DEVON AREA
INTERNAL REPORT

ENVIRONMENT AGENCY

INVESTIGATION INTO POTENTIAL EXFILTRATION OF RAW SEWAGE FROM SALCOMBE SEWER.

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(CATCHMENT 08A)

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Investigation into Potential Exfiltration of Raw Sewage from Salcombe Sewer.

1.0 Introduction

Salcombe main sewer runs along the foreshore of Salcombe town centre. The section of sewer to be investigated begins at Shadycombe Pumping Station and runs in the intertidal zone to a ROTORK valve situated at Sunnycliff Bay (see figure 1). At Sunnycliff the sewer turns inland and runs up to Malborough Waste Water Treatment Works.

1.1 Background

Wastewater from Shadycombe Pumping Station is pumped up to Malborough Waste Water Treatment Works (WWTW) via Salcombe foreshore. There have been problems at Malborough works caused by the infiltration of saltwater into the sewer pipe at Salcombe. In an effort to rectify this problem a ROTORK valve was installed at Sunnycliff Bay (the end section of the pipe on Salcombe foreshore). Also, a saline retention tank has been installed at Malborough WWTW. An investigation into the frequency of overflow from the saline retention tank has been carried out by Robin Pearson (Environment Protection Investigations Officer). The Report, entitled 'Operation of an Overflow Facility from the Saline Retention Tank at Marlborough Waste Water Treatment Works' report Number DEV/EP/16/99 is held within the Investigation Team.

The ROTORK valve operates by opening and closing to varying degrees in an effort to equilibrate the pressure of the sewage in the pipe with the rising and falling tide. The concern is that if the pipe is over pressurised raw sewage could be forced out of the same defects in the pipe that allowed the infiltration of saltwater initially.

1.2 Aims

The aim of this investigation is to locate any exfiltration from the main sewer running along Salcombe foreshore. This will be achieved by dosing the length of sewer from a manhole located in Shadycombe carpark, to the ROTORK valve at Sunnycliff bay (with the biological tracer *Bacilus globigii*) then, sampling the body of water above the main sewer during high tide.

1.2 Project Team

Project Manager – Trevor Cronin
Project Leader – Stuart Hunter
Project Officers – Emma-May Harrison, Peter Rose and Robin Pearson

2.0 Method

A site visit was made to Salcombe on the 16th July 1999 to view the site and meet with Ted Pritchard (Environment Protection Officer) and representatives of South West Water Limited. During this visit access points to the sewer were identified and the flow regimes through the sewer discussed. Myself and Trevor Cronin (Environment Protection Investigations Team Leader) made a follow up site visit on the 6th August 1999. During this visit dosing and sampling points were identified and a risk assessment was completed, this included

photographing the site and visually assessing areas of potential risk, a copy of the risk assessment can be seen in appendix 2.

When the ROTORK valve closes any defects in the pipe structure could potentially leak sewage and *B. globigii* into the water above. This will be detected by sampling from a boat at planned locations running up the length of the pipe. The survey was planned to take place during a spring tide when pressure on the pipe would be greatest and also to give the maximum depth and time for sampling over the pipe.

A plan of Salcombe showing the sewerage network was obtained from SWWL, this showed the route of the sewer and the location of laterals entering the sewer. Sixteen sample points were chosen along the main sewer. These were sites that were easily visible and repeatable when working from a boat and near to junctions of the main sewer with laterals; these positions were considered sites of potential leakage. Site 3 was identified by the Environment Protection Officer as a hot spot of potential leakage. Eight sites were chosen for background data, four upstream of Sunnycliff and four downstream of Shadycombe. Site 1 was situated in the vicinity of Shadycombe tank storm overflow on the far bank. See figure 1 and 2 for sample point and background sample site locations.

The survey took place on 23rd September 1999; high tide at Salcombe was 5.09m at 17:29 BST. Dosing was started at 12:11 (all times in BST) using a Watson and Marlow variable speed peristaltic pump set at 50% (approx. 3 litres per hour). The peristaltic pump was increased to 55% at 13:40, 60% at 14:44, 70% at 15:15 and finally to 80% at 16:06. During this period approximately 11 litres of *Bacillus globigii* solution was injected into the sewer. The solution was made up of 100ml of *Bacillus globigii* solution added to 24.9 litres of water (see appendix 3 for dilution calculations). The pump was stopped at 17:25.

In an attempt to establish that the entire length of the sewer was dosed with *B. globigii* samples were taken at the first manhole beyond the ROTORK valve. This manhole was situated at Sunnycliff Bay (figure 1). Flow observations were also made here, see table 1.

Table 1

Flow observations from manhole at Sunnycliff (post ROTORK).

Time of Observation	Observation
13:45	High
14:00	Slightly Less
14:15	As 14:00
14:30	Low
14:45	Trickle
15:00	No Flow
15:15	No Flow
15:30	Low
15:45	Low
16:00	Low
16:15	Low
16:30	Low

Sampling from the boat started at 13:45 and finished at 18:48. Six runs were made in the boat. Background samples were taken at the start of the survey above and below the area of sampling and once above on the seaward side at the mid point of the survey and above and below near the end of the survey. See figure 2 showing the location of background samples.

All samples were analysed for *B. globigii* only, at the Environment Agency Laboratory Manley House Exeter.

3.0 Results

A titre taken in the Investigation Laboratory prior to departing on the survey had a concentration of 5.1×10^7 *Bacillus globigii* per µl. All samples collected from the boat including background and from the manhole down stream of the ROTORK valve were negative for the presence of *Bacillus globigii*.

4.0 Discussion

All samples were negative for the presence of *Bacillus globigii*. This could be due to there being no leakage from the sewer. But as the samples taken from the sewer below the ROTORK valve were also negative, this suggests the tracer bacteria did not dose the entire length of the sewer. In fact there is no way of knowing how far the tracer travelled along the sewer.

The sewerage system at Salcombe is very dynamic. There are many variables all with the potential to influence the flow regime within the network.

The holding tank at Shadycombe Pumping Station is designed to regulate flow into the sewer depending on the state of the tide, position of the ROTORK valve and the free capacity within the sewer.

Laterals join the main sewer along its entire length. Any volume of wastewater entering the main pipe from these (once the ROTORK has begun to close) will potentially cause a backup within the system. This could have the effect of blocking the dosed wastewater travelling down the pipe and thus escaping into the environment through any defects in the pipe structure.

Dosing started 5 hours 18 minutes before high water. Had the dosing been started earlier it could have ensured the sewer was completely saturated with the tracer. This was not done because of the risk of *B. globigii* solution being discharged into the estuary via Malborough WWTW outfall prior to or during the survey.

5.0 Conclusions

The results of the survey only show that more work is necessary on time of travel and on flow regimes within the sewer. If a successful survey is to be undertaken we must be sure that the entire sewer is dosed with tracer bacteria before the high tide closes the ROTORK valve preventing further flow through the sewer. Even with further work the dynamic nature of the sewerage system would make the flow regime during every high tide different.

6.0 Recommendations

If EPO requires further work it would be necessary to determine time of travel of sewage to the ROTORK valve; in an attempt to ensure the sewer is completely dosed with the tracer bacteria.

A new survey is undertaken taking into account the results from the time of travel work.

Action: Environment Protection Officer to instigate new investigation if necessary.

Figure 1

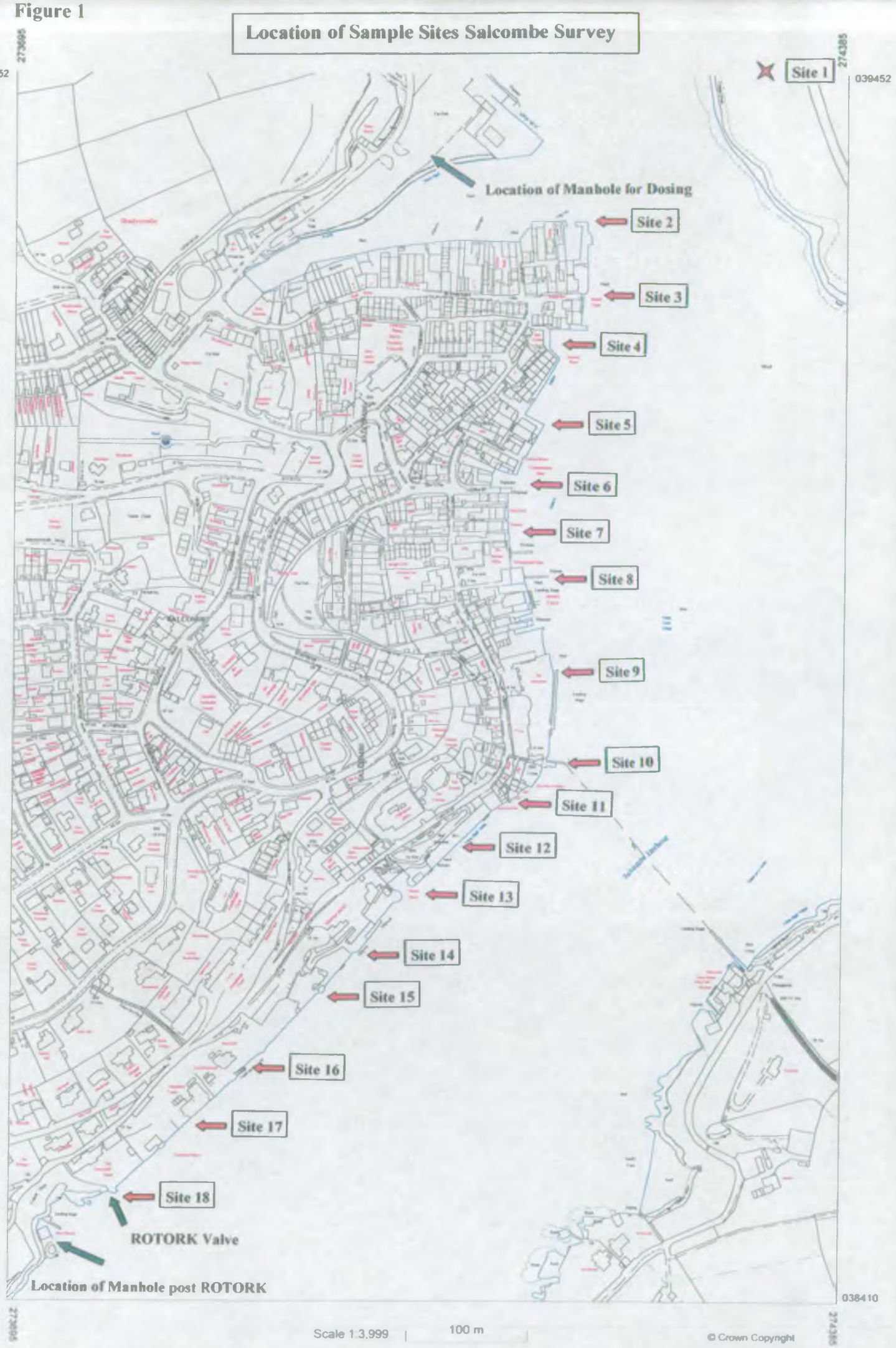
Location of Sample Sites Salcombe Survey
273695
274385
039452
038410
Site 1
Location of Manhole for Dosing
Site 2
Site 3
Site 4
Site 5
Site 6
Site 7
Site 8
Site 9
Site 10
Site 11
Site 12
Site 13
Site 14
Site 15
Site 16
Site 17
Site 18
ROTORK Valve
Location of Manhole post ROTORK
Scale 1:3,999
100 m
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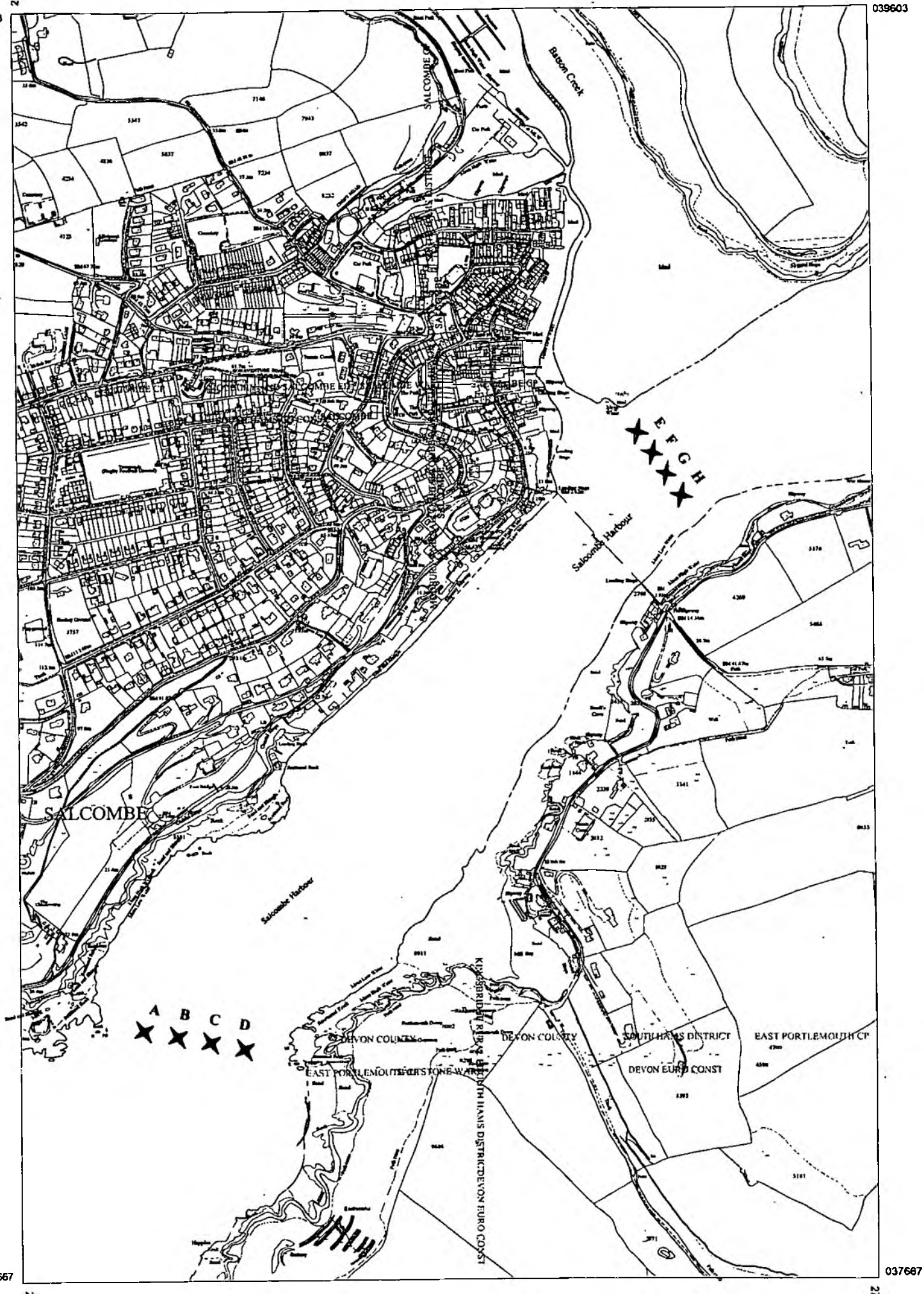
Figure 2

Location of Background Samples



APPENDICES

Appendix 1.

Sample results from the Salcombe Survey, 23 September 1999

Sample Point : 70819999 CATCHMENT 08A
Samples Taken From : 23/09/1999 10:18 To : 23/09/1999 18:48

Site Number/Name	Date of Survey	Time of Sample	B. globigii no per 100ml (3030)
Titre	23/09/99	10:18	5.1×10^7 per µl
Post Rotork	23/09/99	13:45	< 10
Post Rotork	23/09/99	14:00	< 10
Background E	23/09/99	14:10	< 10
Background F	23/09/99	14:12	< 10
Background G	23/09/99	14:15	< 10
Post Rotork	23/09/99	14:15	< 10
Background H	23/09/99	14:17	< 10
Background A	23/09/99	14:23	< 10
Background B	23/09/99	14:25	< 10
Background C	23/09/99	14:26	< 10
Background D	23/09/99	14:26	< 10
18	23/09/99	14:27	< 10
17	23/09/99	14:28	< 10
16	23/09/99	14:29	< 10
15	23/09/99	14:30	< 10
Post Rotork	23/09/99	14:30	< 10
14	23/09/99	14:31	< 10
13	23/09/99	14:32	< 10
12	23/09/99	14:34	< 10
11	23/09/99	14:36	< 10
10	23/09/99	14:37	< 10
9	23/09/99	14:38	< 10
8	23/09/99	14:40	< 10
7	23/09/99	14:42	< 10
6	23/09/99	14:43	< 10
5	23/09/99	14:44	< 10
4	23/09/99	14:44	< 10
3	23/09/99	14:45	< 10
Post Rotork	23/09/99	14:45	< 10
2	23/09/99	14:46	< 10
1	23/09/99	14:47	< 10
18	23/09/99	15:04	< 10

17	23/09/99	15:05	< 10
16	23/09/99	15:06	< 10
15	23/09/99	15:07	< 10
14	23/09/99	15:08	< 10
13	23/09/99	15:09	< 10
12	23/09/99	15:10	< 10
11	23/09/99	15:11	< 10
10	23/09/99	15:12	< 10
9	23/09/99	15:15	< 10
8	23/09/99	15:16	< 10
7	23/09/99	15:17	< 10
6	23/09/99	15:18	< 10
5	23/09/99	15:19	< 10
4	23/09/99	15:20	< 10
3	23/09/99	15:21	< 10
2	23/09/99	15:22	< 10
1	23/09/99	15:23	< 10
Post Rotork	23/09/99	15:30	< 10
Post Rotork	23/09/99	15:45	< 10
18	23/09/99	15:53	< 10
17	23/09/99	15:54	< 10
16	23/09/99	15:55	< 10
15	23/09/99	15:56	< 10
14	23/09/99	15:57	< 10
13	23/09/99	15:58	< 10
12	23/09/99	15:59	< 10
11	23/09/99	16:00	< 10
Post Rotork	23/09/99	16:00	< 10
10	23/09/99	16:05	< 10
9	23/09/99	16:06	< 10
8	23/09/99	16:07	< 10
7	23/09/99	16:08	< 10
6	23/09/99	16:09	< 10
5	23/09/99	16:10	< 10
4	23/09/99	16:11	< 10
3	23/09/99	16:12	< 10
2	23/09/99	16:13	< 10
1	23/09/99	16:14	< 10
Post Rotork	23/09/99	16:15	< 10
Post Rotork	23/09/99	16:30	< 10
Background A	23/09/99	16:45	< 10
Background B	23/09/99	16:46	< 10
Background C	23/09/99	16:47	< 10
Background D	23/09/99	16:48	< 10

18	23/09/99	16:49	< 10
17	23/09/99	16:50	< 10
16	23/09/99	16:51	< 10
15	23/09/99	16:52	< 10
14	23/09/99	16:53	< 10
13	23/09/99	16:54	< 10
12	23/09/99	16:55	< 10
11	23/09/99	16:56	< 10
10	23/09/99	16:57	< 10
9	23/09/99	17:05	< 10
8	23/09/99	17:06	< 10
7	23/09/99	17:07	< 10
6	23/09/99	17:08	< 10
5	23/09/99	17:09	< 10
4	23/09/99	17:10	< 10
3	23/09/99	17:11	< 10
2	23/09/99	17:12	< 10
1	23/09/99	17:13	< 10
14	23/09/99	17:19	< 10
Site at Dosing point from boat	23/09/99	17:40	< 10
18	23/09/99	17:45	< 10
17	23/09/99	17:46	< 10
16	23/09/99	17:47	< 10
15	23/09/99	17:48	< 10
13	23/09/99	17:50	< 10
12	23/09/99	17:51	< 10
11	23/09/99	17:52	< 10
10	23/09/99	17:58	< 10
9	23/09/99	17:59	< 10
8	23/09/99	18:00	< 10
7	23/09/99	18:01	< 10
6	23/09/99	18:02	< 10
5	23/09/99	18:03	< 10
4	23/09/99	18:04	< 10
3	23/09/99	18:05	< 10
2	23/09/99	18:06	< 10
1	23/09/99	18:07	< 10
Background E	23/09/99	18:15	< 10
Background F	23/09/99	18:16	< 10
Background G	23/09/99	18:17	< 10
Background H	23/09/99	18:18	< 10
Background A	23/09/99	18:26	< 10
Background B	23/09/99	18:27	< 10
Background C	23/09/99	18:28	< 10

Background D	23/09/99	18:29	< 10
18	23/09/99	18:30	< 10
17	23/09/99	18:31	< 10
16	23/09/99	18:32	< 10
15	23/09/99	18:33	< 10
14	23/09/99	18:34	< 10
13	23/09/99	18:35	< 10
12	23/09/99	18:36	< 10
11	23/09/99	18:37	< 10
10	23/09/99	18:38	< 10
9	23/09/99	18:39	< 10
8	23/09/99	18:40	< 10
7	23/09/99	18:41	< 10
6	23/09/99	18:42	< 10
5	23/09/99	18:43	< 10
4	23/09/99	18:45	< 10
3	23/09/99	18:46	< 10
2	23/09/99	18:47	< 10
1	23/09/99	18:48	< 10

Appendix 2

DEVON AREA INVESTIGATIONS TEAM ACTIVITY RISK ASSESSMENT

Date last modified 23/11/99
by (name) R Pearson

SITE:	CATCHMENT
Salcombe Sewer	08A

Date of Assessment	Jul-99	Name of Officer	Stuart Hunter

CONSIDERATION	YES	NO	ACTIONS REQUIRED
(A) GENERAL			
1. Do you need to notify site manager/ landowner of Agency presence?	X		If parking in restricted zone of car park
2. Do you need to be accompanied by site staff?		X	
3. Does task require more than one person?	X		For lifting manholes and for boat work
4. Are you working outside daylight hours?		X	
5. Is the site isolated		X	
5. Do you need to employ Lone Worker procedures?	X		Liaise with Comms when doing boat work
6. Is protective clothing required?	X		Usual boat wear, protective gloves and boots for lifting manholes
7. Will seasonal factors affect site safety?		X	
8. Are there dangers from the following			
chemicals		X	
biological hazard	X		Glob dosing and crude sewage in sewer
explosive gases	X		possibility when openning manholes, give time for venting after openning
inhalation of fumes/dust/asbestos		X	
moving vehicles	X		in carpark and on the water
machinery		X	
falling objects		X	
9. Are overhead power supplies present?		X	
10. Is site secure for equipment installation?		X	
(B) VEHICLE ACCESS			
1. Is there safe vehicle acces to site?	X		
2. Can vehicles be parked/left safely?	X		with permission from L.A.

(C) FOOT ACCESS

	YES	NO	
1. Is there safe foot access to the site?	X		
2. Are there fences/ditches etc. to cross?		X	

(D) BANK SITES

1. Are banks steep or slippery?		X	
2. Might banks be undercut?		X	
3. Is water deep/strong currents?		X	

(E) CLIFF OR SIMILAR SITES

1. Are there dangers from falling?		X	
2. Is the terrain steep/slippery?		X	
3. Might the cliff be overhanging?		X	
4. Are ropes required?		X	

(F) CONFINED SPACES

1. Are confined spaces involved? IF *YES* YOU MUST COMPLETE THE CONFINED SPACE FORM HELD IN OFFICE			

(G) BOAT WORK

1. Is boat work involved?	X		high tide needed for survey

(H) MANHOLES

1. Is the area around the manhole safe?	X		
2. Are bollards/cones required?	X		
3. Can cover be lifted safely?	X		with two people
4. Are cover keys/other equipment needed?		X	keys and spanners for releasing nuts holding down internal cover

(I) AGGRESSIVE BEHAVIOUR

1. Are people likely to be aggressive?		X	
2. Are guard dogs/farm dogs/other livestock a risk?		X	

(J) OTHER

Appendix 3

Dilution and number of *Bacillus globigii* dosed at Salcombe Sewer on 23 September 1999

Titre = 5.1×10^7 per ul

no. per ml = $5.1 \times 10^7 \times 1000 =$ 5.1×10^{10} per ml

no. per 100ml= $5.1 \times 10^{10} \times 100 =$ 5.1×10^{12} per 100 ml

100 ml of glob solution was added to 24900 ml of water

dilution factor: 24900 / 100 = 249

$$\frac{5.1E+12}{249} = 20481927711$$

2.05E+10

$$\frac{5.1 \times 10^{12}}{249} = 2.05 \times 10^{10} \text{ per 25l}$$

11 litres of glob solution used during the survey:

$2.05 \times 10^{10} / 25$ = no. per litre

$$\frac{20481927711}{25} = 819277108.4 \text{ no. per litre}$$

819277108.4×11 = no. in 11 litres

819277108.4 X 11 = 9012048192.40

9.01×10^9 number of *Bacillus globigii* dosed in 11 litres of glob solution