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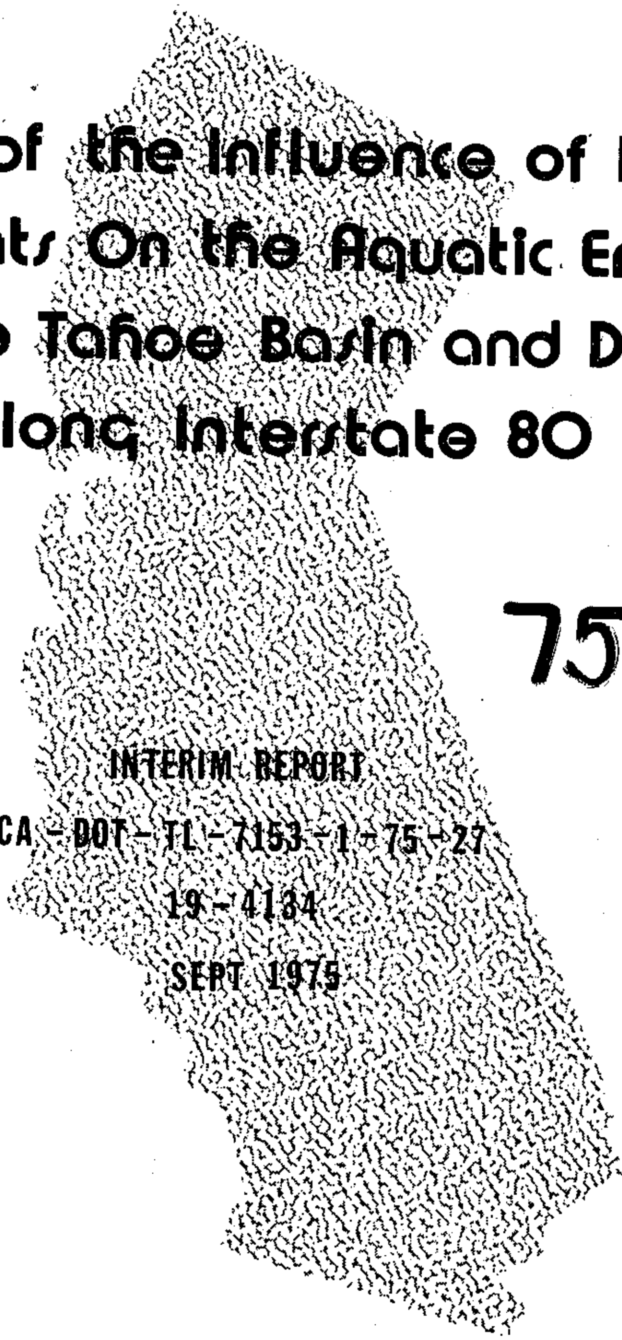

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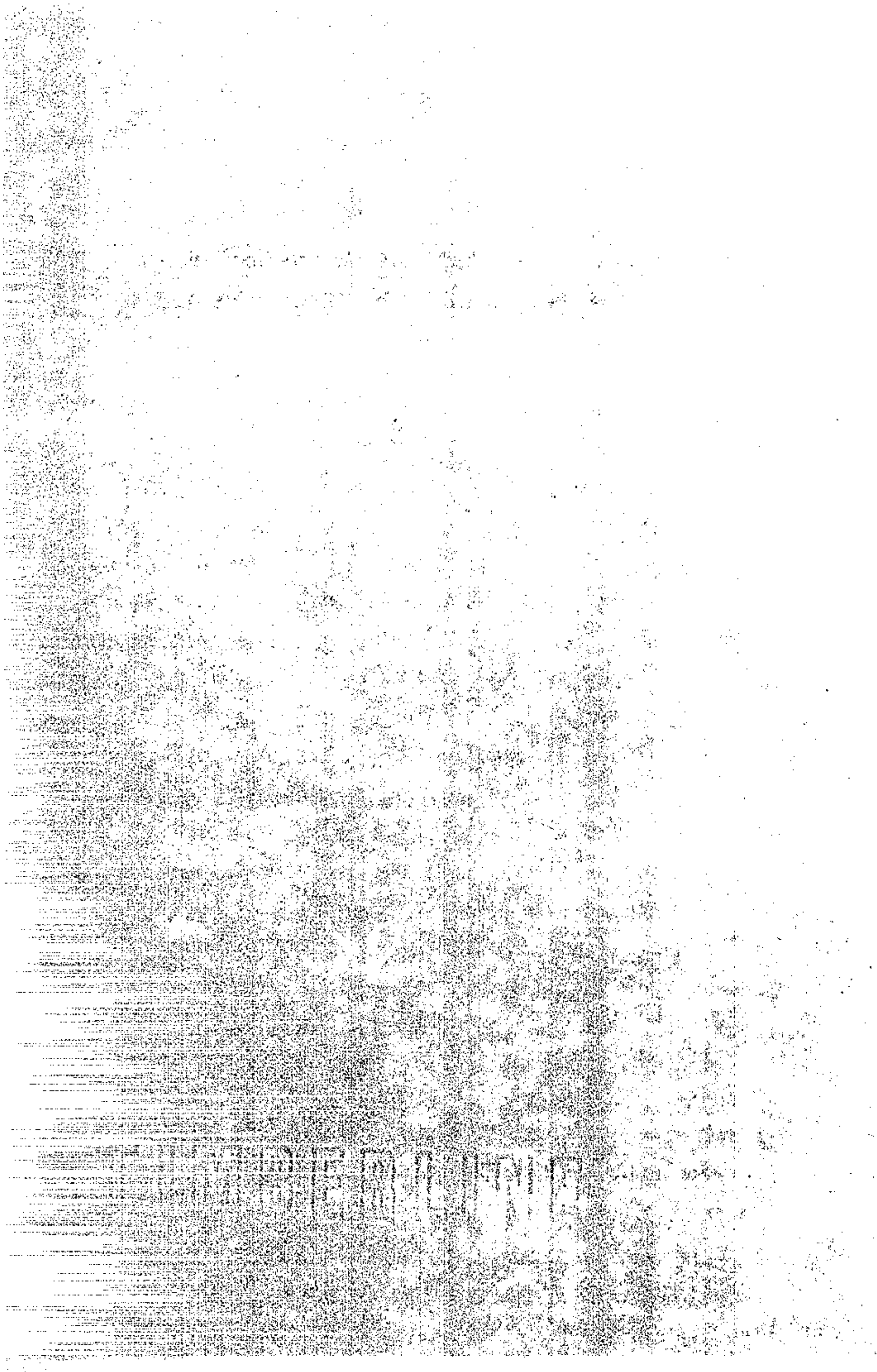

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A Study of The Influence of Highway Deicing Agents on Aquatic Environments in the Lake Tahoe Basin and Drainages Along Interstate 80

Interim Report

June 1975

Prepared by:
Ecological Research Associates
Davis, California

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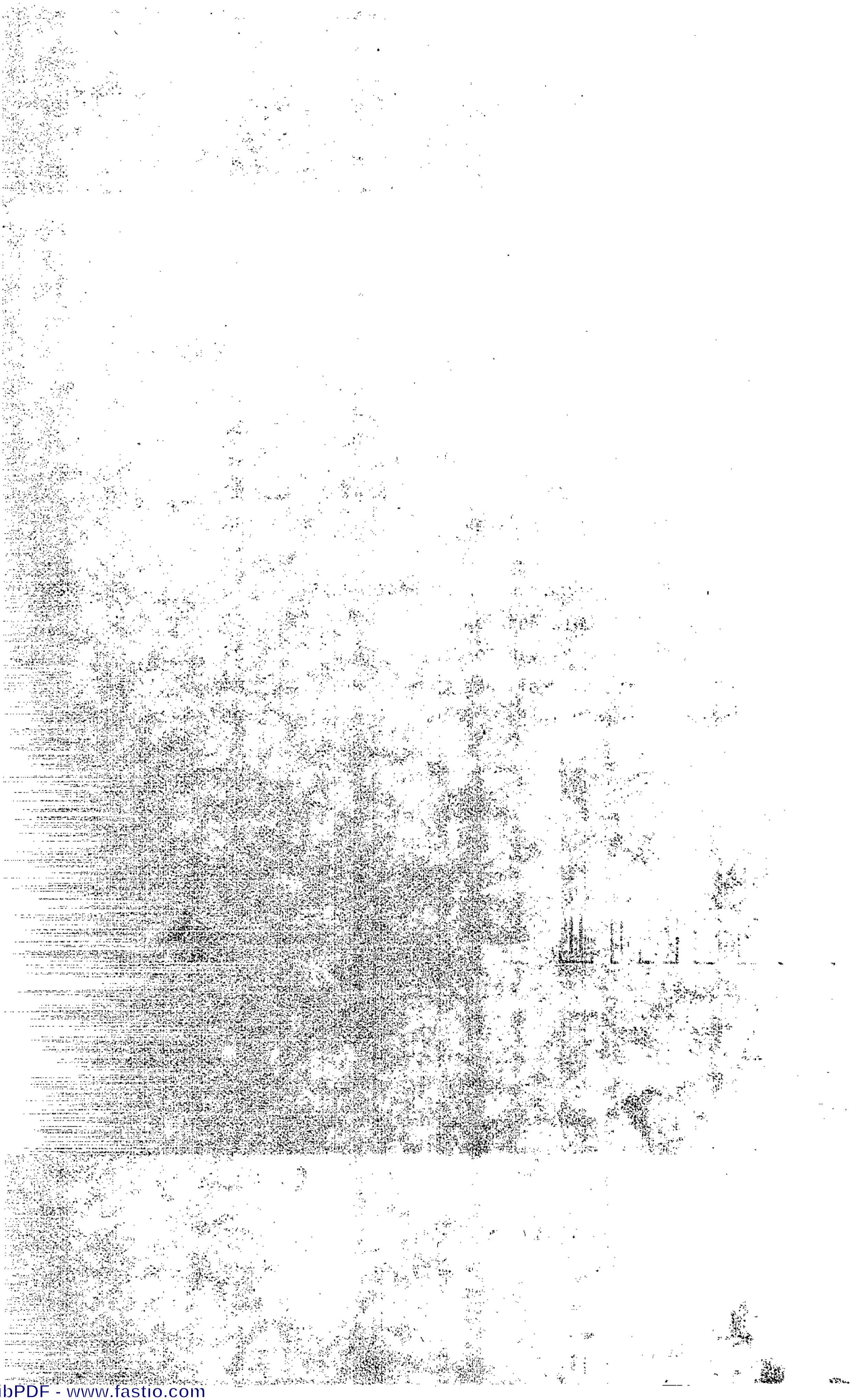

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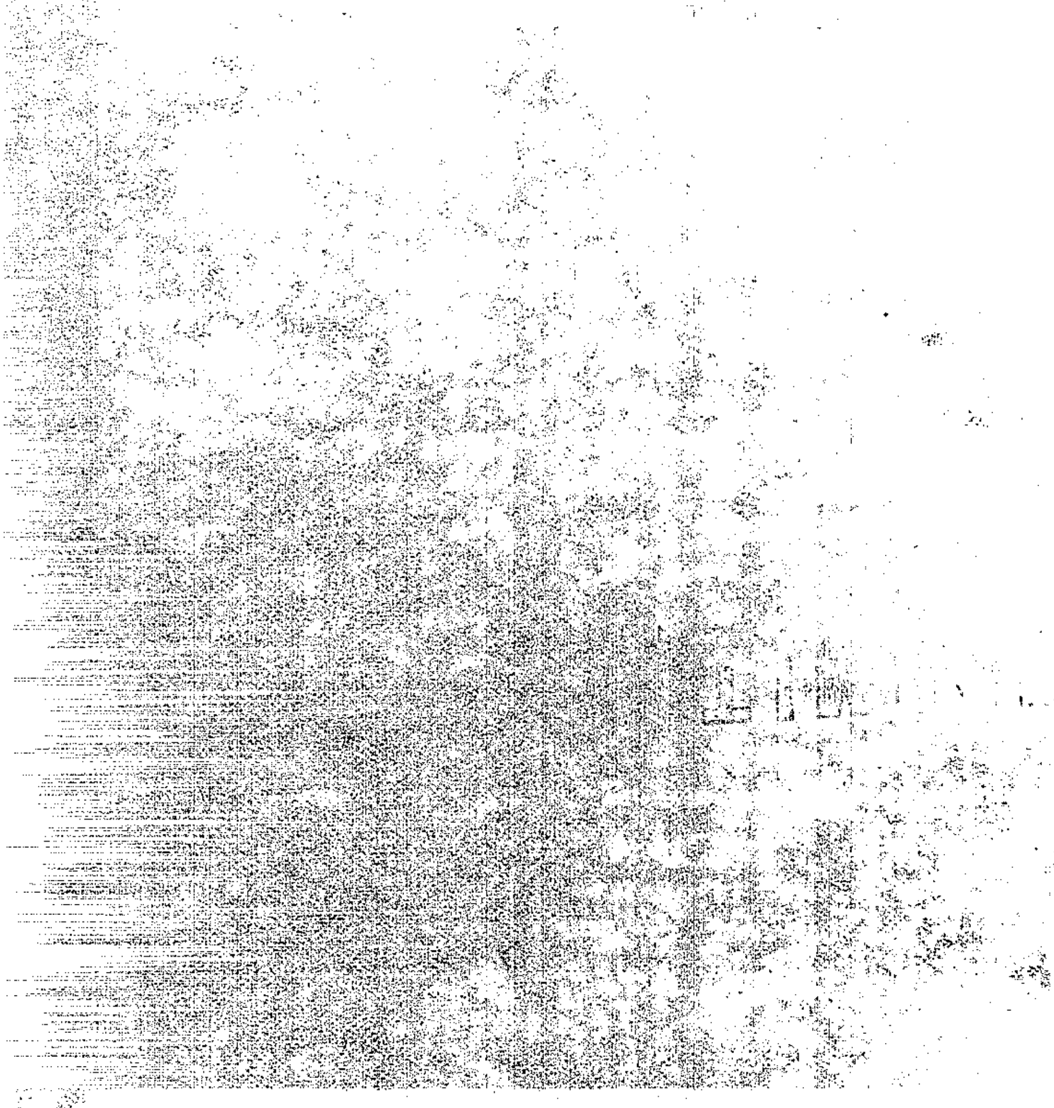


INTRODUCTION

The following report summarizes the work performed to date on the study entitled "A Study on the Influence of Highway Deicing Agents on Aquatic Environments in the Lake Tahoe Basin and Drainages Along Interstate 80" (#SA 19-4134). The work is being performed by Ecological Research Associates of Davis, California, under contract with the Transportation Laboratory of the Department of Transportation, State of California. Principal investigator for Ecological Research Associates is Dr. Charles R. Goldman. Mr. Earl Shirley, Chief of the Environmental Improvement Branch of the Transportation Laboratory, Department of Transportation, is the co-principal investigator for the State.

The study's objectives are to:

1. Determine the influence of deicing compounds on productivity and eutrophication rates in aquatic ecosystems;
2. To investigate the effects of deicing materials on the physical aspects of aquatic ecosystems;
3. Determine the present distribution of road salts in specific lakes and ponds receiving road drainage; and
4. Analyze road salts for important trace element contaminants.

The major portion of work has been completed for each objective. More detailed analysis of road salt effects on productivity is currently being performed. All field data for the assessment of physical impacts will have been collected by the end of June, 1975 and only a small amount of additional analysis is needed to complete trace element contamination determinations.

Preparation for the study began in March, 1974. Thirty study sites have been sampled regularly since June, 1974. Approximately 120 samples per month have been taken. Most sampling has been bimonthly, although a monthly schedule was used on Lake Tahoe and on all lakes during the winter months. Locations of the sampling sites are given on the map entitled "Project 657153 Sampling Sites" (Appendix I). Site locations and names are given in Appendix II. In addition, snow and runoff samples have been taken and a lake uninfluenced by any highway has been sampled. Sampling of more control lakes will be done in the summer of 1975.

Work yet to be completed includes bioassays of phytoplankton and bacterial metabolism under the influence of different deicing compounds, atomic absorption analysis for zinc, copper, cadmium, manganese, iron, molybdenum, lead, and mercury, and spectrophotometric analysis for boron. This work is currently being performed.

Much of the analysis has been included as tables and graphs in this interim report. The reader is directed to these portions of the report, particularly the graphs, for an understanding of the study findings to date. These graphs show the study results most clearly and are easily comprehensible. The text highlights the most important findings of each section, and lengthy discussion of each particular study component has been avoided in this report.

The report is divided into three sections and a Summary. The Summary contains the major points from each section. No conclusions are made, since they would be premature without complete data analysis. Section I, Bioassays, contains results pertaining to the influence of deicing materials on productivity. Section II reports trace contaminants studies, and Section III discusses eutrophication rates in aquatic ecosystems and the distribution of road salts in lakes receiving highway drainage.

SUMMARY

The following is a brief summary of our study findings to date. More detailed analysis is given in this interim report and a complete analysis will be given in the final report.

1. Bioassays using Donner Lake water sampled on 28 March 1975, using additions of 1.5 ml of 31.03mmol/l deicing compound solutions. Ethylene glycol was the only compound that stimulated phytoplankton photosynthesis. More detailed analysis is still required and will be completed during the summer.

2. Bioassays using additions of TKPP to stream water supplied by the Transportation Laboratory indicate stimulation by TKPP.

3. Bioassays are specific to the aquatic community to which they are supplied and should be performed statewide. Bioassays on other aquatic communities in the Tahoe Basin and along U.S. 80 will be performed during the summer of 1975.

4. All deicing compounds contain high levels of contaminants. Contaminants include both biological stimulating and inhibiting substances. Phosphorous, nitrogen, silicon, sulfur, and iron are among the most important impurities.

5. Deicing salts from the Southwest Salt Company, Los Angeles and West Coast Salt and Milling Company, Bakersfield, was found to be especially high in contaminants.

6. Standards for contaminations level should be established and suppliers should be sought who can meet these standards.

7. Alternative deicing compounds which are composed of substances known to be stimulating to aquatic communities should not be used with-

out detailed studies of their local impacts (i.e., urea, TKPP).

8. Ti (titanium), Ni (nickel), Cu (copper), Zn (Zinc), Hg (mercury), and Pb (lead) have been found in most deicing compounds. The effects of these elements will depend upon local circumstances, but several are known to stimulate growth at low concentrations and to inhibit phytoplankton metabolism when provided in large quantities.

9. Lake Tahoe and Donner Lake do not exhibit altered vertical salinity profiles due to increased chloride concentration from road salting.

10. Putt's Lake, however, exhibits a marked chloride density gradient which maintains an unstable thermal structure during late winter. The shallow lake basin is a key factor in preventing monimolimnion (a dense layer of water which does not mix with the rest of the lake) development, but one could easily have developed in a deeper, more protected, lake basin given the current salt input. A check for monimolimnion development in small lakes near salted highways should be made throughout the state.

11. Culverts from the freeway which empty directly into Putt's Lake are responsible for the salt layer and should probably be changed.

12. Gold Run Pond and Summit Roadside West Pond show temporary increases of chloride with depth, but these parallel the thermal structure. A combination of chloride and thermal density gradients are indicated, but both ponds are holomictic (mix completely to the bottom of the lake).

13. Smaller ponds near the freeway are most subject to influence by deicing compounds. A statewide reconnaissance of these types of ponds should be made, followed by a yearly monitoring program.

14. Specific conductivity is of limited use in indicating chloride levels since other ions can give moderately high conductivities while

chloride levels may be negligible in the readings.

15. Lakes with watersheds transected by major highways exhibit higher chloride concentration than those not affected by a highway.

16. Streams crossing U. S. 80 show marked increase in chloride concentration.

17. Chloride levels increase in tributaries which cross U. S. 80, but no consistent pattern of chloride increase has been noted in tributaries crossed by Highways 89 and 50.

18. It is doubtful if the chloride levels presently found will have significant affects on the tributaries around Lake Tahoe.

19. Highway runoff is very rich in chloride when compared to runoff from areas not receiving deicing compound applications.

SECTION I

BIOASSAYS

WINTER BIOASSAYS

Graphs I-1 through I-22 and Tables I-III contain data from bioassay conducted during March 1975. These bioassays were made with Donner Lake water taken on 28 March 1975 from 0 m. Lake conditions were very rough on that day, with 2-2.5 foot waves on Donner Lake making sampling dangerous. Since the water column was thoroughly mixed, and there was thick cloud cover, light inhibition would not be expected.

Treatments consisted of adding 0.5 ml of 31.03 mmols deicing compound solution to 500 ml of lake water. (31.03 mmols is equivalent to 1,100 ppm NaCl.) Duplication of treatments was done in all cases except treatment number four. One flask from treatment number four was broken on the first day of the experiment.

These experiments were conducted in different incubators and each incubator had its own control. Therefore, treatments 1 - 10 should be compared to control 1 - 2, treatments 11 - 18 to control 3 - 4, and treatments 19 - 21 to control 5 - 6.

For most treatments no clear picture of stimulation or inhibition was found during this experiment. Treatment number 20, the addition of ethylene glycol, has an apparent stimulating effect. This is best seen in Graph I-20, Ethylene Glycol Addition. Since statistical analysis of duplicated samples is not possible, detailed analysis will have to await experiments using triplicated treatments. Results of other treatments are not clear, and no statement on stimulation or inhibition can be made without further experimentation.

Bioassays on different water sources and using several levels of additions and triplicated treatments will be conducted during the summer.

These experiments will yield more detailed information on deicing compounds' effects on phytoplankton and bacterial metabolism at a time when populations are greater and most responsive. Completion of this work will fulfill study objectives on productivity and eutrophication effects.

A special bioassay using TKPP additions to water supplied by the Transportation Laboratory shows possible stimulation. Treatments were run in triplicate, and statistical analysis of this experiment will be done in the final report. Stimulation is apparent in Graph I-22. Treatment information and mean counts per minute are given in Table III, TKPP Bioassay.

We must re-emphasize the fact that bioassays are specific to the water and phytoplankton communities used in each experiment. The results of Experiment I-22 compared to I-5 help show this. The same amount of TKPP was added in each experiment, but stimulation over control is much clearer in I-22 than I-5. This is due to the different water and phytoplankton communities used in each case. The communities in I-22 may have been limited by phosphorus while those of I-5 (Donner Lake) are probably not limited by the same element or in the same manner. We recommend that bioassays be conducted wherever highway deicing compounds applications result in heavy runoff into a lake because of the specific responses of different aquatic communities.

The use of the Carbon-14 uptake method for bioassays has proven satisfactory during these experiments. The methods have been described by Goldman (1963) and in the study proposal. Natural water is taken from a lake or stream and transported in opaque containers to a laboratory. Carbon-14 is then added to the water, and the water with the Carbon-14 is distributed amongst 500 ml capped Erlenmeyer flasks. These flasks have been previously inoculated with varying amounts of the deicing compound under study. These flasks are incubated under constant light and temperature. Subsamples are removed daily and filtered. These filters, which contain phytoplankton (microscopic suspended plants) and bacteria from the natural water, are counted by a Geiger-Mueller counter for their levels of radioactivity. By comparing the counts/minute of the treatments to control flasks (using reagent grade sodium chloride additions or no additions), the amount of stimulation or inhibition of phytoplankton metabolism is determined.

The method is based upon the uptake of bicarbonate and carbonate ions by phytoplankton during photosynthesis. The relationship can be shown in simplified form by the equation

$$6\ CO_2 + 6\ H_2O \longrightarrow C_6H_{12}O_6 + 3O_2$$

$C_2H_{12}O_6$ is the sugar produced by photosynthesis. If labeled Carbon-14 is added, it is incorporated into the sugars, and the resulting measure of radioactivity in phytoplankton cells gives a sensitive measure of metabolism rates.

TABLE I

TREATMENTS--WINTER BIOASSAYS

Treatment: 0.5 ml additions of 31.03 mmols deicing compound solution were added to 500 ml of Donner Lake water. Duplicates were used in all cases except treatment number four. (Sample was lost by breakage.) Controls of no addition were run in duplicate.

KEY TO TREATMENTS, WINTER BIOASSAY:

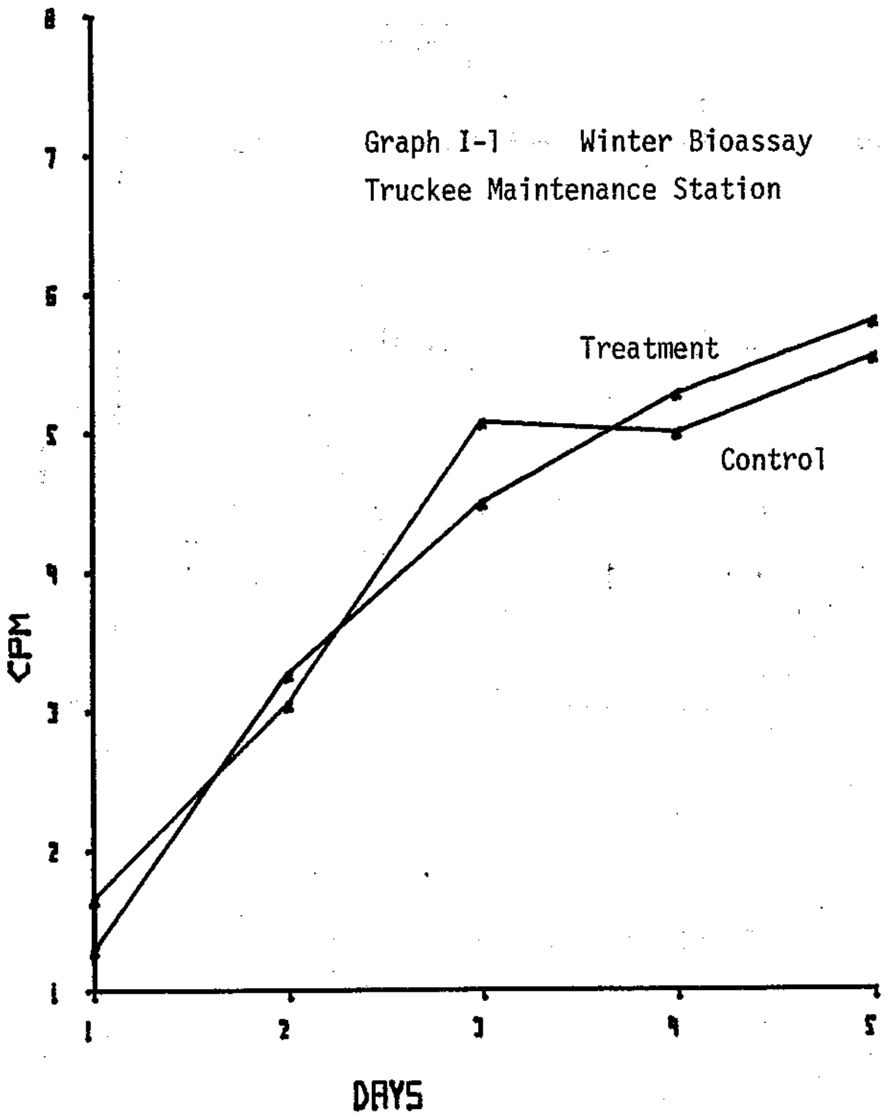
Treatment No.	Deicing compound
C-1-2	Control -- no addition
1	Truckee Maintenance Station - NaCl
2	Kingvale Maintenance Station - NaCl
3	Whitmore Maintenance Station - NaCl
4	Tahoe City Maintenance Station - NaCl
5	TKPP
6	Kyburz Maintenance Station - NaCl
7	Vincent Maintenance Station - NaCl
8	Woodside Maintenance Station - NaCl
9	Sodium sulfate
10	Potassium phosphate
C-3-4	Control -- no addition
11	Urea
12	Descanso Maintenance Station - NaCl
13	Magnesium Sulfate
14	Sodium formate
15	Sodium benzoate
16	Sodium metasilicate
17	Calcium formate
18	Magnesium chloride
C-5-6	Control -- no addition
19	Sodium acetate
20	Ethylene glycol
21	Dimethyl formamide

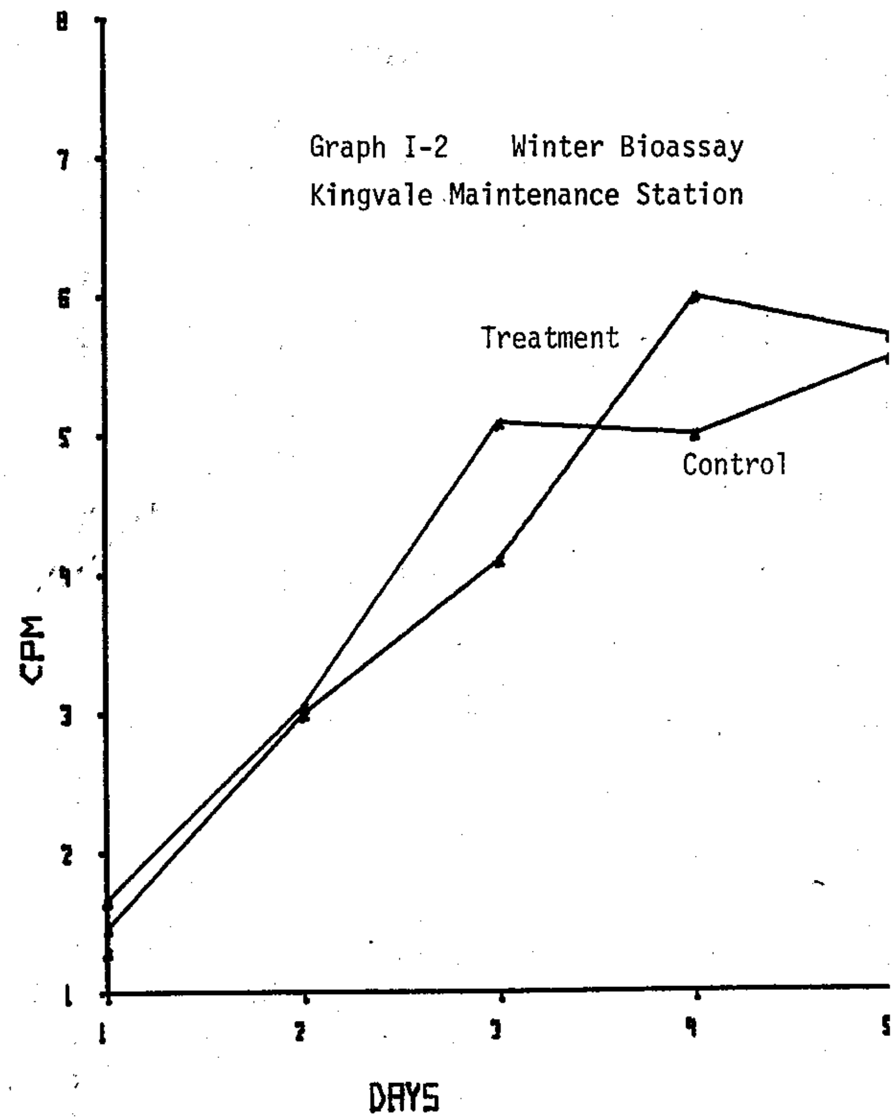
TABLE II

COUNTS/MIN.: WINTER BIOASSAY

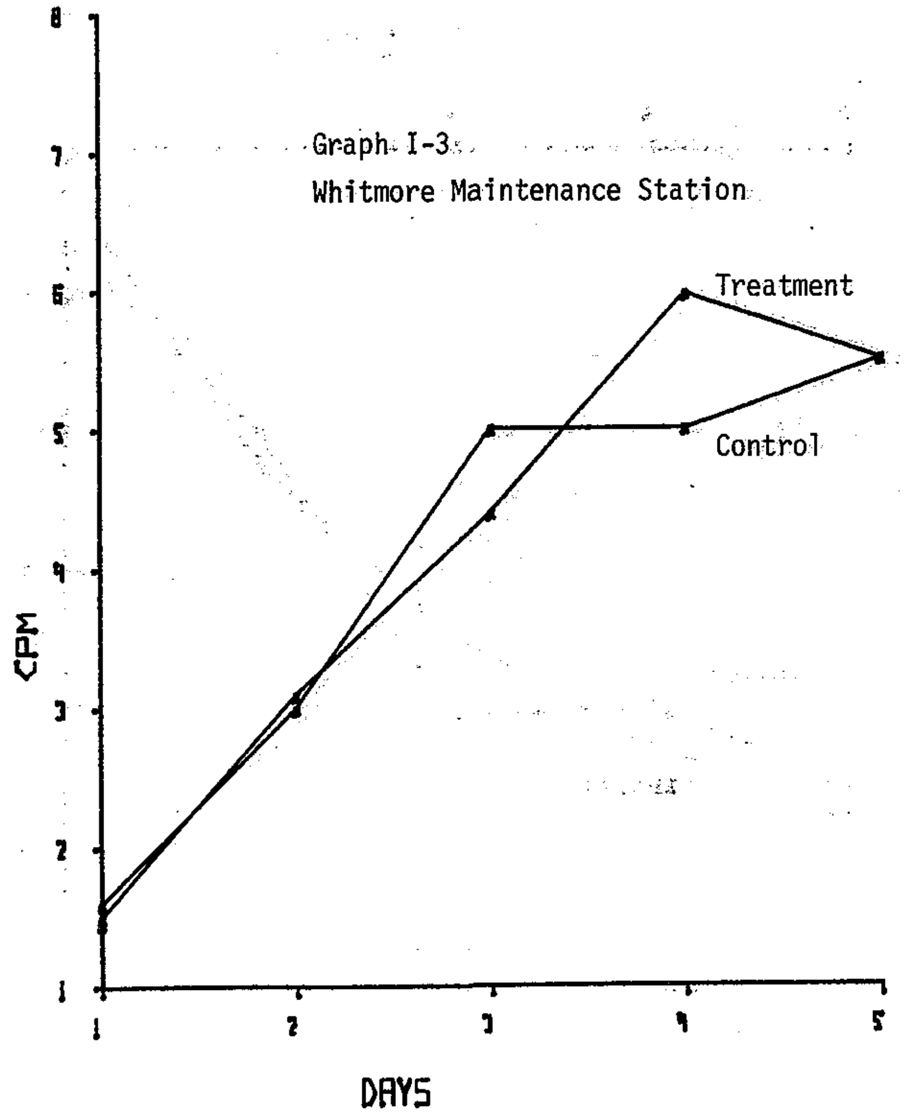
Treatment	Day 1	2	3	4	5
C1-2	1658.4	3053.4	5076.1	5000.0	5540.2
1	1294.5	3268.0	4504.5	5277.0	5797.1
2	1457.7	3007.5	4098.4	5988.0	5698.0
3	1534.9	3105.6	4386.0	5970.1	5494.5
4	1618.1	2724.8	4566.2	4902.0	5405.4
5	1548.0	3448.3	4338.4	6369.4	5970.1
6	1557.6	3289.5	4008.0	6116.2	5714.3
7	1886.8	3048.4	4024.1	6079.2	5361.9
8	1727.1	3231.0	3584.2	5814.0	6153.8
9	1619.4	3372.7	4264.4	6451.6	5235.6
10	1294.5	2994.0	3846.2	5797.1	6250.0
C3-4	1620.7	3333.3	4201.7	6557.4	5464.5
11	1573.6	2985.1	3690.7	5917.2	6250.0
12	1490.3	3241.5	3876.0	6211.2	6024.1
13	1522.1	3220.6	3876.0	6296.6	5698.0
14	1445.1	3367.0	4310.3	7067.1	6802.7
15	1364.3	3164.6	3787.9	5376.3	5952.4
16	1400.6	2677.4	3448.3	4926.1	5291.0
17	1618.1	2853.1	4123.7	5988.0	4048.6
18	1571.1	2195.4	3952.6	6622.5	6269.4
C5-6	1697.8	3448.3	5208.3	5917.2	6116.2
19	1757.5	3546.1	5115.1	6309.1	6410.3
20	1666.7	3802.3	5763.7	6896.6	7547.2
21	1632.7	3496.5	5479.5	5988.0	5848.0

NOTE: 1. All counts are the mean of duplicate samples.
2. Water taken from Donner Lake, III/28/75, o m.


Graph I-1 Winter Bioassay
Truckee Maintenance Station
Treatment
Control
CPM
DAYS
1
2
3
4
5
6
7
8


Graph I-2 Winter Bioassay
Kingvale Maintenance Station
Treatment
Control
CPM
DAYS
1
2
3
4
5
6
7
8

CPMx1000


Graph I-3
Whitmore Maintenance Station
Treatment
Control
CPM
DAYS
1
2
3
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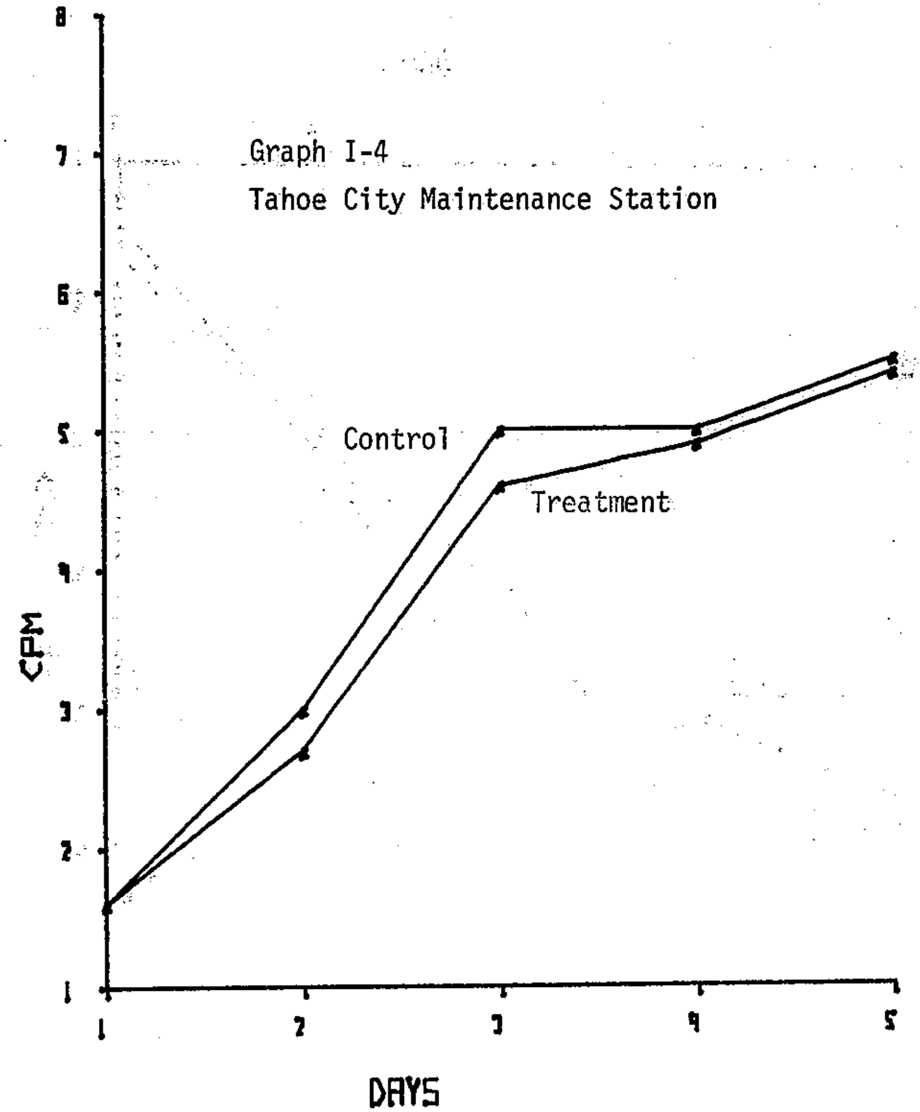
5
6
7
8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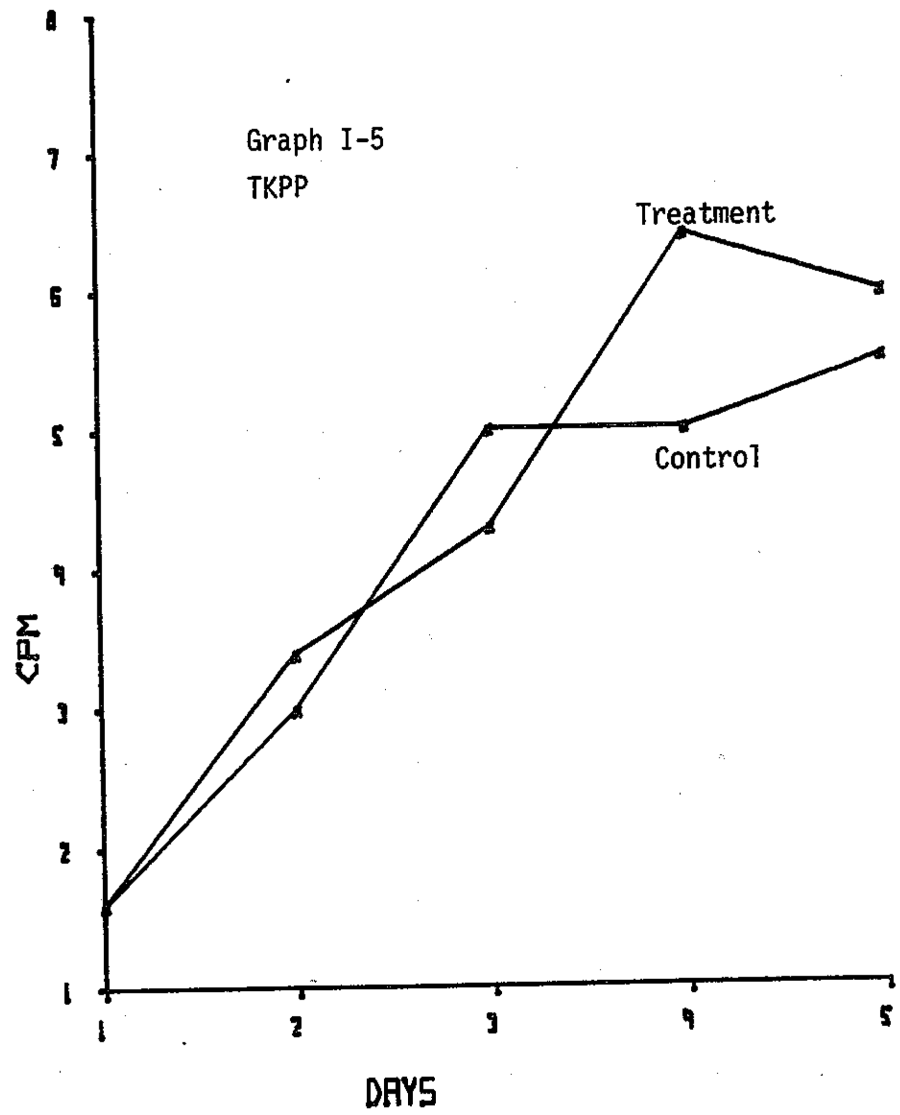
Tahoe City Maintenance Station
Control
Treatment
CPM
DAYS
1
2
3
4
5
6
7
8

CPMx1000



Graph I-5
TKPP
Treatment
Control
CPM
8
7
6
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4
3
2
1
1
2
3
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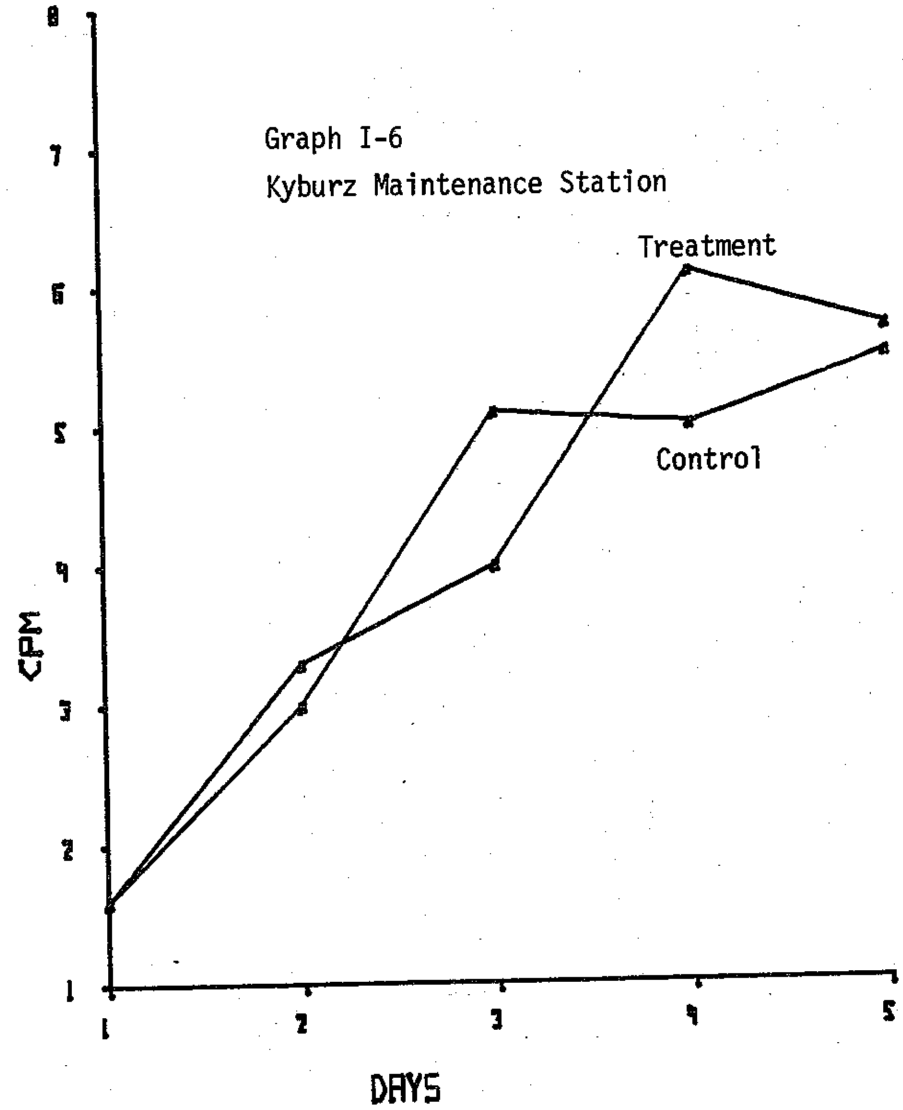
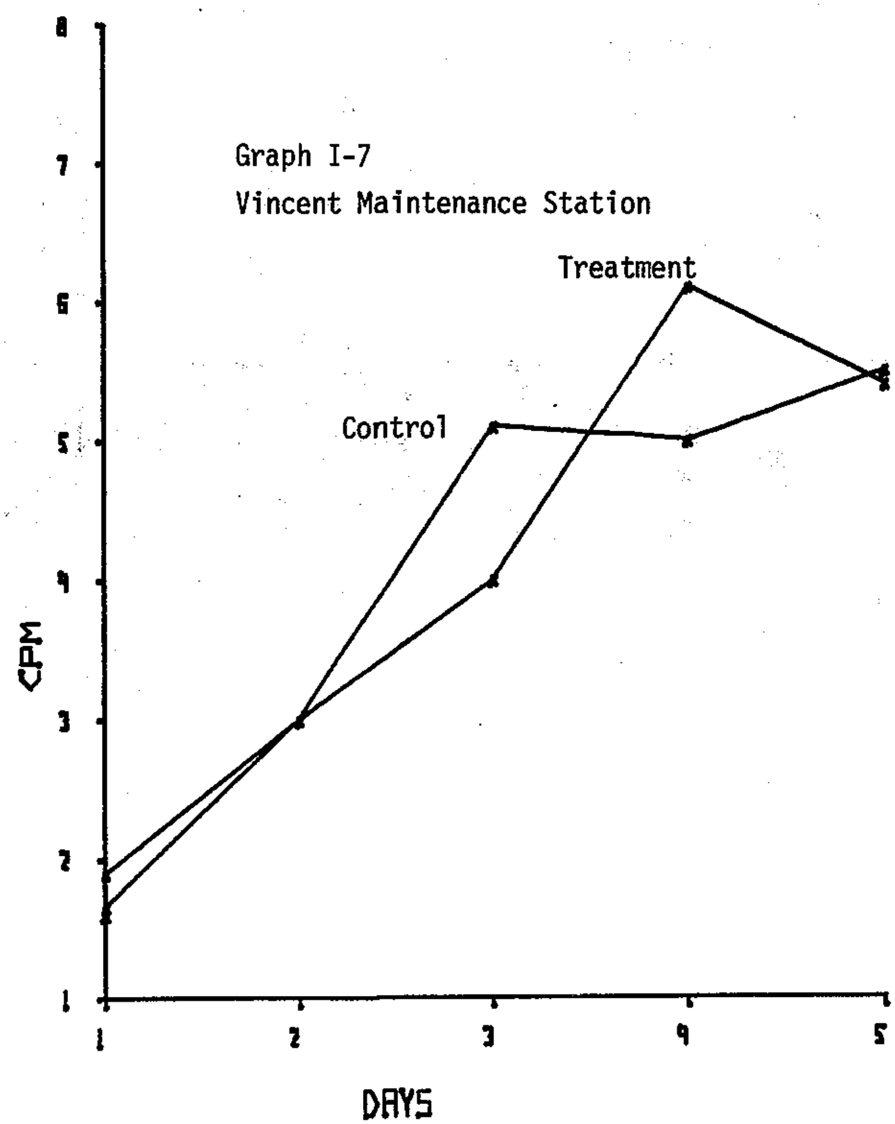
5
DAYS



Graph I-6
Kyburz Maintenance Station
Treatment
Control
CPM
8
7
6
5
4
3
2
1
1
2
3
4
5
DAYS

CPMx1000


Graph I-7
Vincent Maintenance Station
Treatment
Control
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3
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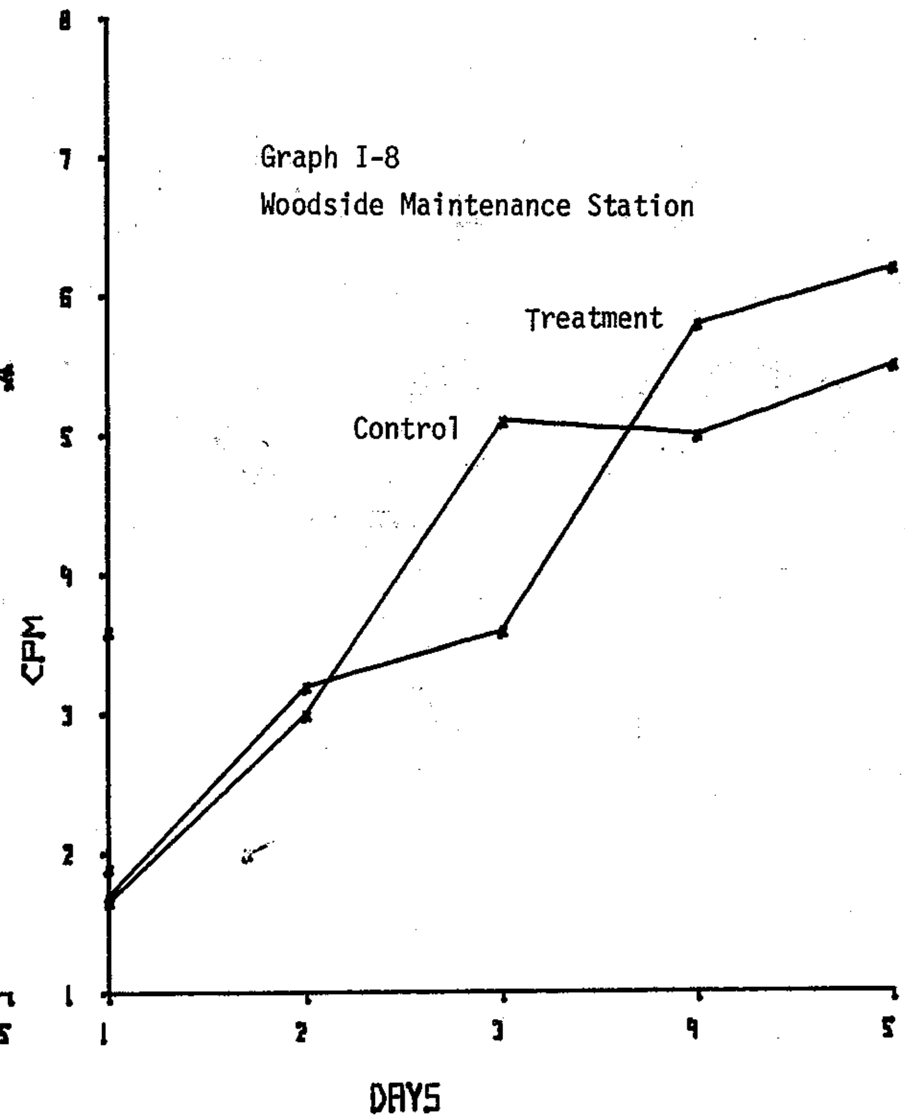
DAYS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Woodside Maintenance Station
Treatment
Control
CPM
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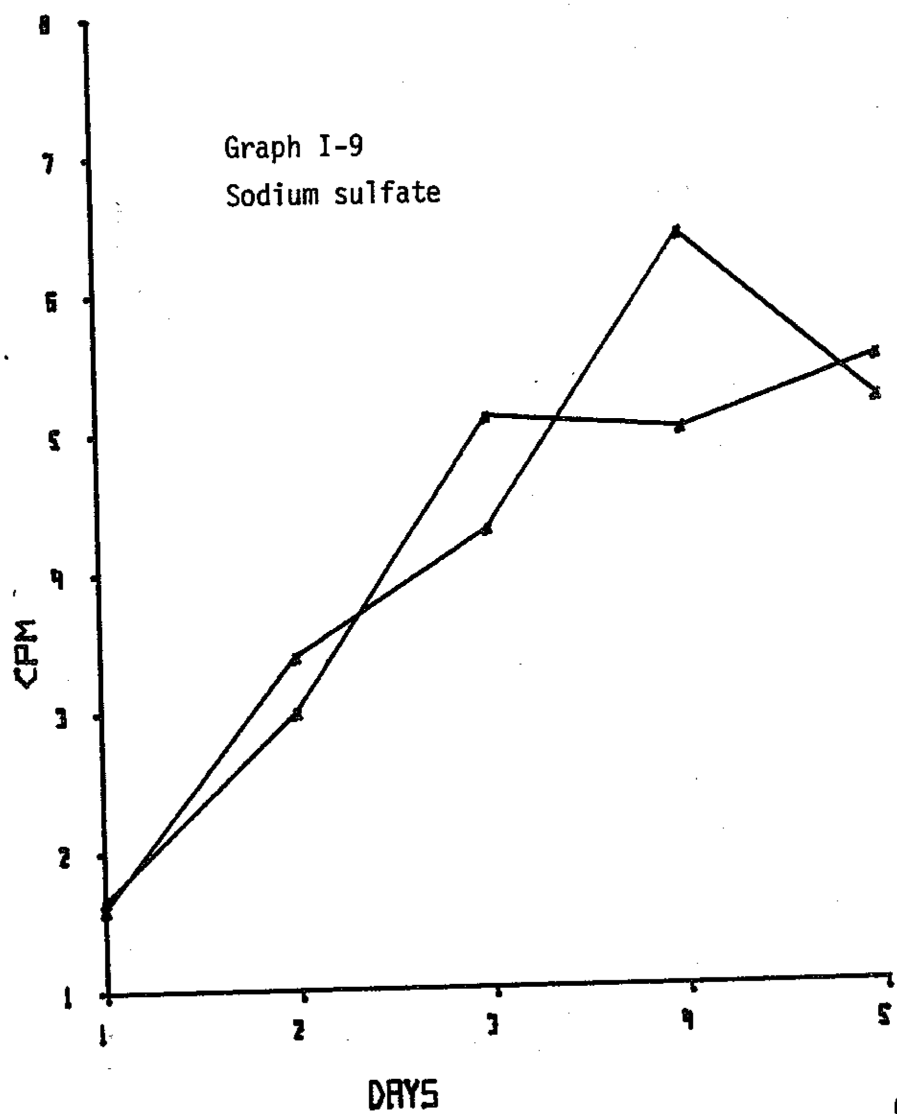
CPMx1000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Sodium sulfate
CPM
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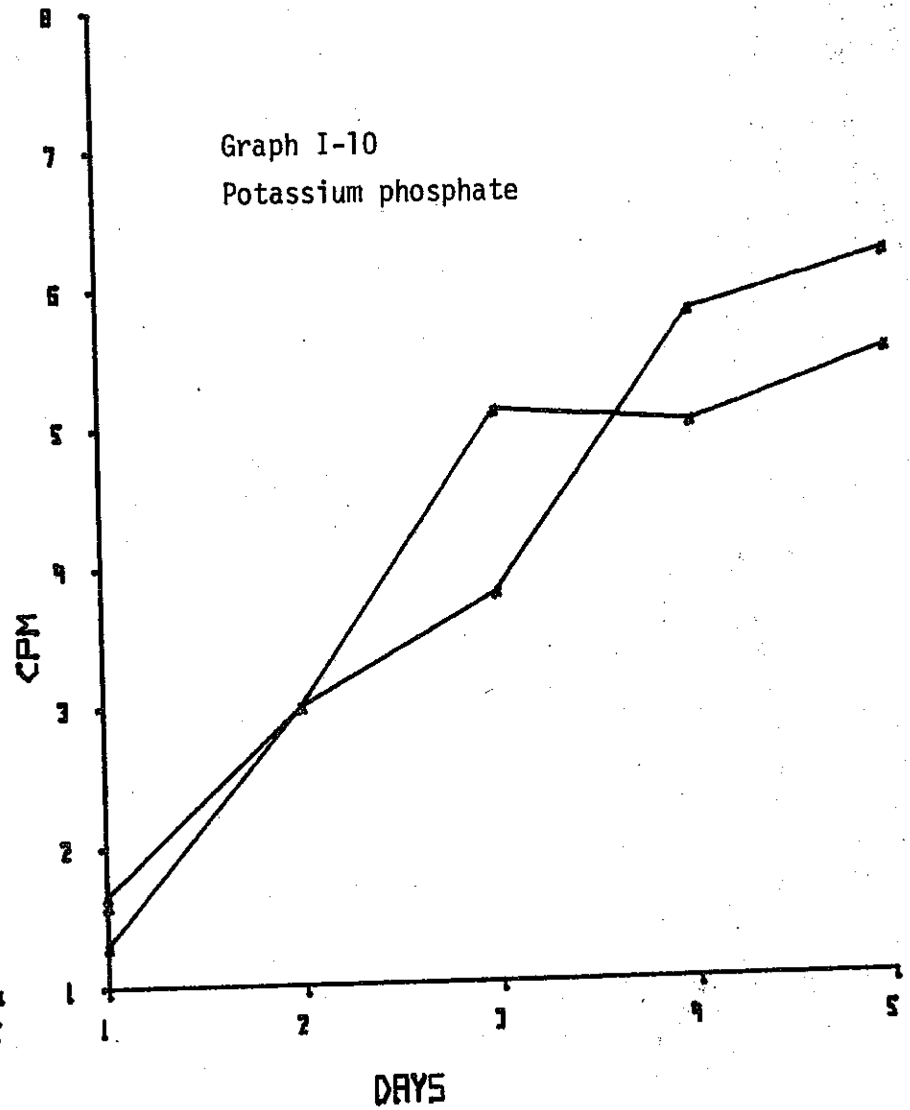
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Potassium phosphate
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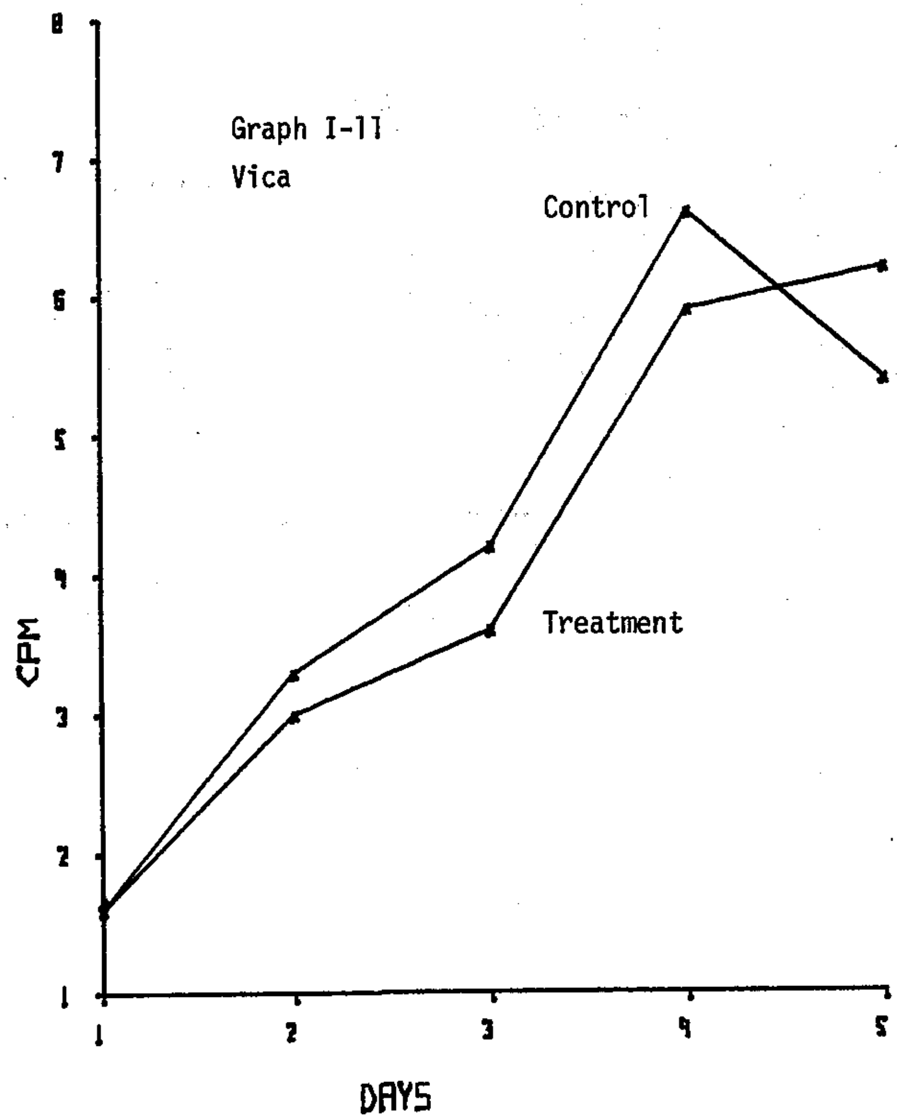
CPMx1000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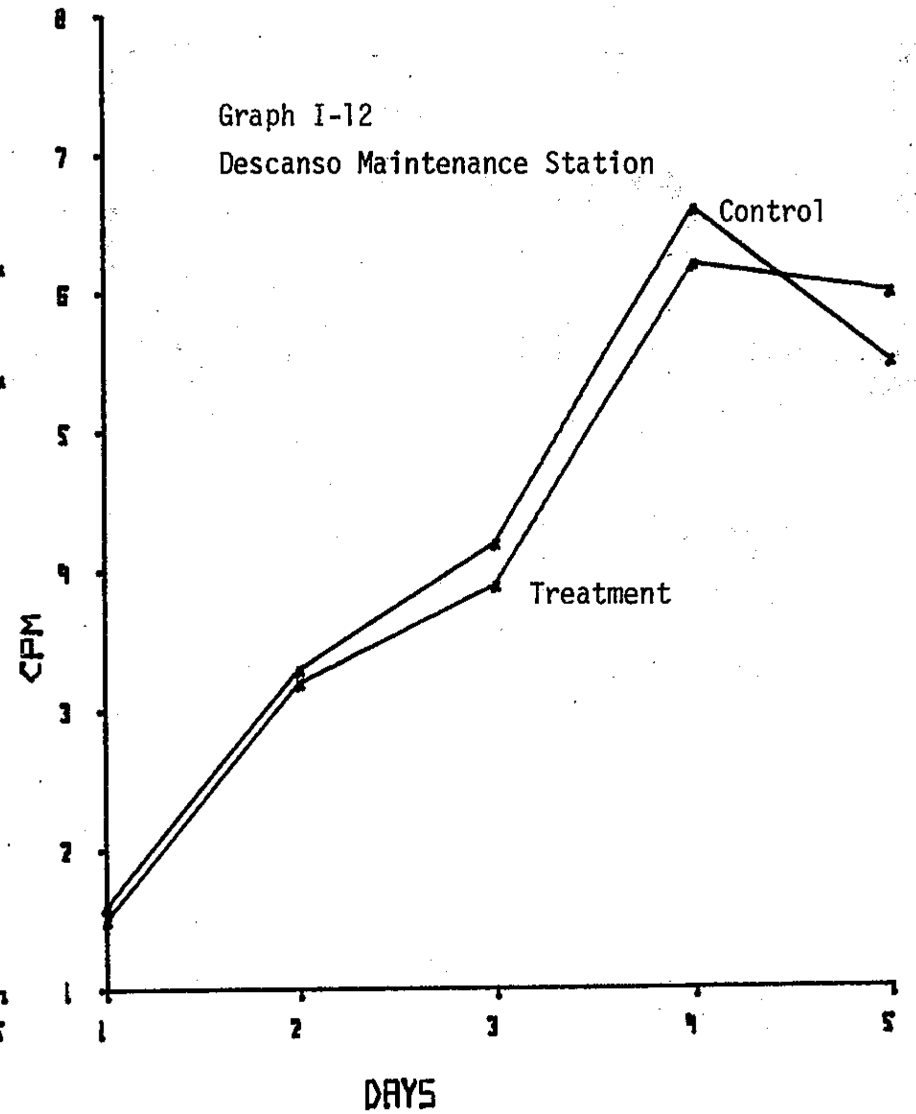
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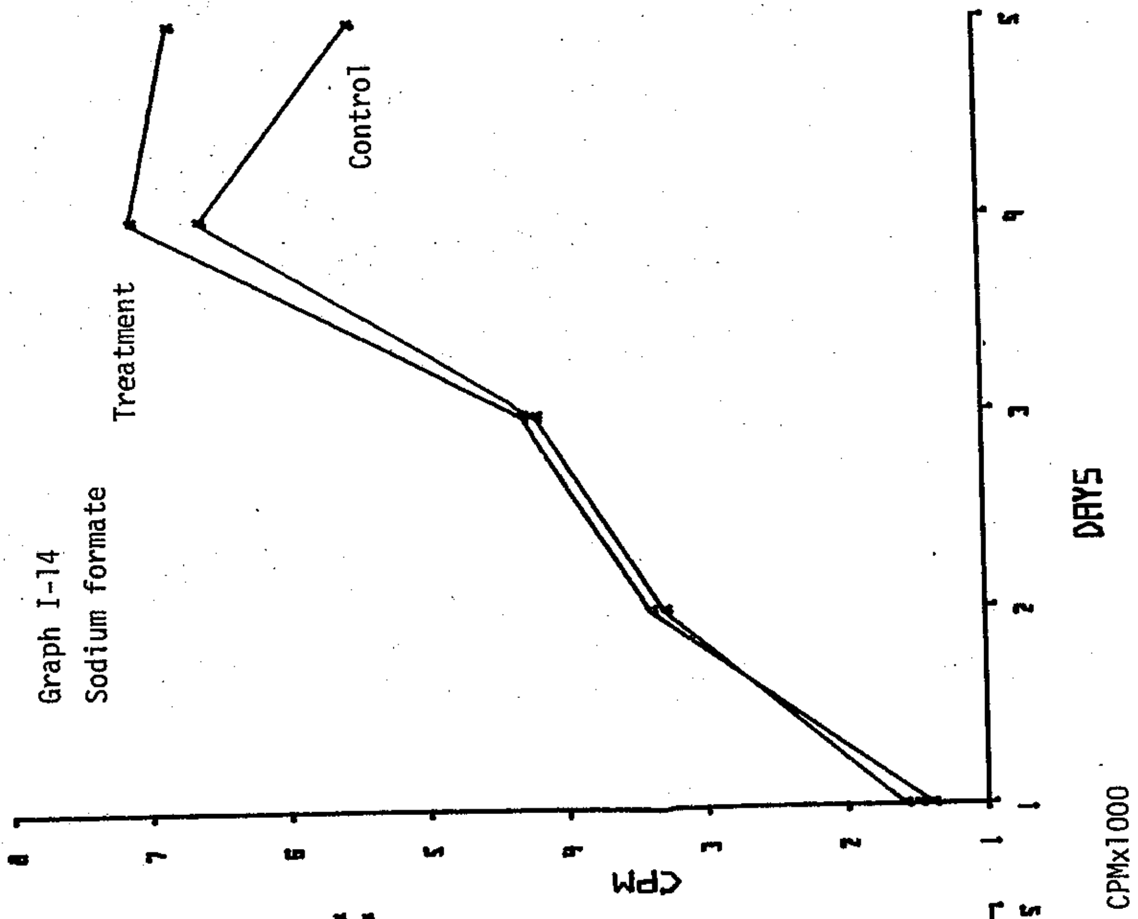
CPMx1000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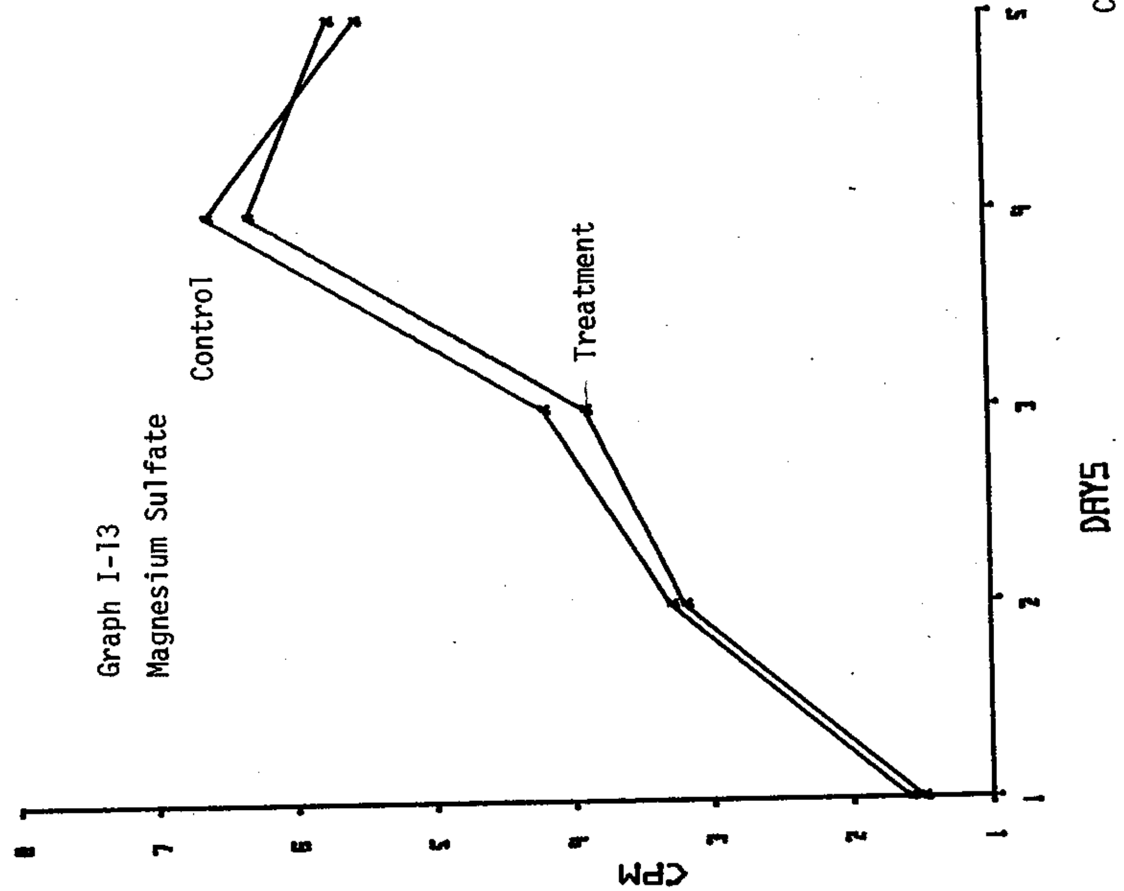
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Magnesium Sulfate
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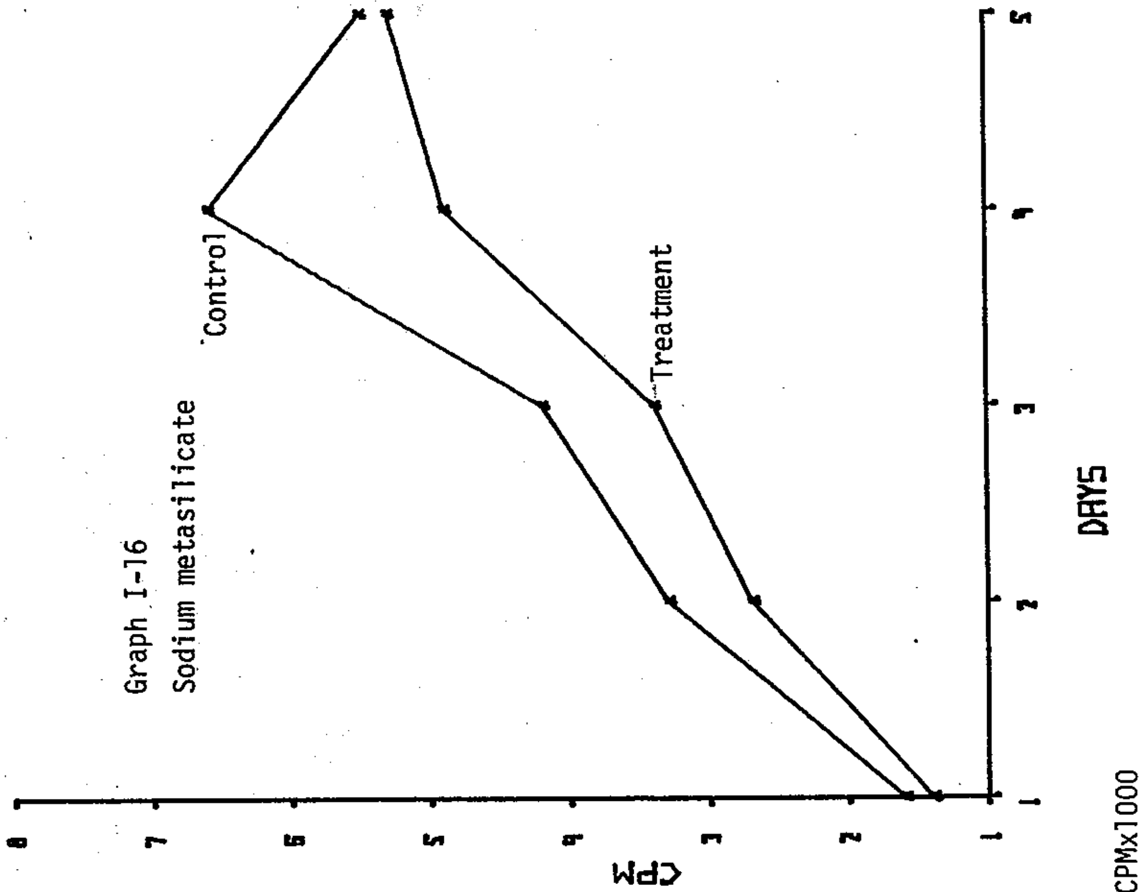
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Sodium metasilicate
Control
Treatment
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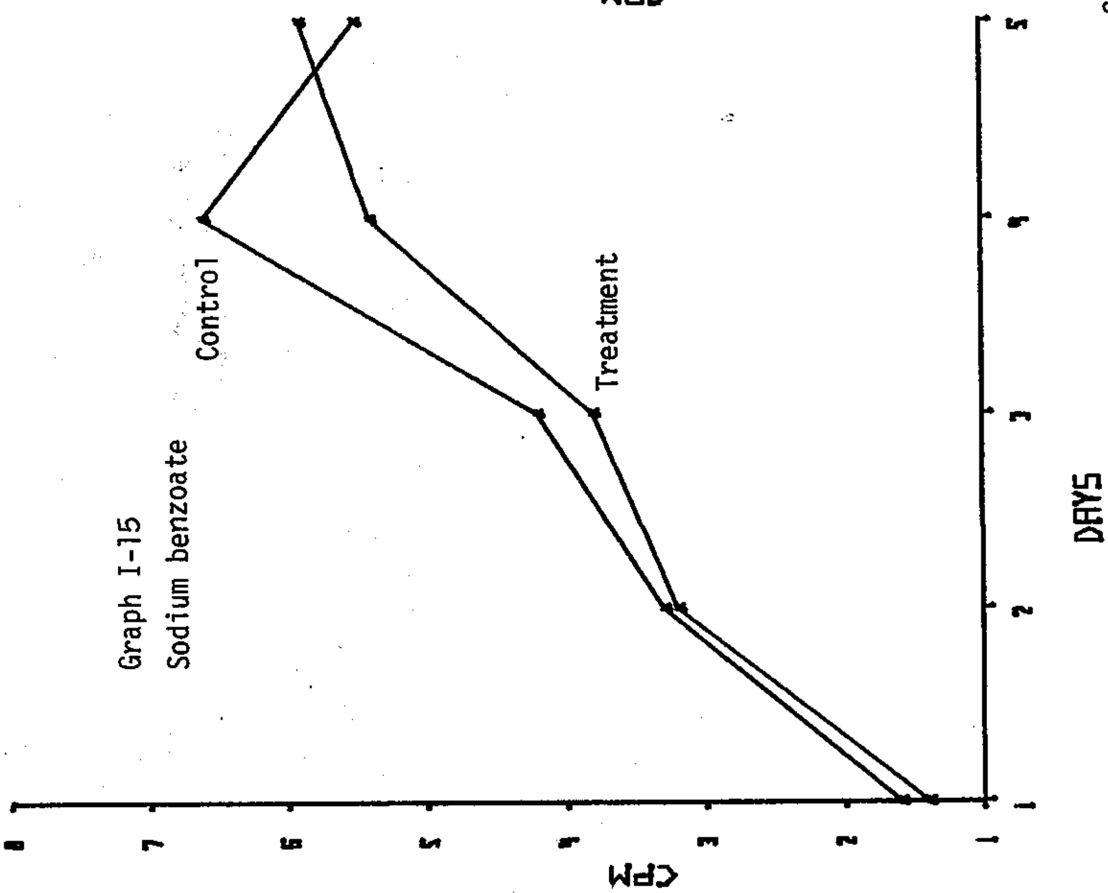
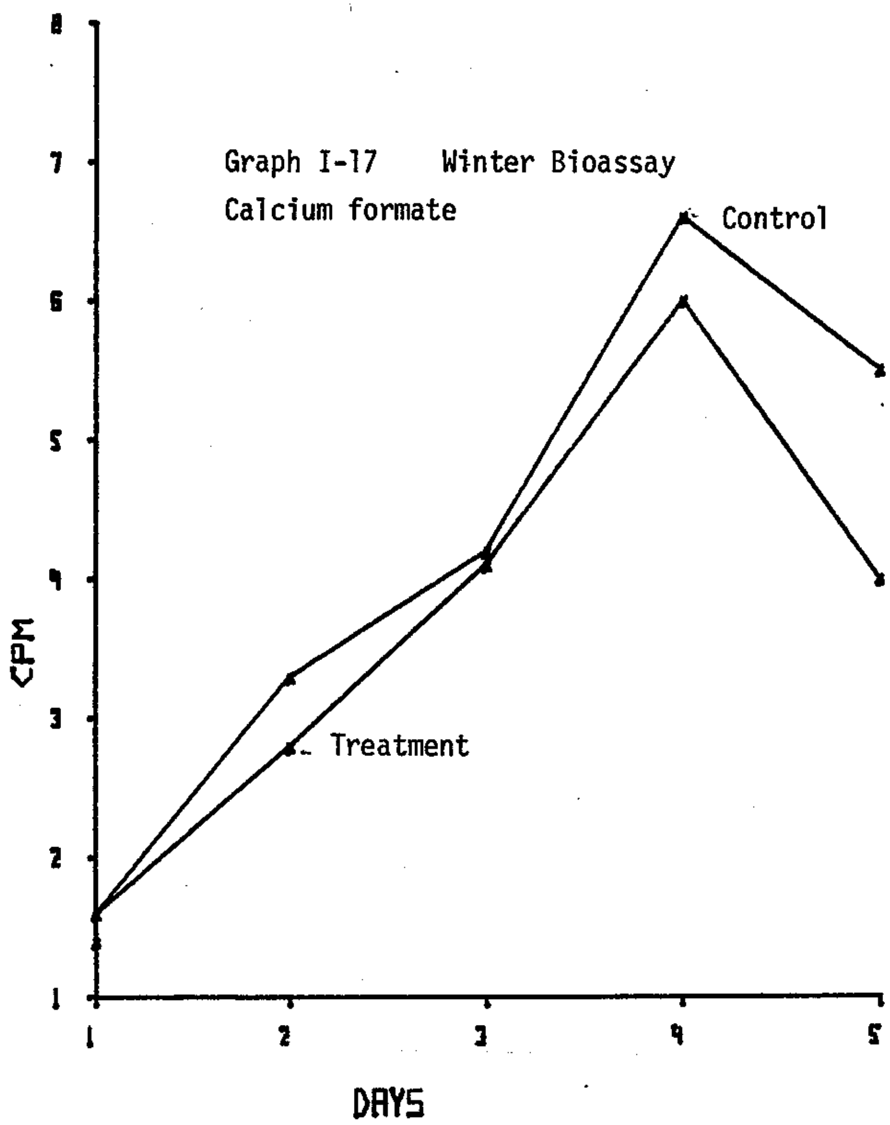
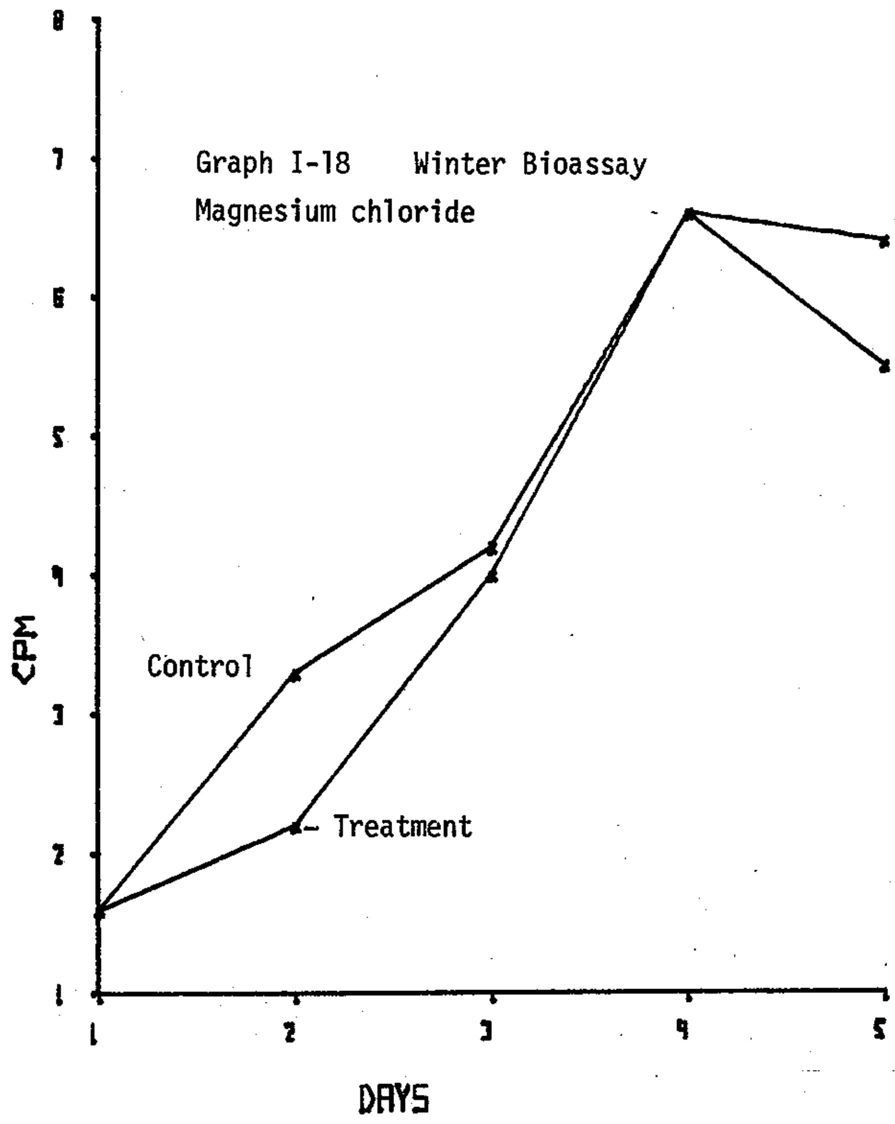
DAYS
CPMx1000


Graph I-15
Sodium benzoate
Control
Treatment
CPM
DAYS


Graph I-17 Winter Bioassay
Calcium formate
Control
Treatment
CPM
DAYS
1
2
3
4
5
6
7
8


Graph I-18 Winter Bioassay
Magnesium chloride
Control
Treatment
CPM
DAYS
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2
3
4
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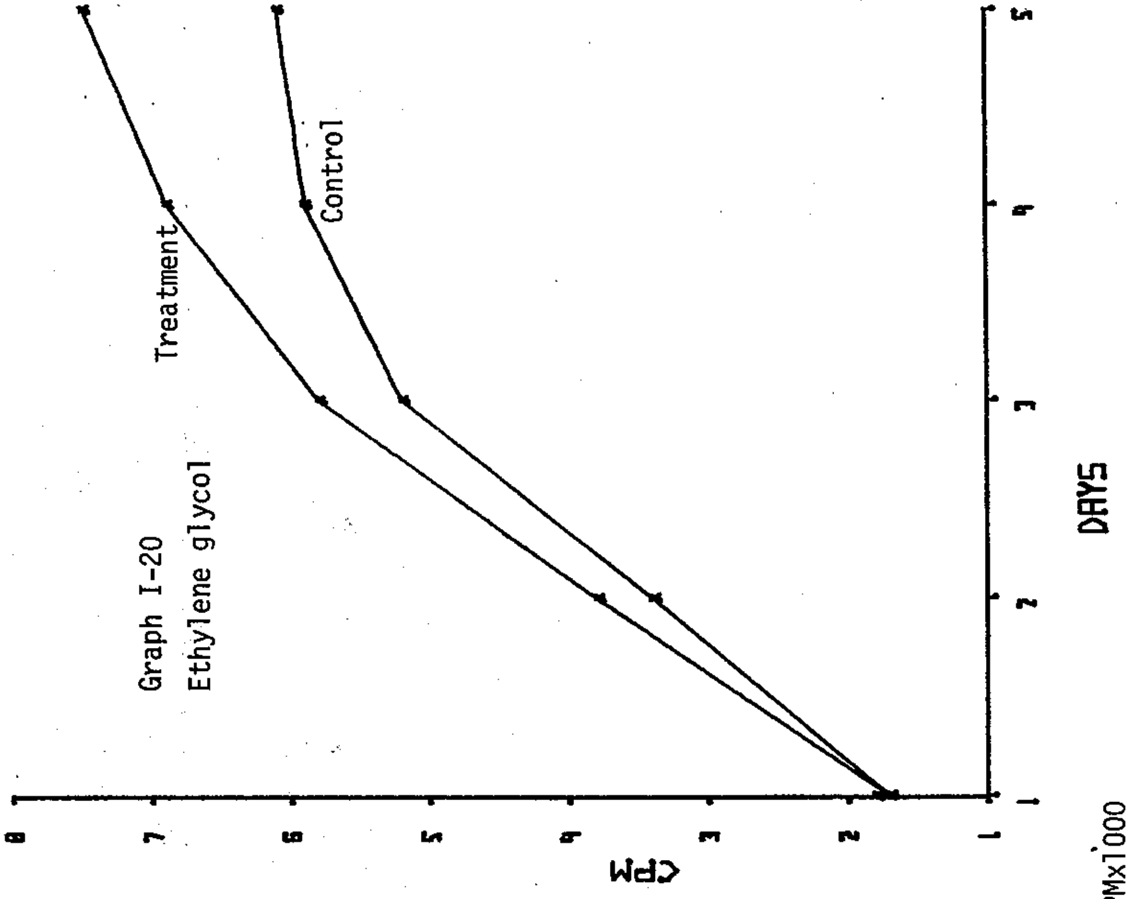
CPMx1000


Graph I-20
Ethylene glycol
Treatment
Control
CPM
DAYS
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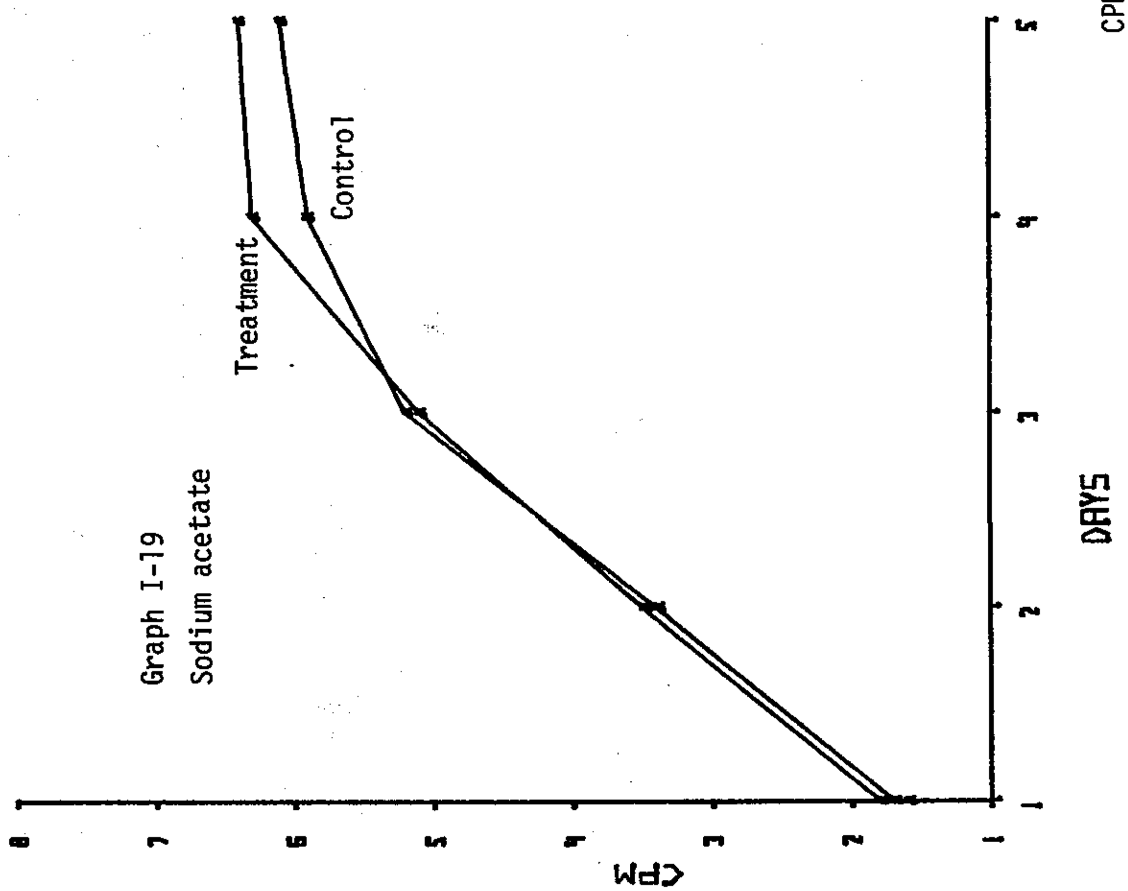
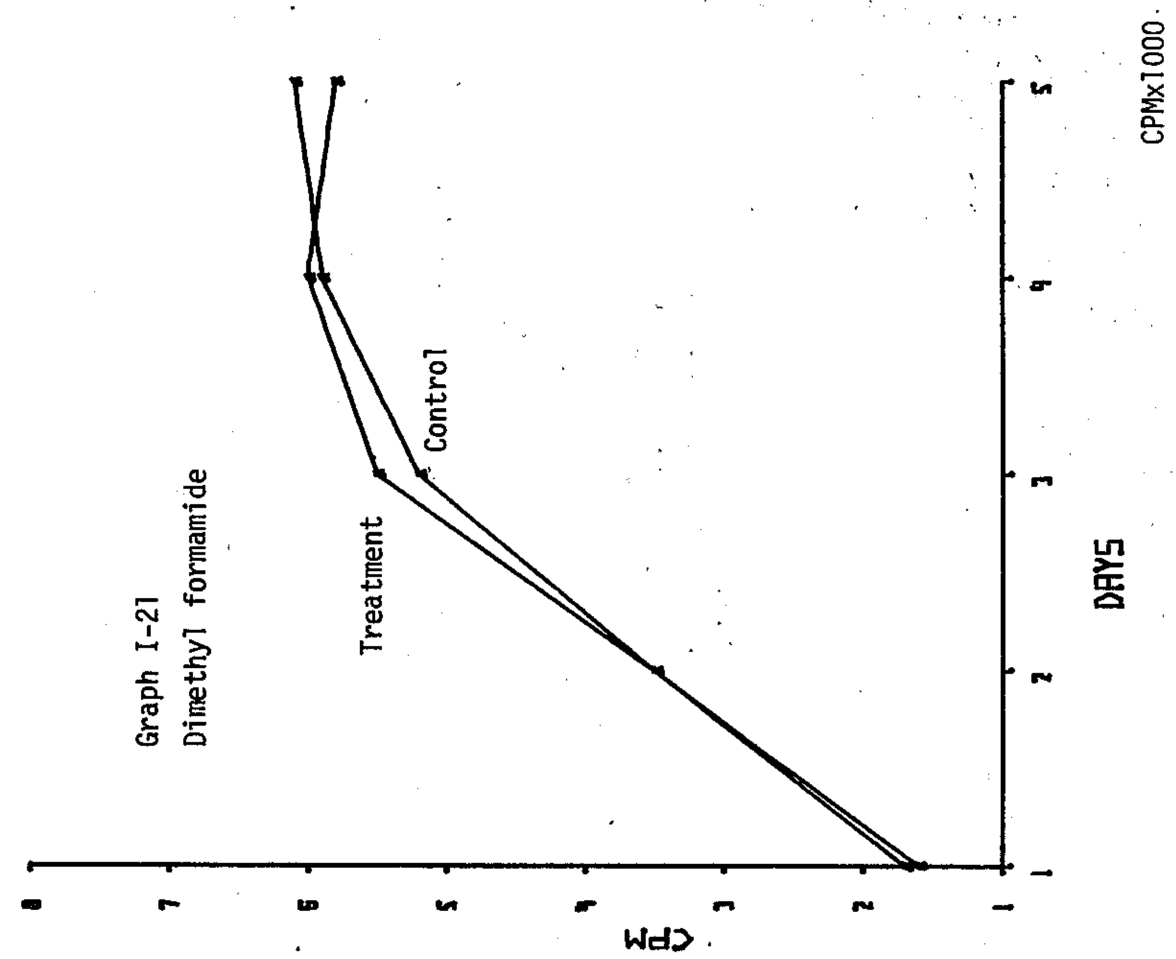
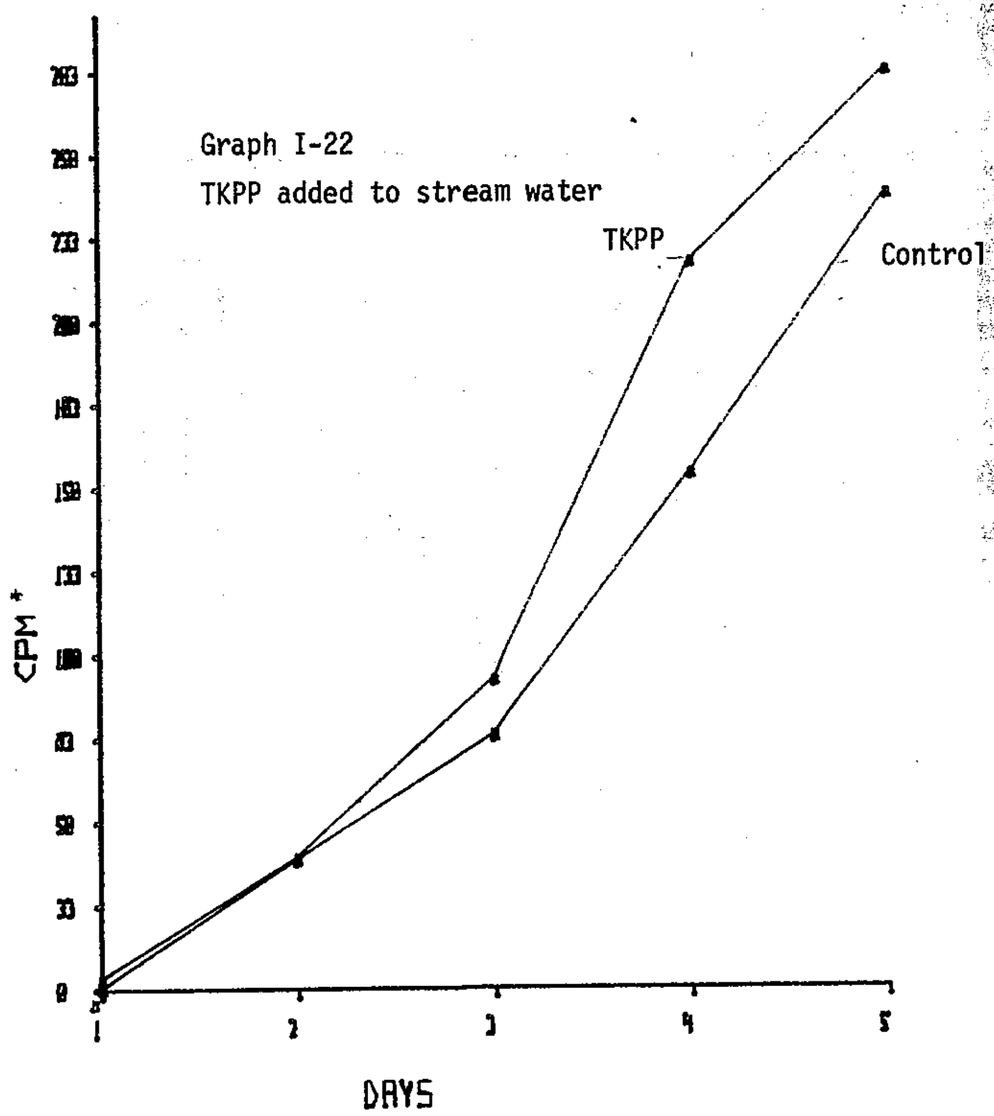
2
3
4
5
6
7
8
CPMx1000


Graph I-19
Sodium acetate
Treatment
Control
CPM
DAYS
1
2
3
4
5
6
7
8



Graph I-21
Dimethyl formamide
Treatment
Control
CPM
DAYS
CPMx1000
1
2
3
4
5
6
7
8



DAYS

CPMx1000

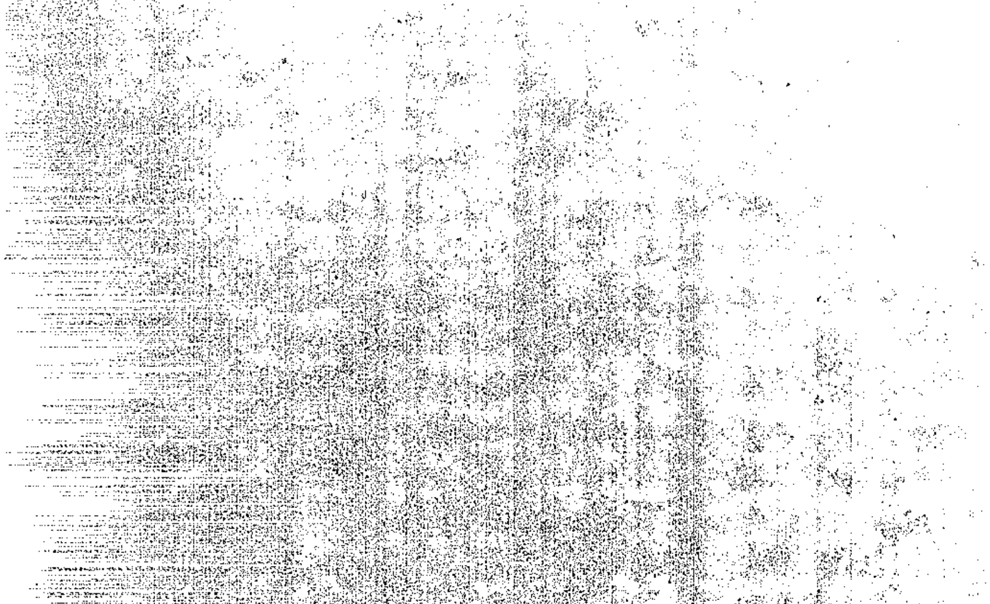
TABLE III

TKPP BIOASSAY

Water: Supplied by California Department of Transportation, Transportation Laboratory

Treatment: 0.5 ml of 31.03 mmol TKPP to 500 ml stream water three replicates, three controls (no additions)

Treatment	CPM(mean) Day 1	2	3	4	5
Control	859.8	4694.8	3403.4	16212.2	24590.2
TKPP	1149.4	4754.3	10067.1	22556.4	28301.9



SECTION II -- DEICING COMPOUND CONTAMINANTS

DEICING COMPOUND CONTAMINANTS

Data for macronutrient and trace element contaminants of deicing compounds is seen in Tables V and VI, respectively. Table IV, Deicing Salt Sampling Table, supplies compound formulas, suppliers, sampling locations, and code number of the different deicing compounds.

Various macronutrients are quite high in some deicing compounds. Phosphorus (P) was found in concentrations of 25.696 ppm in deicing salt taken from Descanso Maintenance Station (District 11, Hwy 50) and 14.312 ppm from Vincent Maintenance Station (District 07, Hwy 14). Nitrate-nitrogen ($N\text{-}NO_3$) and iron (Fe) were also high in the Descanso sample. Iron was found in concentrations of 159.89 ppm and nitrate-nitrogen, 3.772 ppm. Iron was high in several samples, and was found in concentrations of more than 1 ppm in eleven samples.

Sulfate-sulfur ($S\text{-}SO_4$) was found in high concentrations in all samples. Concentrations ranged from 4243.800 ppm (Vincent sample) to 6.780 in magnesium chloride. The average bulk salt sample contained 1182.104 ppm $S\text{-}SO_4$. The average macronutrient concentration for P, $N\text{-}NO_3$, Si (silicon), $S\text{-}SO_4$, and Fe of the deicing salt samples taken from different maintenance stations is given below.

Average Contaminant Levels in Deicing Salts

Element	P	$N\text{-}NO_3$	$N\text{-}NH_3$	Si	$S\text{-}SO_4$	Fe
Concentration (ppm)	5.252	1.340	0.212	15	1182.104	25.65

This combination of nutrients would be stimulatory for practically any body of water if additions of high concentration were made. The

response of a phytoplankton or bacterial community will depend upon what factors are currently limiting and the amounts of these compounds added.

Below, average concentrations of P, N-NO_3, N-NH_3, Si, S-SO_4, and Fe for salts by their supplier are listed.

	Element (ppm)					
Supplier	P	N-NO_3	N-NH_3	Si	S-SO_4	Fe
Leslie Foods, Newark, CA	.213	.131	.205	53	124.400	1.73
Utah Salt Co. Salt Lake City, Utah	.231	.157	.183	27	1034.883	5.17
Southwest Salt Co. Los Angeles, CA	25.696	3.772	.372	13	736.667	159.89
Morton Salt Co. Burlingame, CA	.872	.110	.059	N.D.	212.483	1.01
West Coast Salt & Milling Co. Bakersfield, CA	14.312	.748	.331	N.D.	4243.800	21.86

From the above table it is obvious that salt supplied by the Southwest Salt Co. and the West Coast Salt and Milling Co. contain higher levels of nutrients than salt from other suppliers. The source of salt is undoubtedly very important, and eutrophicating (enriching or fertilizing) impacts of deicing compound applications will be minimized by the least contaminated salts. Standards of contamination levels should be formulated and suppliers should be required or sought who can meet these standards.

Contaminants which at high levels may be toxic have also been found in the deicing compounds. Particularly Ni (nickel), Cu (copper), Zn (zinc), As (arsenic), Hg (mercury), and Pb (lead) have been identified by X-ray florescence analysis.

Copper is present in all deicing compounds analyzed. It appears in concentrations of 0.05 to 3.85 ppm. The highest concentration was found in UCAR Runway Deicer. Levels of copper in deicing NaCl samples averaged .21 ppm. Higher levels were measured in several compounds now being considered for use on California's highways. For example, TKPP contained 0.37 ppm, calcium formate 0.24 ppm Cu, and sodium sulfate 0.32 ppm.

Copper has been used as an algacide for many years. It can be stimulating to nitrogen fixation by blue-green algae at very low concentrations (<5 μg/l) but is inhibitory at slightly higher levels (5-10 μg/liter additions) (Horne and Goldman, 1974). Sensitivity varies with species, and blue green algae have been reported highly sensitive by several authors (Horne and Goldman, 1974; Steeman Nielsen and Wium Andersen, 1971; Gibson, 1972). Adaptation to higher ambient copper levels have also been reported (Stokes, Hutchinson, and Krauter, 1973). Copper toxicity varies with the chelating capacity and particularly the pH of natural waters. The interactions are very complex and models predicting copper toxicity are infeasible. (See Wilson, 1972). More effects would be expected through the use of the proposed alternative deicing compounds since many of these have higher levels of copper.

Zinc has also been found in several deicing compounds, particularly the proposed alternatives. It was found in only two salt samples and then at low levels (0.02 and 0.03 ppm). Zinc is also toxic to algae (see Bartlett, Rabe, and Funk, 1974) and has been shown to inhibit phytoplankton productivity in Lake Tahoe (Elder, 1974).

Nickel can also inhibit algae metabolism (Stokes, Hutchinson, and Krauter, 1973). It has been found in several deicing compounds. Concentrations in sodium chloride samples ranged from 0.22 ppm (Old Woodside Maintenance Station) to non-detectable and averaged 0.06 ppm. Alternative compounds contained a range of nickel concentrations. TKPP contained 0.37 ppm, $MgSO_4$ (magnesium sulfate) had 0.28 ppm, and Shell Urea had 0.20 ppm.

Titanium was found in as high a concentration as 0.85 ppm (calcium formate), 0.77 ppm (sodium acetate), 20.09 ppm (Descanso samples), and 2.73 ppm (Vincent sample). Other elements found include arsenic (As), barium (Ba), lead (Pb), mercury (Hg), tin (Sn), and other metallic elements.

Barium was also found in some deicing compounds. The Descanso sample contained 2.54 ppm Ba and 3.58 ppm Sn. Arsenic was also found at 5.33 in the Vincent sample. This is a potent herbicide. Lead was at various levels in almost all deicing compounds with 0.79 ppm Pb present in the Descanso sample.

From the preceding discussion, it is apparent that deicing compounds contain both stimulating and inhibiting contaminants. Some of the contaminants, such as Hg, Pb, and As, are also hazards to human and animal health at higher concentrations. Most of the toxic elements are in relatively low concentrations. Several of the nutrients are in high concentrations. Which factors will exert a dominant influence on phytoplankton and bacterial growth will depend upon the composition and health of the aquatic communities affected.

Analysis for boron and atomic absorption analysis of copper, zinc, cadmium, manganese, molybdenum, lead, and mercury will be completed this summer. Atomic absorption analysis will make use of the APDC-MIBK extraction system to bring the concentrations of above elements to detectable levels.

Some comments on the x-ray florescence analysis of samples 11, 12, 14, 15, 16, 18, and 20 is appropriate here. The new automated x-ray florescence program is designed for general analysis. Because of this, elements such as Mn, Cd, and Hg are not automatically analyzed by the program and in the presence of high iron levels, manganese detection is severely curtailed by the new program. Cadmium is also disregarded since cadmium output peaks are disguised by output from other elements. We can adjust the computer analysis for specific elements and this is now being done. Although Mn, Hg, and Cd are not reported in Table VI for the alternative deicing compounds, their presence is suspected and will be checked in the next analysis.

TABLE IV

DEICING SALT SAMPLING TABLE

Sample No.	Location	Date Sampled	Supplier	Remarks
1	Old Woodside Maintenance Station Dist. 04, Hwy. 84, Woodside	3-13-74	Leslie Foods 7220 Central Avenue Newark, CA 94560	Collected from 40-ton Bulk Stockpile
2	Whitmore Maintenance Station, Dist. 03, Hwy. 80	3-14-74	Utah Salt Co., Inc. 2150 S. 2nd West Suite ID Salt Lake City, Utah 84115	Collected from Bulk Salt Stockpile
3	Tahoe City Maintenance Sta. Dist. 03, Hwy. 89	3-14-74	Utah Salt Co., Inc.	Collected from Bulk Salt Hopper
4	Kingvale Maintenance Station, Dist. 03, Hwy. 80	3-14-74	Utah Salt Co., Inc.	Collected from Bulk Stockpile
5	Truckee Maintenance Station, Dist. 03, Hwy. 80	3-14-74	Utah Salt Co., Inc.	Collected from Bulk Salt Hopper
6	TKPP Sample Translab	3-18-74	Monsanto Company St. Louis, MO	Collected from 100-lb. Bag
7	Descanso Maintenance Station, Dist. 11, Hwy. 8	3-14-74	Southwest Salt Co. 714 W. Olympic Blvd. Los Angeles, CA 90015	Collected from Bulk Stockpile
8	Kyburz Maintenance Station, Dist. 03, Hwy. 50	3-19-74	Morton Salt Co. 1710 Trousdale Dr. Burlingame, CA 94010	Collected from Bulk Stockpile
9	Vincent Station @ Pearl Blossom Dist. 07, Hwy. 14	3-28-74	West Coast Salt & Milling Co. 407 Kentucky Street Bakersfield, CA 93305	Collected from Bulk Salt Hopper
10	Sodium Formate Technical Grade	4-23-74	Van Waters & Rogers --Translab Hercules Mfg. Co. Wilmington, DEL	Collected from 50-lb. Bag

TABLE IV (Continued)

Deicing Salt Sampling Table

Sample No.	Chemical	Date Sampled	Supplier	Remarks
11	UCAR Runway Deicer	5-31-74	Union Carbide Corporation Chemicals and Plastics South Charleston, W. Va.	Collected from 55-gallon container.
12	Calcium Formate	5-3-74	UAW Waters and Rodgers-Mathison Coleman & Bell Norwood (Cincinnati) Ohio	Collected from 5-lb. bottle
13	Sodium Metasilicate	5-31-74	VWR- J.T. Baker Chemical Co.	Collected from 5-lb. bottle
14	Shell Urea 40-0-0	5-31-74	Shell Chemical Co., San Francisco, CA 94106	Collected from 100-lb. bag
15	Sodium Sulfate, Anhydrous	7-22-74	VWR- Stauffer Chemical Co. Industrial Chemical Div. Westport, CT 06880	Collected from 50-lb. bag
16	Sodium Acetate, Anhydrous	7-22-74	VWR- Union Carbide Corp. 270 Park Ave., New York, N.Y. 10017	Collected from 50-lb. bag
17	Dimethylformamide	7-22-74	VWR- J.T. Baker Chemical Co.	500 gram bottle
18	Magnesium Sulfate U.S.P.	7-22-74	VWR- Philadelphia Quartz Co. Valley Forge, PA 19482 Manufactured in Berkeley, CA	Collected from 100-lb. bag
19	Magnesium chloride, Technical grade	7-22-74	VWR- Dow Chemical Corporation	Collected from 50-lb. bag

TABLE IV (Continued)

Sample No.	Chemical	Date Sampled	Supplier	Remarks
20	Sodium Benzoate	7-22-74	VWR- Dow Chemical Corporation	Collected from 50-lb. bag
21	Potassium phosphate, tribasic AR grade	7-22-74	VWR	From 5-lb. bottle

TABLE V

MACRONUTRIENTS FOUND IN ROADSALTS

Concentrations reported in ppm element (gm element/1000 mg NaCl)

Sample No.	1	2	3	4	5	6	7	8	9	10
Element										
P	.213	.408	.154	.185	.177	*	25.696	.872	14.312	I*
$N-NO_3$	.181	.189	.144	.151	.144	.019	3.772	.110	.748	.057
$N-NO_2$	.026	.107	.025	.066	.070	.033	.579	.026	.313	.052
$N-NH_3$	.205	.150	.211	.170	.201	.059	.372	.059	.331	.264
Si	53	ND	15	20	20	ND	13	ND	ND	ND
$S-SO_4$	124.400	2023.000	1664.600	264.400	187.533	710.000	736.667	212.433	4243.800	15.000
Inorg. C.	ND	ND	ND	ND	ND	372.000	ND	ND	702.667	ND
Mg	.086	.666	.666	.600	.640	.026	.013	.080	.001	ND
Ca	.086	.519	.340	.387	.414	ND	.223	.073	ND	.020
K	.399	7.090	7.037	5.400	7.283	--	.193	.267	3.668	.101
Na	--	--	--	--	--	2.016	--	--	--	--

TABLE V (Continued)

MACRONUTRIENTS FOUND IN ROADSALTS

Concentrations reported in ppm element (mg element/100 mg NaCl)

Sample No.	11	14	15	16	18	19
Element						
P	.825	.315	.877	1.475	.777	.154
$N-NO_3$	.006	.053	.082	ND	.018	.091
$N-NH_3$	.070	--	.032	.464	.029	.804
Si	7.437	2.958	3.234	ND	ND	ND
$S-SO_4$	15.731	25.143	--	14.935	--	6.280
I.C.	573.194	ND	204.364	ND	ND	ND
Mg	ND	ND	ND	.060	--	--
Ca	ND	ND	ND	.120	.207	.389
K	5.974	ND	.267	.120	ND	.792
Na	.033	.027	--	--	ND	1.623

TABLE VI

ROAD SALT TRACE METALS

Concentration in parts per million

Sample No.	1	2	3	4	5	6	7	8	9	10
Element										
Ti	0.19	0.44	0.63	0.45	0.70		20.09	0.16	2.73	
Ba		0.73		0.15	0.11		2.54		0.29	
Cr		0.03		0.04	0.06	0.11	0.34		0.07	
Mn			0.05		0.03		1.64		0.30	
Fe	1.73	8.49	4.06	2.98	5.16	0.54	159.89	1.01	21.86	1.45
Ni	0.22	0.10	0.05	0.03	0.02	0.37		0.04		0.10
Cu	0.15	0.14	0.18	0.13	0.13	0.16	0.16	0.10	0.16	0.37
Zn		0.03			0.02		0.69			1.30
Ca							0.16			
As		0.02		0.01					5.33	
Se									0.07	
Hg		0.02	0.03					0.02		
Pb	0.18	0.08	0.09	0.04	0.04		0.79	0.14	0.06	0.08
Ra		0.01	0.02		0.04		0.91		0.08	
Sn	0.01		0.05		0.08		3.58			
Y							0.29		0.01	
Zr		0.05	0.18		0.33	0.35				
Nb							0.12		0.94	
Mb		0.12	0.10	0.07	0.10				0.12	

TABLE VI (Continued)

ROAD SALT TRACE METALS

Concentration in parts per million

Sample No.	11	12	14	15	16	18	20
Element							
Ti	0.08	0.85	0.13	0.09	0.77	0.08	0.40
Ba							
Cr			0.06		0.05		0.04
Mn		0.31					
Fe	0.33	14.19	0.75	0.71	4.45	1.29	0.99
Ni	0.11		0.20	0.05	0.07	0.28	0.07
Cu	3.85	0.24	0.11	0.05	0.32	0.16	0.09
Zn	0.25	0.08	0.05	0.109	0.40	0:04	0.07
Ca							
As							
Se							
Hg							
Pb		0.18	0.01	0.01	0.13	0.12	0.03
Ra							
Sn							
Y							
Zr							
Nb							
Mb						0.08	

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SECTION III -- CHLORIDE AND FIELD DATA

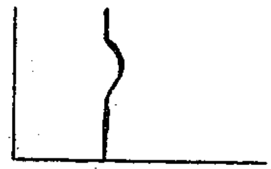
CHLORIDE AND FIELD DATA

Chloride data for the period of May 5, 1974 through May 10, 1975 has been tabulated in Table VII. Data from selected sites has been graphed in Graphs II-1 through III-9. Additional samples for chloride are now being analyzed and will be included in the final version of these tables.

Chloride profiles for lakes have been presented in Graphs II-1 through II-5. Several lakes show uniform profile of chloride vs. depth, but Gold Run Pond, Putt's Lake, and Summit Roadside West Pond show increased chloride concentration with depth during different times of the year.

Graph II-1 shows the chloride profile of Donner Lake during sampled dates in January, 1975, March, 1975, July, 1974, and October, 1974. Concentrations of chloride are generally fairly uniform with some deviations in hypolimnion. Levels are generally between 9 and 13 ppm. Field data of temperature and conductivity profiles to 50 m parallel the chloride profiles. More exact analysis of conductivity measurements will have to await temperature corrections of specific conductivity, but a general picture can now be reported. Field data for Donner Lake is in Table IX.

Lake Tahoe chloride profile is plotted in Graph II-2. The months of January, 1975, May, 1975, July, 1974, and September, 1974 have been graphed. January, May, and September show fairly uniform profiles with concentrations staying under 1 ppm. July exhibits a positive heterograde curve with low concentrations at the surface and bottom but higher concentrations in the region from 100 - 400 m. Explanation of the positive heterograde curve will have to await analysis of the temperature profile, but probably represents a density layer. Positive heterograde curves are those which have an increase in chloride level (or whatever element is being analyzed) at an intermediate depth. An idealized positive heterograde curve is given by the accompanying graph:



Lake Tahoe is generally thermally stratified during July, and the thermal structure may influence the chloride profiles.

Lakes Tahoe and Donner are the two largest lakes sampled during the study. Neither lake appears to be suffering adverse effects due to highway deicing compounds influencing the density structure. We would expect these lakes to show the least effects due to salt inputs. Because of their great volume, large amounts of salt would be needed to alter their normal density structure. Deicing activity effects on lake productivity will be investigated with future bioassays, and more detailed work on trace elements is called for.

The chloride profile of Putt's Lake is plotted in Graph II-3. During the months of January, July, and October, nearly uniform profiles are exhibited. A slight increase (10 ppm) in the bottom two meters is noted in January. By April, this distribution has changed to one exhibiting marked chloride increase with depth. Chloride concentrations increase from 20.00 ppm at the surface to 105.00 ppm at the bottom. This is a 27.5 ppm increase during the last meter, and an average of 28 ppm increase/meter. Putt's Lake also exhibits very high conductivities.

These are seen in Table X. At certain times of the year, unstable thermal profiles have been maintained by the high salt levels in Putt's Lake. This occurred in February, March, and April, 1974.

This increase in chloride with depth is quite significant in Putt's Lake. This profile develops beneath ice cover, but not until road salting and some melting have taken place. The profile is transitory, and disappeared in 1974 after the melt and circulation. The shallow basin morphometry of Putt's Lake is very important in allowing this remixing. This shallow small lake with a large surface area to volume ratio and high exposure to wind mixing is apt to restrict development of a monimolimnion to the ice covered period. If this lake was not so well exposed to the wind and was deeper with a smaller surface area to volume ratio, a persistent monimolimnion could quite possibly develop.

The chloride profile of Putt's Lake is also significant since Putt's Lake is directly adjacent to the freeway and receives runoff directly from U.S. 80 through culverts. It also has a major portion of its small watershed transected by the freeway.

Putt's Lake provides an excellent example of the fact that highway deicing operations in California can provide enough salt to cause a density gradient in small roadside lakes. This is especially true if the lake receives runoff directly from the freeway or a major portion of its watershed is crossed by the freeway. A state-wide survey of roadside lakes should be conducted to check for monimolimnion (non-mixing layer) development due to salt inputs from highway deicing operations. Attention should be given to those deeper lakes that may serve as a sump for road runoff.

Summit Roadside West Pond also shows a chloride concentration increase with depth. This is plotted in Graph II-4. The gradient persists year-long, although the variation with depth in chloride may be small. The largest increase plotted is 9.07 ppm in the last meter of depth. This occurred in October, 1974. July, 1974 and January, 1975 showed much smaller increases. This density roughly parallels temperature and conductivity profiles; these increases are not as sharp as chloride. The pond does mix at times, so this does not represent a classic monimolimnion. Salt inputs would be primarily from direct blowoff from the parking area, since most of the watershed is above U.S. 80. The field data is provided in Table XI.

Gold Run Pond also shows a chloride increase with depth during certain months. The most pronounced increase occurred during March. Conductivity and thermal profiles paralleled the chloride profile in March, as they did in other months. The density of structure of this pond is due to a combination of temperature and chloride. No monimolimnion persists. High chloride contents are not expected due to its distance from the freeway, diffuse inflow, and lower elevation. Gold Run Pond data is contained in Table XII and Graph II-5.

Chloride and field data is provided for Lake van Norden and a control lake which lies beyond Negro Canyon (Tables XIII and XIV). Profiles are uniform for both these lakes. Lake van Norden was allowed to drain this winter, and the control lake is inaccessible during winter. The control lake was sampled in November, 1974 and showed conductivities intermediate to those found in lakes affected by U.S. 80, but with no detectable chloride. This means that chloride makes up a greater proportion of the total conductivity of lakes with watersheds transected by U.S. 80. Highway deicing salts are suspected of causing this finding, but this is not proven. Future work using more control lakes may help confirm this possibility.

This finding also indicates the limits of using just conductivity measurements to indicate chloride levels. Chloride levels intermediate to those found in lakes affected by U.S. 80 would be suspected in the control lake only if conductivity had been measured. This is erroneous, and chloride levels must be measured. A chloride specific electrode is a desirable addition to field sampling equipment.

Stream station chloride levels are plotted in Graphs III-1 through III-9. The dates of the sample numbers are given in Table XV. More detailed analysis of the relation of stream chloride level to highway road salt application will be done when the dates of application are supplied. A general picture, however, is already very clear from the existing data. Sample number 15 is the 5th and 6th of December, 1974, and number 17 is the 18-19 of January, 1975. Sharp increases of chloride levels in streams crossed by U.S. 80 are seen at most stations during this period. These high levels continue until approximately May and are undoubtedly of road salt origin.

The evidence for road salt origins is increased by comparing stations from above and below U.S. 80. Upper Castle Creek increases chloride levels by approximately 60 ppm after crossing U.S. 80. (See Graph III-1.) (The sample site at Boreal Ridge was buried under 15-20 feet of snow and hence was unsampleable this winter.) Negro Creek (Graph III-V) has non-detectable levels of chloride most of the year before it crosses U.S. 80 and then levels increase to approximately 3 to 30 ppm below U.S. 80. Further downstream, near the outlet to Donner Lake, chloride levels have increased even further. Summit Creek also picks up considerable amounts of chloride after crossing the freeway (Graph III-3). These levels are changed very little by the time it reaches the residential area near Donner Lake. The data shows that there is no detectable increase in chloride as Summit Creek passes through this residential area (Graph III-4). This may be due to the fact that they are now connected to the sewer line serving Donner Lake.

Emigrant Gap Creek (Graph III-6) shows a chloride increase as early as August, presumably from the concentration of salts due to low flow volume and high temperatures. These high levels are maintained for the major portion of the winter and decrease in May.

Canyon Creek (Graph III-5) increases in chloride content in November and high levels are maintained through March. Deicing operations are the likely source of this chloride since Canyon Creek runs adjacent to the freeway in several areas.

Donner Creek (Graph III-7) exhibits fairly constant chloride levels but had a marked decrease during June and July, 1974. These concentrations are considerably lower throughout the year than Summit Creek and Negro Creek.

Lakeview Creek is from a watershed unaffected by U.S. 80. Chloride levels are generally below detectable limits, but a slight increase during winter is seen (Graph III-8). This slight increase (highest level ≃ 2 ppm) may be caused by a freezeout (freezing of water which excludes chloride and concentrates it in the unfrozen water). This process occurs because of freezing point depression of the salt laden water. The very low levels are significant and are similar to levels found in streams before they cross U.S. 80. These levels are probably those which occurred before watersheds were disturbed by freeway construction and deicing operations.

The dilution of chloride levels is seen in Graph III-9 of the South Fork of the Yuba River. Chloride concentrations at the Norden station are high during the winter and closely parallel the levels found in Upper Castle Creek as it enters Lake van Norden. The levels are reduced, and fluctuations are damped on the river at the Cisco Grove Station.

This is due to a large input of low chloride containing water between the sampling stations.

The finding that the chloride levels leaving Lake van Norden are very similar to Upper Castle Creek as it enters the lake suggests a lake management strategy for chloride control. The lake was empty this winter, and the water flowed through, carrying the high chloride load with it. The condition of inflowing chloride being mixed and reaching a somewhat intermediate level of the lake outflow is exemplified by Donner Lake. Undoubtedly, the general chloride levels of Donner Lake are higher due to sodium chloride runoff from the freeway, and this is unlikely to occur in Lake van Norden this year. This management strategy is of very limited applicability and is severe in nature. Obviously, it is impossible with larger lakes or lakes which take more than a few months to fill during the spring, but it may be practical in certain shallow roadside situations, which may be desirable for fisheries programs. These programs will be recommended in the final report.

Chloride data for snow and runoff samples is provided in Table 8. Snow samples were divided on the basis of the obvious signs of blow-off from snowplows or cleanliness. Clean samples generally show very low levels of chloride (maximum levels of 12.32 were found, but most samples had nondetectable levels). Levels as high as 447.63 ppm Cl^- were found in samples with blow-off. Runoff samples contained very high chloride levels (range from 10.35 - 1972.00 pm Cl^-). The samples from Canyon Creek and Lake van Norden were from areas unaffected by road salting operations. These levels are much lower (mean 8.55 ppm) than runoff from U.S. 80 (mean 483.52 ppm). This merely evidences the fact that runoff from the highways is indeed rich in chloride.

The final report will contain the rest of the Spring 1975 analyses and will contain finalized recommendations for improved strategy of road salt management.

TABLE VII

Chloride Data - Streams and Lakes

Results in mg/l Cl$^-$

ND: not detectable
N.S.: not sampled
M.D.: missing data

Site	V/15/74	V/29/74	VI/12/74	VI/26/74
Gold Run Pond				
0 m	10.5	11.60	11.60	14.15
1.0 m	11.80	13.95	13.95	9.70
2.0 m	7.05	13.95	13.95	12.15
3.0 m	14.15	2.79	10.45	9.70
4.0 m	16.50	25.55	16.25	9.70
5.0 m	56.60	32.50	32.50	29.15
Putt's Lake				
0 m	N.S.	60.40	60.40	63.10
1.0 m	56.60	58.05	13.95	65.50
2.0 m	56.60	58.05	65.05	58.95
3.0 m	56.60	58.05	60.40	61.30
3.5 m	56.60	60.40	62.70	--
Lake van Norden				
0 m		0.93	ND	ND
1.0 m	N.S.	M.D.	0.46	ND
2.0 m	Iced	1.39	ND	ND
3.0 m	over	0.46	ND	0.47
4.0 m	"	1.86	ND	0.48
5.0 m	"	—	ND	--
Donner Lake				
0 m	N.S.	10.22	9.29	8.74
10 m	10.52	9.29	9.75	8.74
20 m	10.84	11.15	11.15	11.65
30 m	10.98	11.61	11.61	10.68
40 m	11.44	11.61	11.61	11.65
50 m	11.44	13.01	11.15	11.65
60 m	11.44	11.61	11.61	11.65
Summit Roadside Rest West Pond				
0 m	N.S.	0.46	1.39	1.41
1.0 m		0.46	1.39	0.94
2.0 m		0.46	1.39	0.94
2.5 m		10.22	1.39	

TABLE VII

Chloride Data

Results in mg/l Cl^-

/: 0.5 meter mark
ND: not detectable
N.S.: not sampled
M.D.: missing data

Site	VII/16/74	VII/29	VIII/8-9	VIII/19	IX/10	IX/24/74
Gold Run Pond						
0 m	14.45	14.00	12.15	9.65	16.50	16.50
1.0 m	12.05	9.30	12.15	19.35	16.50	14.15
2.0 m	12.05	14.00	12.15	12.10	14.10	14.15
3.0 m	12.05	9.20	12.15	14.50	14.10	11.80
4.0 m	7.25	9.30	12.15	/12.10	14.10	14.15
5.0 m	--	7.25	12.15	--	--	--
Putt's Lake						
0 m	60.25	59.90	60.70	70.10	75.45	70.70
1.0 m	65.05	65.25	70.40	62.25	73.10	80.15
2.0 m	63.20	60.70	72.80	67.50	70.70	77.80
3.0 m	65.05	62.90	70.40	67.70	73.10	75.45
3.5 m	62.25	62.90	--	--	--	--
Lake van Norden						
0 m	.46	.93	1.45	1.93	1.88	1.41
1.0 m	.48	.93	1.94	1.93	36	1.89
2.0 m	.96	ND	1.45	1.93	2.83	1.41
3.0 m	.48	.93	1.45	2.90	--	/1.41
4.0 m	/1.45	/.92	1.45	--	--	--
5.0 m	--	--	--	--	--	--
Donner Lake						
0 m	9.16	9.32	9.22	8.70	9.90	9.90
10 m	8.68	9.32	9.22	9.19	9.43	9.43
20 m	10.60	9.68	11.17	11.60	11.32	11.32
30 m	11.57	10.60	12.14		9.90	9.43
40 m	17.83	12.62	12.62	13.05	12.26	11.79
50 m	11.57	10.60	12.62	12.57	10.84	11.79
60 m	12.53	11.18	12.14	12.57	11.79	8.02
70 m						11.32
Summit Roadside West Pond						
0 m	1.87	1.38	3.40	2.90	3.77	4.24
1.0 m	1.45	.92	3.40	2.90	3.77	4.24
2.0 m	2.41	2.33	2.91	2.90	3.30	3.77
2.5 m	--	--	--	--	--	--

TABLE VII

Chloride Data

Results in mg/l Cl⁻

/: 0.5 meter mark
N.D.: not detectable
N.S.: not sampled
M.D.: missing data

Site	Date				
	X/7/74	X/23/74	XI/6/74	XI/25/74	XII/5-6/74
Gold Run Pond					
0 m	17.10	14.56	12.41	9.71	
1.0 m	14.65	14.56	7.45	9.71	10.07
2.0 m	12.20	12.14	17.38	7.28	7.55
3.0 m	17.10	14.56	14.90	9.71	10.07
4.0 m	14.65	--	19.86	--	10.00
5.0 m	--	--	12.41	--	7.55
outflow	--	--	--	10.07	--
Putt's Lake					
0 m	80.70	82.54	76.96	72.82	75.83
1.0 m	80.70	77.68	79.44	70.40	83.16
2.0 m	75.80	82.54	76.96	--	70.00
3.0 m	78.25	82.54	--	--	70.47
3.5 m	--	--	--	--	--
Lake van Norden					
0 m	1.96	2.91	2.50	3.88	4.53
1.0 m	2.44	2.91	3.48	--	5.38
2.0 m	2.44	2.91	3.48	--	7.05
3.0 m	2.44	--	3.00	--	--
4.0 m	--	--	--	--	--
5.0 m	--	--	--	--	--
Donner Lake					
0 m	10.76	10.20	10.00	10.12	11.74
10 m	10.27	10.20	9.93	10.12	7.34
20 m	2.44	11.17	12.00	10.12	11.07
30 m	0.98	11.65	12.41	11.57	17.12
40 m	12.22	11.65	11.92	11.09	13.21
50 m	7.82	7.28	11.92	11.57	12.08
60 m	12.71	12.62	12.41	--	12.72
70 m	--	12.14	11.50	--	12.08
Summit Roadside West Pond					
0 m	4.40	9.71	4.96	4.34	5.50
1.0 m	4.89	4.37	4.47	--	5.87
2.0 m	13.91	4.86	4.50	--	7.05
2.5 m	--	--	--	--	--

TABLE VII

Chloride Data

Results in mg/l Cl⁻

/:	0.5 meter mark
N.D.:	not detectable
N.S.:	not sampled
M.D.:	missing data

SITE	DATE I/18-19/75	II/22-23/75
Gold Run Pond		
0 m	5.69	
1.0 m	5.69	9.86
2.0 m	7.76	9.37
3.0 m	12.94	
4.0 m	1.55	39.44
5.0 m	10.00	39.44
Outflow	8.80	4.93
Putt's Lake		
0 m	64.69	66.02
1.0 m	70.00	70.90
2.0 m	70.00	78.24
3.0 m	80.22	185.58
3.5 m		
Lake van Norden		
0 m	N.D.	Empty
1.0 m		
2.0 m		
3.0 m		
4.0 m		
5.0 m		
Donner Lake		
0 m	12.42	10.85
10 m	12.94	10.85
20 m	11.90	10.85
30 m	13.46	11.34
40 m	11.90	10.85
50 m	12.42	
60 m	12.42	10.85
70 m	11.90	
Summit Roadside West Pond		
0 m	7.00	
1.0 m	7.00	
2.0 m	10.00	
2.5 m		

TABLE VII

Chloride Data

Results in mg/l Cl^-

/: 0.5 meter mark
ND: not detectable
N.S.: not sampled
M.D.: missing data

Site	III/27/28/75	IV/12-13/75	IV/26/75
Gold Run Pond			
0 m	5.38	17.50	17.50
1.0 m	6.36	17.87	20.00
2.0 m	6.36	28.08	20.00
3.0 m	10.27	35.74	30.00
4.0 m	10.27	48.50	32.50
5.0 m	9.29	60.00	
Outflow	6.36	15.00	20.00
Putt's Lake			
0 m			20.00
1.0 m	75.80	82.50	25.00
2.0 m	85.58	75.00	77.50
3.0 m		117.50	105.00
3.5 m			
Lake Van Norden			
0 m			
1.0 m			
2.0 m			
3.0 m			
4.0 m			
5.0 m			
Donner Lake			
0 m		11.74	12.00
10 m		12.25	12.50
20 m		12.25	12.00
30 m		12.76	12.50
40 m		11.23	12.00
50 m		12.76	12.50
60 m		12.25	12.00
70 m		12.25	
Summit Roadside Rest West Pond			
0 m			
1.0 m			
2.0 m			
2.5 m			

TABLE VII

Chloride Data

Results in mg/l Cl^-

/: 0.5 meter mark
ND: not detectable
N.S.: not sampled
M.D.: missing data

Site	Date
	V/10/75
Gold Run Pond	
0 m	21.13
1.0 m	20.93
2.0 m	22.97
3.0 m	27.87
4.0 m	33.18
5.0 m	38.29
Outflow	21.13
Putt's Lake	
0 m	
1.0 m	
2.0 m	
3.0 m	
3.5 m	
Lake van Norden	
0 m	
1.0 m	
2.0 m	
3.0 m	
4.0 m	
5.0 m	
Donner Lake	
0 m	15.82
10 m	12.76
20 m	12.05
30 m	12.76
40 m	13.27
50 m	14.49
60 m	12.25
70 m	3.78
Summit Roadside Rest West Pond	
0 m	
1.0 m	
2.0 m	
2.5 m	

TABLE VII, continued

Site	Date					
	VII/16	VII/29	VIII/8-9	VIII/19	IX/10	IX/24
Lake Tahoe						
0 m	ND			0.94		0.94
10 m	4.61			2.83		1.41
20 m	5.53			0.94		1.41
50 m	.46			1.88		0.94
75 m	5.53			1.41		1.41
100 m	4.15			1.41		1.41
150 m	21.67			0.94		0.94
200 m	5.53			1.41		1.88
250 m	6.45			1.41		0.94
300 m	3.23			0.94		1.88
350 m	4.15			1.88		1.41
400 m	4.15			1.88		1.88
450 m	.46			--		1.88
Frog Pond						
0 m	31.35	31.55	41.25	48.35	63.65	82.50
2/3 m	28.10		34.00	43.50	--	--
Outflow	30.42	32.60	36.40	38.70	Dry	Dry
Canyon Creek	8.68	9.32	10.20	9.67	9.90	9.90
South Fork, Yuba R. at Cisco Grove	5.41	5.13	4.37	4.84	3.77	0.47
South Fork, Yuba R. at Norden	6.93	1.45	1.45	1.93	1.88	2.83
Upper Castle Crk. at Boreal Ridge	0.94	1.94	3.40	4.84	8.49	11.32
Upper Castle Crk. at Old U.S. 80	8.19	31.07	31.07	28.30	42.62	70.70
Summit Crk., summit above 80	9.16	4.37	4.37	5.32	6.60	Dry
Summit Creek, above houses	3.86	15.05	17.96	18.37	13.20	Dry
Summit Creek, at bridge	9.64	8.85	9.71	9.67	9.43	9.43
Negro Creek, above 80	ND	ND	ND	ND	ND	ND
Negro Creek, below below 80	2.41	1.40	5.34	5.80	7.07	5.66
Negro Creek, at bridge	ND	6.99	7.28	7.74	6.60	6.12

TABLE VII, continued

Site	Date				
	X/7	X/23	XI/6	XII/25-6	XII/5-6
Lake Tahoe					
0 m					
10 m					
20 m					
50 m					
75 m					
100 m					
150 m					
200 m					
250 m					
300 m					
350 m					
400 m					
450 m					
Frog Pond					
0 m					58.70
2/3 m					
Outflow	105.15	123.80	64.54	41.27	53.81
Canyon Creek	10.76	1.94	9.50	14.56	10.76
South Fork, Yuba R at Cisco Grove	1.96	2.91	4.00	12.53	20.55
South Fork, Yuba R at Norden	1.96	1.94	3.48	4.86	7.83
Upper Castle Crk. at Boreal Ridge	18.09	19.42	14.00	11.65	10.76
Upper Castle Crek at Old U.S. 80	92.90	72.82	89.37	89.82	73.38
Summit Crk., summit above 80	Empty	Empty	Empty	N.D.	5.03
Summit Crk., below 80	Empty	Empty	9.43	11.65	22.01
Summit Creek, above houses	Empty	Empty	24.33	24.58	24.46
Summit Creek at bridge	15.65	11.17	13.00	22.17	--
Negro Creek above 80	N.D.	N.D.	N.D.	N.D.	N.D.
Negro Creek, below 80	1.96	3.40	2.98	1.45	1.96
Negro Creek, at bridge	7.34	7.28	7.50	8.19	16.14

TABLE VII, continued

Site	X/74	I/18-19	I/75	II/8-9	II/22-23	III/7-8
Lake Tahoe						
0 m	1.00		1.01			
10 m	1.00		0.50			
20 m	0.50		ND			
50 m	0.50		0.50			
75 m	1.00		0.50			
100 m	2.00		1.01			
150 m	1.00		1.01			
200 m	1.00		1.01			
250 m	1.00		1.01			
300 m	ND		1.01			
350 m	0.50		0.50			
400 m	1.50		1.01			
450 m	1.00		1.01			
Frog Pond						
0 m		46.58		38.84	ND	
Outflow		54.34		53.40	49.30	
Canyon Creek	11.00	16.04	15.10	17.96	10.85	22.97
South Fork, Yuba R. at Cisco Grove	15.50	20.00	21.15	21.36	24.65	26.32
South Fork, Yuba R. at Norden	9.50	40.89	42.29	111.66	29.58	55.03
Upper Castle Crk. at Boreal Ridge	9.00	15.50	20.14			
Upper Castle Crk. at Old US 80	112.50	18.63	81.57	121.38	78.88	81.34
Summit Crk., summit above 80	ND	5.00	ND		ND	
Summit Crk., summit below 80	45.50	23.29	28.47		32.04	
Summit Creek, above houses		52.00	41.40	38.84	50.78	43.06
Summit Creek, at bridge	29.00	49.16	32.73	41.75	64.09	38.28
Negro Creek, above 80	ND	66.76	ND	ND	ND	ND
Negro Creek, below 80	3.50	5.18	3.02	9.71	5.42	31.58
Negro Creek, at bridge	13.66	33.64	157.86	33.98	32.04	33.50

TABLE VII, Continued

Site	Date				
	III/15	IV/12-13	IV/23	IV/26	IV/28
Lake Tahoe					
0 m	0.50				
10 m					
20 m	0.50				
50 m	2.00				
75 m					
100 m	1.00				
150 m	0.50				
200 m	1.00				
250 m	0.50				
300 m	1.00				
350 m	0.50				
400 m	1.00				
450 m	0.50				
Frog Pond	III/27-28				
Outflow	61.12	94.44		42.50	
Canyon Creek	6.00	11.74		6.00	
South Fork, Yuba R. at Cisco Grove	17.50	28.08		22.50	
South Fork, Yuba R. at Norden	46.46	55.00		65.00	
Upper Castle Crk. at Boreal Ridge					
Upper Castle Crk. at Old US 80	80.00	105.00		85.00	
Summit Crk., summit above 80		ND	ND	ND	ND
Summit Crk., summit below 80		43.39	82.50	55.00	48.90
Summit Creek, above houses	45.00	63.81		37.50	40.08
Summit Creek, at bridge	40.00	56.16	48.50	35.00	39.12
Negro Creek, above 80	ND	ND	ND	ND	ND
Negro Creek, below 80	8.31		11.23	7.50	6.13
Negro Creek, at bridge	30.00		42.50	20.00	20.42

TABLE VII, Continued

Site	Date	
	IV/30	V/10
Lake Tahoe		
0 m		
10 m		
20 m		
50 m		
75 m		
100 m		
150 m		
200 m		
250 m		
300 m		
350 m		
400 m		
450 m		
Frog Pond		
0 m		
2/3 m		
Outflow		34.50
Canyon Creek		3.57
South Fork, Yuba R. at Cisco Grove		10.21
South Fork, Yuba R. at Norden		3.57
Upper Castle Creek at Boreal Ridge		8.68
Upper Castle Creek at Old US 80		6.13
Summit Crk., summit above 80	ND	ND
Summit Crk., summit below 80	42.44	14.67
Summit Creek, above houses	35.74	14.67
Summit Creek, at bridge	34.23	14.67
Negro Creek, above 80	ND	ND
Negro Creek, below 80	4.89	2.25 (also ND)
Negro Creek, at bridge	10.21	11.74

TABLE VII (Continued)

Site	Date			
Lake Tahoe		15 May		13 June
0 m		0.47		1.39
10 m		0.92		0.93
20 m	ND	ND		0.46
50 m		0.47		1.39
75 m		1.83		0.93
100 m		0.92		0.93
150 m		1.37		1.39
200 m		0.92		0.46
250 m		0.92		0.93
300 m		0.46		1.39
400 m		0.92		1.39
450 m		--		0.93
Frog Pond			12 June	26 June
0 m			23.25	26.70
2/3 m			26.01	33.00
Outflow			18.60	23.60
Canyon Creek			6.97	7.77
South Fork, Yuba River at Cisco Grove			ND	0.47
South Fork, Yuba River at Norden			ND	0.48
Upper Castle Creek at Boreal Ridge			16.26	ND
Upper Castle Creek at Old U.S. 80			0.46	2.83
Summit Creek, summit above 80			ND	ND
Summit Creek, summit below 80			0.46	ND
	12 May	29 May	12 June	25 June
Summit Creek, above houses	N.S.	N.S.	1.39	3.40
Summit Creek, at bridge	5.03	2.32	0.93	
Negro Crk., above 80	ND	ND	ND	ND
Negro Crk., below 80	N.S.	N.S.	0.93	1.94
Negro Crk., at bridge	ND	0.93	2.79	4.37

TABLE VII. Continued.

Site	Date					
	7/16	7/29	8/8-9	8/19	9/10	9/24
Lakeview Creek, above houses	ND	ND	ND	ND	ND	ND
Lakeview Creek, below bridge	6.08	ND	ND	ND	Dry	Dry
Donner Creek	0.48	7.92	9.22	9.67	9.90	9.43
Emigrant Gap Crk.	21.21	6.52	3.40	23.69	40.55	51.39
Ward Creek, above bridge	ND	ND	ND	ND	ND	ND
Ward Creek, below bridge	ND	ND	ND	ND	ND	ND
Meeks Creek, above bridge	ND	ND	ND	ND	ND	ND
Meeks Creek, below bridge	ND	ND	ND	ND	0.47	ND
Cascade Creek, above bridge	ND	ND	ND	ND	ND	ND
Cascade Creek, below bridge	ND	ND	ND	ND	ND	ND
Upper Truckee Number 1	0.96	.93	1.94	2.90	3.30	3.77
Upper Truckee Number 2	0.96	1.40	1.45	3.38	8.49	5.19
Upper Truckee Number 3	0.96	2.33	2.91	5.80	4.24	4.72
Upper Truckee Number 4	1.48	1.40	2.43	5.80	4.24	4.72
Truckee River, outflow	0.94	1.45	0.48	0.97	1.41	0.94
Truckee River near Donner Creek	1.90	1.45	1.45	1.93	1.41	7.07

TABLE VII, Continued

Site	Date				
	10/7/74	10/23	11/6	11/25-6	12/5-6
Lakeview Creek, above houses	0.98	0.97	0.99	ND	0.98
Lakeview Creek, below bridge				4.82	0.98
Donner Creek	8.80	9.71	11.00	5.30	11.74
Emigrant Gap Creek	56.25	53.40	54.62	43.70	35.24
Ward Creek, above bridge	ND	ND	ND	ND	ND
Ward Creek, below bridge	ND	ND	0.50	ND	0.49
Meeks Creek, above bridge	ND	ND	ND	ND	ND
Meeks Creek, below bridge	ND	ND	ND	ND	0.49
Cascade Creek, above bridge	ND		ND	ND	ND
Cascade Creek, below bridge	ND			ND	ND
Upper Truckee Number 1	3.91	4.86	4.47	3.37	3.91
Upper Truckee Number 2	6.85	3.88	4.47	3.37	4.89
Upper Truckee Number 3	3.91	5.34	4.50	3.86	3.91
Upper Truckee Number 4	4.40	4.86	4.96	4.34	4.40
Truckee River, outflow	0.98	0.97	1.49	0.48	1.96
Truckee River near Donner Creek	3.91	1.46	1.00	ND	2.01

TABLE VII, Continued

Site	Date					
	12/17-18	1/18-19	1/30	2/8-9	2/22-23	3/7-8
Lakeview Creek, above houses	N.D.	2.07	1.55	0.97	0.49	N.D.
Lakeview Creek, below bridge	N.D.					
Donner Creek	12.00	11.90	12.08	10.68	10.85	11.48
Emigrant Gap Crek	42.50	60.00	54.34	N.D.	39.44	31.10
Ward Creek, above bridge	N.D.	N.D.	N.D.	29.13	N.D.	N.D.
Ward Creek, below bridge	N.D.	N.D.	N.D.	1.94	N.D.	N.D.
Meeks Creek above bridge	N.D.	N.D.	N.D.	N.D.	N.D.	N.D.
Meeks Creek, below bridge	N.D.	0.52	N.D.	N.D.	N.D.	N.D.
Cascade Creek, above bridge	N.D.	N.D.	N.D.			
Cascade Creek, below bridge	N.D.	N.D.	N.D.			
Upper Truckee Number 1		4.66	4.53	4.86	2.96	4.78
Upper Truckee Number 2		4.66	1.51	39.81	61.62	5.74
Upper Truckee Number 3	4.50	3.00	3.62	8.74	3.45	3.83
Upper Truckee Number 4	4.00	5.18	4.66	13.59	2.96	4.31
Truckee River, outflow	1.00	1.55	1.01	1.94	0.99	0.96
Truckee River near Donner Creek	12.00	2.00	1.51	7.77	3.94	2.87

TABLE VII, Continued

Site	Date				
	III/27-28	IV/12-13	IV/23	IV/26	IV/28
Lakeview Creek, above houses	ND	ND	0.51	0.50	ND
Lakeview Creek, below bridge					
Donner Creek	12.00	11.74		12.50	
Emigrant Gap Creek	36.68	50.00		35.00	
Ward Creek, above bridge	ND	ND		ND	
Ward Creek, below bridge	ND	ND		ND	
Meeks Creek, above bridge	ND	ND		ND	
Meeks Creek, below bridge	ND	ND		ND	
Cascade Creek, above bridge		ND		ND	
Cascade Creek, below bridge		ND		0.82	
Upper Truckee Number 1	7.00	6.13		5.50	
Upper Truckee Number 2	3.00	6.13		6.00	
Upper Truckee Number 3	3.42	5.10		7.66	
Upper Truckee Number 4	4.00	4.08		6.00	
Truckee River, outflow	1.50	1.53		0.50	
Truckee River near Donner Creek	4.50	2.50		2.50	

TABLE VII, Continued

Site	Date	
	IV/30	V/10
Lakeview Creek, above houses	ND	ND
Lakeview Creek, below bridge		
Donner Creek		12.05
Emigrant Gap Creek		23.99
Ward Creek, above bridge		ND
Ward Creek, below bridge		ND
Meeks Creek, above bridge		ND
Meeks Creek, below bridge		ND
Cascade Creek, above bridge		0.82
Cascade Creek, below bridge		ND
Upper Truckee Number 1		1.53
Upper Truckee Number 2		7.66
Upper Truckee Number 3		13.58
Upper Truckee Number 4		2.63
Truckee River, outflow		1.43
Truckee River, near Donner Creek		5.62

TABLE VIII

CHLORIDE DATA - SNOW AND RUNOFF SAMPLES

DATE: 11/25-26

Snow samples:
away from blow-off

Lake van Norden	N.D.
Summit Roadside Rest	N.D.

DATE: 12/5-6

Snow samples:
away from blowoff

Upper Castle Creek at Old US 80	N.D.
Ward Creek	N.D.
Cascade Creek	7.34

Snow samples:
near blow-off

Summit Roadside Rest	447.63
Frog Pond	6.36
Ward Creek	N.D.
Cascade Creek	10.27

DATE: 1/18-19

Snow samples:
away from blow-off

Putt's Lake	1.00
Summit Roadside Rest	N.D.
Upper Castle Creek at Old US 80	2.00
Summit Creek, above houses	N.D.
Negro Creek at bridge	N.D.
Lakeview Creek, above houses	2.07
Ward Creek	1.04
Meeks Creek	N.D.
Cascade Creek	7.76

Snow samples:
with blow-off

Putt's Lake	4.14
Summit Roadside Rest	62.50
Upper Castle Crk. at Old US 80	140.00

DATE: 1/18-19

Runoff samples:

Lake van Norden	10.35

DATE: 1/30

Snow samples:
away from blow-off

Cascade Creek	7.76
Upper Truckee #1	1.04

Snow samples:
with blow-off

Meeks Creek	13.59

TABLE VIII (Continued)

CHLORIDE DATA

DATE: 2/8-9

Snow samples: away from blow-off

Frog Pond	
Canyon Creek	N.D.
South Fork, Yuba R. at Norden	N.D.
Summit Creek, above US 80	N.D.
Negro Creek, at bridge	N.D.
Donner Creek	N.D.
Ward Creek	N.D.
Meeks Creek	7.77

Runoff samples:

Emigrant Gap collector	31.56
Meyers	83.51

Snow samples: with blow-off

Frog Pond	121.38
Upper Castle Crk. at Old US 80	7.78
Meeks Creek	0.97
Upper Truckee R. #3	131.08

DATE: 2/22-23

Snow samples: away from blow-off

Negro Creek, below 80	9.86
Lakeview Creek, above house	N.D.
Summit Roadside Rest	12.32
Ward Creek	2.96
Meeks Creek	N.D.
Upper Truckee R., #1	0.99
Upper Truckee R., #2	N.D.
Upper Truckee R., #3	N.D.
Lake van Norden	N.D.

Runoff samples:

Summit Roadside Rest	157.76
Emigrant Gap collector	59.16
Upper Truckee #3	157.76
Meeks Creek	916.98
Ward Creek	1972.00
Negro Creek, near 80	1089.53

Snow samples: with blow-off

Putt's Lake	5.92
Summit Roadside Rest	11.39
Donner Lake	10.85
Summit Roadside Rest	69.02
Summit Creek, above houses	N.D.
Ward Creek	8.31

TABLE VIII Continued

CHLORIDE DATA

DATE: 3/7-8

Snow samples:
away from blow-off

Yuba River, Cisco Grove	1.44
Lake van Norden	N.D.
Ward Creek	5.74
Upper Truckee R. #1	0.96
Lakeview Creek	N.D.
Upper Truckee #3	N.D.

Runoff samples:

Canyon Creek	15.31
Negro Creek	610.09
Emigrant Gap collector	598.12

Snow samples:
with blow-off

Castle Creek, at Old US 80	9.57
Summit Creek	N.D.
Meeks Creek	N.D.
Upper Truckee #1	N.D.

DATE: 3/27-28

Snow samples:
away from blow-off

South Fork Yuba R., Cisco Grove	4.40
Frog Pond	N.D.
Putt's Lake	N.D.
Lakeview Creek	N.D.
Lake van Norden	N.D.
Ward Creek	1.00
Upper Truckee #2	N.D.
Meeks Creek	N.D.

Runoff samples:

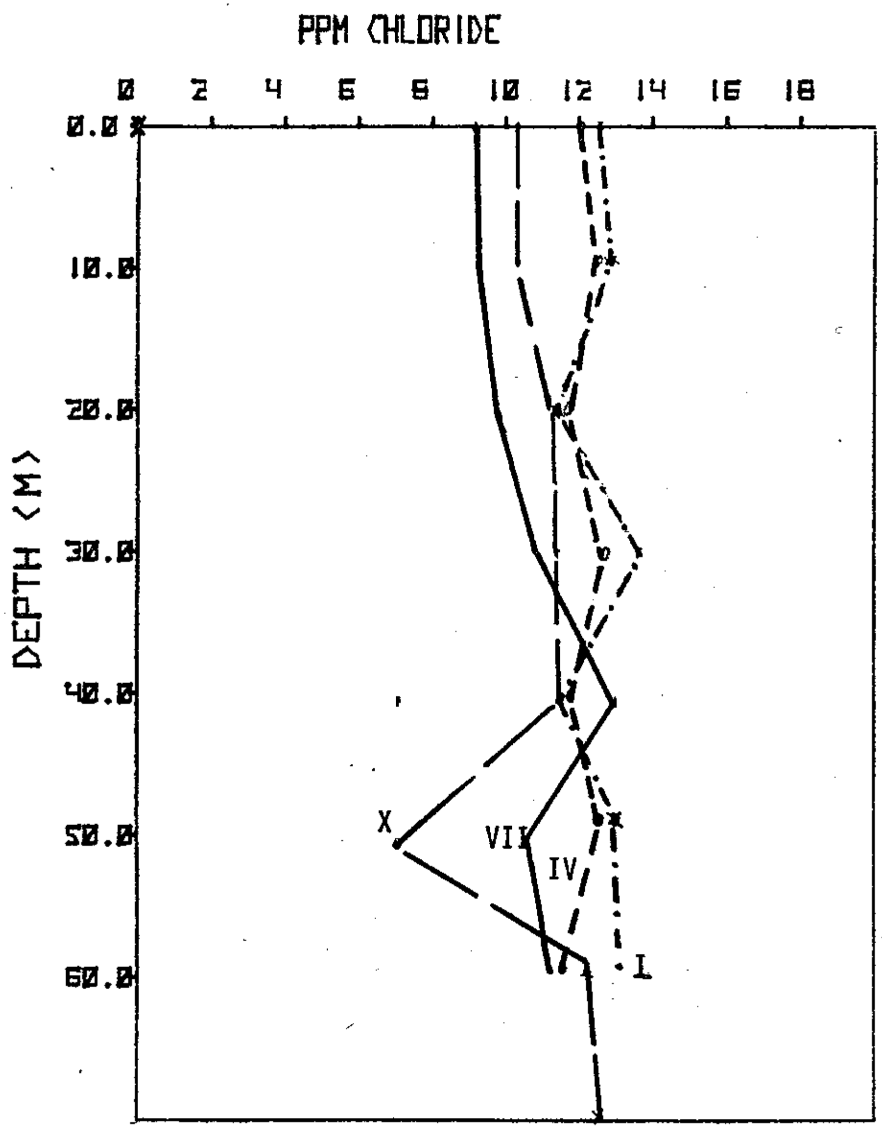
Canyon Creek	N.D.
Emigrant Gap collector	75.80
Upper Truckee #2	50.00

Snow samples:
with blow-off

Upper Truckee #1	3.91
Negro Creek, at bridge	N.D.
Summit Creek, above houses	N.D.
Upper Castle Crk. at Old US 80	95.00
Negro Creek at 80	25.00

Graph II-1

Donner Lake Chloride Profile



Data
ppm Chloride

Depth (m)	Month I	IV	VII	X
0	12.42	12.00	9.32	10.20
10	12.94	12.50	9.32	10.20
20	11.90	12.00	9.68	11.17
30	13.46	12.50	10.60	11.65
40	11.90	12.00	12.62	11.65
50	12.42	12.50	10.60	7.28
60	12.42	12.00	11.18	12.62
70	11.90		--	12.14

TABLE IX

Field Data

Donner Lake

DATE	Depth (m)	T(C)	Sp.C.	D.O.	pH
9 August, 10:30 A.M.	0	21.0	62	8.5	8.30
	5	19.5	61	8.2	7.62
	10	13.0	52	12.0	7.62
	15	8.6	50	11.8	7.62
	20	6.5	48	11.2	7.42
	25	6.5	48	10.8	7.19
	30	5.8	48	11.0	6.98
	35	5.8	48	10.0	6.82
	40	5.8	48	9.8	6.70
	45	5.8	48	9.8	6.72
	50	5.1	50	9.3	6.95
20 August, 8:30 A.M.	0	18.8	74	10.0	8.70
	5	18.1	74	10.8	8.44
	10	16.4	71	11.2	8.38
	15	8.0	64	11.6	8.48
	20	6.4	62	11.8	8.38
	25	6.4	63	11.8	8.31
	30	6.0	62	12.0	8.28
	35	6.0	62	11.6	8.23
	40	5.9	61	11.5	8.24
	45	5.9	60	11.2	8.29
	50	6.0	62	11.6	8.35
9 September, 3:00 P.M.	0	18.2	84	8.4	8.52
	5	18.2	84	8.4	8.52
	10	17.8	83	8.3	8.21
	15	17.2	83	8.1	7.82
	20	9.0	71	11.8	7.95
	25	6.3	68	10.0	7.69
	30	6.0	68	9.9	7.64
	35	5.8	68	9.7	7.57
	40	5.6	68	9.6	7.52
	45	5.8	68	9.1	7.51
	50	5.8	68	8.7	7.53
24 September, 12:30 P.M.	0	20.1	90		8.32
	5	19.0	85		8.20
	10	18.5	84		8.09
	15	11.4	76		8.16
	20	8.0	70		7.70
	25	7.1	69		7.45
	30	6.4	63		7.32
	35	6.0	68		7.18
	40	5.9	68		7.11
	45	5.8	68		7.05
	50	5.6	68		6.77

TABLE IX (Continued)

Donner Lake

DATE	Depth (m)	T(C)	Sp.C.	D.O.	pH
6 December, 10:20 A.M.	0	6.9	50	11.7	7.29
	5	6.8	50	11.7	7.40
	10	6.6	49	11.8	7.33
	15	6.6	49	11.7	7.34
	20	6.6	49	11.7	7.33
	25	6.5	49	11.6	7.34
	30	6.6	49	11.8	7.30
	35	6.0	50	9.6	7.03
	40	5.8	50	8.5	6.81
	45	5.6	50	8.0	6.76
	50	5.5	51	7.8	6.70
18 January, 1975 9:00 A.M.	0	4.2	49	12.0	
	5	4.2	49	11.8	
	10	4.2	49	11.6	
	15	4.2	49	11.6	
	20	4.2	49	10.0	
	25	4.2	49	10.3	
	30	4.2	49	10.8	
	35	4.2	49	11.2	
	40	4.2	49	10.8	
	45	4.1	49	10.4	
	50	4.1	49	10.4	
22 February, 4:00 P.M.	0	2.8	46	12.0	6.98
	5	2.8	44	12.0	6.78
	10	2.8	44	12.0	6.71
	15	2.8	44	12.0	6.69
	20	2.9	44	11.8	6.61
	25	3.0	44	11.6	6.56
	30	3.0	44	11.2	6.41
	35	3.0	44	11.4	6.34
	40	3.0	44	11.4	6.32
	45	3.1	44	11.2	6.32
	50	3.1	45	11.0	6.12
27 March 1975	Unsampleable due to very high waves (2-1/2 ft.)				
26 April, 11:30 P.M.	0	3.5	48	13.8	
	5	4.0	48	12.4	
	10	4.0	48	12.4	
	15	4.0	48	12.2	
	20	4.0	48	12.0	
	25	4.0	48	12.0	
	30	4.0	48	12.0	
	35	4.0	48	12.0	
	40	4.0	48	12.0	
	45	4.0	48	12.0	
	50	4.0	48	12.0	

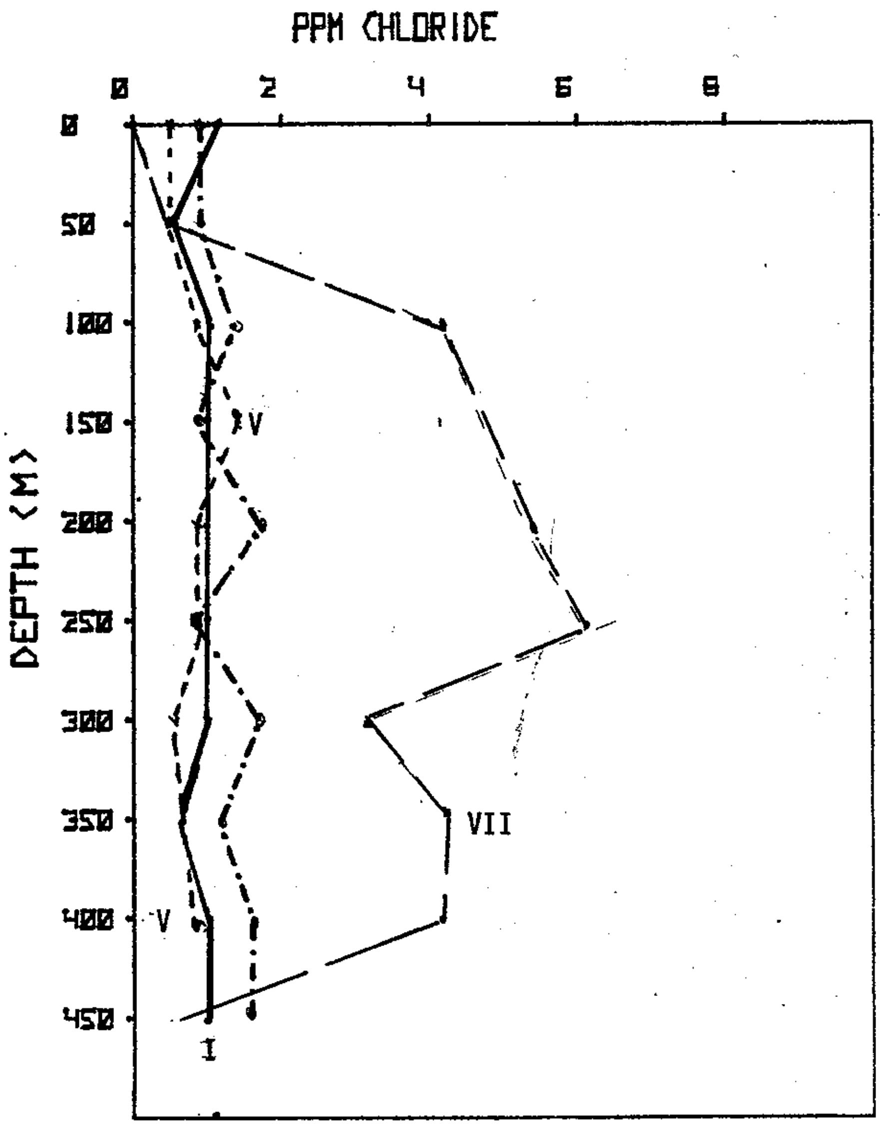
TABLE IX (Continued)

Donner Lake

DATE	Depth (m)	T(C)	Sp.C.	D.O.	pH
7 October, 4:45 P.M.	0	15.8	81		8.06
	5	15.8	80		8.03
	10	15.6	80		7.92
	15	10.0	73		7.83
	20	7.8	70		7.53
	25	7.0	68		7.24
	30	6.2	68		6.87
	35	6.0	68		6.73
	40	5.9	68		6.67
	45	5.8	68		6.59
	50	5.6	68		6.54
23 October, 2:45 P.M.	0	11.8	77	11.6	7.88
	5	11.8	77	11.0	7.88
	10	11.6	76	11.0	7.83
	15	8.4	71	13.0	7.72
	20	6.0	70	12.2	7.48
	25	5.3	68	10.4	7.32
	30	4.5	68	10.2	7.15
	35	4.2	67	8.6	6.97
	40	4.1	67	8.5	6.93
	45	4.0	67	8.4	6.92
	50	4.0	67	8.2	6.87
6 November, 3:00 P.M.	0	9.0	69	10.4	7.58
	5	9.0	72	10.6	7.70
	10	8.9	72	10.6	7.72
	15	8.9	72	10.8	7.64
	20	6.2	72	10.8	7.36
	25	5.0	69	10.8	7.15
	30	4.5	68	9.4	7.10
	35	4.2	68	9.3	6.98
	40	4.0	68	8.8	6.89
	45	4.0	68	8.4	6.78
	50	4.0	68	7.8	6.72
26 November, 10:45 A.M.	0	7.5	50	10.8	7.21
	5	7.3	50	10.9	7.21
	10	7.1	50	10.9	7.22
	15	7.0	50	10.8	7.22
	20	7.0	50	10.8	7.20
	25	6.5	50	10.2	7.00
	30	5.5	50	8.8	6.70
	35	5.2	50	8.0	6.65
	40	5.0	50	7.4	6.59
	45	5.0	50	7.2	6.58
	50	5.0	50	7.1	6.58

Graph II-2

Lake Tahoe Chloride Profile

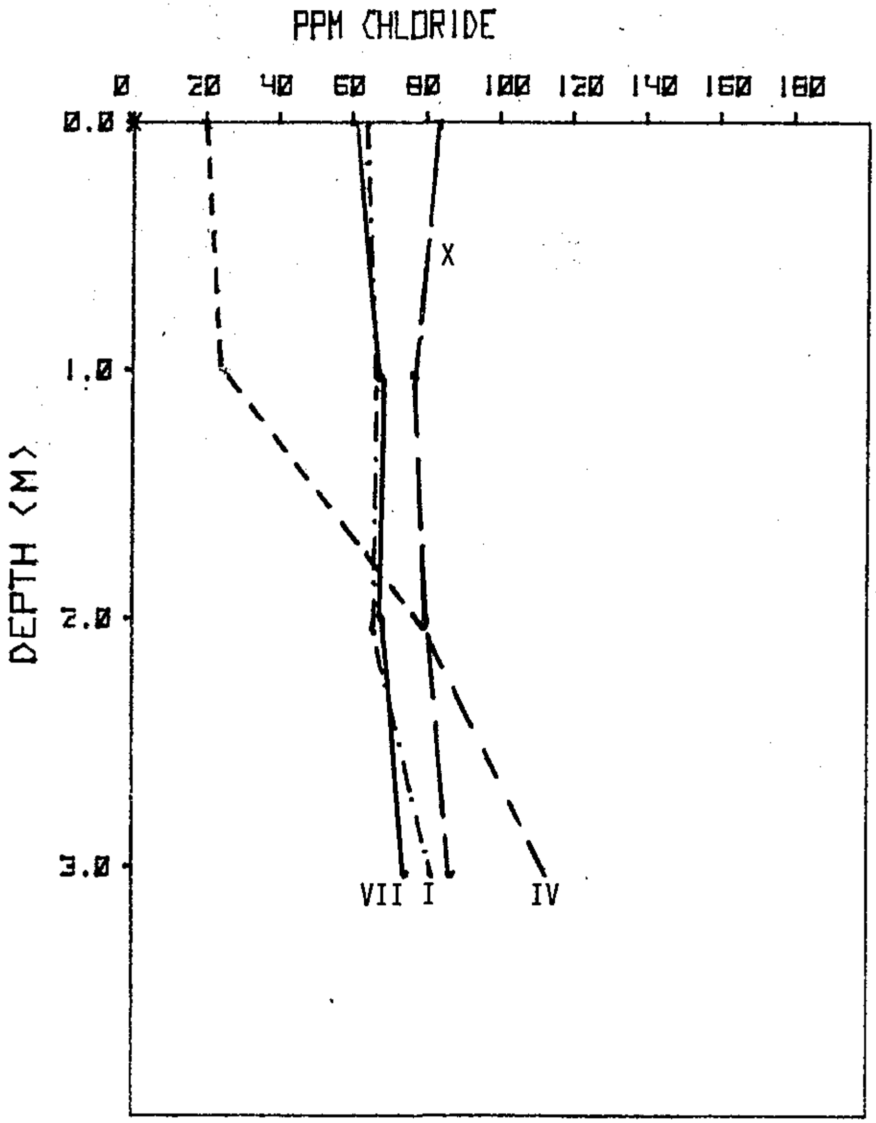


Data
ppm Chloride

Depth (m)	Month I	V	VII	IX
0	1.01	0.47	N.D.	0.94
50	0.50	0.47	0.46	0.94
100	1.01	0.92	4.15	1.41
150	1.01	1.37		0.94
200	1.01	0.92	5.53	1.88
250	1.01	0.92	6.45	0.94
300	1.01	0.46	3.23	1.88
350	0.50	-	4.15	1.41
400	1.01	0.92	4.15	1.88
450	1.01	-	0.46	1.88

Graph II-3

Putt's Lake Chloride Profile



Data
ppm Chloride

Depth	Month: I	IV	VII	X
0	64.69	20.00	60.25	82.54
1	70.00	25.00	65.05	77.68
2	70.00	77.50	63.20	82.54
3	80.22	105.00	65.05	82.54
3.5	--	--	62.25	--

TABLE X

Field Data

Putt's Lake

DATE	Depth (m)	T(C)	Sp.C.	D.O.	pH
8 August, 11:30 A.M.	0	24.2	218	8.1	7.32
	0.5	24.2	218	8.2	7.21
	1.0	24.2	218	7.8	7.18
	1.5	24.2	218	7.5	7.13
	2.0	24.1	218	7.5	7.06
	2.5	24.0	218	7.7	6.97
	3.0	24.0	216	7.6	6.88
19 August, 10:30 A.M.	0	21.7	200	8.2	7.80
	0.5	21.7	200	8.2	7.80
	1.0	21.6	200	8.1	7.70
	1.5	21.7	200	8.0	7.58
	2.0	21.8	200	8.0	7.56
	2.5	21.7	200	8.0	7.51
	3.0	21.5	200	7.9	7.43
	3.5	21.5	200	7.8	7.18
9 September, 11:30 A.M.	0	22.5	307	8.6	8.25
	0.5	22.5	307	8.6	8.25
	1.0	22.5	308	8.3	8.15
	1.5	22.5	306	8.3	8.07
	2.0	22.4	305	8.0	7.80
	2.5	22.2	306	7.6	7.68
	3.0	22.3	302	7.0	7.57
24 September, 8:30 A.M.	0	19.2	300		7.64
	0.5	19.3	300		7.60
	1.0	19.3	300		7.54
	1.5	19.4	300		7.50
	2.0	19.3	300		7.46
	2.5	19.3	300		7.43
	3.0	19.5	300		6.76
7 October, 8:30 A.M.	0	13.2	242		7.88
	0.5	13.2	244		7.75
	1.0	13.2	242		7.63
	1.5	13.2	260		7.49
	2.0	13.2	260		7.40
	2.5	13.3	260		7.31
23 October, 10:15 A.M.	0	10.6	260	10.6	7.80
	0.5	10.6	260	10.2	7.65
	1.0	10.6	260	12.2	7.54
	1.5	10.6	260	10.8	7.30
	2.0	10.6	260	10.6	7.23
	2.5	10.7	260	10.8	7.18
	2.7	10.8	260	9.8	6.97

TABLE X (Continued)

Putt's Lake

DATE	Depth (m)	T(C)	Sp.C.	D.O.	pH
6 November, 8:05 A.M.	0	5.2	220	12.6	8.10
	0.5	5.3	220	12.6	7.96
	1.0	5.3	220	12.7	7.85
	1.5	5.2	220	12.8	7.78
	2.0	5.3	220	12.4	7.69
	2.5	5.2	220	12.6	7.64
25 November, 11:00 A.M.	0	4.9	147	12.0	6.61
	0.5	4.9	146	11.8	6.61
	1.0	4.9	146	11.9	6.62
	1.5	4.8	146	11.8	6.62
	2.0	4.8	142	12.0	6.60
	2.5	4.9	148	12.0	6.63
6 December, 3:30 P.M.	0	4.3	150	14.2	6.56
	0.5	4.2	150	14.0	6.56
	1.0	4.5	150	14.1	6.60
	1.5	4.5	150	14.0	6.69
	2.0	4.4	150	14.2	6.68
	2.5	4.5	150	14.0	6.72
	3.0	4.5	150	14.0	6.86
18 January, 1974	0	3.0	120	13.8	Malfunction
11:30 P.M.	0.5	3.0	120	13.7	
	1.0	3.0	130	13.3	
	1.5	3.2	140	13.2	
22 February, 4:30 P.M.	0	1.0	78	11.6	Malfunction
	0.5	3.0	82	10.2	
	1.0	4.0	87	9.7	
	1.5	4.0	90	9.2	
	2.0	4.2	100	8.0	
	2.5	4.8	125	5.0	
27 March, 10:00 A.M.	0				
	0.5				
	1.0				
	1.5	1.5	135	10.0	Malfunction
	2.0	3.0	170	9.0	
	2.5	4.5	195	7.7	
	3.0	5.0	210	5.4	
	3.5	5.0	235	4.2	
	4.0	5.0	225	2.5	

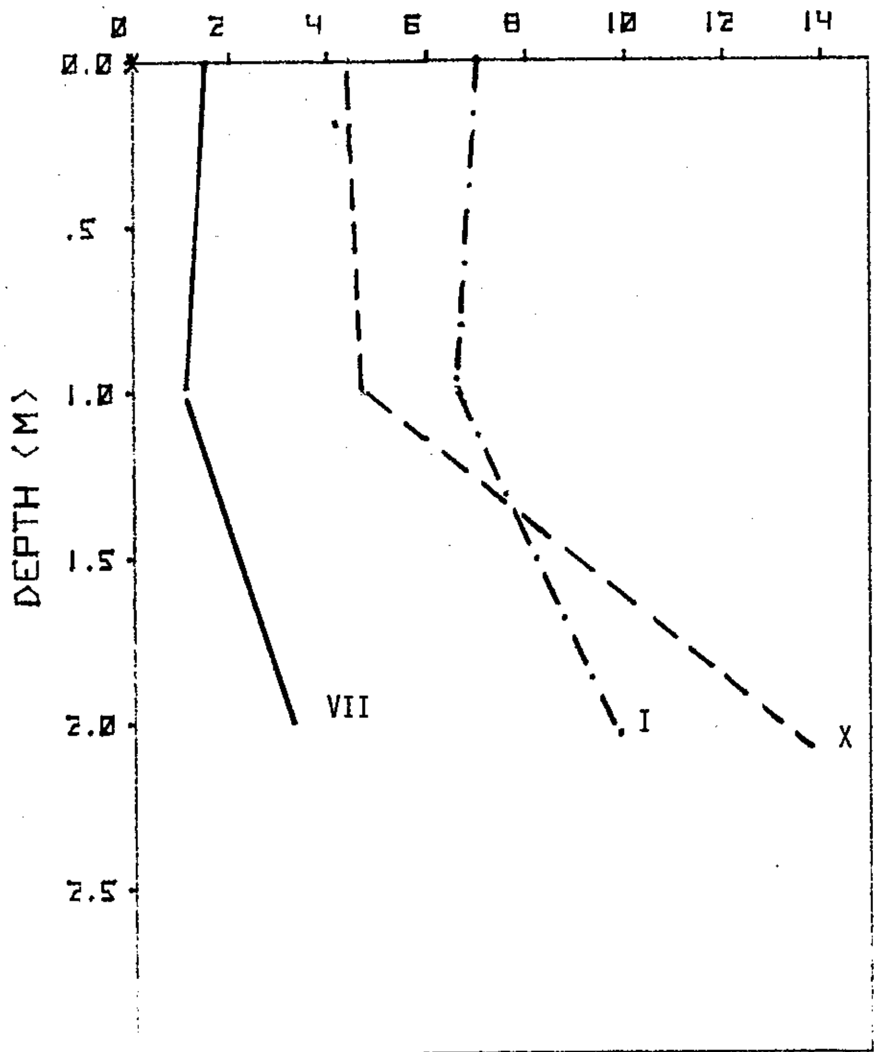
TABLE X (Continued)

Putt's Lake

DATE	Depth (m)	T(C)	Sp.C.	D.O.	pH
26 April, 1975	0	0.2	32	4.9	Malfunction
	0.5	0.2	34	4.9	
	1.0	0.2	34	4.9	
	1.5	0.3	40	4.4	
	2.0	0.5	49	4.2	
	2.5	1.0	54	4.0	
	3.0	4.0	82	4.1	
	3.5	5.0	47	2.4	
	4.0	5.2	66	1.0	

Graph II-4

Summit Roadside Rest
West Pond Chloride Profile



Data
ppm Chloride

Depth (m)	I	IV	VII	X
		Month		
0	7.00	N.S.	1.87	4.40
1	7.00		1.45	4.89
2	10.00		2.41	13.91

TABLE XI

Field Data

Summit Roadside Rest, West

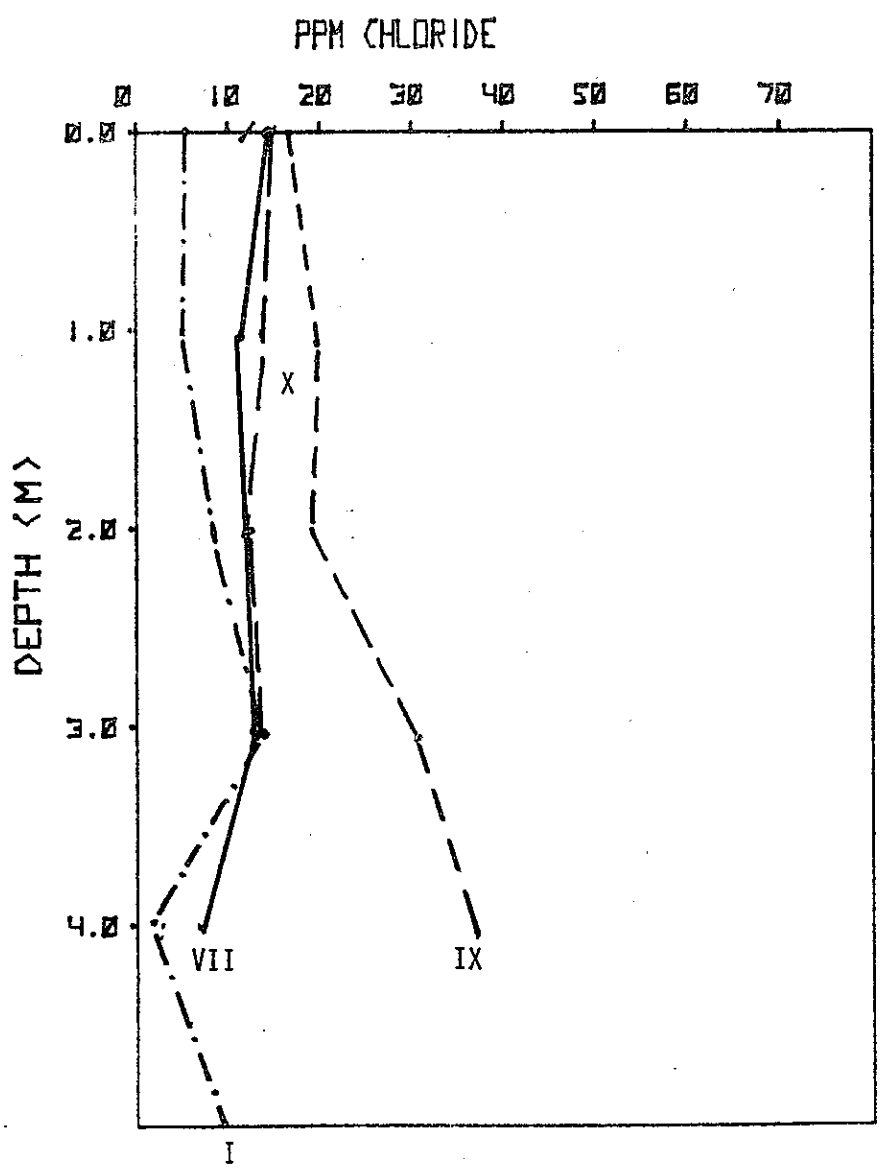
DATE	Depth (m)	T(C)	Sp.C.	D.O.	pH
9 August, 12:35 P.M.	0	21.0	17	7.0	6.84
	0.5	21.0	17	6.9	6.76
	1.0	21.0	17.5	6.4	6.64
	1.5	20.8	17.5	6.7	6.57
	2.0	20.4	17.3	6.2	6.42
20 August, 10:30 A.M.	0	17.2	22	7.3	8.68
	0.5	17.4	22	7.2	8.67
	1.0	17.4	23	7.6	8.65
	1.5	17.4	23	7.0	8.64
	2.0	17.4	23	7.1	8.60
9 September, 4:45 P.M.	0	21.3	27	8.2	7.08
	0.5	21.3	27	8.2	7.25
	1.0	19.5	26	8.4	7.39
	1.5	19.0	26	8.6	7.26
	2.0	19.0	26	7.4	6.40
24 September, 11:30 A.M.	0	17.3	27	*	7.76
	0.5	17.0	27		7.57
	1.0	17.0	26		7.51
	1.5	17.0	26		7.44
	2.0	16.8	26		6.18
7 October, 3:30 P.M.	0	12.5	26		7.96
	0.5	12.3	25		7.78
	1.0	12.2	25		7.69
	1.5	12.0	25		6.90
23 October, 12:45 A.M.	0	8.0	24	11.0	7.68
	0.5	8.0	24	11.0	7.54
	1.0	7.8	23	11.0	7.38
	1.5	7.6	23	10.4	7.26
	2.0	7.6	23	10.0	7.00
6 November, 12:30 P.M.	0	4.0	22	10.6	7.86
	0.5	4.0	22	10.7	7.44
	1.0	3.8	21	10.8	7.32
	1.5	3.8	21	10.8	7.15
	2.0	3.5	21	10.6	6.25

TABLE XI (Continued)

Summit Roadside Rest

DATE	Depth (m)	T(C)	Sp.C.	D.O.	pH
26 November, 1974	0	3.0	18	10.8	6.22
	Not safe for sampling.				
6 December, 12 Noon	0	3.0	14	11.2	6.68
	0.5	4.0	17	10.2	6.03
	1.0	4.0	17	9.6	5.98
	1.5	4.0	17	9.8	5.97
	2.0	4.0	18	7.8	5.97
18 January, 1975	0	1.0	21	4.4	Malfunction
3:15 P.M.	0.5	1.0	16	3.8	
	1.0	1.0	16	3.1	
	1.5	1.0	16	2.2	
	2.0	1.0	18	2.0	
	2.5	3.0	21	1.4	
22 February, 1975	No pullout				
March 1975	" "				
April 1975	" "				
May 1975	" "				

Graph II-5
Gold Run Pond Chloride Profile



Data
ppm Chloride

Depth (m)	I	IV	VII	X
	Month			
0	5.69	17.50	14.45	14.56
1	5.69	20.00	12.05	14.56
2	7.75	20.00	12.05	12.14
3	12.94	30.00	12.05	14.56
4	1.55	32.50	7.25	--
5	10.00	--	--	--

TABLE XII

Field Data

Gold Run Pond

DATE	Depth (m)	T (C)	Sp.C.	D.O.	pH
8 August, 10:00 A.M.	0 m	26.3	141	8.6	7.24
CCW	0.5	26.3	143	8.5	7.23
	1.0	26.2	143	8.4	7.22
	1.5	26.2	142	8.4	7.17
	2.0	26.1	142	8.8	7.08
	2.5	26.0	141	8.3	7.06
	3.0	26.0	141	8.4	7.03
	3.5	26.0	140	8.3	6.92
	4.0	25.8	140	6.0	6.65
	4.5	24.0	140	4.6	6.72
	5.0	22.3	138	0.6	7.08
19 August, 9:30 A.M.	0	24.0	133	7.6	7.46
	0.5	24.0	133	7.6	7.45
	1.0	24.0	135	7.6	7.44
	1.5	23.8	135	7.6	7.42
	2.0	23.8	132	7.3	7.40
	2.5	23/5	133	7.4	7.36
	3.0	23.5	135	7.3	7.36
	3.5	23.5	135	7.1	7.32
	4.0	23.5	135	7.0	7.31
	4.5	23.8	132	6.9	7.16
9 September, 10:30 A.M.	0	24.0	195	8.0	7.77
	0.5	24.0	200	8.2	7.72
	1.0	24.0	200	7.4	7.69
	1.5	23.8	200	7.5	7.67
	2.0	23.8	200	7.5	7.68
	2.5	23.8	200	6.9	7.78
	3.0	23.8	200	6.8	7.69
	3.5	23.7	200	7.0	7.65
	4.0	23.6	200	6.5	7.61
	4.5	23.4	200	3.2	7.44
24 September, 7:00 A.M.	0	21.3	190		7.51
	0.5	21.4	190		7.56
	1.0	21.7	190		7.49
	1.5	21.8	190		7.48
	2.0	21.9	190		7.47
	2.5	21.9	190		7.46
	3.0	21.9	190		7.45
	3.5	21.9	190		7.42
	4.0	22.0	190		7.42
	4.5	21.8	190		7.32

TABLE XII (Continued)

Gold Run Pond

DATE	Depth (m)	T(C)	Sp.C.	D.O.	pH
7 October, 7:15 A.M.	0	17.4	168		7.45
	0.5	17.6	168		7.43
	1.0	17.5	168		7.41
	1.5	17.6	169		7.39
	2.0	17.6	168		7.34
	2.5	17.8	168		7.31
	3.0	17.9	168		7.30
	3.5	17.9	169		7.28
	4.0	17.9	170		7.27
23 October, 9:15 A.M.	0	13.8	165	9.0	7.25
	0.5	13.8	165	10.4	7.24
	1.0	13.8	165	10.2	7.26
	1.5	13.8	165	10.0	7.26
	2.0	13.8	165	9.2	7.27
	2.5	13.8	165	9.0	7.28
	3.0	13.8	165	8.8	7.30
	3.5	13.8	165	8.6	7.29
	4.0	13.8	165	9.4	7.31
6 November, 7:00 A.M.	0	9.3	160	7.4	7.01
	0.5	9.2	160	7.4	7.11
	1.0	9.2	160	7.3	7.09
	1.5	9.2	160	7.4	7.04
	2.0	9.2	160	7.3	7.01
	2.5	9.2	160	7.3	7.01
	3.0	9.2	160	7.3	7.00
	3.5	9.2	160	7.2	6.99
	4.0	9.2	160	7.1	6.99
	4.5	9.2	160	7.0	6.90
25 November, 9:30 A.M.	0	9.0	110	9.0	6.51
	0.5	9.0	110	8.9	6.53
	1.0	9.0	110	8.9	6.54
	1.5	9.0	110	9.0	6.56
	2.0	9.0	110	8.8	6.55
	2.5	9.0	110	8.8	6.56
	3.0	8.9	110	8.9	6.56
	3.5	8.9	110	9.0	6.55
	4.0	9.0	110	8.8	6.56
	4.5	8.9	110	8.7	6.58

TABLE XII (Continued)

Gold Run Pond

DATE	Depth (m)	T (C)	Sp.C.	D.O.	pH
6 December, 4:15 P.M.	0	8.0	110	10.8	6.74
	0.5	8.0	110	10.8	6.74
	1.0	8.0	110	10.8	6.72
	1.5	7.9	110	10.8	6.72
	2.0	7.9	110	10.7	6.71
	2.5	7.6	110	10.6	6.73
	3.0	7.6	110	10.5	6.73
	3.5	7.5	110	10.8	6.71
	4.0	7.5	110	10.5	6.70
	4.5	7.5	110	10.8	6.70
	5.0	7.5	110	10.4	6.70
18 January, 10:00 A.M.	0	6.0	64	12.2	pH malfunction
	0.5	6.0	64	11.8	
	1.0	6.0	64	12.0	
	1.5	5.8	63	11.6	
	2.0	5.5	67	10.6	
	2.5	5.4	70	10.6	
	3.0	5.6	82	8.8	
	3.5	5.7	89	8.4	
	4.0	5.7	90	8.4	
	4.5	5.5	91	8.4	
	5.0	5.5	92	8.4	
22 February, 3:30 P.M.	0	6.1	65	11.2	6.08
	0.5	6.1	64	11.2	6.02
	1.0	5.8	65	11.2	6.22
	1.5	5.8	65	11.2	6.24
	2.0	6.0	64	11.2	5.98
	2.5	5.8	63	11.6	5.95
	3.0	5.3	65	11.6	6.00
	3.5	5.2	71	10.6	6.02
	4.0	5.1	88	8.6	5.88
	4.5	5.0	125	7.8	5.90
	5.0	5.0	125	7.0	6.03
27 March, 8:30 A.M.	0	6.0	46	13.7	pH malfunction
	0.5	6.0	46	13.2	
	1.0	6.0	46	13.2	
	1.5	6.0	46	13.0	
	2.0	6.0	47	13.0	
	2.5	6.0	48	12.8	
	3.0	5.3	57	12.4	
	3.5	5.0	58	12.0	
	4.0	5.0	60	11.8	
	4.5	5.0	60	11.6	
	5.0	5.0	54	11.6	

TABLE XII (Continued)

Gold Run Pond

DATE	Depth (m)	T (C)	Sp.C.	D.O.	pH
26 April, 7:00 A.M.	0	8.1	100	10.4	pH malfunct
	0.5	8.2	100	10.4	
	1.0	8.2	100	10.4	
	1.5	8.2	100	10.4	
	2.0	8.2	100	10.4	
	2.5	8.1	110	10.2	
	3.0	8.0	120	10.2	
	3.5	7.4	120	10.2	
	4.0	7.0	120	10.2	
	4.5	7.0	135	10.2	

TABLE XIII

Field Data

Lake van Norden

DATE	Depth (m)	T(C)	Sp.C.	D.O.	pH
8 August, 2:00 P.M.	0	21.3	23.2	8.4	7.40
	0.5	21.3	23.2	8.4	7.34
	1.0	21.2	23.2	8.3	7.30
	1.5	21.2	23.2	8.2	7.26
	2.0	21.2	23.2	8.4	7.16
	2.5	21.2	23.2	8.2	7.08
	3.0	21.0	23.1	8.2	7.03
	3.5	21.0	23.1	8.2	6.96
	4.0	20.8	23.1	8.6	7.03
19 August, 11:30 A.M.	0	18.4	26	8.4	7.92
	0.5	18.4	25	8.6	7.84
	1.0	18.3	25	8.3	7.84
	1.5	18.3	25	8.3	7.81
	2.0	18.2	25	8.3	7.75
	2.5	18.2	25	8.3	7.75
	3.0	18.2	25	8.6	7.67
9 September, 12:45 P.M.	0	19.0	38	9.0	7.95
	0.5	19.0	38	8.6	7.84
	1.0	18.8	38	7.9	7.67
	1.5	18.7	38	7.5	7.64
	2.0	19.0	38	7.6	7.70
24 September, 10:00 A.M.	0	17.0	39		8.27
	0.5	16.5	38		8.12
	1.0	16.3	38		8.03
	1.5	16.1	38		7.74
	2.0	16.0	38		7.68
	2.5	16.0	38		7.60
7 October, 10:00 A.M.	0	10.8	35		7.90
(Phil Moeller)	0.5	10.5	24		7.75
	1.0	10.6	34		7.74
	1.5	10.6	34		7.73
	2.0	10.7	34		7.66
	2.5	10.5	34		7.68
23 October, 11:45 A.M.	0	7.8	34	12.2	7.86
	0.5	7.8	34	11.8	7.82
	1.0	7.8	34	11.8	7.81
	1.5	7.8	34	11.5	7.78
	2.0	7.8	34	11.8	7.76
	2.5	7.8	34	11.2	7.67

TABLE XIII (Continued)

Lake Van Norden

DATE	Depth (m)	T(C)	Sp.C.	D.O.	pH
6 November, 10:00 A.M.	0	2.5	62	11.4	7.80
	0.5	2.5	62	11.7	7.86
	1.0	2.4	61	12.0	7.86
	1.5	2.4	61	11.9	7.87
	2.0	2.2	61	12.2	7.91
	2.5	2.3	62	12.4	7.88
25 November, 3:05 P.M.	0	1⁰	18	12.2	6.92
	Not safe for sampling -- sides not iced.				
6 December, 1:30 P.M.	0	4.0	28	14.2	7.30
	0.5	4.0	28	14.2	7.22
	1.0	4.0	28	14.3	7.26
	1.5	4.0	28	14.4	7.19
	2.0	4.0	31	12.8	7.04
18 January, 1975	Lake has been drained.				
22 February, 1975	" " " "				
April, 1975	" " " "				
May, 1975	" " " "				

TABLE XIVII

Field Data

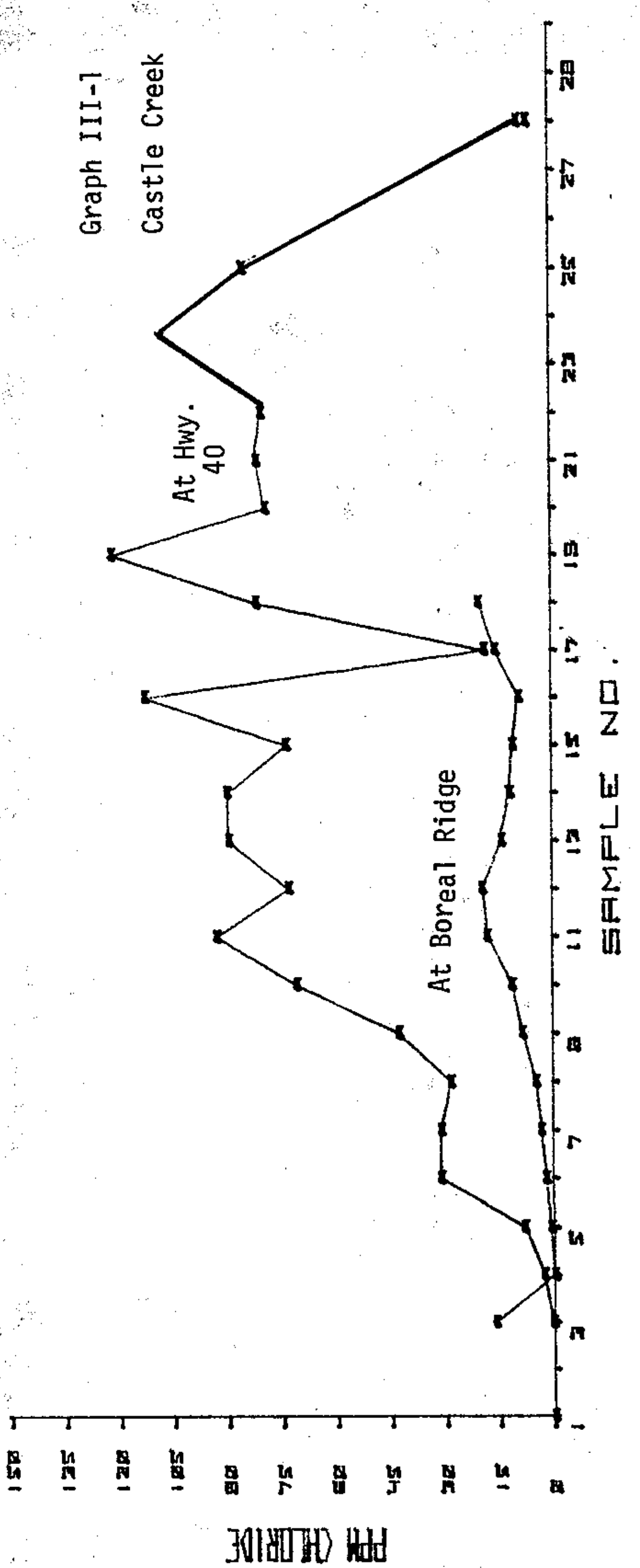
Control Lake

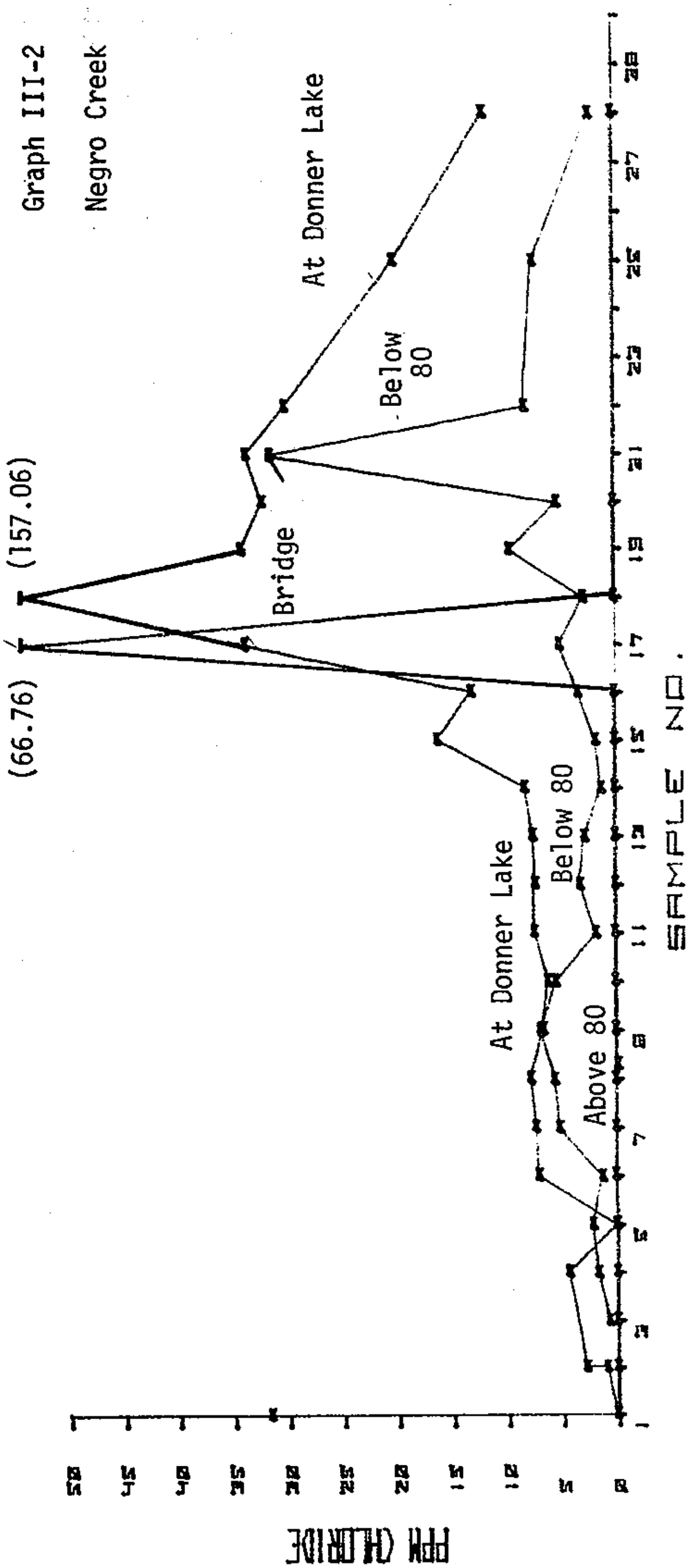
DATE	Depth(m)	T(C)	Sp.C.	D.O.	pH
6 November, 11:30 A.M.	0	5.0	34	11.4	7.92
	0.5	5.0	34	11.4	7.86
	1.0	5.0	34	11.4	7.83
	1.5	5.0	34	11.6	7.84
	2.0	5.0	34	11.5	7.80
	2.5	4.0	34	11.6	7.75
	3.0	4.0	34	11.6	7.71

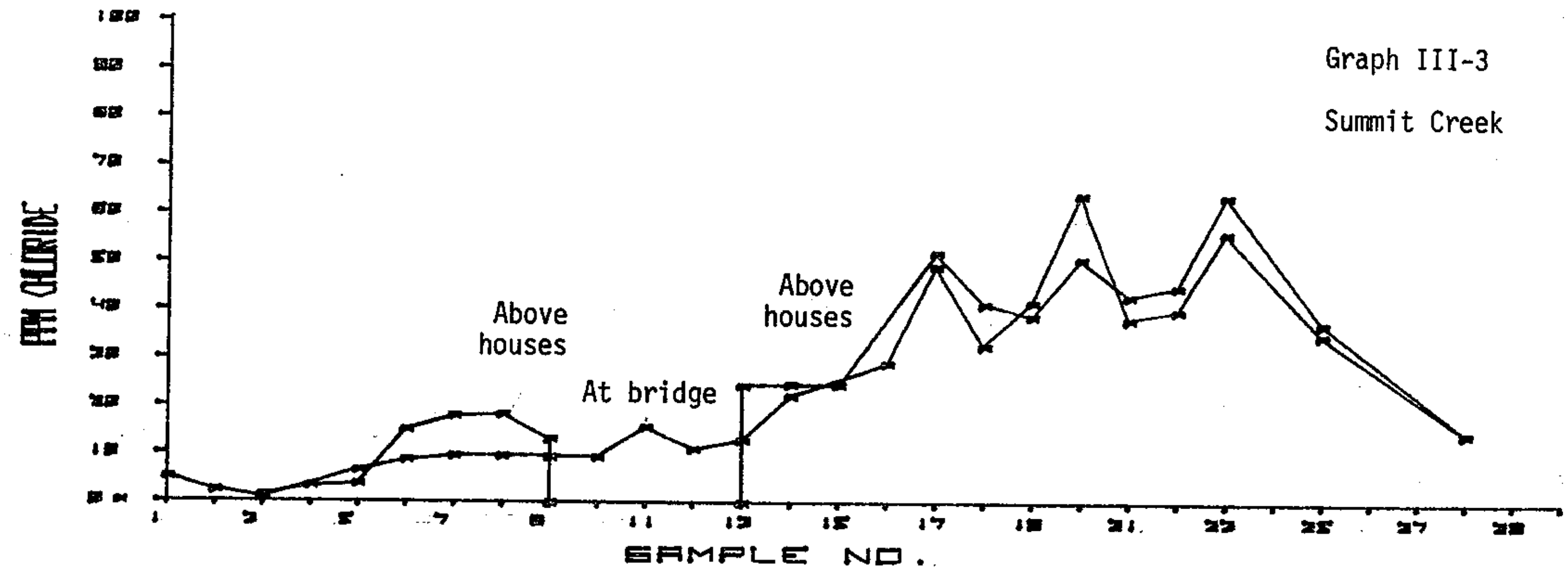
TABLE XV

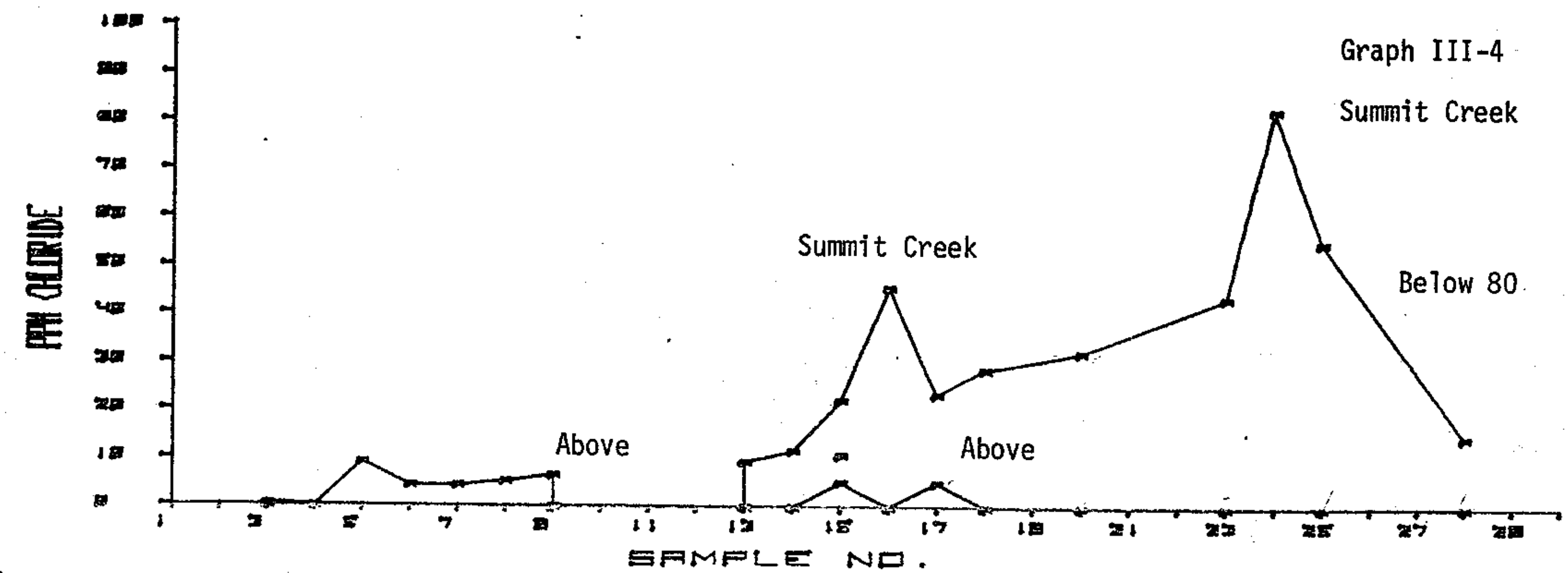
Key to Sample Numbers

Sample Number	Date Taken
1	12 V 74
2	29 V 74
3	12 VI 74
4	25 VI 74
5	16 VII 74
6	29 VII 74
7	8-9 VIII 74
8	19 VIII 74
9	10 IX 74
10	24 IX 74
11	7 X 74
12	23 X 74
13	6 XI 74
14	25-26 XI 74
15	5-6 XII 74
16	17-18 XII 74
17	18-19 I 75
18	30 I 75
19	8-9 II 75
20	22-23 II 75
21	7-8 III 75
22	27-28 III 75
23	12-13 IV 75
24	23 IV 75
25	26 IV 75
26	28 IV 75
27	30 IV 75
28	10 V 75
29	
30	


Graph III-1
Castle Creek
At Hwy. 40
At Boreal Ridge
SAMPLE NO.
PPM CHLORIDE

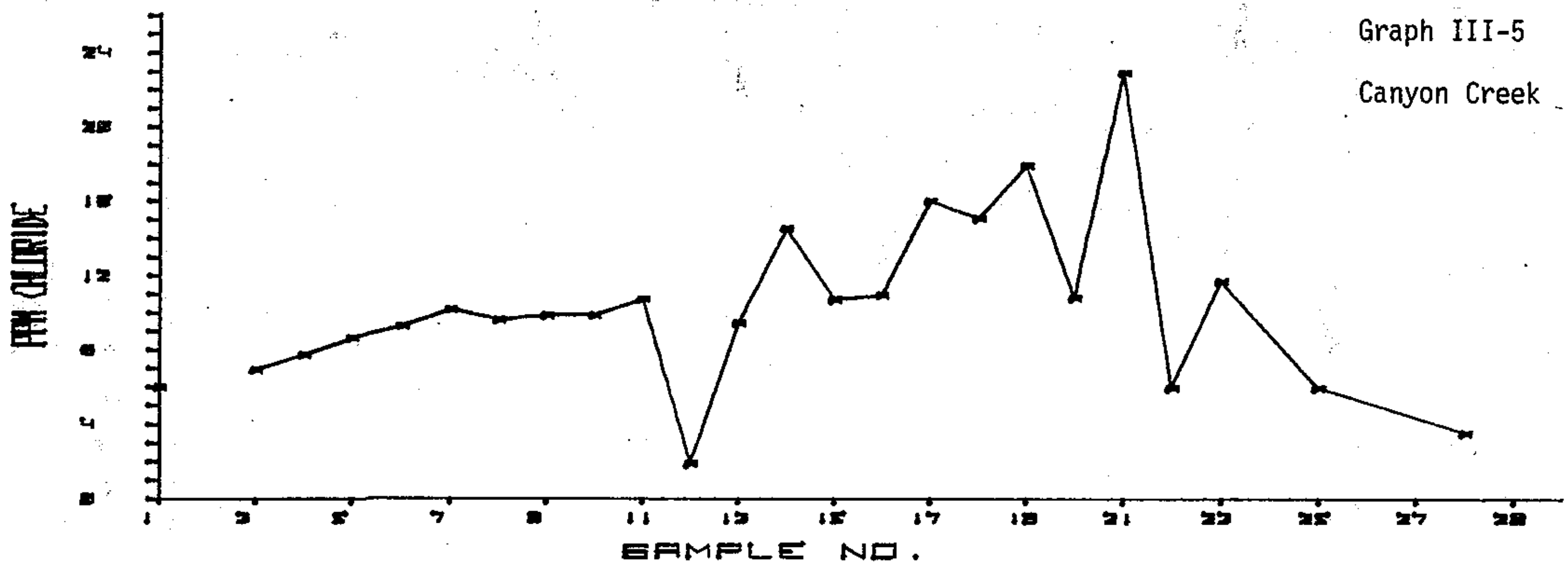

Graph III-2
Negro Creek
At Donner Lake
Below 80
Bridge
(157.06)
(66.76)
At Donner Lake
Below 80
Above 80
SAMPLE NO.
PPM CHLORIDE


Graph III-3
Summit Creek
PPM CHLORIDE
Above houses
At bridge
Above houses
SAMPLE NO.


Graph III-4
Summit Creek
PPM CHLORIDE
Summit Creek
Below 80
Above
Above
SAMPLE NO.

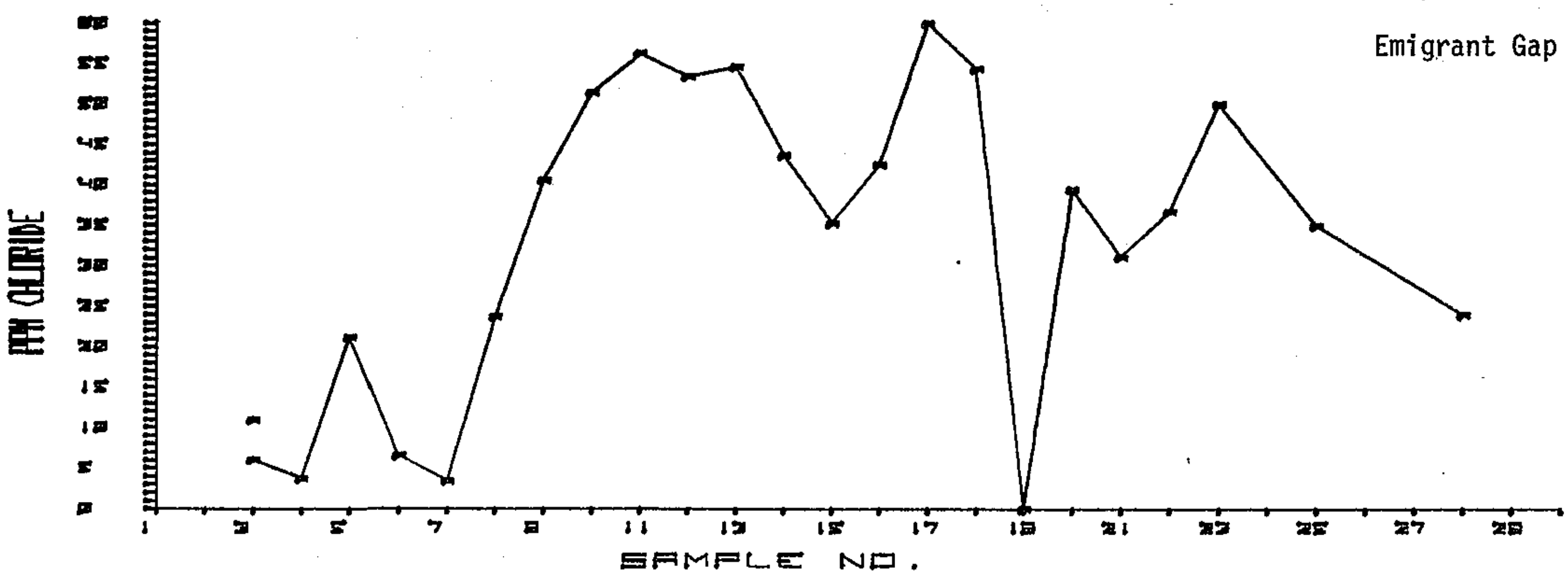
Graph III-5

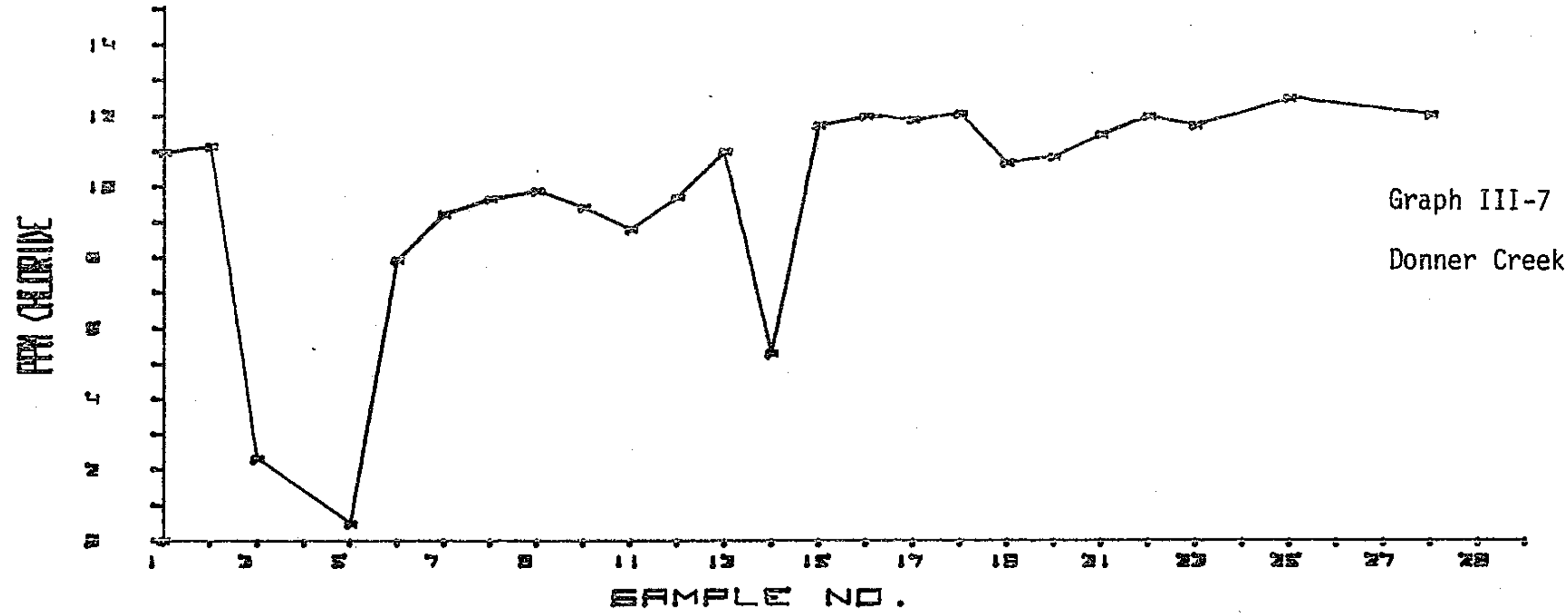
Canyon Creek

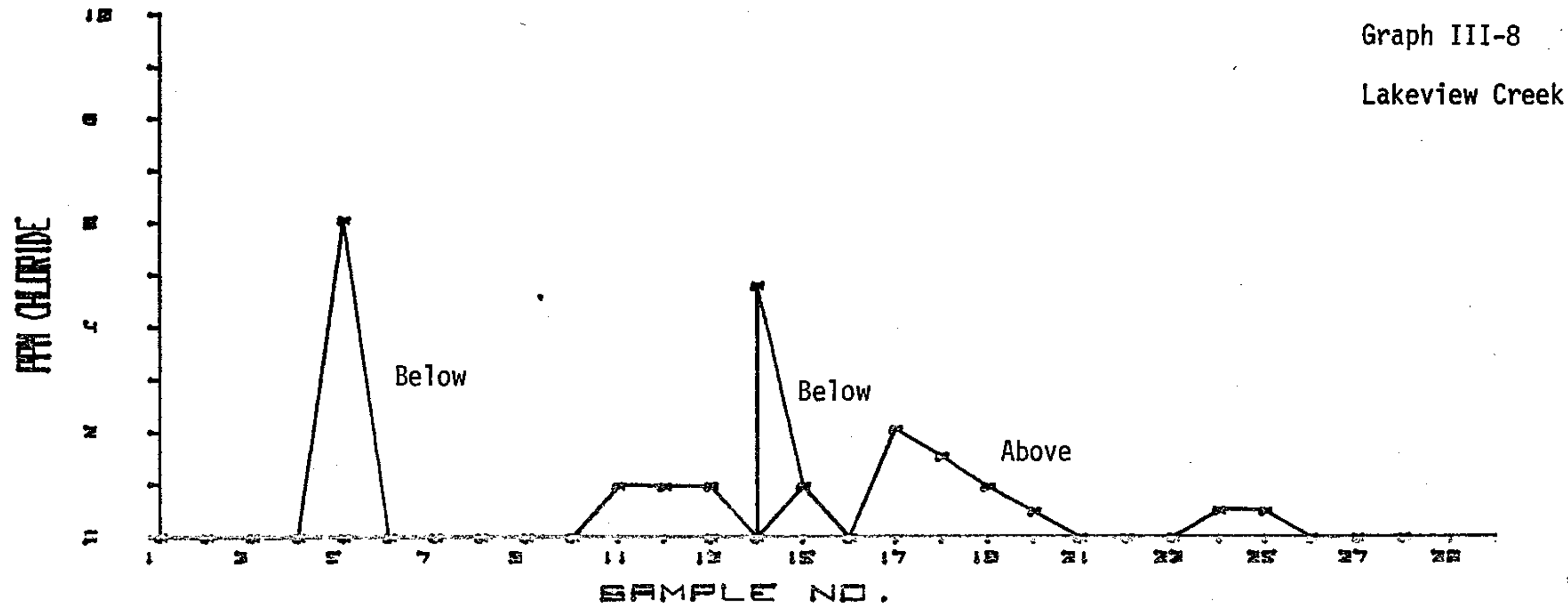


Graph III-6

Emigrant Gap Creek

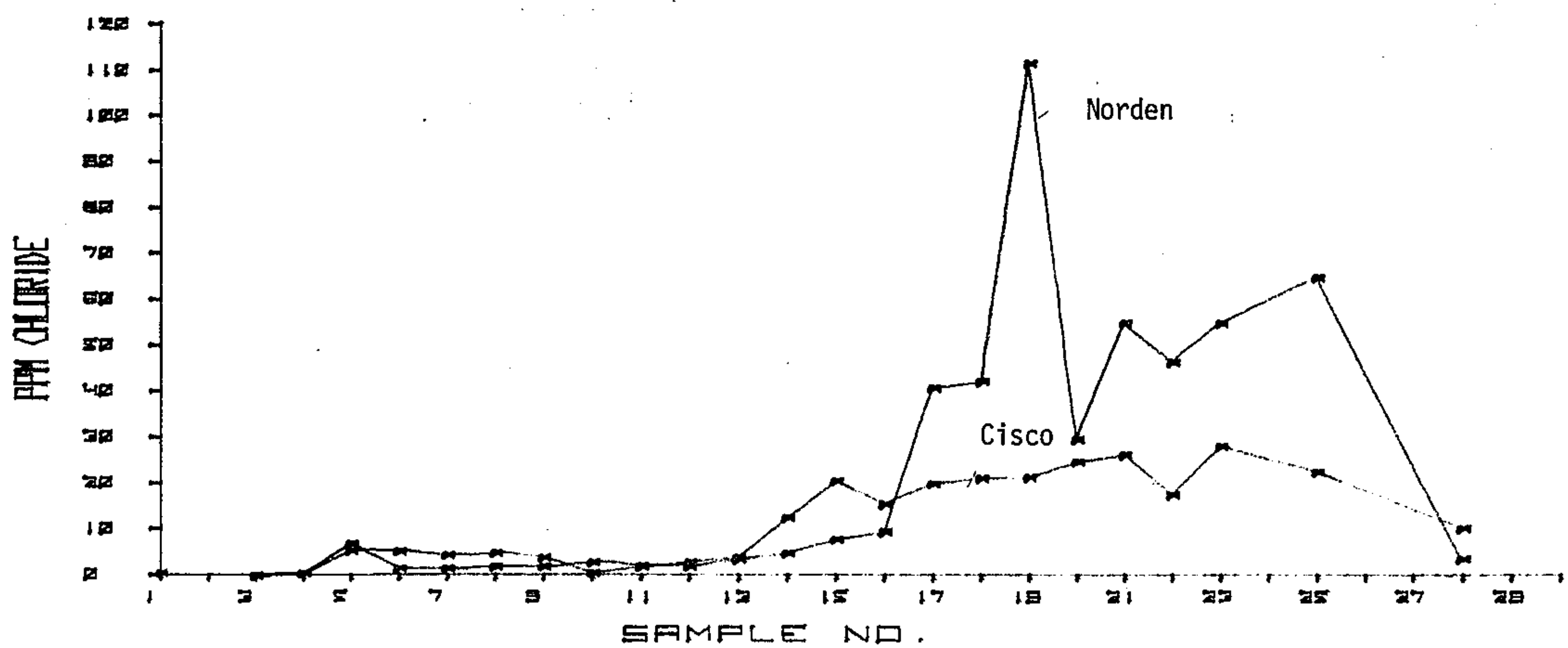



Graph III-7
Donner Creek
PPM CHLORIDE
SAMPLE NO.


Graph III-8
Lakeview Creek
PPM CHLORIDE
Below
Below
Above
SAMPLE NO.

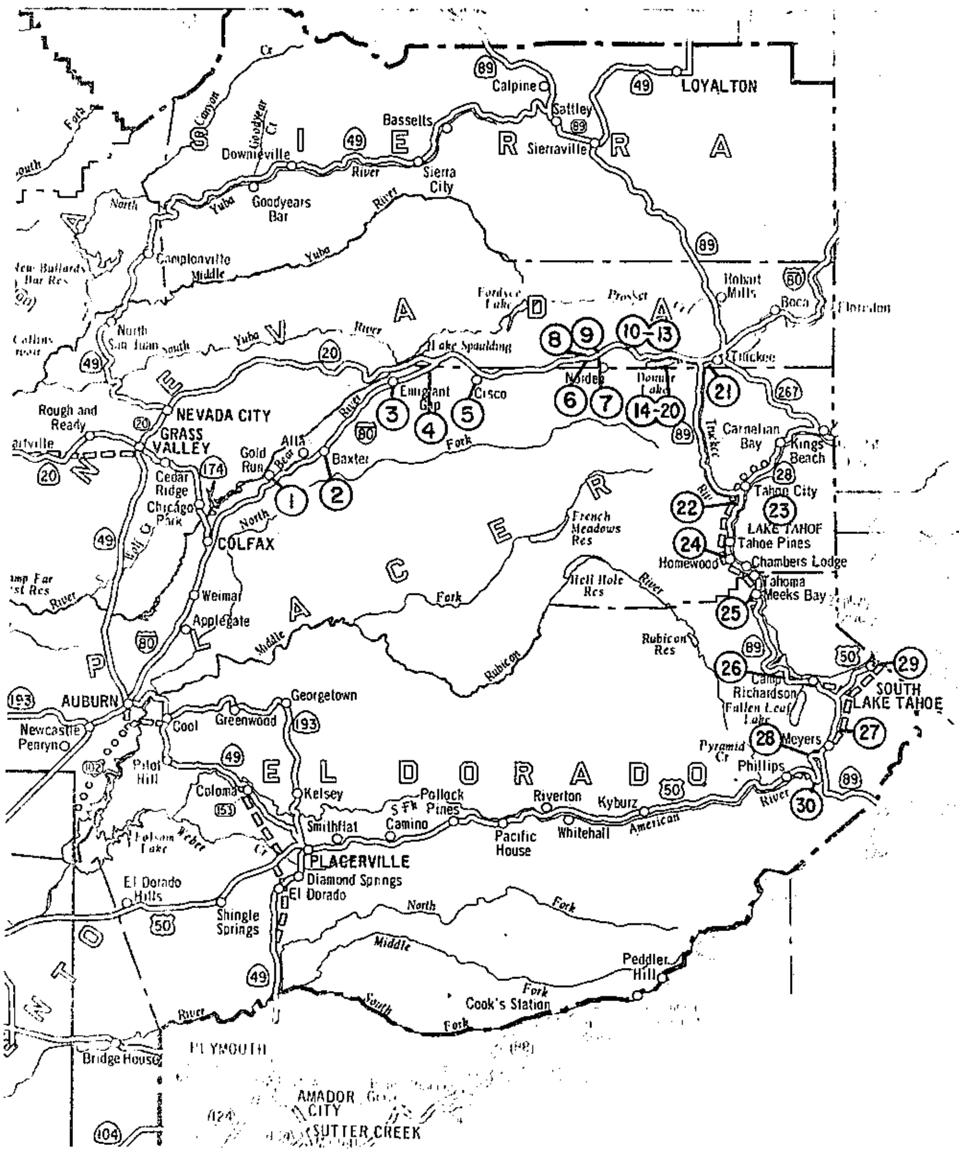
Graph III-9

South Fork of the Yuba River



APPENDICES

PROJECT 657153 SAMPLE SITES



SITE	LOCATION	SITE	LOCATION
1	03 Pla 80 P.M. 42$\underline{66}$	16 & 17	Summit Creek
2	03 Pla 80 P.M. 46$\underline{00}$	18	Lake View Creek
3	03 Pla 80 P.M. 54$\underline{81}$	19	Donner Lake
4	03 Pla 80 P.M. 56$\underline{06}$	20	Donner Creek
5.	03 Pla 80 P.M. 63$\underline{43}$	21	03 Pla 89 P.M. 21$\underline{51}$
6	Lake Van Norden Outlet	22	03 Pla 89 P.M. 8$\underline{46}$
7	Lake Van Norden	23	Lake Tahoe
8	03 Nev 80 P.M. 4$\underline{00}$	24	03 Pla 89 P.M. 5$\underline{84}$
9	03 Nev 80 P.M. 4$\underline{11}$	25	Meeks Creek
10	03 Nev 80 P.M. B 5$\underline{70}$	26	03 ED 89 P.M. 14$\underline{83}$
11	03 Nev 80 P.M. B 5$\underline{47}$	27	03 ED 50 P.M. 72$\underline{69}$
12	03 Nev 80 P.M. 6$\underline{00}$	28	03 ED 50 P.M. 70$\underline{23}$
13	03 Nev 80 P.M. 6$\underline{00}$	29	03 ED 50 P.M. 76$\underline{41}$
14&15	Negro Creek	30	03 ED 50 P.M. 68$\underline{50}$

APPENDIX II

Project Sampling Site Locations and Names

Site	Location	Name
1	03 Pla 80 P.M. $42^{\underline{66}}$	Gold Run Pond (depth)
2	03 Pla 80 P.M. $46^{\underline{00}}$	Canyon Creek
3	03 Pla 80 P.M. $54^{\underline{81}}$	Putt's Lake (depth)
4	03 Pla 80 P.M. $56^{\underline{06}}$	Emigrant Gap Creek
5	03 Pla 80 P.M. $63^{\underline{43}}$	So. Fork, Yuba River at Cisco Grove
6	Lake van Norden Outlet	So. Fork, Yuba River at Norden
7	Lake van Norden	Lake van Norden (depth)
8	03 Nev 80 P.M. $4^{\underline{00}}$	Upper Castle Creek at Old US 80
9	03 Nev 80 P.M. $4^{\underline{11}}$	Upper Castle Creek at Boreal Ridge
10	03 Nev 80 P.M. $5^{\underline{70}}$	Ephemeral Pond - Summit (East)
11	03 Nev 80 P.M. B $5^{\underline{47}}$	Summit Roadside Rest - West
12	03 Nev 80 P.M. $6^{\underline{00}}$	Summit Creek, above Highway 80
13	03 Nev 80 P.M. $6^{\underline{00}}$	Summit Creek below Highway 80
14	Negro Creek	Negro Creek above Highway 80
15	Negro Creek	Negro Creek below Highway 80
		Negro Creek at confluence to Donner Lake
16	Summit Creek	Summit Creek above houses
17	Summit Creek	Summit Creek at bridge
18	Lakeview Creek	Lakeview Creek (above and below road)
19	Donner Lake	Donner Lake (depth)
20	Donner Creek	Donner Creek
21	03 Pla 89 P.M. $21^{\underline{51}}$	Truckee River near Donner Creek
22	03 Pla 89 P.M. $8^{\underline{46}}$	Truckee River outflow
23	Lake Tahoe	Lake Tahoe (depth)
24	03 Pla 89 P.M. $5^{\underline{34}}$	Ward Creek (above Hwy 89)
		Ward Creek (below Hwy 89)
25	Meeks Creek	Meeks Creek (above Hwy 89)
		Meeks Creek (below Hwy 89)
26	03 ED 89 P.M. $14^{\underline{33}}$	Cascade Creek

27	03 ED 50 P.M. 72$\underline{69}$	Upper Truckee River - #1
28	03 ED 50 P.M. 70$\underline{23}$	Upper Truckee River - #2
29	03 ED 50 P.M. 76$\underline{41}$	Upper Truckee River - #3 (above Hwy 50)
		Upper Truckee River - #4 (below Hwy 50)
30	03 ED 50 P.M. 68$\underline{50}$	Frog Pond (pond and outflow)