ENVIRONMENT AGENCY

WATER QUALITY SECTION
CORNWALL AREA

FINAL DRAFT REPORT

LELANT WATERMILL BACTERIAL CONTAMINATION INVESTIGATION 1995

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Author: Mark Walton
Investigations Technician

Geoff Boyd
Area Manager

LELANT WATERMILL - BACTERIAL CONTAMINATION INVESTIGATION - 1995.

1. INTRODUCTION.

(i) Background.

In December 1995 the owners of The Watermill Restaurant, Lelant, reported that the well associated with the property was suffering bacterial contamination (Fig 2, site G). A number of potential sources were identified for investigation drawing on anecdotal information and prior knowledge of historical problems in the area. These included the repeated blockage of a local sewer serving St. Ives Holiday Village and the contamination, in previous years, of the well at the nearby Golden Cock by farm waste from Splatternridden Farm (Fig 2).

(ii) Objectives.

To ascertain the cause of bacterial contamination of the well at The Watermill, Lelant.

2. METHODS.

(i) Review of archive data.

(ii) Assessment of possible local sources of contamination; including location of the sewerage system, details of sludge injection on land adjacent to the watercourse and local routes of disposal of farm and domestic waste.

(iii) Single tracer survey of the St. Ives Holiday Village sewer using *Bacillus globigii*.
A suspension of *B. globigii* containing 2.5×10^9 ml^{-1} was dosed into the St. Ives Holiday Village sewer at a rate of 2 ml min^{-1} over a period of four days, commencing on 12 March and finishing on 16 March 1996. Samples were taken from the sewer below the dosing point, from a number of sites on the adjacent watercourse (Mill Stream) and from the well at The Watermill (see Fig. 2). Samples were taken daily between the 12 March and 22 March and were analysed for faecal coliforms, total coliforms, faecal streptococci and *B. globigii*.

(iv) Dual tracer survey of the septic tank at The Watermill using *Serratia* phage and the farm effluent pits at Splatternridden Farm using *B. globigii*.
A 10l suspension containing 7.3×10^{12} *Serratia* was applied directly to the septic tank of The Watermill.
A 10l suspension containing 2.0×10^{13} *B. globigii* was applied directly to each of two effluent pits at Splatternridden Farm.
Both dosings were carried out on 19 April 1996.
Samples were taken from the adjacent watercourse (Mill Stream), and the wells at The Watermill and Golden Cock, daily between 19 April and 25 April and then on 29 April and 02 March (see Fig. 4). The roadside breakout rising outside The Watermill (Fig 2, site E) had ceased to run since the previous survey.
Samples were analysed for faecal coliforms, total coliforms, faecal streptococci, *B. globigii* and *Serratia*.

3. RESULTS.

(i) Data showing the occurrence of the original bacterial fouling of the well at The Watermill, Lelant, are summarised in Fig 1.

(ii) Results from the single tracer survey of the St. Ives Holiday Village sewer using *Bacillus globigii* are summarised in Fig 3.

(iii) Results from the dual tracer survey of the septic tank at The Watermill using *Serratia* phage and the farm effluent pits at Splatternridden Farm using *B. globigii* are summarised in Fig 5 (i) & (ii).

4. DISCUSSION.

(i) *B. globigii* dosed into the St. Ives Holiday Village sewer was detected throughout the surveyed length of the watercourse in low concentrations, including the well at The Watermill.
The detection of *B. globigii* in the well was not associated with elevated levels of faecal bacteria.

(ii) *Serratia* phage dosed into the septic tank at The Watermill was detected in the adjacent stream immediately downstream of the tank.
Serratia was not detected in The Watermill well.

(iii) *B. globigii* dosed into the two effluent pits at Splatternridden Farm was detected throughout the surveyed length of the watercourse, but was primarily found in the wells at both The Watermill (site 9) and Golden Cock (site 10) and in the stream downstream of The Watermill (sites 2, 3 & 5).
The tracer was detected in the well at Golden Cock three days after dosing and at the well at The Watermill and site 5 four days after. At sites 2 and 3 the tracer was detected five days after dosing.
As in the single tracer survey the detection of tracer in the wells was not associated with an increase in levels of faecal bacteria.

(iv) SWWSL provided information on application of sewage sludge in the area. A 63 acre field adjacent to the stream was injected in August and September 1995 (Fig 2).

(v) In the period between the two surveys outlined above, local residents reported that maintenance / cleaning of the sewer outside The Watermill took place. This was coincidental with the roadside breakout at site E ceasing to run.

5. CONCLUSIONS.

(i) There is the potential for sewage effluent from St. Ives Holiday Village to contaminate the well at The Watermill by direct seepage from the sewer. Given that the survey occurred at a time when the Village was closed for business, and flows were therefore low, it must be assumed that the potential for contamination will increase with the seasonal rise in population. It is also likely that the well at The Watermill is vulnerable to contamination should the sewer become blocked and overflow, as has happened frequently in the past.

(ii) Despite the fact that the septic tank at The Watermill is soaking away directly to the adjacent stream it does not appear to contaminate the well on the property.

(iii) Farm effluent stored in pits at Splatternridden Farm is entering the groundwater directly, causing contamination of the wells at both Golden Cock and The Watermill. These wells would appear to have a common source.
Overflow from the well at The Watermill flows from under the building into the Mill Stream upstream of the road bridge. By far the most serious and long lasting contamination of the surface water occurred downstream of The Watermill via this route.

(iv) Application of sewage sludge to land directly adjacent to the Mill Stream and in close proximity to the well must be considered a potential source of contamination of both the surface and groundwater.

(v) The well at The Watermill, Lelant, is a potable groundwater supply whose source is unknown, but clearly shared with the well at Golden Cock. This investigation was generated by an incident of gross fouling of the well in December 1995, and points to the source of this fouling being the ingress of farm waste from Splatternridden into the groundwater.
The results of this work also highlight the persistent occurrence of more minor sources of bacterial contamination of this supply.

6. ACTIONS.

(i) Immediate remedial action was taken at Splatternridden Farm. The effluent pits were pumped out and lined to prevent further seepage, whilst longer term alternatives to the current storage system are sought.
Action: Lee Portlock.

(ii) The application of sewage sludge to the land adjacent to the Mill Stream should be reviewed with a view to placing some limits on the injection of sludge close to vulnerable surface / groundwaters.
Action: Lee Portlock.

(iii) More information is required on the nature of the maintainance work carried out on the sewer between the two surveys in order to see if it is related to the cessation of the roadside breakout reported in 4 (iv).
Action: Mark Walton.

(iv) Although we have shown that there was transfer of tracer to the well from the St. Ives Holiday Village sewer this would appear to be a minor source compared to Splatternridden, probably contributing persistent low-level contamination. Due to the porous nature of the sewer pipe some seepage is inevitable and the results of this survey do not justify taking any further action on the sewer. It should however be noted that the potential exists for contamination via this route and that the well is vulnerable to more serious fouling in the event of blockage or overflow of the sewer. SWWSL and St. Ives Holiday Village should be encouraged to improve management of the Village sewerage system to minimise the risk of blockage.
Action: Lee Portlock.

7. NOTE.

It is impossible to protect a groundwater resource of this diffuse nature from all potential sources of bacteria and to guarantee its purity. This investigation clearly shows the range of potential sources of contamination to this supply. Anybody wishing to use a supply of this nature for drinking would therefore be well advised to apply at least simple physical treatment and / or disinfection before use.

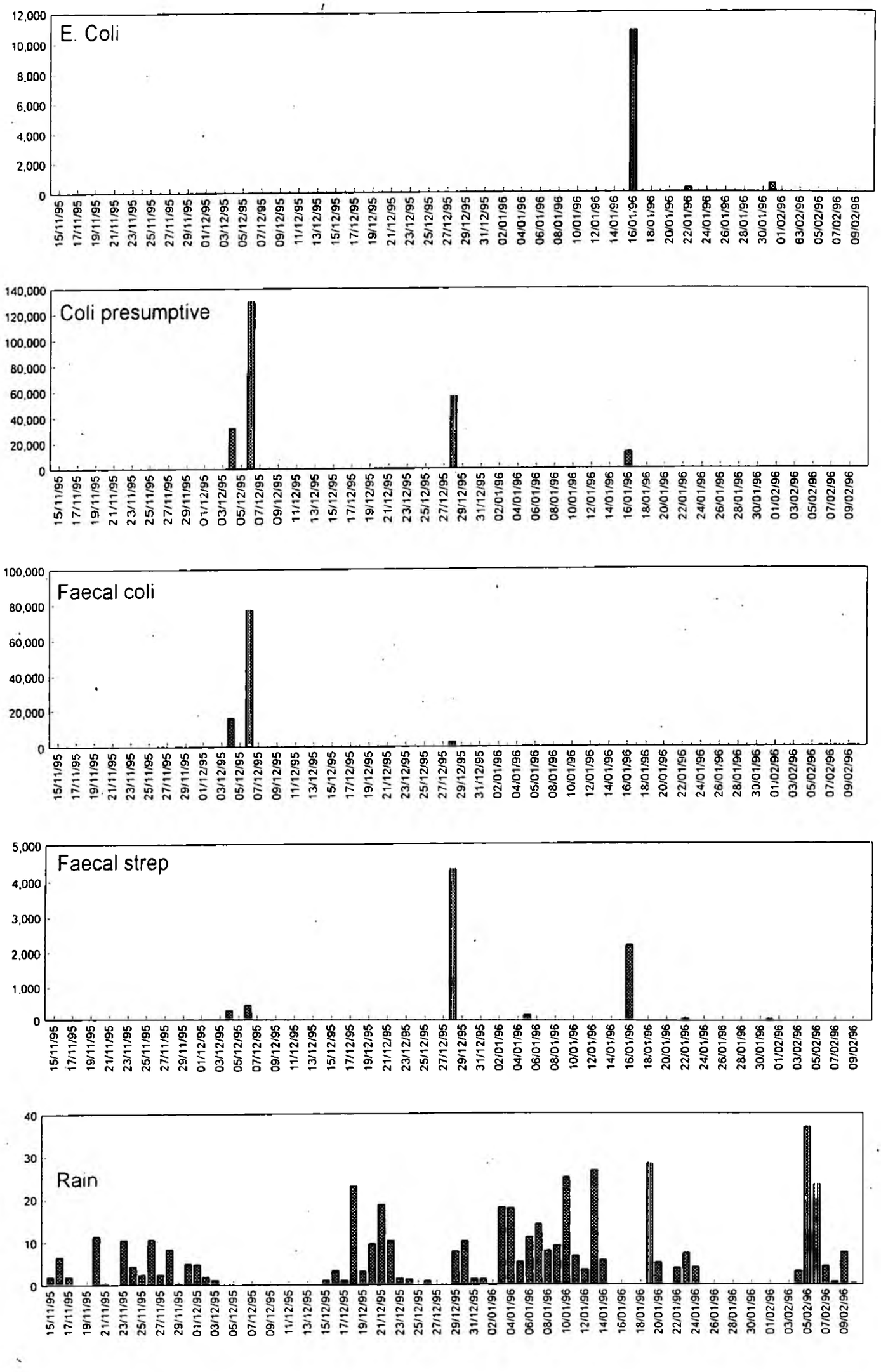

Figure 1: Bacteria levels and rainfall for the well at The Watermill, Lelant, 1995-6.

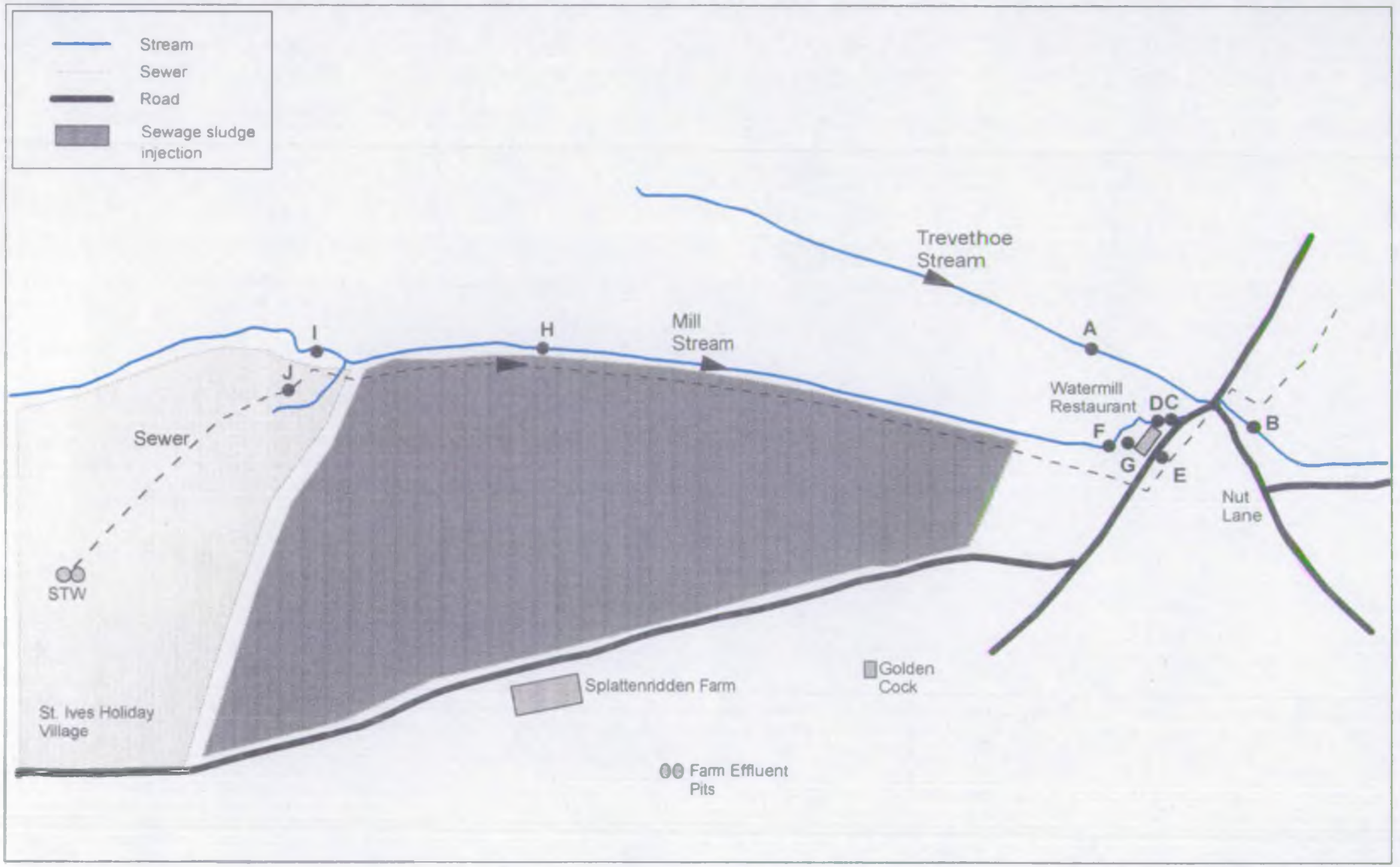

Figure 2: Sampling sites for *B. globigii* dosing of St. Ives Holiday Village sewer.

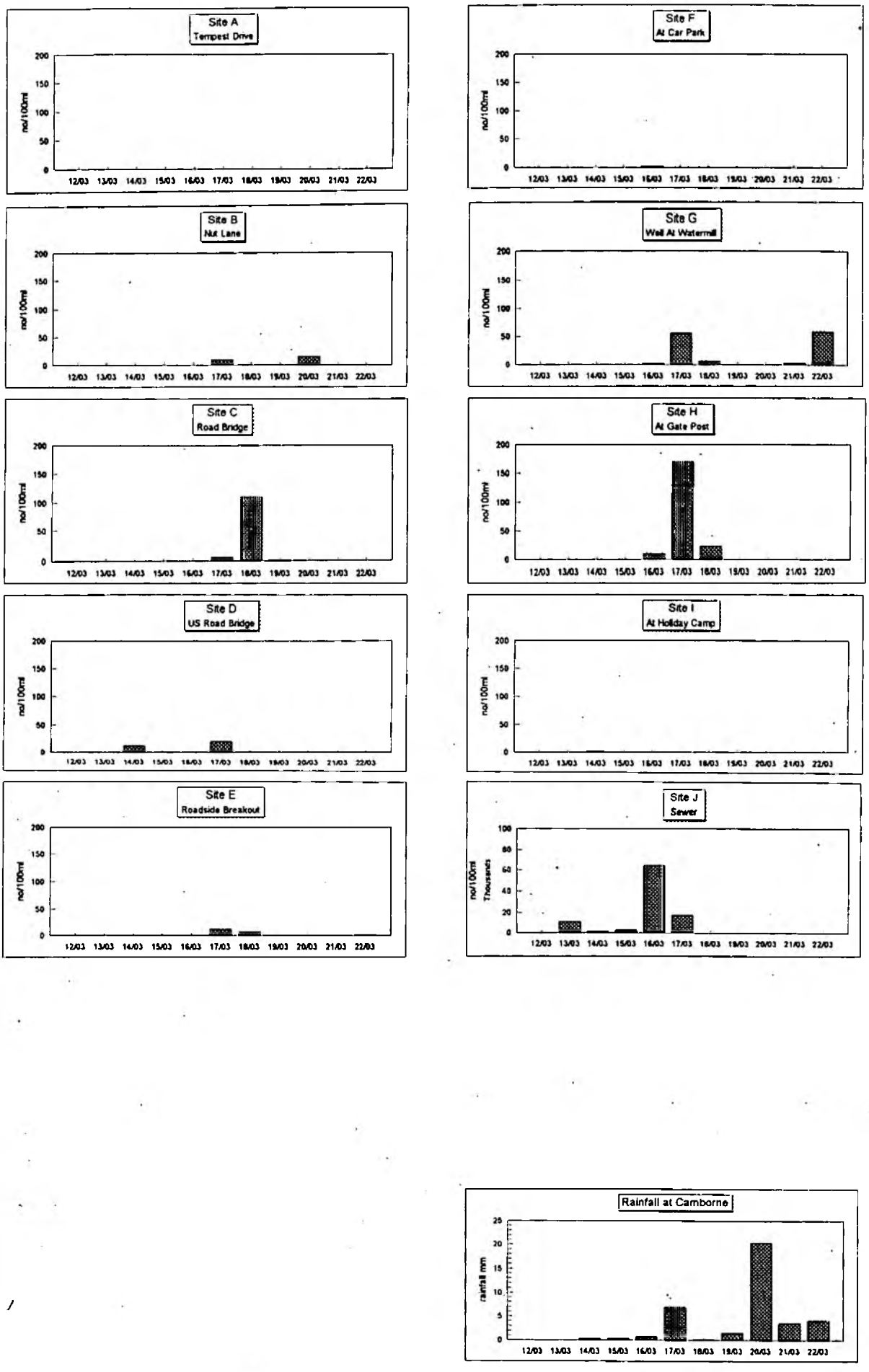

Figure 3: Charts showing occurance of the tracer B. globigii in the surface and groundwater, following dosing of the St. Ives Holiday Village sewer.

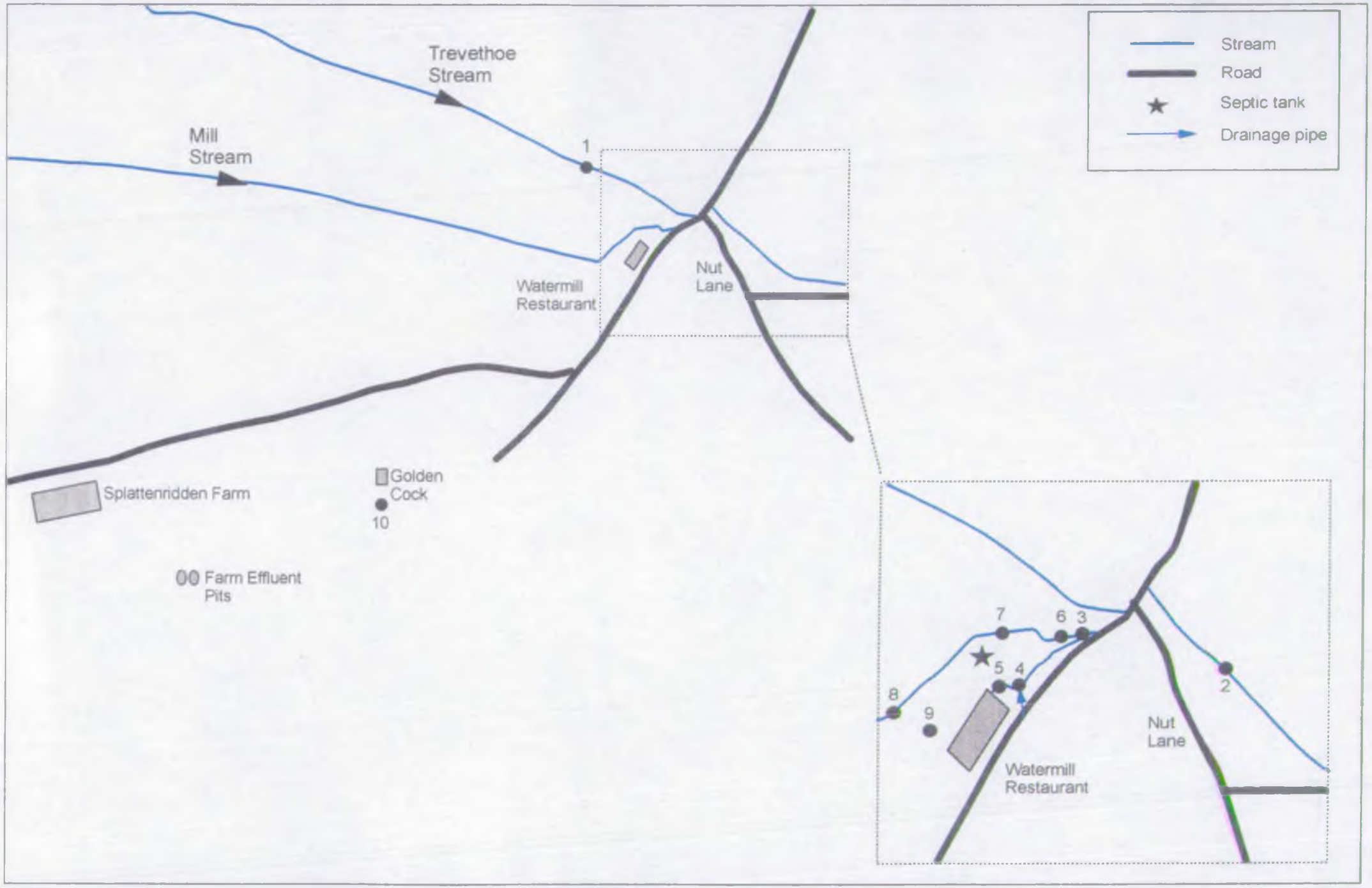

Figure 4 Sampling sites for *B. globigii* dosing of Splattenridden effluent pits and *Serratia* dosing of Watermill septic tank

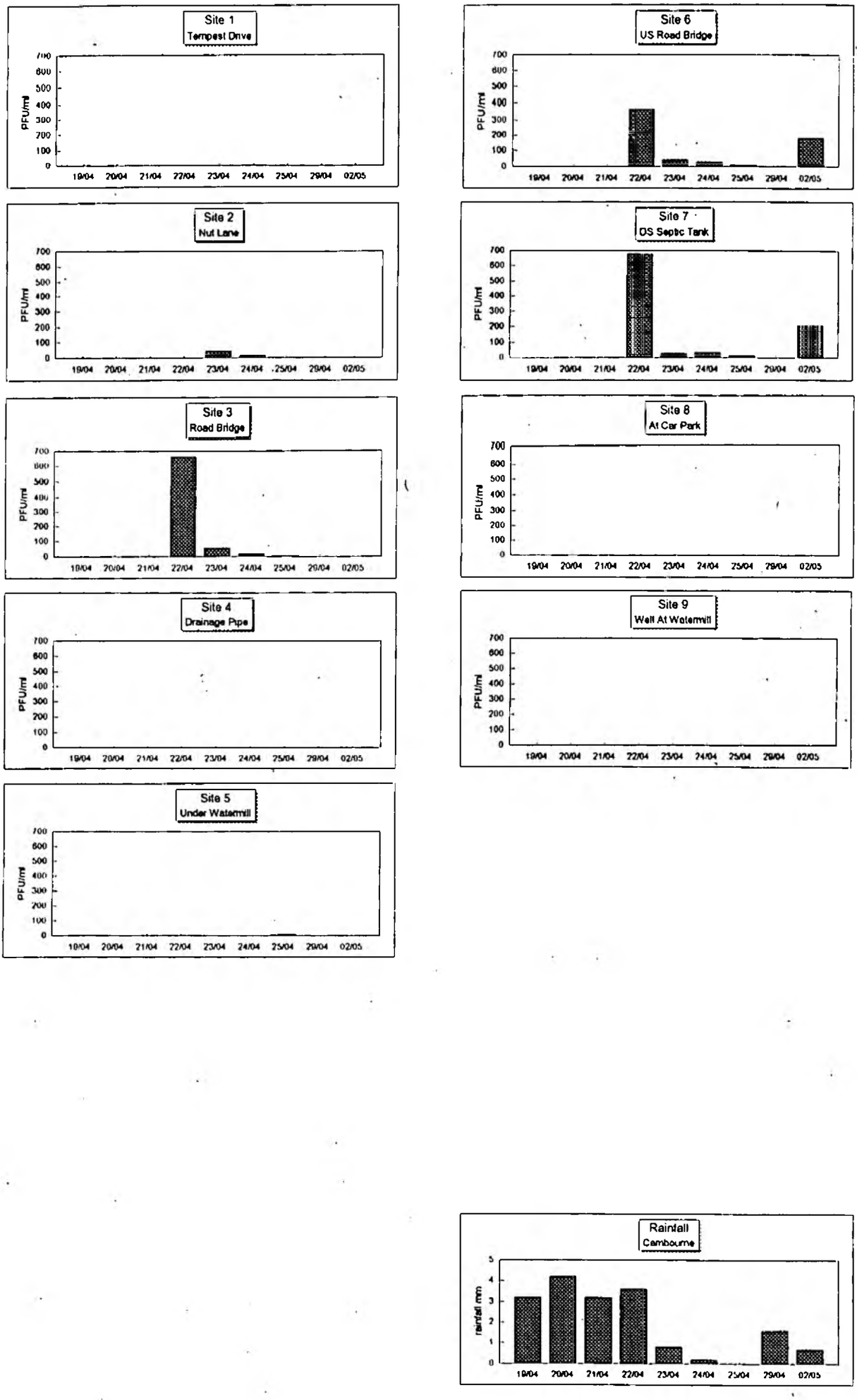

Figure 5(i): Dual tracer survey.
Charts showing occurance of Serratia phage in the surface and groundwater following dosing of the Watermill septic tank.

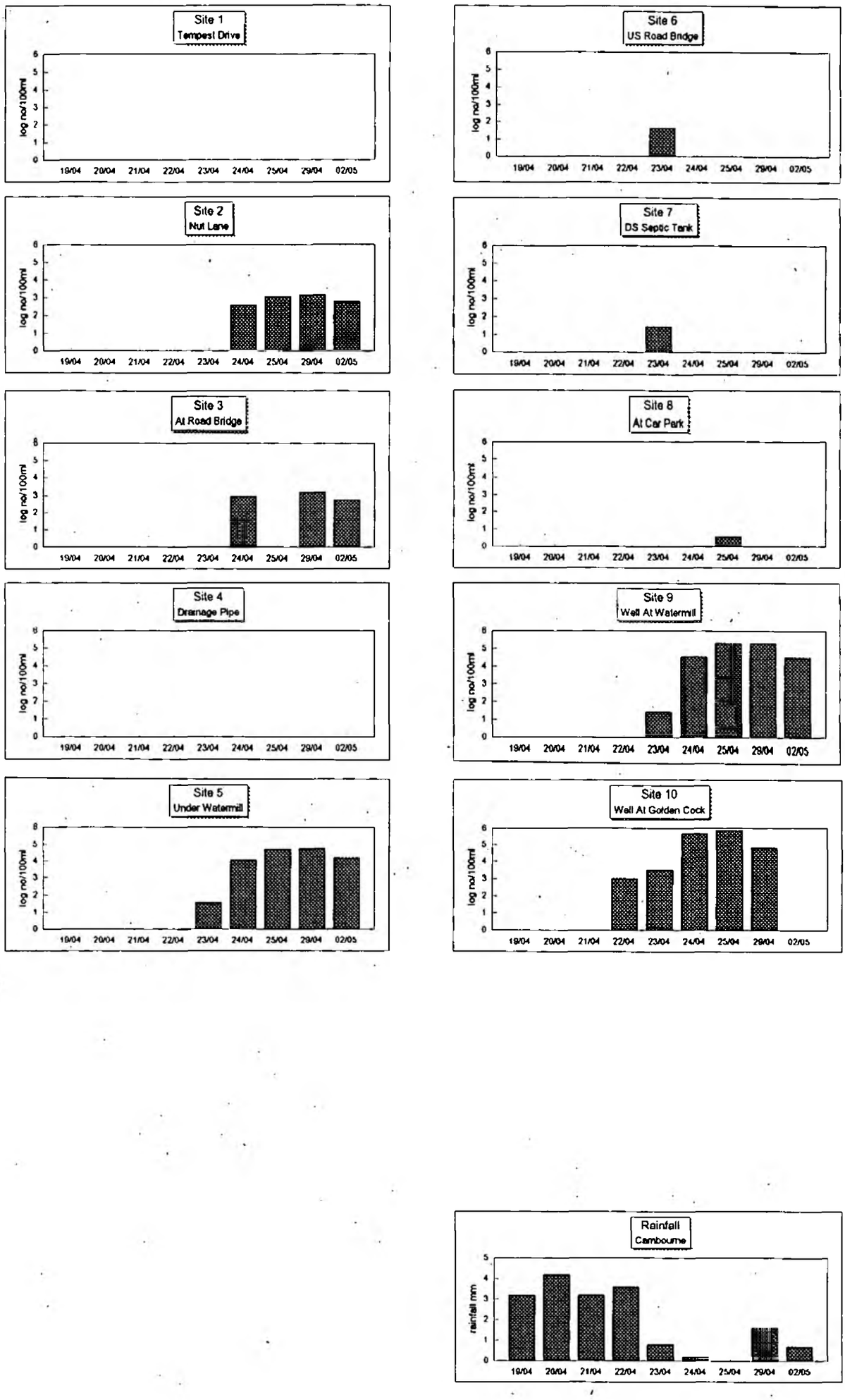

Figure 5(ii): Dual tracer survey.
Charts showing occurance of B. globigii in surface and groundwater following dosing of Splatternridden Farm effluent pits.