GRAPHICAL REPRESENTATIONS OF CERTAIN METALS AND ORGANICS CONCENTRATIONS IN RELATION TO FLOW RATES AND SAMPLING TIMES FOR SOME OF THE RIVERS IN DISTRICT 6

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INTRODUCTION

The aim of this report is to establish a link between certain metals and organic compounds and the factors that may influence their concentration. The factors considered are flow rate and the time of sampling for the river Wandle, the Beverley Brook, the Ravensbourne and the tidal Thames.

The data used has been collated over the period January 1986 to September 1990.

RESULTS DESCRIPTION

1. Variation of concentrations with flow in the Beverley Brook at Priests Bridge

1.1 Zinc concentrations variation with flow (Fig.1)

From the results the majority of samples were taken at flows between 0.3 m^3s^{-1} to 1.1 m^3s^{-1} and Zinc concentrations of 0.033 ugl^{-1} to 0.103 ugl^{-1}. Of the three samples taken at times of flow greater than 1.2 m^3s^{-1} there appears to be no relationship between zinc concentration and flow, reflecting the pattern of the results overall.

1.2 HCH γ concentration variation with flow (Fig.2)

Sampling took place at times of relatively low flow (0.03 to 1.1 m^3s^{-1}) where HCH concentrations varied between 0.035 to 0.2 ugl^{-1}. However, there appears to be no obvious affiliation between the parameters.

1.3 Dieldrin concentration variation with flow (Fig.3)

Over the period 9.2.88 to 8.8.90, 21 samples were analysed for dieldrin concentration. The flow rates at the times of sampling fluctuated between 0.4 to 0.13 m^3s^{-1}. Dieldrin concentrations loosely increased with the flow rate from 0.001 to 0.02 ugl^{-1}.

1.4 Trichloroethene concentration variation with flow (Fig.4)

All of the nine samples taken for Trichloroethene analysis from 11.12.89 to 8.8.90 were taken when the flow rate ranged from 0.3 to 0.86 m^3s^{-1}. The trichloroethene concentrations varied from 0.1 to 0.3 ugl^{-1} with one exceptionally high value at 4.2 ugl^{-1}. Overall there appears to be no obvious relationship between flow and concentration.

2. Variation of concentration with flow in the Ravensbourne at Deptford Bridge

2.1 Zinc concentration variation with flow (Fig.5)

The majority of the 23 samples taken for zinc analysis were taken at times of relatively low flow (0.1 to 0.55 m^3s^{-1}) where zinc concentration ranged from 0.01 to 0.054 mgl^{-1} in no particular arrangement. The two samples taken at flows of 0.61 and 1.14 m^3s^{-1} had zinc concentrations of 0.05 and 0.06 mgl^{-1} respectively. Overall the results appear to be of a random nature.

2.2 HCH γ concentration variation with flow (Fig.6)

From the 19 HCH γ samples taken, most occur in the 0.1 to 0.61 m^3s^{-1} flow range, with only two samples taken at flows greater than this. As in the case with zinc, there appears to be little or no correlation of HCH concentration to flow rate. However, the maximum concentration value of 0.077 ugl^{-1} occurs at 0.14 m^3s^{-1} and the joint minimum value of 0.001 ugl^{-1} at 1.14 m^3s^{-1}. Most of the concentrations of HCH γ at the low flows are less than 0.03 ugl^{-1}.

2.3 Dieldrin concentration variation with flow (Fig.7)

Dieldrin concentrations vary between 0.001 and 0.005 ugl^{-1} and appear unaffected by flow rates, remaining random in their distribution.

2.4 Trichloroethene concentration variation with flow (Fig.8)

Out of the eight samples taken, seven have concentrations of 0.1 ugl^{-1} at flow rates varying between 0.15 to 0.62 m^3s^{-1}. The only "outlier" result is a sample with a concentration of 0.3 ugl^{-1} at a flow rate of 0.13 m^3s^{-1}.

3. Variation of concentration with flow in the Thames at Teddington

3.1 Zinc concentration variation with flow (Fig.9)

The trend in zinc concentration with flow is one of an even distribution of concentration values throughout the range of flows. The majority of samples had concentrations varying between 0.01 to 0.03 mgl^{-1}, but at both ends of the flow range (4 - 334 m^3s^{-1}) higher values did occur.

3.2 HCH γ concentration variation with flows (Fig.10)

The flow rates when sampling fluctuated between 4 to 334 m^3s^{-1} and the majority of samples were taken when flows were less than 100 m^3s^{-1}. HCH γ concentrations of the samples taken when flows were less than 100 m^3s^{-1}, varied mainly between 0.01 and 0.055 ugl^{-1}, however there were five samples which had concentrations exceeding 0.055 ugl^{-1}, the largest of which was 0.306 ugl^{-1}. Samples taken when flows exceeded 100 m^3s^{-1} showed far less variation in concentration (0.005 to 0.024 ugl^{-1}) and less samples were taken under these conditions.

3.3 Dieldrin concentration variation with flow (Fig.11)

Dieldrin concentrations remained constant with changes in flow, at a level of 0.005 ugl^{-1}. However, lower values, to a minimum of 0.001 ugl^{-1} were also recorded and their distribution was mainly random in relation to the different flow rates.

3.4 Trichloroethene concentration variation flow (Fig.12)

Trichloroethene concentration varied between 0.7 to 14 ugl^{-1} but values are mostly in the 1 - 3 ugl^{-1} range. The highest values of concentration occur at the lowest flows when most of the samples were taken. The three samples taken, when the flow rate exceeded 40 m^3s^{-1}, had values between 1 and 2 ugl^{-1}.

4. Variation of concentration with flow in the Wandle at the Causeway

4.1 Zinc concentration variation with flow (Fig.13)

The majority of sampling occurred during times of relatively low flow (between 1 and 3 cumecs), where zinc concentrations ranged between 0.003 to 0.143 mgl^{-1} plus two exceptionally high values of 0.493 and 0.465 mgl^{-1}. Only 7 of the 59 samples were taken when flows exceeded 3 cumecs with the zinc values ranging from 0.01 to 0.053 mgl^{-1}, plus one exceptionally high result of 0.29 mgl^{-1}.

4.2 HCH γ concentration variation with flow (Fig.14)

From the 29 samples taken between 14.12.87 and 8.8.90, 25 were taken between flow rates of 1.1 and 2.3 m^3s^{-1} and only 4 samples at flows greater than 2.3 m^3s^{-1}. The range of HCH γ concentrations obtained at flows between 1.1 and 2.3 m^3s^{-1} varied between 0.001 TO 0.2 ugl^{-1}, plus one exceptional value of 0.683 ugl^{-1} at 1.12 m^3s^{-1}. HCH γ concentration values at flows greater than 2.3 m^3s^{-1} deviated between 0.085 ugl^{-1} (at 3.64 m^3s^{-1}) and 0.15 ugl^{-1} (at 2.76 m^3s^{-1}), concentration therefore decreases with an increase in flow.

4.3 Dieldrin concentration variation with flow (Fig.15)

During the period 21.3.88 to 8.8.90, 21 samples were taken for Dieldrin analysis. The majority of sampling (19 samples) occurred at times of relatively low flow (1.2 - 2.24 m^3s^{-1}) and only two samples taken at greater flows (3.28 - 3.64 m^3s^{-1}). The Dieldrin concentration values at the flows between 1.2 and 2.24 m^3s^{-1} fluctuated between 0.001 to 0.018 ugl^{-1} with no apparent relationship between flow and Dieldrin concentration. At the greater flows the minimum result was 0.003 ugl^{-1} and at the lower flows the maximum result was 0.005 ugl^{-1}.

4.4 Trichloroethene concentration variation with flow (Fig.16)

From the results it appears that Trichloroethene concentration increases with flow, the lowest value of 0.1 ugl^{-1} is recorded at flows of between 1.1 and 1.5 cumecs with one of the highest values of 0.8 ugl^{-1} occurring at 2.24 cumecs. There is one high "outlier" value of 2.0 ugl^{-1} at 1.71 cumecs.

5. Variation of concentration with sampling time

5.1 Variation of Nickel concentration with sampling time In the Wandle at the Causeway (Fig.17)

All sampling took place between 10.00 hours and 16.30 hours. The minimum Nickel concentration recorded was 0.005 mgl^{-1} and the maximum concentration was 0.044 mgl^{-1}. Most of the samples taken had a concentration of 0.01 mgl^{-1} and all values appeared to be independent of the time of sampling.

5.2 Variation in Chromium concentration with sampling time in the Beverley Brook at Priests Bridge (Fig.18)

All of the samples were taken between 10.00 hours and 18.00 hours. The majority of the concentrations recorded were at one of either two values : 0.005 or 0.01 mgl^{-1}, with only one exception of 0.009 mgl^{-1}. From the graph there appears to be no direct correlation between sampling time and Chromium concentration.

5.3 Variation in Chromium concentration with sampling time in the Wandle at the Causeway (Fig.19)

The lowest Chromium concentration recorded was 0.005 mgl^{-1} and the highest concentration was 0.044 mgl^{-1}. However, the majority of the samples taken had either a concentration of 0.005 mgl^{-1} or 0.01 mgl^{-1} and there appeared to be no obvious relationship between Chromium concentrations and sampling time.

5.4 Variation in Zinc concentration with sampling time in the Beverley Brook at Priests Bridge (Fig.20)

The Zinc concentrations varied between the maximum of 0.247 mgl^{-1} at 11.18 hours and the minimum value of 0.04 mgl^{-1} at 10.10 hours. However, the majority of samples had concentrations ranging between 0.04 mgl^{-1} and 0.08 mgl^{-1} spread randomly through the 10.00 to 16.00 hours sampling window. The higher concentrations were recorded between 11.00 and 13.00 hours.

5.5 Variation in Zinc concentration with sampling time In the Wandle at the Causeway (Fig.21)

All samples were taken between 10.00 and 16.30 hours, where Zinc concentrations ranged between 0.004 and 0.493 mgl^{-1}. Concentration values are randomly spread throughout the sampling window and mainly vary between 0.04 and 0.11 mgl^{-1}.

6. Variation of concentrations in the tidal Thames in relation to flows at Teddington

In this section the determinand concentrations for each zone of the tidal Thames are related to one of two flow rates taken at Teddington. The first flow rate ("low flow") relates to a flow of 20 cumecs or less for at least 7 days before the sample was taken, and the second flow rate ("high flow") relates to a flow of 40 cumecs or greater, also for at least 7 days before the sample was taken.

6.1 Variation in HCH γ concentration in the Thames in relation to flow rates at Teddington (Fig.22)

As Fig.22 shows, HCH γ concentrations decrease as samples are taken towards the estuary. The maximum recorded value of 0.103 ugl^{-1} occurs in zone 3 and was recorded at a time of "low flow" at Teddington. The minimum concentration of 0.002 ugl^{-1} was recorded in zone 29 at a time of "high flow" at Teddington. On the whole the lowest values in each zone correspond to times of "high flow" at Teddington.

6.2 Variation in Atrazine concentration in the Thames in relation to flow rates at Teddington (fig.23)

Most of the samples taken were taken at times of "low flow" at Teddington. Apart from some "outliers" the maximum concentration of Atrazine in the Thames remains consistent at approximately 0.9 ugl^{-1}, but eventually starts to decrease from zone 17 to 0.06 ugl^{-1} in zone 27. Those samples taken during times of "high flow" appear randomly intermixed with the concentrations of samples taken during "low flow".

6.3 Variation in Simazine concentration in the Thames in relation to flow rates at Teddington (Fig.24)

Simazine concentration levels rise from zone 3 to the peak at 1.5 ugl^{-1} in zone 9. Samples taken in later zones show a decline in concentration to zone 27 where the maximum concentration recorded was 0.09 ugl^{-1} . The higher concentrations in each zone were recorded at times of "low flow" at Teddington.

6.4 Variation in Cadmium concentration in the Thames in relation to flow rates at Teddington (Fig.25)

The maximum Cadmium concentration of 0.002 mgl^{-1} was recorded in zone 27, but the overall trend appears to be a gradual decline in concentration from zone 3 towards the estuary. All samples from zones 1-7 were taken at times of "low flow" at Teddington, all the samples taken further down the estuary were taken at times of "high flow" at Teddington.

6.5 Variation in Copper concentration in the Thames in relation to flow rates at Teddington (Fig.26)

Essentially, two peaks in maximum zonal Copper concentrations are recorded : one at zone 9 and one at zone 18. Levels rise from 0.015 mgl^{-1} in zone 2 to 0.031 mgl^{-1} in zone 9. Concentrations then fall to 0.01 mgl^{-1} in zone 14 and increase to 0.022 mgl^{-1} in zone 18, which is followed by another decline in concentration to 0.007 mgl^{-1} in zone 29. Flow rate at Teddington appears to have no obvious effect on levels of concentration.

6.6 Variation in Mercury concentration in the Thames in relation to flow rates at Teddington (Fig.27)

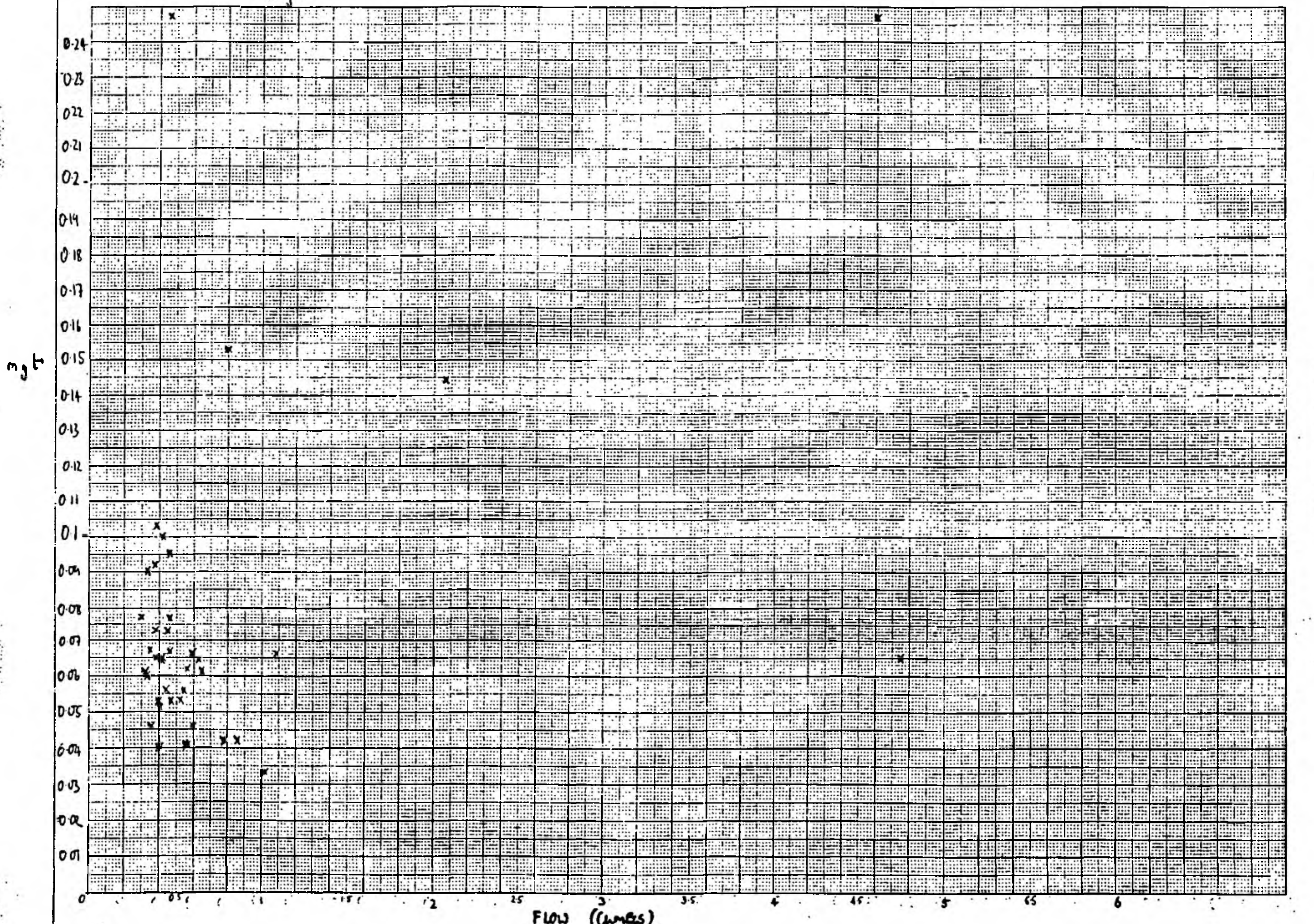
The peak in Mercury concentration is located in the central zones, levels decrease both further up and downstream. The lowest maximum concentration of 0.15 ugl^{-1} is found in zone 29. Concentration in all zones exhibit large variations between their maximum and minimum values, most minimum values are less than 0.06 ugl^{-1}. The flow rates at Teddington appear to bear no relationship with concentration.

6.7 Variation in Zinc concentration in the Thames in relation to flow rates at Teddington (Fig.28)

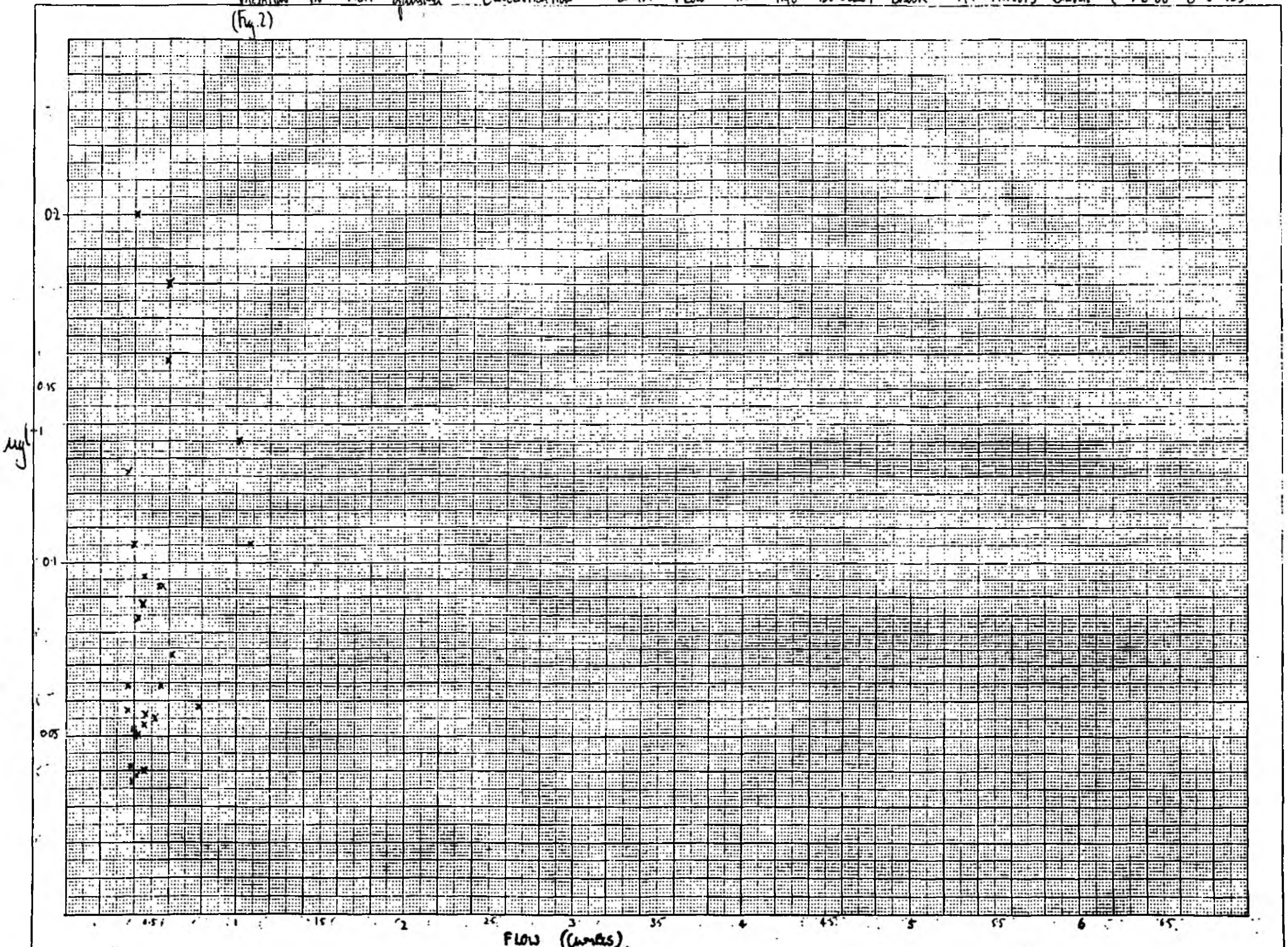
Zinc concentration exhibits a random variation throughout all the zones with results varying between 0.249 mgl^{-1} in zone 17 and 0.005 mgl^{-1} in zones 27 and 28. However, in the earlier zones (up to 18) all the maximum concentrations were recorded at times of "low flow" at Teddington and vice versa further down the estuary.

Variation in Zinc Concentration with Flow in the Beverley Brook at Priests Bridge (11.2.86 – 12.9.90)

(Fig 1)

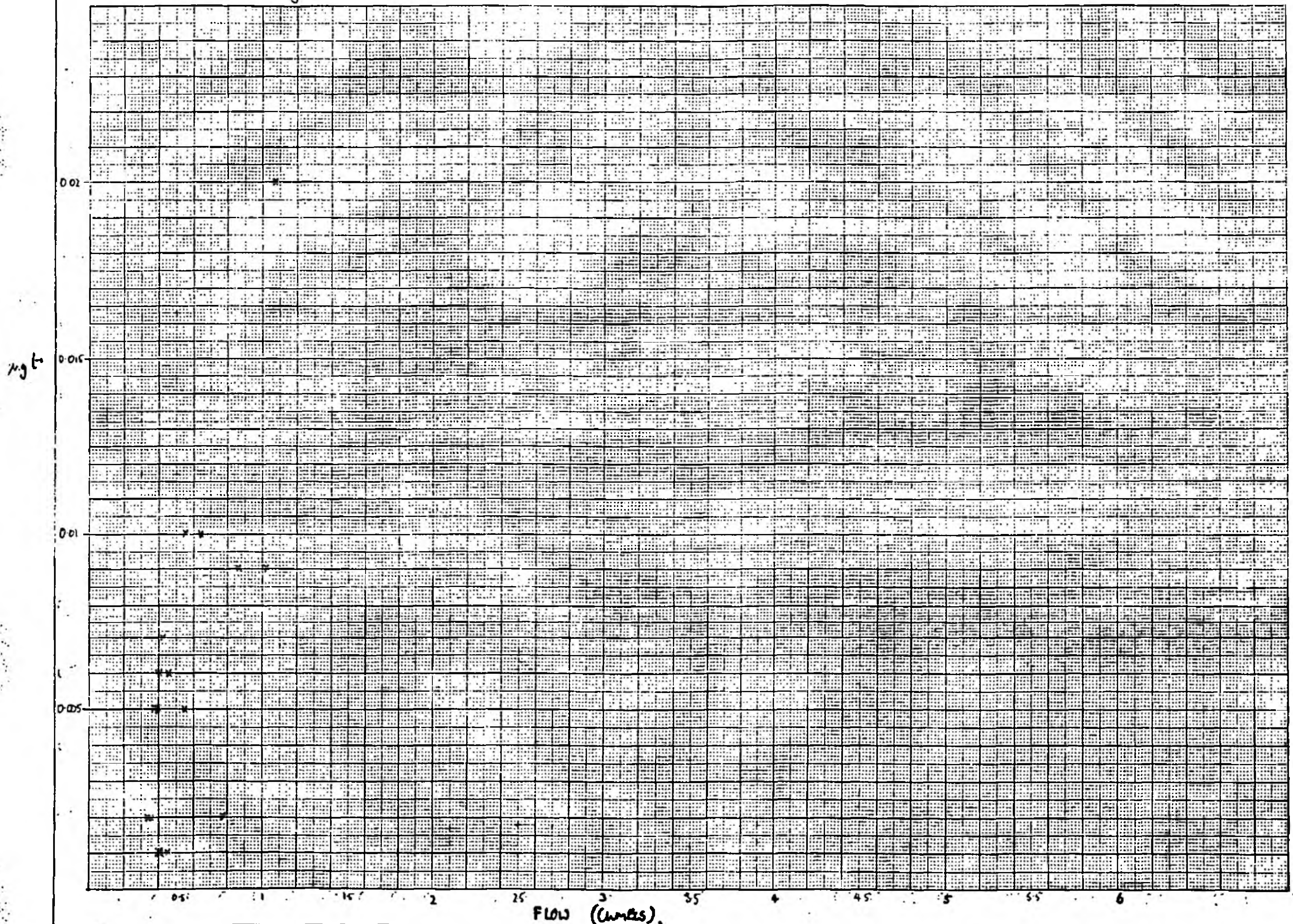


VARIATION IN HCH gamma CONCENTRATION WITH FLOW IN THE BEVERLEY BROOK AT PRIESTS BRIDGE (9.2.88 – 8.8.90).
(Fig. 2)

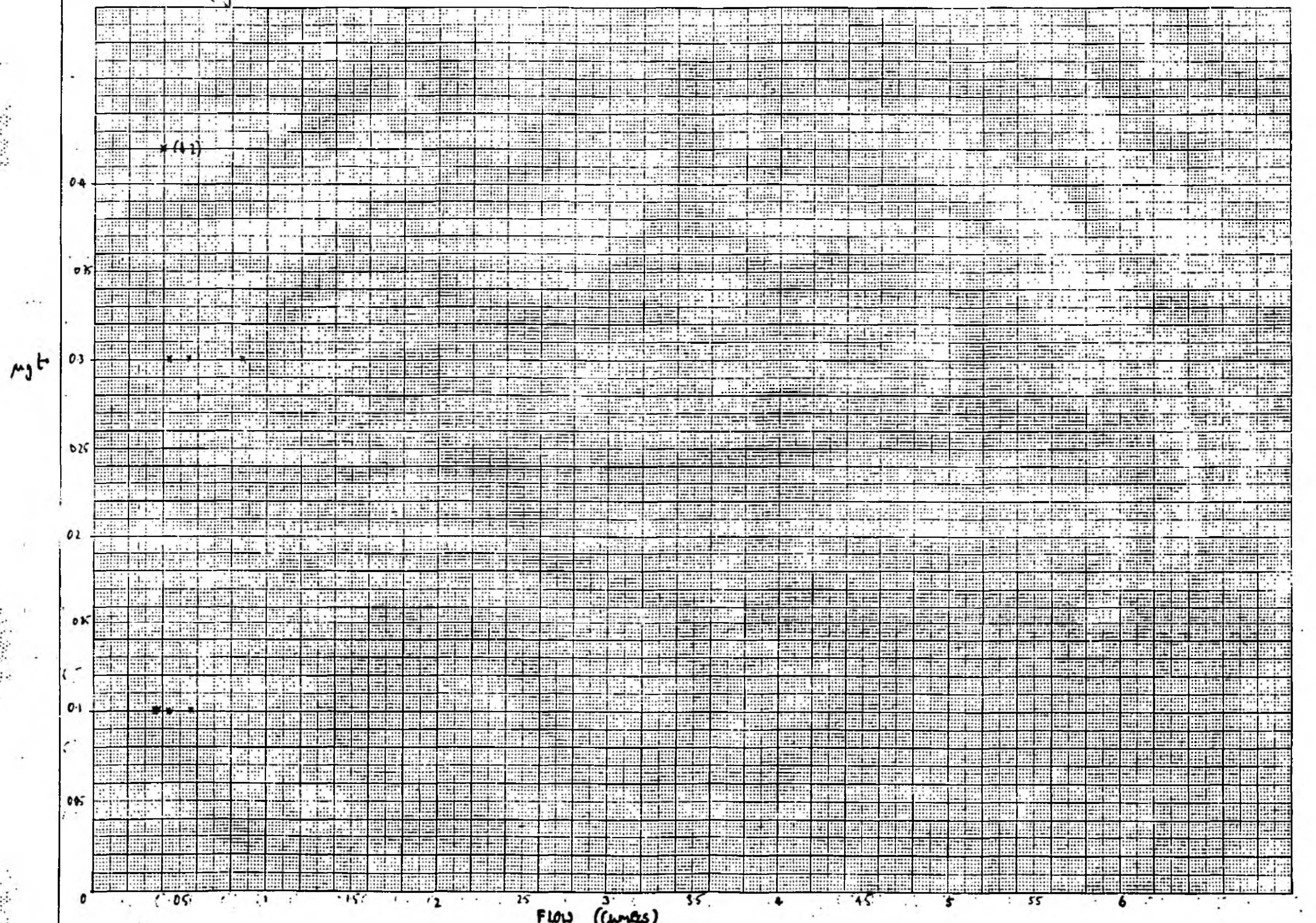


VARIATION IN DIELDRIN CONCENTRATION WITH FLOW IN THE BEVERLEY BROOK AT PRIESTS BRIDGE (9/2/88 – 8/8/90)

Fig 3

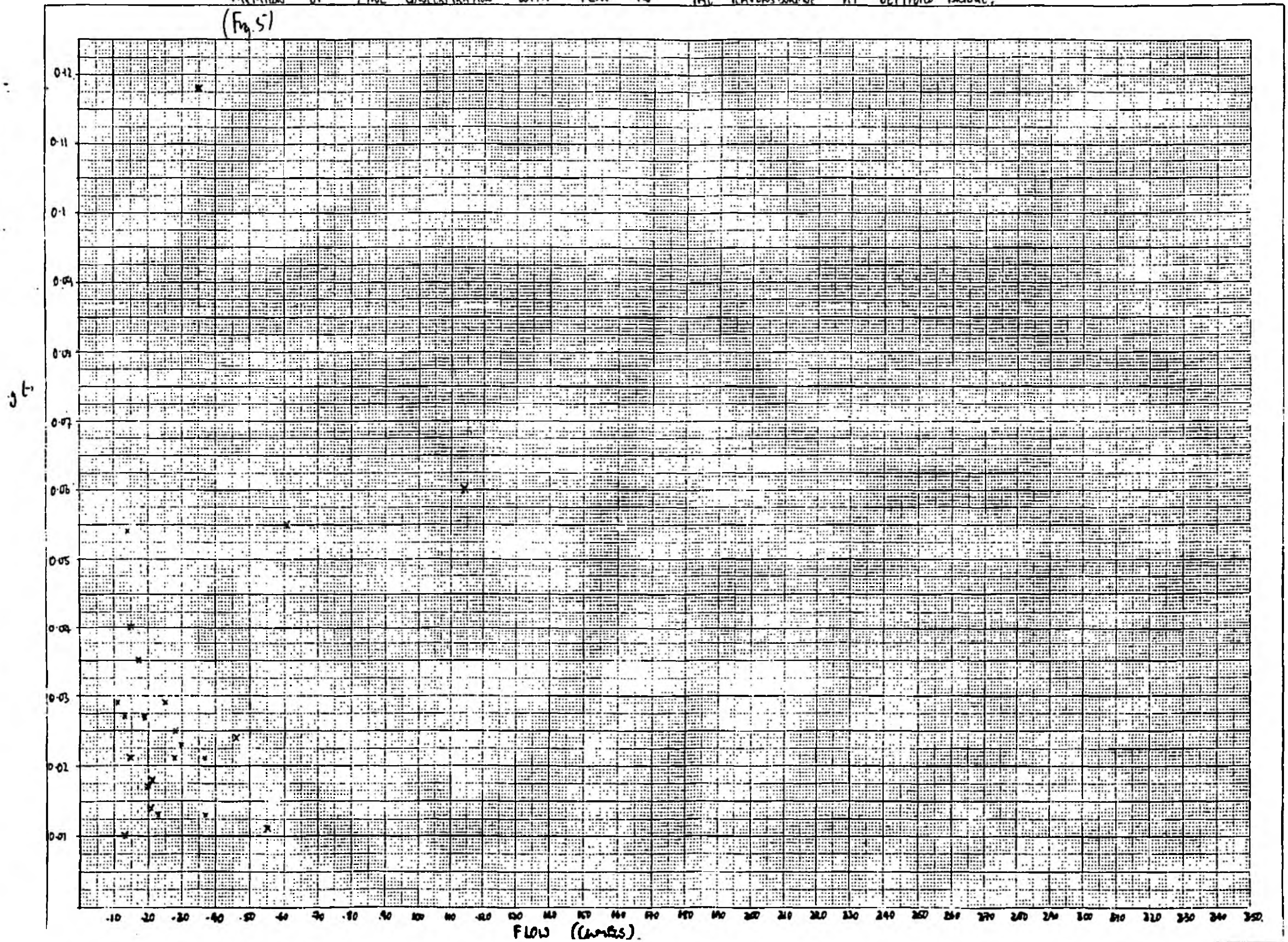


Variation in Trichloroethene Concentration with Flow in the Revelley Brook at Priests Bridge (11/12/89 - 8/8/90)
(Fig. 4)

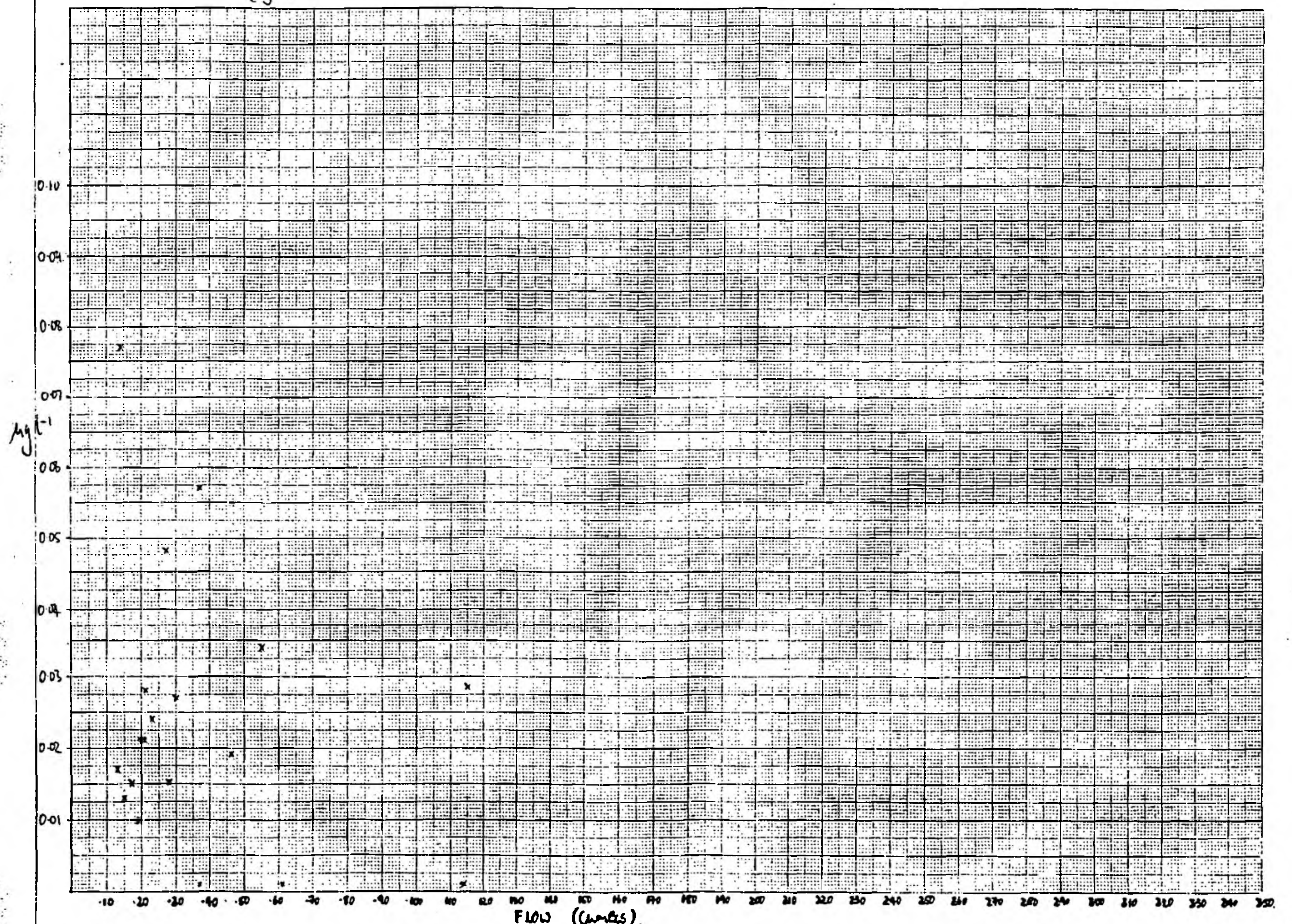


Variation of Zinc Concentration with Flow in the Ravensbourne at Deptford Bridge.

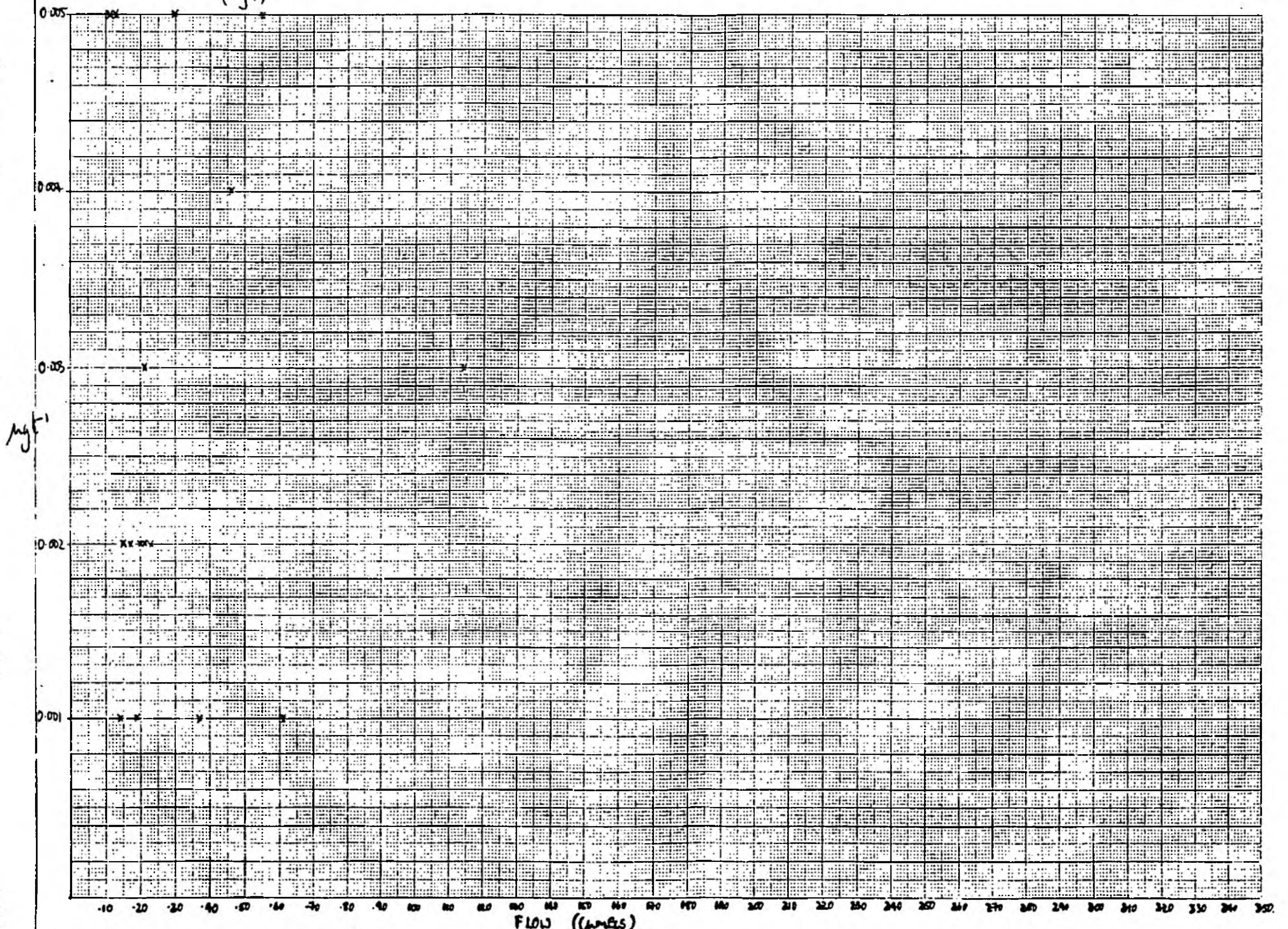
(Fig. 5)



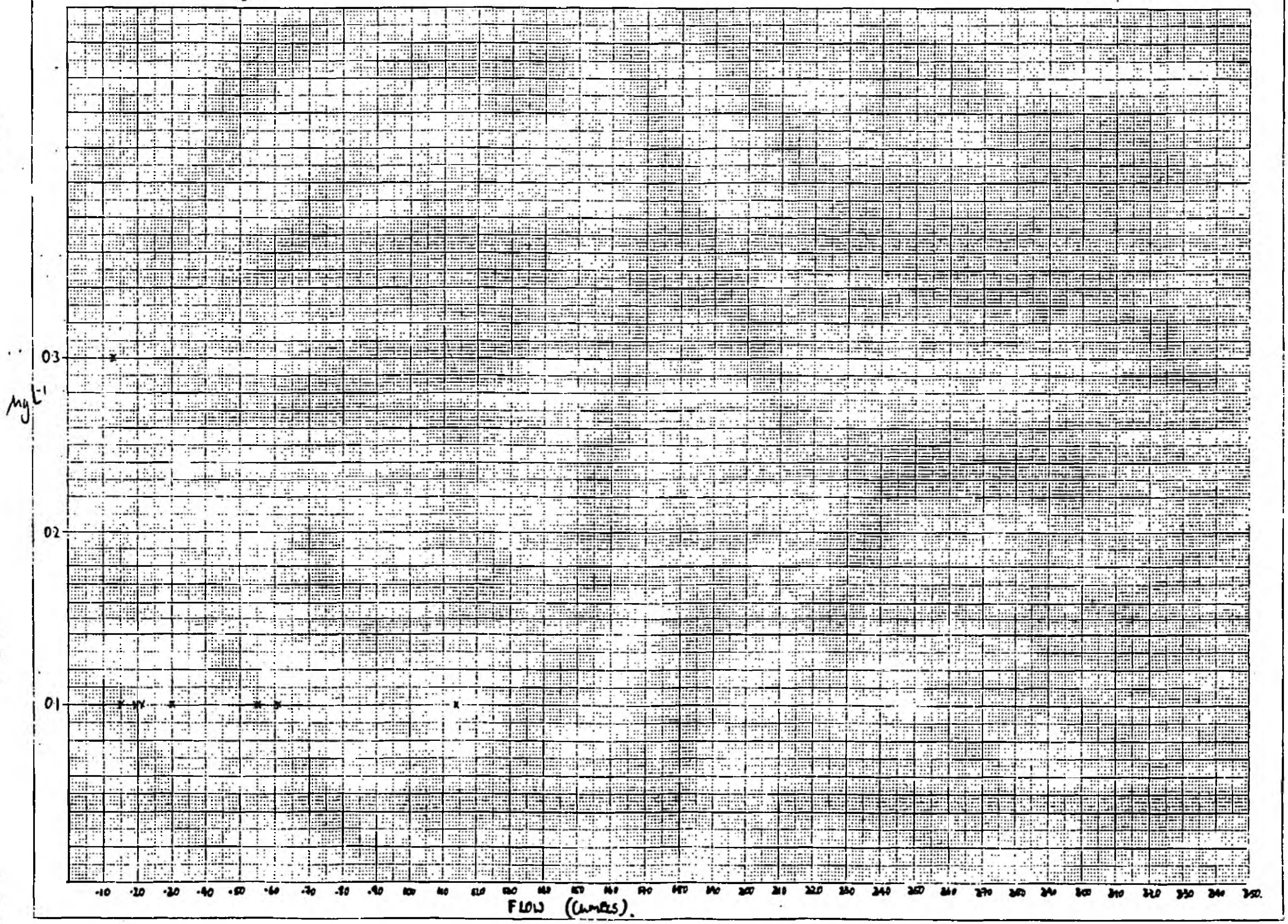
VARIATION OF HCH gamma CONCENTRATION WITH FLOW IN THE RAVENSBOURNE AT DEPTFORD BRIDGE.
(Fig. 6)



VARIATION IN DIELDRIN CONCENTRATION WITH FLOW IN THE RAVENSBOURNE AT DEPTFORD BRIDGE (7-3-88 - 8-8-90)
(Fig 7)

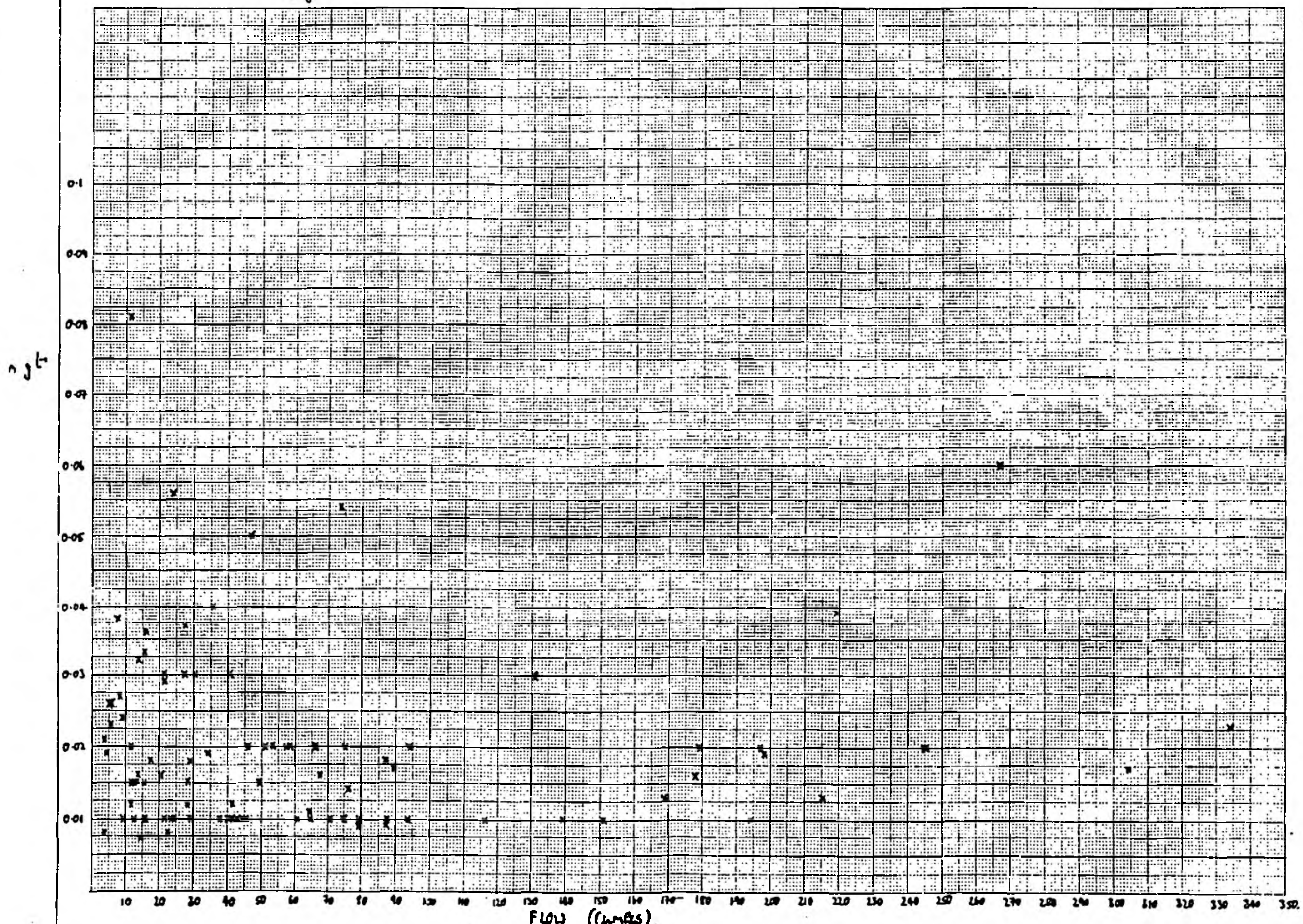


Variation in Trichloroethene Concentration with Flow in the Ravensbourne at Deptford Bridge (5.12.89 – 8.8.90)
(Fig 8)



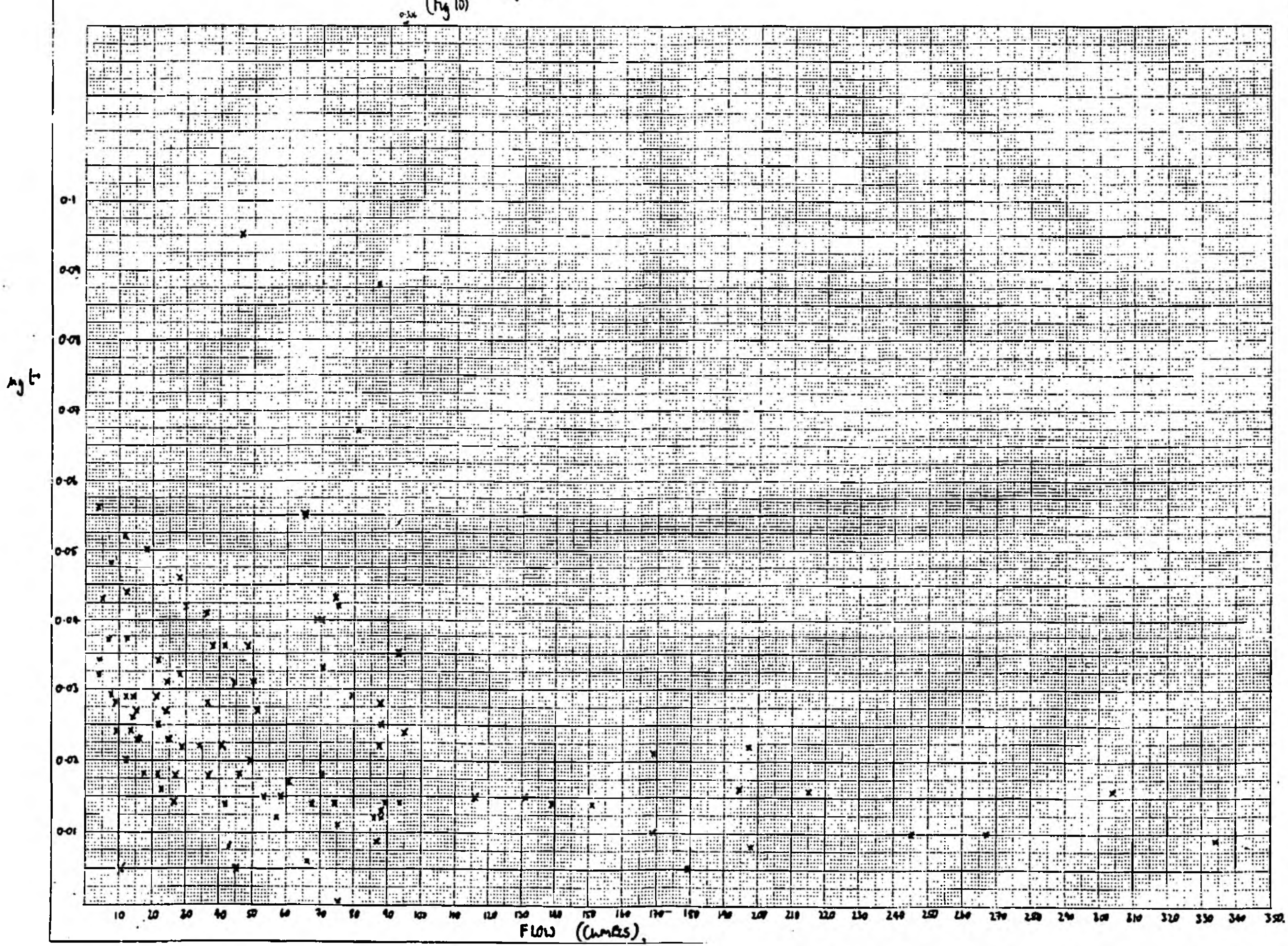
VARIATION OF ZINC CONCENTRATION WITH FLOW IN THE THAMES AT TEDDINGTON WEIR (9/1/66 - 9/8/90).

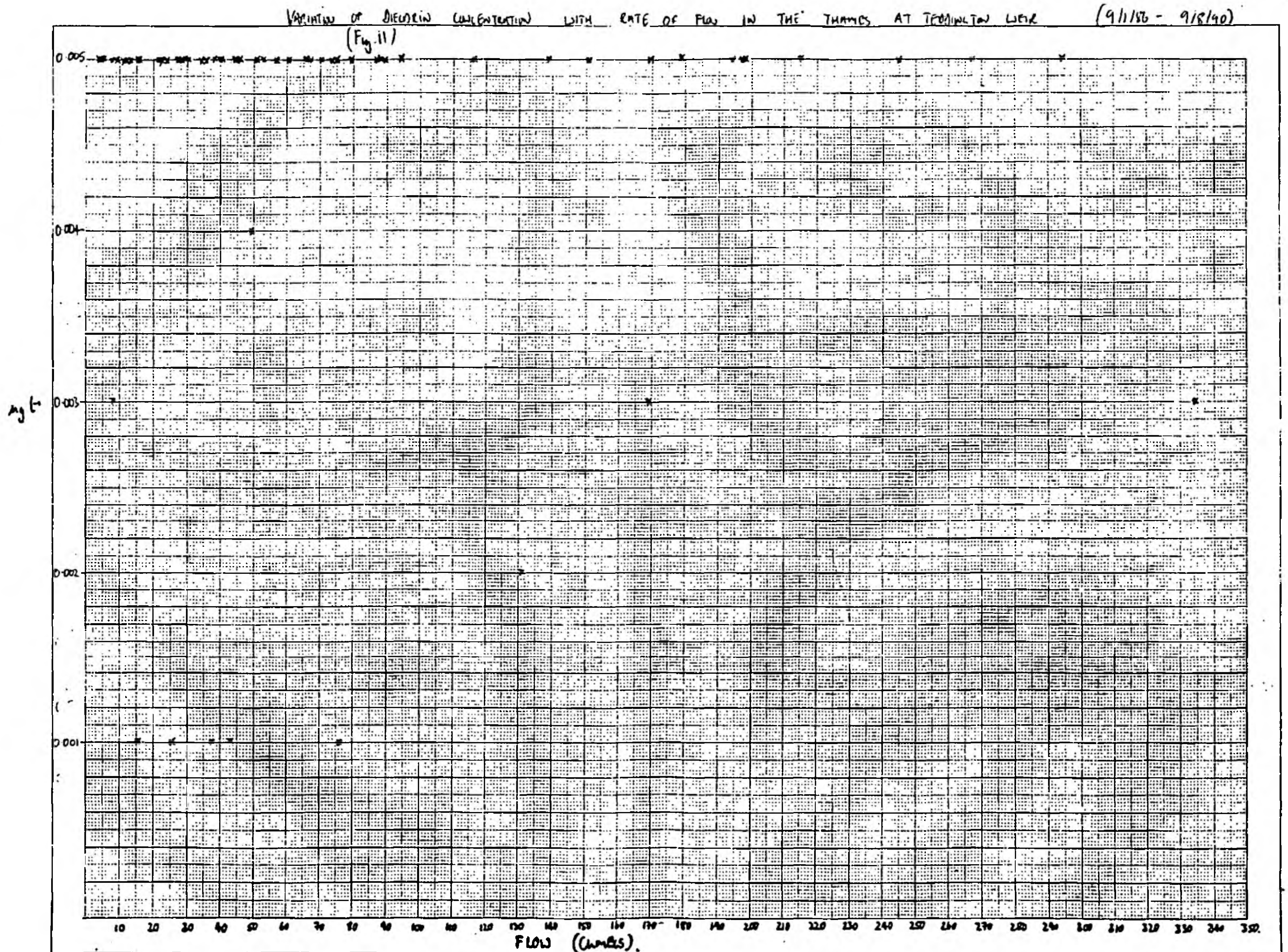
(Fig. 9)



Variation of HCH (gamma) Concentration With Flow in the Thames at Teddington Weir (9/1/86 - 9/8/90).

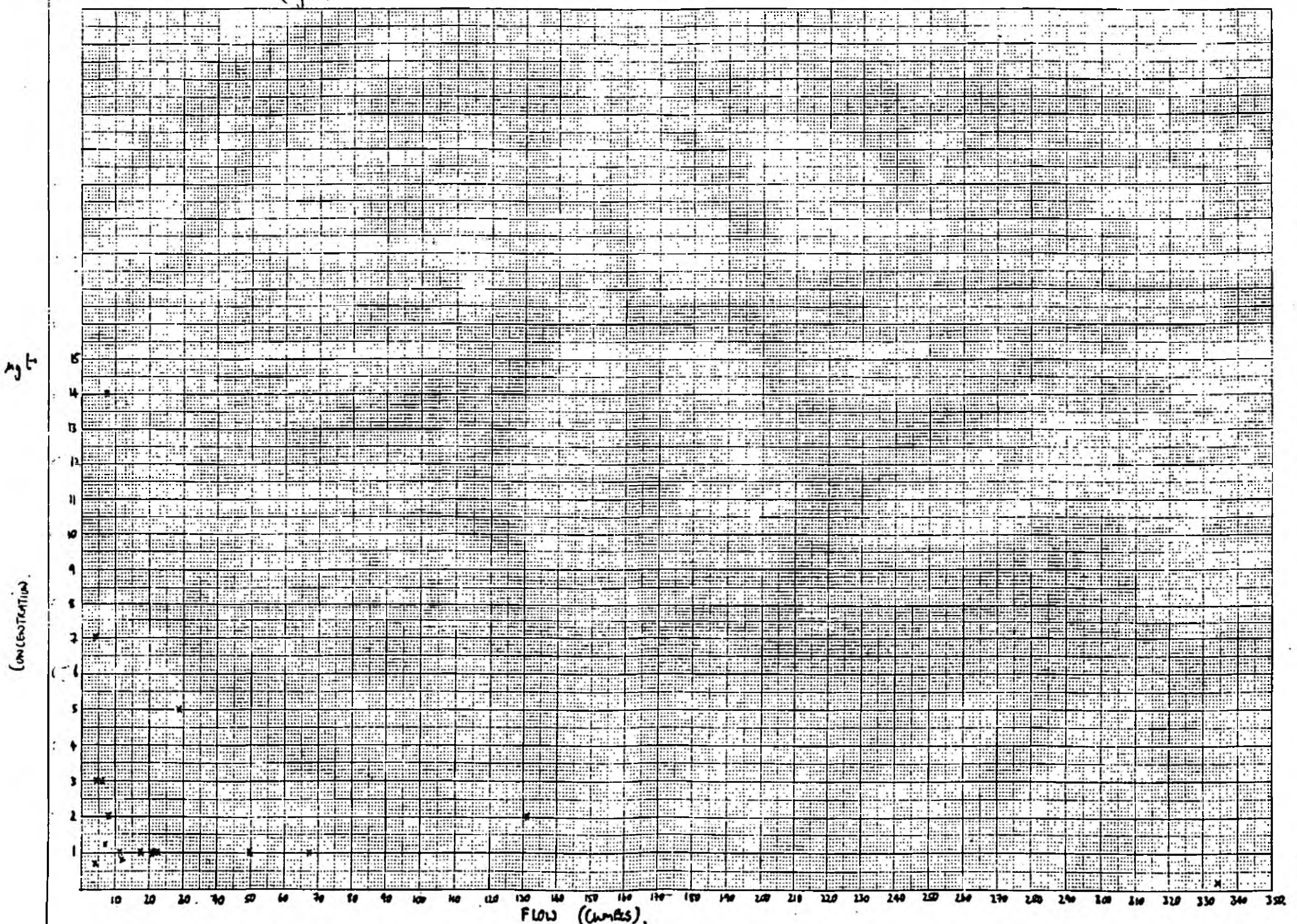
(Fig 10)




VARIATION OF DIELDRIN CONCENTRATION WITH RATE OF FLOW IN THE THAMES AT TEDDINGTON WEIR (9/1/86 - 9/8/90)
(Fig. 11)
mg l⁻¹
0.005
0.004
0.003
0.002
0.001
10 20 30 40 50 60 70 80 90 100 110 120 130 140 150 160 170 180 190 200 210 220 230 240 250 260 270 280 290 300 310 320 330 340 350
FLOW (CUMECS)

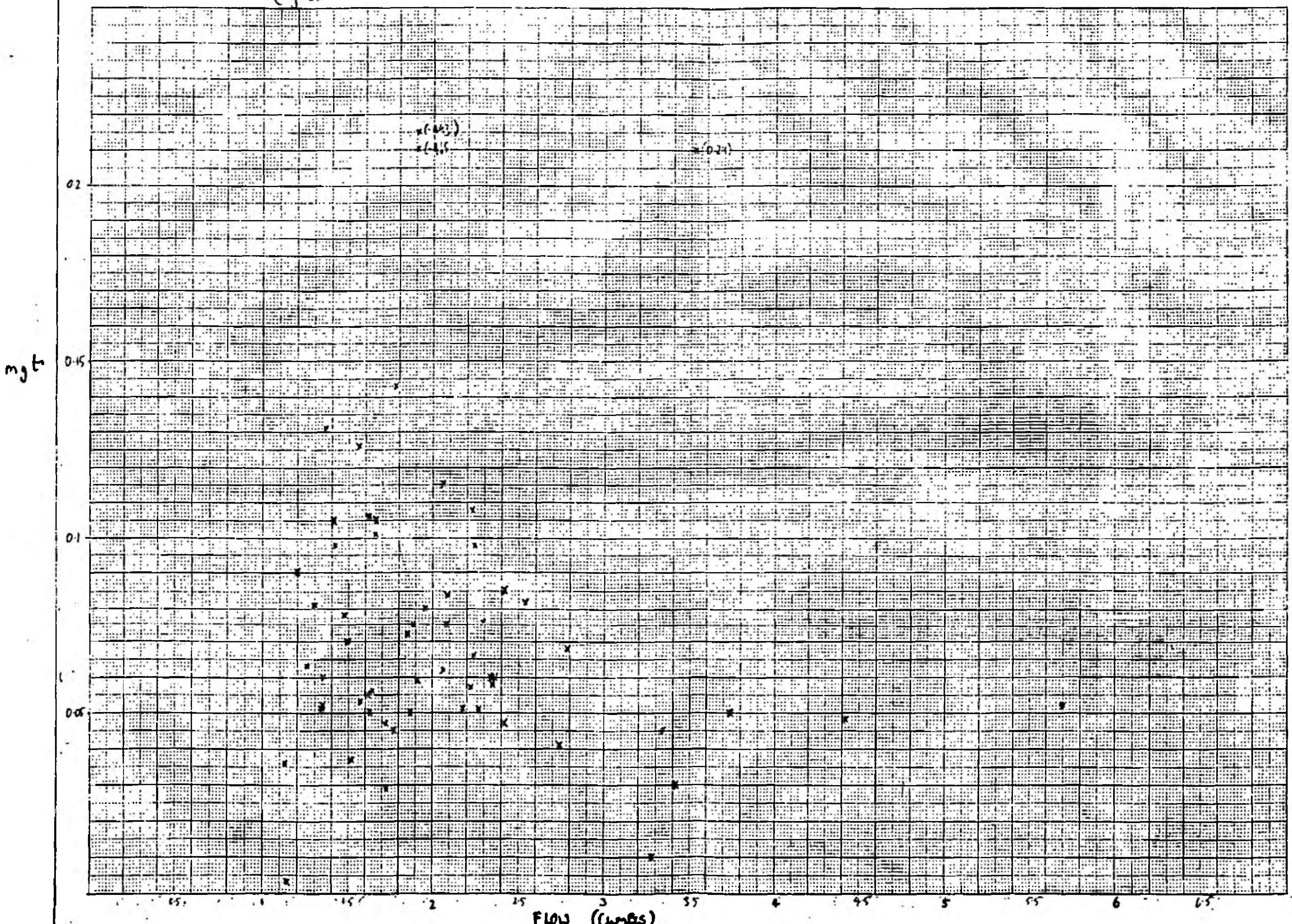
Variation of Trichloroethene Concentration with Flow in the Thames at Teddington Weir. (9/1/86 - 9/8/90)

(Fig. 12)



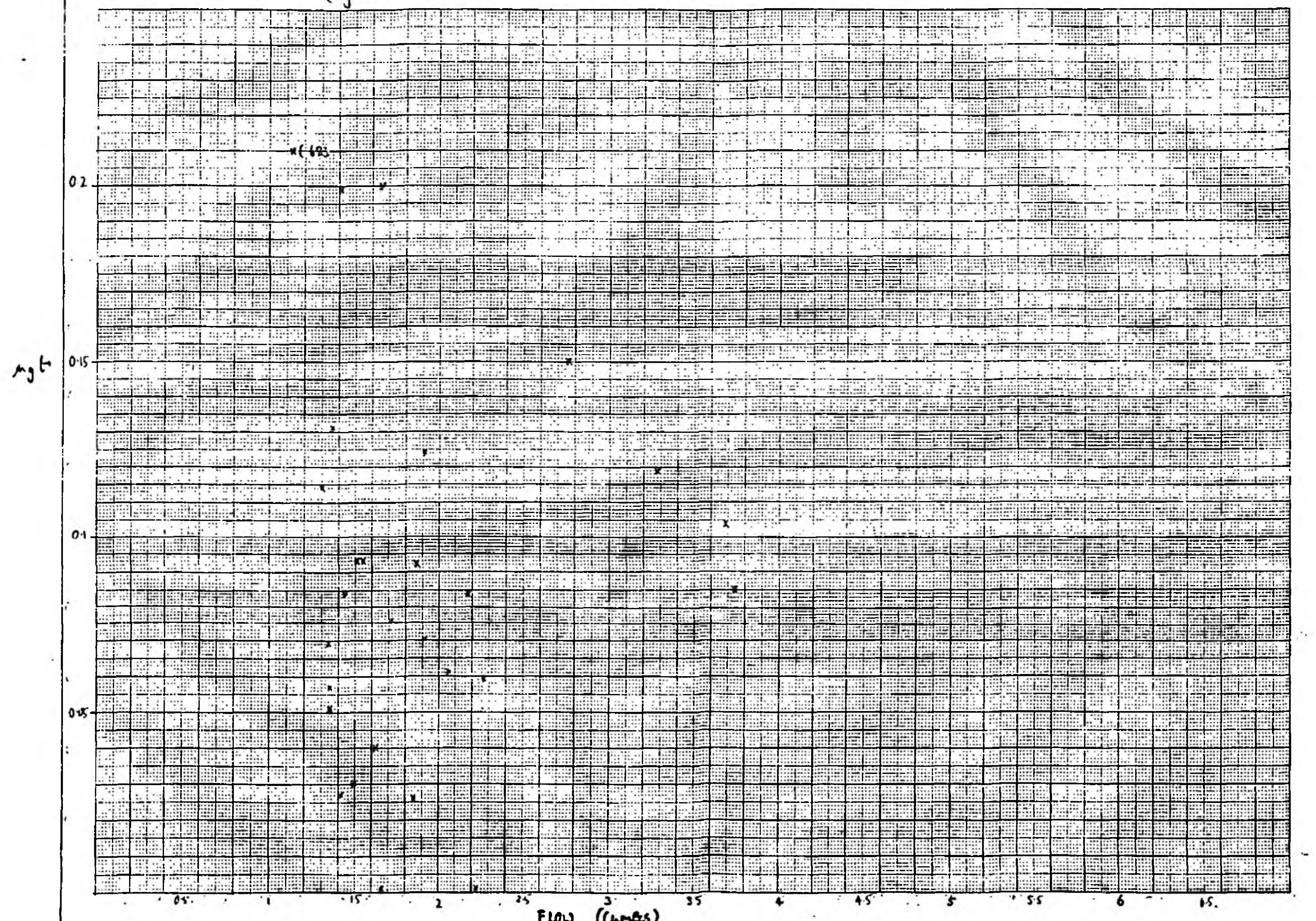
Variation of Zinc Concentration With Flow in the Wandle at the Causeway, Wandsworth (6.2.88 – 12.9.90).

(Fig. B)



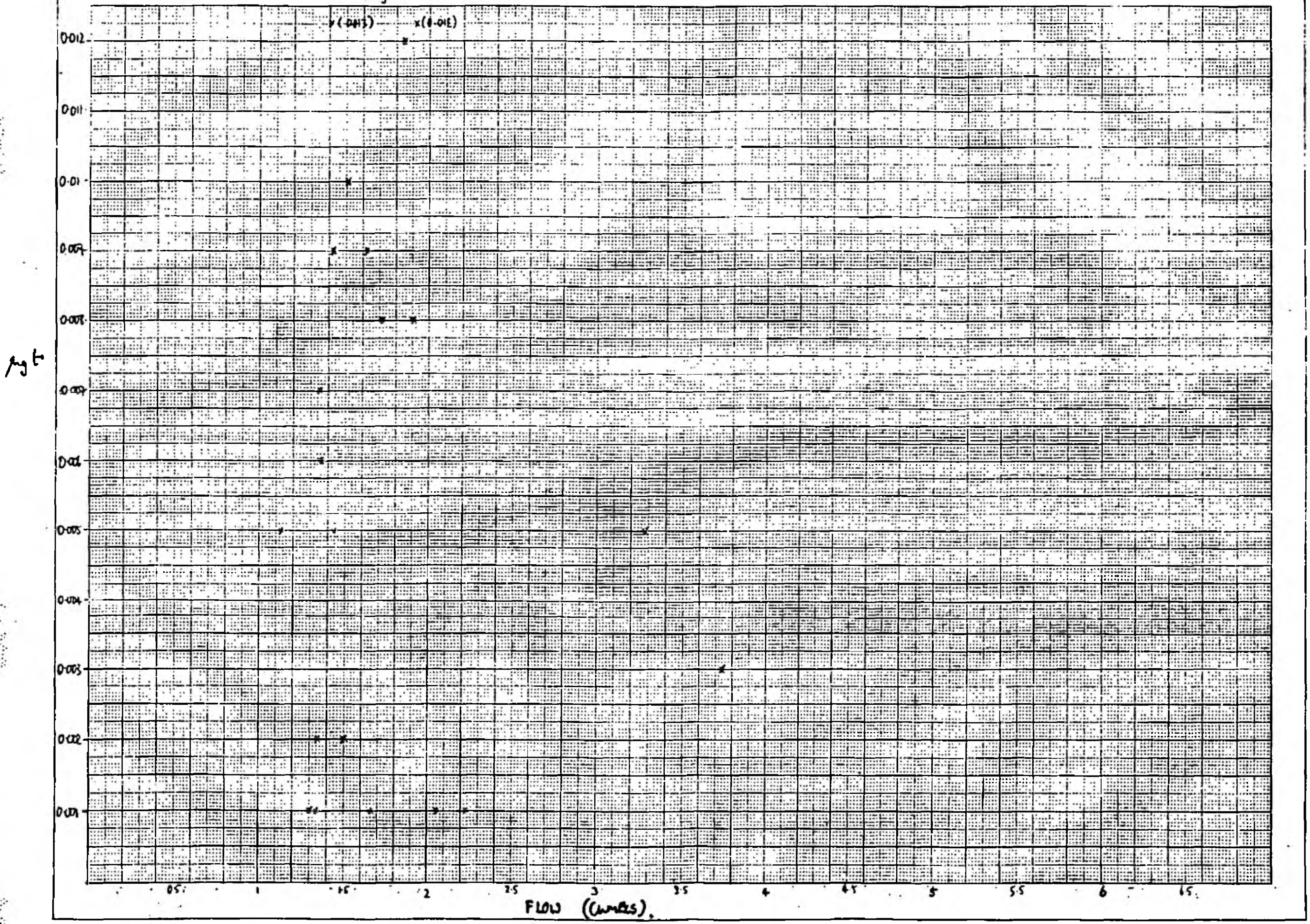
Variation of HCH gamma Concentration With Flow in the Wandle at the Causeway, Wandsworth (14.12.87 - 8.8.90)

(Fig 14)



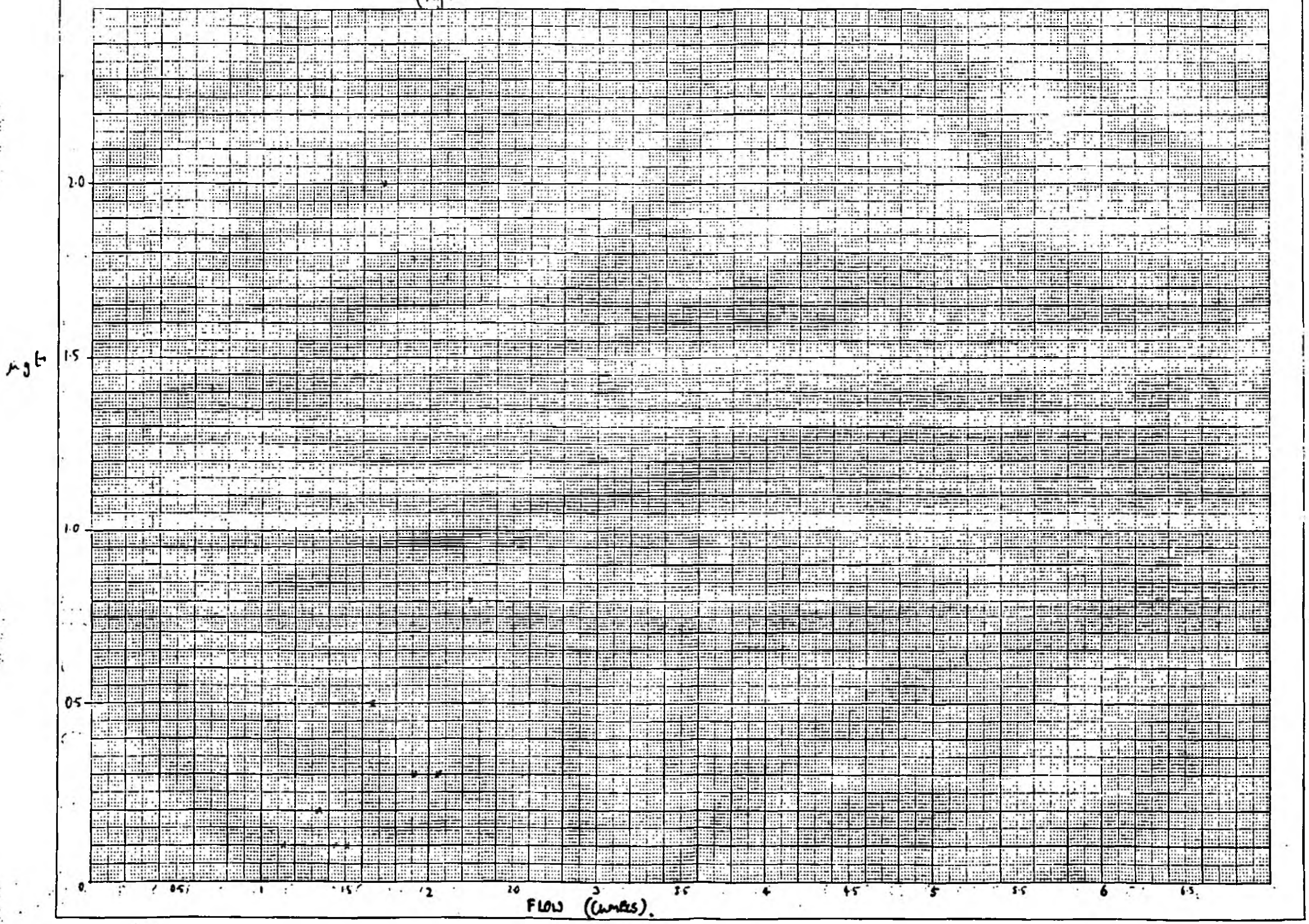
Variation of Dieldrin Concentration with Flow in the Wandle at the Causeway, Wandsworth (21.3.88 - 8.8.90)

(Fig. 15)



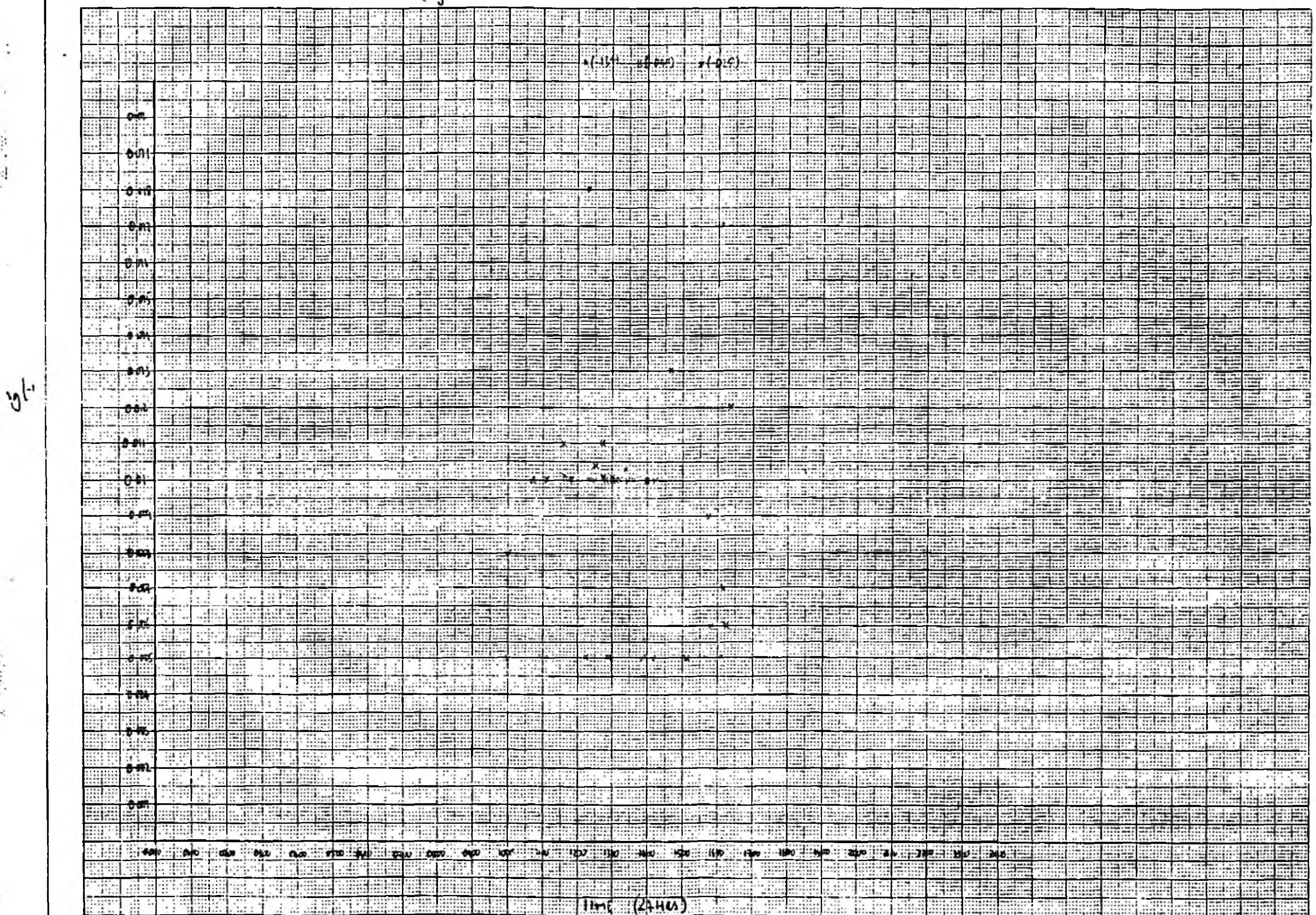
Variation of Trichloroethene Concentration with Flow in the Wandle at the Causeway, Wandsworth (11.12.89 - 12.9.90).

(Fig. 16)

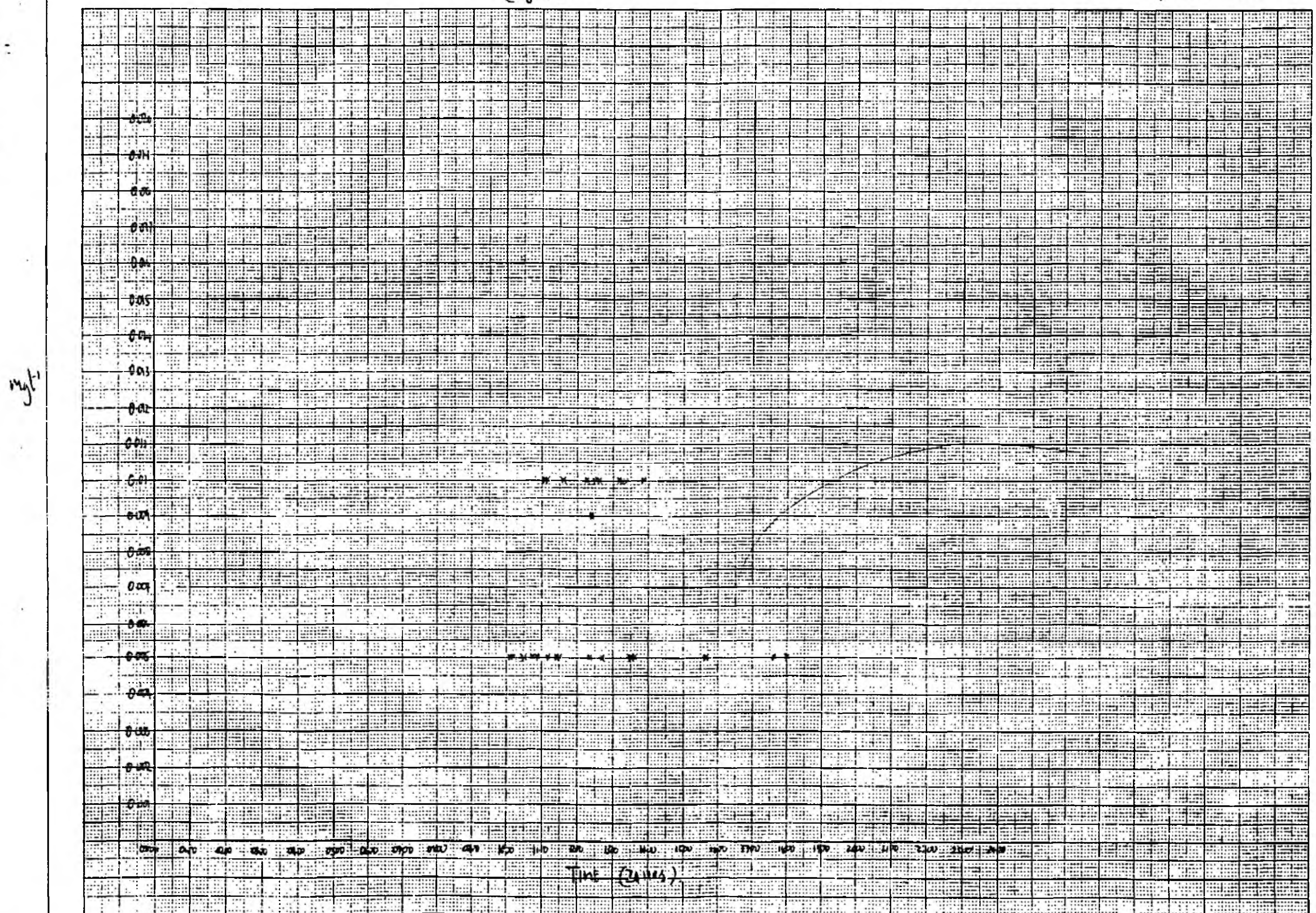


Variation in Nickel Concentration with Sampling Time in the Wandle at the Causeway (5.3.86 – 12.4.90).

(Fig. 17)



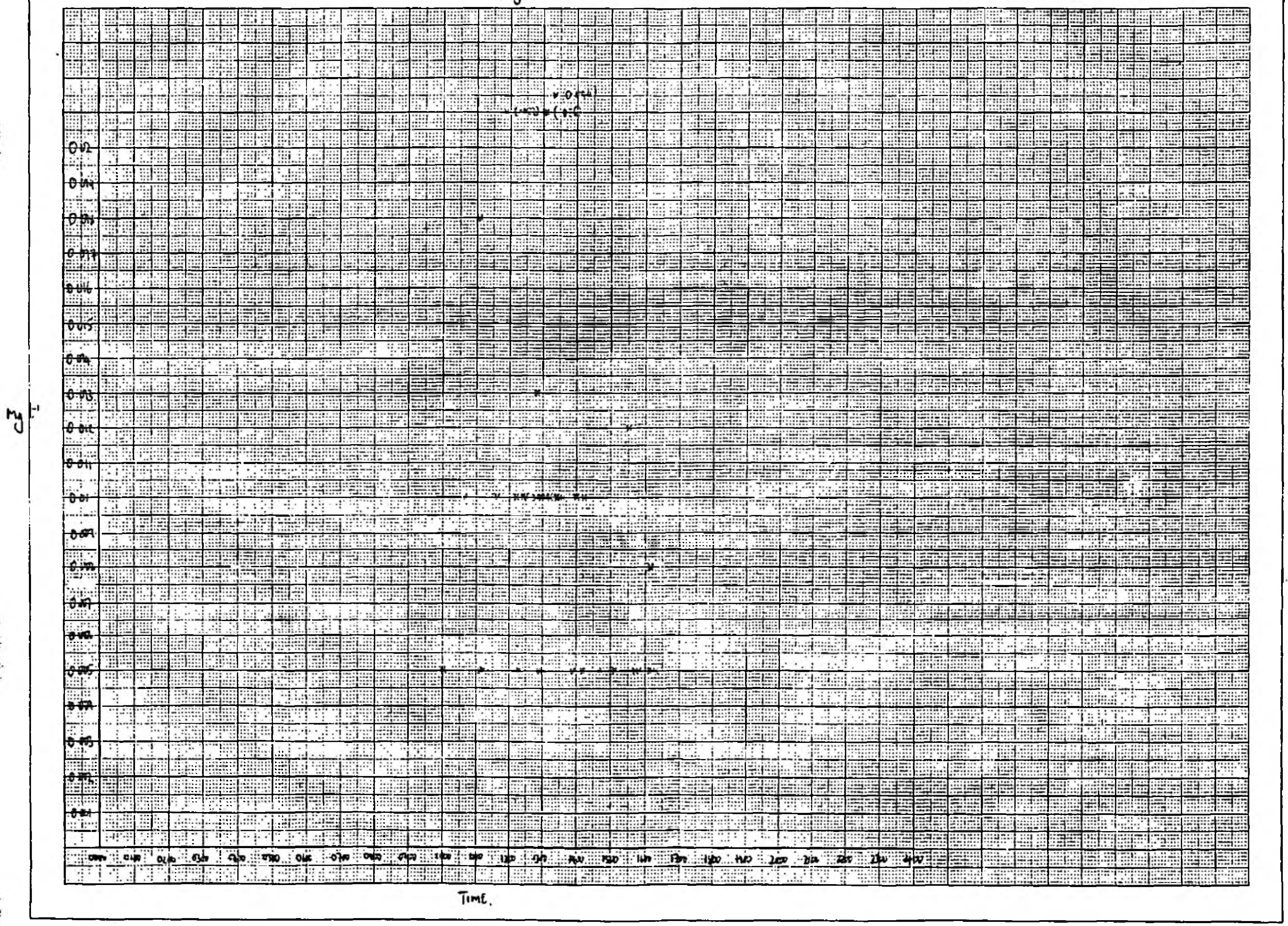
Variation in Chromium Concentration with Sampling Time in the Beverley Brook at Priests Bridge (11.3.86 – 12.9.90).



(Fig. 18)

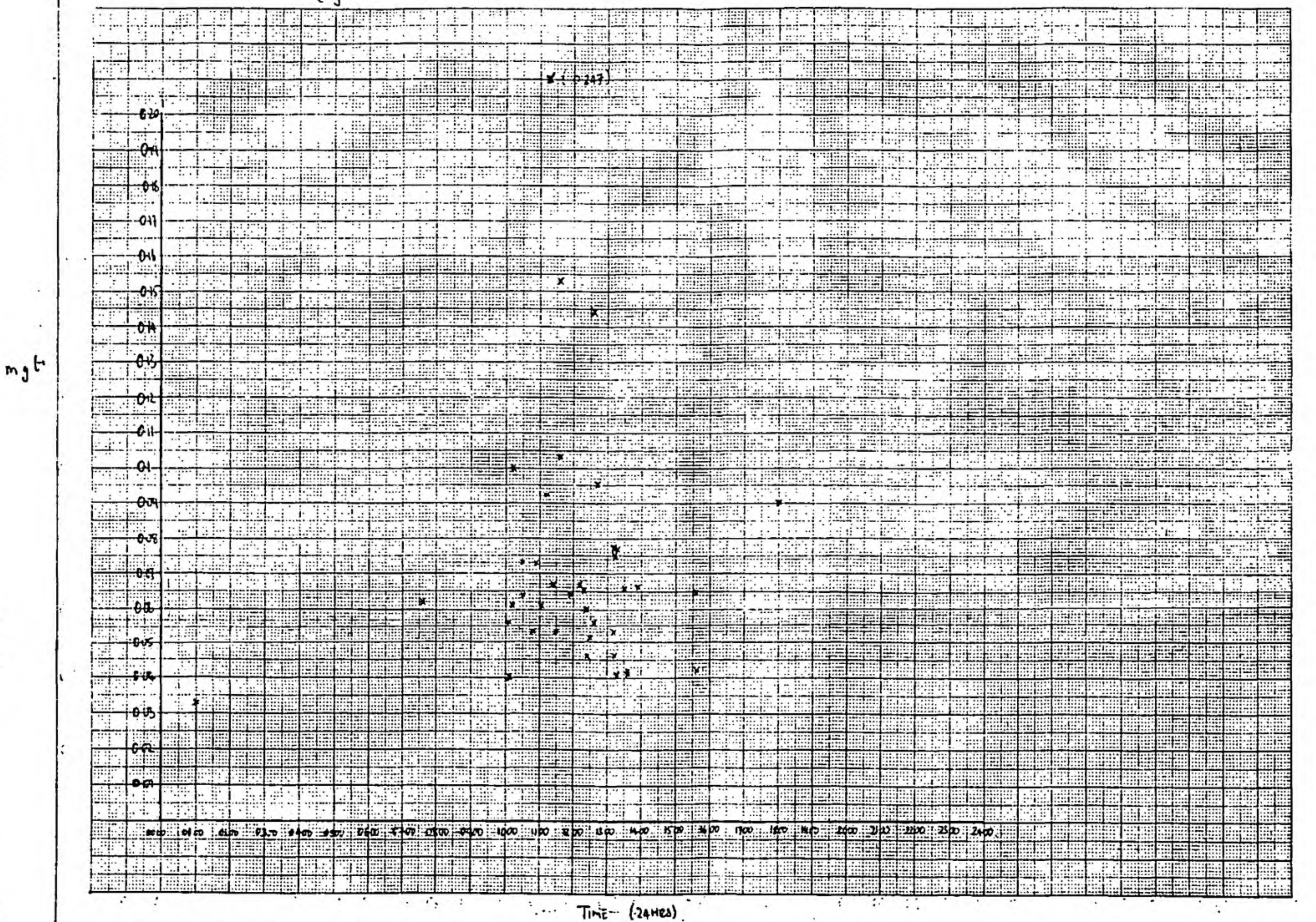
Variation in Chromium Concentration with Sampling Time in the Wandle at the Causeway (5.3.86 - 12.4.90).

(Fig. 19)



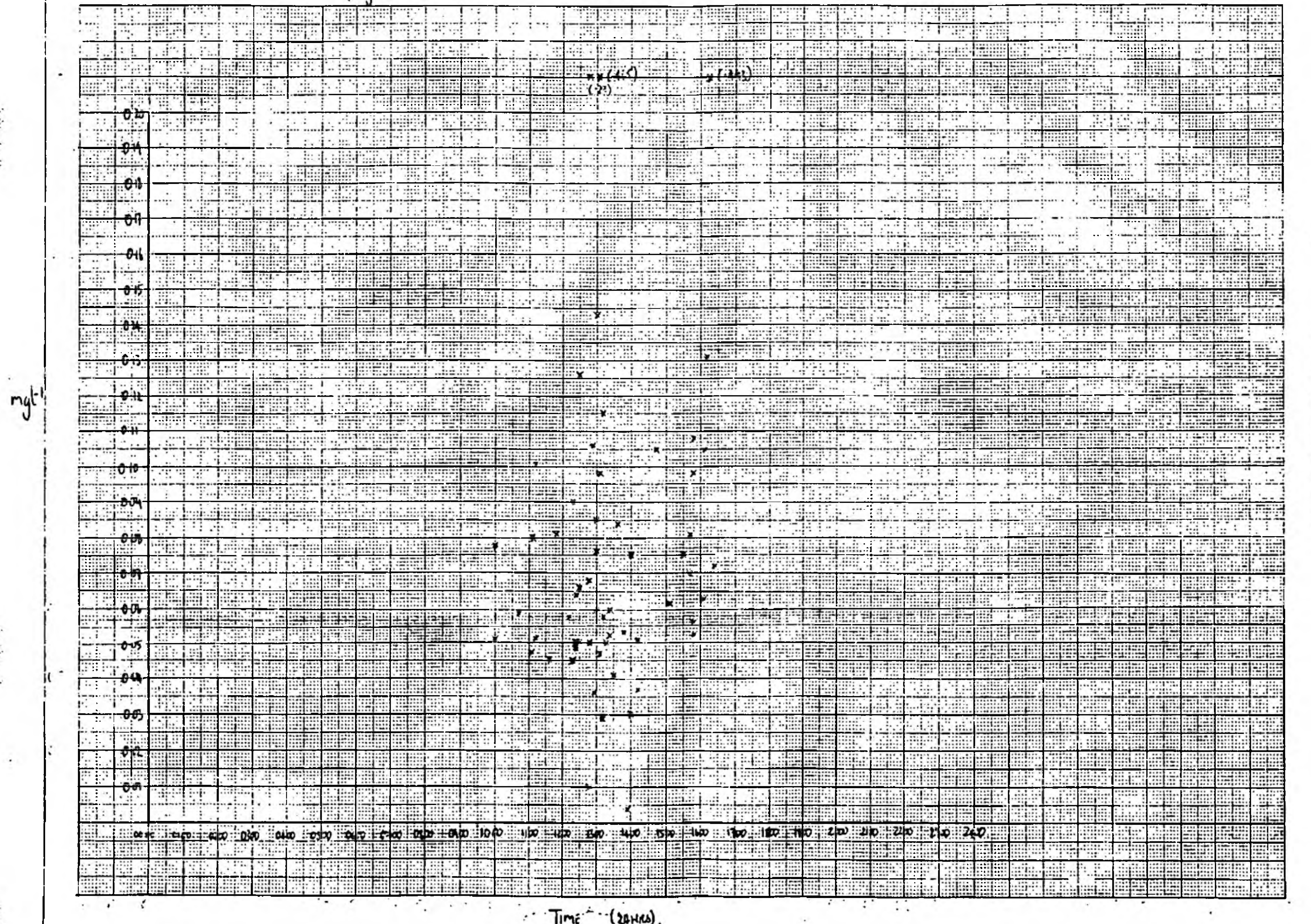
VARIATION IN ZINC CONCENTRATION WITH SAMPLING TIME IN THE BEVERLEY BROOK AT PRIESTS BRIDGE (11.2.88 - 11.9.90)

(Fig 20)



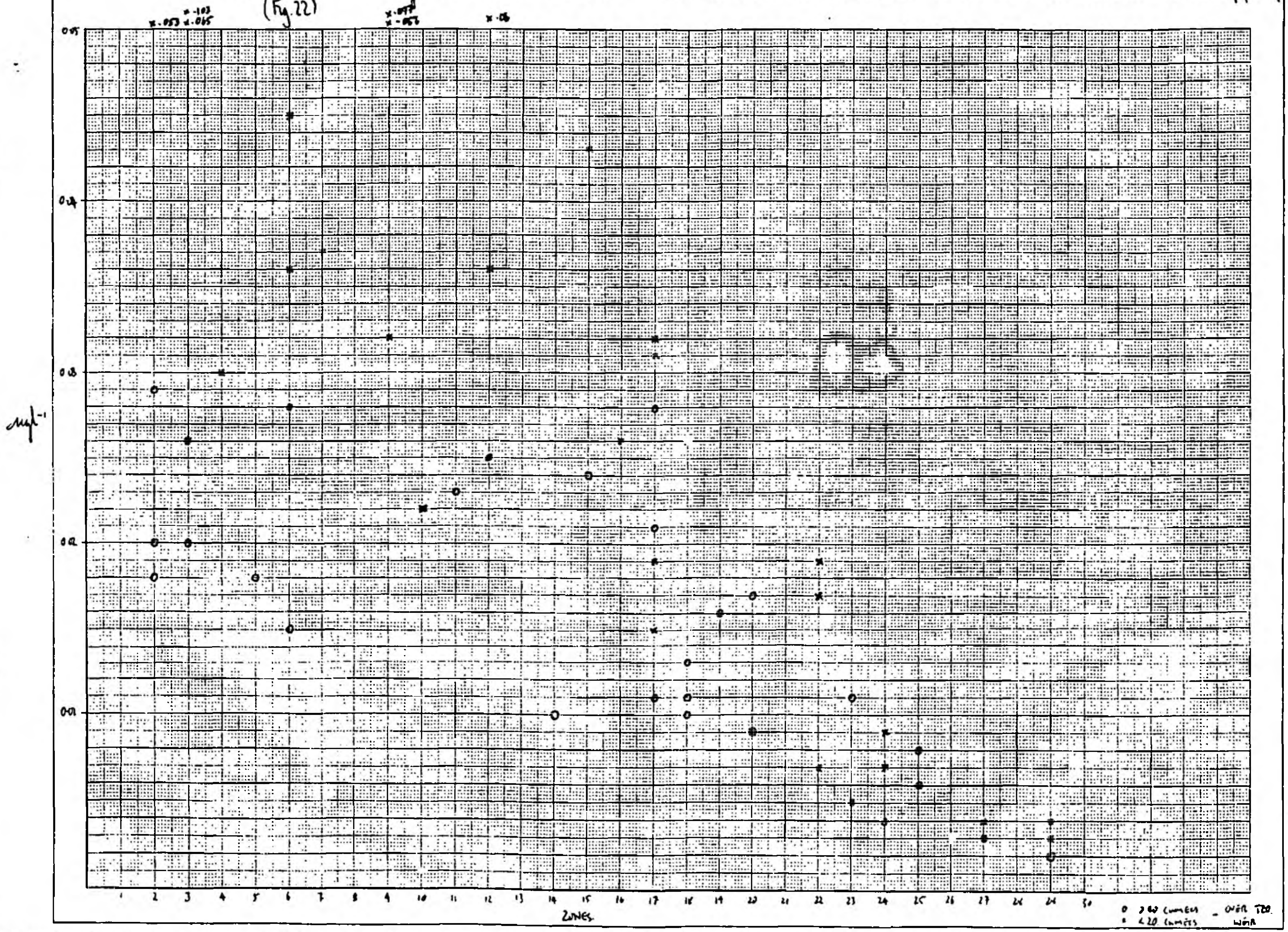
VARIATION IN ZINC CONCENTRATION WITH SAMPLING TIME IN THE LLANDDLE AT THE CAUSEWAY (6.2.88 - 12.9.90)

(Fig 21)



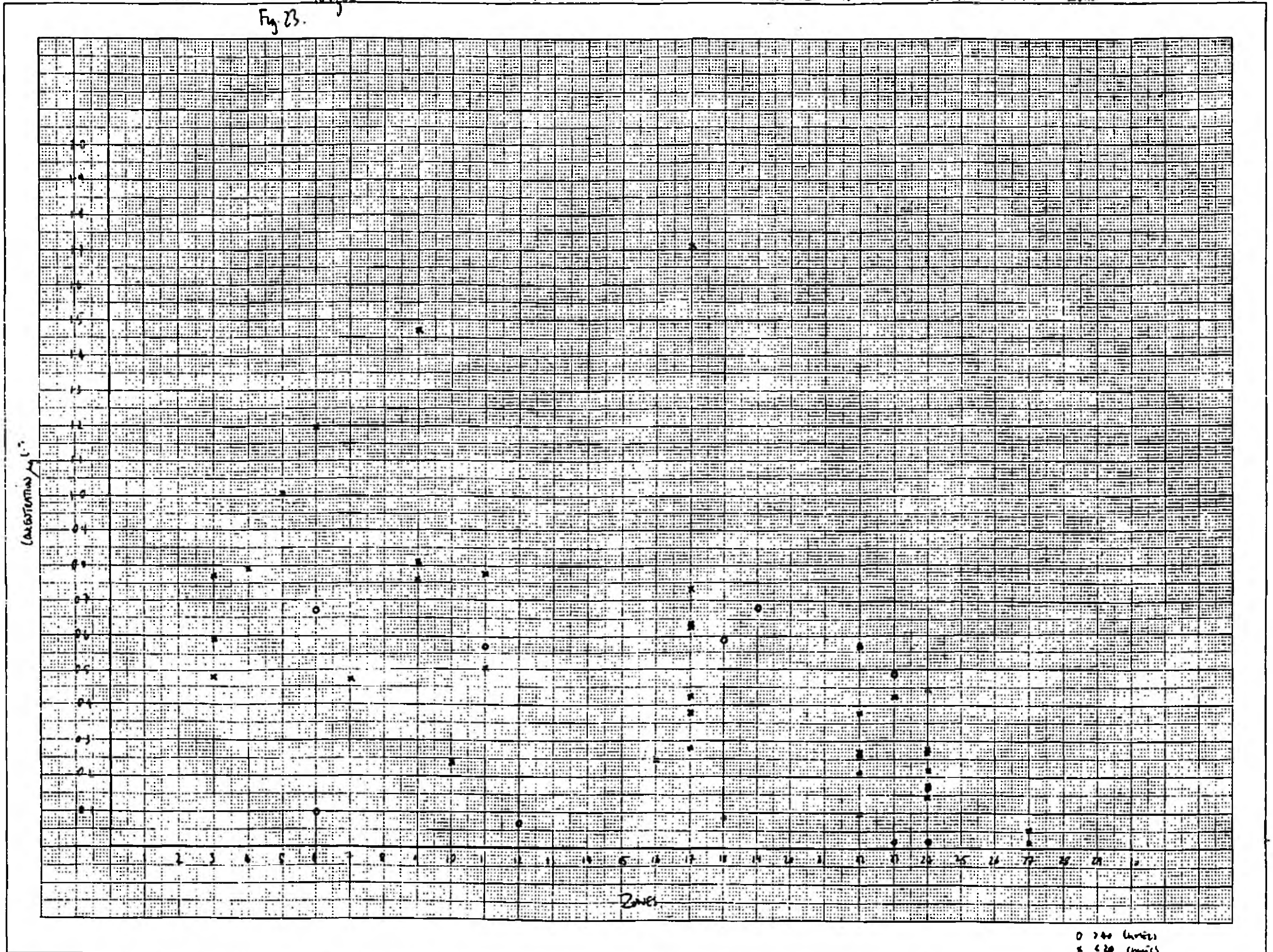
Variation in HCH γ concentration throughout the Thames zones and in relation to flow rates at Teddington (1 week b/f sampling).

(Fig. 22)



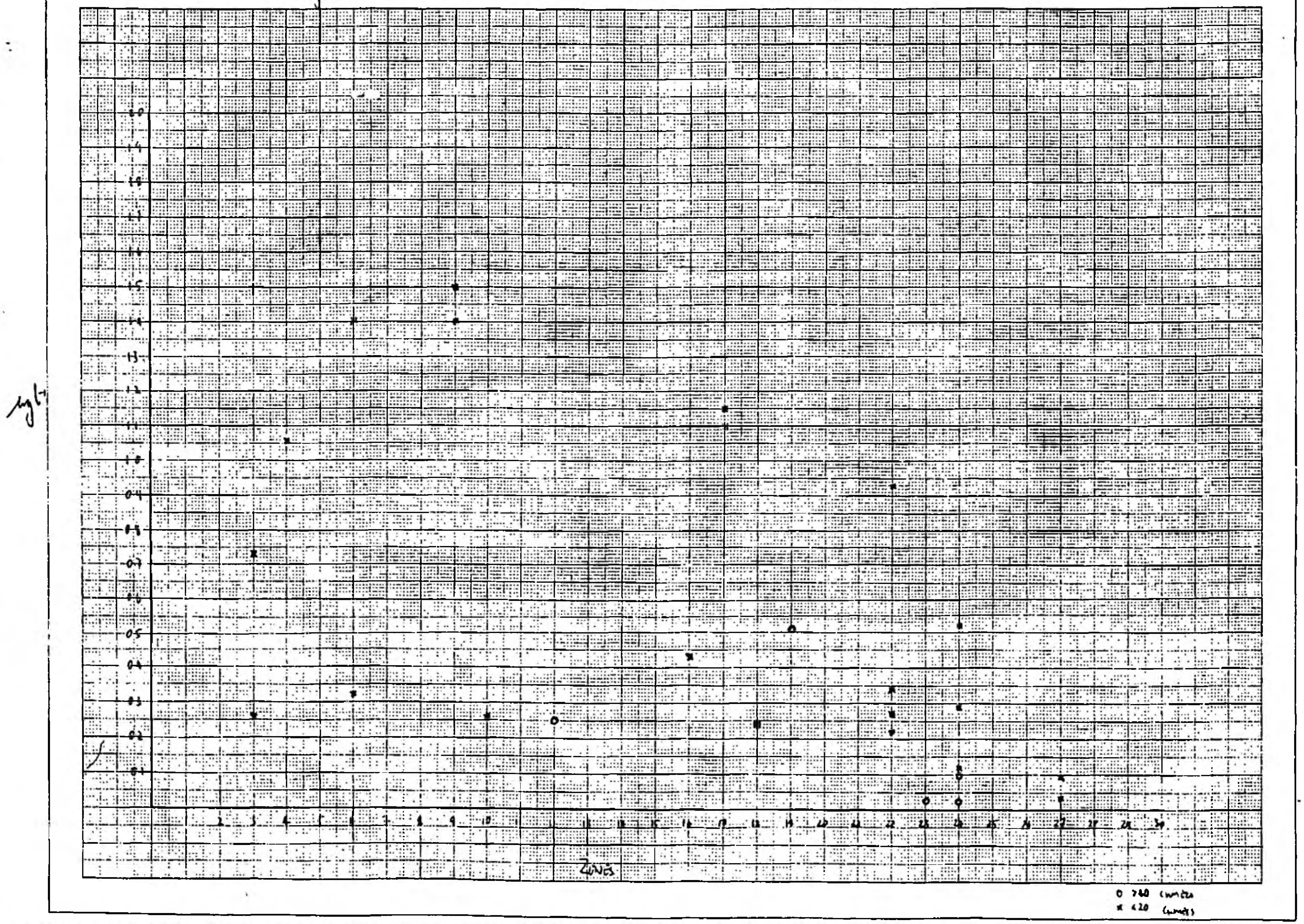
Variation in Atrazine Concentration Throughout the Thames Zones in Relation to Flow Rates at Teddington Weir.

Fig. 23.



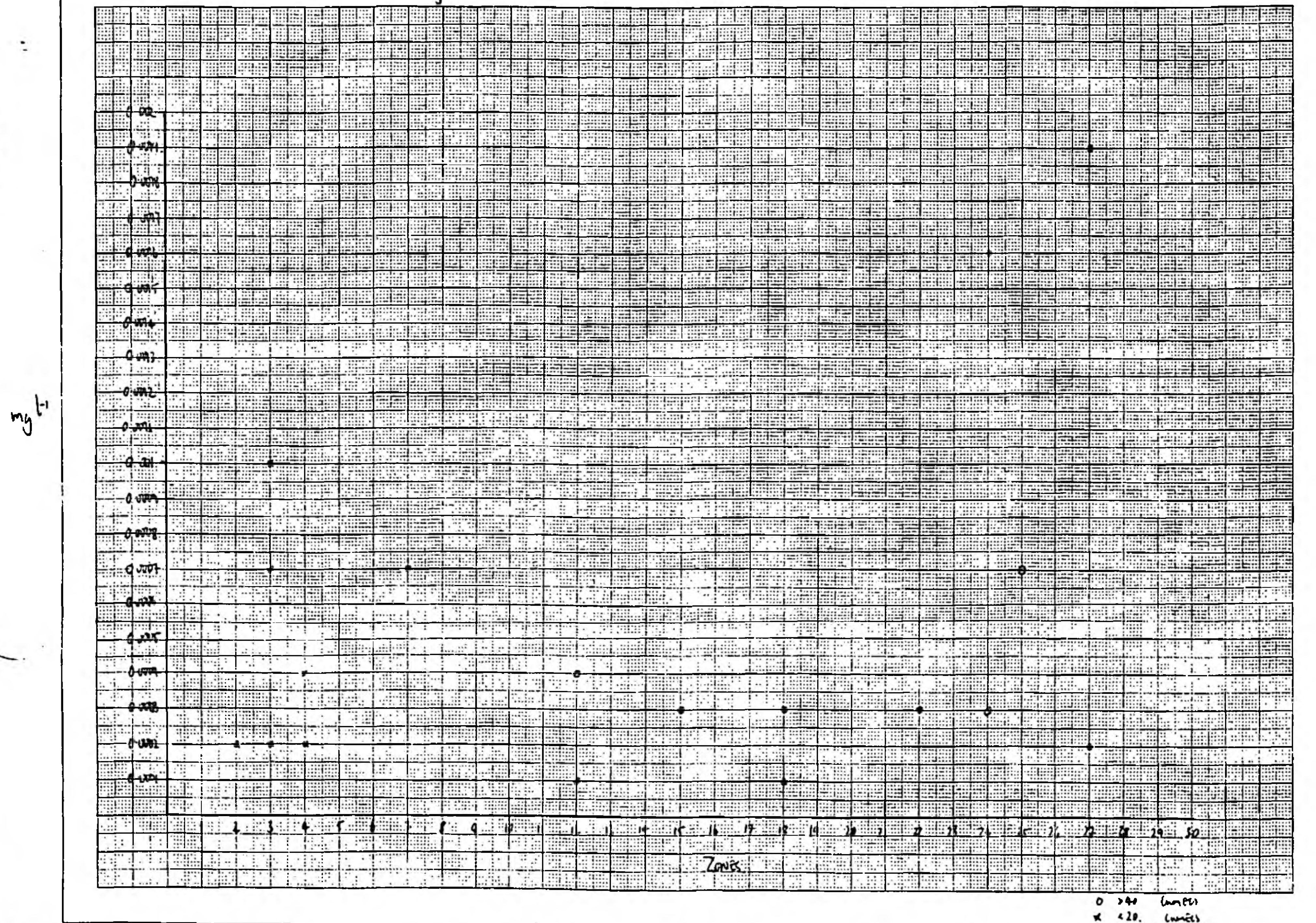
Variation in [illegible] Concentration Throughout the Thames Zones and in Relation to Flow Rates at Teddington

Fig. 24



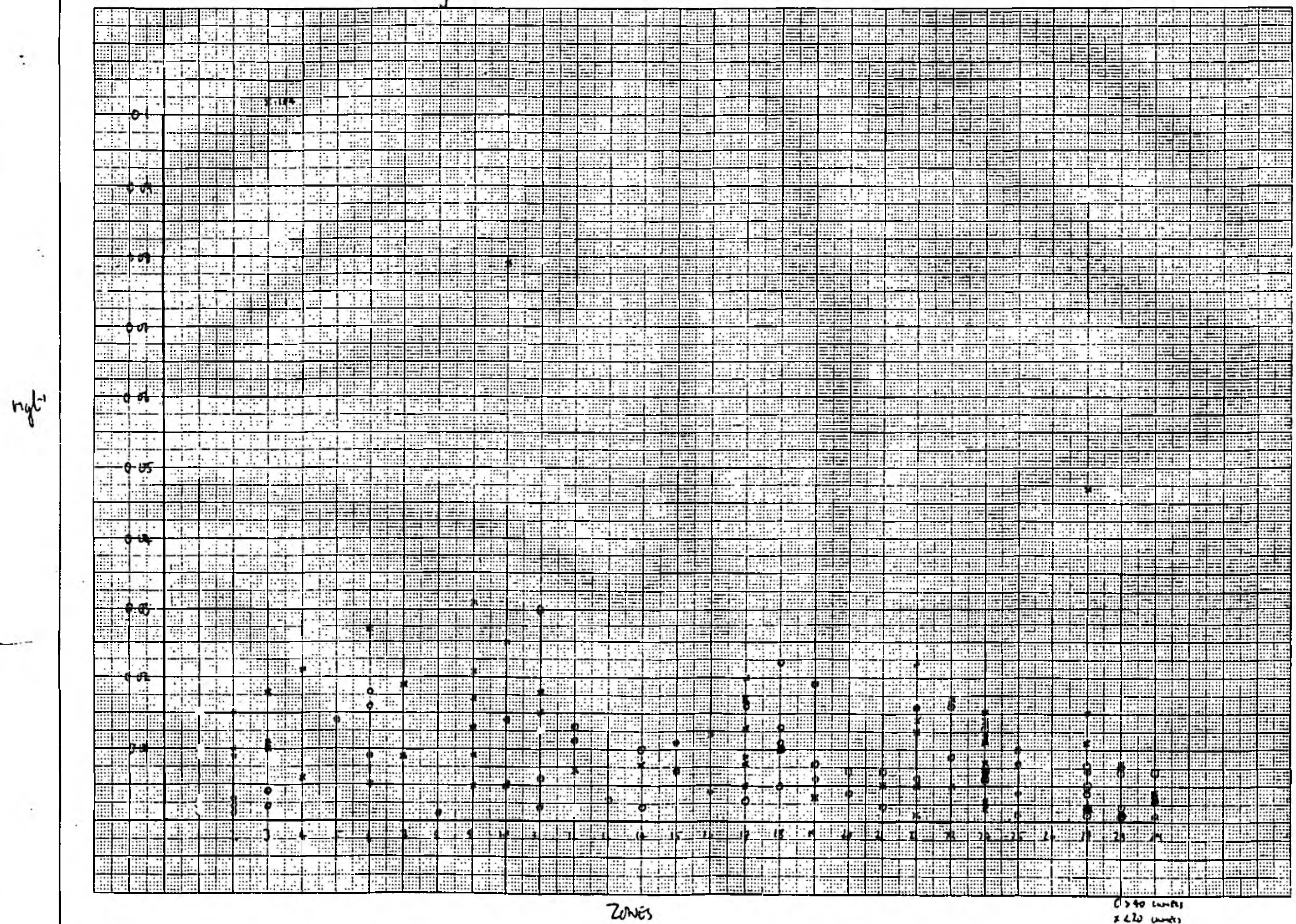
Variation in Cadmium Concentration in the Thames Zones in Relation to Flow Rates at Teddington.

Fig 25



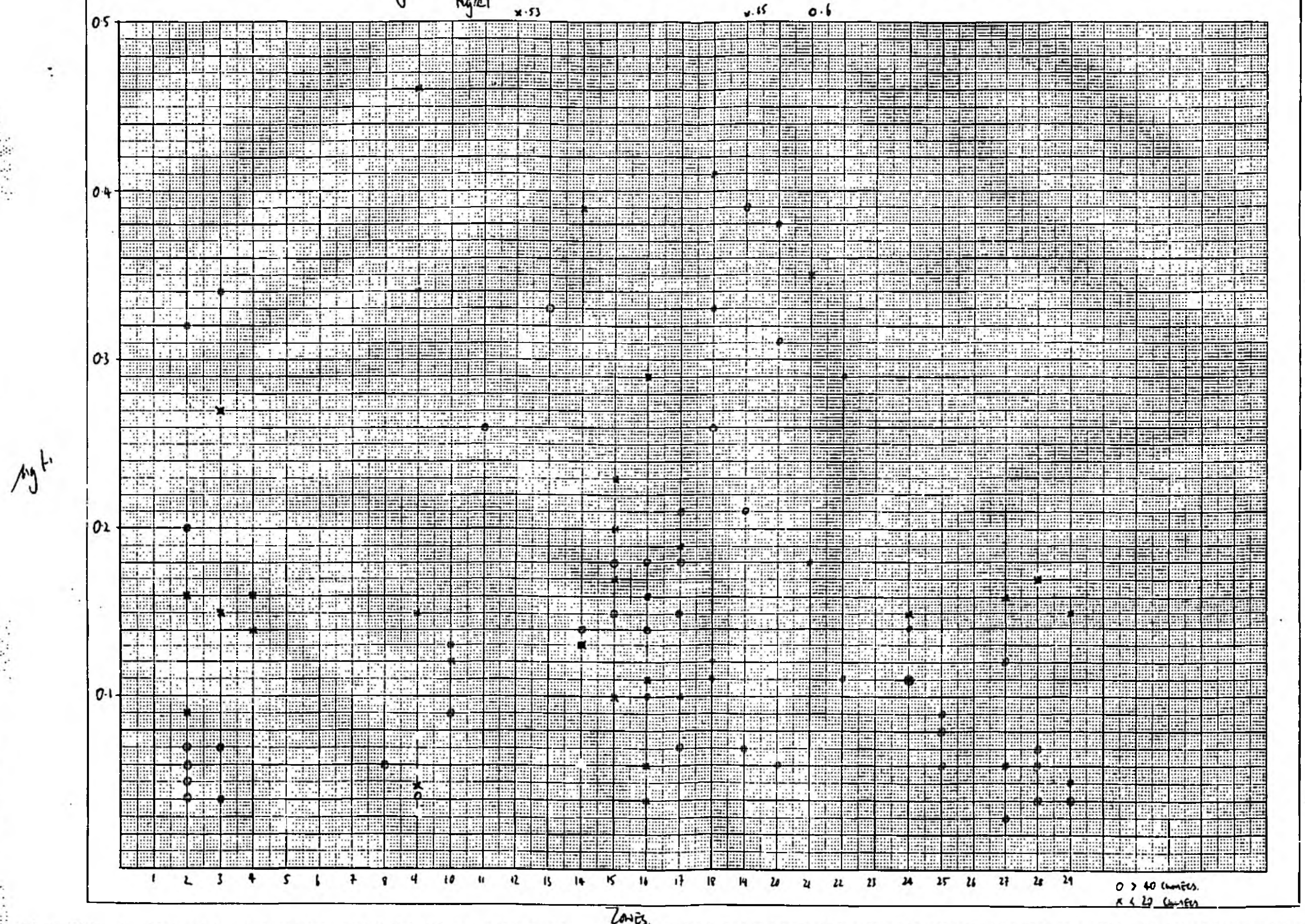
Variation in Copper Concentration in the Thames Zones in Relation to Flow Rates at Teddington Weir.

Fig. 26



Variation in Mercury Concentrations in the Thames Zones in relation to flow rates at Teddington.

Fig 27



Variation in Zinc Concentration throughout the Thames Zones in Relation to Flow Rates at Teddington.

Fig. 28.