NRA South West 187

# ENVIRONMENTAL PROTECTION

NRA

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South West Region

## IDENTIFICATION OF WATER QUALITY PROBLEMS IN THE STRAT AND NEET CATCHMENTS.

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Author :J.Proctor

GORDON H BIELBY BSc
Regional General Manager

C V M Davies
Environmental Protection
Manager

## SUMMARY.

A study was undertaken to determine the causes of non-compliance with the designated River Quality Objectives's (RQO) within the Strat and Neet catchments. Although the river system has a RQO of 1B the 1989 NWC classification showed the catchment to contain stretches of classes 3 and 4.

A desk study examined routine water quality data, farm campaign data and pollution risk assessments of industry to identify potential causes of water quality problems. A 24 hour water quality survey and a biological investigation augmented the desk study approach.

Diurnal water quality patterns resulting from the photosynthetic activity of planktonic and benthic algae have led to non-compliance with the 1B RQO's during the summer months. High nutrient loadings from the catchments together with high temperatures and low flows, exacerbated by the 1989 and 1990 droughts, have enabled large algal biomasses to develop in the lower catchment. Theoretical calculations revealed that the majority of this nutrient load is agricultural in origin.

Of the 128 farms in the catchment, 62 (= 48%) were identified as causing pollution or could potentially pollute, principally resulting from yard runoff problems. Agricultural runoff is thought to be the cause of non-compliance during the winter throughout the catchment.

Of the four significant STW's that discharge into the Rivers Strat and Neet only Week St. Mary was shown to have a major local impact on the receiving watercourse. The other STW's were not thought to present water quality problems in the catchment, although deteriorating summer effluent quality and low flows may lead to seasonal local problems.

None of the 8 significant trade discharges identified were considered to be polluting.

Insufficient water passes over the weir at the head of the Bude Canal into the River Strat leading to extreme water quality problems in stagnated stretches downstream in the River Strat. This weir should be modified to ameliorate problems during low flows.

The RQO of 1B is stricter than necessary to meet the uses of the Bude Canal. The nature of the water body is such that the RQO of 1B is probably unachievable and a more appropriate RQO of NWC Class 2 would be more approriate.

It is recommended that the effectiveness of the farm campaign and the performance of Week St. Mary STW to meet its new more stringent consent should be closely monitored.

Benthic Algae in the River Neet (1990).

The Low Flows Experienced in the River Strat (1990).

The Weir that Diverts Water into the River Strat - Taken at High Flow (1991).

Algal blooms in the River Strat (1990).

Breakdown of Algae (1990).

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# IDENTIFICATION OF WATER QUALITY PROBLEMS IN THE STRAT AND NEET CATCHMENTS.

## 1. INTRODUCTION.

The study was undertaken to determine the causes of non-compliance with River Quality Objectives (RQO) within the Strat and Neet catchments.

The report makes recommendations that once implemented will lead to an improvement in water quality.

A desk study was undertaken to examine routine water quality data used in the 1989 National Water Council (NWC) Classification. Farm campaign data and pollution risk assessments of agriculture and industry collected during 1990 and 1991 were also employed to identify potential causes of non-compliance.

Fieldwork was carried out during summer 1990 where necessary to augment the desk study approach.

## 2. THE STUDY AREA.

The Strat Catchment lies on the North-east coast of Cornwall and comprises two river systems the Strat and the Neet (see Fig. 1). Both rivers feed the Bude Canal.

There are two distinct physical divisions within the catchment: the Culm Ridges which lie in the eastern headwaters of the catchment, and the Strat Valley near Bude. The Culm Ridges are characterised by steep slopes greatly dissected by short, fast flowing streams. This has resulted in dramatic channel erosion in the catchment. The Strat Valley has more extensive areas of gently sloping land.

The Bude Canal has a weir near the head of the canal at Helebridge which diverts flow into the lower River Strat. During summer this section of the River Strat does not receive any river flow and as a consequence has a ponded freshwater section.

### 2.1. River Use.

The Strat and Neet Catchment has been assigned a River Quality Objectives of Class 1B and has the following identified uses:

* Protection of Aesthetic Quality
* Protection of Salmonid Fish
* Protection of Other Aquatic Life & Dependent Organisms
* Protection for Livestock Watering
* Protection for Irrigation of Crops

The Bude Canal in common with the rest of the catchment is designated for salmonid fish. However, the nature of the canal is such that a salmonid fishery could not be supported and a coarse fishery exists. Therefore, Bude Canal should be identified as a coarse fishery, which would consequently alter the RQO for the stretch.

## 2.2. River Quality.

There are 7 routine water quality monitoring sites within the catchment (see Fig. 1). Recent classifications at each site using the 1989 NWC water quality system are given in Table 1.

TABLE 1. River Quality Classification for the period 1987 to 1989 on the Rivers Strat and Neet (- = compliance with the 1B RQO).

| | pH | Temp. | Diss. Oxygen | BOD | Ammonia |
|---|---|---|---|---|---|
| River Strat: | | | | | |
| Stratton | - | 3 | - | 3 | 2 |
| Helebridge | - | - | 2 | 3 | 2 |
| Rodds Bridge | 3 | 3 | 2 | 4 | 2 |
| River Neet: | | | | | |
| Langford Bridge | - | - | 2 | 2 | 2 |
| Helebridge | - | 3 | 2 | - | - |
| Bude Canal: | | | | | |
| Rodds Bridge | - | 3 | 2 | - | 2 |
| Falcon Bridge | 3 | 3 | 2 | 2 | - |

## 3. SEWAGE TREATMENT WORKS.

The Strat and Neet Rivers receive significant effluent discharges from four sewage treatment works (STW). The details of the four works are given in the table below and their location is shown in Fig. 1.

TABLE 2. Consent and compliance of the 4 sewage treatment works.

| | NGR | Consent Determinands in mg/l | No. times consent exceeded |
|---|---|---|---|
| Widemouth Bay | SS2140 0340 | BOD=35, Solids=50 | 3 of 36 samples (1987-1989) |
| Week St. Mary | SX2373 9809 | BOD=10, Solids=15 Ammonia=3 | 4 of 4 samples. (since 4.4.91) |
| Jacobstow | SX2020 9580 | Descriptive | |
| Launcells | SS2620 0680 | Descriptive | |

Until recently only Widemouth Bay STW has had a numerical consent. Its consented conditions have been exceeded on 3 occasions (Suspended Solids-

SS, BOD, SS and BOD) in the period 1987-1989. It is envisaged that the consent for Widemouth Bay STW will be reviewed at a later date. The other works were descriptively consented. A numerical consent was applied to Week St. Mary STW on 4 April 1991. Four monthly samples have been taken since the issue of the consent and all samples have failed to comply with consented conditions (3 failed on BOD, SS and ammonia and 1 on BOD and SS only).

### 3.1. Impact assessment.

To obtain an assessment of the impact of the four STW's on water quality aquatic invertebrate samples (3+1 min kick) were taken up and downstream of the STW's (Ref 1). Theoretical impact assessments were made using routine data and calculation of available dilution.

#### Biological assessment.

No significant differences were found between the up and downstream sites when cluster analysis was used to sort invertebrate distribution. However, upstream of Week St. Mary STW discharge a sample could not be taken because there was not sufficient flow in the stream at the time of sampling. The site downstream of the works was grossly polluted. However, significant recovery had occurred in the macroinvertebrate community of the Week St. Mary Stream prior to its confluence (4 Km downstream) with the River Neet.

In a previous survey (Ref. 2) the upstream site was sampled and found to be of good quality, whereas the downstream site was again found to be grossly polluted.

#### Theoretical assessment.

Theoretical ADF and Q95 flows were used in the calculations since flow gauging data were unavailable. The consented flows were used for the calculations at Widemouth Bay and Week St. Mary STW's, whereas theoretical flows, based on the population served by the STW's, were used at Launcells and Jacobstow.

TABLE 3. Dilutions of the final effluents.

| | Dilution | |
|---|---|---|
| | ADF | Q95 |
| Widemouth Bay STW | 265X | 14X |
| Week St. Mary STW | 13X | none |
| Launcells STW | 8.5X | none |
| Jacobstow STW | 124X | 11X |

The maximum and mean ammonia concentrations measured in the final effluents were compared with the estimated dilutions to provide an estimate of the resultant concentrations within the river.

TABLE 4. Estimated ammonia concentrations (in mg/l) within the receiving river originating from the 4 STW's.

| | In FE | Estimated Ammonia Concentrations At ADF | At Q95 (mg/l) |
|---|---|---|---|
| Widemouth Bay STW | Mean ammonia | 0.018 | 0.335 |
| | Max. ammonia | 0.069 | 1.272 |
| Week St. Mary STW | Mean ammonia | 1.104 | 14.2 |
| | Max. ammonia | 4.441 | 57.1 |
| Launcell's STW | Mean ammonia | 0.187 | 12.7 |
| | Max. ammonia | 0.822 | 55.9 |
| Jacobstow STW | Mean ammonia | 0.095 | 1.05 |
| | Max. ammonia | 0.244 | 2.69 |

Theoretical calculations indicated that Week St. Mary STW had the greatest impact on water quality. Chronic pollution and hence RQO failure is likely to occur even during average flows (see Table 4). Launcell's STW can cause sporadic pollution during average flows. All STW's cause chronic pollution during Q95 flows except Widemouth Bay STW. However, this STW is likely to cause sporadic pollution during flows lower than Q95.

These theoretical calculations were supported by the invertebrate results (see above). Compliance with the new and much tighter consent at Week St. Mary should reduce the local impact of this STW, although the absence of dilution at the theoretical Q95 could still cause pollution problems. The possible transfer of effluent from Week ST. Mary to Widemouth Bay STW has recently been proposed (1991).

It is concluded that the STW final effluents are generally diluted by the receiving watercourses, except at Week St. Mary where a local problem was identified.

## 4. TRADE DISCHARGES.

### 4.1. Tiscott Wood Disposal Site (NGR SS 232 093)

A site assessment was carried out during 1990 (Ref. 3). The study stated that 4680 tonnes per annum of commercial, domestic and industrial waste is received at this site. A medium/high pollution risk to surface water was attributed to this site. Leachate springs emerge from the site and combine with surface water springs in a marsh on the valley floor. The tip liquor is pumped to nearby woods for soakaway.

Invertebrate samples were taken up and downstream of the disposal site in the River Strat (Ref. 1). The communities of these samples were indicative of good water quality.

### 4.2. Mink Farm (NGR SS 234 077)

The mink farm that was previously thought to have caused ware quality problems has since closed down.

### 4.3. Caravan Sites

The details of the 6 sites identified are given in the table below. Any discharges were investigated by the Pollution Section (1991) and did not appear to represent potential pollution problems. However, following these investigations the discharge from Ivyleaf Combe was found not to be consented. Improvements to the treatment process and the consent application are now being undertaken.

TABLE 5. Details of the caravan sites.

| Name | No. units | NGR | Sewage Disposal Arrangement |
|---|---|---|---|
| Upper Lynstone Farm | 80 | SS206 054 | Mains sewer to the Long-sea outfall at Bude |
| Wooda Valley | 35 | SS232 082 | Mains sewer to the Long-sea outfall at Bude |
| Ivyleaf Combe | 100 | SS233 086 | Aeration treatment plant to R.Strat |
| Bude Meadows Caravan Park | 100 | SS215 010 | Bio disc to grass treatment plots to R.Strat |
| Keywood | 40 | SX254 996 | Septic tank with monojet to biological filter to R.Strat |
| Bude Caravan Park | 1000 | SS205 080 | Mains sewer to the Long-sea outfall at Bude |

## 5. FARMS.

Examination of routine water quality data revealed high BOD and ammonia concentrations throughout the catchment during the winter months (Appendix II). These were associated with rainfall. This common input associated with rainfall is thought to result from agricultural runoff.

### 5.1. Farm Campaign 1990.

Of the 128 farms in the Strat and Neet catchments the majority are mixed stock farms.

20% of the farms were polluting (red code) at the time of the Farm Campaign whilst 29% had the potential to pollute (green code). Therefore, 48% of all the farms in the catchment have the potential to or do pollute. The location of the farms according to their pollution codes is indicated on Fig. 2.

73% of the pollution problems were due to yard runoff while lagoon overflow, silage problems and land runoff accounted equally for the remainder.

Intensive farms, which have weeping walls and lagoons, have tended to pollute (see Table 6).

TABLE 6. Percentage of farms storing waste in relation to pollution codes allocated during the farm campaign.

| | Weeping wall | Lagoon | Dung heap | Tank |
|---|---|---|---|---|
| Red and Green code farms | 16 | 50 | 76 | 3 |
| Blue code farms (no risk) | 5 | 8 | 86 | 0 |

All polluting and potentially polluting farms have been advised to seek professional assistance to resolve the drainage difficulties. At an appropriate time these farms will be revisited to ensure that remedial works have been implemented.

Yard runoff and poor farm waste storage have led to an extensive agricultural nutrient input and pollution events throughout the catchment (see Fig. 2).

## 6. EUTROPHICATION.

### 6.1. Bude Canal.

The water quality problems identified from routine data collected from the Bude Canal have involved high pH, temperature, ammonia, BOD and extremes of dissolved oxygen. These have occurred during the summer months (see Appendix II).

The timing of the routine sample collection has been important as temperature, dissolved oxygen, pH and BOD are all higher when the sample has been taken in the afternoon.

These water quality problems and the diurnal pattern of the above determinands are characteristic of photosynthetic activity.

Bude Canal has a RQO of 1B, which is inappropriate for the slow-flowing conditions and the coarse fishery which it supports.

### 6.2. Strat and Neet Rivers.

Similar patterns of water quality exist within the Strat and Neet rivers, in particular at Helebridge, Rodd's Bridge and Stratton on the River Strat and Helebridge on the River Neet. These have led to non-compliance with the RQO's during the summer months.

Very high amounts of benthic algae (up to 100% cover) have been noted in the catchment. Photosynthetic activity of benthic algae appears to have caused these summer water quality problems.

Nutrient loadings from farm waste and the STW final effluents coupled with low flow conditions provide suitable conditions for algal growth.

Extreme values for pH, temperature, dissolved oxygen, BOD, suspended solids and ammonia have been recorded at Rodd's Bridge on the River Strat. The River Strat downstream of its separation from the Bude Canal experiences extremely low flows due to the presence of a weir that prevents adequate flows entering the River Strat.

### 6.3. Source of nutrients.

Calculations were made to provide estimates of the contribution of the STW's final effluents to the nitrogen loading of the receiving waters. These were calculated at Stratton on the River Strat and at Helebridge on the River Neet, where algal growths occur.

The mean ammonia loadings from the STW's over 3 years (1987-1989) and the approximate loadings within the receiving watercourse (mean ammonia concentration X ADF) were used in the calculations. Other nutrient determinands are not measured routinely in the final effluents and so could not be included in these calculations.

The STW'S were found to contribute little to the ammonia loading of the receiving river (see Table 7).

TABLE 7. Estimated ammonia loadings from the STW final effluents and within the river at Helebridge.

| | Ammonia Loading (mg/day) | | |
|---|---|---|---|
| STW | Final Effluent | Helebridge | % |
| Widemouth Bay | 1 185 720 | 14 310 864 | 8 |
| Week St. Mary | 852 000 | 13 458 864 | 6 |
| Jacobstow | 181 720 | 14 129 144 | 1 |
| Launcells | 257 810 | 8 196 084 | 3 |

It is concluded that the cause of eutrophication is farm waste.

### 6.4. 24 hour Investigation

The summer water quality problems identified during routine monitoring and thought to result from algal growths were investigated further with a 24 hour water quality survey.

Hourly measurements of dissolved oxygen, BOD, ammonia, pH, suspended solids and temperature were taken manually over a period of 24 hours on the 1 and 2 August 1990 at 6 sites in the catchment. These data are represented graphically in Appendix III.

TABLE 8. Location of the survey sites.

| Description | NGR | |
|---|---|---|
| Rodd's Bridge, Bude Canal | SS | 211 048 |
| Rodd's Bridge, R.Strat | SS | 212 048 |
| Helebridge, R.Strat | SS | 215 037 |
| 100m D/S STW, R.Neet | SS | 214 035 |
| STW Final Effluent | SS | 215 034 |
| 50m U/S STW, R.Neet | SS | 215 032 |

The pattern of dissolved oxygen concentrations recorded at all the sites is typical of waters with a diurnal variation in photosynthetic activity and respiratory demand. At all the sites except at Helebridge on the River Strat the percentage saturation of oxygen fell beneath the RQO standard of 60% at night. This diurnal variation in dissolved oxygen is exacerbated by the low flows at Rodd's Bridge on the River Strat.

pH values at Rodd's Bridge on the River Strat rose to 9.5 and remained over 9 for 2 hours and exceeded the limits for the 1B RQO. The variation in river pH is characteristic of photosynthetic activity.

The suspended solids concentrations recorded at all of the survey sites exceeded the standard for the 1B RQO over the 24 hour period. Peaks of BOD were often found to coincide with peaks of suspended solids. Casual observations indicated that these peaks are probably due to the presence of algae in the samples. The movement of algae in the water column is possible, but not well documented. Benthic algae would rise with photosynthetic activity, but this would require ponded or extremely slow-flowing stretches of river as at Rodd's Bridge on the River Strat. In other sites physical disturbance by cattle and people is a more likely cause of the peaks and variance in the data.

Apart from marginally high ammonia values recorded downstream of Widemouth Bay STW, concentrations at the other sites were much lower and within the requirements of a class 1B river.

Smooth temperature profiles were not obtained due to operational problems with the digital thermometers. However, temperatures in excess of the 21.5 °C standard for a class 1B river were recorded at every site included in the survey.

### 6.5. Autumn Ammonia Problems

High ammonia concentrations were recorded during autumn 1987 (22.09.87) at 3 locations within the catchment and were not associated with high BOD values.

Further investigation is required to determine whether ammonia is released during the breakdown of algal matter during autumn.

## 7. DROUGHT.

The 1989 and 1990 droughts drastically reduced river flows throughout the catchment which probably exacerbated water quality non-compliance.

Land drainage in the upper catchment compounds the problem of low summer flows by reducing the base flow component.

Previous to the drought years of 1989 and 1990, recorded temperature levels during routine monitoring had not exceeded the 21.5 °C limit for a class 1B river. However, the time temperatures are taken must be borne in mind as the high temperature in 1989 was recorded at 13.20 whereas in 1987 and 1988 the latest temperature recording was made at 11.15 in the morning.

The river locations failing the temperature criteria for a Class 1B river were at Rodd's Bridge and Stratton on the River Strat, Falcon Bridge and Rodd's Bridge on the Bude Canal and Helebridge on the River Neet. The exposed nature of the lower catchment with little shade results in temperature regimes characterised by large diurnal and annual variation (see Appendix II & III). High temperatures will lead to greater algal productivity. Promoting tree growth along the river banks would help to mitigate this water quality problem.

## 8. CONCLUSIONS.

1. Diurnal water quality patterns resulting from the photosynthetic activity of planktonic and epilithic algae have led to extremes in dissolved oxygen concentrations and pH, which exceed RQO's of 1B during summer months.

2. High nutrient loadings from the catchments together with high temperatures and low flows, exacerbated by the droughts, have enabled large algal biomasses to develop in the lower catchment.

3. The majority of the nutrient load is thought to be agricultural in origin. STW's contribute little to the ammonia load of the rivers.

4. 48.4% of the farms in the catchment were identified as either causing pollution or having the potential to pollute, principally due to yard runoff problems.

5. Agricultural runoff is thought to be the cause of high ammonia and BOD concentrations, which exceed the RQO's of 1B, during winter throughout the catchment.

6. Of the four STW's that discharge into the Strat and Neet rivers only Week St. Mary was shown to have a major local impact on the receiving watercourse.

7. The other STW's were not thought to cause water quality problems in the catchment, although deteriorating summer effluent quality and low flows may lead to seasonal local problems, especially at Widemouth Bay STW.

8. None of the trade discharges identified were considered to be polluting.

9. High autumn concentrations of ammonia within the catchment are likely to result from the breakdown of the benthic algal biomass.

10. The low flows experienced during the 1989 and 1990 droughts exacerbated the summer water quality problems.

11. Insufficient water passes over the weir at the head of the Bude Canal into the River Strat leading to extreme water quality problems in stagnated stretches downstream in the R.Strat.

12. The RQO of 1B is stricter than necessary to maintain the uses of the Bude Canal and the nature of the water body is such that an RQO of NWC Class 2 would be more appropriate.

## 9. RECOMMENDATIONS.

1. The RQO for the Bude Canal should be changed from 1B to 2 and the Bude Canal designated for coarse fish.

   - Action Freshwater Scientist.

2. The weir at the head of the Bude Canal, which diverts water into the River Strat should be modified to allow sufficient water down the R.Strat. North Cornwall District Council operate the canal and weir, and also the weir below Nanny Moore's Bridge. Consultation is needed on the method of operation of these.

   - Action Water Resources Protection Officer/Fisheries Officer.

3. An appraisal of the effectiveness of the farm campaign should be carried out by assessing any improvement in routine biological and chemical water quality data and also by assessing the state of the farms on revisits.

   - Action Pollution Officer/Freshwater Officer.

4. The performance of Week St. Mary STW to its new more stringent consent should be monitored using routine data.

   - Action Quality Regulation Officer.

5. Further investigation is required to determine whether ammonia is released during the breakdown of algal matter during autumn.

   - Action Catchment Scientist.

6. Phosphate should be measured in all significant effluent discharges.

   - Action Quality Regulation Officer.

## 10. REFERENCES.

1. Geatches,T.R. (1991) Biological Investigations of the River Strat and River Neet Catchments July 1990. FWI/91/009

2. Hilton,B.S. (1988) Macroinvertebrate Survey of the Rivers Neet and Strat.

3. Waste Disposal Site Assessment Study (8905/46)

**Figure 1.** **Strat & Neet Catchments**

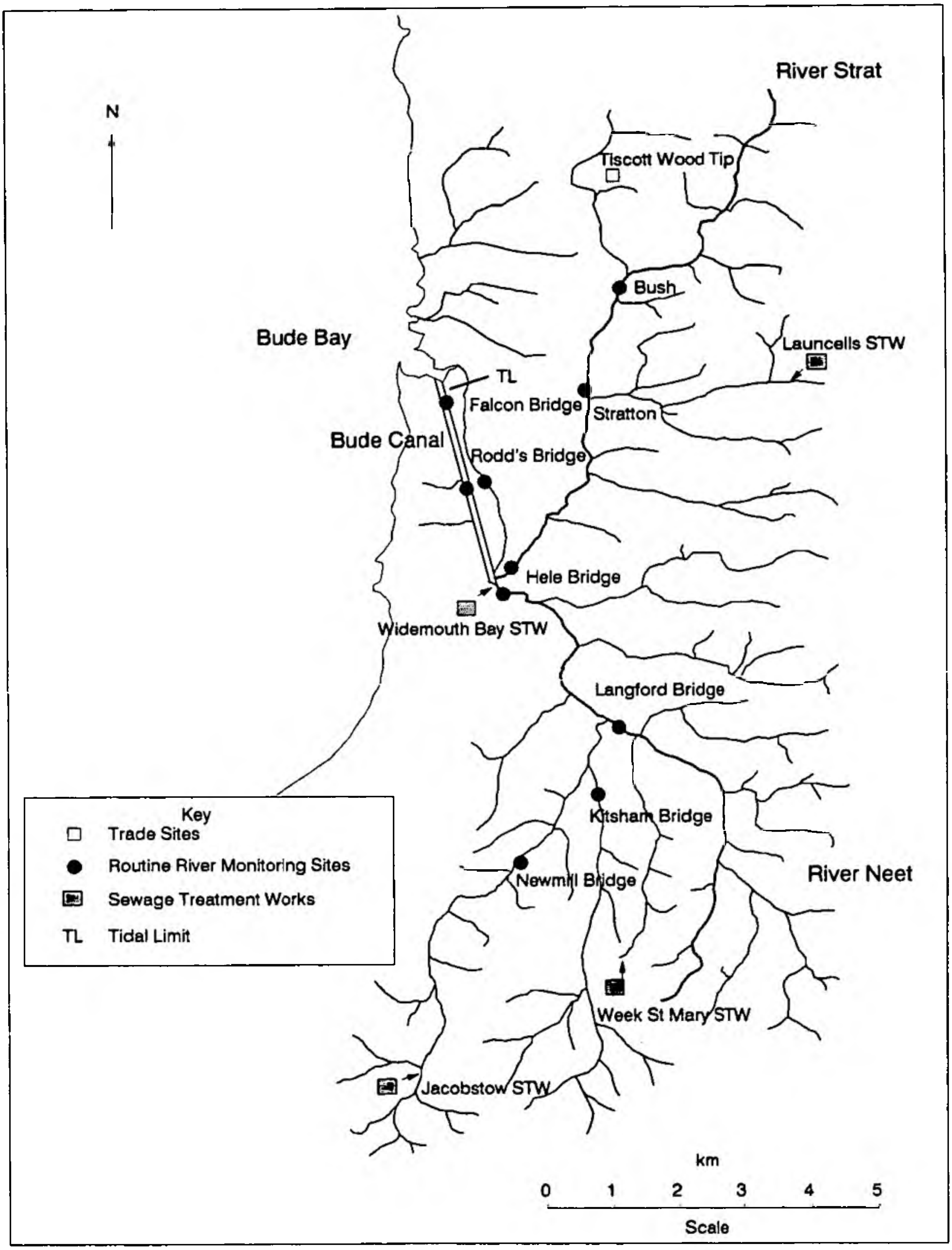
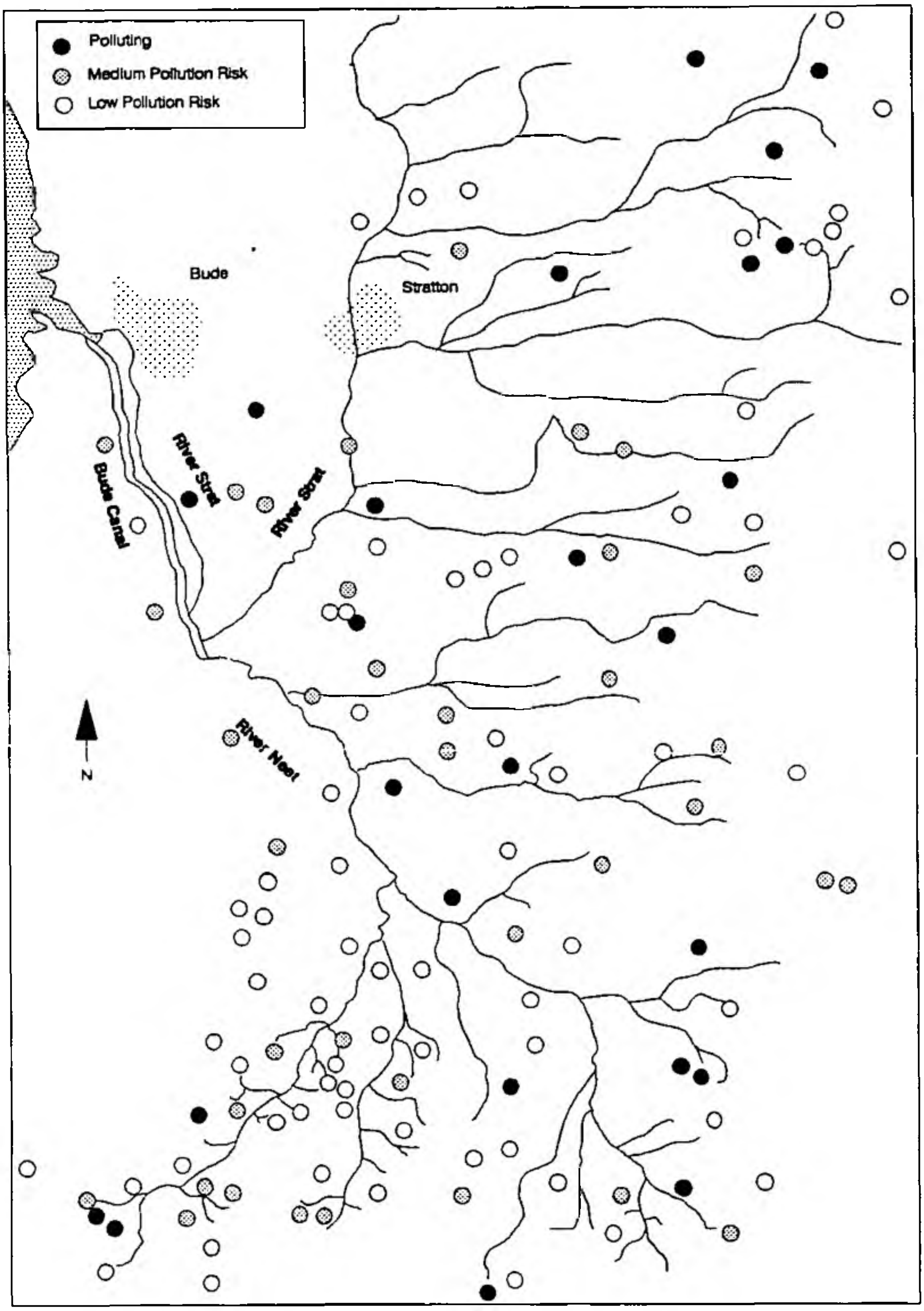


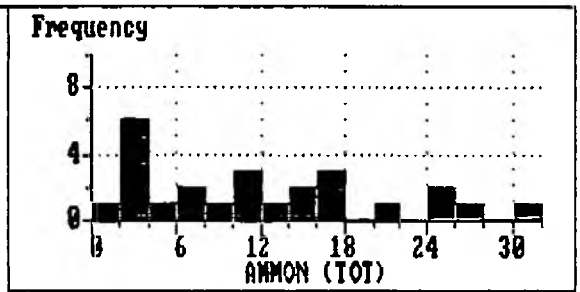
**Figure 2. Pollution codes allocated to farms in the River Strat & Neet Catchments**

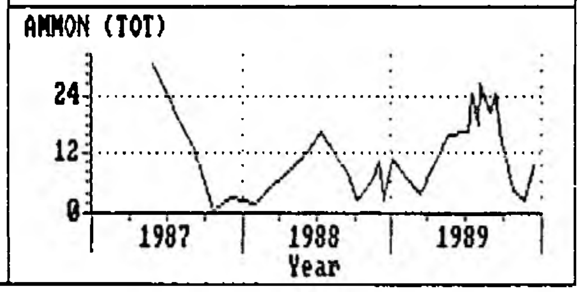


APPENDIX I. Routine Monitoring Data for the four Sewage Treatment Works in the Strat and Neet Catchments (01.01.87 - 31.12.89).

JACOBSTOW FINAL EFFLUENT AMMON (TOT) 27/ 5/87 to 12/12/89

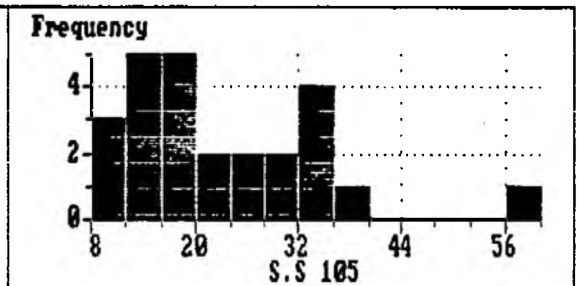
| | |
|---|---|
| Number of observations | 25 |
| Minimum | 0.7 |
| Mean | 11.8 |
| Maximum | 30.2 |
| Standard deviation | 8.66 |
| SDD | 5.74 |
| Non-parametric estimate of: | |
| 5 percentile | 1.1 |
| 10 percentile | 2.1 |
| 20 percentile | 2.5 |
| Median | 10.6 |
| 80 percentile | 19.8 |
| 90 percentile | 25.1 |
| 95 percentile | 29.0 |

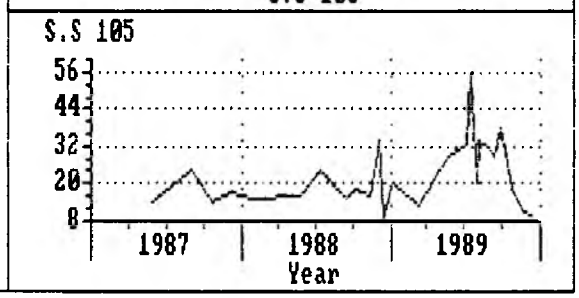



JACOBSTOW FINAL EFFLUENT S.S 105 27/ 5/87 to 12/12/89

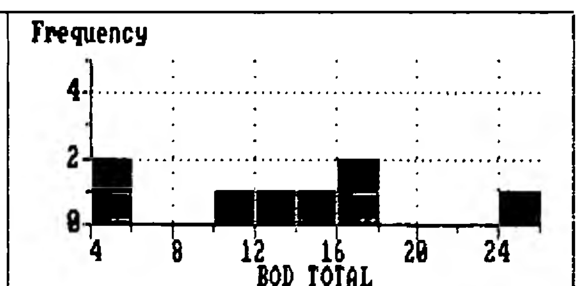
| | |
|---|---|
| Number of observations | 25 |
| Minimum | 9.0 |
| Mean | 22.4 |
| Maximum | 56.0 |
| Standard deviation | 11.01 |
| SDD | 9.79 |
| Non-parametric estimate of: | |
| 5 percentile | 9.3 |
| 10 percentile | 10.6 |
| 20 percentile | 14.0 |
| Median | 18.0 |
| 80 percentile | 32.8 |
| 90 percentile | 35.6 |
| 95 percentile | 50.6 |

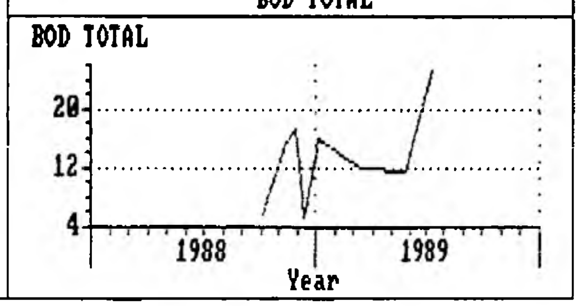



JACOBSTOW FINAL EFFLUENT BOD TOTAL 27/ 5/87 to 12/12/89

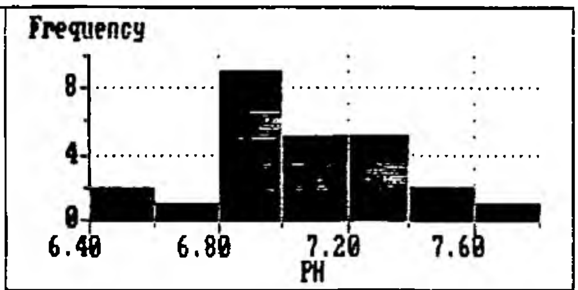
| | |
|---|---|
| Number of observations | 8 |
| Minimum | 5.30 |
| Mean | 13.45 |
| Maximum | 25.00 |
| Standard deviation | 6.389 |
| SDD | 6.699 |
| Non-parametric estimate of: | |
| 20 percentile | 5.70 |
| Median | 13.50 |
| 80 percentile | 18.60 |

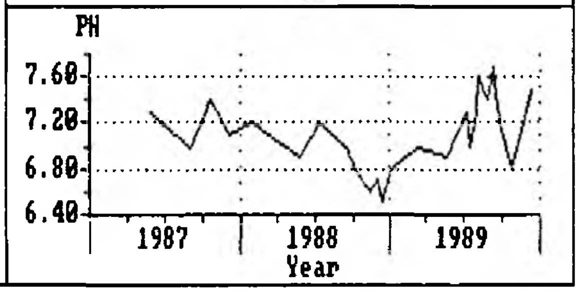


JACOBSTOW FINAL EFFLUENT PH 27/ 5/87 to 12/12/89

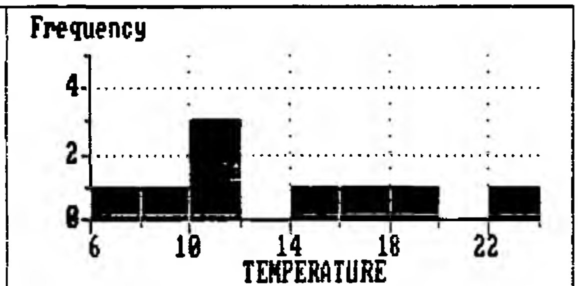
| | |
|---|---|
| Number of observations | 25 |
| Minimum | 6.500 |
| Mean | 7.096 |
| Maximum | 7.700 |
| Standard deviation | 0.3075 |
| SDD | 0.2116 |
| Non-parametric estimate of: | |
| 5 percentile | 6.530 |
| 10 percentile | 6.660 |
| 20 percentile | 6.800 |
| Median | 7.100 |
| 80 percentile | 7.380 |
| 90 percentile | 7.540 |
| 95 percentile | 7.670 |

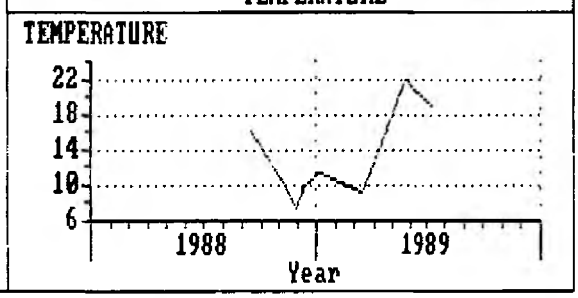



JACOBSTOW FINAL EFFLUENT TEMPERATURE 27/ 5/87 to 12/12/89

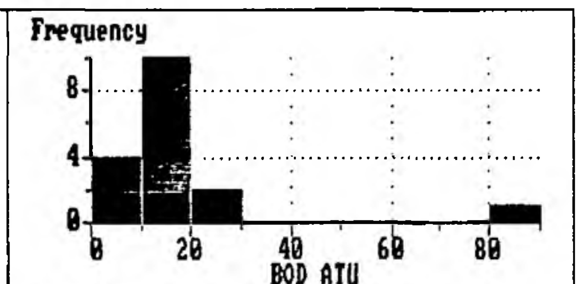
| | |
|---|---|
| Number of observations | 9 |
| Minimum | 7.40 |
| Mean | 13.21 |
| Maximum | 22.00 |
| Standard deviation | 4.927 |
| SDD | 3.964 |
| Non-parametric estimate of: | |
| 10 percentile | 7.40 |
| 20 percentile | 9.00 |
| Median | 11.50 |
| 80 percentile | 19.00 |
| 90 percentile | 22.00 |

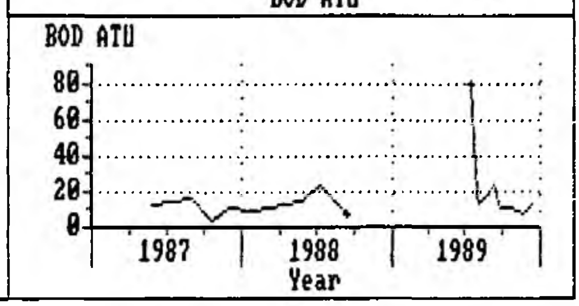



JACOBSTOW FINAL EFFLUENT BOD ATU 27/ 5/87 to 12/12/89

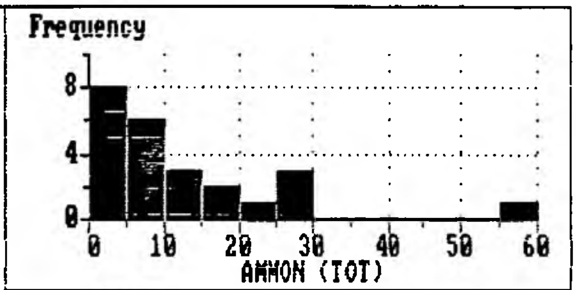
| | |
|---|---|
| Number of observations | 17 |
| Minimum | 4.0 |
| Mean | 16.8 |
| Maximum | 80.0 |
| Standard deviation | 17.19 |
| SDD | 13.18 |
| Non-parametric estimate of: | |
| 10 percentile | 5.6 |
| 20 percentile | 7.4 |
| Median | 12.0 |
| 80 percentile | 20.0 |
| 90 percentile | 35.2 |

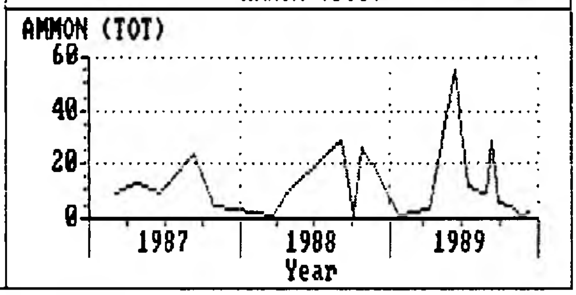


LAUNCELLS FINAL EFFLUENT AMMON (TOT) 5/ 3/87 to 12/12/89

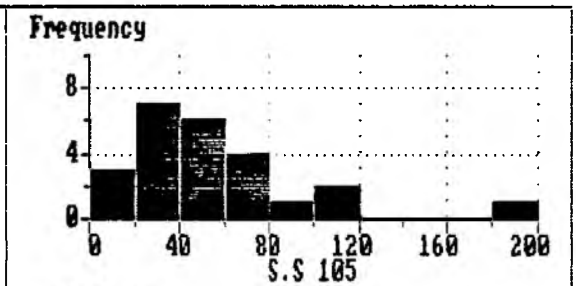
| | |
|---|---|
| Number of observations | 24 |
| Minimum | 0.5 |
| Mean | 12.7 |
| Maximum | 55.9 |
| Standard deviation | 12.81 |
| SDD | 13.85 |
| Non-parametric estimate of: | |
| 5 percentile | 0.6 |
| 10 percentile | 0.8 |
| 20 percentile | 1.9 |
| Median | 9.7 |
| 80 percentile | 24.3 |
| 90 percentile | 28.6 |
| 95 percentile | 49.1 |

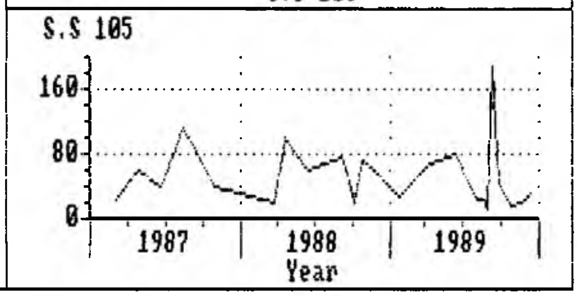



LAUNCELLS FINAL EFFLUENT S.S 105 5/ 3/87 to 12/12/89

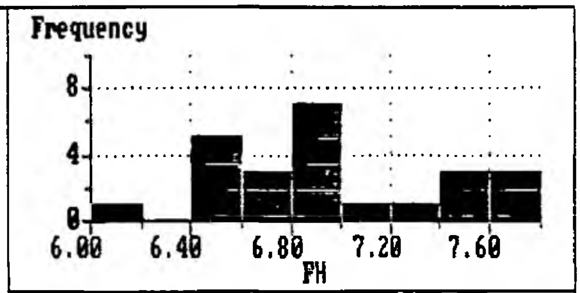
| | |
|---|---|
| Number of observations | 24 |
| Minimum | 11.0 |
| Mean | 53.2 |
| Maximum | 190.0 |
| Standard deviation | 40.61 |
| SDD | 43.61 |
| Non-parametric estimate of: | |
| 5 percentile | 12.2 |
| 10 percentile | 17.5 |
| 20 percentile | 21.0 |
| Median | 41.0 |
| 80 percentile | 78.0 |
| 90 percentile | 105.5 |
| 95 percentile | 170.2 |

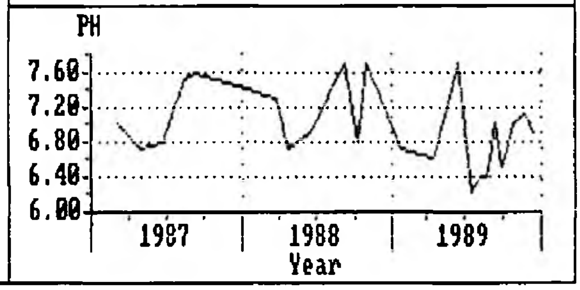


LAUNCELLS FINAL EFFLUENT PH 5/ 3/87 to 12/12/89

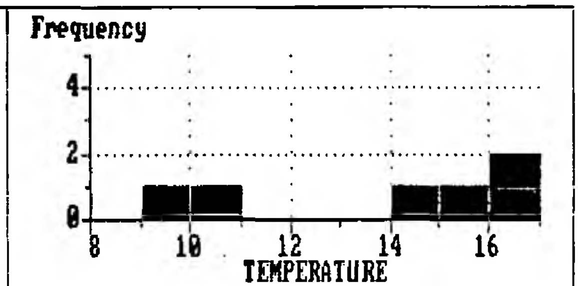
| | |
|---|---|
| Number of observations | 24 |
| Minimum | 6.200 |
| Mean | 6.971 |
| Maximum | 7.700 |
| Standard deviation | 0.4525 |
| SDD | 0.4413 |
| Non-parametric estimate of: | |
| 5 percentile | 6.250 |
| 10 percentile | 6.400 |
| 20 percentile | 6.600 |
| Median | 6.900 |
| 80 percentile | 7.500 |
| 90 percentile | 7.700 |
| 95 percentile | 7.700 |

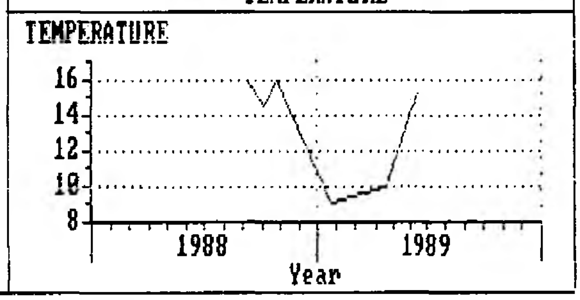



LAUNCELLS FINAL EFFLUENT TEMPERATURE 5/ 3/87 to 12/12/89

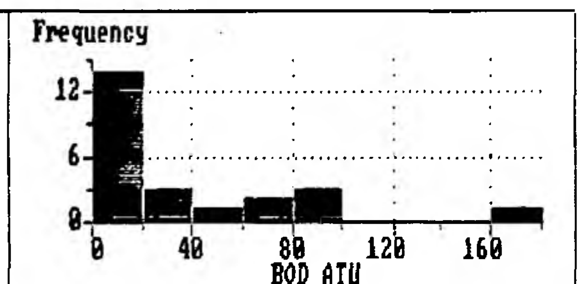
| | |
|---|---|
| Number of observations | 6 |
| Minimum | 9.00 |
| Mean | 13.47 |
| Maximum | 16.00 |
| Standard deviation | 3.138 |
| SDD | 3.213 |
| Non-parametric estimate of: | |
| 20 percentile | 9.40 |
| Median | 14.90 |
| 80 percentile | 16.00 |

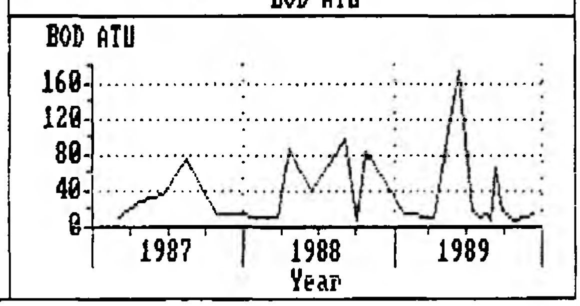



LAUNCELLS FINAL EFFLUENT BOD ATU 5/ 3/87 to 12/12/89

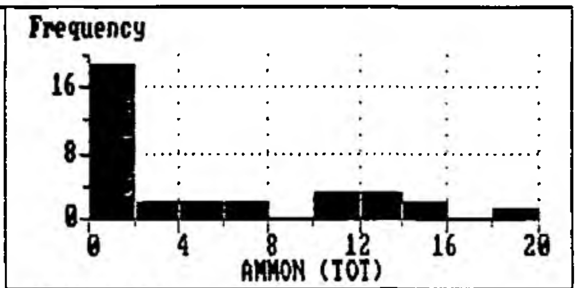
| | |
|---|---|
| Number of observations | 24 |
| Minimum | 7.0 |
| Mean | 37.1 |
| Maximum | 172.0 |
| Standard deviation | 40.88 |
| SDD | 45.29 |
| Non-parametric estimate of: | |
| 5 percentile | 7.0 |
| 10 percentile | 7.1 |
| 20 percentile | 9.8 |
| Median | 15.0 |
| 80 percentile | 74.0 |
| 90 percentile | 91.5 |
| 95 percentile | 153.2 |

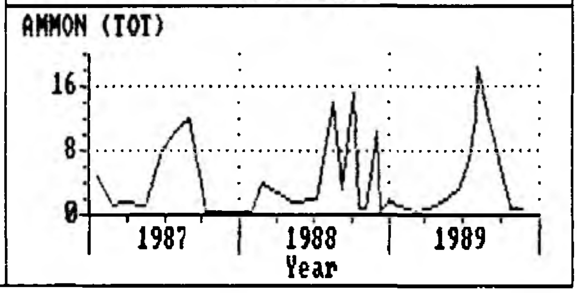


WIDEMOUTH BAY FINAL EFFLUENT    AMMON (TOT)    21/ 1/87 to 21/11/89

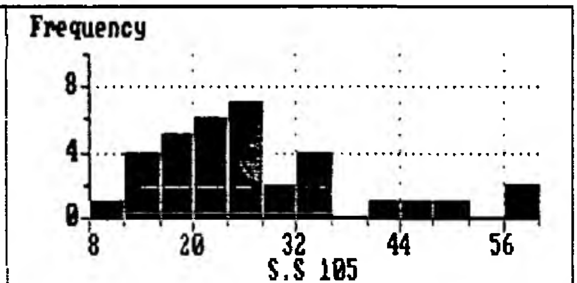
| | |
|---|---|
| Number of observations | 34 |
| Minimum | 0.50 |
| Mean | 4.82 |
| Maximum | 18.30 |
| Standard deviation | 5.396 |
| SDD | 4.492 |
| Non-parametric estimate of: | |
| 5 percentile | 0.50 |
| 10 percentile | 0.50 |
| 20 percentile | 0.60 |
| Median | 1.50 |
| 80 percentile | 11.40 |
| 90 percentile | 13.45 |
| 95 percentile | 15.90 |

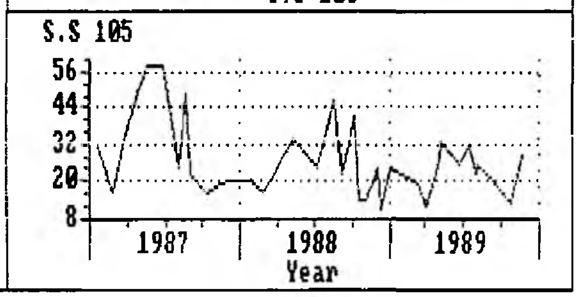



WIDEMOUTH BAY FINAL EFFLUENT    S.S 105    21/ 1/87 to 21/11/89

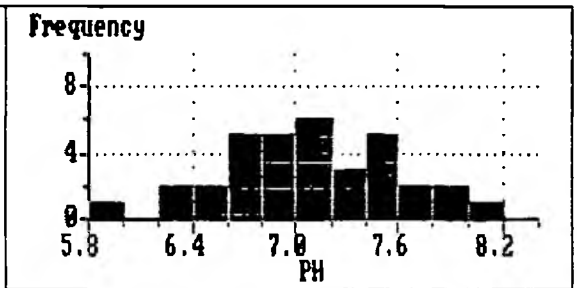
| | |
|---|---|
| Number of observations | 34 |
| Minimum | 11.0 |
| Mean | 26.4 |
| Maximum | 58.0 |
| Standard deviation | 12.22 |
| SDD | 10.86 |
| Non-parametric estimate of: | |
| 5 percentile | 11.7 |
| 10 percentile | 13.5 |
| 20 percentile | 16.0 |
| Median | 24.0 |
| 80 percentile | 34.0 |
| 90 percentile | 48.0 |
| 95 percentile | 58.0 |

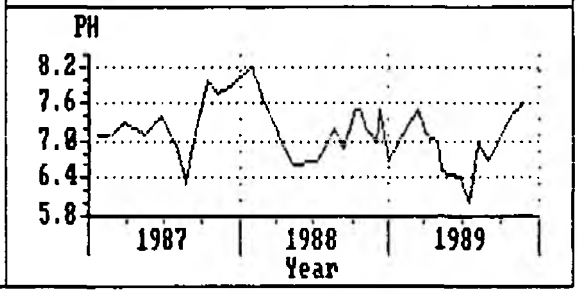


WIDEMOUTH BAY FINAL EFFLUENT — PH — 21/ 1/87 to 21/11/89

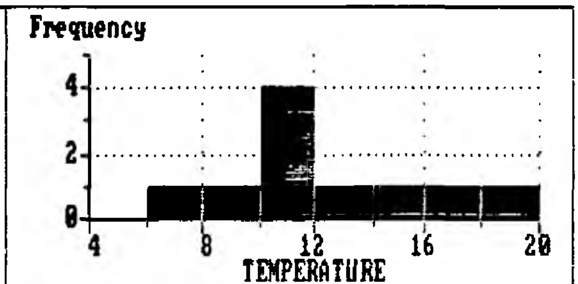
| | |
|---|---|
| Number of observations | 34 |
| Minimum | 6.000 |
| Mean | 7.129 |
| Maximum | 8.200 |
| Standard deviation | 0.5024 |
| SDD | 0.3608 |
| Non-parametric estimate of: | |
| 5 percentile | 6.225 |
| 10 percentile | 6.450 |
| 20 percentile | 6.700 |
| Median | 7.100 |
| 80 percentile | 7.500 |
| 90 percentile | 7.850 |
| 95 percentile | 8.050 |

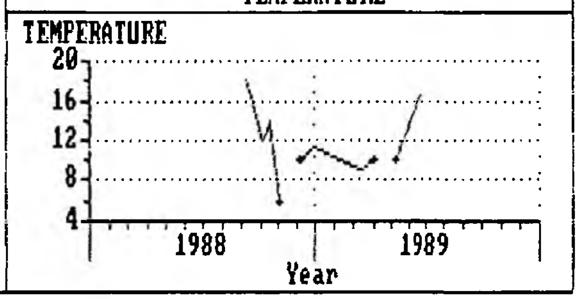



WIDEMOUTH BAY FINAL EFFLUENT — TEMPERATURE — 21/ 1/87 to 21/11/89

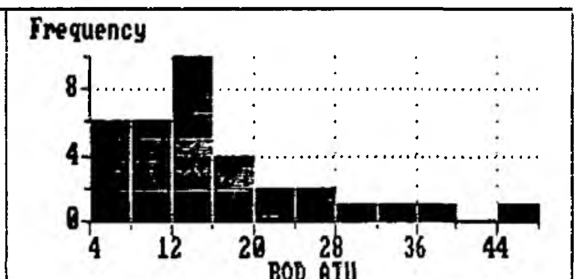
| | |
|---|---|
| Number of observations | 10 |
| Minimum | 6.00 |
| Mean | 11.70 |
| Maximum | 18.00 |
| Standard deviation | 3.599 |
| SDD | 3.603 |
| Non-parametric estimate of: | |
| 10 percentile | 6.30 |
| 20 percentile | 9.20 |
| Median | 10.75 |
| 80 percentile | 16.00 |
| 90 percentile | 17.85 |

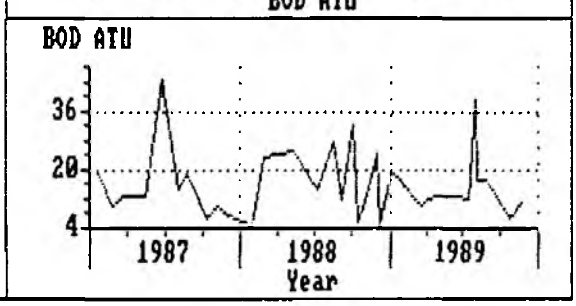



WIDEMOUTH BAY FINAL EFFLUENT — BOD ATU — 21/ 1/87 to 21/11/89

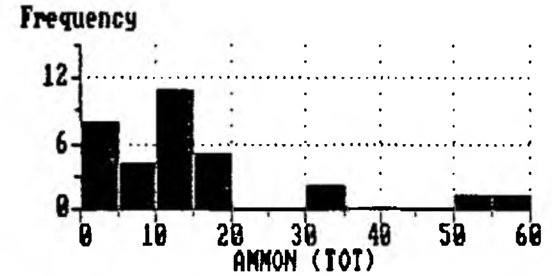
| | |
|---|---|
| Number of observations | 34 |
| Minimum | 4.4 |
| Mean | 15.8 |
| Maximum | 45.0 |
| Standard deviation | 9.40 |
| SDD | 10.09 |
| Non-parametric estimate of: | |
| 5 percentile | 4.5 |
| 10 percentile | 5.9 |
| 20 percentile | 9.9 |
| Median | 13.0 |
| 80 percentile | 23.0 |
| 90 percentile | 30.0 |
| 95 percentile | 40.5 |

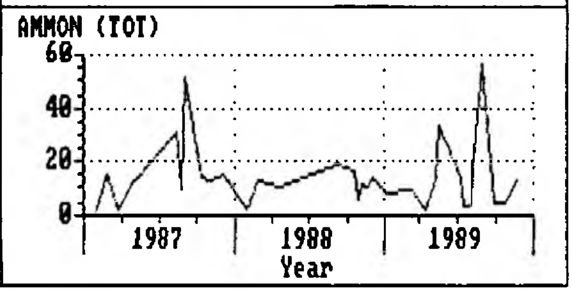


WEEK ST MARY FINAL EFFLUENT AMMON (TOT) 27/ 1/87 to 21/11/89

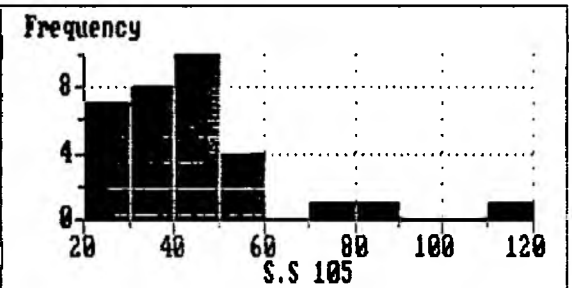
| | |
|---|---|
| Number of observations | 32 |
| Minimum | 0.5 |
| Mean | 14.2 |
| Maximum | 57.1 |
| Standard deviation | 12.91 |
| SDD | 13.33 |
| Non-parametric estimate of: | |
| 5 percentile | 1.3 |
| 10 percentile | 2.4 |
| 20 percentile | 4.0 |
| Median | 12.3 |
| 80 percentile | 17.2 |
| 90 percentile | 32.6 |
| 95 percentile | 53.3 |

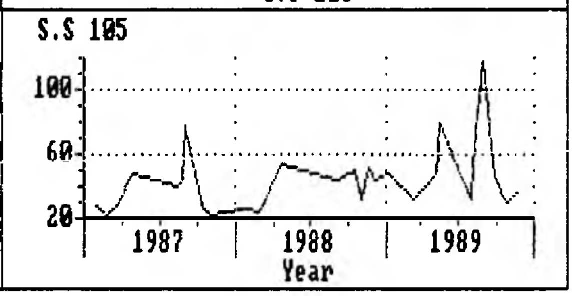



WEEK ST MARY FINAL EFFLUENT S.S 105 27/ 1/87 to 21/11/89

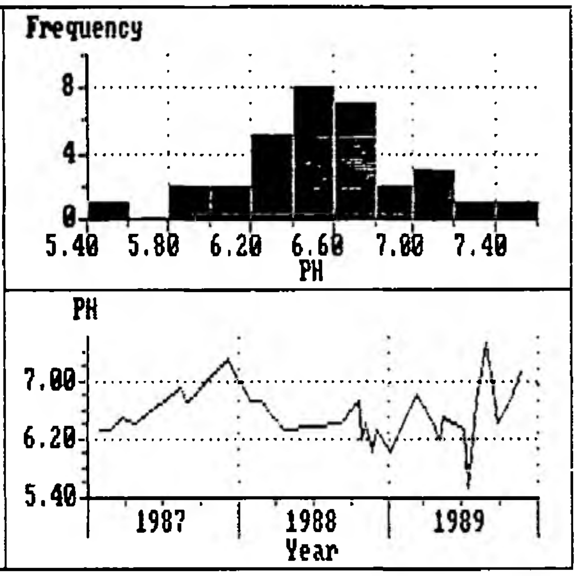
| | |
|---|---|
| Number of observations | 32 |
| Minimum | 21.0 |
| Mean | 42.9 |
| Maximum | 118.0 |
| Standard deviation | 19.65 |
| SDD | 17.73 |
| Non-parametric estimate of: | |
| 5 percentile | 21.6 |
| 10 percentile | 23.3 |
| 20 percentile | 27.6 |
| Median | 41.0 |
| 80 percentile | 50.8 |
| 90 percentile | 70.8 |
| 95 percentile | 93.3 |



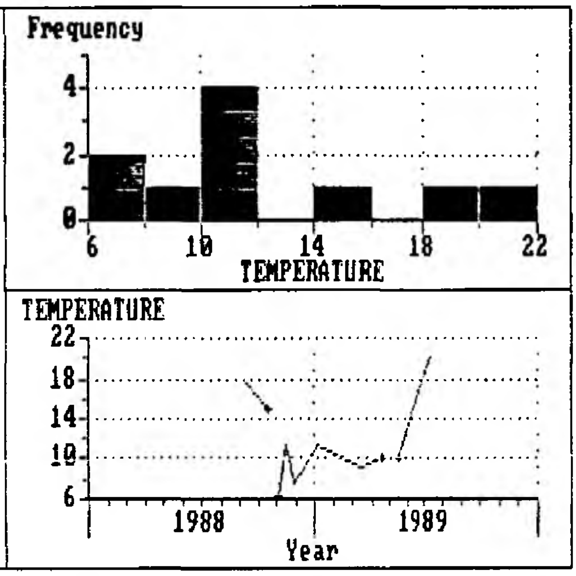
WEEK ST MARY FINAL EFFLUENT PH 27/ 1/87 to 21/11/89

| | |
|---|---|
| Number of observations | 32 |
| Minimum | 5.500 |
| Mean | 6.547 |
| Maximum | 7.500 |
| Standard deviation | 0.4016 |
| SDD | 0.3246 |
| Non-parametric estimate of: | |
| 5 percentile | 5.825 |
| 10 percentile | 6.060 |
| 20 percentile | 6.300 |
| Median | 6.500 |
| 80 percentile | 6.840 |
| 90 percentile | 7.100 |
| 95 percentile | 7.370 |



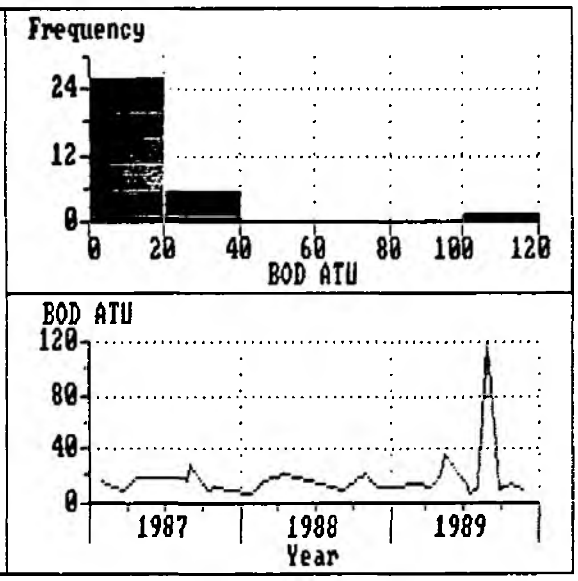

WEEK ST MARY FINAL EFFLUENT TEMPERATURE 27/ 1/87 to 21/11/89

| | |
|---|---|
| Number of observations | 10 |
| Minimum | 6.30 |
| Mean | 11.86 |
| Maximum | 20.00 |
| Standard deviation | 4.463 |
| SDD | 3.783 |
| Non-parametric estimate of: | |
| 10 percentile | 6.42 |
| 20 percentile | 7.80 |
| Median | 10.65 |
| 80 percentile | 17.40 |
| 90 percentile | 19.80 |



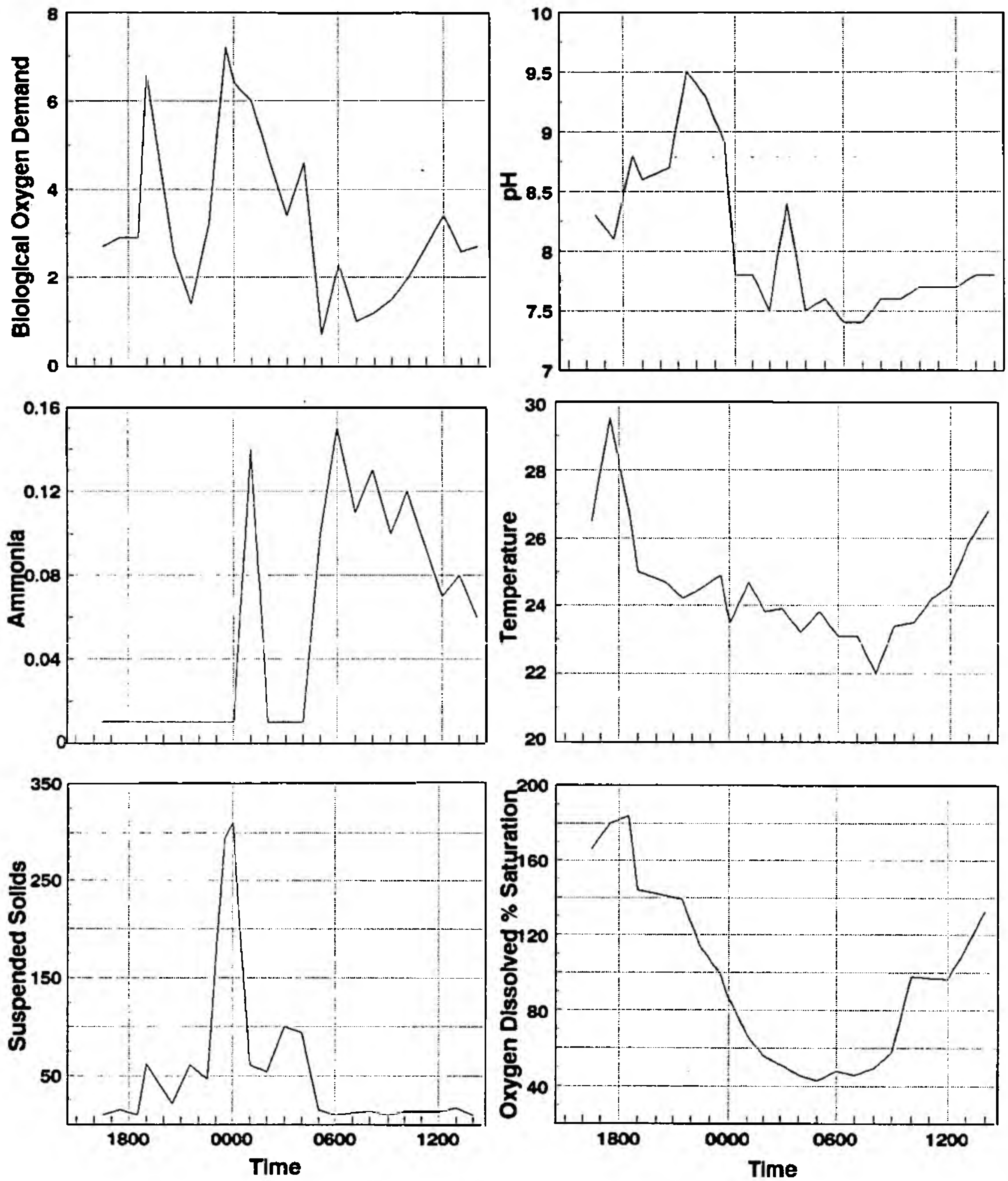

WEEK ST MARY FINAL EFFLUENT BOD ATU 27/ 1/87 to 21/11/89

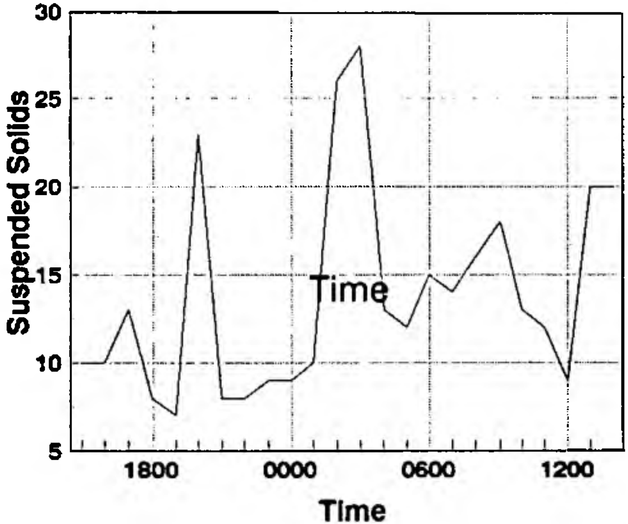
| | |
|---|---|
| Number of observations | 32 |
| Minimum | 7.5 |
| Mean | 17.9 |
| Maximum | 118.0 |
| Standard deviation | 19.30 |
| SDD | 20.17 |
| Non-parametric estimate of: | |
| 5 percentile | 7.6 |
| 10 percentile | 8.3 |
| 20 percentile | 9.2 |
| Median | 14.0 |
| 80 percentile | 19.4 |
| 90 percentile | 26.4 |
| 95 percentile | 64.7 |

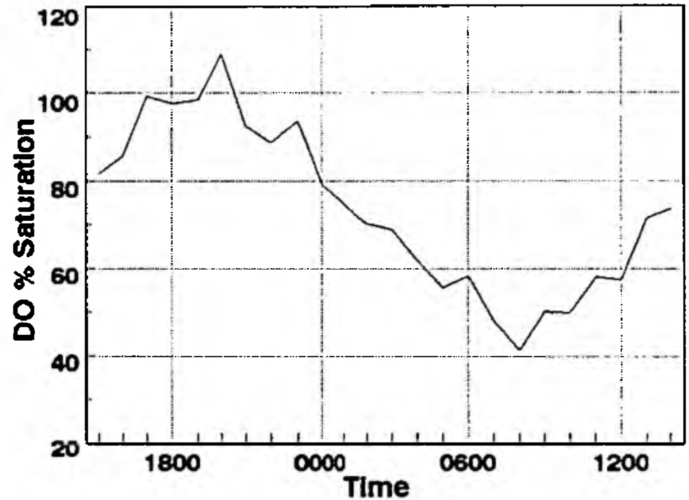


APPENDIX II. Line Graphs of the Data Collected During the 24 hour Investigation on 1-2 August 1990.

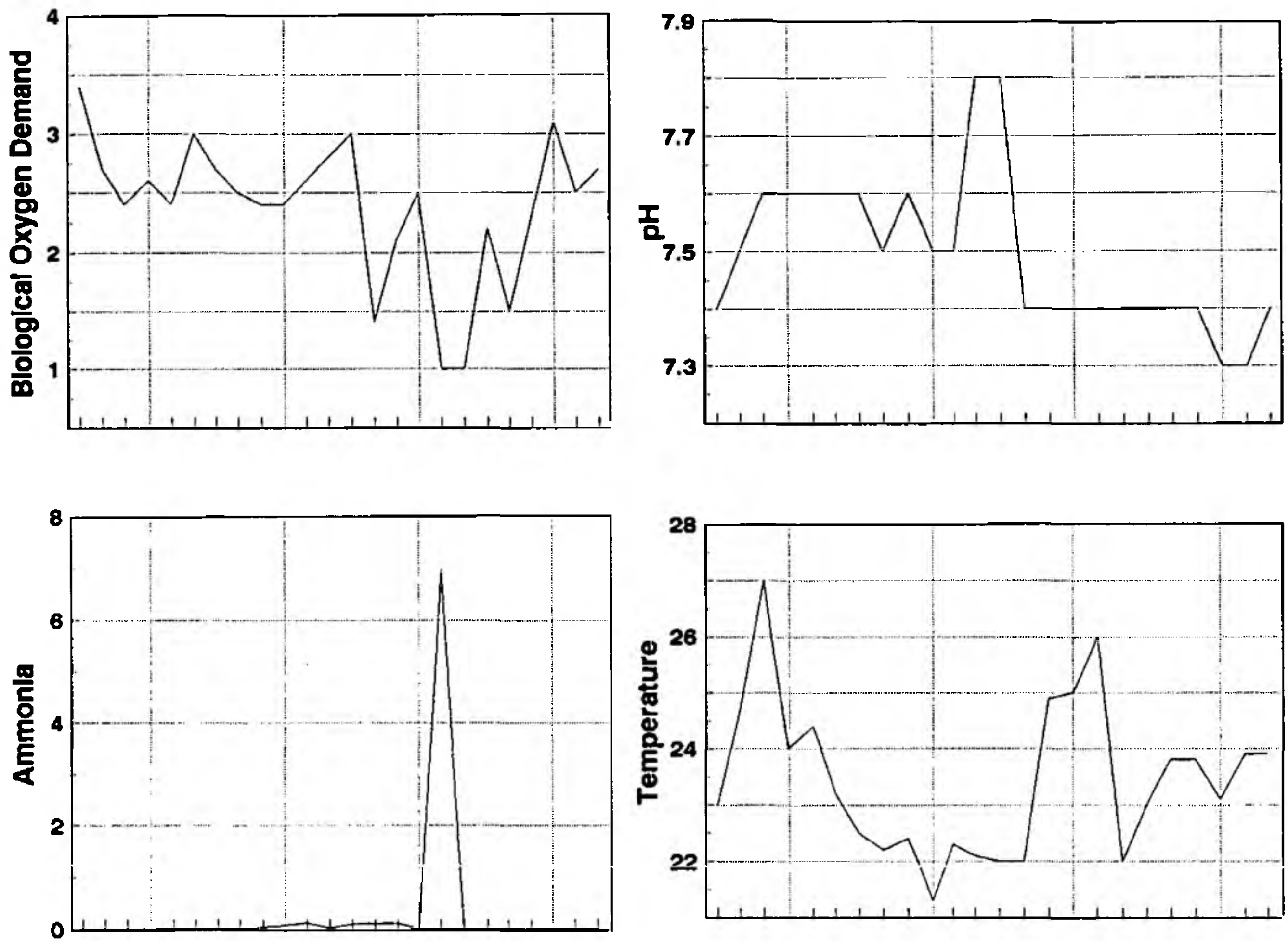
Water Quality in the River Strat at Rodd's Bridge.



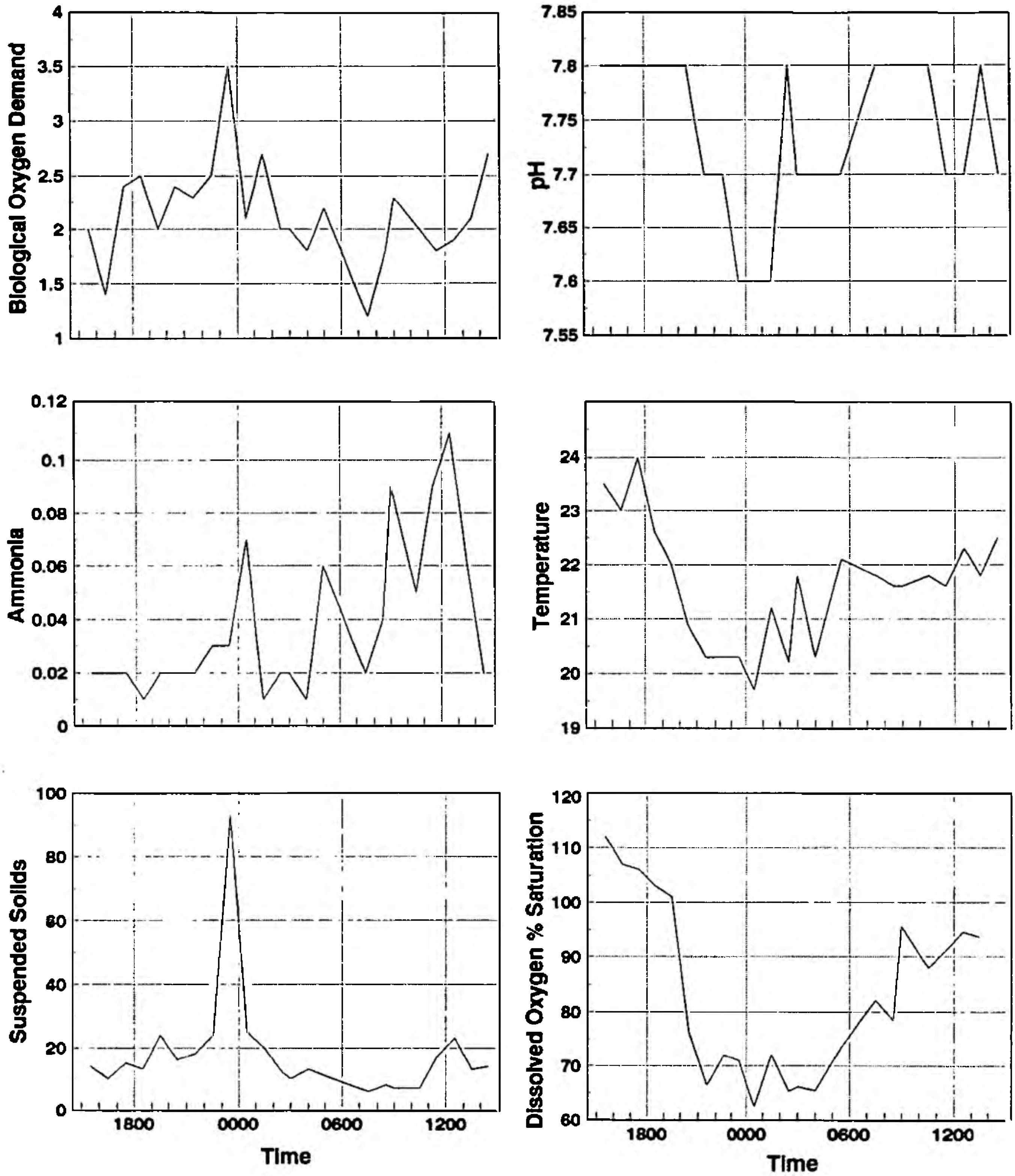

Suspended Solids
30
25
20
15
10
5
Time
1800
0000
0600
1200
Time


DO % Saturation
120
100
80
60
40
20
1800
0000
0600
1200
Time

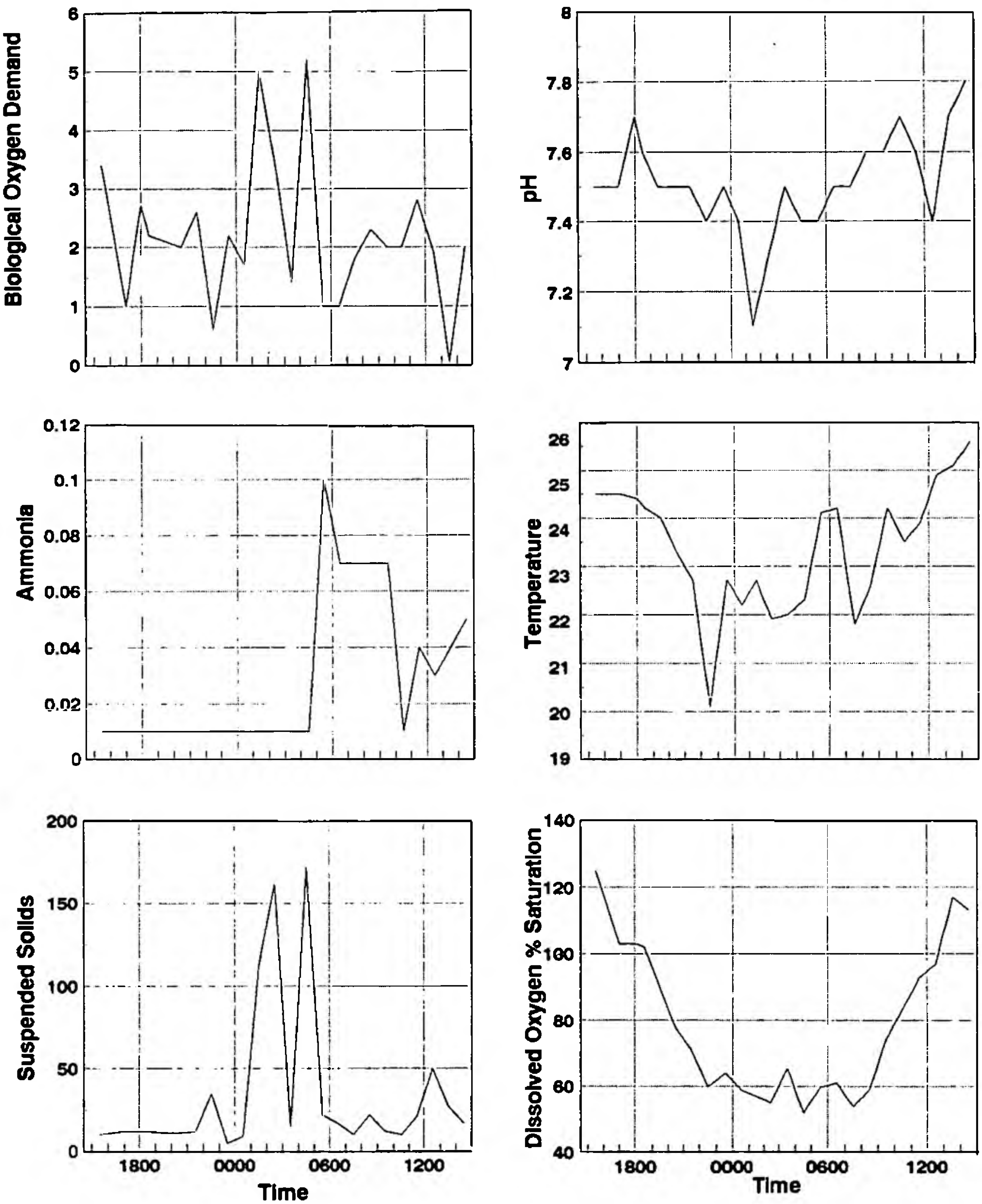
## Water Quality in the Bude Canal at Rodd's Bridge.



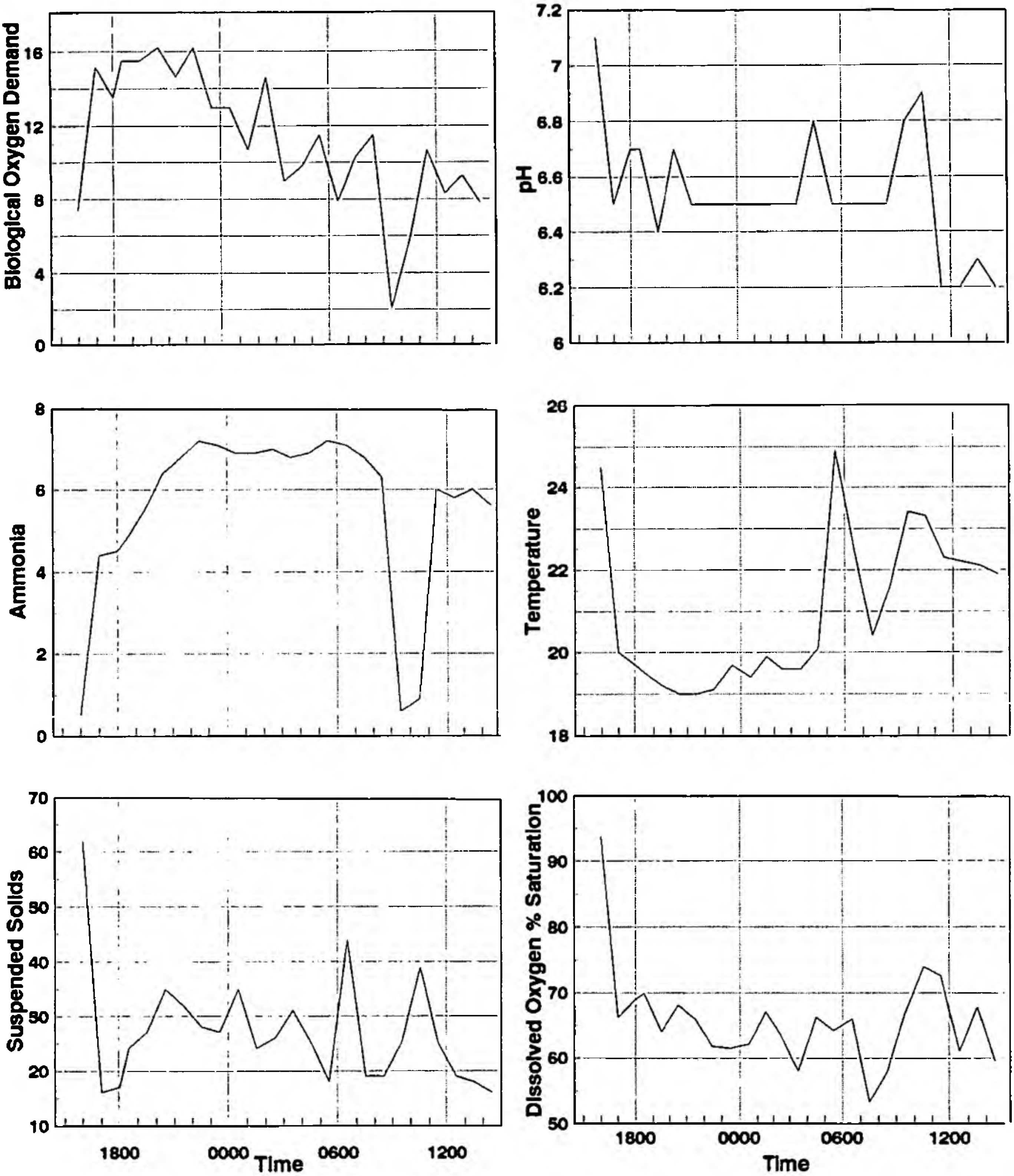
Water Quality In the River Strat at Helebridge.



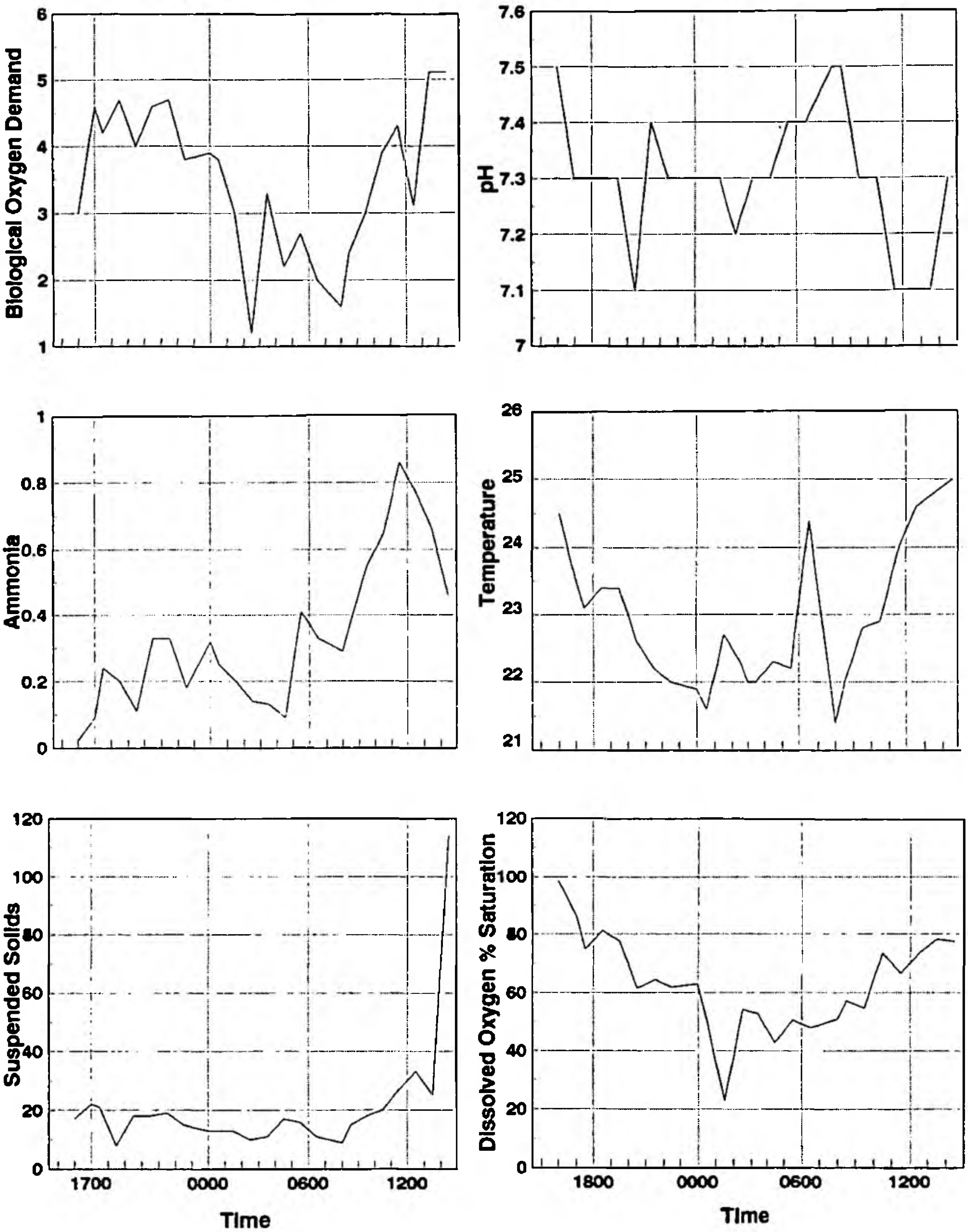
Water Quality in the River Neet Upstream of Widemouth Bay STW.



Water Quality at Widemouth Bay STW.



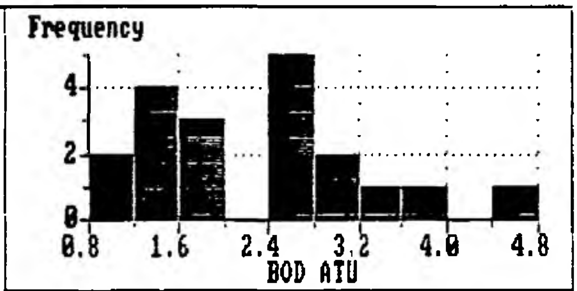
## Water Quality In the River Neet Downstream of Widemouth Bay STW.

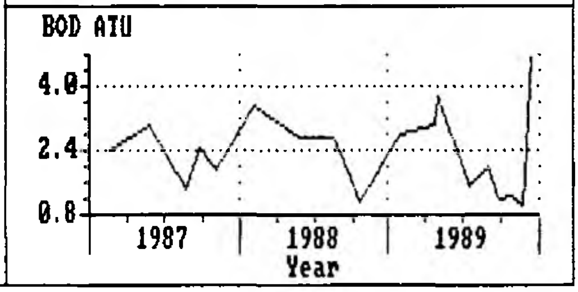


APPENDIX III. Routine Monitoring Data (01.01.87 - 31.12.89) at the Sites of Non-Compliance in the Strat and Neet Catchments.

RIVER NEET AT HELE BRIDGE    BOD ATU    16/ 2/87 to 12/12/89

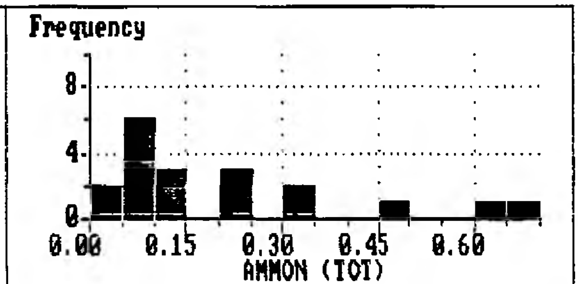
| | |
|---|---|
| Number of observations | 19 |
| Minimum | 1.00 |
| Mean | 2.32 |
| Maximum | 4.70 |
| Standard deviation | 1.016 |
| SDD | 0.992 |
| Non-parametric estimate of: | |
| 5 percentile | 1.00 |
| 10 percentile | 1.10 |
| 20 percentile | 1.30 |
| Median | 2.40 |
| 80 percentile | 3.00 |
| 90 percentile | 3.80 |
| 95 percentile | 4.70 |

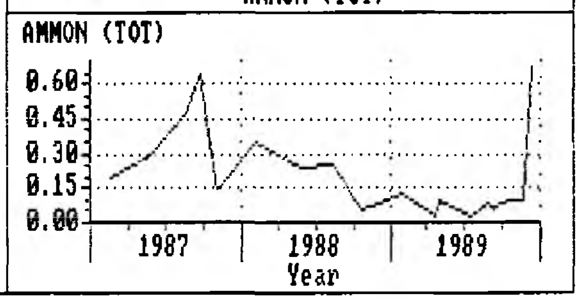



RIVER NEET AT HELE BRIDGE    AMMON (TOT)    16/ 2/87 to 12/12/89

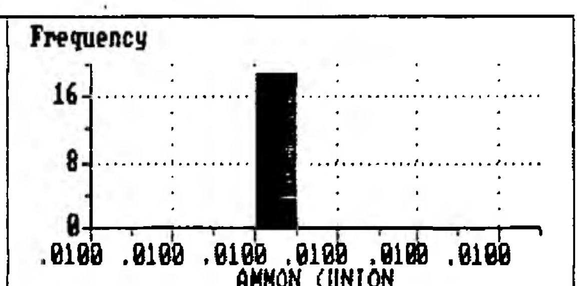
| | |
|---|---|
| Number of observations | 19 |
| Minimum | 0.030 |
| Mean | 0.211 |
| Maximum | 0.670 |
| Standard deviation | 0.1963 |
| SDD | 0.1497 |
| Non-parametric estimate of: | |
| 5 percentile | 0.030 |
| 10 percentile | 0.030 |
| 20 percentile | 0.060 |
| Median | 0.130 |
| 80 percentile | 0.350 |
| 90 percentile | 0.640 |
| 95 percentile | 0.670 |

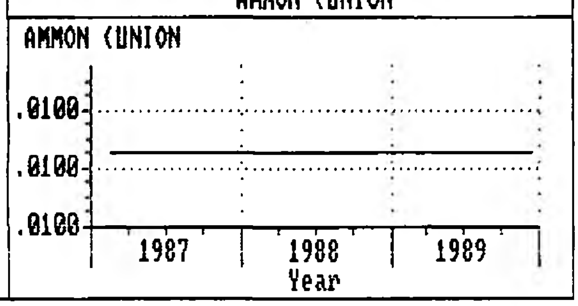



RIVER NEET AT HELE BRIDGE    AMMON (UNION    16/ 2/87 to 12/12/89

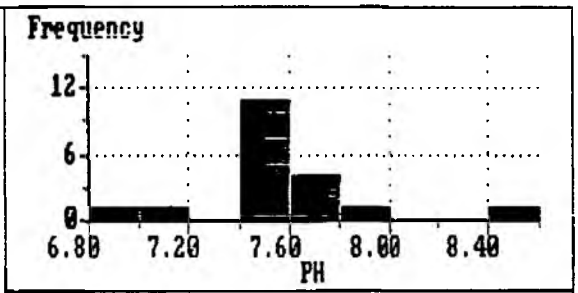
| | |
|---|---|
| Number of observations | 19 |
| Minimum | 0.01 |
| Mean | 0.01 |
| Maximum | 0.01 |
| Standard deviation | 0.000 |
| SDD | 0.000 |
| Non-parametric estimate of: | |
| 5 percentile | 0.01 |
| 10 percentile | 0.01 |
| 20 percentile | 0.01 |
| Median | 0.01 |
| 80 percentile | 0.01 |
| 90 percentile | 0.01 |
| 95 percentile | 0.01 |

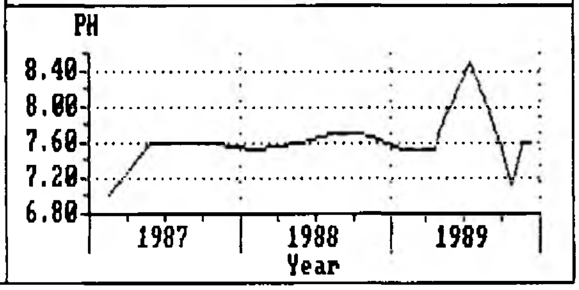


RIVER NEET AT HELE BRIDGE PH 16/ 2/87 to 12/12/89

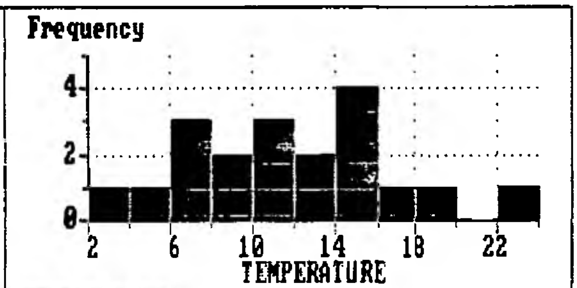
| | |
|---|---|
| Number of observations | 19 |
| Minimum | 7.000 |
| Mean | 7.621 |
| Maximum | 8.500 |
| Standard deviation | 0.3047 |
| SDD | 0.2389 |
| Non-parametric estimate of: | |
| 5 percentile | 7.000 |
| 10 percentile | 7.100 |
| 20 percentile | 7.500 |
| Median | 7.600 |
| 80 percentile | 7.700 |
| 90 percentile | 8.000 |
| 95 percentile | 8.500 |

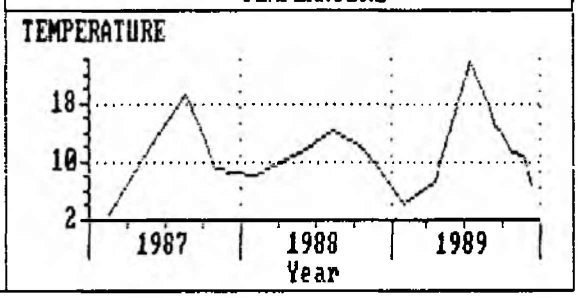



RIVER NEET AT HELE BRIDGE TEMPERATURE 16/ 2/87 to 12/12/89

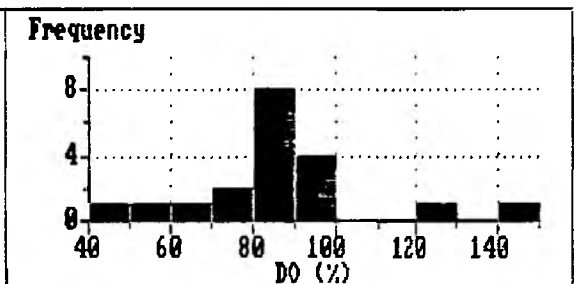
| | |
|---|---|
| Number of observations | 19 |
| Minimum | 2.90 |
| Mean | 11.76 |
| Maximum | 23.80 |
| Standard deviation | 5.216 |
| SDD | 4.106 |
| Non-parametric estimate of: | |
| 5 percentile | 2.90 |
| 10 percentile | 4.00 |
| 20 percentile | 7.10 |
| Median | 11.20 |
| 80 percentile | 15.30 |
| 90 percentile | 19.20 |
| 95 percentile | 23.80 |

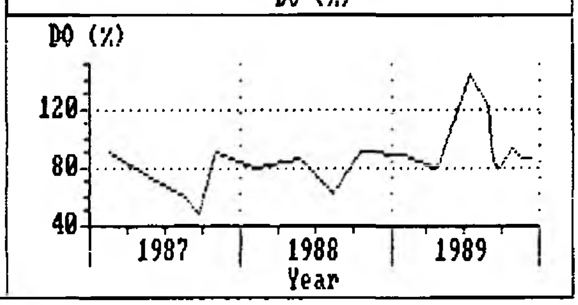



RIVER NEET AT HELE BRIDGE DO (%) 16/ 2/87 to 12/12/89

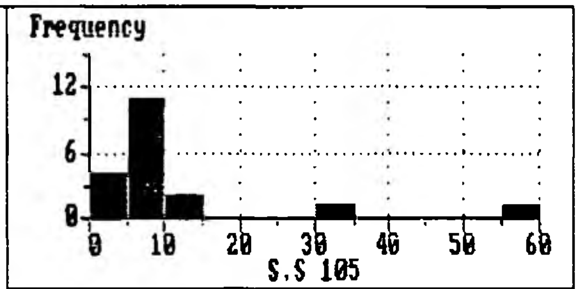
| | |
|---|---|
| Number of observations | 19 |
| Minimum | 49.0 |
| Mean | 85.3 |
| Maximum | 144.0 |
| Standard deviation | 20.77 |
| SDD | 17.32 |
| Non-parametric estimate of: | |
| 5 percentile | 49.0 |
| 10 percentile | 59.0 |
| 20 percentile | 72.0 |
| Median | 86.0 |
| 80 percentile | 91.0 |
| 90 percentile | 121.0 |
| 95 percentile | 144.0 |

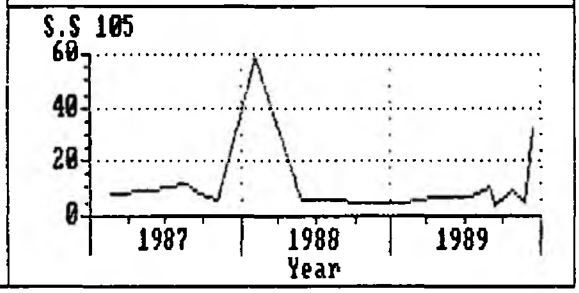


RIVER NEET AT HELE BRIDGE    S.S 105    16/ 2/87 to 12/12/89

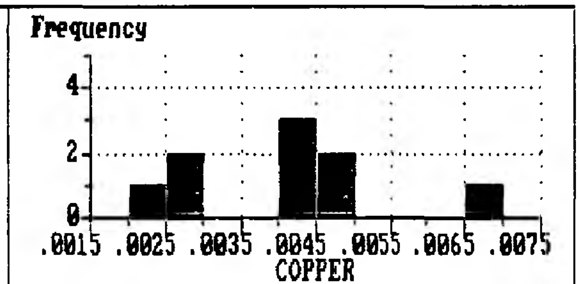
| | |
|---|---|
| Number of observations | 19 |
| Minimum | 3.0 |
| Mean | 10.9 |
| Maximum | 59.0 |
| Standard deviation | 13.17 |
| SDD | 13.80 |
| Non-parametric estimate of: | |
| 5 percentile | 3.0 |
| 10 percentile | 4.0 |
| 20 percentile | 4.8 |
| Median | 6.8 |
| 80 percentile | 10.0 |
| 90 percentile | 32.0 |
| 95 percentile | 59.0 |

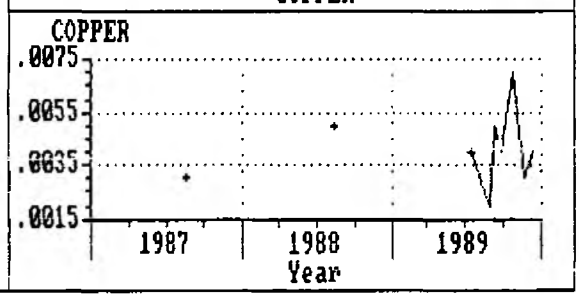



RIVER NEET AT HELE BRIDGE    COPPER    16/ 2/87 to 12/12/89

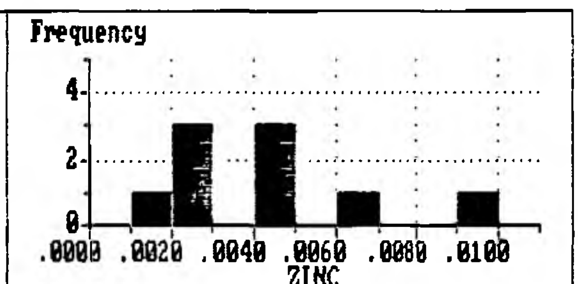
| | |
|---|---|
| Number of observations | 9 |
| Minimum | 0.00200 |
| Mean | 0.00411 |
| Maximum | 0.00700 |
| Standard deviation | 0.001453 |
| SDD | 0.002000 |
| Non-parametric estimate of: | |
| 10 percentile | 0.00200 |
| 20 percentile | 0.00300 |
| Median | 0.00400 |
| 80 percentile | 0.00500 |
| 90 percentile | 0.00700 |

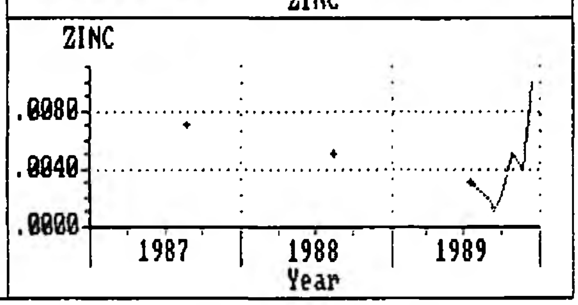



RIVER NEET AT HELE BRIDGE    ZINC    16/ 2/87 to 12/12/89

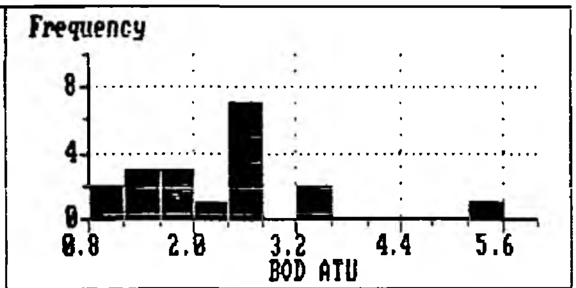
| | |
|---|---|
| Number of observations | 9 |
| Minimum | 0.00100 |
| Mean | 0.00433 |
| Maximum | 0.01000 |
| Standard deviation | 0.002828 |
| SDD | 0.002214 |
| Non-parametric estimate of: | |
| 10 percentile | 0.00100 |
| 20 percentile | 0.00200 |
| Median | 0.00400 |
| 80 percentile | 0.00700 |
| 90 percentile | 0.01000 |

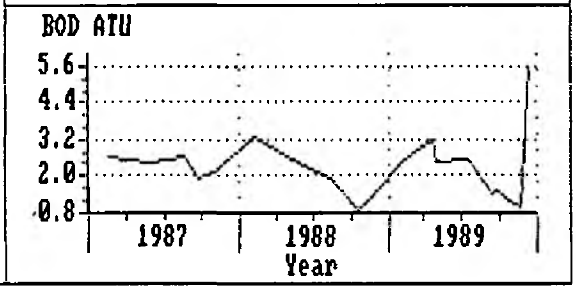


RIVER NEET AT LANGFORD BRIDGE BOD ATU 16/ 2/87 to 12/12/89

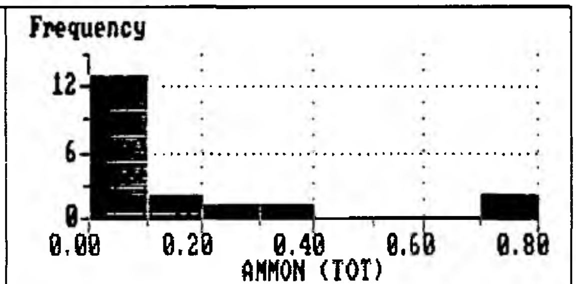
| | |
|---|---|
| Number of observations | 19 |
| Minimum | 0.90 |
| Mean | 2.29 |
| Maximum | 5.60 |
| Standard deviation | 1.061 |
| SDD | 0.936 |
| Non-parametric estimate of: | |
| 5 percentile | 0.90 |
| 10 percentile | 1.00 |
| 20 percentile | 1.40 |
| Median | 2.40 |
| 80 percentile | 2.70 |
| 90 percentile | 3.30 |
| 95 percentile | 5.60 |

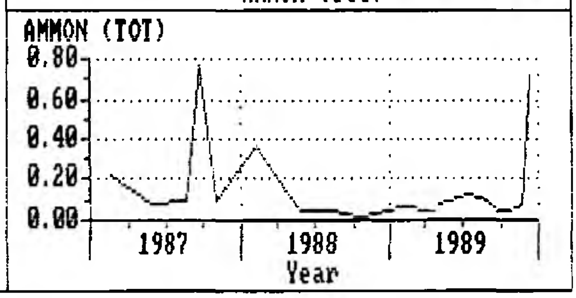



RIVER NEET AT LANGFORD BRIDGE AMMON (TOT) 16/ 2/87 to 12/12/89

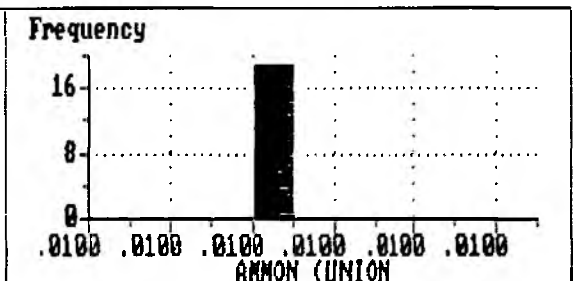
| | |
|---|---|
| Number of observations | 19 |
| Minimum | 0.020 |
| Mean | 0.161 |
| Maximum | 0.770 |
| Standard deviation | 0.2203 |
| SDD | 0.2118 |
| Non-parametric estimate of: | |
| 5 percentile | 0.020 |
| 10 percentile | 0.040 |
| 20 percentile | 0.040 |
| Median | 0.070 |
| 80 percentile | 0.220 |
| 90 percentile | 0.720 |
| 95 percentile | 0.770 |

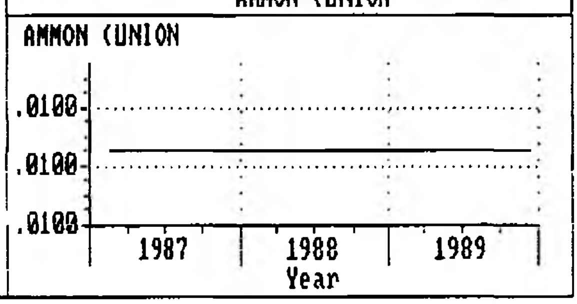



RIVER NEET AT LANGFORD BRIDGE AMMON (UNION 16/ 2/87 to 12/12/89

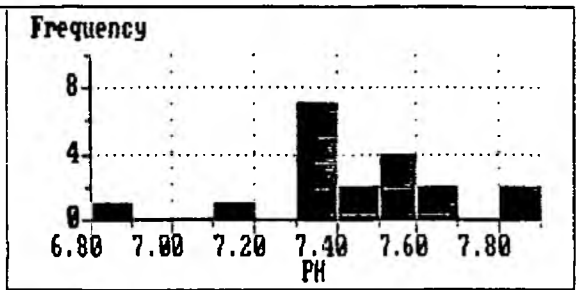
| | |
|---|---|
| Number of observations | 19 |
| Minimum | 0.01 |
| Mean | 0.01 |
| Maximum | 0.01 |
| Standard deviation | 0.000 |
| SDD | 0.000 |
| Non-parametric estimate of: | |
| 5 percentile | 0.01 |
| 10 percentile | 0.01 |
| 20 percentile | 0.01 |
| Median | 0.01 |
| 80 percentile | 0.01 |
| 90 percentile | 0.01 |
| 95 percentile | 0.01 |

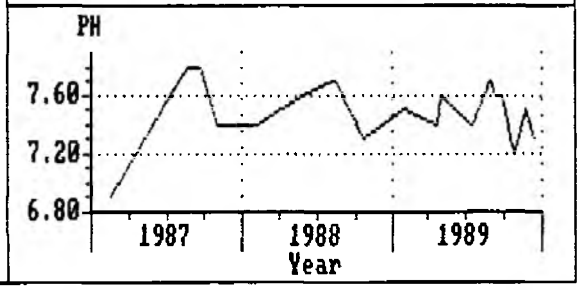


RIVER NEET AT LANGFORD BRIDGE PH 16/ 2/87 to 12/12/89

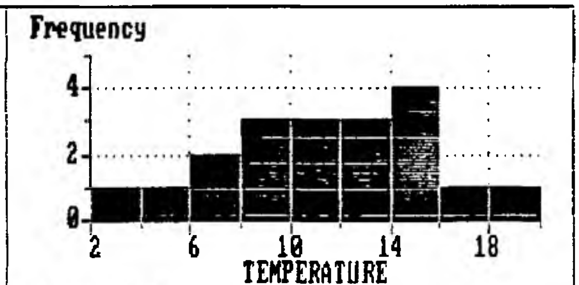
| | |
|---|---|
| Number of observations | 19 |
| Minimum | 6.900 |
| Mean | 7.479 |
| Maximum | 7.800 |
| Standard deviation | 0.2200 |
| SDD | 0.1955 |
| Non-parametric estimate of: | |
| 5 percentile | 6.900 |
| 10 percentile | 7.200 |
| 20 percentile | 7.300 |
| Median | 7.500 |
| 80 percentile | 7.700 |
| 90 percentile | 7.800 |
| 95 percentile | 7.800 |

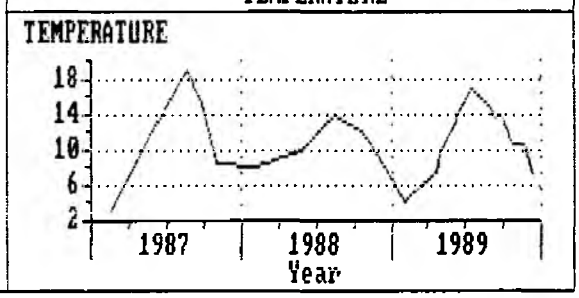



RIVER NEET AT LANGFORD BRIDGE TEMPERATURE 16/ 2/87 to 12/12/89

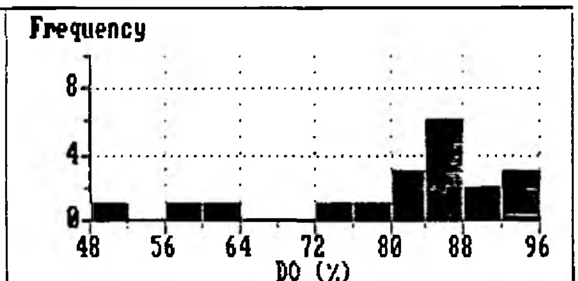
| | |
|---|---|
| Number of observations | 19 |
| Minimum | 3.00 |
| Mean | 11.12 |
| Maximum | 19.00 |
| Standard deviation | 4.206 |
| SDD | 3.327 |
| Non-parametric estimate of: | |
| 5 percentile | 3.00 |
| 10 percentile | 4.00 |
| 20 percentile | 7.50 |
| Median | 10.70 |
| 80 percentile | 15.00 |
| 90 percentile | 16.80 |
| 95 percentile | 19.00 |

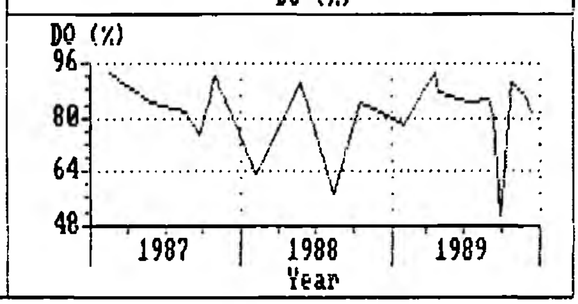



RIVER NEET AT LANGFORD BRIDGE DO (%) 16/ 2/87 to 12/12/89

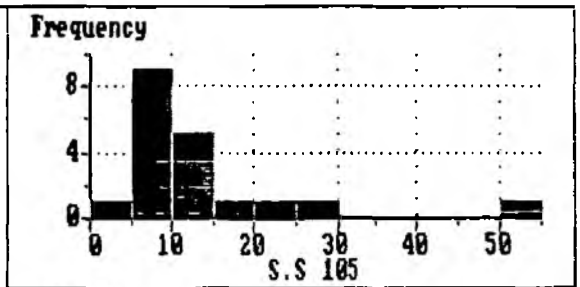
| | |
|---|---|
| Number of observations | 19 |
| Minimum | 51.0 |
| Mean | 81.1 |
| Maximum | 93.0 |
| Standard deviation | 11.93 |
| SDD | 13.93 |
| Non-parametric estimate of: | |
| 5 percentile | 51.0 |
| 10 percentile | 57.0 |
| 20 percentile | 75.0 |
| Median | 85.0 |
| 80 percentile | 90.0 |
| 90 percentile | 93.0 |
| 95 percentile | 93.0 |

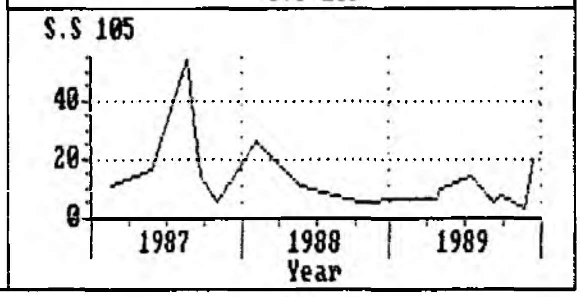


RIVER NEET AT LANGFORD BRIDGE — S.S 105 — 16/ 2/87 to 12/12/89

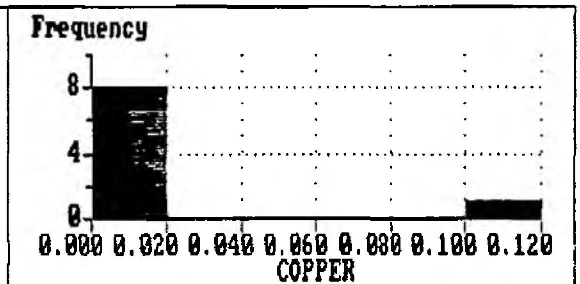
| | |
|---|---|
| Number of observations | 19 |
| Minimum | 2.8 |
| Mean | 12.3 |
| Maximum | 54.0 |
| Standard deviation | 11.67 |
| SDD | 11.15 |
| Non-parametric estimate of: | |
| 5 percentile | 2.8 |
| 10 percentile | 5.0 |
| 20 percentile | 5.4 |
| Median | 8.0 |
| 80 percentile | 16.0 |
| 90 percentile | 26.0 |
| 95 percentile | 54.0 |

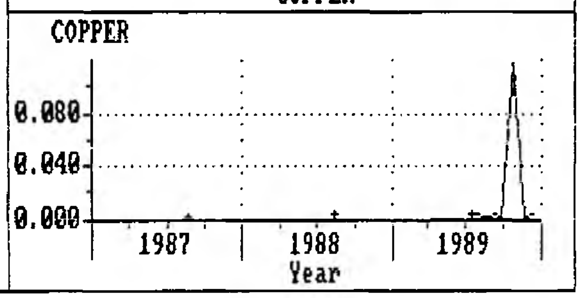



RIVER NEET AT LANGFORD BRIDGE — COPPER — 16/ 2/87 to 12/12/89

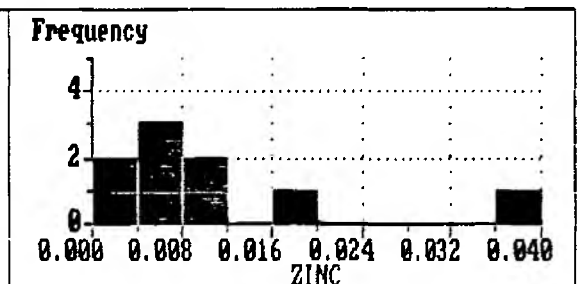
| | |
|---|---|
| Number of observations | 9 |
| Minimum | 0.0020 |
| Mean | 0.0164 |
| Maximum | 0.1180 |
| Standard deviation | 0.03811 |
| SDD | 0.05168 |
| Non-parametric estimate of: | |
| 10 percentile | 0.0020 |
| 20 percentile | 0.0020 |
| Median | 0.0050 |
| 80 percentile | 0.0050 |
| 90 percentile | 0.1180 |

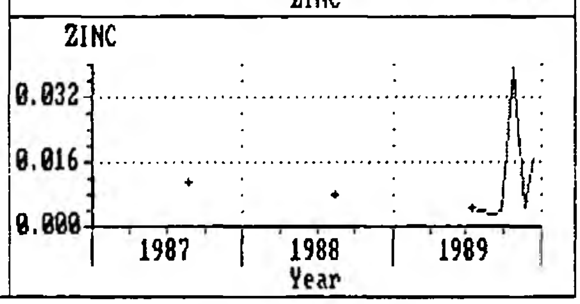



RIVER NEET AT LANGFORD BRIDGE — ZINC — 16/ 2/87 to 12/12/89

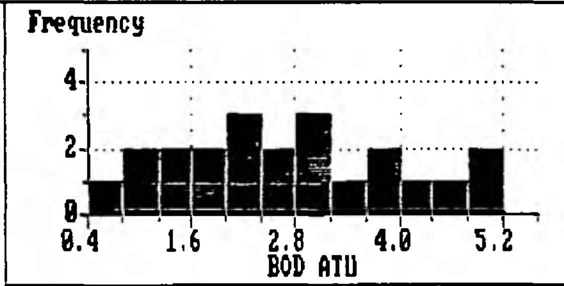
| | |
|---|---|
| Number of observations | 9 |
| Minimum | 0.0030 |
| Mean | 0.0106 |
| Maximum | 0.0390 |
| Standard deviation | 0.01160 |
| SDD | 0.01591 |
| Non-parametric estimate of: | |
| 10 percentile | 0.0030 |
| 20 percentile | 0.0030 |
| Median | 0.0050 |
| 80 percentile | 0.0170 |
| 90 percentile | 0.0390 |

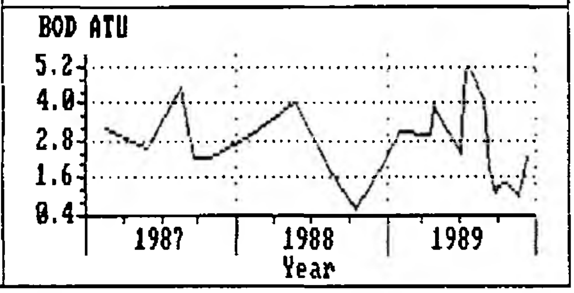


BUDE CANAL AT FALCON BRIDGE BOD ATU 16/ 2/87 to 12/12/89

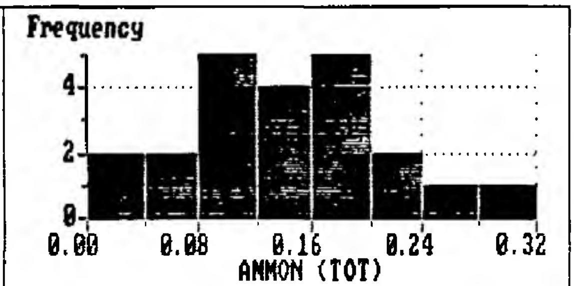
| | |
|---|---|
| Number of observations | 22 |
| Minimum | 0.60 |
| Mean | 2.74 |
| Maximum | 5.20 |
| Standard deviation | 1.324 |
| SDD | 1.034 |
| Non-parametric estimate of: | |
| 5 percentile | 0.66 |
| 10 percentile | 1.03 |
| 20 percentile | 1.36 |
| Median | 2.50 |
| 80 percentile | 4.04 |
| 90 percentile | 4.95 |
| 95 percentile | 5.18 |

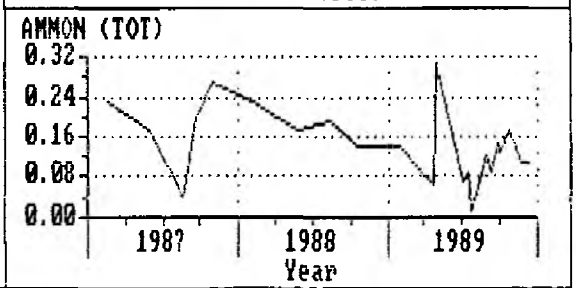



BUDE CANAL AT FALCON BRIDGE AMMON (TOT) 16/ 2/87 to 12/12/89

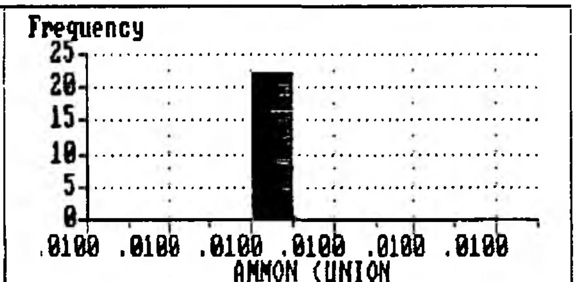
| | |
|---|---|
| Number of observations | 22 |
| Minimum | 0.010 |
| Mean | 0.145 |
| Maximum | 0.310 |
| Standard deviation | 0.0742 |
| SDD | 0.0732 |
| Non-parametric estimate of: | |
| 5 percentile | 0.014 |
| 10 percentile | 0.046 |
| 20 percentile | 0.082 |
| Median | 0.140 |
| 80 percentile | 0.212 |
| 90 percentile | 0.258 |
| 95 percentile | 0.304 |

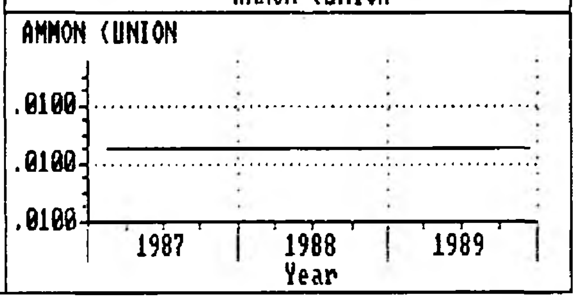



BUDE CANAL AT FALCON BRIDGE AMMON (UNION 16/ 2/87 to 12/12/89

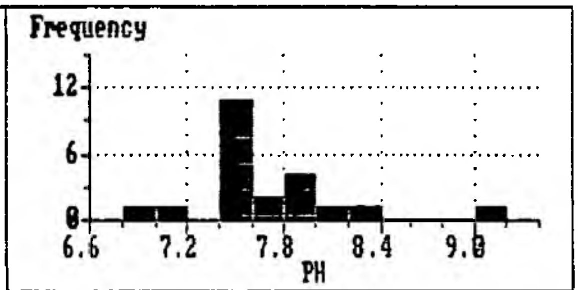
| | |
|---|---|
| Number of observations | 22 |
| Minimum | 0.01 |
| Mean | 0.01 |
| Maximum | 0.01 |
| Standard deviation | 0.000 |
| SDD | 0.000 |
| Non-parametric estimate of: | |
| 5 percentile | 0.01 |
| 10 percentile | 0.01 |
| 20 percentile | 0.01 |
| Median | 0.01 |
| 80 percentile | 0.01 |
| 90 percentile | 0.01 |
| 95 percentile | 0.01 |

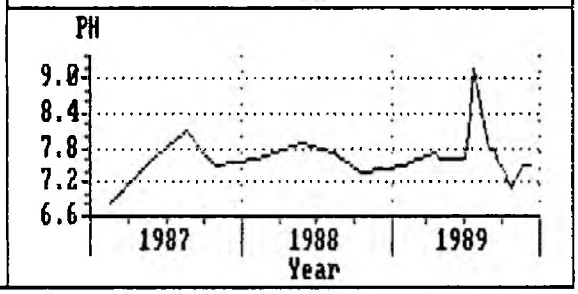


BUDE CANAL AT FALCON BRIDGE PH 16/ 2/87 to 12/12/89

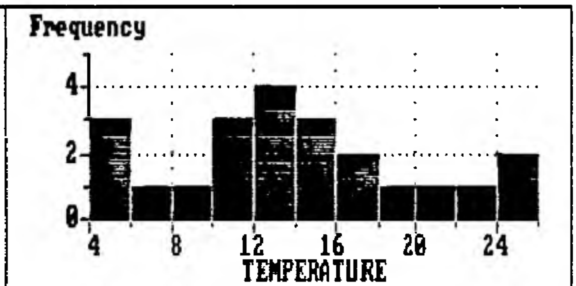
| | |
|---|---|
| Number of observations | 22 |
| Minimum | 6.800 |
| Mean | 7.686 |
| Maximum | 9.200 |
| Standard deviation | 0.4632 |
| SDD | 0.3539 |
| Non-parametric estimate of: | |
| 5 percentile | 6.845 |
| 10 percentile | 7.190 |
| 20 percentile | 7.500 |
| Median | 7.600 |
| 80 percentile | 7.840 |
| 90 percentile | 8.310 |
| 95 percentile | 9.080 |

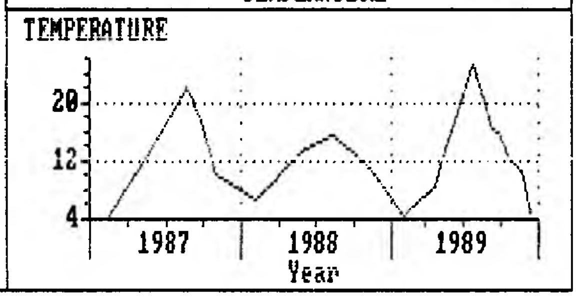



BUDE CANAL AT FALCON BRIDGE TEMPERATURE 16/ 2/87 to 12/12/89

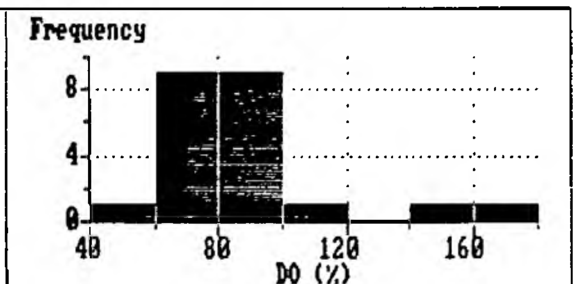
| | |
|---|---|
| Number of observations | 22 |
| Minimum | 4.20 |
| Mean | 13.74 |
| Maximum | 25.10 |
| Standard deviation | 6.176 |
| SDD | 3.928 |
| Non-parametric estimate of: | |
| 5 percentile | 4.20 |
| 10 percentile | 4.38 |
| 20 percentile | 7.74 |
| Median | 13.25 |
| 80 percentile | 19.74 |
| 90 percentile | 23.47 |
| 95 percentile | 24.95 |

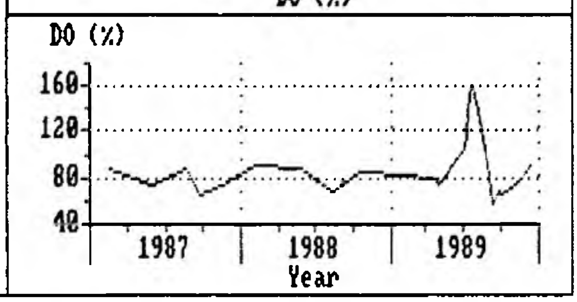



BUDE CANAL AT FALCON BRIDGE DO (%) 16/ 2/87 to 12/12/89

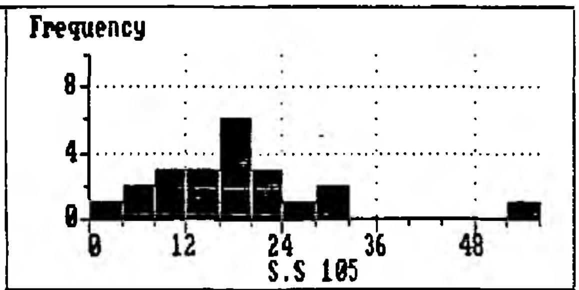
| | |
|---|---|
| Number of observations | 22 |
| Minimum | 57.0 |
| Mean | 85.2 |
| Maximum | 162.0 |
| Standard deviation | 26.13 |
| SDD | 17.62 |
| Non-parametric estimate of: | |
| 5 percentile | 58.0 |
| 10 percentile | 64.3 |
| 20 percentile | 67.0 |
| Median | 80.5 |
| 80 percentile | 89.4 |
| 90 percentile | 139.4 |
| 95 percentile | 160.9 |

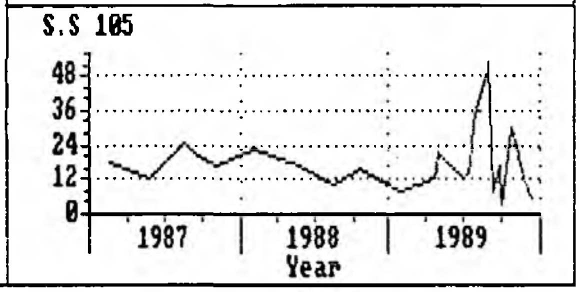


BUDE CANAL AT FALCON BRIDGE S.S 105 16/ 2/87 to 12/12/89

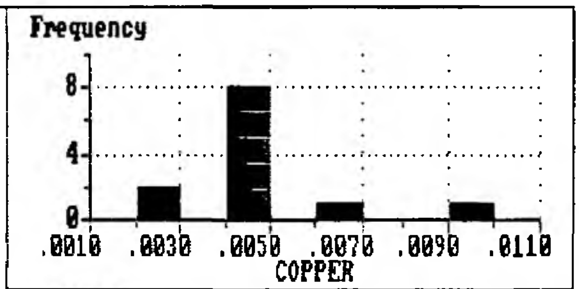
| | |
|---|---|
| Number of observations | 22 |
| Minimum | 3.2 |
| Mean | 17.5 |
| Maximum | 53.0 |
| Standard deviation | 10.79 |
| SDD | 10.83 |
| Non-parametric estimate of: | |
| 5 percentile | 3.5 |
| 10 percentile | 5.9 |
| 20 percentile | 9.0 |
| Median | 16.5 |
| 80 percentile | 23.2 |
| 90 percentile | 31.3 |
| 95 percentile | 49.8 |

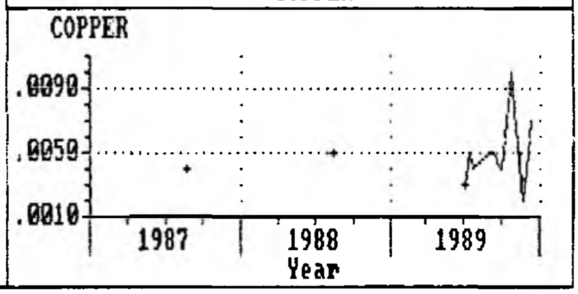



BUDE CANAL AT FALCON BRIDGE COPPER 16/ 2/87 to 12/12/89

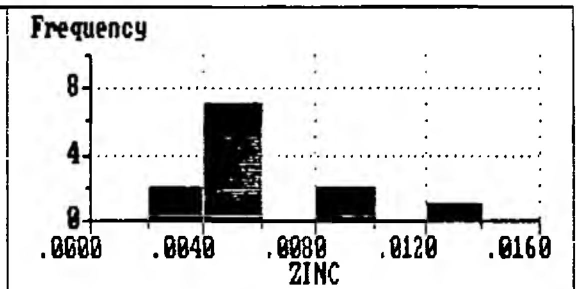
| | |
|---|---|
| Number of observations | 12 |
| Minimum | 0.00200 |
| Mean | 0.00483 |
| Maximum | 0.01000 |
| Standard deviation | 0.002038 |
| SDD | 0.002872 |
| Non-parametric estimate of: | |
| 10 percentile | 0.00230 |
| 20 percentile | 0.00360 |
| Median | 0.00450 |
| 80 percentile | 0.00580 |
| 90 percentile | 0.00910 |

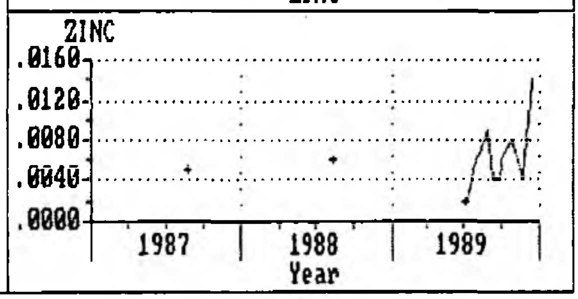



BUDE CANAL AT FALCON BRIDGE ZINC 16/ 2/87 to 12/12/89

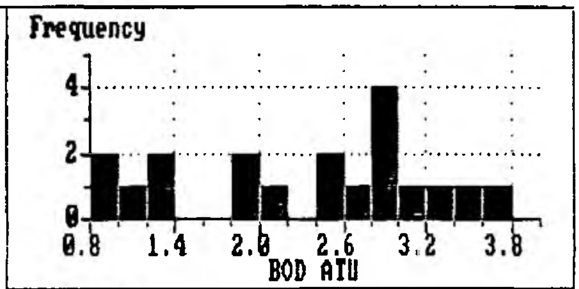
| | |
|---|---|
| Number of observations | 12 |
| Minimum | 0.00200 |
| Mean | 0.00583 |
| Maximum | 0.01400 |
| Standard deviation | 0.003243 |
| SDD | 0.003260 |
| Non-parametric estimate of: | |
| 10 percentile | 0.00230 |
| 20 percentile | 0.00360 |
| Median | 0.00500 |
| 80 percentile | 0.00840 |
| 90 percentile | 0.01250 |

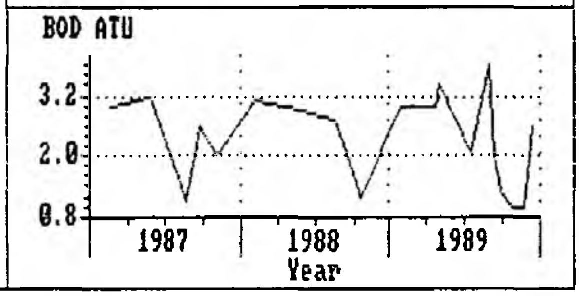


BUDE CANAL AT RODDS BRIDGE    BOD ATU    16/ 2/87 to 12/12/89

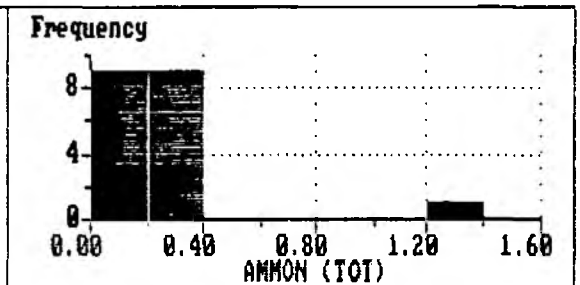
| | |
|---|---|
| Number of observations | 19 |
| Minimum | 1.00 |
| Mean | 2.37 |
| Maximum | 3.80 |
| Standard deviation | 0.889 |
| SDD | 0.857 |
| Non-parametric estimate of: | |
| 5 percentile | 1.00 |
| 10 percentile | 1.00 |
| 20 percentile | 1.20 |
| Median | 2.60 |
| 80 percentile | 3.10 |
| 90 percentile | 3.40 |
| 95 percentile | 3.80 |

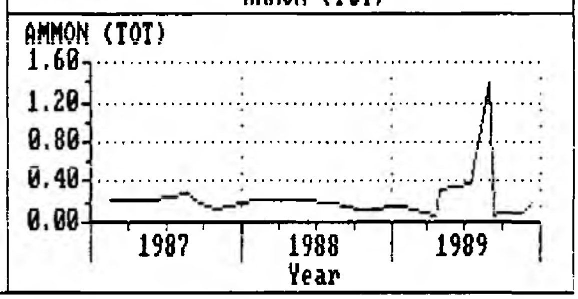



BUDE CANAL AT RODDS BRIDGE    AMMON (TOT)    16/ 2/87 to 12/12/89

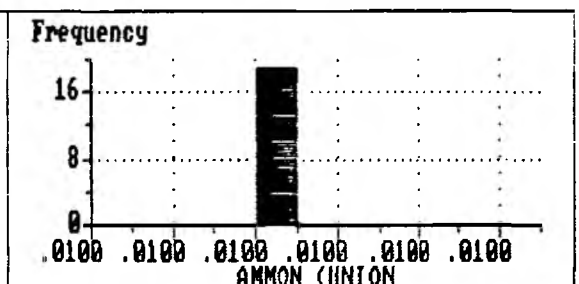
| | |
|---|---|
| Number of observations | 19 |
| Minimum | 0.060 |
| Mean | 0.241 |
| Maximum | 1.400 |
| Standard deviation | 0.2932 |
| SDD | 0.2956 |
| Non-parametric estimate of: | |
| 5 percentile | 0.060 |
| 10 percentile | 0.060 |
| 20 percentile | 0.080 |
| Median | 0.200 |
| 80 percentile | 0.280 |
| 90 percentile | 0.370 |
| 95 percentile | 1.400 |

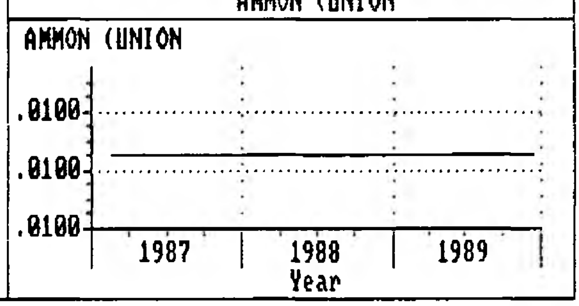



BUDE CANAL AT RODDS BRIDGE    AMMON (UNION    16/ 2/87 to 12/12/89

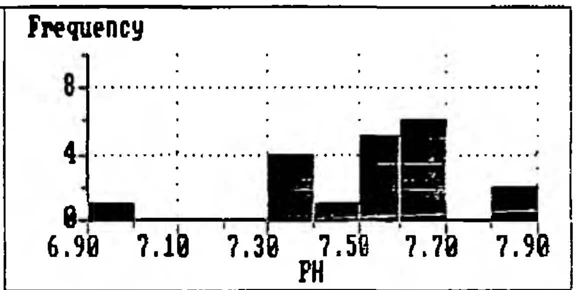
| | |
|---|---|
| Number of observations | 19 |
| Minimum | 0.01 |
| Mean | 0.01 |
| Maximum | 0.01 |
| Standard deviation | 0.000 |
| SDD | 0.000 |
| Non-parametric estimate of: | |
| 5 percentile | 0.01 |
| 10 percentile | 0.01 |
| 20 percentile | 0.01 |
| Median | 0.01 |
| 80 percentile | 0.01 |
| 90 percentile | 0.01 |
| 95 percentile | 0.01 |

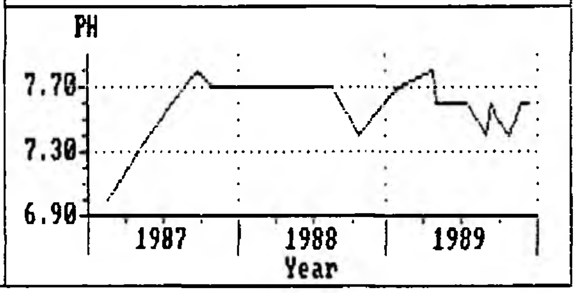


BUDE CANAL AT RODDS BRIDGE PH 16/ 2/87 to 12/12/89

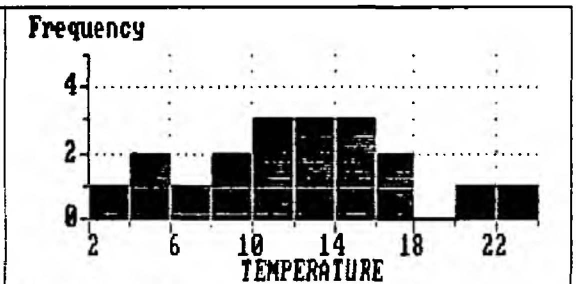
| | |
|---|---|
| Number of observations | 19 |
| Minimum | 7.000 |
| Mean | 7.574 |
| Maximum | 7.800 |
| Standard deviation | 0.1910 |
| SDD | 0.1372 |
| Non-parametric estimate of: | |
| 5 percentile | 7.000 |
| 10 percentile | 7.400 |
| 20 percentile | 7.400 |
| Median | 7.600 |
| 80 percentile | 7.700 |
| 90 percentile | 7.800 |
| 95 percentile | 7.800 |

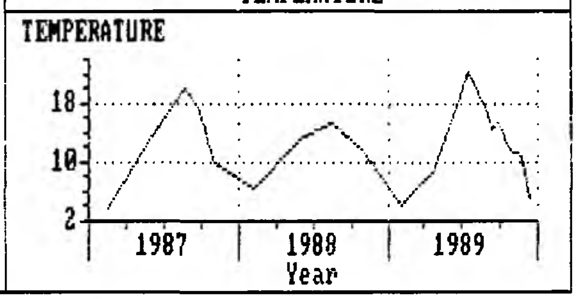



BUDE CANAL AT RODDS BRIDGE TEMPERATURE 16/ 2/87 to 12/12/89

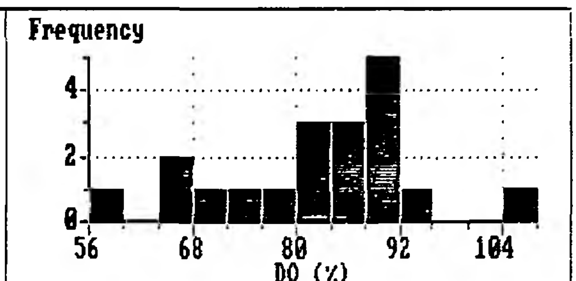
| | |
|---|---|
| Number of observations | 19 |
| Minimum | 3.80 |
| Mean | 12.07 |
| Maximum | 22.30 |
| Standard deviation | 5.151 |
| SDD | 4.123 |
| Non-parametric estimate of: | |
| 5 percentile | 3.80 |
| 10 percentile | 4.10 |
| 20 percentile | 6.50 |
| Median | 12.00 |
| 80 percentile | 17.00 |
| 90 percentile | 20.00 |
| 95 percentile | 22.30 |

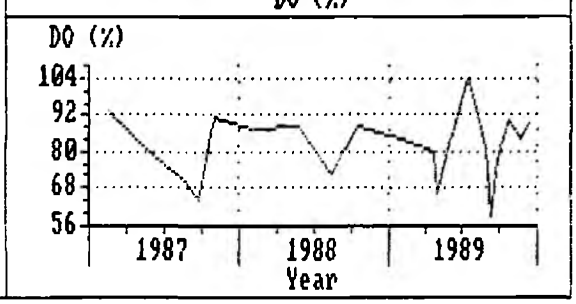



BUDE CANAL AT RODDS BRIDGE DO (%) 16/ 2/87 to 12/12/89

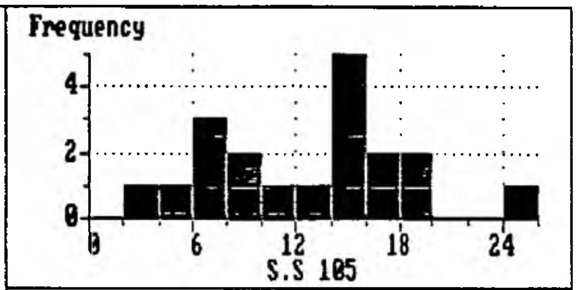
| | |
|---|---|
| Number of observations | 19 |
| Minimum | 59.0 |
| Mean | 81.5 |
| Maximum | 104.0 |
| Standard deviation | 11.25 |
| SDD | 11.90 |
| Non-parametric estimate of: | |
| 5 percentile | 59.0 |
| 10 percentile | 64.0 |
| 20 percentile | 70.0 |
| Median | 84.0 |
| 80 percentile | 90.0 |
| 90 percentile | 93.0 |
| 95 percentile | 104.0 |

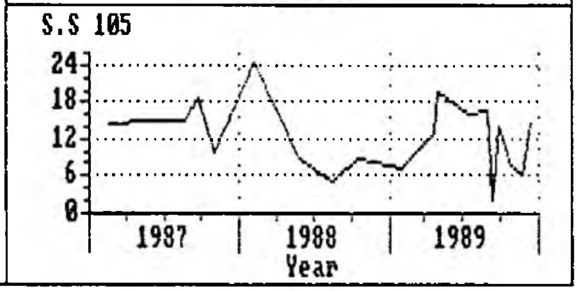


BUDE CANAL AT RODDS BRIDGE S.S 105 16/ 2/87 to 12/12/89

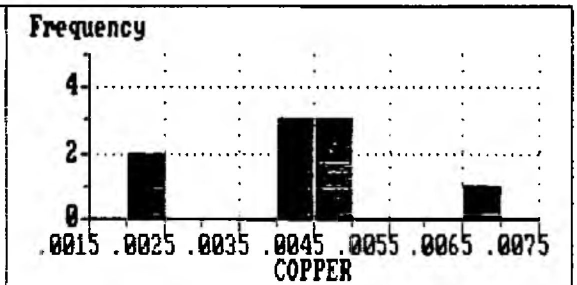
| | |
|---|---|
| Number of observations | 19 |
| Minimum | 2.00 |
| Mean | 12.53 |
| Maximum | 24.50 |
| Standard deviation | 5.671 |
| SDD | 5.796 |
| Non-parametric estimate of: | |
| 5 percentile | 2.00 |
| 10 percentile | 5.20 |
| 20 percentile | 7.40 |
| Median | 14.00 |
| 80 percentile | 16.80 |
| 90 percentile | 19.60 |
| 95 percentile | 24.50 |

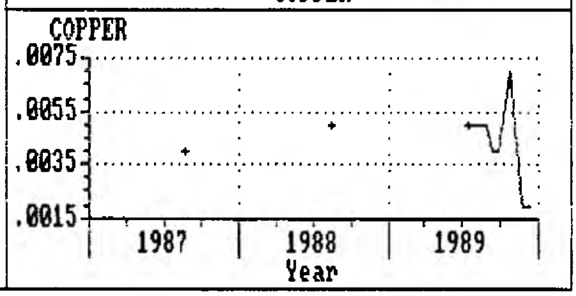



BUDE CANAL AT RODDS BRIDGE COPPER 16/ 2/87 to 12/12/89

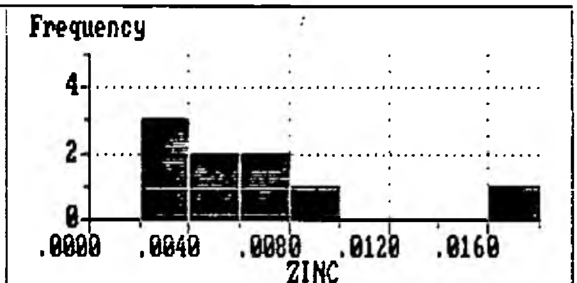
| | |
|---|---|
| Number of observations | 9 |
| Minimum | 0.00200 |
| Mean | 0.00422 |
| Maximum | 0.00700 |
| Standard deviation | 0.001563 |
| SDD | 0.001871 |
| Non-parametric estimate of: | |
| 10 percentile | 0.00200 |
| 20 percentile | 0.00200 |
| Median | 0.00400 |
| 80 percentile | 0.00500 |
| 90 percentile | 0.00700 |

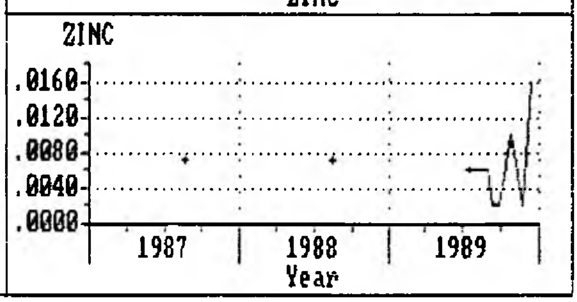



BUDE CANAL AT RODDS BRIDGE ZINC 16/ 2/87 to 12/12/89

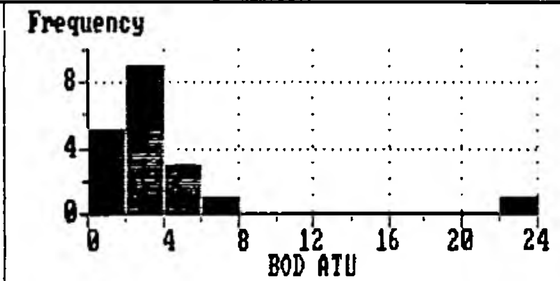
| | |
|---|---|
| Number of observations | 9 |
| Minimum | 0.00200 |
| Mean | 0.00644 |
| Maximum | 0.01600 |
| Standard deviation | 0.004531 |
| SDD | 0.005831 |
| Non-parametric estimate of: | |
| 10 percentile | 0.00200 |
| 20 percentile | 0.00200 |
| Median | 0.00600 |
| 80 percentile | 0.01000 |
| 90 percentile | 0.01600 |

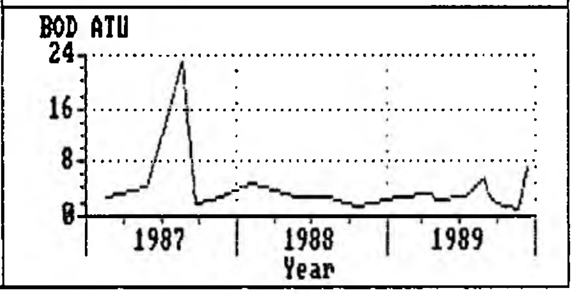


RIVER STRAT AT RODDS BRIDGE BOD ATU 16/ 2/87 to 12/12/89

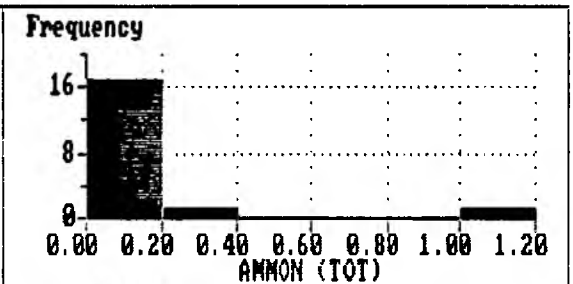
| | |
|---|---|
| Number of observations | 19 |
| Minimum | 1.00 |
| Mean | 4.01 |
| Maximum | 23.00 |
| Standard deviation | 4.855 |
| SDD | 5.073 |
| Non-parametric estimate of: | |
| 5 percentile | 1.00 |
| 10 percentile | 1.10 |
| 20 percentile | 1.60 |
| Median | 2.80 |
| 80 percentile | 4.80 |
| 90 percentile | 7.00 |
| 95 percentile | 23.00 |

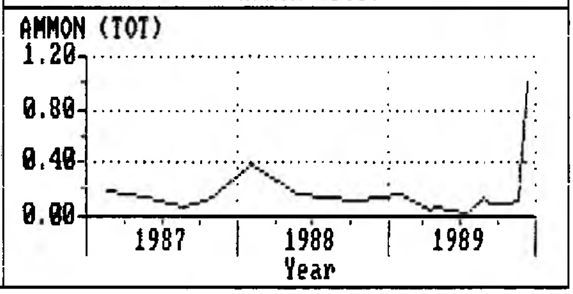



RIVER STRAT AT RODDS BRIDGE AMMON (TOT) 16/ 2/87 to 12/12/89

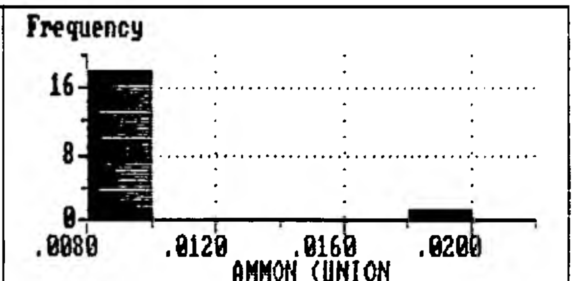
| | |
|---|---|
| Number of observations | 19 |
| Minimum | 0.010 |
| Mean | 0.171 |
| Maximum | 1.020 |
| Standard deviation | 0.2198 |
| SDD | 0.1691 |
| Non-parametric estimate of: | |
| 5 percentile | 0.010 |
| 10 percentile | 0.050 |
| 20 percentile | 0.070 |
| Median | 0.120 |
| 80 percentile | 0.170 |
| 90 percentile | 0.390 |
| 95 percentile | 1.020 |

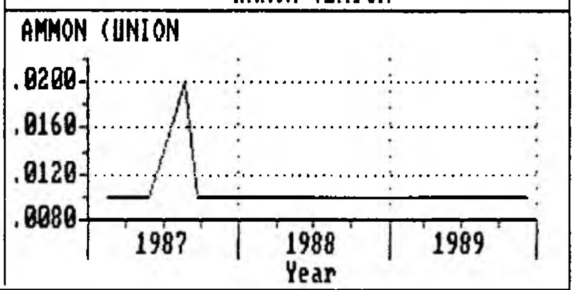



RIVER STRAT AT RODDS BRIDGE AMMON (UNION 16/ 2/87 to 12/12/89

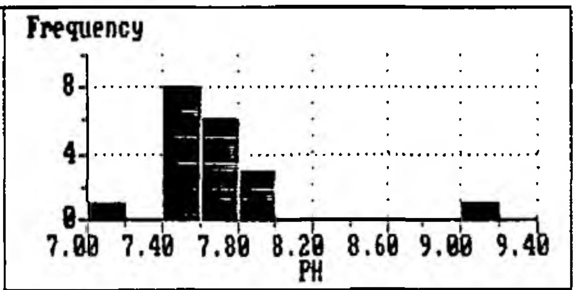
| | |
|---|---|
| Number of observations | 19 |
| Minimum | 0.01000 |
| Mean | 0.01053 |
| Maximum | 0.02000 |
| Standard deviation | 0.002294 |
| SDD | 0.002425 |
| Non-parametric estimate of: | |
| 5 percentile | 0.01000 |
| 10 percentile | 0.01000 |
| 20 percentile | 0.01000 |
| Median | 0.01000 |
| 80 percentile | 0.01000 |
| 90 percentile | 0.01000 |
| 95 percentile | 0.02000 |

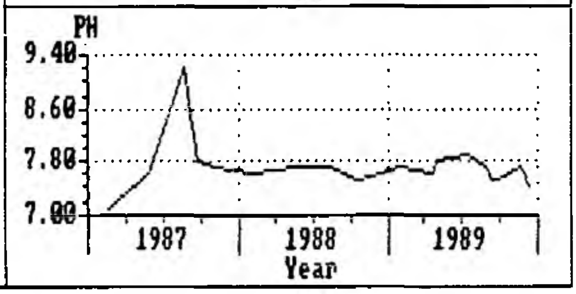


RIVER STRAT AT RODDS BRIDGE PH 16/ 2/87 to 12/12/89

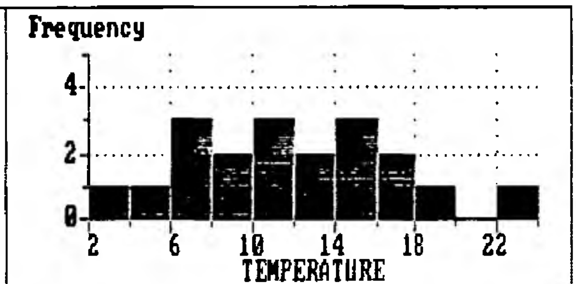
| | |
|---|---|
| Number of observations | 19 |
| Minimum | 7.100 |
| Mean | 7.700 |
| Maximum | 9.200 |
| Standard deviation | 0.4028 |
| SDD | 0.3884 |
| Non-parametric estimate of: | |
| 5 percentile | 7.100 |
| 10 percentile | 7.400 |
| 20 percentile | 7.500 |
| Median | 7.700 |
| 80 percentile | 7.800 |
| 90 percentile | 7.900 |
| 95 percentile | 9.200 |

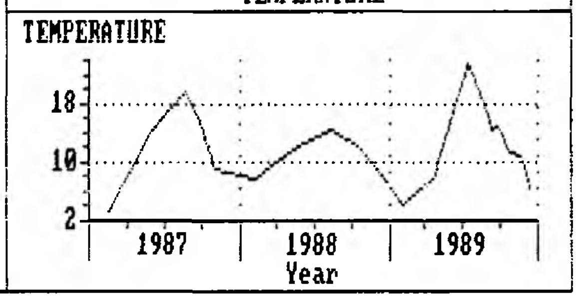



RIVER STRAT AT RODDS BRIDGE TEMPERATURE 16/ 2/87 to 12/12/89

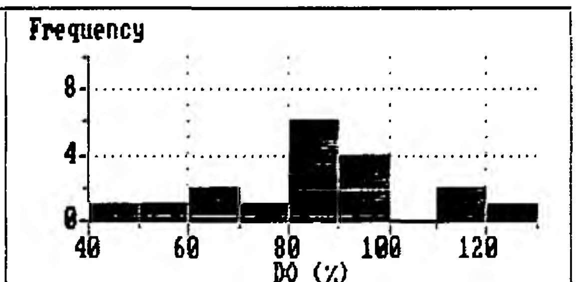
| | |
|---|---|
| Number of observations | 19 |
| Minimum | 3.20 |
| Mean | 11.90 |
| Maximum | 23.70 |
| Standard deviation | 5.176 |
| SDD | 4.205 |
| Non-parametric estimate of: | |
| 5 percentile | 3.20 |
| 10 percentile | 4.00 |
| 20 percentile | 7.50 |
| Median | 11.90 |
| 80 percentile | 16.00 |
| 90 percentile | 19.50 |
| 95 percentile | 23.70 |

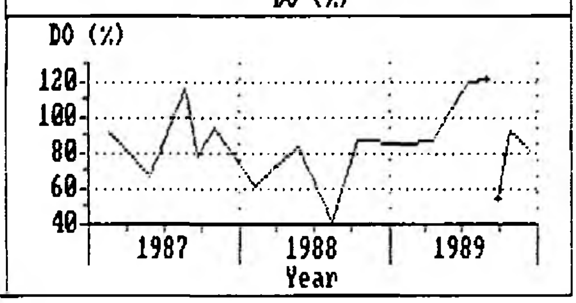



RIVER STRAT AT RODDS BRIDGE DO (%) 16/ 2/87 to 12/12/89

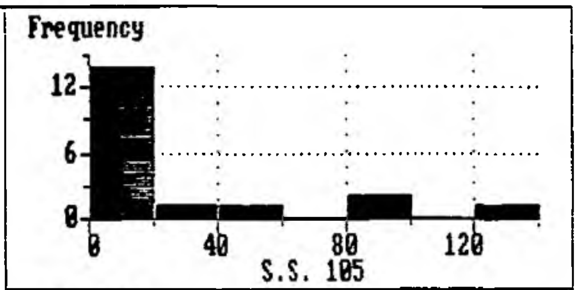
| | |
|---|---|
| Number of observations | 18 |
| Minimum | 42.0 |
| Mean | 85.3 |
| Maximum | 121.0 |
| Standard deviation | 20.98 |
| SDD | 20.66 |
| Non-parametric estimate of: | |
| 10 percentile | 52.8 |
| 20 percentile | 65.0 |
| Median | 86.5 |
| 80 percentile | 98.4 |
| 90 percentile | 119.2 |

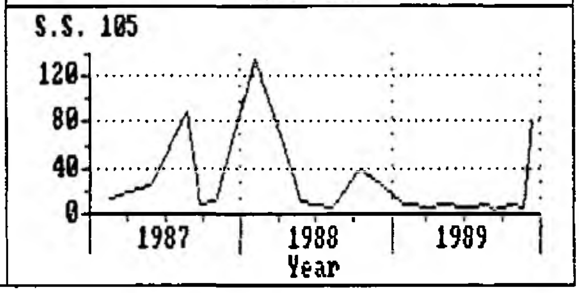


## RIVER STRAT AT RODDS BRIDGE    S.S. 105    16/ 2/87 to 12/12/89

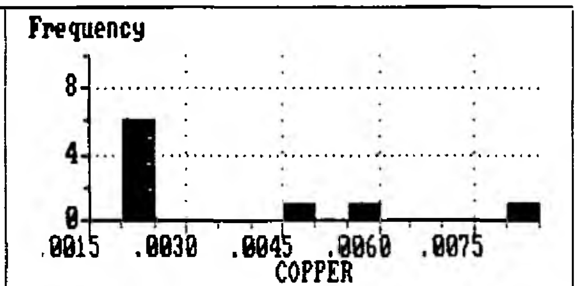
| | |
|---|---|
| Number of observations | 19 |
| Minimum | 3.0 |
| Mean | 24.7 |
| Maximum | 135.0 |
| Standard deviation | 36.83 |
| SDD | 38.85 |
| Non-parametric estimate of: | |
| 5 percentile | 3.0 |
| 10 percentile | 3.6 |
| 20 percentile | 6.0 |
| Median | 7.6 |
| 80 percentile | 40.0 |
| 90 percentile | 90.0 |
| 95 percentile | 135.0 |

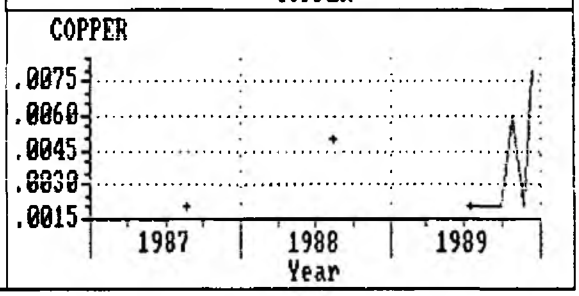



## RIVER STRAT AT RODDS BRIDGE    COPPER    16/ 2/87 to 12/12/89

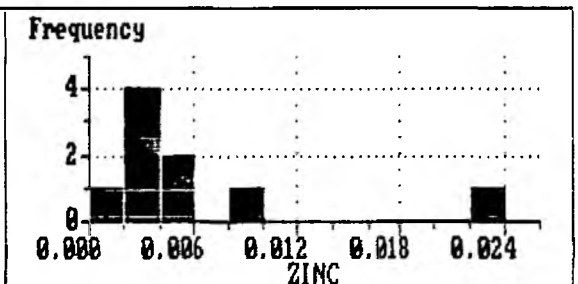
| | |
|---|---|
| Number of observations | 9 |
| Minimum | 0.00200 |
| Mean | 0.00344 |
| Maximum | 0.00800 |
| Standard deviation | 0.002297 |
| SDD | 0.002608 |
| Non-parametric estimate of: | |
| 10 percentile | 0.00200 |
| 20 percentile | 0.00200 |
| Median | 0.00200 |
| 80 percentile | 0.00600 |
| 90 percentile | 0.00800 |

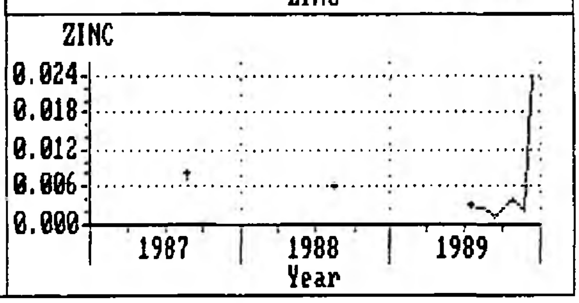



## RIVER STRAT AT RODDS BRIDGE    ZINC    16/ 2/87 to 12/12/89

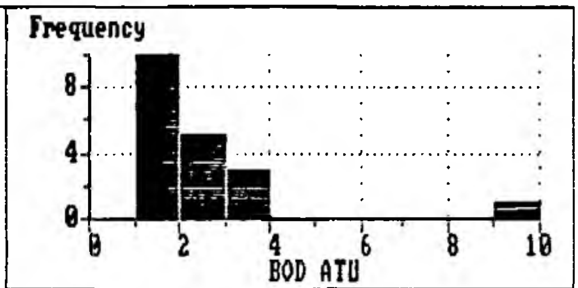
| | |
|---|---|
| Number of observations | 9 |
| Minimum | 0.00100 |
| Mean | 0.00578 |
| Maximum | 0.02400 |
| Standard deviation | 0.007190 |
| SDD | 0.007036 |
| Non-parametric estimate of: | |
| 10 percentile | 0.00100 |
| 20 percentile | 0.00200 |
| Median | 0.00300 |
| 80 percentile | 0.00800 |
| 90 percentile | 0.02400 |

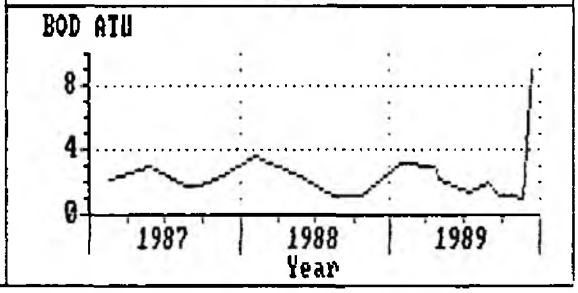


RIVER STRAT AT HELE BRIDGE    BOD ATU    16/ 2/87 to 12/12/89

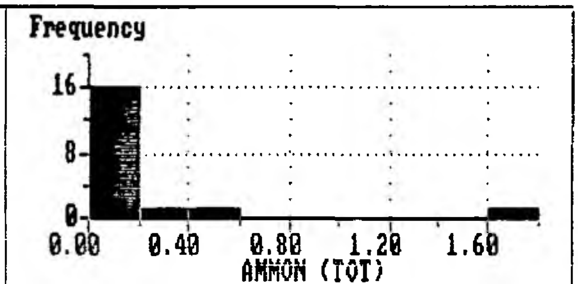
| | |
|---|---|
| Number of observations | 19 |
| Minimum | 1.00 |
| Mean | 2.33 |
| Maximum | 9.10 |
| Standard deviation | 1.806 |
| SDD | 1.520 |
| Non-parametric estimate of: | |
| 5 percentile | 1.00 |
| 10 percentile | 1.10 |
| 20 percentile | 1.20 |
| Median | 1.90 |
| 80 percentile | 3.00 |
| 90 percentile | 3.50 |
| 95 percentile | 9.10 |

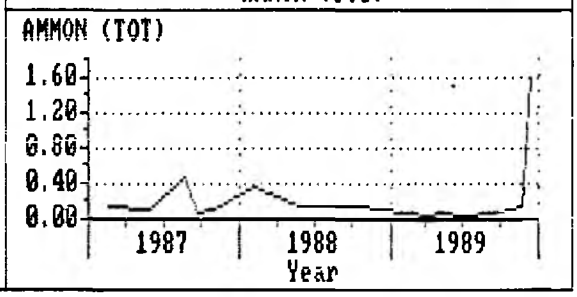



RIVER STRAT AT HELE BRIDGE    AMMON (TOT)    16/ 2/87 to 12/12/89

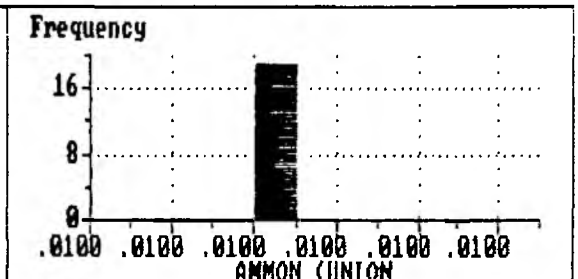
| | |
|---|---|
| Number of observations | 19 |
| Minimum | 0.020 |
| Mean | 0.203 |
| Maximum | 1.600 |
| Standard deviation | 0.3554 |
| SDD | 0.2770 |
| Non-parametric estimate of: | |
| 5 percentile | 0.020 |
| 10 percentile | 0.040 |
| 20 percentile | 0.060 |
| Median | 0.100 |
| 80 percentile | 0.150 |
| 90 percentile | 0.470 |
| 95 percentile | 1.600 |

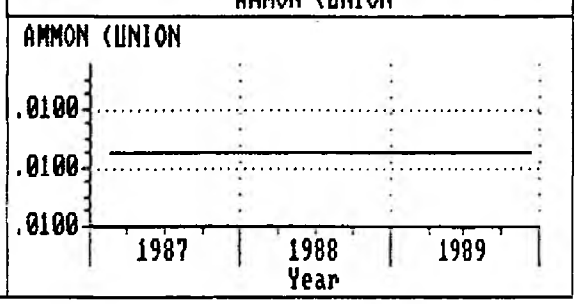



RIVER STRAT AT HELE BRIDGE    AMMON (UNION    16/ 2/87 to 12/12/89

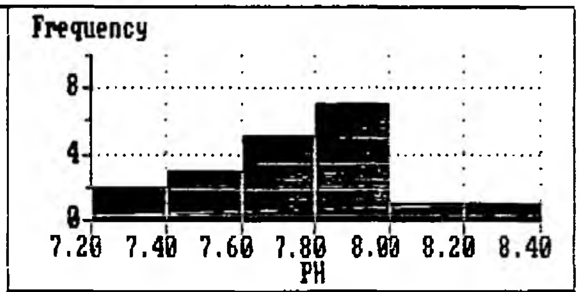
| | |
|---|---|
| Number of observations | 19 |
| Minimum | 0.01 |
| Mean | 0.01 |
| Maximum | 0.01 |
| Standard deviation | 0.000 |
| SDD | 0.000 |
| Non-parametric estimate of: | |
| 5 percentile | 0.01 |
| 10 percentile | 0.01 |
| 20 percentile | 0.01 |
| Median | 0.01 |
| 80 percentile | 0.01 |
| 90 percentile | 0.01 |
| 95 percentile | 0.01 |

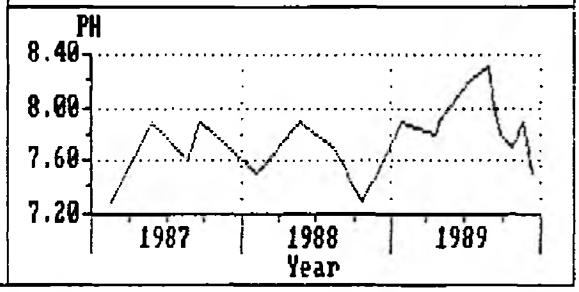


RIVER STRAT AT HELE BRIDGE PH 16/ 2/87 to 12/12/89

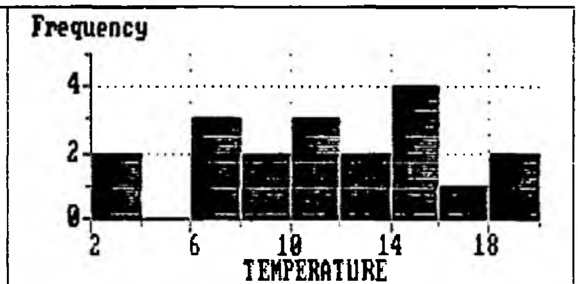
| | |
|---|---|
| Number of observations | 19 |
| Minimum | 7.300 |
| Mean | 7.784 |
| Maximum | 8.300 |
| Standard deviation | 0.2630 |
| SDD | 0.2314 |
| Non-parametric estimate of: | |
| 5 percentile | 7.300 |
| 10 percentile | 7.300 |
| 20 percentile | 7.500 |
| Median | 7.800 |
| 80 percentile | 7.900 |
| 90 percentile | 8.200 |
| 95 percentile | 8.300 |

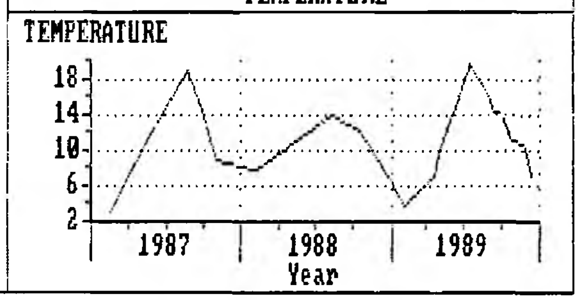



RIVER STRAT AT HELE BRIDGE TEMPERATURE 16/ 2/87 to 12/12/89

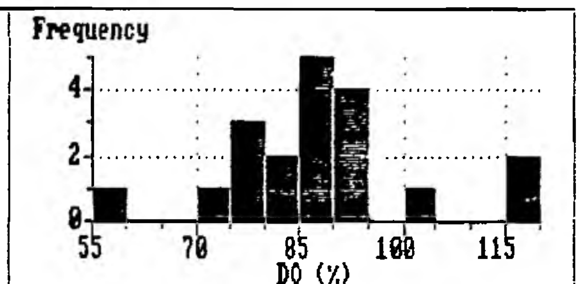
| | |
|---|---|
| Number of observations | 19 |
| Minimum | 3.00 |
| Mean | 11.40 |
| Maximum | 19.70 |
| Standard deviation | 4.587 |
| SDD | 3.593 |
| Non-parametric estimate of: | |
| 5 percentile | 3.00 |
| 10 percentile | 3.90 |
| 20 percentile | 7.00 |
| Median | 11.50 |
| 80 percentile | 15.00 |
| 90 percentile | 19.00 |
| 95 percentile | 19.70 |

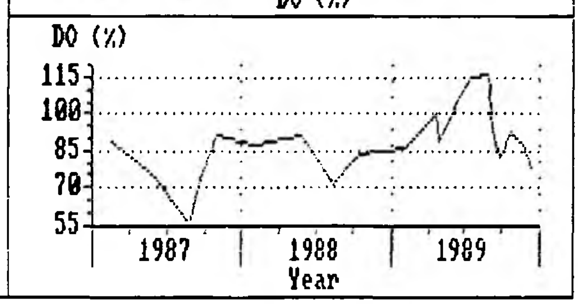



RIVER STRAT AT HELE BRIDGE DO (%) 16/ 2/87 to 12/12/89

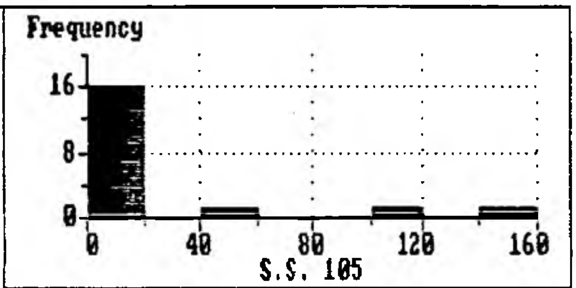
| | |
|---|---|
| Number of observations | 19 |
| Minimum | 56.0 |
| Mean | 87.6 |
| Maximum | 116.0 |
| Standard deviation | 13.91 |
| SDD | 10.42 |
| Non-parametric estimate of: | |
| 5 percentile | 56.0 |
| 10 percentile | 72.0 |
| 20 percentile | 76.0 |
| Median | 88.0 |
| 80 percentile | 93.0 |
| 90 percentile | 115.0 |
| 95 percentile | 116.0 |

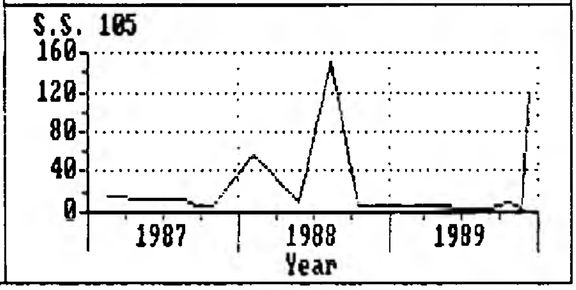


RIVER STRAT AT HELE BRIDGE S.S. 105 16/ 2/87 to 12/12/89

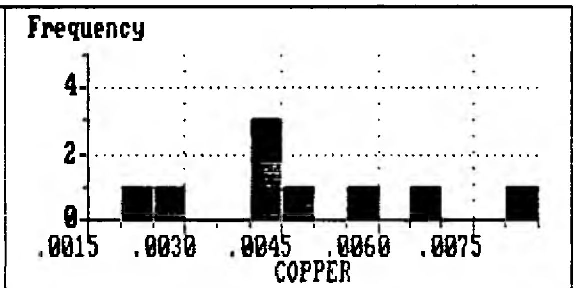
| | |
|---|---|
| Number of observations | 19 |
| Minimum | 1.0 |
| Mean | 22.9 |
| Maximum | 152.0 |
| Standard deviation | 41.73 |
| SDD | 41.87 |
| Non-parametric estimate of: | |
| 5 percentile | 1.0 |
| 10 percentile | 2.8 |
| 20 percentile | 4.0 |
| Median | 6.8 |
| 80 percentile | 14.4 |
| 90 percentile | 118.0 |
| 95 percentile | 152.0 |

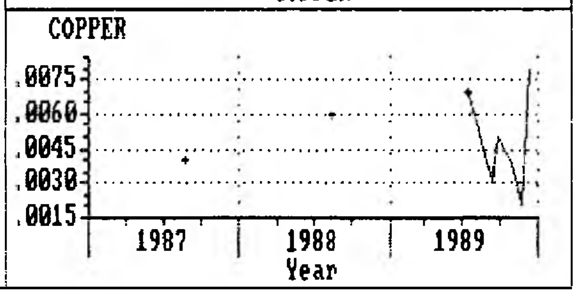



RIVER STRAT AT HELE BRIDGE COPPER 16/ 2/87 to 12/12/89

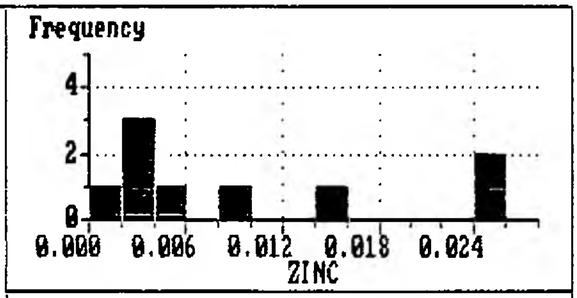
| | |
|---|---|
| Number of observations | 9 |
| Minimum | 0.00200 |
| Mean | 0.00478 |
| Maximum | 0.00800 |
| Standard deviation | 0.001922 |
| SDD | 0.002345 |
| Non-parametric estimate of: | |
| 10 percentile | 0.00200 |
| 20 percentile | 0.00300 |
| Median | 0.00400 |
| 80 percentile | 0.00700 |
| 90 percentile | 0.00800 |

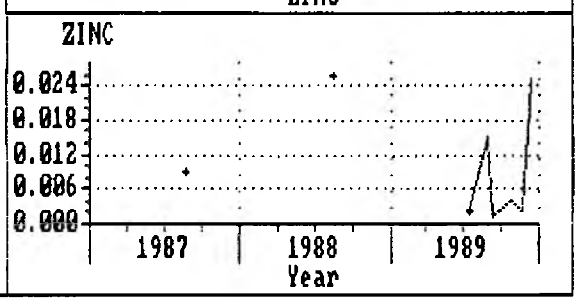



RIVER STRAT AT HELE BRIDGE ZINC 16/ 2/87 to 12/12/89

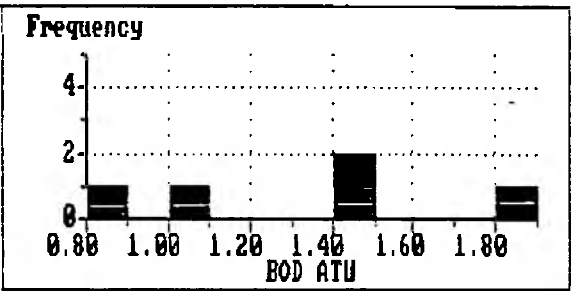
| | |
|---|---|
| Number of observations | 9 |
| Minimum | 0.00100 |
| Mean | 0.00956 |
| Maximum | 0.02600 |
| Standard deviation | 0.010088 |
| SDD | 0.009503 |
| Non-parametric estimate of: | |
| 10 percentile | 0.00100 |
| 20 percentile | 0.00200 |
| Median | 0.00400 |
| 80 percentile | 0.02500 |
| 90 percentile | 0.02600 |

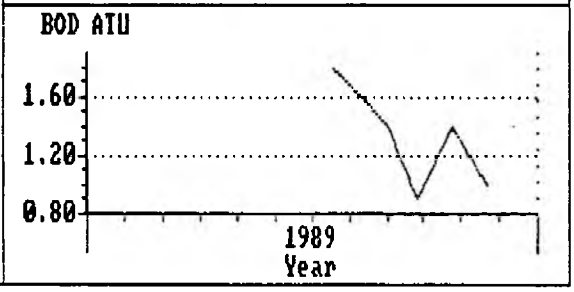


RIVER STRAT AT BUSH BOD ATU 18/ 7/89 to 21/11/89

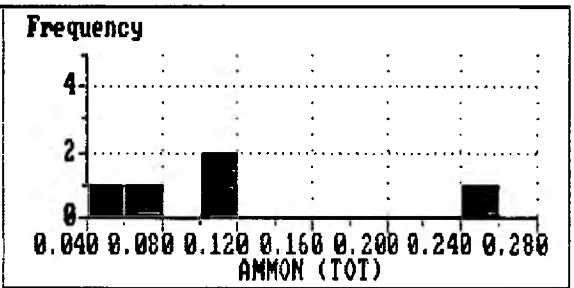
| | |
|---|---|
| Number of observations | 5 |
| Minimum | 0.900 |
| Mean | 1.300 |
| Maximum | 1.800 |
| Standard deviation | 0.3606 |
| SDD | 0.3697 |
| Non-parametric estimate of: | |
| 20 percentile | 0.920 |
| Median | 1.400 |
| 80 percentile | 1.720 |

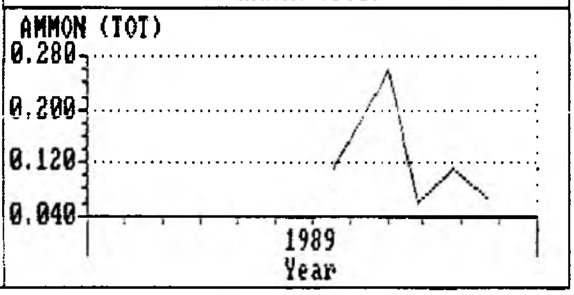



RIVER STRAT AT BUSH AMMON (TOT) 18/ 7/89 to 21/11/89

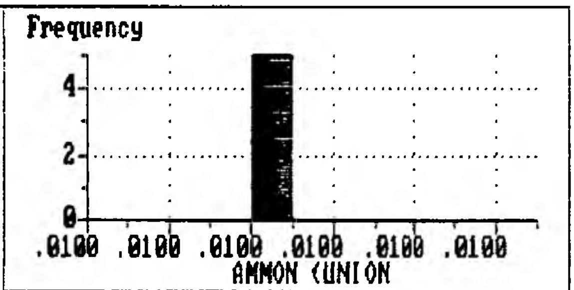
| | |
|---|---|
| Number of observations | 5 |
| Minimum | 0.0600 |
| Mean | 0.1220 |
| Maximum | 0.2600 |
| Standard deviation | 0.08044 |
| SDD | 0.10536 |
| Non-parametric estimate of: | |
| 20 percentile | 0.0620 |
| Median | 0.1100 |
| 80 percentile | 0.2300 |

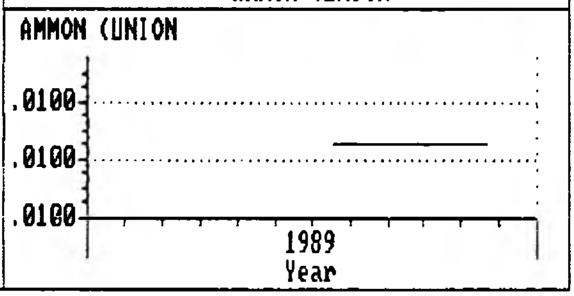



RIVER STRAT AT BUSH AMMON (UNION 18/ 7/89 to 21/11/89

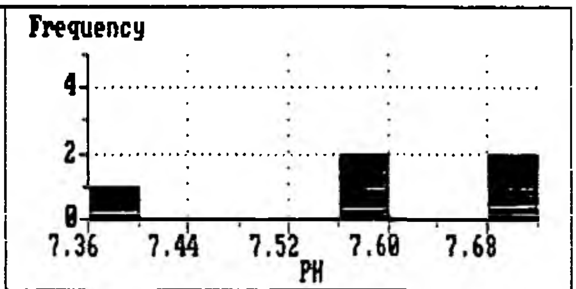
| | |
|---|---|
| Number of observations | 5 |
| Minimum | 0.01 |
| Mean | 0.01 |
| Maximum | 0.01 |
| Standard deviation | 0.000 |
| SDD | 0.000 |
| Non-parametric estimate of: | |
| 20 percentile | 0.01 |
| Median | 0.01 |
| 80 percentile | 0.01 |

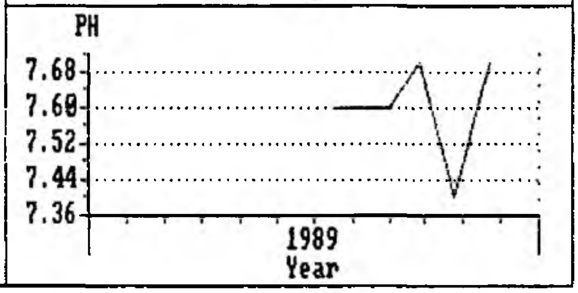


RIVER STRAT AT BUSH PH 18/ 7/89 to 21/11/89

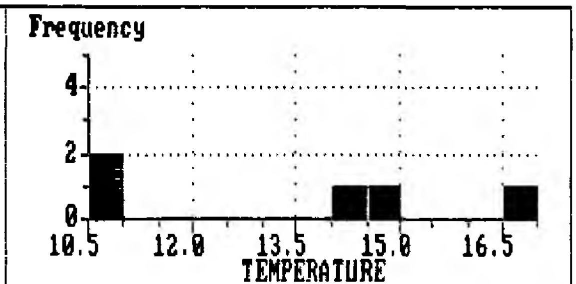
| | |
|---|---|
| Number of observations | 5 |
| Minimum | 7.400 |
| Mean | 7.600 |
| Maximum | 7.700 |
| Standard deviation | 0.1225 |
| SDD | 0.1780 |
| Non-parametric estimate of: | |
| 20 percentile | 7.440 |
| Median | 7.600 |
| 80 percentile | 7.700 |

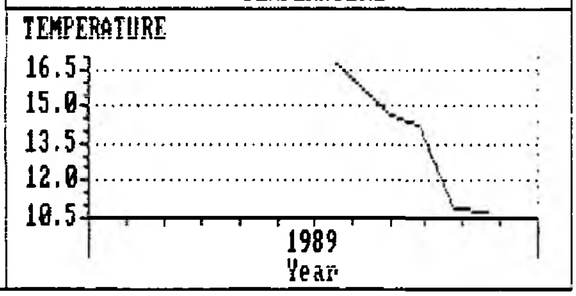



RIVER STRAT AT BUSH TEMPERATURE 18/ 7/89 to 21/11/89

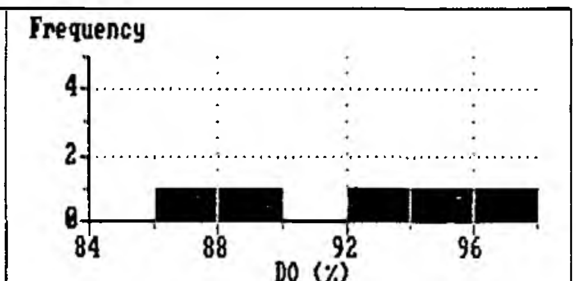
| | |
|---|---|
| Number of observations | 5 |
| Minimum | 10.70 |
| Mean | 13.44 |
| Maximum | 16.70 |
| Standard deviation | 2.582 |
| SDD | 1.638 |
| Non-parametric estimate of: | |
| 20 percentile | 10.74 |
| Median | 14.30 |
| 80 percentile | 16.28 |

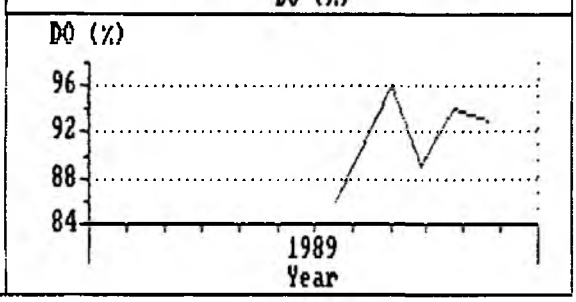



RIVER STRAT AT BUSH DO (%) 18/ 7/89 to 21/11/89

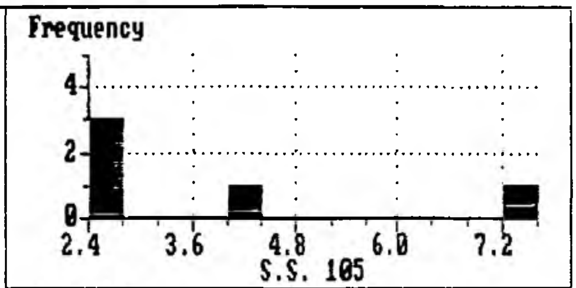
| | |
|---|---|
| Number of observations | 5 |
| Minimum | 86.00 |
| Mean | 91.60 |
| Maximum | 96.00 |
| Standard deviation | 4.037 |
| SDD | 5.401 |
| Non-parametric estimate of: | |
| 20 percentile | 86.60 |
| Median | 93.00 |
| 80 percentile | 95.60 |

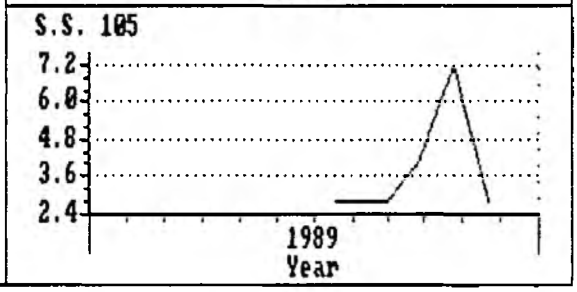


RIVER STRAT AT BUSH S.S. 105 18/ 7/89 to 21/11/89

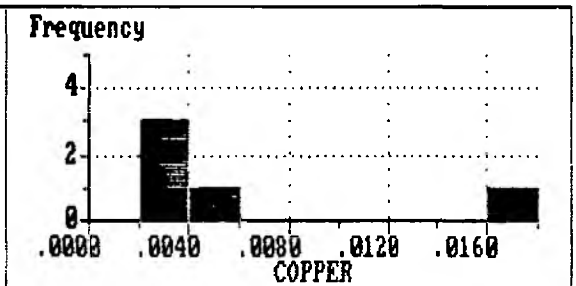
| | |
|---|---|
| Number of observations | 5 |
| Minimum | 2.80 |
| Mean | 3.92 |
| Maximum | 7.20 |
| Standard deviation | 1.906 |
| SDD | 2.274 |
| Non-parametric estimate of: | |
| 20 percentile | 2.80 |
| Median | 2.80 |
| 80 percentile | 6.56 |

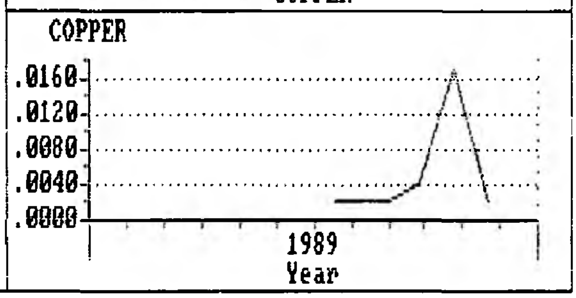



RIVER STRAT AT BUSH COPPER 18/ 7/89 to 21/11/89

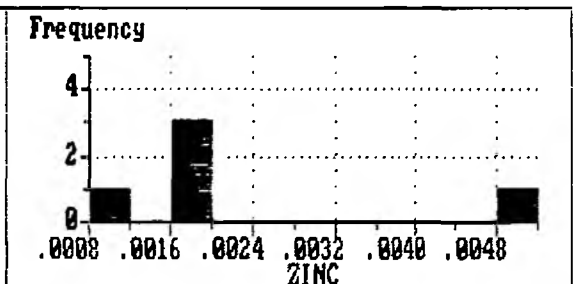
| | |
|---|---|
| Number of observations | 5 |
| Minimum | 0.00200 |
| Mean | 0.00540 |
| Maximum | 0.01700 |
| Standard deviation | 0.006542 |
| SDD | 0.008145 |
| Non-parametric estimate of: | |
| 20 percentile | 0.00200 |
| Median | 0.00200 |
| 80 percentile | 0.01440 |

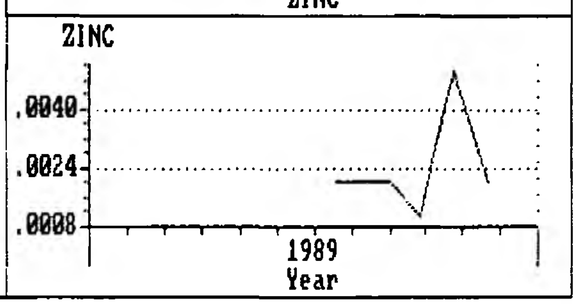



RIVER STRAT AT BUSH ZINC 18/ 7/89 to 21/11/89

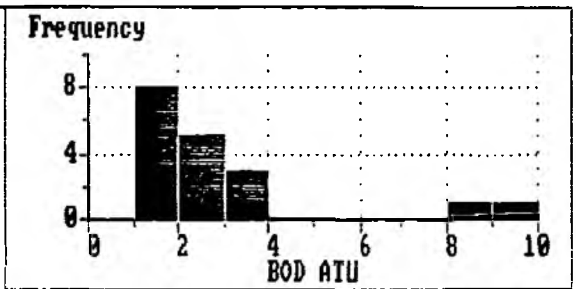
| | |
|---|---|
| Number of observations | 5 |
| Minimum | 0.00100 |
| Mean | 0.00240 |
| Maximum | 0.00500 |
| Standard deviation | 0.001517 |
| SDD | 0.002082 |
| Non-parametric estimate of: | |
| 20 percentile | 0.00120 |
| Median | 0.00200 |
| 80 percentile | 0.00440 |

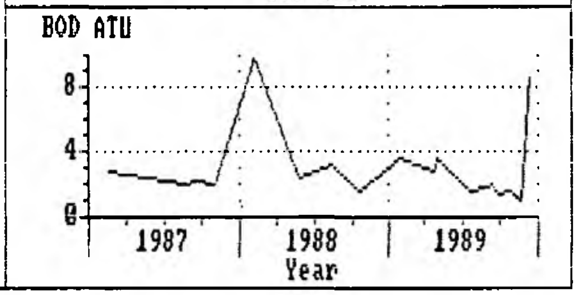


RIVER STRAT AT STRATON BOD ATU 16/ 2/87 to 12/12/89

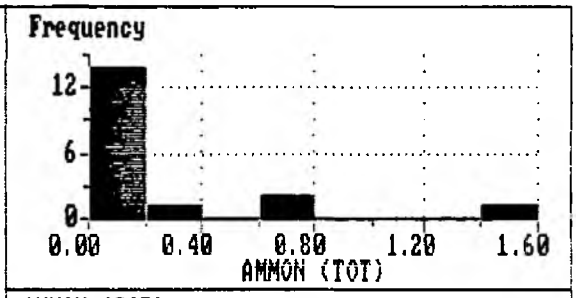
| | |
|---|---|
| Number of observations | 18 |
| Minimum | 1.00 |
| Mean | 2.96 |
| Maximum | 9.80 |
| Standard deviation | 2.415 |
| SDD | 2.440 |
| Non-parametric estimate of: | |
| 10 percentile | 1.27 |
| 20 percentile | 1.50 |
| Median | 2.10 |
| 80 percentile | 3.52 |
| 90 percentile | 8.81 |

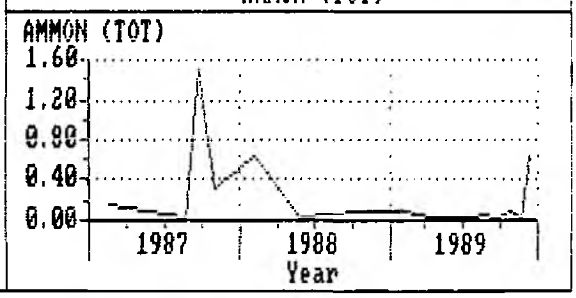



RIVER STRAT AT STRATON AMMON (TOT) 16/ 2/87 to 12/12/89

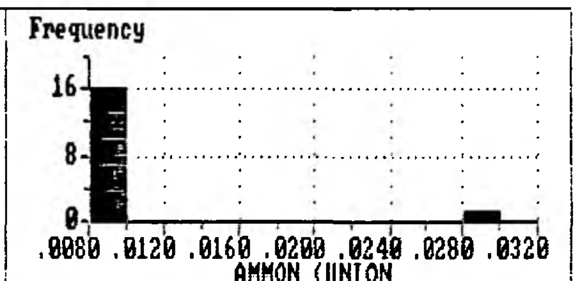
| | |
|---|---|
| Number of observations | 18 |
| Minimum | 0.010 |
| Mean | 0.213 |
| Maximum | 1.500 |
| Standard deviation | 0.3775 |
| SDD | 0.3735 |
| Non-parametric estimate of: | |
| 10 percentile | 0.019 |
| 20 percentile | 0.028 |
| Median | 0.050 |
| 80 percentile | 0.370 |
| 90 percentile | 0.735 |

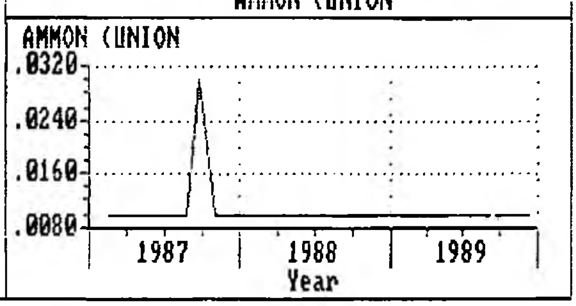



RIVER STRAT AT STRATON AMMON (UNION 16/ 2/87 to 12/12/89

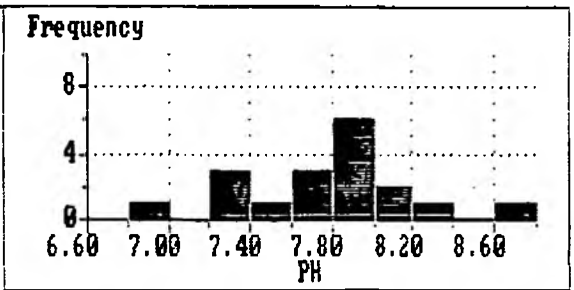
| | |
|---|---|
| Number of observations | 17 |
| Minimum | 0.01000 |
| Mean | 0.01118 |
| Maximum | 0.03000 |
| Standard deviation | 0.004851 |
| SDD | 0.005345 |
| Non-parametric estimate of: | |
| 10 percentile | 0.01000 |
| 20 percentile | 0.01000 |
| Median | 0.01000 |
| 80 percentile | 0.01000 |
| 90 percentile | 0.01400 |

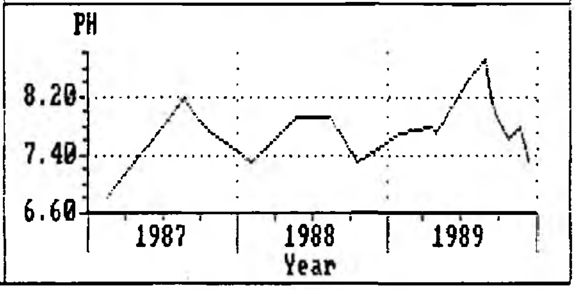


RIVER STRAT AT STRATON PH 16/ 2/87 to 12/12/89

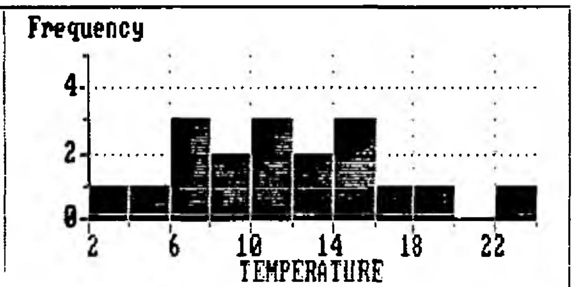
| | |
|---|---|
| Number of observations | 18 |
| Minimum | 6.800 |
| Mean | 7.783 |
| Maximum | 8.700 |
| Standard deviation | 0.4436 |
| SDD | 0.3729 |
| Non-parametric estimate of: | |
| 10 percentile | 7.250 |
| 20 percentile | 7.300 |
| Median | 7.800 |
| 80 percentile | 8.200 |
| 90 percentile | 8.430 |

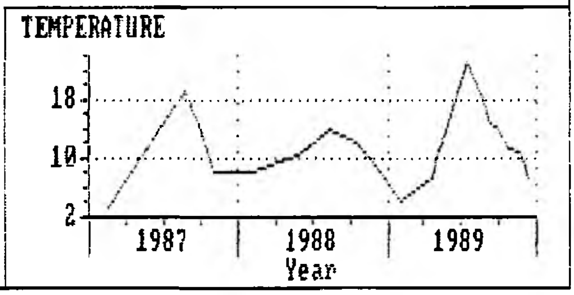



RIVER STRAT AT STRATON TEMPERATURE 16/ 2/87 to 12/12/89

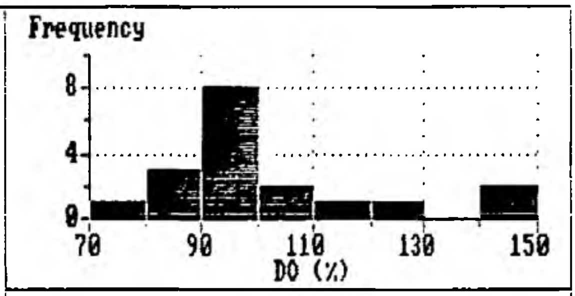
| | |
|---|---|
| Number of observations | 18 |
| Minimum | 3.20 |
| Mean | 11.56 |
| Maximum | 23.10 |
| Standard deviation | 5.186 |
| SDD | 4.582 |
| Non-parametric estimate of: | |
| 10 percentile | 3.92 |
| 20 percentile | 7.08 |
| Median | 10.85 |
| 80 percentile | 15.62 |
| 90 percentile | 19.41 |

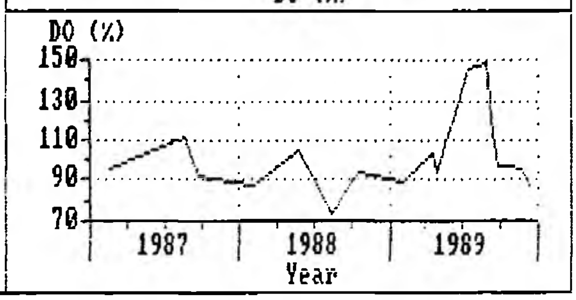



RIVER STRAT AT STRATON DO (%) 16/ 2/87 to 12/12/89

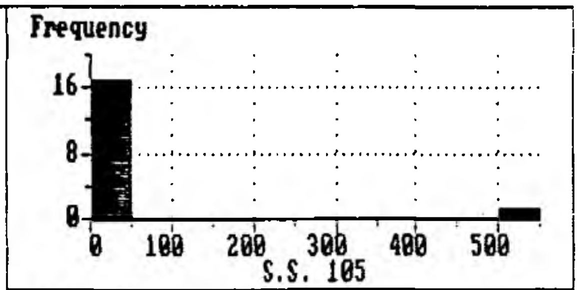
| | |
|---|---|
| Number of observations | 18 |
| Minimum | 73.0 |
| Mean | 101.2 |
| Maximum | 148.0 |
| Standard deviation | 19.31 |
| SDD | 14.39 |
| Non-parametric estimate of: | |
| 10 percentile | 85.6 |
| 20 percentile | 88.8 |
| Median | 95.0 |
| 80 percentile | 112.8 |
| 90 percentile | 145.3 |

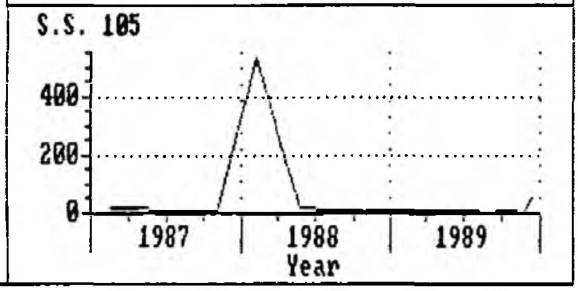


RIVER STRAT AT STRATON S.S. 105 16/ 2/87 to 12/12/89

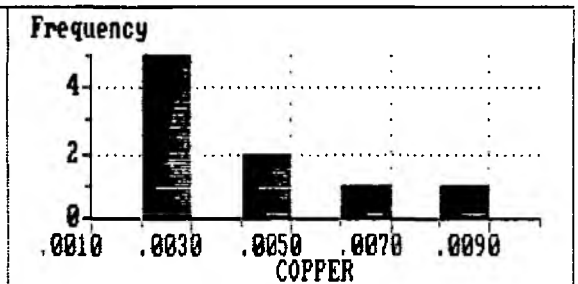
| | |
|---|---|
| Number of observations | 18 |
| Minimum | 1.0 |
| Mean | 38.2 |
| Maximum | 526.0 |
| Standard deviation | 122.19 |
| SDD | 128.76 |
| Non-parametric estimate of: | |
| 10 percentile | 1.5 |
| 20 percentile | 3.7 |
| Median | 7.6 |
| 80 percentile | 14.8 |
| 90 percentile | 95.8 |

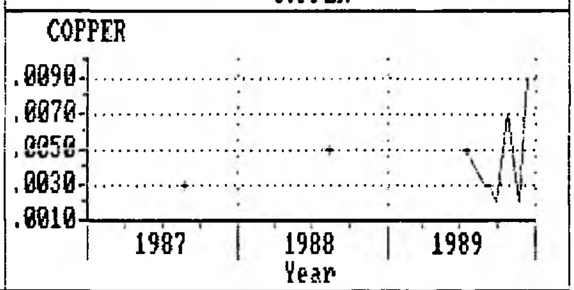



RIVER STRAT AT STRATON COPPER 16/ 2/87 to 12/12/89

| | |
|---|---|
| Number of observations | 9 |
| Minimum | 0.00200 |
| Mean | 0.00433 |
| Maximum | 0.00900 |
| Standard deviation | 0.002398 |
| SDD | 0.003225 |
| Non-parametric estimate of: | |
| 10 percentile | 0.00200 |
| 20 percentile | 0.00200 |
| Median | 0.00300 |
| 80 percentile | 0.00700 |
| 90 percentile | 0.00900 |




RIVER STRAT AT STRATON ZINC 16/ 2/87 to 12/12/89

| | |
|---|---|
| Number of observations | 9 |
| Minimum | 0.00100 |
| Mean | 0.00644 |
| Maximum | 0.02400 |
| Standard deviation | 0.007213 |
| SDD | 0.007556 |
| Non-parametric estimate of: | |
| 10 percentile | 0.00100 |
| 20 percentile | 0.00200 |
| Median | 0.00300 |
| 80 percentile | 0.00800 |
| 90 percentile | 0.02400 |