ENVIRONMENT AGENCY



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**N.B.** The opinions expressed in this report are those of the Author, and do not necessarily reflect those of the NRA.

# An Investigation into the Water Quality of a treated effluent from Hambledon Dairy, Todber, Dorset.

**Investigations Team**
**South Wessex Area**
**January 1996 WQI/95/16**

**Key Words:** Ammonia, BOD, Consent, Dairy Effluent, pH, Suspended Solids.

## Background

Hambledon Dairy is situated at Todber, Sturminster Newton, Dorset , NGR ST 8011 2016 (See Schematic Representation). The dairy has a consent to discharge treated sewage effluent, milk parlour washings and waste from the pasteurisation unit via the treatment plant installed at the site. The final effluent is discharged to a lagoon which connects via a series of drainage ditches to the Key Brook, a tributary of the River Stour. The consent specifies that the final effluent should contain no more than 20mg/l BOD, 30 mg/l Suspended Solids, 20mg/l Ammonia and a have a pH in the range 6 to 8 pH units.

Routine Audit of the effluent and additional monitoring by Water Quality highlighted persistent consent failures from the treatment plant installed at the site. The dairy runs at peak output from 0600 to 1200 and off-peak output from 1200 to 0600, Monday to Friday and shuts down completely over the weekend. It was suspected that the effluent quality may vary over time due to the variety of dairy processes and the intermittent use of cleaning chemicals which include Hydrogen Peroxide, Phosphoric acid and Hypochlorite.

## Objectives

The objective of the survey was to continuously monitor the effluent over a week long period to detect any temporal variation in the water quality. It was hoped that Water Quality staff could then link effluent quality to the various dairy processes and management practices carried out at Hambledon Dairy.

## Methods

An Epic autosampler and sampling vessel were deployed at the final discharge point (see Schematic Representation) to take samples two hourly from 0600 to 1200, four hourly from 1200 to 0600, Monday to Friday and four hourly over the weekend shut down. Site visits were made on a daily basis over the week with samples dispatched the same evening. Weekend samples were collected and dispatched to the laboratory on Monday. Standard sewage effluent analysis was undertaken on all the samples.

On all site visits Analytical Quality Control (AQC) samples were collected directly from the effluent pipe as soon as the Epic had sampled the effluent contained in the sampling vessel. This allowed direct comparison between the samples taken from the sampling vessel and samples taken directly from the pipe as there was some concern that the suspended solids would continuously settle out in the sample container and possibly cause spurious results.

## Results

The sample results for the consented parameters are included in Table 1. Graphs 1 to 5 plot the results for each consented parameter over the entire sampling period to show the overall trend of the effluent quality over time. The AQC results have also been plotted on these charts to allow direct comparison between the Epic samples and the AQC samples. The results from the quality checks show that the sediment settling out in the sampling chamber did not substantially affect the results from the autosampler.

In order to allow closer analysis of the results over time Graphs 5 to 29 plot all parameters over each 24 hour period of monitoring. This would allow any daily trends in the effluent quality to be detected.

From 1200 on 10 November the samples collected remained in the Epic and were dispatched to the Laboratory on 13 November. This would increase the potential errors involved in the laboratory analysis and subsequently the results are less reliable although the laboratory will guarantee the maximum analytical errors at +/-20% for Ammonia and pH, +/-22% for Suspended Solids and +/-26% for BOD. All the samples processed fell well within the maximum error allowed by the laboratory.

Due to the exceptionally high results for suspended solids and BOD Graphs 14-21 show the results plotted with scales to fit the data and Graphs 22-29 show the results plotted on identical scales to exhibit the relative variation in results.

The autosampler failed to take one sample between 1000 on the 14 November and 1200 on the 15 November. Consequently the sample times cannot be guaranteed. The charts have been plotted assuming that the 1000 sample was missed, but it should be noted that all the sample results may actually have been taken two hours before. The 1200 sample on 15 November is plotted correctly.

**Discussion**

The production of dairy products is known to result in large volumes of variable strength organic waste. As Hambledon Dairy operates at two production rates for five days and then closes down completely for two days the variability of the flow to the treatment plant is extreme. The waste water from milk and cheese production usually has high levels of Suspended Solids and Ammonia, high BOD and variable pH due to the alkaline properties of milk and the acidity of some of the cleaning agents. It would therefore be expected that the water quality of the samples taken from the final effluent discharge point would be extremely varied in quality and that a pattern may emerge which could be linked to the production processes.

The pH of the effluent remained relatively constant at the upper limit of the consent throughout the survey with results between 7.8 and 8.15. Although the consent was breached on many of the samples taken the maximum laboratory error on pH analysis of +/-20% would discount these results as marginal failures.

During the course of the survey the Ammonia results remained largely below the limit of consent. Some results from the 8 and 9 November were over the consent level but all but three of these results can be discounted as failures due to the +/-20% analytical error allowed by the laboratory.

During the course of the survey the suspended solids results were generally high with only 36% of the samples falling below the consent limit once the laboratory error of +/-22% had been allowed. On one site visit on 08 November the flow from the effluent pipe increased dramatically and became highly coloured due to a faulty float switch. This flow state persisted for some time and an additional sample was taken at 0815. The suspended solids result for this sample was 2580 mg/l. This sample was exceptional but the results were generally high often

with minor peaks in the suspended solids loading occurring during the peak production period from 0600 to 1200. On the 10 November a noticeable result occurred at 2000 when the Suspended Solids result was measured at 314 mg/l and remained relatively high over the shut down on the 11 November .

BOD results were also poor with 39% of the samples failing the consent despite a +/-26% analytical error being applied. It is interesting that the BOD results were extremely high during the same period of time that high suspended solids results were occurring. It is possible that some cleaning process is undertaken at the end of the weekly production causing high BOD and suspended solids levels to be discharged. The two results are often closely linked and the samples appeared 'milky' on collection.

On 14 November the dairy owner informed the sampler that heavy rain over the weekend of the 11 and 12 November had caused the level of the lagoon to rise above the top of the sampling vessel and hence samples from this period may be erroneous. Some of the samples collected over the weekend period were black in appearance which may be due to this rise in water level (see Table of Results). However site visits made at 1200 on the 10 November and 0800 on the 13 November revealed water levels well below the sampling vessel. Rainfall data from the Fifehead Magdelene Meteorological Office Rainguage is included within Table 1 for information.

**Conclusions**

The treated effluent produced by the treatment plant was found to be of a consistently poor quality on all its consented parameters during the early part of the survey but a marked improvement was experienced, most noticeably in the levels of BOD and suspended solids towards the end of the monitoring period. This suggests that the treatment plant installed at the site is not capable of treating this volume of effluent to the quality required by the Authority under the terms of the consent.

It is suspected that the variable quality of the effluent may be attributed to the variety of dairy processes undertaken. However no definite conclusions may be drawn without further investigation by Water Quality into specific dairy activities over the course of the initial survey.

**Table 1: Results of Laboratory Analysis and Rainfall Data for the Sampling Period**

| Date | Time | BOD (ATU) | Suspended | Ammonia | pH | Rainfall | Comments |
|---|---|---|---|---|---|---|---|
| 08-Nov-95 | 06:00 | 85.60* | 67.00* | 24.70 | 8.00 | 0.80 | |
| 08-Nov-95 | 08:00 | 34.60* | 39.00* | 24.40 | 8.05 | | |
| 08-Nov-95 | 08:01 | 49.00* | 47.00* | 25.10 | 8.10 | | |
| 08-Nov-95 | 08:15 | 297.00* | 2580.00* | 22.80 | 7.80 | | |
| 08-Nov-95 | 10:00 | 28.00* | 42.00* | 23.10 | 8.05 | | |
| 08-Nov-95 | 12:00 | 16.50 | 37.00 | 23.30 | 8.10 | | |
| 08-Nov-95 | 16:00 | 101.00* | 70.00* | 24.00 | 8.05 | | |
| 08-Nov-95 | 20:00 | 77.70* | 59.00* | 24.40 | 8.05 | | |
| 08-Nov-95 | 23:59 | 55.00* | 54.00* | 24.50 | 8.05 | | |
| 09-Nov-95 | 04:00 | 47.00* | 55.00* | 24.70 | 8.10 | 22.50 | |
| 09-Nov-95 | 06:00 | 46.00* | 52.00* | 24.70 | 8.05 | | |
| 09-Nov-95 | 08:00 | 54.00* | 56.00* | 24.60 | 8.05 | | |
| 09-Nov-95 | 08:01 | 63.00* | 53.00* | 24.50 | 8.15 | | |
| 09-Nov-95 | 10:00 | 49.70* | 52.00* | 24.80 | 8.10 | | |
| 09-Nov-95 | 12:00 | 38.90* | 61.00* | 25.20* | 8.10 | | |
| 09-Nov-95 | 16:00 | 44.40* | 52.00* | 25.20* | 8.10 | | |
| 09-Nov-95 | 20:00 | 16.10 | 28.00 | 25.50* | 8.10 | | |
| 09-Nov-95 | 23:59 | 8.80 | 57.00* | 9.30 | 7.95 | | |
| 10-Nov-95 | 04:00 | 5.70 | 40.00* | 7.40 | 7.95 | 10.20 | |
| 10-Nov-95 | 06:00 | 23.40 | 160.00* | 10.60 | 7.95 | | |
| 10-Nov-95 | 08:00 | 9.90 | 52.00* | 12.00 | 8.05 | | |
| 10-Nov-95 | 10:00 | 5.90 | 27.00 | 10.50 | 8.05 | | |
| 10-Nov-95 | 12:00 | 10.90 | 33.00 | 12.20 | 8.05 | | |
| 10-Nov-95 | 12:01 | 11.00 | 27.00 | 12.20 | 8.00 | | |
| 10-Nov-95 | 16:00 | <10.0 | 17.00 | 14.90 | 8.10 | | |
| 10-Nov-95 | 20:00 | <30.0* | 314.00* | 18.10 | 7.90 | | Sample Discoloured |
| 10-Nov-95 | 23:59 | 381.00* | 127.00* | 25.20 | 7.90 | | Sample Discoloured |
| 11-Nov-95 | 04:00 | 359.00* | 114.00* | 24.70 | 7.90 | 13.40 | Sample discoloured |
| 11-Nov-95 | 08:00 | 142.00* | 79.00* | 14.90 | 7.85 | | |

*Consent Failure

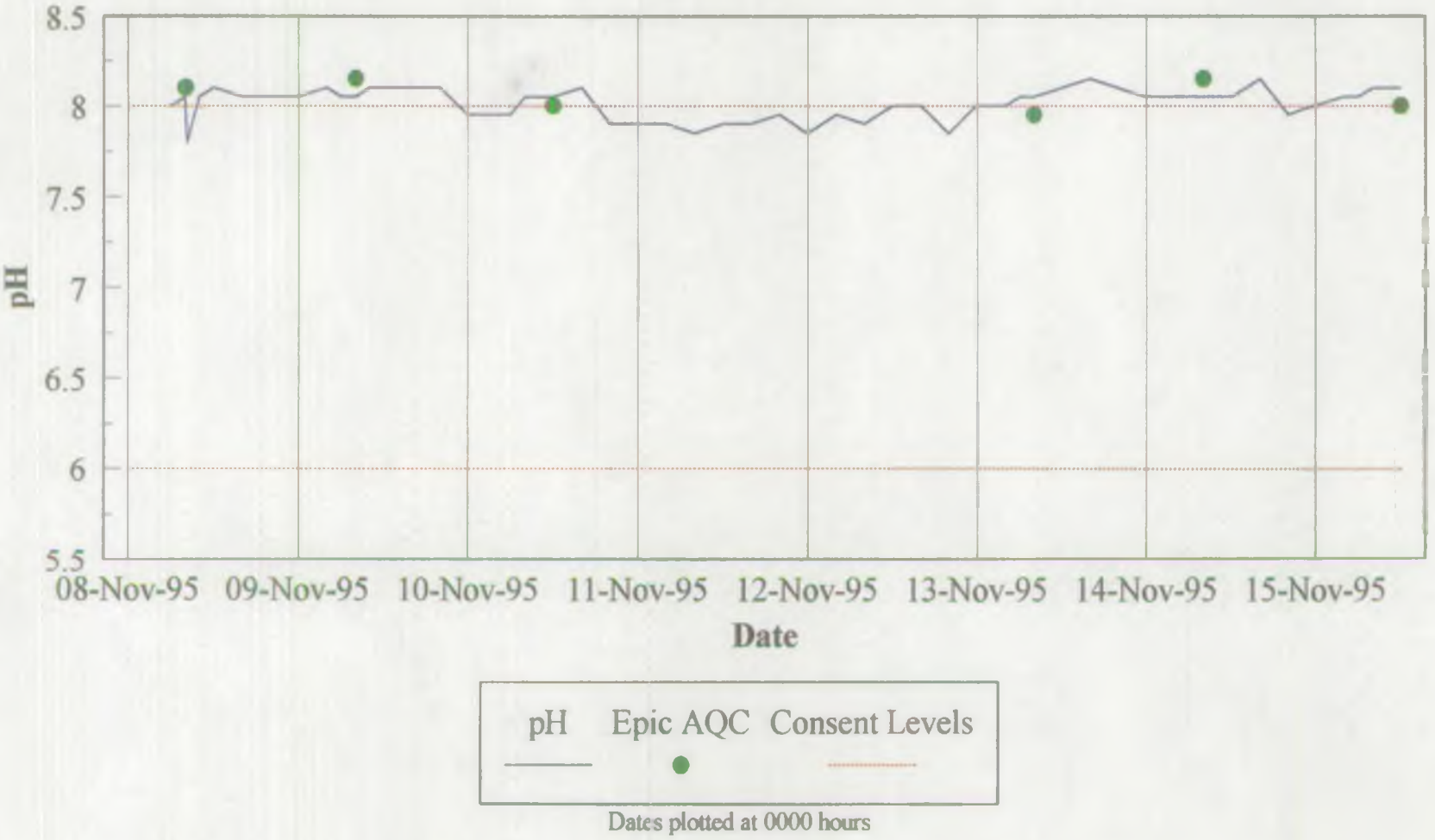
**Table 1 continued.**

| Date | Time | BOD (ATU) | Suspended | Ammonia | pH | Rainfall | Comments |
|---|---|---|---|---|---|---|---|
| 11-Nov-95 | 12:00 | 195.00* | 88.00* | 16.30 | 7.90 | | |
| 11-Nov-95 | 20:00 | >216.0* | 76.00* | 18.80 | 7.95 | | |
| 11-Nov-95 | 23:59 | 38.60* | 90.00* | 6.70 | 7.85 | | |
| 12-Nov-95 | 04:00 | 26.40 | 48.00* | 8.00 | 7.95 | 6.80 | |
| 12-Nov-95 | 08:00 | 42.60* | 78.00* | 12.80 | 7.90 | | |
| 12-Nov-95 | 12:00 | 9.40 | 53.00* | 6.00 | 8.00 | | |
| 12-Nov-95 | 16:00 | 16.60 | 42.00* | 11.20 | 8.00 | | |
| 12-Nov-95 | 20:00 | <8.0 | 40.00* | 5.60 | 7.85 | | |
| 12-Nov-95 | 23:59 | <6.0 | 27.00 | 7.70 | 8.00 | | |
| 13-Nov-95 | 04:00 | 12.40 | 43.00* | 14.20 | 8.00 | 0.30 | |
| 13-Nov-95 | 06:00 | 10.50 | 35.00 | 12.90 | 8.05 | | |
| 13-Nov-95 | 08:00 | 8.20 | 22.00 | 11.60 | 8.05 | | |
| 13-Nov-95 | 08:01 | <8.0 | 14.00 | 11.60 | 7.95 | | |
| 13-Nov-95 | 12:00 | 8.90 | 61.00* | 13.60 | 8.10 | | |
| 13-Nov-95 | 16:00 | 8.90 | 26.00 | 15.30 | 8.15 | | |
| 13-Nov-95 | 20:00 | 10.80 | 30.00 | 15.80 | 8.10 | | |
| 13-Nov-95 | 23:59 | 16.00 | 58.00* | 18.10 | 8.05 | | |
| 14-Nov-95 | 04:00 | 18.50 | 51.00* | 18.00 | 8.05 | 4.00 | |
| 14-Nov-95 | 06:00 | 24.00 | 51.00* | 18.20 | 8.05 | | |
| 14-Nov-95 | 08:00 | 23.00 | 40.00* | 18.20 | 8.05 | | |
| 14-Nov-95 | 08:01 | 26.10 | 31.00 | 18.30 | 8.15 | | |
| 14-Nov-95 | 12:00 | 16.10 | 30.00 | 17.40 | 8.05 | | Sample time may be incorrect |
| 14-Nov-95 | 16:00 | 10.10 | 22.00 | 16.80 | 8.15 | | Sample time may be incorrect |
| 14-Nov-95 | 20:00 | 6.00 | 19.00 | 5.60 | 7.95 | | Sample time may be incorrect |
| 14-Nov-95 | 23:59 | 4.80 | 18.00 | 8.80 | 8.00 | | Sample time may be incorrect |
| 15-Nov-95 | 04:00 | 5.80 | 16.00 | 12.20 | 8.05 | 2.00 | Sample time may be incorrect |
| 15-Nov-95 | 06:00 | 12.10 | 42.00* | 17.20 | 8.05 | | Sample time may be incorrect |
| 15-Nov-95 | 08:00 | 7.40 | 27.00 | 16.00 | 8.10 | | Sample time may be incorrect |
| 15-Nov-95 | 10:00 | 7.10 | 20.00 | 14.80 | 8.10 | | Sample time may be incorrect |
| 15-Nov-95 | 12:00 | 6.60 | 20.00 | 12.40 | 8.10 | | Sample Time Correct |
| 15-Nov-95 | 12:01 | 5.30 | 17.00 | 12.20 | 8.00 | | |

* Consent Failure

# Graph 1: Hambledon Dairy Investigation

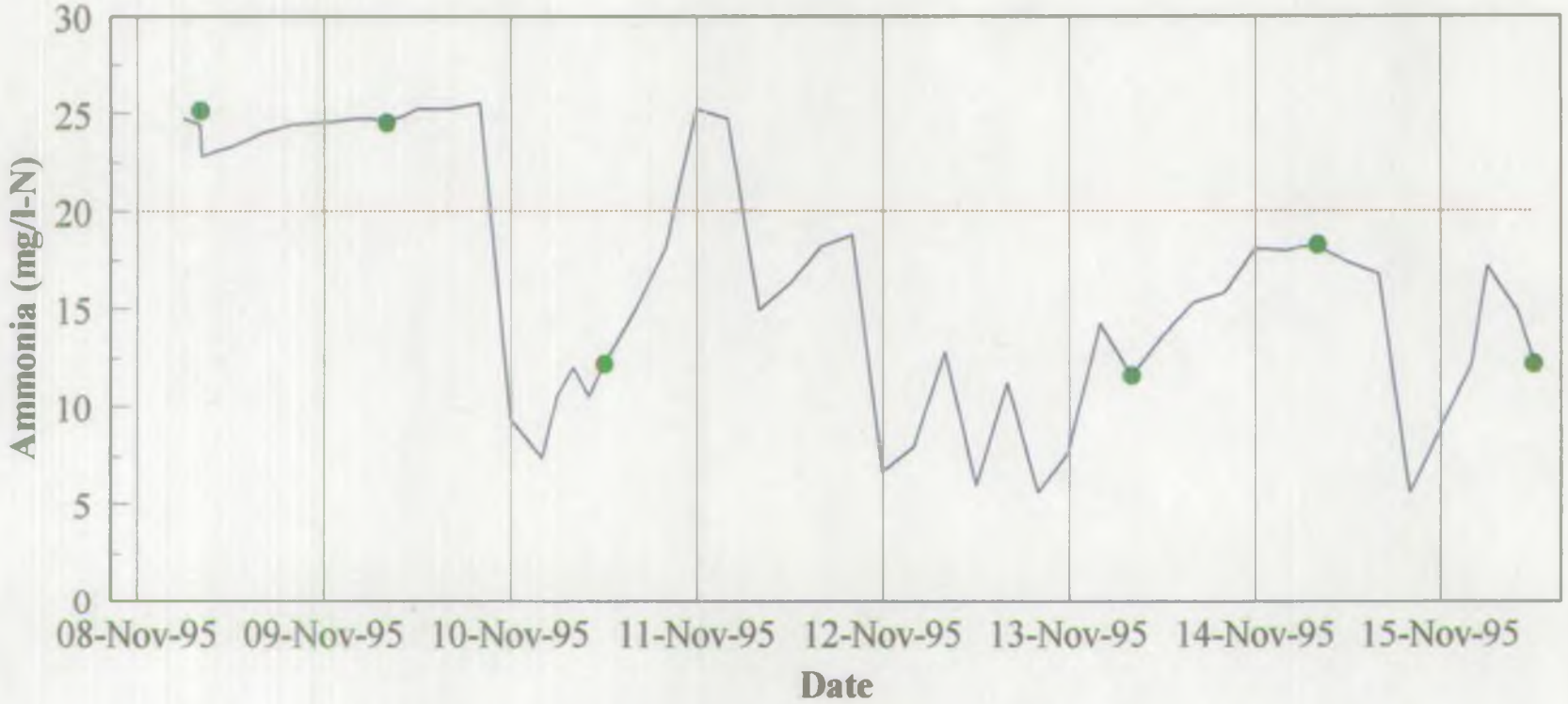
pH Results 08-Nov-95 to 15-Nov-95




Dates plotted at 0000 hours

# Graph 2: Hambledon Dairy Investigation

Ammonia Results 08-Nov-95 to 15-Nov-95




Dates plotted at 0000 hours.

# Graph 3: Hambledon Dairy Investigation

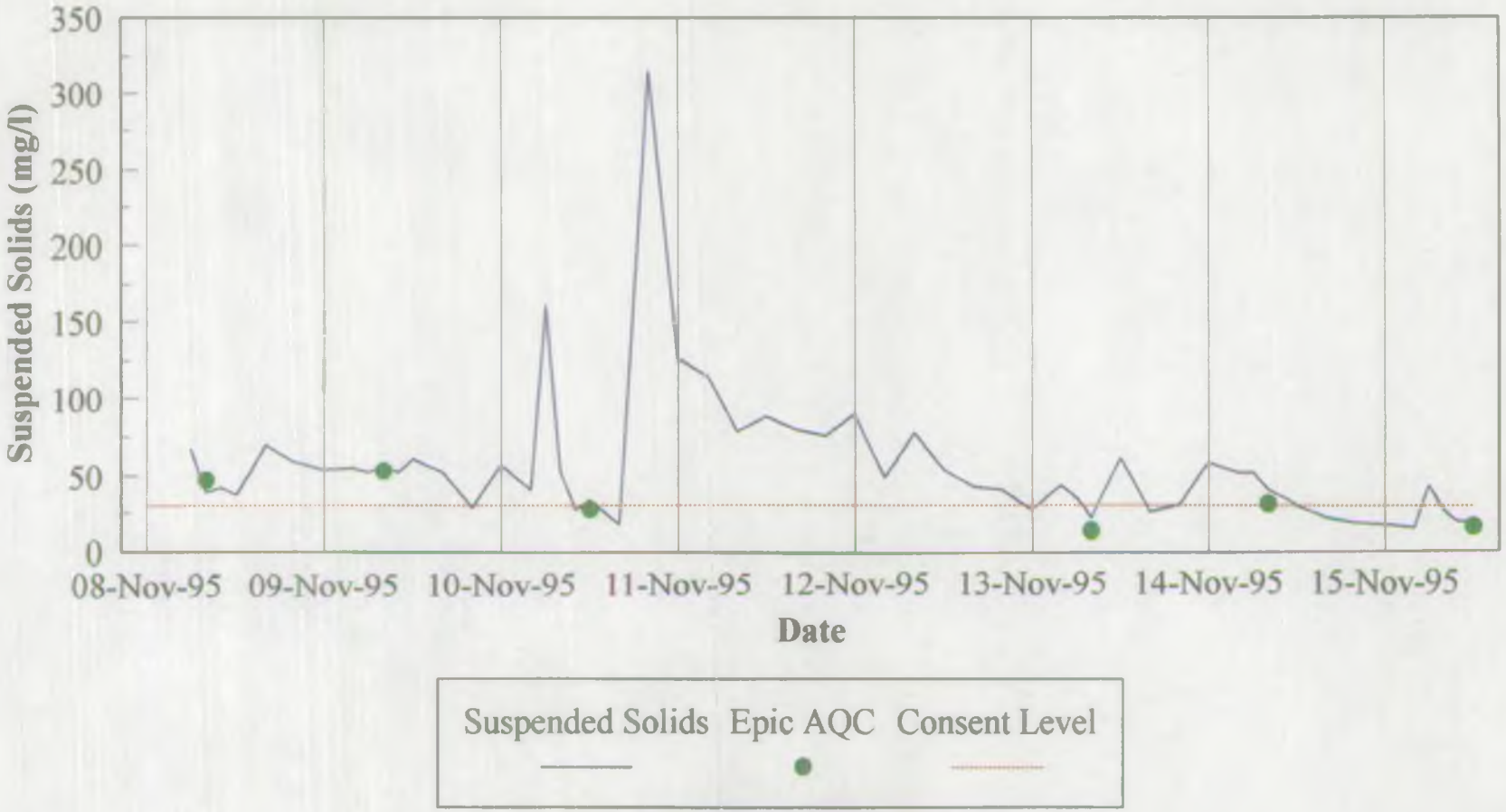
BOD Results 08-Nov-95 to 15-Nov-95


Dates plotted at 0000 hours

Lab Results given as < or > are plotted as actual values (refer to Table of Results for details.)

# Graph 4: Hambledon Dairy Investigation

Suspended Solids Results 08-Nov-95 to 15-Nov-95

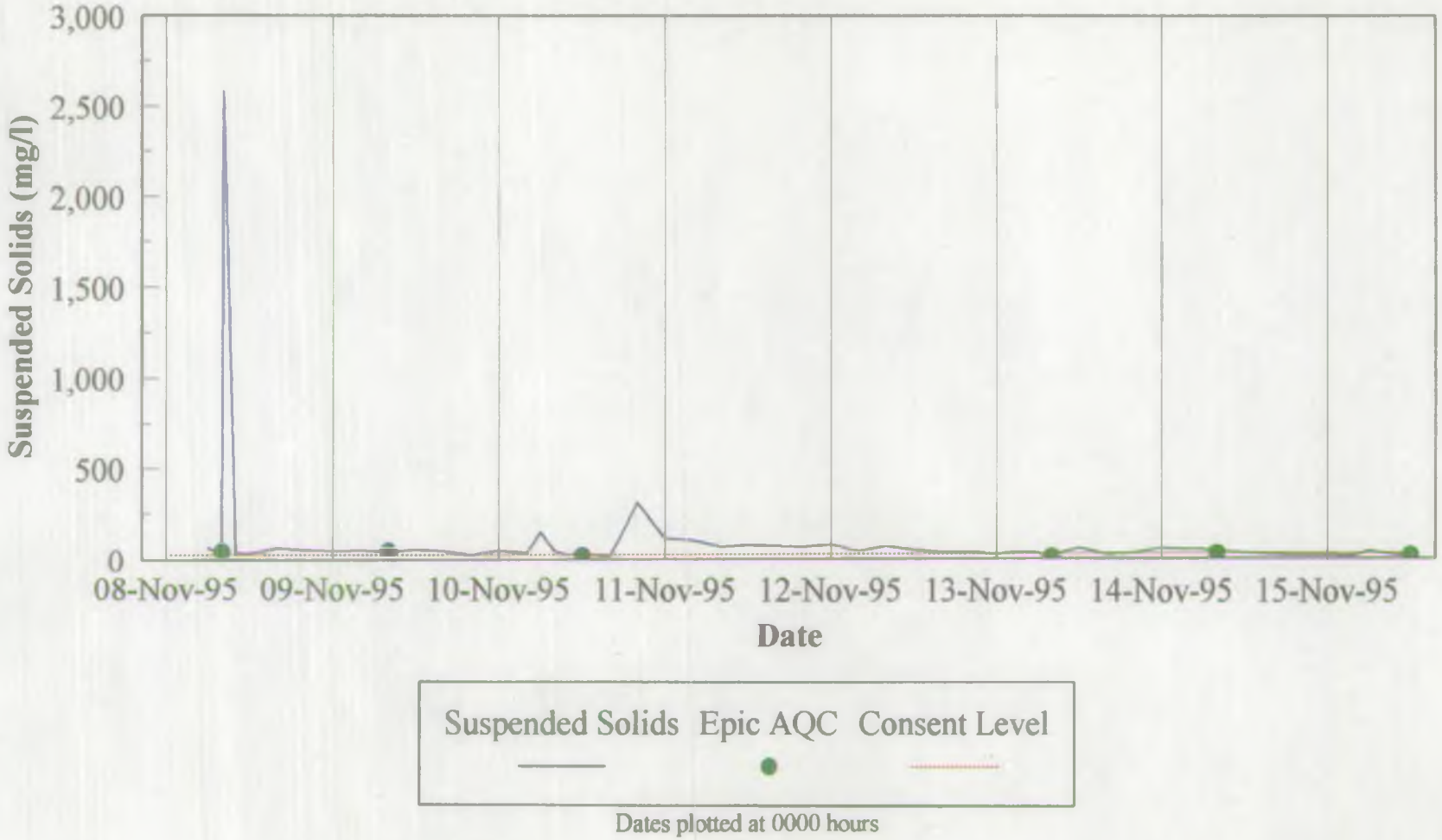



Dates plotted at 0000 hours

Plot enhanced by removal of exeptional result from 08-Nov-95.

# Graph 5: Hambledon Dairy Investigation

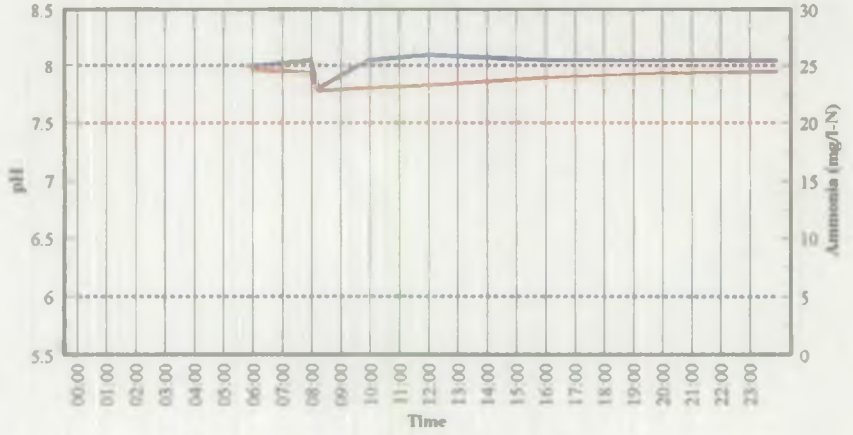
Suspended Solids Results 08-Nov-95 to 15-Nov-95



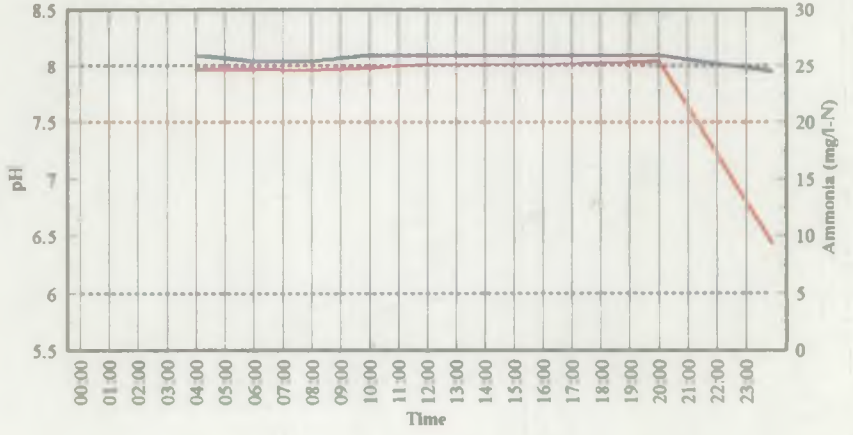
# Hambledon Dairy Investigation

## pH and Ammonia Results 08 November to 11 November 1995

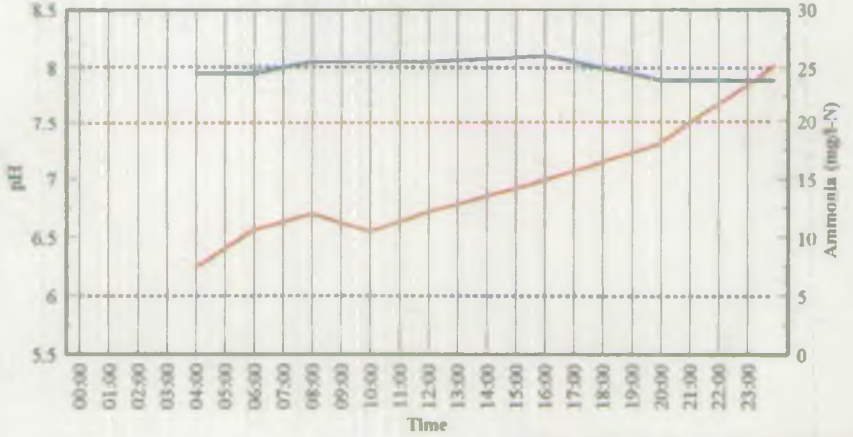
**Graph 6: Wednesday 08 November 1995**



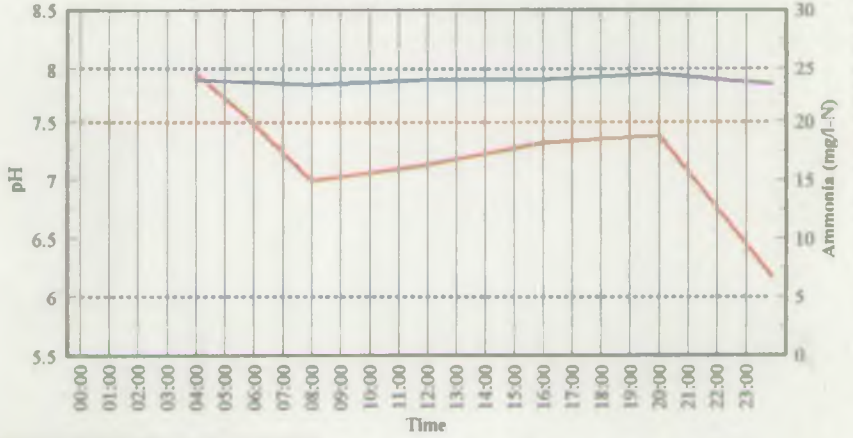

**Graph 7: Thursday 09 November 1995**




**Graph 8: Friday 10 November 1995**




**Graph 9: Saturday 11 November 1995**



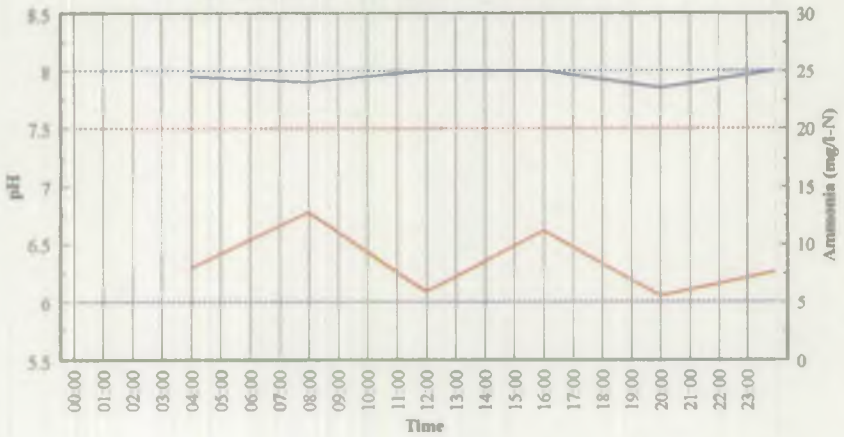

pH — Ammonia mg/l-N

pH Consent ····· Ammonia Consent ····

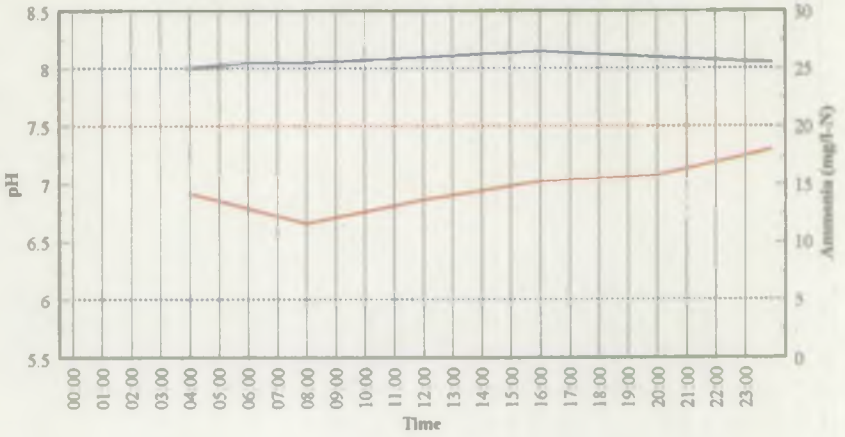
# Hambledon Dairy Investigation

## pH and Ammonia Results 12 November to 15 November 1995

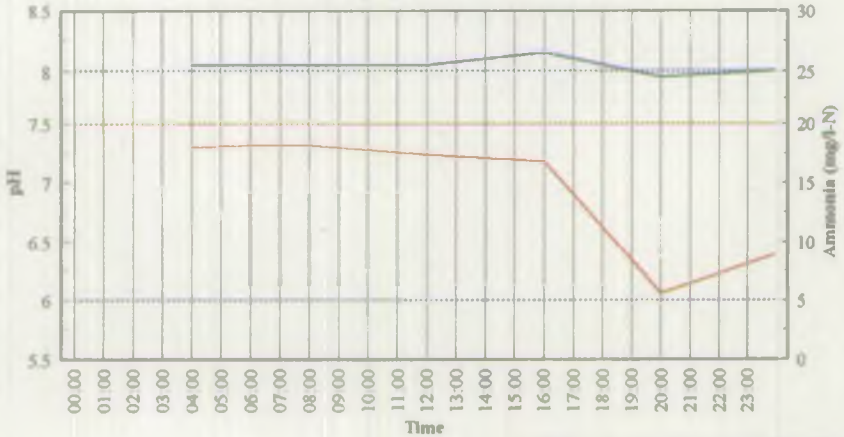
**Graph 10: Sunday 12 November 1995**



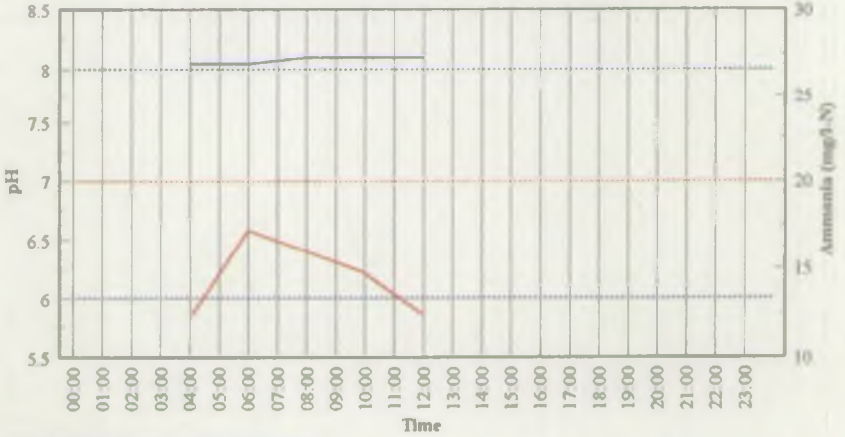

**Graph 11: Monday 13 November 1995**




**Graph 12: Tuesday 14 November 1995**




**Graph 13: Wednesday 15 November 1995**




pH — Ammonia mg/l-N

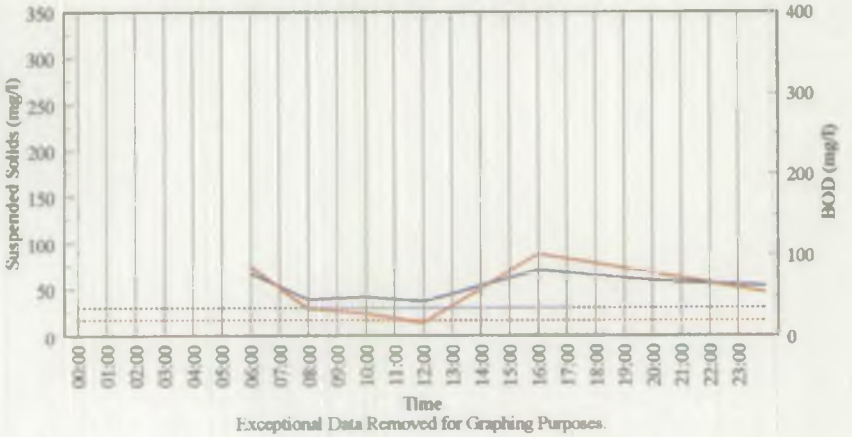
pH Consent ····· Ammonia Consent

# Hambledon Dairy Investigation

## Suspended Solids and BOD Results 08 November to 11 November 1995

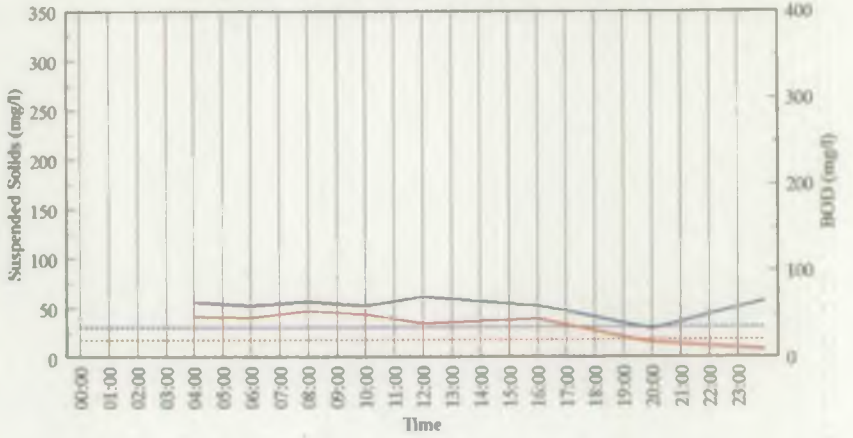
## Scales not comparable

**Graph 14: Wednesday 08 November 1995**

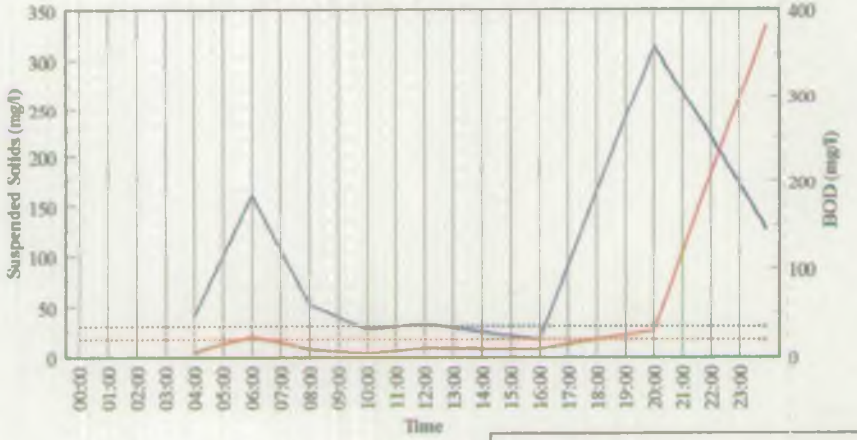



Exceptional Data Removed for Graphing Purposes.

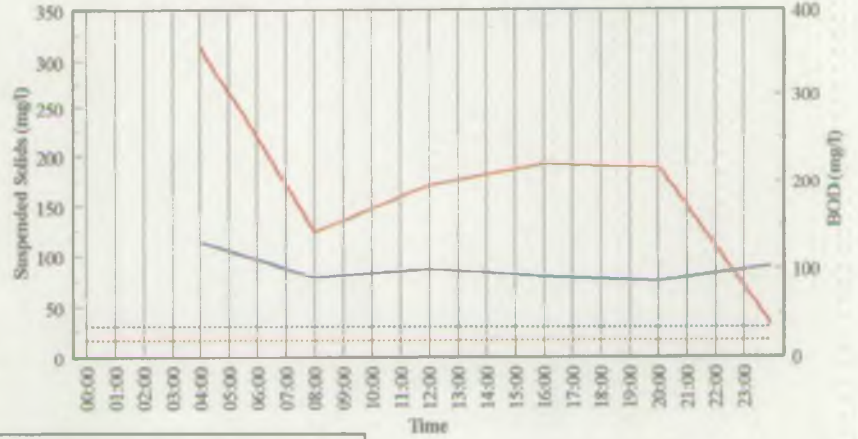
**Graph 15: Thursday 09 November 1995**




**Graph 16: Friday 10 November 1995**




**Graph 17: Saturday 11 November 1995**



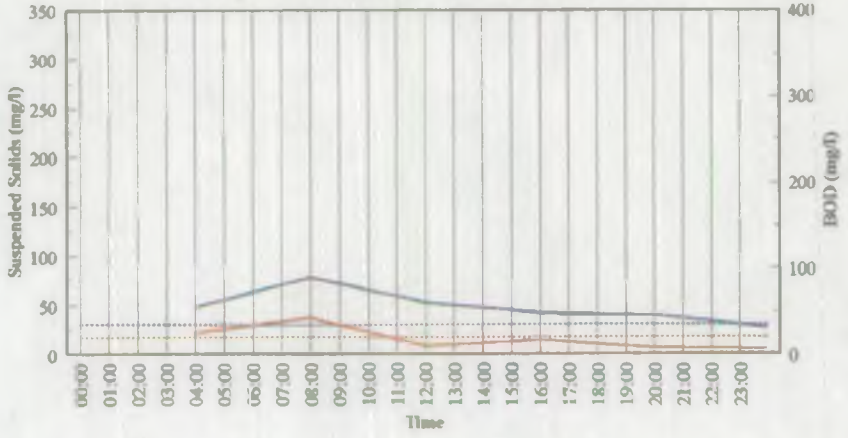

Suspended Solids — BOD

Suspended Solids Consent ····· BOD Consent ····

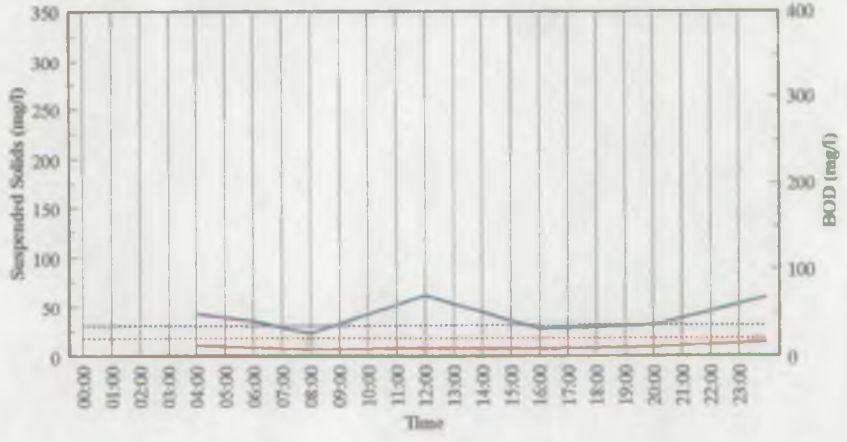
# Hambledon Dairy Investigation

## Suspended Solids and BOD Results 12 November to 15 November 1995

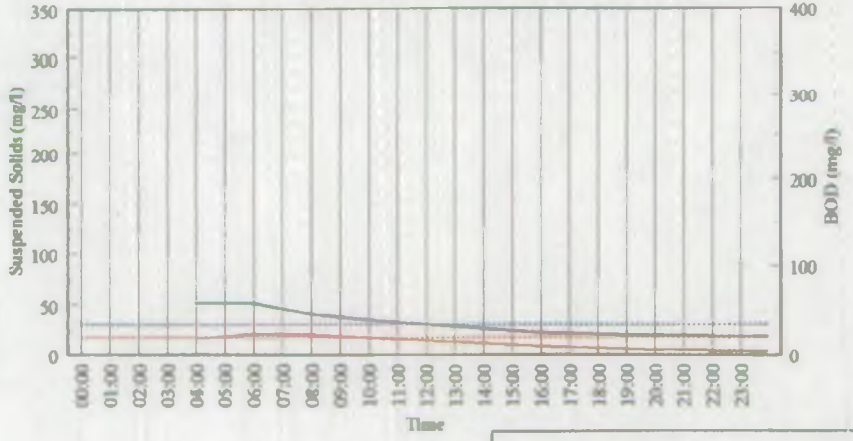
**Graph 18: Sunday 12 November 1995**



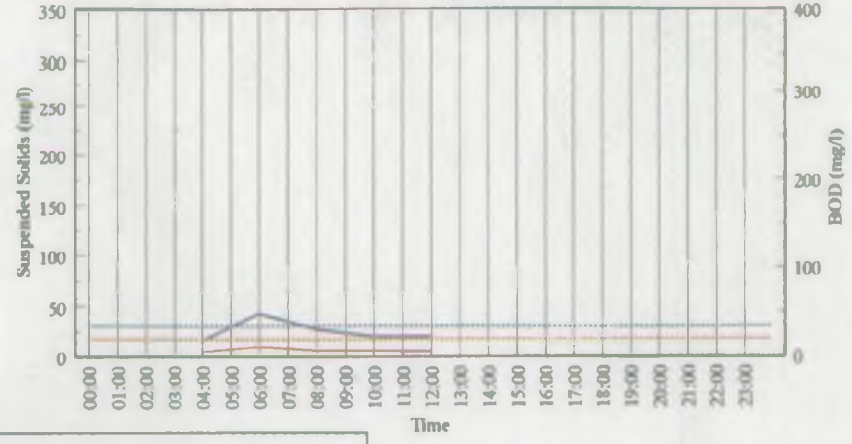

**Graph 19: Monday 13 November 1995**




**Graph 20: Tuesday 14 November 1995**




**Graph 21: Wednesday 15 November 1995**




Suspended Solids — BOD

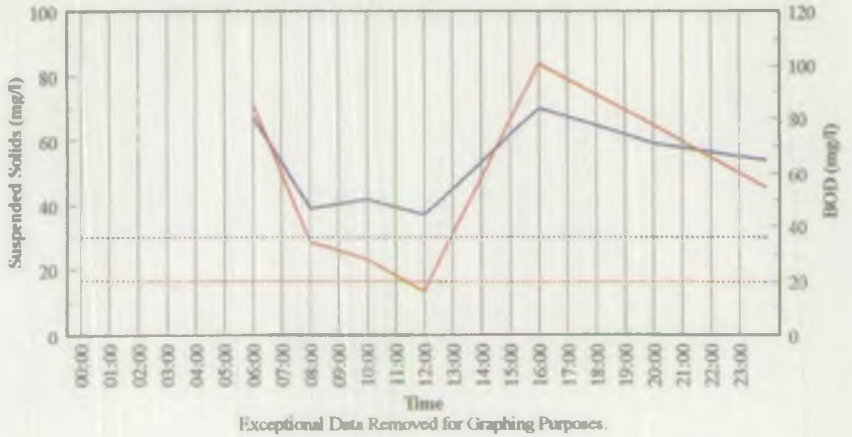
Suspended Solids Consent ····· BOD Consent

# Hambledon Dairy Investigation

## Suspended Solids and BOD Results 08 November to 11 November 1995

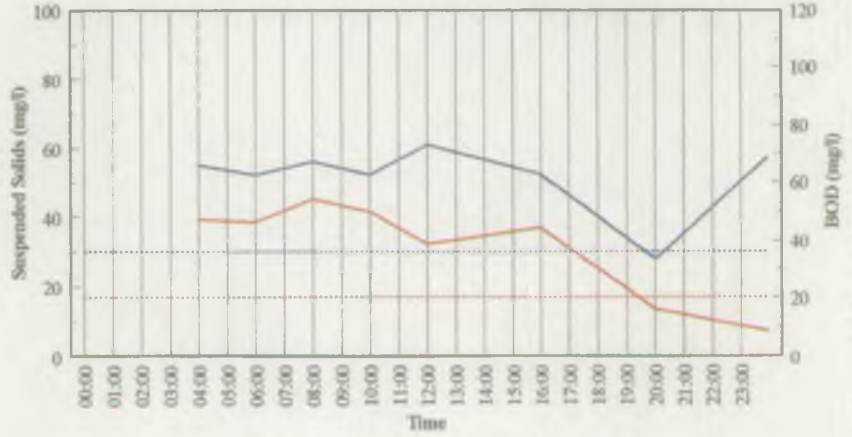
## Scales comparable

**Graph 22: Wednesday 08 November 1995**

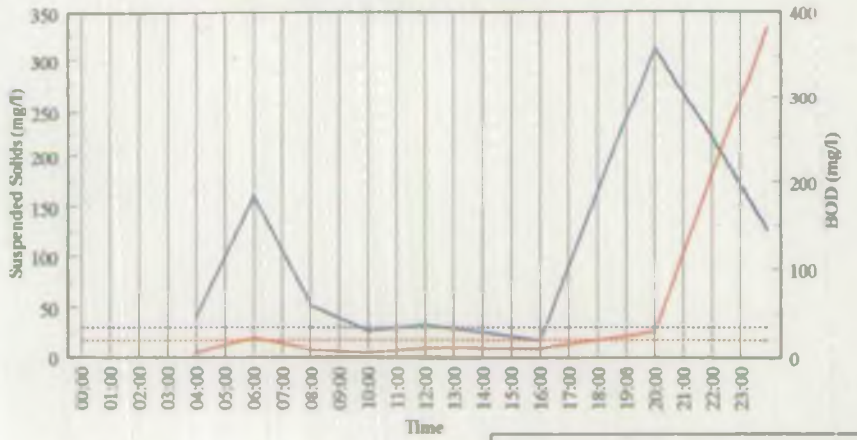



Exceptional Data Removed for Graphing Purposes.

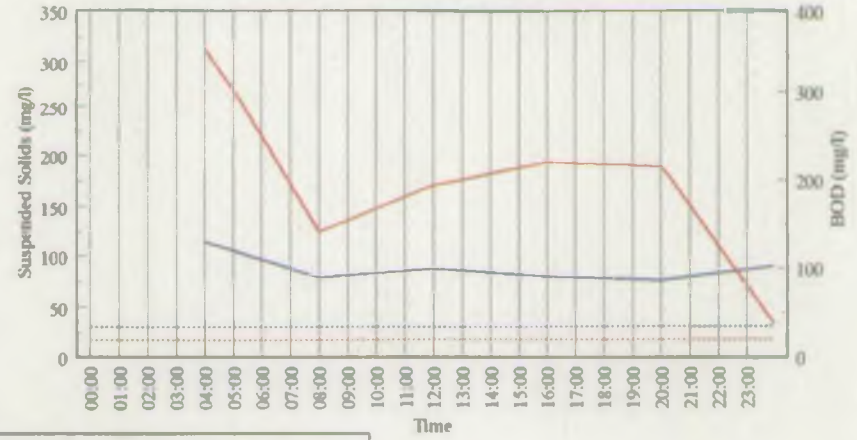
**Graph 23: Thursday 09 November 1995**




**Graph 24: Friday 10 November 1995**




**Graph 25: Saturday 11 November 1995**




Suspended Solids — BOD

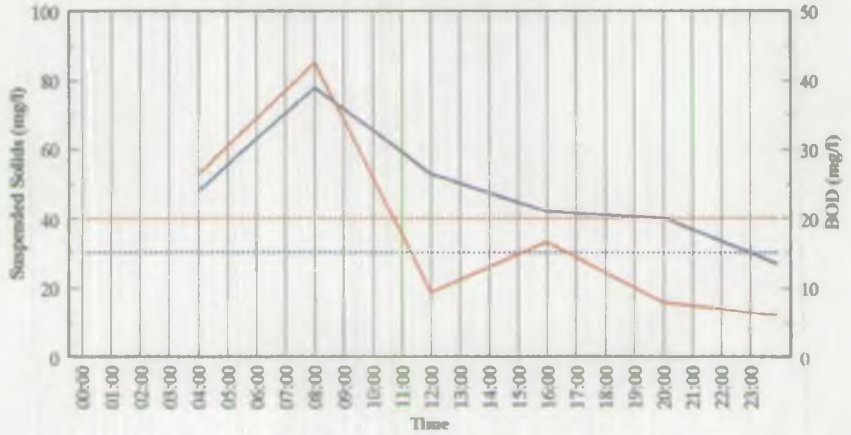
Suspended Solids Consent ····· BOD Consent

# Hambledon Dairy Investigation

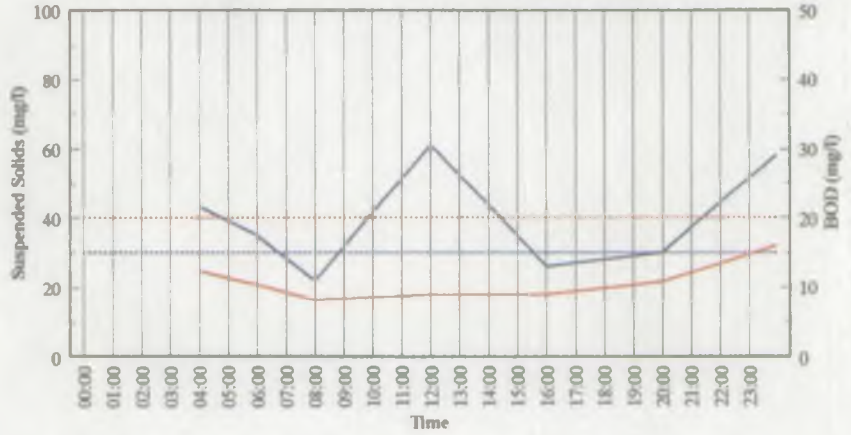
## Suspended Solids and BOD Results 12 November to 15 November 1995

## Scales comparable

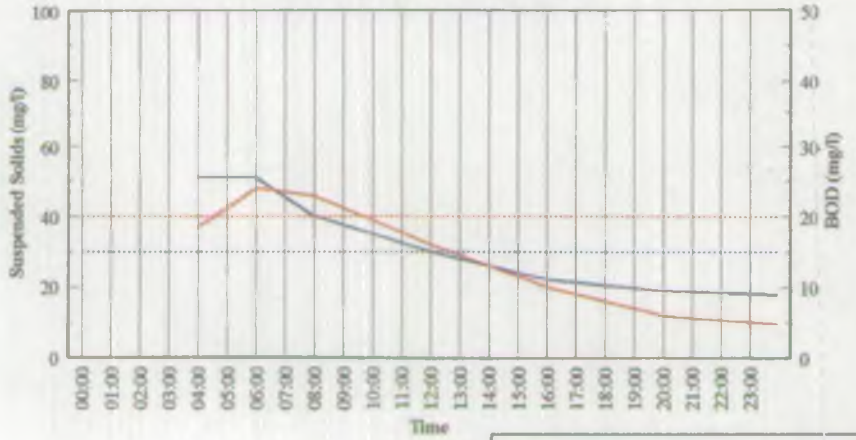
**Graph 26: Sunday 12 November 1995**



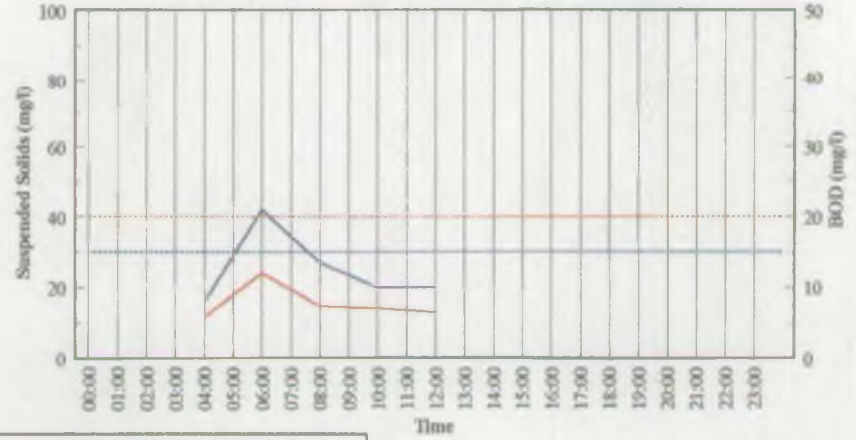

**Graph 27: Monday 13 November 1995**




**Graph 28: Tuesday 14 November 1995**




**Graph 29: Wednesday 15 November 1995**




Suspended Solids — BOD

Suspended Solids Consent ····· BOD Consent ····