REGIONAL WATER QUALITY CONTROL BOARD
CENTRAL COASTAL REGION

STAFF REPORT

WATER QUALITY DATA
LOS OSOS/BAYWOOD PARK
SAN LUIS OBISPO COUNTY

August, 1987

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LOS OSOS/BAYWOOD PARK
WATER QUALITY CONDITIONS

BACKGROUND

The Los Osos/Baywood Park area of San Luis Obispo County has been the subject of numerous groundwater quality studies since the adoption of a prohibition of additional individual wastewater disposal systems for the area in the Regional Board's Interim Water Quality Control Plan in 1971. That original prohibition was lifted by the Board in 1974, upon the promise by the county that an intensive, long term monitoring program would be conducted. Four years ago, the Regional Board used the data collected by the county (which did not continue the monitoring program at the frequency or level as promised), in addition to data collected by staff of the State Water Resources Control Board, and others, to establish that groundwater in the area was continuing to degrade, and that individual disposal systems were a significant part of the cause. Through an amendment to the Water Quality Control Plan for the Central Coastal Basin, the Regional Board ordered San Luis Obispo County to solve that part of the problem, and established a time schedule for project completion.

During the last four years, the County has tried to progress toward construction of a sewer system. It has not achieved that goal. The Regional Board has requested periodic project status reports from the County during this time. This staff report was prepared to summarize shallow ground water quality data collected from the Los Osos/Baywood area. It is intended to supplement a progress report the County will make to the Regional Board on September 4, 1987.

OBJECTIVE

To review concentrations of salts commonly used as indicators of sewage (nitrate, TDS, chloride, and sodium) within the Los Osos ground water basin and determine if any correlation between population growth and salt concentrations existed by comparing water quality data with population growth over time. Constituents other than nitrates were included in this report because if their concentrations rise along with nitrate concentrations, it provides a better indication that wastewater is a significant source. For example, few commercial fertilizers include sodium and chloride, but domestic waste water does contain elevated concentrations of those two constituents.

METHODOLOGY

Historic data are from an October 1973, Department of Water Resources report entitled "Los Osos-Baywood Ground Water Protection Study." The October, 1983 to February, 1987, water quality data are from the monitoring program San Luis Obispo County is conducting as required by Regional Board Resolution 83-13 (Note: data are unavailable between August, 1984, and May, 1987 because the County unilaterally discontinued the monitoring program). The County gave the May, 1987 data to Regional Board staff on August 17, 1987. These data were incorporated into the following evaluation. Well identification numbers used throughout this report are based on the state well numbering system. The first part of the number are the Township and Range, and the last four or five digits are the section number, subsection letter, and sequential number of the well. Thus, well number 30S/10E-10B5 would be the fifth well located in subsection "B" of Section "10" within Township 30 South, and Range 10 East. (Township and Range in the Los Osos Baywood area are all based on the Mount Diablo Base and Meridian.) Current wells being sampled are listed as follows:

30S/10E-13A7	30S/11E-7L3	30S/11E-18J6
-13L5	-7N1	-18Q1
-13Q1	-7Q1	-18R1
	-17F4	-21D3

Historic water quality data are not available for most of the current wells. To mitigate this problem, nearby wells were evaluated to see if they could be used to provide historic water quality data to be incorporated in this comparison. Nearby wells were evaluated and selected, based upon the following criteria:

-The nearby well's casing perforation intervals are approximately at the same elevation (relative to sea level) as the current well's, (Table 1);

-The nearby well is at approximately the same location with regard to development density (e.g. the adjoining well is not located at the fringes of a developed area if the current well is located in the middle of development), Figure 1;

-The nearby well is approximately at the same location within a ground water flow pattern (e.g. adjoining well is not too far up or down gradient of the current well). An accurate ground water contour map was not available, so the assumption was made ground water generally follows the topography, see Figure 2; and,

-The nearby well had a significant quantity of historical data available.

The above criteria eliminated a significant number of wells with historical water quality data. In each case, associated wells were selected to provide the most representative data available. The following table presents a listing of the wells currently being sampled by the County and the wells selected to provide historical ground water quality data for each of them.

Current Wells	Associated Wells
30S/10E-13A7	13A1, 13A6, 13A7, and 13B2
-13L5	13L1 and 13L2
-13Q1	13L1, 13L2, and 13P1
-23H1	(non-residential area)
30S/11E-7L3	7G3, 7N1, and 7Q1
-7N1	(complete history available)
-7Q1	(complete history available)
-17F4	(no associated well available)
-18J6	18H1
-18Q1	(complete history available)
-18R1	(historic data, but only one sample) and 18Q1
-21D3	21D4 and 21E1
	8R1 (agricultural drainage area)

Two wells, 30S/10E-23H1 (Figure 5) and 30S/11E-8R1 (Figure 6), were selected to give an indication of water quality in an undeveloped and agriculturally influenced area, respectively. Well 23H1 is located in the southwest corner of Los Osos outside the Board's prohibition boundary. Well 8R1 is located in the northeast corner of Baywood Park on the east side and adjacent to Los Osos Creek.

Water quality data used for enclosed graphs are in Table 2. Other items plotted on the enclosed graphs are described as follows:

TDS - Total Dissolved Solids: This value is based on taking seventy percent (70%) of the Electrical Conductivity (EC) value and dividing by ten (10). The reason for this approach is the February, 1987 water quality data provided by the County did not include TDS. In order to correlate this recent data to past data, it was decided to use the EC concentration and apply a "rule of thumb" factor for converting it to TDS (70% of EC will yield an approximate TDS value for the type of soils and ground water associated with the Los Osos/Baywood Park area). Values were divided by ten

for convenience of plotting on the same scale as the other constituents.

NO_3 - Nitrates: The values listed in the DWR October, 1973 report were given as nitrates. The County nitrate values were recorded as nitrogen. This report uses nitrate as nitrate. To convert nitrate as nitrogen to nitrate as nitrate, multiply the nitrate as nitrogen by 4.43 (atomic weight of Nitrate, 62, divided by the atomic weight of Nitrogen, 14, equals 4.43). Most of the nitrogen in sewage fresh out of the septic tank is in the form of ammonia and organic nitrogen. As effluent from septic tanks is discharged into the soil and eventually ground water via leach fields or pits, ammonia and organic nitrogen are converted by bacteria utilizing oxygen to nitrate. The ground water quality data submitted by the County include nitrogen sources in the form of ammonia, NH_3, and nitrite, N_2. However, concentrations associated with these constituents were very low. Generally, all nitrogen forms discharged to the soils of the Los Osos ground water basin will eventually be converted to nitrates. The Public Health Drinking Water Standard for nitrate is 45 mg/l as nitrate.

Cl - Chloride: This constituent was used as recorded in the literature.

Na - Sodium: This constituent was used as recorded in the literature sources.

Population: The population curve was obtained from the Brown and Caldwell "Phase I Water Quality Management Study," dated April, 1983, Figure 3-3, page 3-5, using the moderate growth curve. It should be noted the actual population from 1983 to present has been slightly less than the moderate growth curve. The population data shown on the graph have been divided by one-thousand (1000) in order to use the same scale used for other data. Growth factors employed are as follows:

Time Period	Population	Growth Factor (%/month)
1950-1960	600- 1,480	0.7552
1960-1965	1,480- 2,670	0.9882
1965-1970	2,670- 3,487	0.4459
1970-1975	3,487- 7,600	1.3070
1975-1980	7,600-10,933	0.6079
1980-1985	10,933-13,750	0.3828
1985-1990	13,750-15,300	0.1782

Rainfall: Rainfall data were obtained from the San Luis Obispo County Hydrology Unit. The purpose for including this information was to see if nitrate fluctuations were associated with the seasons (e.g. initial period of precipitation, early winter, would flush nitrates down to ground water, leading to higher concentrations. Continued precipitation, mid to late winter, will dilute the ground water leading to lower nitrate concentrations).

EVALUATION

The reader is directed to the Regional Board Staff Report for Resolution 83-13, dated September, 1983, for discussion on the sources of nitrates to ground water. In summary, it is the Regional Board's position, nitrate increases in the Los Osos ground water basin are primarily due to effluent from individual sewage disposal systems (septic tanks). In the following discussion, reference is made to residential development (also referred to as development or growth) as being the cause of the trends observed. This reference is meant to refer to increasing development causing additional septic tank effluent to be discharged to ground water.

The graphs were evaluated by grouping them based on geographic and demographic areas (subareas) within the Los Osos/Baywood Park study area (Figure 1A). The sections are generally described as follows:

EAST - The area east of Los Osos Creek is the agriculturally influenced area, represented by wells 30S/11E-21E1, 21D3, 21D4, and 8R1 (Figures 3, 4 & 5).

UNDEVELOPED - The southwestern portion of the study area outside both the Regional Board prohibition boundary and the developed areas of Los Osos/Baywood Park, represented by well 30S/10E-23H1 (Figure 6).

SOUTHEAST - The densely developed areas, located in the southeast quarter of the prohibition area, represented by wells 30S/11E-18J6, 18H1, 18R1, and 18Q1 (Figure 7, 8, & 9).

LARGE PARCELS - The large parcel (one acre or larger) areas located west and adjacent to Los Osos Creek outside the prohibition area, represented by well 30S/11E-17F4 (Figure 11).

SOUTHWEST - The densely developed areas located in the southwest quarter of the prohibition area, represented

by wells 30S/10E-13L1, 13L2, 13L5, 13P1, and 13Q1 (Figure 12, 13, 14, 15 & 16).

CENTRAL - The densely developed areas located in the western central portion of the prohibition area, represented by wells 30S/10E-13A1, 13A2, 13A6, 13A7, and 13B2 (Figure 17, 18, 19 & 20).

NORTH - The densely developed sections located in the northern portion of the prohibition area, represented by wells 30S/10E-7G3, 7L3, 7N1, and 7Q1 (Figure 21, 22, 23 & 24).

The following discussions of the water quality data and the graphs mentioned above are grouped by these areas. At the conclusion of the discussion of each area, a table of average historical and current salt concentration values are presented for each area to provide a quick, and somewhat simplistic summary of what the data show. These values are useful for quick comparisons, but should not be taken as absolutely perfect representations of groundwater quality (Figure 1A).

EAST (wells 30S/11E-21D3, 21D4, 21E1, and 8R1)

Well 8R1 (Figure 5) was selected as an indicator of the historic water quality data in a remote undeveloped portion of the agricultural area east of Los Osos Creek. It indicates TDS, Na and Cl concentrations in the sixties are consistent with more recent data from wells 21D4, 21D3, and 21E1 (Figures 3 and 4). These three wells are also in a similar land use area in the "east" subarea (residential/agricultural). However, nitrate concentrations have increased (taking the extremes) from 2 mg/l to over 100 mg/l. Wells 21D4, and 21D3 (Figure 4), generally indicate a continued high concentration, 60 mg/l or greater of nitrates over the last 17 years, probably due to historic and current agricultural practices in this immediate area. The area near wells 21D3, 21D4 and 21E1 have seen an increase in both residential development and agricultural usage over the past 26 years. There appears to be correlation between development and nitrate increases.

Concentration	Average Concentrations, mg/l Past	Present
TDS	800	800
NO_3	5	80
Cl	100	100
Na	60	60

UNDEVELOPED (well 30S/10E-23H1)

Well 23H1 (Figure 6) was selected as an indicator of pre-development water quality and is used as a comparison for the other wells west of Los Osos Creek which also has undeveloped areas. Salt concentrations from this well are low for all indicators. This well provides a glimpse of how good the natural quality of the shallow ground water in the Los Osos/Baywood Park really is.

Concentration	Average Concentrations, mg/l Past
TDS	200
NO_3	8
Cl	45
Na	30

SOUTHEAST (wells 30S/11E-18H1, 18J6, 18Q1, and 18R1)

Well 18R1 (Figure 7 & 8) had only one historic data reference, but indicates a significant increase in all constituents (nitrates went from 3 to 66 mg/l). However, to supplement historic water quality data, well 18Q1 (Figure 8) was used. Well 18Q1's historic water quality data, combined with well 18R1's present water quality data, indicate the upward trend of nitrate, sodium, and total dissolved solids (nitrates went from 28 to 55/mg/l). It appears the development in this area, which has been significant over the past ten years, correlates well with these increases.

However, well 18Q1's (Figure 10), historic and present water quality data, by itself, show a decreasing trend for nitrates, a constant trend for TDS, and an increasing trend for sodium and chloride. Well 18J6 (combined with 18H1 in Figure 9) shows a slight increase in nitrate values in a developed area. When associated with well 18H1 (Figure 9), there appears to be no increase in nitrate, but all the other constituents have increased. Averaging all data from the southeast area, all constituents show an increase.

Concentration	Southeast Average Concentrations, mg/l Past	Present
TDS	180	260
NO_3	20	26
Cl	40	55
Na	25	40

LARGE PARCELS (well 30S/11E-17F4)

Well 17F4 (Figure 11) represents water quality in the lowest density areas west of Los Osos Creek (lot sizes one acre or larger). Historic data weren't available for this well and there were no comparable adjoining wells. The 1983-87 nitrate concentrations are less than 20 mg/l, indicating, in the less densely populated areas, nitrate remains fairly low.

Concentration	Average Concentrations, mg/l Present
TDS	400
NO_3	10
Cl	85
Na	60

SOUTHWEST (wells 30S/10E-13L1, 13L2, 13L5, 13P1, and 13Q1)

Three wells, 13L1 (Figure 12), 13L2 (Figure 13) and 13P1 (Figure 14), were associated with well 13Q1. This association gave three alternative historic trends which indicated significant increases in all constituents. Two wells, 13L1 (Figure 15) and 13L2 (Figure 16), were associated with 13L5. Two graphs were produced indicating significant increase in all constituents over time.

Concentration	Average Concentrations, mg/l Past	Present
TDS	150	400
NO_3	5	85
Cl	30	65
Na	25	80

CENTRAL (wells 30S/10E-13A1, 13A2, 13A6,13B2, and 13A7)

Four wells, 13A1 (Figure 17), 13A2 (Figure 18), 13A6 (Figure 19), and 13B2 (Figure 20), were associated with well 13A7. This association produced four graphs which indicate the concentrations have remained relatively constant over the past twenty-five years, but at a high concentration. This is as expected, given this is downgradient of a densely developed area, and is within an older developed area. When comparing well 13A7 to 23H1 (Figure 6), which is indicative of a pre-developed area, degradation of water quality has been significant and is continuing.

Concentration	Average Concentrations, mg/l Past	Present
TDS	300	300
NO_3	40	40
Cl	60	70
Na	40	50

NORTH (wells 30S/10E-7G3, 7L3, 7N1, and 7Q1)

Three wells 7G3 (Figure 21), 7N1 (Figure 22), and 7Q1 (Figure 23) were associated with well 7L3. The three graphs developed show a significant increase in all constituents over time.

Well 7Q1 (Figure 24), in and of itself, has adequate historic water quality data, and there can be no doubt degradation has occurred over time in this high growth area.

Well 7N1 (Figure 25), shows an increase in all constituents. However, the concentrations are fairly low.

Concentration	Average Concentrations, mg/l Past	Present
TDS	150	350
NO_3	10	60
Cl	30	60
Na	20	50

CONCLUSION

The salts used in this analysis are merely indicators of the presence of waste water. With the exception of nitrates, they are not harmful in themselves unless present in such high concentrations that most people would not consume the water because of its taste. Treatment for their removal does not necessarily make the resulting water free of other materials contained in sewage which could be harmful if consumed. Higher nitrate concentrations in ground water can be caused by the use of commercial fertilizers for landscaping, and urban areas tend to use significant quantities of fertilizer. But when other salt constituent concentrations increase, too, the possibility of waste water being a significant factor becomes important.

Analysis of the data examined for this report clearly shows that the quality of the shallow ground water in much of the

Los Osos/Baywood Park area is being changed by the urbanization of the area. The preponderance of evidence shows increasing mineralization of ground water over time. In the more densely developed area of Los Osos/Baywood Park, only one well suggests a downward trend for nitrate concentrations. Of even more concern is the fact that some of the wells are showing relatively steep increases in mineralization in recent years. Since water quality in the undeveloped area 25 years ago had lower mineral concentrations than any of the groundwater existing under the developed areas now, staff attributes the changes which have occurred to the increasing residential development densities. The staff report prepared for the original hearing four years ago showed that, of the sources identified (urban irrigation, commercial and residential sewage, agricultural irrigation), residential waste water contributed more than 80% of the nitrogen in the Los Osos/Baywood shallow groundwater basin. No evidence to change that conclusion exists today.

The facts are inescapable. The shallow ground waters in the Los Osos/Baywood area are continuing to be degraded. The discharges from individual and community waste water systems are the major source, and they can be controlled.

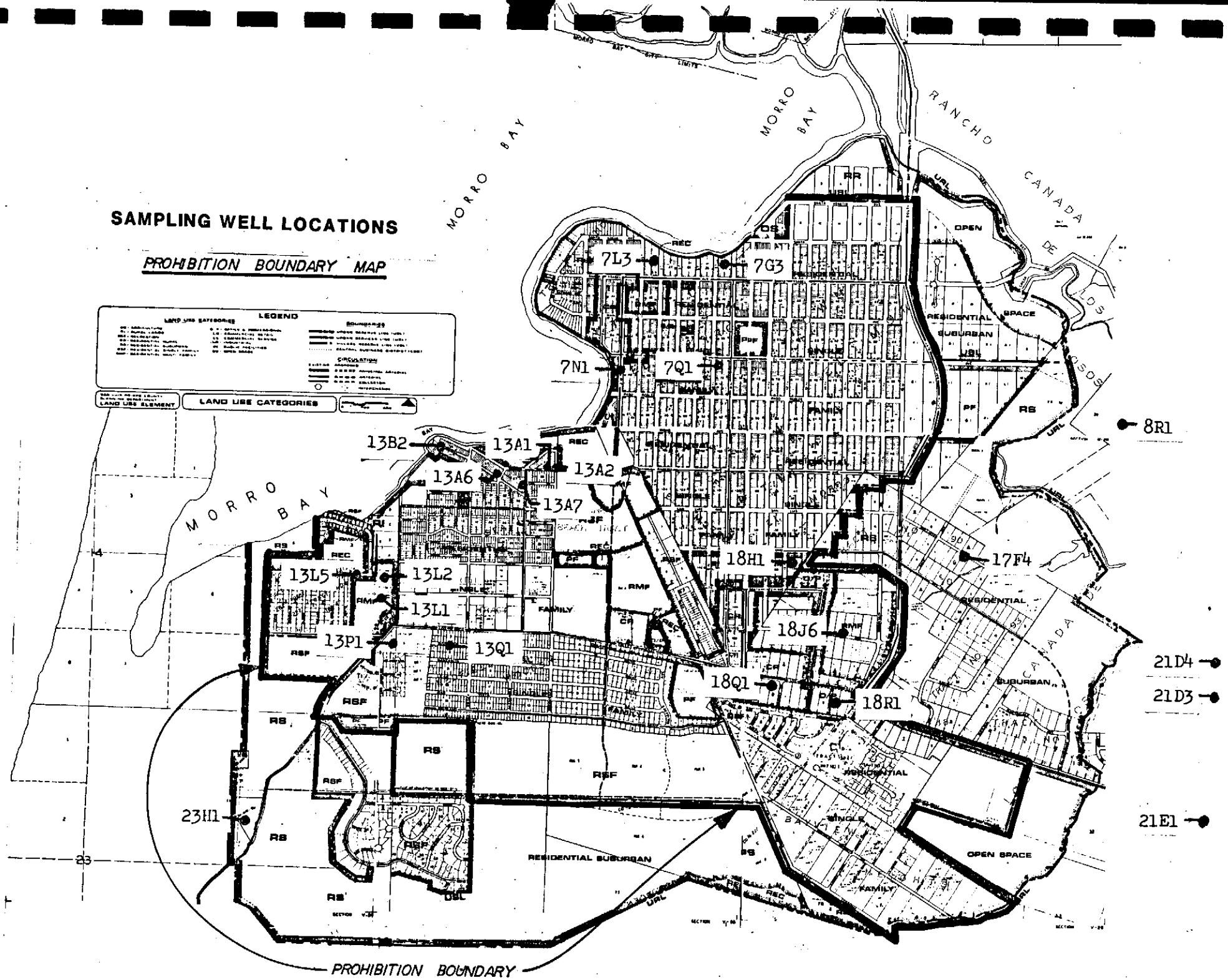

SAMPLING WELL LOCATIONS
PROHIBITION BOUNDARY MAP
LEGEND
LAND USE CATEGORIES
MORRO BAY
RANCHO CANADA DE LOS OSOS
7L3
7G3
7N1
7Q1
8R1
13B2
13A1
13A2
13A6
13A7
13L5
13L2
13L1
13P1
13Q1
18H1
17F4
18J6
18Q1
18R1
21D4
21D3
21E1
23H1
PROHIBITION BOUNDARY

FIGURE 1

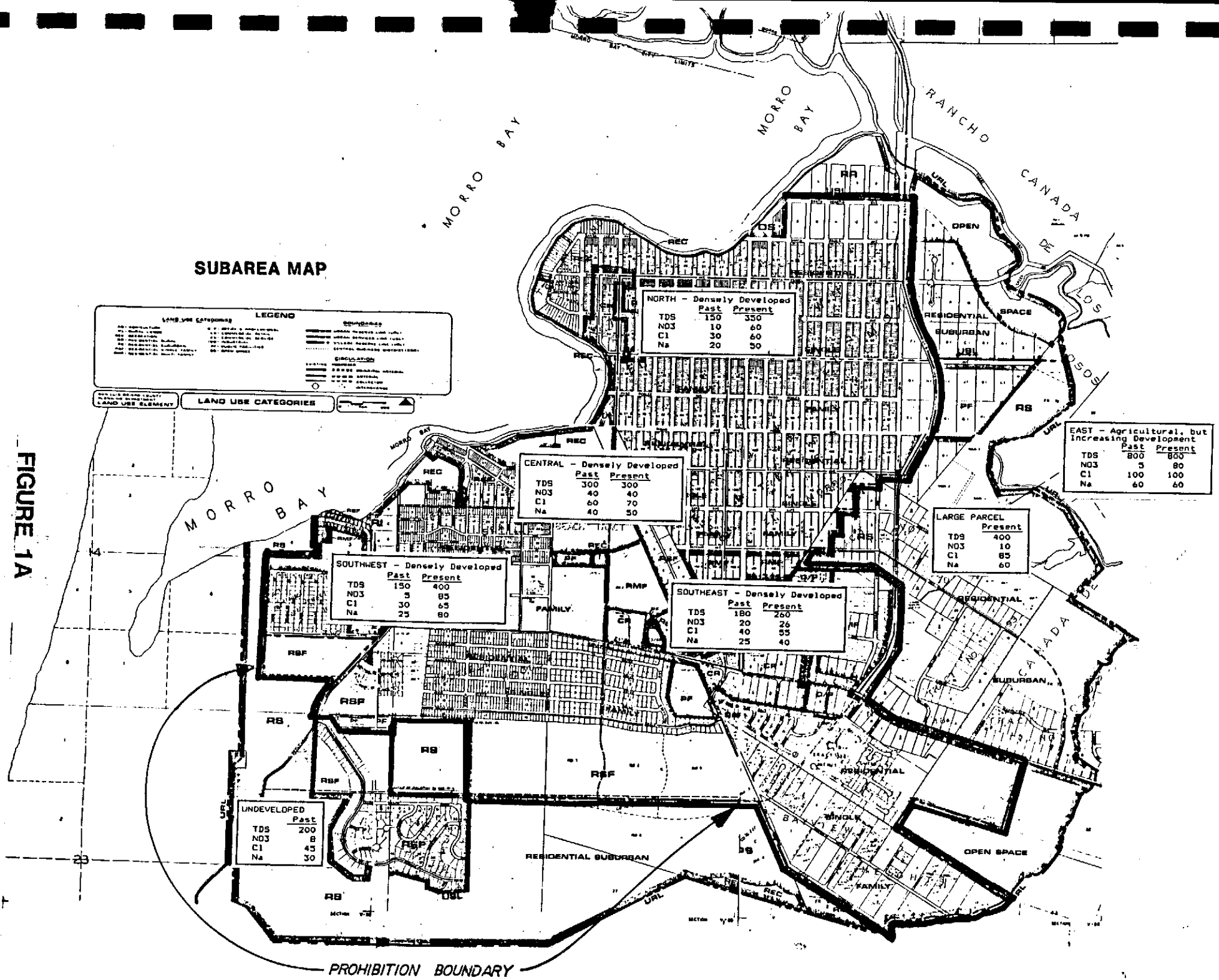
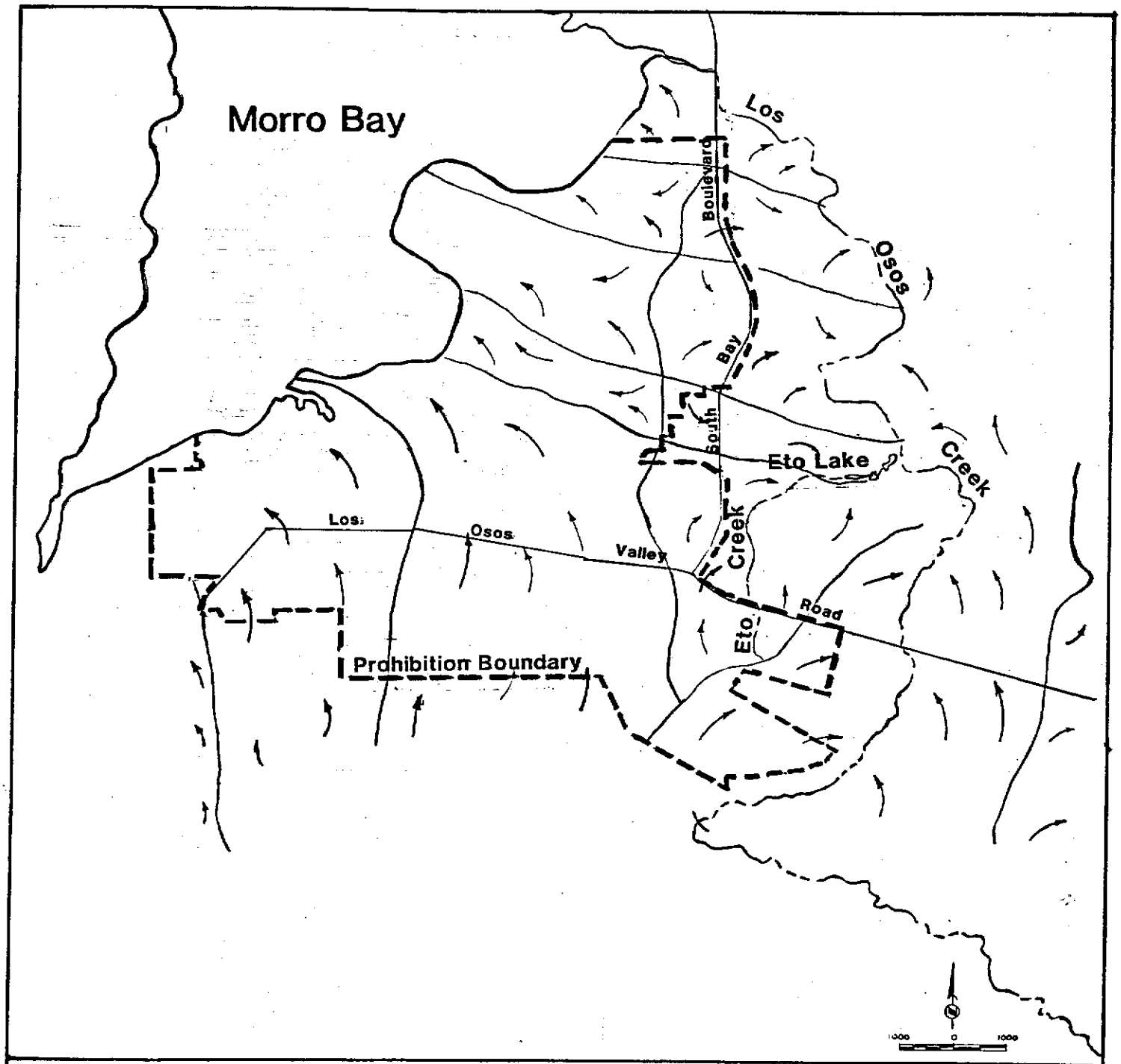

SUBAREA MAP
LEGEND
LAND USE CATEGORIES
MORRO BAY
RANCHO CANADA DE LOS OSOS
NORTH - Densely Developed
Past Present
TDS 150 350
NO3 10 60
Cl 30 60
Na 20 50
CENTRAL - Densely Developed
Past Present
TDS 300 300
NO3 40 40
Cl 60 70
Na 40 50
SOUTHWEST - Densely Developed
Past Present
TDS 150 400
NO3 5 85
Cl 30 65
Na 25 80
SOUTHEAST - Densely Developed
Past Present
TDS 180 260
NO3 20 26
Cl 40 55
Na 25 40
EAST - Agricultural, but Increasing Development
Past Present
TDS 800 800
NO3 5 80
Cl 100 100
Na 60 60
LARGE PARCEL
Present
TDS 400
NO3 10
Cl 85
Na 60
UNDEVELOPED
Past
TDS 200
NO3 8
Cl 45
Na 30
RESIDENTIAL SUBURBAN
OPEN SPACE
PROHIBITION BOUNDARY

FIGURE 1A



TOPOGRAPHY

(Topographic Highs/Surface Water Flow Patterns)

FIGURE 2

WATER QUALITY GRAPHS

LOS OSOS/BAYWOOD PARK GROUNDWATER

21E1 (3/70) & 21D3 (10/83-3/87)

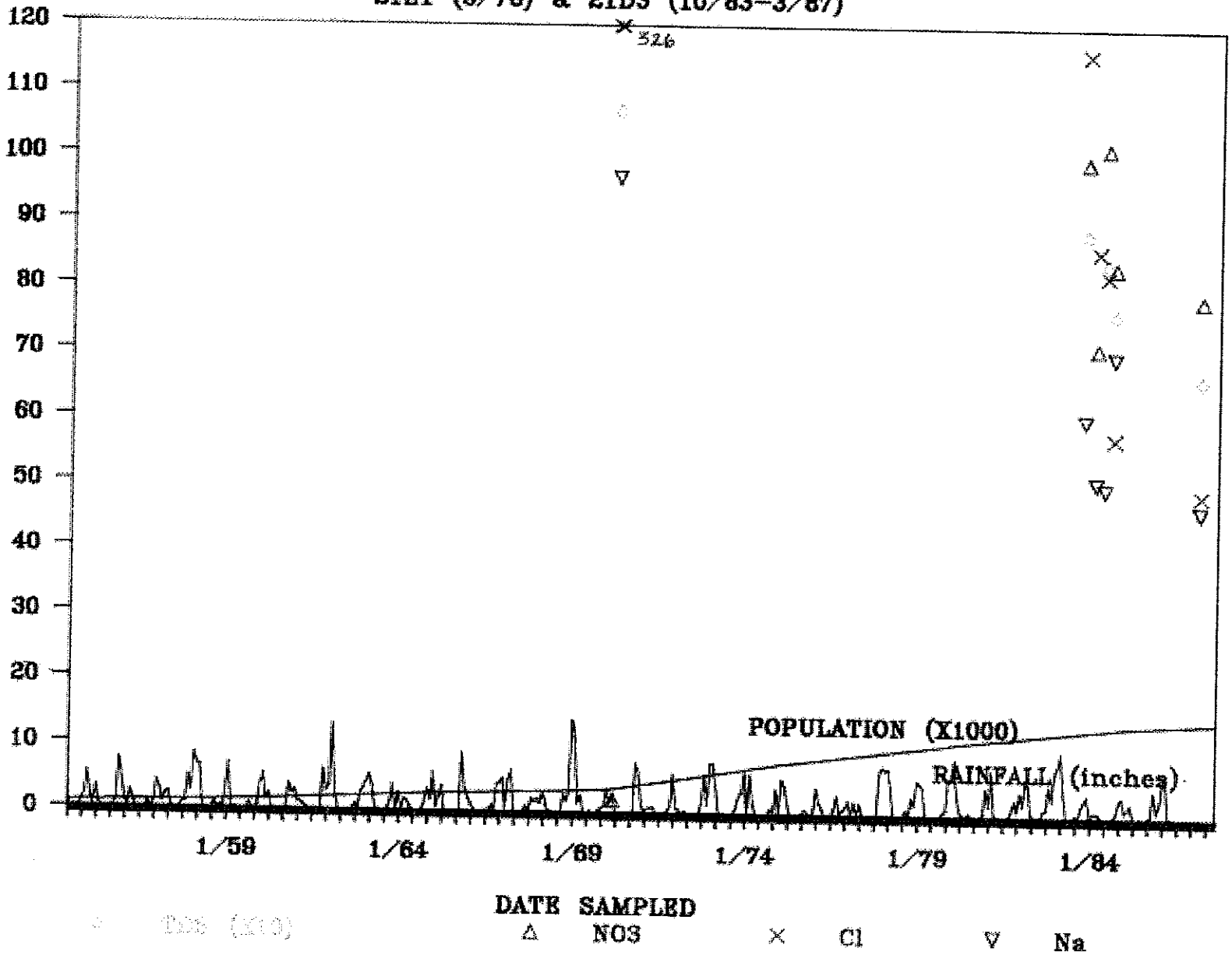


FIGURE 3

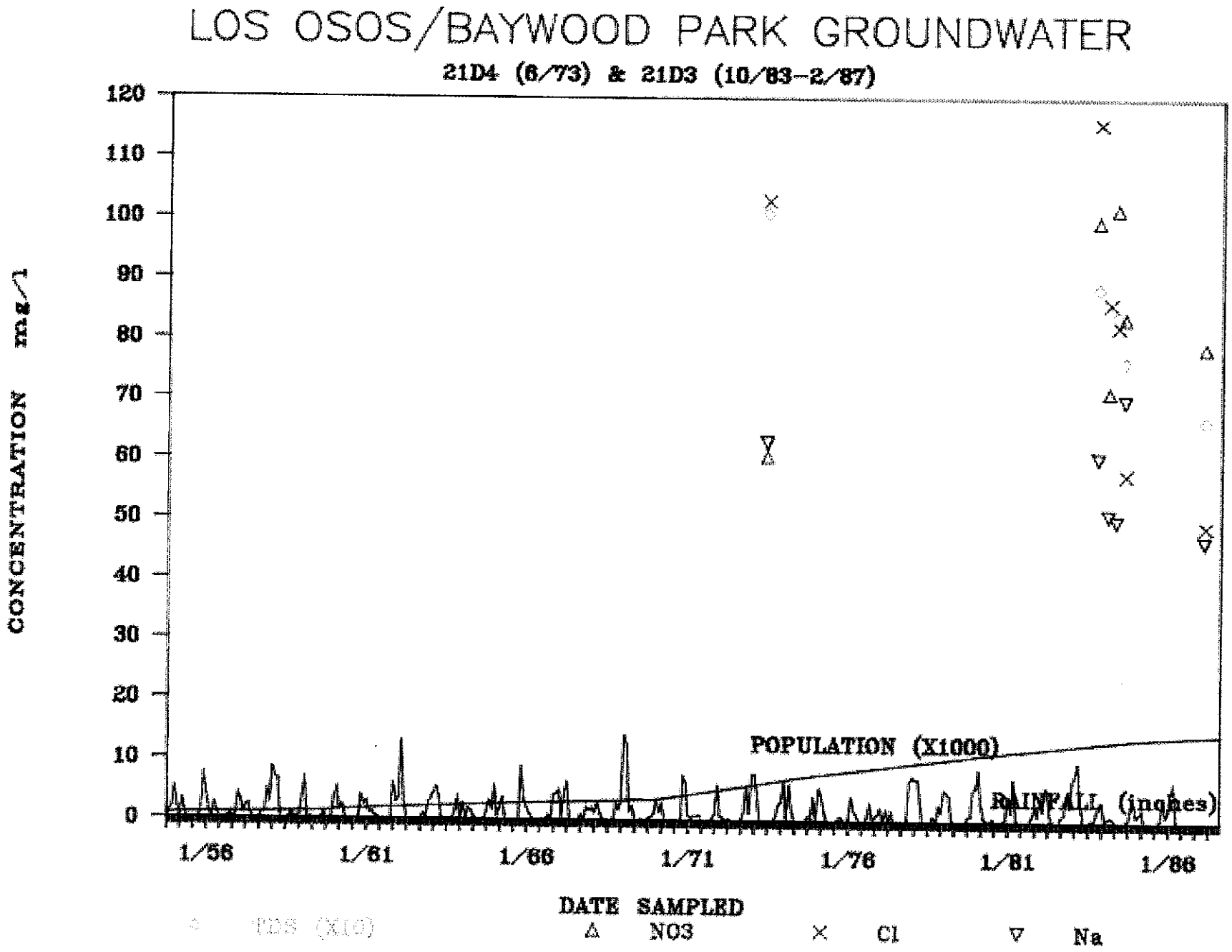

LOS OSOS/BAYWOOD PARK GROUNDWATER
21D4 (6/73) & 21D3 (10/83-2/87)
CONCENTRATION mg/l
120
110
100
90
80
70
60
50
40
30
20
10
0
POPULATION (X1000)
RAINFALL (inches)
1/56
1/61
1/66
1/71
1/76
1/81
1/86
DATE SAMPLED
TDS (X10)
NO3
Cl
Na

FIGURE 4

LOS OSOS/BAYWOOD PARK GROUNDWATER

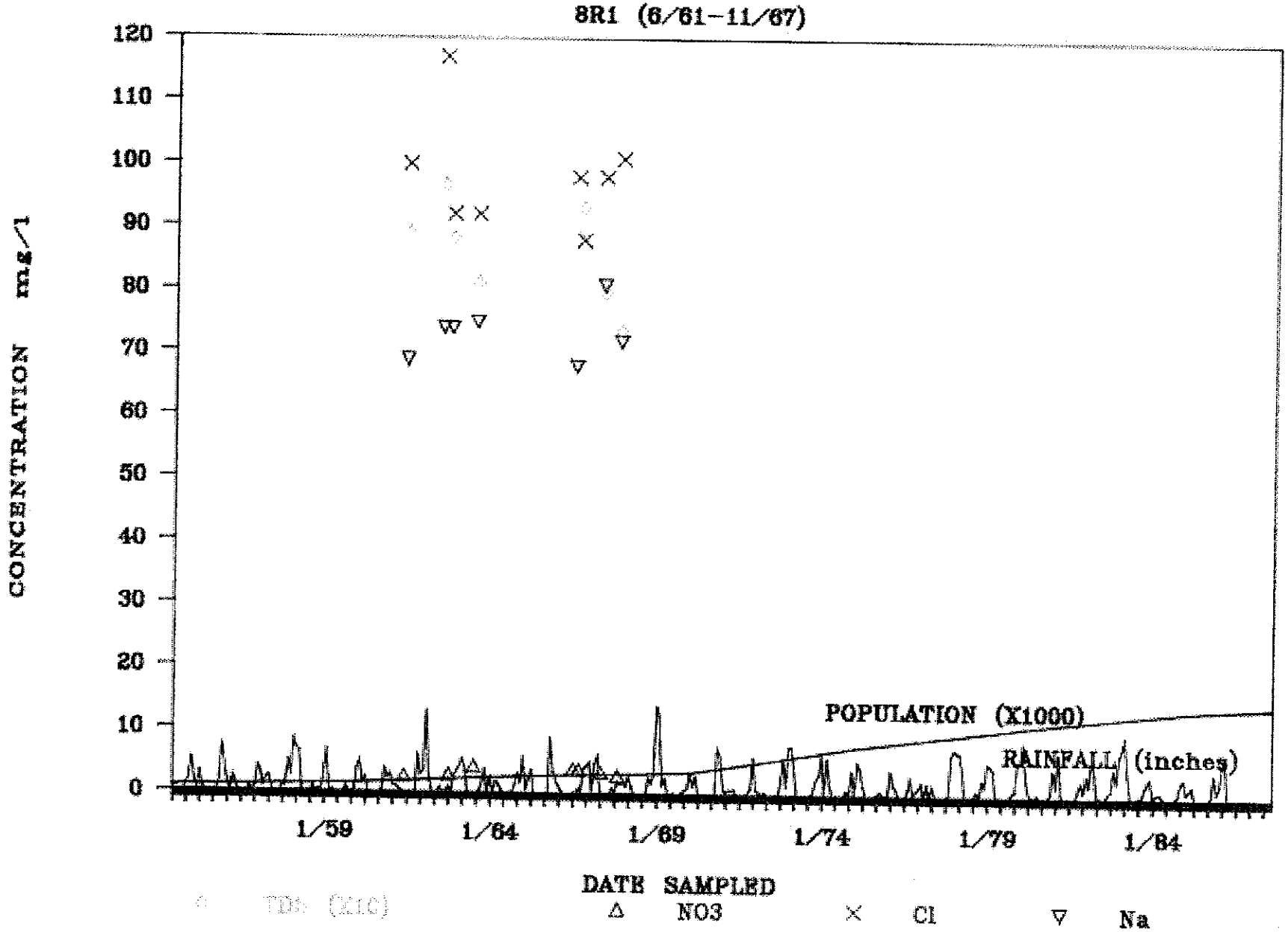


FIGURE 5

LOS OSOS/BAYWOOD PARK GROUNDWATER

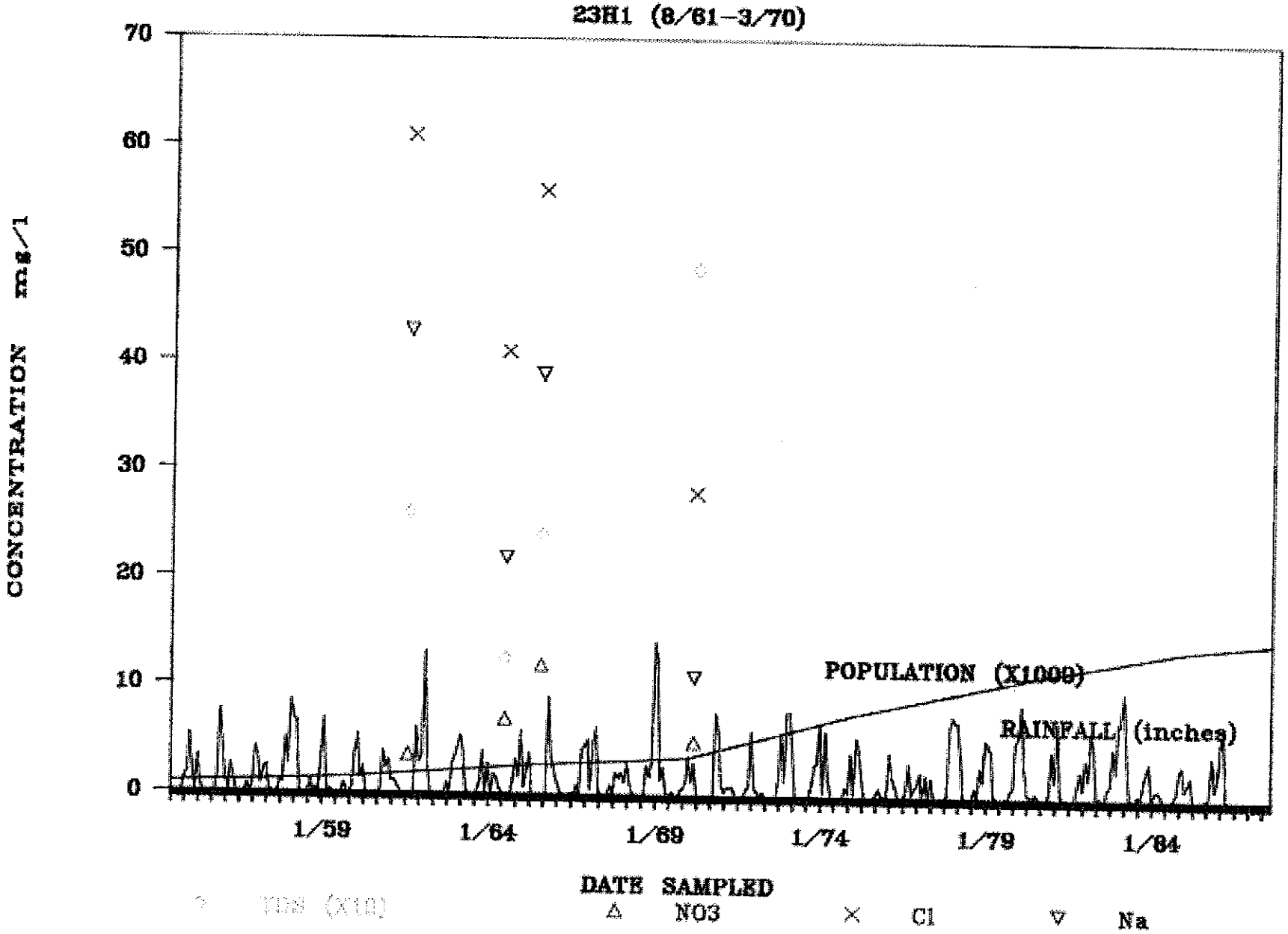


FIGURE 6

LOS OSOS/BAYWOOD PARK GROUNDWATER

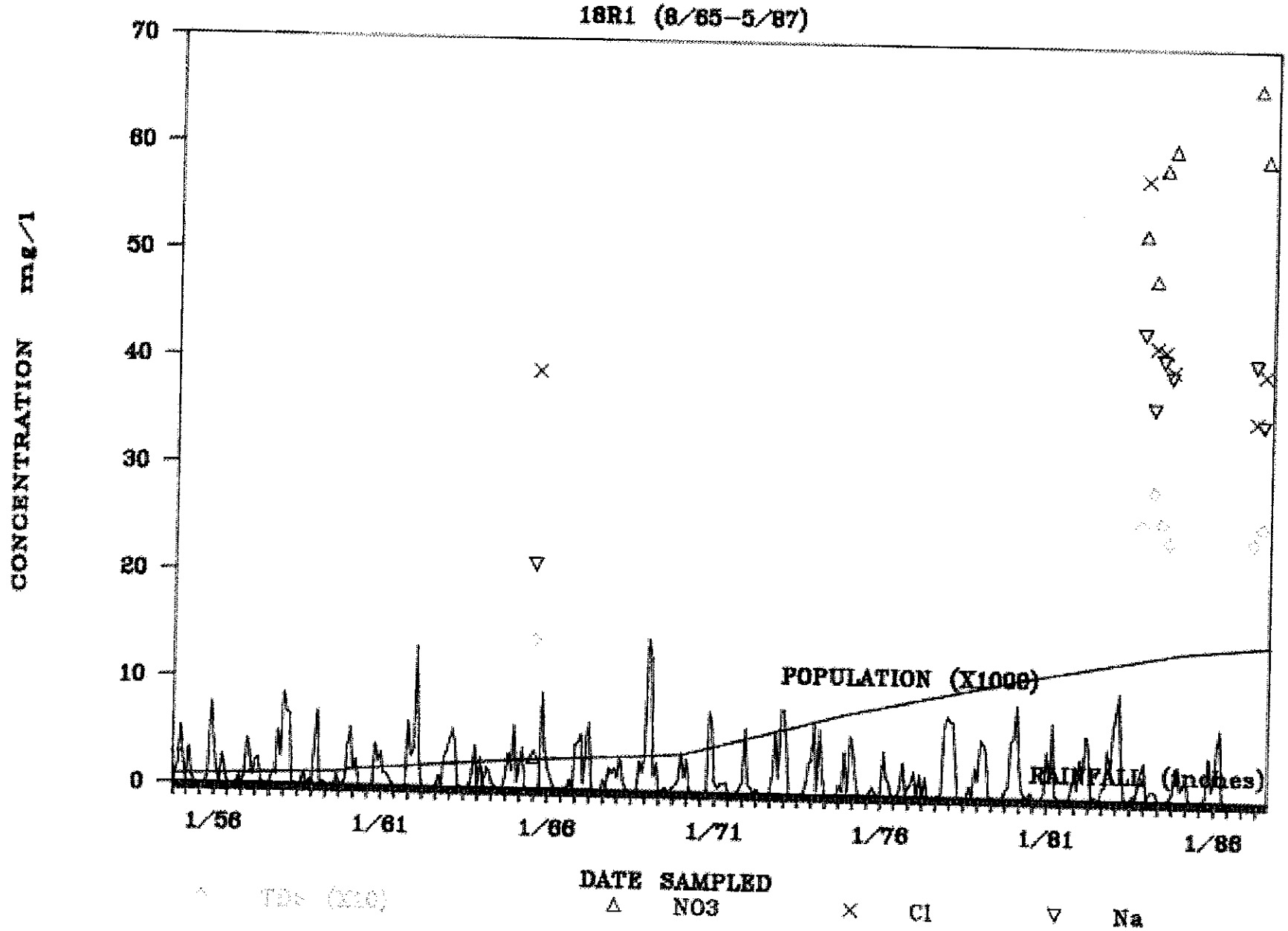


FIGURE 7

LOS OSOS/BAYWOOD PARK GROUNDWATER

18Q1 (6/54–12/69) & 18R1 (10/83–5/87)

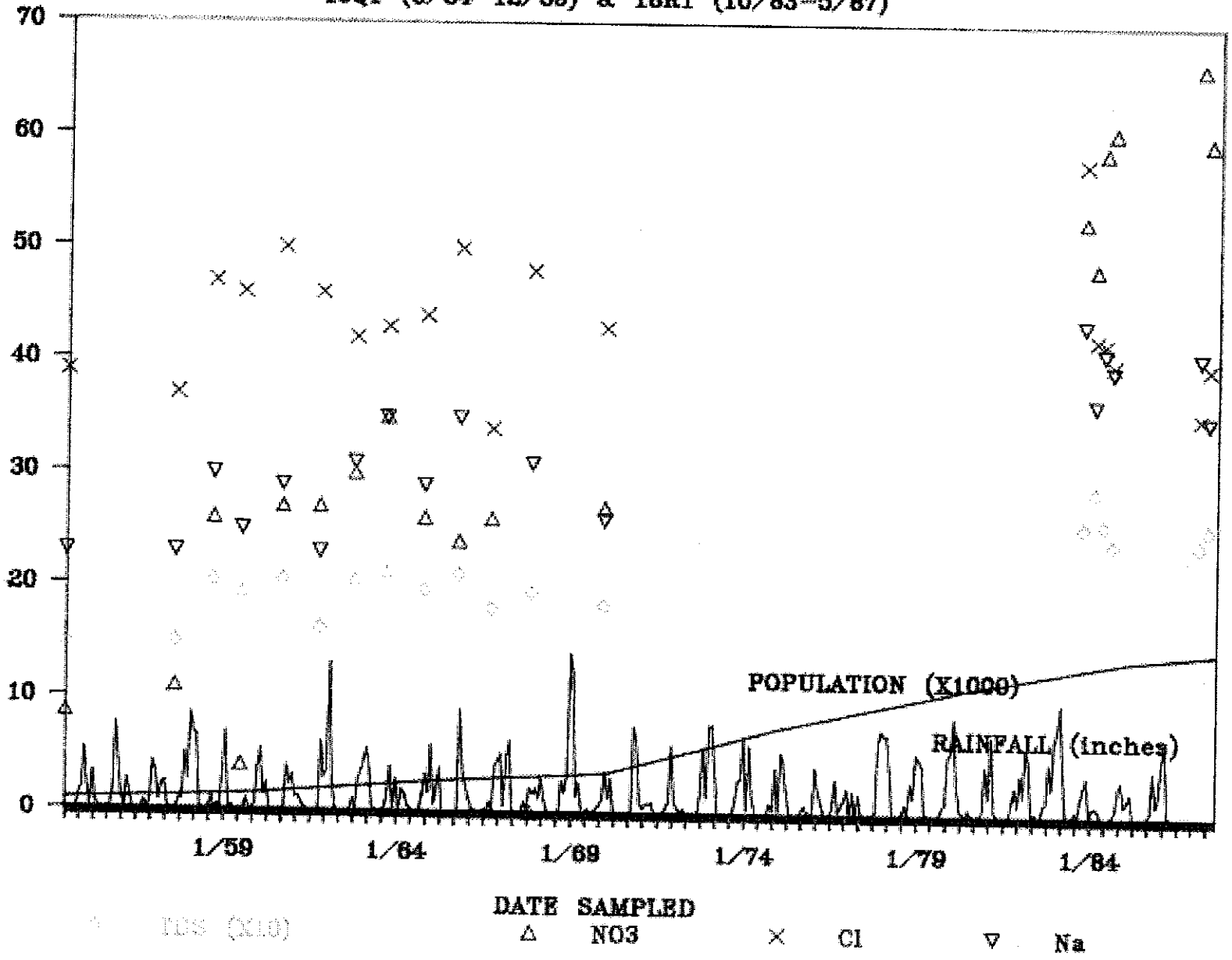


FIGURE 8

LOS OSOS/BAYWOOD PARK GROUNDWATER

18H1 (12/59–3/72) & 18J6 (10/83–5/87)

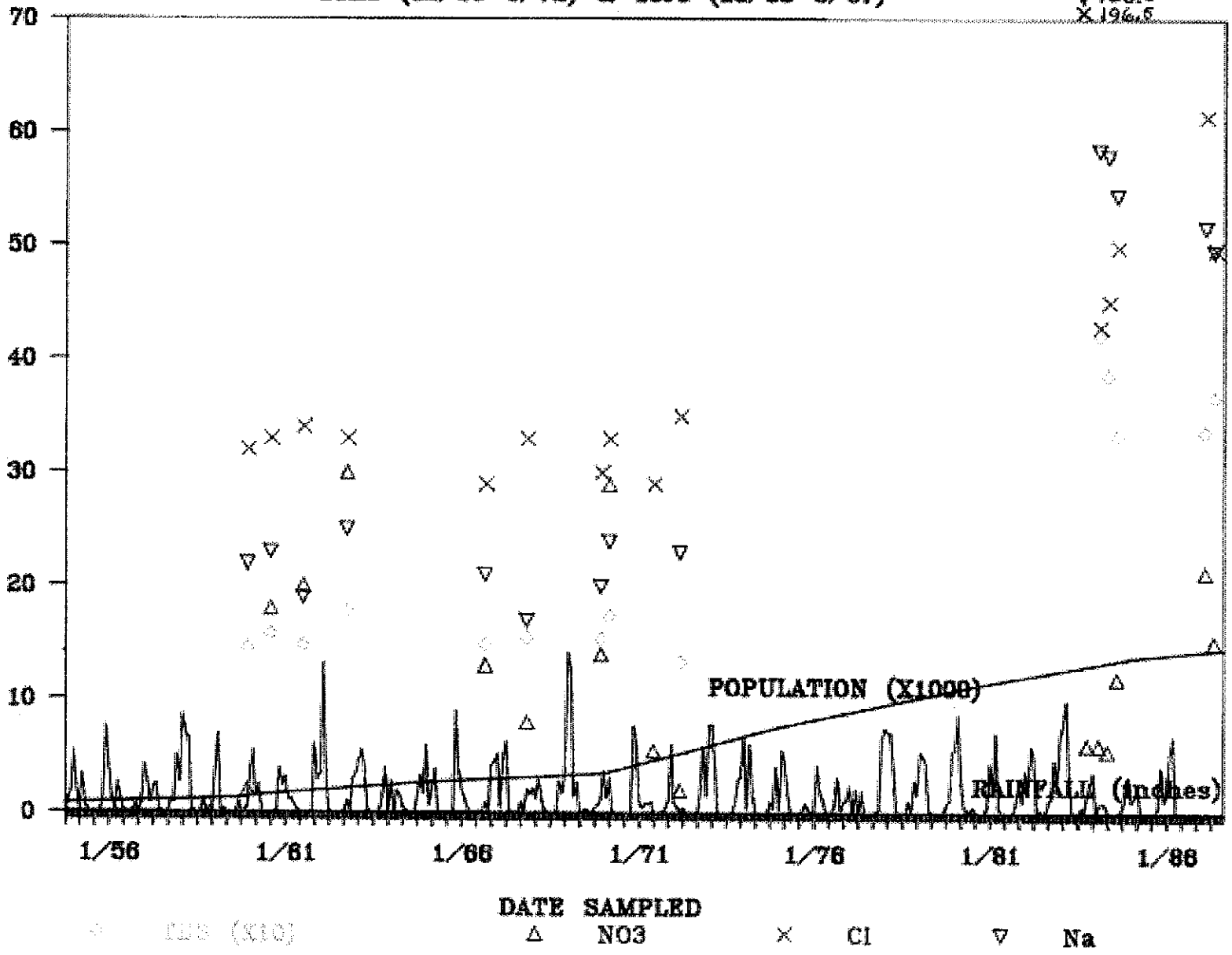


FIGURE 9

LOS OSOS/BAYWOOD PARK GROUNDWATER

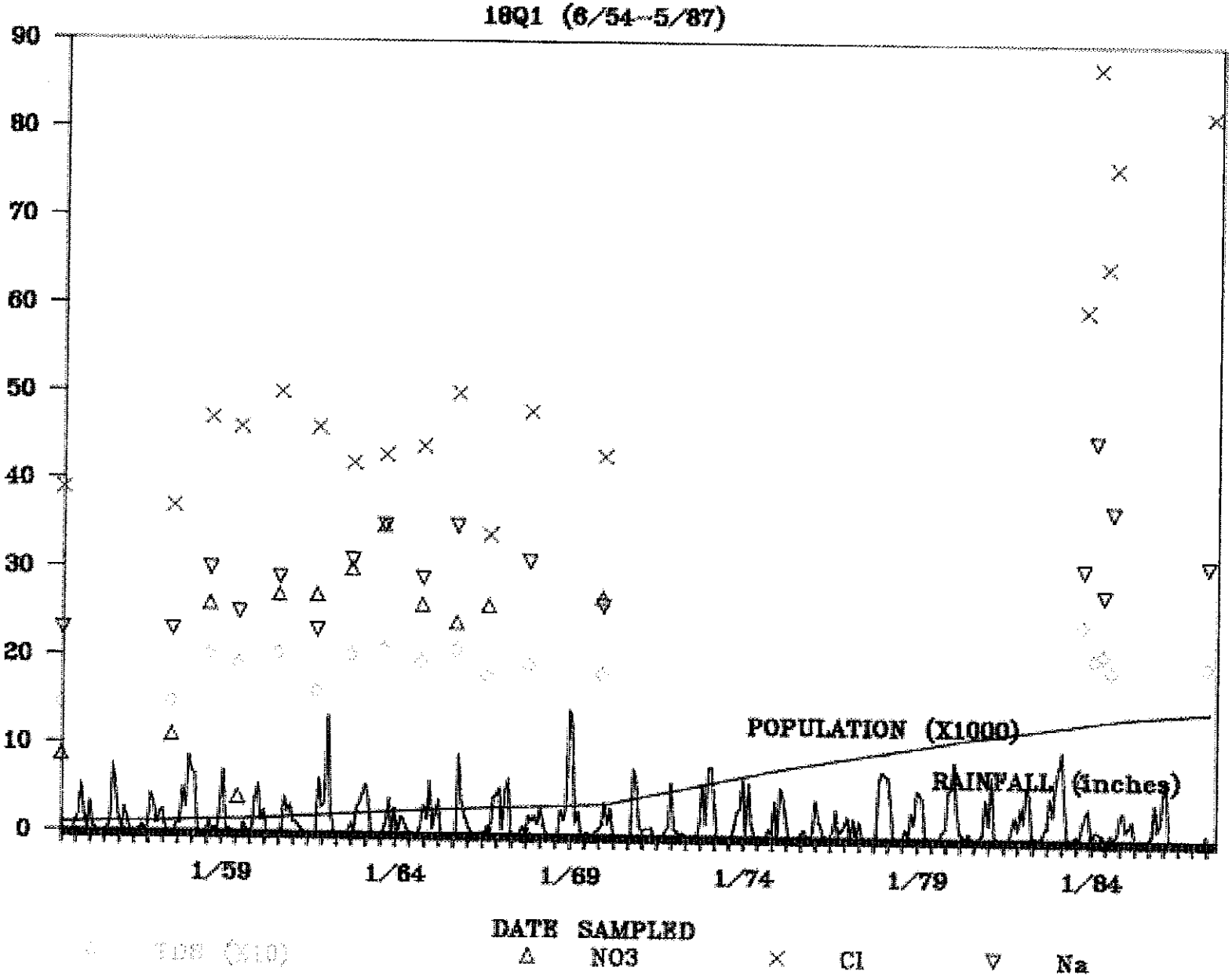


FIGURE 10

LOS OSOS/BAYWOOD PARK GROUNDWATER

17F4 (10/83–5/87)

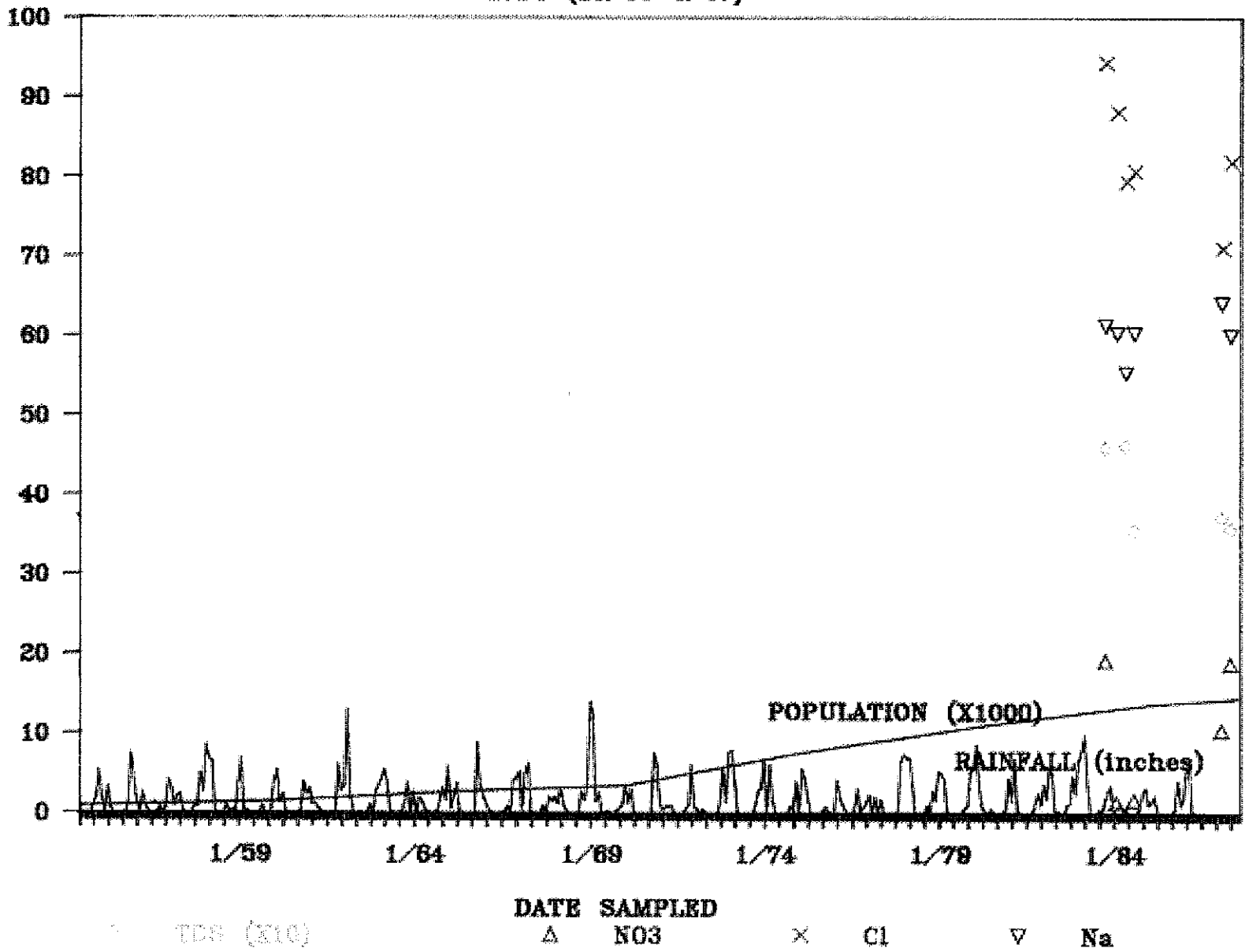


FIGURE 11

LOS OSOS/BAYWOOD PARK GROUNDWATER

13L2 (6/71–10/72) & 13Q1 (10/83–5/87)

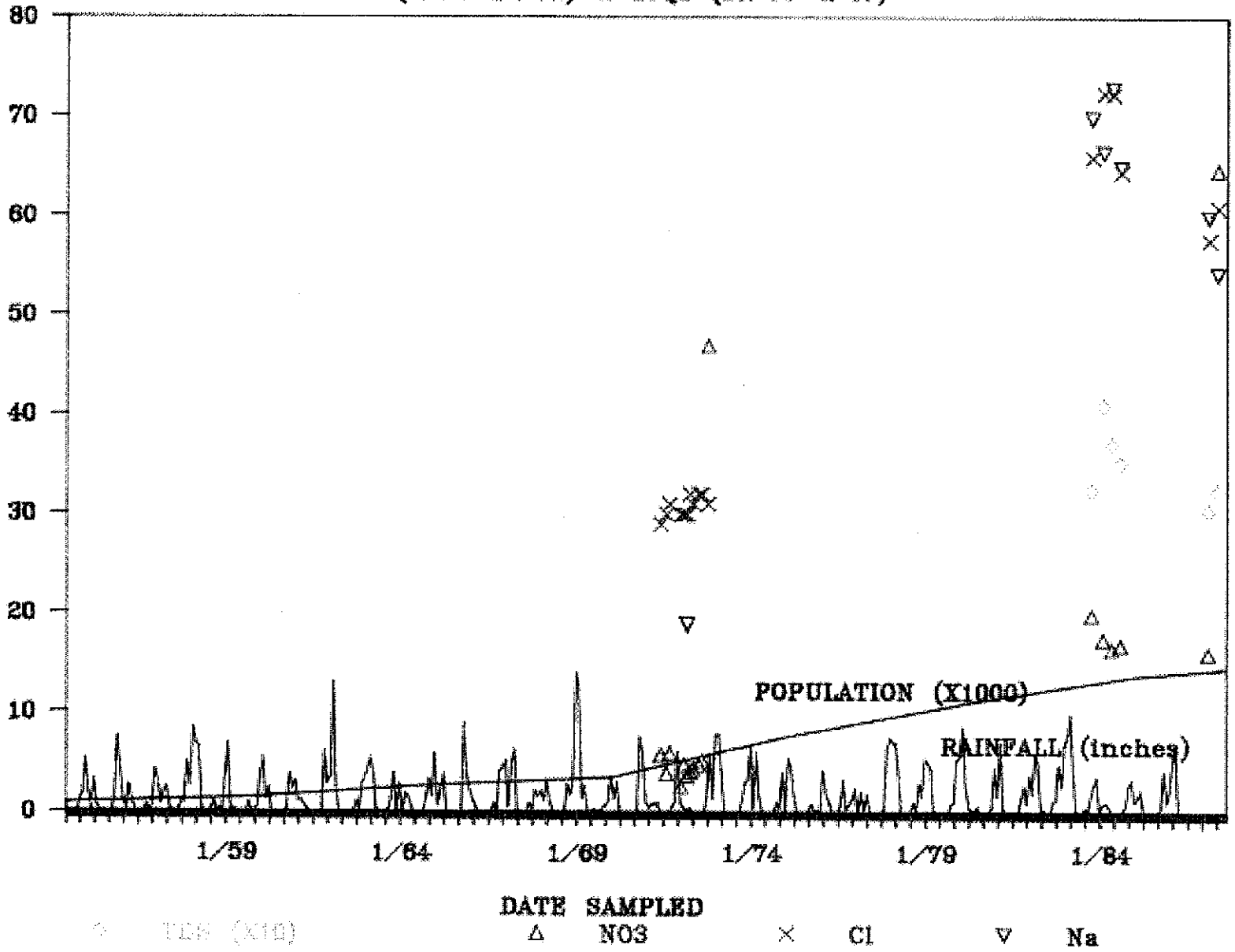


FIGURE 13

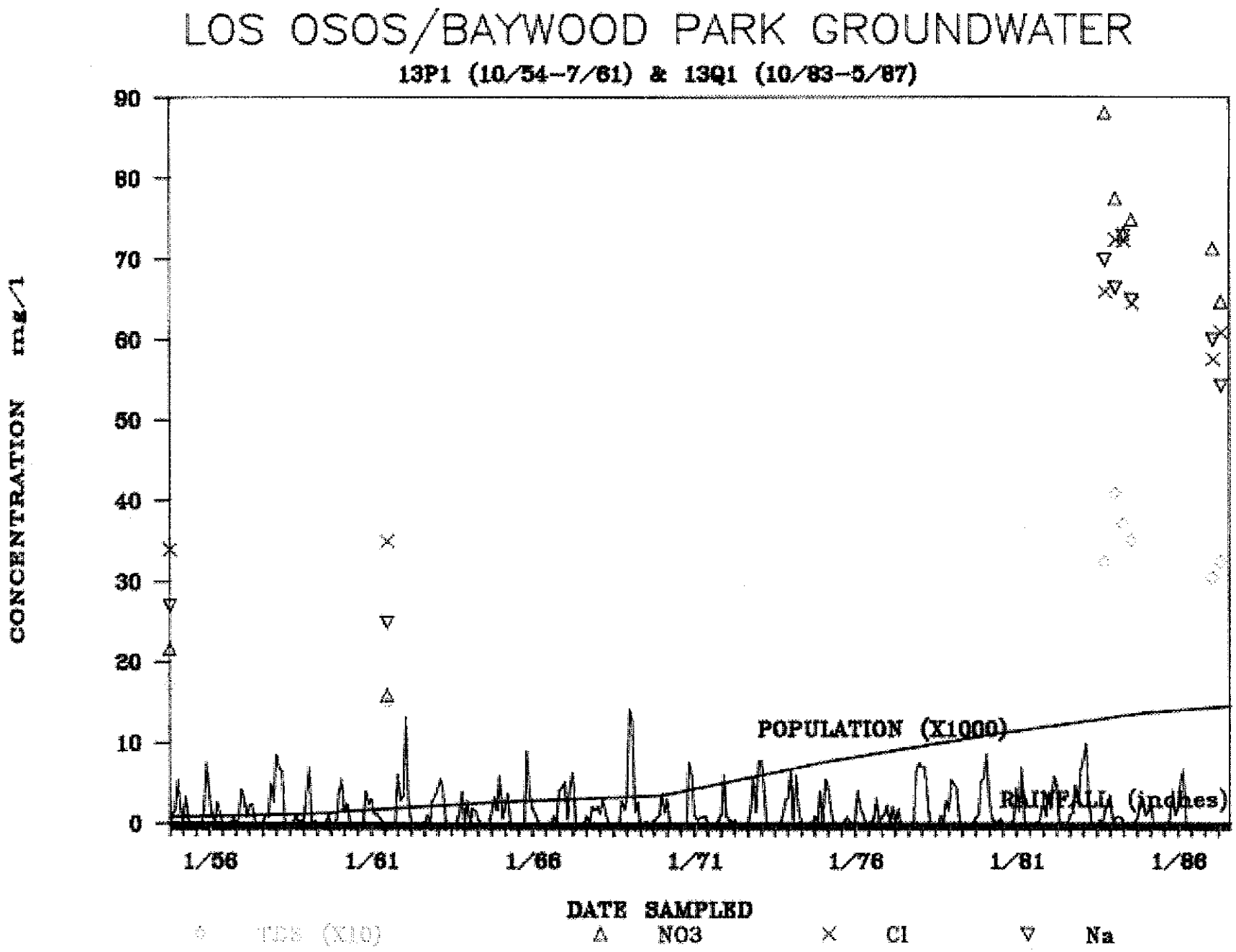

LOS OSOS/BAYWOOD PARK GROUNDWATER
13P1 (10/54-7/61) & 13Q1 (10/83-5/87)
CONCENTRATION mg/l
90
80
70
60
50
40
30
20
10
0
POPULATION (X1000)
RAINFALL (inches)
1/56
1/61
1/66
1/71
1/76
1/81
1/86
DATE SAMPLED
TDS (X10)
NO3
Cl
Na

FIGURE 14

LOS OSOS/BAYWOOD PARK GROUNDWATER

13L1 (6/60–3/70) & 13L5 (10/83–5/87)

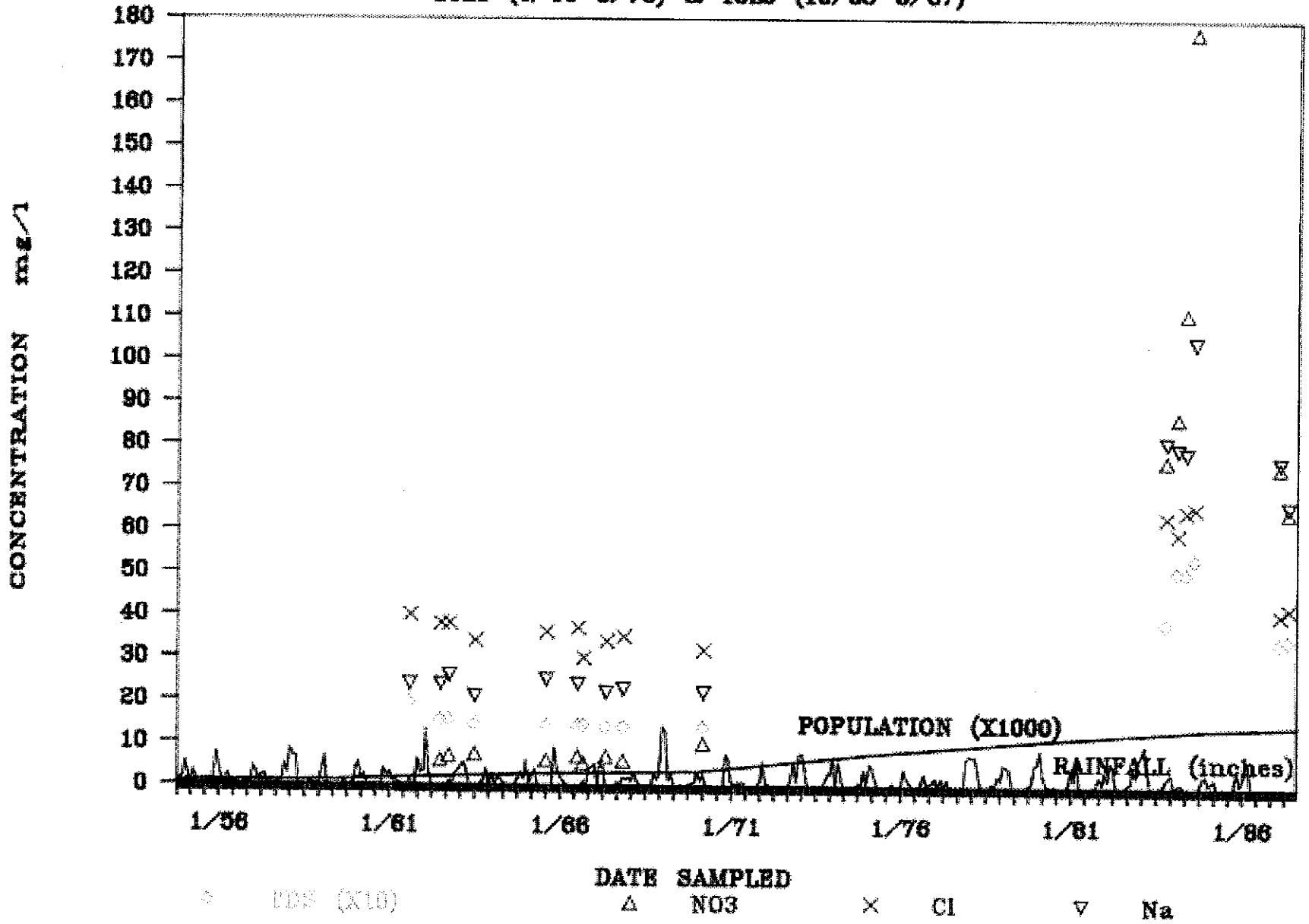


FIGURE 15

LOS OSOS/BAYWOOD PARK GROUNDWATER

13L2 (6/71-10/72) & 13L5 (10/83-5/87)

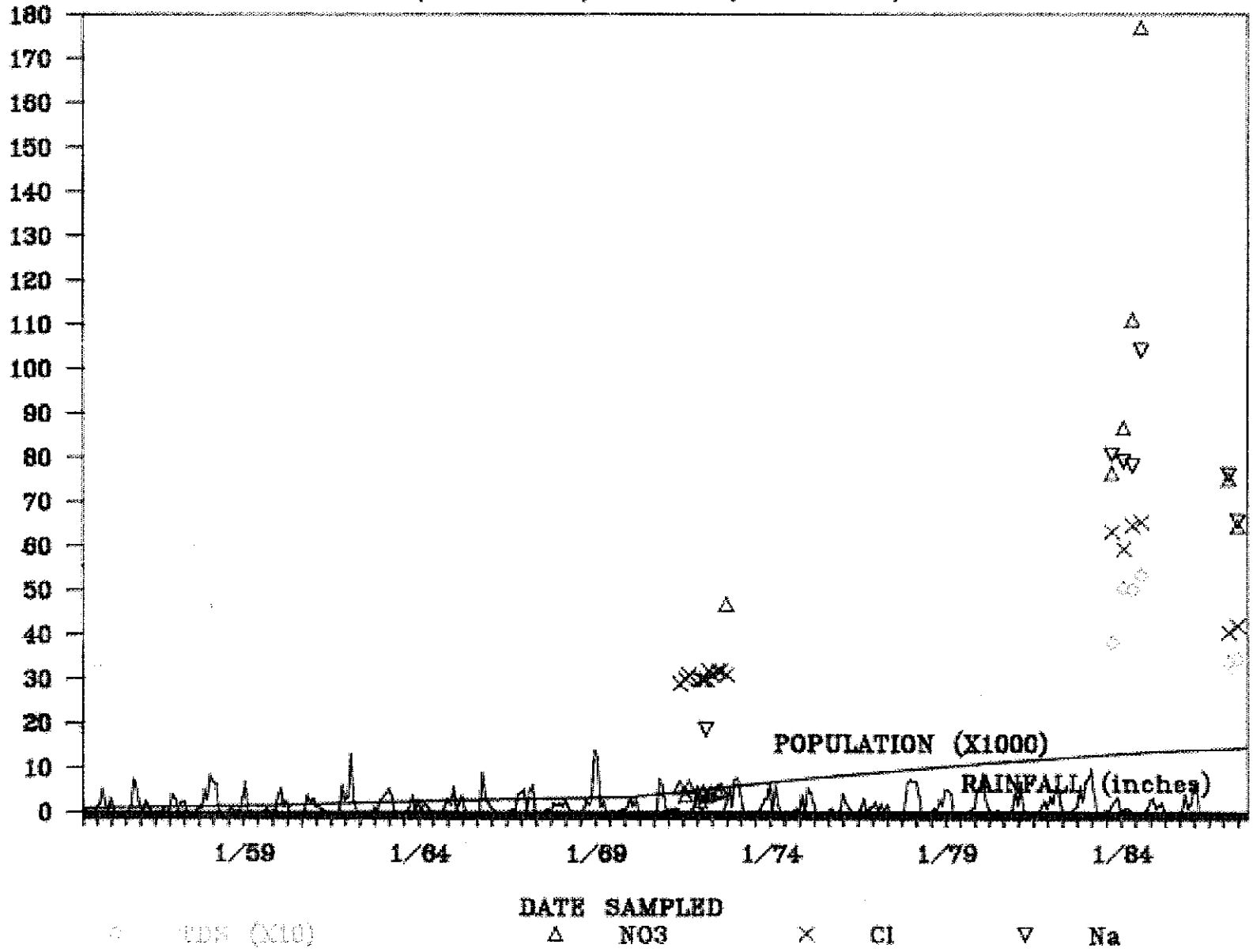


FIGURE 16

LOS OSOS/BAYWOOD PARK GROUNDWATER

13A1 (8/61–8/65) & 13A7 (10/83–5/87)

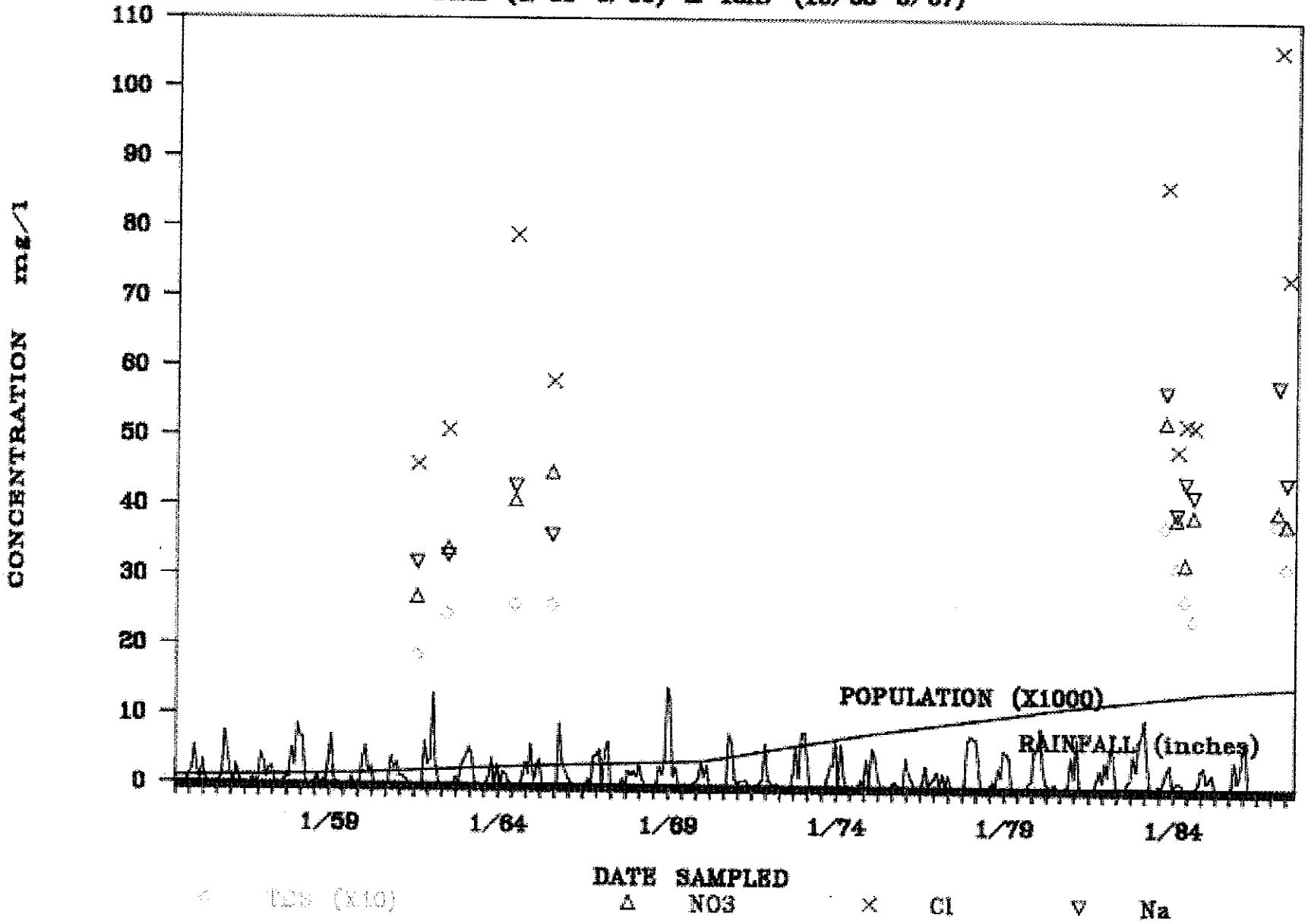


FIGURE 17

LOS OSOS/BAYWOOD PARK GROUND WATER

13A2 (8/61-8/65) & 13A7 (10/83-5/87)

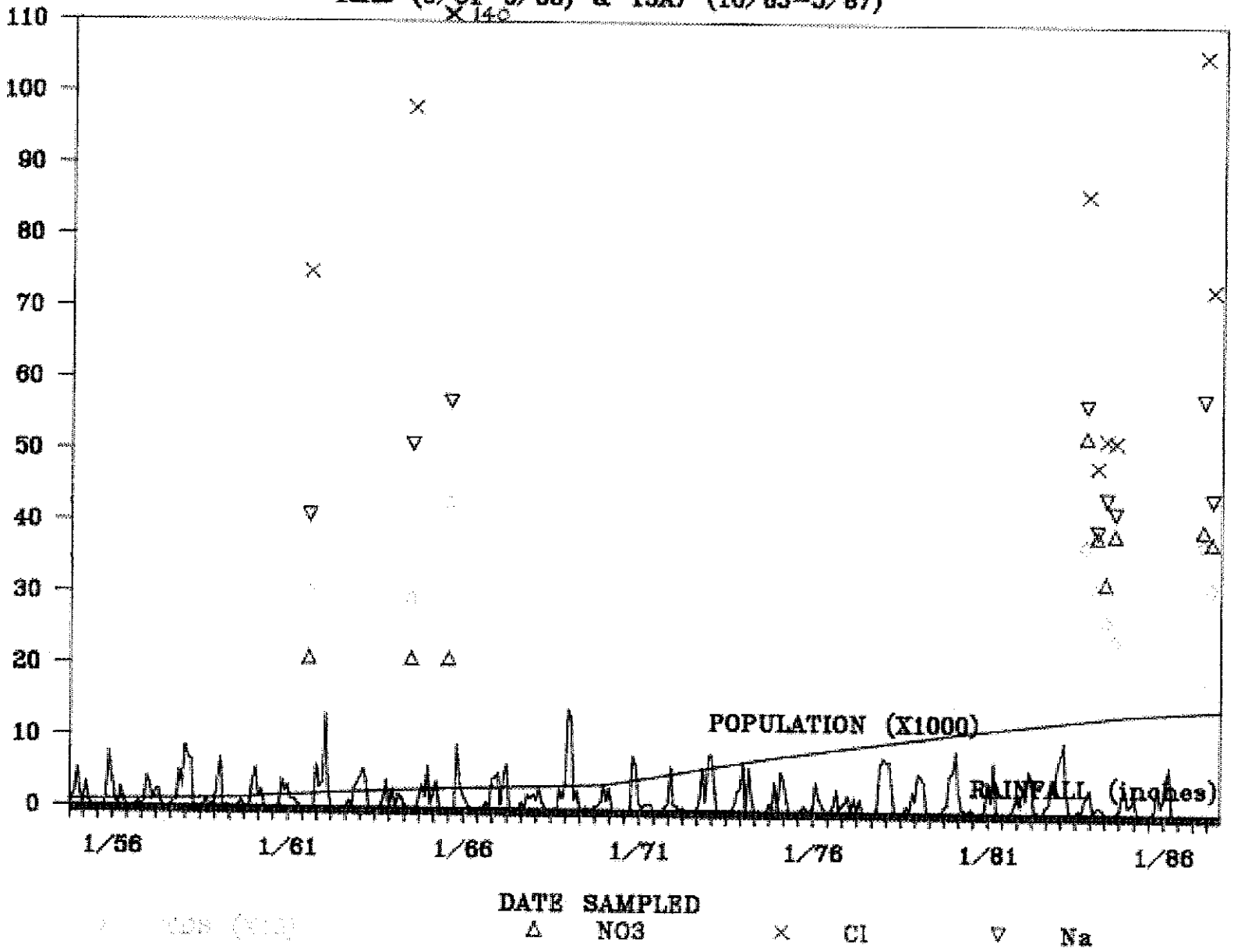


FIGURE 18

LOS OSOS/BAYWOOD PARK GROUNDWATER

13B2 (8/61-11/67) & 13A7 (10/83-5/87)

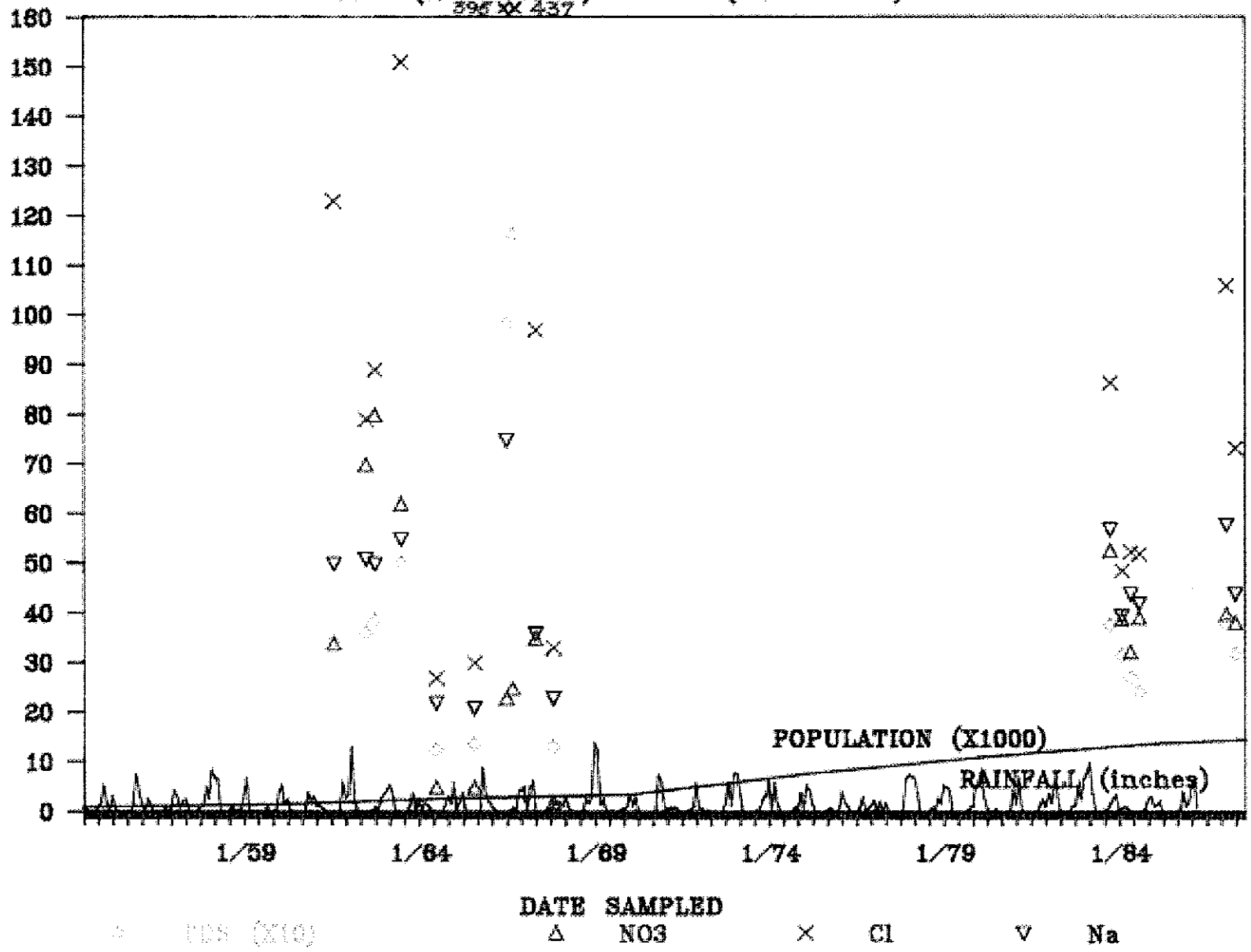


FIGURE 20

LOS OSOS/BAYWOOD PARK GROUNDWATER

7G3 (8/61-11/87) & 7L3 (10/83-5/87)

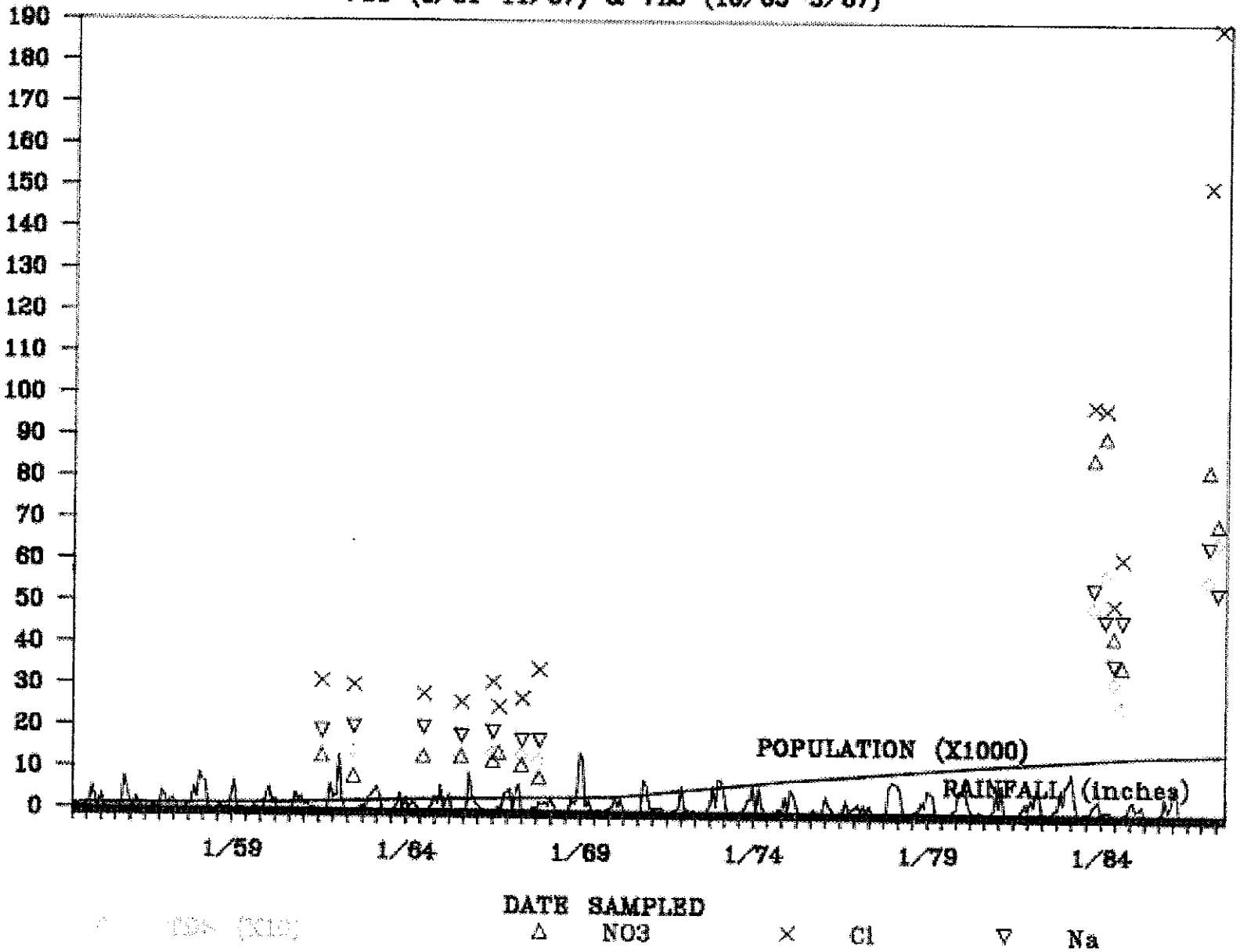


FIGURE 21

LOS OSOS/BAYWOOD PARK GROUNDWATER

7N1 (10/54/-3/72) & 7L3 (10/83-5/87)

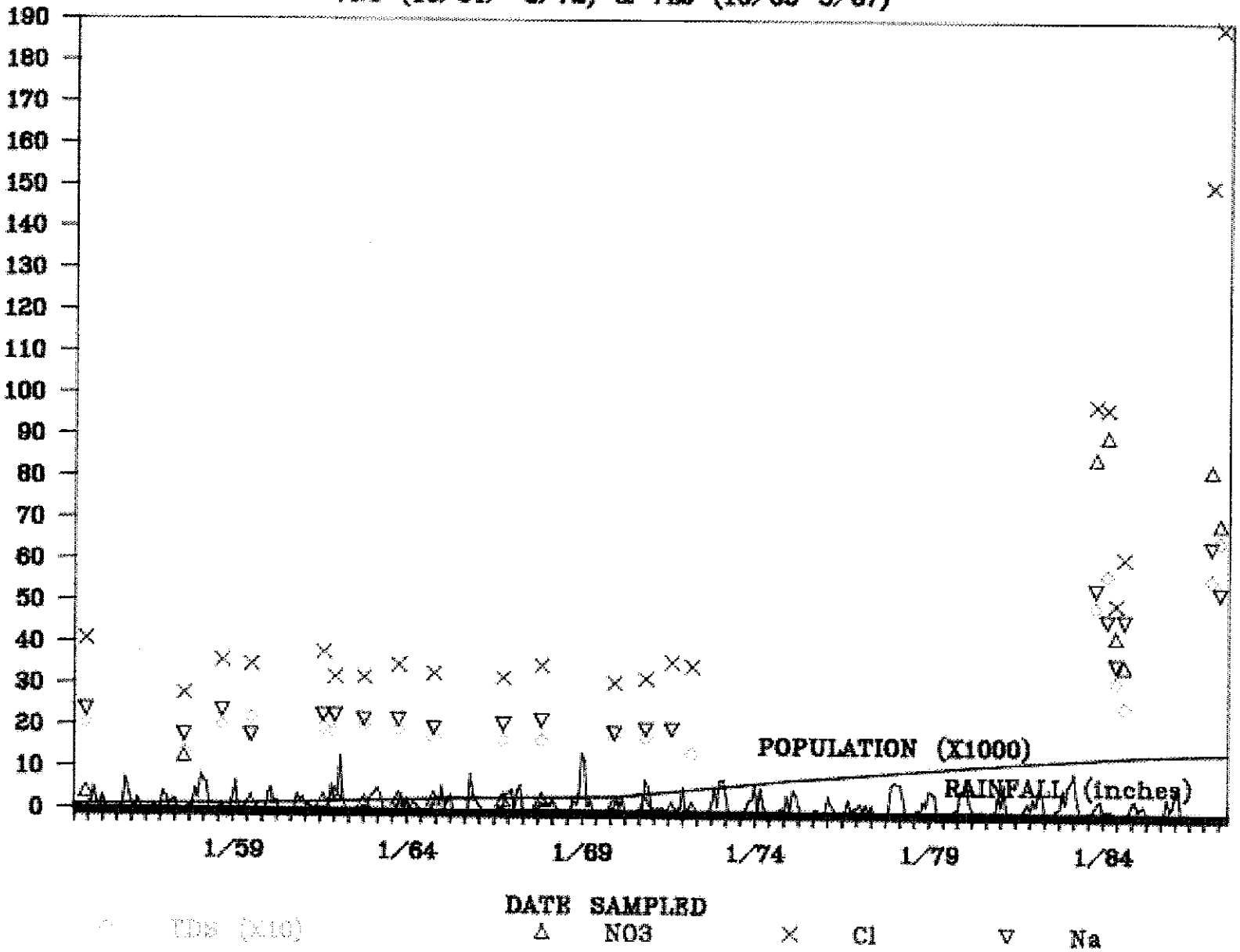


FIGURE 22

TABLES

TABLE 1 Well Perforation Depths

8/87 MJW

Well No.	Perforation Depth (ft.)	Perforation Elevation MSL #	Well Head Elevation MSL #
7L3	42-45	1, -2	43
7N1	61-83	-46, -68	15
7G3 *	62	-42	20
7Q1	29-75	-5, -51	24
13A7	30-40	-18, -28	10
13A1 *	30	-27	13
13A2 *	30	-12	18
13A6 *	20	-10	20
13B2 *	20	-15	5
13L5	32-35	-2, -5	30
13L1	80-140	-45, -105	35
13L2	100-140	-68, -108	32
13Q1	97-100	2, -1	99
13P1	115-135	-40, -60	75
13L1	80-140	-45, -105	35
13L2	100-140	-68, -108	32
18R1	40-50	129, 119	169
18Q1	78-86	64, 54	140
18J6	22-25	101, 98	123
18H1	112-231	50, -69	162
17F4	48-72	28, 4	76
21D3	125-140	-55, -70	70
21D4	40-140	28, -92	68
21E1	140-143	-66, -69	74

* Bottom depth of casing was all that was availab
# Mean Sea Level (ft.)

TABLE 2 Water Quality Data

FJD/MJW (Note: The TDS values are based on Electrical Conductivity multiplied by 0.7
9/87 The NO3 values, for 10/83-5/87, are NO3 as N times 4.43)

DATE		6/54	10/54	8/57	9/58	7/59	12/59	8/60	9/60	6/61	7/61
POPULATION		891	918	1188	1311	1414	1469	1619	1639	1817	1837
RAINFALL, in			0	0	1.17	0	0.57	0	0	0	0
WELL #		CONSTITUENTS, mg/l									
30S/10E	TDS		170.8								149.1
	NO3		21.7								16
13P1	Cl		34								35
	Na		27								25
30S/11E	TDS		208.6	136.5	203	221.2					
	NO3		4.3	13	0	2					
7N1	Cl		41	28	36	35					
	Na		24	18	24	18					
7Q1	TDS						132.3	182			
	NO3						1.3	5.3			
	Cl						30	31			
	Na						19	43			
8R1	TDS									889	
	NO3									2.7	
	Cl									100	
	Na									69	
18H1	TDS						144.9	157.5			147
	NO3						2	18			20
	Cl						32	33			34
	Na						22	23			19
18Q1	TDS	147		149.1	203	191.8			204.4		
	NO3	8.7		11	26	4			27		
	Cl	39		37	47	46			50		
	Na	23		23	30	25			29		

DATE		8/61	10/61	12/61	7/62	8/62	10/62	7/63	9/63	10/63	7/64	10/64	8/65	10/65
POPULATION		1857	1897	1936	2075	2095	2135	2313	2353	2373	2551	2611	2765	2793
RAINFALL, in		0	0	2.89	0	0	1.08	0	0.28	1.35	0	1.44	0	0
WELL #		CONSTITUENTS, mg/l												
30S10E	TDS	185.5			245						259		258.3	
	NO3	27			34						41		45	
13A1	Cl	46			51						79		58	
	Na	32			33						43		36	
13A2	TDS	303.8									294		428.4	
	NO3	21									21		21	
	Cl	75									98		140	
	Na	41									51		57	
13A6	TDS	335.3									210		130.2	
	NO3	53									42		2	
	Cl	66									46		27	
	Na	50									41		21	
13B2	TDS	343.7			360.5		384.3	500.5			126		137.2	
	NO3	17			20		80	87			3		5	
	Cl	123			79		89	151			27		30	
	Na	50			51		50	55			22		21	
13L1	TDS	194.6			154		154	142.8					139.3	
	NO3	0			6		7	7.4					6	
	Cl	40			38		38	34					36	
	Na	24			24		26	21					25	
23H1	TDS	260.4									126		240.8	
	NO3	3.6									7		12	
	Cl	61									41		56	
	Na	43									22		39	

30S11E	TDS	136.5			140						126		130.9	
7G3	NO3	13			8						13		13	
	Cl	31			30						28		26	
	Na	19			20						20		18	
7N1	TDS	197.4		186.9			203			193.2		175.7		
	NO3	2.3		3.9			2			3		3		
	Cl	38		32			32			35		33		
	Na	23		23			22			22		20		
7Q1	TDS	154					147.7							
	NO3	15					17							
	Cl	35					29							
	Na	21					20							
8R1	TDS				966		882	812						
	NO3				0		3	4.3						
	Cl				117		92	92						
	Na				74		74	75						
18H1	TDS						177.1							
	NO3						30							
	Cl						33							
	Na						25							
18R1	TDS												139	
	NO3												3	
	Cl												39	
	Na												21	
18Q1	TDS		161.7				203		210			196		210
	NO3		27				30		35			26		24
	Cl		46				42		43			44		50
	Na		23				31		35			29		35

DATE		7/66	9/66	10/66	1/67	5/67	11/67	12/69	3/70	11/70	5/71	6/71	8/71
POPULATION		2915	2942	2956	2997	3051	3133	3473	3624	4173	4584	4652	4789
RAINFALL, in		0.18	0.91	0	5.21	0.21	2.14	1.21	3.09	7.7	0.98	0	0
WELL #		CONSTITUENTS, mg/l											
30S/10E	TDS	983.5	1162			336.7	130.9						
13B2	NO3	23	25			35	2						
	Cl	395	437			97	33						
	Na	75				36	23						
13L1	TDS	141.4	142.1			137.2	138.6		135.8				
	NO3	7	5.4			7	6		10				
	Cl	37	30			34	35		32				
	Na	24				22	23		22				
13L2	TDS												
	NO3											5.8	3.9
	Cl											29	30
	Na												
23H1	TDS								487.2				
	NO3								5				
	Cl								28				
	Na								11				
30S/11E	TDS	135.8	138.6			133	119.7						
7G3	NO3	12	14			11	8						
	Cl	31	25			27	34						
	Na	19				17	17						
7N1	TDS			169.4			169.4	175.7		176.4			
	NO3			2.8			3	2		2			1.1
	Cl			32			35	31		32			36
	Na			21			22	19		20			20
7Q1	TDS		149.1				149.8	133.7	143.5		156.1		
	NO3		18				21	18	22		24	21	22
	Cl		30				34	29	32		31	31	33
	Na		20				21	18	20		22		
8R1	TDS	884.1	931			796.6	735.7						
	NO3	4	3.9			3.5	3						
	Cl	98	88			98	101						
	Na	68				81	72						

18H1	TDS		147.7				154	153.3	172.9				
	NO3		13				8	14	29			5.5	
	Cl		29				33	30	33			29	
	Na		21				17	20	24				
18B1	TDS		179.9				193.9	183.4					
	NO3		26				0	27					
	Cl		34				48	43					
	Na						31	26					
21E1	TDS								1068.				
	NO3								2				
	Cl								326				
	Na								97				

DATE		9/71	10/71	12/71	1/72	2/72	3/72	4/72	5/72	7/72	8/72	10/72	6/73
POPULATION		4858	4927	5064	5132	5201	5269	5338	5406	5544	5612	5749	6298
RAINFALL, in		0.1	0.55	6.1	0.86	0.53	0.03	0.44	0	0	0	2.08	0
WELL #		CONSTITUANTS, mg/l											
30S/10E	TDS												
	NO3	6			2.6	4.8	3.7	4.1	4.4	4.8	5.2	47	
13L2	Cl	31			30	30	30	32	31	32	32	31	
	Na						19						
30S/11E	TDS						140						
	NO3						1						
7N1	Cl						35						
	Na												
7B1	TDS						140						
	NO3	22	20	28	22	24	23	22	2.3	21	2.2	24	
	Cl	33	33	30	32	32	35	32	33	33	32	31	
	Na						18						
18H1	TDS						133						
	NO3						2						
	Cl						35						
	Na						23						
21D4	TDS												1009
	NO3												60.6
	Cl												103
	Na												63

DATE		10/83	2/84	5/84	8/84	2/87	5/87
POPULATION		13046	13234	13374	13515	14375	14452
RAINFALL, in		1.74	0.84	0	0.03		
WELL #		CONSTITUANTS, mg/l					
30S/10E	TDS	375.2	315.7	270.2	241.5	378.7	317
	NO3	52.71	38.80	32.29	39.11	39.87	38.1
13A7	Cl	86.4	48.5	52.3	52	106	73.3
	Na	57	39.5	44	42	57.9	44
13L5	TDS	383.6	506.1	502.6	534.8	340.9	347
	NO3	76.63	86.82	111.1	177.2	75.31	64.7
	Cl	63.4	59.5	64.8	65.6	40.7	42.2
	Na	81	79.5	78.5	104.5	76.5	66
13B1	TDS	324.1	409.5	371	351.4	304	324
	NO3	19.9	17.5	16.5	16.9	16.1	64.7
	Cl	66	72.4	72.3	64.5	57.6	60.9
	Na	70	66.5	73	65	60	54.3
30S/11E	TDS	495.6	573.3	316.4	256.2	563.5	655
	NO3	85.49	90.81	42.74	35.66	82.84	70
7L3	Cl	98.1	97.4	50.4	61.5	151	189
	Na	54	46.5	36	46.5	64.5	53.4
7N1	TDS	210	233	204	183		169
	NO3	11.2	12.8	6.38	9.3		7.5
	Cl	35.2	41.7	38.6	35		31.1
	Na	24.5	26	30.5	34		21.8

DATE		10/83	2/84	5/84	8/84	2/87	5/87
7B1	TDS	311.5	298.9	307.3	294	313.6	389
	NO3	48.73	53.16	60.69	55.37	62.02	61.1
	Cl	47.4	51	41.7	47.1	42.5	49.7
	Na	43.5	43.5	43	47	47.2	50
17F4	TDS	459.9	0	462.7	356.3	371.7	358
	NO3	19.40	1.506	0	1.816	10.63	19
	Cl	94.5	88.2	79.5	80.8	71.1	82
	Na	61.5	60.5	55.5	60.5	64.3	60.2
18J6	TDS	829.5	421.4	385.7	333.2	336.7	367
	NO3	6.069	6.024	5.537	11.91	21.26	15.1
	Cl	196.5	42.9	45.1	49.9	61.5	49.7
	Na	168	58.5	58	54.5	51.7	49.6
18R1	TDS	256.2	287	258.3	240.8	240.8	255
	NO3	52.71	48.50	58.91	60.69	66.45	59.8
	Cl	57.8	42.2	41.9	40	35.4	39.8
	Na	43.5	36.5	41	39.5	40.7	35.1
18B1	TDS	242	204	210	191		198
	NO3	6.93	0.09	0	0		0
	Cl	59.9	87.4	64.8	76.1		82
	Na	30.5	45	27.5	37		31
21D3	TDS	885.5	0	840.7	763.7	665.7	
	NO3	99.67	71.32	101.8	83.72	78.85	
	Cl	116	86.1	82.4	57.7	49.2	
	Na	60.5	51	50	70	46.7	