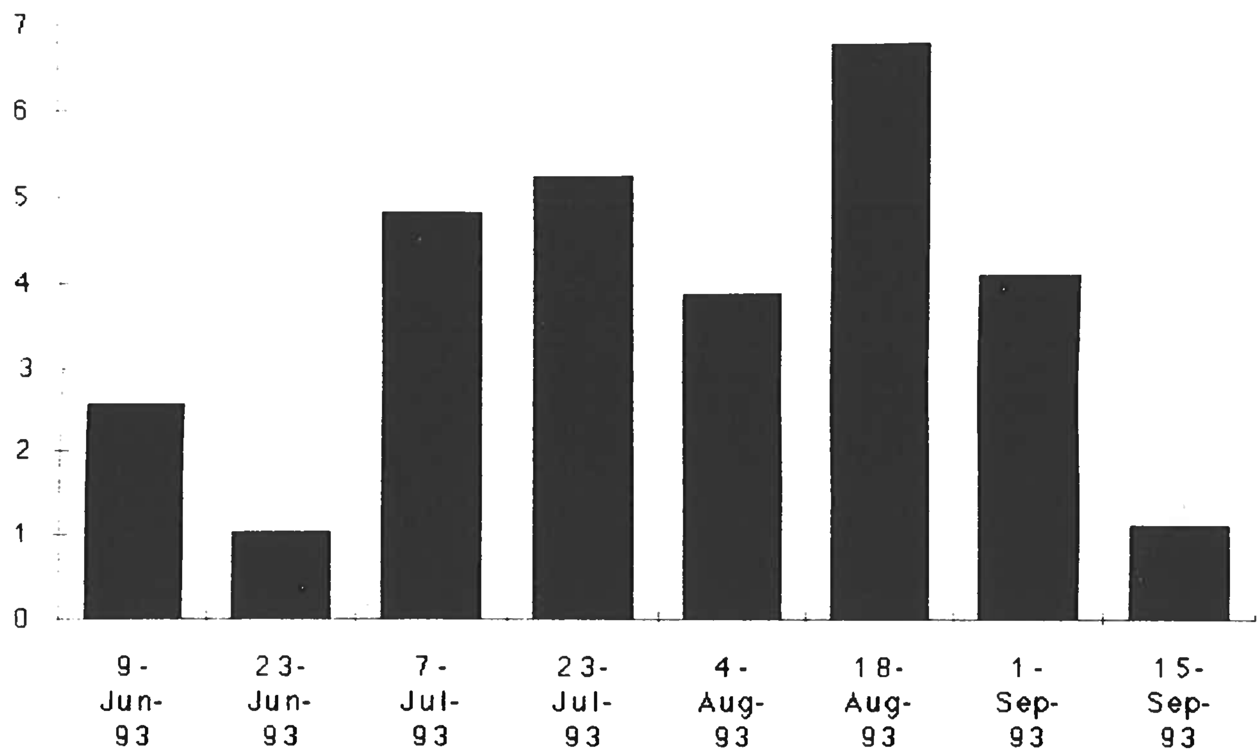
9/15/93 GRAPH 2

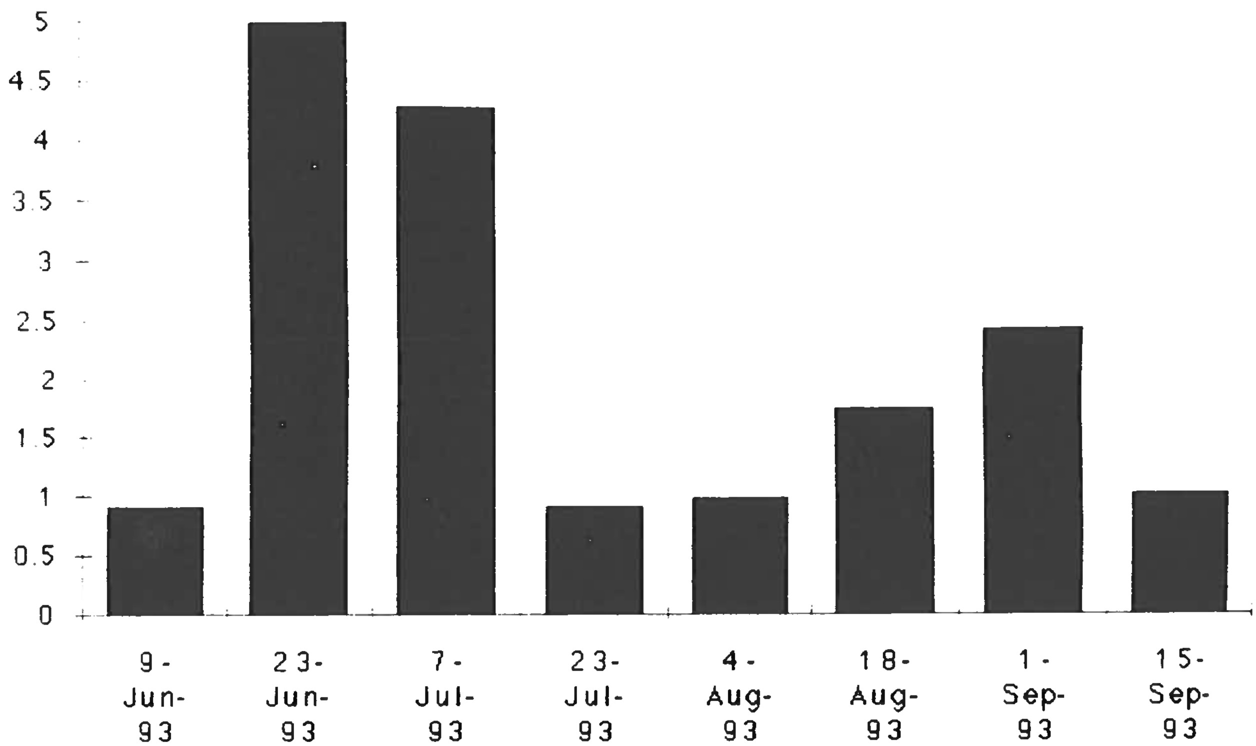


SITES ON BROOK

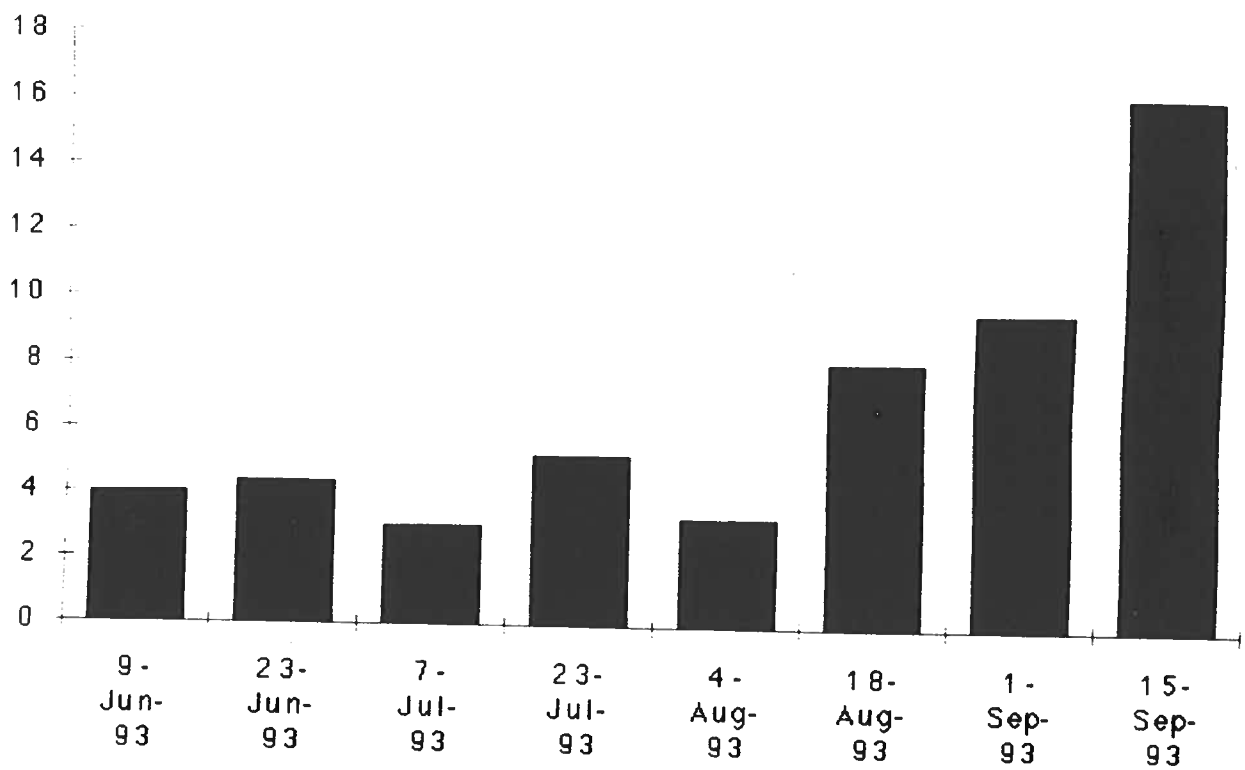

8
7
6
5
4
3
2
1
0
9-Jun-93
23-Jun-93
7-Jul-93
23-Jul-93
4-Aug-93
18-Aug-93
1-Sep-93
15-Sep-93

CHANDLER RIVER




5
4.5
4
3.5
3
2.5
2
1.5
1
0.5
0
9-Jun-93
23-Jun-93
7-Jul-93
23-Jul-93
4-Aug-93
18-Aug-93
1-Sep-93
15-Sep-93

TODDY BROOK


18
16
14
12
10
8
6
4
2
0
9-Jun-93
23-Jun-93
7-Jul-93
23-Jul-93
4-Aug-93
18-Aug-93
1-Sep-93
15-Sep-93

RANGES OF TURBIDITY

The highest turbidity found on the Royal River was 17 which was at the 3rd site on July 23, 1993. The lowest site found on the Royal River was .20 which was at the 17th site on July 23, 1993. By taking the average of these we found out that the average turbidity of the Royal River was 8.60. You can use this number to see how the turbidity of the water at different sites compares to the average.

TOTAL COLIFORM BACTERIA

Introduction

Water. It can contain many types of bacteria in large numbers. Some are beneficial or harmless, but certain other types are pathogenic, which means they cause disease. Pathogens enter the water through discharges or runoff that contain human fecal material.

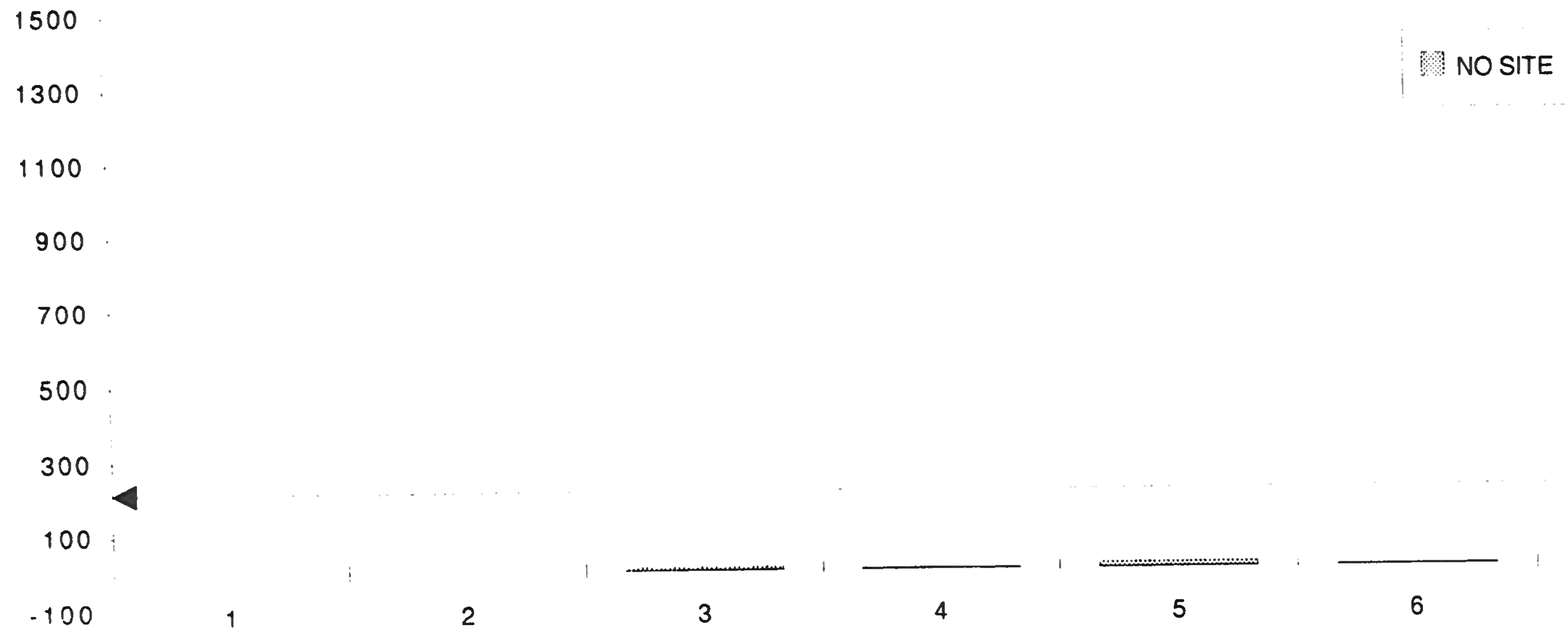
The coliform group of bacteria are present in the gut and feces of warm-blooded animals. Elevated coliform populations are suggestive of significant contamination by the excrement of warm-blooded animals. As a group, coliforms may persists in water when pathogens have disappeared.

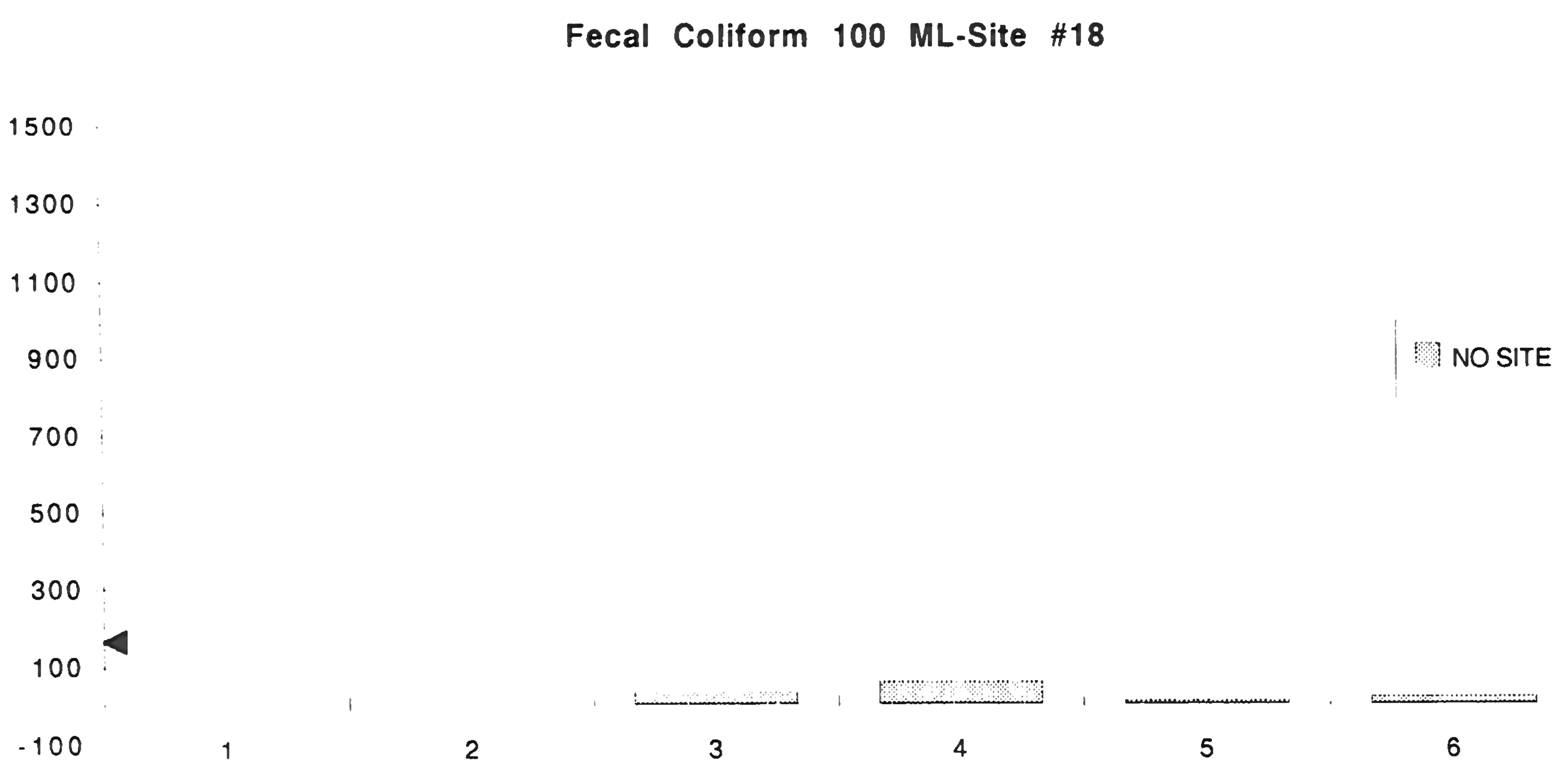
The component of the total coliform population that is derived from fecal sources is fecal coliforms. High fecal coliform counts indicate relatively recent pollution. Fecal coliform values may aid in the differentiation of animal from human waste. The reported ratio of fecal coliforms to fecal strep in human waste is greater than 4. The ratio for other animals investigated is less than 0.7. This makes it possible to infer whether the source is human or animal. Caution must be taken in the interpretation of such data because of the technical difficulties in performing precise counts.

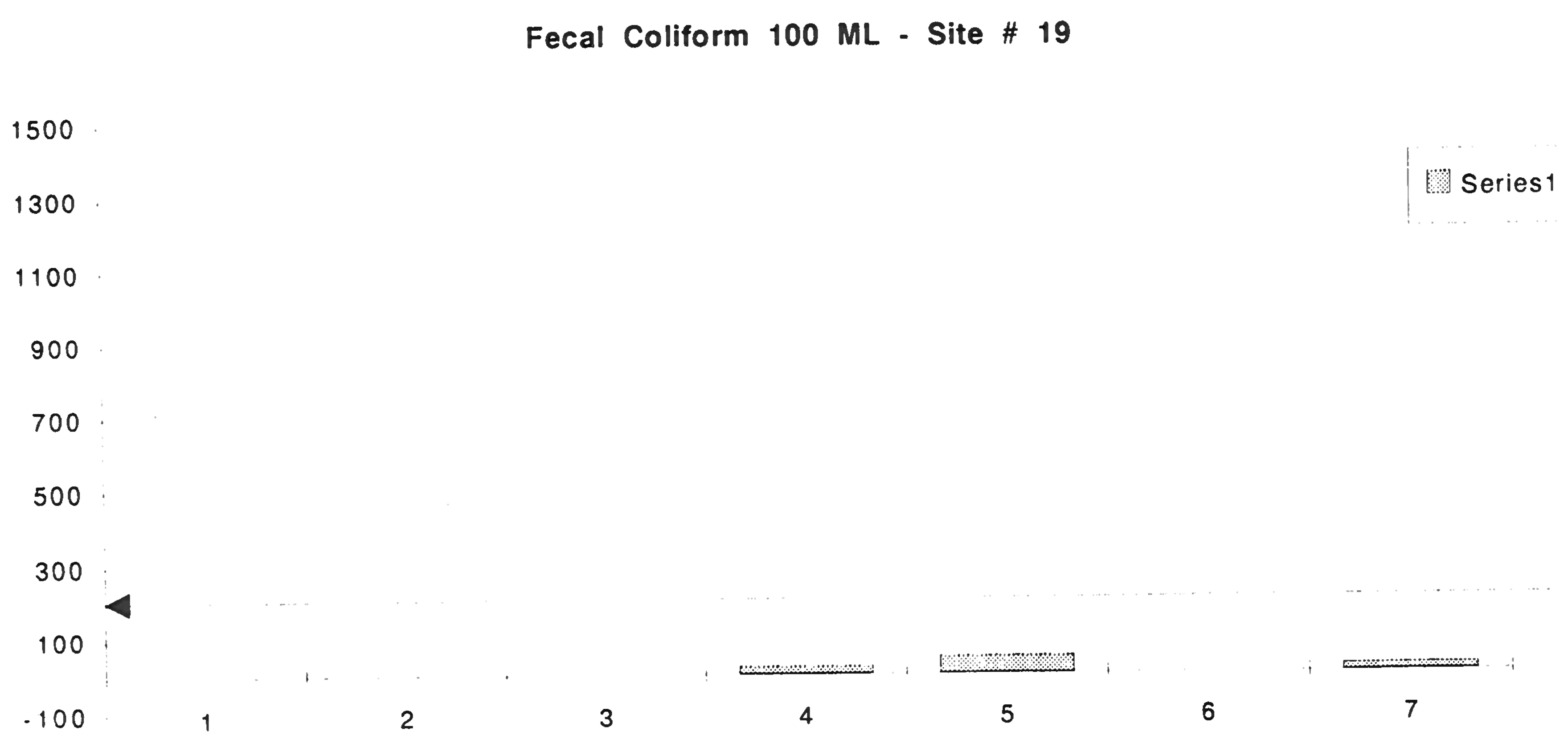
The presence of fecal streptococci indicates fecal pollution by warm-blooded animals. They cannot reproduce in water supplies and they offer a valid index of the presence of pollution. The absence of fecal strep does not necessarily mean that water is bacteriologically safe.

When total coliform testing has been done in the past, it has been adequate. When doing the testing, one must be sure to understand that the information obtained from total coliform counts is limited and that there is no way to identify whether the source is human or animal. The difficulties in performing and interpreting the tests for fecal coliform and fecal strep ratios mean that only those who choose to specialize in this area will do them.

Fecal Coliform 100 ML - Site # 17

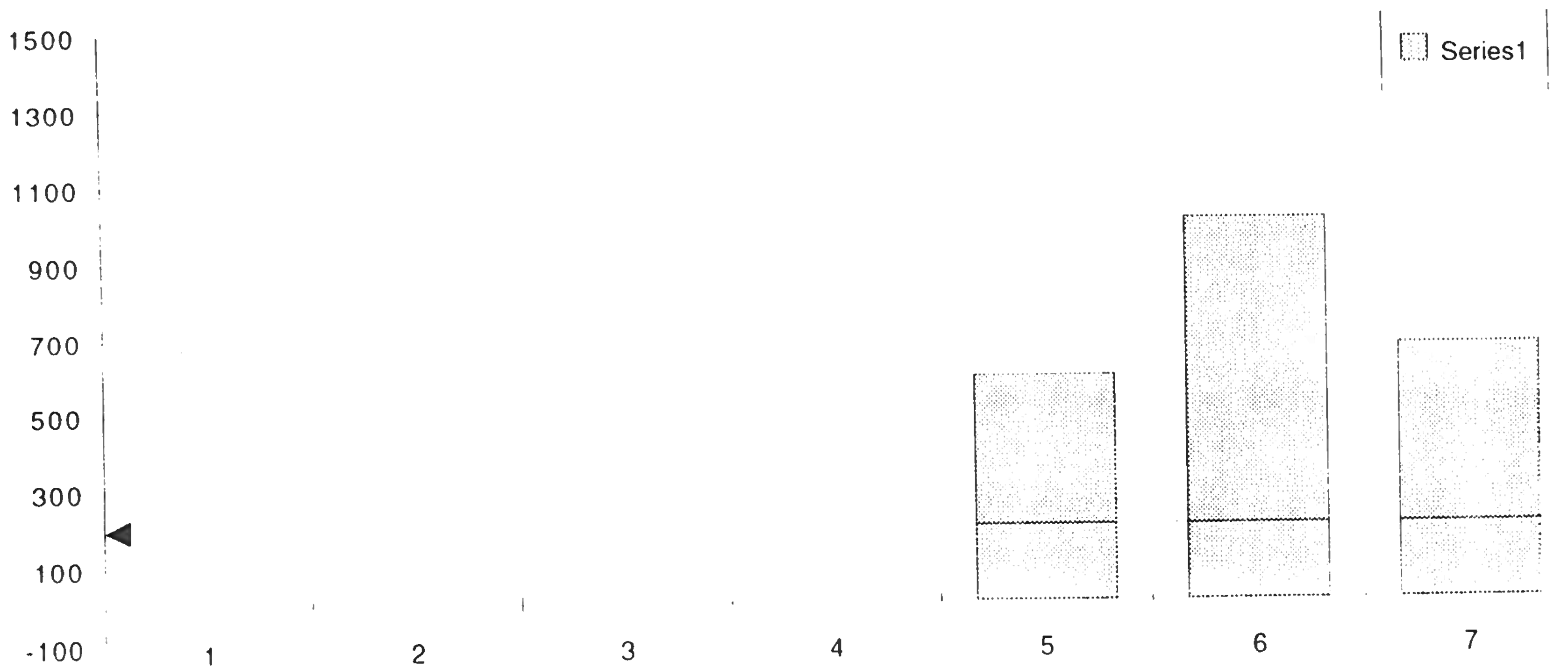


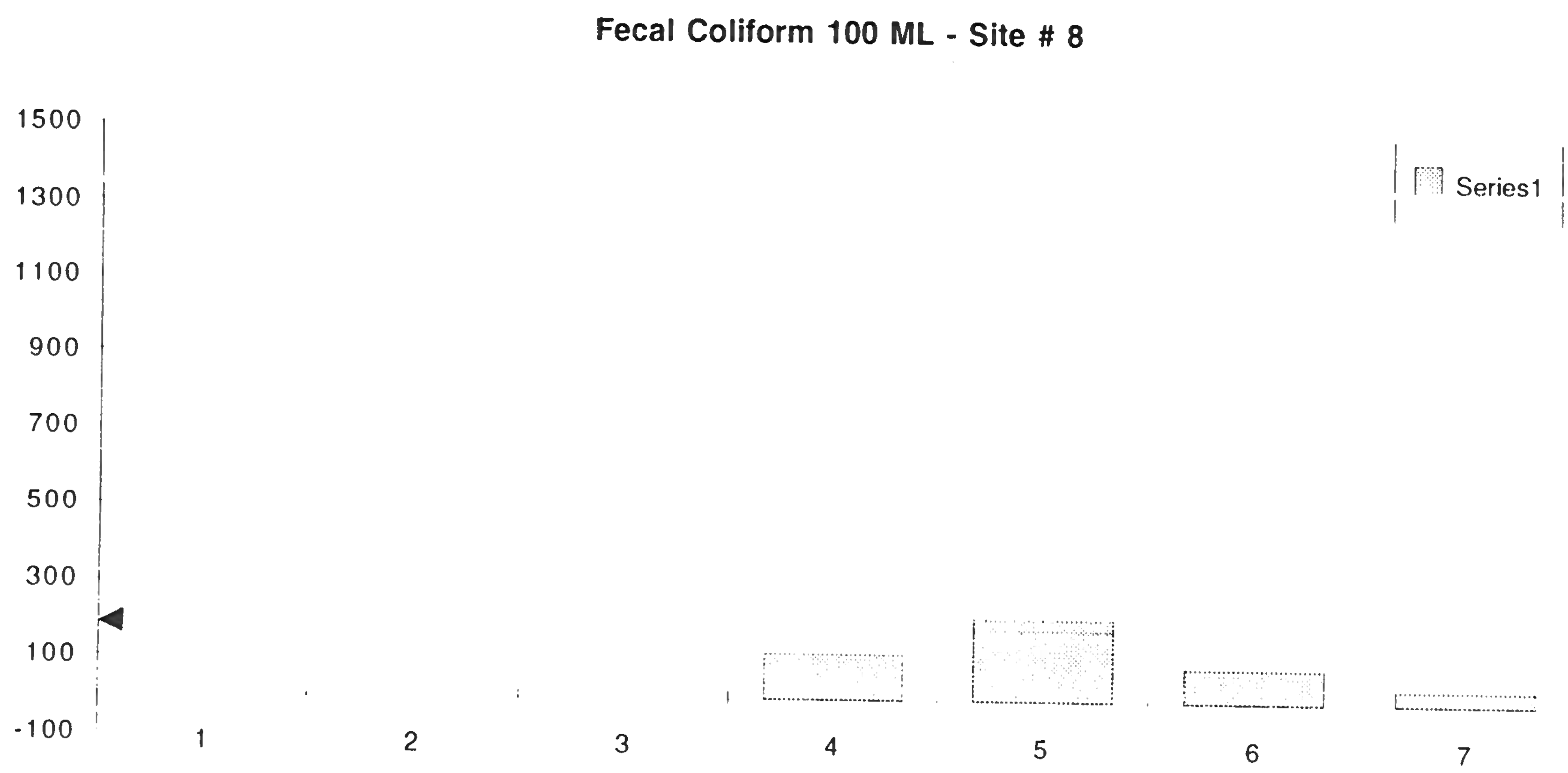

Fecal Coliform 100 ML-Site #18
1500
1300
1100
900
700
500
300
100
-100
1
2
3
4
5
6
NO SITE

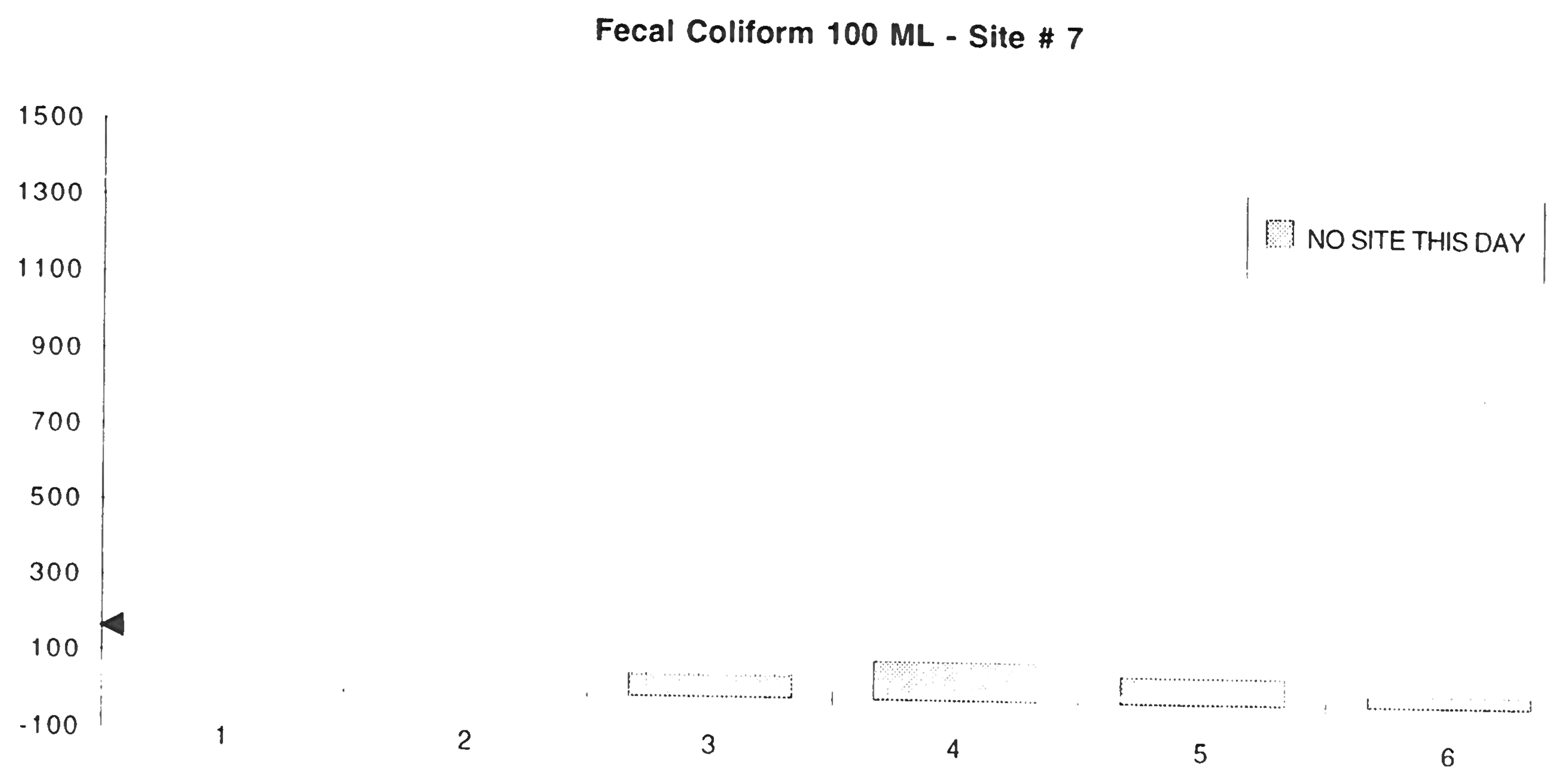


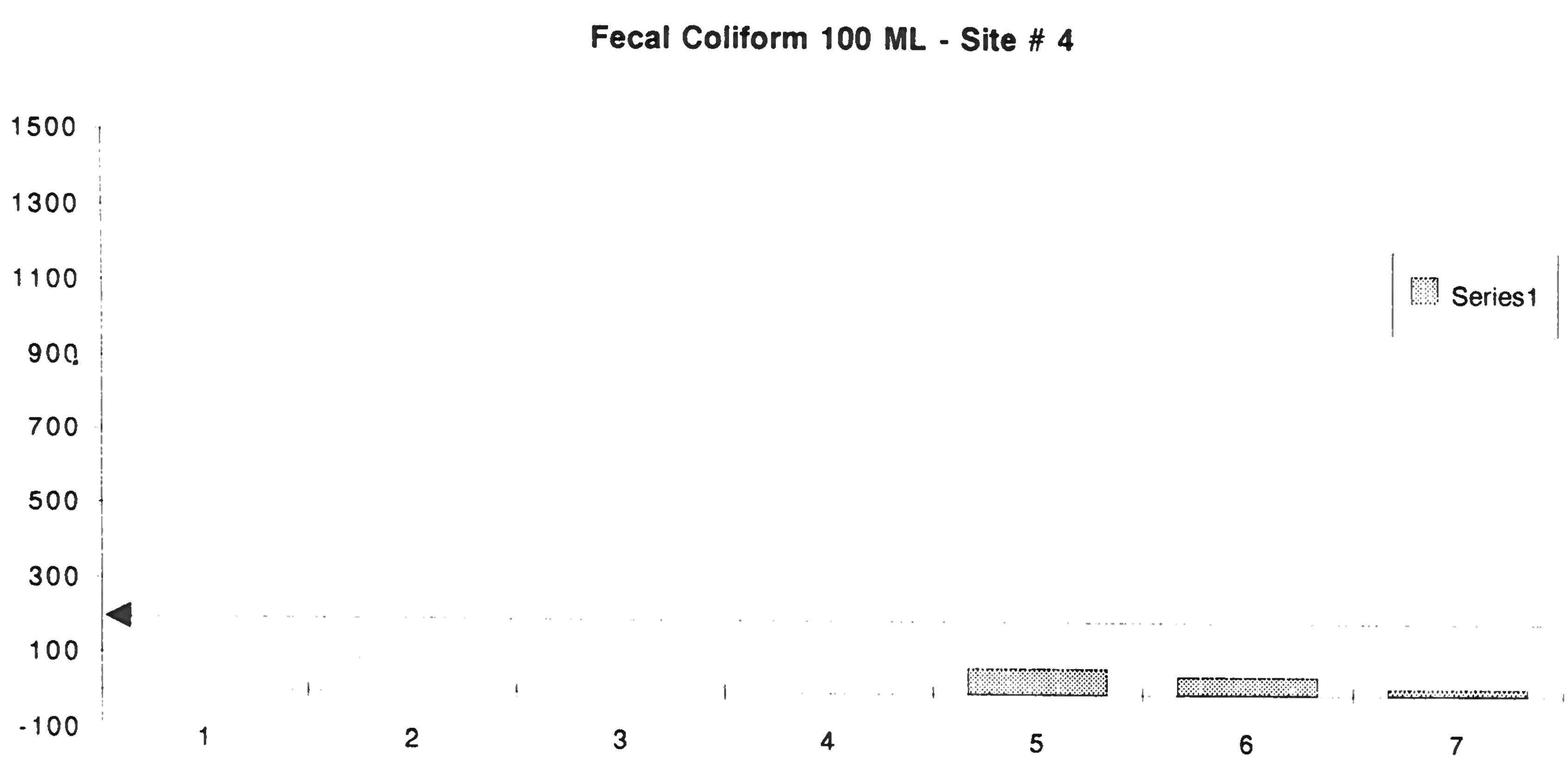
Fecal Coliform 100 ML - Site # 19
1500
1300
1100
900
700
500
300
100
-100
1
2
3
4
5
6
7
Series1

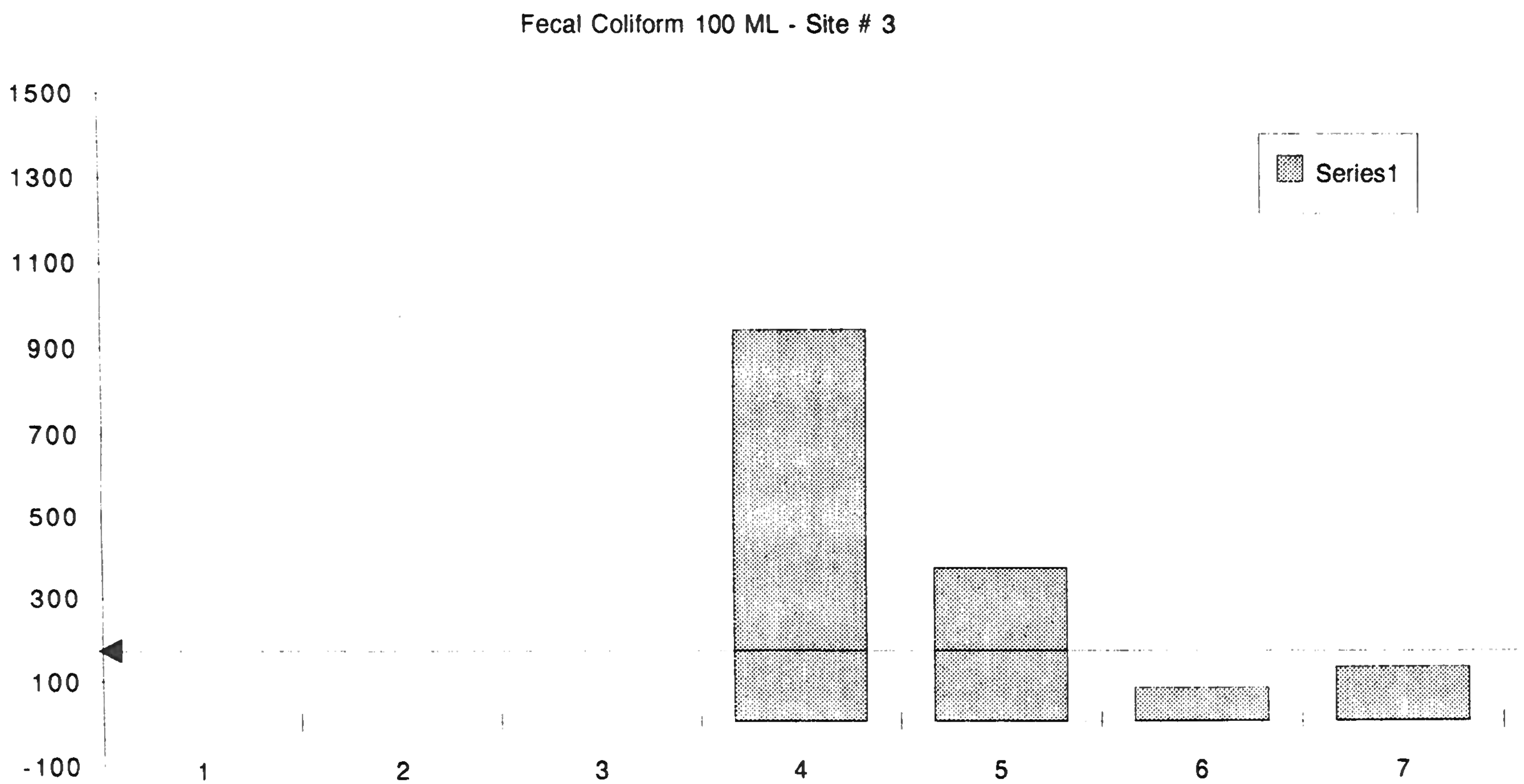
Fecal Coliform 100 ML - Site # 11

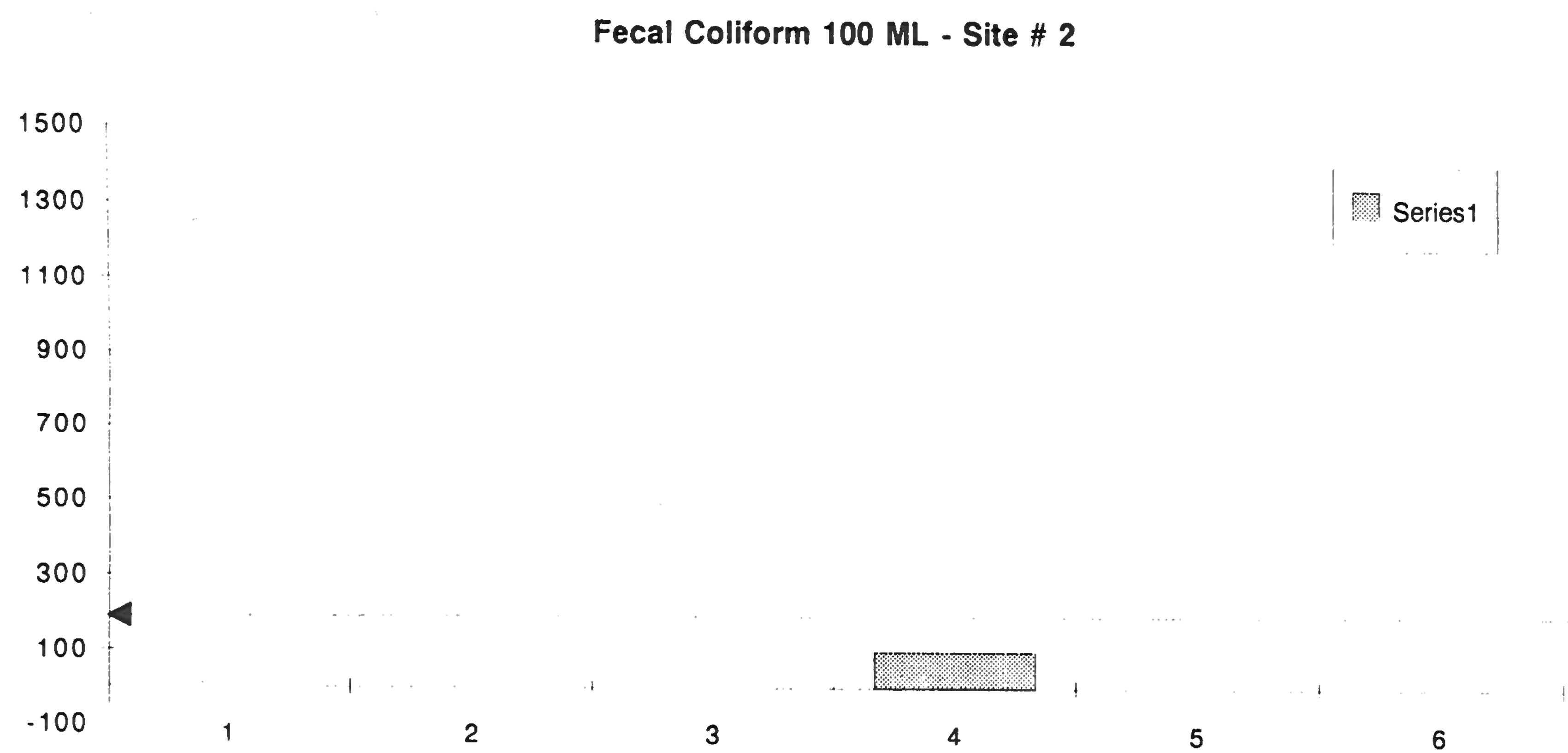


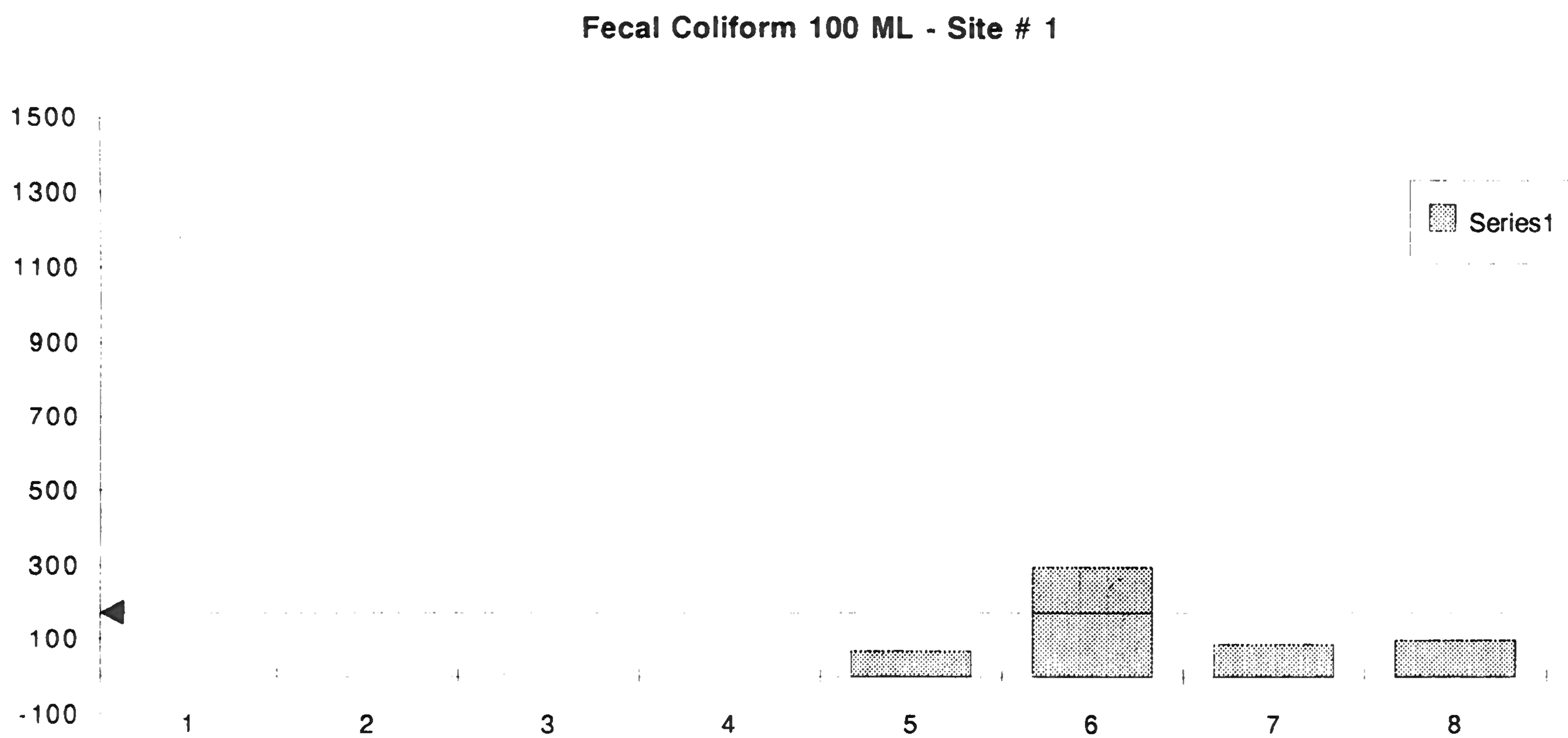

Fecal Coliform 100 ML - Site # 8
1500
1300
1100
900
700
500
300
100
-100
1
2
3
4
5
6
7
Series1

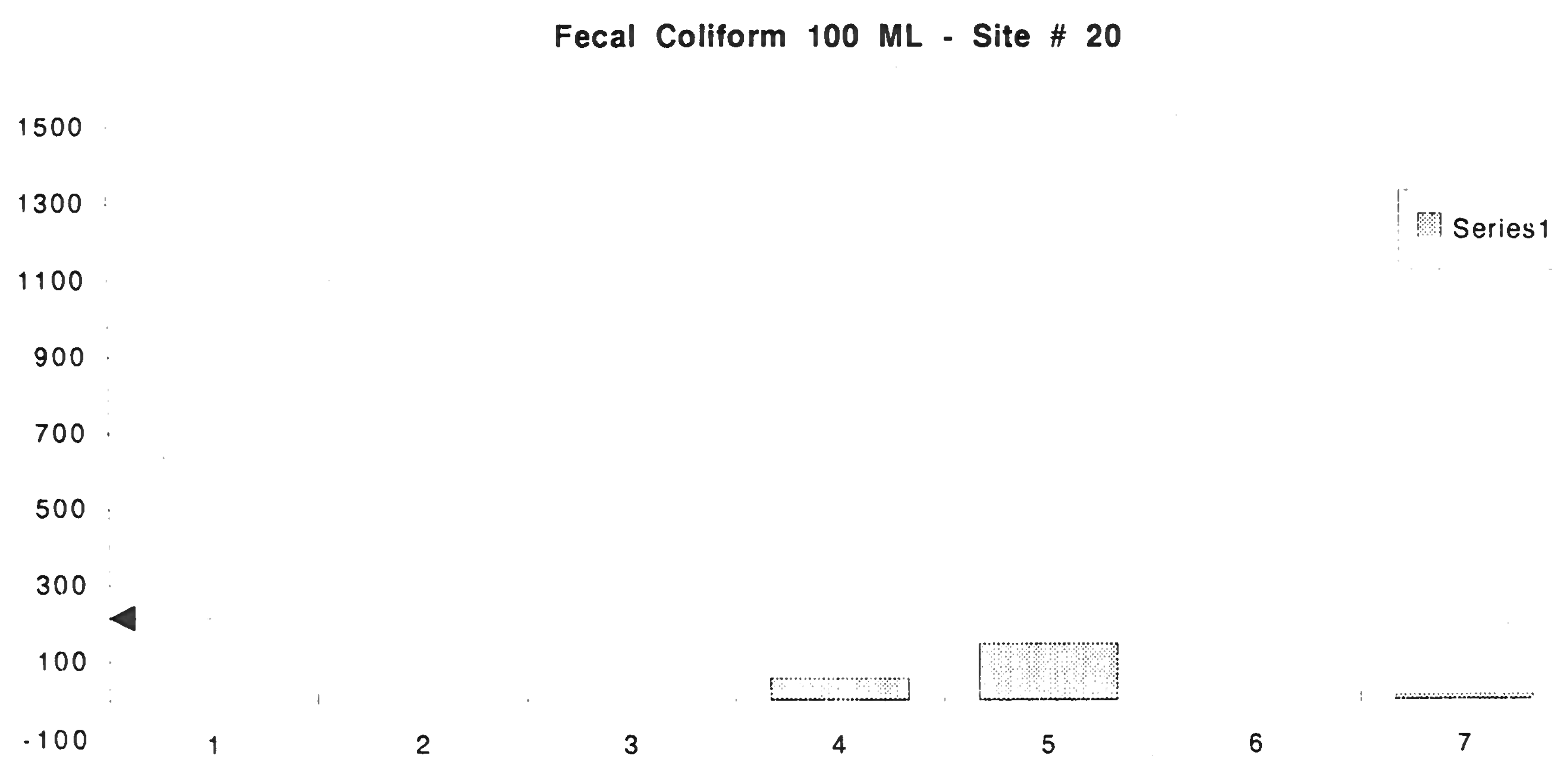

Fecal Coliform 100 ML - Site # 7
1500
1300
1100
900
700
500
300
100
-100
1
2
3
4
5
6
NO SITE THIS DAY


Fecal Coliform 100 ML - Site # 4
1500
1300
1100
900
700
500
300
100
-100
1
2
3
4
5
6
7
Series1

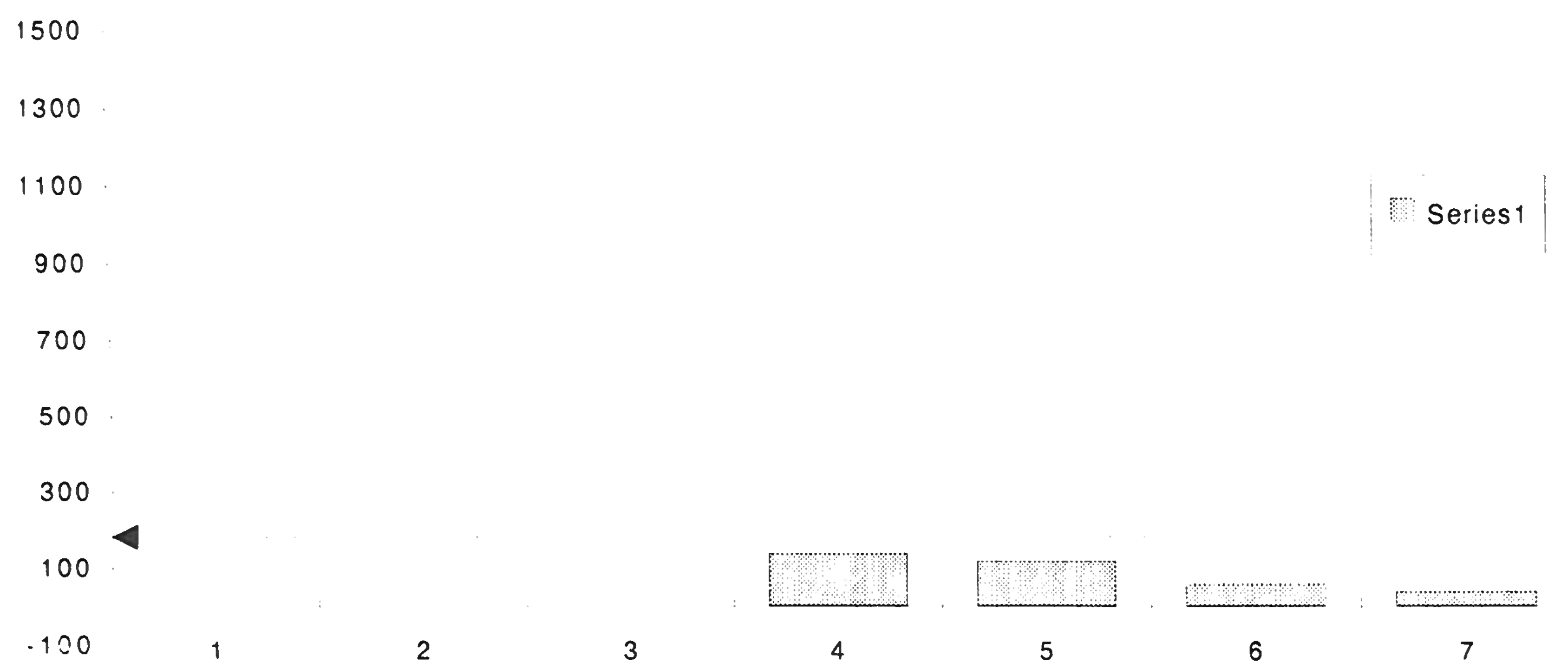

Fecal Coliform 100 ML - Site # 3
1500
1300
1100
900
700
500
300
100
-100
1
2
3
4
5
6
7
Series1


Fecal Coliform 100 ML - Site # 2
1500
1300
1100
900
700
500
300
100
-100
1
2
3
4
5
6
Series1

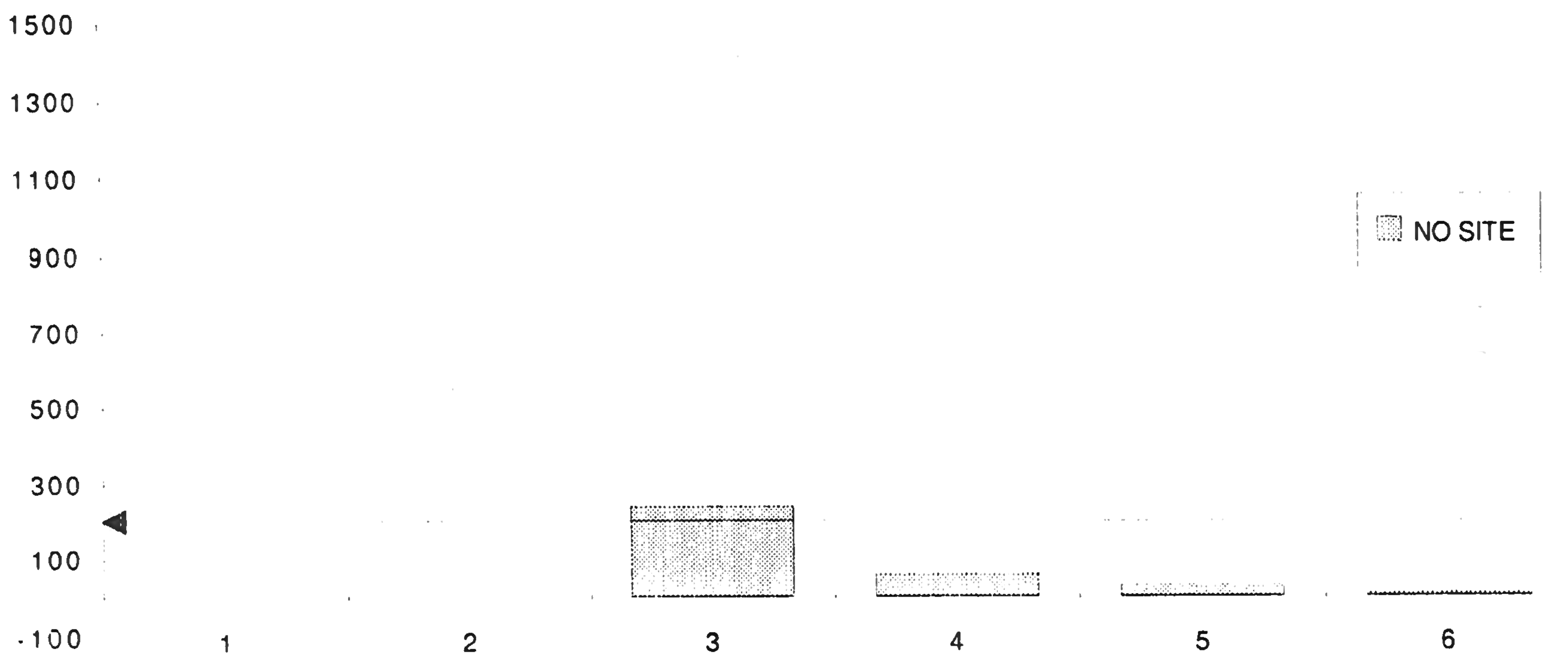

Fecal Coliform 100 ML - Site # 1
1500
1300
1100
900
700
500
300
100
-100
1
2
3
4
5
6
7
8
Series1


Fecal Coliform 100 ML - Site # 20
1500
1300
1100
900
700
500
300
100
-100
1
2
3
4
5
6
7
Series1

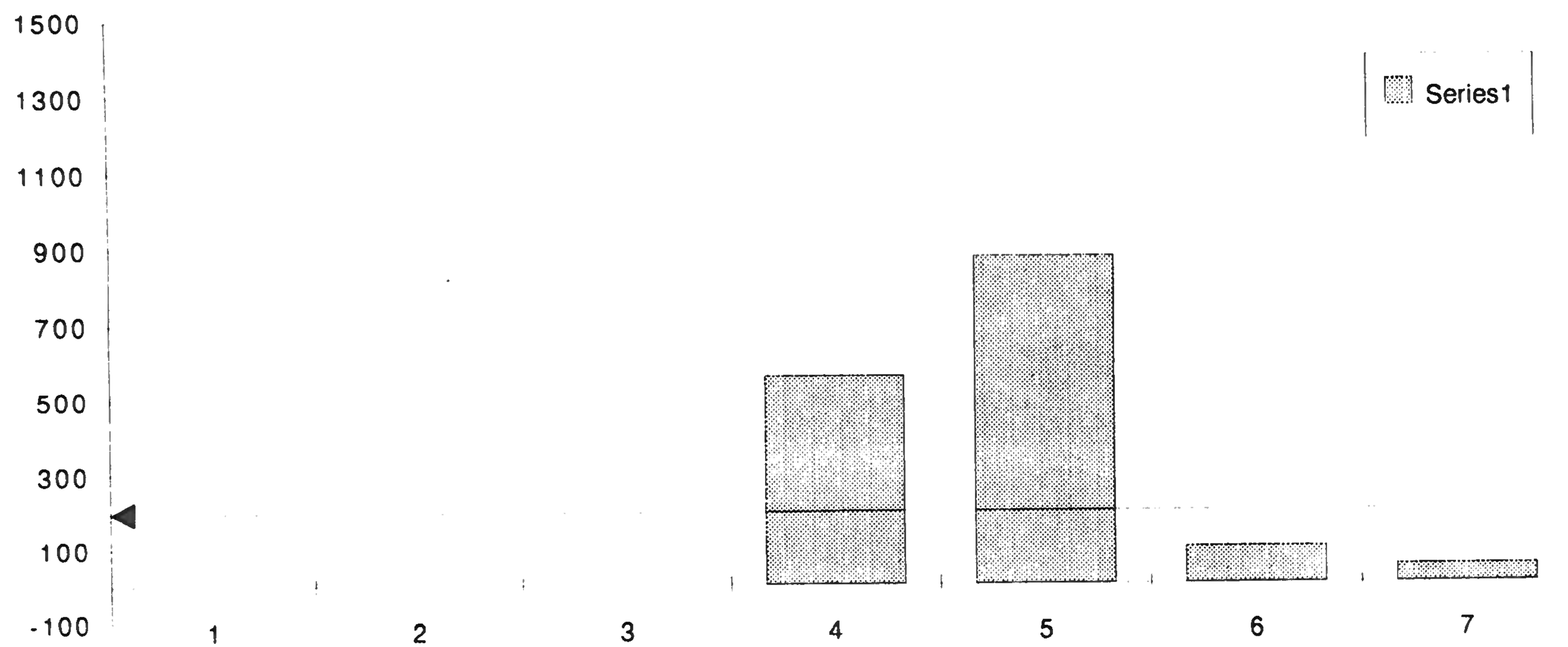
Fecal Coliform 100 ML - Site # 13

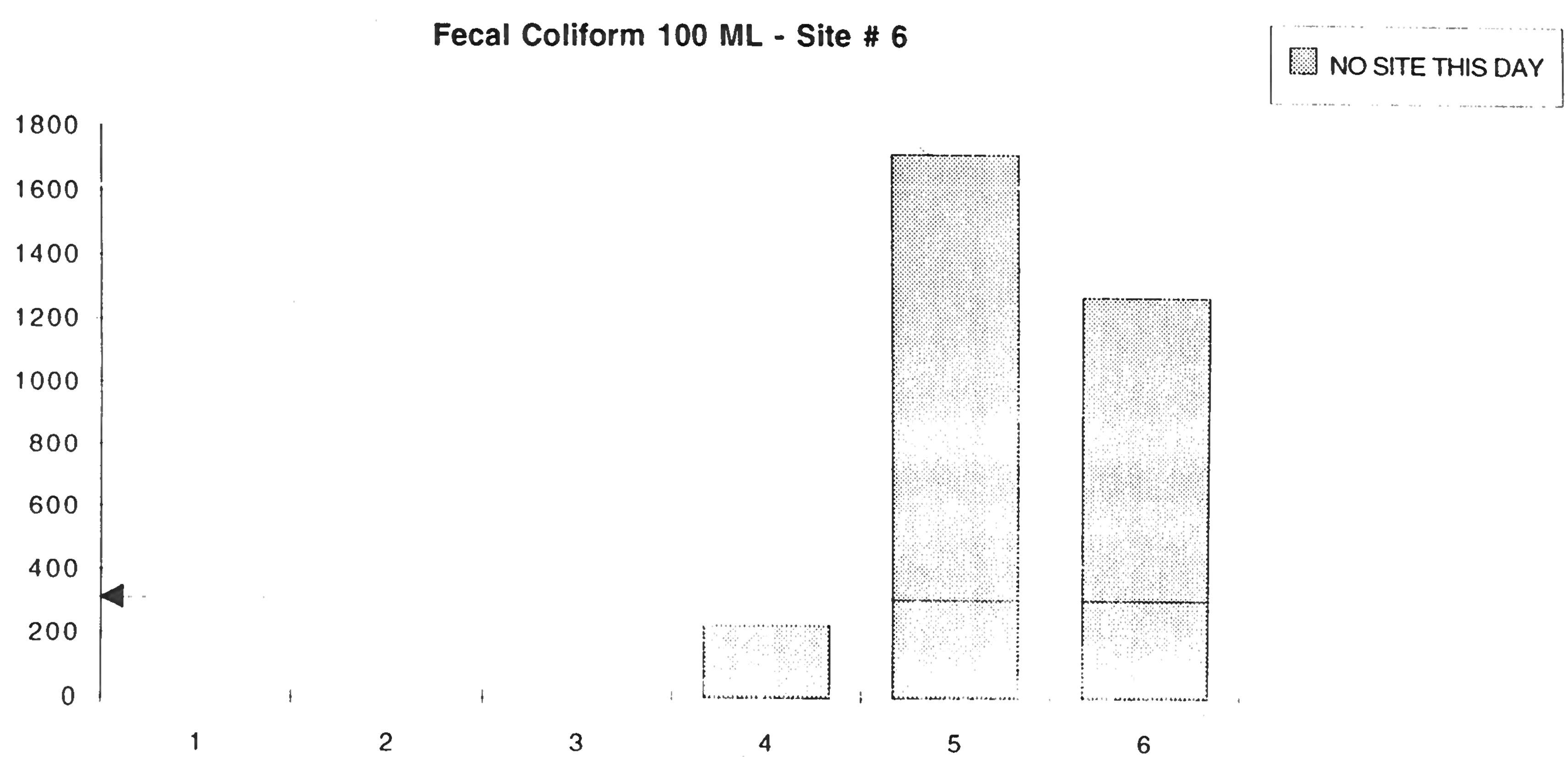


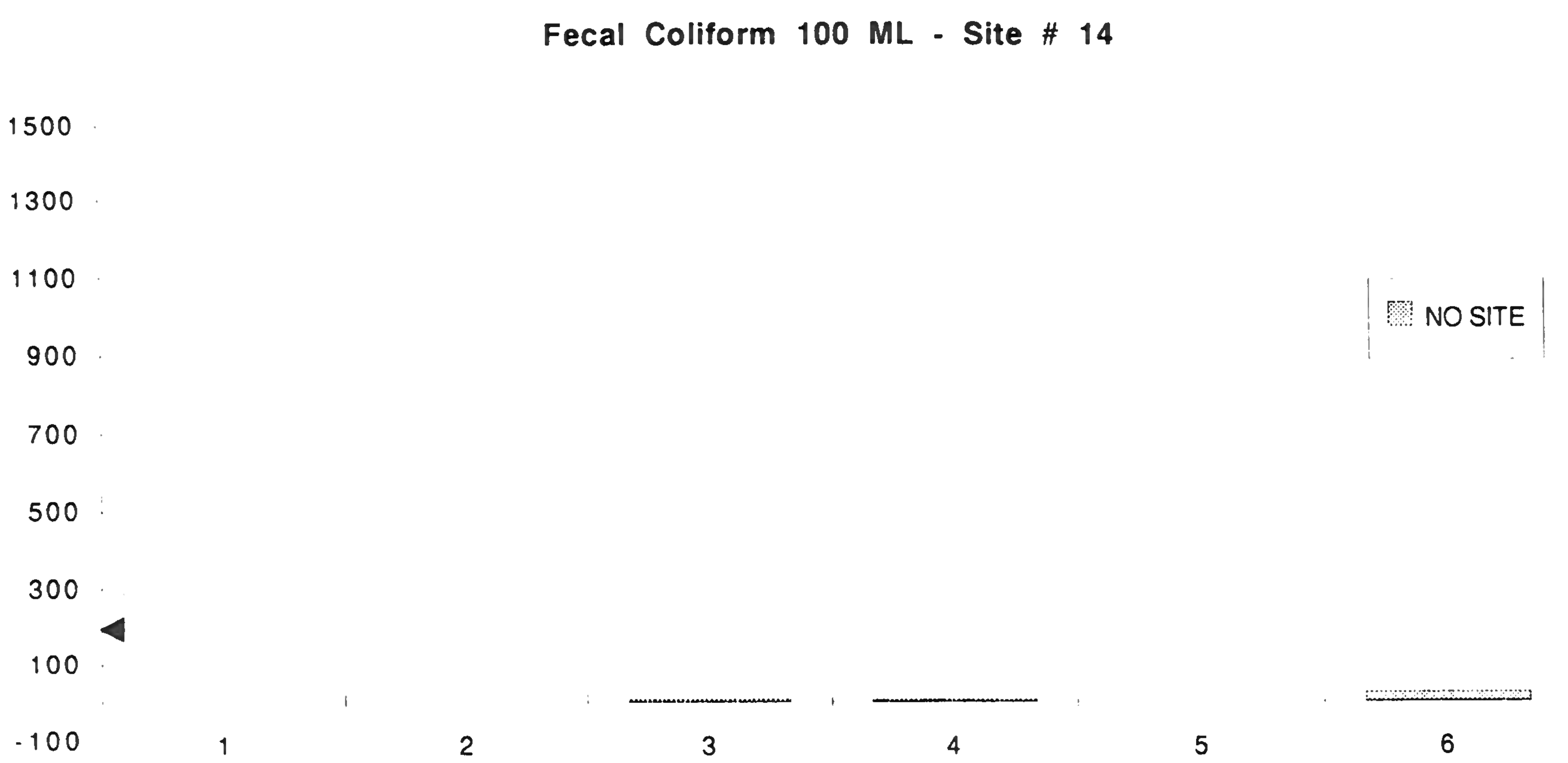
Fecal Coliform 100 ML - Site # 12

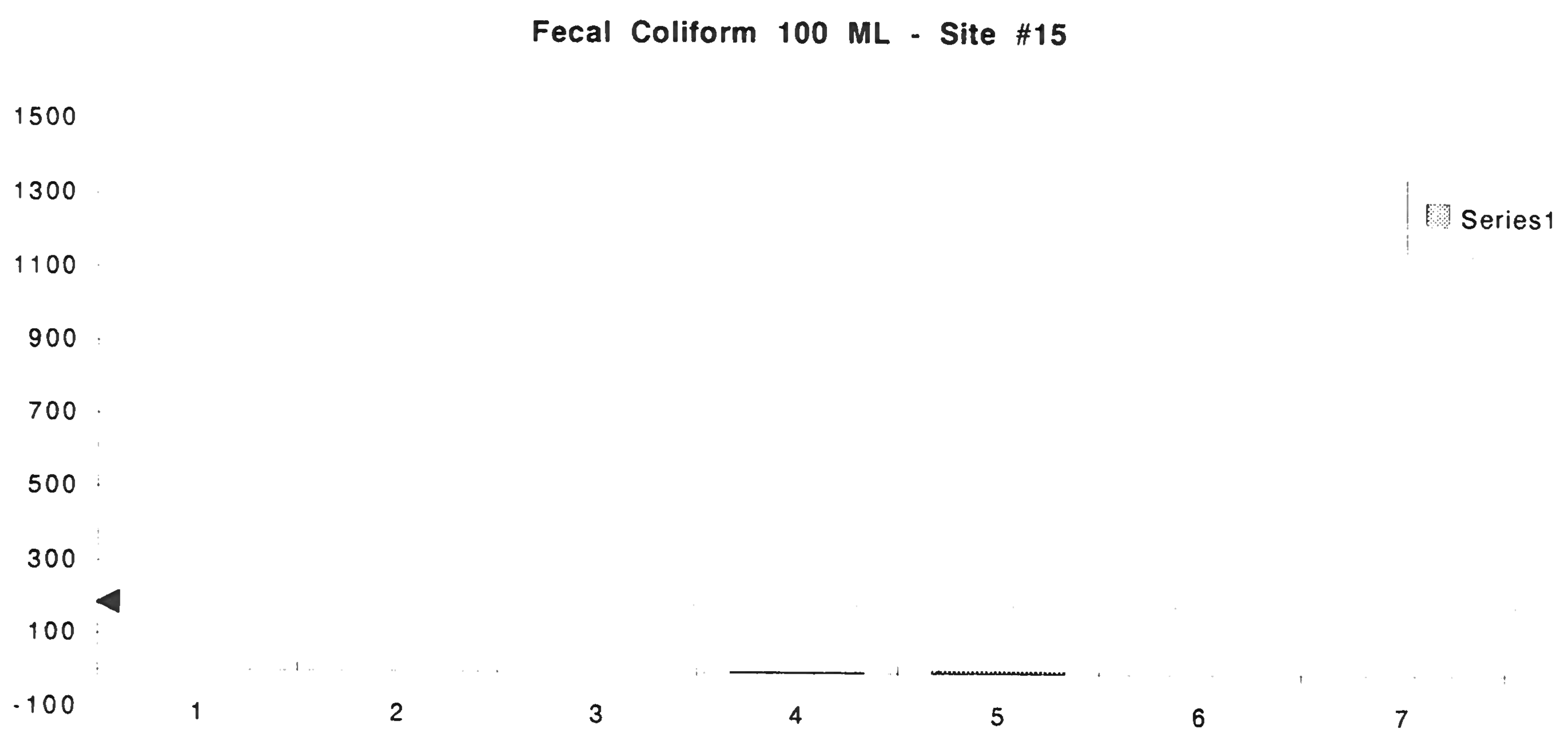


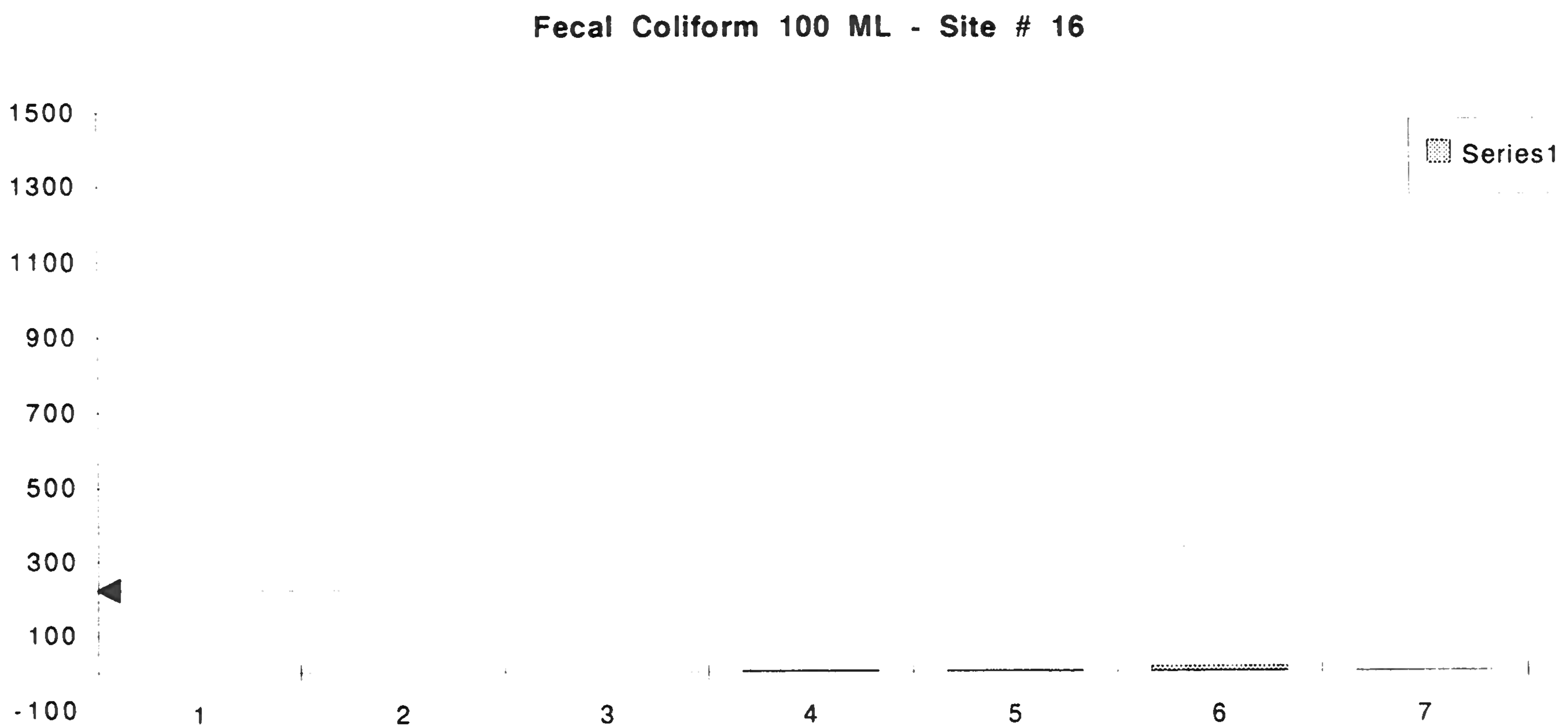
Fecal Coliform 100 ML - Site # 5



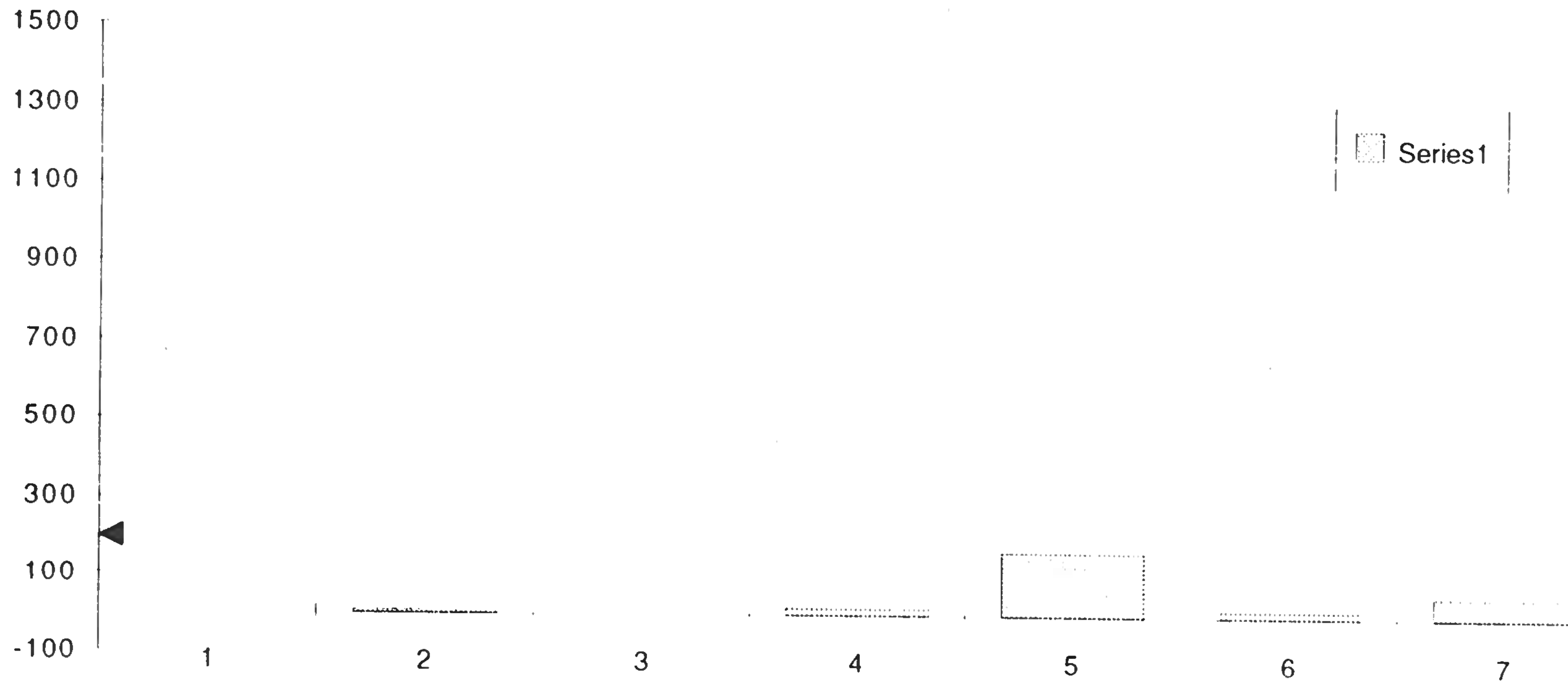

Fecal Coliform 100 ML - Site # 6
NO SITE THIS DAY
1800
1600
1400
1200
1000
800
600
400
200
0
1
2
3
4
5
6


Fecal Coliform 100 ML - Site # 14
1500
1300
1100
900
700
500
300
100
-100
1
2
3
4
5
6
NO SITE

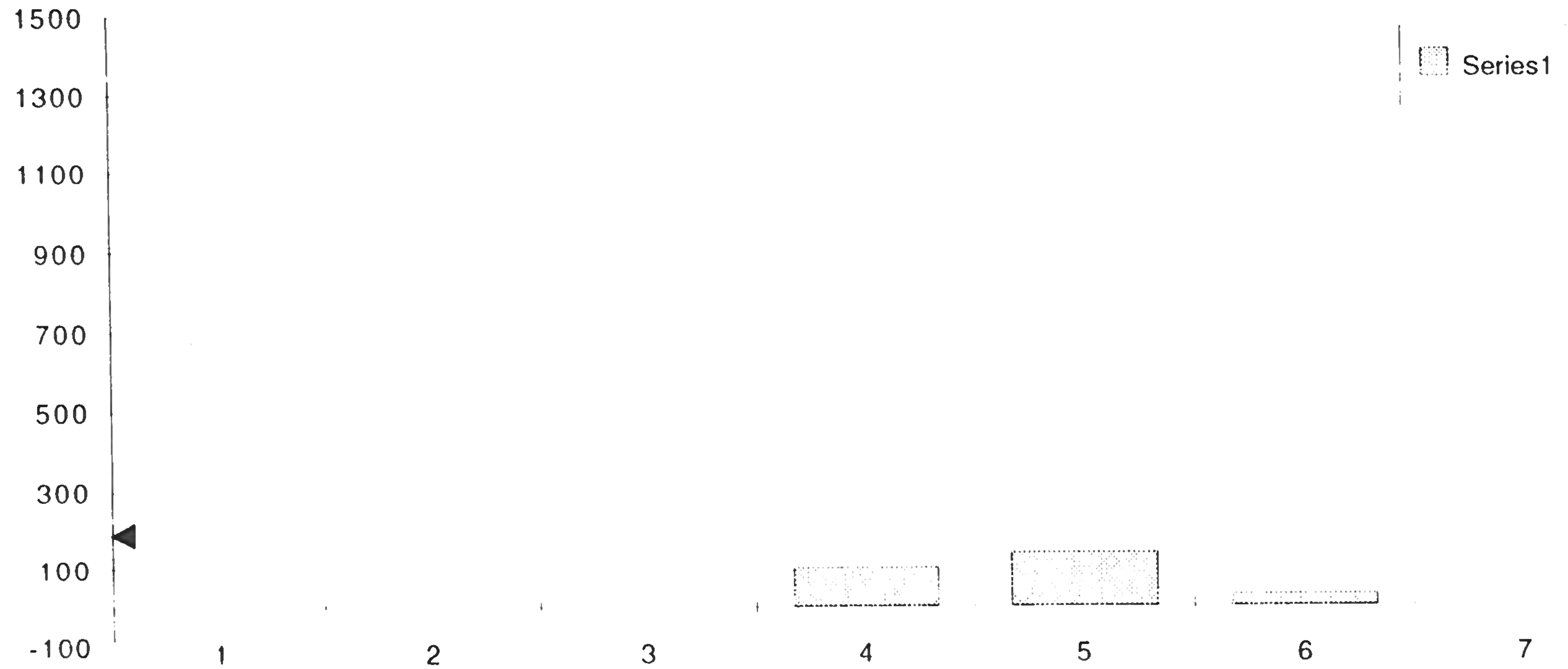

Fecal Coliform 100 ML - Site #15
1500
1300
1100
900
700
500
300
100
-100
1
2
3
4
5
6
7
Series1


Fecal Coliform 100 ML - Site # 16
1500
1300
1100
900
700
500
300
100
-100
1
2
3
4
5
6
7
Series1

Fecal Coliform 100 ML - Site # 10



Coliform Fecal 100 ML - Site # 9



Composite of the 3 replicates

River Watch Network – Benthic Macroinvertebrate Identification Sheet (Level 1)

Site #: ____________

River/Stream: Forester Brook

Date Sampled: Nov 93

Name(s): ____________

Date of Lab Work: 15 Feb 94

Total # Squares in Tray Grid: 12

REPLICATE # / MAJOR GROUP	Replicate #1 D	Replicate #1 R	Replicate #2 D	Replicate #2 R	Replicate #3 D	Replicate #3 R	AVERAGE (MEAN) D	AVERAGE (MEAN) R
Order: EPHEMEROPTERA (Mayflies)	1		5				2	
Order: PLECOPTERA (Stoneflies)	9		9		3		7	
Order: TRICHOPTERA (Caddisflies)	63		53		64		60	
Order: DIPTERA, Family: CHIRONOMIDAE	*1 27						18	
Order: DIPTERA, Family: Tipulidae	*2 1							
Order: DIPTERA, Family: Chironomidae			8					
Order: DIPTERA, Family:								
Order: DIPTERA, Family:								
Order: ODONATA	1		1				1	
Order: MEGALOPTERA	4		1		1		2	
Order: COLEOPTERA			3		1		1	
Order: AMPHIPODA								
Order: ISOPODA								
Order: DECAPODA								
Class: GASTROPODA	2		2		1		2	
Class: PELECYPODA								
Phylum: ANNELIDA	1				3		1	
Class: HIRUDINEA								
OTHER: pupae cases	6							
OTHER: Hemiptera	1		3				1	
OTHER: ~~[illegible]~~			~~[illegible]~~				1	
OTHER:								
OTHER:								
TOTALS								

	Replicate #1	Replicate #2	Replicate #3
# SQUARES PICKED FROM TRAY	all	all	all

Notes: *1 - Tanytarsus

*2 - Antocha

Majority all Class I (intolerant to pollution)

Composite of the 3 replicates

River Watch Network – Benthic Macroinvertebrate Identification Sheet (Level 1)

Site #: ______________________ **River/Stream:** Eddy Brook

Date Sampled: 10/15 + 10/16/93 **Name(s):** ______________________

Date of Lab Work: 3/9 + 4/13/94 **Total # Squares in Tray Grid:** 12

	DENSITY (D) AND RICHNESS (R)							
REPLICATE #	**Replicate #1**		**Replicate #2**		**Replicate #3**		**AVERAGE (MEAN)**	
MAJOR GROUP	**D**	**R**	**D**	**R**	**D**	**R**	**D**	**R**
Order: EPHEMEROPTERA	78		32		43		51	
Order: PLECOPTERA	14		3		13		10	
Order: TRICHOPTERA	48		59				55	
Order: DIPTERA, Family: CHIRONOMIDAE	1		18		13		12	
Order: DIPTERA, Family:								
Order: DIPTERA, Family:								
Order: DIPTERA, Family:								
Order: DIPTERA, Family:								
Order: ODONATA			1					
Order: MEGALOPTERA	1							
Order: COLEOPTERA	24		10		15		16	
Order: AMPHIPODA								
Order: ISOPODA								
Order: DECAPODA								
Class: GASTROPODA	5						2	
Class: PELECYPODA								
Phylum: ANNELIDA								
Class: HIRUDINEA								
OTHER:								
OTHER:								
OTHER:								
OTHER:								
OTHER:								
TOTALS								

	Replicate #1	**Replicate #2**	**Replicate #3**
# SQUARES PICKED FROM TRAY	all	all	all

Notes: Majority fall into Class 1 ; intolerant to pollution ,

ANALYSIS

ANALYSIS AND CONCLUSIONS

These analyses were arrived at by looking at the "big picture" and drawing preliminary conclusions. No sophisticated techniques were used to work with the data. No attempt was made to compare data with weather events which can often explain "spikes" and "dips." Rather, these are overall and general statements about results which immediately stand out.

DISSOLVED OXYGEN

Main Stem of the Royal River:

Of the 80 samples taken over the term of the project, only four did not meet the requirements for being Class B water. This translates into a 95% compliance with the state regulations for the river. Three of the four occurred in the last three miles of the river and below all of the tested tributaries. The lowest DO reading occurred in early June just below were Chandler Brook meets the Royal and above Toddy Brook.

The Tributaries:

Moose Brook, a little less than five miles from the source of the river, had two incidents of non-compliance early in the season.

Chandler Brook had 27 incidents of non-compliance with the regulations for Class B water. With the five sampling sites resulting in 40 pieces of data, this is a 58% compliance rate. Especially frequent non-compliance occurred near the source of Chandler at Runaround Pond although all sites had three or more incidents.

Collyer Brook had one incident of non-compliance on the last testing date.

Toddy Brook had no incidents of non-compliance.

Conclusion:

The main stem of the river has a very high rate of compliance with the state regulations for a Class B river for the time of the year tested.

Chandler Brook, a major tributary, has a very low rate of compliance.

The other tributaries combined had high rates of compliance.

TURBIDITY

Main Stem of the River:

The turbidity was measured in NTU's. There are no set standards in the state regulations for Class B rivers regarding turbidity. Therefore, the data gathered can best serve to give relative comparisons and as a base for future studies.

The Royal River is not a crystal clear mountain steam. That is obvious. It tends to become more turbid and cloudy around Mile 5 and continues to increase in turbidity up to Site 3 at Mile 23. However, in its last three miles to the mouth, a tendency to become less turbid occurs.

The Tributaries:

Moose Brook was over time the most turbid.
Chandler was slightly less turbid than Moose.
Toddy and Collyer were the clearest.

Conclusion:

No conclusions are made at this time. The average turbidity reading on the main stem was 8.60 NTU's. More information on standards and acceptable levels are needed before definitive statements can be made.

TOTAL COLIFORM BACTERIA

The Main Stem:

It was recommended that over 200 colonies/100 ml be used as the level to target for closer consideration when analyzing the data. On the main stem, this did not occur until Mile 13 (the halfway point) where this was exceeded on the last three testing dates. By Mile 16 the levels were again below 200 and remained that way until Mile 23 (Site 3) which had two incidents. The last two sites had one incidence of over 200 over the entire testing period.

The Tributaries:

Moose Brook had no readings over 200.

Collyer Brook had one reading on two sites just over 200.

Toddy Brook had four readings on two sites over 200 mid to late summer.

Chandler Brook with on its five sites generally had very low readings over the entire testing period with no readings over 200 and only two incidents that were even close to 200.

Conclusion:

The tributaries do not appear to contribute directly to high readings which occur on the main stem. For example, readings on the main stem (Site 4) directly below Toddy Brook, the tributary with the highest readings, were very low, while Site 3 below Site 4, and with no intervening tributaries between them, had high readings.

Macro-Invertebrates

Eddy Brook:

Analysis of the collected bottom dwellers from Eddy Brook, a tributary of the Royal, shows that the majority are classified Class 1 - Intolerant of Pollution.

Forester Brook:

Analysis of the collected bottom dwellers from Forester Brook, a tributary of the Royal, shows that the majority are classified Class 1 - Intolerant of Pollution.

Conclusion:

The living creatures present give a longer term perspective of the quality of the water. The presence in the samples of a high number of individuals of pollution intolerant species indicates that the water of these two tributaries of the Royal River is of acceptable quality.