RIVER BASIN WATER QUALITY

STATUS REPORT

Spokane River Basin

ENVIRONMENTAL PROTECTION AGENCY

SURVEILLANCE AND ANALYSIS DIVISION REGION X SEATTLE WASHINGTON

1975

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PROFILE SUMMARY

INTRODUCTION TO REPORT

Describing the water quality of the Spokane River Basin is a somewhat unique task in that it actually involves three water system or sub-basins, as shown in Figure 0-1. The upper sub-basin includes the Coeur d'Alene River and the St. Joe River. The middle sub-basin encompasses Coeur d'Alene Lake and the lower covers the mainstem o the Spokane River, including the Little Spokane River and Hangman C Accordingly, this report is organized by sub-basin and the individu sections provide an in-depth analysis and summary of their respecti water qualities.

The objective of this part of the profile is to introduce the report and the entire basin in the most concise and summarized forma possible. Included in it are a short discussion of the most importa water quality problems accompanied by three illustrating figures and listing of findings and conclusions.

ABSTRACT

OVERVIEW OF THE BASIN

Initial inspection of the data presented in this profile indicates that hiohly variable flow conditions occur in the basin and have a major influence upon the water quality in the Spokane River Basin. Figure 0-2 illustrates high and low flow conditions and visually provides a scale for comparison, indicating a 10 to 1 proportionate relationship. In addition, each flow must be plotted on a log scale due to the tremendous range each involves. These factors have a direct impact on the other prominent water quality parameters.

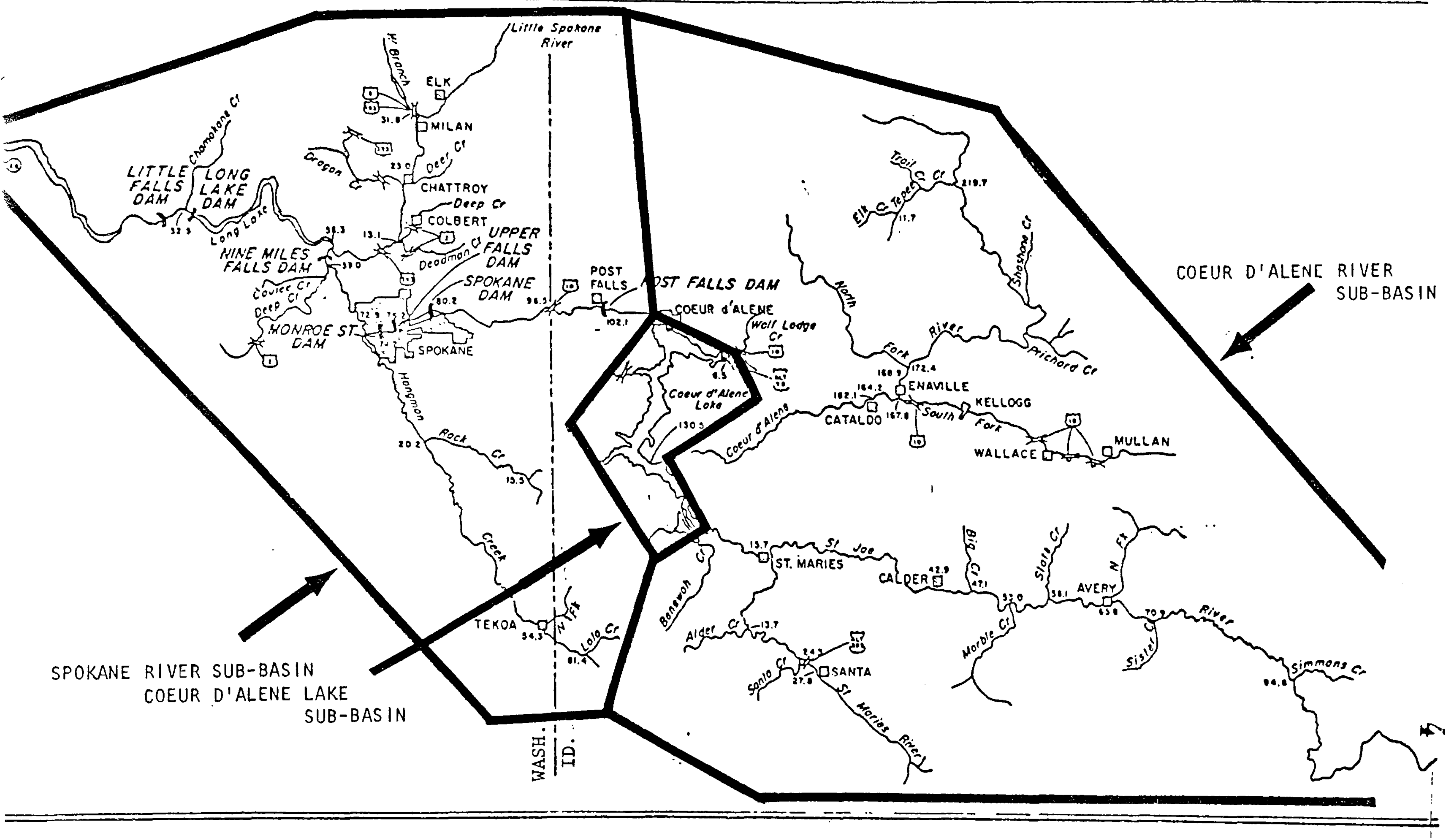
Heavy metals loadings are a definite, definable problem in the basin, especially in the Coeur d'Alene sub-basin. Zinc can be used to illustrate the role heavy metals play and Figure 0-3 has been included for this purpose. The heavy metals originate on the Southfork of the Coeur d'Alene River where numerous mining operations are active, the largest of which is the Bunker Hill Company. Treated and untreated mine wastes, non-point source tailing pond leakages, and groundwater inflows with high metals concentrations are the primary source that must be considered in the resolution of this problem.

The net effect of these various sources is significant in quality as well as quantity. The Coeur d'Alene River below the mining district is generally toxic to salmonoid fishery during both low and high flow periods. Coeur d'Alene Lake acts as a settling basin and removes a portion of the loadings, as the zinc graph, Figure 0-3, indicates. The waters of the St. Joe River in addition help dilute the metals' concentrations as they travel through the lake. As a result of these two factors, the waters leaving the lake and forming the Spokane

River are not especially toxic to a salmonoid fishery, but may be hig enough to affect other aquatic biota.

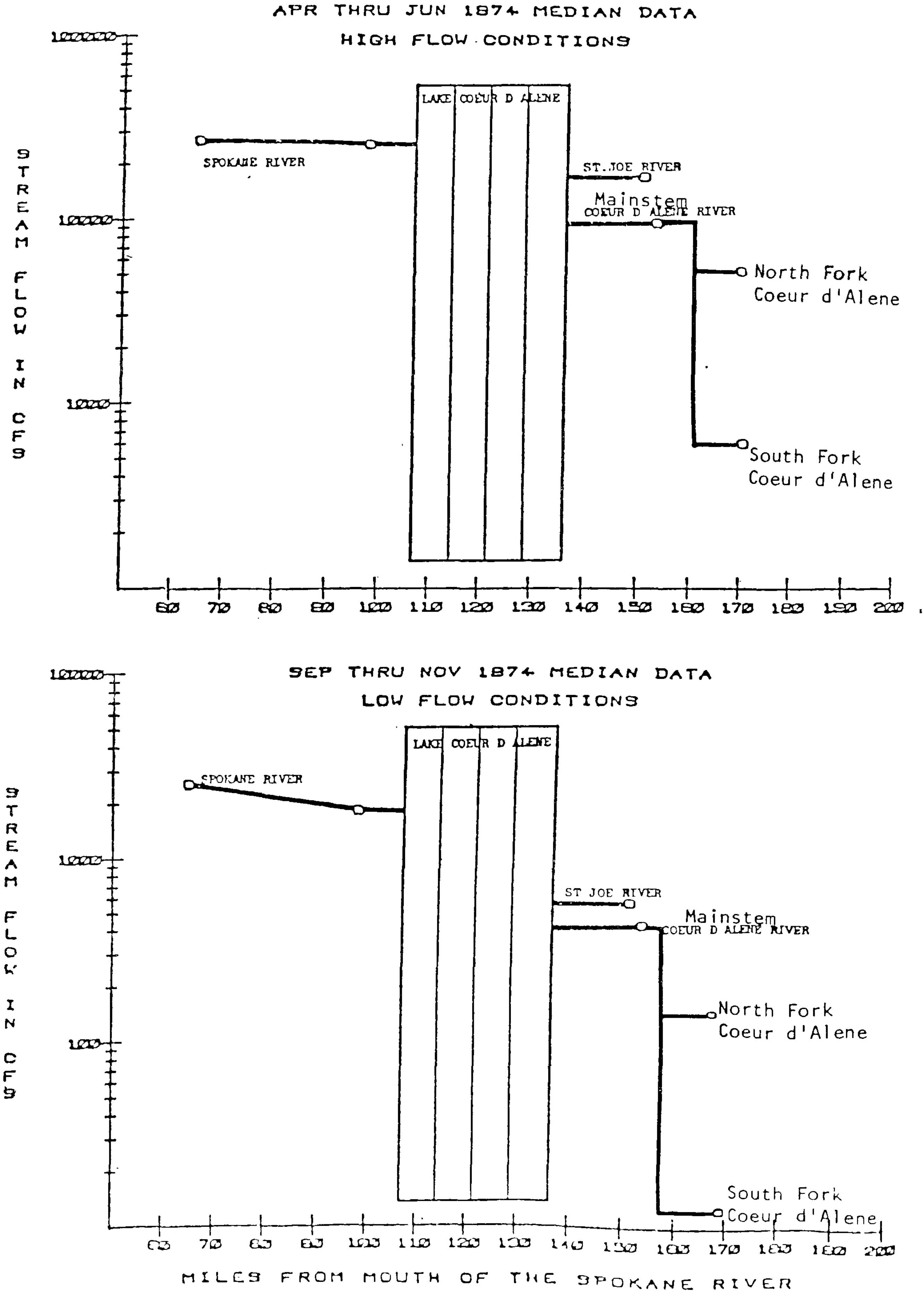
Nutrient loadings originating from both municipal and industrial point sources on the mainstem of the Spokane River as well as ground-water inflow loadings have a significant on the river. The phosphoru graph, Figur O-4, has been included to illustrate nutrient characteri During high flow conditions, natural processes raise the 3 month medi phosphorus concentrations in the Coeur d'Alene River above the potent algal bloom level while the Spokane STP's effluent, by far the large phosphorus point source in the basin, is diluted to a level below al bloom potential. The lake acts as a sink for phosphorus during high due to the close relationship phosphorus has with the suspended soli traveling downstream which settle out upon reaching the lake. The phosphorus graph during the 3 month low flow period clearly indicate the Spokane STP to be the primary source of phosphorus in the basin. Concentrations abruptly exceed the potential algal bloom level by a substantial margin below the STP outfall. Algal blooms downstream of Spokane in Long Lake are present although the heavy metal concen-trations act somewhat as a deterant to their potential level of grow Nightly algal respiration depresses Dissolved Oxygen concentrations in Long Lake[1]; thereby, significantly reducing the quality of the Sp River.

1 R.A.Soltero, <u>An Investigation of the Cause and Effect of Eutrophi in Long Lake, Washington</u>, Eastern Wash. State College, Dept. of B Cheney, Wash. 99004 7/1/73 p. 76-77.


Little Spokane River
W. Branch
ELK
MILAN
31.8
Chamokane Cr
Dragoon Cr
Deer Cr
23.0
CHATTROY
Deep Cr
COLBERT
13.1
LITTLE FALLS DAM
LONG LAKE DAM
Long Lake
32.3
38.3
NINE MILES FALLS DAM
39.0
UPPER FALLS DAM
Deadman Cr
SPOKANE DAM
80.2
Coulee Cr
Deep Cr
MONROE ST. DAM
SPOKANE
96.5
POST FALLS
POST FALLS DAM
102.1
COEUR d'ALENE
Wolf Lodge Cr
Coeur d'Alene Lake
130.5
Hangman Creek
Rock Cr
20.2
15.5
TEKOA
N Fk
54.3
Lolo Cr
61.4
WASH.
ID.
Trail Cr
Elk Cr
Tepee Cr
219.7
11.7
Shoshone Cr
North Fork River
Prichard Cr
168.9
172.4
ENAVILLE
164.2
162.1
CATALDO
167.8
South Fork
KELLOGG
Coeur d'Alene
WALLACE
MULLAN
COEUR D'ALENE RIVER SUB-BASIN
15.7
St Joe
ST. MARIES
Benewah Cr
Alder Cr
13.7
24.3
SANTA
Santa Cr
27.8
St Maries River
CALDER
42.9
Big Cr
47.1
53.0
Marble Cr
Slate Cr
58.1
AVERY
63.8
N Fk
70.9
Sister Cr
River
Simmons Cr
94.8
SPOKANE RIVER SUB-BASIN
COEUR D'ALENE LAKE SUB-BASIN

SPOKANE RIVER BASIN

FIGURE 0-2



SPOKANE RIVER BASIN

FIGURE 0-3

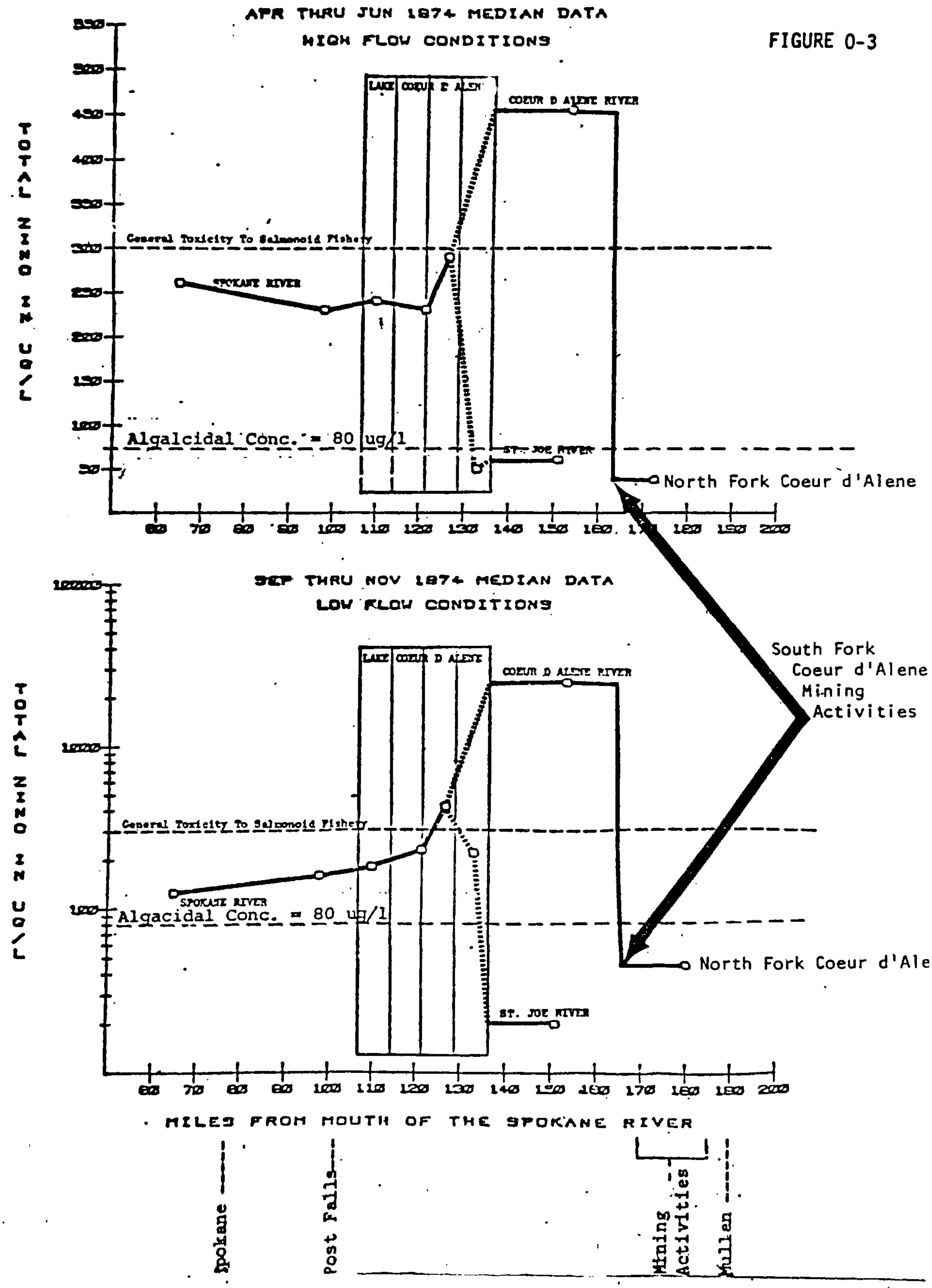
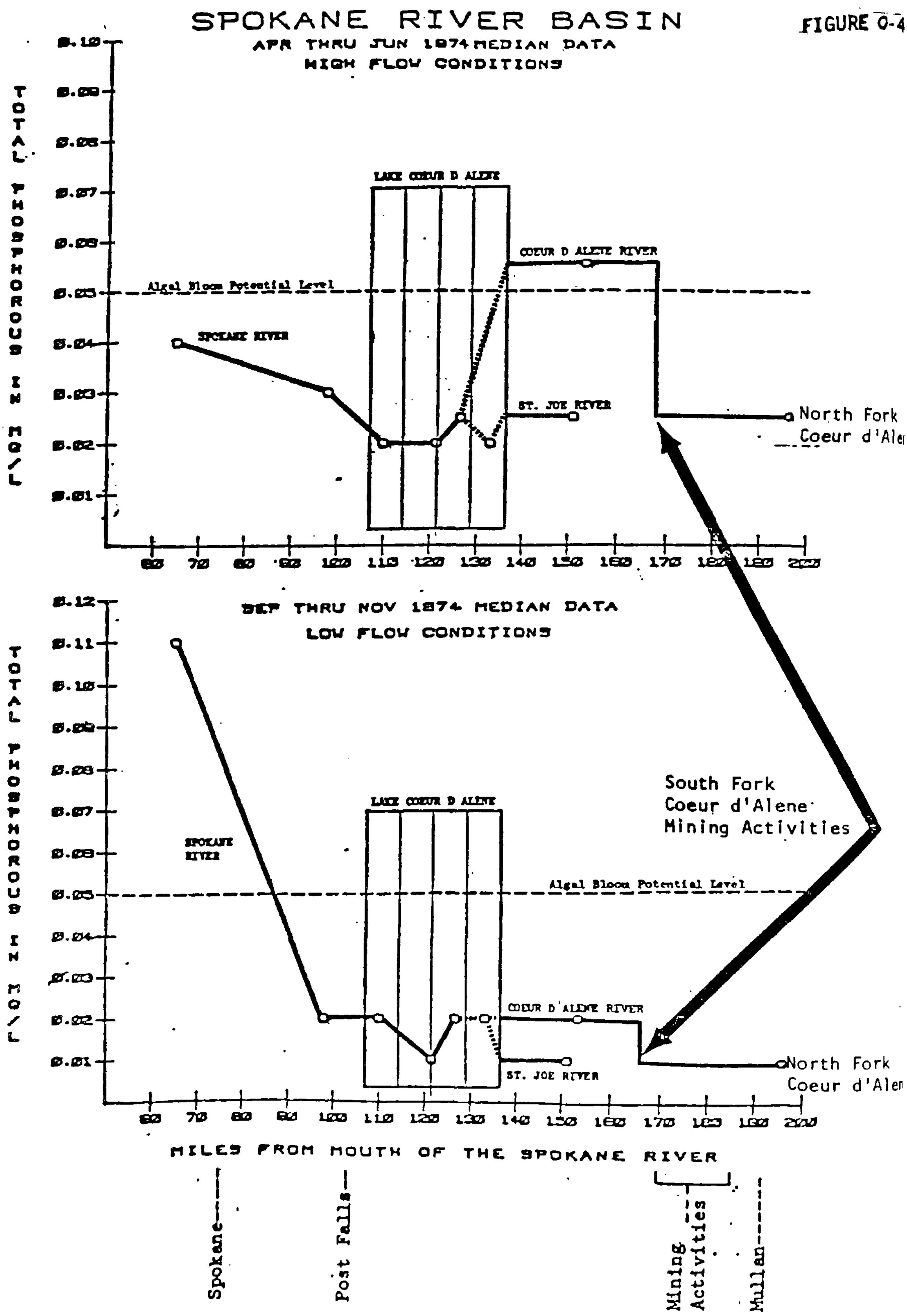


FIGURE 0-4


SPOKANE RIVER BASIN
APR THRU JUN 1974 MEDIAN DATA
HIGH FLOW CONDITIONS
TOTAL PHOSPHOROUS IN MG/L
LAKE COEUR D ALENE
COEUR D ALENE RIVER
Algal Bloom Potential Level
SPOKANE RIVER
ST. JOE RIVER
North Fork
Coeur d'Ale
SEP THRU NOV 1974 MEDIAN DATA
LOW FLOW CONDITIONS
South Fork
Coeur d'Alene
Mining Activities
SPOKANE RIVER
COEUR D'ALENE RIVER
ST. JOE RIVER
North Fork
Coeur d'Ale
MILES FROM MOUTH OF THE SPOKANE RIVER
Spokane
Post Falls
Mining Activities
Mullan

SUMMARY OF

FINDINGS AND CONCLUSIONS

The findings and conclusions in this profile are presented in two different formats; a) they are listed in summarized form according to their respective sections in this Overview Section, and, b) they are explained in more specifics immediately prior to their respective sections in the main body of the report. In both formats the findings and conclusions are divided according to sub-basins.

AMBIENT PROFILE SECTION

Coeur d'Alene Sub-Basin

1. Total Phosphorus concentrations at Rose Lake on the mainstem Coeur d'Alene River have been reduced since 1968 due to the installation of municipal and industrial treatment facilities on the South Fork Coeur d'Alene River.

2. Diminishing Zinc concentrations during low flow periods at Rose Lake on the Mainstem Coeur d'Alene River are indicative of reduced mine discharged pollutants.

Spokane Sub-Basin

1. Ammonia concentrations appear to be increasing at the station below Long Lake.

2. Nitrate (NO2+NO3) concentrations fluctuate throughout the trend period, but consistently exceed the level for potential algal bloom at the station below Long Lake. They fall below that level downstream at the Stateline station.

3. The station monitored below Long Lake indicates phosphorus concentrations continue to increase while both it and the Staeline monitoring station continue to exceed the level for potential algal bloom.

4. Bacteria levels have been increasing significantly throughout the sub-basin; however, we can expect a turnabout due to new treatment facilities' installations upstream. Present levels exceed Washington Water Quality Class A Standards.

5. The latest Long Lake Chlorophyll A data trends indicate that the water quality is worsening, especially during the summer to fall period with highly mesotrophic to eutrophic conditions existing year round.

SUMMARY OF

FINDINGS AND CONCLUSIONS

SOURCE PROFILE SECTION

SPOKANE RIVER BASIN
POINT SOURCE LOADINGS SUMMARY TABLE

% Municipal/Industrial Table

	LB/D	%I	%M
Phosphorus	3400	34	66
Nitrate	6875	16	84
Suspended Solids	29,334	34	66
BOD	28,190	18	82
Combined Heavy Metals	3655	100	0

Sub-Basin Contribution Table

	%Phos	%NO3	%SS	%BOD	%CHM
Coeur d'Alene Sub-Basin	8.2	5.5	9.7	30.8	100
Coeur d'Alene Lake Sub-Basin	1.3	.5	1.2	-	-
Spokane Sub-Basin	90.5	94	89.1	69.2	-

Major Municipal & Industrial Contributors Table

	%Phos	%NO3	%SS	%BOD	%CHM
MUNICIPAL - Spokane STP	48.9	67.2	52.9	61.5	-
INDUSTRIAL - Bunker Hill Co.	-	-	1	-	95.

/- = negligible
/CHM = Combined Heavy Metals - Pb, Cd, Hg, Sb, Zn

SUMMARY OF FINDINGS & CONCLUSIONS

CAUSE AND EFFECT SECTION

Coeur d'Alene River Sub-Basin

1. The problems in this sub-basin occur in the Southfork and Mainstem Coeur d'Alene River. The Northfork Coeur d'Alene River has very good water quality as it flows through the Coeur d'Alene National Forest showing little degradation from man related activities.

2. Heavy metals loadings from mining activities in the Southfork Coeur d'Alene basin are the major cause of water quality problems in the Coeur d'Alene Sub-basin.

   a) The Bunker Hill Company is the major contributor of heavy metals in the basin. They are directly responsible for high levels of zinc, cadmium, lead, and in addition iron, fluoride, and phosphorous.

   b) It is apparent that the majority of zinc and cadmium loadings originate from uncontrolled tailing pond leakage and unpermitted discharges from the Bunker Hill Company.

   c) The highest levels of arsenic and antimony were found downstream of the Sunshine Mining Company operations on Big Creek.

   d) Toxic levels for trout due to high metals concentrations extends from the Southfork Coeur d'Alene River near Wallace downstream through the mainstem and part of Lake Coeur d'Alene.

3. Phosphorous levels in the Southfork Coeur d'Alene River exceed algal bloom potential level below the Bunker Hill Company discharges.

Coeur d'Alene Lake Sub-Basin

*Entering Lake - Coeur d'Alene River

1. Phosphorous concentrations entering Coeur d'Alene Lake (at Rose Lake) appear to be directly proportional to flow, indicating erosion as the major source.

2. Zinc concentrations entering Coeur d'Alene Lake (at Rose Lake) appear to be inversely related to flow, indicating point sources, groundwater, and/or tailing pond leakages as the major source.

SUMMARY OF FINDINGS & CONCLUSIONS

CAUSE AND EFFECT SECTION

Coeur d'Alene Lake Sub-Basin (cont)

*Entering Lake - St. Joe River

3. There were no serious water quality in the St. Joe river at the sampling site tested (near St. Maries). However, there were two discharges downstream of this station in the slack water reach which may contribute some nutrient loadings to the Lake.

*Lake Proper

4. During 1974, Coeur d'Alene Lake functioned as a sink for phosphorous, zinc, lead, and cadmium; and as a source for nitrogen.

5. Detention times for inflowing waters from the Coeur d'Alene River and the St. Joe River have been calculated to be within the range of 40 to 120 days.

*Leaving Lake - Spokane River

6. Total phosphorous concentrations leavinq Coeur d'Alene Lake (at Post Falls) exceeded the 0.05 mg/l concentration considered minimum for algal blooms from February thru April of 1974 (high flow period).

7. Zinc concentrations leaving Coeur d'Alene Lake (at Post Falls) exceeded levels considered toxic for a salmonoid fishery (300 ug/l) for nearly half of 1974. All concentrations exceeded the algacidal level (80 ug/l) throughout 1974.

Spokane River Sub-Basin (Oct. 1972 to Sept. 1973 Data)

Mainstem Spokane River

1. The Spokane STP, Hangman Creek, the Little Spokane River, and groundwater inflows in the Spokane area have significant impact on the water quality of the Spokane River.

2. Turbidity levels increase significantly due to the inflow of Hangman Creek during the high flow period. The turbidity decreased as it settled out in Long Lake.

3. Dissolved Oxygen concentrations violated Washington Water Quality Class A standards below Long Lake during the low flow period due to eutrophic conditions in the Lake and algal activity.

CAUSE AND EFFECT SECTION

4. Total phosphorous and dissolved ortho-phosphorous levels exceeded the potential algal bloom concentration downstream of the Spokane STP during both high and low flow periods. The Spokane STP is the major source of phosphorous in the Spokane River. In addition, Hangman Creek is a significant source of total phosphorous during the high flow runoff.

5. Nitrate concentrations exceed the potential level for algal blooms below Hangman Creek during high flow periods due to non-point source loadings from runoff. During low flow periods, nitrate concentrations exceed the potential level for algal blooms from the area above Spokane downstream through Long Lake due to groundwater inflows in the Spokane area.

6. Ammonia and kjeldahl nitrogen levels significantly increase below the Spokane STP during both the high and low flow periods.

7. High zinc concentrations from the upper reaches of the Spokane River were diluted by groundwater inflows and tributaries to such an extent that by the time they reach Long Lake they were below the general salmonoid fishery toxic level (300 ug/l) during both high and low flow periods and below the algacidal level (80 ug/l) during the low flow period.

8. Total Coliform counts exceeded Washington Class A Water Quality Standards as they entered Washington and continued to exceed standard levels downstream to Long Lake during both high and low flow periods. The waters leaving Long Lake were within standard levels.

Hangman Creek

9. Hangman Creek enters the Spokane River at river mile 74.2 and is predominately influenced by seasonal runoff.

10. Highly variable flow is an important characteristic of the stream as it ranges from 2 to 400 cfs and greatly influences water quality. Turbidity is directly related to flow, ranging from 0 to 1050 JTU. Non-point source runoff from agricultural lands resulted in high concentrations of nitrate, ammonia, phosphorous, and bacteria during high flow.

11. Nitrate concentrations exceeded the potential level for algal blooms the entire year while phosphorous and dissolved ortho-phosphorous concentrations exceeded it during moderate to high flow periods only.

12. pH values exceeded the Washington Class A Standard the period of April through July.

SUMMARY OF FINDINGS & CONCLUSIONS

CAUSE AND EFFECT SECTION

Little Spokane River

13. The Little Spokane River enters the Spokane River at river mile 56.3 and in contrast with Hangman Creek it is predominately influenced by groundwater inflow.

14. Between the mouth of the Little Spokane River and the city of Wandermere, flow measurements indicate that 200 to 250 cfs of groundwater inflow are present.

15. Nitrate concentrations exceeded algal bloom potential level the entire year and the major source appears to be groundwater inflow.

16. Total phosphorous concentrations exceeded algal bloom potential level during the high flow periods (Dec-March). Dissolved ortho-phosphorous levels exceeded it for most of the year. Phosphorous levels are directly related to river flow indicating the contribution to be of non-point source origin.

17. Bacteria levels exceeded the Class A Standard throughout most of the year with the highest levels occuring during the high flow period of December through March.

REFERENCES, CLASSIFICATIONS, AND WATER QUALITY INDICATORS

This section of the profile attempts to explain the various water quality standards, interpretations, and classifications as they appear throughout the data presentation. In June of 1973 the Department of Ecology of the State of Washington released a document that related every natural water system to a set of water quality criteria. These Water Quality Standards and their respective river systems appear on the following page. Following that are a number of additional water quality indicator levels taken from referenced literature.

Class AA Waters

Chehalis River from Rock Creek to headwaters

Coastal waters from Ilwaco to Cape Flattery

Duckabush River and tributaries

Elwha River and tributaries

Grays River from Grays River Falls to headwaters

Hoh River and tributaries from mouth to headwaters

Naselle River from Naselle Falls to headwaters

Queets River from mouth to RM 3.0

Queets River from RM 3.0 to headwaters

Quillayute River

Quinault River from mouth to RM 2.0

Quinault River from RM 2.0 to headwaters

Satsop River, east fork, from mouth to headwaters

Satsop River, middle fork, from mouth to headwaters

Satsop River, west fork, from mouth to headwaters

Soleduck River and tributaries

Wishkah River from west fork of Wishkah River to intersection of the river with south boundary of Sec.33, R.8W., T.21N.

Wishkah River from intersection of the river with south boundary of Sec.33,R.8W., T.21N. to headwaters. Special condition - no waste discharge will be permitted

Class A Waters

Chehalis River from Scammon Creek to Newaukum River. Special Condition - dissolved oxygen shall exceed 5.0 mg/l or 50% saturation whichever is greater, from June 1 to September 15. For the remainder of the year the dissolved oxygen shall meet Class A criteria.

Chehalis River from Newaukum River to Rock Creek

Chehalis River, south fork, from mouth to headwaters.

Grays Harbor west of longitude 123°59' W

Newaukum River from mouth to headwaters

Willapa Bay seaward of a line bearing 70° true through Mailboat Slough Light.

Willapa River upstream of line bearing 70° true through Mailboat Slough Light. Special Condition - total coliform organisms shall not exceed median values of 240 with less than 20% of sample exceeding 1,000 when associated with any fecal source.

Class B Waters

Grays Harbor east of longitude 123°59' W. to longitude 123°45'45" W. (Cosmopolis) Special Condition - dissolved oxygen shall exceed 5.0 mg/l or 60% saturation, whichever is greater.

Hoquiam River from mouth to RM 9.

Wishkah River from mouth to RM 6.

WAC 173-201-030 GENERAL WATER USE AND CRITERIA CLASSES. The following criteria shall be applicable to the various classes of waters in the State of Washington:

CLASS AA (Extraordinary)

(a) General characteristic. Water quality of this class shall markedly and uniformly exceed the requirements for all or substantially all uses.

(b) Characteristic uses. Characteristic uses shall include, but are not limited to the following:

(i) Water supply (domestic, industrial, agricultural).

(ii) Wildlife habitat, stock watering.

(iii) General recreation and aesthetic enjoyment (picnicking, hiking, fishing, swimming, skiing, and boating).

(iv) General marine recreation and navigation.

(v) Fish and shellfish reproduction, rearing, and harvest.

(c) Water quality criteria.

(i) Total coliform organisms shall not exceed median values of 50 (fresh water) or 70 (marine water) with less than 10% of samples exceeding 230 when associated with any fecal source.

(ii) Dissolved oxygen shall exceed 9.5 mg/l (fresh water) or 7.0 mg/l (marine water).

(iii) Total dissolved gas - the concentration of total dissolved gas shall not exceed 110% of saturation at any point of sample collection.

(iv) Temperature - water temperatures shall not exceed 60° F. (fresh water) or 55° F. (marine water) due in part to measurable (0.5° F.) increases resulting from human activities; nor shall such temperature increases, at any time, exceed t = 75/(T-22) (fresh water) or t = 24/(T-39) (marine water); for purposes hereof "t" represents the permissive increase and "T" represents the water temperature due to all causes combined.

(v) pH shall be within the range of 6.5 to 8.5 (fresh water) or 7.0 to 8.5 (marine water) with an induced variation of less than 0.1 units.

(vi) Turbidity shall not exceed 5 JTU over natural conditions.

(vii) Toxic, radioactive, or deleterious material [illegible]

CLASS A (excellant)

(a) General characteristic. Water quality of this class shall meet or exceed the requirements for all or substantially all uses.

(b) Characteristic uses. Characteristic uses shall include, but are not limited to, the following:

(i) Water supply (domestic, industrial, agricultural).

(ii) Wildlife habitat, stock watering.

(iii) General recreation and aesthetic enjoyment (picnicking, hiking, fishing, swimming, skiing and boating).

(iv) Commerce and navigation.

(v) Fish and shellfish reproduction, rearing and harvest.

(c) Water quality criteria.

(i) Total coliform organisms shall not exceed median value of 240 (fresh water) with less than 20% of samples exceeding 1,000 when associated with any fecal sources or 70 (marine water) with less than 10% of samples exceeding 230 when associated with any fecal sources.

(ii) Dissolved oxygen shall exceed 8.0 mg/l (fresh water) or 6.0 mg/l (marine water).

(iii) Total dissolved gas - the concentration of total dissolved gas shall not exceed 110% of saturation at any point of sample collection.

(iv) Temperature - water temperatures shall not exceed 65° F. (fresh water) or 61° F. (marine water) due in part to measurable (0.5° F.) increases resulting from human activities; nor shall such temperature increases, at any time, exceed t = 90/(T-19) (fresh water) or t = 40/(T-35) (marine water); for purposes hereof "t" represents the permissive increase and "T" represents the water temperature due to all causes combined.

(v) pH shall be within the range of 6.5 to 8.5 (fresh water) or 7.0 to 8.5 (marine water) with an induced variation of less than 0.25 units.

(vi) Turbidity shall not exceed 5 JTU over natural conditions.

(vii) Toxic, radioactive, or deleterious material concentrations shall be below those of public health significance [illegible]

Class B (Good)

(a) General characteristic. Water quality of this class shall meet or exceed the requirements for most uses.

(b) Characteristic uses. Characteristic uses shall include, but are not limited to, the following:

(i) Industrial and agricultural water supply.

(ii) Fishery and wildlife habitat.

(iii) General recreation and aesthetic enjoyment (picnicking, hiking, fishing, and boating).

(iv) Stock watering.

(v) Commerce and navigation.

(vi) Shellfish reproduction and rearing, and crustacea (crabs, shrimp, etc.) harvest.

(c) Water quality criteria.

(i) Total coliform organisms shall not exceed median values of 1,000 with less than 20% of samples exceeding 2,400 when associated with any fecal source.

(ii) Dissolved oxygen shall exceed 6.5 mg/l (fresh water) or 5.0 mg/l (marine water), or 70% saturation, whichever is greater.

(iii) Total dissolved gas - the concentration of total dissolved gas shall not exceed 110% of saturation at any point of sample collection.

(iv) Temperature - water temperatures shall not exceed 70° F. (fresh water) or 65° F. (marine water) due in part to measurable (0.5° F.) increases resulting from human activities; nor shall such temperature increases, at any time, exceed t = 110/(T-15) (fresh water) or t = 52/(T-32) (marine water); for purposes hereof "t" represents the permissive increase and "T" represents the water temperature due to all causes combined.

(v) pH shall be within the range of 6.5 to 8.5 (fresh water) or 7.0 to 8.5 (marine water) with an induced variation of less than 0.5 units.

(vi) Turbidity shall not exceed 10 JTU over natural conditions.

(vii) Toxic, radioactive, or deleterious material concentrations shall be below those which adversely affect [illegible]

WATER QUALITY CRITERIA REFERENCE TABLE

PARAMETER	INDICATED MEASUREMENT	ENVIRONMENTAL IMPACT	REFERENCE
Ammonia Nitrogen(NH3-N)	.2 mg/l	Organic Pollution Level	Klein,L. River Pollution 1., Chemical Analysis Academic Press Inc., New York 1959 Sawyer,C.N., Factors Involved in Disposal of Sewage Effluents to Lakes, Sewage and Industrial Wastes, Vol. 26 No. 3 pp.317-325 1954
Cadmium	30 ug/l 3 ug/l	Generally Toxic to Aquatic Life Toxic to Salmonoid Eggs	EPA R3.73.033 Ecological Research Series, Water Quality Criteria 1972, U.S.Government Printing Office, March 1973 p.180
Chlorophyll-A	less than 3 mg/l between 3 and 20 mg/l more than 20 mg/l	Oligtrophic Mesotrphic Eutrophic	Vollenweider, Dr.R.A., Water Management Re-search-Scientific Fundamentals of the Eutro-fication of Lakes and Flowing Waters with Particular Reference to Nitrogen and Phos-phorus as Factors in Eutrophication , DAS/CSI/68.27, Organisation For Economic Cooperation And Development - Directorate For Scientific Affairs, 1968 p.40
Lead	30 ug/l	Generally Toxic to Aquatic Life	EPA R3.73.033 op.cit. p.181
Nitrate-Nitrogen	.3 mg/l	Algal Bloom Potential	Klein op.cit. Sawyer op.cit.
Phosphorus, Dissolved Ortho	.01 mg/l	Algal Bloom Potential	Klein op.cit. Sawyer op.cit.
Phosphorus, Total	.05 mg/l	Algal Bloom Potential	Klein op.cit. Sawyer op.cit.
Zinc, Total	300 ug/l	Approximate Algacidal Concentration for Selenastrum Capriconutum	Green, et.al National Eutrophication Research Program, Report To Region X On The Results Of The Spokane River Algal Assays , Corvallis, Ore 1973.

BASIN DESCRIPTION

BASIN DESCRIPTION-SPOKANE RIVER BASIN

The Spokane River Basin encompasses an area of approximately 6,640 square miles and is located in northern Idaho and northeastern Washington, Figure BD-1. The basin's roughly elliptical shape has its main axis running southeast to northwest.

The basin's main stream, the Spokane River, Figure BD-2, is fed by two major tributaries which discharge into and are buffered by Coeur d'Alene Lake, Figure BD-3. These two streams, the Coeur d'Alene River and the St.Joe River, Figure BD-4, discharge into the southern portion of the lake and have proportionate flows of 1 to 1 to .5 respectively. Any further physical comparison of similar attributes ends here however as their water qualities differ significantly. The Coeur d'Alene River drainage basin consists of two sub-drainages; the South Fork Coeur d'Alene River draining the mining district and the North Fork Coeur d'Alene River traversing the Coeur d'Alene National Forest. The waters of the St.Joe River are free of mine wastes but have been affected to some extent by sewage disposal, logging, and farming activities. The Spokane River is the only surface outlet of Coeur d'Alene Lake.

The stretch of the Spokane River above Spokane, the St.Joe River, andthe North Fork Coeur d'Alene River support excellant sport fisheries and can be classified as having good water quality. In contrast the Mainstem and South Fork Coeur d'Alene River and the Spokane River below Spokane are subject to the serious effects of municipal and industrial pollutants, including a reduced diversity of biota.

As early as 1885 wastes from the Coeur d'Alene mining district have been transported by the waters of the South Fork and Mainstem Coeur d'Alene River into Coeur d'Alene Lake. An extensive survey by Ellis in 1932 showed the Coeur d'Alene River to be devoid of life from the city of Wallace to its mouth and the delta to be deficient in phytoplankton, fish, and bottom organisms.

The effect of increasing population and inadequate municipal sewage treatment facilities can be seen in Coeur d'Alene Lake by the extensive growth of blue-green algae and macrophytes, in shallower portions. The Spokane River below Spokane also suffers from oppresive municipal pollution; most notably from BOD, phosphorus, and suspended solids loadings. In addition, natural groundwater contributes significant nitrate loadings.

Maps of each of the three sub-basins will follow the summary sheets outlining pertinant facts related to that sub-basin.

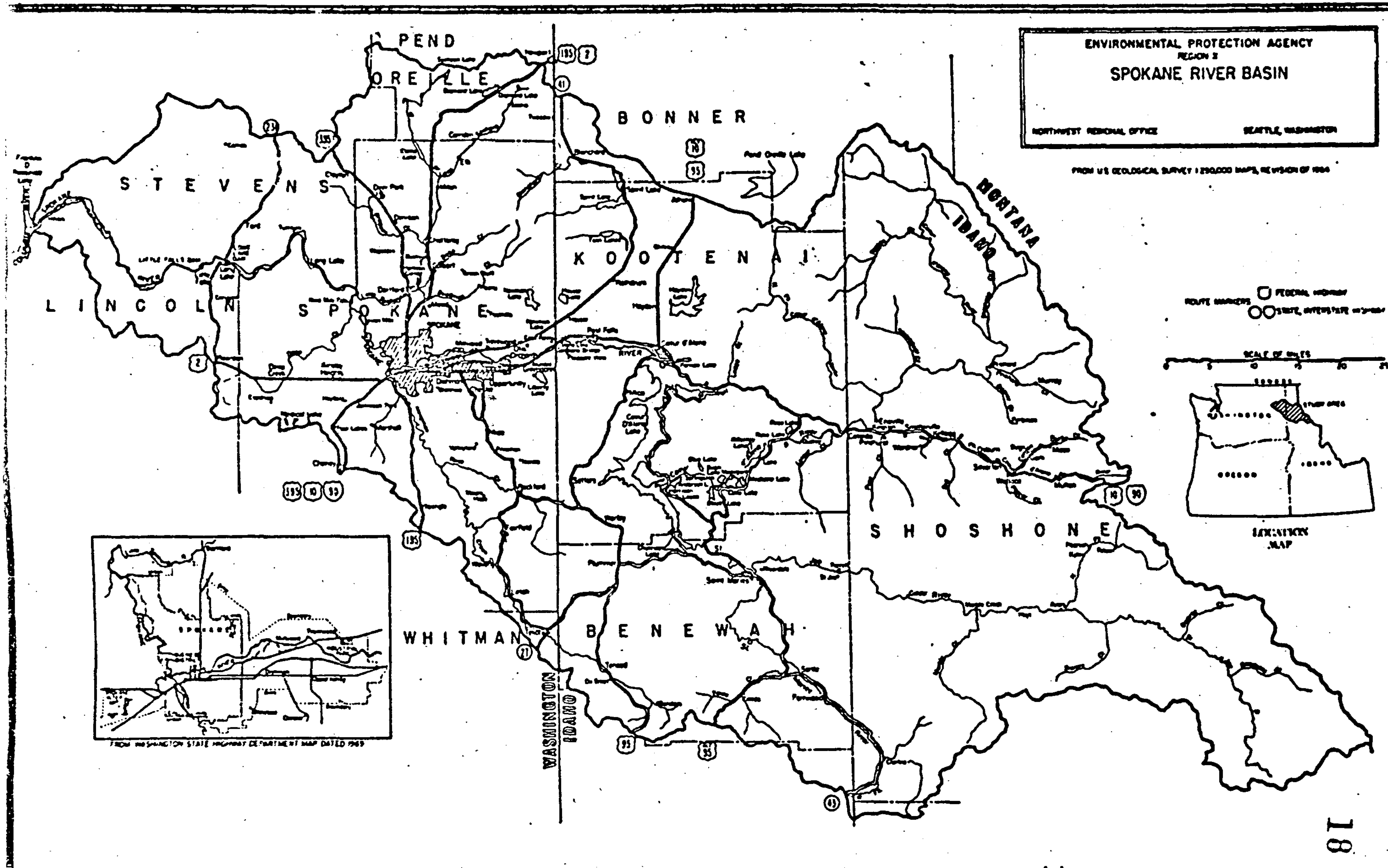


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FIGURE BD-1

COEUR D'ALENE SUB-BASIN

The sub-basin encompasses the South Fork Coeur d'Alene River from the city of Mullan to its mouth and the Mainstem to its confluence with Coeur d'Alene Lake. The major emphasis is on the heavy metal and phosphorus loadings from the Coeur d'Alene mining district as they appear to be the major constituents causing water quality degradation in the sub-basin. Groundwater leaching of old deposits and tailing pond leakage contribute significantly to loadings of heavy metals in the sub-basin.

Mainstream Mileage - RM 131.3 -

Flow-yearly mean--Mainstem Coeur d'Alene River @ Cataldo

High 15,000 - 20,000 cfs
Low 300 - 400 cfs

South Fork Coeur d'Alene @ Smelterville

High 2,000 - 4,000
Low 90 - 130 cfs

Waste Sources - Municipal = 14
Industrial = 5
19

Largest City - Kellogg-3,800

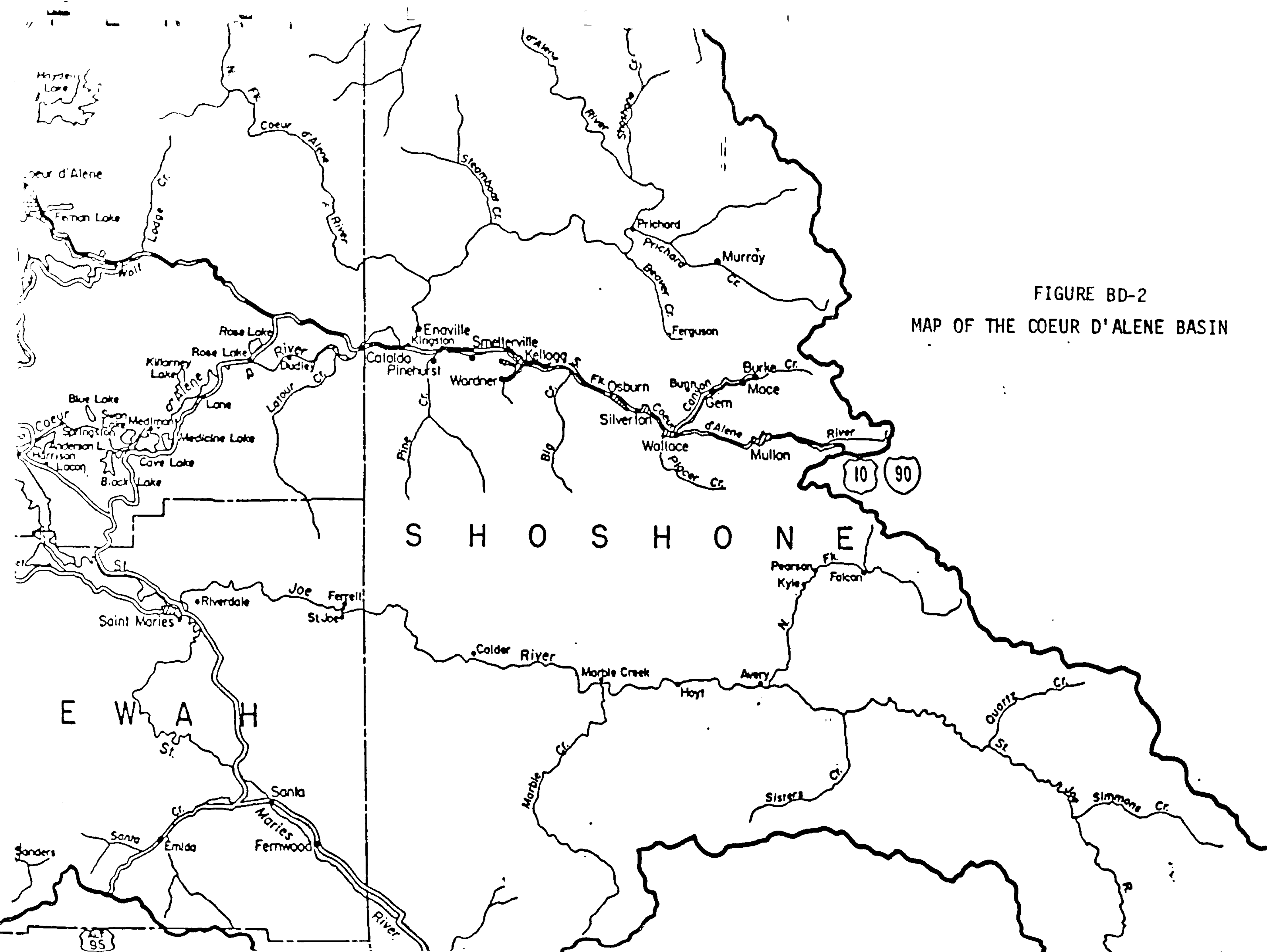


FIGURE BD-2
MAP OF THE COEUR D'ALENE BASIN

COEUR D'ALENE LAKE SUB-BASIN

This sub-basin encompasses Coeur d'Alene Lake from the mouth of the Coeur d'Alene River and the St.Joe River to its outlet near the city of Coeur d'Alene. The threefold emphasis in this report includes:

a) General water quality conditions
b) Hydrodynamics of the lake in relation to detention times of the waters of the Coeur d'Alene River and the St. Joe River.
c) Hydrodynamics of the lake in relation to the lake's role as a buffer for certain water quality parameters between the Coeur d'Alene sub-basin and the Spokane sub-basin.

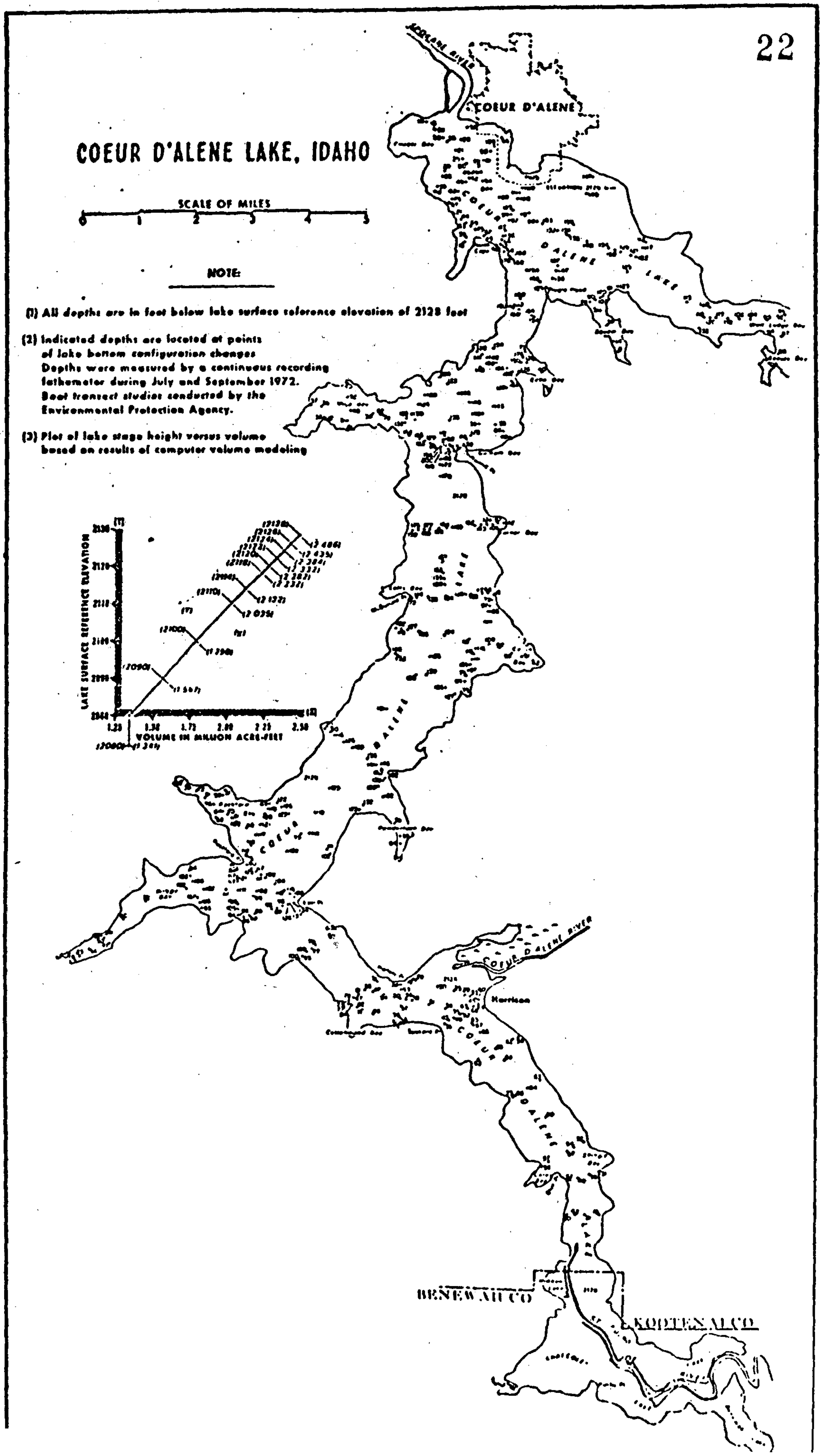
Mainstream Mileage - RM 110 - 135

Lake Volume - 2.5 Million Acre-feet

Flow, yearly mean - Post Falls- 10,000 cfs

Waste Sources - Municipal - 3
Industrial- 1
4

Largest City - Coeur d'Alene - 16,200


22
COEUR D'ALENE LAKE, IDAHO
SCALE OF MILES
0 1 2 3 4 5
NOTE:
(1) All depths are in feet below lake surface reference elevation of 2128 feet
(2) Indicated depths are located at points of lake bottom configuration changes Depths were measured by a continuous recording fathometer during July and September 1972. Boat transect studies conducted by the Environmental Protection Agency.
(3) Plot of lake stage height versus volume based on results of computer volume modeling
LAKE SURFACE REFERENCE ELEVATION
VOLUME IN MILLION ACRE-FEET
SPOKANE RIVER
COEUR D'ALENE
COEUR D'ALENE LAKE
COEUR D'ALENE RIVER
Harrison
BENEWAH CO
KOOTENAI CO

SPOKANE RIVER SUB-BASIN

This sub-basin encompasses the Spokane River from the outlet of Coeur d'Alene Lake to its mouth. Special attention is paid to municpal sewage, phosphorus, and related pollutants' loadings and their effects on algal bloom occurences, especially below the city of Spokane. Natural groundwater nitrate loadingsare also examined in relation to the same problem.

Drainage Area - 3840 Sq.M.

Mainstream Mileage - RM 0-110

Flow-yearly mean - Post Falls- 10,100 cfs

Waste Sources - Municipal - 17
Industrial - 5
22

Largest City - Spokane- 171,000

Projected Populations For The Entire Basin

1980	2000	2020
447,900	619,200	826,800

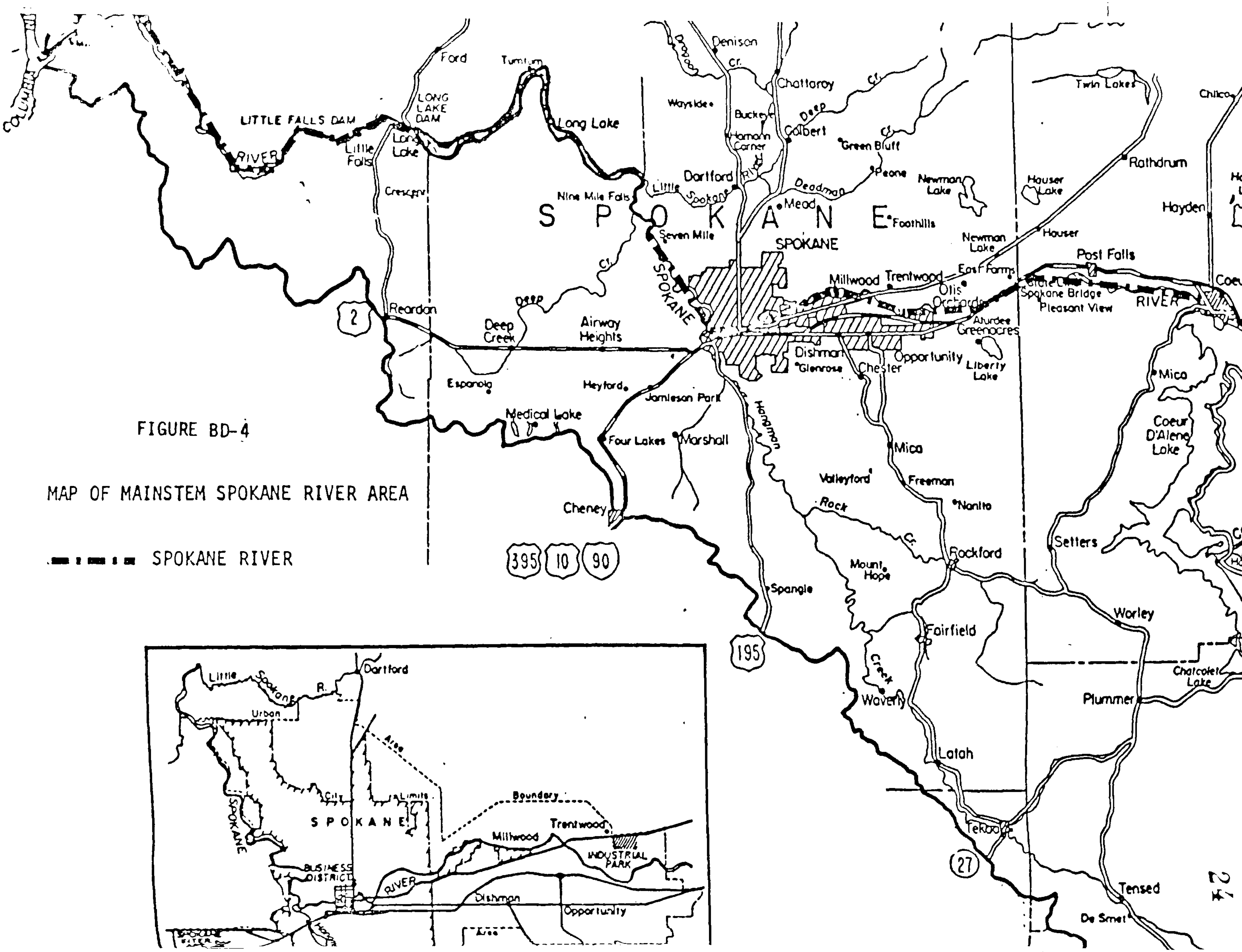


FIGURE BD-4

MAP OF MAINSTEM SPOKANE RIVER AREA

▬ ▪ ▬ ▪ ▬ SPOKANE RIVER

AMBIENT PROFILE

AMBIENT PROFILE SECTION

CONTENTS

Flow is shown on each figure for the purpose of comparing the various water quality parameters with flow in the basin.

FINDINGS AND CONCLUSIONS

AMBIENT PROFILE SECTION

Coeur d'Alene River Sub-Basin

1. Total phosphorus concentrations have been reduced[1] throughout the year over the six year period from 1968 through 1974. The change is due to a reduction in phosphorus discharged from the Bunker Hill Company and collection and treatment of municipal discharges in the South Fork Coeur d'Alene River area.
   FIGURE AP-3, page 31.

2. Nitrate concentrations in the Coeur d'Alene River at Rose Lake show little change between 1968 and 1974. The concentrations are well below the .3 mg/l algal bloom potential level throughout the year.
   FIGURE AP-2, page 30.

3. Zinc concentrations in the Coeur d'Alene River at Rose Lake show a significant reduction during the low flow periods of the year when comparing 1968 to 1974[1]. The largest improvement occurs during periods of low flow indicating the result of reduced point source discharges from the upstream mining industries.
   FIGURE AP-4, page 32.

Spokane River Sub-Basin

1. Ammonia concentrations have increased significantly at the station below the Long Lake Dam since 1972. The Stateline station shows a slight increasing trend.
   FIGURE AP-8, page 37.

2. Nitrate (NO2+NO3) has consistently maintained a high concentration capable of sustaining algal blooms at the station below Long Lake. The trends appear slightly increasing and decreasing respectively at the Long Lake and Stateline stations.
   FIGURE AP-7, page 36.

3. Total phosphorus concentrations at the station below Long Lake show a slightly increasing trend and have consistently exceeded the 0.05 mg/l level for algal bloom potential. Total phosphorus levels at Stateline are presently showing a slight decreasing trend with current concentrations ranging below the algal bloom level.
   FIGURE AP-9, page 38.

---

1 Data from STORET WATER QUALITY DATA and EPA Discharge Monitoring Reports

FINDINGS AND CONCLUSIONS

AMBIENT PROFILE SECTION

Spokane River Sub-Basin (cont'd)

4. Bacteria levels at the Stateline station have been increasing significantly. However, we can expect a turnabout due to the instillation of new municipal treatment facilities upstream. Present levels violate Washington Water Quality Class A Standards.
   FIGURE AP-11, page 40.

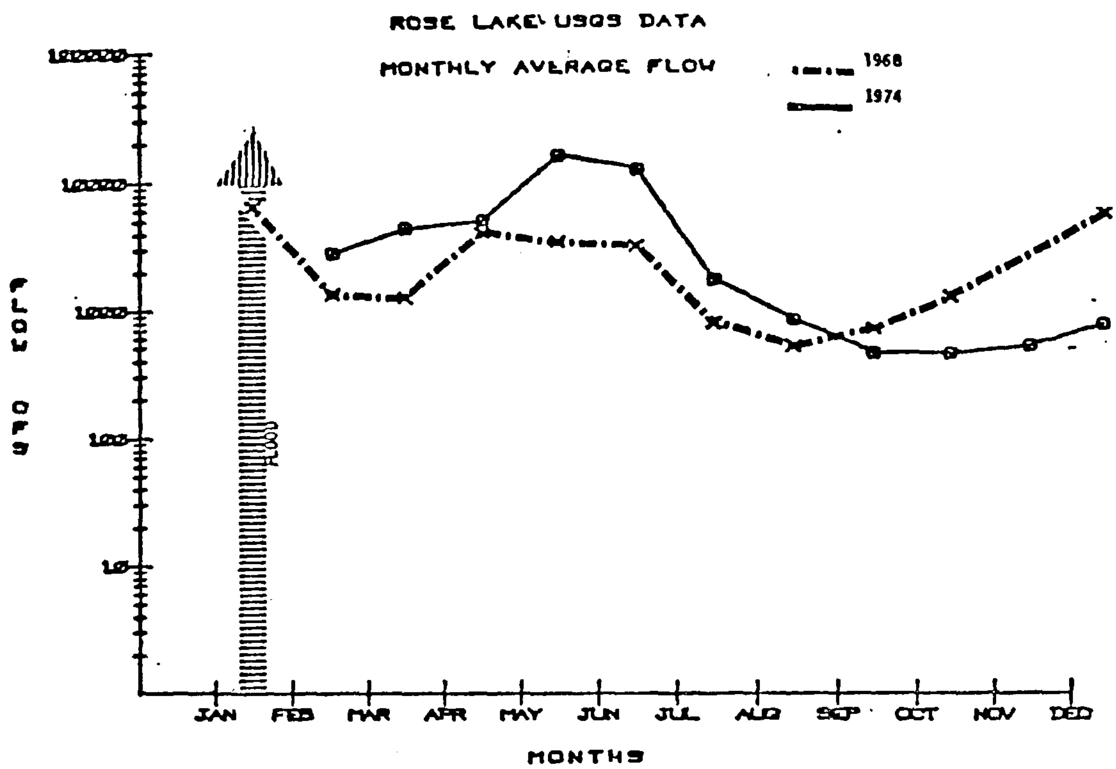
5. The Chl-A levels indicate that highly mesotrophic to eutrophic conditions presently exist in Long Lake. The 1973 levels are most severe but there is not enough data to establish a trend at this time. As expected the greatest algal productivity period occurs during the warmest summer or early fall periods.
   FIGURE AP-12, page 42.

AMBIENT PROFILE

Graph Set 1
Figures AP-1 To AP-4

Coeur d'Alene River At Rose Lake
RM 153

FIGURE AP-1


ROSE LAKE-USGS DATA
MONTHLY AVERAGE FLOW
1968
1974
JAN FEB MAR APR MAY JUN JUL AUG SEP OCT NOV DEC
MONTHS

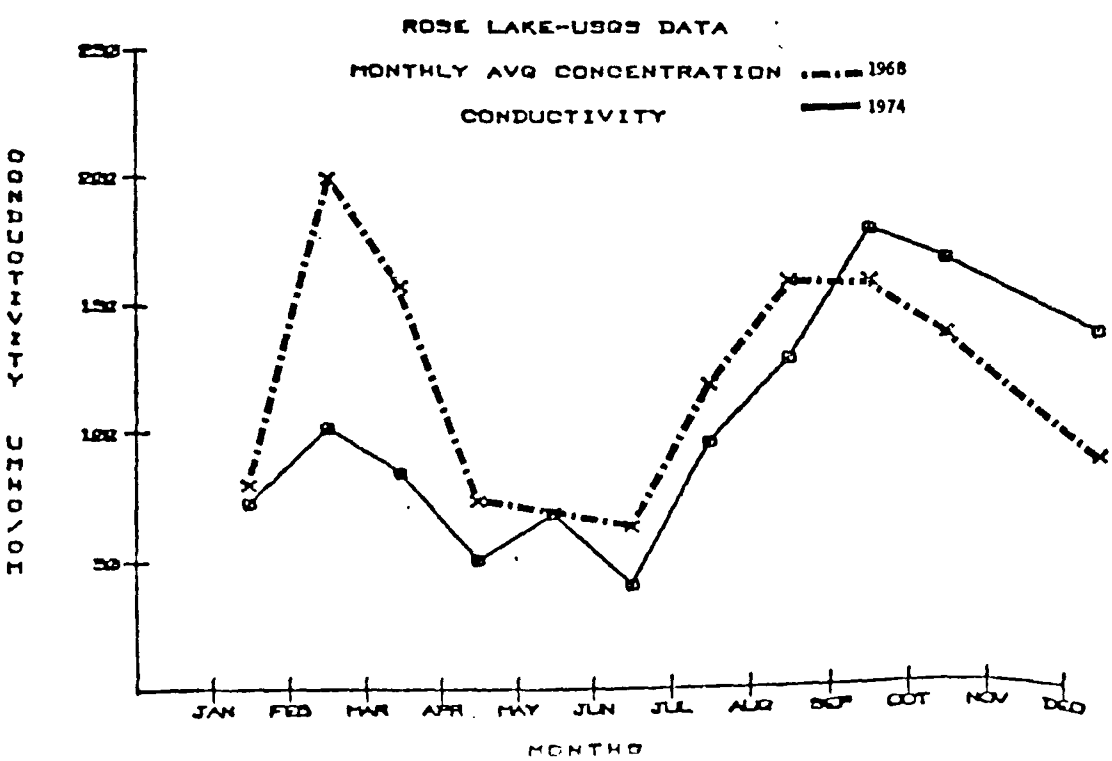
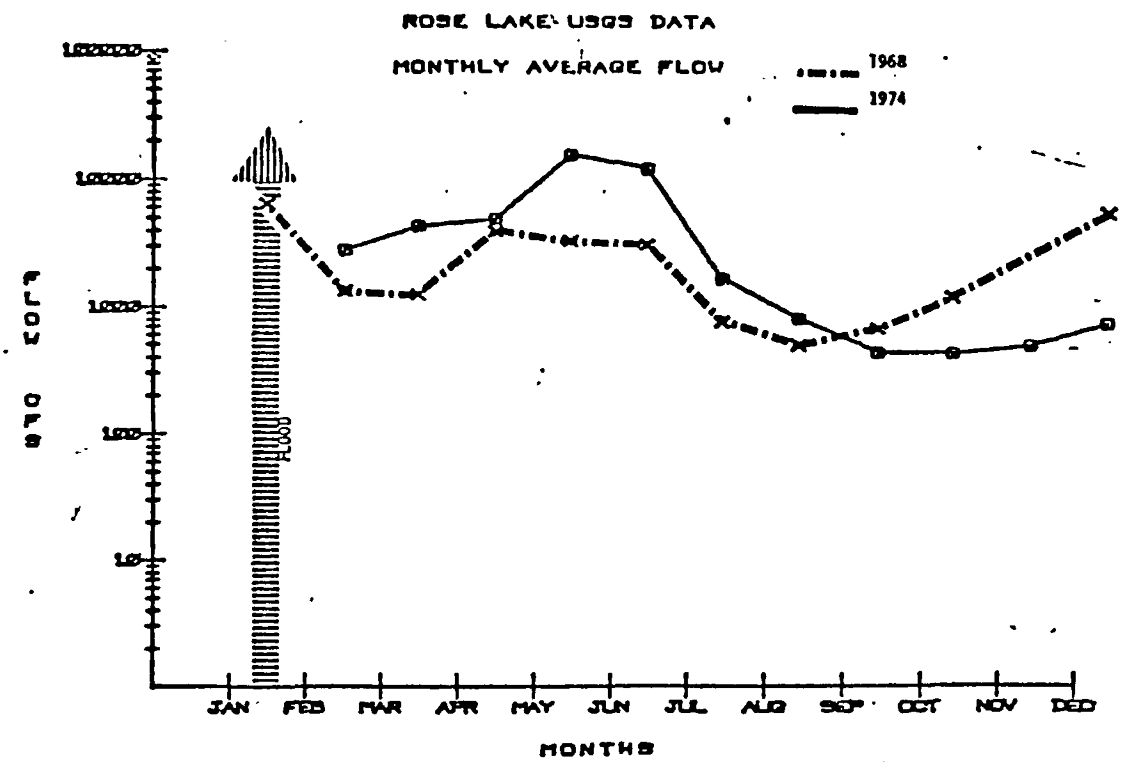

ROSE LAKE-USGS DATA
MONTHLY AVG CONCENTRATION
CONDUCTIVITY
1968
1974
250
200
150
100
50
CONDUCTIVITY UMHO/CM
JAN FEB MAR APR MAY JUN JUL AUG SEP OCT NOV DEC
MONTHS

FIGURE AP-2


ROSE LAKE-USGS DATA
MONTHLY AVERAGE FLOW
1968
1974
FLOW CFS
FLOOD
JAN FEB MAR APR MAY JUN JUL AUG SEP OCT NOV DEC
MONTHS

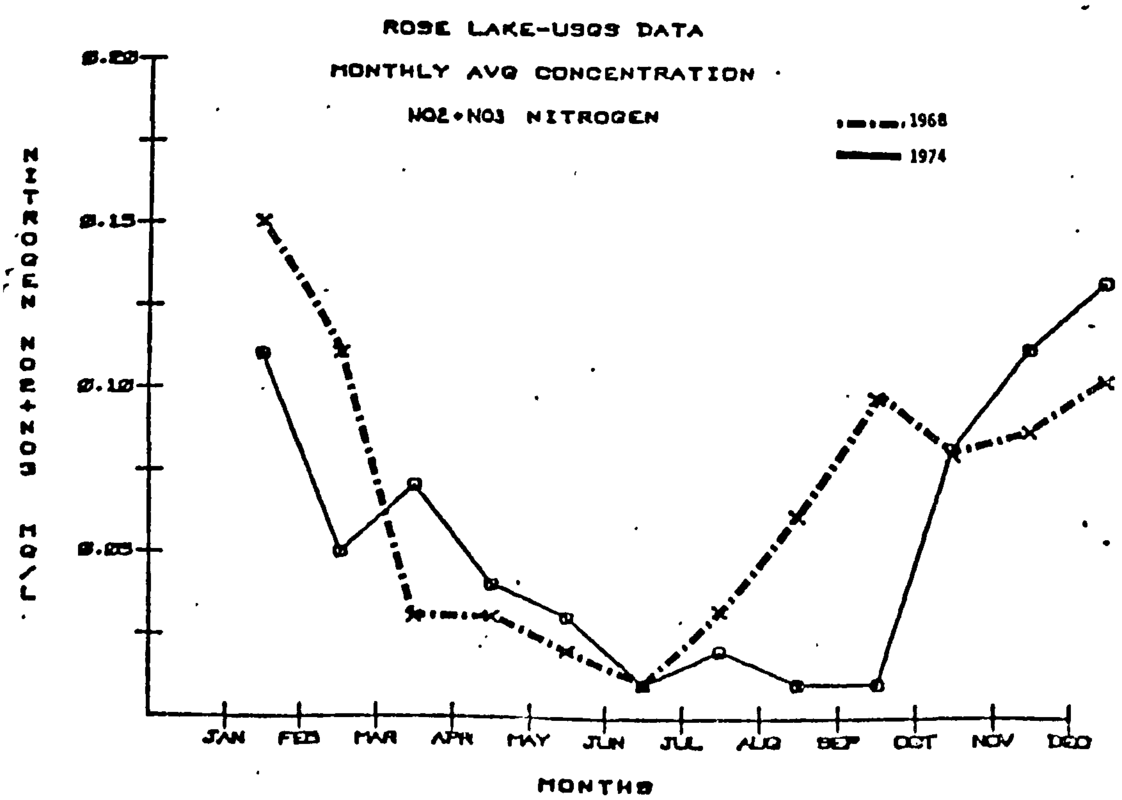
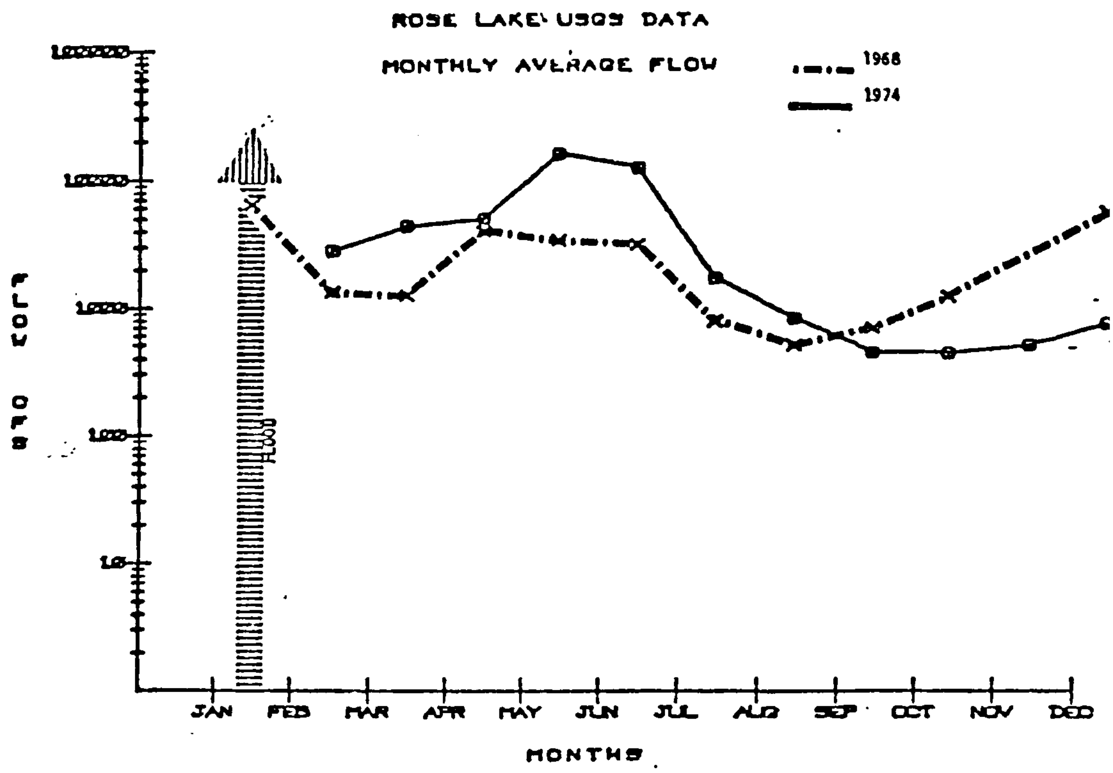

ROSE LAKE-USGS DATA
MONTHLY AVG CONCENTRATION
NO2+NO3 NITROGEN
1968
1974
0.20
0.15
0.10
0.05
NITROGEN NO2+NO3 MG/L
JAN FEB MAR APR MAY JUN JUL AUG SEP OCT NOV DEC
MONTHS

FIGURE AP-3


ROSE LAKE-USGS DATA
MONTHLY AVERAGE FLOW
1968
1974
FLOW CFS
FLOOD
JAN FEB MAR APR MAY JUN JUL AUG SEP OCT NOV DEC
MONTHS

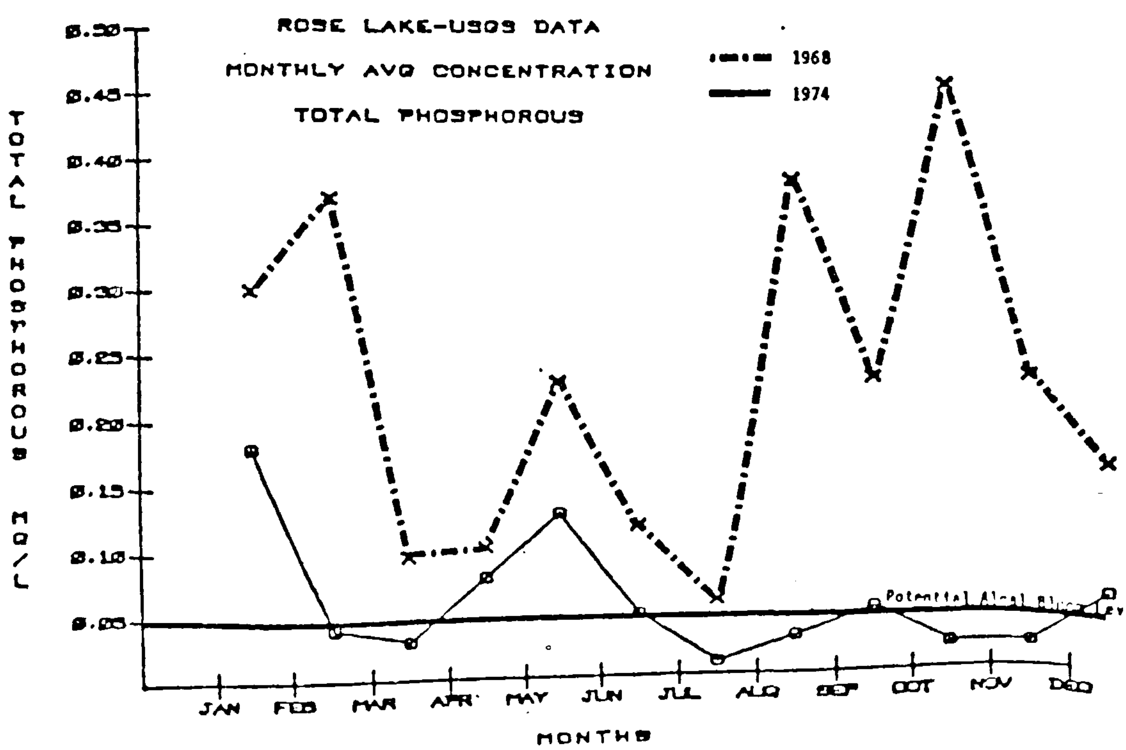
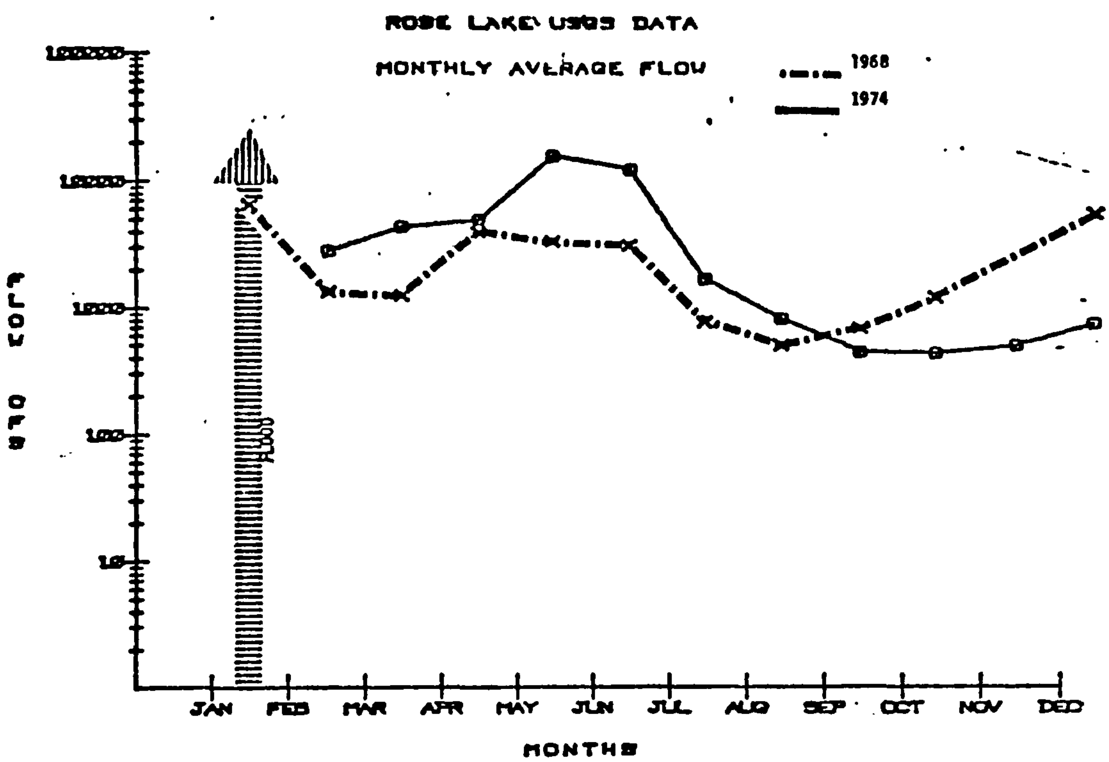
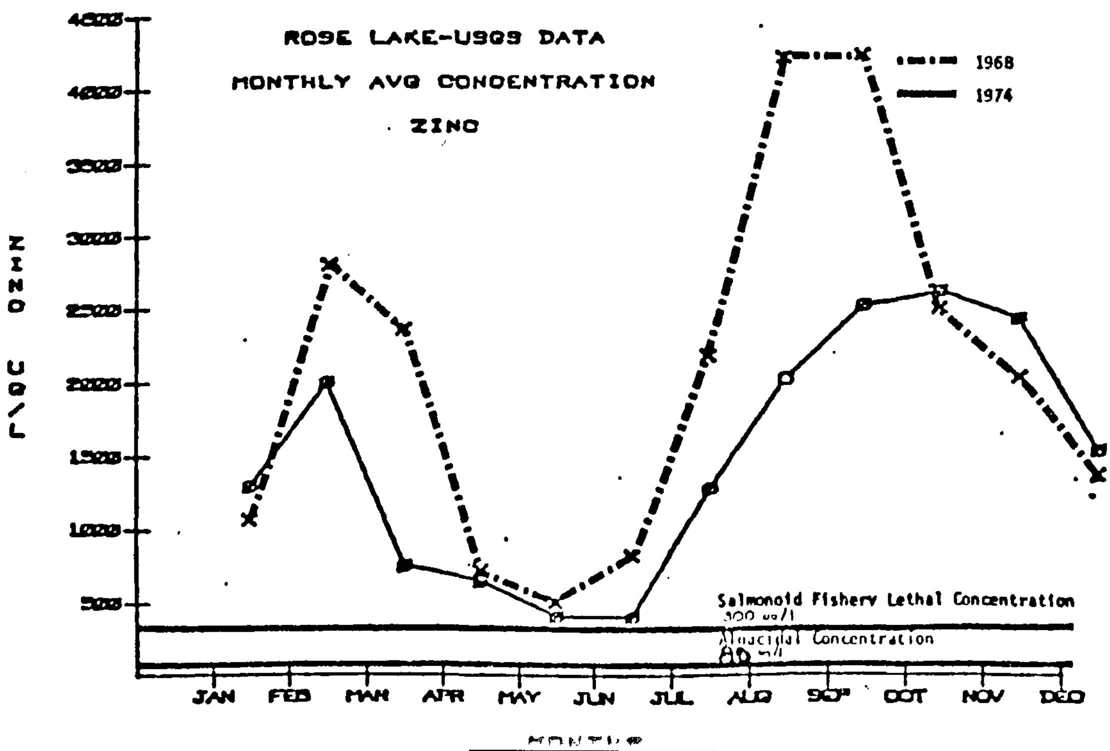

ROSE LAKE-USGS DATA
MONTHLY AVG CONCENTRATION
TOTAL PHOSPHOROUS
1968
1974
0.50
0.45
0.40
0.35
0.30
0.25
0.20
0.15
0.10
0.05
TOTAL PHOSPHOROUS MG/L
JAN FEB MAR APR MAY JUN JUL AUG SEP OCT NOV DEC
MONTHS

FIGURE AP-4


ROSE LAKE USGS DATA
MONTHLY AVERAGE FLOW
1968
1974
10000
1000
100
10
JAN
FEB
MAR
APR
MAY
JUN
JUL
AUG
SEP
OCT
NOV
DEC
MONTHS


ROSE LAKE-USGS DATA
MONTHLY AVG CONCENTRATION
ZINC
1968
1974
4000
3500
3000
2500
2000
1500
1000
500
ZINC UG/L
Salmonoid Fishery Lethal Concentration
Algacidal Concentration
JAN
FEB
MAR
APR
MAY
JUN
JUL
AUG
OCT
NOV
DEC

AMBIENT PROFILE

Graph Set 2
Figures AP-5 To AP-11

1 - Station # 12433000	Spokane River blw Long Lake Dam	RM 33.
2 - Station # 150114	Spokane River @ Stateline	RM 101
3 - Station # 12419000	Spokane River nr Post Falls	RM 99

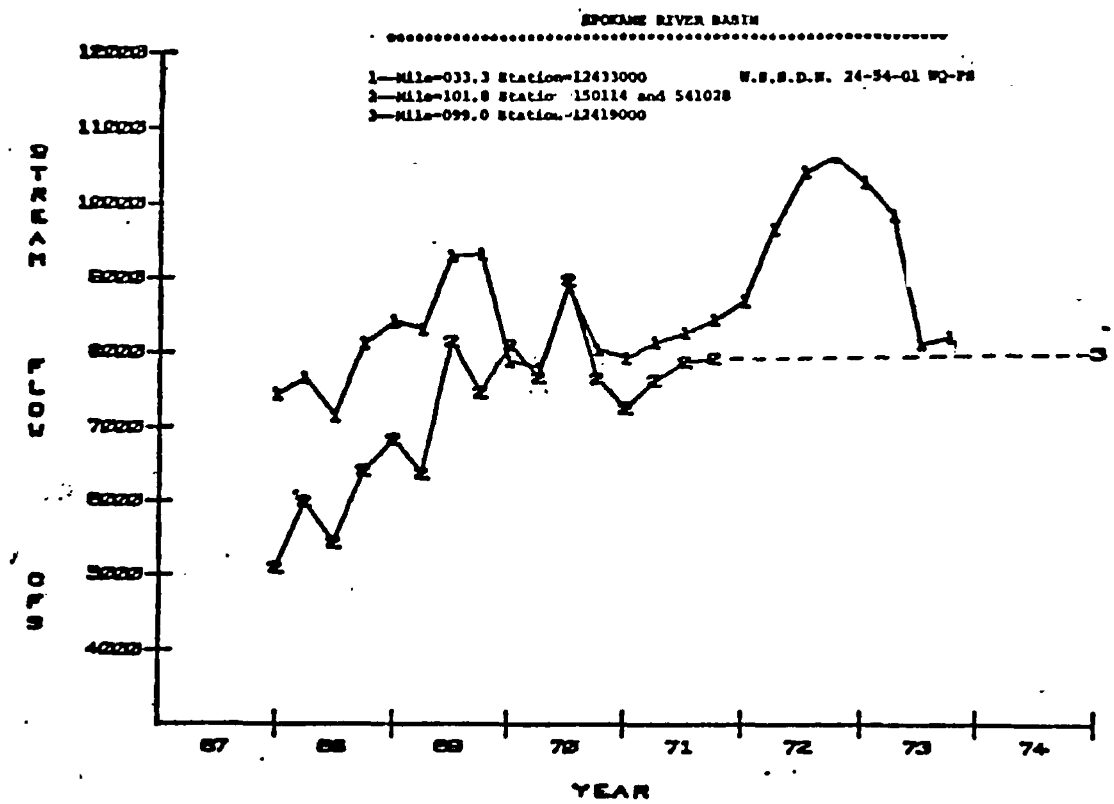
Note: Stations 2&3 combined represent water entering Spokane River.

Graph Explanation

The two year running average technique used in this section is a graphical representation of long term ambient data designed to smooth out seasonal irregularities in the data. The technique has no statistical significance; however, it does show long term trends in the data.

Data from 1966 to 1974 was reduced to consecutive monthly medians. Then the monthly medians for two years, January 1966 to December 1967, were averaged and the point was plotted at December 1967. Next, the time plot was advanced 3 months and the monthly medians for that corresponding two year period, April 1966 to March 1968, were averaged and that point was plotted at March 1968. This process was continued at 3 month increments until December 1974 Total coliform values represent geometric means as dictated by convention.

FIGURE AP-5


SPOKANE RIVER BASIN
1—Mile=033.3 Station=12433000
W.S.S.D.N. 24-54-01 WQ-PS
2—Mile=101.8 Statio 150114 and 541028
3—Mile=099.0 Station-12419000
STREAM FLOW CFS
12000
11000
10000
4000
67
68
69
70
71
72
73
74
YEAR

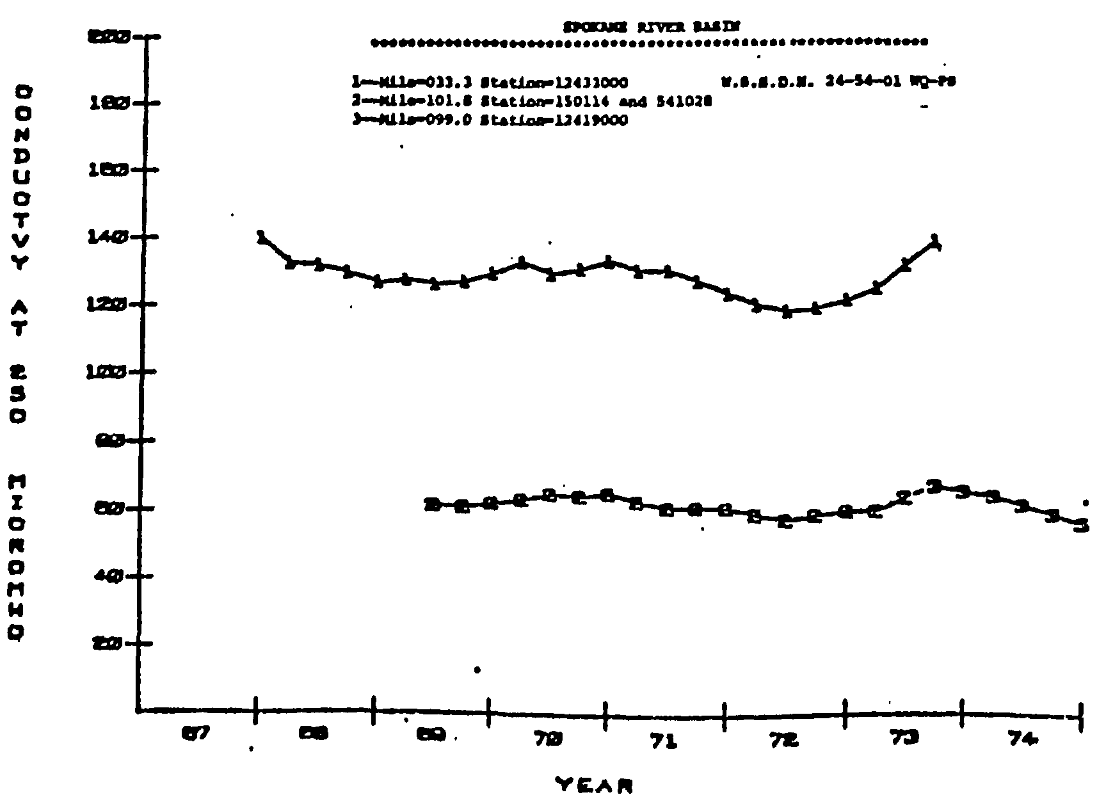
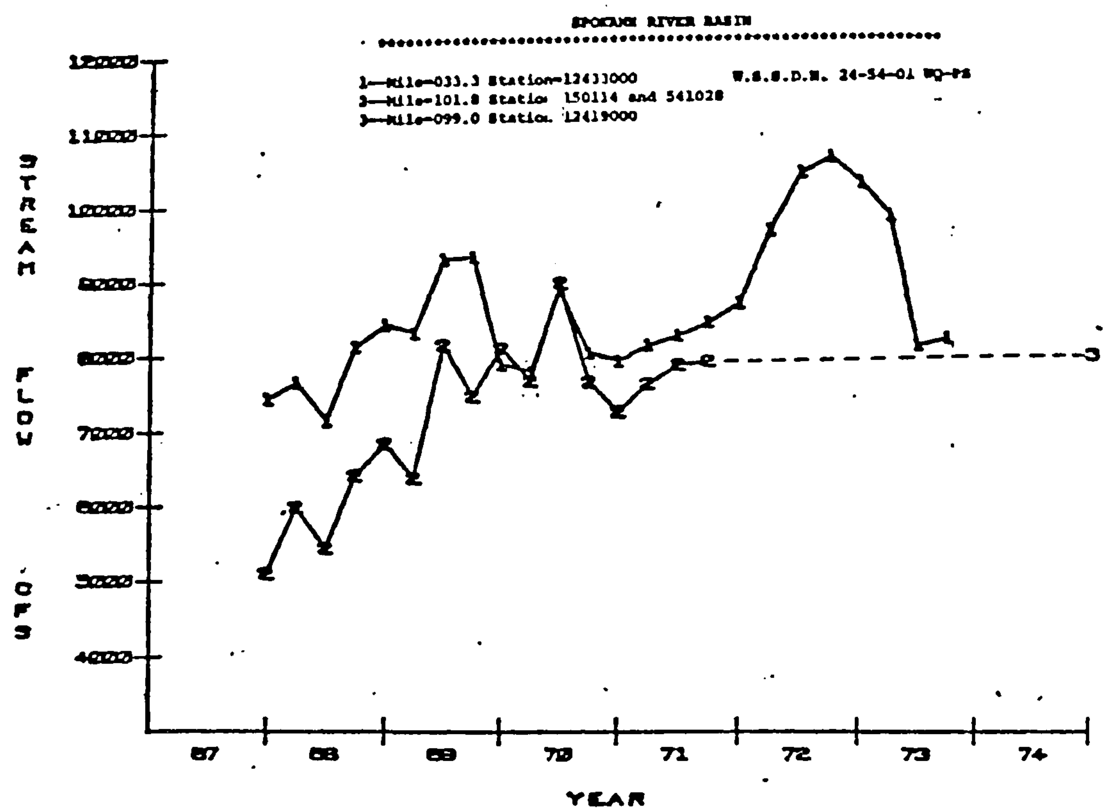
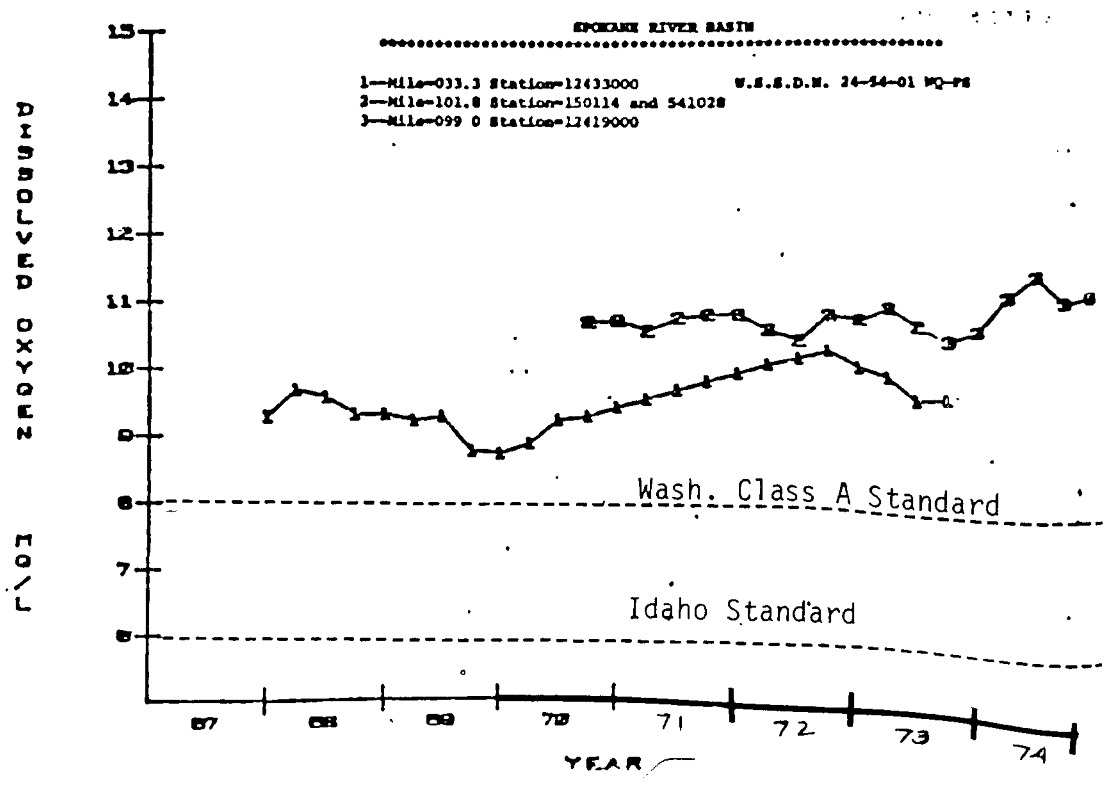

SPOKANE RIVER BASIN
1—Mile=033.3 Station=12433000
W.S.S.D.N. 24-54-01 WQ-PS
2—Mile=101.8 Station=150114 and 541028
3—Mile=099.0 Station=12419000
CONDUCTIVITY AT 25C MICROMHO
140
120
100
40
20
67
68
69
70
71
72
73
74
YEAR

FIGURE AP-6


SPOKANE RIVER BASIN
1—Mile=033.3 Station=12433000
2—Mile=101.8 Station 150114 and 541028
3—Mile=099.0 Station 12419000
W.S.S.D.M. 24-54-01 WQ-PS
STREAM FLOW CFS
12000
11000
10000
9000
8000
7000
6000
5000
4000
67
68
69
70
71
72
73
74
YEAR


SPOKANE RIVER BASIN
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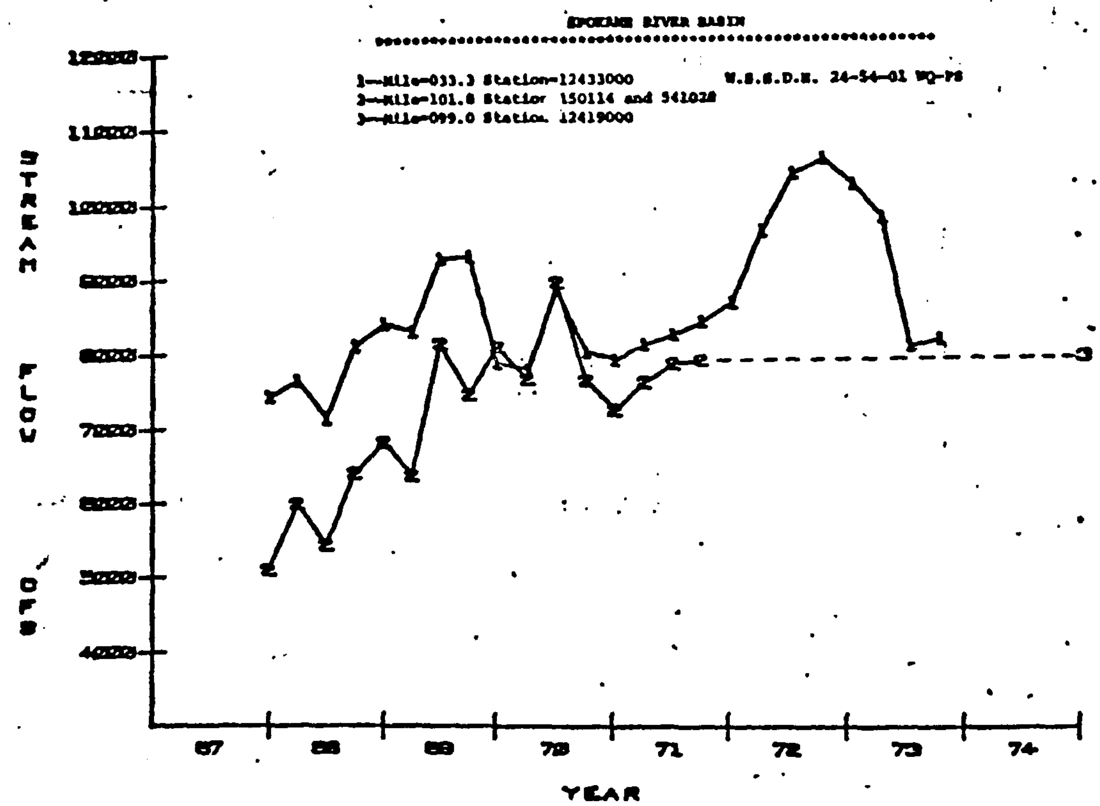
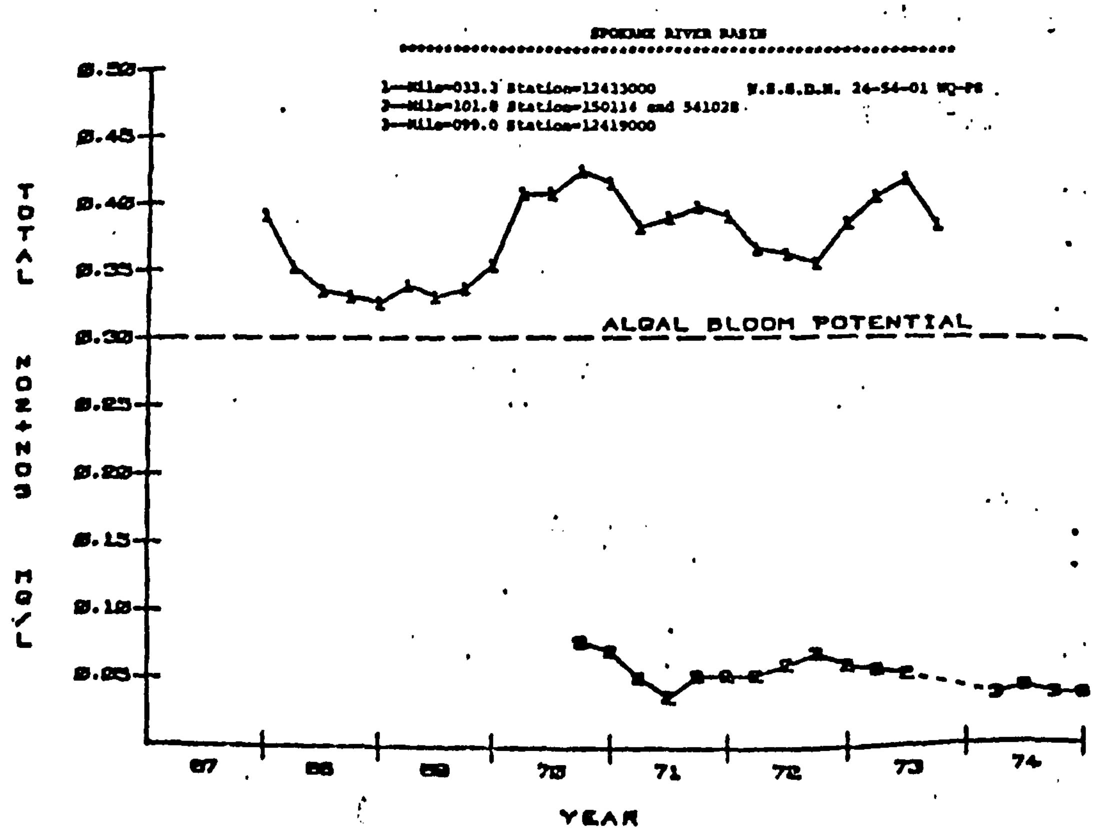
2—Mile=101.8 Station=150114 and 541028
3—Mile=099 0 Station=12419000
W.S.S.D.M. 24-54-01 WQ-PS
DISSOLVED OXYGEN MG/L
15
14
13
12
11
10
9
8
7
6
Wash. Class A Standard
Idaho Standard
67
68
69
70
71
72
73
74
YEAR

FIGURE AP-7


SPOKANE RIVER BASIN
1--Mile=033.3 Station=12433000
2--Mile=101.8 Station 150114 and 541028
3--Mile=099.0 Station 12419000
STREAM FLOW CFS
12000
11000
10000
9000
8000
7000
6000
5000
4000
67
68
69
70
71
72
73
74
YEAR


SPOKANE RIVER BASIN
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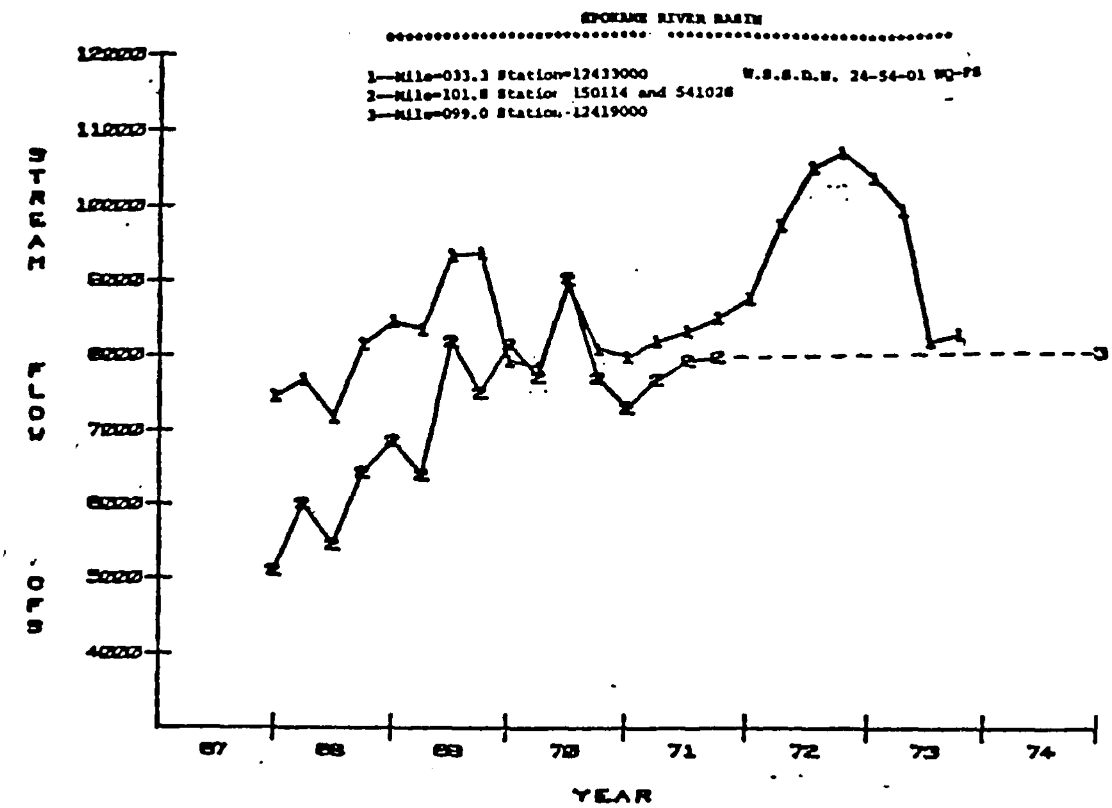
2--Mile=101.8 Station=150114 and 541028
3--Mile=099.0 Station=12419000
TOTAL NO2+NO3 MG/L
0.50
0.45
0.40
0.35
0.30
0.25
0.20
0.15
0.10
0.05
ALGAL BLOOM POTENTIAL
67
68
69
70
71
72
73
74
YEAR

FIGURE AP-8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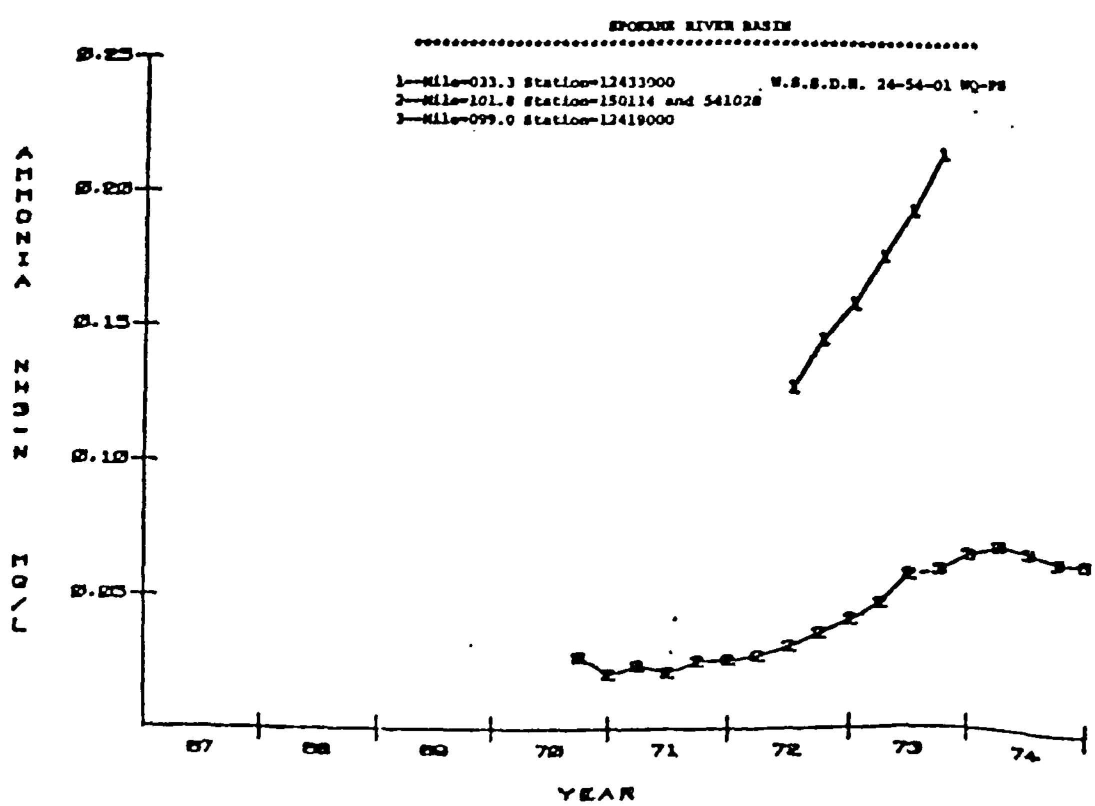
2--Mile=101.8 Station 150114 and 541028
3--Mile=099.0 Station 12419000
W.S.S.D.H. 24-54-01 WQ-PS
12000
11000
10000
9000
8000
7000
6000
5000
4000
STREAM FLOW CFS
67
68
69
70
71
72
73
74
YEAR


SPOKANE RIVER BASIN
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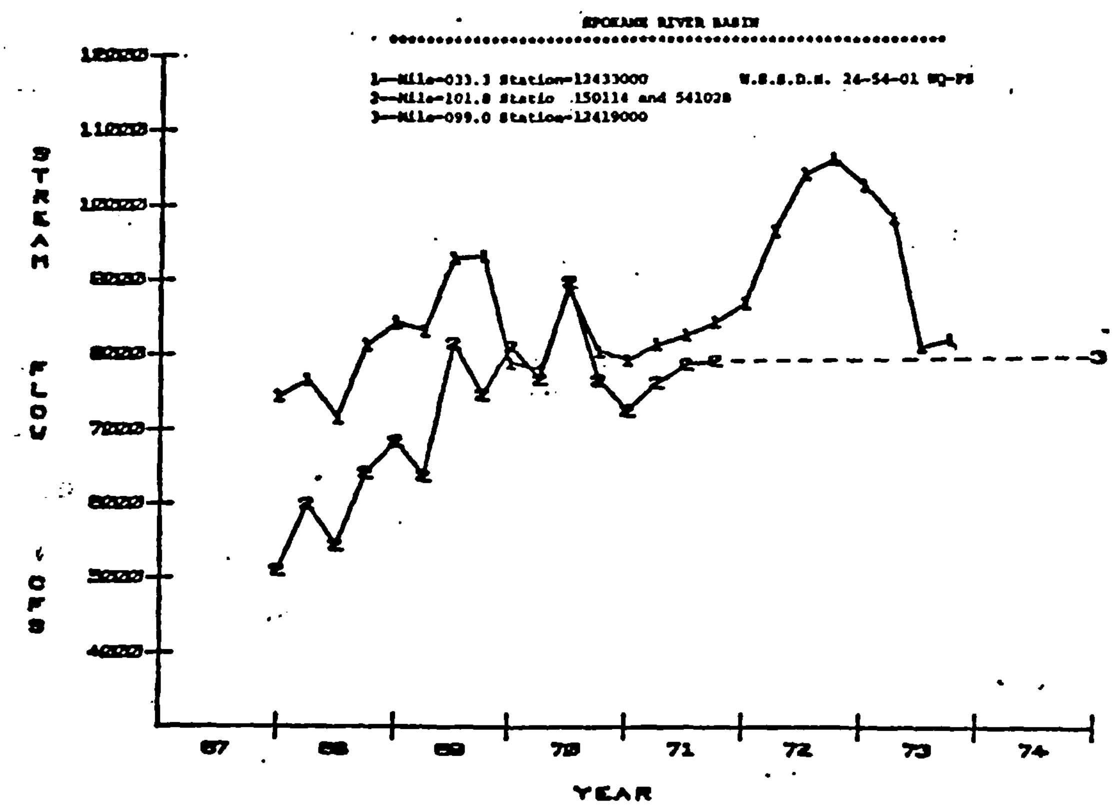
2--Mile=101.8 Station=150114 and 541028
3--Mile=099.0 Station=12419000
W.S.S.D.H. 24-54-01 WQ-PS
0.25
0.20
0.15
0.10
0.05
AMMONIA NH3-N MG/L
67
68
69
70
71
72
73
74
YEAR

FIGURE AP-9


SPOKANE RIVER BASIN
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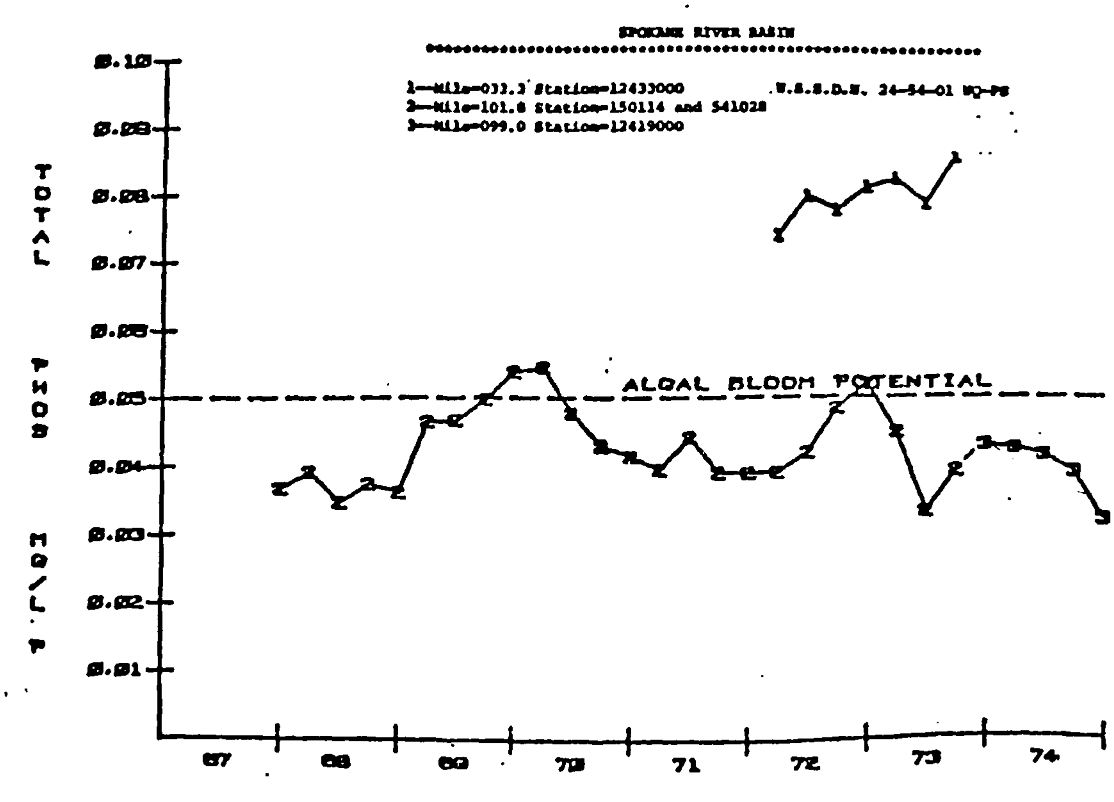
W.S.S.D.H. 24-54-01 WQ-PS
2—Mile=101.8 Statio 150114 and 541028
3—Mile=099.0 Station=12419000
STREAM FLOW CFS
67
68
69
70
71
72
73
74
YEAR


SPOKANE RIVER BASIN
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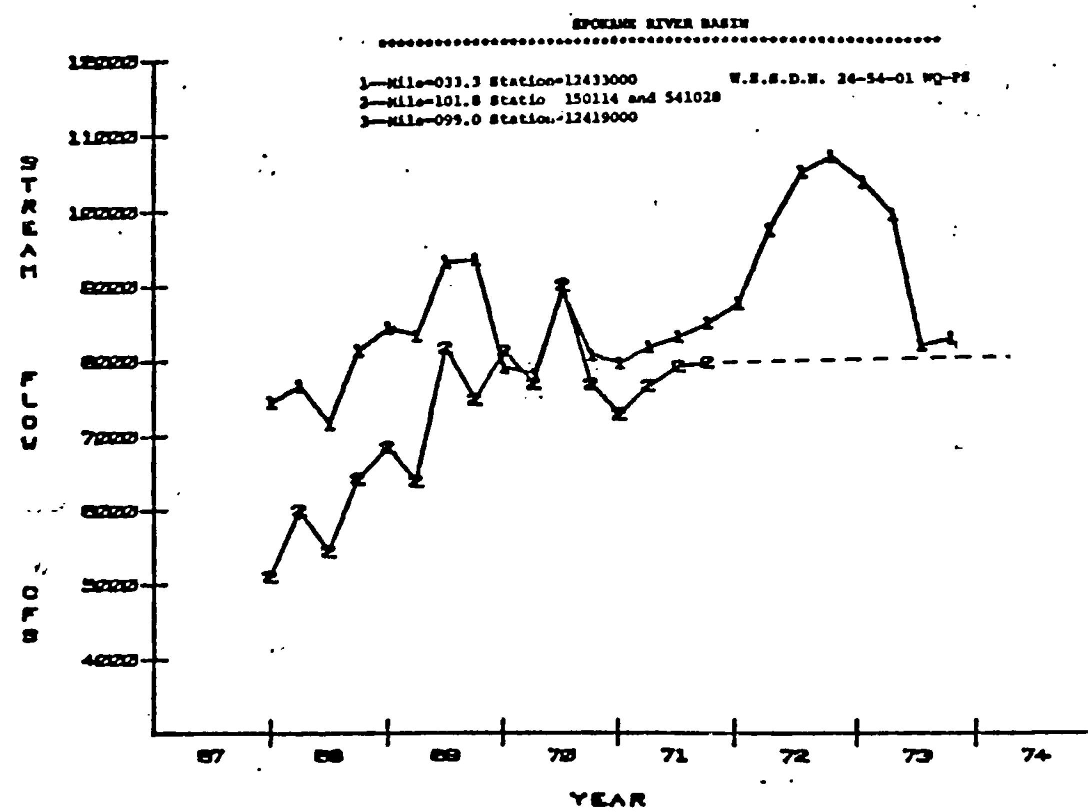
W.S.S.D.H. 24-54-01 WQ-PS
2—Mile=101.8 Station=150114 and 541028
3—Mile=099.0 Station=12419000
TOTAL PHOS MG/L-P
0.10
0.09
0.08
0.07
0.06
0.05
0.04
0.03
0.02
0.01
ALGAL BLOOM POTENTIAL
67
68
69
70
71
72
73
74
YEAR

FIGURE AP-10


SPOKANE RIVER BASIN
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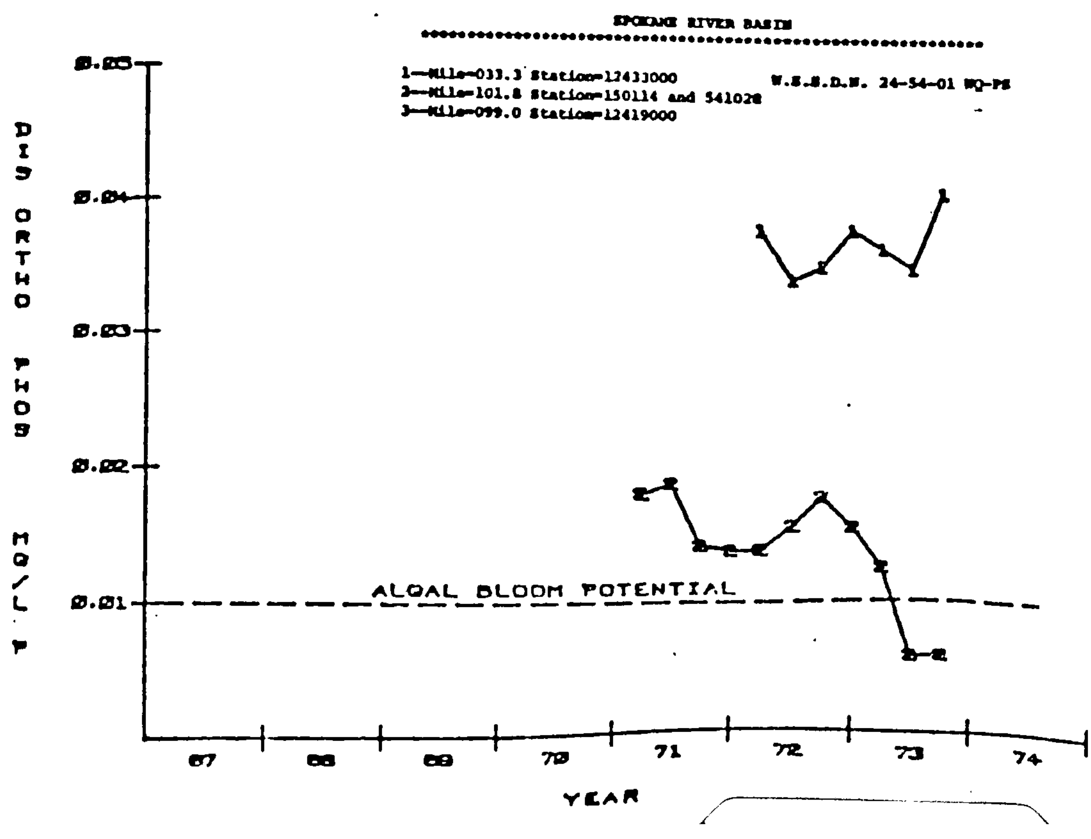
2—Mile=101.8 Statio 150114 and 541028
3—Mile=099.0 Station=12419000
W.S.S.D.N. 24-54-01 WQ-PS
STREAM FLOW CFS
12000
11000
10000
9000
8000
7000
6000
5000
4000
67
68
69
70
71
72
73
74
YEAR


SPOKANE RIVER BASIN
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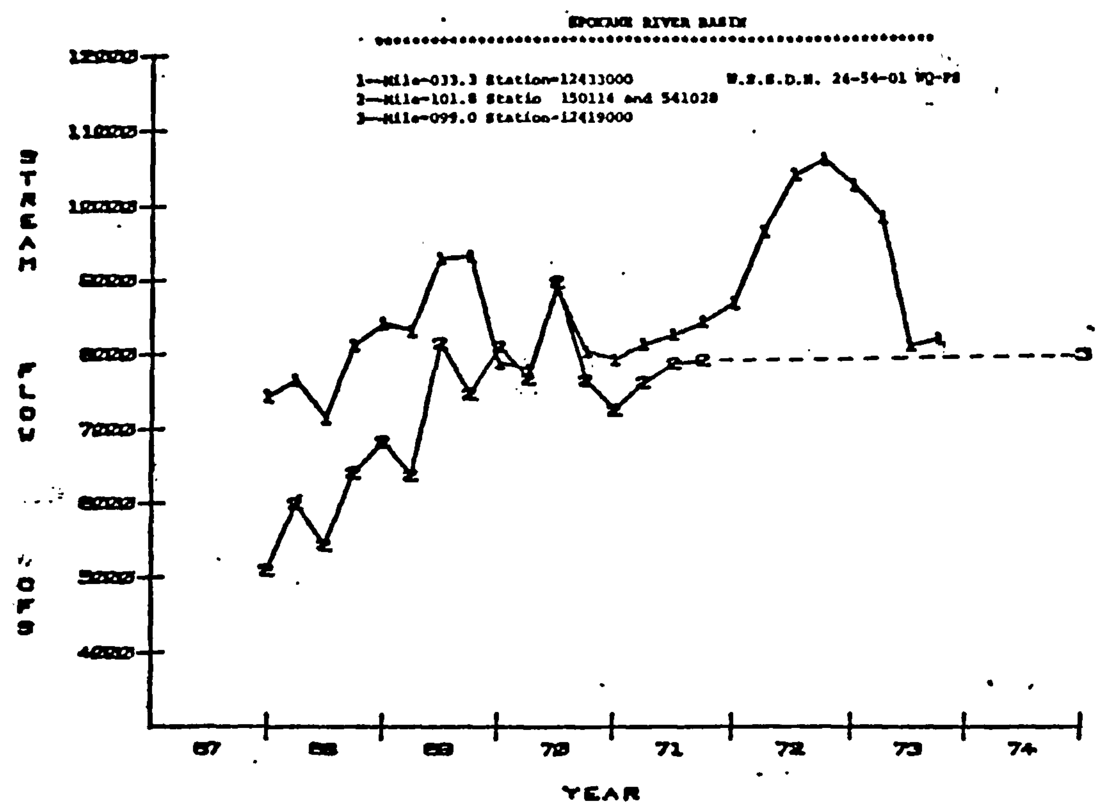
2—Mile=101.8 Station=150114 and 541028
3—Mile=099.0 Station=12419000
W.S.S.D.N. 24-54-01 WQ-PS
DIS ORTHO PHOS MG/L P
0.05
0.04
0.03
0.02
0.01
ALGAL BLOOM POTENTIAL
67
68
69
70
71
72
73
74
YEAR

FIGURE AP-11


SPOKANE RIVER BASIN
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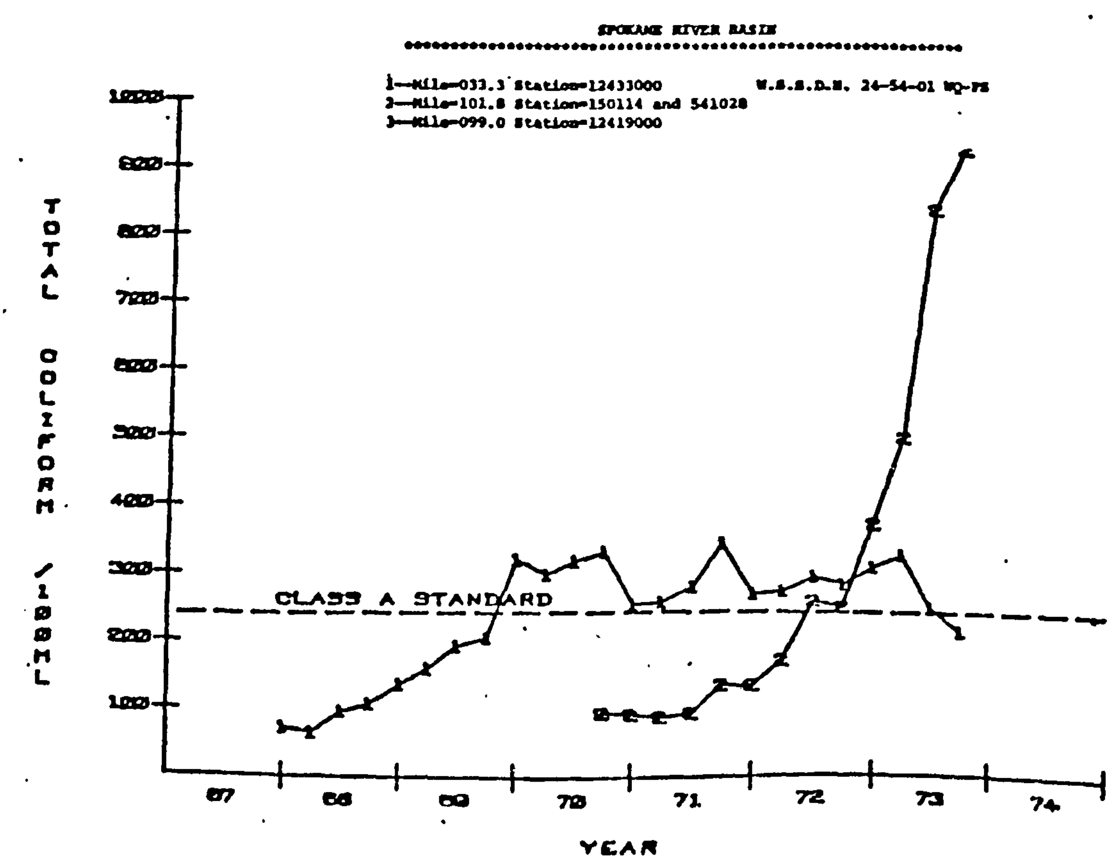
W.S.S.D.N. 24-54-01 WQ-PS
2—Mile-101.8 Statio 150114 and 541028
3—Mile-099.0 Station-12419000
STREAM FLOW CFS
67
68
69
70
71
72
73
74
YEAR


SPOKANE RIVER BASIN
1—Mile-033.3 Station-12433000
W.S.S.D.N. 24-54-01 WQ-PS
2—Mile-101.8 Station-150114 and 541028
3—Mile-099.0 Station-12419000
TOTAL COLIFORM /100ML
CLASS A STANDARD
67
68
69
70
71
72
73
74
YEAR

AMBIENT PROFILE

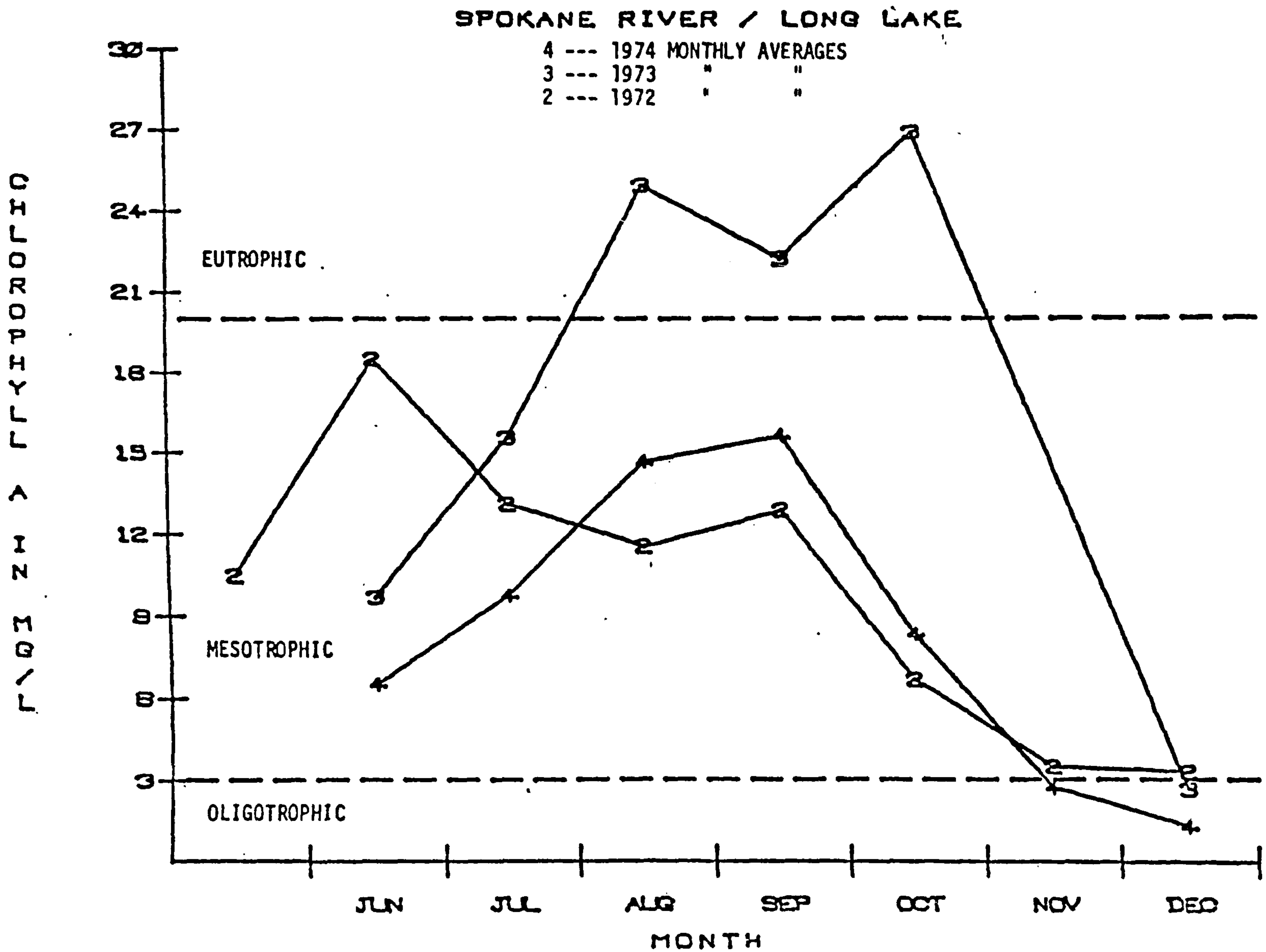
Graph Set 3

Chlorophyl A At Long Lake Dam

Data obtained from R.A.Soltero

FIGURE AP-12

SPOKANE RIVER BASIN



SOURCE PROFILE

SOURCE PROFILE

This section of the profile provides a compilation of all existing point source discharge data for the municipal and industrial effluents in the Spokane River Basin. The sources listed represent the significant contributors in the basin. Effluent data found in the tables originated in the Discharge Monitoring Reports files, from population equivalent calculations, or other filed reports. In addition to the actual loading figures, percent relative loading contributions from municipal and industrial discharges have been included.

TABLE SP-1

POINT SOURCE BASIN SUMMARY TABLE

	PHOS lb/d	% Mun	% Ind	NO3 lb/d	% Mun	% Ind	SS lb/d	% Mun	% Ind	BOD lb/d	% Mun	% Ind	CHM* lb/d	% Mun	% Ind.
COEUR D'ALENE BASIN															
Municipal	268.3	12		372.6	6.9		2218.9	11.5		8682	37.5		-	-	
Industrial	9.8		1	.2		-	627.4		6.5	-		-	-		-
TOTAL	278.1			372.8			2846.3			8682			-		
COEUR D'ALENE LAKE															
Municipal	6.6	-		17	-		22	-		19	-		-	-	
Industrial	36		3	22		2	324		3	54		1	-		-
TOTAL	42.6			39			346			53			-		
SPOKANE BASIN															
Municipal	1955.3	88		5383.5	93.5		17111.8	88.5		14342.2	62.9		-	-	
Industrial	1123		96	1080.3		98	9029.8		90.5	5093.2		99	3654.6		100
TOTAL	3078.3			6463.8			26141.6			19435.4			3654.6		

SUB-BASIN CONTRIBUTION	PHOS	NO3	SS	BOD	CHM*
COEUR D'ALENE BASIN	8.2	5.5	9.7	30.8	100
COEUR D'ALENE LAKE	1.3	.5	1.2	-	-
SPOKANE BASIN	90.5	94.0	89.1	69.2	-

* CHM = Combined Heavy Metals - Pb, Cd, Hg, Sb, Zn

TABLE SP-2

SPOKANE RIVER BASIN

MUNICIPAL POINT SOURCE INVENTORY

DISCHARGER	RIVER MILE	FLOW MGD	T-PHOS lb/d	% M	% B	SS lb/d	% M	% B	NO3 lb/d	% M	% B	BOD lb/d	% M
COEUR D'ALENE BASIN													
South Fork Coeur d'Alene													
Pinehurst	2.5		16.4	-	-	247	1.27	1.0	45.5	-	-	210	1.35
Smelterville	5.0	.25	8.1	-	-	15.9	-	-	20.9	-	-	13.9	-
Kellogg	5.0		48	2.1	1.4	1000	5.15	3.4	123.3	3.8	1.8	850	5.5
Wardner	9.0		4.8	-	-	100	-	-	12.3	-	-	85	-
Elizabeth Park	9.5		2.4	-	-	3.7	-	-	6.7	-	-	30.8	-
Elk Creek	9.2		.9	-	-	18.8	-	-	2.3	-	-	18	-
Osburn	14.0		16.3	-	-	340	1.6	1.2	42	-	-	289	1.9
Silverton	17.0		3.8	-	-	80	-	-	9.9	-	-	68	-
Woodland Park	19.1		3.6	-	-	76	-	-	9.4	-	-	65	-
Mullan	25.7		138.8	6.0	4.1	250	1.3	1.0	35.5	-	-	245	1.6
St. Joes River													
St. Maries	15	.3	20.4	-	-	40	-	-	52.4	-	-	35	-
Avery	65.5		2*	-	-	42	-	-	5.2	-	-	35.7	-
St. Maries													
Emida	24.3*	.018	1.5	-	-	2.9	-	-	3.8	-	-	2.5	-
Santa	27.5	.016	1.3	-	-	2.6	-	-	3.4	-	-	2.2	-
COEUR D'ALENE LAKE BASIN													
Coeur d'Alene Lake													
Plummer	130.4	.05	4.1	-	-	8.0	-	-	10.5	-	-	7	-
Worley	130.4	.03	2.0		-	4.0	-	-	5.3	-	-	3.5	
Harrison	131.5		.5	-	-	10	-	-	1.2	-	-	8.5	-
Medical Lake													
Eastern State Hospital		.18	9.8	-	-	27.2	-	-	29.6	-	-	25.8	-
Lakeland Village		.75	9.0	-	-	17.6	-	-	23	-	-	26.4	-
Medical Lake		.034	14.2	-		348	1.8	1.2	36.5	-	-	25	-
Spirit Lake			7	-	-	138	-	-	17	-	-	117	-
SPOKANE RIVER BASIN													
Main Stem Spokane River													
Bell Terrace	54.5		.6	-	-	1.2	-	-	1.6	-	-	1.1	
Spokane	67	28.8	1661	72	48.9	15515	80	52.9	4623	80	67.2	13200	85
Veradale	80		.7		-	1.2	-	-	1.7	-	-	1.1	
Millwood	83	.01	4.4		-	14	-	-	12.3		-	57	-
Industrial Park	86	.6	20.4	-	-	43	-	-	52	-	-	35	-
Post Falls	100.7		19	-	-	397	2	1.4	49	-	-	337	2
Rathdrum	103		6.7	-	-	140	-	-	17.3	-	-	119	-
Coeur d'Alene	110.8	1.35	98	4.3	2.9	152	-	-	252	4.3	3.7	97	-
Little Spokane River													
Colbert	1 .1		1.0	-	-	1.[illegible]	-	-	2.1	-	-	1.4	-
Deer Park	15.0	.15	10.6	-	-	20.8	-	-	27.2	-	-	31.2	-
Northwest Terrace			4.6	-	-	9.8	-	-	11.7	-	-	7.8	-
Hangman Creek													
Cheney		.9	68.4	3	2	134.4	-	-	176	3	2.6	200	1.3
Spangle	19.2		4.1		-	8.0	-	-	10.5	-	-	7	-
Rockford	20.2	.035	2.8	-	-	5.6	-	-	7.3	-	-	4.9	-
Fairfield	33.0	.5	3.9	-	-	80	-	-	10.1	-	-	6.7	-
Tekoa	54.6	.095	7.7		-	31.2	-	-	19.9	-	-	13.3	-
Tensed	53		1.4		-	30	-	-	3.7		-	25.5	-

- = Negligible
%M = Municipal % Contribution
%B = Basin % Contribution

TABLE SP-3

SPOKANE RIVER BASIN

INDUSTRIAL POINT SOURCE INVENTORY

DISCHARGER	RIVER MILE	FLOW MGD	PHOS lb/d	% I	% B	SS lb/d	% I	% B	NO3 lb/d	% I	% B	BOD lb/d	% I	% B	CHM* lb/d	% I
COEUR D'ALENE BASIN																
SF Coeur d'Alene River																
Bunker Hill CIA	5.4	4.5	1.1	-	-	300	3.0	1.0	-	-	-	-	-	-	106	2.9
Consolidated Silver	13.1	2.05	.5	-	-	40.5	-	-	-	-	-	-	-	-	2	-
Star Morning #6	24.6	.12	.3	-	-	26.6	-	-	-	-	-	-	-	-	2.5	-
Lucky Friday	26.6	.55	2	-	-	145	1.5	.4	-	-	-	-	-	-	1.0	-
Bunker Hill Tailings Pond Leakages			-	-	-	-	-	-	-	-	-	-	-	-	1400	38.3
Silver King Creek																
Bunker Hill Zinc Plt.	1.7	1.9	3.7	-	-	-	-	-	-	-	-	-	-	-	182	5.0
Bunker Hill Pump Sta.	1.0	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
Other Bunker Hill			-	-	-	-	-	-	-	-	-	-	-	-	1800	49.3
Big Creek																
Sunshine Mine	.2	.94	.3	-	-	27	-	-	-	-	-	-	-	-	150	4.1
Crescent Mine	.18	.13	.04	-	-	14	-	-	-	-	-	-	-	-	-	-
Lake Creek																
American Smelt.&Ref.	1.0	.3	.25	-	-	16.2	-	-	-	-	-	-	-	-	1.4	-
Ninemile Creek																
Day Mines	2.9	.14	.1	-	-	28.3	-	-	-	-	-	-	-	-	6.4	-
Canyon Creek																
Star Morning Mine&Hi	7.3	4.8	-	-	30	-	-	-	-	-	-	-	-	-	3.3	-
TOTAL BUNKER HILL		7.3	4.8+	-	-	300+	3.0	1.0	-	-	-	-	-	-	3488	95.4
COEUR D'ALENE LAKE BASIN																
Coeur d'Alene Lake																
Potlatch		4.3	36	3.1	1.1	324	3.2	1.1	22	2.0	.4	54	1.1	.4	-	-
St.Joe River																
Potlatch	5.0	.38	1.0	-	-	-	-	-	.2	-	-	-	-	-	-	-
Ch.,Milw.,St.P.,Pac.RR	42.9	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
SPOKANE RIVER BASIN																
Mainstem Spokane River																
Soft Water Co.	74	.3	-	-	-	-	-	-	-	-	-	-	-	-	-	-
Inland Empire	82.6	5.5	1.0	-	-	66	-	-	.2	-	-	1568	30.3	7.3	-	-
Kaiser	86	18.2	1095	93.7	32.[illegible]	8950	87.7	30.5	1070	97	15.6	3500	60	16.[illegible]	-	-
Spokane Industrial	87	.3	27	1.0	-	-	-	-	6.5	-	-	24	-	-	-	-
Hillyard	97.5	.55	-	-	-	13.8	-	-	3.6	-	-	1.2	-	-	-	-

* = Combined Heavy Metals - Pb, Cd, Hg, Sb, Zn
- = Negligible
\+ = Plus More From Unreported Discharges

CAUSE-EFFECT ANALYSIS

INTRODUCTION

CAUSE AND EFFECT RELATIONSHIPS

Water pollution problems occur throughout the basin due to municipal, industrial, and agricultural wastes. These problems include toxic metals, algal blooms, dissolved oxygen depressions, bacterial contamination, and turbidity.

Coeur d'Alene Sub-basin: The heavy metals and phosphorus loadings that originate on the South Fork Coeur d'Alene River appear to be the major constituents causing water quality degradation in the basin. It seems groundwater leaching of old tailings deposits and tailing pond leakages contribute significantly to loadings of heavy metals in the basin.

Coeur d'Alene Lake Sub-basin: The nutrient requirements necessary for a high eutrophic condition in Coeur d'Alene Lake are present. However, heavy metals toxicity appears to suppress the algal bloom growth in some areas of the lake.

Spokane River Sub-basin: It was found that toxic levels of zinc occur in the Spokane River as a result of high zinc concentrations in Coeur d'Alene Lake. Excessive total coliform concentrations were found to occur periodically due to the city of Spokane discharging untreated sewage through storm overflows and discharging inadequately disinfected primary treated effluent. Low dissolved oxygen concentrations were found at various times in some reaches of the Spokane River and particularly in Long Lake (and Downstream) during the summer monthes. Phosphorus concentrations from the Spokane STP and industrial wastes above Stateline, in conjunction with nitrate concentrations from groundwater inflow, are believed to be the major causes of excessive algal growths in Long Lake.

CAUSE AND EFFECT RELATIONSHIPS

Coeur d'Alene River Sub-basin

Graph Set 1 - July 1974 EPA Survey South Fork Coeur d'Alene River
Figure CE-1 to CE-13

- Bunker Hill Study
Figure CE-14 to CE-16

Coeur d'Alene Lake Sub-basin

Graph Set 2 - Coeur d'Alene River At Rose Lake
Figure CE-17 to CE-23

Graph Set 3 - St.Joe River At St.Maries
Figure CE-24 to CE-30

Graph Set 4 - Spokane River At Post Falls
Figure CE-31 to CE-37

Graph Set 5 - Coeur d'Alene Lake Mass Balance
Figure CE-38 to CE-43

Graph Set 6 - Coeur d'Alene Lake
Figure CE-44 to CE-93

Spokane River Sub-basin

Graph Set 7 - Spokane River river-mile trends
Figure CE-94 to CE-107

Graph Set 8 - Hangman Creek at Mouth at Spokane Profile
Figure CE-108 to CE-122

Graph Set 9 - Little Spokane River, Two Stations' Profiles
Figure CE-123 to CE-136

FINDINGS & CONCLUSIONS

CAUSE & EFFECT RELATIONSHIPS

Coeur d'Alene River Sub-Basin Section

1. The problems in this sub-basin occur in the Southfork and Mainstem Coeur d'Alene River. The Northfork Coeur d'Alene River has very good water quality as it flows through the Coeur d'Alene National Forest showing little degradation from man related activities.

2. The number one problem in Coeur d'Alene sub-basin is heavy metals loadings. The high concentrations of Lead, Cadmium, Arsenic, Mercury, Antimony and Zinc can be directly attributed to the mining activities on the South Fork of the Coeur d' Alene River. FIG CE4 to CE8, pages 58 to 62 show the significant increases of these metals in the South Fork of the Coeur d'Alene.

3. The Bunker Hill Company was determined to be the largest contributor of heavy metals loadings in the entire Spokane River Basin.[1] They are directly responsible for high levels of Zinc, Cadmium, Lead, and in addition, Iron, Fluoride, and Phosphorous. FIG CE4, CE5, CE6, CE9, CE3, and CE10 show major increases in these water quality parameters immediately downstream of the Bunker Hill Company operations.

4. It was determined that the majority of heavy metals loadings for Zinc and Cadmium originated from uncontrolled inflows attributable to the Bunker Hill Company. These include seepage inflows from the Bunker Hill CIA Pond to the South Fork Coeur d'Alene River unpermitted discharges, violations of permitted discharges, and unidentified inflows to Silver King Creek.
   Pages 58 to 59 including Table CE14 and FIG CE16.

5. The highest levels of Arsenic and Antimony were found downstream of Big Creek (river mile 11), where the Sunshine Mining operation is located.
   FIG CE7 and CE8, pages 61 and 62.

6. Zinc concentrations exceed both the concentrations generally toxic for a salmonoid fishery (300 ug/l) and the algacidal level (80 ug/l) throughout the vast majority of the South Fork's waters (FIG CE4 page 58, mile 18 to 0). Cadmium and Lead also exceed EPA's hazard levels for their respective parameters for an aquatic environment in much the same way. FIG C-5 and C-6 page 59, 60.

[1] See Source Profile Section of this report.

FINDINGS & CONCLUSIONS

CAUSE & EFFECT RELATIONSHIPS

Coeur d'Alene River Sub-Basin Section (cont)

7. Phosphorous levels exceed the level for potential algal bloom below the Bunker Hill Company operations at river mile 6 (FIG CE10 page 64). However it should be noted that the Zinc levels in this same reach are much greater than the listed algacidal level (see 5 above).

8. The waters of the South Fork of the Coeur d'Alene River below Wallace and mainstem of the Coeur d'Alene River below the confluence with the South Fork are acutely toxic to Rainbow Trout. This acute toxicity is carried into Coeur d'Alene Lake. The toxicity is believed to be due to the high concentrations of heavy metals throughout the study area which are far in excess of literature values known to be toxic to Rainbow Trout.[2] FIG C-13 page 67.

Coeur d'Alene Lake Sub-Basin Section

*Entering-Coeur d'Alene River

1. Phosphorous concentrations entering Coeur d'Alene Lake (at Rose Lake) appeared to be directly proportional to flow, indicating erosion of old deposited tailings was the reason for these levels. FIG. CE-22, PAGE 81

2. Zinc levels entering Coeur d'Alene Lake (Rose Lake Station) appeared to be inversely related to the magnitude of flow, indicating that point sources, groundwater, or tailing pond leakage were the main source. FIG. CE-23, PAGE 82

*Entering-St. Joe River

3. There were no serious water quality problems in the St. Joe River at the sample site tested. However, there were two discharges downstream of the station which enter the slack water reach of the St. Joe River and these may contribute some nutrient loadings to Coeur d'Alene Lake. REFERENCE TABLE SP-2

*Leaving Spokane River

4. The Post Falls water quality station is important in that it functions as an interstate station between Idaho and Washington , and reflects the water quality of Coeur d'Alene Lake as well.

[2] Environmental Protection Agency, Region X, Seattle, Wash., Ronald Kreizenbeck, "Livebox Study 1974."

CAUSE & EFFECT RELATIONSHIPS

Coeur d'Alene Lake Sub-Basin Section (cont)

*Leaving Spokane River (cont)

5. Total Phosphorous concentrations leaving Coeur d'Alene Lake (Post Falls Station) exceeded the 0.05 mg/l concentration considered minimum for algal blooms from February through April of 1974. FIG. CE-36 PAGE 97

6. Zinc concentrations in the Spokane River below Coeur d'Alene Lake (Post Falls) exceeded toxic levels for a salmonoid fishery (300 ug/l) for nearly half of 1974. All concentrations exceeded the Algacidal level (80 ug/l) throughout 1974. FIG. CE-37 PAGE 98

*Lake Proper

7. During 1974 Coeur d'Alene Lake functioned as a sink for Phosphorous, Zinc, Lead, and Cadmium and as source for nitrogen. PAGES 99-105

8. Detention time for inflowing waters from the Coeur d'Alene River and the St. Joe River has been calculated to fall within the range of 40 to 120 days.

Spokane River Sub-Basin SubSection (Based on Data From 10/72-9/73)

Mainstem

1. Two tributaries, a major point source, and groundwater inflow have significant impacts on the already polluted waters of the Spokane River. Specifically, these sources include the Little Spokane River, (river mile 56.3) Hangman Creek (river mile 72.4), the Spokane STP (river mile 67.2), and the groundwater inflows in the Spokane area (river mile 70 to 90).

2. Turbidity concentrations experienced a significant increase at river mile 70 as a result of Hangman Creek during high flow. The turbidity decreased as it settled out in Long Lake between river miles 33 to 55. FIG CE98 page 185.

3. Dissolved Oxygen concentrations violated Washington Water Quality Class A standards below Long Lake during the low flow period (FIG CE100 page 187) due to eutrophic conditions in the Lake and algal activity. It is unclear whether these violations are the result of man-made or natural causes. Possible W.Q. standard reclarification of their segment may be necessary.

FINDINGS & CONCLUSIONS

CAUSE & EFFECT RELATIONSHIPS

Mainstem (cont)

4. Total Phosphorous and Dissolved Ortho-Phosphorous levels exceeded the potential algal bloom concentration downstream of the Spokane STP during both high and low flow periods. It appears that the Spokane STP is the major source of Phosphorous in the Spokane River. In addition, Hangman Creek is a significant source of total Phosphorous during the high flow runoff. FIG CE101, CE102, pages 188, 189.

5. Nitrate (NO2+NO3) concentrations exceed the potential level for algal blooms (.3 mg/l) below Hangman Creek during high flow periods (Dec.-Feb) due to non-point source loadings from runoff. During low flow periods, (July thru Sept) Nitrate concentrations exceed the potential level for algal blooms from the area above Spokane downstream through Long Lake due to groundwater inflows from river miles 70 to 90 in the Spokane area. During the Dec. to Feb. high flow period, the effects of these groundwater inflows are minimized. FIG CE103 page 190.

6. Ammonia and Kjeldahl Nitrogen levels significantly increase below the Spokane STP (river mile 67.2) during both the high and low flow periods. FIG CE104, C-105 page 191, 192.

7. High Zinc concentrations from the upper reaches of the Spokane River were diluted by groundwater inflows between river miles 70 to 90 and the Little Spokane River at mile 55 to such an extent that by the time they reach Long Lake they were below the general salmonoid fishery toxic level during both high and low flow periods and below the algacidal level during low flow (July to Sept). FIG CE97 page 184

8. Total Coliform counts exceeded Washington Class A Water Quality Standards as they entered Washington at river mile 98 and continued to exceed standard levels downstream to Long Lake, approximately river mile 40 during both high and low flow periods. The waters leaving Long Lake were within standard levels (river mile 33). FIG CE107 page 194.

CAUSE & EFFECT RELATIONSHIPS

Hangman Creek

1. Hangman Creek enters the Spokane River at river mile 74.2 predominately influenced by seasonal runoff.

2. Highly variable flow is an important characteristic of the stream as it ranges from 2 to 400 cfs and greatly influences water quality .
   FIG CE109 page 197.

3. Turbidity is directly related to flow, ranging from levels near 1000 JTU during high flow (Dec-Mar).
   FIG CE111 page 199.

4. Non-point source runoff from agricultural lands resulted in high concentrations of Nitrate, Ammonia, Phosphorous, and bacteria during high flow (Dec-Mar).
   FIG CE117,to CE121, pages 205 to 209.

5. Nitrate concentrations exceeded the potential level for algal blooms (.3 mg/l) the entire year while Phosphorous and Dissolved Ortho-Phosphorous concentrations exceeded it during moderate to high flow periods only (Dec-June).
   FIG CE117,CE119,CE120, pages 205, 207, 208.

6. pH values exceeded the Washington Class A Standard of 8.5 during the period of October and April through July.
   FIG CE114, page 202.

7. The measured Dissolved Oxygen concentration met the Washington Class A Water Quality Standard the entire year. However, it is suspected that depressions may occur diurnally due to algal activity.
   FIG CE113, page 201.

Little Spokane River

1. The Little Spokane River enters the Spokane River at river mile 56.3 and in contrast with Hangman Creek it is predominately influenced by groundwater inflow.

2. Between the mouth of the Little Spokane River and the city of Wandermere flow measurements indicate 200 to 250 cfs of groundwater inflow are present.
   FIG CE123, page 212.

CAUSE & EFFECT RELATIONSHIPS

Little Spokane River (cont)

3. Nitrate concentrations exceeded algal bloom potential level the entire year and the major source appears to be groundwater inflow.
   FIG CE130, page 219.

4. Ammonia Nitrogen concentrations exceeded the .2 mg/l level indicating organic pollution during high flow in Feb-Mar.
   FIG CE131, page 220.

5. Total Phosphorous concentrations exceeded algal bloom potential level during the high flow periods (Dec-March). Dissolved Ortho-Phosphorous levels exceeded it for most of the year. Phosphorous levels are directly related to river flow indicating the contribution to be of non-point source origin.
   FIG CE133, page 222.

6. The measured Dissolved Oxygen concentration met the Washington Class A Water Quality Standard the entire year. However, it is suspected that depressions may occur diurnally due to algal activity.
   FIG CE129, page 218.

7. Bacteria levels exceeded the Washington Class A Standard throughout most of the year with the highest levels occuring during the high flow period of December through March indicating contributions from non-point source origins.
   FIG CE135, page 224.

GRAPH SET 1

Coeur d'Alene River Sub-basin

This first set of graphs presents the data collected during the July 1974 EPA survey on the South Fork Coeur d'Alene River. Below the graphs are the significant inflows located appropriately along the river mile axis. The consistency of the trends throughout the range of parameters included indicates the Bunker Hill Company is the major contributor of heavy metals loadings and the South Fork as being a definite water quality problem area.

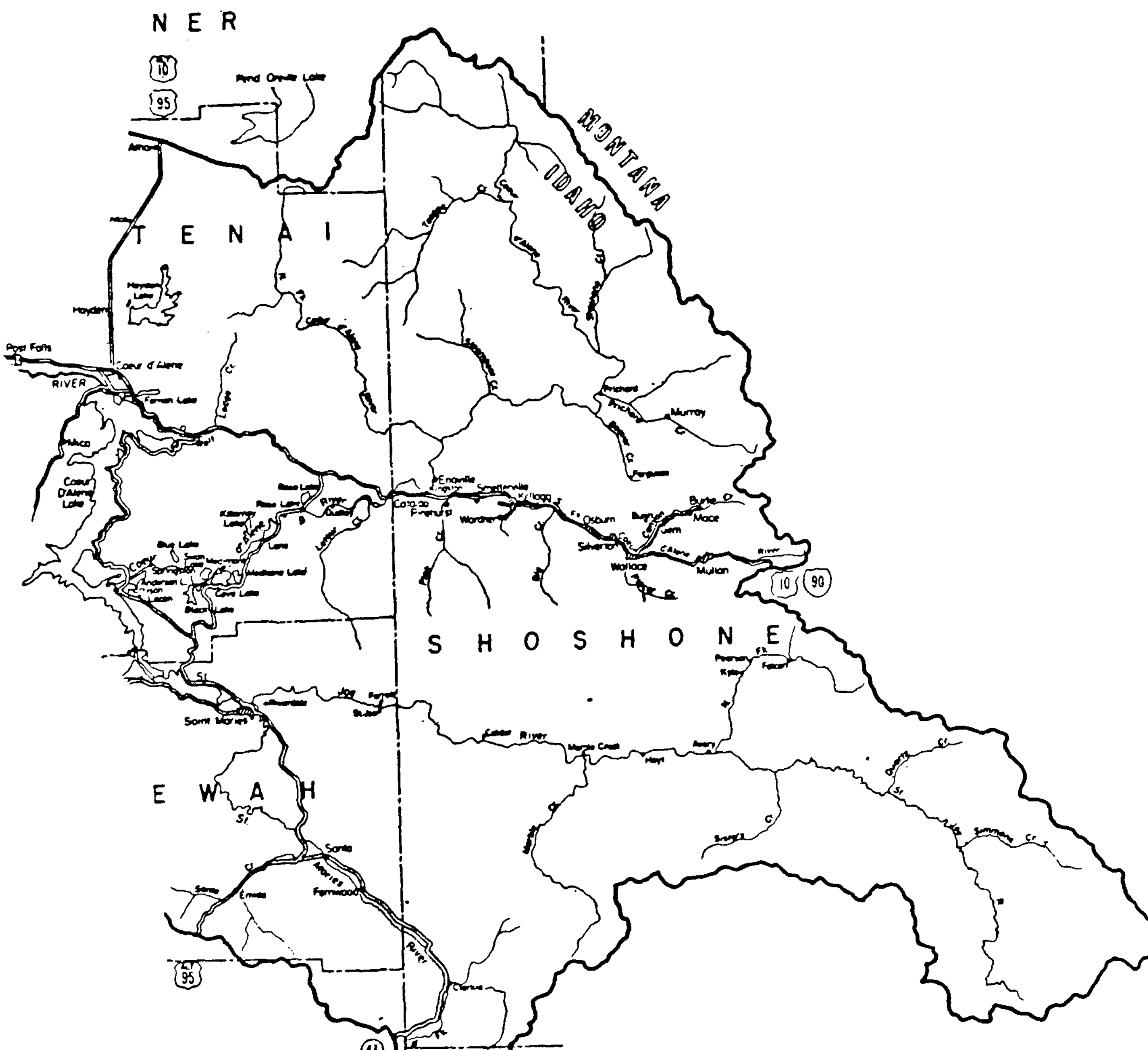


FIGURE CE-1

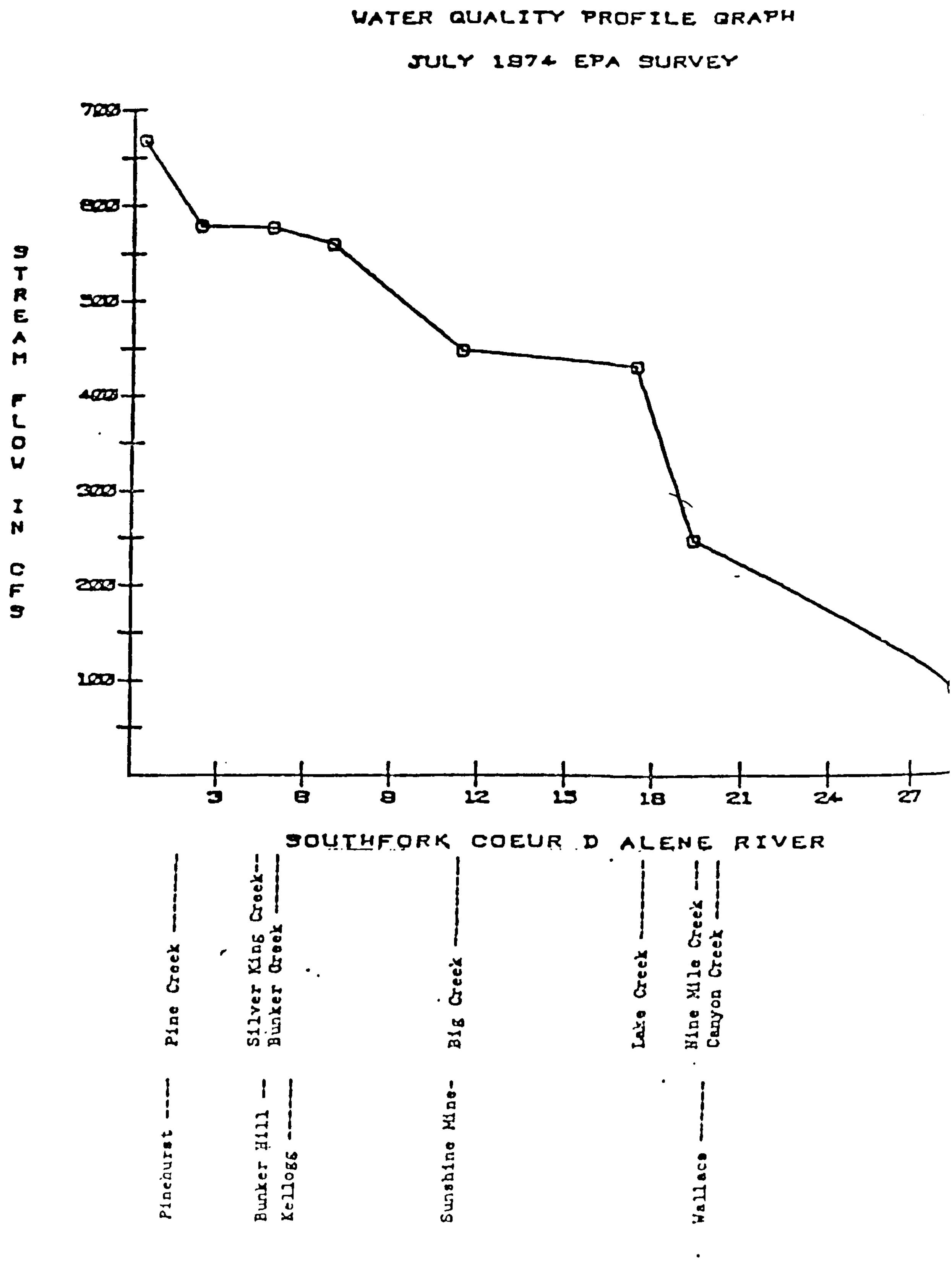

WATER QUALITY PROFILE GRAPH
JULY 1974 EPA SURVEY
STREAM FLOW IN CFS
700
600
500
400
300
200
100
3
6
9
12
15
18
21
24
27
SOUTHFORK COEUR D ALENE RIVER
Pine Creek
Silver King Creek
Bunker Creek
Big Creek
Lake Creek
Nine Mile Creek
Canyon Creek
Pinehurst
Bunker Hill
Kellogg
Sunshine Mine
Wallace

FIGURE CE-2

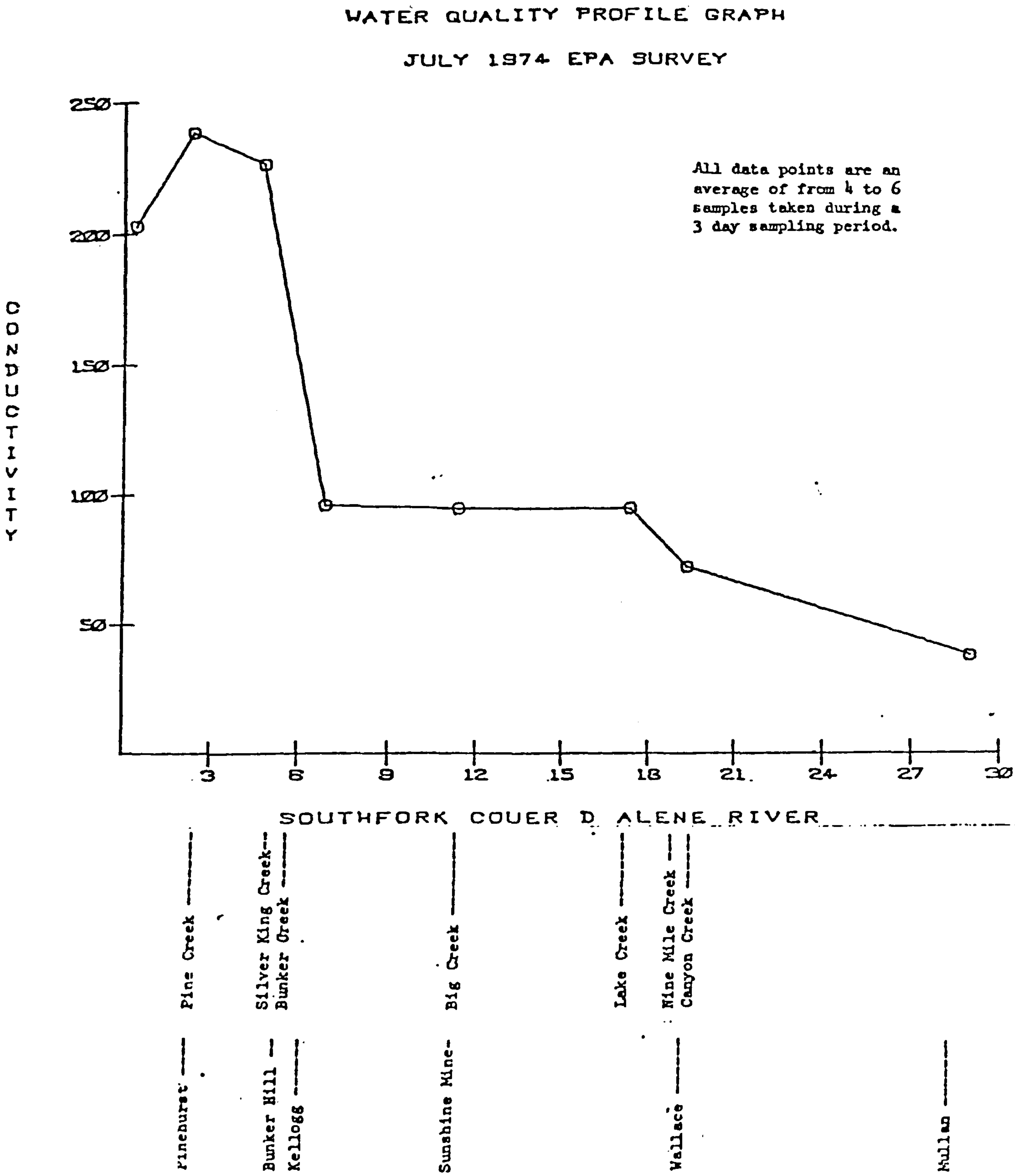
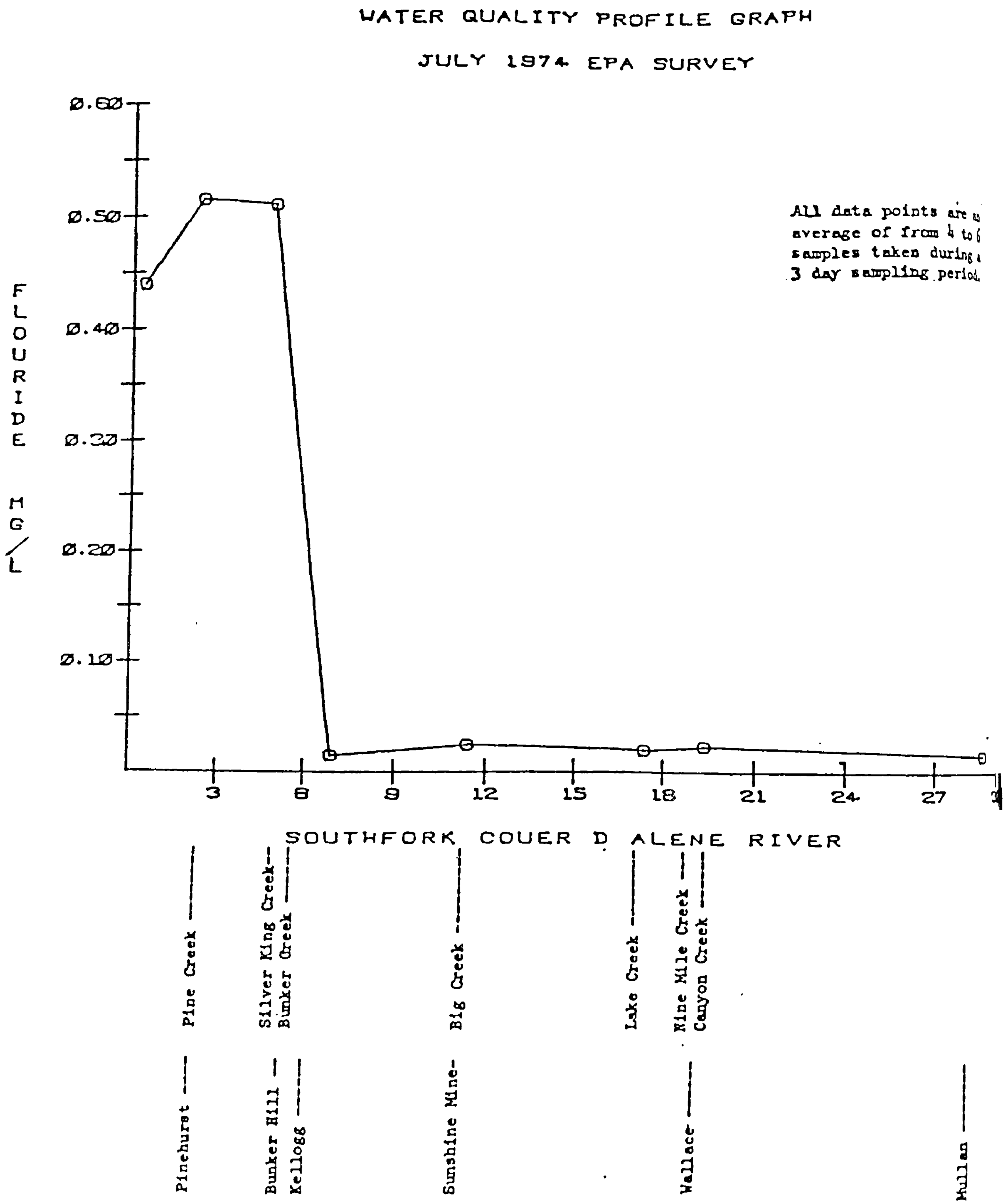

WATER QUALITY PROFILE GRAPH
JULY 1974 EPA SURVEY
All data points are an average of from 4 to 6 samples taken during a 3 day sampling period.
CONDUCTIVITY
250
200
150
100
50
3
6
9
12
15
18
21
24
27
30
SOUTHFORK COUER D ALENE RIVER
Pine Creek
Silver King Creek
Bunker Creek
Big Creek
Lake Creek
Nine Mile Creek
Canyon Creek
Pinehurst
Bunker Hill
Kellogg
Sunshine Mine
Wallace
Mullan

FIGURE CE-3


WATER QUALITY PROFILE GRAPH
JULY 1974 EPA SURVEY
FLOURIDE MG/L
Ø.6Ø
Ø.5Ø
Ø.4Ø
Ø.3Ø
Ø.2Ø
Ø.1Ø
All data points are an average of from 4 to 6 samples taken during a 3 day sampling period.
3
6
9
12
15
18
21
24
27
SOUTHFORK COUER D ALENE RIVER
Pine Creek
Silver King Creek
Bunker Creek
Big Creek
Lake Creek
Nine Mile Creek
Canyon Creek
Pinehurst
Bunker Hill
Kellogg
Sunshine Mine
Wallace
Mullan

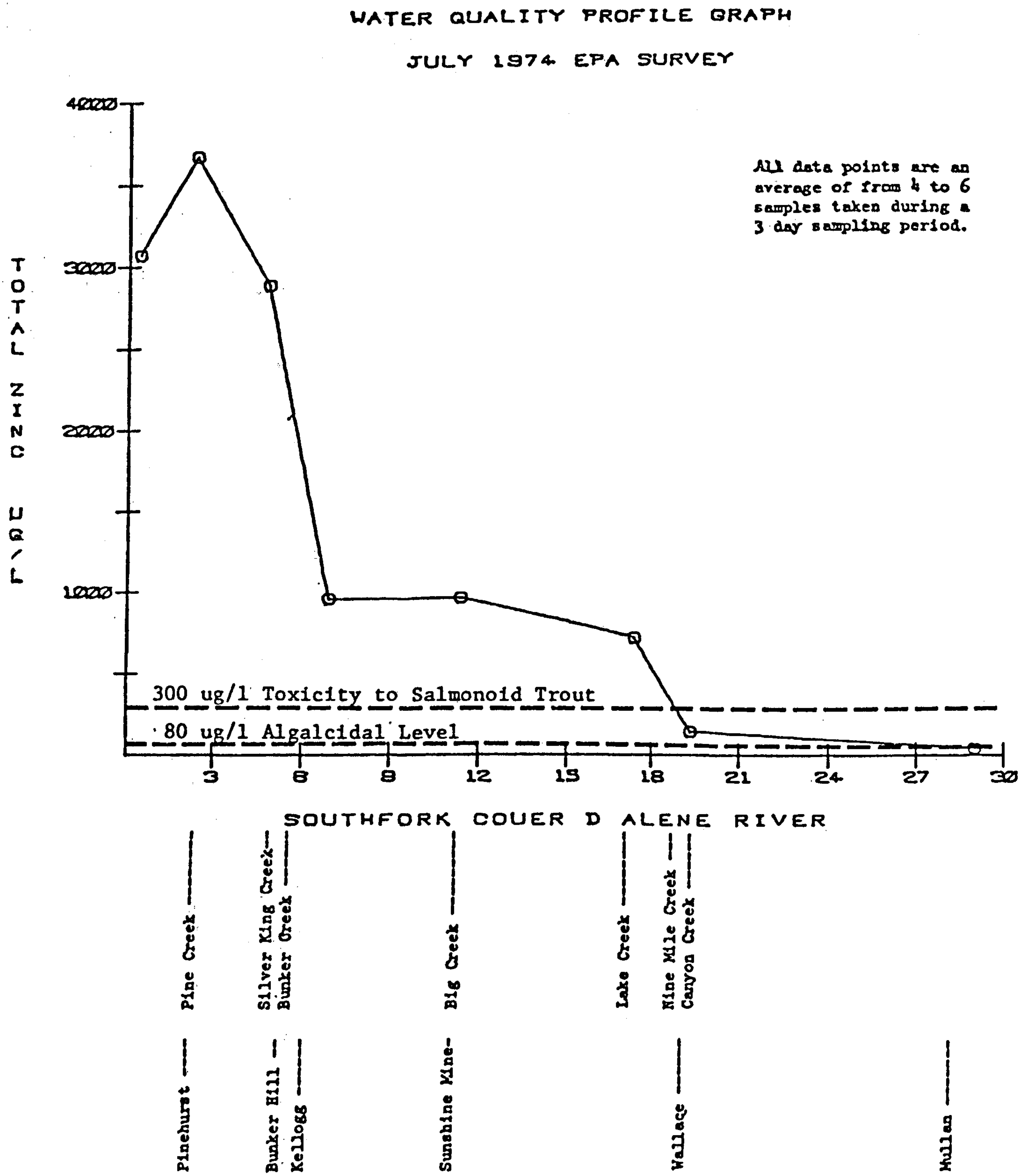

WATER QUALITY PROFILE GRAPH
JULY 1974 EPA SURVEY
TOTAL ZINC UG/L
4000
3000
2000
1000
All data points are an average of from 4 to 6 samples taken during a 3 day sampling period.
300 ug/l Toxicity to Salmonoid Trout
80 ug/l Algalcidal Level
3
6
9
12
15
18
21
24
27
30
SOUTHFORK COUER D ALENE RIVER
Pine Creek
Silver King Creek
Bunker Creek
Big Creek
Lake Creek
Nine Mile Creek
Canyon Creek
Pinehurst
Bunker Hill
Kellogg
Sunshine Mine
Wallace
Mullan

FIGURE CE-5

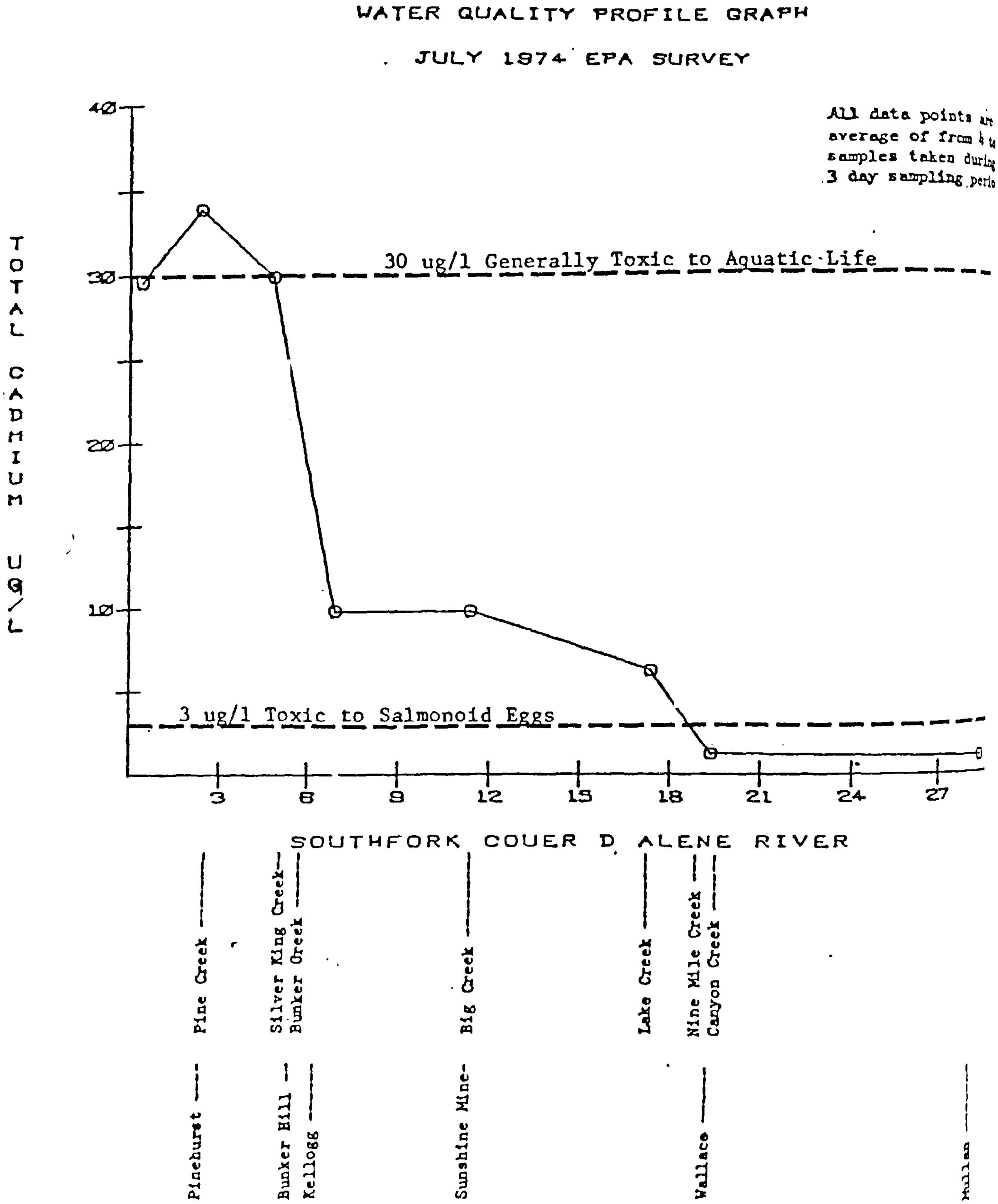

WATER QUALITY PROFILE GRAPH
JULY 1974 EPA SURVEY
All data points are average of from 4 to samples taken during 3 day sampling period
TOTAL CADMIUM UG/L
40
30
20
10
30 ug/l Generally Toxic to Aquatic Life
3 ug/l Toxic to Salmonoid Eggs
3
6
9
12
15
18
21
24
27
SOUTHFORK COUER D ALENE RIVER
Pine Creek
Silver King Creek
Bunker Creek
Big Creek
Lake Creek
Nine Mile Creek
Canyon Creek
Pinehurst
Bunker Hill
Kellogg
Sunshine Mine
Wallace
Mullan

FIGURE CE-6

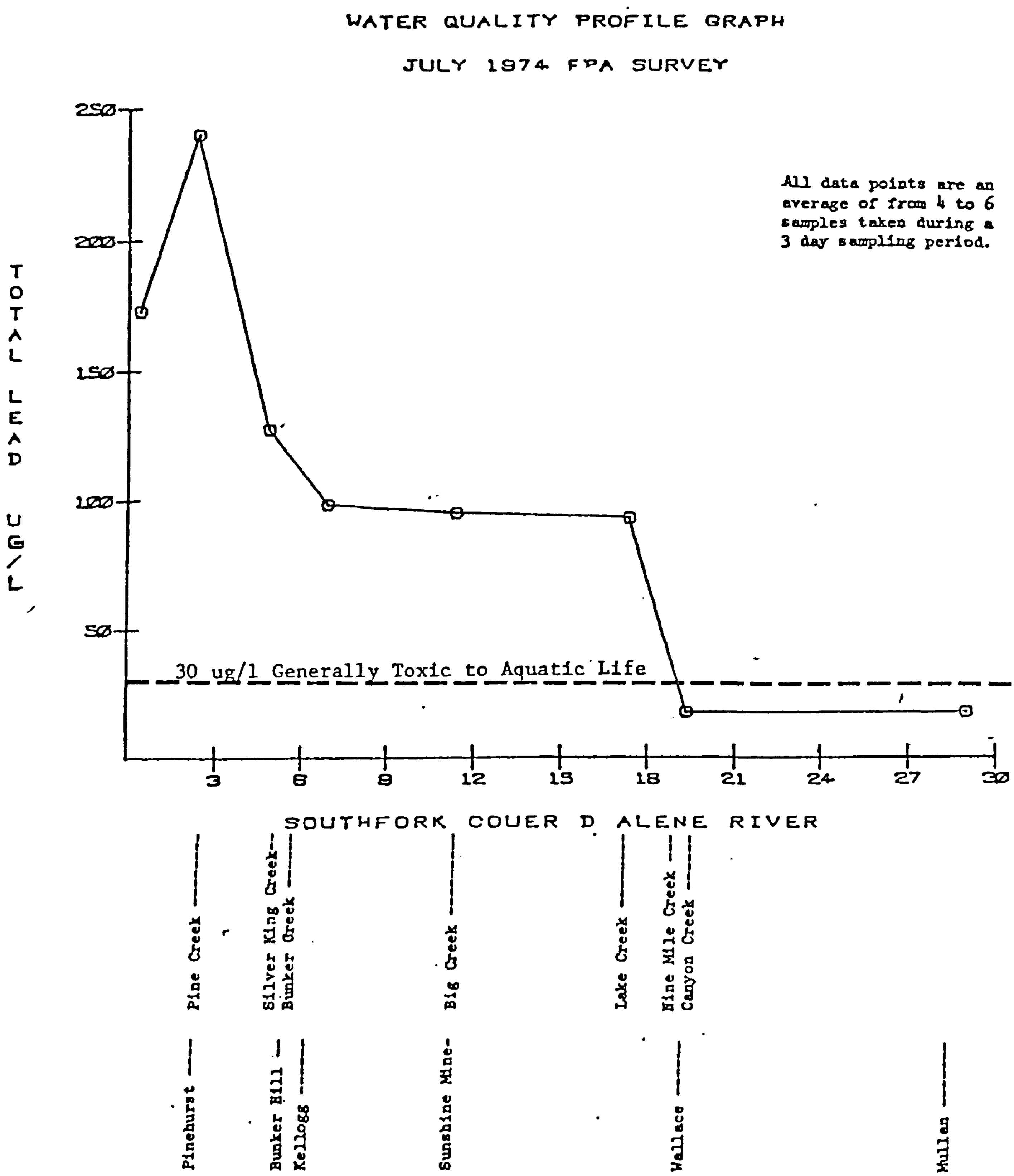

WATER QUALITY PROFILE GRAPH
JULY 1974 EPA SURVEY
All data points are an average of from 4 to 6 samples taken during a 3 day sampling period.
TOTAL LEAD UG/L
250
200
150
100
50
30 ug/1 Generally Toxic to Aquatic Life
3
6
9
12
15
18
21
24
27
30
SOUTHFORK COUER D ALENE RIVER
Pine Creek
Silver King Creek
Bunker Creek
Big Creek
Lake Creek
Nine Mile Creek
Canyon Creek
Pinehurst
Bunker Hill
Kellogg
Sunshine Mine
Wallace
Mullan

FIGURE CE-7

WATER QUALITY PROFILE GRAPH

JULY 1974 EPA SURVEY

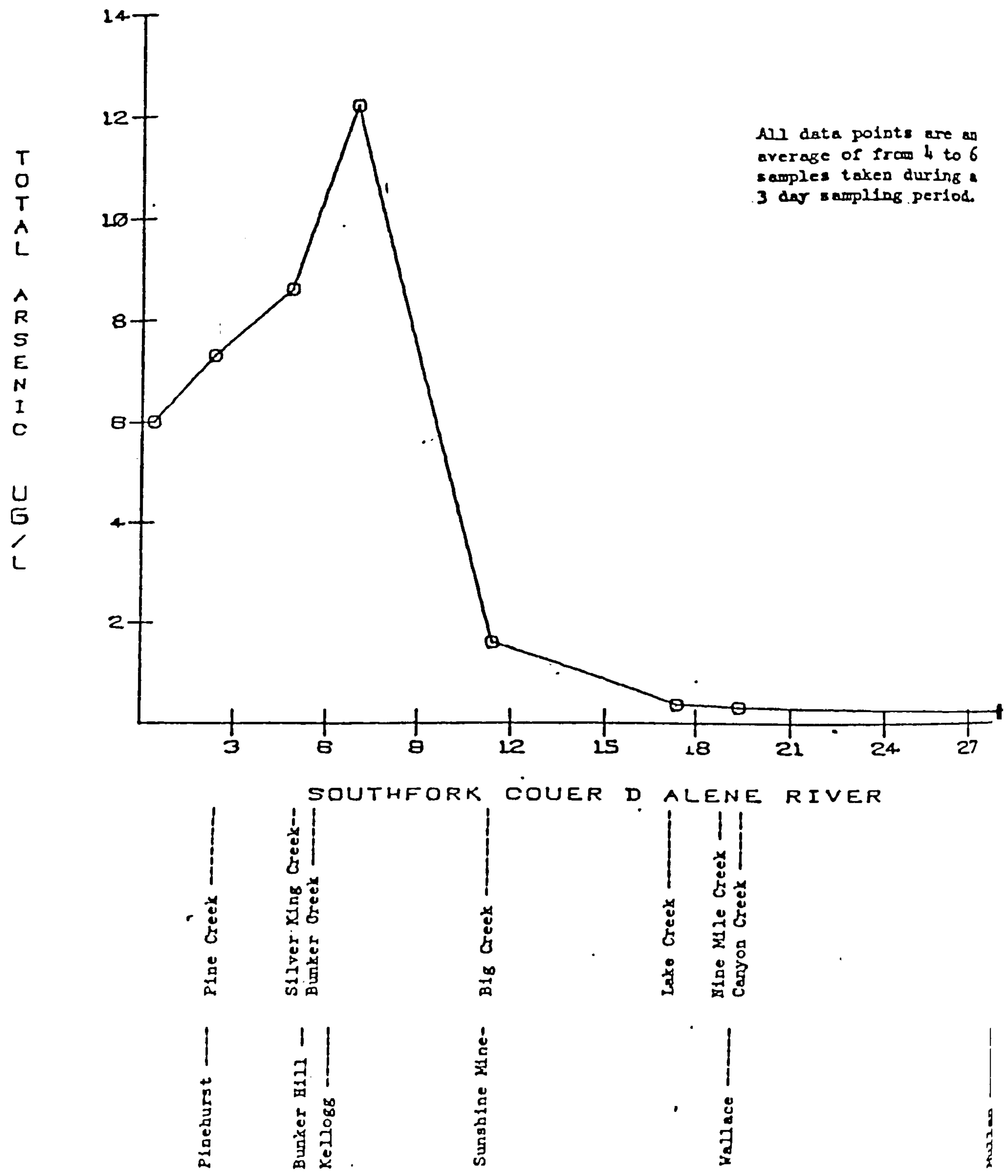


FIGURE CE-8

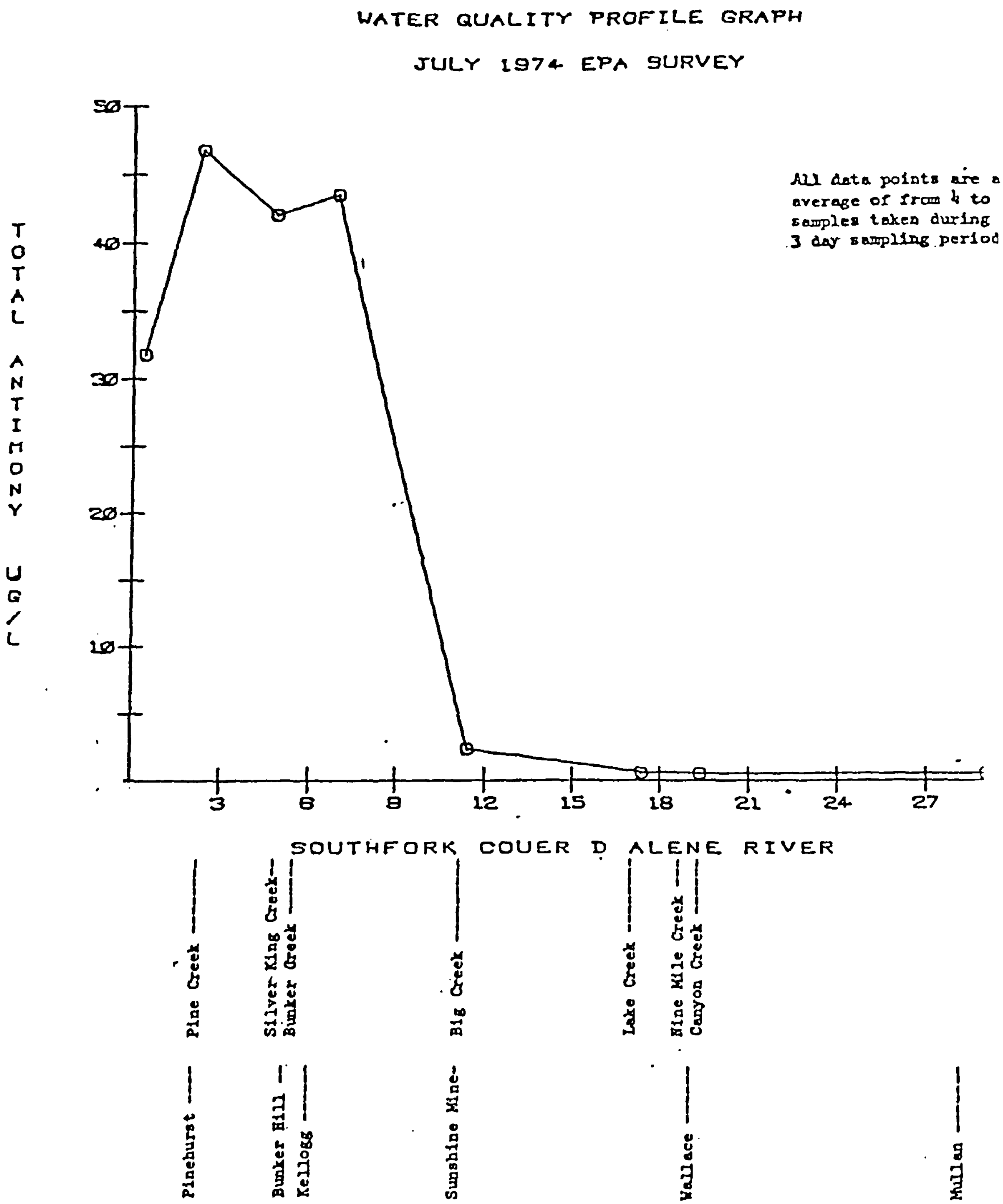

WATER QUALITY PROFILE GRAPH
JULY 1974 EPA SURVEY
TOTAL ANTIMONY UG/L
50
40
30
20
10
3
6
8
12
15
18
21
24
27
All data points are a average of from 4 to samples taken during 3 day sampling period
SOUTHFORK COUER D ALENE RIVER
Pine Creek
Silver King Creek
Bunker Creek
Big Creek
Lake Creek
Nine Mile Creek
Canyon Creek
Pinehurst
Bunker Hill
Kellogg
Sunshine Mine
Wallace
Mullan

FIGURE CE-9

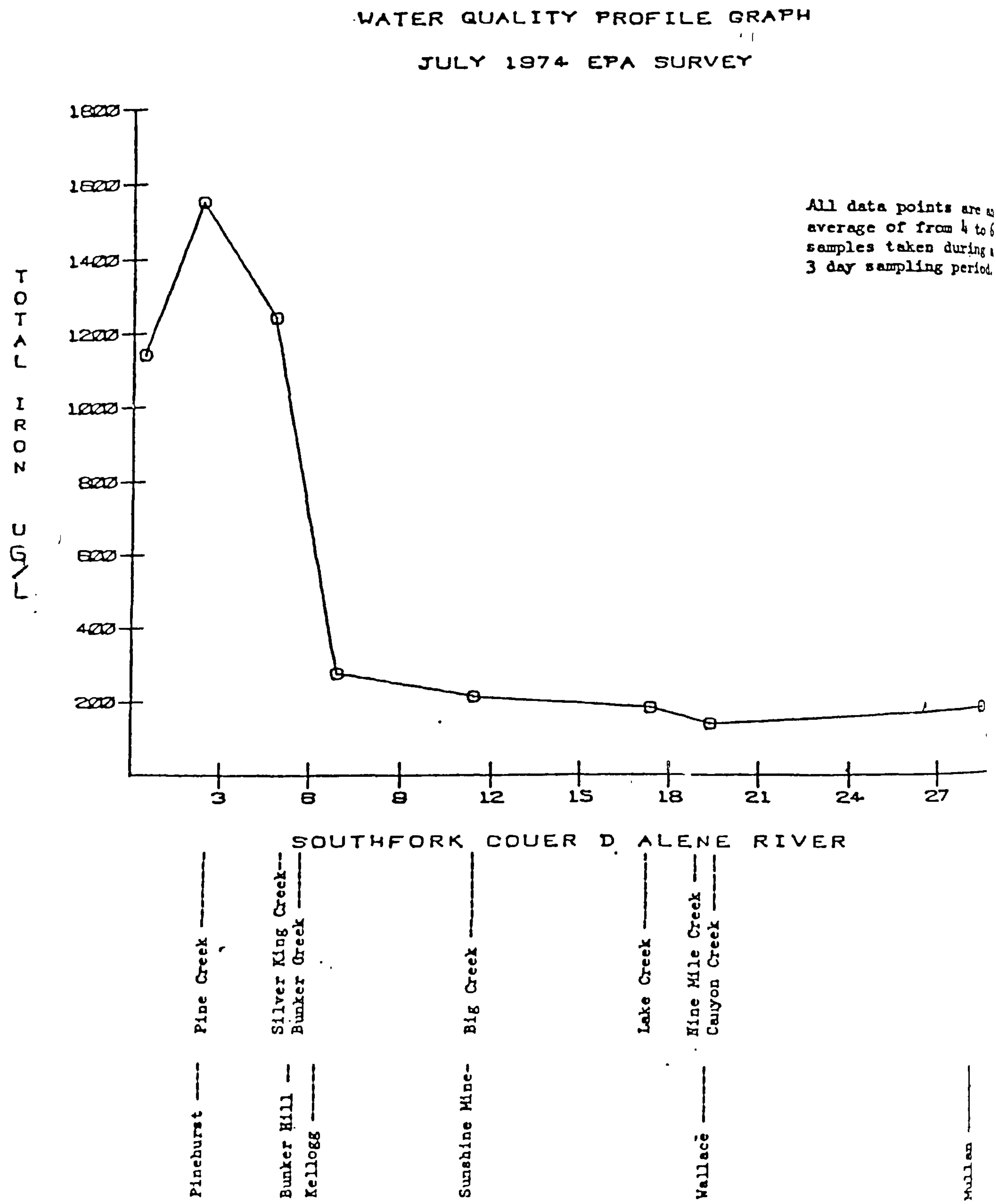

WATER QUALITY PROFILE GRAPH
JULY 1974 EPA SURVEY
All data points are an average of from 4 to 6 samples taken during a 3 day sampling period.
TOTAL IRON UG/L
1800
1600
1400
1200
1000
800
600
400
200
3
6
9
12
15
18
21
24
27
SOUTHFORK COUER D ALENE RIVER
Pine Creek
Silver King Creek
Bunker Creek
Big Creek
Lake Creek
Nine Mile Creek
Canyon Creek
Pinehurst
Bunker Hill
Kellogg
Sunshine Mine
Wallace
Mullan

FIGURE CE-10

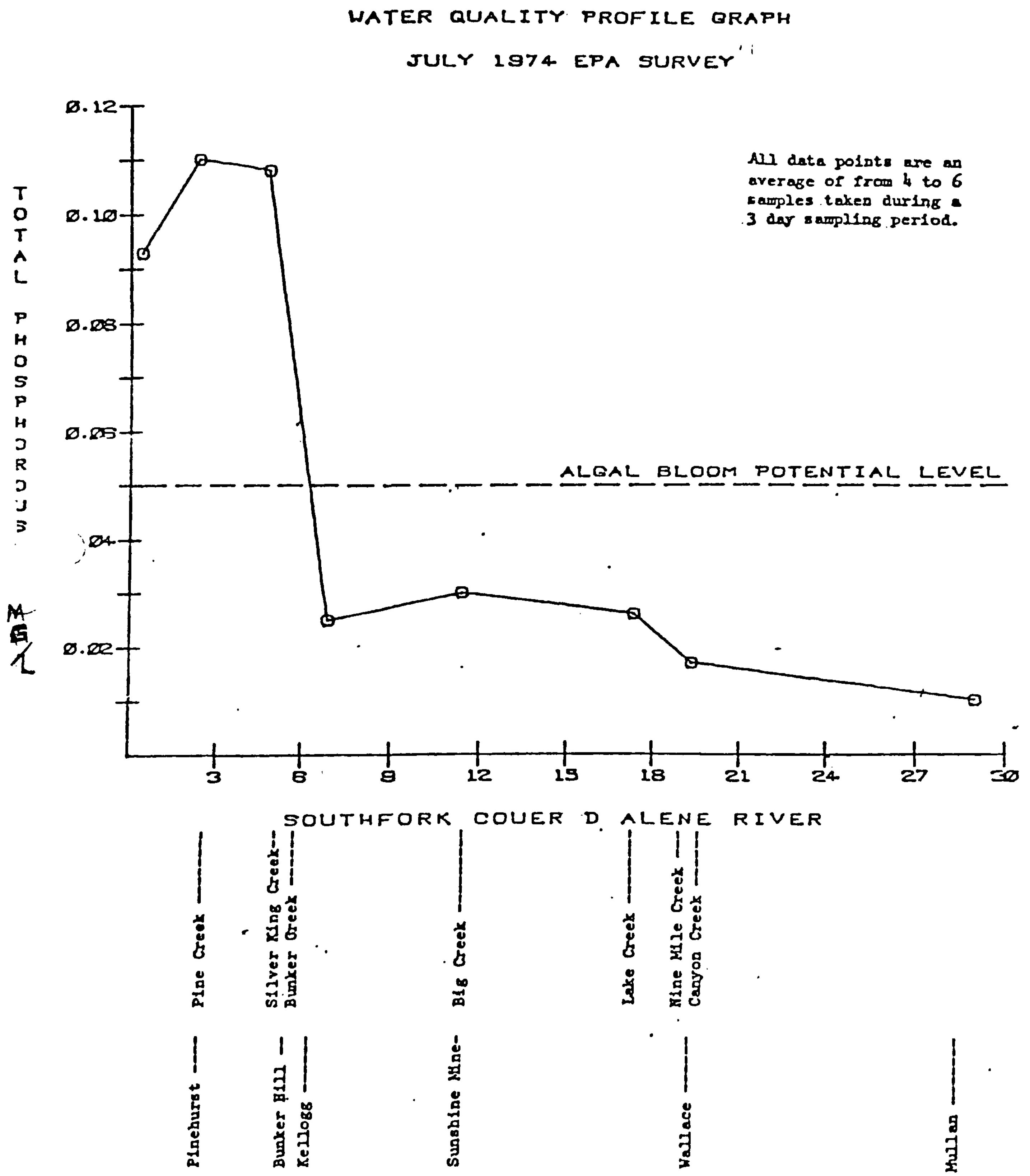

WATER QUALITY PROFILE GRAPH
JULY 1974 EPA SURVEY
TOTAL PHOSPHOROUS
MG/L
Ø.12
Ø.10
Ø.08
Ø.06
Ø4
Ø.02
All data points are an average of from 4 to 6 samples taken during a 3 day sampling period.
ALGAL BLOOM POTENTIAL LEVEL
3
6
9
12
15
18
21
24
27
30
SOUTHFORK COUER D ALENE RIVER
Pine Creek
Silver King Creek
Bunker Creek
Big Creek
Lake Creek
Nine Mile Creek
Canyon Creek
Pinehurst
Bunker Hill
Kellogg
Sunshine Mine
Wallace
Mullan

FIGURE CE-11

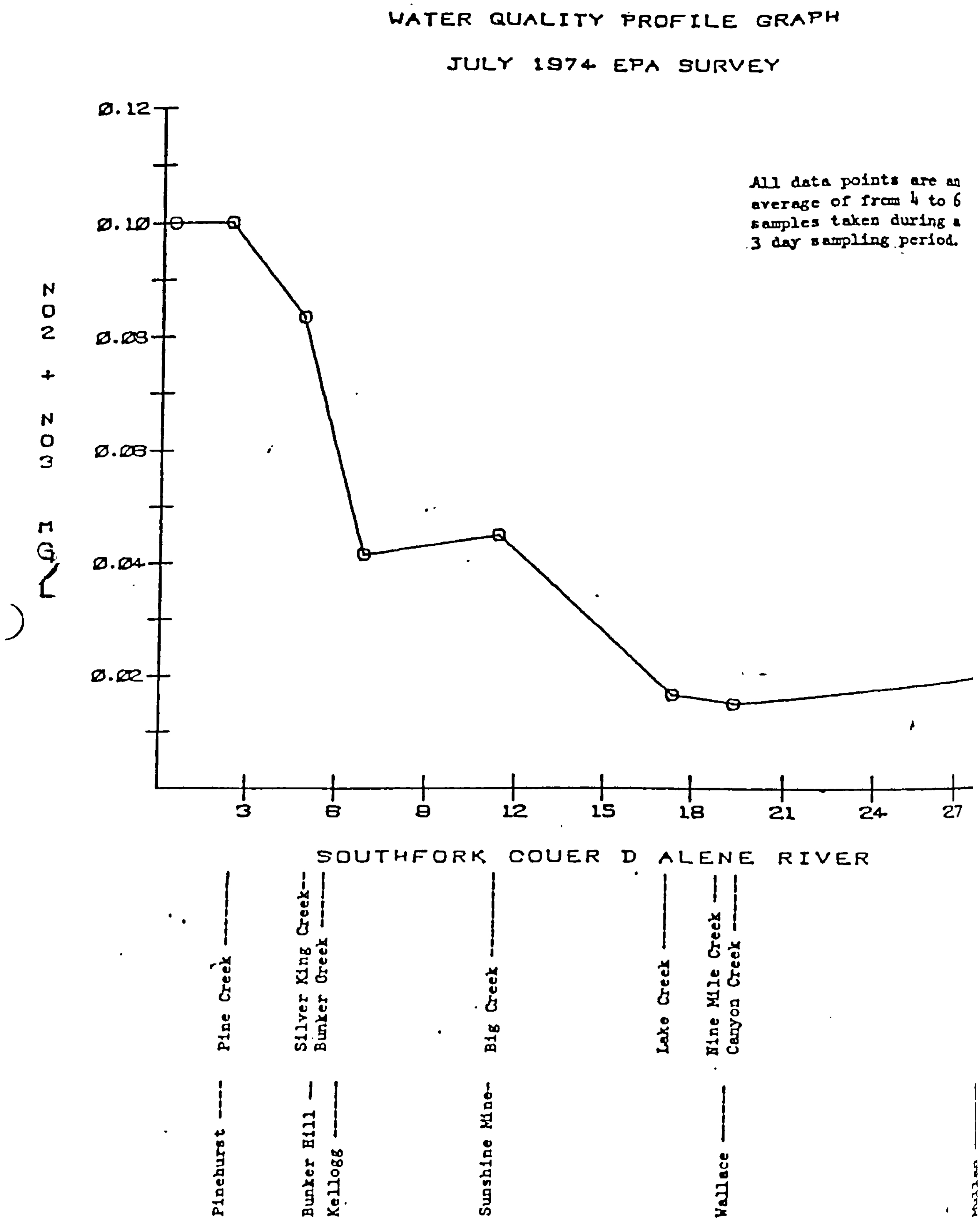
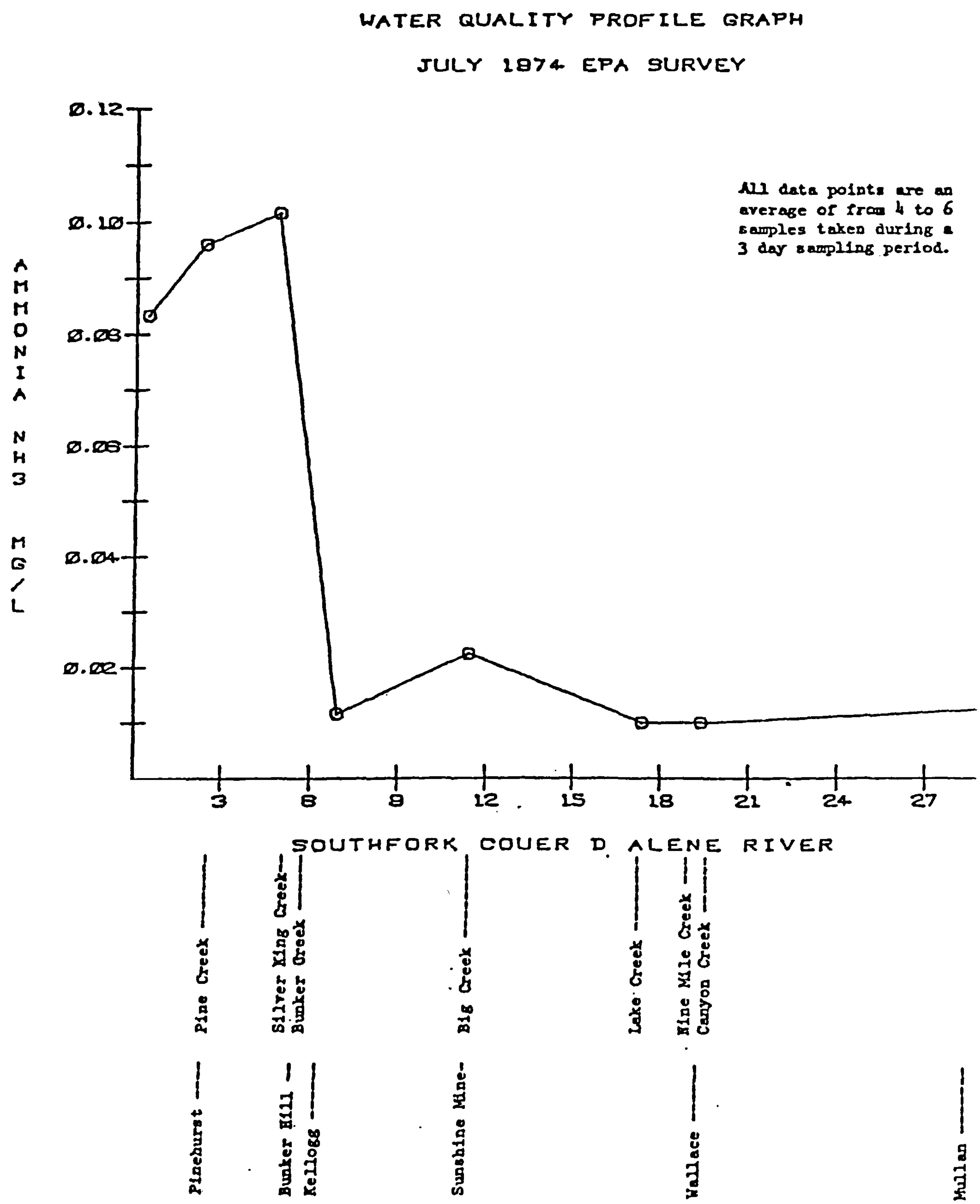
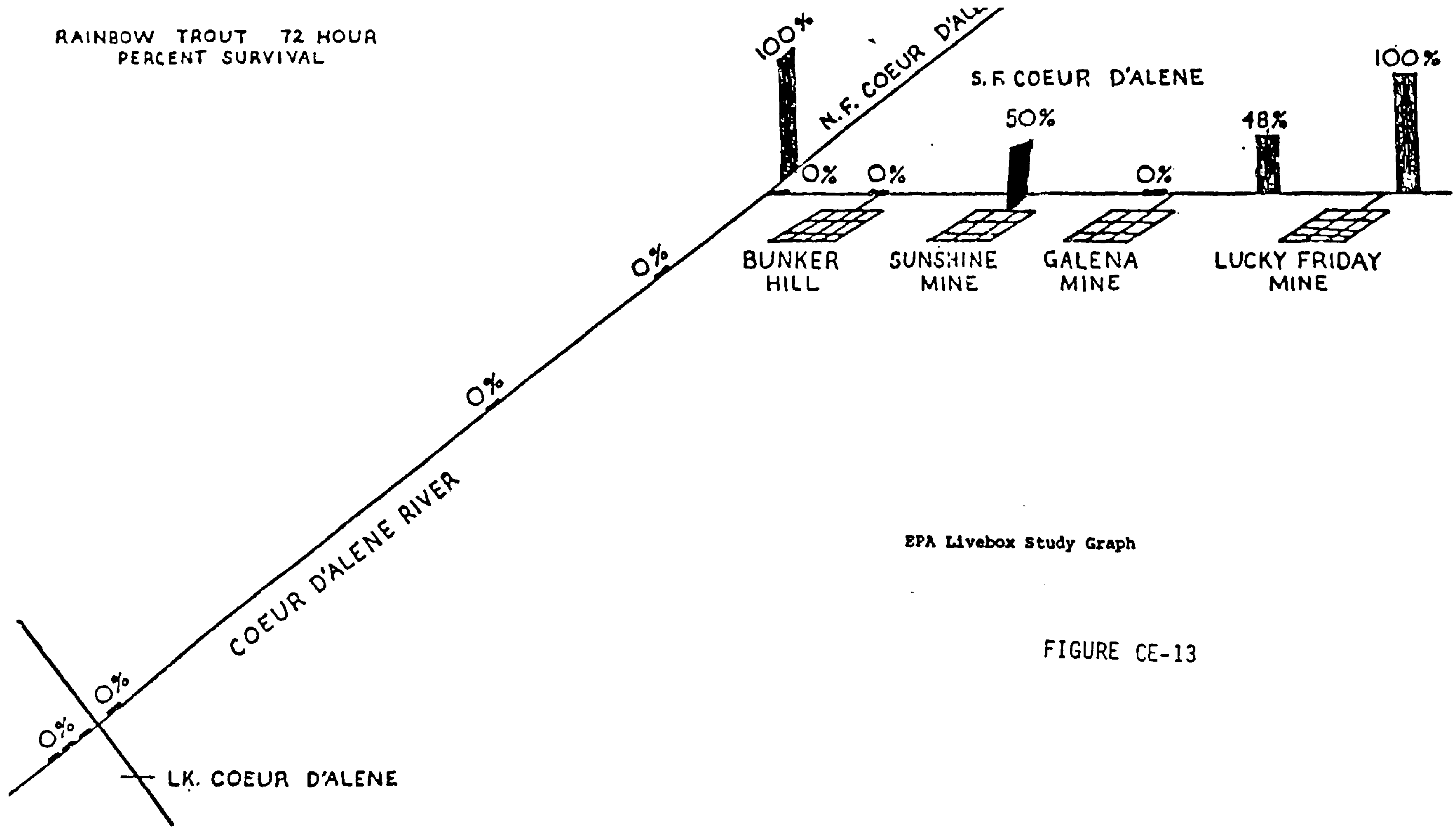

WATER QUALITY PROFILE GRAPH
JULY 1974 EPA SURVEY
All data points are an average of from 4 to 6 samples taken during a 3 day sampling period.
NO2 + NO3 MG/L
0.12
0.10
0.08
0.06
0.04
0.02
3
6
9
12
15
18
21
24
27
SOUTHFORK COUER D ALENE RIVER
Pine Creek
Silver King Creek
Bunker Creek
Big Creek
Lake Creek
Nine Mile Creek
Canyon Creek
Pinehurst
Bunker Hill
Kellogg
Sunshine Mine
Wallace

FIGURE CE-12


WATER QUALITY PROFILE GRAPH
JULY 1974 EPA SURVEY
All data points are an average of from 4 to 6 samples taken during a 3 day sampling period.
AMMONIA NH3 MG/L
Ø.12
Ø.10
Ø.08
Ø.06
Ø.04
Ø.02
3
6
9
12
15
18
21
24
27
SOUTHFORK COUER D ALENE RIVER
Pine Creek
Silver King Creek
Bunker Creek
Big Creek
Lake Creek
Nine Mile Creek
Canyon Creek
Pinehurst
Bunker Hill
Kellogg
Sunshine Mine
Wallace
Mullan



EPA Livebox Study Graph

FIGURE CE-13

LEAKAGES AND OTHER INFLOWS TO THE SOUTH FORK COEUR D'ALENE RIVER IN THE BUNKER HILL AREA

In the last three years, several EPA-Idaho water quality surveys have identified two uncontrolled areas of major heavy metals pollution in the South Fork Coeur d'Alene River near the mining operations of the Bunker Hill Company (river Mile 4.9 to 6.9). The first is a severe [redacted] pollution problem attributable to leakage or seepage inflows from the Bunker Hill CIA Pond and Slag Pile. The second is the occurence of unidentified inflows, unpermitted discharges, and violations of permitted discharges to Silver King Creek, a tributary of the South Fork Coeur d'Alene River.

The relative loadings and percent contributions for all sources of zinc, cadmium, and lead are summarized in Table CE-14, page 69, for the South Fork Coeur d'Alene River (based on the October 1974 EPA survey). It is evident from the data that the major loading contributions of zinc and cadmium come from presently uncontrolled sources in the area of the Bunker Hill Company. These sources account for 66% of the zinc (3250 #/D) and 74% of the cadmium (34 #/D) for the entire South Fork basin. Seepage inflows entering the South Fork Coeur d'Alene River from the Bunker Hill CIA Pond account for approximately 28% of the zinc (1350 #/D) and 7% of the cadmium (3 #/D).

The location and effect of the seepage inflows for conductivity (associated with heavy metals)and zinc are graphically depicted on Figures CE-15 and CE-16, pages 70 and 71 ,(based on a March 1975 EPA survey).

FIGURE CE-14

LOADINGS AND PERCENT CONTRIBUTIONS

SOUTHFORK COEUR D'ALENE RIVER
OCTOBER 1974 EPA SURVEY

SOURCE	TOTAL ZINC		TOTAL CADMIUM		TOTAL LEAD	
	#/Day	%	#/Day	%	#/Day	%
All other sources including headwaters and other industries	1590	32%	10	22%	80	67%
Bunker Hill CIA Main Effluent	60	1%	2	4%	5	4%
Seepage Inflows from the Bunker Hill CIA Pond and Slag pile	1350	28%	3	7%	15	13%
SILVER KING CREEK						
Bunker Hill #004 Eff. (in permit violation)	300	6%	19	41%	4	3%
Bunker Hill Zinc Plt. Creek	800	16%	10	22%	3	2%
Unidentified inflows to Silver King Creek	800	16%	2	4%	13	11%
TOTAL BASIN LOADING	4900	100%	46	100%	120	100

FIGURE CE-15

BUNKER HILL CIA POND SEEPAGE INFLOWS
SOUTHFORK COEUR D ALENE RIVER
MARCH 1975 EPA SURVEY

CONDUCTIVITY IN UMHO/CM

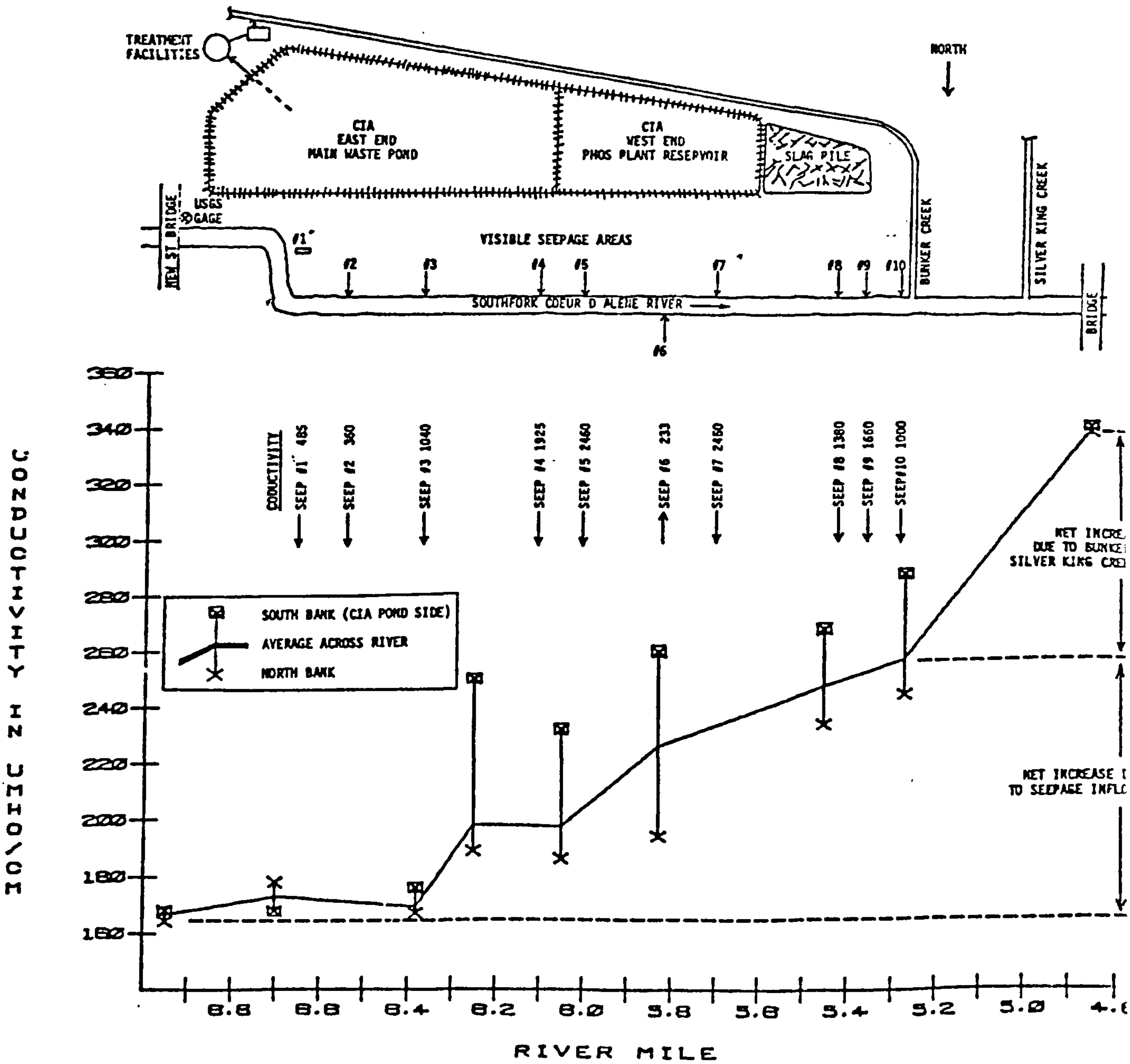
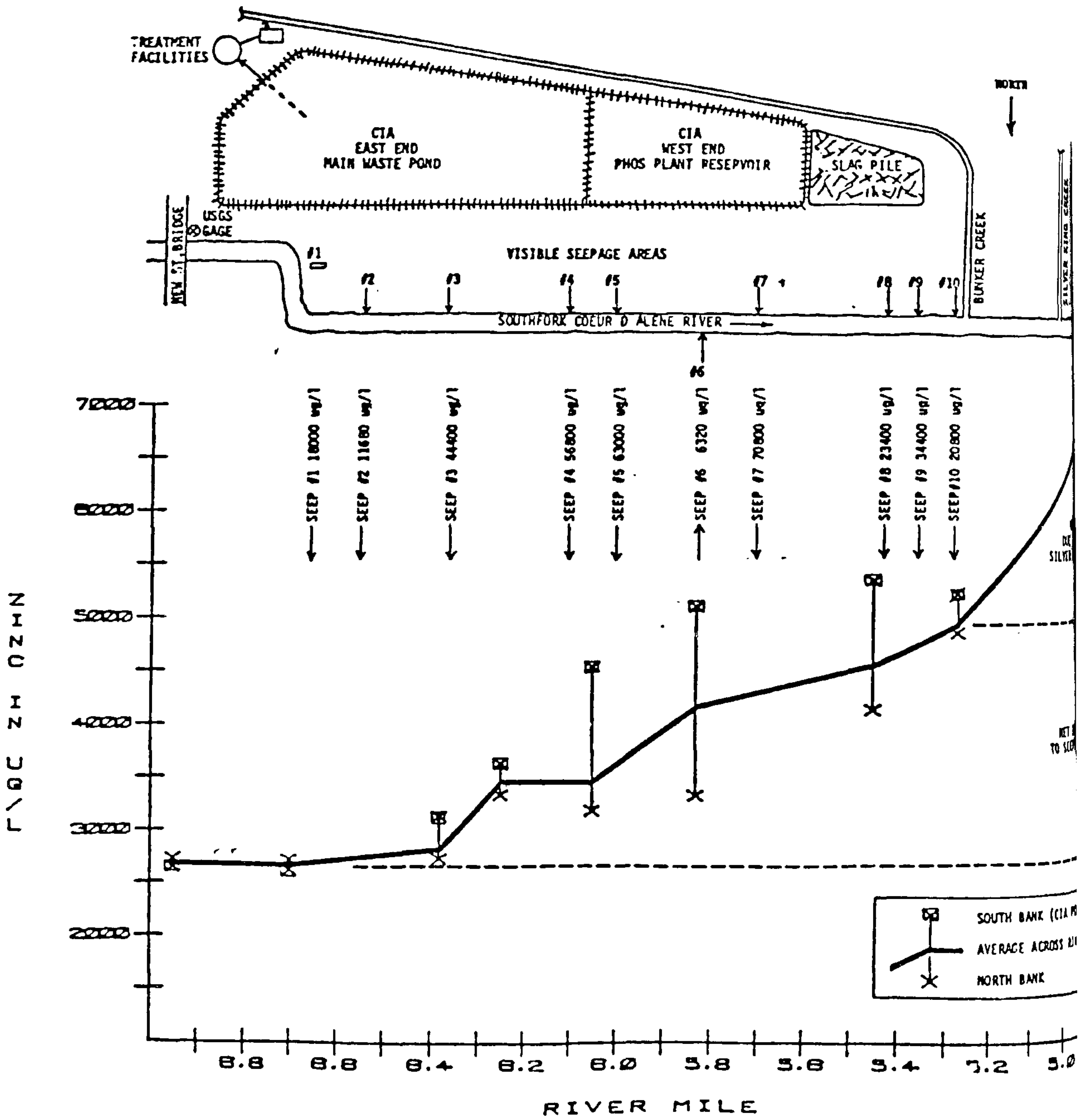


FIGURE CE-16

BUNKER HILL CIA POND SEEPAGE INFLOWS
SOUTHFORK COEUR D ALENE RIVER
MARCH 1975 EPA SURVEY

TOTAL ZINC IN UG/L



COEUR D'ALENE LAKE SUB-BASIN SECTION

COEUR D 'ALENE LAKE SUB-BASIN

(TABLE OF CONTENTS)

COEUR D' ALENE LAKE SUB-BASIN OVERVIEW

Graph sets 2, 3, and 4 show the water quality conditions for the Coeur d'Alene River at Rose Lake, the St. Joe River at St. Maries, and the Spokane River at Post Falls respectively.

In one sense they are supporting data for the following series of graphs concerning Coeur d'Alene Lake: the mass balance graphs (Set No.5) and the vertical profiles, time plots, and lake mile graphs (Set No.6). In addition, they allow the reader to analyze individual seasonal variations, problem areas, and the general status of each of their locations, as they best represent their net effect on the entire basin.

The location of river stations defined in graph set 2, 3, and 4 are shown on the map in Figure C-17.

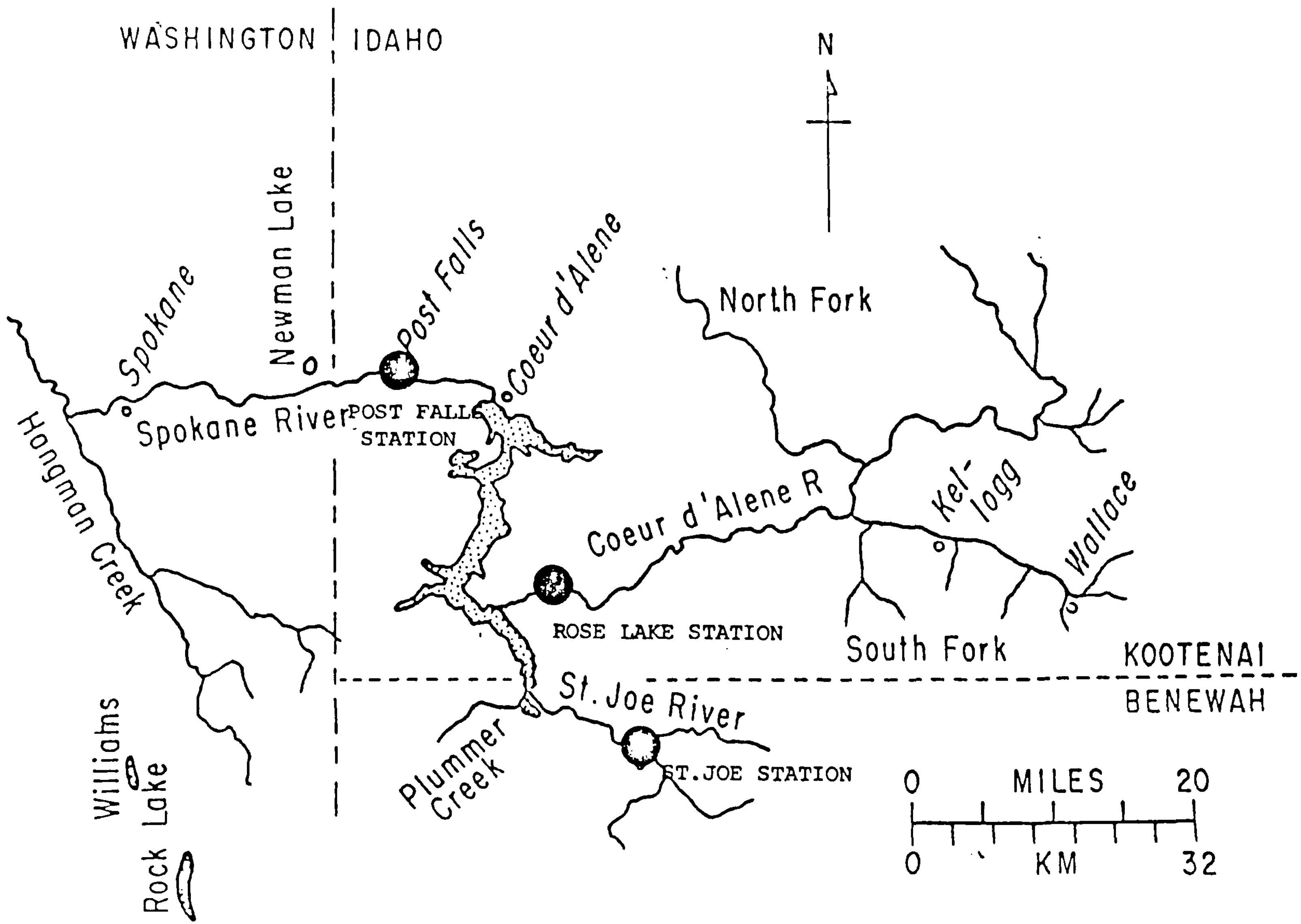
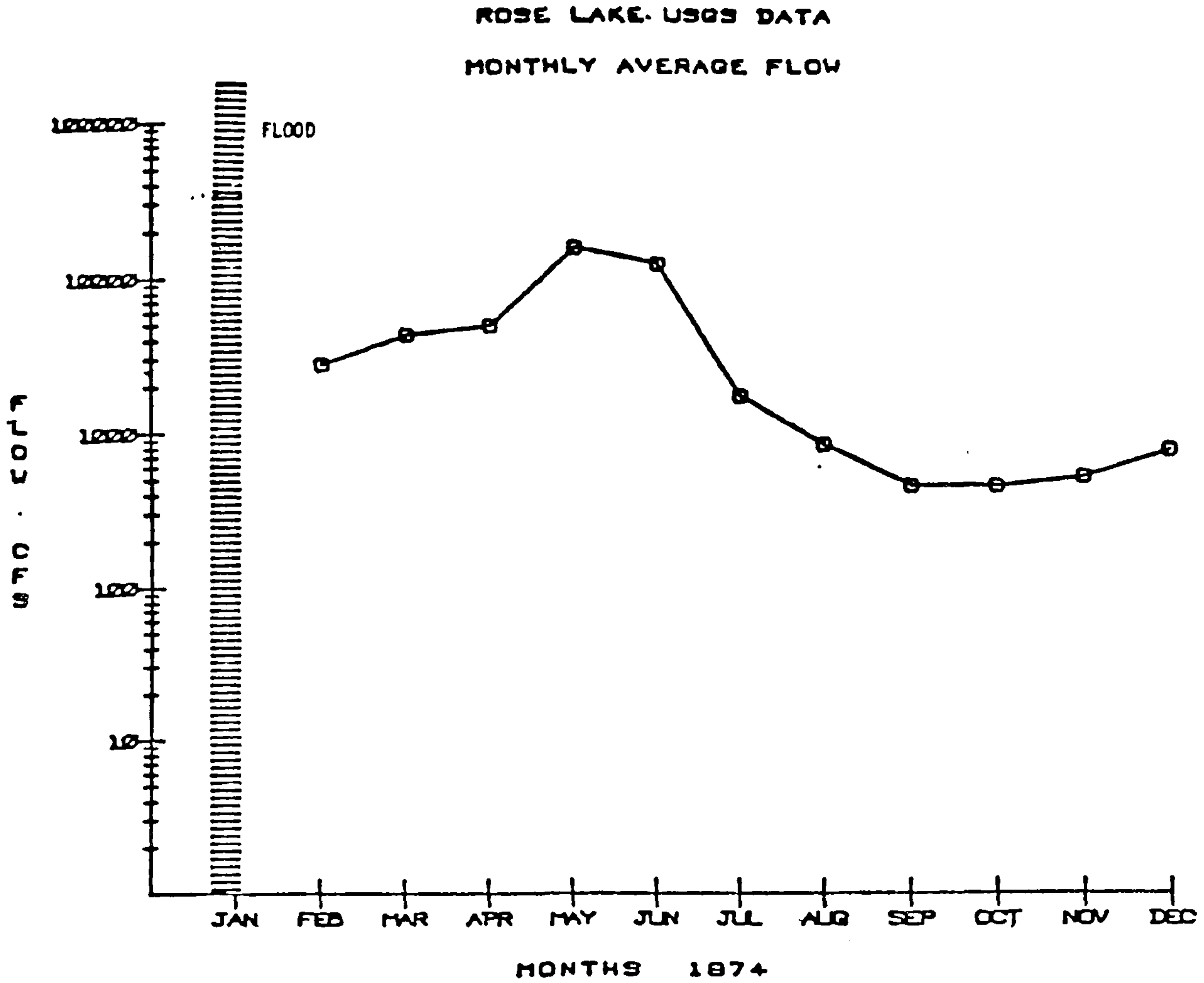

WASHINGTON
IDAHO
N
Newman Lake
Spokane
Post Falls
Coeur d'Alene
North Fork
Spokane River
POST FALLS STATION
Hangman Creek
Coeur d'Alene R
Kellogg
Wallace
ROSE LAKE STATION
South Fork
KOOTENAI
BENEWAH
St. Joe River
Plummer Creek
ST.JOE STATION
Williams
Rock Lake
0 MILES 20
0 KM 32

FIGURE CE-17

GRAPH SET NO. 2

COEUR D'ALENE RIVER AT ROSE LAKE

FIGURE CE-18


ROSE LAKE USGS DATA
MONTHLY AVERAGE FLOW
FLOOD
FLOW . CFS
100000
10000
1000
100
10
JAN
FEB
MAR
APR
MAY
JUN
JUL
AUG
SEP
OCT
NOV
DEC
MONTHS 1874

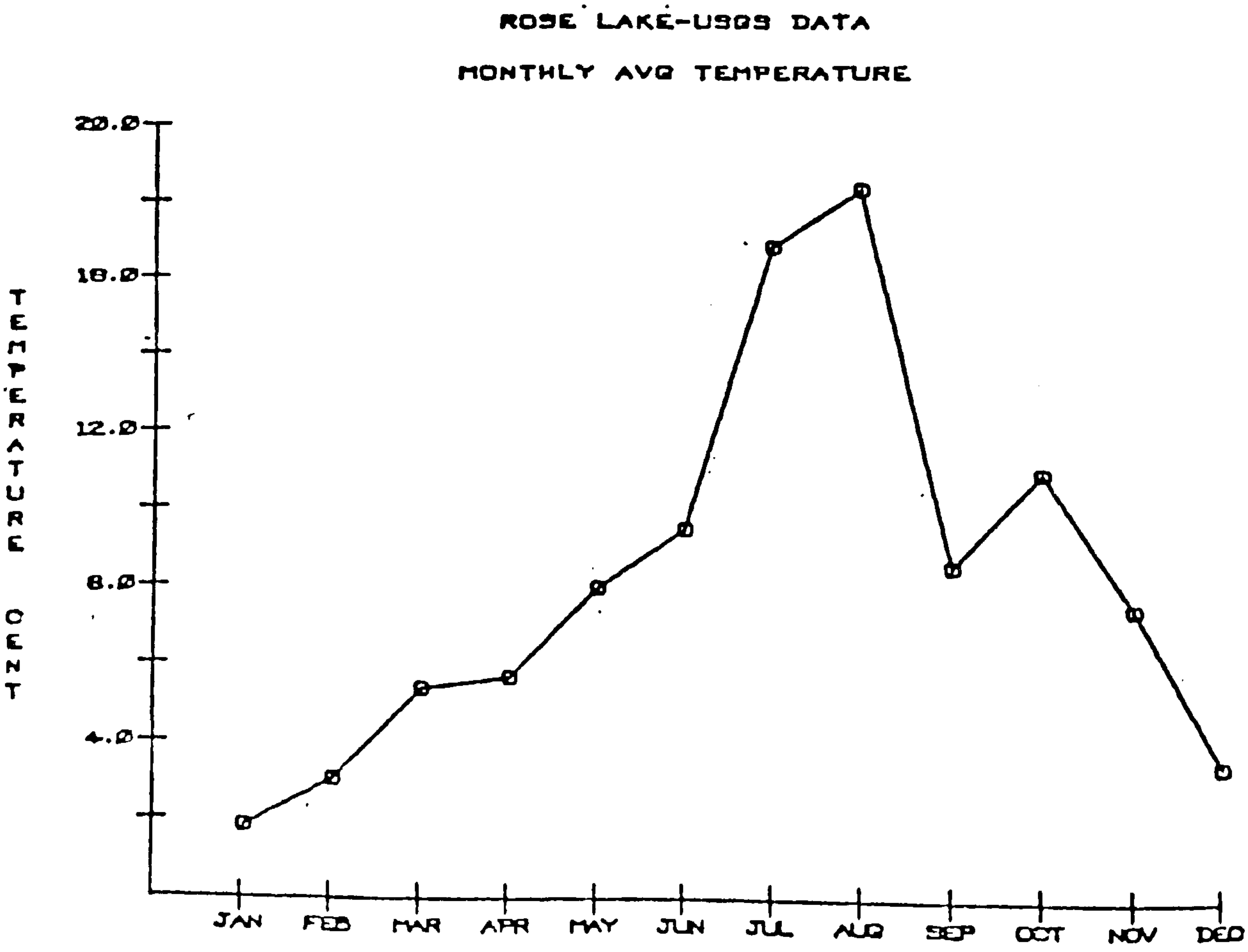
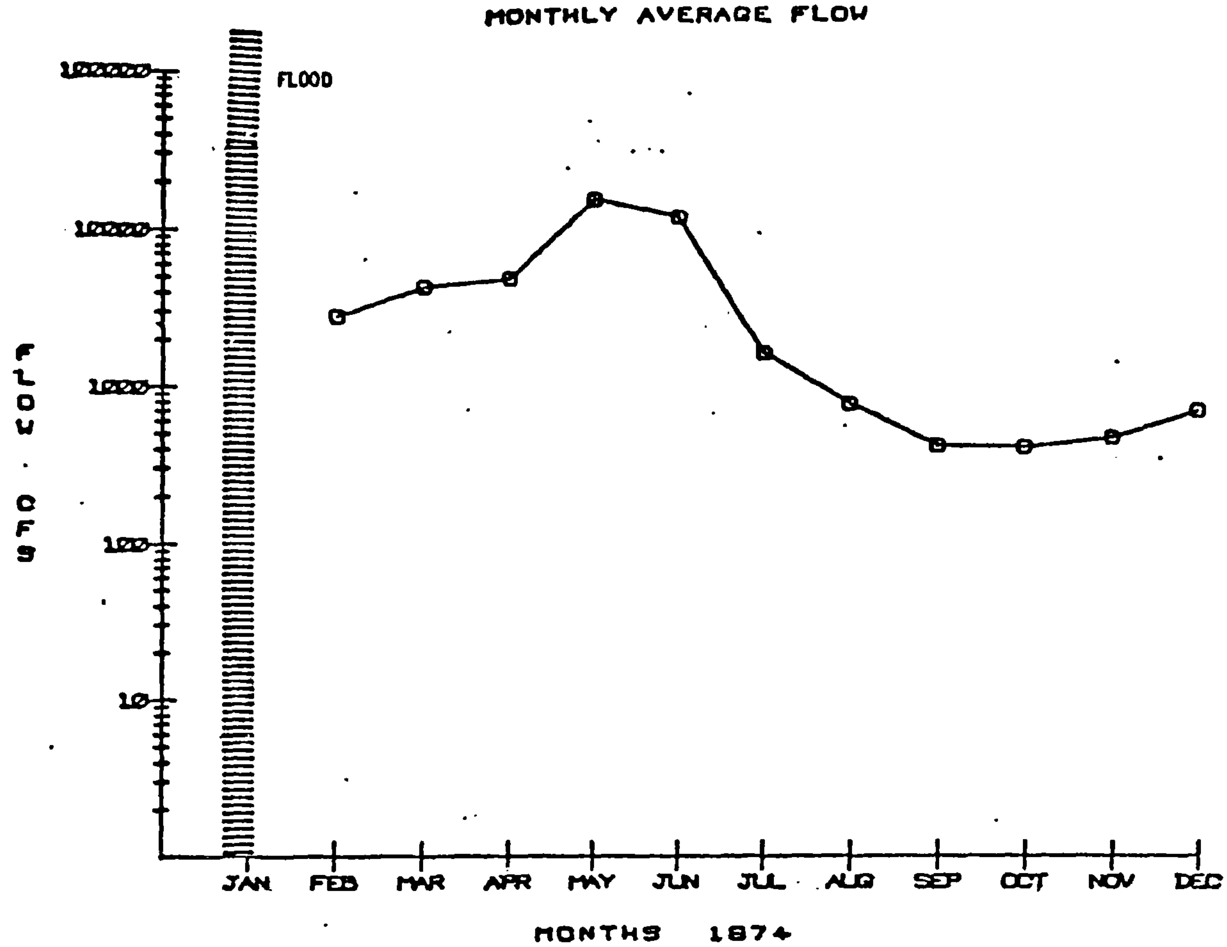

ROSE LAKE-USGS DATA
MONTHLY AVG TEMPERATURE
TEMPERATURE CENT
20.0
16.0
12.0
8.0
4.0
JAN
FEB
MAR
APR
MAY
JUN
JUL
AUG
SEP
OCT
NOV
DEC

FIGURE CE-19

ROSE LAKE-USGS DATA

MONTHLY AVERAGE FLOW



ROSE LAKE-USGS DATA

MONTHLY AVG CONCENTRATION

CONDUCTIVITY

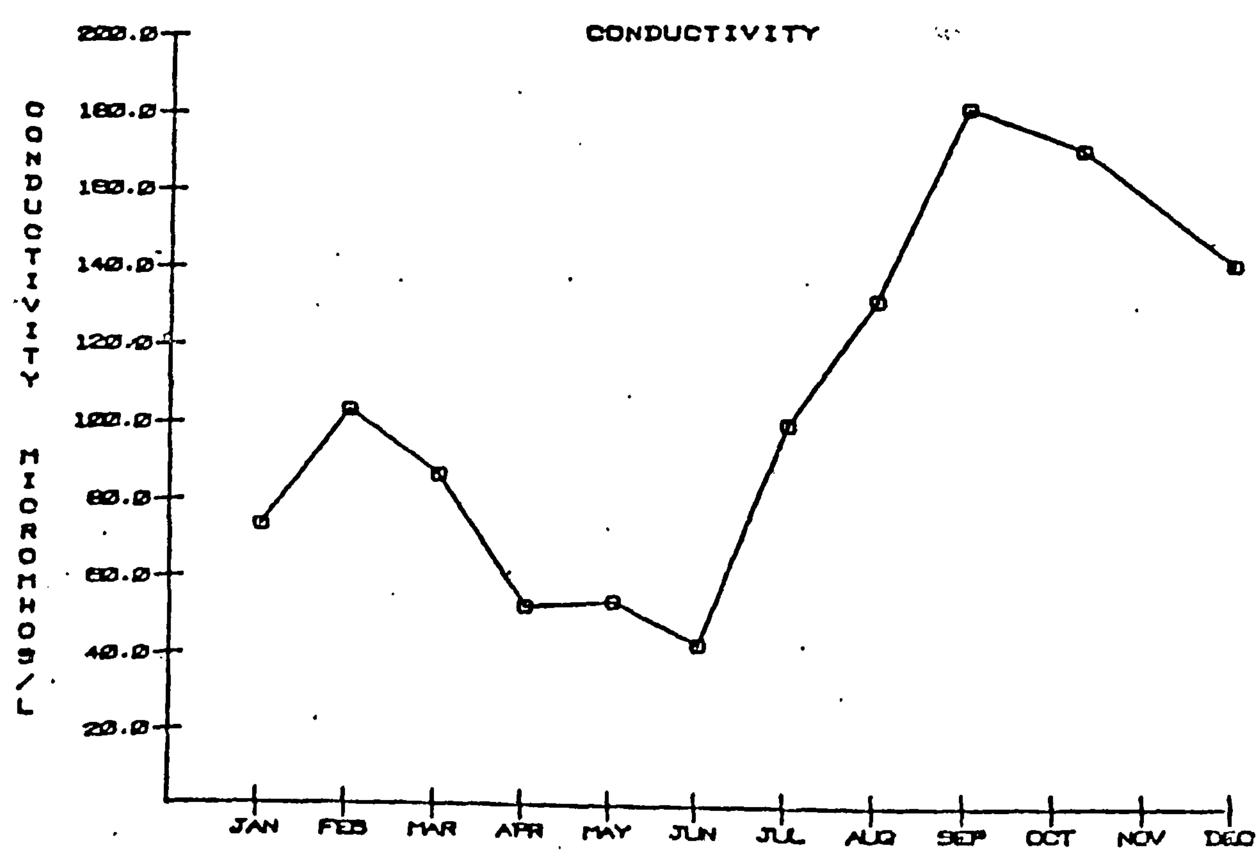
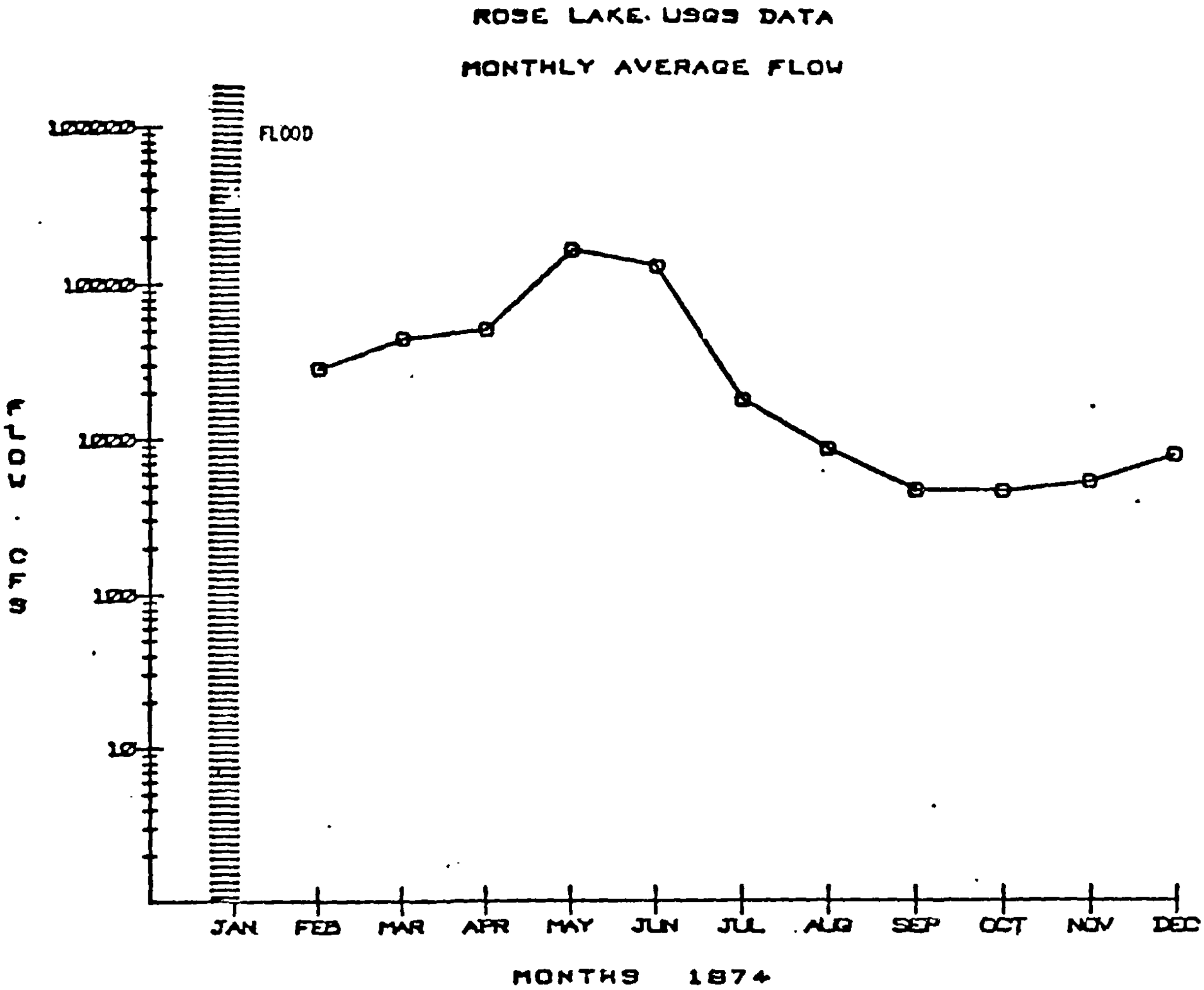


FIGURE CE-20


ROSE LAKE-USGS DATA
MONTHLY AVERAGE FLOW
FLOOD
1000000
100000
10000
1000
100
10
FLOW, CFS
JAN
FEB
MAR
APR
MAY
JUN
JUL
AUG
SEP
OCT
NOV
DEC
MONTHS 1974

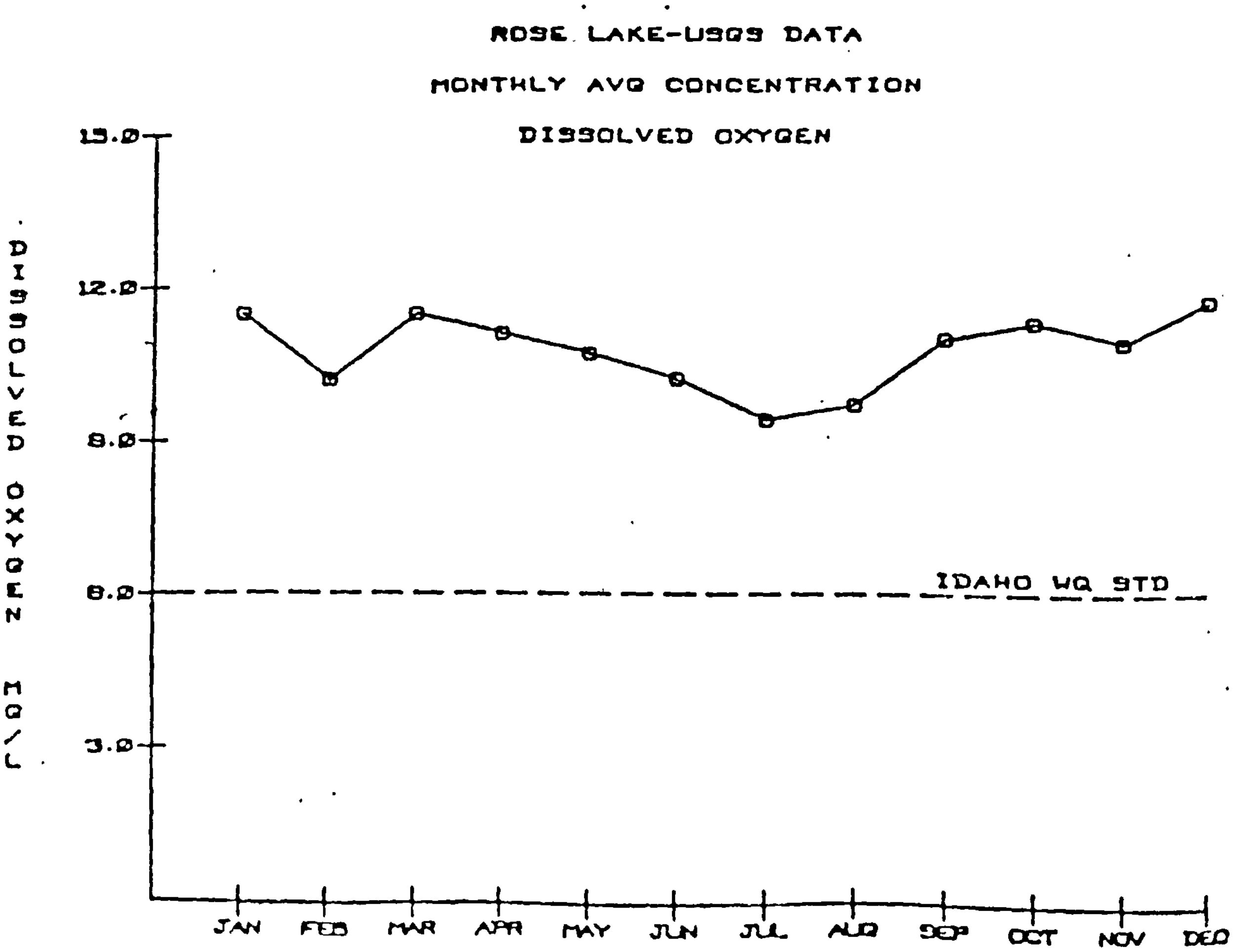
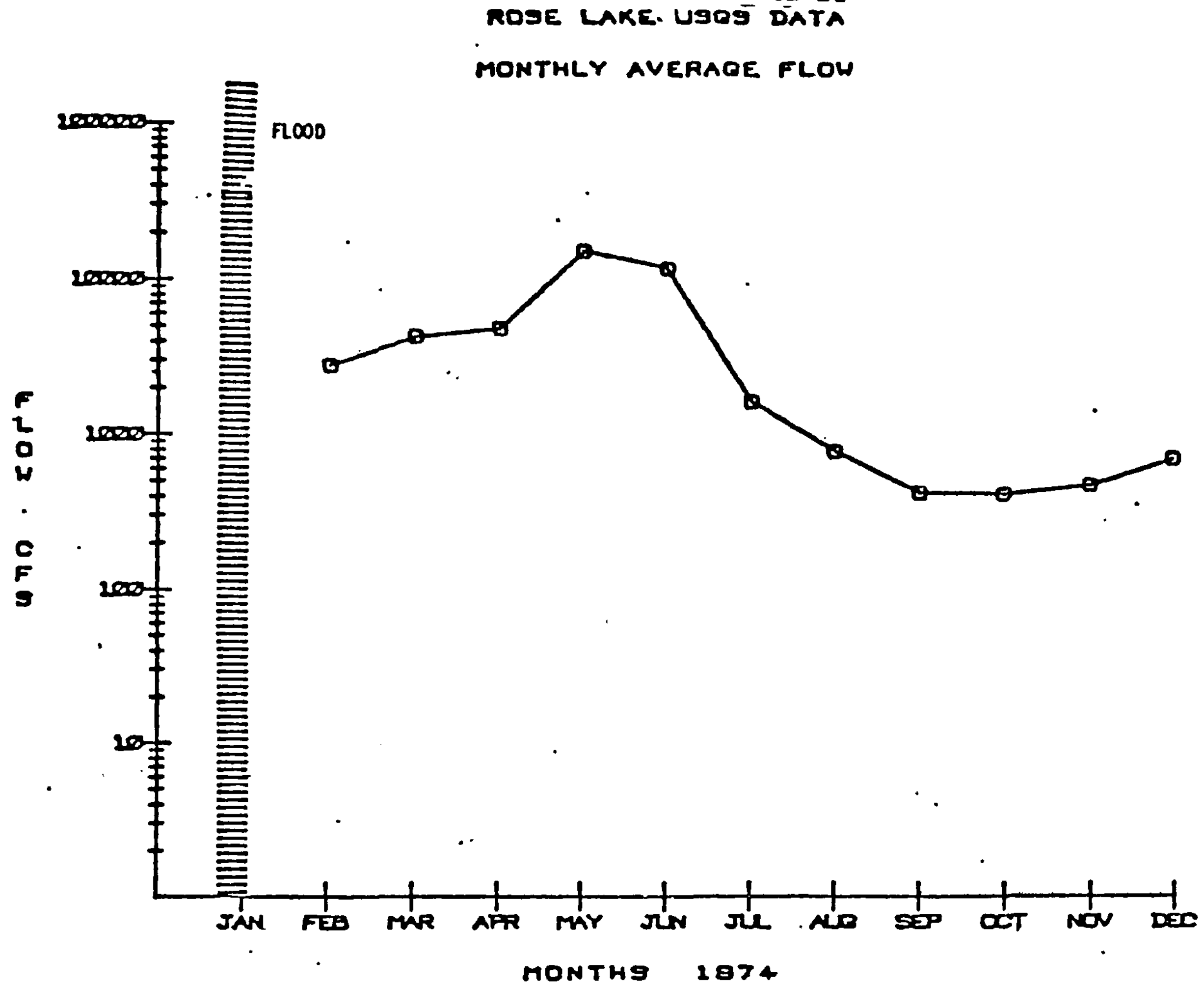

ROSE LAKE-USGS DATA
MONTHLY AVG CONCENTRATION
DISSOLVED OXYGEN
15.0
12.0
9.0
6.0
3.0
DISSOLVED OXYGEN MG/L
IDAHO WQ STD
JAN
FEB
MAR
APR
MAY
JUN
JUL
AUG
SEP
OCT
NOV
DEC

FIGURE CE-21


ROSE LAKE- USGS DATA
MONTHLY AVERAGE FLOW
FLOOD
FLOW . CFS
JAN
FEB
MAR
APR
MAY
JUN
JUL
AUG
SEP
OCT
NOV
DEC
MONTHS 1974

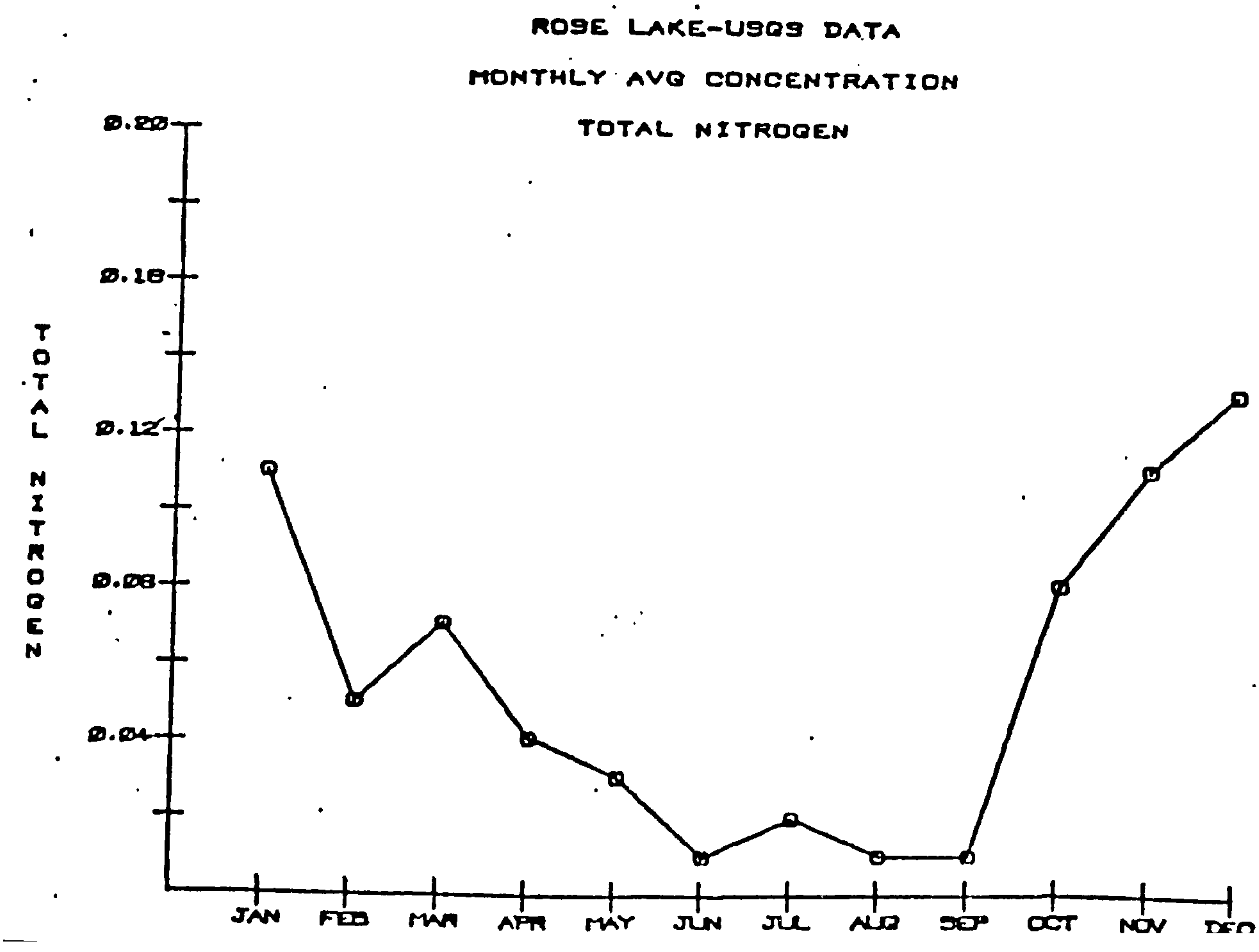
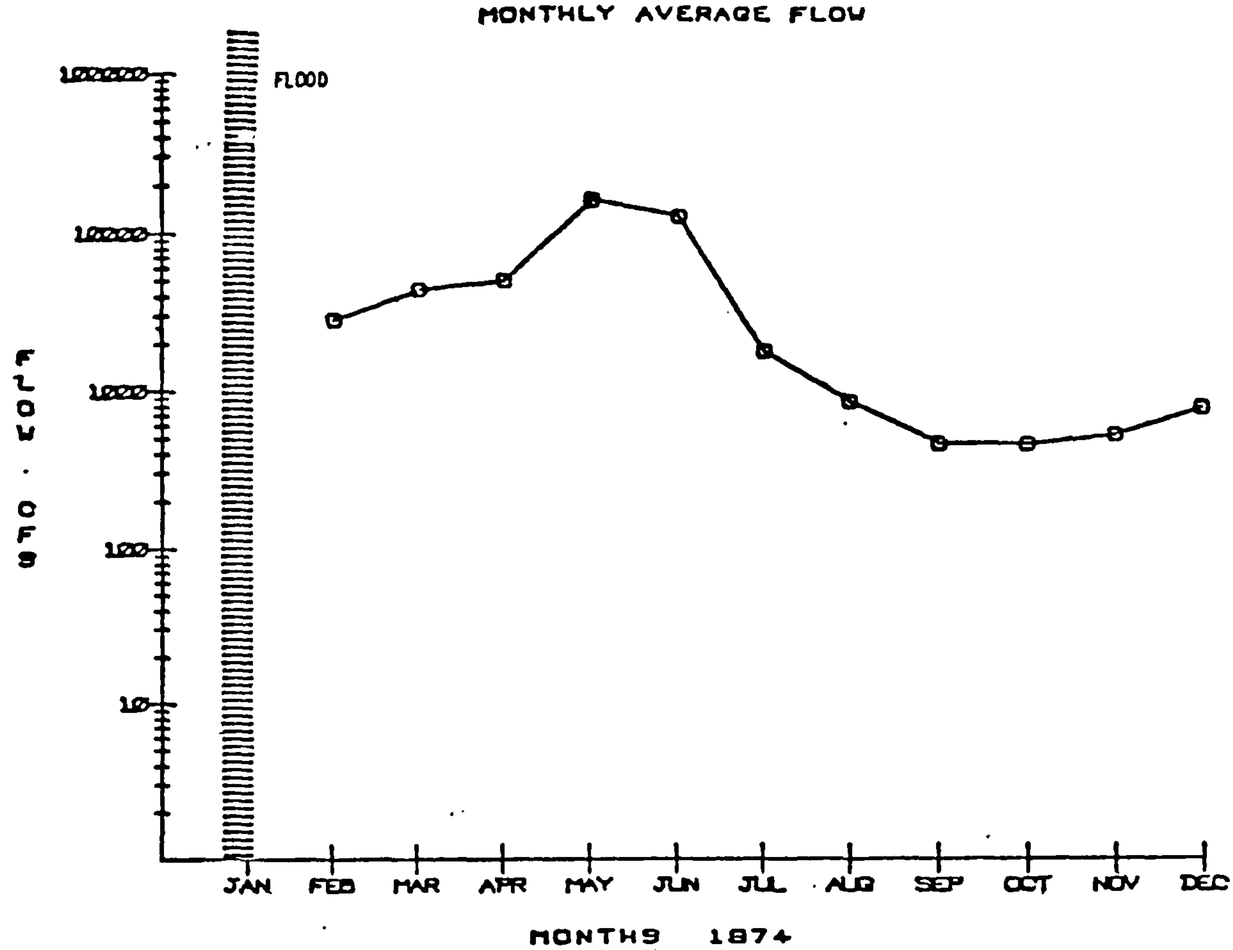

ROSE LAKE-USGS DATA
MONTHLY AVG CONCENTRATION
TOTAL NITROGEN
0.20
0.16
0.12
0.08
0.04
TOTAL NITROGEN
JAN
FEB
MAR
APR
MAY
JUN
JUL
AUG
SEP
OCT
NOV

FIGURE CE-22

ROSE LAKE-USGS DATA

MONTHLY AVERAGE FLOW



ROSE LAKE-USGS DATA

MONTHLY AVG CONCENTRATION

TOTAL PHOSPHOROUS

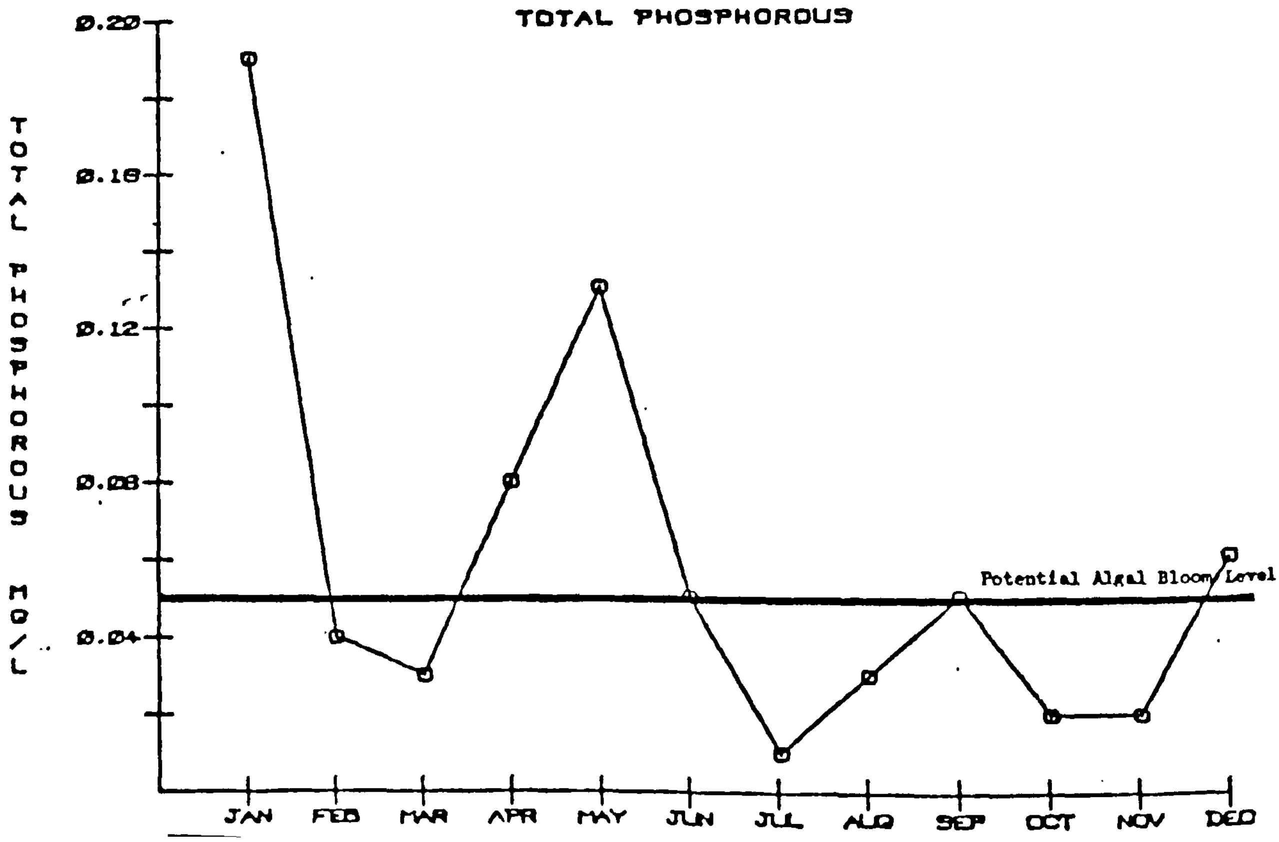
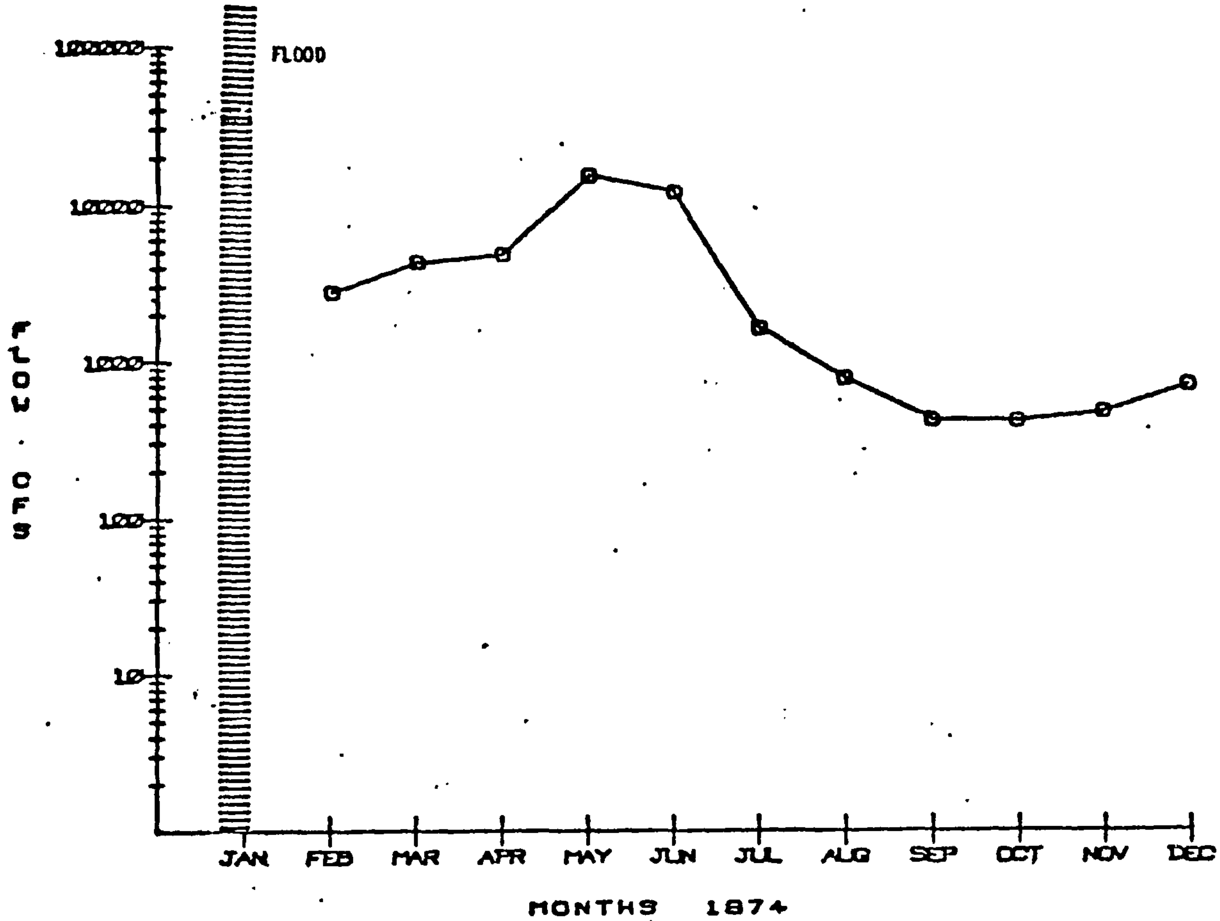


FIGURE CE-23

ROSE LAKE-USGS DATA

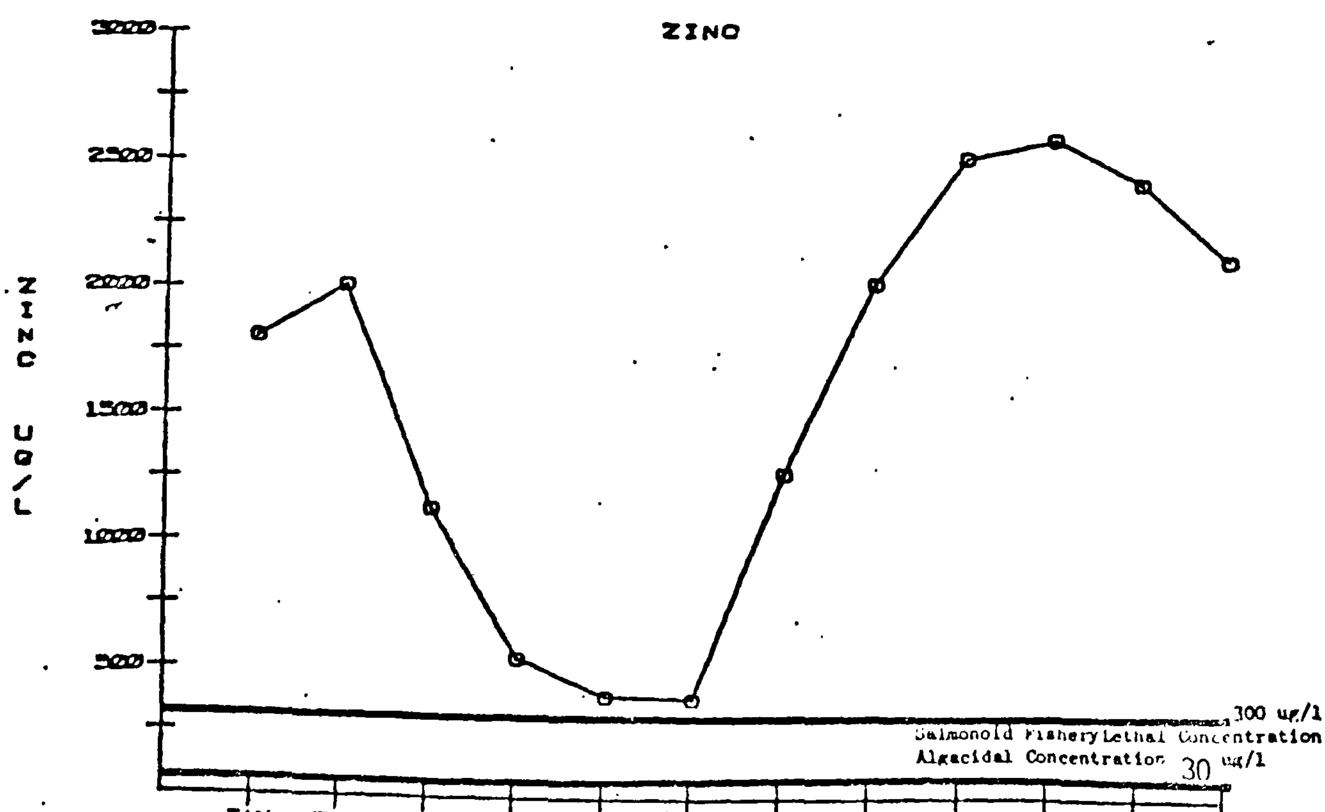
MONTHLY AVERAGE FLOW



ROSE LAKE-USGS DATA

MONTHLY AVG CONCENTRATION

ZINC



GRAPH SET NO. 3

ST. JOE RIVER AT ST. MARIES

FIGURE CE-24

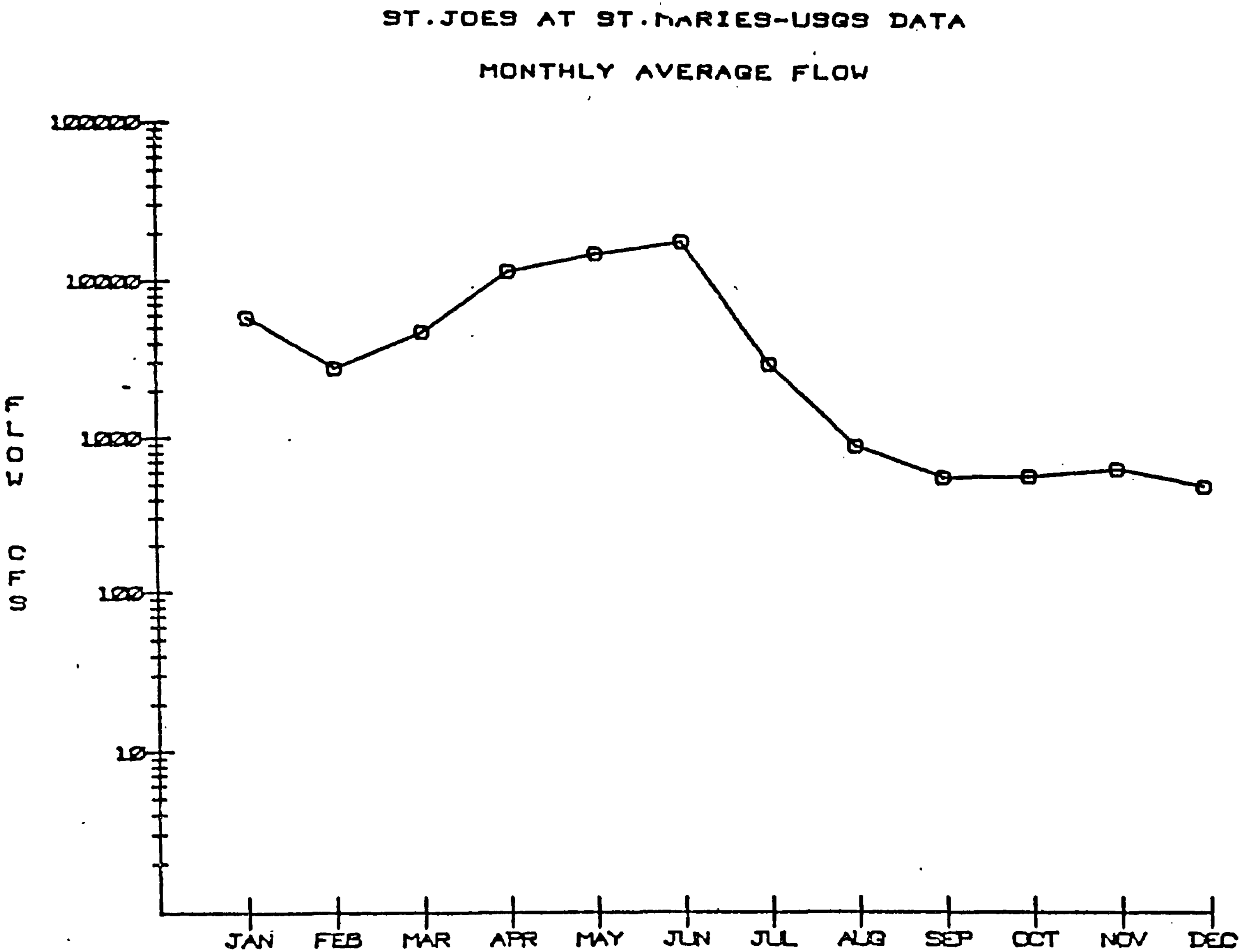

ST.JOES AT ST.MARIES-USGS DATA
MONTHLY AVERAGE FLOW
FLOW CFS
1000000
100000
10000
1000
100
10
JAN
FEB
MAR
APR
MAY
JUN
JUL
AUG
SEP
OCT
NOV
DEC

FIGURE CE-25

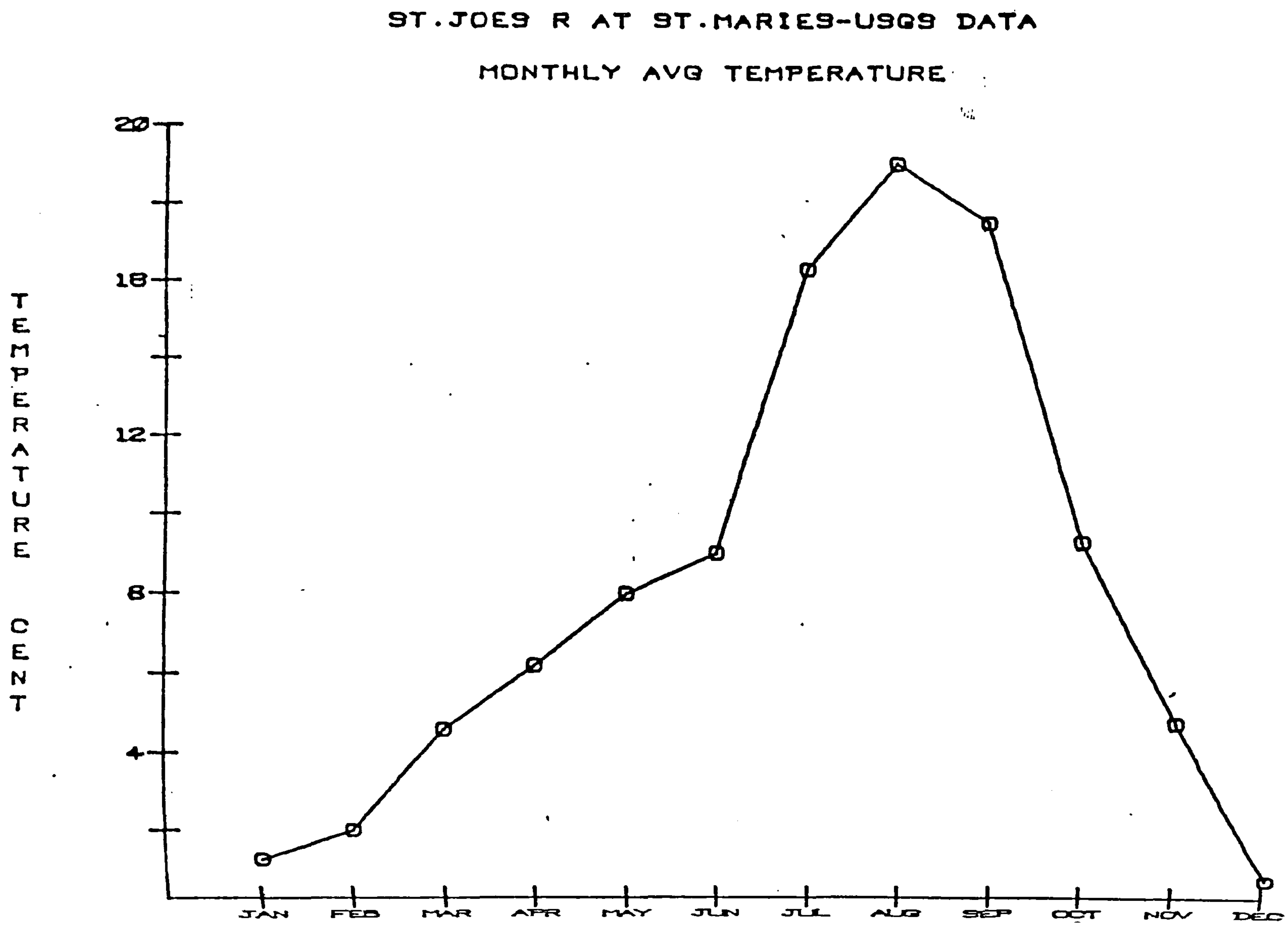
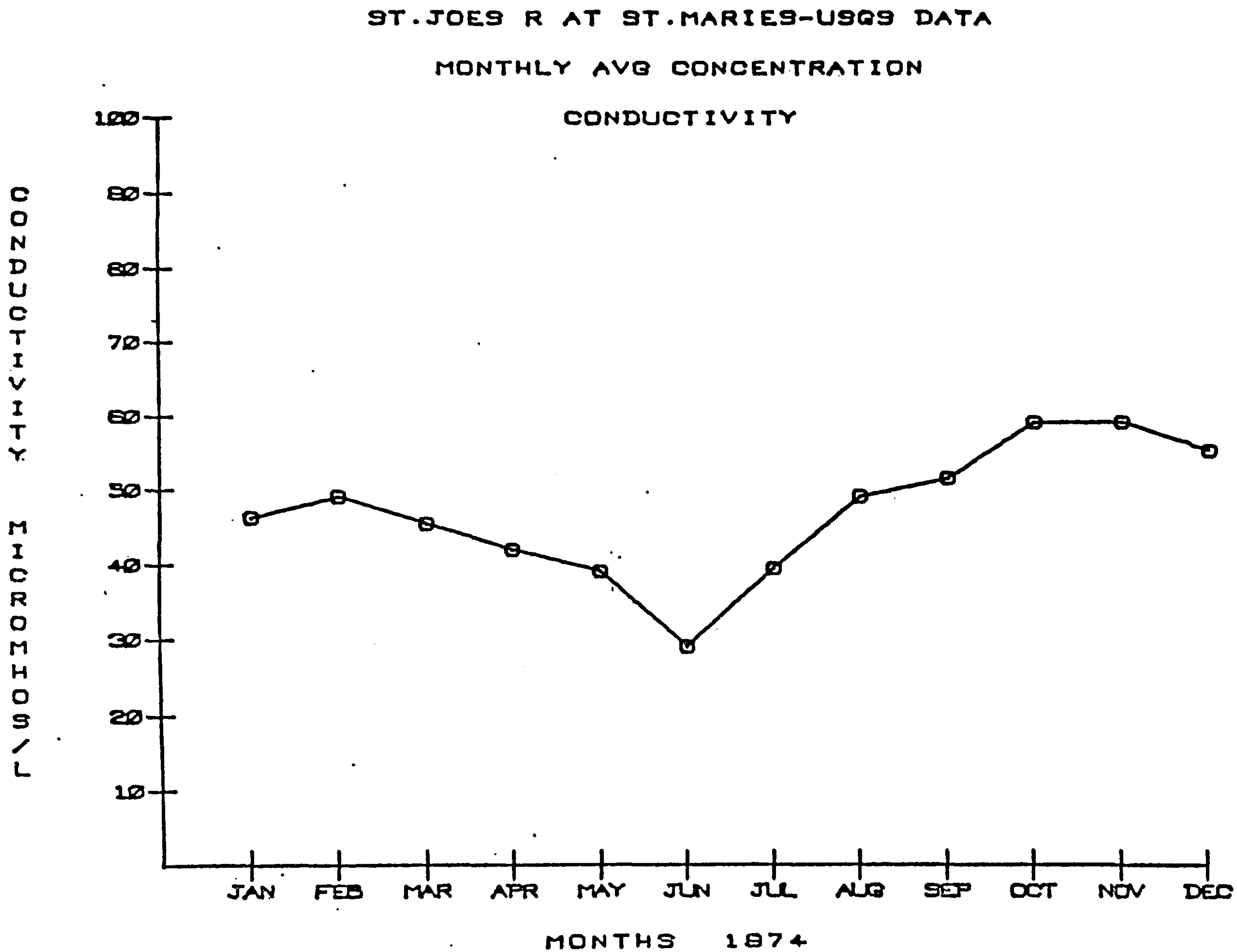


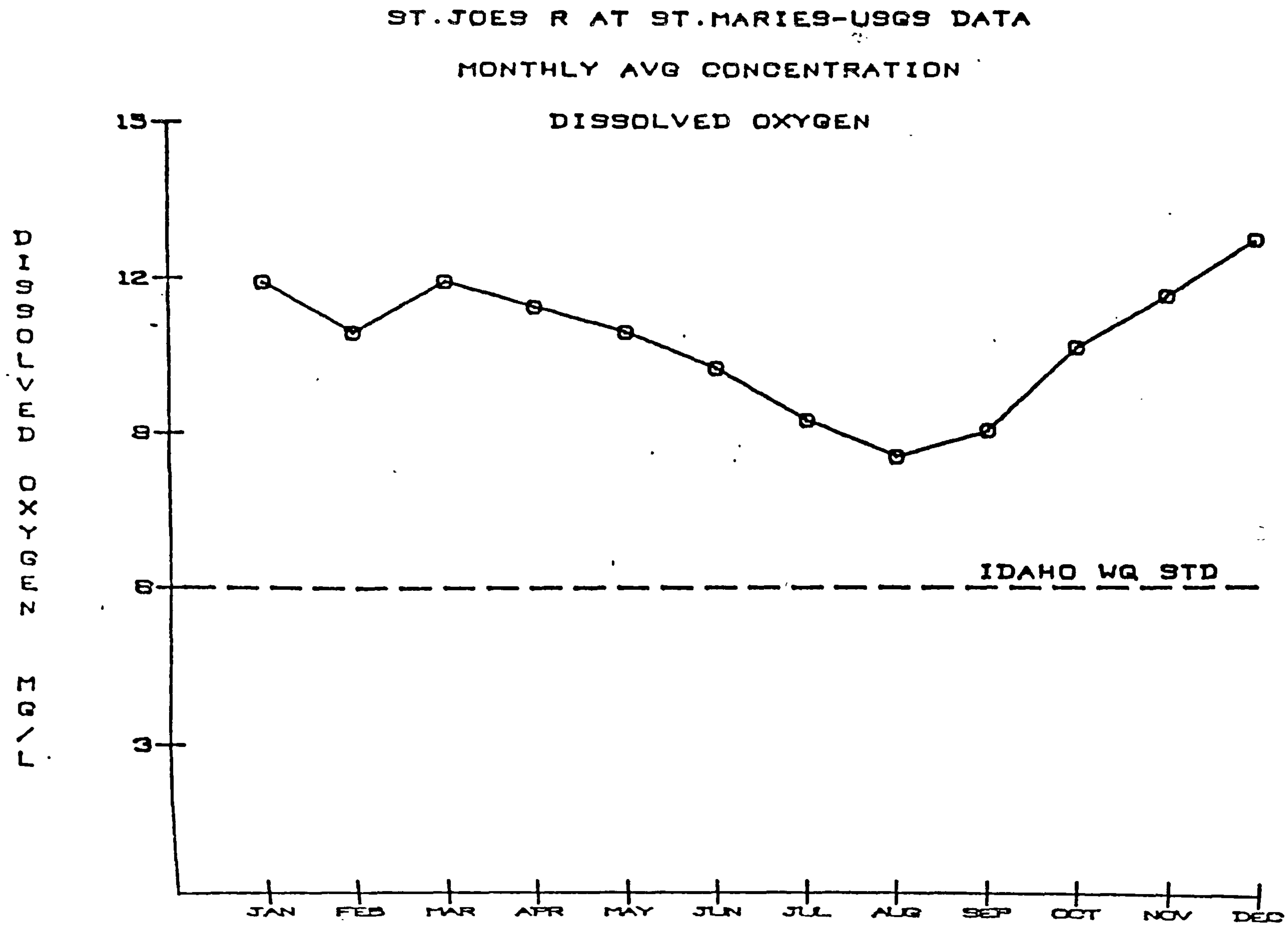
FIGURE CE-26

FIGURE CE-26



ST.JOES R AT ST.MARIES-USGS DATA
MONTHLY AVG CONCENTRATION
CONDUCTIVITY
CONDUCTIVITY MICROMHOS/L
100
80
60
70
60
50
40
30
20
10
JAN
FEB
MAR
APR
MAY
JUN
JUL
AUG
SEP
OCT
NOV
DEC
MONTHS 1974

FIGURE CE-27



ST.JOES R AT ST.MARIES-USGS DATA
MONTHLY AVG CONCENTRATION
DISSOLVED OXYGEN
DISSOLVED OXYGEN MG/L
15
12
9
6
3
IDAHO WQ STD
JAN
FEB
MAR
APR
MAY
JUN
JUL
AUG
SEP
OCT
NOV
DEC

FIGURE CE-28

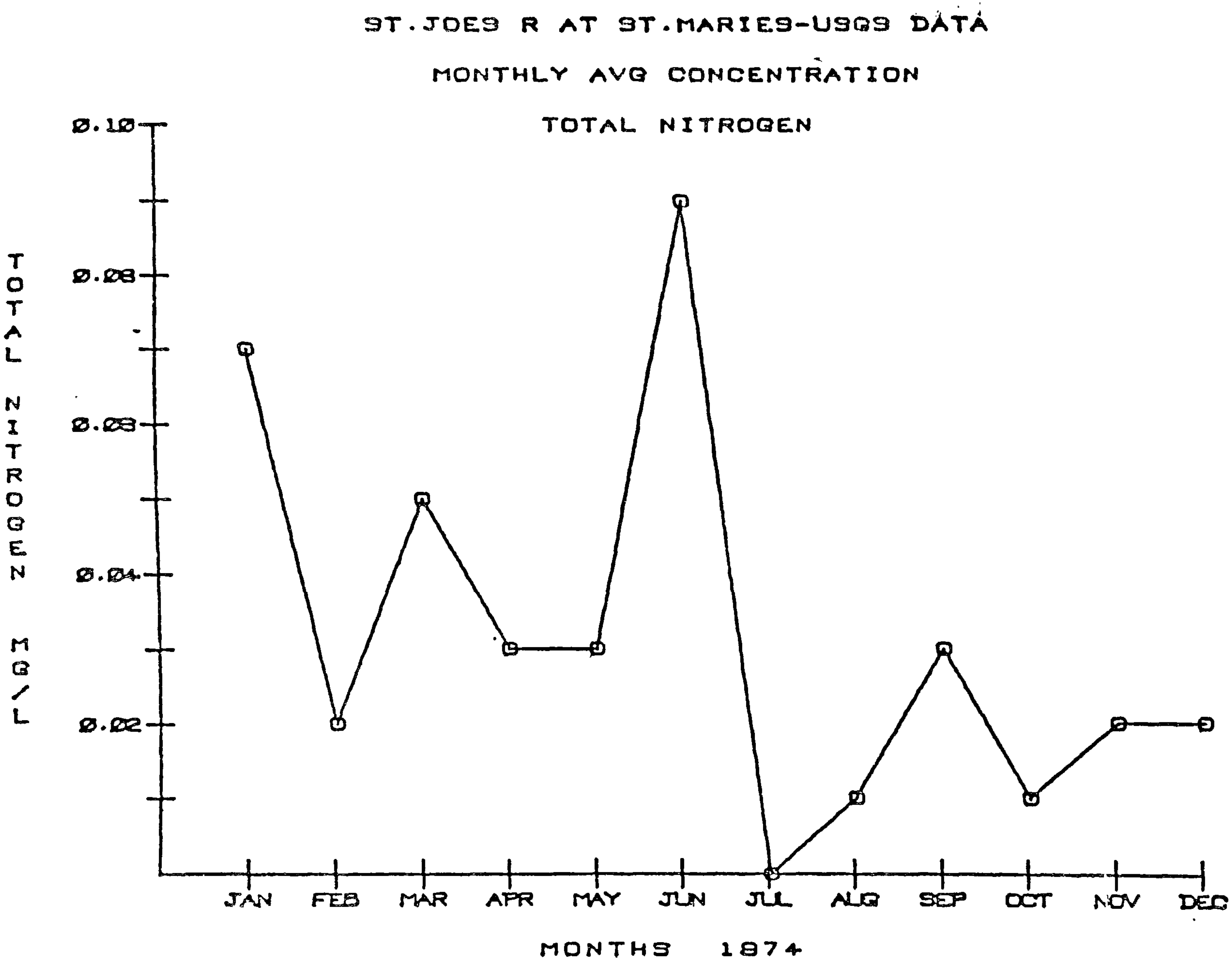

ST.JOES R AT ST.MARIES-USGS DATA
MONTHLY AVG CONCENTRATION
TOTAL NITROGEN
Ø.1Ø
Ø.Ø8
Ø.Ø6
Ø.Ø4
Ø.Ø2
TOTAL NITROGEN MG/L
JAN
FEB
MAR
APR
MAY
JUN
JUL
AUG
SEP
OCT
NOV
DEC
MONTHS 1874

FIGURE CE-29

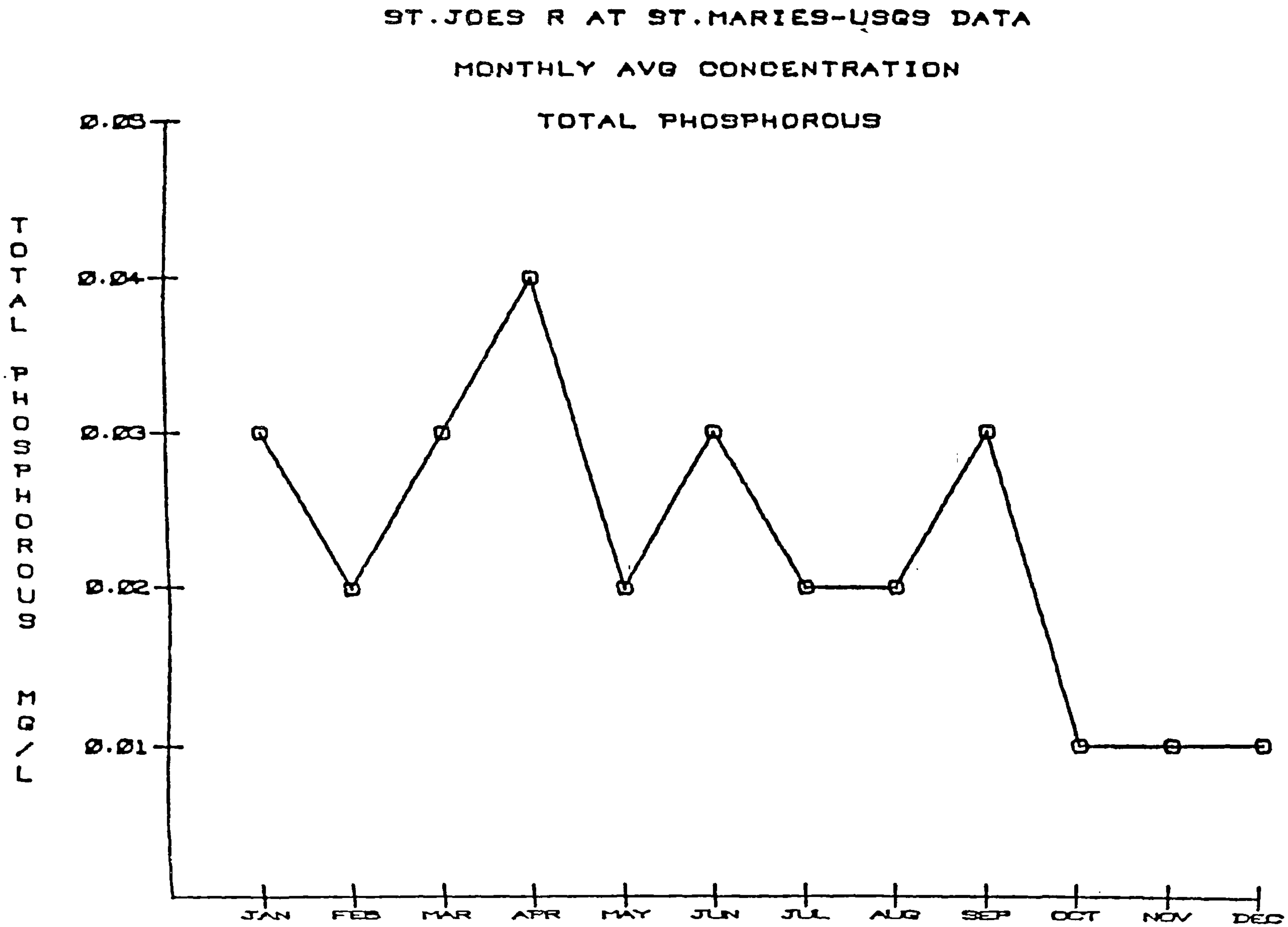
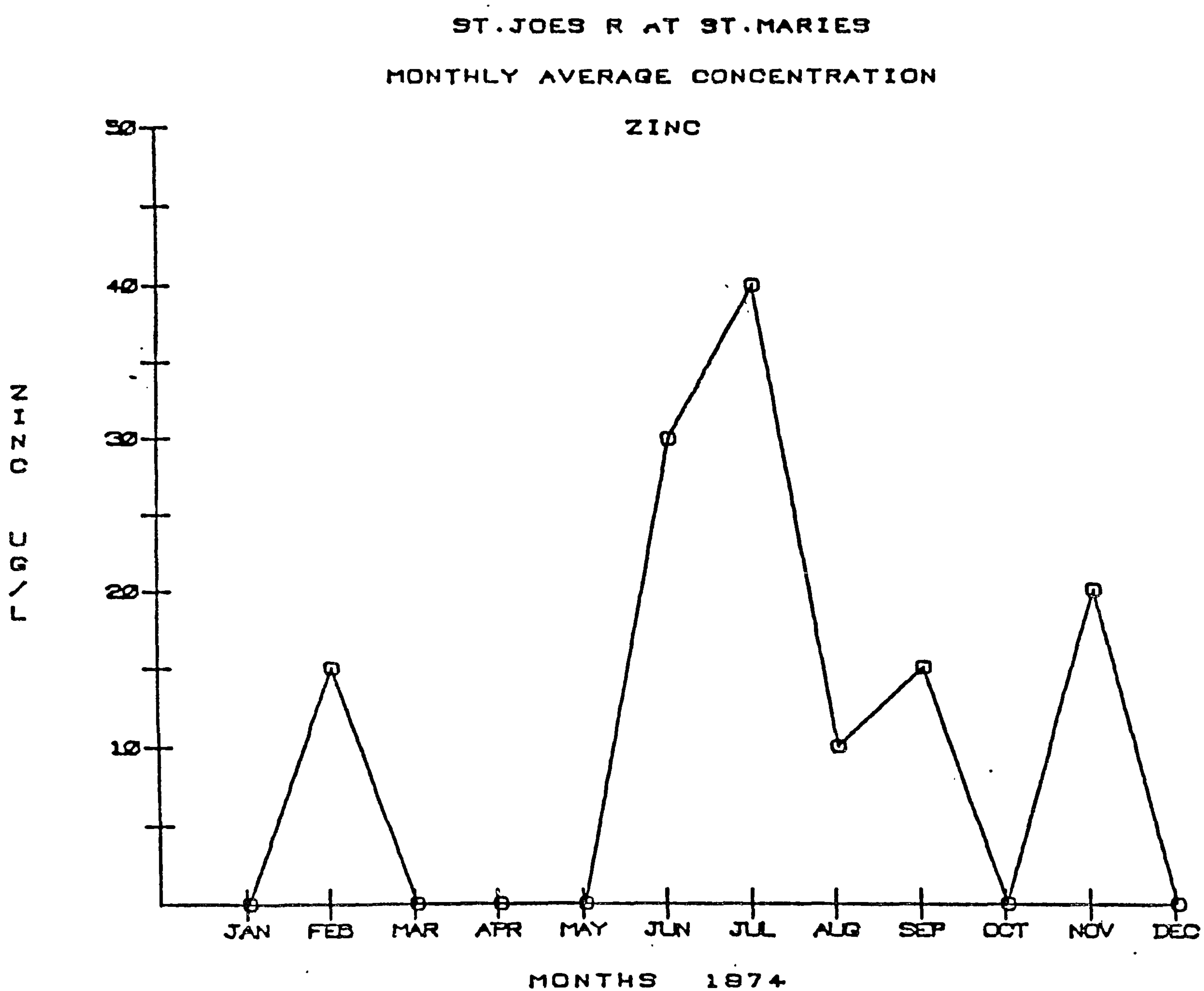

ST.JOES R AT ST.MARIES-USGS DATA
MONTHLY AVG CONCENTRATION
TOTAL PHOSPHOROUS
TOTAL PHOSPHOROUS MG/L
0.05
0.04
0.03
0.02
0.01
JAN
FEB
MAR
APR
MAY
JUN
JUL
AUG
SEP
OCT
NOV
DEC

FIGURE CE-30


ST.JOES R AT ST.MARIES
MONTHLY AVERAGE CONCENTRATION
ZINC
50
40
30
20
10
ZINC UG/L
JAN
FEB
MAR
APR
MAY
JUN
JUL
AUG
SEP
OCT
NOV
DEC
MONTHS 1974

GRAPH SET NO. 4

SPOKANE RIVER AT POST FALLS

FIGURE CE-31

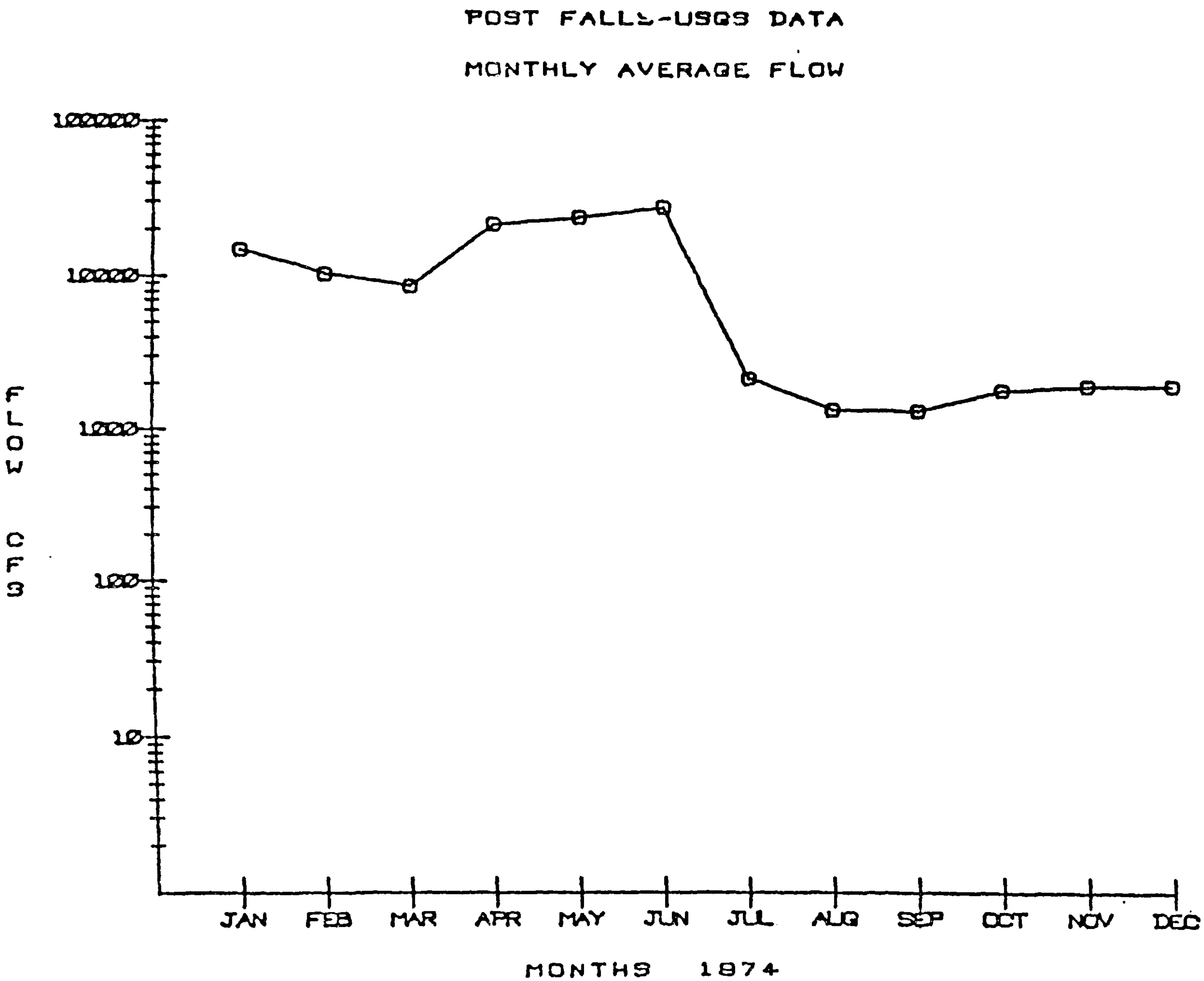

POST FALLS-USGS DATA
MONTHLY AVERAGE FLOW
100000
10000
1000
100
10
FLOW CFS
JAN
FEB
MAR
APR
MAY
JUN
JUL
AUG
SEP
OCT
NOV
DEC
MONTHS 1974

FIGURE CE-32.

POST FALLS-USGS DATA

MONTHLY AVERAGE TEMPERATURE

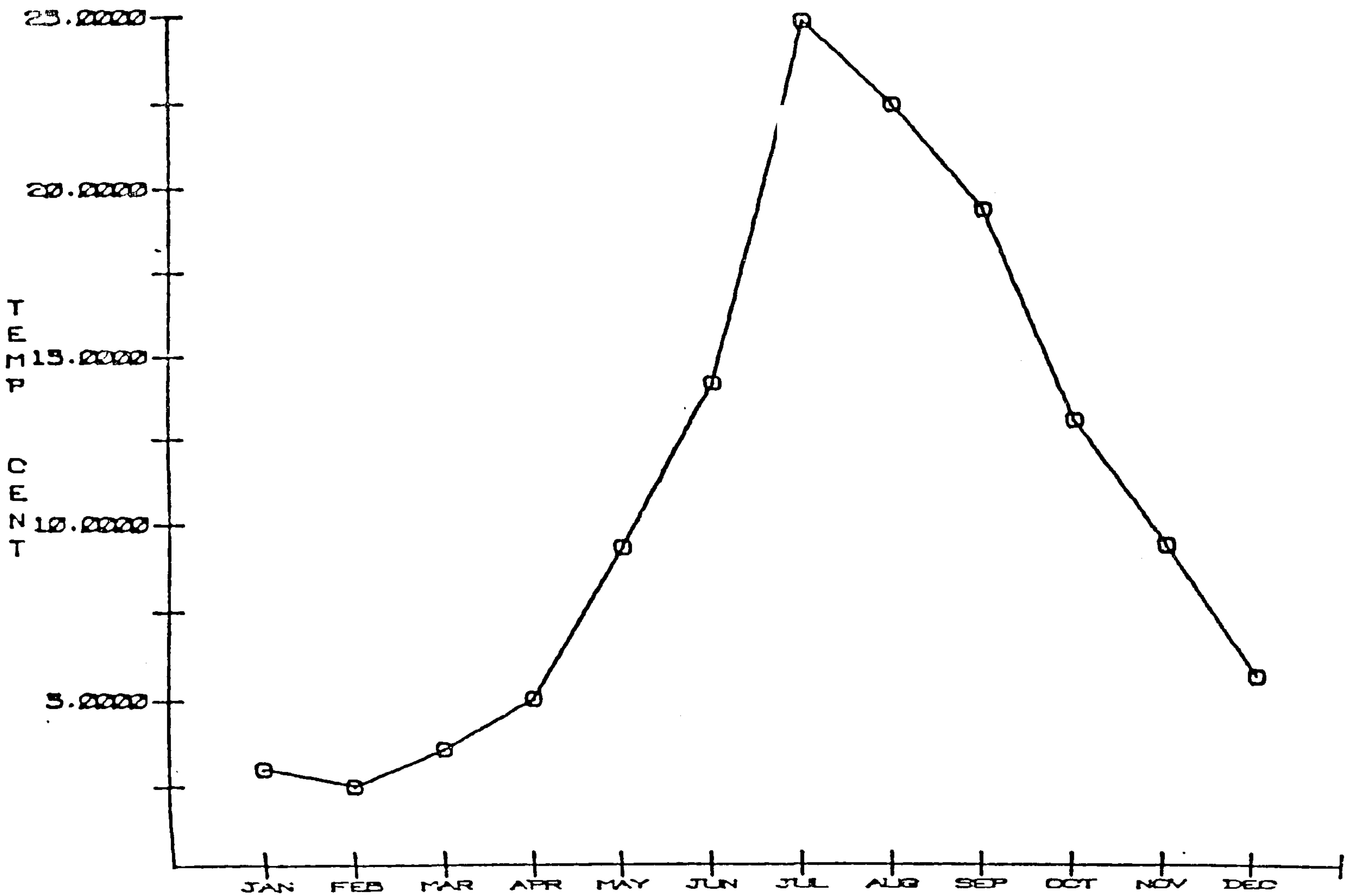


FIGURE CE-33

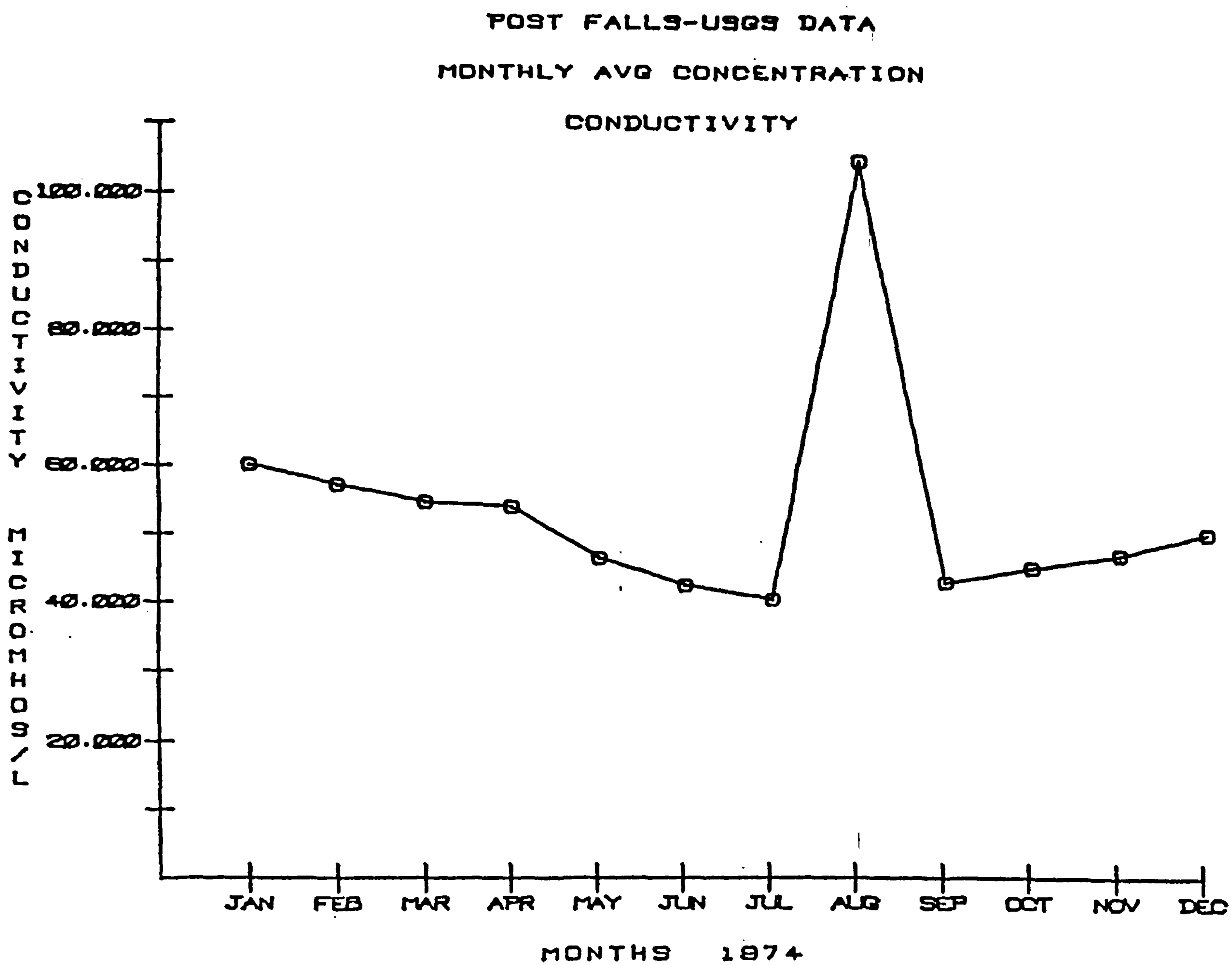

POST FALLS-USGS DATA
MONTHLY AVG CONCENTRATION
CONDUCTIVITY
CONDUCTIVITY MICROMHOS/L
100.000
80.000
60.000
40.000
20.000
JAN
FEB
MAR
APR
MAY
JUN
JUL
AUG
SEP
OCT
NOV
DEC
MONTHS 1974

FIGURE CE-34

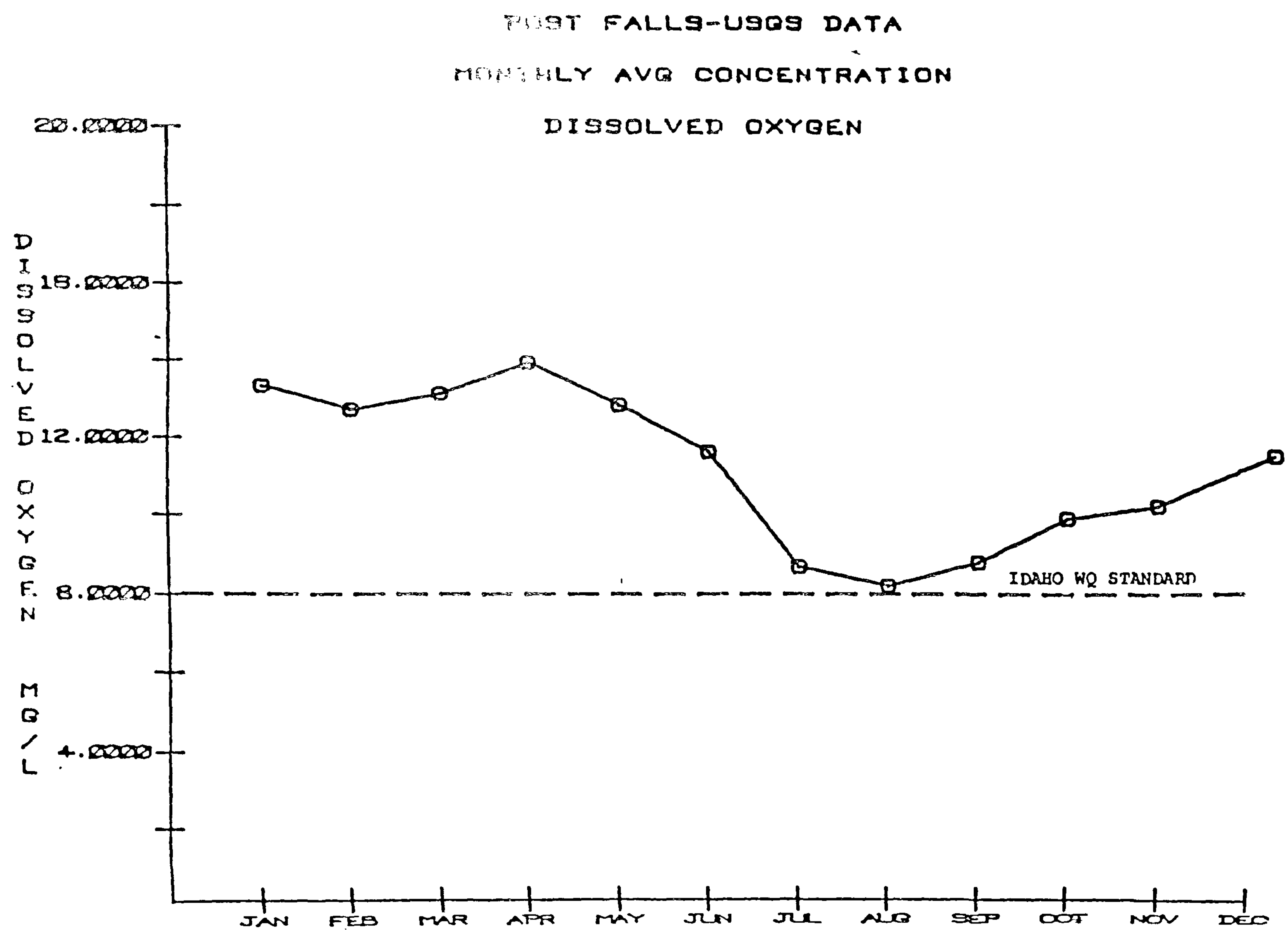

POST FALLS-USGS DATA
MONTHLY AVG CONCENTRATION
DISSOLVED OXYGEN
20.0000
16.0000
12.0000
8.0000
4.0000
DISSOLVED OXYGEN MG/L
IDAHO WQ STANDARD
JAN
FEB
MAR
APR
MAY
JUN
JUL
AUG
SEP
OCT
NOV
DEC

FIGURE CE-35

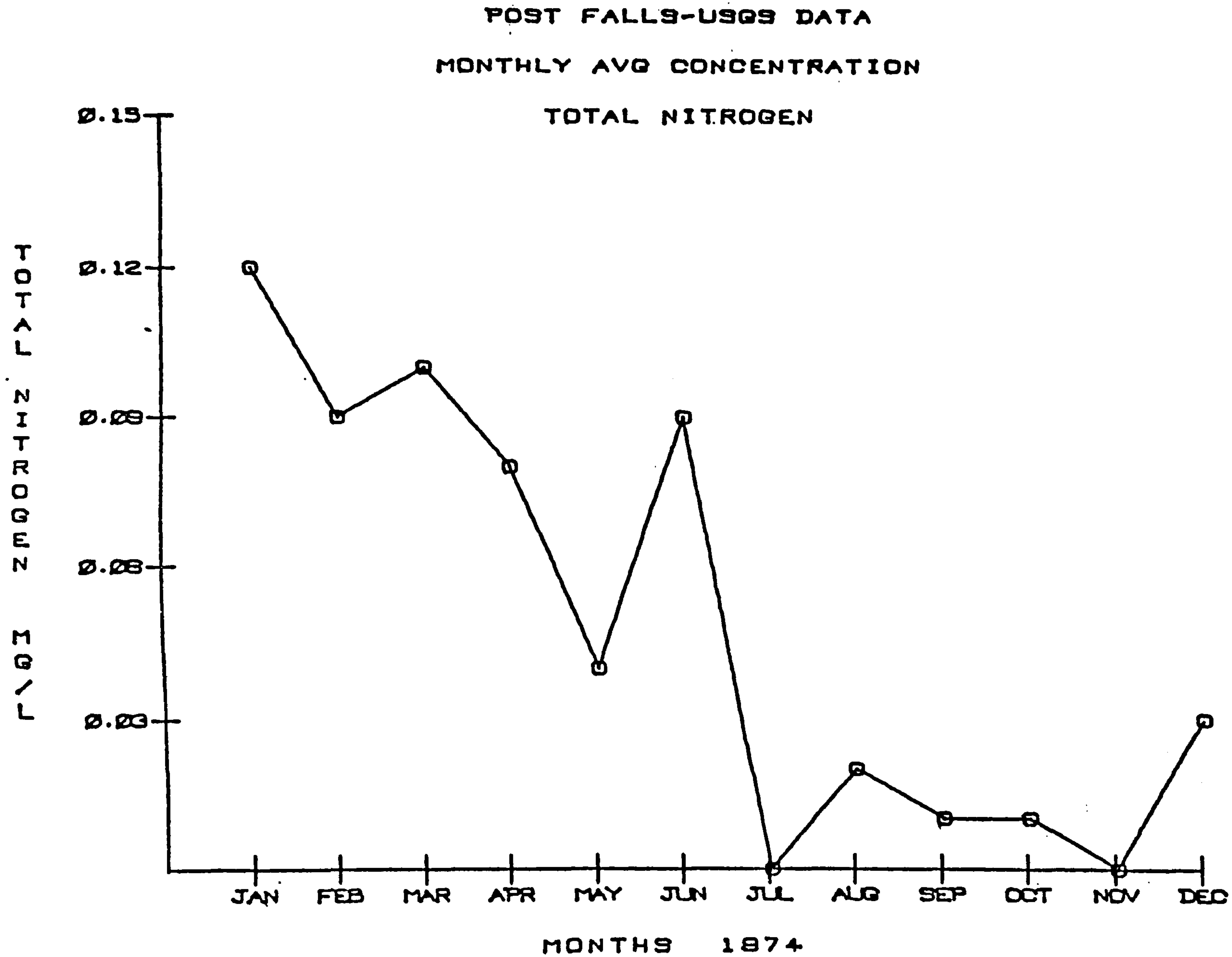

POST FALLS-USGS DATA
MONTHLY AVG CONCENTRATION
TOTAL NITROGEN
0.15
0.12
0.09
0.06
0.03
TOTAL NITROGEN MG/L
JAN
FEB
MAR
APR
MAY
JUN
JUL
AUG
SEP
OCT
NOV
DEC
MONTHS 1974

FIGURE CE-36

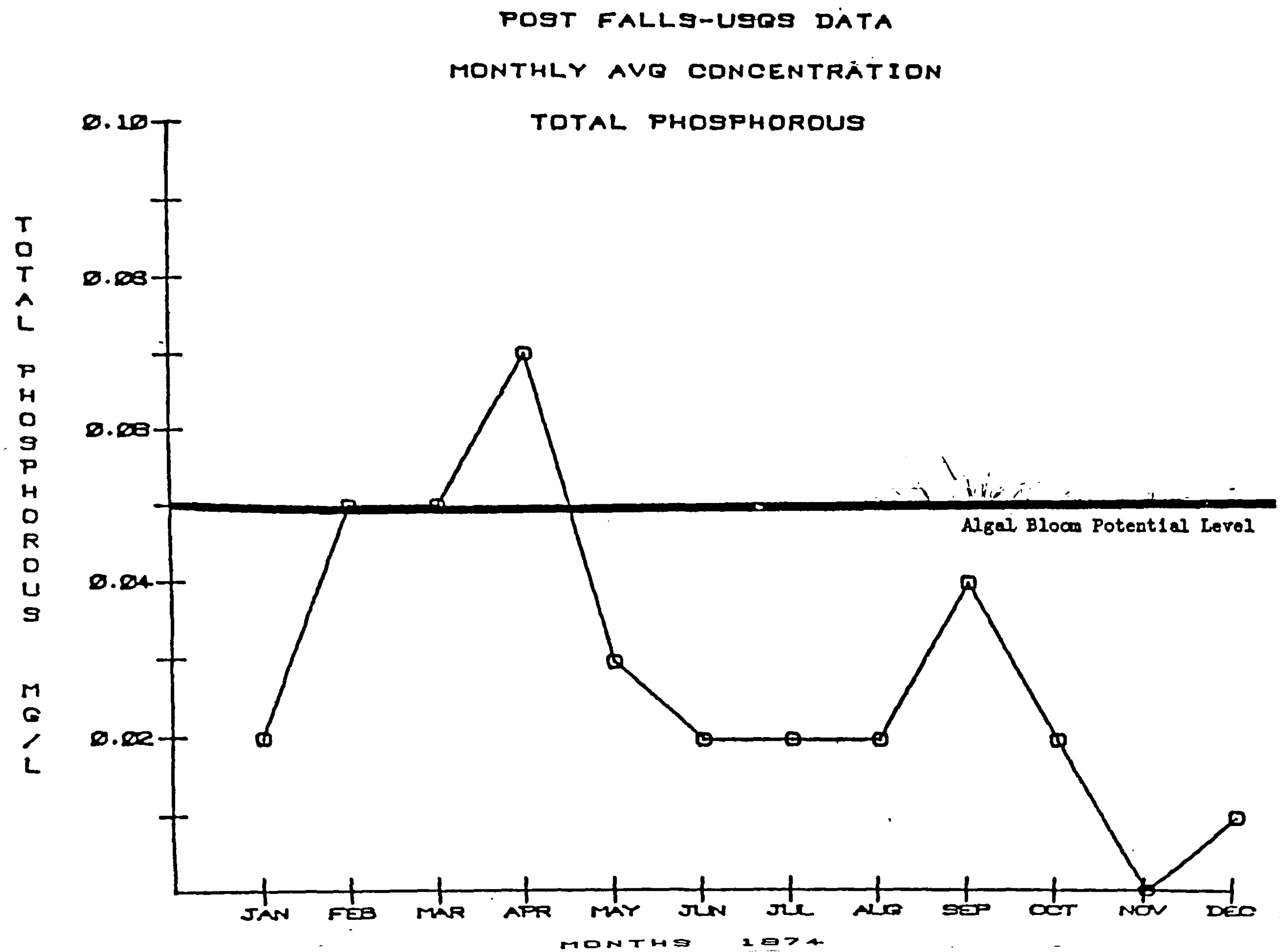
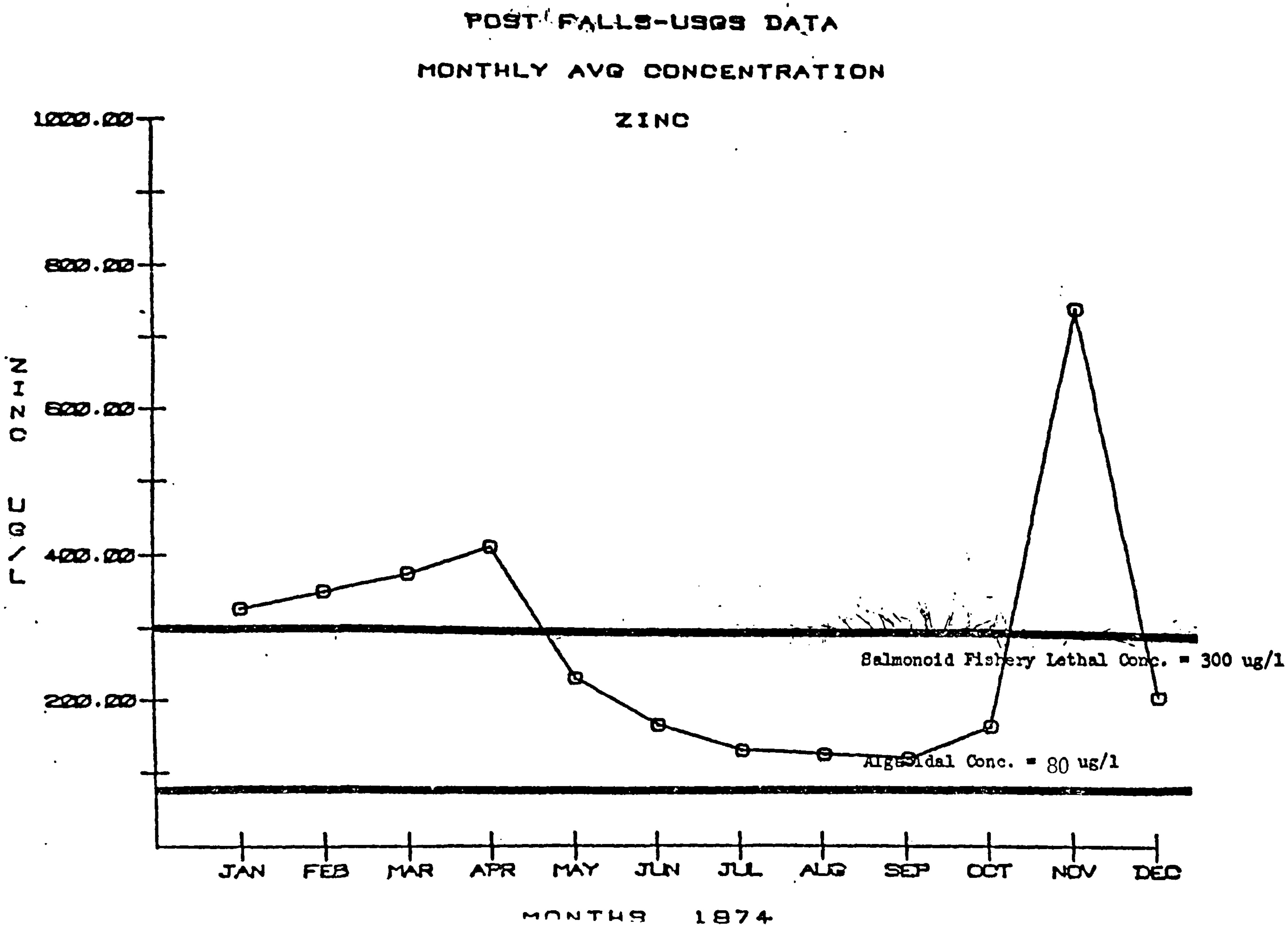

POST FALLS-USGS DATA
MONTHLY AVG CONCENTRATION
TOTAL PHOSPHOROUS
Ø.1Ø
Ø.Ø8
Ø.Ø6
Ø.Ø4
Ø.Ø2
TOTAL PHOSPHOROUS MG/L
Algal Bloom Potential Level
JAN
FEB
MAR
APR
MAY
JUN
JUL
AUG
SEP
OCT
NOV
DEC
MONTHS 1974

FIGURE CE-37


POST FALLS-USGS DATA
MONTHLY AVG CONCENTRATION
ZINC
1000.00
800.00
600.00
400.00
200.00
ZINC UG/L
Salmonoid Fishery Lethal Conc. = 300 ug/l
Conc. = 80 ug/l
JAN
FEB
MAR
APR
MAY
JUN
JUL
AUG
SEP
OCT
NOV
DEC
MONTHS 1874

GRAPH SET NO. 5

COEUR D'ALENE LAKE MASS BALANCE

Figs. C-38 to C-42 graphically present mass balance calculations for Coeur d'Alene Lake. This set of graphs indicates the lakes role as a source or a sink for various parameters throughout the year. It allows the reader to observe possible relationships between individual parameters and flows.

Loadings for the major inflows, the Coeur d'Alene and St. Joe Rivers, were compiled and defined as the lake inflow with Post Falls loadings in the Spokane River representing the lake outflow loadings. The net difference for each parameter was graphed for each month of 1974 on the upper half of each figure. The lower half of each figure represents incoming and dishcarging flows for the lake.

Table C-43, at the end of Graph Set. No. 5, numerically summarizes these mass balance calculations.

FIGURE CE-38

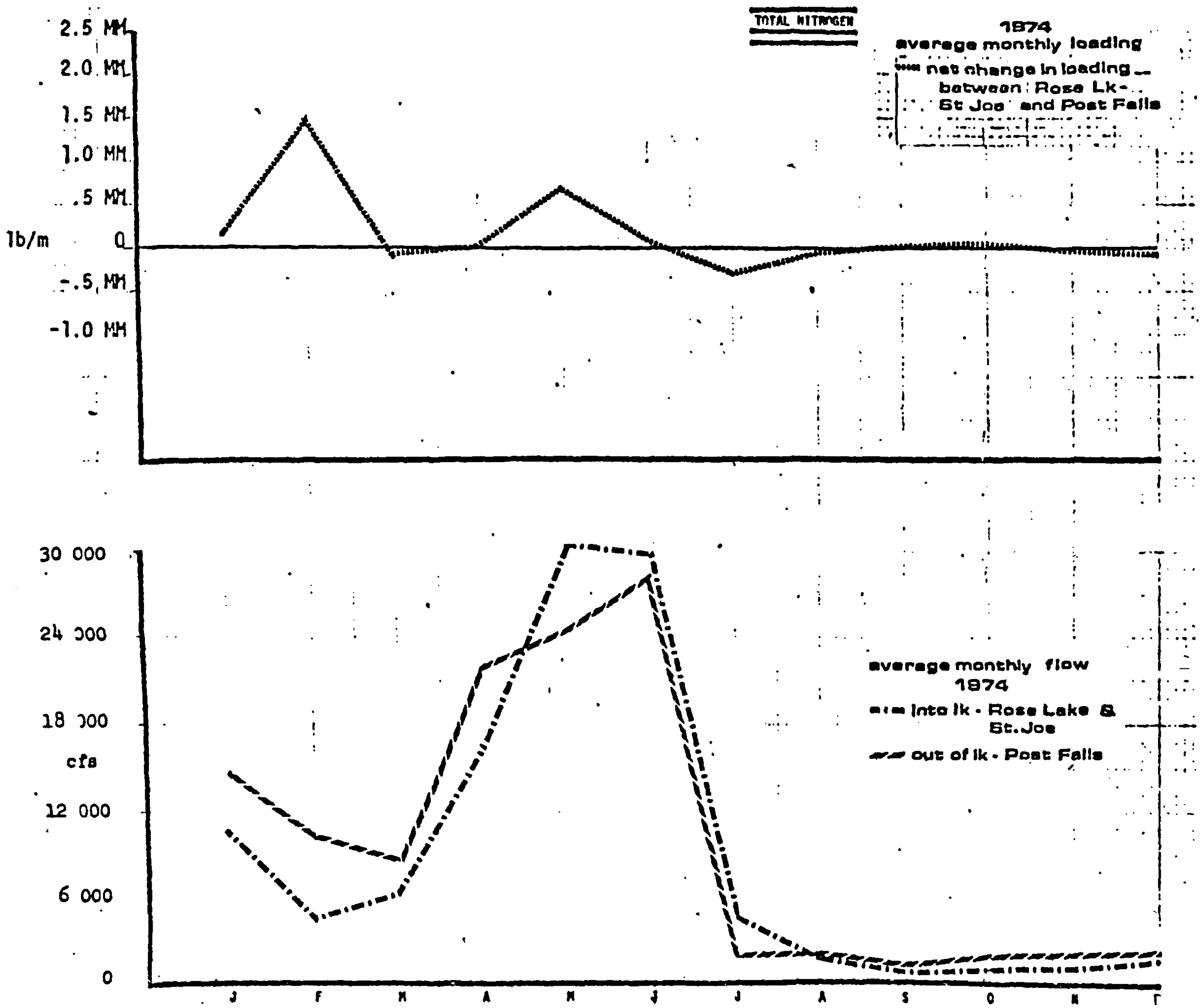

TOTAL NITROGEN
1974
average monthly loading
net change in loading between Rose Lk-St Joe and Post Falls
2.5 MM
2.0 MM
1.5 MM
1.0 MM
.5 MM
lb/m
0
-.5 MM
-1.0 MM
30 000
24 000
18 000
cfs
12 000
6 000
0
average monthly flow
1974
into lk - Rose Lake & St.Joe
out of lk - Post Falls
J
F
M
A
M
J
J
A
S
O
N
D

FIGURE CE-39

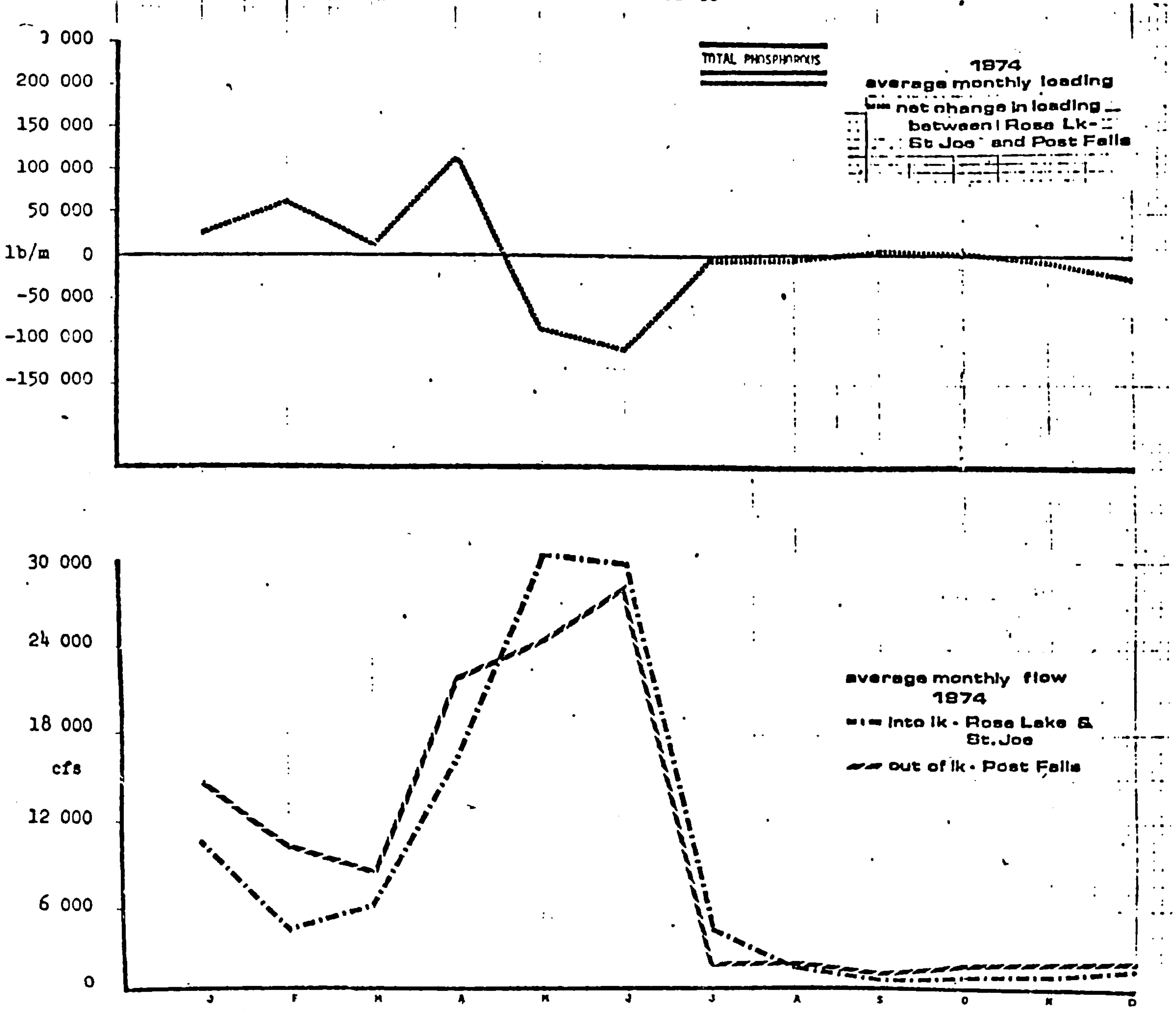
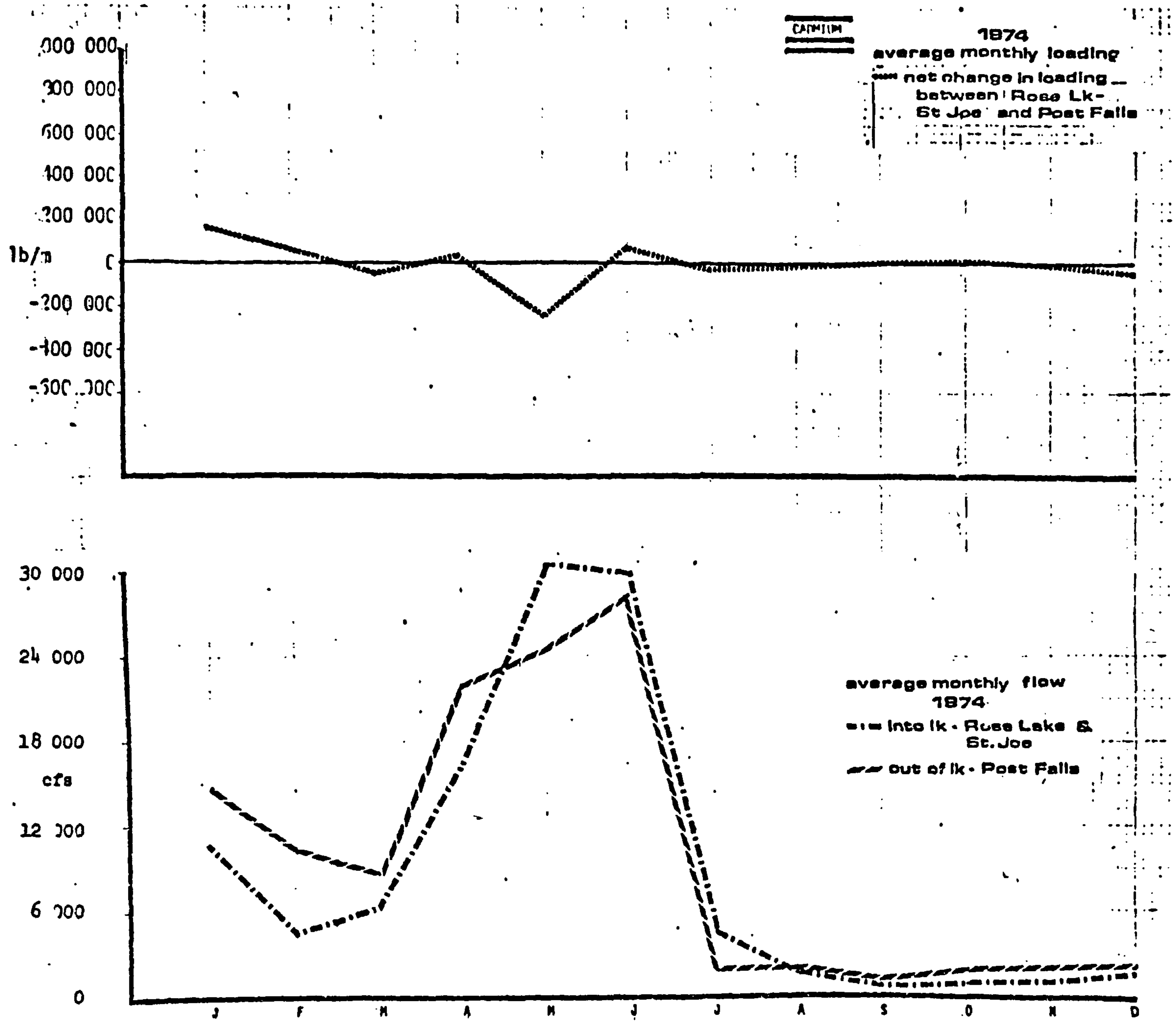

TOTAL PHOSPHOROUS
1974
average monthly loading
net change in loading between Rose Lk-St Joe and Post Falls
lb/m
200 000
150 000
100 000
50 000
0
-50 000
-100 000
-150 000
average monthly flow
1974
into lk - Rose Lake & St. Joe
out of lk - Post Falls
cfs
30 000
24 000
18 000
12 000
6 000
0
J
F
M
A
M
J
J
A
S
O
N
D

FIGURE CE-40



CADMIUM
1974
average monthly loading
net change in loading between Rose Lk-St Joe and Post Falls
lb/m
0
-200 000
average monthly flow
1974
into lk - Rose Lake & St. Joe
out of lk - Post Falls
30 000
24 000
18 000
cfs
0
J
F
M
A
M
J
J
A
S
O
N
D

FIGURE CE-41

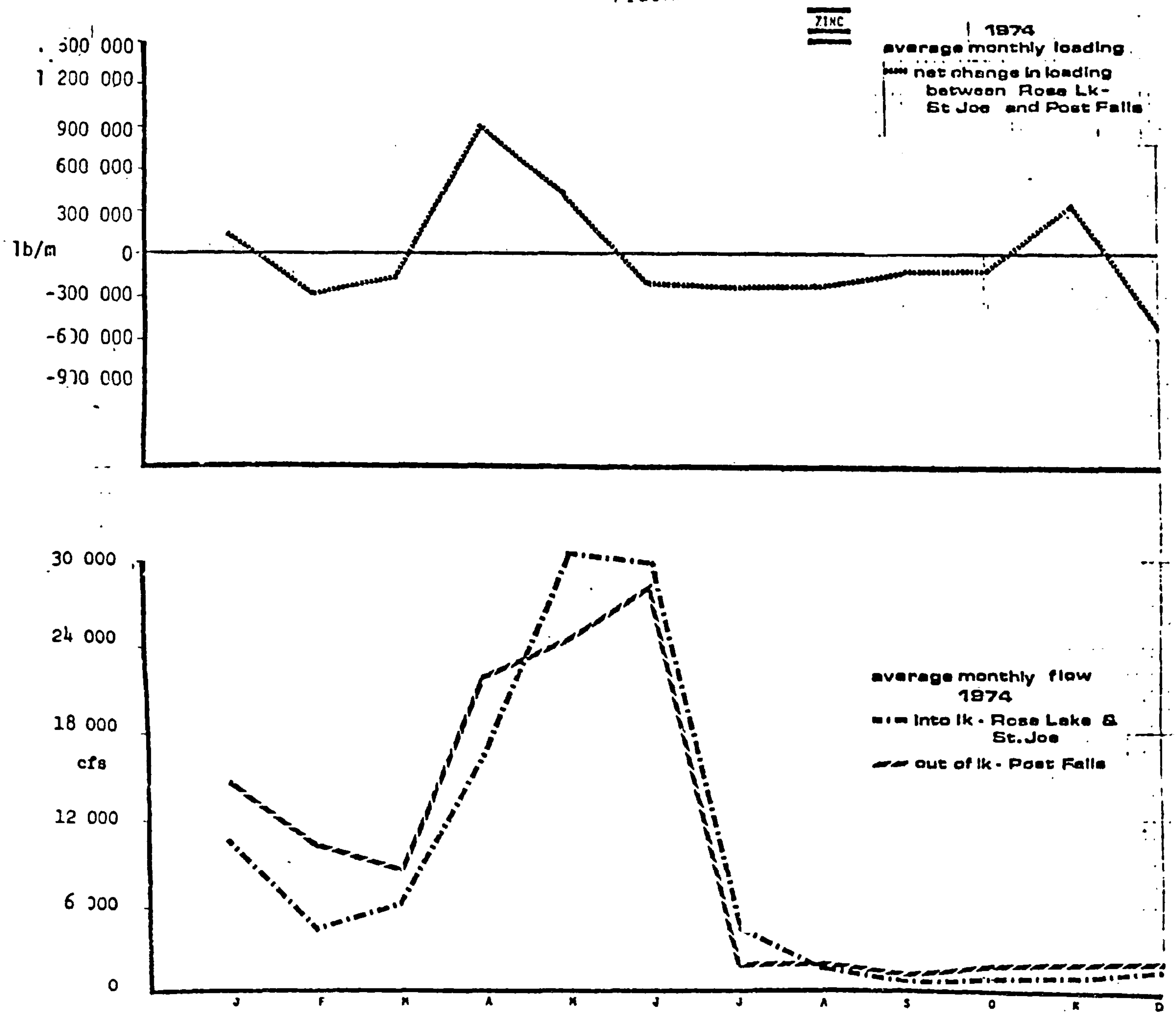
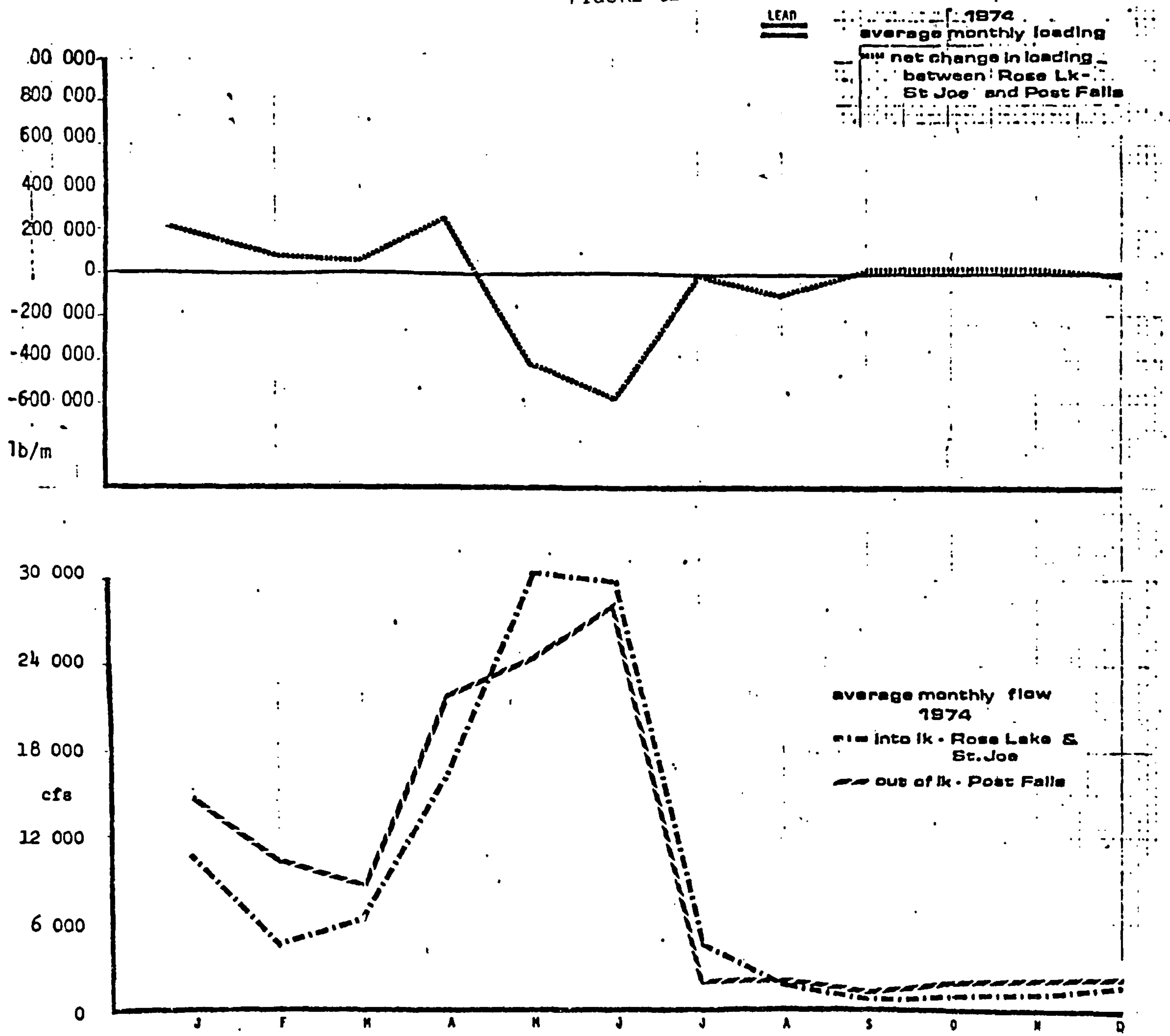

ZINC
1974
average monthly loading
net change in loading between Rose Lk-St Joe and Post Falls
1 500 000
1 200 000
900 000
600 000
300 000
lb/m
0
-300 000
-600 000
-900 000
30 000
24 000
18 000
cfs
12 000
6 000
0
average monthly flow 1974
into lk - Rose Lake & St. Joe
out of lk - Post Falls
J
F
M
A
M
J
J
A
S
O
N
D

FIGURE CE-42



LEAD
1974
average monthly loading
net change in loading between Rose Lk-St Joe and Post Falls
100 000
800 000
600 000
400 000
200 000
0
-200 000
-400 000
-600 000
lb/m
30 000
24 000
18 000
cfs
12 000
6 000
0
average monthly flow
1974
into lk - Rose Lake & St.Joe
out of lk - Post Falls
J
F
M
A
M
J
J
A
S
O
N
D

FIGURE CE-43

LAKE COEUR D 'ALENE MASS BALANCE SUMMARY * **

MONTH	TOTAL NITROGEN	TOTAL PHOSPHORUS	TOTAL CADMIUM	TOTAL LEAD	TOTAL ZINC
JAN	(+) 160,000	(+) 25,000	(+) 160,000	(+) 130,000	(+) 220,000
FEB	(+) 1,500,000	(+) 60,000	(+) 80,000	(-) 280,000	(+) 80,000
MAR	(-) 100,000	(+) 12,000	(-) 50,000	(-) 160,000	(+) 60,000
APR	(+) 50,000	(+) 117,000	(+) 18,000	(+) 900,000	(+) 230,000
MAY	(+) 570,000	(-) 83,000	(-) 240,000	(+) 430,000	(-) 440,000
JUN	(+) 100,000	(-) 110,000	(+) 70,000	(-) 200,000	(-) 560,000
JUL	(-) 300,000	(-) 7,000	(-) 35,000	(-) 240,000	(-) 20,000
AUG	(-) 50,000	(-) 6,000	(-) 20,000	(-) 220,000	(-) 100,000
SEP	(+) 20,000	(+) 3,000	(+) 5,000	(-) 120,000	(+) 20,000
OCT	(+) 50,000	(+) 2,000	(+) 10,000	(-) 120,000	(+) 30,000
NOV	(-) 70,000	(-) 10,000	(-) 10,000	(+) 360,000	(+) 30,000
DEC	(-) 100,000	(-) 25,000	(-) 60,000	(-) 510,000	(-) 20,000
NET	(+) 1,800,000	(-) 22,000	(-) 72,000	(-) 30,000	(-) 470,000

* (+) indicates source (-) indicates sink

all data in lbs/month

GRAPH SET NO. 6

COEUR D 'ALENE LAKE

I. INTRODUCTION

Water Quality observations of Lake Coeur d 'Alene are presented in the following graphs along two major lines of investigation;

(1) Examination of the water quality in relation to the State of Idaho Water Quality Standards.

(2) The functioning and the effect on the lake as an intermediate stage between the inflowing waters of the Coeur d 'Alene and St. Joe Rivers, and the outflowing water which forms the Spokane River.

The majority of lake data under evaluation is a result of monthly sampling for the period 74/04/25 thru 75/01/16. In addition, an intensive survey was conducted by EPA for the period 74/07/09 thru 74/07/11. It was during this period only, that metals and nutrient data were collected at depth.

A more extensive evaluation of Lake Coeur d 'Alene in the form of a separate report is anticipated in the near future.

II. DISCUSSION

The vertical profile and lake mile plots indicate three different stages occuring in the water column with respect to temperature throughout most of the lake. These are; (1) July data depicts a situation where formation of a thermocline is in progress, (2) September data depicts a pronounced establishment of the thermocline, (3) and January data depicts isothermal conditions prevailing.

The Coeur d'Alene and St. Joe Rivers seem to mix with the lake at variable depths depending on the respective temperatures of the input and lake waters. Detention time of the inflowing waters and flushing period of the lake itself is heavily dependent upon these variable stages of temperature distribution throughout the lake.

Dissolved oxygen concentrations show a response to temperature variations in the lake. During the period when a thermocline is firmly established the most significant decrease in dissolved oxygen with depth occurs and is exhibited through vertical profile and lake mile plots.

The occurrence of this dissolved oxygen sag, in an area commonly referred to as the hypolimnion, is a result of two factors. In addition to being cut off from circulation with upper waters and not receiving oxygen from the atmosphere during stratification, algal decomposition at depth exerts a Biological Oxygen Demand on these waters.

Influence from algal decomposition at depth is also indicated through substandard pH values exhibited at most depths. Specifically, the 74/09/30 pH lake mile plot shows substandard values for all stations at the 66 foot level and, with the exception of station 153397, the same is true at the 33 foot level.

Correlations between heavy metals and conductivity are apparent in the July vertical profiles. During this period, a decrease in surface ion and heavy metals concentrations occurs concurrently with a increase for the same at depth as the north end of the lake is approached. This is indicative of an increased rate of heavy metals settling out as the Coeur d'Alene River's waters travels north.

According to detention time calculations, input waters residing in the lake during July would have entered during high flow conditions with the majority of heavy metal loadings existing in a dissolved state. Thus, greater time and travel distance through the lake would be required for sediment deposition to occur. This is supported by sediment data showing increased metals concentrations occuring as the northern end of the lake is approached.

The September vertical profiles and lake mile plots depict a decrease in conductivity throughout the water column towards the north end of Lake Coeur d'Alene. Assuming, through detention time calculations, that the river water inflow under consideration in this situation entered the lake during low flow conditions, the majority of heavy metal loadings would be associated with settleable solids and thus reach the lake bottom near the point of input. The September conductivity vertical profile for station 153386 depicts a situation such as this occuring.

January conductivity values show a generally constant ion concentration throughout the lake at depth. This would seem reasonable assuming that due to significantly colder input water an even mixing within the lake would eventually occur in a northern direction.

Secchi disc readings respond to the flow cycles of the Coeur d'Alene and St. Joe Rivers. Turbidity throughout the lake generally increases during periods of high flow (with corresponding decreases in secchi disc values).

Surface values for total Phosphorous also seem cyclic with lower concentrations occuring during the summer months due to increasing primary production. In addition, total Zinc concentrations in the surface waters range from approximately 100-300 ug/l, which exceeds the Algalcidal concentration of 80 ug/l throughout most of the year. Data indicates this to be a widespread occurrence, with the majority of Lake Coeur d'Alene being involved.

III. DATA PRESENTATION

Figure C-44 shows station locations which correspond to station graphs which follow

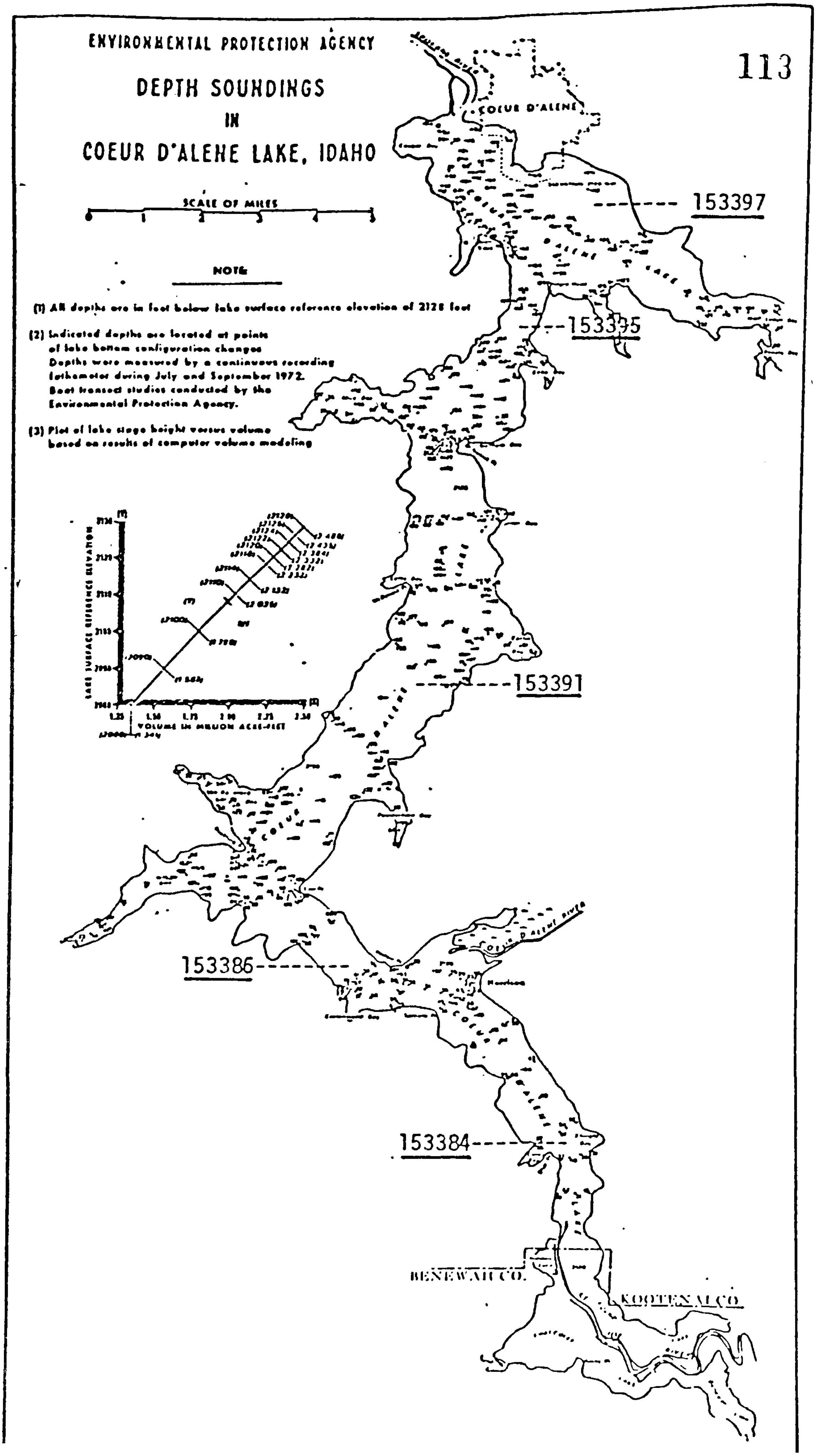
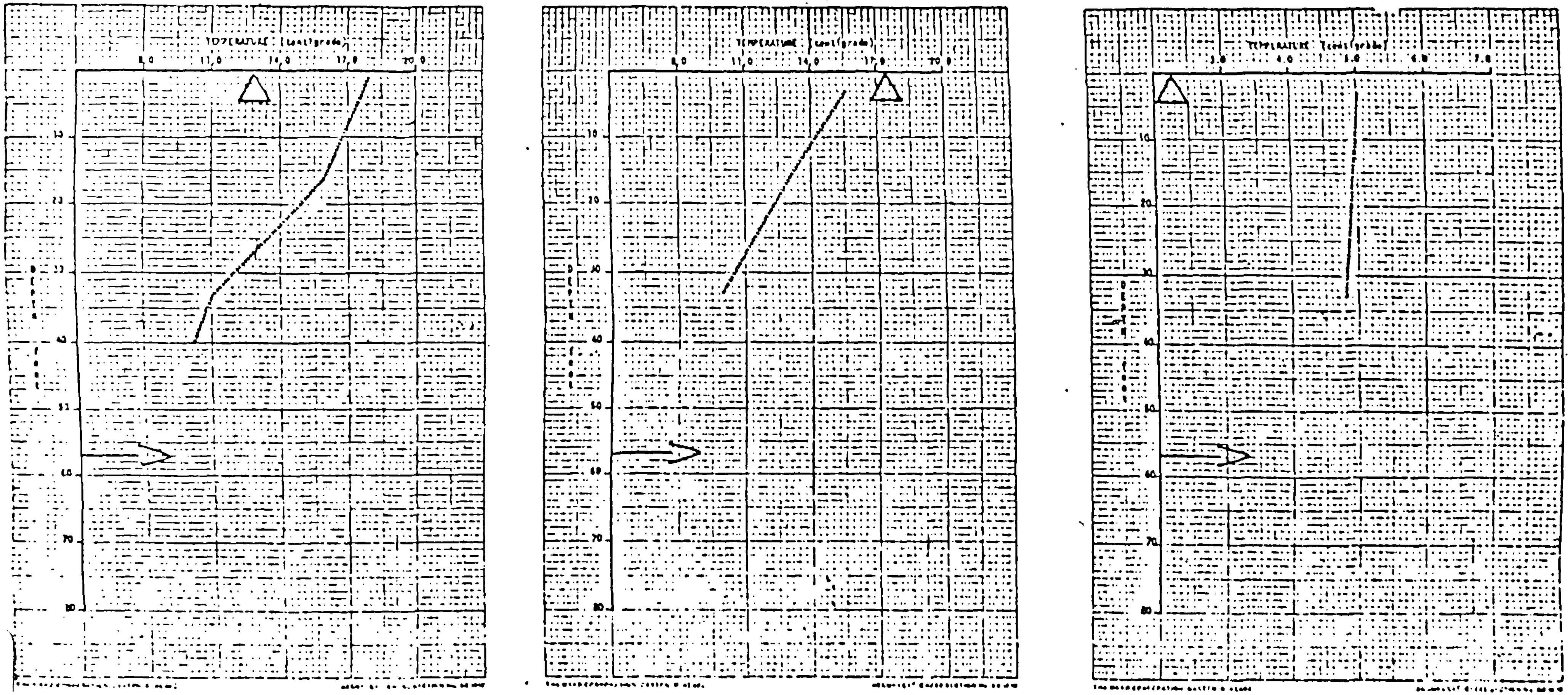

ENVIRONMENTAL PROTECTION AGENCY
DEPTH SOUNDINGS
IN
COEUR D'ALENE LAKE, IDAHO
SCALE OF MILES
0 1 2 3 4 5
NOTE
(1) All depths are in feet below lake surface reference elevation of 2128 feet
(2) Indicated depths are located at points of lake bottom configuration changes
Depths were measured by a continuous recording fathometer during July and September 1972.
Boat transect studies conducted by the Environmental Protection Agency.
(3) Plot of lake stage height versus volume based on results of computer volume modeling
VOLUME IN MILLION ACRE-FEET
COEUR D'ALENE
153397
153395
153391
153386
153384
BENEWAH CO.
KOOTENAI CO.

FIGURE CE-44

STATION 153384

FIGURE CE-45



74/07/09 74/09/30 74/12/17

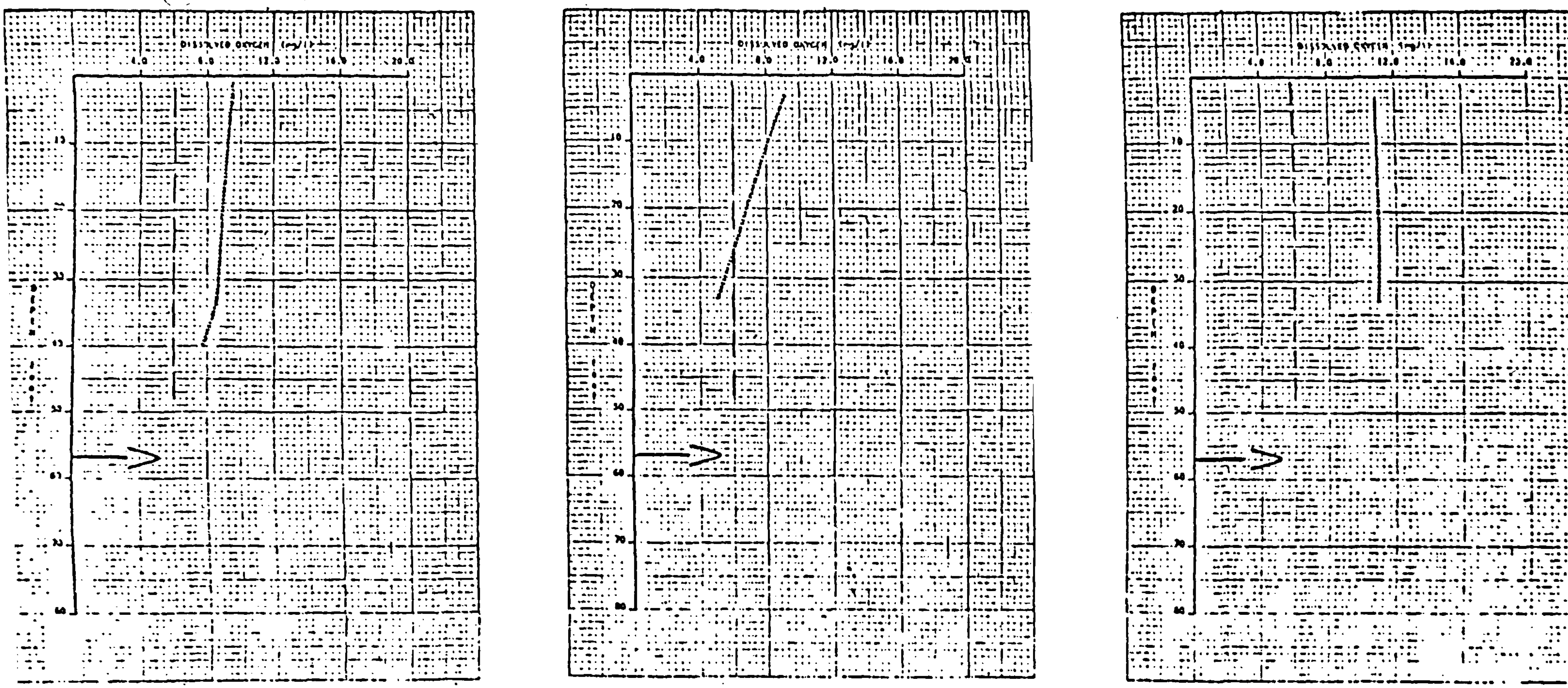
LAKE COUER D'ALENE STATION NO.153384
(single sample values)

△ Designates sample value from St. Joe River at St. Maries from approximately same time period as vertical plots.

74/07/11 = 13.0 74/08/21 = 17.5 74/12/13 = 1.0

——> Indicates lake bottom

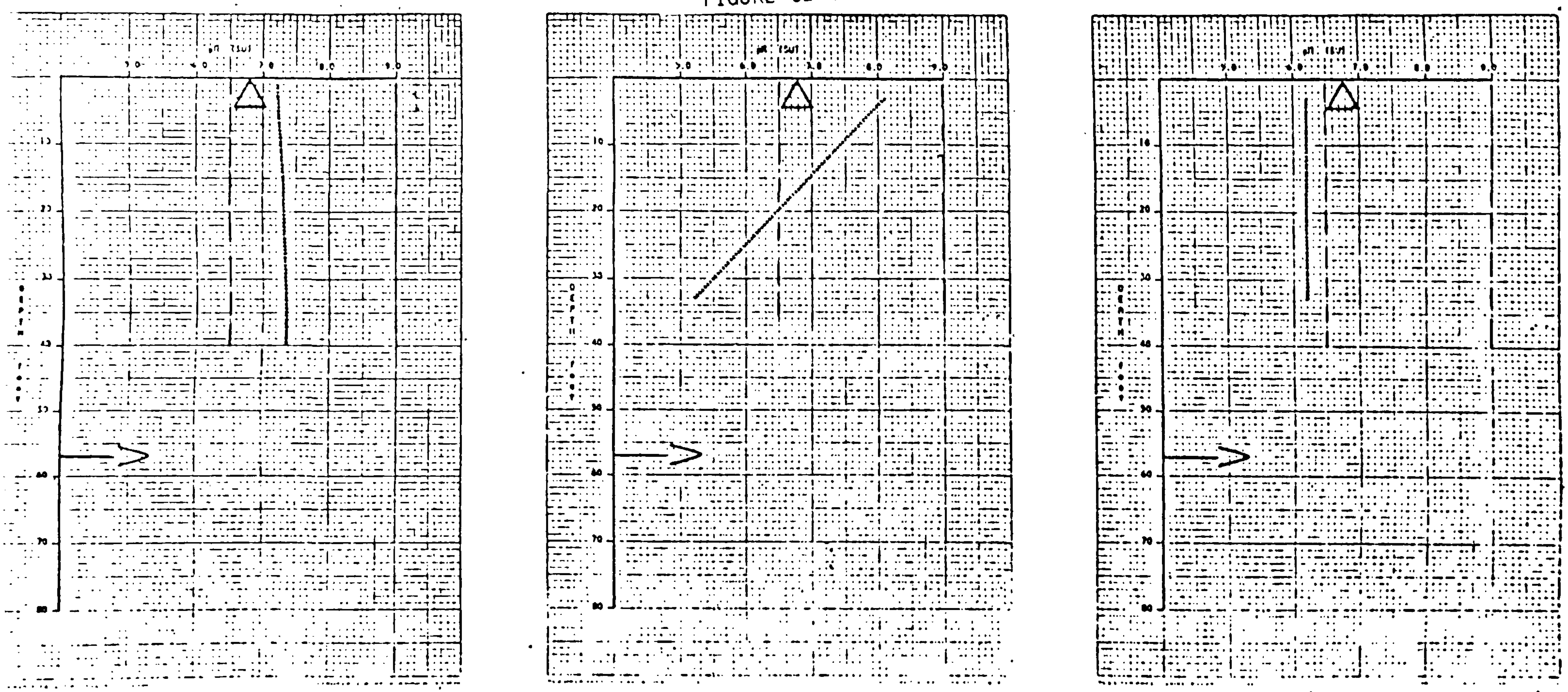
FIGURE CE-46



74/07/09 74/09/30 74/12/17

LAKE COUER D'ALENE STATION NO.153384
(single sample values)
Dissloved Oxygen Standard (6.0 mg/l) — — —
——> Indicates lake bottom

FIGURE CE-47



74/07/09 74/09/30 74/12/17

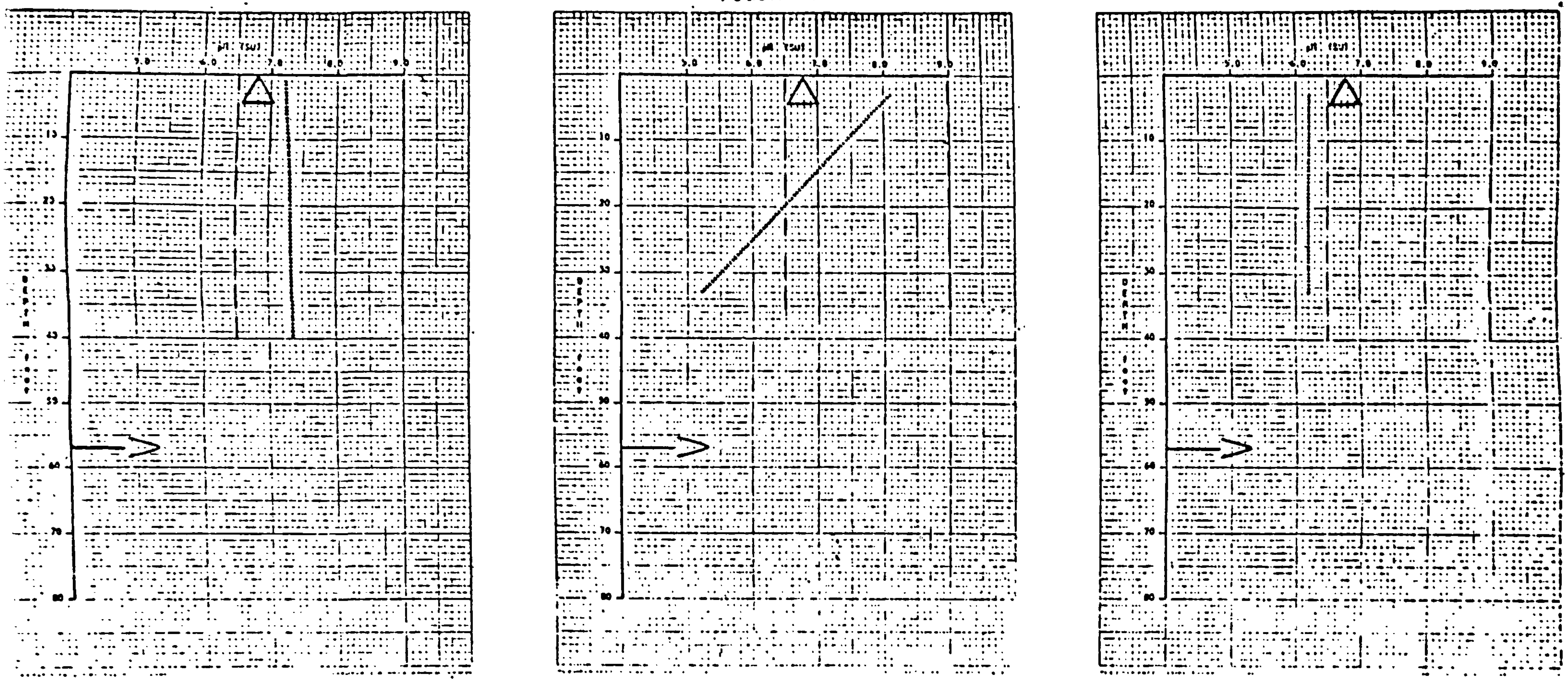
LAKE COUER D 'ALENE STATION NO.153384
(single sample values)
pH Standard Range (6.50 - 9.00)— — —

△ Designates sample value on St. Joe River at St. Maries from approximately same time period as vertical plots.

74/07/11 = 6.80 74/08/21 = 6.80 74/12/13 = 6.80

——> Indicates lake bottom

FIGURE CE-48



74/07/09 74/09/30 74/12/17

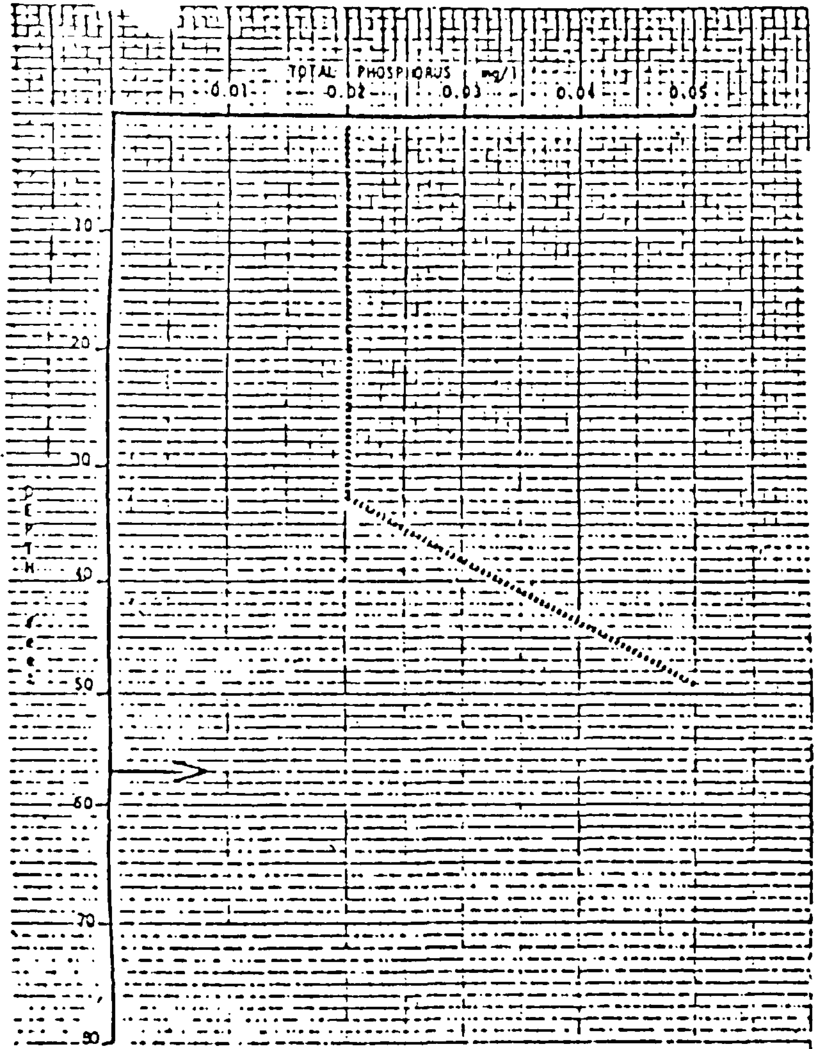
LAKE COUER D 'ALENE STATION NO.153384
(single sample values)
pH Standard Range (6.50 - 9.00)— — —

△ Designates sample value on St. Joe River at St. Maries from approximately same time period as vertical plots.

74/07/11 = 6.80 74/08/21 = 6.80 74/12/13 = 6.80

——> Indicates lake bottom

FIGURE CE-49



STATION 153384
74/07/09
(single sample values)
—> Indicates lake bottom

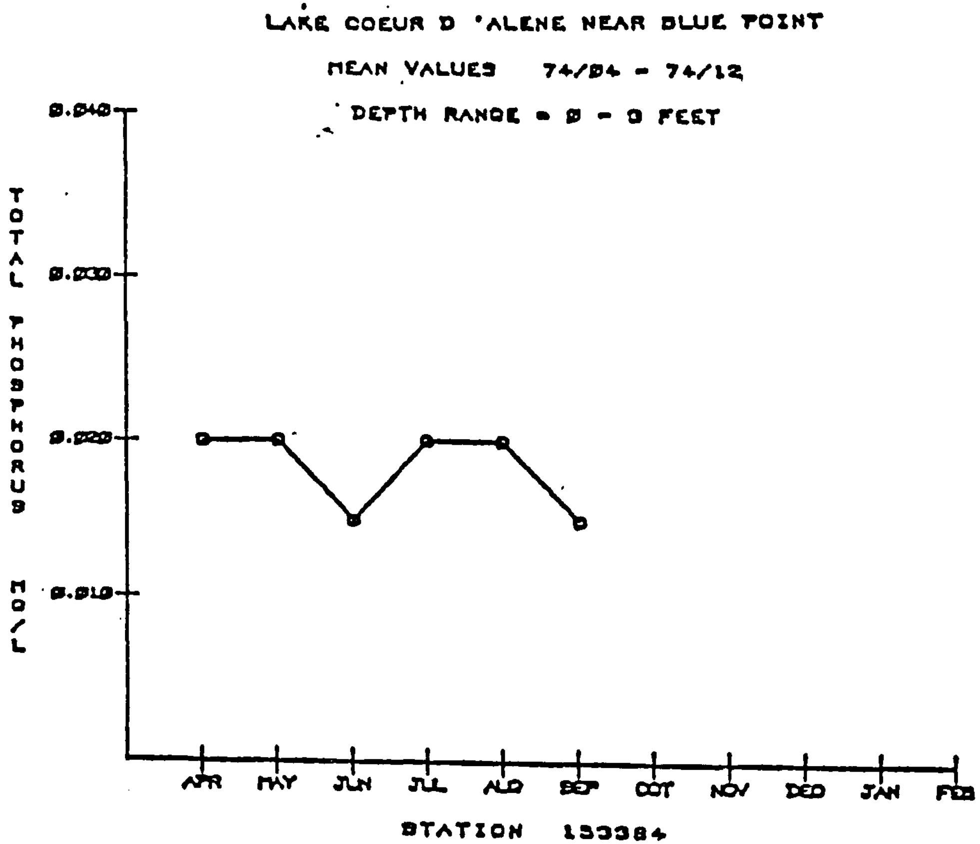
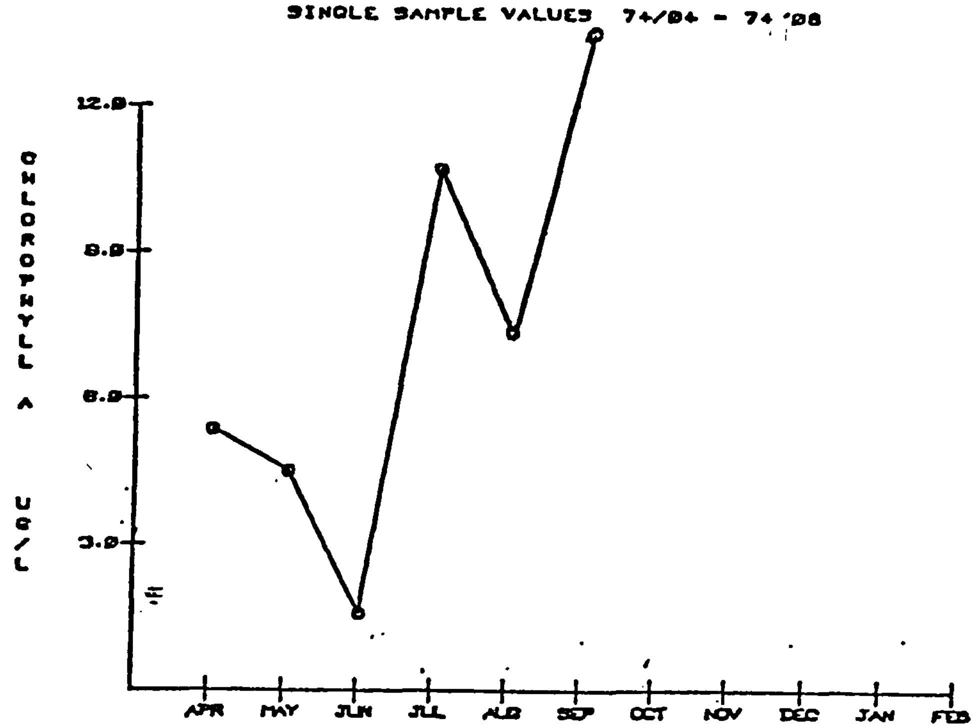


FIGURE CE-50

LAKE COEUR D 'ALENE NEAR BLUE POINT

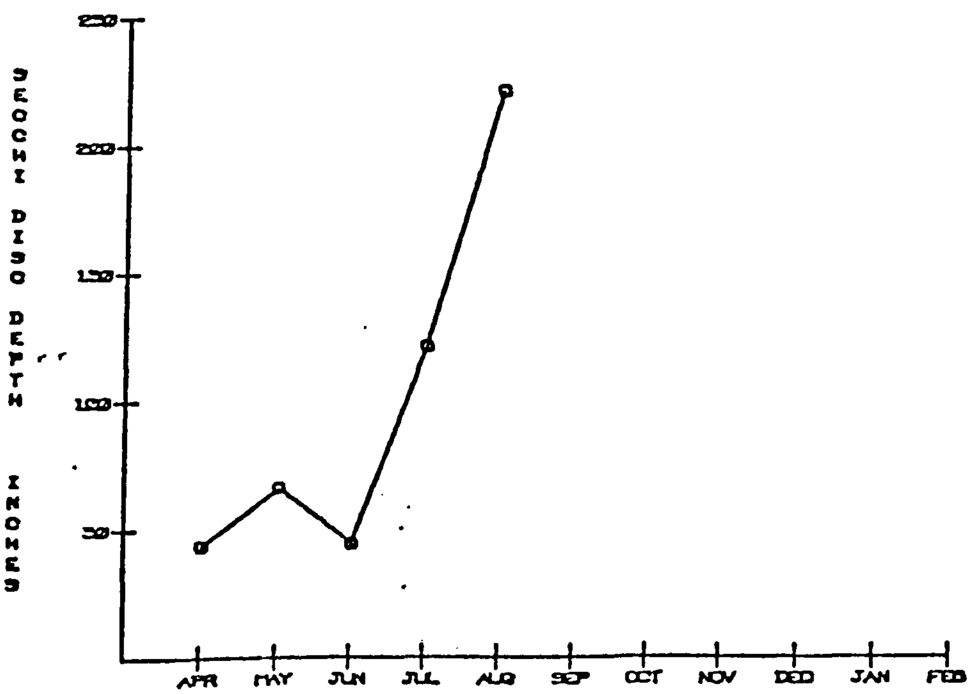
SINGLE SAMPLE VALUES 74/04 - 74/08



STATION 153384

LAKE COEUR D 'ALENE NEAR BLUE POINT

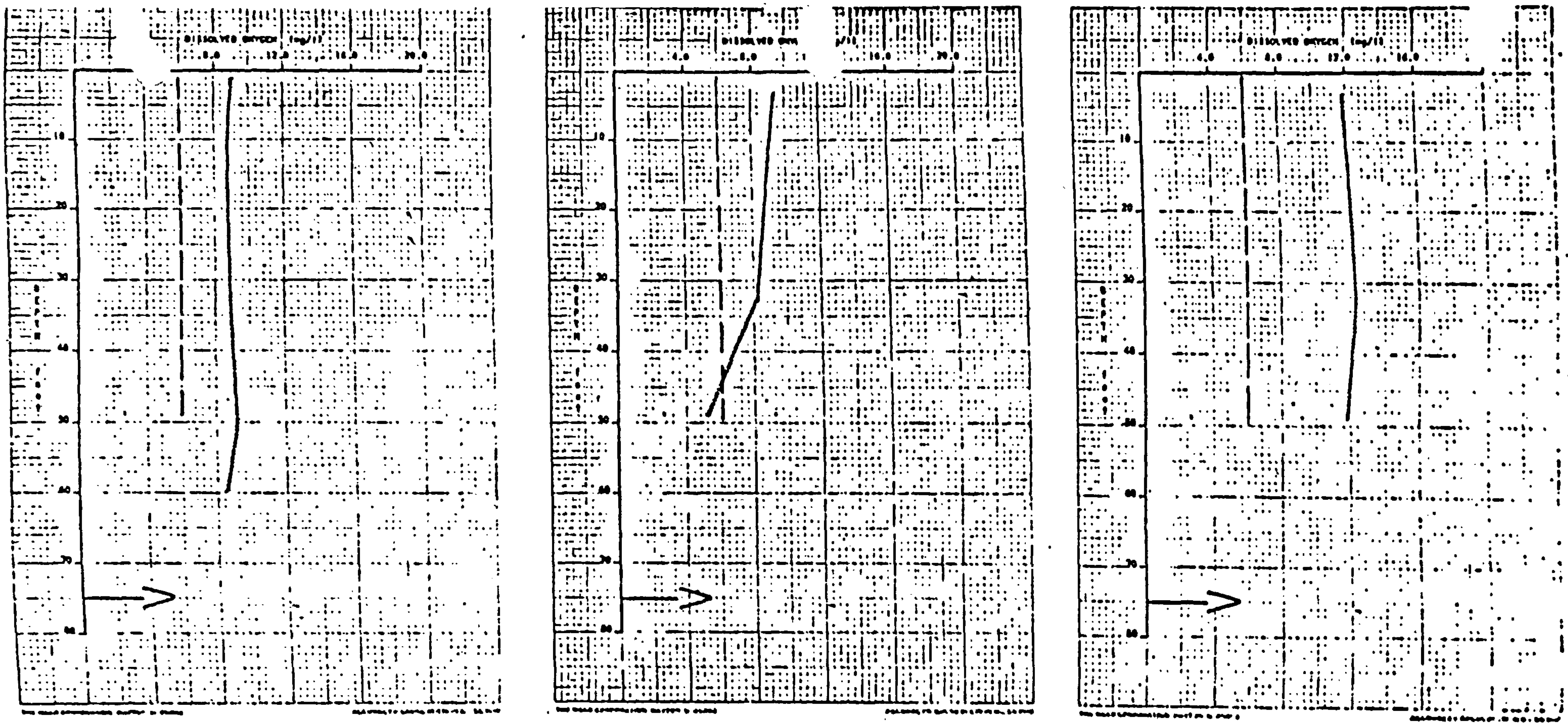
SINGLE SAMPLE VALUES 74/04 - 74/12



STATION 153384

STATION 153386

FIGU CE-52



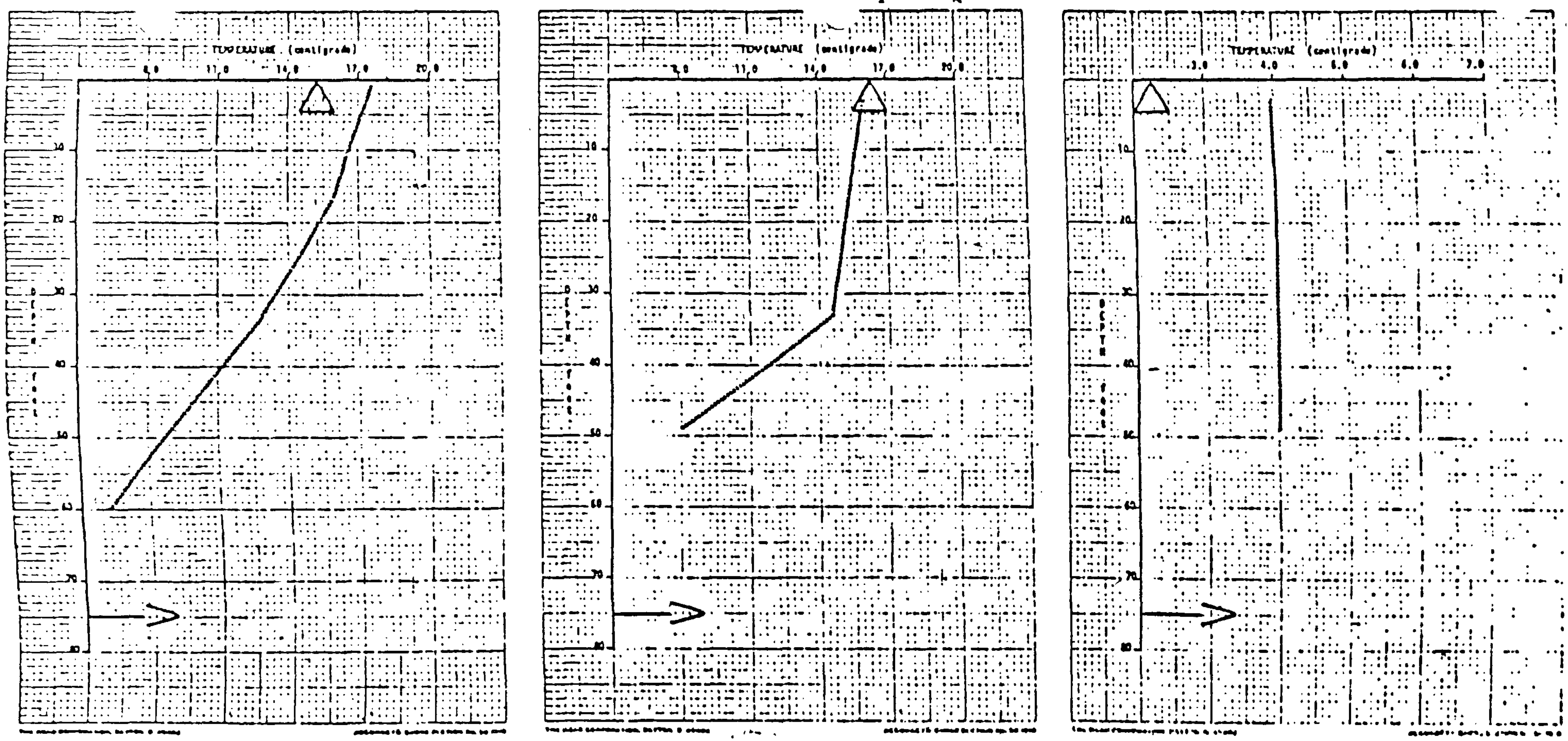
74/07/10 74/09/30 75/01/16

LAKE COEUR D'ALENE STATION NO.153386
(single sample values)
Dissolved Oxygen Standard (6.0 mg/l) — — —

——> Indicates lake bottom

1:2

FIGURE CE-51



74/07/09 74/09/30 75/01/16

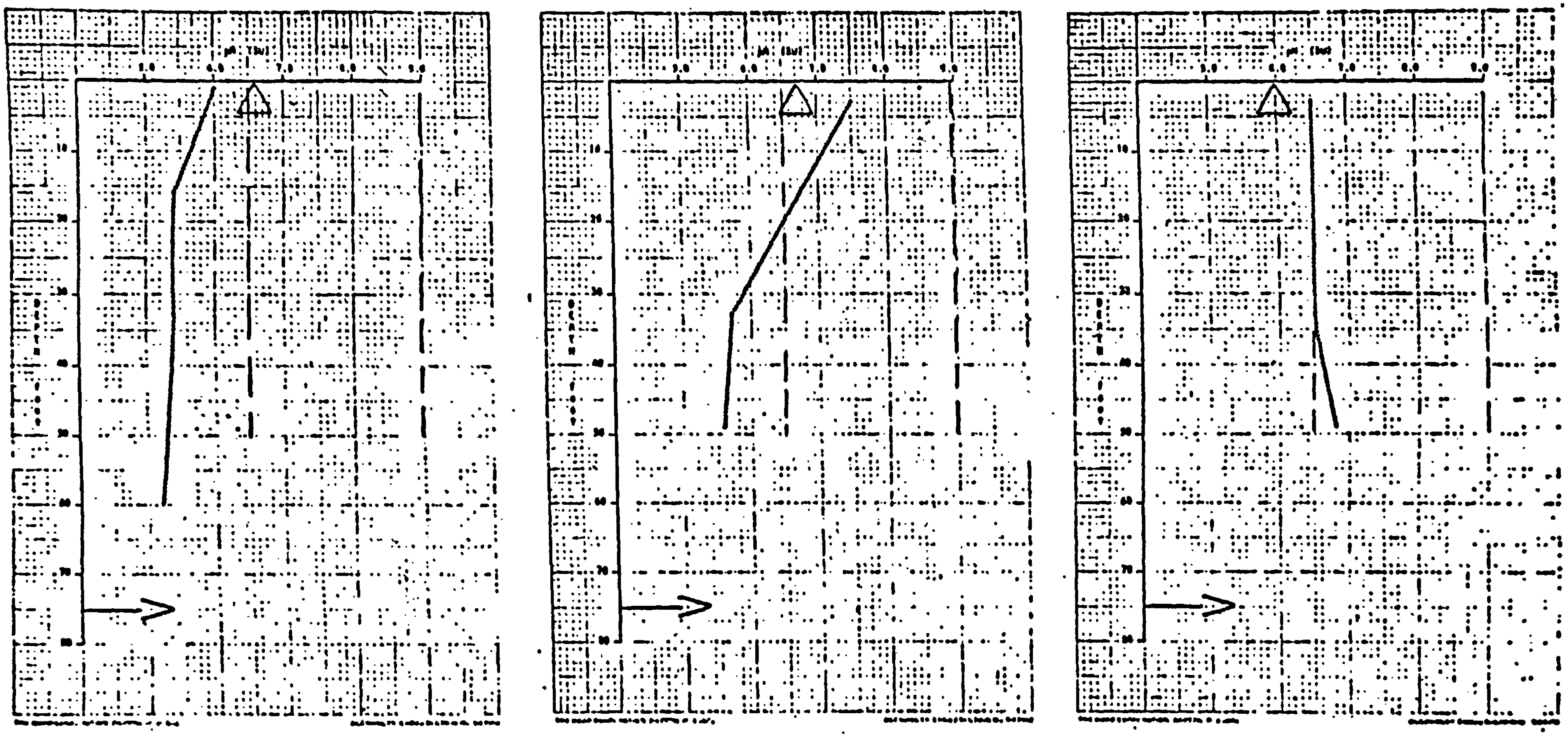
LAKE COEUR D'ALENE STATION NO.153386
(single sample values)

△ Designates sample value on Coeur d 'Alene River at Rose Lake from approximately same time period as vertical plots.

74/07/11 = 15.25 74/08/20 = 16.50 75/01/22 = 1.50

——> Indicates lake bottom

FIGURE CE-53



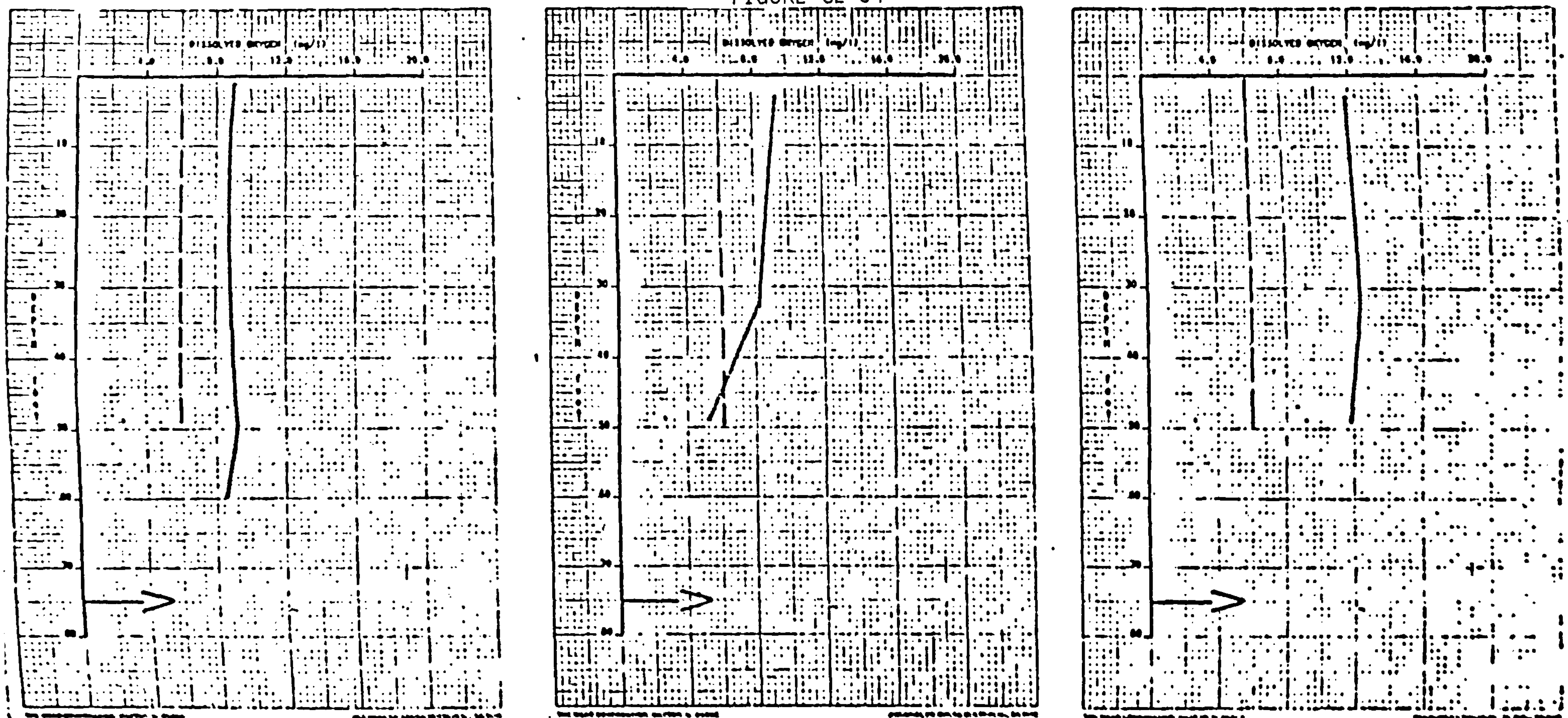
74/07/10 74/09/30 75/01/16

LAKE COEUR D'ALENE STATION NO.153386
(single sample values)
pH Standard Range (6.50 - 9.00) — — —

△ Designates sample value on Coeur d 'Alene River at Rose Lake from approximately same time period as vertical plots.

74/07/11 = 6.60 74/08/20 = 6.70 75/01/22 = 6.00

FIGURE CE-54

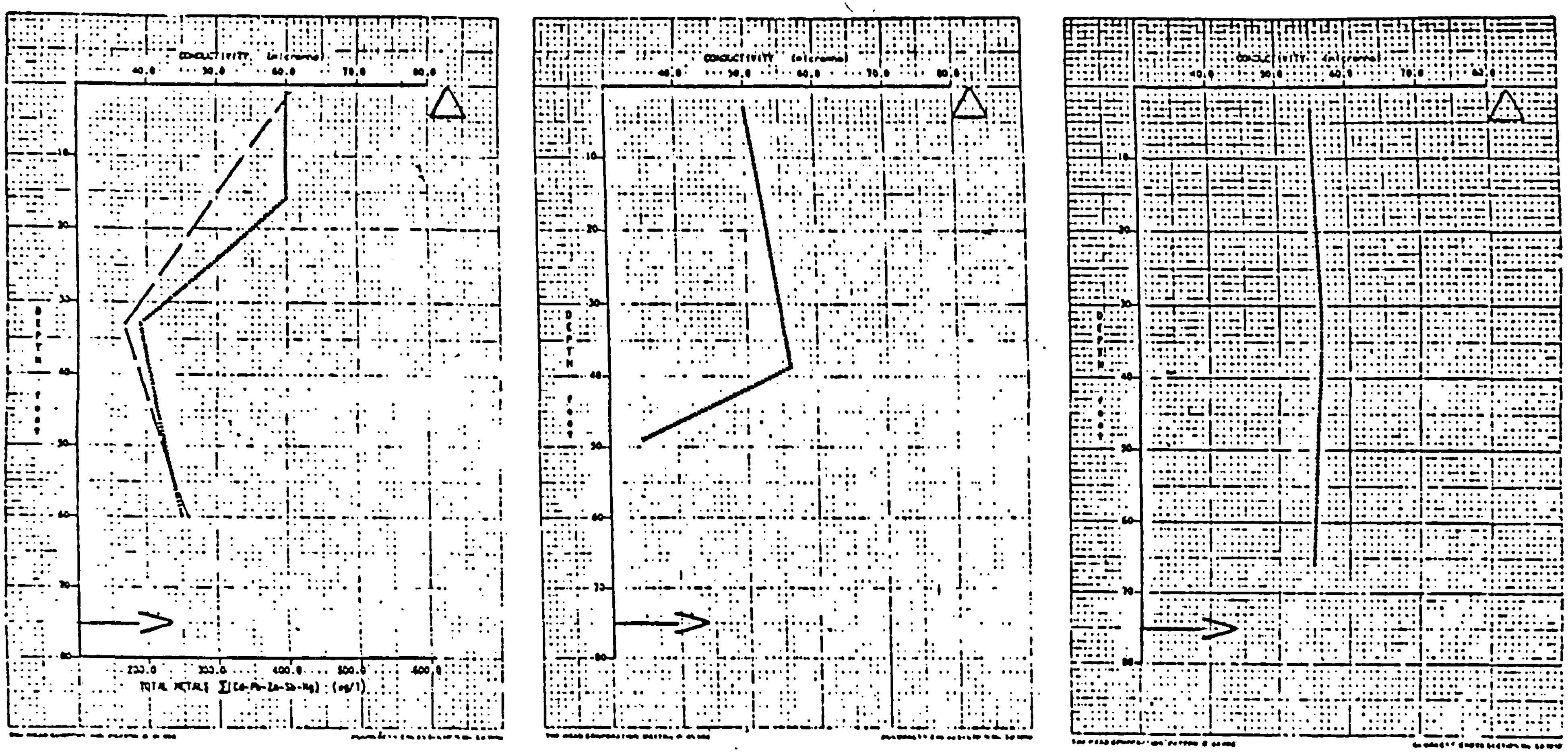


74/07/10 74/09/30 75/01/16

LAKE COEUR D'ALENE STATION NO.153386
(single sample values)
Dissolved Oxygen Standard (6.0 mg/l) — — —

——> Indicates lake bottom

FIGURE CE-55



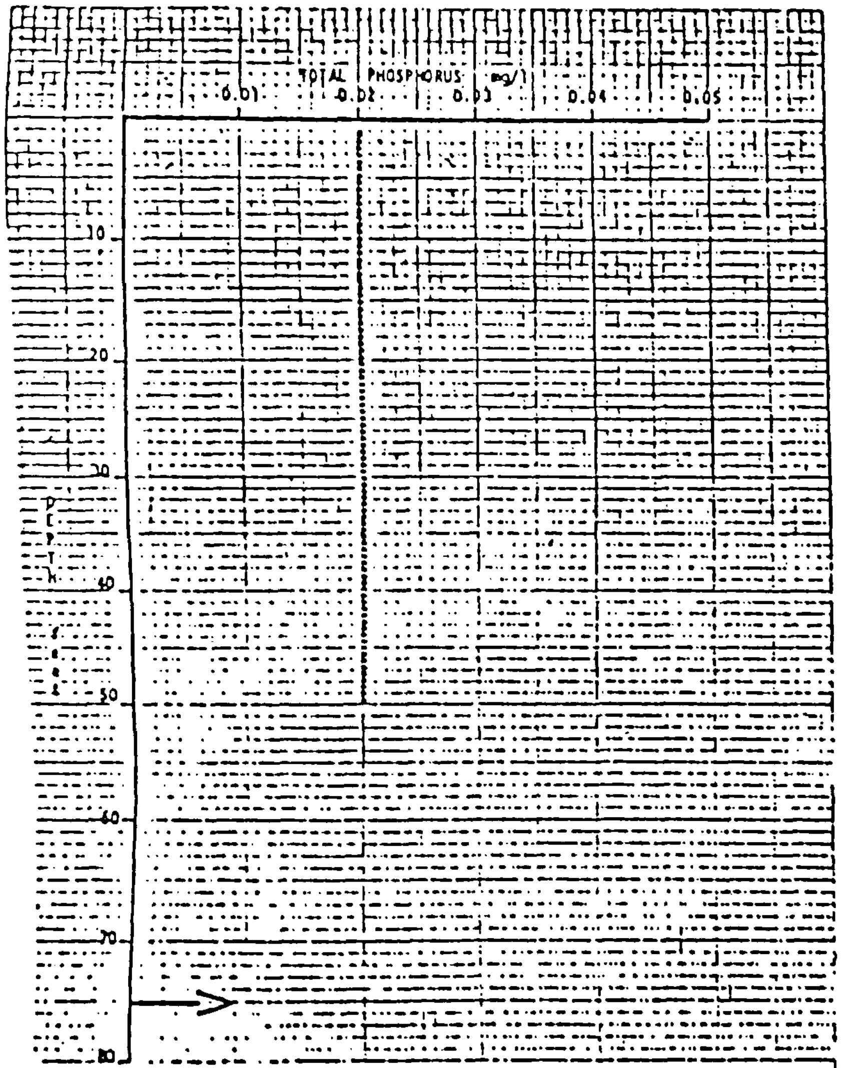
LAKE COEUR D'ALENE STATION NO.153386
(single sample values)
Total Metals Σ(Cd-Pb-Zn-Sb-Hg) (ug/l) — — —

△ Designates sample value on Coeur d 'Alene River at Rose Lake from approximately same time period as vertical plots.

74/07/11 = 120 | 74/08/20 = 127 | 75/01/22 = 102

——> Indicates lake bottom

FIGURE CE-56



STATION 153386
74/07/10
(single sample values)
——> Indicates lake bottom

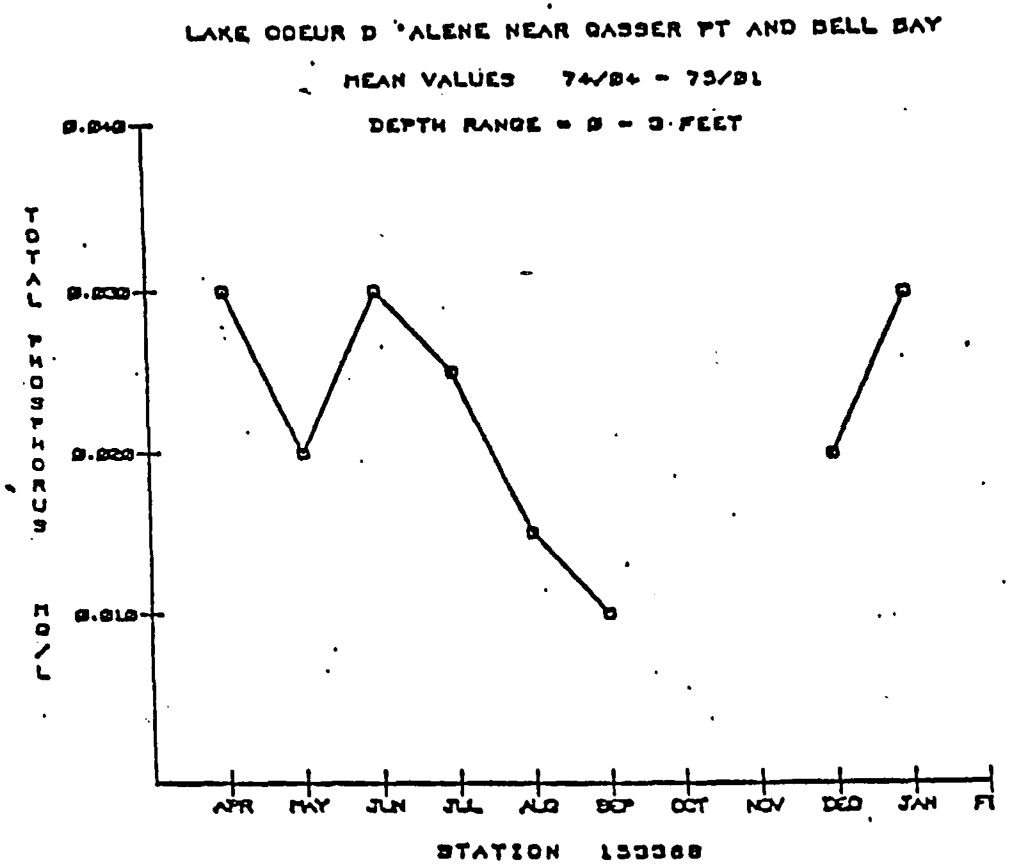


FIGURE CE-57

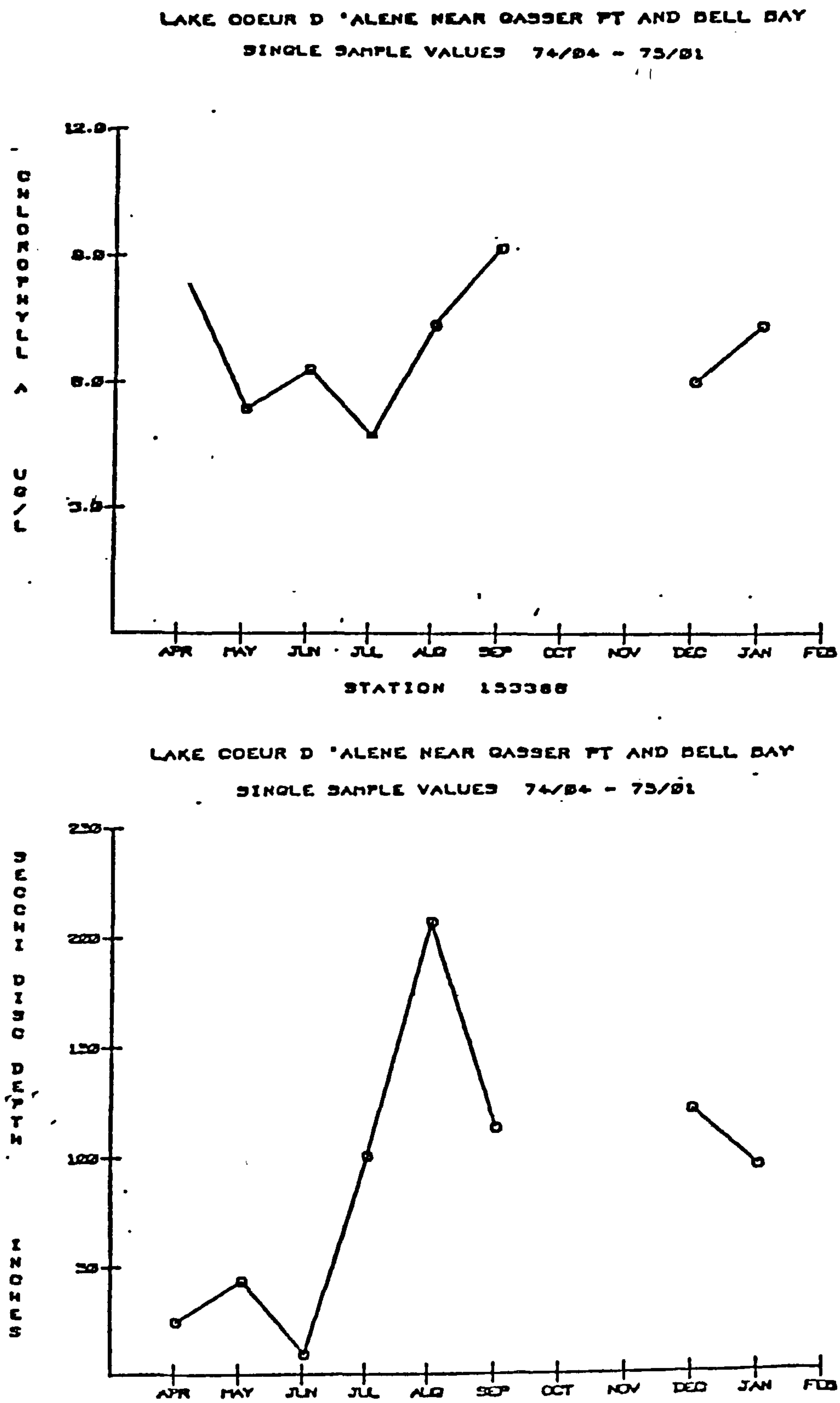
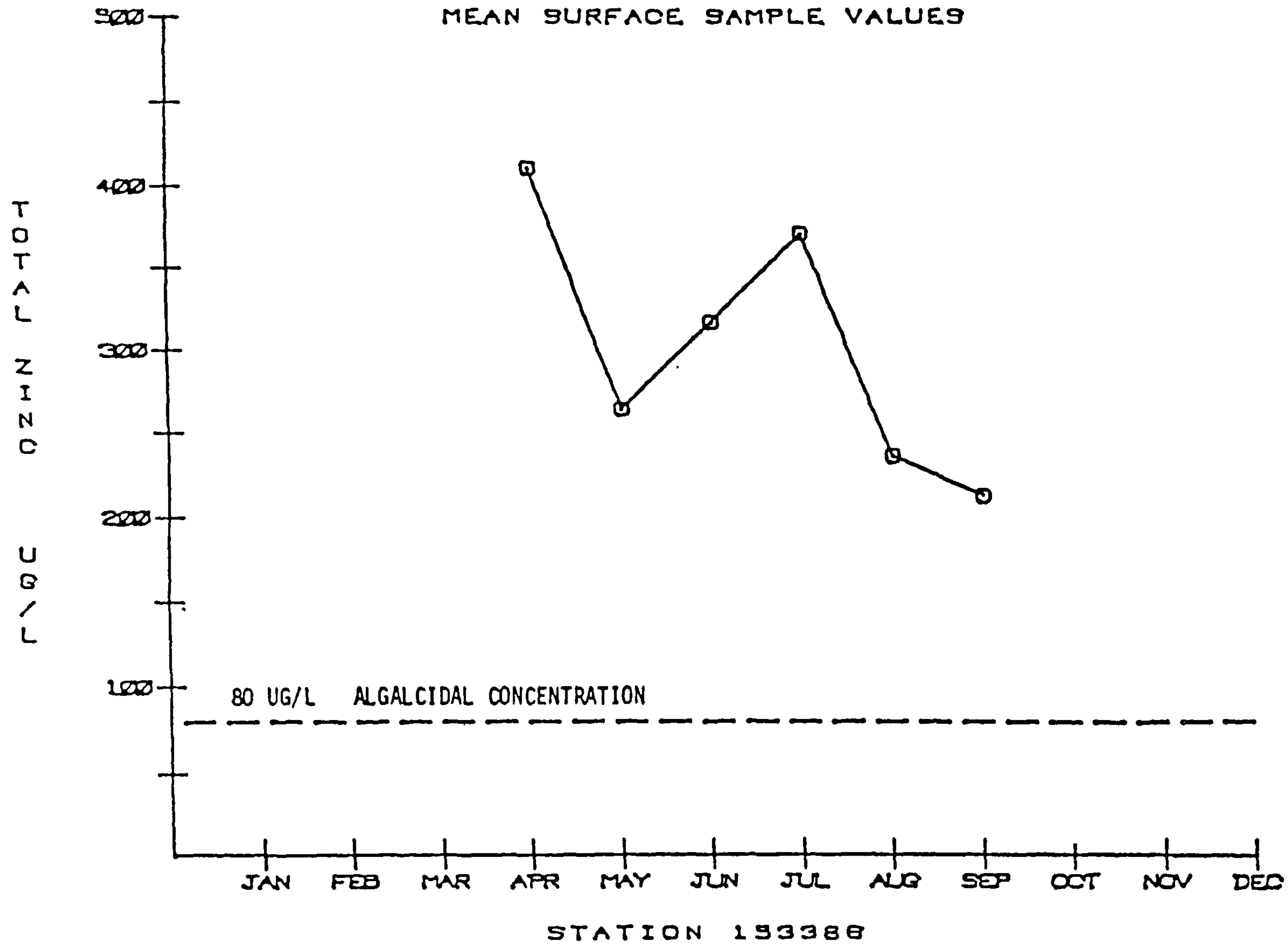

LAKE COEUR D 'ALENE NEAR GASSER PT AND BELL BAY
SINGLE SAMPLE VALUES 74/04 - 75/01
CHLOROPHYLL A UG/L
12.0
9.0
6.0
3.0
APR
MAY
JUN
JUL
AUG
SEP
OCT
NOV
DEC
JAN
FEB
STATION 153388
LAKE COEUR D 'ALENE NEAR GASSER PT AND BELL BAY
SINGLE SAMPLE VALUES 74/04 - 75/01
SECCHI DISC DEPTH INCHES
250
200
150
100
50

FIGURE CE-58'

LAKE COEUR D 'ALENE NEAR GASSER PT AND BELL BAY

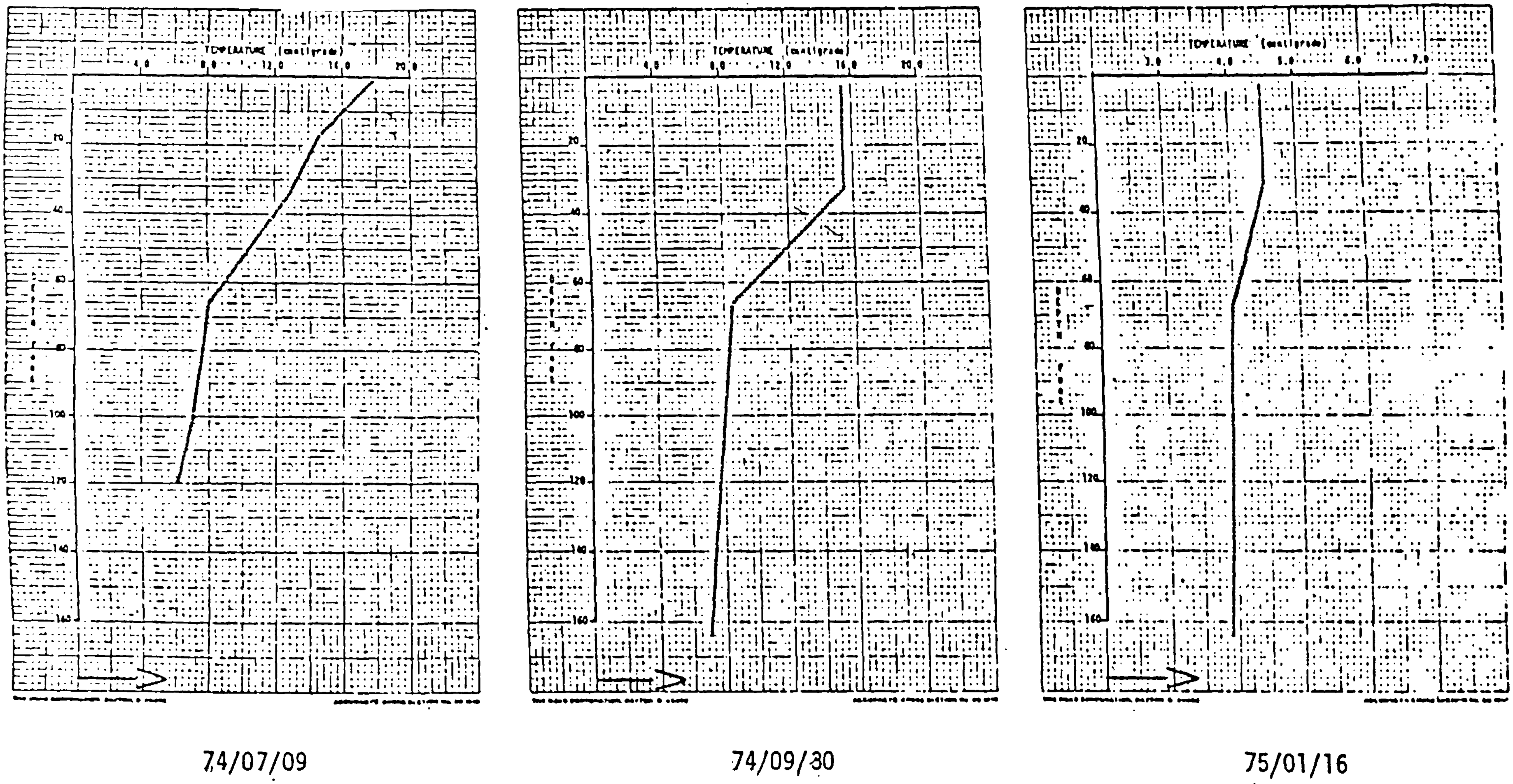
DATE RANGE = 74/04 - 74/08

MEAN SURFACE SAMPLE VALUES



STATION 153391

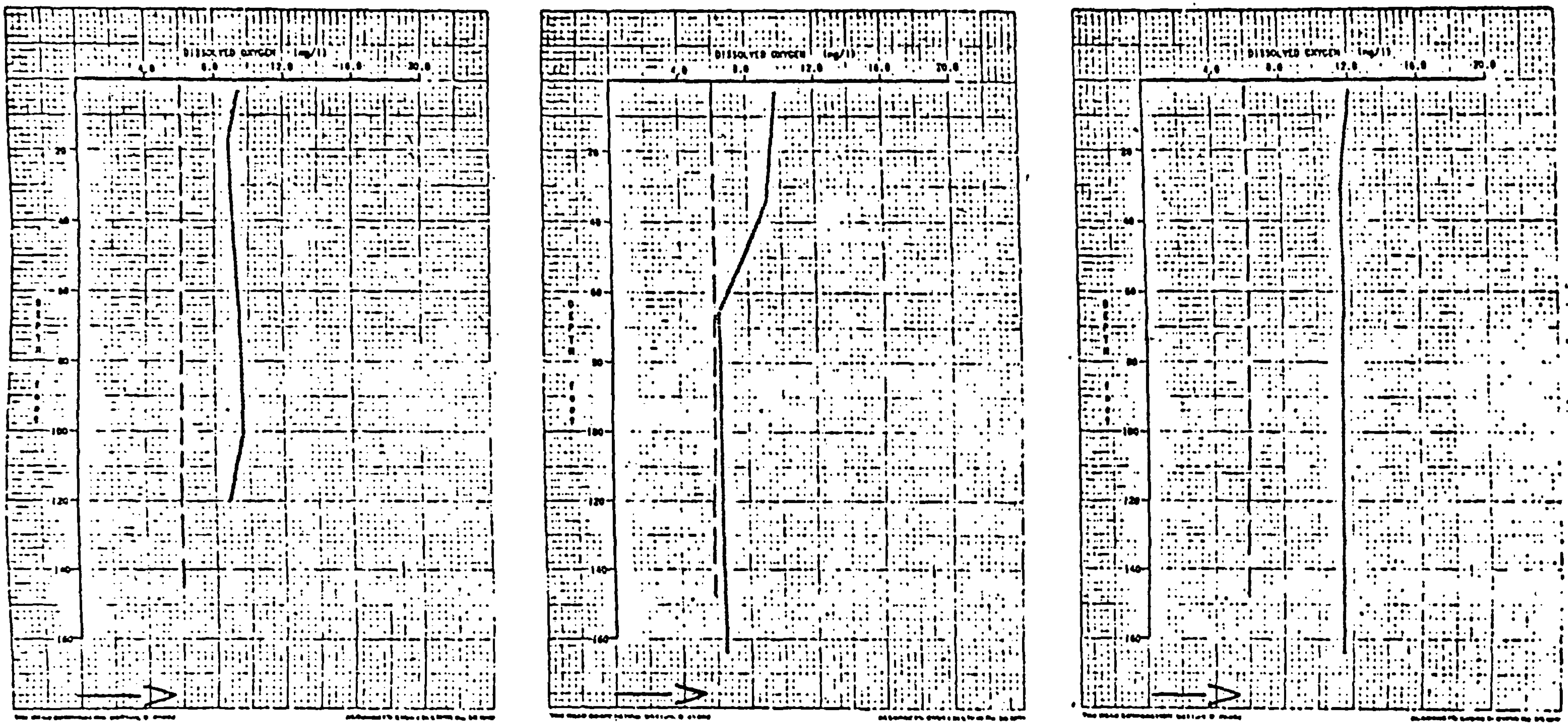
FIGURE CE-59



LAKE COEUR D'ALENE STATION NO. 153391
(single sample values)

——> Indicates lake bottom

FIGURE CE-60

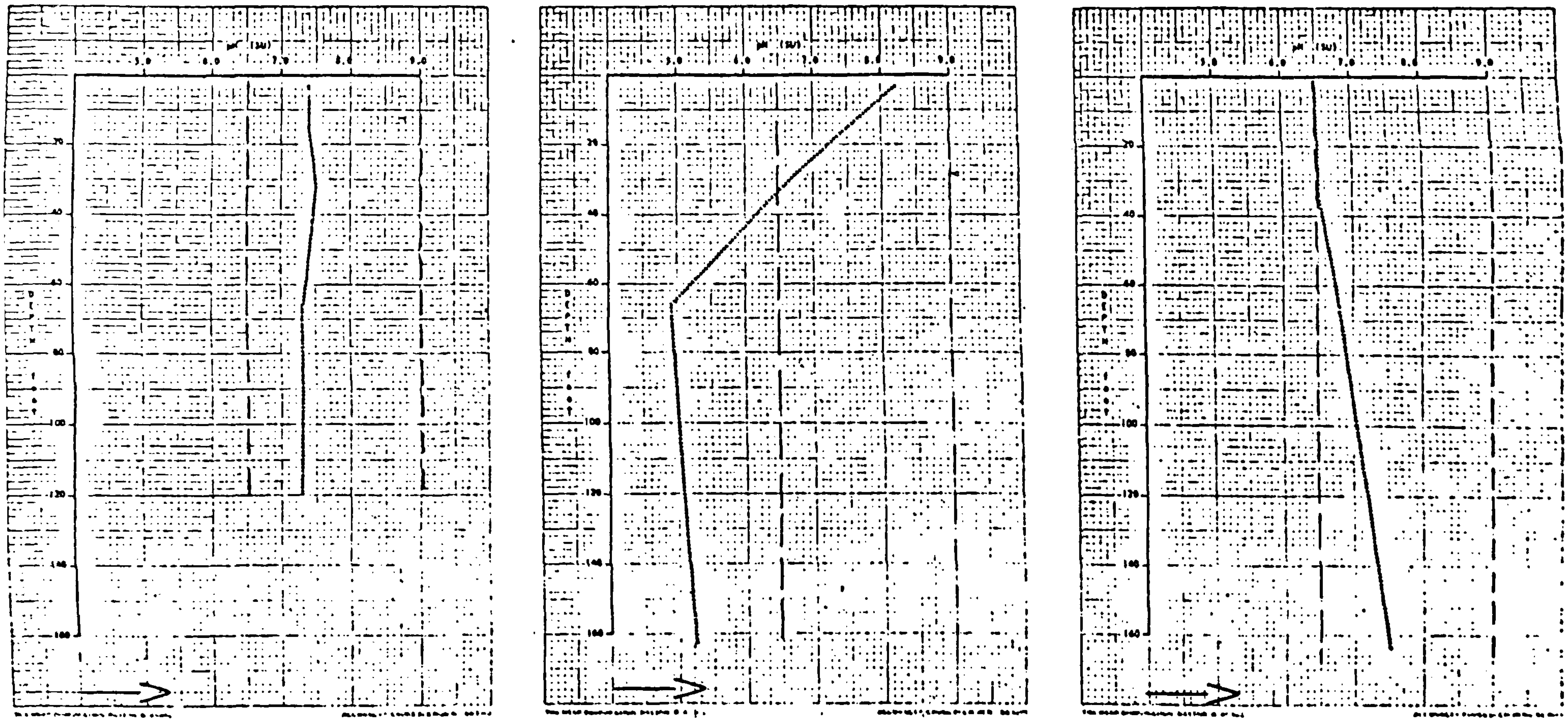


74/07/09 74/09/30 75/01/16

LAKE COEUR D'ALENE STATION NO.153391
(single sample values)
Dissolved Oxygen Standard (6.0 mg/l) — — —

——> Indicates lake bottom

FIGURE CE-61

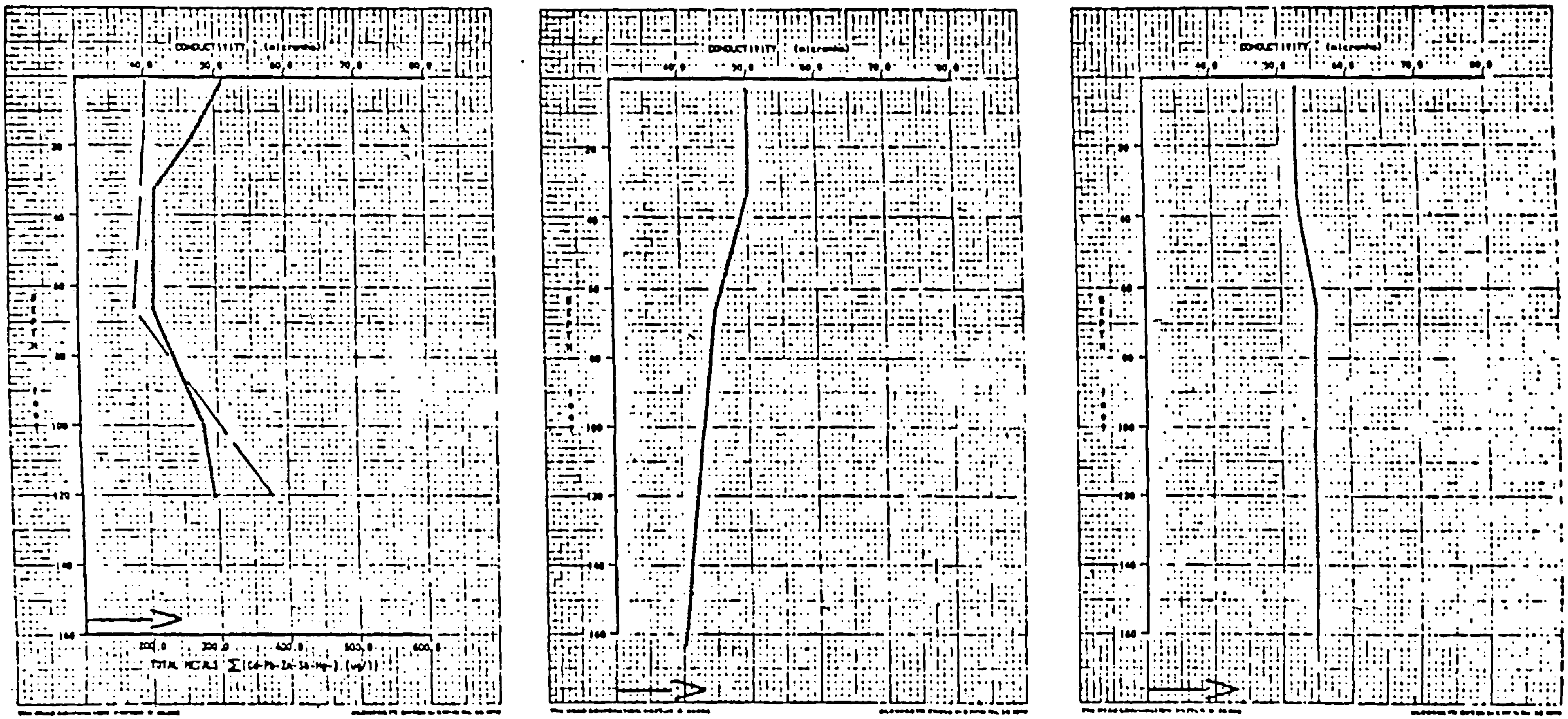


74/07/09 74/09/30 75/01/16

LAKE COEUR D'ALENE STATION NO. 153391
(single sample values)
pH Standard Range (6.50 - 9.00) — — —

——> Indicates lake bottom

FIGURE CE-62

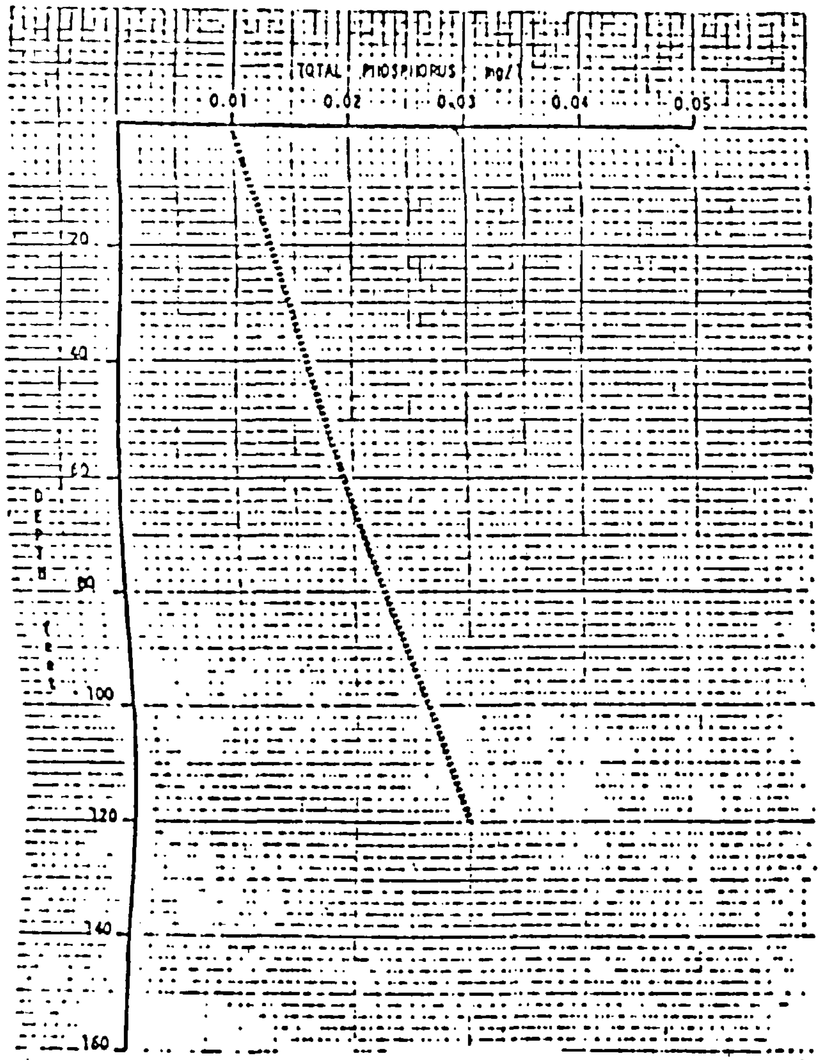


74/07/09 74/09/30 75/01/16

LAKE COEUR D'ALENE STATION NO.153391
(single sample values)
Total Metals ∑(Cd-Pb-Zn-Sb-Hg) (ug/l) — — —

⟶ Indicates lake bottom

FIGURE CE-63



STATION 153391
74/07/09
(single sample values)
---> Indicates lake bottom

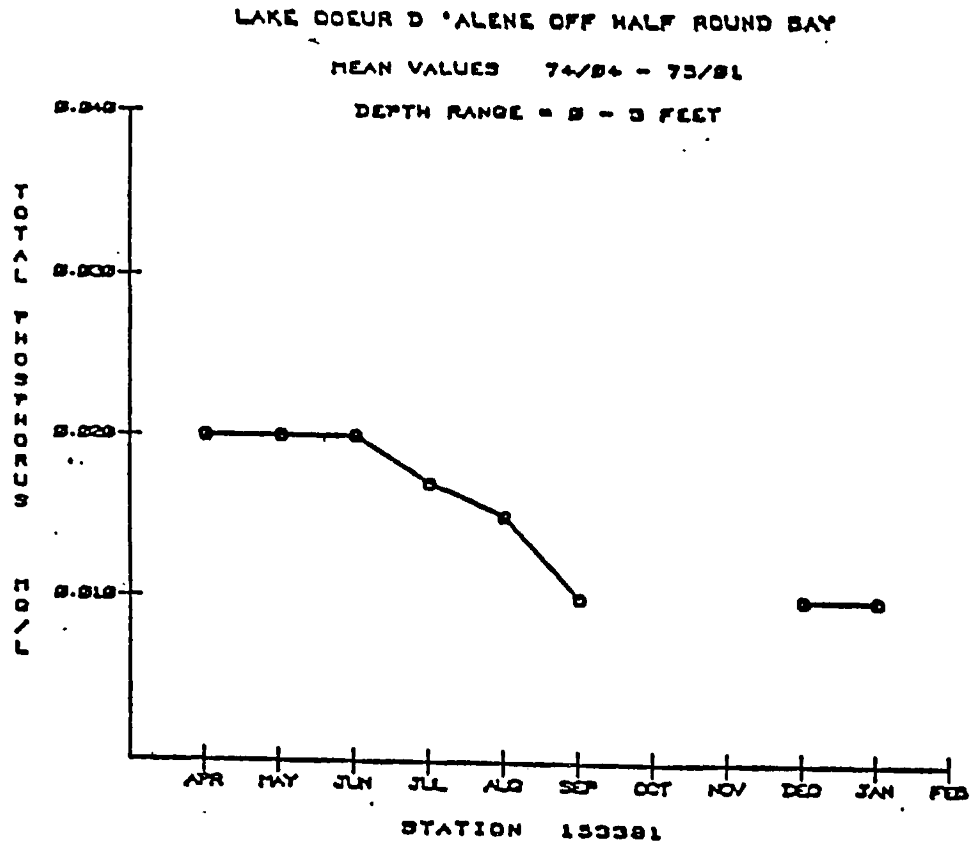
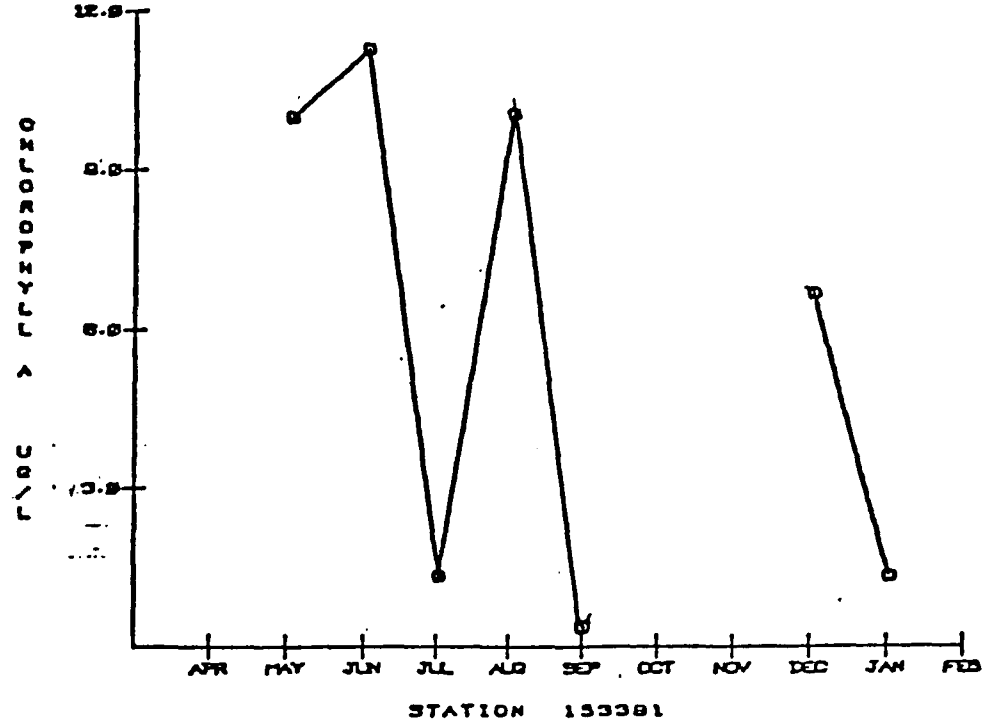


FIGURE CE-64

LAKE COEUR D 'ALENE OFF HALF ROUND BAY

SINGLE SAMPLE VALUES 74/05 - 75/01



LAKE COEUR D 'ALENE OFF HALF ROUND BAY

SINGLE SAMPLE VALUES 74/04 - 75/01

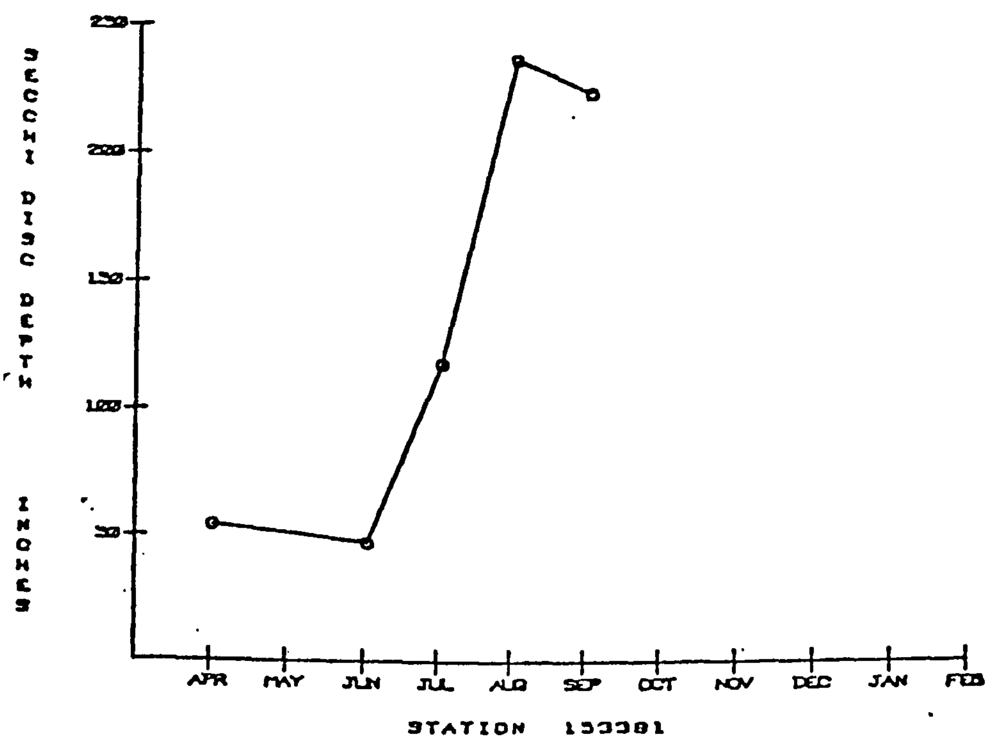
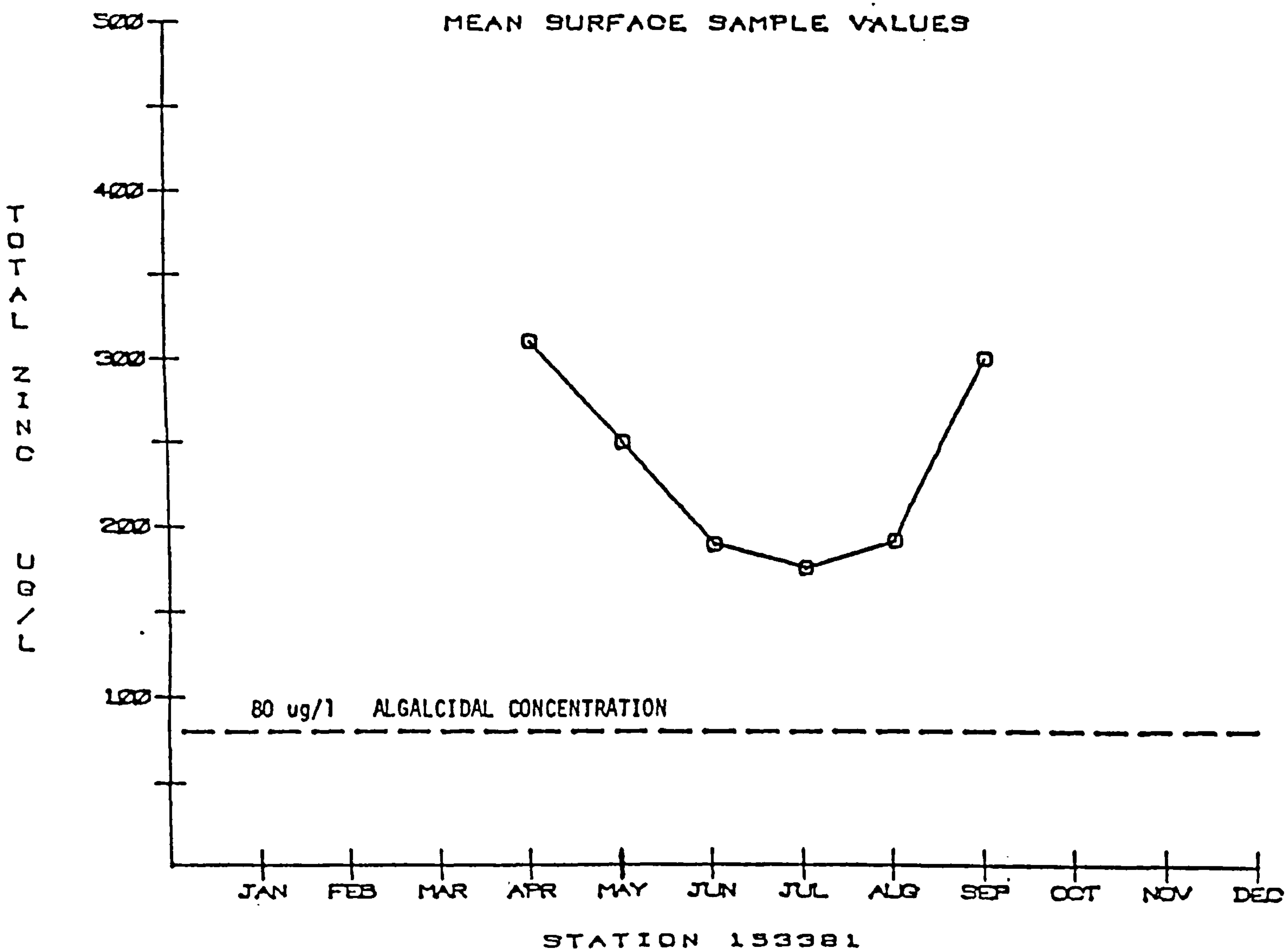


FIGURE CE-65

LAKE COEUR D 'ALENE OFF HALF ROUND BAY

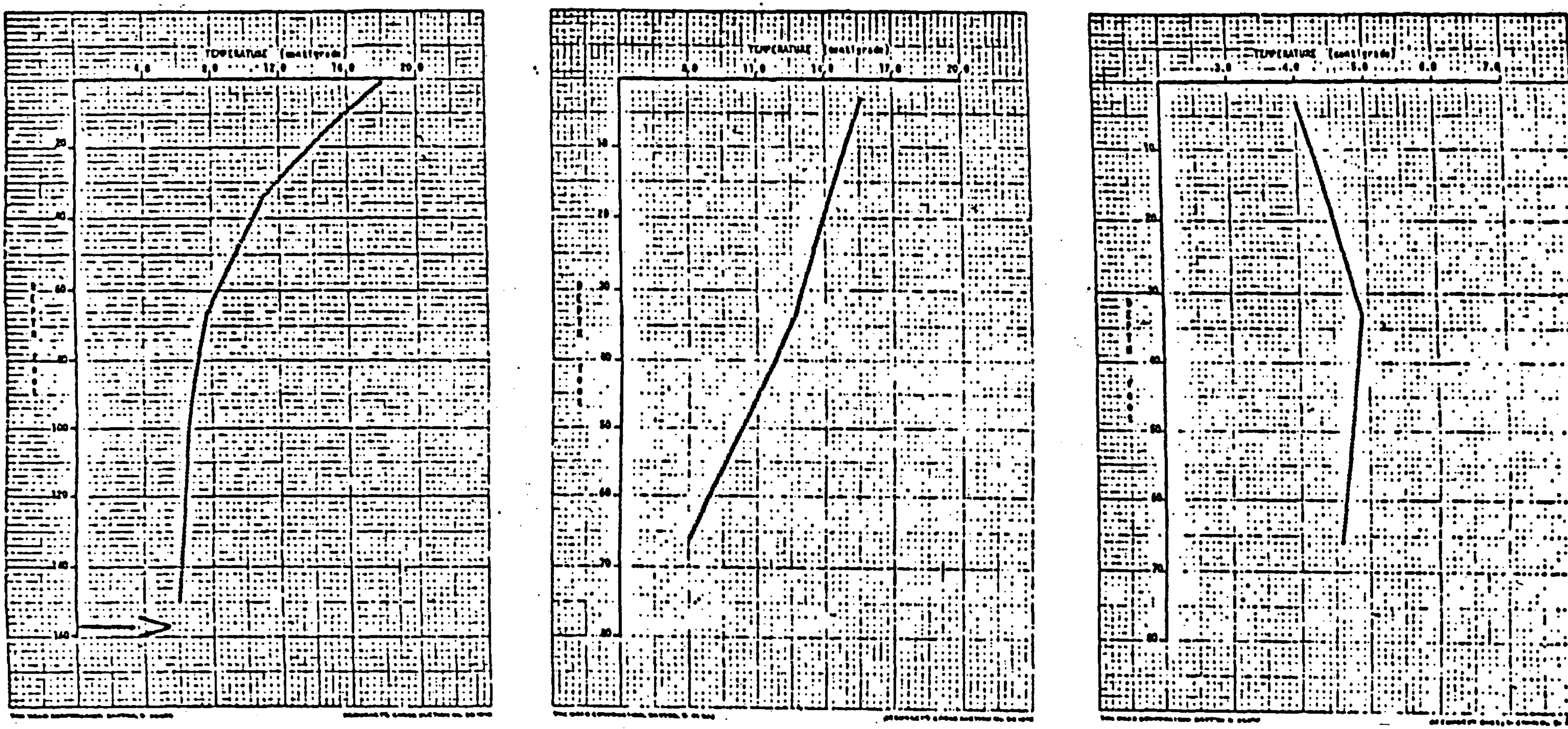
DATE RANGE = 74/04 - 74/08

MEAN SURFACE SAMPLE VALUES



STATION 153395

FIGURE CE-66

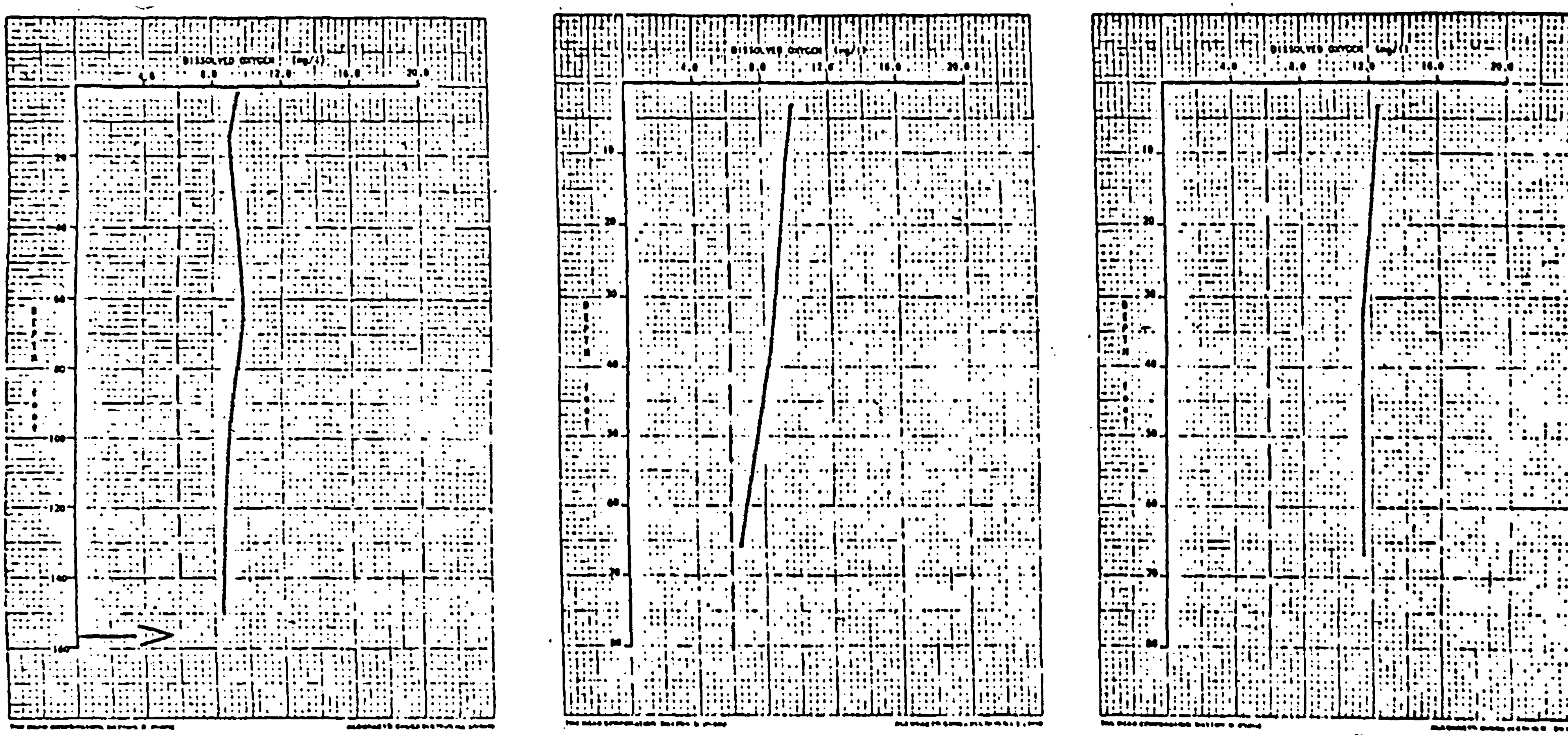


74/07/09 74/09/20 75/01/16

LAKE COEUR D'ALENE STATION NO.153395
(single sample values)

——> Indicates lake bottom

FIGURE CE-67

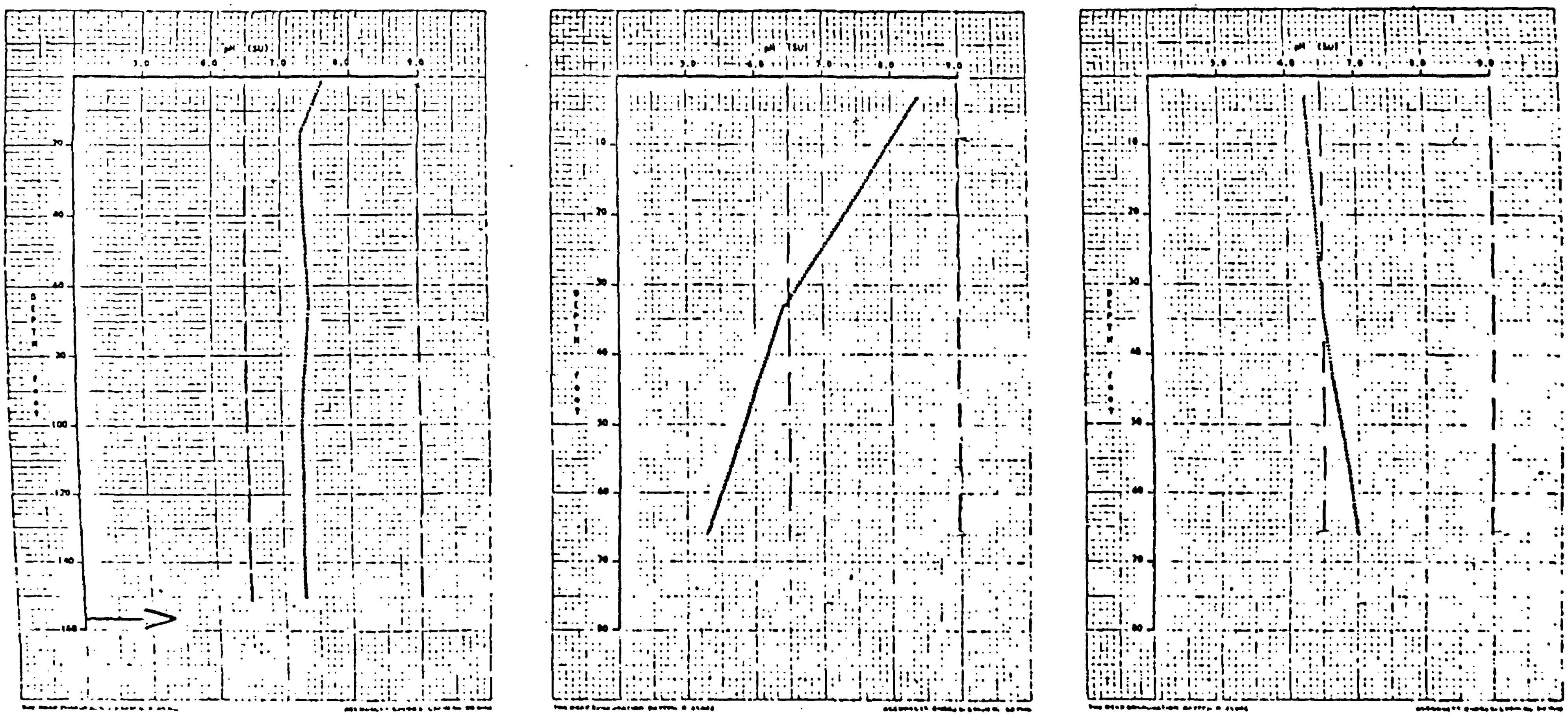


74/07/09 74/09/30 75/01/16

LAKE COEUR D'ALENE STATION NO.153395
(single sample values)
Dissolved Oxygen Standard (6.0 mg/l) — — —

—> Indicates lake bottom

FIGURE CE-68

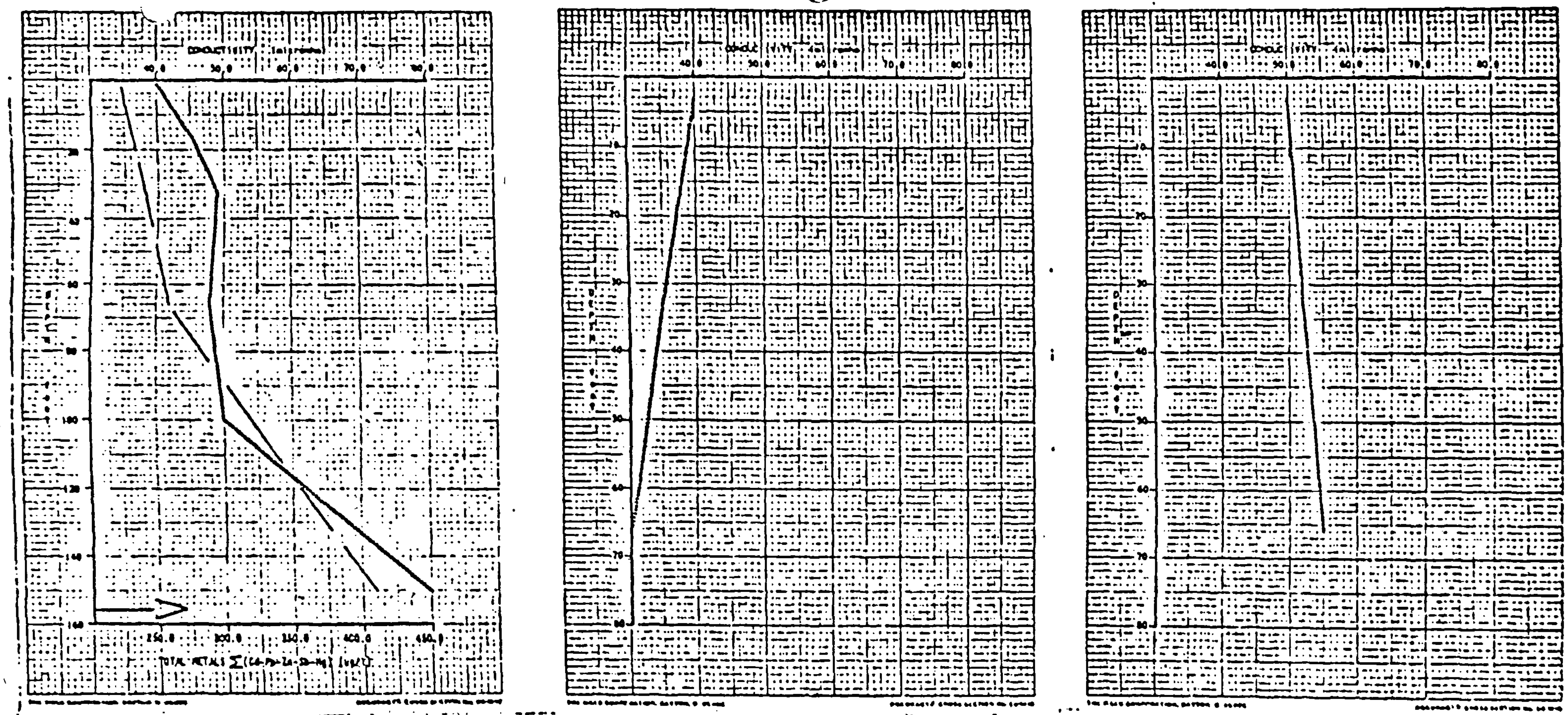


74/07/09 74/09/30 75/01/16

LAKE COEUR D'ALENE STATION NO.153395
(single sample values)
pH Standard Range (6.50 - 9.00) — — —

——> Indicates lake bottom

FIGURE CE-69

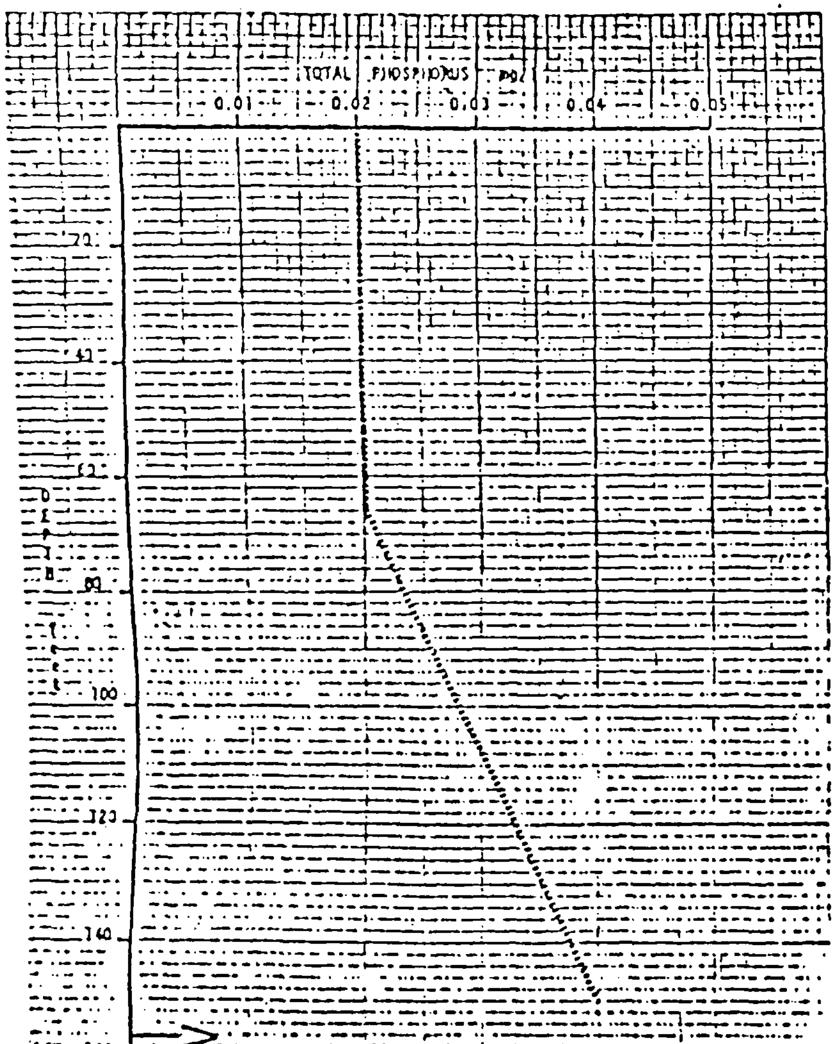


74/07/09 | 74/09/30 | 75/01/16

LAKE COEUR D'ALENE STATION NO.153395
(single sample values)
Total Metals $\sum$(Cd-Pb-Zn-Sb-Hg) (ug/l) — — —

—> Indicates lake bottom

FIGURE CE-70



STATION 153395
74/07/09
(single sample values)
—> Indicates lake bottom

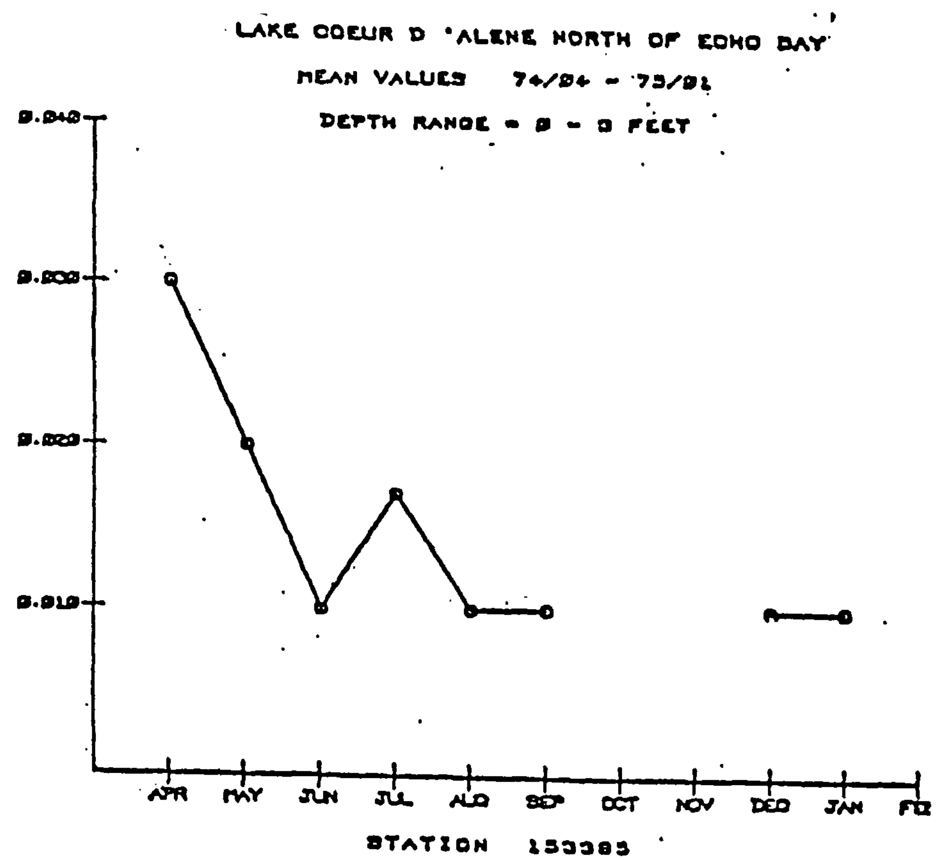
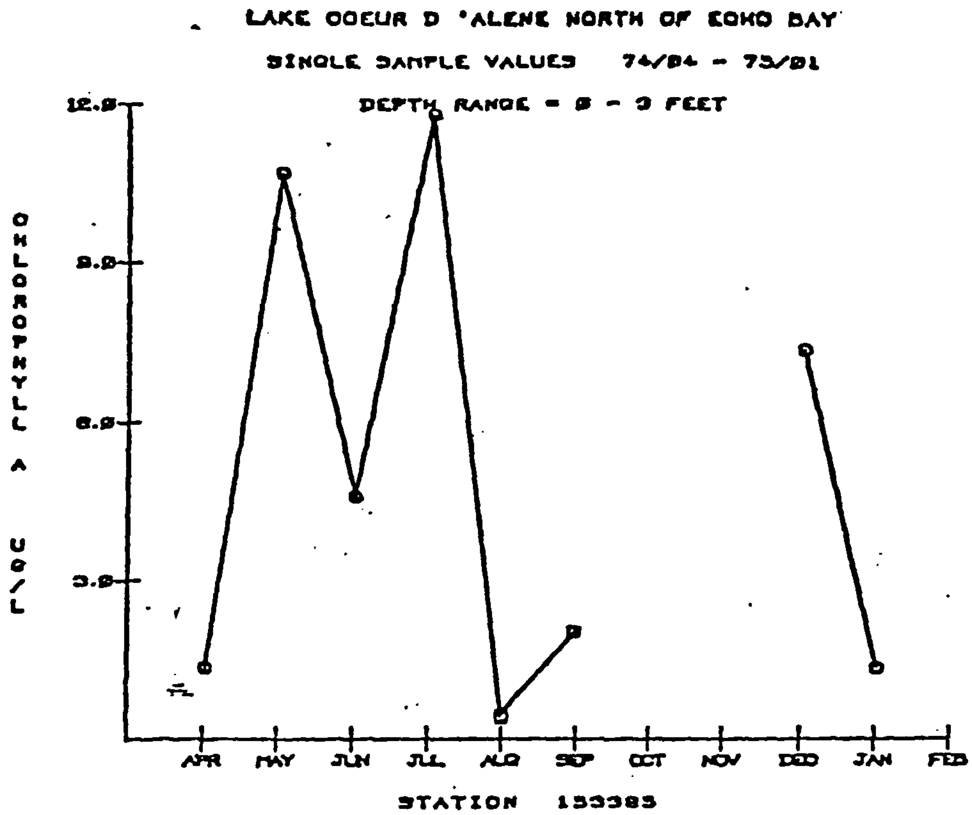
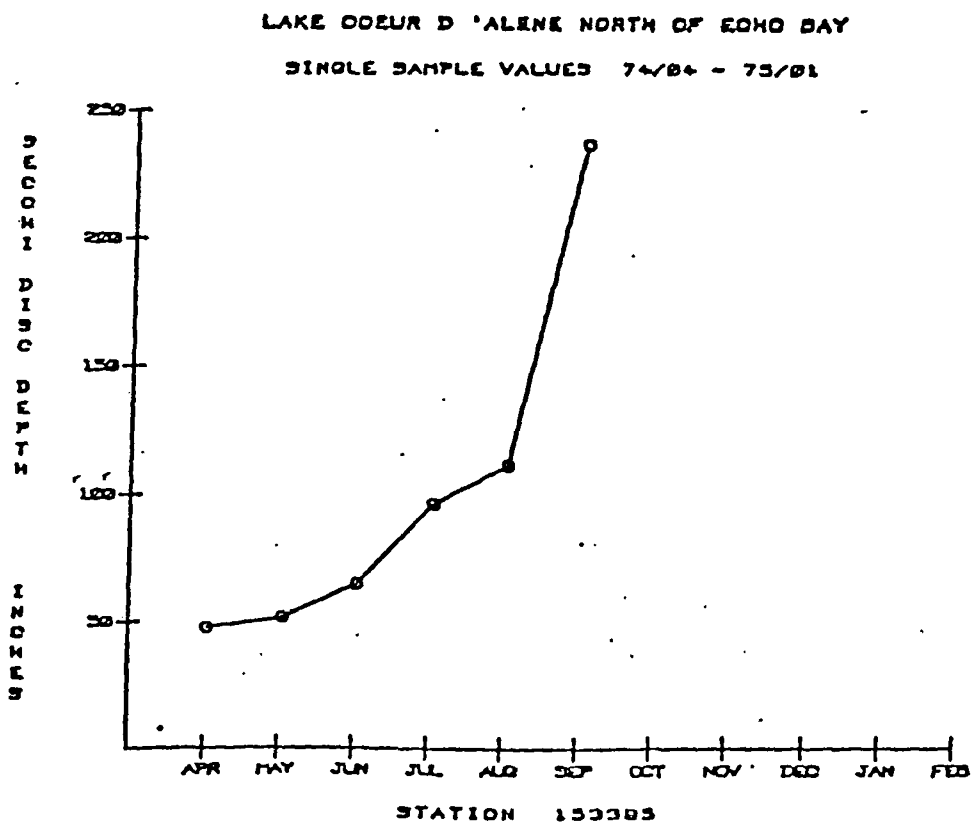


FIGURE CE-71

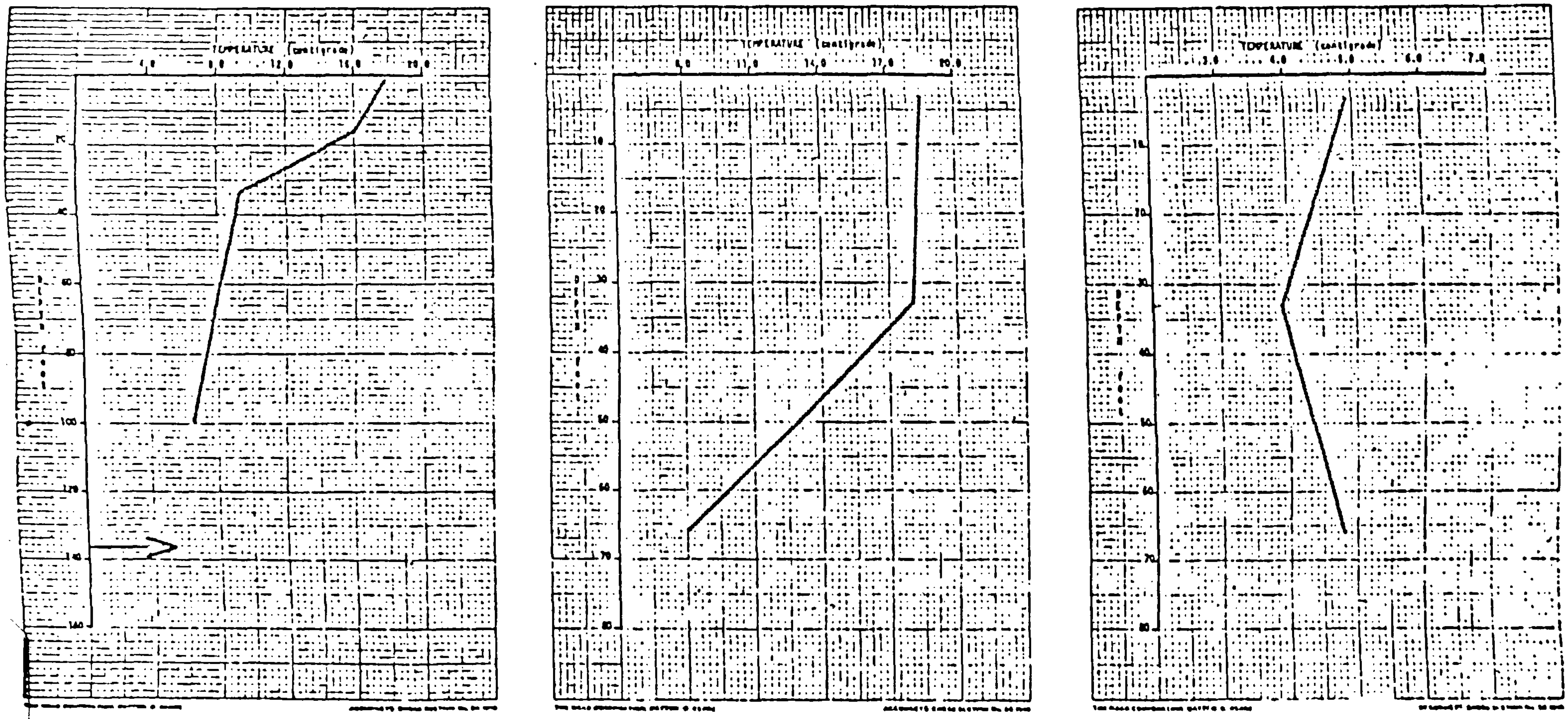

LAKE COEUR D 'ALENE NORTH OF ECHO BAY
SINGLE SAMPLE VALUES 74/04 - 75/01
DEPTH RANGE = 0 - 3 FEET
12.0
9.0
6.0
3.0
CHLOROPHYLL A UG/L
APR
MAY
JUN
JUL
AUG
SEP
OCT
NOV
DEC
JAN
FEB
STATION 153385


LAKE COEUR D 'ALENE NORTH OF ECHO BAY
SINGLE SAMPLE VALUES 74/04 - 75/01
250
200
150
100
50
SECCHI DISC DEPTH INCHES
APR
MAY
JUN
JUL
AUG
SEP
OCT
NOV
DEC
JAN
FEB
STATION 153385

STATION 153397

STATION 153397

FIGURE CE-72

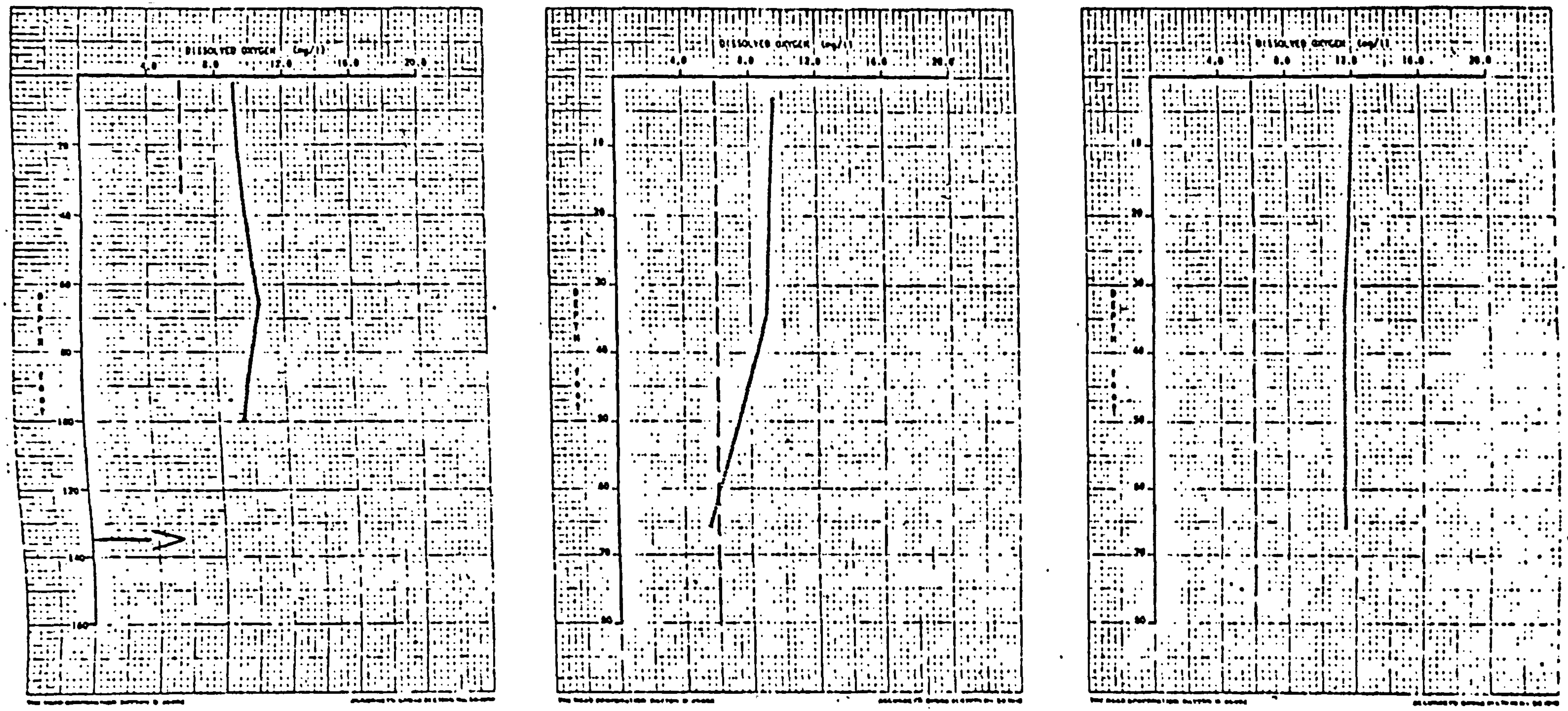


74/07/09 74/09/10 75/01/16

LAKE COEUR D'ALENE STATION NO.153397
(single sample values)

⟶ Indicates lake bottom

FIGURE CE-73



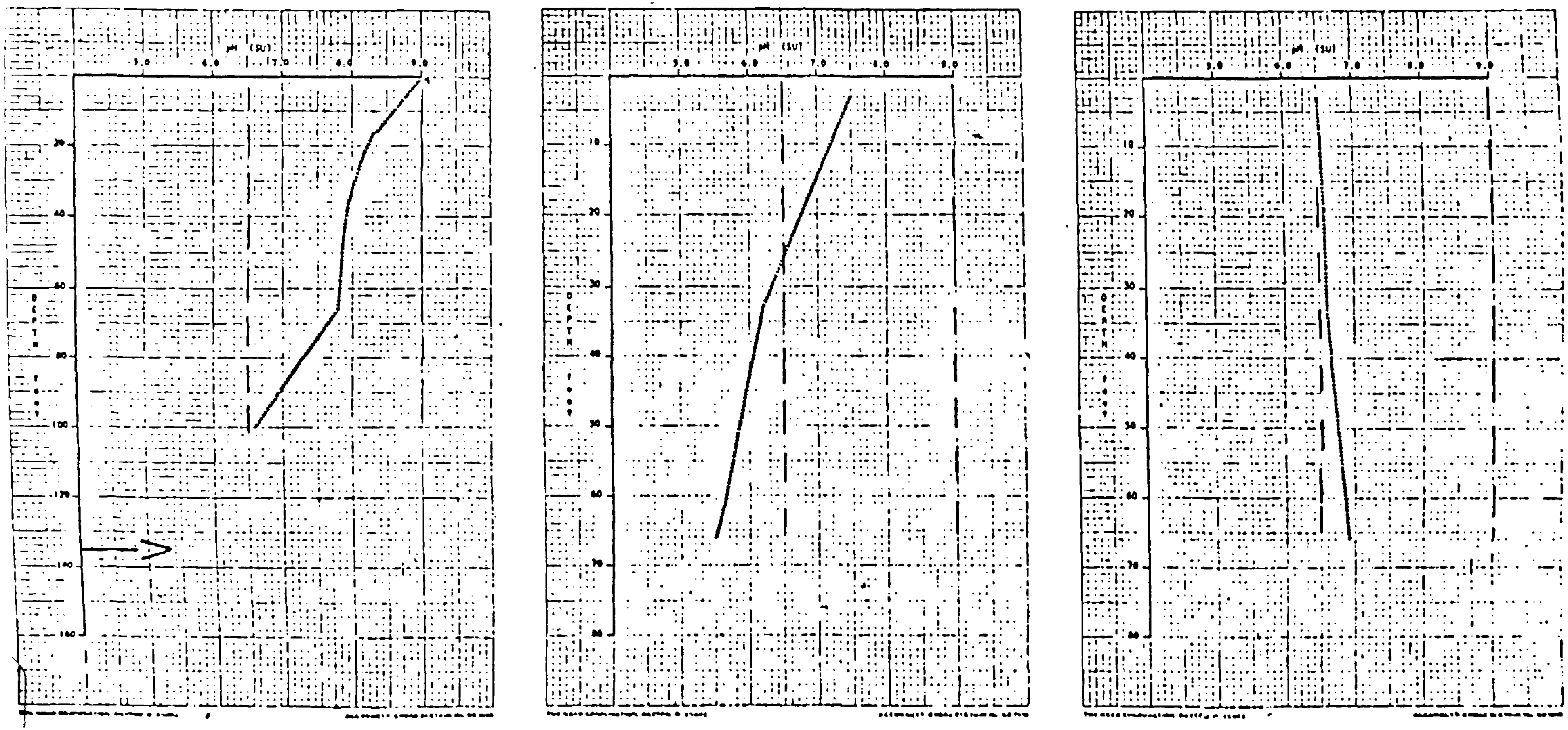
74/07/09 74/09/10 75/01/16

LAKE COEUR D'ALENE STATION NO.153397
(single sample values)
Dissolved Oxygen Standard* (6.0 mg/l) — — —

* 74/07/09 vertical plot subject to D.O. Standard in top 33 feet of water column only, due to the presence of thermocline.

——> Indicates lake bottom

FIGURE CE-74.

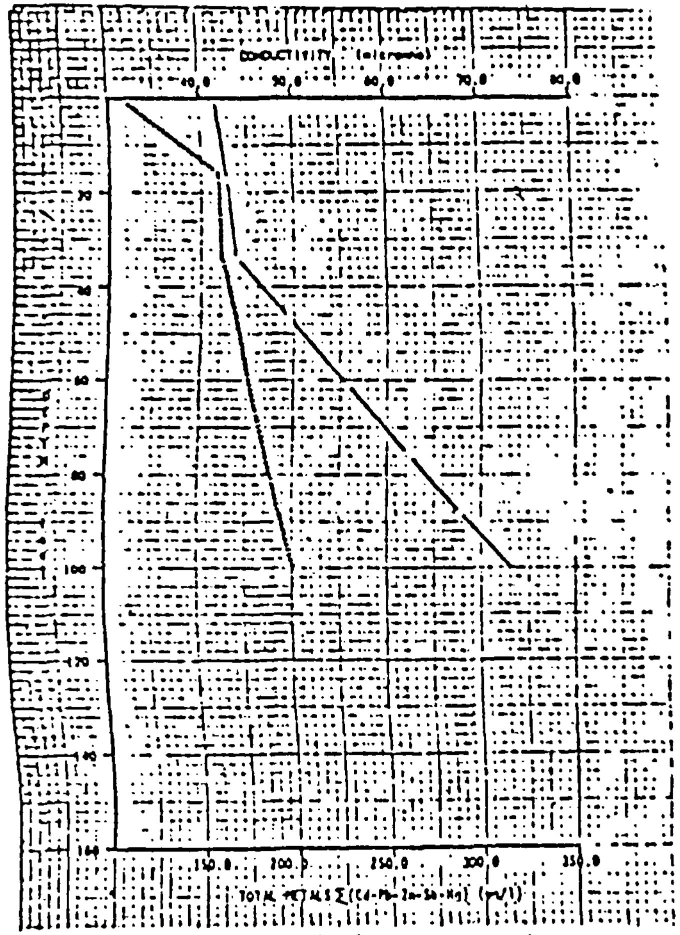


74/07/09 74/09/10 75/01/16

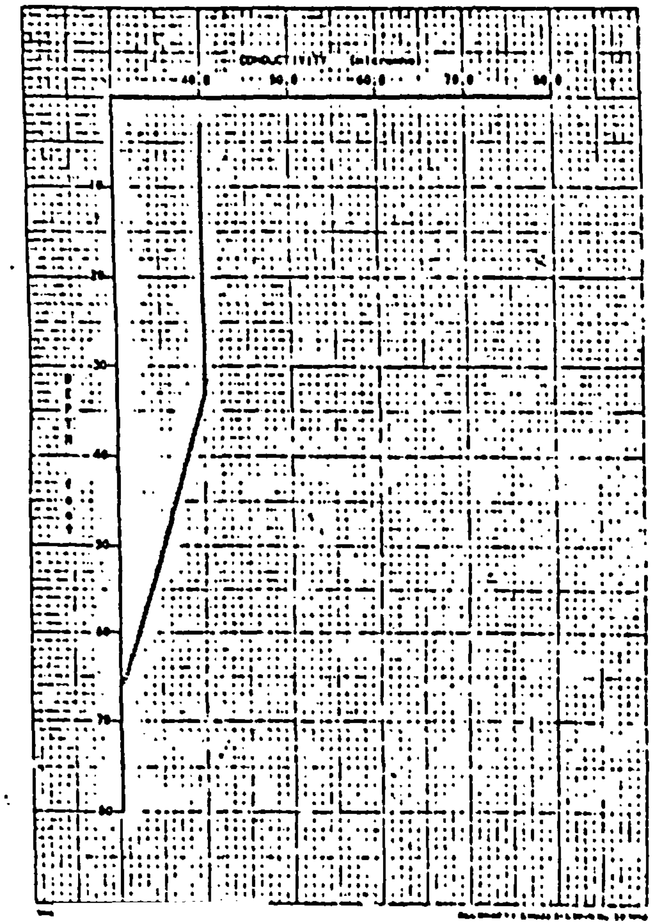
LAKE COEUR D'ALENE STATION NO.153397
(single sample values)
pH Standard Range (6.50 - 9.00) — — —

——> Indicates lake bottom

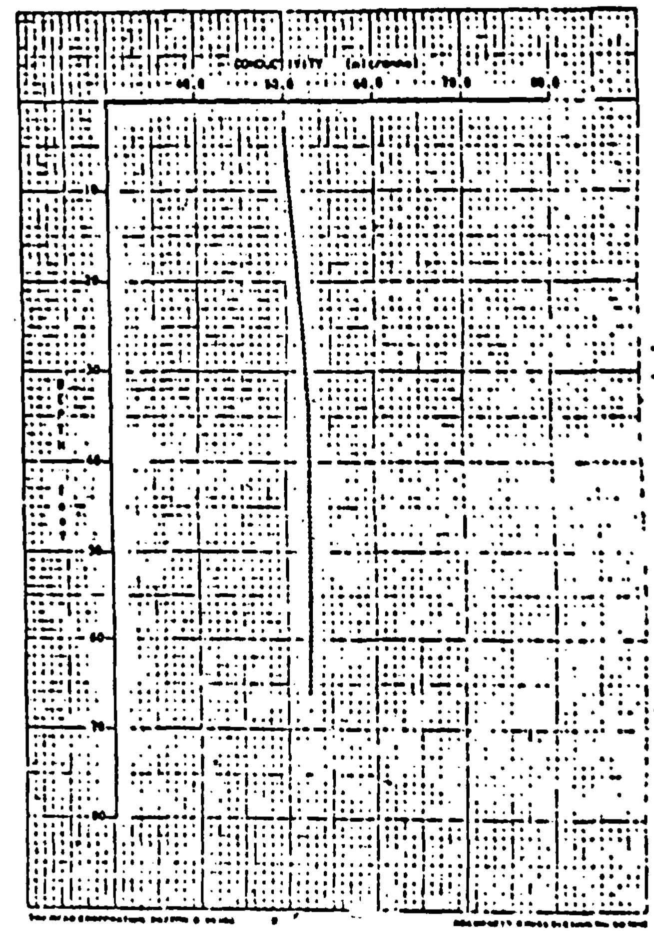
FIGURE CE-75



74/07/09



74/09/10

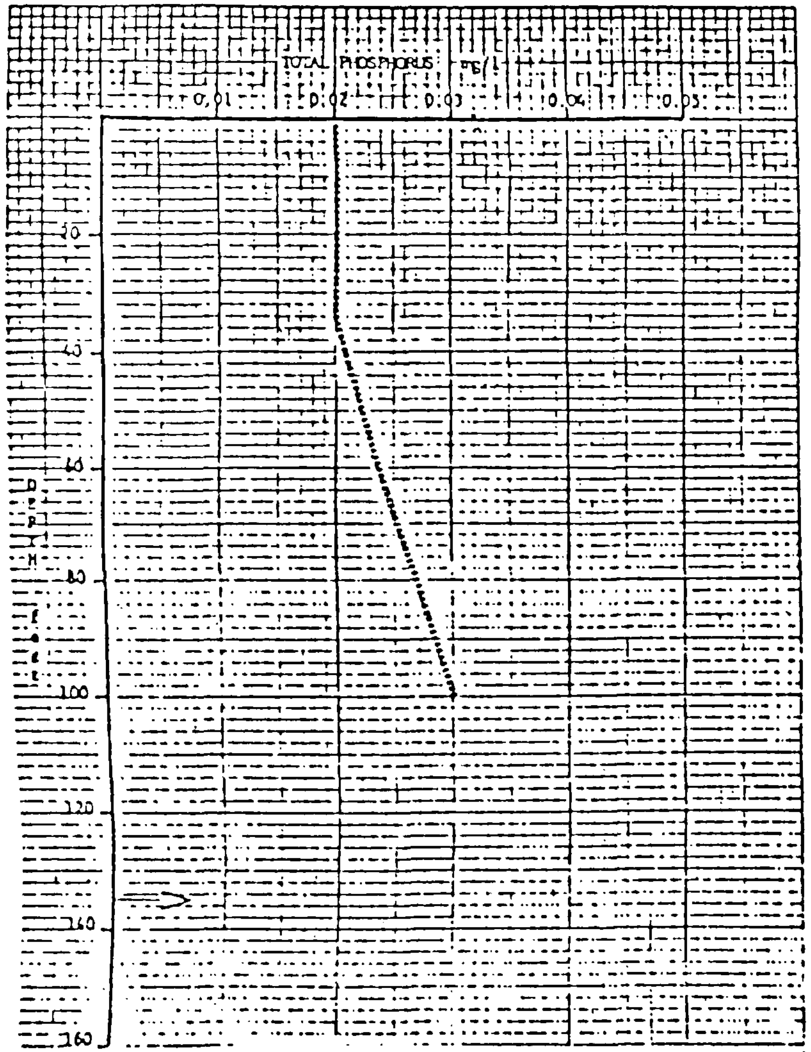


75/01/16

LAKE COEUR D'ALENE STATION NO.153397
(single sample values)
Total Metals ∑(Cd-Pb-Zn-Sb-Hg) (ug/l) — — —

——> Indicates lake bottom

FIGURE CE-76



STATION 153397
74/07/09
(single sample values)
⟶ indicates lake bottom

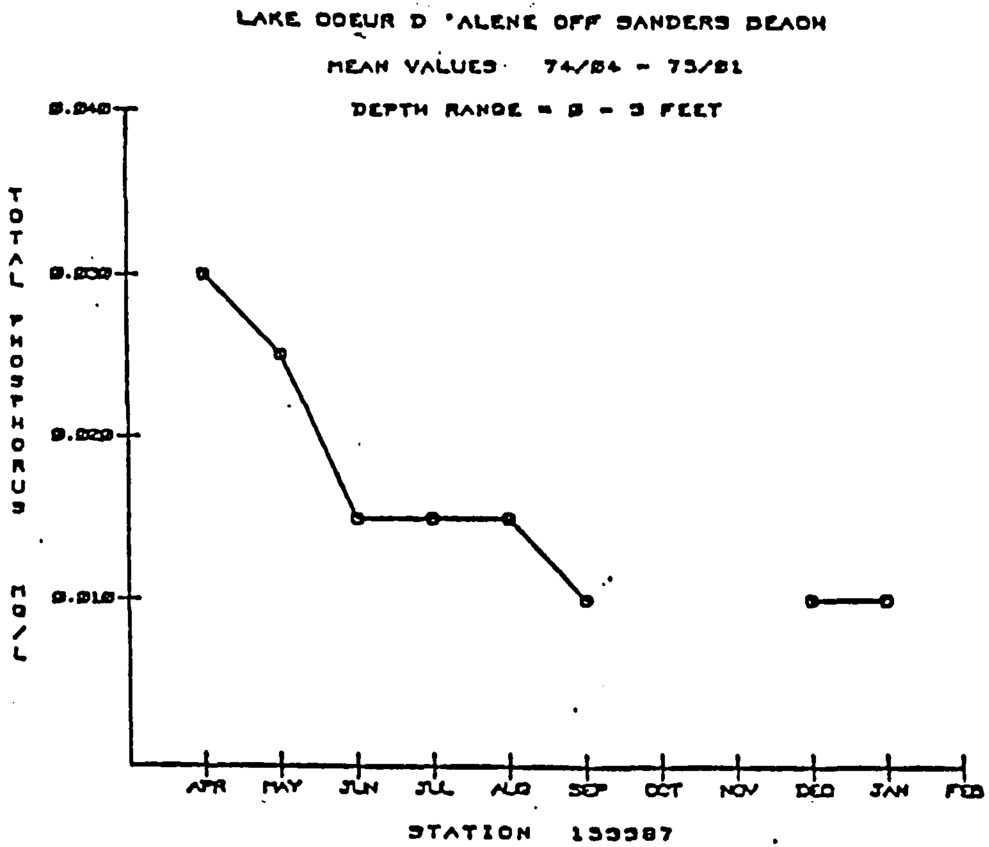
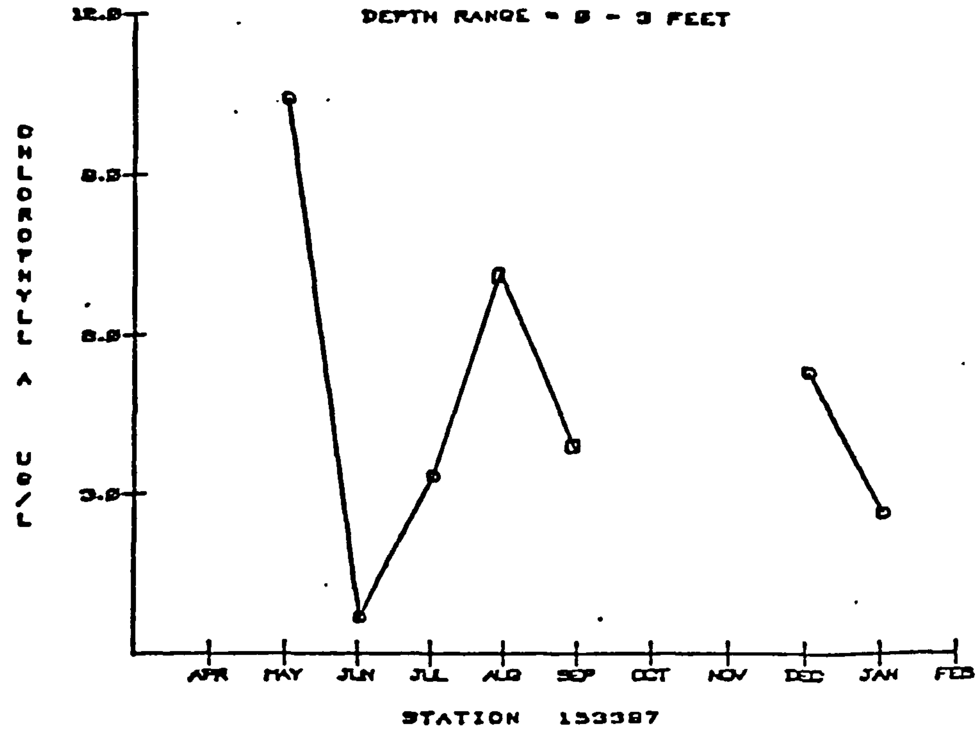


FIGURE CE-77

LAKE COEUR D 'ALENE OFF SANDERS BEACH

SINGLE SAMPLE VALUES 74/05 - 75/01

DEPTH RANGE = 0 - 3 FEET



LAKE COEUR D 'ALENE OFF SANDERS BEACH

SINGLE SAMPLE VALUES 74/04 - 75/01

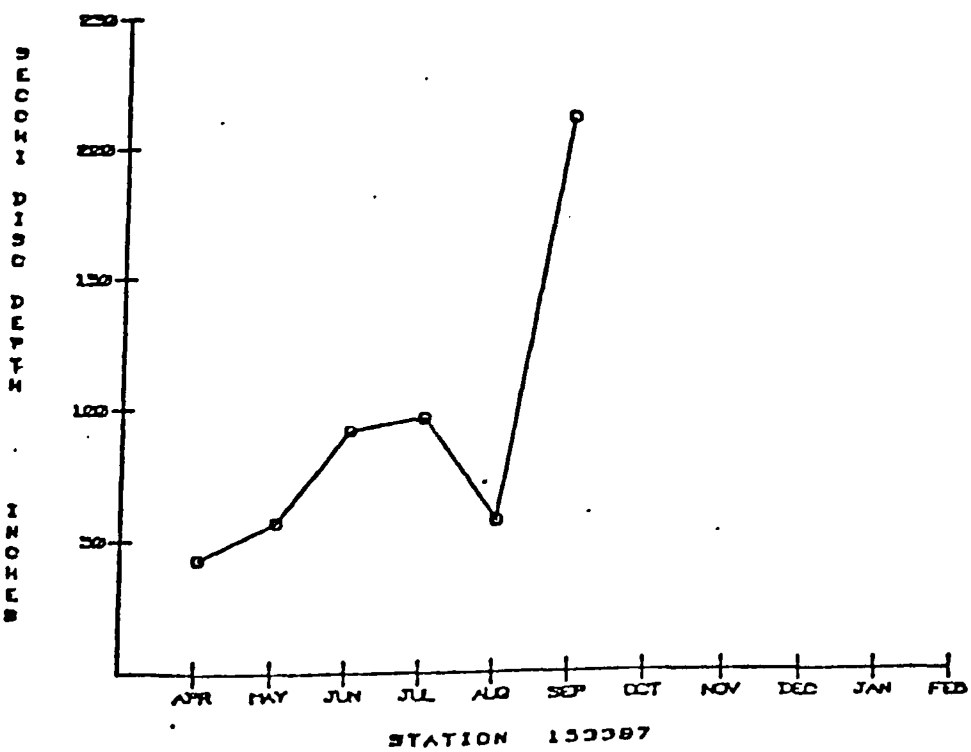
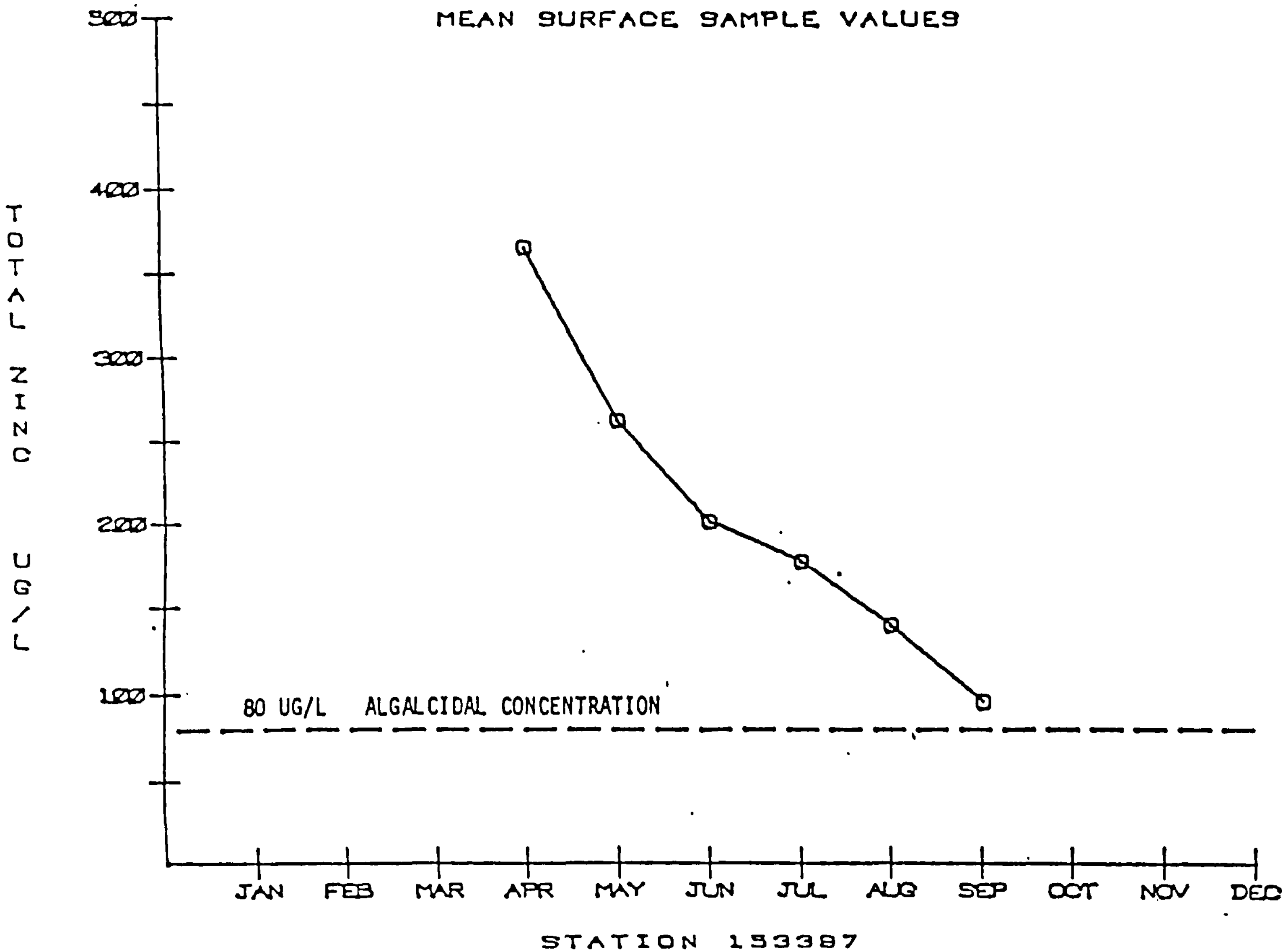


FIGURE CE-78

LAKE COEUR D 'ALENE OFF SANDERS BEACH

DATE RANGE = 74/04 - 74/08

MEAN SURFACE SAMPLE VALUES



B. SUBSTANDARD WATER QUALITY CONDITIONS

B. SUMMARY OF SUBSTANDARD WATER QUALITY CONDITIONS 1/

The standards of water quality under consideration, as established by the Idaho Board of Environmental and Community Services include;

--Dissolved Oxygen; Greater than 6.0 mg/l or 90% saturation.
--Hydrogen Ion Concentration (pH); Inside a range of 6.5 - 9.0.

STATION	DATE	CONDITION	Percent substandard condition 2/	
			Dissolved Oxygen	pH
153384	74/09/30	pH < 6.5 at depths $\geq$ 20'	1/37 = 2.7%	13/43 = 30.2%
	74/09/30	D.O. < 6.0 at depths $\geq$ 28'		
	74/12/17	pH < 6.5 at all depths		
153386	74/07/10	pH < 6.5 at all depths	3/50 =6.0%	19/60 = 31.6%
	74/09/30	D.O < 6.0 at depths $\geq$ 45'		
	74/09/30	pH < 6.5 at depths $\geq$ 21'		
153391	74/09/30	pH < 6.5 at depths $\geq$ 35'	0/61 = 0.0%	23/68 = 33.8%
153395	74/09/30	pH < 6.5 at depths $\geq$ 33'	0/52 = 0.0%	19/58 = 32.7%
	75/01/16	pH < 6.5 at depths $\geq$ 33'		
153397	74/09/10	pH < 6.5 at depths $\geq$ 27'	0/52 = 0.0%	8/60 = 13.3%

1/ List depticts only those presented in vertical profile graphs

2/ Percent figure considers all samples taken

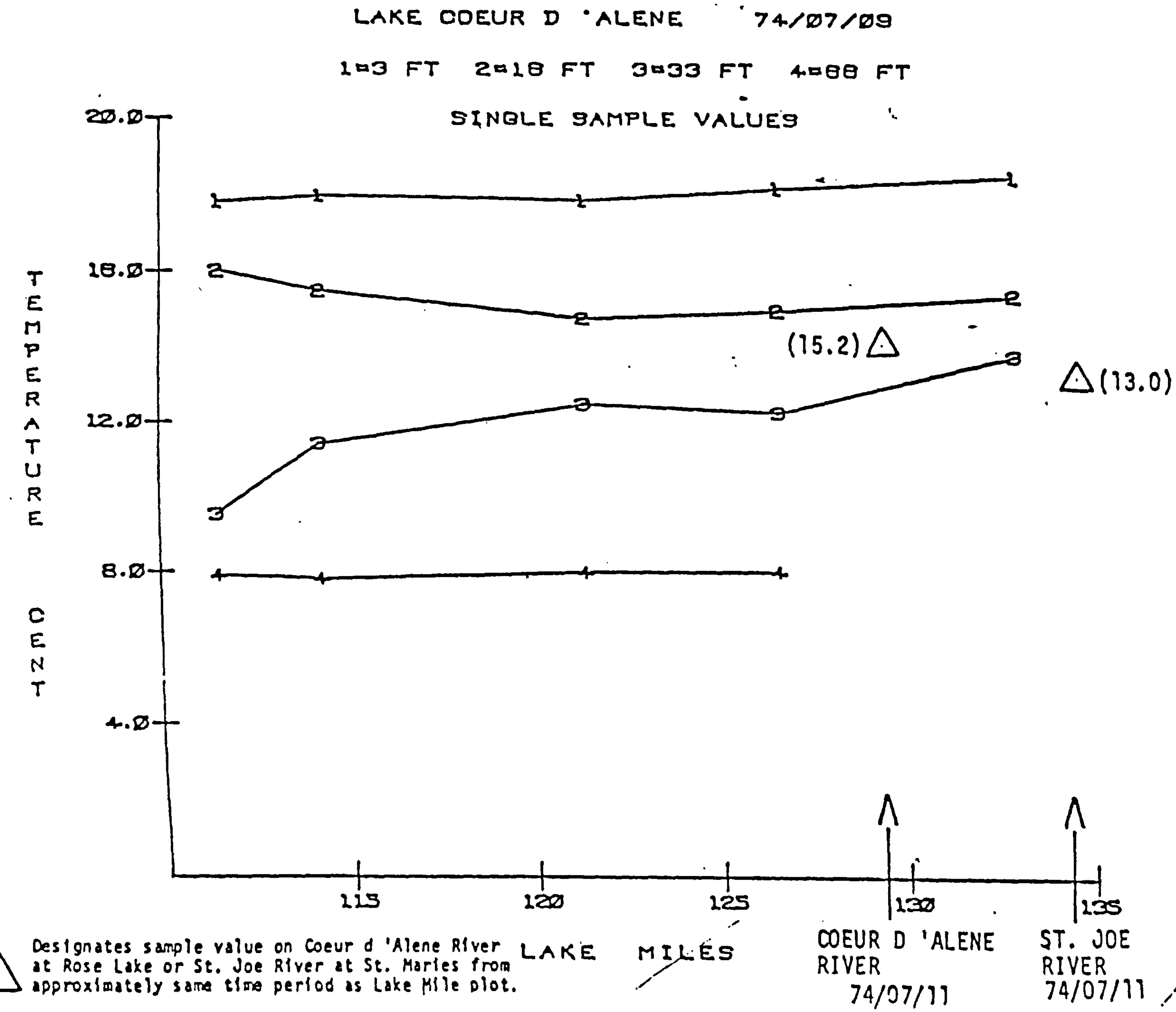
C. LAKE MILE PLOTS

Temperature, Dissolved Oxygen, pH, and Conductivity values are graphed in this section by lake mile and are represenative for three periods of temperature distribution within the lake;

- July - Thermocline forming
- September - Thermocline established
- January - Isothermal conditions

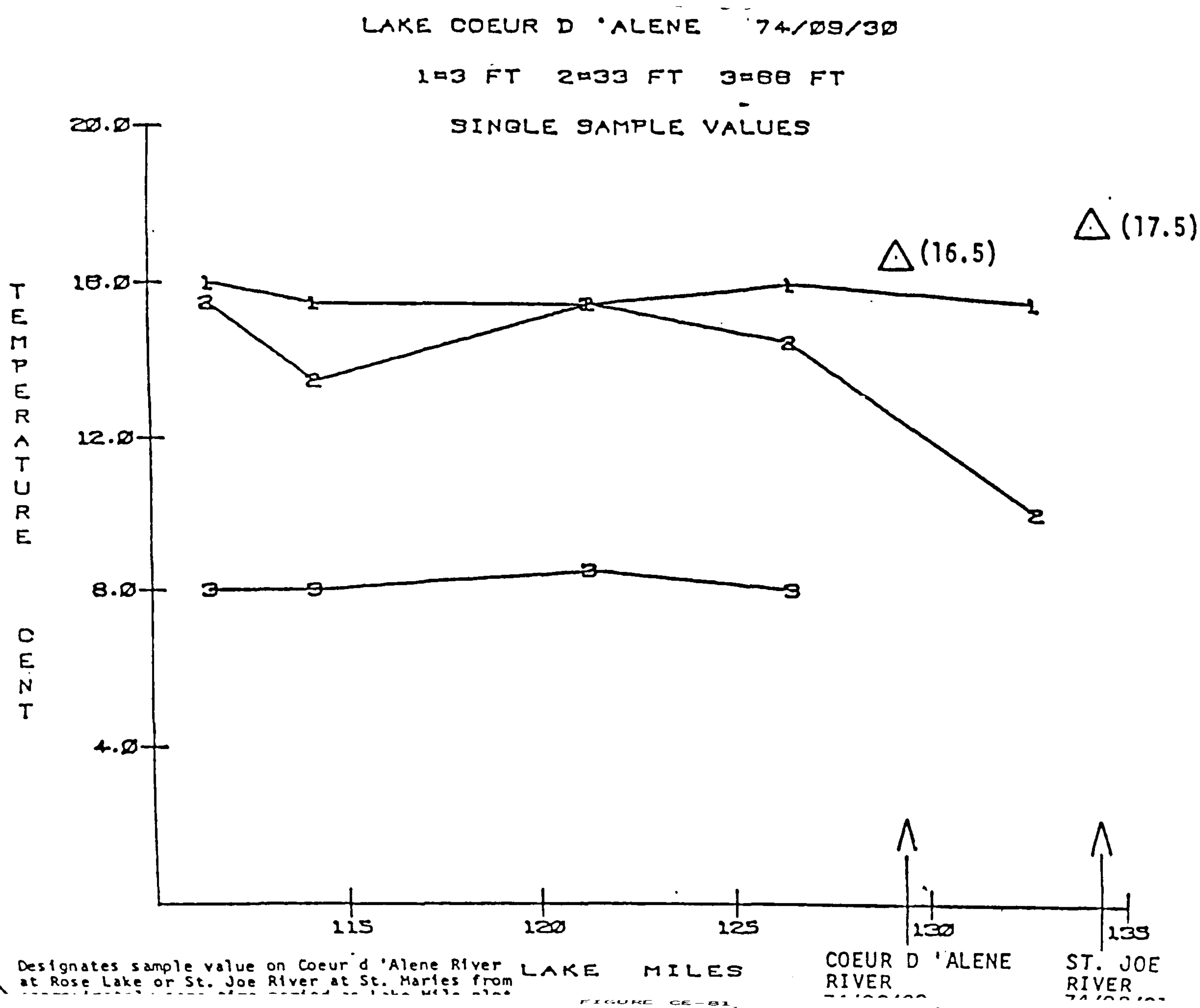
TEMPERATURE

FIGURE CE-79



△ Designates sample value on Coeur d 'Alene River at Rose Lake or St. Joe River at St. Maries from approximately same time period as Lake Mile plot.

FIGURE CE-80



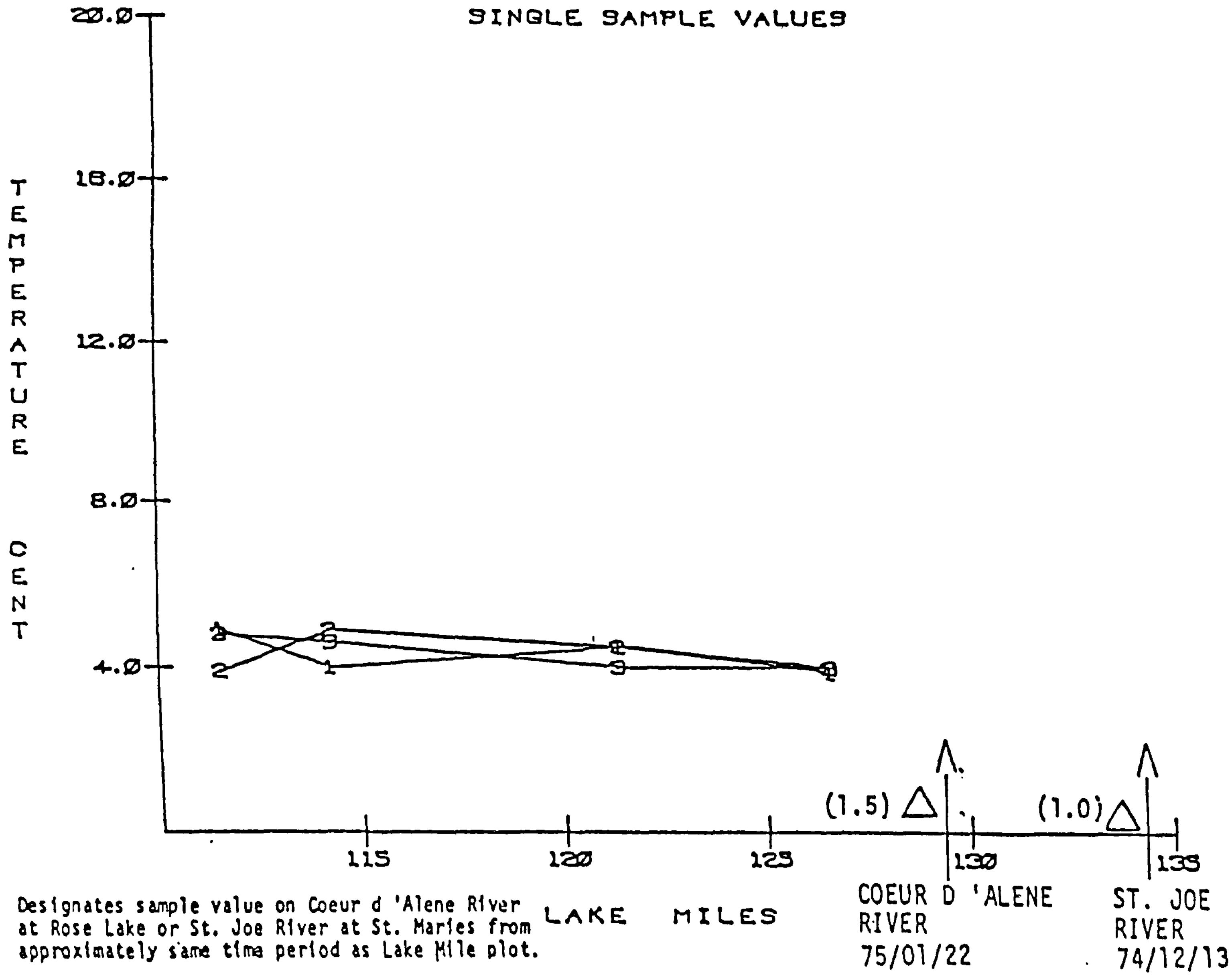
Designates sample value on Coeur d 'Alene River at Rose Lake or St. Joe River at St. Maries from

FIGURE CE-81

LAKE COEUR D 'ALENE 75/01/18

1=3 FT 2=33 FT 3=88 FT

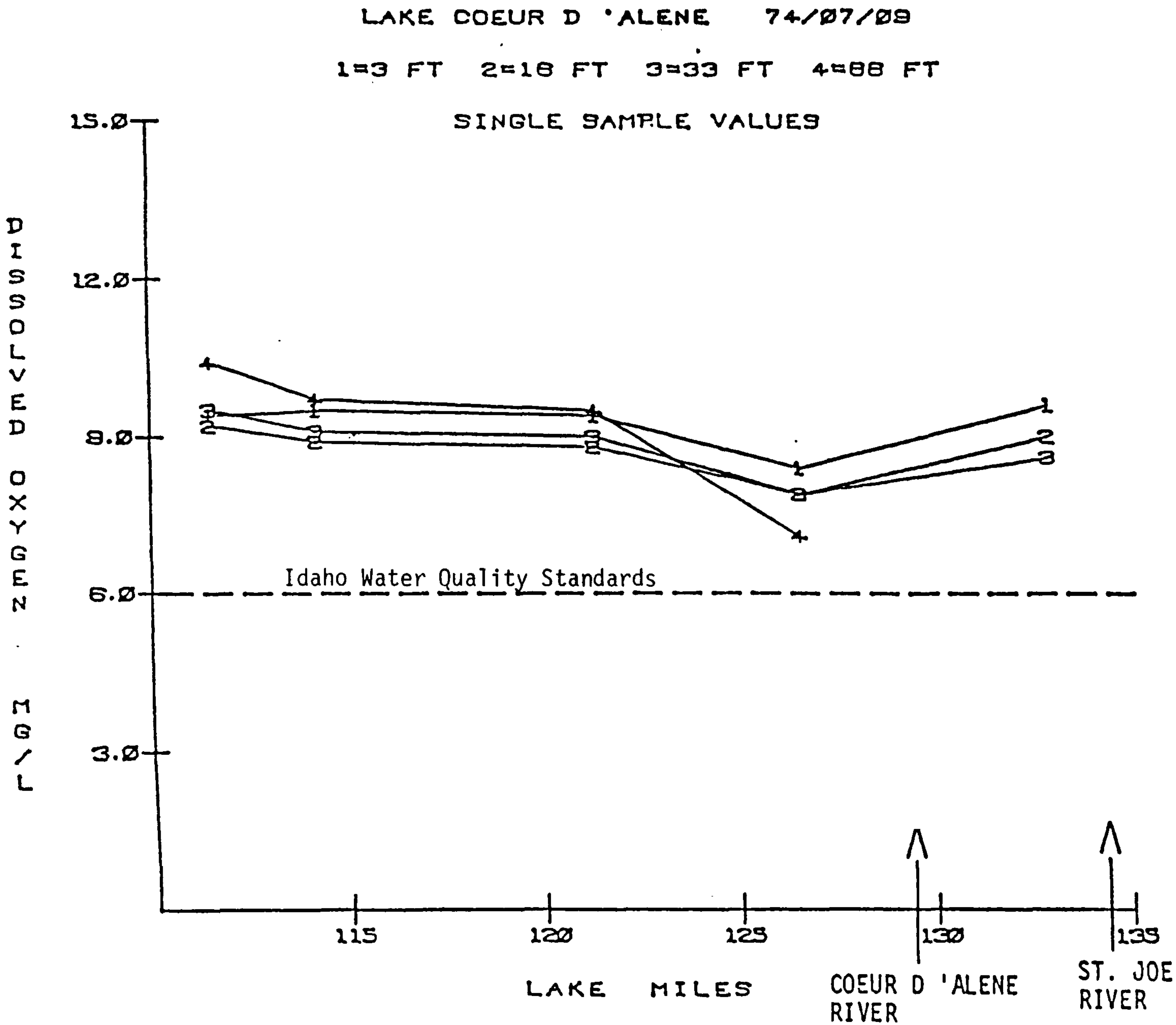
SINGLE SAMPLE VALUES



△ Designates sample value on Coeur d 'Alene River at Rose Lake or St. Joe River at St. Maries from approximately same time period as Lake Mile plot.

DISSOLVED OXYGEN

FIGURE CE-82



LAKE COEUR D 'ALENE 74/07/09
1=3 FT 2=16 FT 3=33 FT 4=66 FT
SINGLE SAMPLE VALUES
DISSOLVED OXYGEN MG/L
15.0
12.0
9.0
6.0
3.0
Idaho Water Quality Standards
115
120
125
130
135
LAKE MILES
COEUR D 'ALENE RIVER
ST. JOE RIVER

FIGURE CE-83

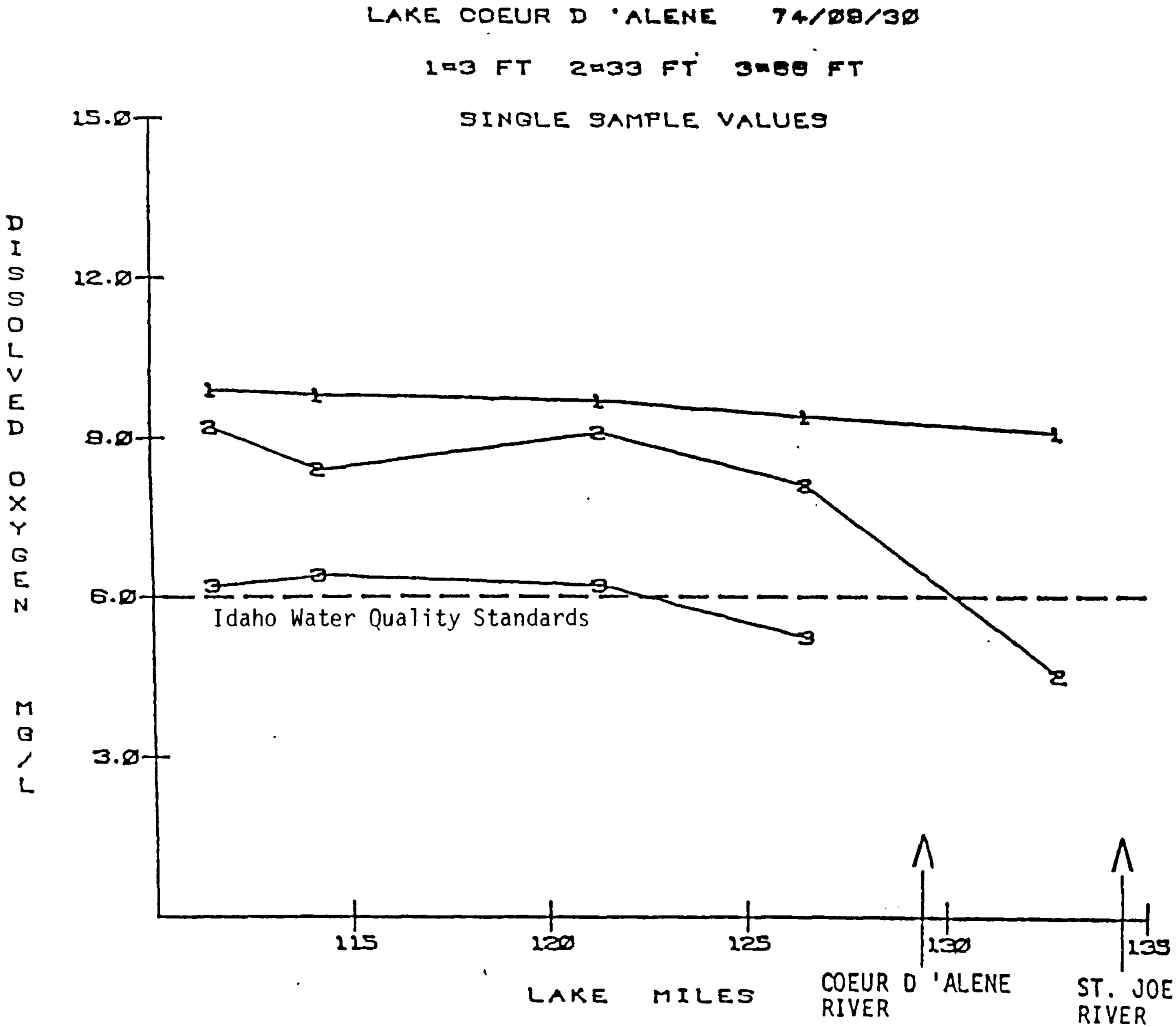
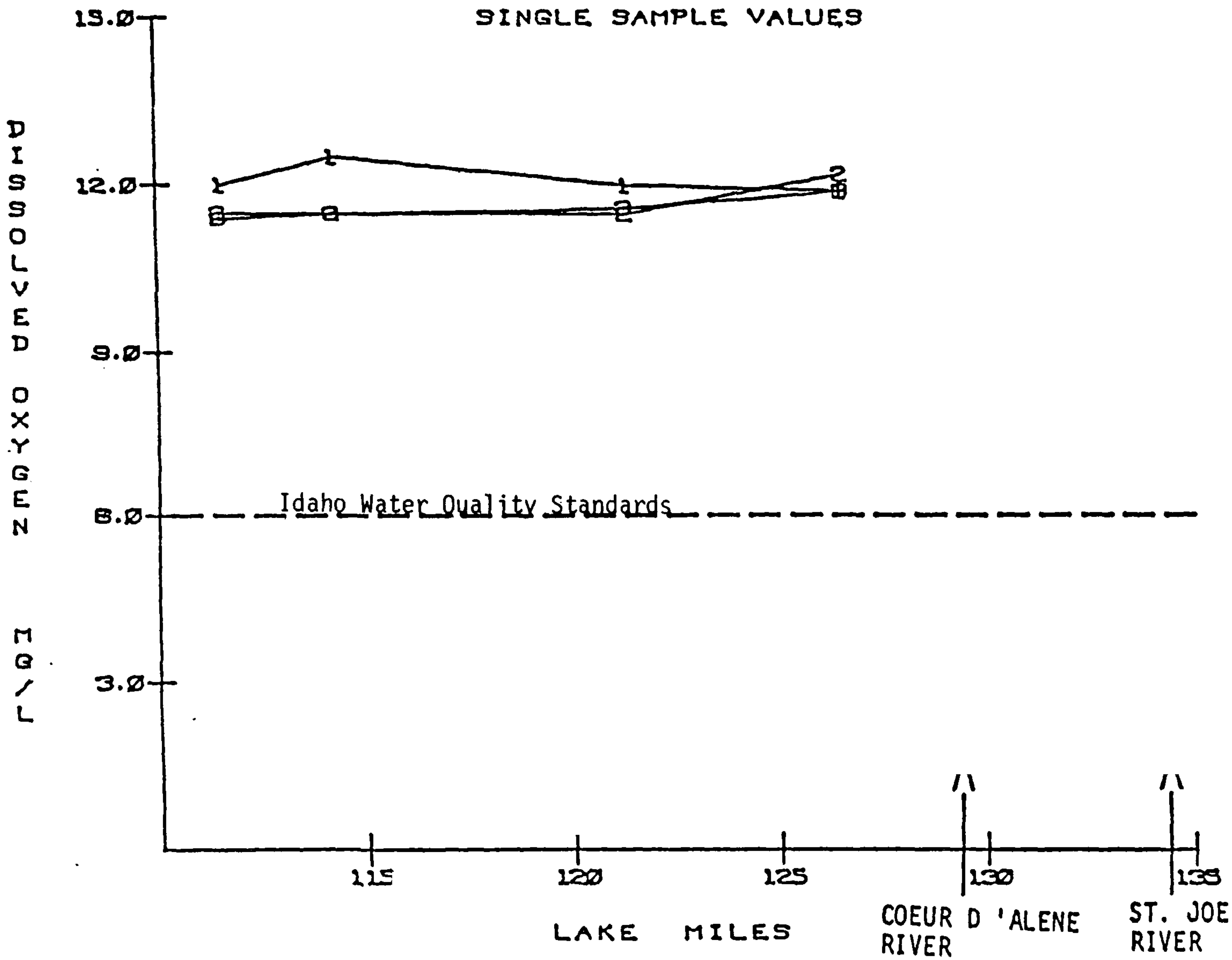

LAKE COEUR D 'ALENE 74/Ø8/3Ø
1=3 FT 2=33 FT 3=88 FT
SINGLE SAMPLE VALUES
DISSOLVED OXYGEN MG/L
15.Ø
12.Ø
8.Ø
6.Ø
3.Ø
Idaho Water Quality Standards
115
120
125
130
135
LAKE MILES
COEUR D 'ALENE RIVER
ST. JOE RIVER

FIGURE CE-84

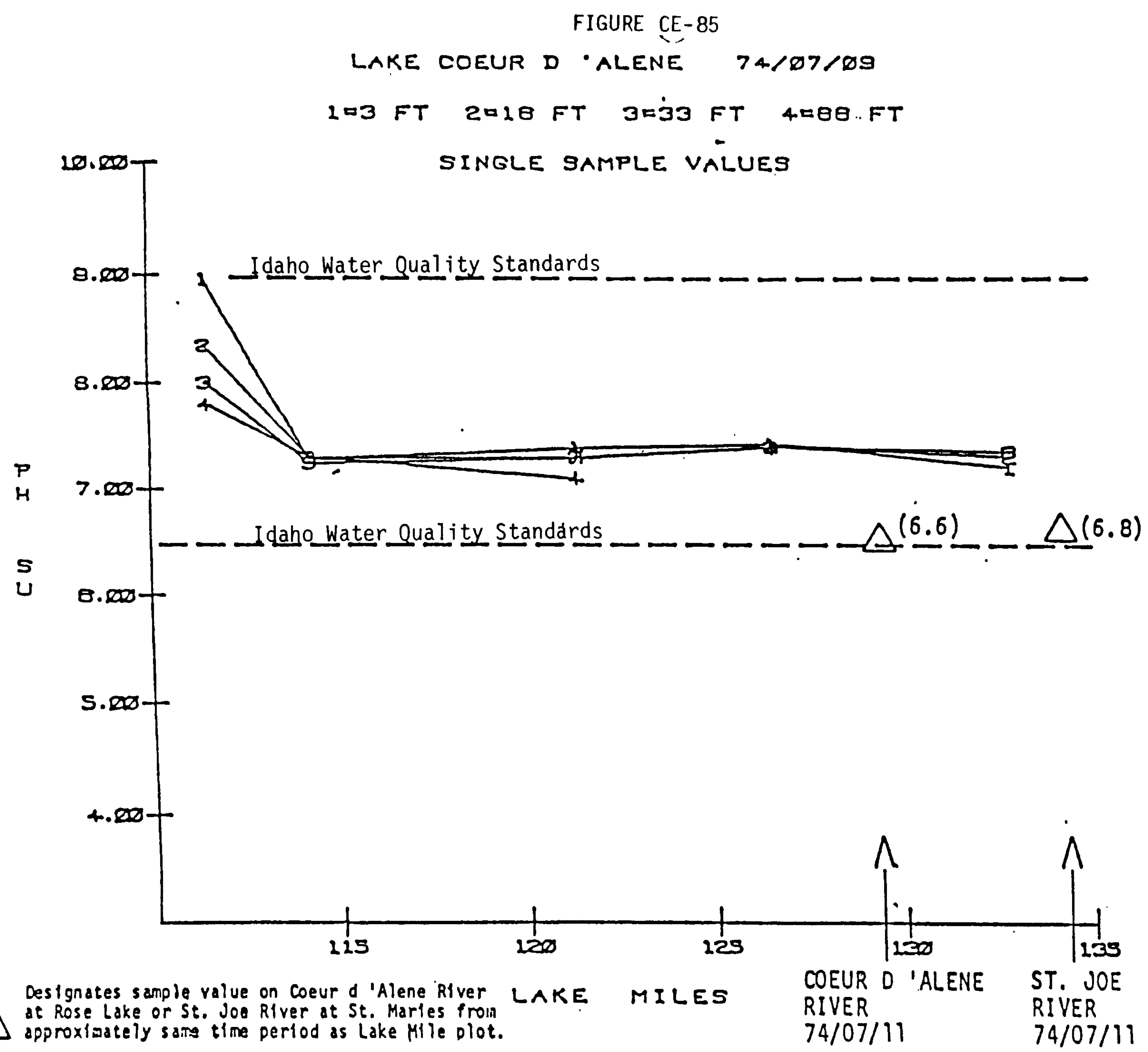
LAKE COEUR D 'ALENE 75/01/18

1=3 FT 2=33 FT 3=88 FT

SINGLE SAMPLE VALUES

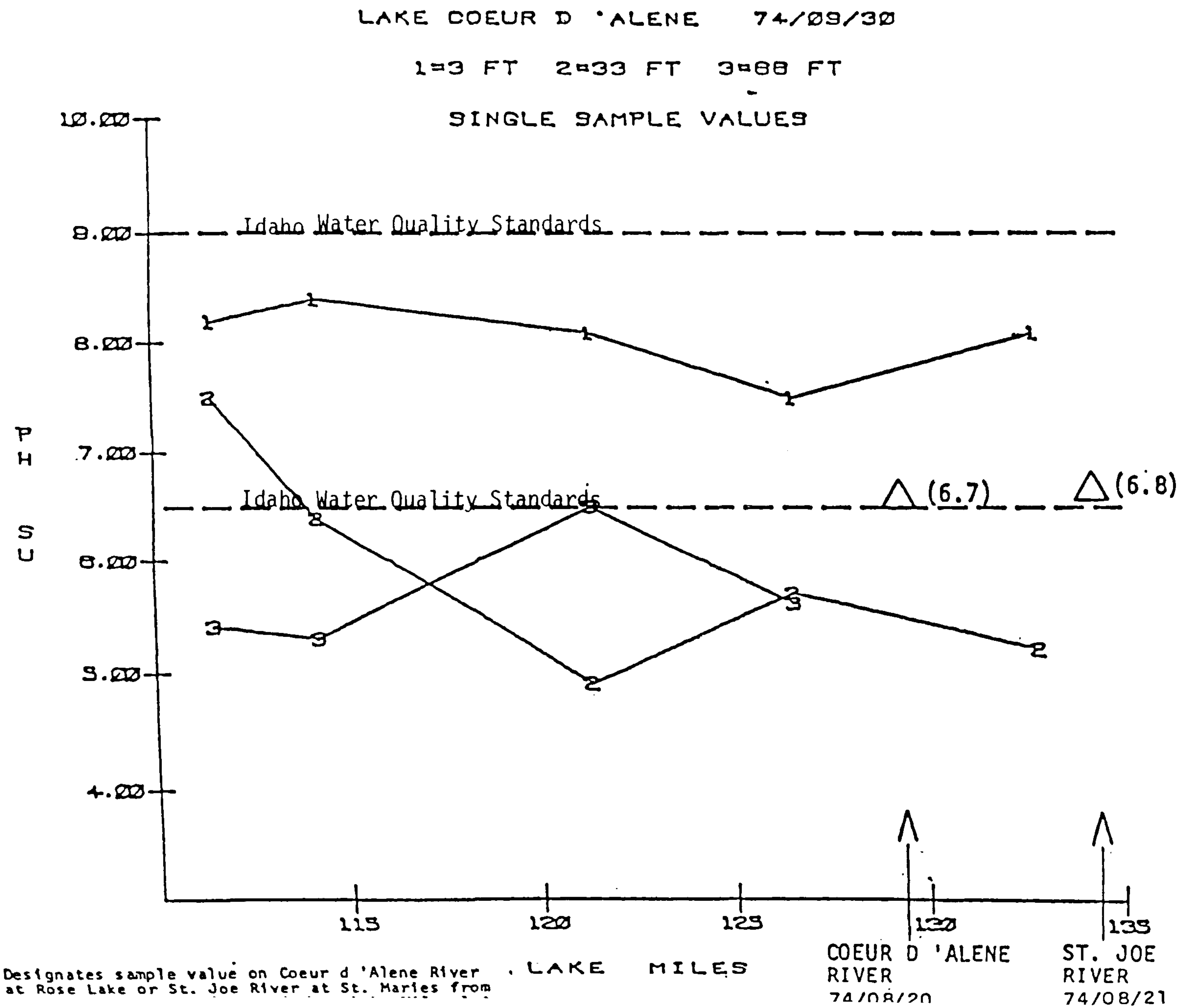


HYDROGEN ION CONCENTRATION (pH)



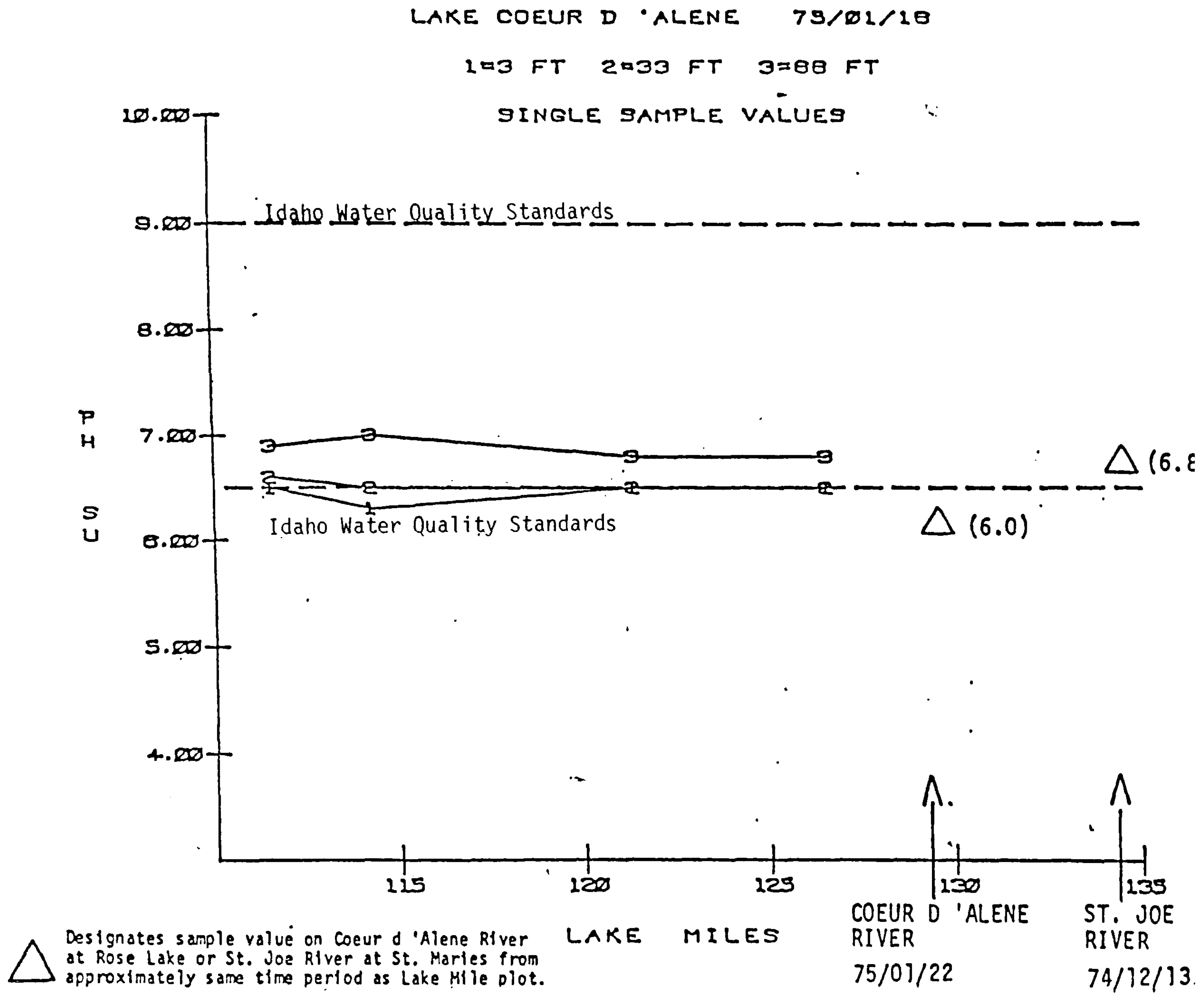
Designates sample value on Coeur d 'Alene River at Rose Lake or St. Joe River at St. Maries from approximately same time period as Lake Mile plot.

FIGURE CE-86



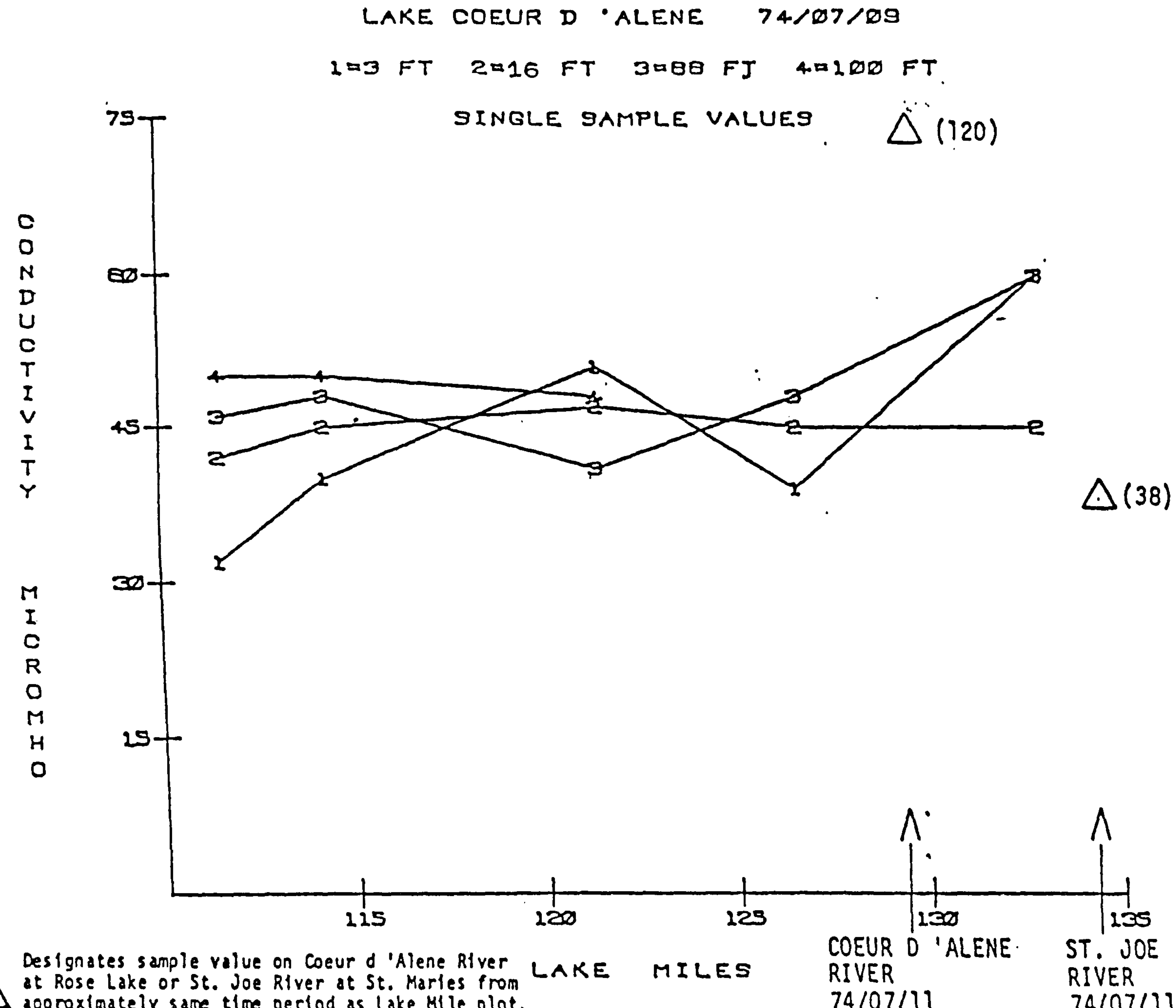
Designates sample value on Coeur d 'Alene River at Rose Lake or St. Joe River at St. Maries from

FIGURE CE-87


LAKE COEUR D 'ALENE 75/01/18
1=3 FT 2=33 FT 3=88 FT
SINGLE SAMPLE VALUES
10.00
9.00
8.00
7.00
6.00
5.00
4.00
PH SU
Idaho Water Quality Standards
Idaho Water Quality Standards
(6.8
(6.0)
115
120
125
130
135
LAKE MILES
COEUR D 'ALENE
RIVER
75/01/22
ST. JOE
RIVER
74/12/13
Designates sample value on Coeur d 'Alene River at Rose Lake or St. Joe River at St. Maries from approximately same time period as Lake Mile plot.

CONDUCTIVITY

FIGURE CE-88



△ Designates sample value on Coeur d 'Alene River at Rose Lake or St. Joe River at St. Maries from approximately same time period as Lake Mile plot.

FIGURE CE-89

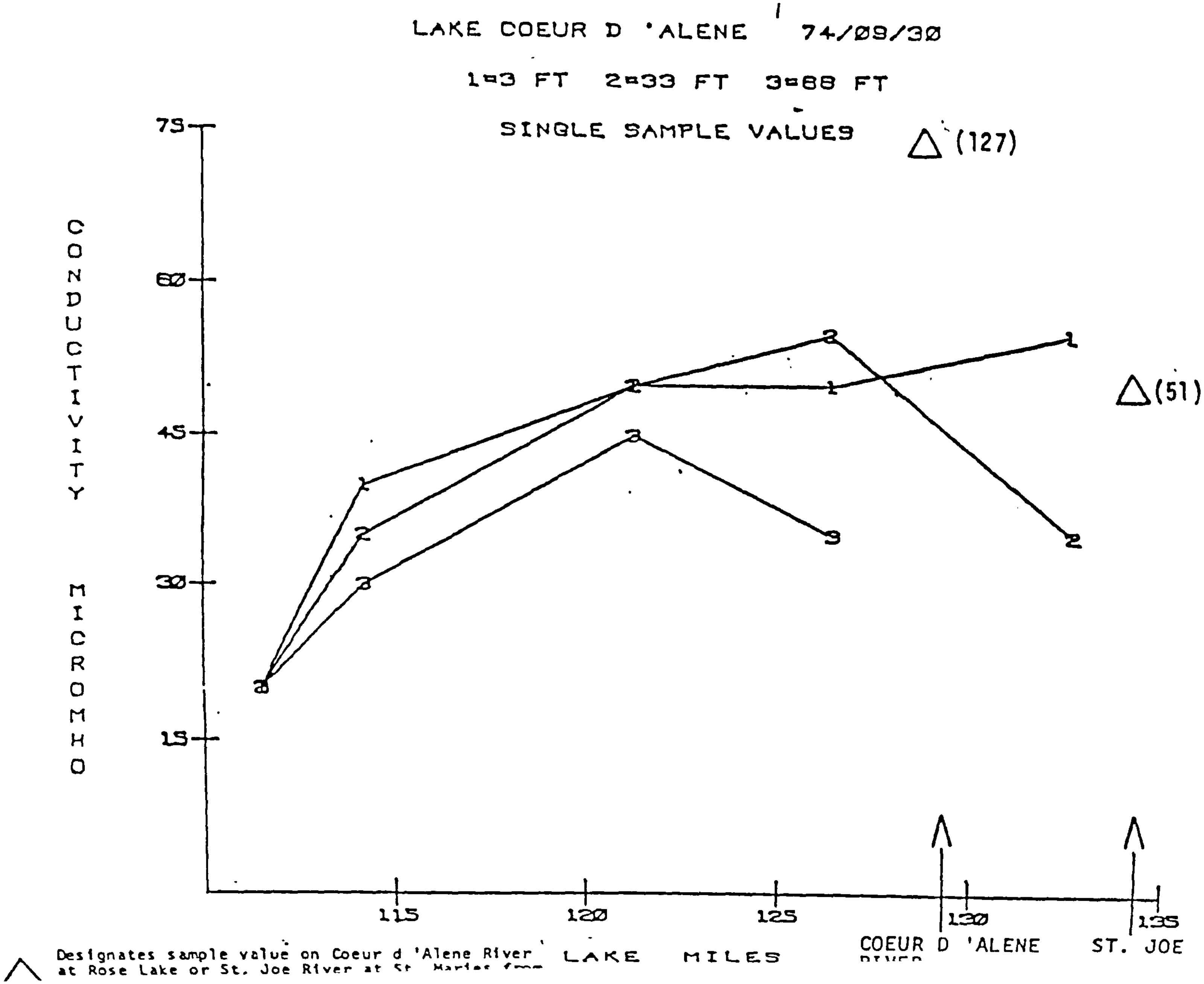
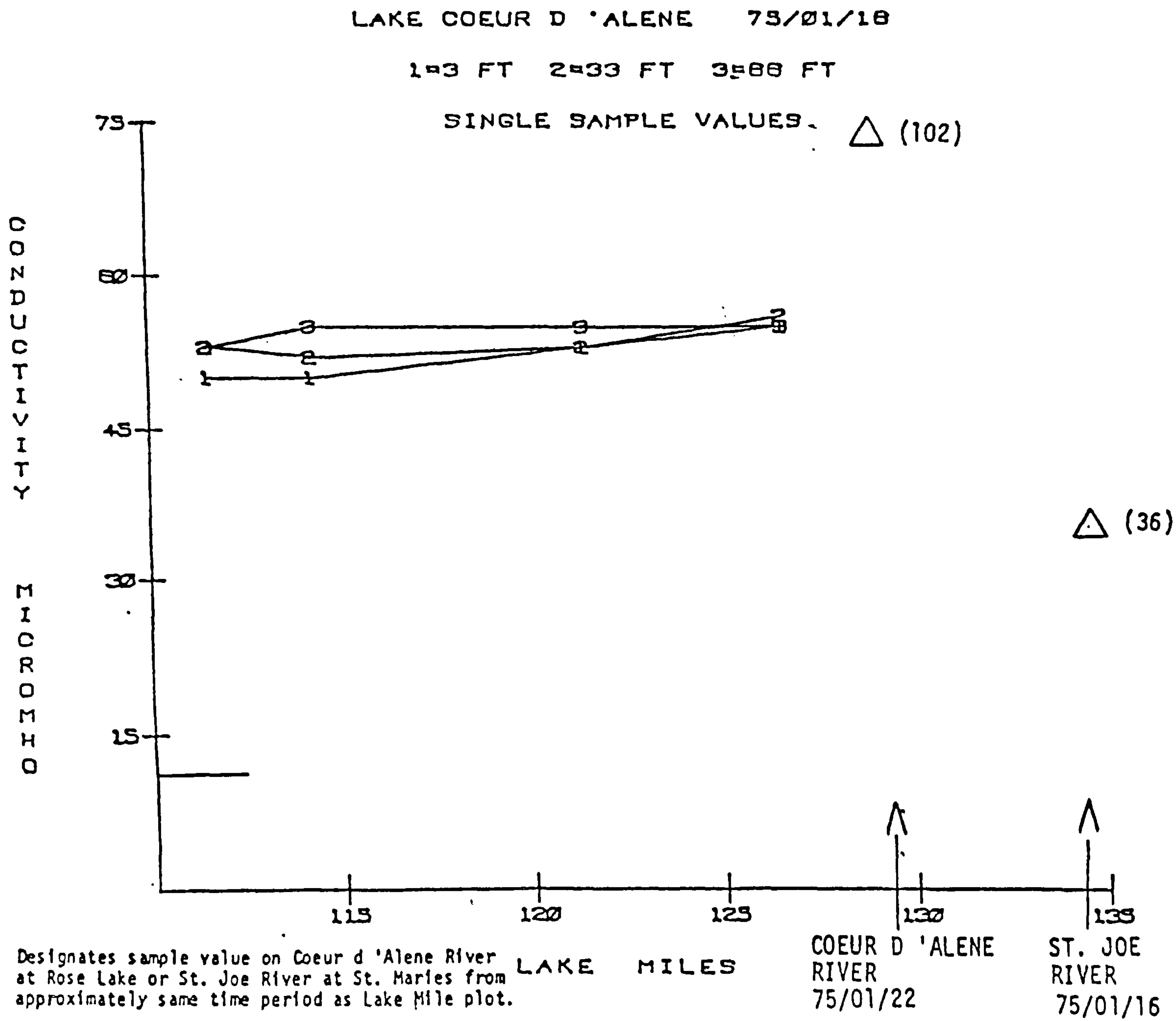

LAKE COEUR D 'ALENE 74/09/30
1=3 FT 2=33 FT 3=88 FT
SINGLE SAMPLE VALUES
(127)
(51)
CONDUCTIVITY MICROMHO
75
60
45
30
15
115
120
125
130
135
LAKE MILES
COEUR D 'ALENE RIVER
ST. JOE
Designates sample value on Coeur d 'Alene River at Rose Lake or St. Joe River at St. Maries from

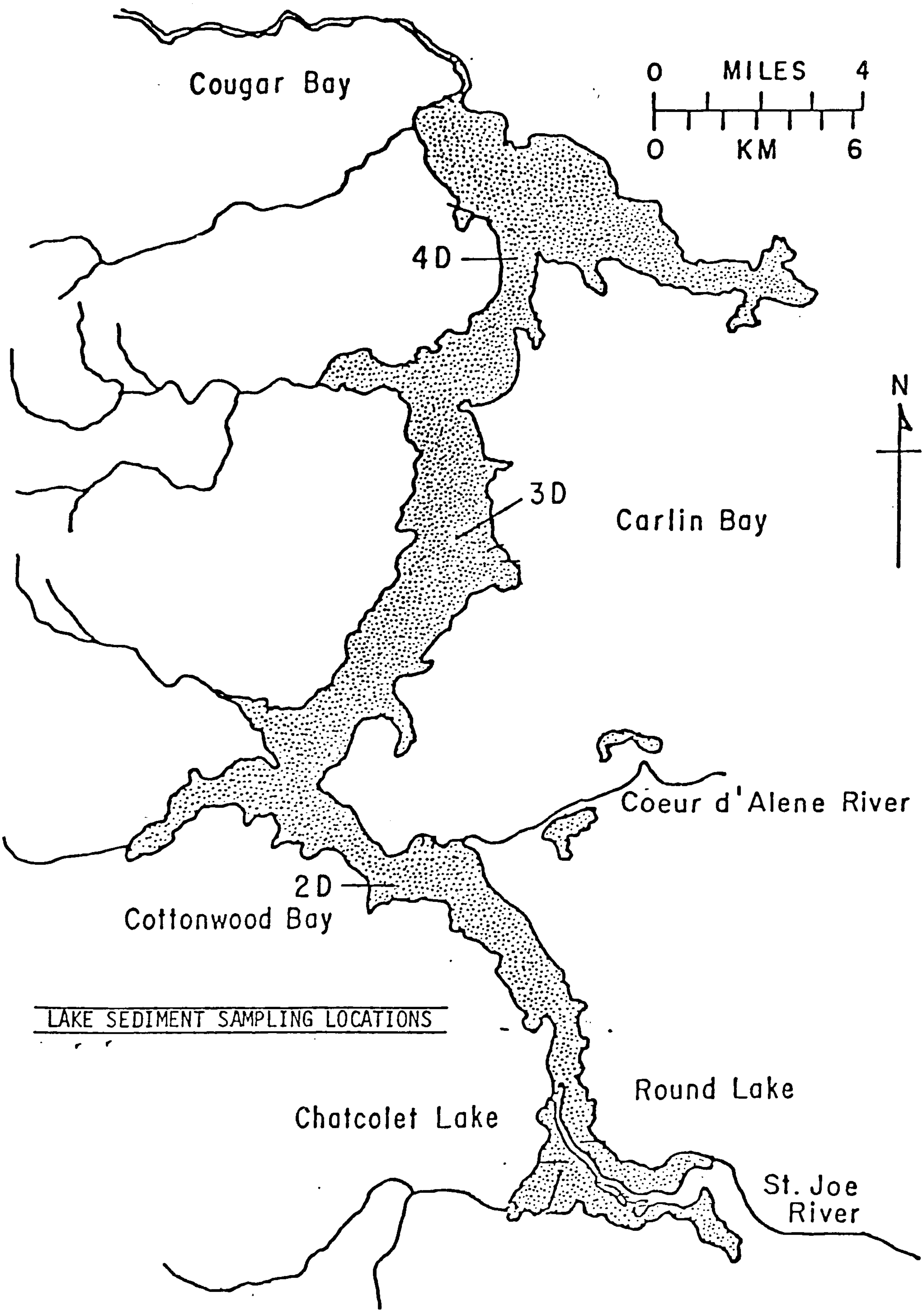
FIGURE CE-90



△ Designates sample value on Coeur d 'Alene River at Rose Lake or St. Joe River at St. Maries from approximately same time period as Lake Mile plot.

D. SEDIMENT DATA

FIGURE CE-91



LAKE SEDIMENT SAMPLING LOCATIONS

SOURCE: Biological Impact of Combined Metallic and Organic Pollution in the Coeur d'Alene-Spokane River Drainage System. William H. Funk, Fred W. Rabe, and Royston Filby, Principal Investigators. June 30, 1973.

FIGURE CE-92

LAKE SEDIMENT METALS CONCENTRATIONS (1971 - 1972)

Station	Concentration mg/kg				
	CU	FE	MG	SB	ZN
2D	61	100,000	435	93	1125
3D	68	75,100	660	120	3400
4D	49	--	--	--	5050

-- indicates no data available

SOURCE: Biological Impact of Combined Metallic and Organic Pollution in the Coeur d'Alene-Spokane River Drainage System. William H. Funk, Fred W. Rabe, and Royston Filby, Principal Investigators. June 30, 1973.

E. DETENTION TIME CALCULATIONS

E. DETENTION TIME CALCULATIONS

Approximate calculations were performed to determine the detention time for inflowing water from the Coeur d 'Alene and St. Joe Rivers.

Four periods of the year were considered with the major variables involved being river input flow variation, temperature relationships between input and the lake itself, and the temperature distribution throughout the lake.

PERIOD	DATE	VOLUME DISPLACED	DETENTION TIME
1	May 1	2.486×10^6 acre ft.	40.5 days
2	July 1	0.504×10^6 acre ft.	125.4 days
3	Sept 1	0.252×10^6 acre ft.	95.8 days
4	Jan 1	2.486×10^6 acre ft.	91.0 days

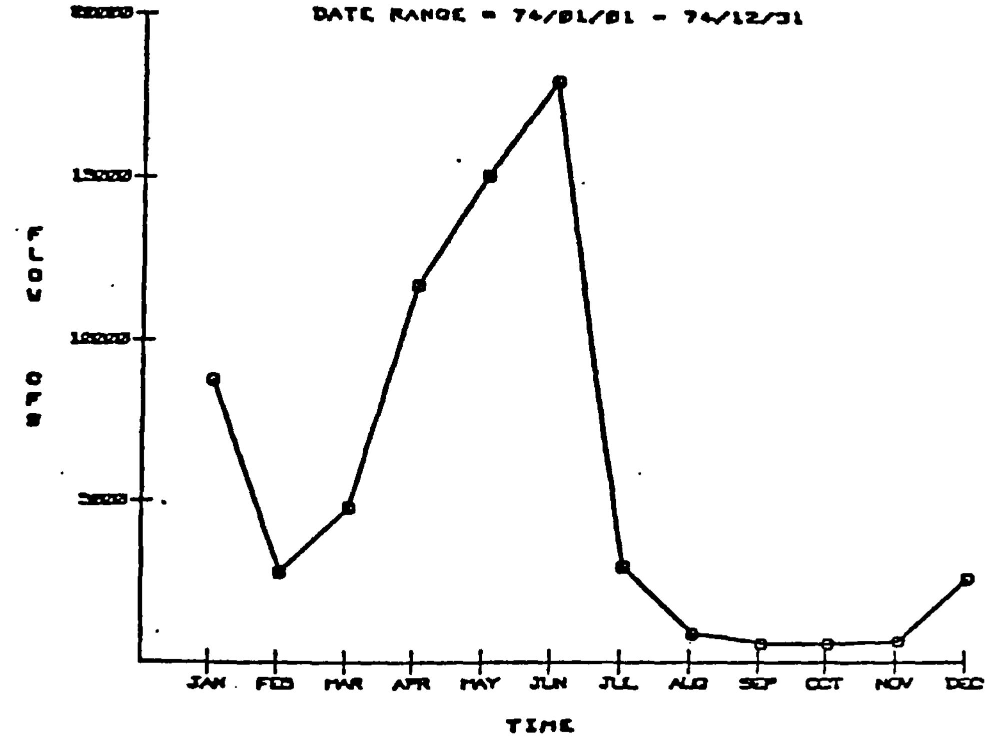
Graphs of flow versus time are also included in section (E) for the readers benefit, with the Coeur d 'Alene River at Rose Lake and the St. Joe River at St. Maries under consideration.

FIGURE CE-93

ST. JOE RIVER AT ST. MARIES

U.S.G.S. DATA MEAN VALUES

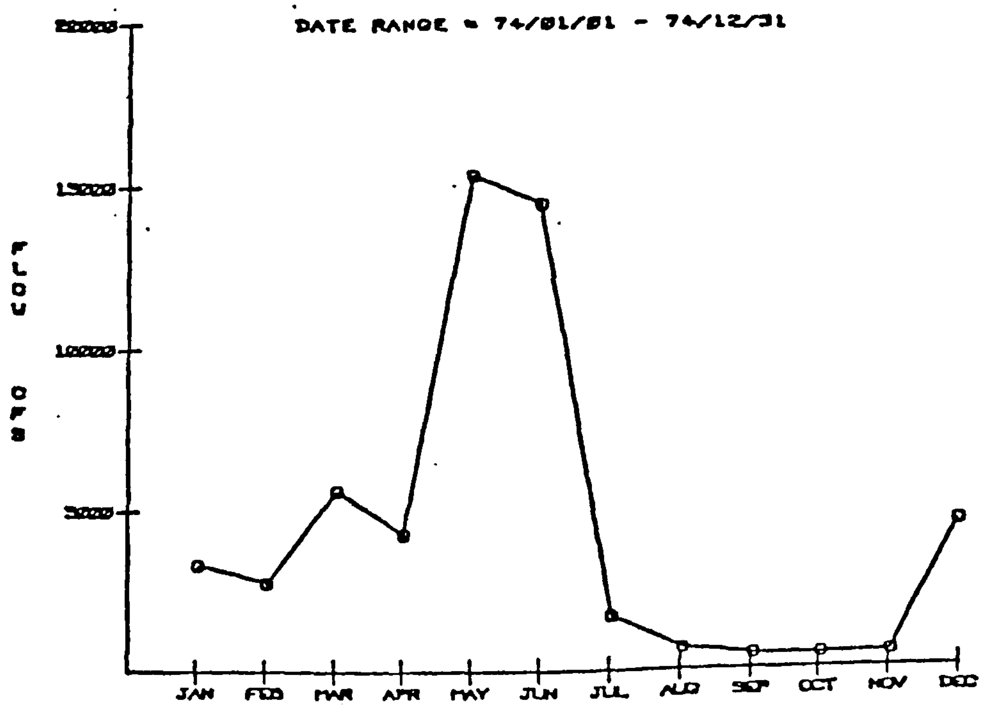
DATE RANGE = 74/01/01 - 74/12/31



COEUR D 'ALENE RIVER AT ROSE LAKE

U.S.G.S. DATA MEAN VALUES

DATE RANGE = 74/01/01 - 74/12/31

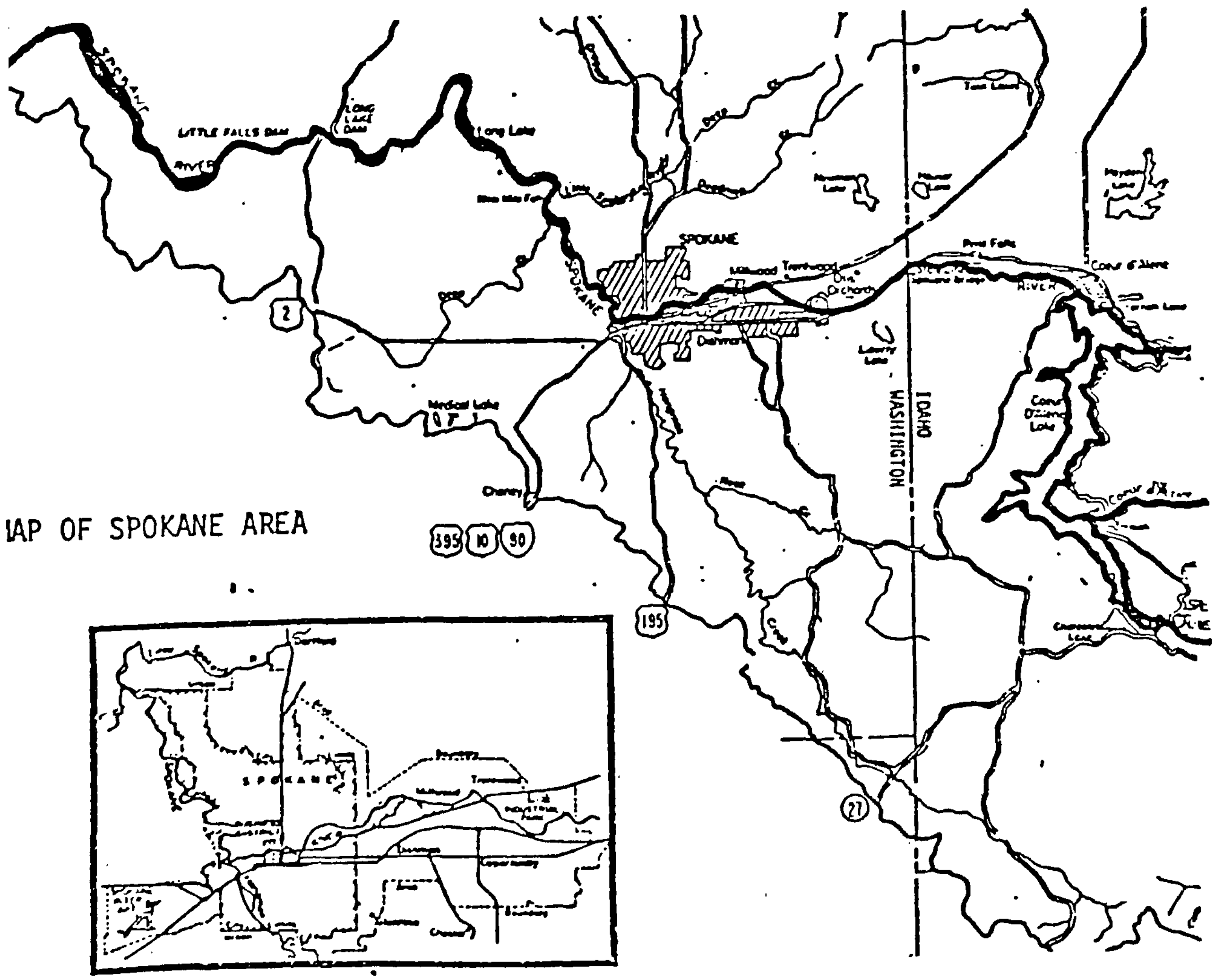


SPOKANE RIVER SUB-BASIN SECTION

GRAPH SET NO. 7

SPOKANE RIVER SUB-BASIN

Graph Set No. 7 illustrates the water quality throughout the Spokane River during a high and low flow condition. These figures allow the reader to identify variability, problem areas along the river, and relate the river's water quality status to the two flow conditions. Below the graphs are significant inflows located appropriately along the river axis.



IAP OF SPOKANE AREA

FIGURE CE-94

SPOKANE RIVER

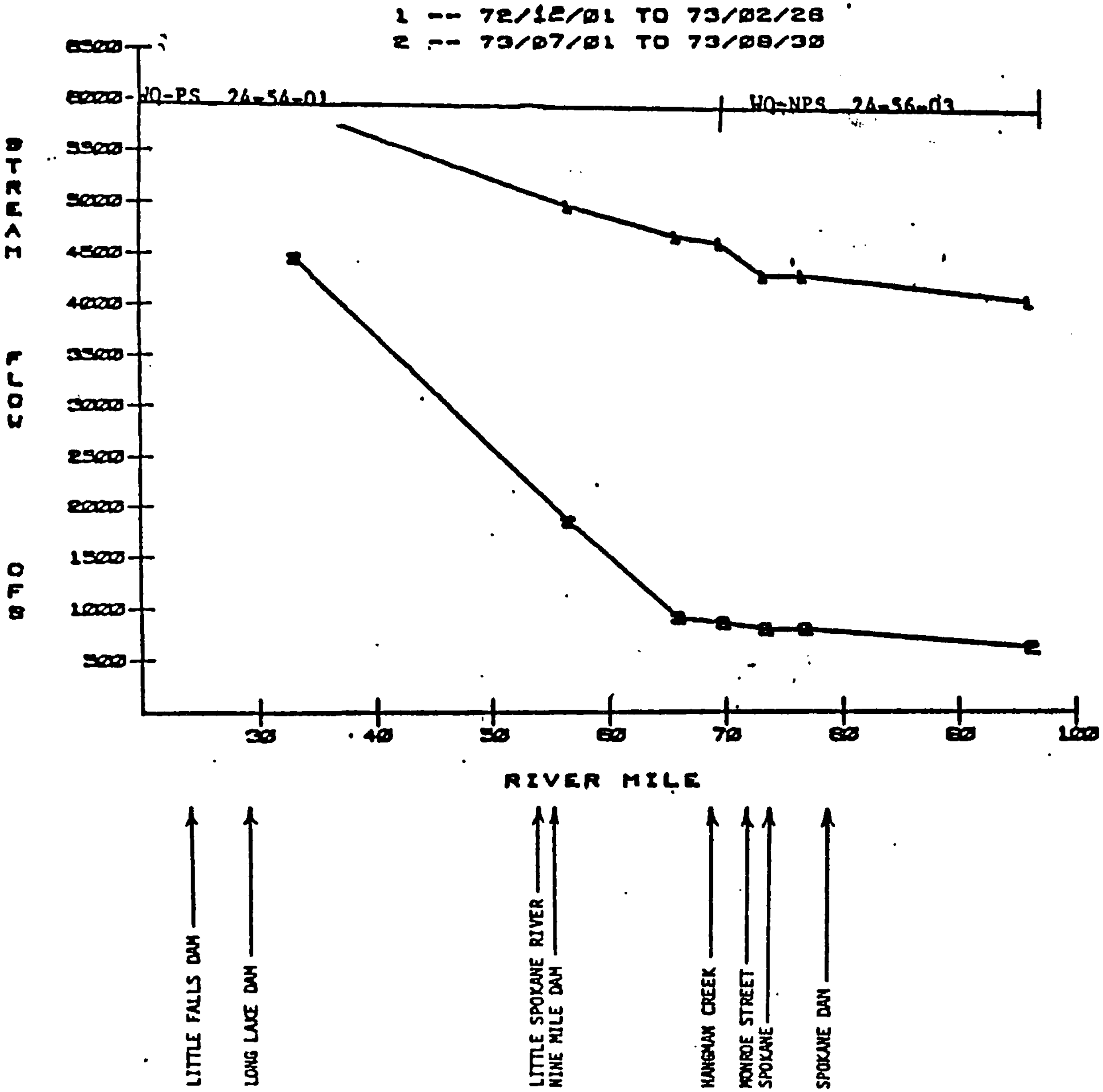


FIGURE CE-95

SPOKANE RIVER

1 -- 72/12/01 TO 73/02/31
2 -- 73/07/01 TO 73/08/31

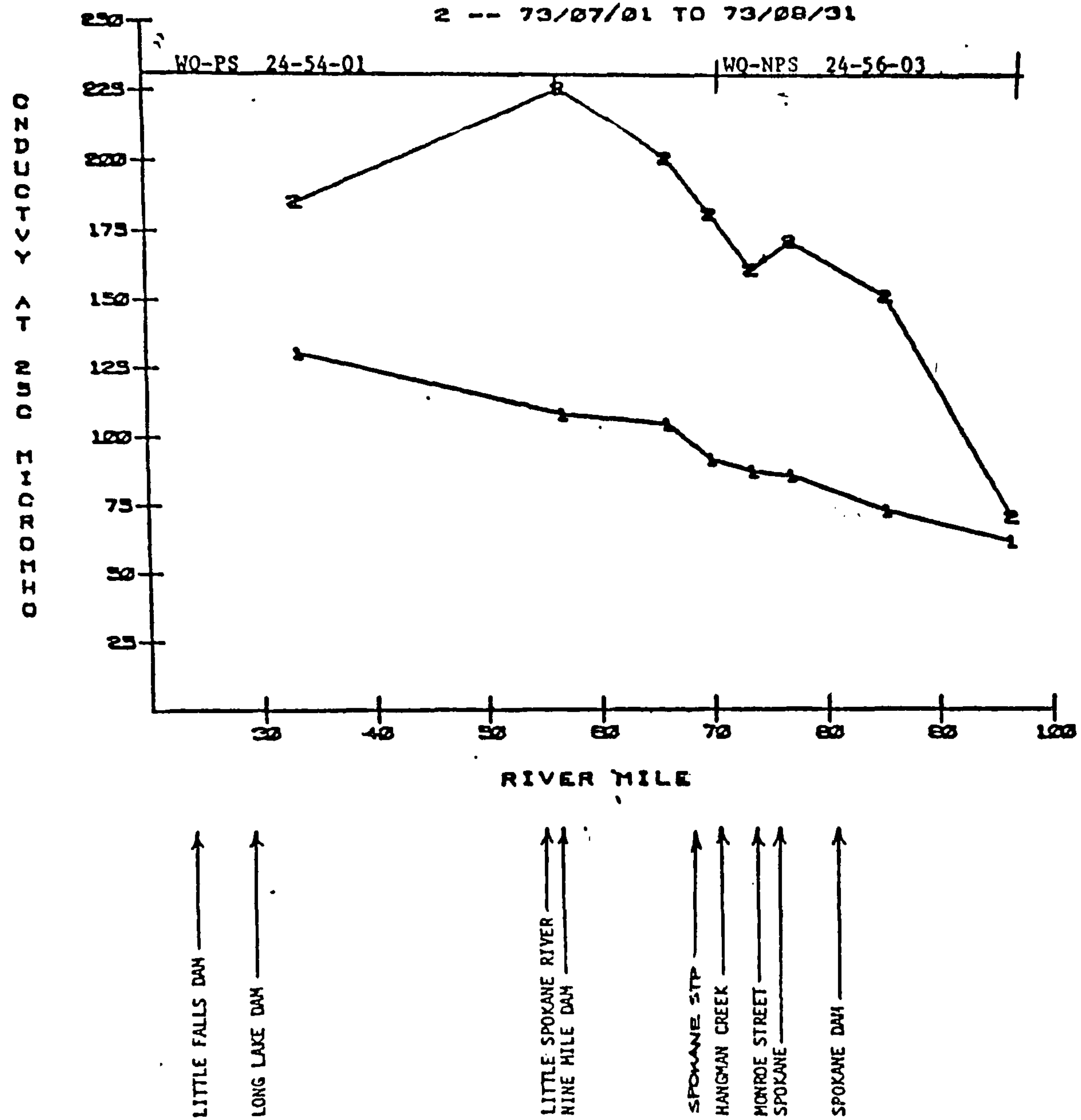


FIGURE CE-96

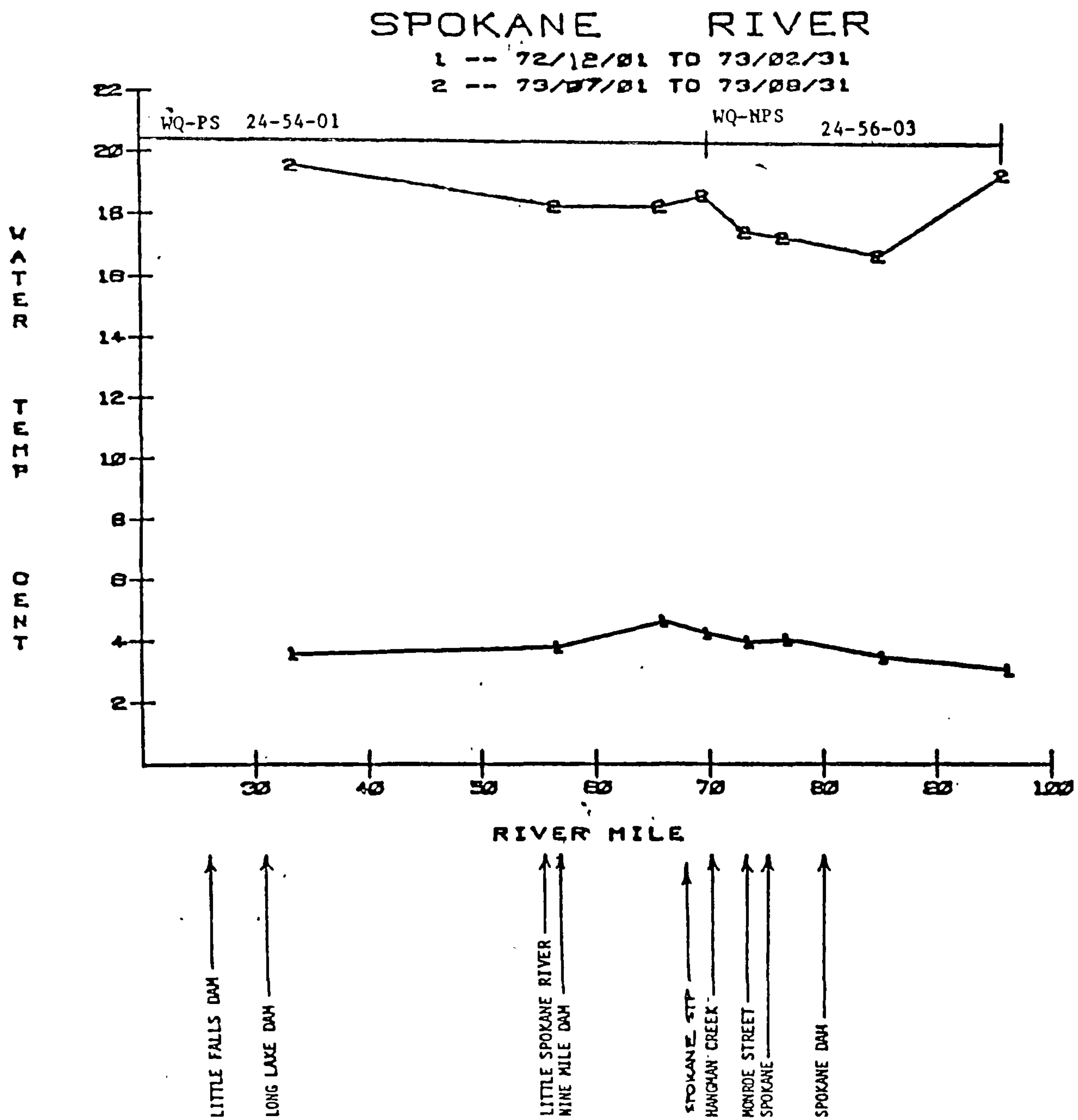

SPOKANE RIVER
1 -- 72/12/01 TO 73/02/31
2 -- 73/07/01 TO 73/08/31
WQ-PS 24-54-01
WQ-NPS
24-56-03
WATER TEMP CENT
RIVER MILE
LITTLE FALLS DAM
LONG LAKE DAM
LITTLE SPOKANE RIVER
NINE MILE DAM
SPOKANE STP
HANGMAN CREEK
MONROE STREET
SPOKANE
SPOKANE DAM

FIGURE CE-97

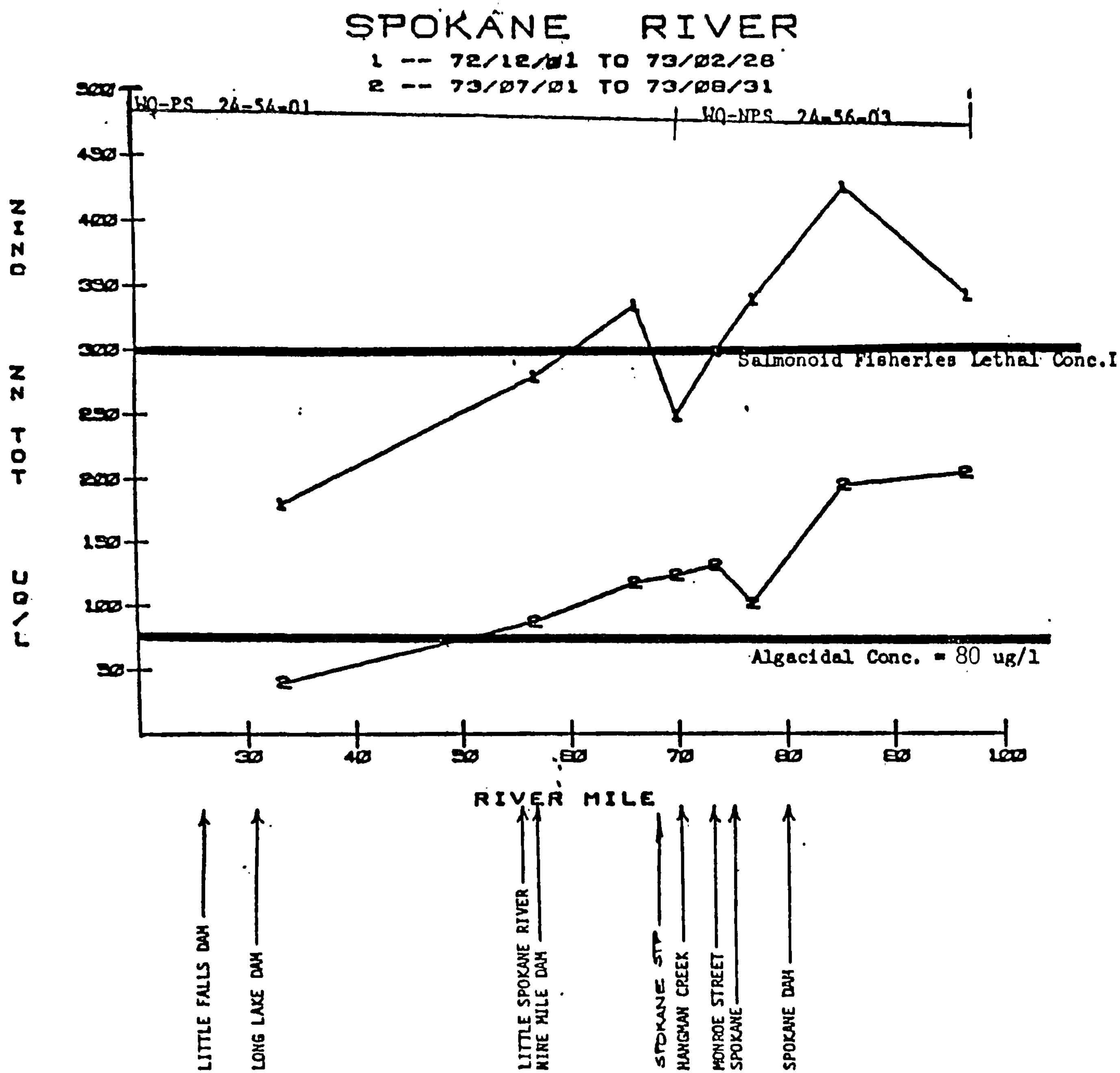

SPOKANE RIVER
1 -- 72/12/01 TO 73/02/28
2 -- 73/07/01 TO 73/08/31
WQ-PS 24-54-01
WQ-NPS 24-56-03
Salmonoid Fisheries Lethal Conc.I
Algacidal Conc. = 80 ug/l
UG/L TOT ZN ZINC
RIVER MILE
LITTLE FALLS DAM
LONG LAKE DAM
LITTLE SPOKANE RIVER
NINE MILE DAM
SPOKANE STP
HANGMAN CREEK
MONROE STREET
SPOKANE
SPOKANE DAM

FIGURE CE-98

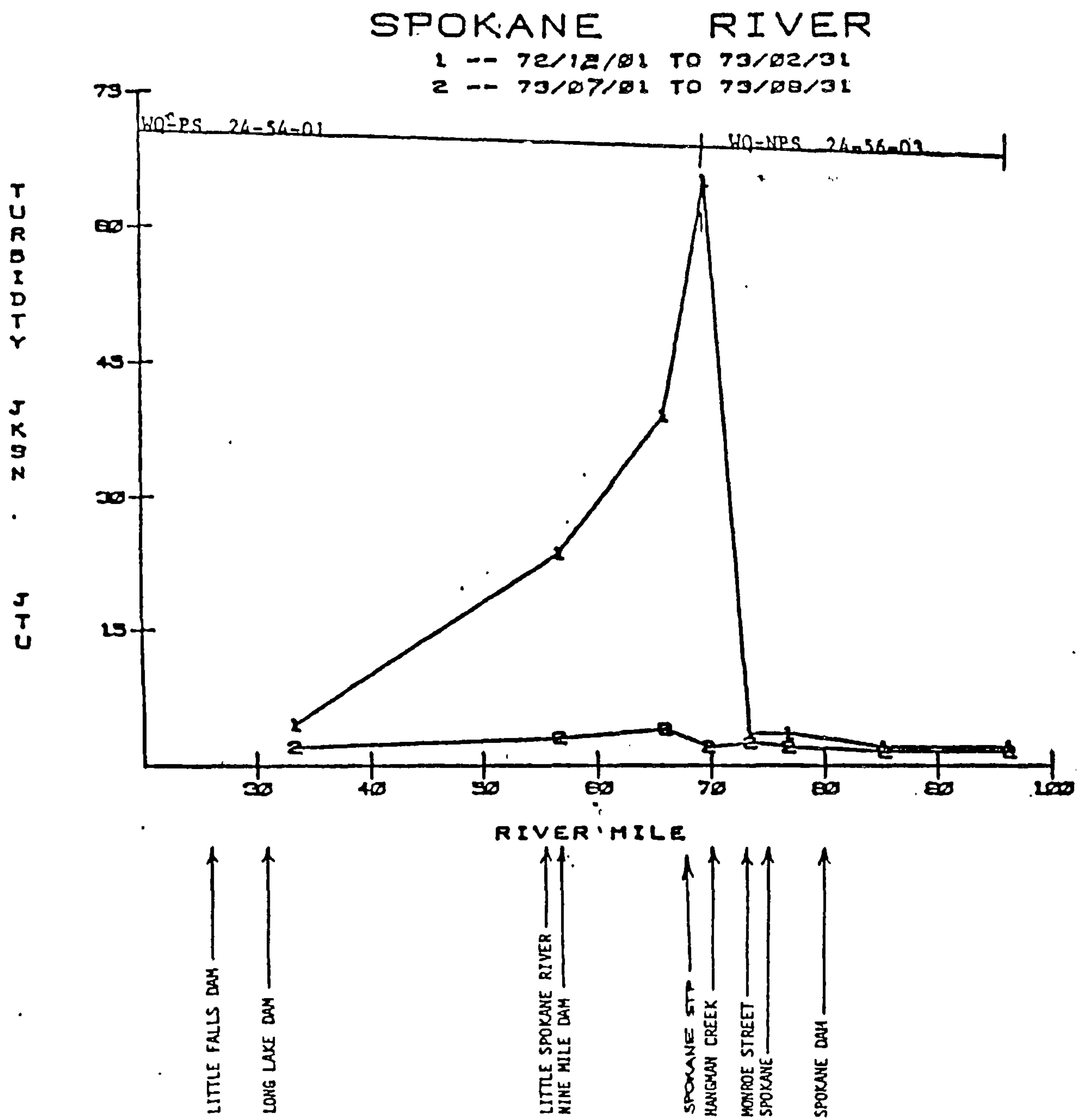

SPOKANE RIVER
1 -- 72/12/01 TO 73/02/31
2 -- 73/07/01 TO 73/08/31
WQ-PS 24-54-01
WQ-NPS 24-56-03
TURBIDTY JKSN. JTU
75
60
45
30
15
30
40
50
60
70
80
90
100
RIVER MILE
LITTLE FALLS DAM
LONG LAKE DAM
LITTLE SPOKANE RIVER
NINE MILE DAM
SPOKANE STP
HANGMAN CREEK
MONROE STREET
SPOKANE
SPOKANE DAM

FIGURE CE-99

SPOKANE RIVER

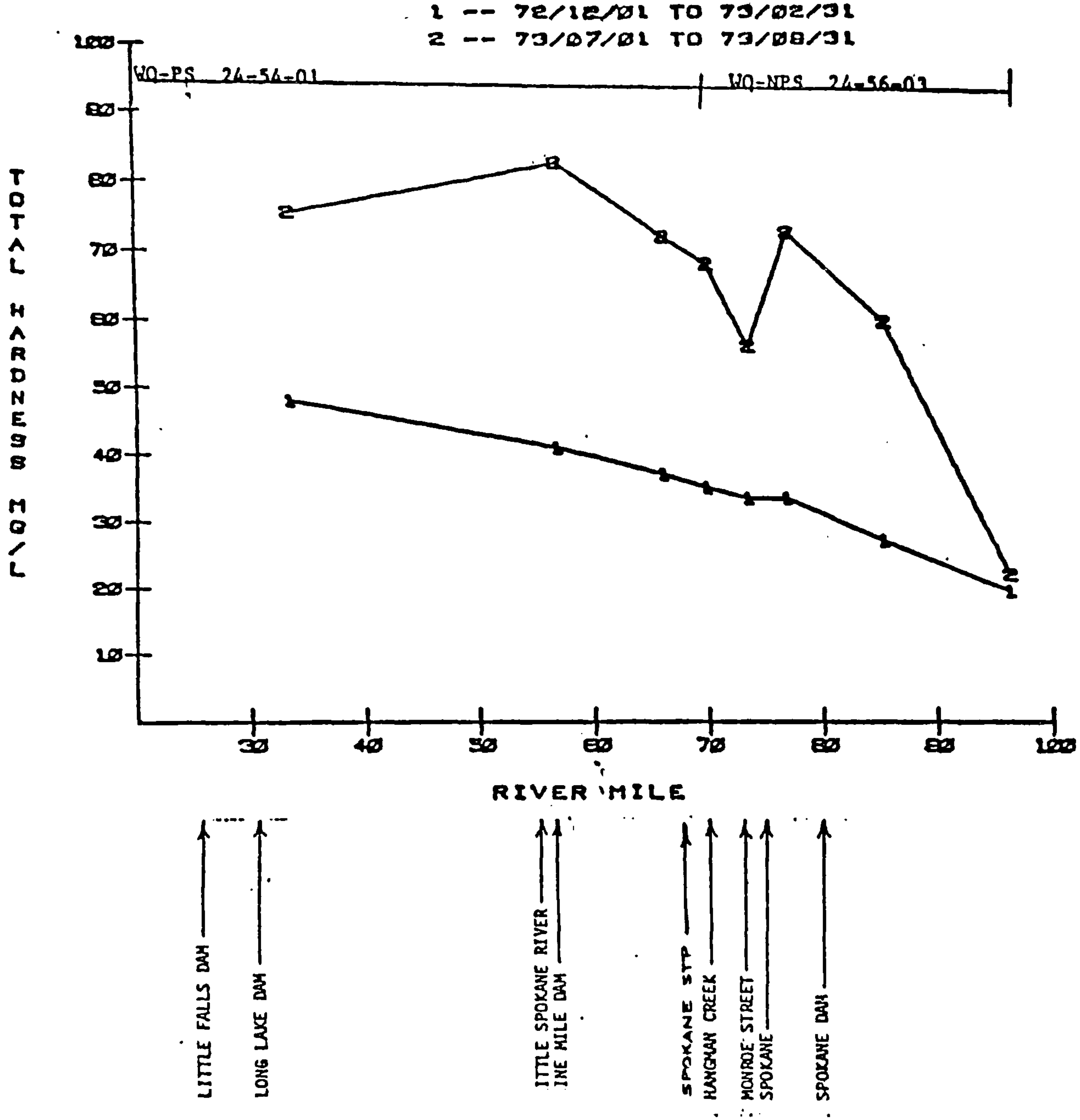


FIGURE CE-100

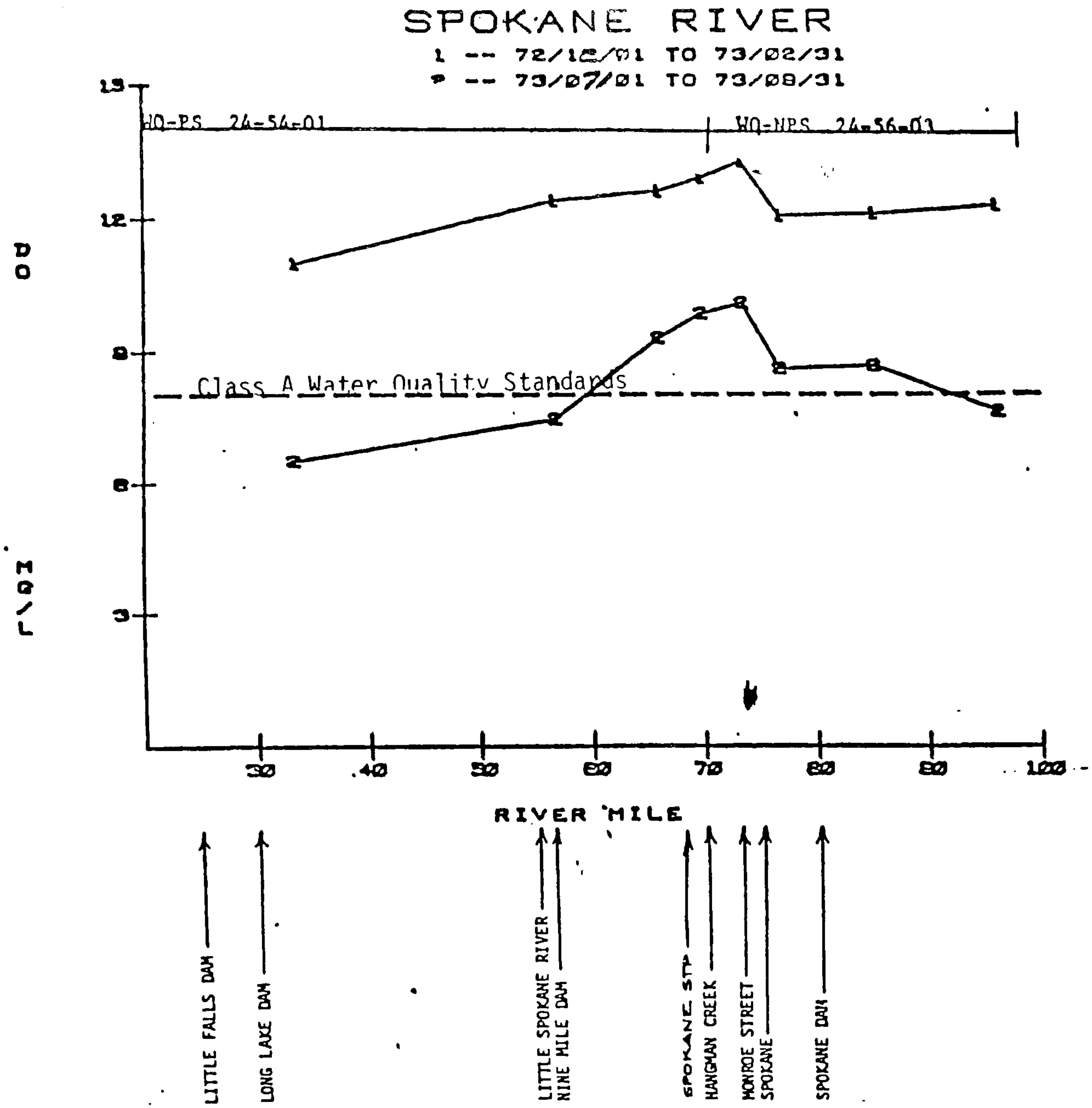


FIGURE CE-101

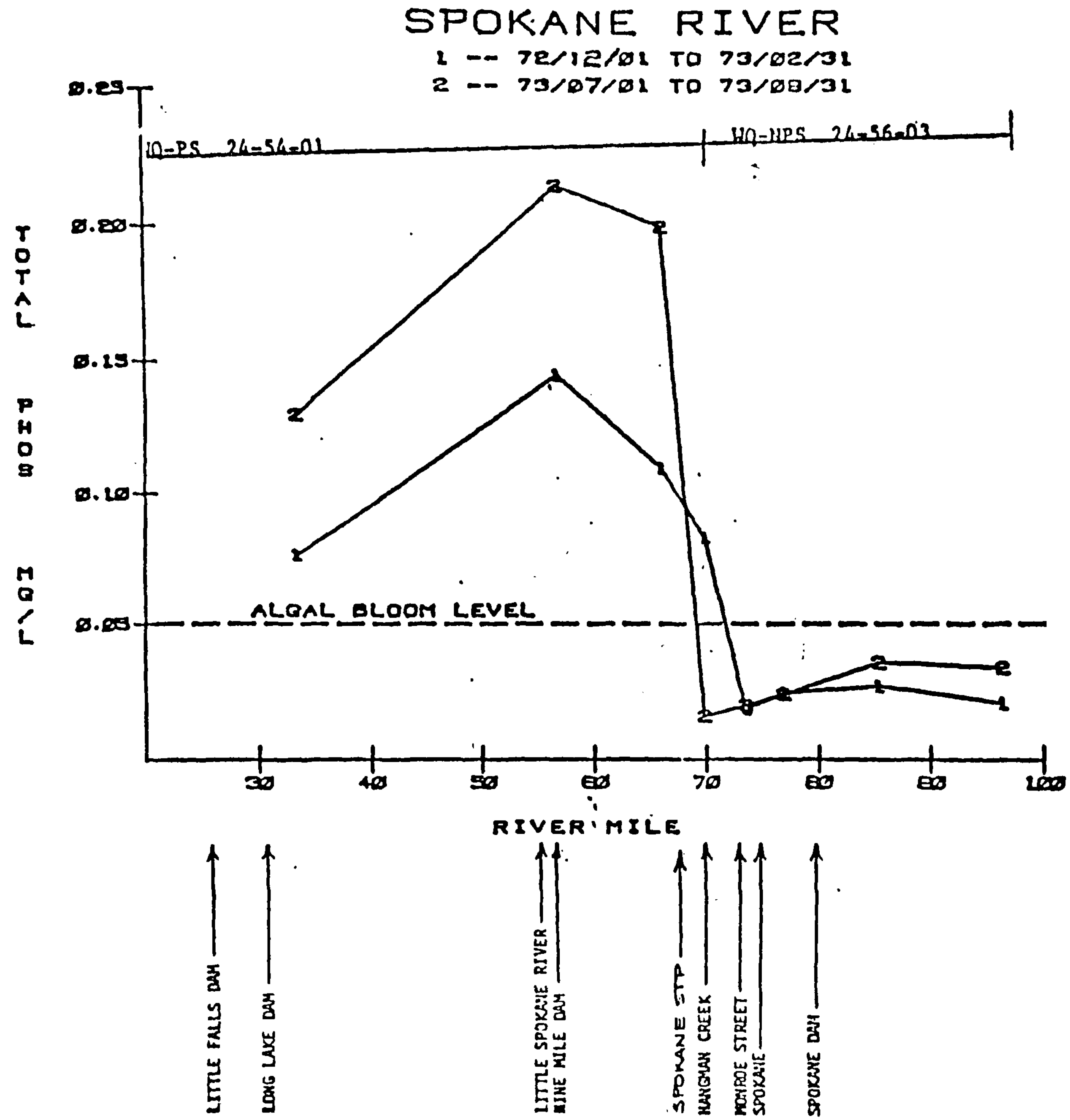


FIGURE CE-102

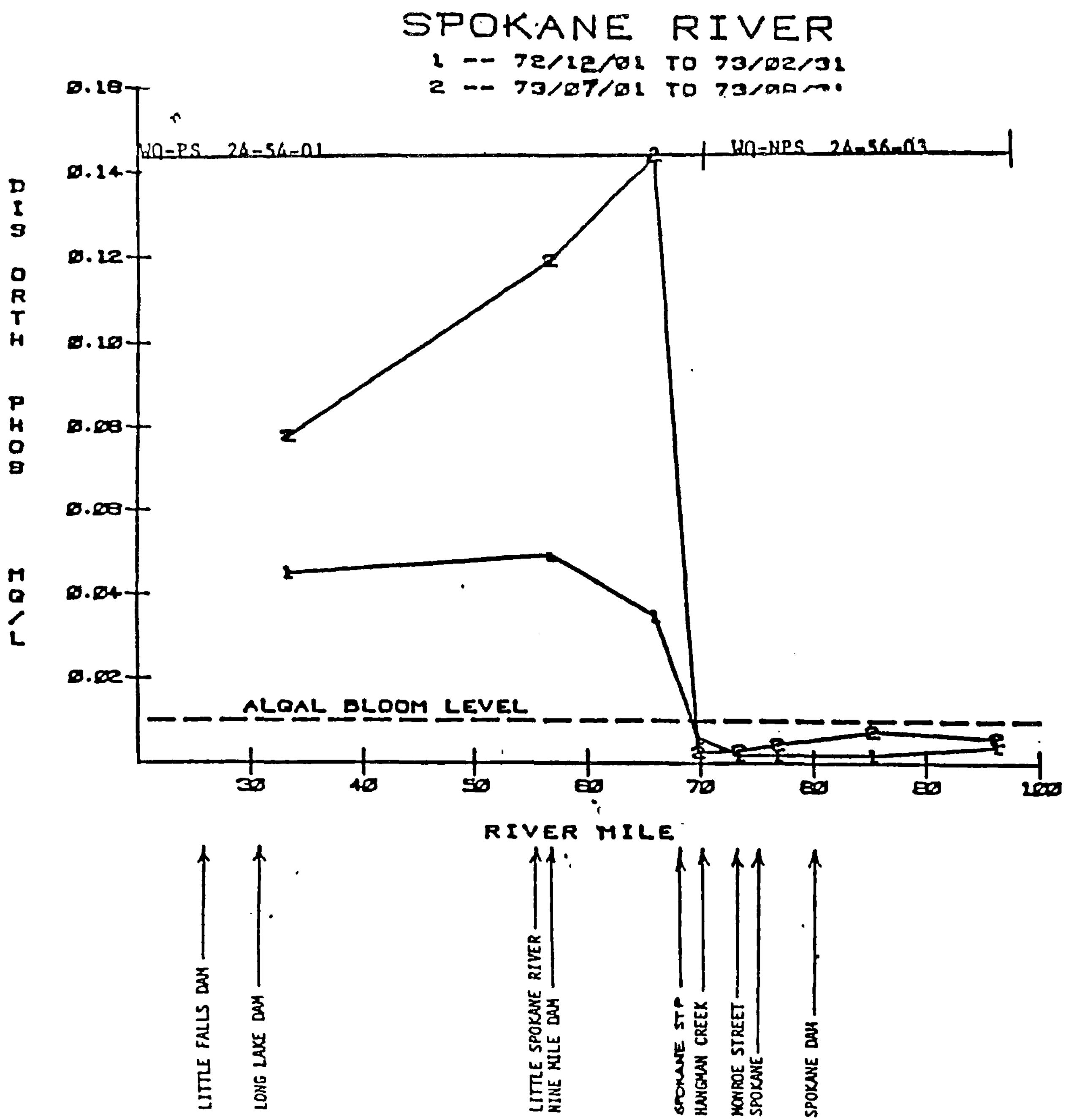


FIGURE CE-103

SPOKANE RIVER

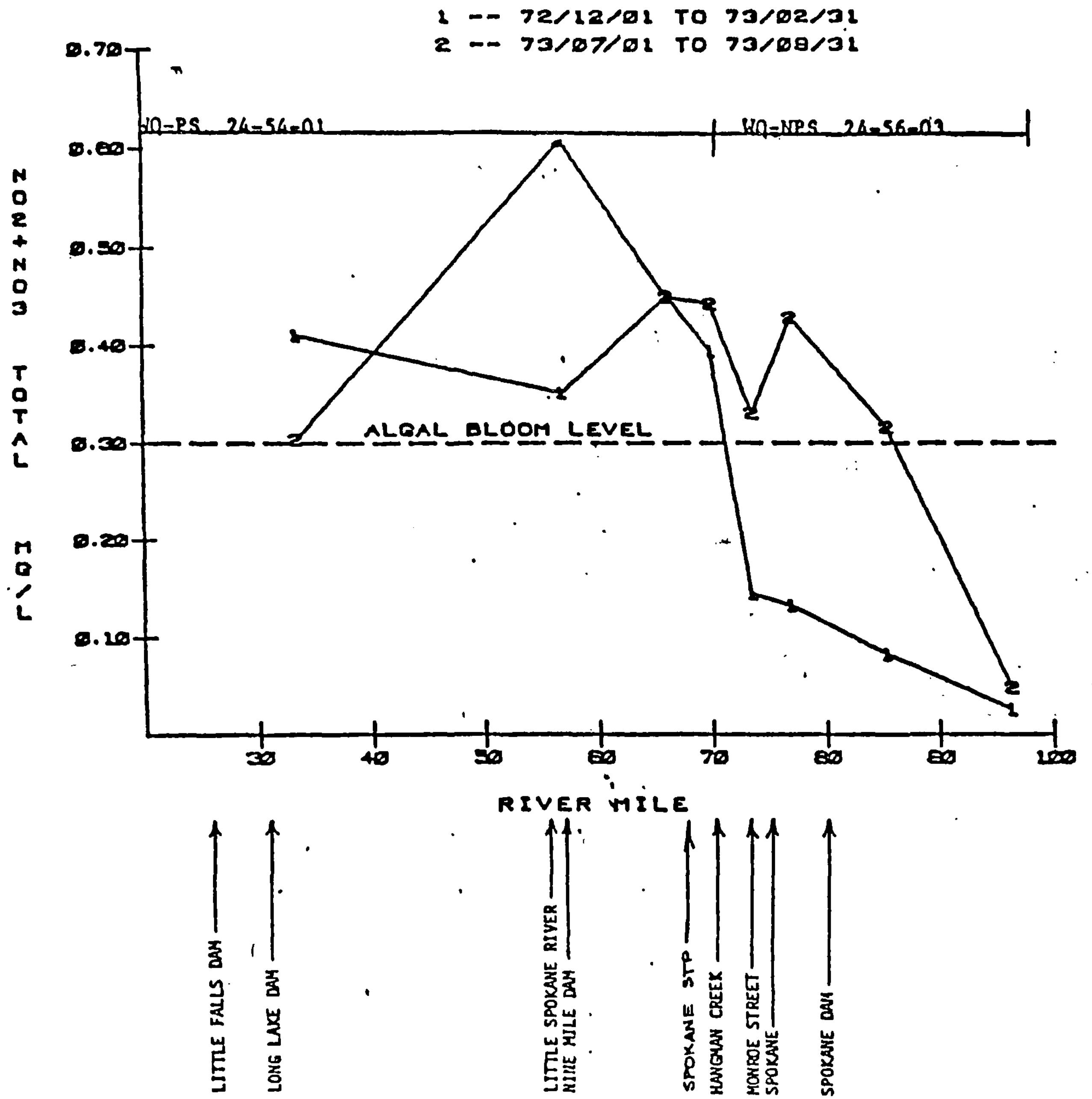


FIGURE CE-104

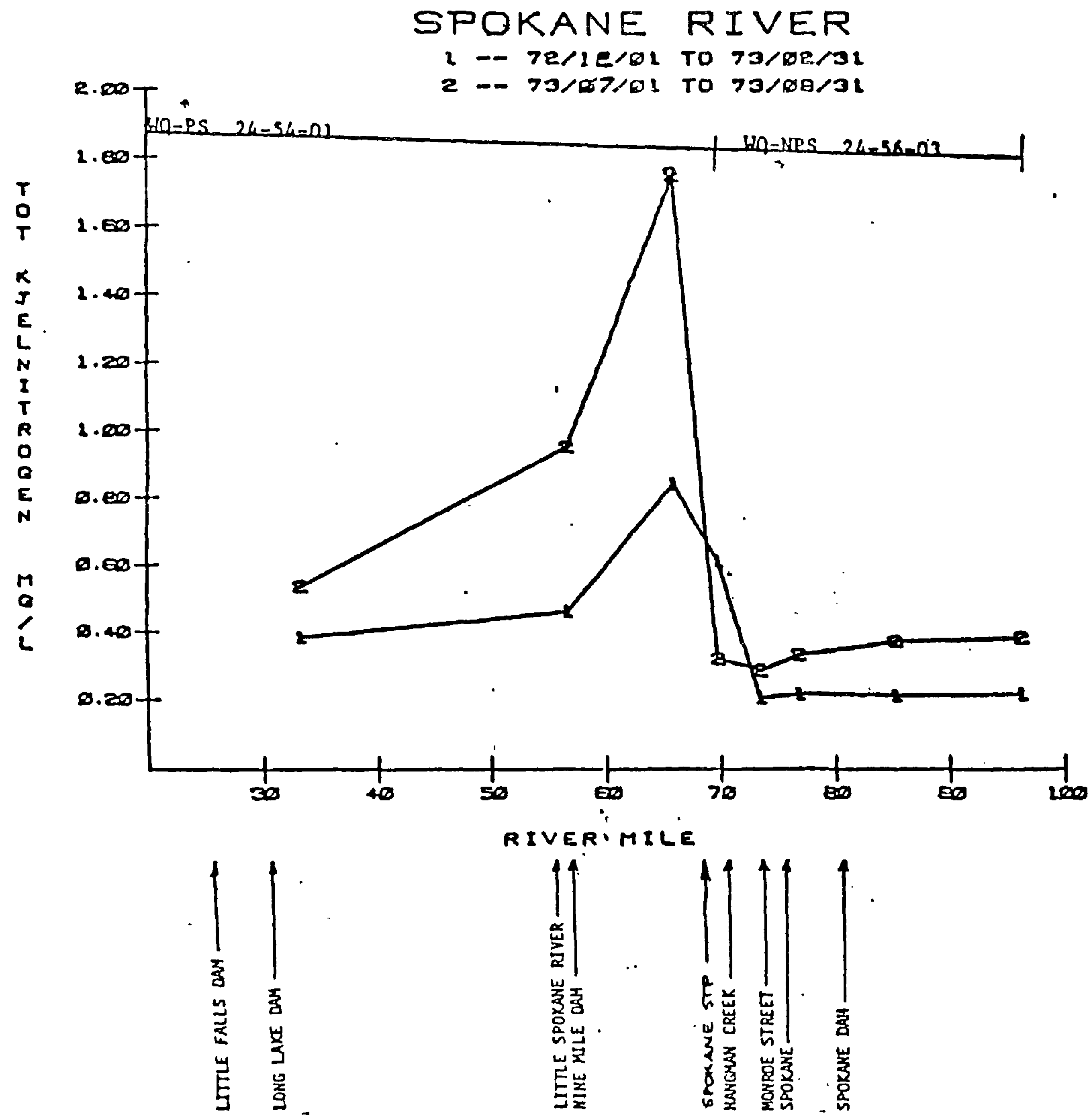


FIGURE CE-105

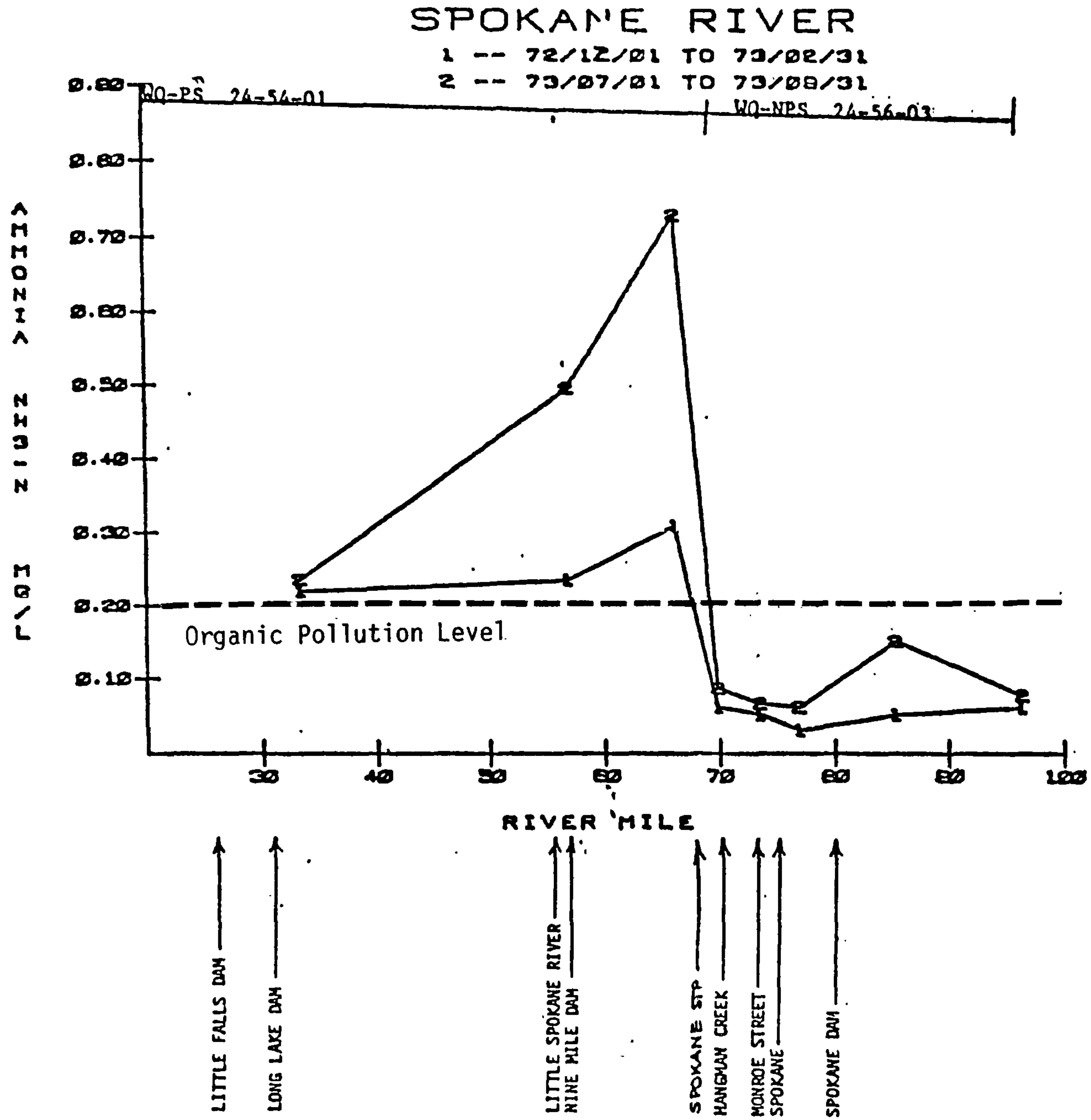


FIGURE CE-106

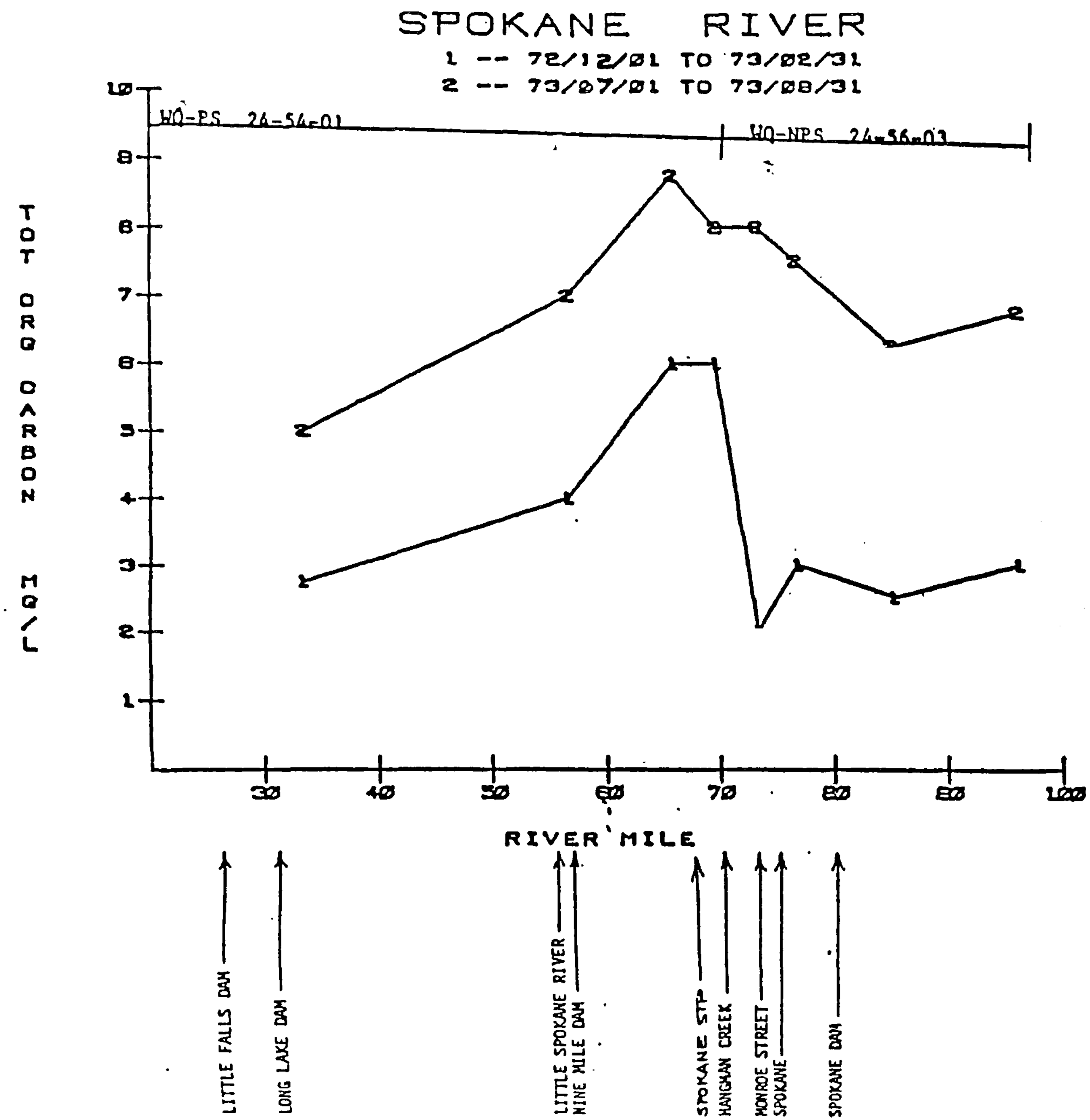


FIGURE CE-107

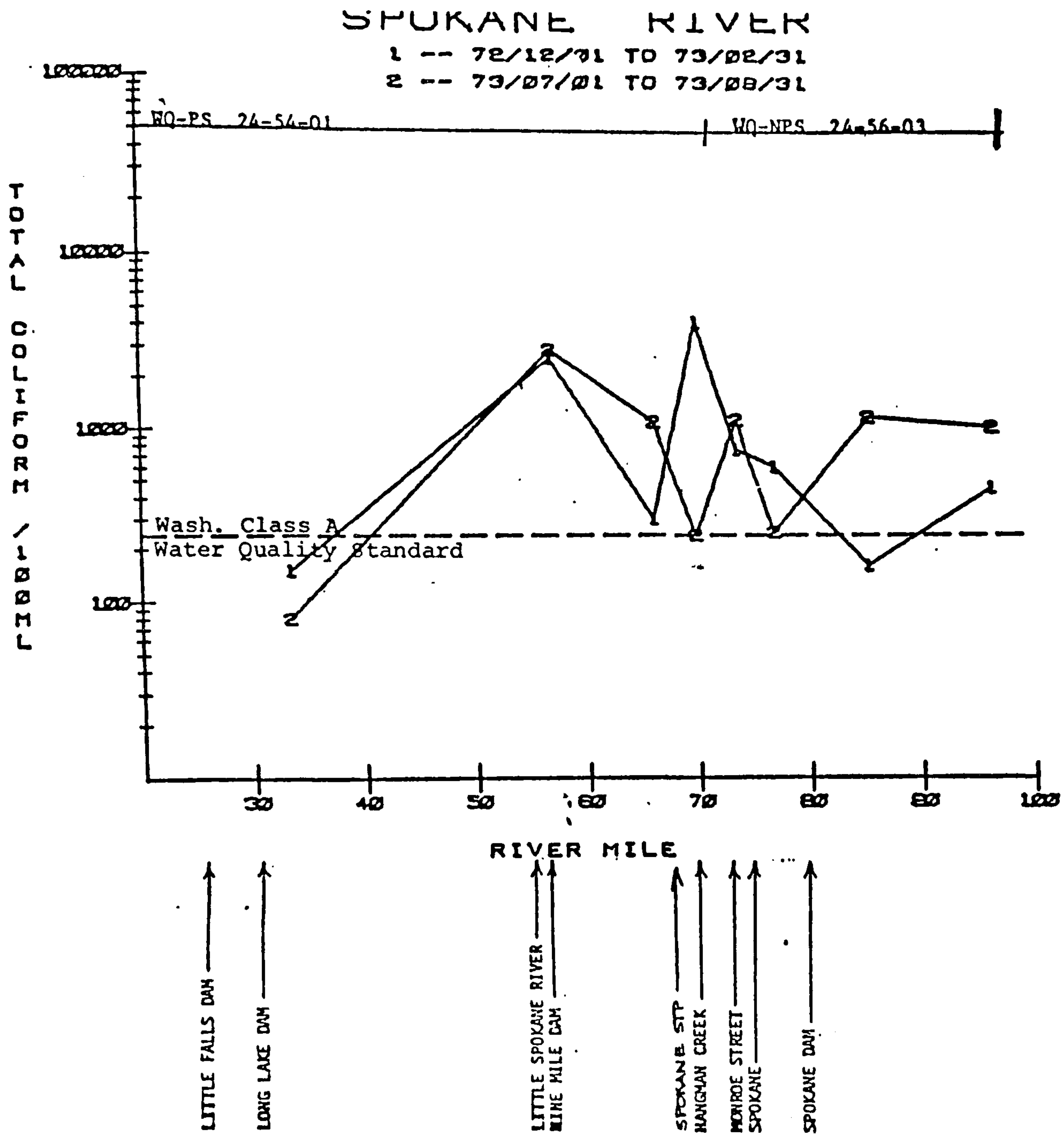
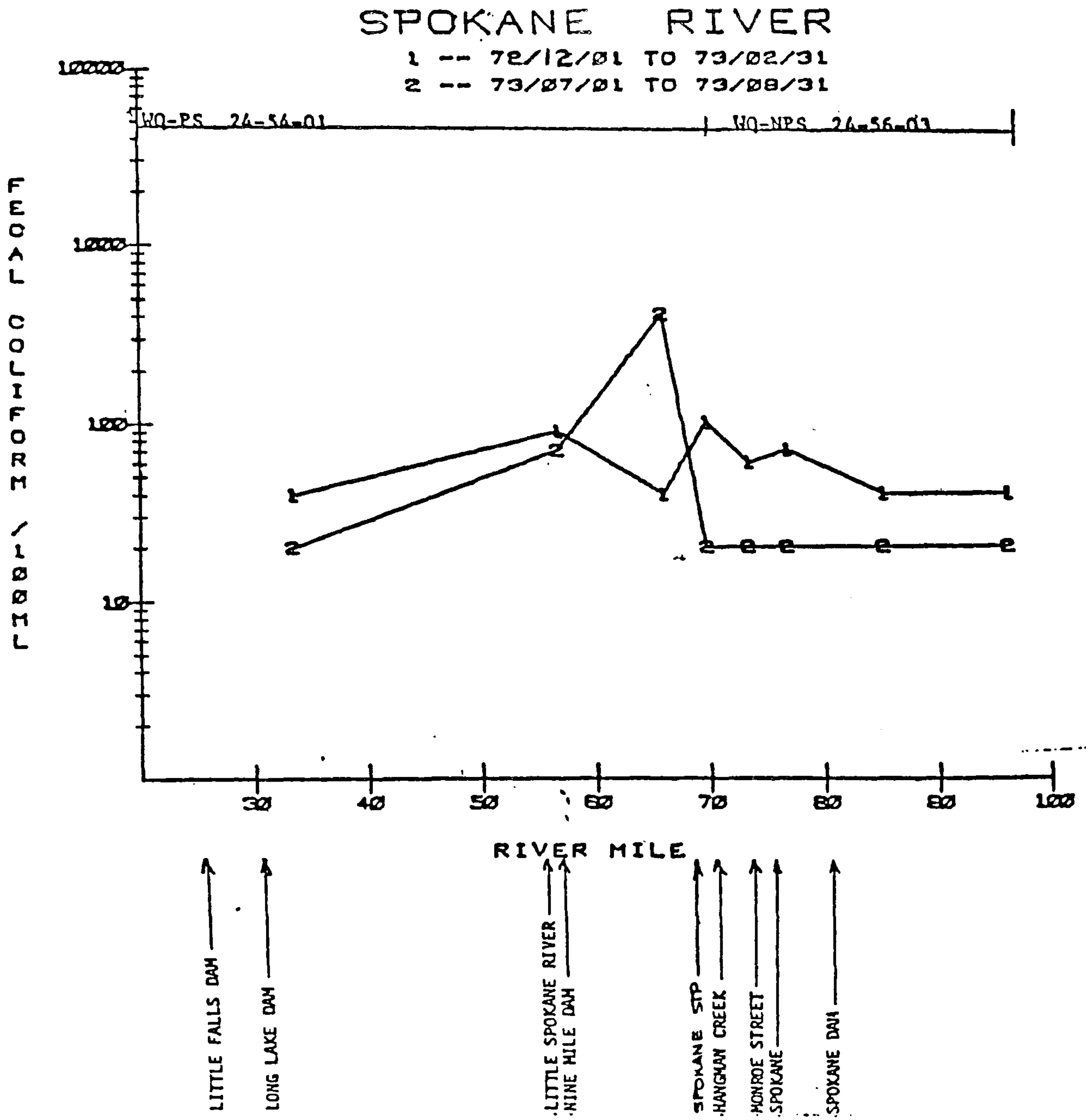


FIGURE CE-108



GRAPH SET NO. 8

Graph Set No. 8 and 9 examine the water quality conditions in Hangman Creek and the Little Spokane River respectively as these are the major tributaries to the mainstem of the Spokane River. These are indicative of the variability in trends, problem areas, and the general status of their waters.

FIGURE CE-109

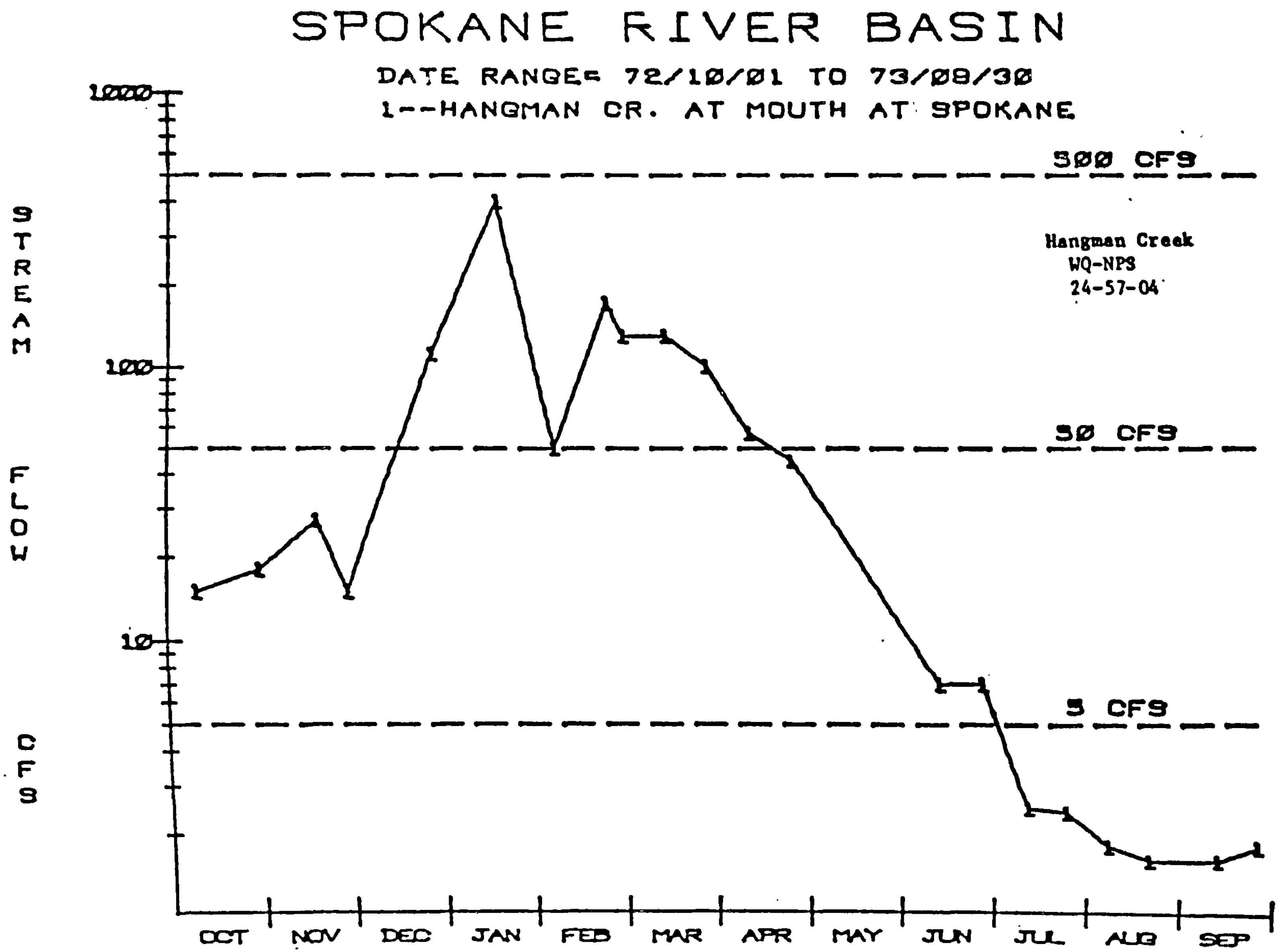


FIGURE CE-110

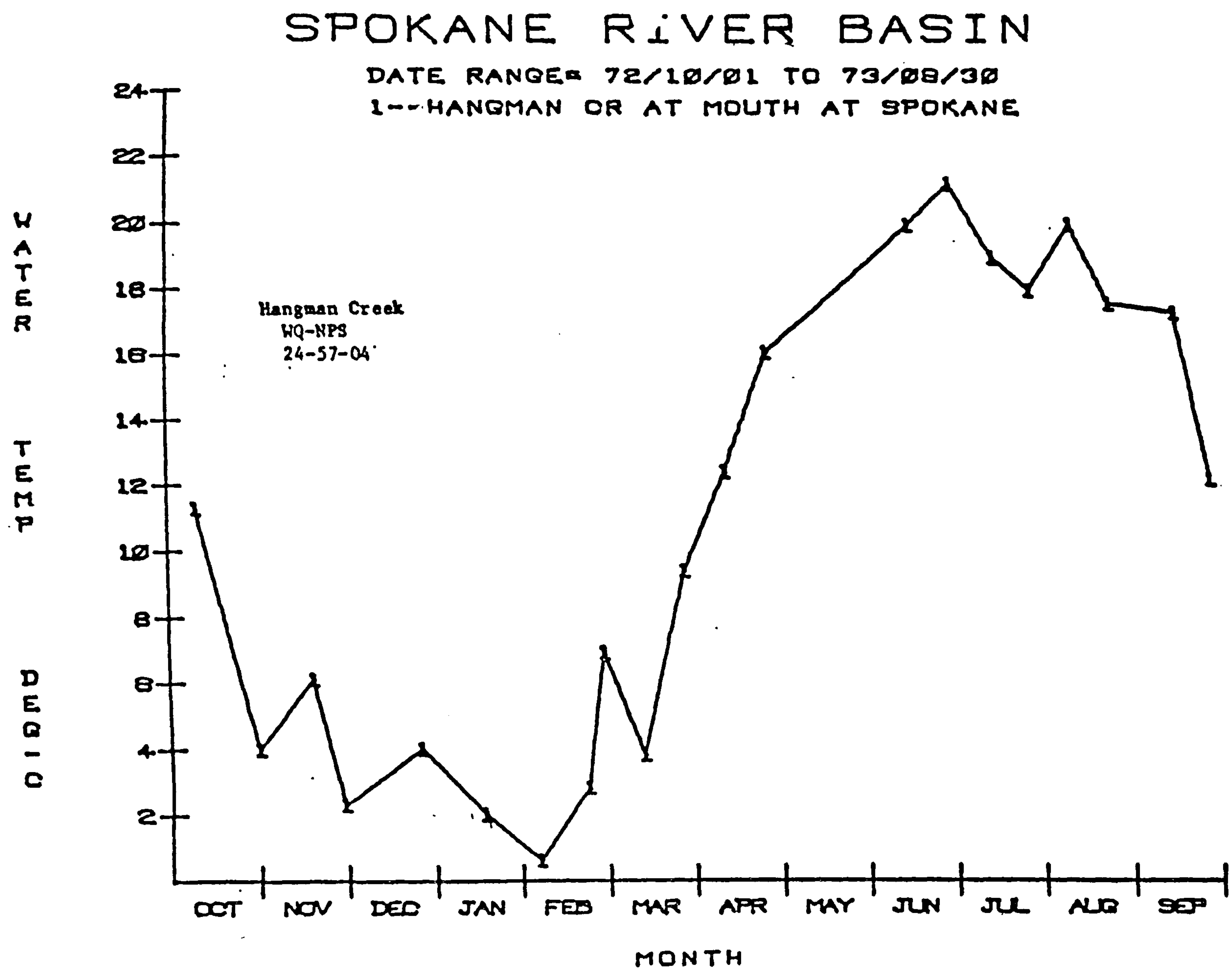


FIGURE CE-111

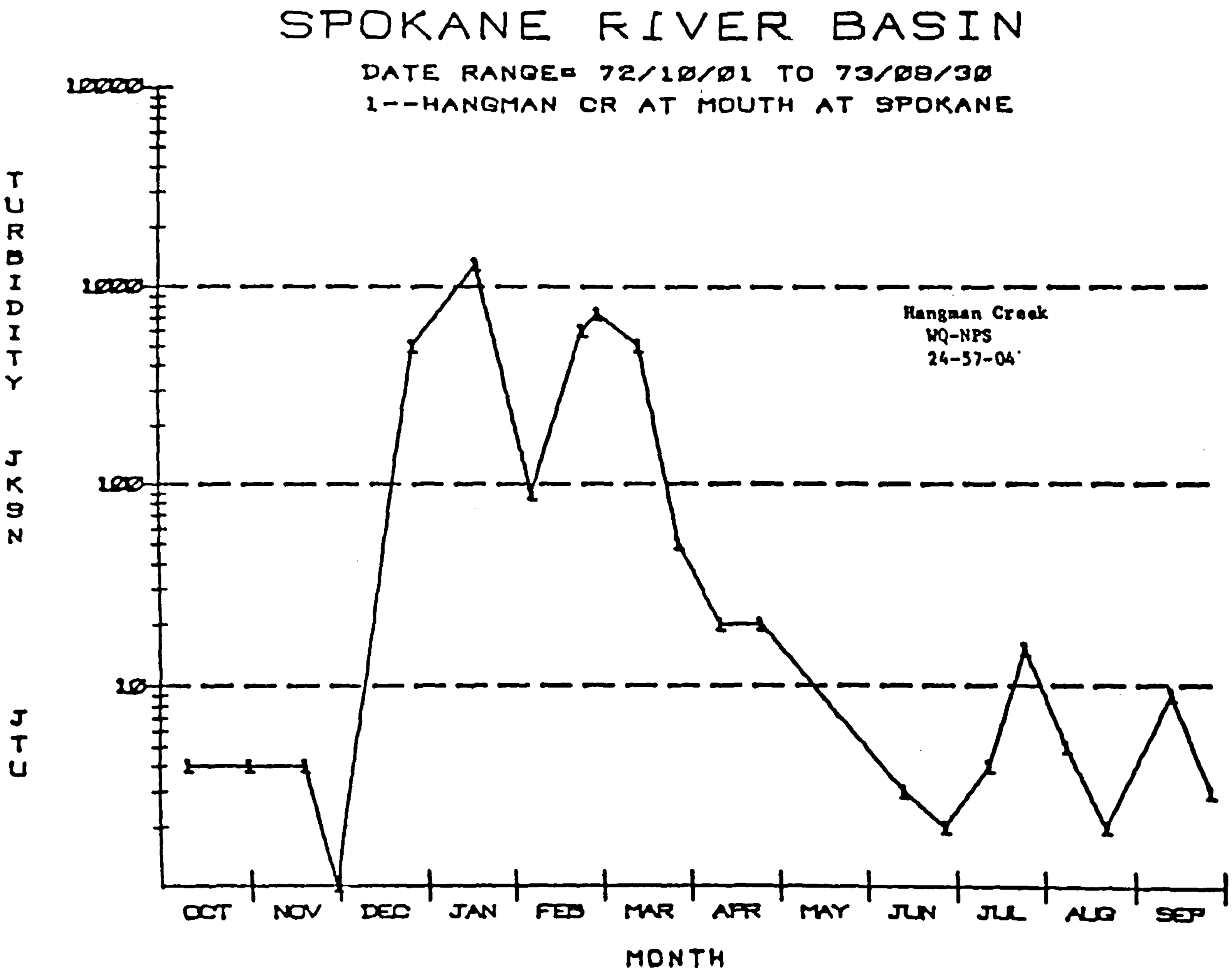


FIGURE CE-112

SPOKANE RIVER BASIN

DATE RANGE= 72/10/01 TO 73/09/30

1--HANGMAN CR AT MOUTH AT SPOKANE

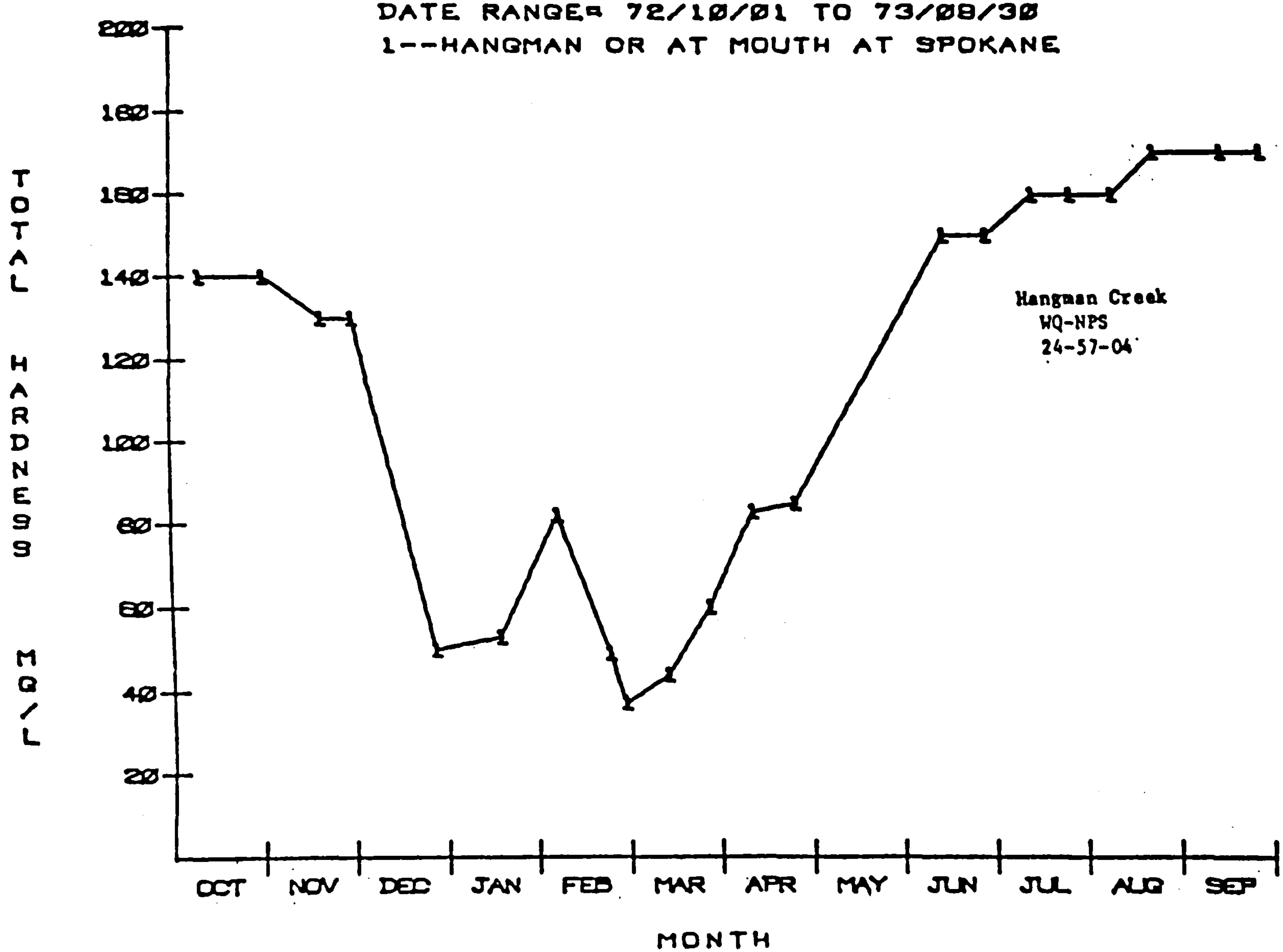


FIGURE CE-113

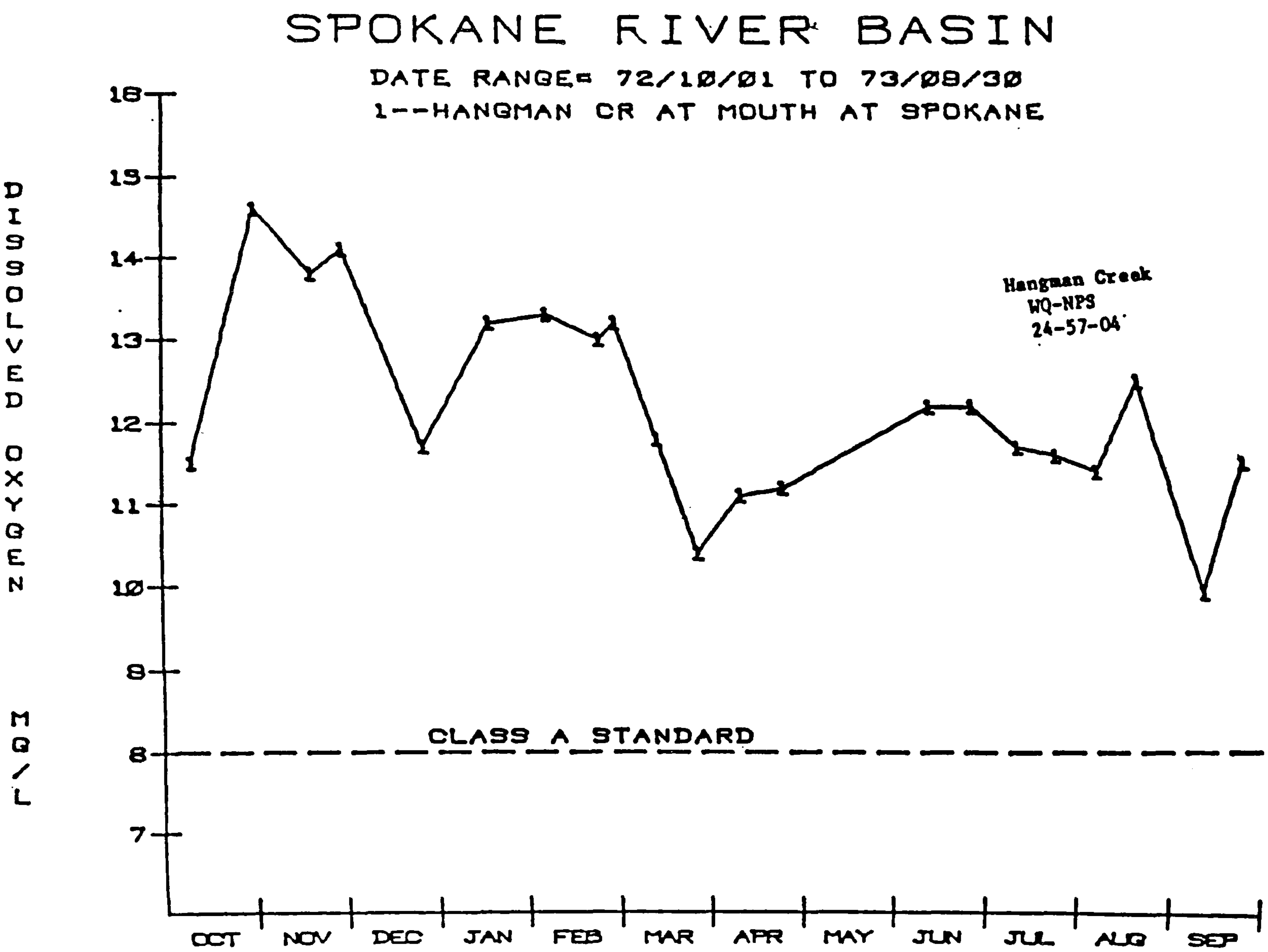


FIGURE CE-114

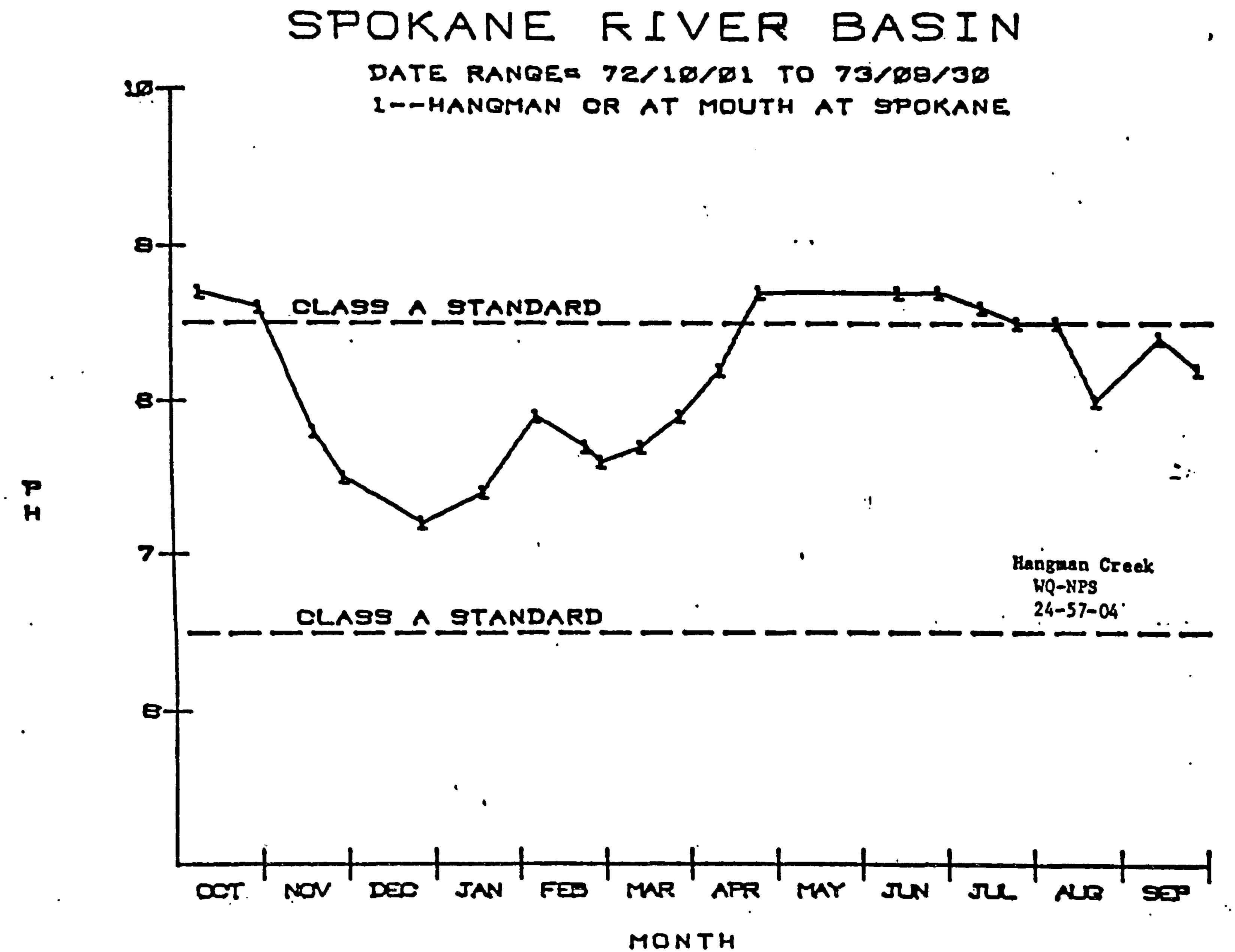


FIGURE CE-115

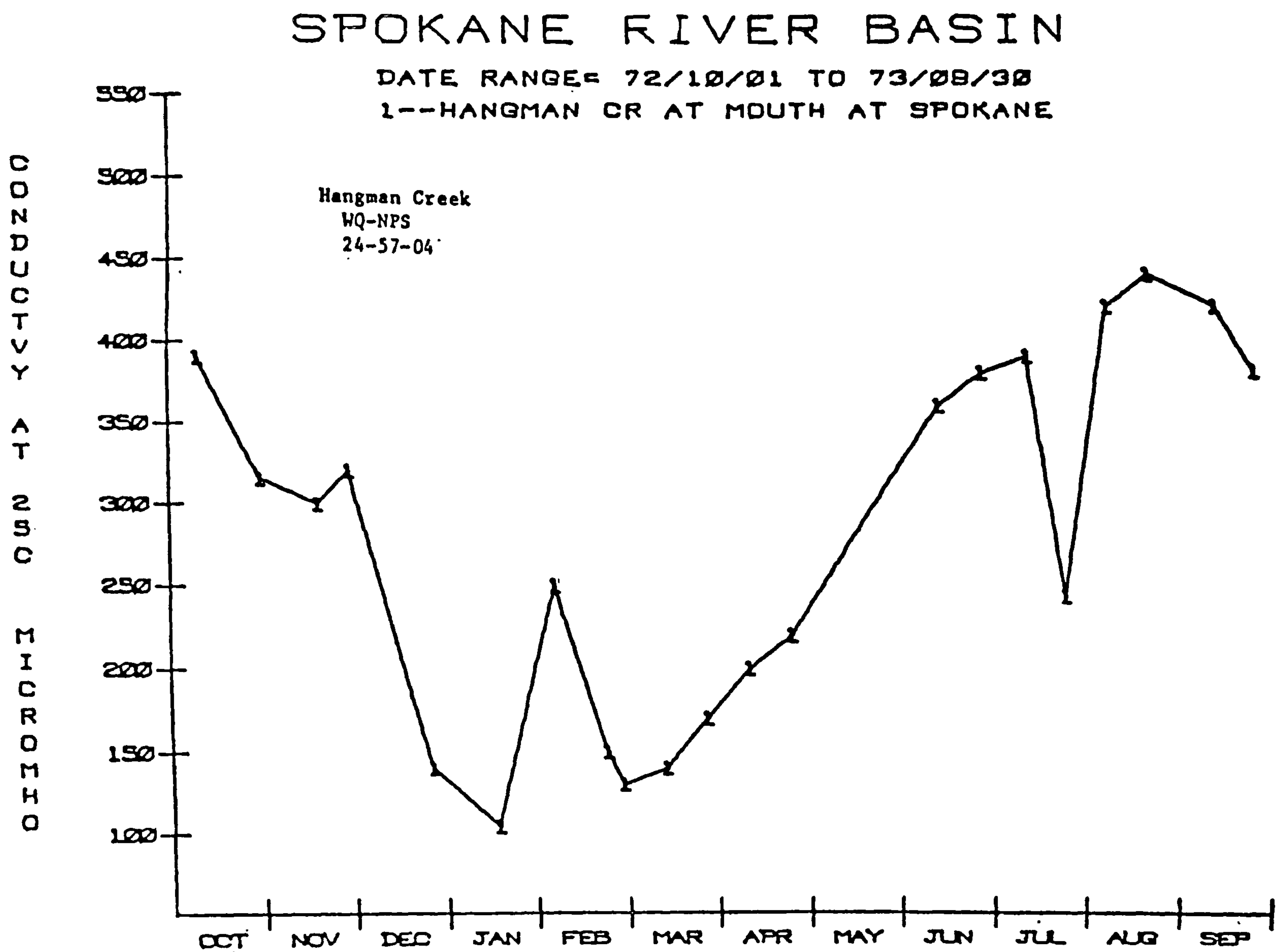


FIGURE CE-116

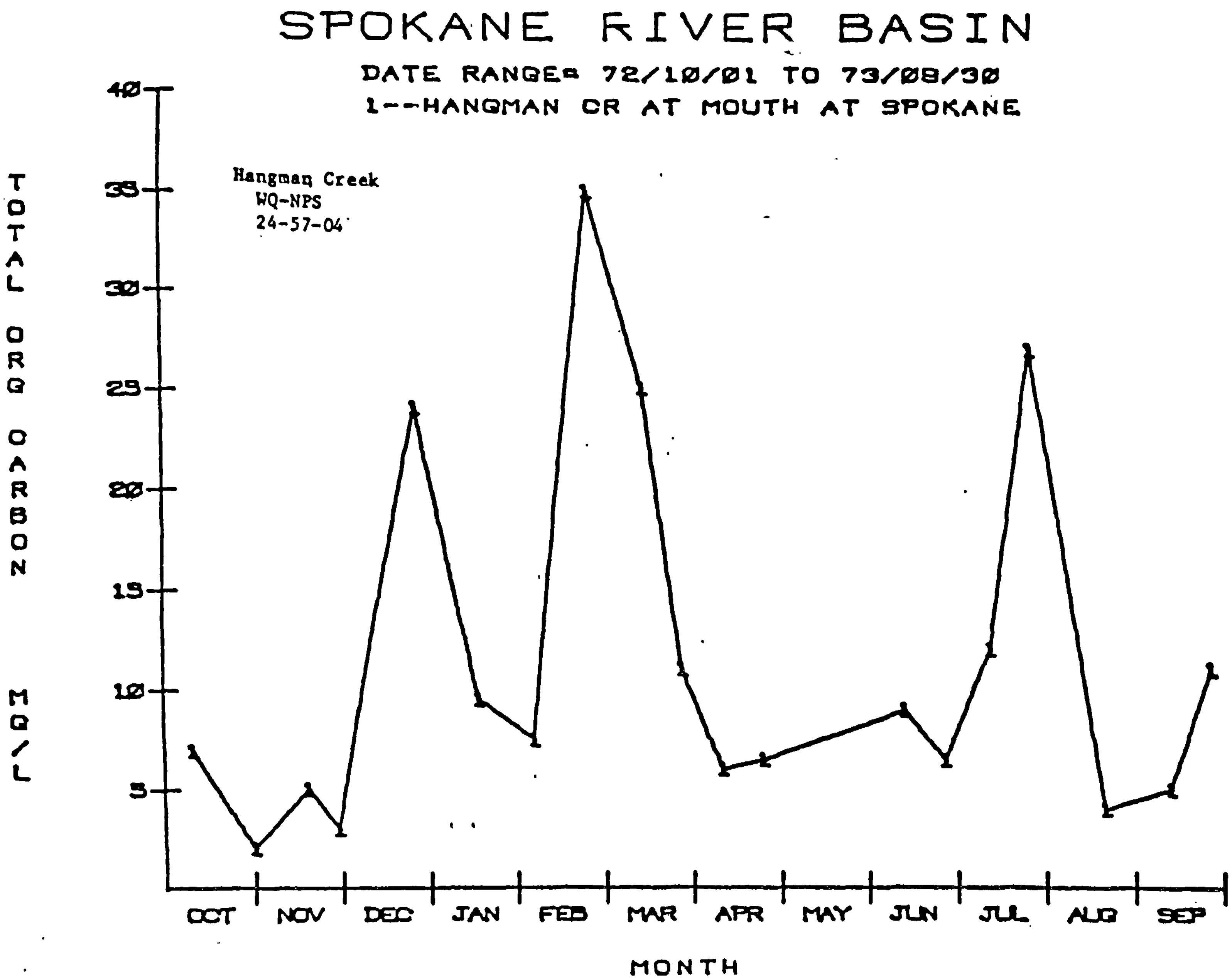


FIGURE CE-117

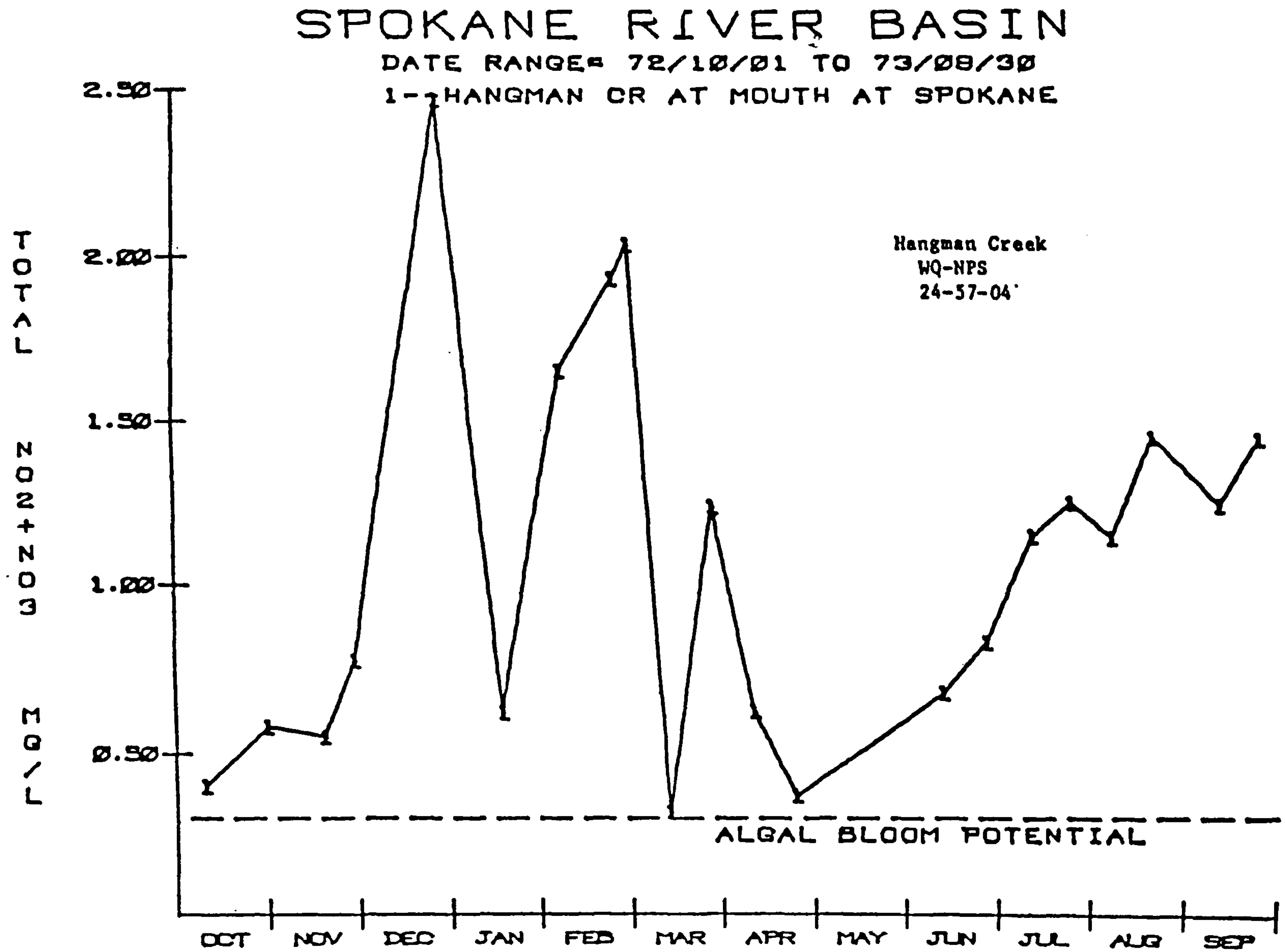
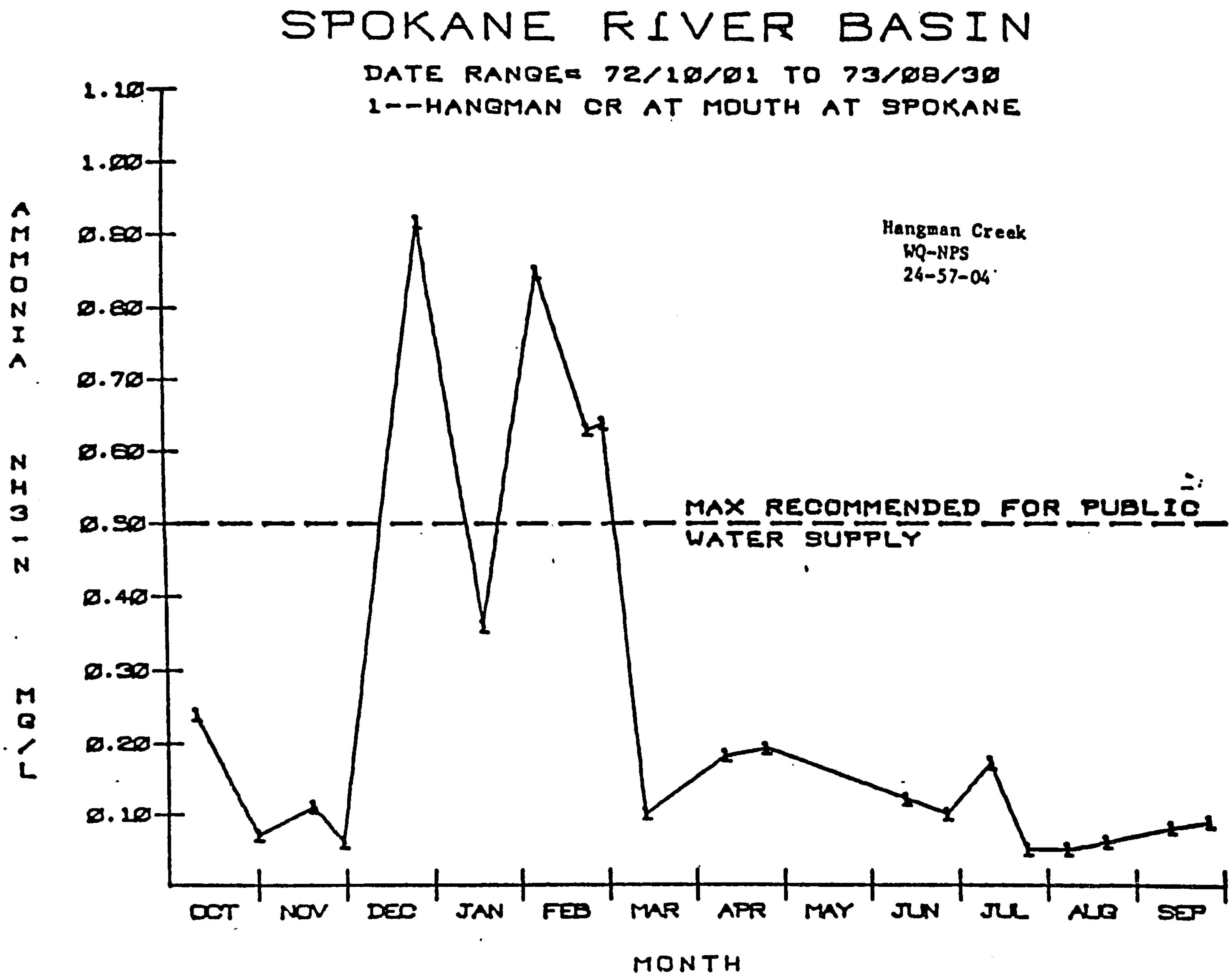


FIGURE CE-17



SPOKANE RIVER BASIN
DATE RANGE= 72/10/01 TO 73/08/30
1--HANGMAN CR AT MOUTH AT SPOKANE
AMMONIA NH3-N MG/L
1.10
1.00
0.90
0.80
0.70
0.60
0.50
0.40
0.30
0.20
0.10
Hangman Creek
WQ-NPS
24-57-04
MAX RECOMMENDED FOR PUBLIC
WATER SUPPLY
OCT
NOV
DEC
JAN
FEB
MAR
APR
MAY
JUN
JUL
AUG
SEP
MONTH

FIGURE CE-119

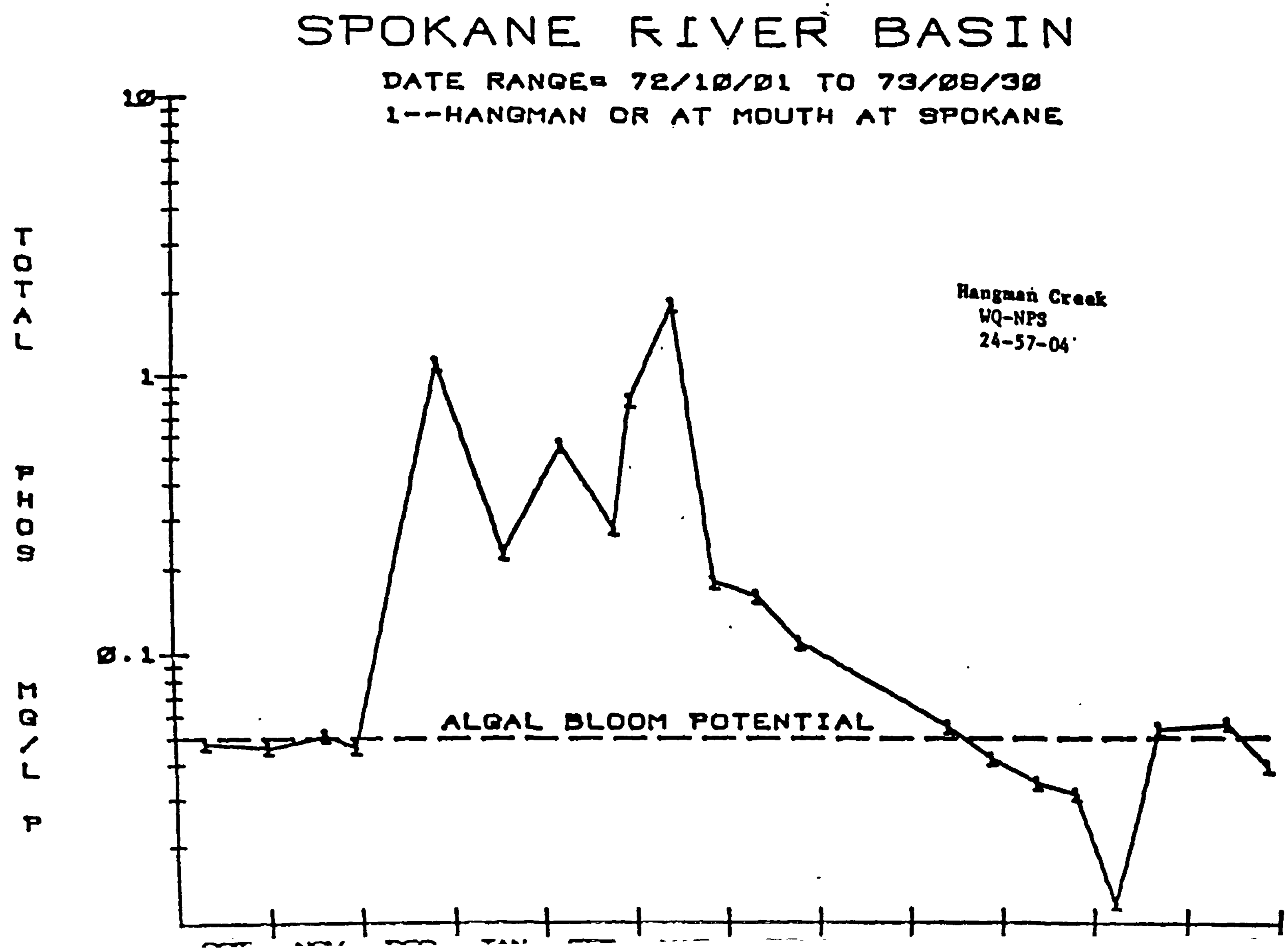


FIGURE CE-120

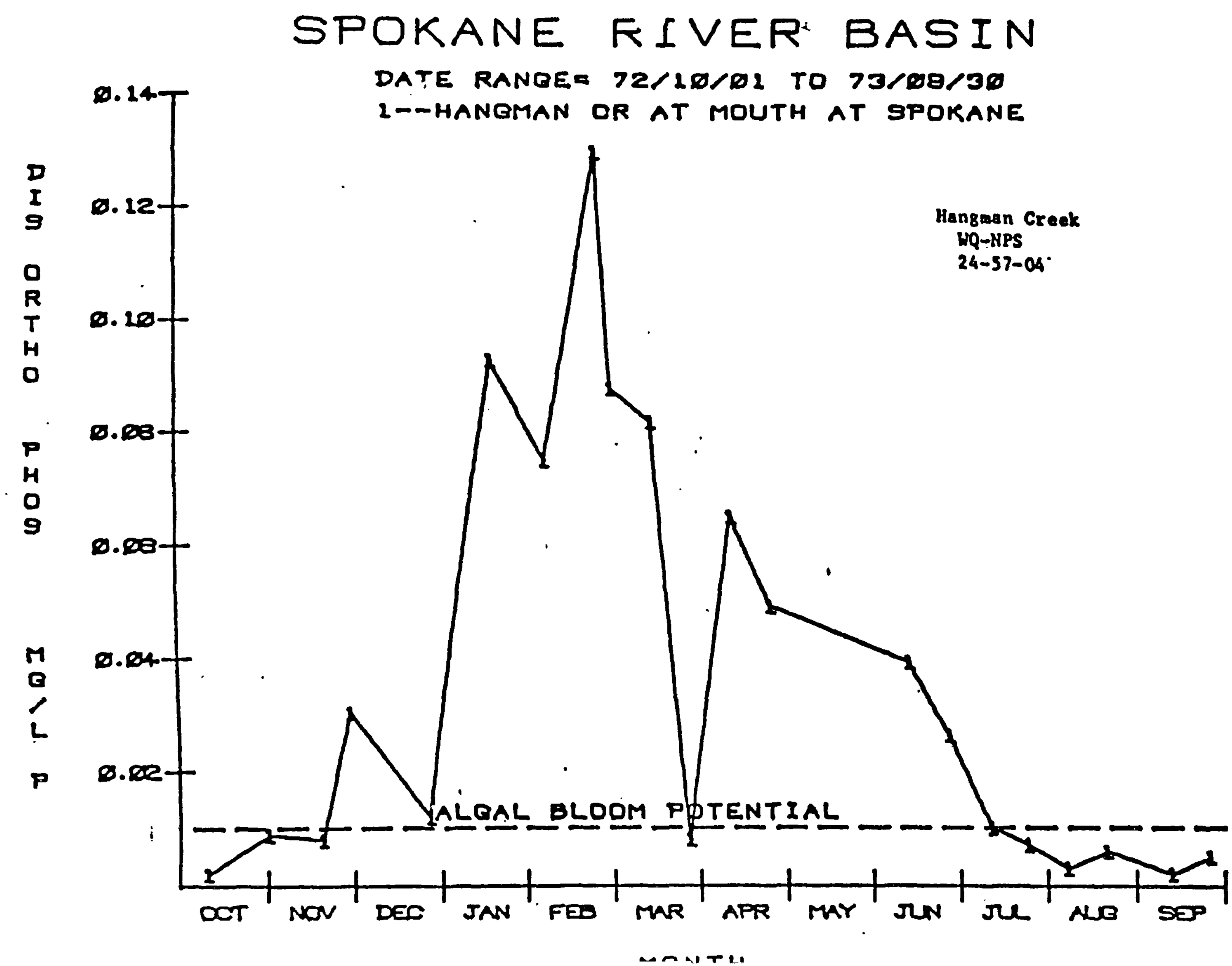


FIGURE CE-121

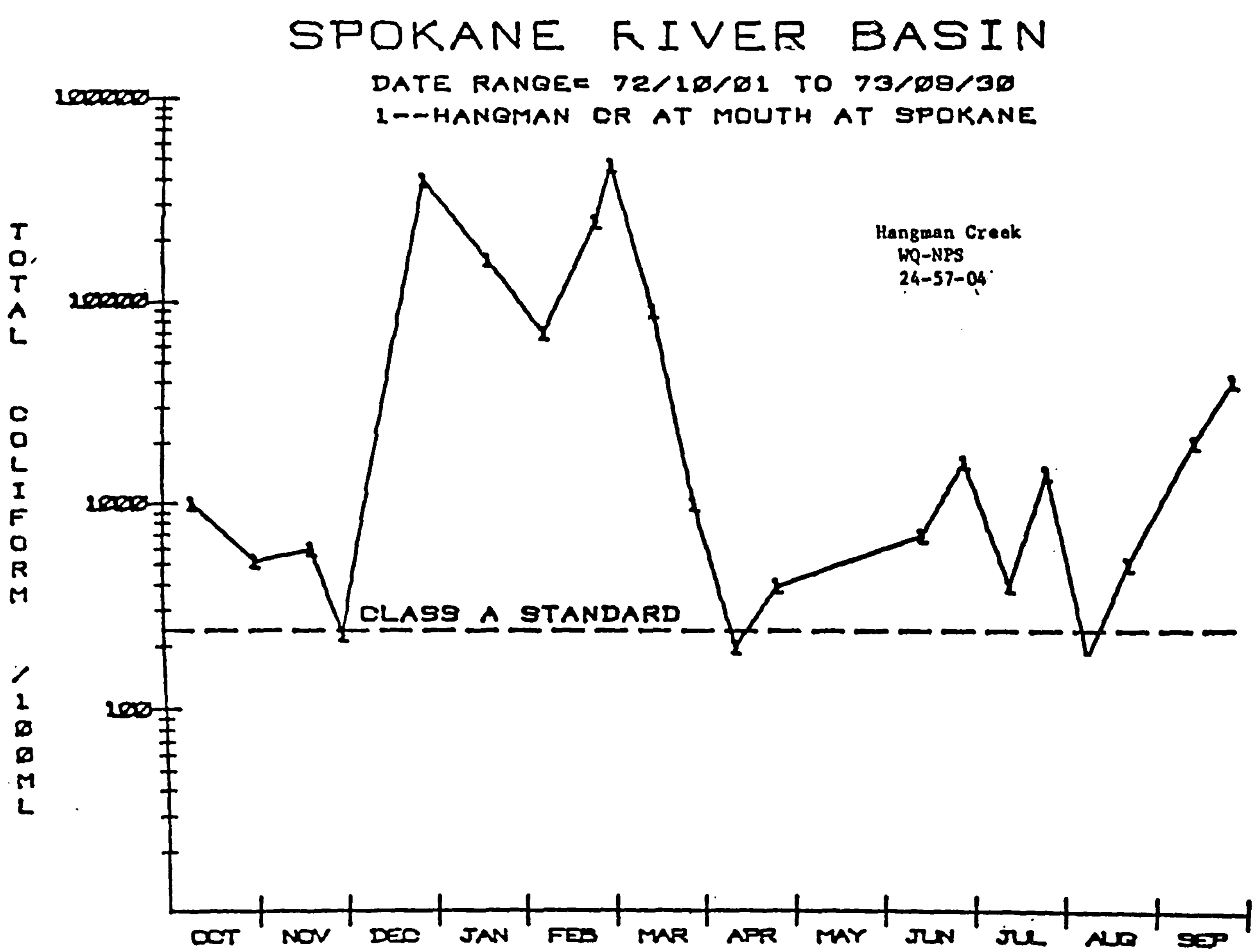
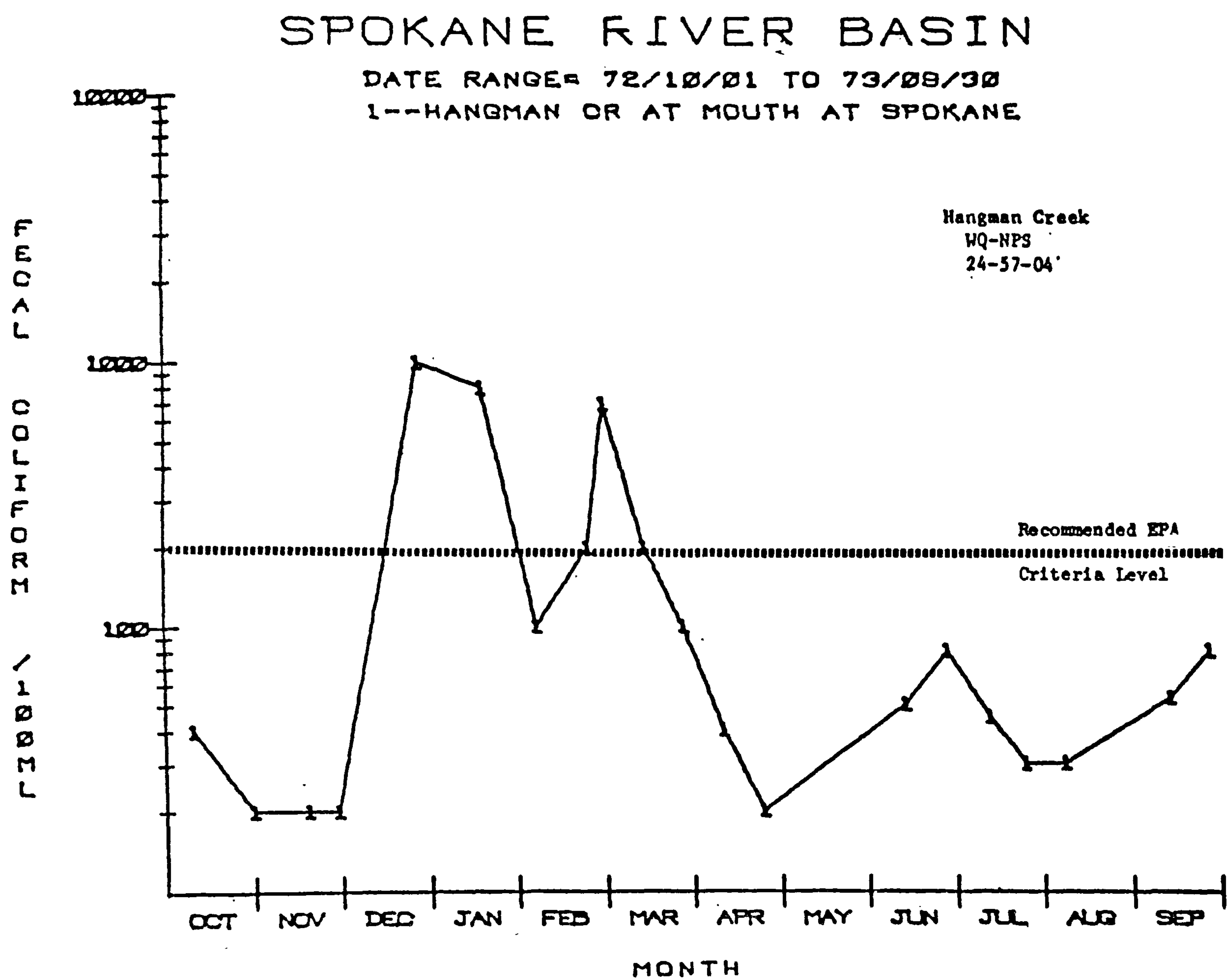


FIGURE CE-122



GRAPH SET NO. 9

LITTLE SPOKANE RIVER

FIGURE CE-123.

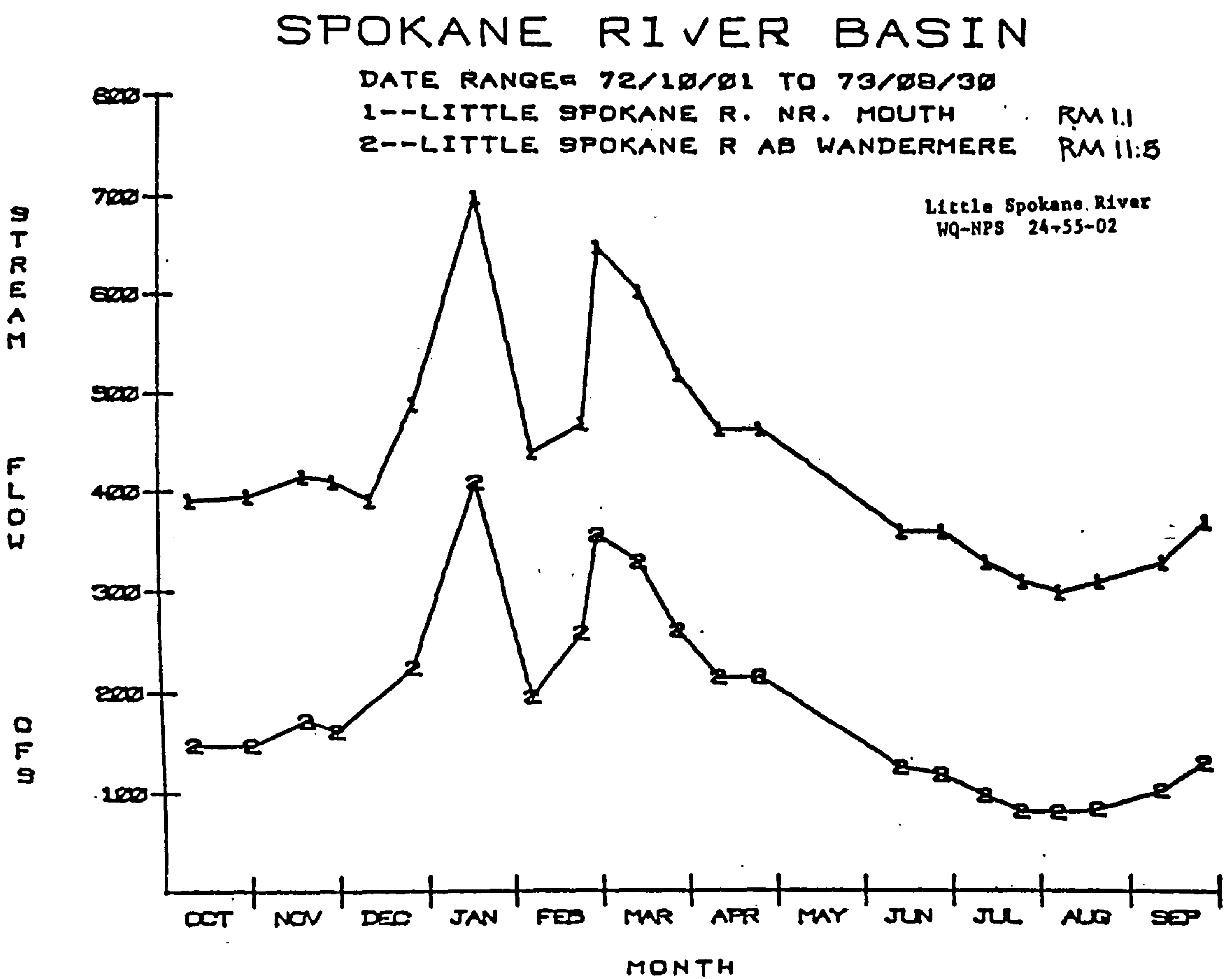


FIGURE CE-124

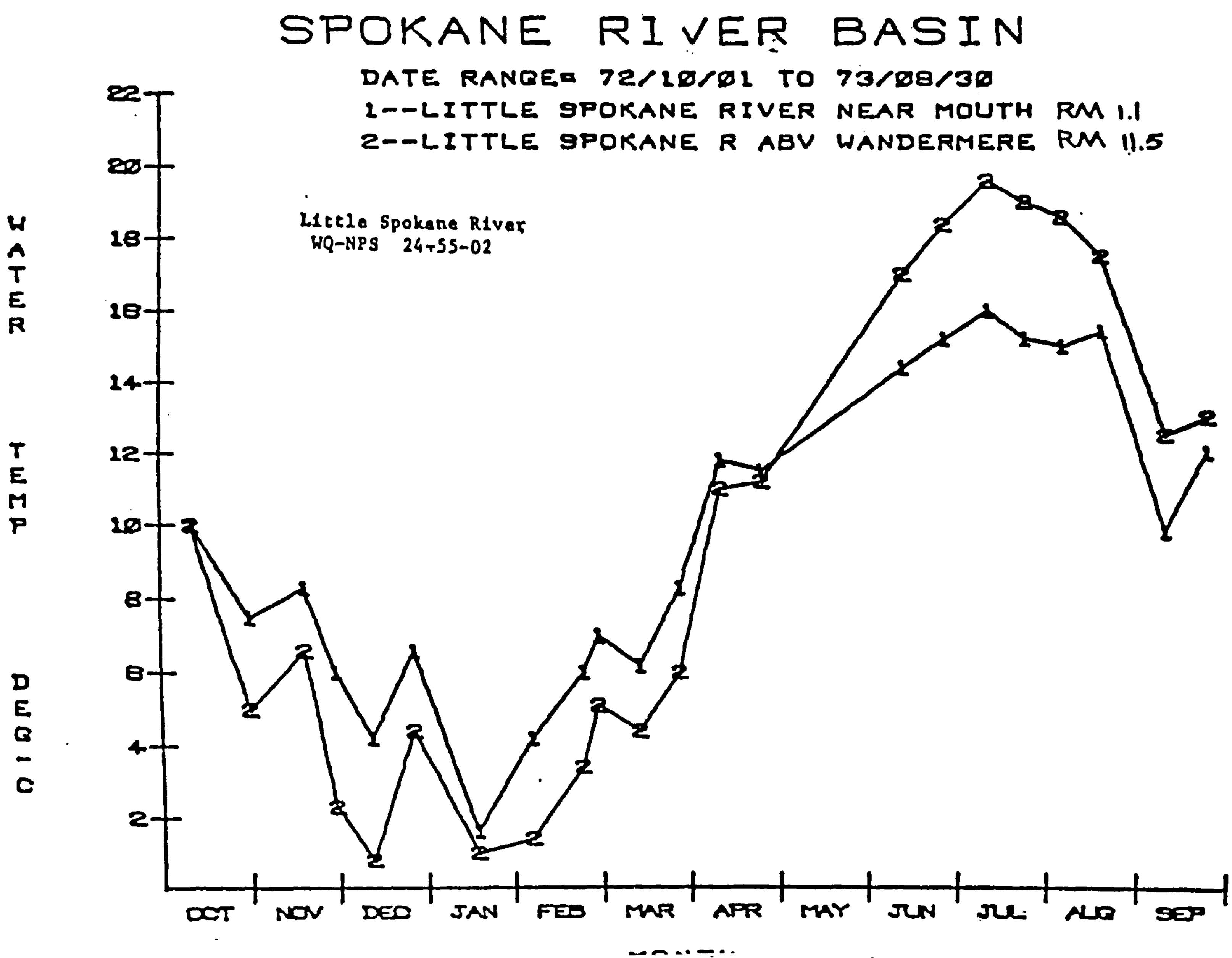


FIGURE CE-125

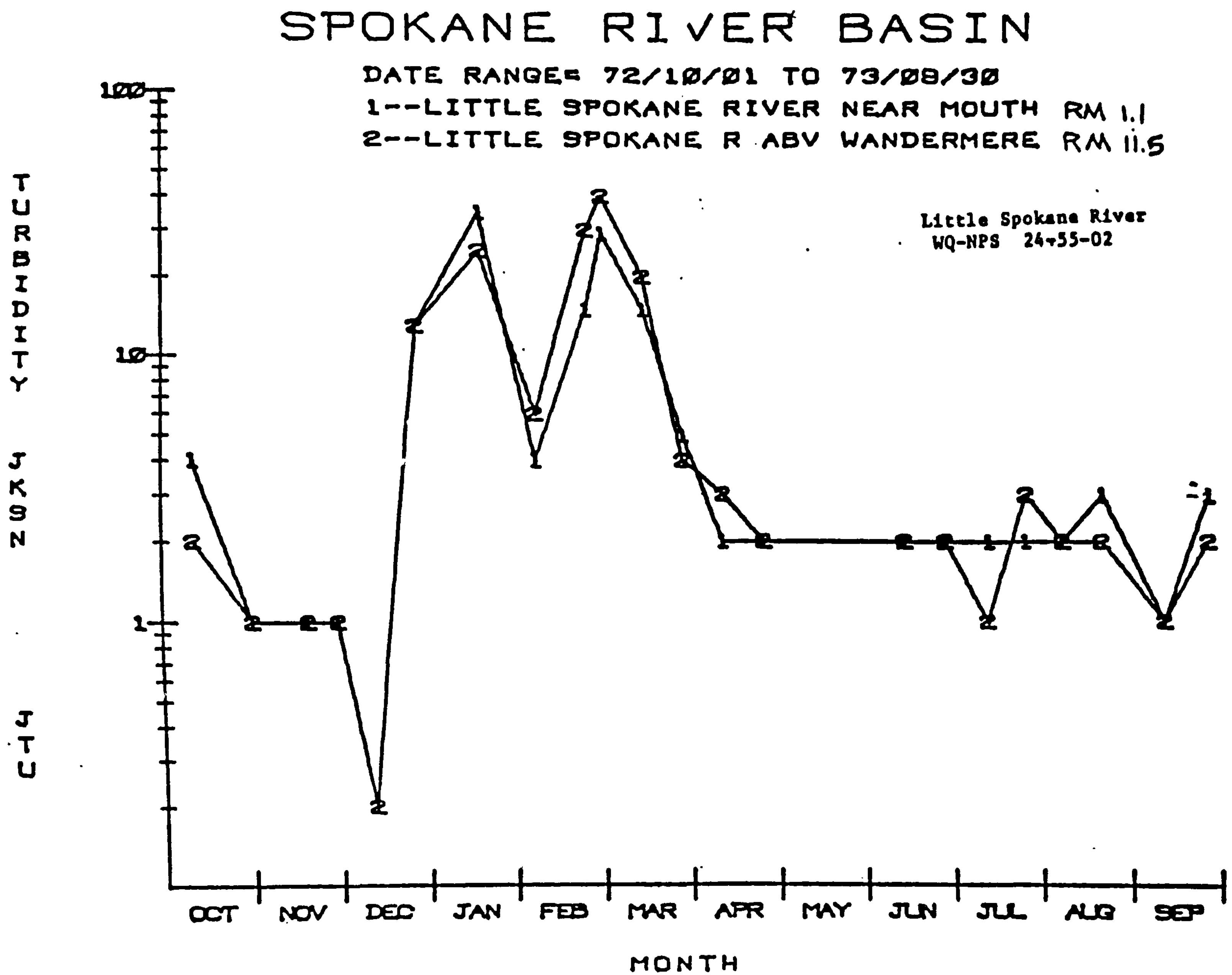


FIGURE CE-126.

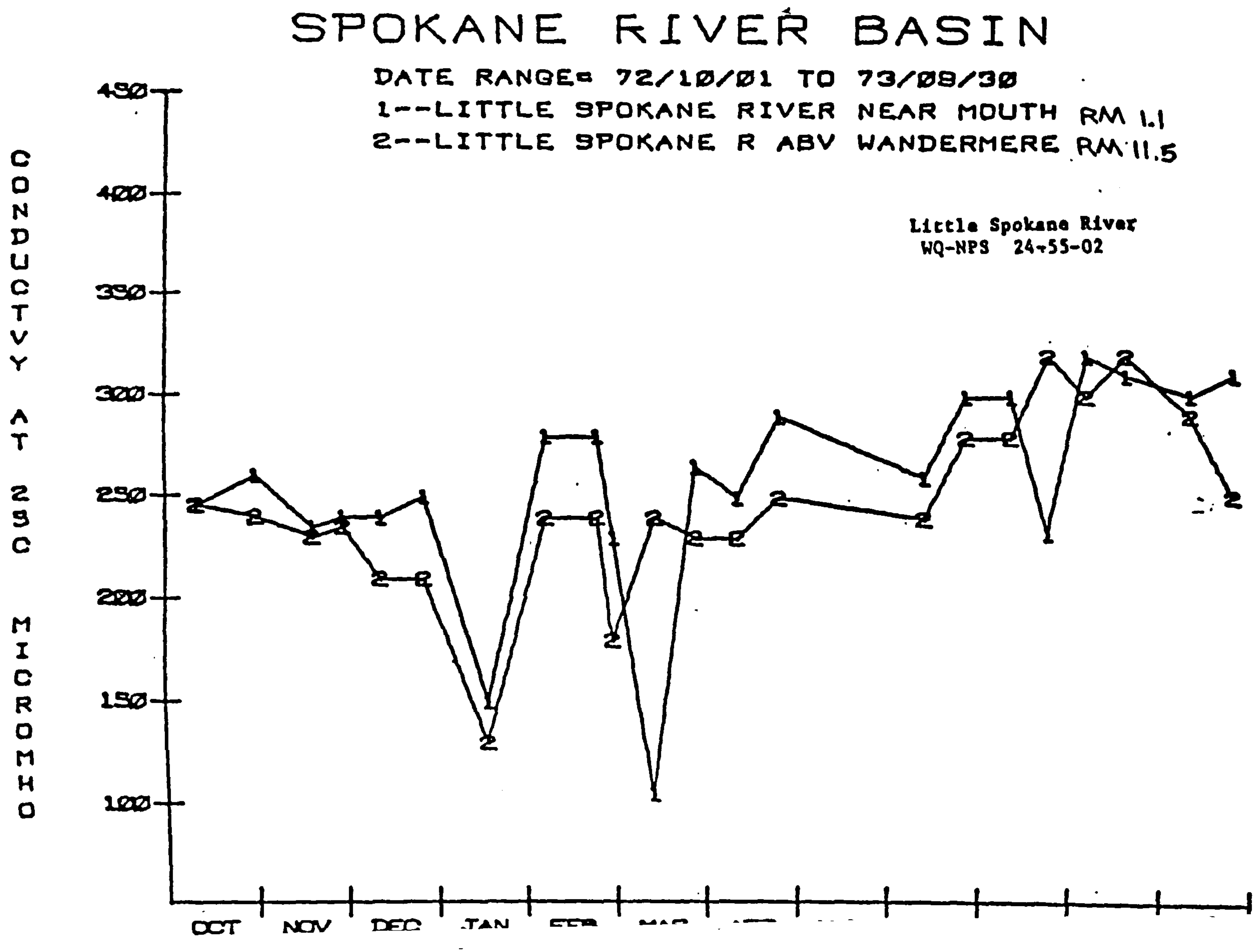


FIGURE CE-127

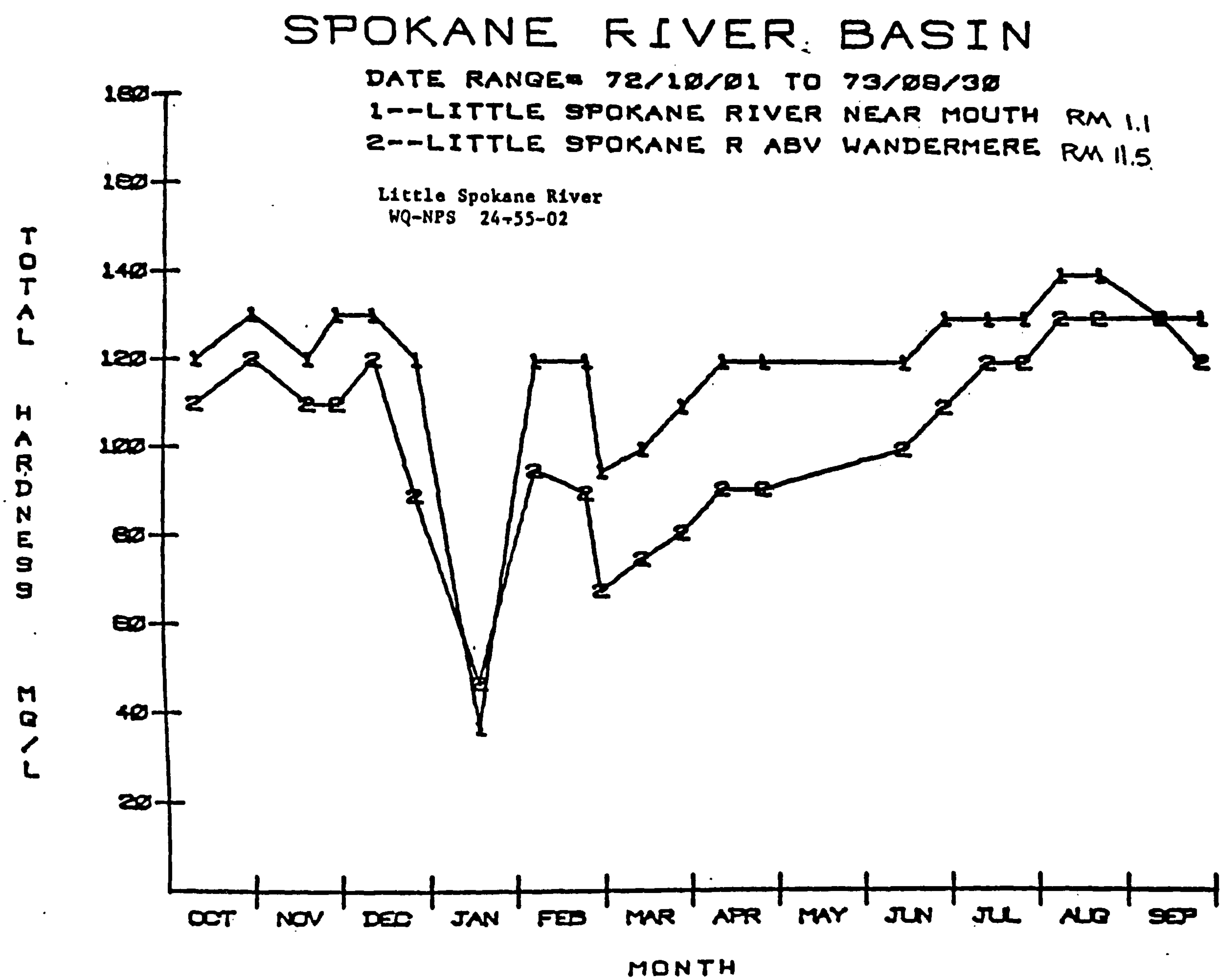


FIGURE CE-128

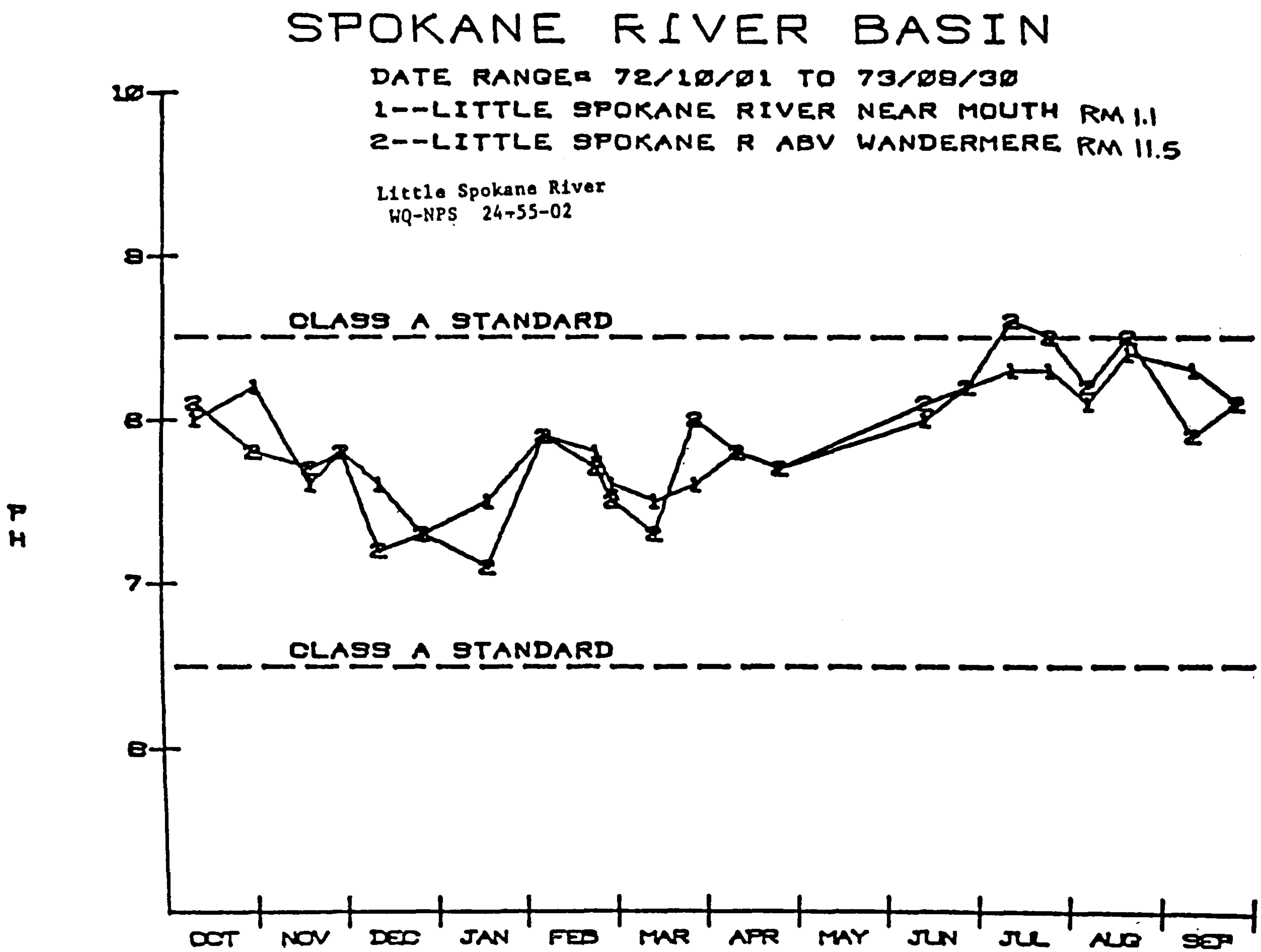


FIGURE CE-129

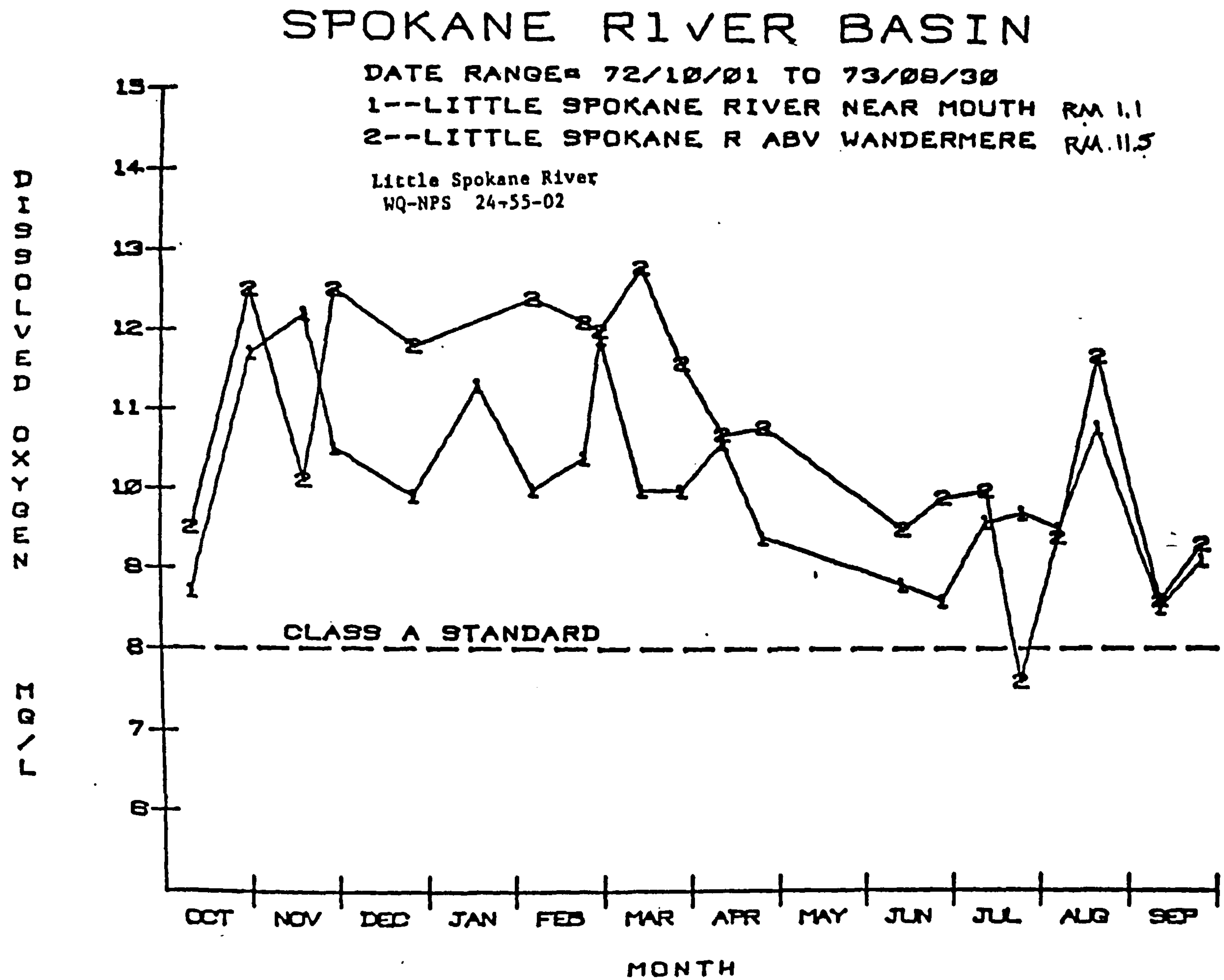


FIGURE CE-130

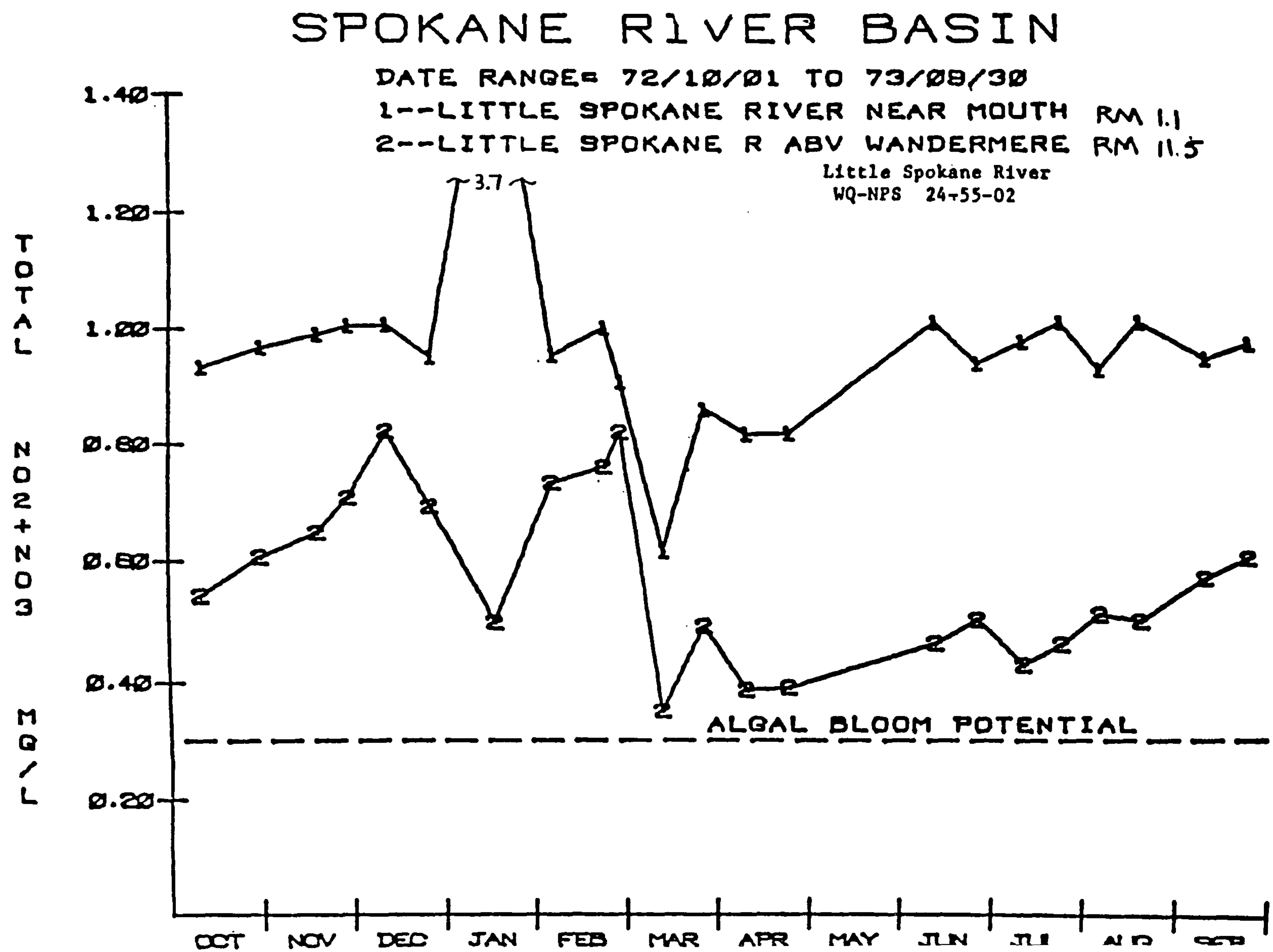


FIGURE CE-131

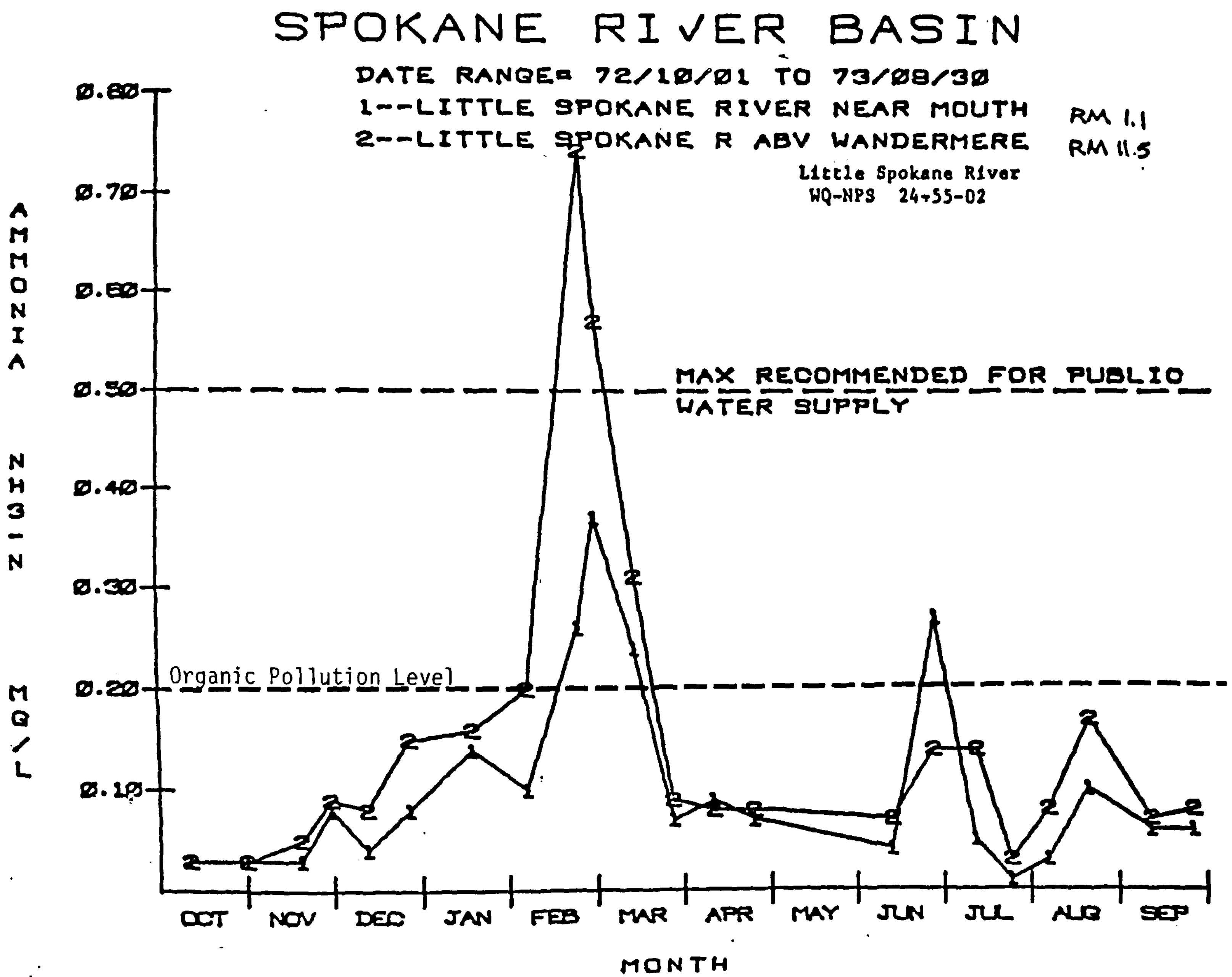


FIGURE CE-132.

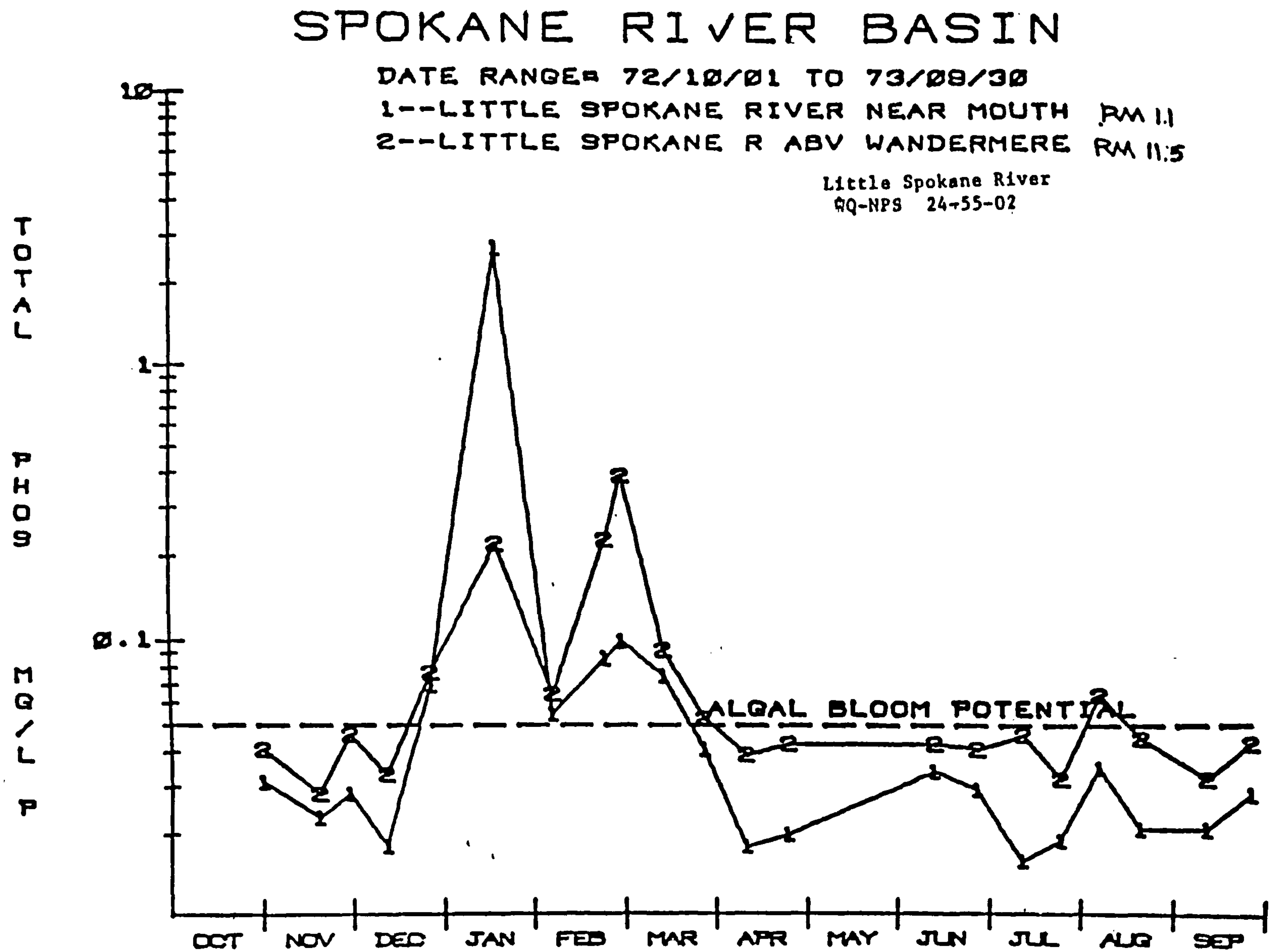


FIGURE CE-133

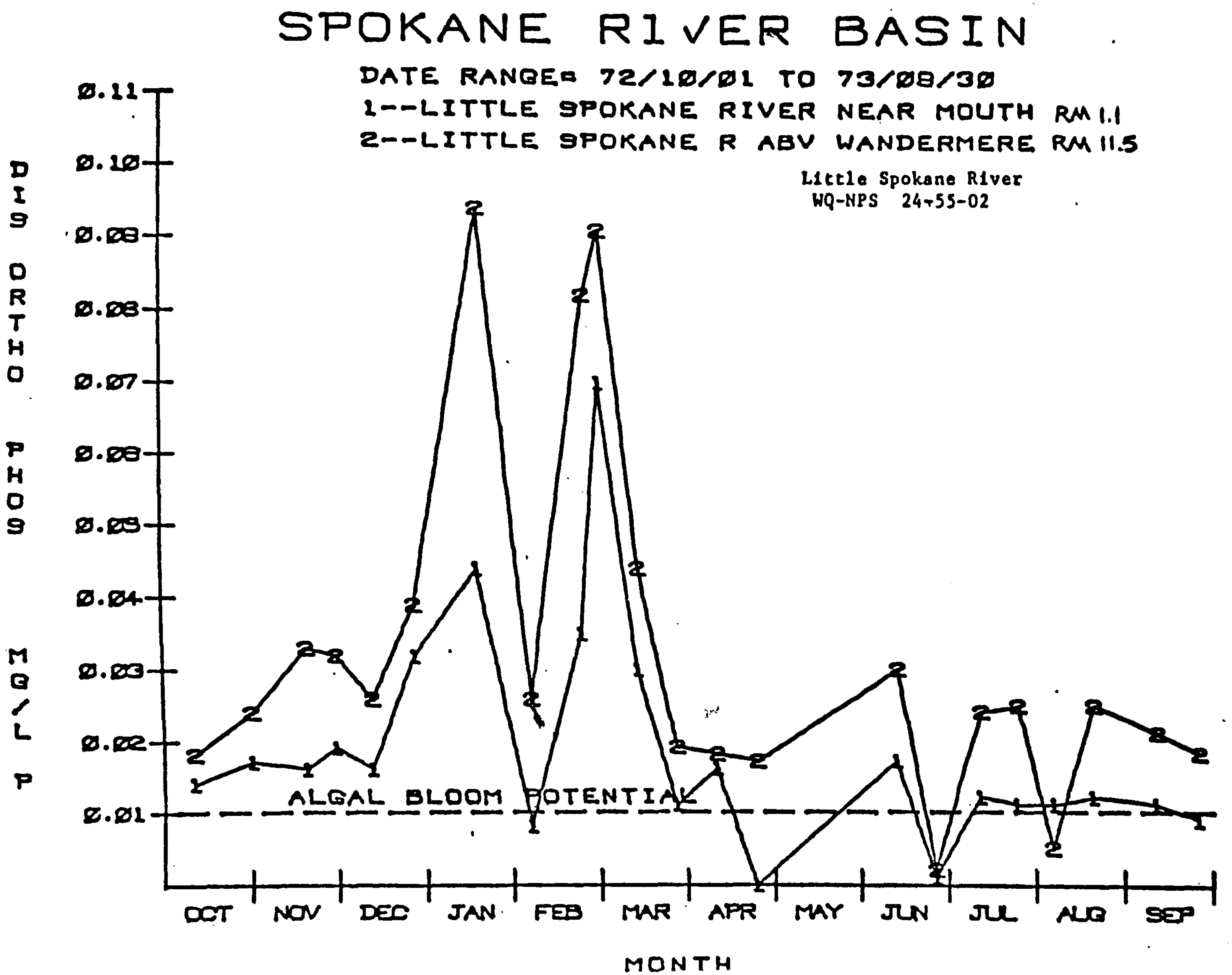


FIGURE CE-134

SPOKANE RIVER BASIN

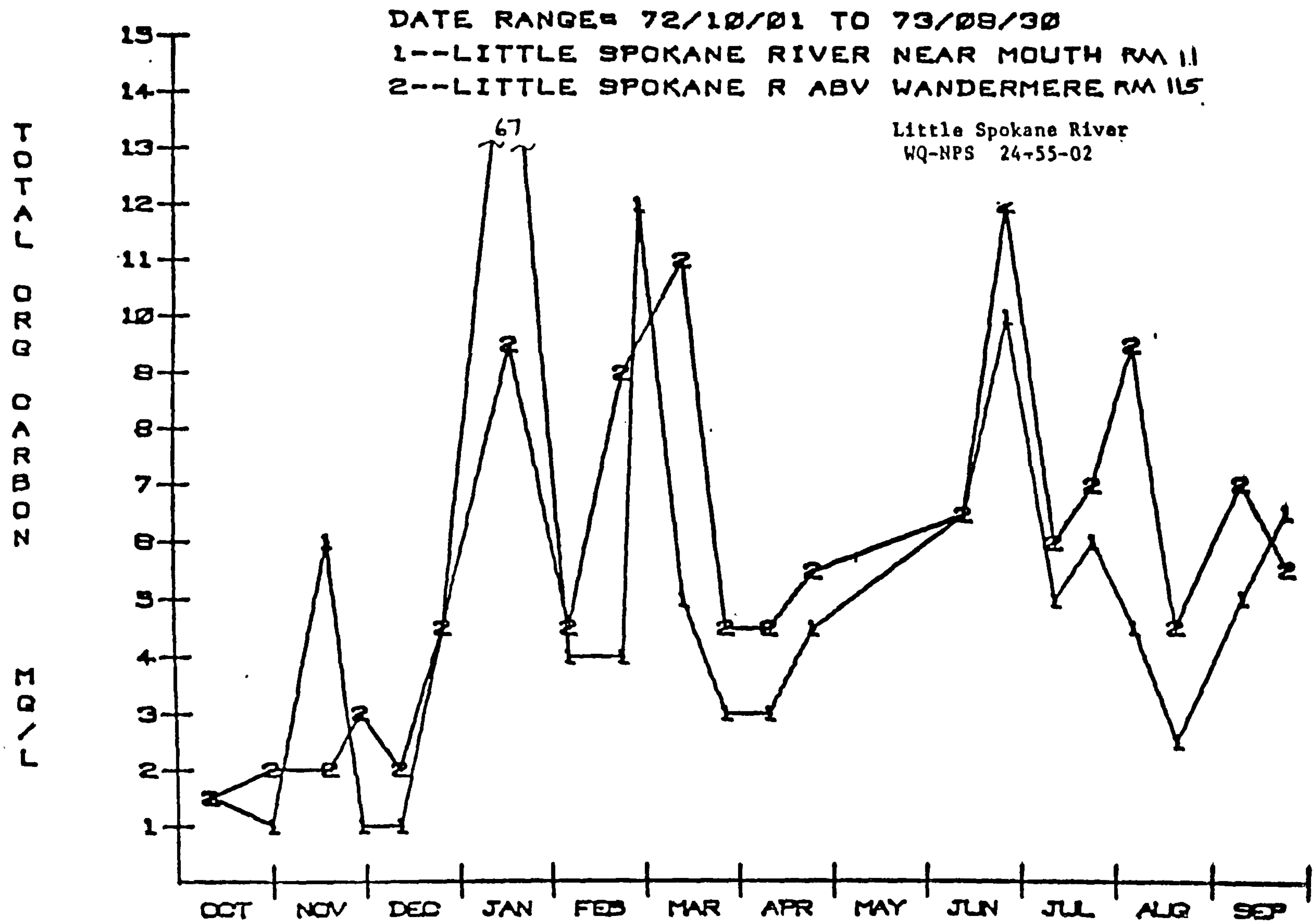


FIGURE CE-135

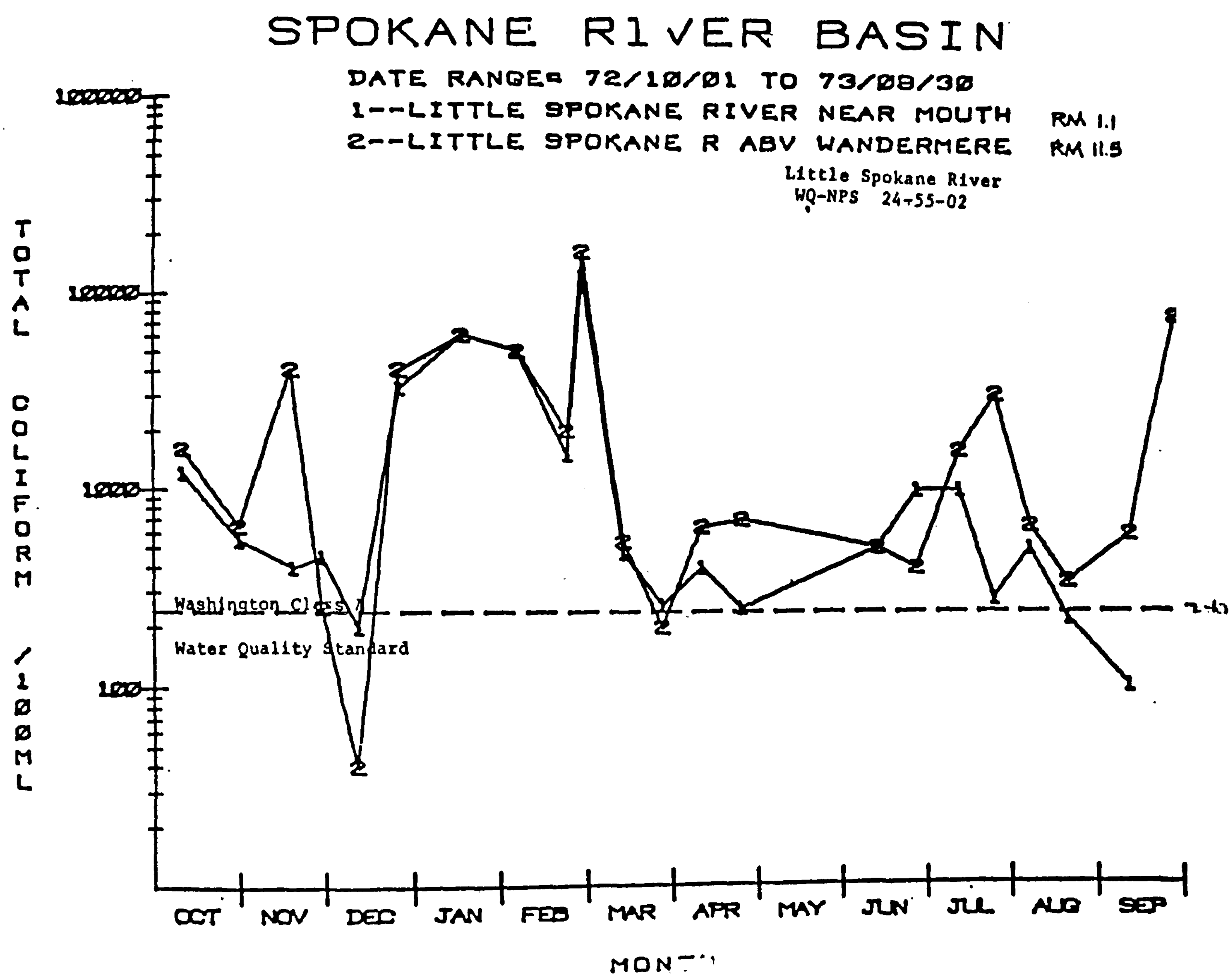


FIGURE CE-136