ENVIRONMENTAL DEPARTMENT
CORNWALL AREA

NRA

FINAL DRAFT REPORT

RIVER TAVY EC FRESHWATER FISH DIRECTIVE FAILURE - 1993

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INV/95/001

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RIVER TAVY

CROWNDALE INVESTIGATION

EC Fish Directive Failure (1993)

AN ASSESSMENT OF RIVER WATER QUALITY IN THE AREA OF CROWNDALE SEWAGE TREATMENT WORKS AND CROWNDALE TIP FOLLOWING AN EC FISH DIRECTIVE FAILURE IN 1993.

INV/95/001

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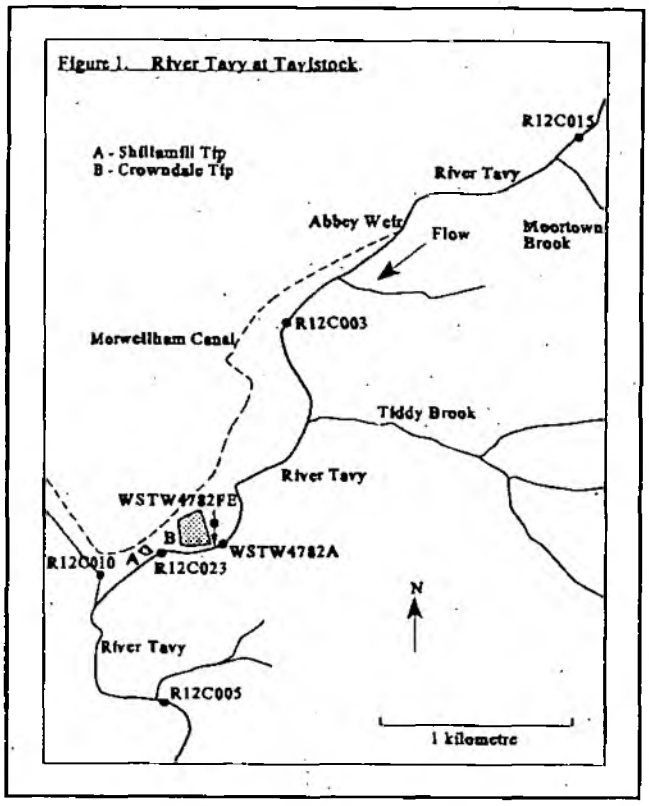
1 INTRODUCTION

1.1 Background

The River Tavy at R12C023, (downstream of Crowndale sewage treatment works), is a designated salmonid site for the EC Freshwater Fish Directive.
In 1993 the site failed the 0.78 mg/l standard for total ammonia. There is a history of water quality problems in this area, with previous work indicating sewage and urban runoff as the major sources.

A previous investigation in 1991, (FWT\91\015), concluded that the Crowndale landfill site was having no impact on the water quality and that the principal cause of total ammonia failure at R12C023 was the effluent from Crowndale Sewage Treatment Works (STW).
This report recommended monitoring the effectiveness of planned capital work to Crowndale STW.



1.2 Objectives

To identify all significant inputs of contamination from Crowndale Tip and assess the impact of Crowndale STW on the River Tavy between site WSTW4782A and the point of confluence with the River Lumburn, in order to determine the cause of the total ammonia failure at site R12C023.

2 METHODS

The following methods were adopted in this investigation:

i Review of archive data and previous investigative work.

ii Preliminary survey using *in situ* methods of assessment; primarily the use of water quality monitors, the identification of aquatic macroinvertebrate indicators of pollution, and a visual assessment of the biome; (especially with respect to the presence of sewage fungus communities (Figure 2).

iii Extensive chemical sampling survey of the relevant section of river to account for all identified potential sources of contamination; (Figure 3).

iv Follow-up chemical sampling at the sewage treatment works to monitor the final effluent and it's effect on the receiving waters; (Figure 4.).

3 RESULTS

Summaries of the water quality monitor results, the macroinvertebrate biological assessment and water chemistry data are contained in Tables 1-2.

The STW chemical spot sampling data are summarised and illustrated in Figure 5; the raw data being presented in Appendix 1.

4 DISCUSSION

The preliminary survey showed the River Lumburn to be of relatively good water quality; allowing this tributary to be eliminated from any further investigation.

Ochrous leachate was found to be entering the River Tavy from several point sources along the perimeter of Crowndale Tip. Although this leachate was of relatively high conductivity and ammonium content, the volume discharging from these seepages was considered too minor to cause significant impact on the main river. It is nevertheless noted that inputs such as these will have a cumulative effect on water quality.

The main River Tavy was found to be of general good water quality, but varying densities of sewage fungus community infestation were encountered throughout the section (Table 1). No sewage fungus was recorded upstream of the STW but in the area immediately downstream of the final effluent discharge it was very abundant. One of the major constituent organisms forming the sewage fungus was identified as *Carchesium polypinum*, an indicator of sewage pollution. The extent of the sewage fungus cover was seen to fluctuate markedly with changes in flow conditions; spate water removing much of the growth, which would then grow back, in relative abundance, during low flow periods.

It was evident that the effluent was not significantly mixing for a considerable distance downstream of the discharge. This resulted in a distinct partitioning of the river for several hundred metres. The results of the tripartite transect chemical survey (Table 2) showed that the effluent was not properly mixed until Site E (Figure 3).

The chemical survey confirmed that the STW discharge was having some effect on the receiving watercourse, but the 0.78mg/l total ammonia standard was only exceeded in one sample. This was taken from the unmixed effluent fraction, downstream of the final effluent discharge, at site G. None of the samples taken downstream of the mixing zone exceeded the standard (Table 2).

The series of spot checks on the STW effluent, together with samples from the appropriate up and downstream sites, confirmed that, although the discharge appeared to remain within it's consent during this survey period, a significant volume of untreated waste was regularly finding it's way into the river via the work's storm overflow. This was observed to flow strongly and quite frequently; generally continuing to flow for some period after rain-fall events. The total ammonium recorded in the storm overflow discharge was in excess of 6 times that of the final effluent.

The total ammonia standard was not exceeded at site R12C023 in any of the samples taken during the entire period of the survey.

5 CONCLUSIONS

5.1 Biological and visual assessment of the River Tavy downstream of Crowndale STW indicated an impact on the river water quality.

5.2 The final effluent from Crowndale STW was not found to exceed it's 7mg/l total ammonia consent in any of the samples taken during this investigation.

5.3 The 0.78mg/l total ammonia standard in the main river was only exceeded in one sample; this was shown to have been within the mixing zone.

5.4 The STW storm overflow was observed to flow frequently and for prolonged periods after rainfall. The total ammonia content of this discharge was recorded as being >6 times that of the final effluent.

5.5 Leachate was found to be entering the River Tavy at several points from Crowndale Tip. This was not, however, considered to be causing more than a local impact.

5.6 Although absent upstream of the STW, sewage fungus was common throughout the downstream section. The most extensive area of growth was along the right bank, within the mixing zone.

5.7 The mixing zone was shown to reach a considerable distance downstream; the effluent not mixing fully until very near to the sampling site R12C023.

6 RECOMMENDATIONS

6.1 Water quality monitors to be installed during low flow period to monitor the final effluent and storm overflow discharges, along with upstream and downstream sites. Action - Investigations Team

6.2 The operating regime of the storm overflow to be investigated in relation to river flow. Action - Investigations Team

6.3 Seepage of leachate from Crowndale tip to be investigated and resolved. Action - SWQO (East)

6.4 Downstream routine monitoring site for STW to be taken at the currently dormant site R12C004, Shillamill above River Lumburn (NGR SX 4680 7190) as some samples taken at R12C023 would appear to have fallen within the mixing zone. Action - Survey Officer

Table 1. Results of Preliminary Survey - 13/7/94

Site	Description	Time	Temperature	Dissolved Oxygen	pH	Ammonium	Turbidity	Conductivity
		Hrs	°C	% Sat.		mg/l	FTU	uS
14	U/S S.T.W.	15:49	21.20	108	7.35	0.0	1	112
13	Final Effluent	15:44	18.00	53	6.50	7.1	26	390
12	D/S S.T.W.	15:37	21.10	108	7.05	0.5	8	143
11	Ochrous Seepage	15:33	14.80	53	6.40	15.0	3	510
10	Mine Leat	14:58	15.40	78	7.50	0.1	0	173
9	Spring/Ochrous Seepage	14:23	13.20	21	6.30	38.0	11	620
8	Downstream Site 9	14:23	-	-	-	-	-	-
7	Ochrous Seepage	14:00	14.70	26	6.20	2.2	35	400
6	D/S Ochrous Seepage	14:06	20.00	100	6.90	0.3	2	135
5	U/S Confluence R.Lumburn	13:28	19.10	99	7.00	0.3	0	138
1	D/S Confluence R.Lumburn	10:53	16.90	82	7.00	0.2	0	137
3	R.Lumburn U/S Landfill Site	11:54	16.00	87	7.40	0.0	0	201
2	R.Lumburn U/S Confluence	11:33	15.80	86	7.45	0.1	1	203
4	Pond at lowest point of tip	10:28	18.00	47	6.60	0.1	0	320

Site	Biological Assessment BMWP Score - W.Q. Category	Visual Assessment
14	199 - Good Quality	Good/Very Good - Water & substrate clean; no visible sewage fungus growth
13	-	Poor - Turbidity high
12	-	Poor - Turbid; substrate choked with fine organic material; excessive sewage fungus
11	-	Leachate clear, but extensive Ochrous deposits; moderate flow
10	-	Leachate clear; flow negligible
9	-	Leachate clear, but extensive Ochrous deposits; substantial flow
8	112 - Good Quality	Moderate - sewage fungus abundant in run immediately d/s of site 9
7	-	Leachate clear, but extensive Ochrous deposits; moderate flow
6	-	Moderate/Poor - Substrate choked with fine organic material; excessive sewage fungus
5	-	Moderate - Some sewage fungus visible on surface of substrate & on macrophytes
1	191 - Good Quality	Moderate/Good - Water & substrate clean; no excessive sewage fungus growth
3	115 - Good Quality	Good - Water & substrate clean, although some siltation; no visible sewage fungus growth
2	121 - Good Quality	Good - Water & substrate clean; no visible sewage fungus growth
4	-	Lentic habitat; extensive macrophytic growth; diverse macroinvertebrate community

Table 2. Results of Tripartate Transect Chemical Sample Survey - 20/7/94

Site	Description	Time	BOD (ATU)	COD	pH	Ammonium	Turbidity	S. Solids	Conductivity
		Hrs	mg/l	mg/l		mg/l	FTU	mg/l	uS
A1	Right Bank	16:10	1.8	<15	8.1	0.26	2	2.1	124
A2	Mid-Channel	16:13	1.7	<15	7.9	0.27	3	2.1	126
A3	Left Bank	16:16	1.6	<15	7.8	0.23	3	<2.00	124
B1	Right Bank	16:40	1.6	<15	7.8	0.36	3	2.5	125
B2	Mid-Channel	16:43	1.4	<15	7.8	0.33	3	2.7	124
B3	Left Bank	16:45	1.6	<15	7.8	0.34	2	2.5	124
C	Tip Leachate	16:50	3.9	26	6.7	22.5	102	7	592
D1	Right Bank	16:52	1.5	<15	7.6	0.28	2	<2.00	124
D2	Mid-Channel	16:55	1.5	<15	7.8	0.3	2	<2.00	126
D3	Left Bank	17:00	1.5	<15	7.8	0.3	2	3.6	125
E1	Right Bank	17:05	1.7	<15	7.8	0.32	3	2.5	126
E2	Mid-Channel	17:07	1.5	<15	7.8	0.3	2	2.9	124
E3	Left Bank	17:10	1.6	<15	7.8	0.3	2	2.9	125
F	Tip Leachate	17:15	1.6	24	7.1	10.4	49	25	466
G1	Right Bank	17:20	3.2	17	7.5	0.95	4	4.2	162
G2	Mid-Channel	17:22	2.2	15	7.6	0.58	3	4	140
G3	Left Bank	17:25	<1.00	<15	7.9	0.04	1	<2.00	111
H	Final Effluent	17:30	11.6	76	6.8	4.8	17	23	366
I1	Right Bank	17:33	<1.00	76	7.6	<0.02	1	<2.00	110
I2	Mid-Channel	17:35	1.4	<15	7.8	<0.02	1	<2.00	110
I3	Left Bank	17:38	<1.00	<15	8	<0.02	1	<2.00	111

Figure 2. Preliminary Survey - 13/07/94.

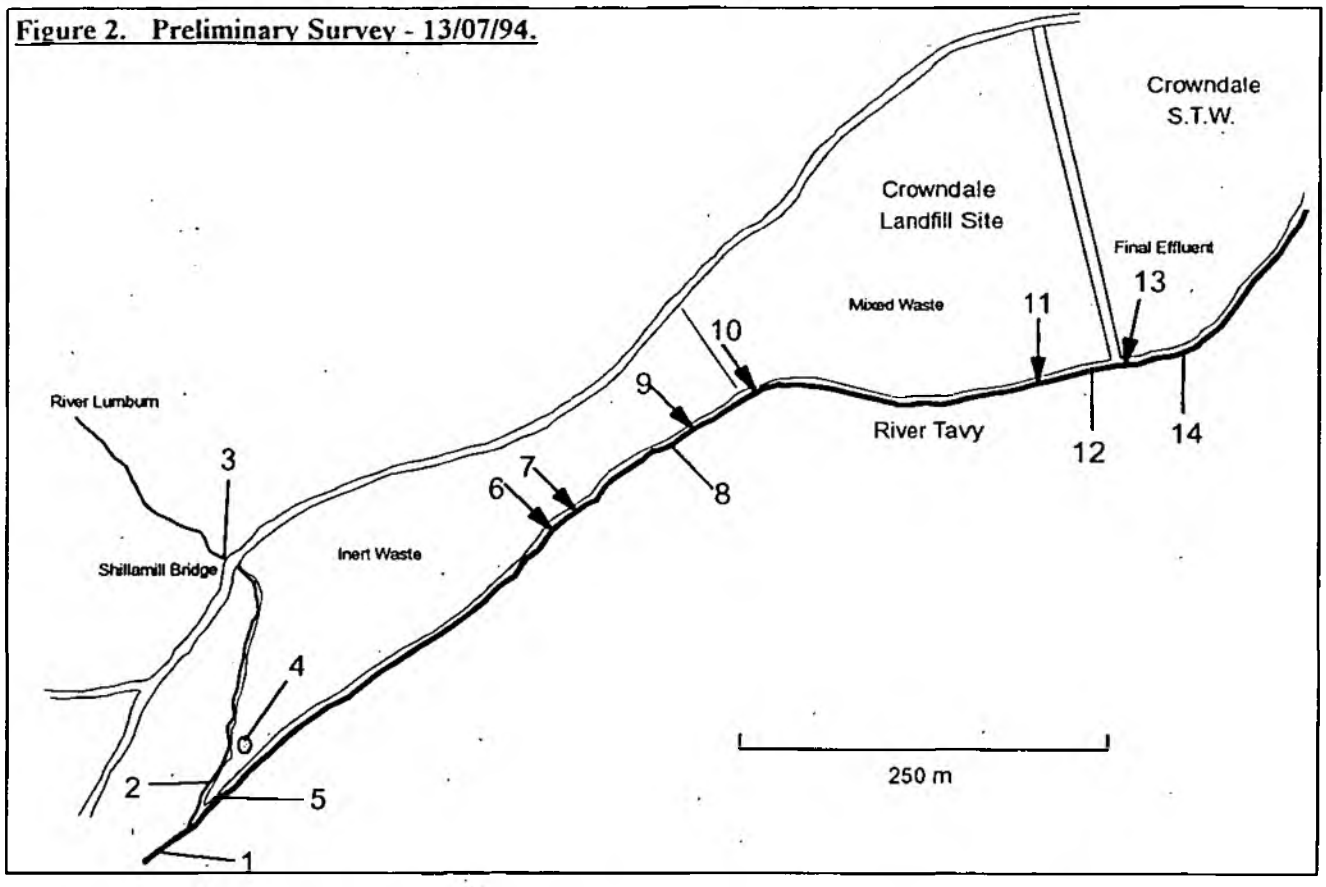


Figure 3. Tripartite Transect Chemical Sample Survey - 20/07/94.

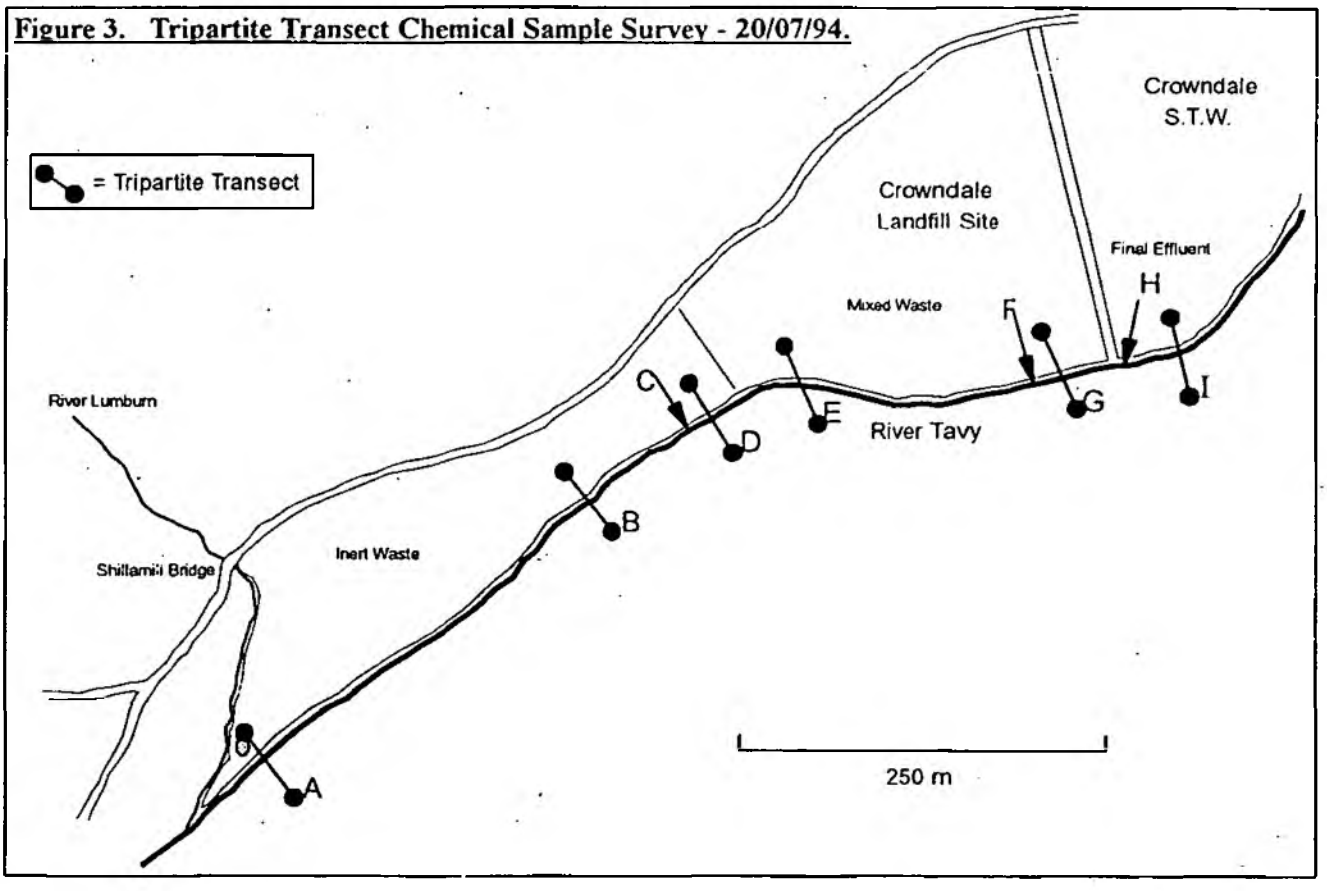


Figure 4. Chemical Spot Sampling Sites - 15/09/94-25/10/94.

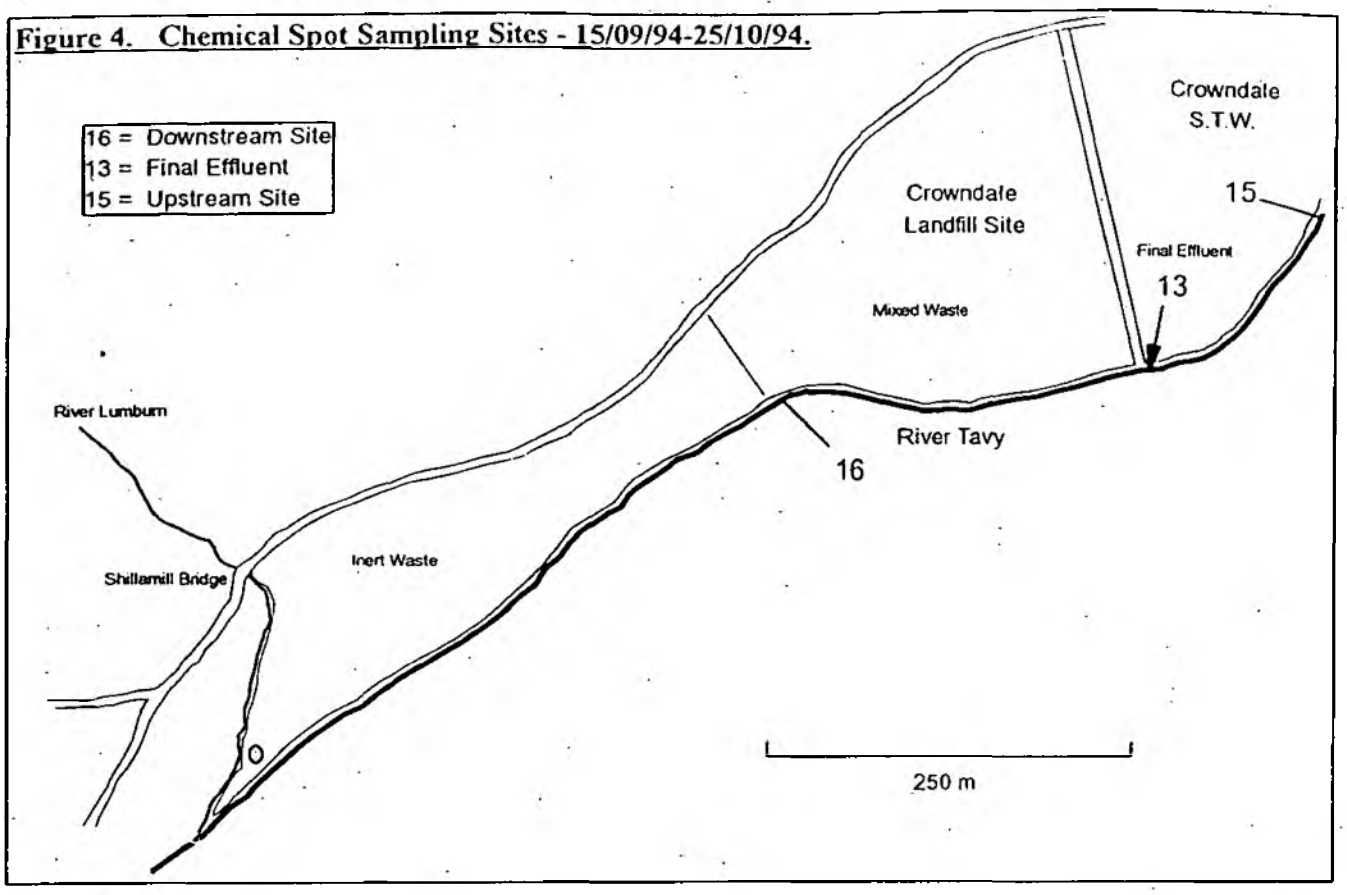
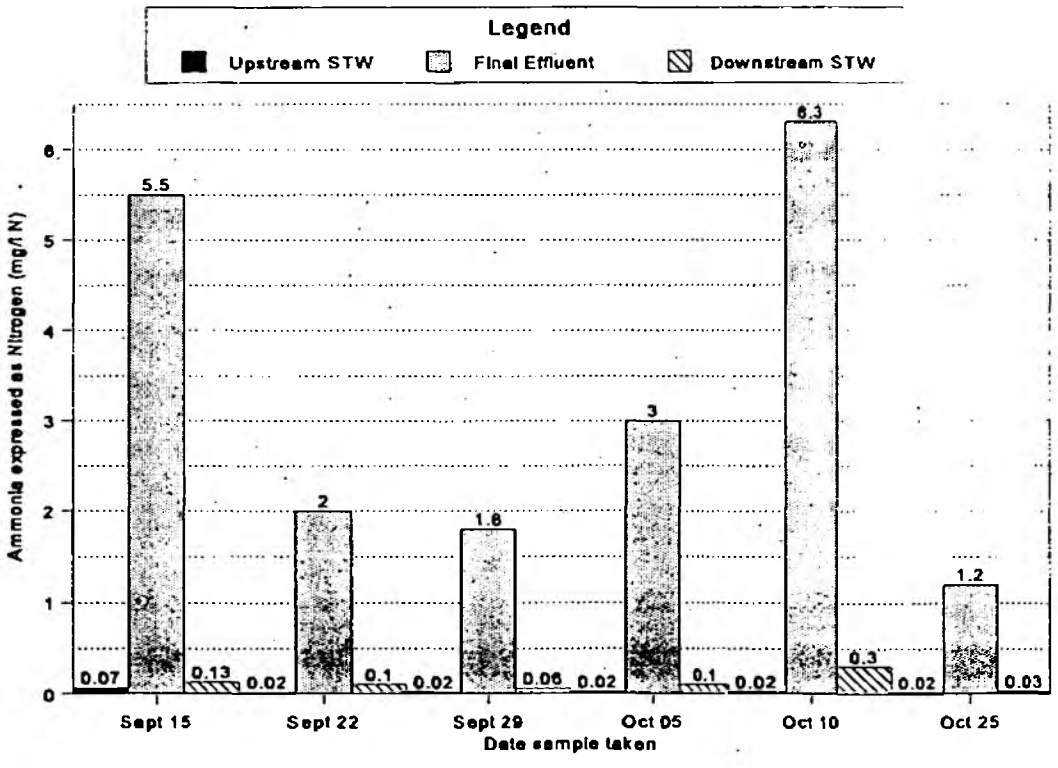


Figure 5. STW Chemical Spot Sample Results.



APPENDIX 1

Sample Analysis Run Report 03-nov-94

Laboratory Ref. : E384248 Sampling Point : WSTW4782A
Date/Time Taken : 03-NOV-94 12:30 Date/Time Received : 04-NOV-94 06:31
River Tavy Upstream Of Tavistock (Crowndale) Stw

Address : U/S Stw

Det.	Code	Description	Result
*61		pH	7.2000 pH
*62		Conductivity at 20 C microsiemens/cm	76.0000 Microsiemens/cm
*68		Turbidity	3.0000 Turbidity FTU
76		Temperature degrees C (in-situ)	No Result
81		Oxygen dissolved % Saturation (in-situ)	No Result
82		Oxygen dissolved (Calculated)	No Result
*85		BOD ATU Worksheet Overlooked	No Result
*92		Chemical Oxygen Demand	< 15.0000 mg/l O
*111		Ammonia expressed as Nitrogen	< 0.0200 mg/l N
*116		Total Oxidised Nitrogen as Nitrogen	1.0000 mg/l N
*117		Nitrate expressed as Nitrogen (Calculated)	0.9940 mg/l N
*118		Nitrite	0.0060 mg/l N
119		Ammonia non-ionised (Calculated)	No Result
*135		Suspended solids 105C	6.4000 mg/l
*143		Solids non-volatile 500C	No Result
*172		Chloride ion	11.0000 mg/l Cl
*180		Ortho-Phosphate	< 0.0200 mg/l P
*182		Silicate Reactive dissolved	4.7000 mg/l SiO2
*183		Sulphate	6.0000 mg/l

'*' Indicates that Laboratory Determination Method is NAMAS Accredited.

Sample Analysis Run Report 15-sep-94

Laboratory Ref. : E365982
Date/Time Taken : 15-SEP-94 14:30
River Tavy D/S Crowndale Stw

Sampling Point : R12C023
Date/Time Received : 17-SEP-94 06:52

Address : D/S Stw

Det.	Code	Description	Result
*61		pH	7.5000 pH
*62		Conductivity at 20 C microsiemens/cm	74.0000 Microsiemens/cm
*[illegible]8		Turbidity	42.2000 Turbidity FTU
[illegible]6		Temperature degrees C (in-situ)	12.2000 Celsius
81		Oxygen dissolved % Saturation (in-situ)	98.0000 % O
[illegible]2		Oxygen dissolved (Calculated)	10.5000 mg/l O
*[illegible]5		BOD ATU	2.4000 mg/l O
*92		Chemical Oxygen Demand	29.0000 mg/l O
*111		Ammonia expressed as Nitrogen	0.1300 mg/l N
*[illegible]16		Total Oxidised Nitrogen as Nitrogen	0.9000 mg/l N
*[illegible]17		Nitrate expressed as Nitrogen (Calculated)	0.8750 mg/l N
*[illegible]18		Nitrite	0.0250 mg/l N
[illegible]19		Ammonia non-ionised (Calculated)	0.0009 mg/l NH3
*135		Suspended solids 105C	43.0000 mg/l
*143		Solids non-volatile 500C	35.0000 mg/l
*[illegible]72		Chloride ion	10.0000 mg/l Cl
*[illegible]80		Ortho-Phosphate	0.0700 mg/l P
*182		Silicate Reactive dissolved	3.7000 mg/l SiO2
*183		Sulphate	7.0000 mg/l

'*' Indicates that Laboratory Determination Method is NAMAS Accredited.

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Sample Analysis Run Report 15-sep-94

Laboratory Ref. : E365984 Sampling Point : WSTW4782A
Date/Time Taken : 15-SEP-94 14:00 Date/Time Received : 17-SEP-94 06:52
River Tavy Upstream Of Tavistock (Crowndale) Stw

Address : U/S Stw

Det.	Code	Description	Result	
*61		pH	7.4000	pH
*62		Conductivity at 20 C microsiemens/cm	68.0000	Microsiemens/cm
*68		Turbidity	80.6000	Turbidity FTU
76		Temperature degrees C (in-situ)	12.2000	Celsius
81		Oxygen dissolved % Saturation (in-situ)	98.0000	% O
82		Oxygen dissolved (Calculated)	10.5000	mg/l O
*85		BOD ATU	2.8000	mg/l O
*92		Chemical Oxygen Demand	46.0000	mg/l O
*111		Ammonia expressed as Nitrogen	0.0700	mg/l N
*116		Total Oxidised Nitrogen as Nitrogen	0.6000	mg/l N
*117		Nitrate expressed as Nitrogen (Calculated)	0.5750	mg/l N
*118		Nitrite	0.0250	mg/l N
119		Ammonia non-ionised (Calculated)	0.0004	mg/l NH3
*135		Suspended solids 105C	84.0000	mg/l
*143		Solids non-volatile 500C	67.0000	mg/l
*172		Chloride ion	9.0000	mg/l Cl
*180		Ortho-Phosphate	0.0500	mg/l P
*182		Silicate Reactive dissolved	3.4000	mg/l SiO2
*183		Sulphate	6.0000	mg/l

'*' Indicates that Laboratory Determination Method is NAMAS Accredited.

Sample Analysis Run Report 15-sep-94

Laboratory Ref. : S365983 Sampling Point : WSTW4782FE
Date/Time Taken : 15-SEP-94 13:30 Date/Time Received : 17-SEP-94 06:52
Tavistock (Crowndale) S T W - Effluent

Contact : South West Water Services Ltd
Peninsula House
Rydon Lane
Exeter
Devon
Ex2 7hr

Address : Stw Fe

Det.	Code	Description	Result
*	61	pH	7.1000 pH
*	62	Conductivity at 20 C microsiemens/cm	322.0000 Microsiemens/cm
*	8	Turbidity	18.0000 Turbidity FTU
	6	Temperature degrees C (in-situ)	14.9000 Celsius
	81	Oxygen dissolved % Saturation (in-situ)	51.0000 % O
	82	Oxygen dissolved (Calculated)	5.1400 mg/l O
*	5	BOD ATU	12.8000 mg/l O
*	92	Chemical Oxygen Demand	67.0000 mg/l O
*	111	Ammonia expressed as Nitrogen	5.5000 mg/l N
*	116	Total Oxidised Nitrogen as Nitrogen	10.3000 mg/l N
*	117	Nitrate expressed as Nitrogen (Calculated)	9.8000 mg/l N
*	118	Nitrite	0.5000 mg/l N
	119	Ammonia non-ionised (Calculated)	0.0187 mg/l NH3
*	135	Suspended solids 105C	18.0000 mg/l
*	143	Solids non-volatile 500C	No Result
*	172	Chloride ion	32.0000 mg/l Cl
*	180	Ortho-Phosphate	2.9000 mg/l P

'*' Indicates that Laboratory Determination Method is NAMAS Accredited.

Sample Analysis Run Report 22-sep-94

Laboratory Ref. : E368561
Date/Time Taken : 22-SEP-94 00:01
River Tavy D/S Crowndale Stw

Sampling Point : R12C023
Date/Time Received : 23-SEP-94 06:54

Address : D/S Stw

Det.	Code	Description	Result
*61		pH	7.6000 pH
*62		Conductivity at 20 C microsiemens/cm	76.0000 Microsiemens/cm
*68		Turbidity	2.0000 Turbidity FTU
76		Temperature degrees C (in-situ)	12.8000 Celsius
81		Oxygen dissolved % Saturation (in-situ)	93.0000 % O
82		Oxygen dissolved (Calculated)	9.8200 mg/l O
*85		BOD ATU	< 1.0000 mg/l O
*92		Chemical Oxygen Demand	< 15.0000 mg/l O
*111		Ammonia expressed as Nitrogen	0.1000 mg/l N
*116		Total Oxidised Nitrogen as Nitrogen	1.0000 mg/l N
*117		Nitrate expressed as Nitrogen (Calculated)	0.9900 mg/l N
*118		Nitrite	0.0100 mg/l N
119		Ammonia non-ionised (Calculated)	0.0009 mg/l NH3
*135		Suspended solids 105C	3.2000 mg/l
*143		Solids non-volatile 500C	No Result
*172		Chloride ion	12.0000 mg/l Cl
*180		Ortho-Phosphate	0.0300 mg/l P
*182		Silicate Reactive dissolved	5.0000 mg/l SiO2
*183		Sulphate	6.0000 mg/l

'*' Indicates that Laboratory Determination Method is NAMAS Accredited.

Sample Analysis Run Report 22-sep-94

Laboratory Ref. : E368563 Sampling Point : WSTW4782A
Date/Time Taken : 22-SEP-94 00:03 Date/Time Received : 23-SEP-94 06:54
River Tavy Upstream Of Tavistock (Crowndale) Stw

Address : U/S Stw

Det.	Code	Description	Result
*61		pH	7.5000 pH
*62		Conductivity at 20 C microsiemens/cm	74.0000 Microsiemens/cm
*		Turbidity	2.0000 Turbidity FTU
		Temperature degrees C (in-situ)	12.9000 Celsius
81		Oxygen dissolved % Saturation (in-situ)	97.0000 % O
		Oxygen dissolved (Calculated)	10.2000 mg/l O
*		BOD ATU	< 1.0000 mg/l O
*92		Chemical Oxygen Demand	< 15.0000 mg/l O
*111		Ammonia expressed as Nitrogen	< 0.0200 mg/l N
*		Total Oxidised Nitrogen as Nitrogen	0.9000 mg/l N
*		Nitrate expressed as Nitrogen (Calculated)	0.8930 mg/l N
*		Nitrite	0.0070 mg/l N
		Ammonia non-ionised (Calculated)	0.0001 mg/l NH3
*135		Suspended solids 105C	3.8000 mg/l
*143		Solids non-volatile 500C	No Result
*		Chloride ion	11.0000 mg/l Cl
*		Ortho-Phosphate	< 0.0200 mg/l P
*182		Silicate Reactive dissolved	4.8000 mg/l SiO2
*		Sulphate	5.0000 mg/l

'*' Indicates that Laboratory Determination Method is NAMAS Accredited.

Sample Analysis Run Report 22-sep-94

Laboratory Ref. : S368562 Sampling Point : WSTW4782FE
Date/Time Taken : 22-SEP-94 00:02 Date/Time Received : 23-SEP-94 06:54
Tavistock (Crowndale) S T W - Effluent

Contact : South West Water Services Ltd
Peninsula House
Rydon Lane
Exeter
Devon
Ex2 7hr

Address : Stw Fe

Det.	Code	Description	Result
*61		pH	7.0000 pH
*62		Conductivity at 20 C microsiemens/cm	286.0000 Microsiemens/cm
*68		Turbidity	5.0000 Turbidity FTU
76		Temperature degrees C (in-situ)	15.3000 Celsius
81		Oxygen dissolved % Saturation (in-situ)	53.0000 % O
82		Oxygen dissolved (Calculated)	5.2900 mg/l O
*85		BOD ATU	6.2000 mg/l O
*92		Chemical Oxygen Demand	38.0000 mg/l O
*111		Ammonia expressed as Nitrogen	2.0000 mg/l N
*116		Total Oxidised Nitrogen as Nitrogen	11.2000 mg/l N
*117		Nitrate expressed as Nitrogen (Calculated)	10.8000 mg/l N
*118		Nitrite	0.4000 mg/l N
119		Ammonia non-ionised (Calculated)	0.0056 mg/l NH3
*135		Suspended solids 105C	10.0000 mg/l
*143		Solids non-volatile 500C	No Result
*172		Chloride ion	29.0000 mg/l Cl
*180		Ortho-Phosphate	1.9000 mg/l P

'*' Indicates that Laboratory Determination Method is NAMAS Accredited.

Sample Analysis Run Report 29-sep-94

Laboratory Ref. : E370989 Sampling Point : R12C023
Date/Time Taken : 29-SEP-94 12:40 Date/Time Received : 30-SEP-94 06:23
River Tavy D/S Crowndale Stw

Address : D/S Stw

Det.	Code	Description	Result
*61		pH	7.4000 pH
*62		Conductivity at 20 C microsiemens/cm	90.0000 Microsiemens/cm
*[illegible]8		Turbidity	1.0000 Turbidity FTU
[illegible]6		Temperature degrees C (in-situ)	12.6000 Celsius
81		Oxygen dissolved % Saturation (in-situ)	93.0000 % O
82		Oxygen dissolved (Calculated)	9.8600 mg/l O
*[illegible]5		BOD ATU	< 1.0000 mg/l O
*[illegible]2		Chemical Oxygen Demand	18.0000 mg/l O
*111		Ammonia expressed as Nitrogen	0.0600 mg/l N
*116		Total Oxidised Nitrogen as Nitrogen	1.2000 mg/l N
*117		Nitrate expressed as Nitrogen (Calculated)	1.1900 mg/l N
*118		Nitrite	0.0120 mg/l N
119		Ammonia non-ionised (Calculated)	0.0003 mg/l NH3
*135		Suspended solids 105C	< 2.0000 mg/l
*143		Solids non-volatile 500C	No Result
*172		Chloride ion	12.0000 mg/l Cl
*180		Ortho-Phosphate	0.0700 mg/l P
*182		Silicate Reactive dissolved	5.8000 mg/l SiO2
*183		Sulphate	9.0000 mg/l

'*' Indicates that Laboratory Determination Method is NAMAS Accredited.

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NRA Exeter Regional Laboratory

Sample Analysis Run Report 29-sep-94

Laboratory Ref. : E370991 Sampling Point : WSTW4782A
Date/Time Taken : 29-SEP-94 12:50 Date/Time Received : 30-SEP-94 06:23
River Tavy Upstream Of Tavistock (Crowndale) Stw

Address : U/S Stw

Det.	Code	Description	Result	
*61		pH	7.6000	pH
*62		Conductivity at 20 C microsiemens/cm	84.0000	Microsiemens/cm
*68		Turbidity	1.0000	Turbidity FTU
76		Temperature degrees C (in-situ)	12.6000	Celsius
81		Oxygen dissolved % Saturation (in-situ)	100.0000	% O
82		Oxygen dissolved (Calculated)	10.6000	mg/l O
*85		BOD ATU	< 1.0000	mg/l O
*92		Chemical Oxygen Demand	< 15.0000	mg/l O
*111		Ammonia expressed as Nitrogen	< 0.0200	mg/l N
*116		Total Oxidised Nitrogen as Nitrogen	1.0000	mg/l N
*117		Nitrate expressed as Nitrogen (Calculated)	0.9960	mg/l N
*118		Nitrite	< 0.0040	mg/l N
119		Ammonia non-ionised (Calculated)	0.0002	mg/l NH3
*135		Suspended solids 105C	< 2.0000	mg/l
*143		Solids non-volatile 500C	No Result	
*172		Chloride ion	12.0000	mg/l Cl
*180		Ortho-Phosphate	< 0.0200	mg/l P
*182		Silicate Reactive dissolved	5.7000	mg/l SiO2
*183		Sulphate	8.0000	mg/l

'*' Indicates that Laboratory Determination Method is NAMAS Accredited.

Sample Analysis Run Report 29-sep-94

Laboratory Ref. : S370990 Sampling Point : WSTW4782FE
Date/Time Taken : 29-SEP-94 12:30 Date/Time Received : 30-SEP-94 06:23
Tavistock (Crowndale) S T W - Effluent

Contact : South West Water Services Ltd
Peninsula House
Rydon Lane
Exeter
Devon
Ex2 7hr

Address : Stw Fe

Det.	Code	Description	Result	
*61		pH	6.5000	pH
*62		Conductivity at 20 C microsiemens/cm	295.0000	Microsiemens/cm
*68		Turbidity	7.0000	Turbidity FTU
76		Temperature degrees C (in-situ)	15.0000	Celsius
81		Oxygen dissolved % Saturation (in-situ)	43.0000	% O
82		Oxygen dissolved (Calculated)	4.3200	mg/l O
*85		BOD ATU	5.4000	mg/l O
*92		Chemical Oxygen Demand	31.0000	mg/l O
*111		Ammonia expressed as Nitrogen	1.8000	mg/l N
*116		Total Oxidised Nitrogen as Nitrogen	12.9000	mg/l N
*117		Nitrate expressed as Nitrogen (Calculated)	12.5000	mg/l N
*118		Nitrite	0.4000	mg/l N
119		Ammonia non-ionised (Calculated)	0.0016	mg/l NH3
135		Suspended solids 105C	9.9000	mg/l
*143		Solids non-volatile 500C	No Result	
*172		Chloride ion	34.0000	mg/l Cl
*180		Ortho-Phosphate	3.5000	mg/l P

'*' Indicates that Laboratory Determination Method is NAMAS Accredited.

MENSAR V2.0.5
NRA Exeter Regional Laboratory

Sample Analysis Run Report 05-oct-94

Laboratory Ref. : E372917
Date/Time Taken : 05-OCT-94 13:00
River Tavy D/S Crowndale Stw

Sampling Point : R12C023
Date/Time Received : 06-OCT-94 06:35

Address : D/S Stw

Det.	Code	Description	Result
*61		pH	7.6000 pH
*62		Conductivity at 20 C microsiemens/cm	106.0000 Microsiemens/cm
*68		Turbidity	1.0000 Turbidity FTU
76		Temperature degrees C (in-situ)	9.6000 Celsius
81		Oxygen dissolved % Saturation (in-situ)	100.0000 % O
82		Oxygen dissolved (Calculated)	11.4000 mg/l O
*85		BOD ATU	1.6000 mg/l O
*92		Chemical Oxygen Demand	< 15.0000 mg/l O
*111		Ammonia expressed as Nitrogen	0.1000 mg/l N
*116		Total Oxidised Nitrogen as Nitrogen	1.6000 mg/l N
*117		Nitrate expressed as Nitrogen (Calculated)	1.5800 mg/l N
*118		Nitrite	0.0190 mg/l N
119		Ammonia non-ionised (Calculated)	0.0007 mg/l NH3
*135		Suspended solids 105C	< 2.0000 mg/l
*143		Solids non-volatile 500C	No Result
*172		Chloride ion	13.0000 mg/l Cl
*180		Ortho-Phosphate	0.1300 mg/l P
*182		Silicate Reactive dissolved	6.4000 mg/l SiO2
*183		Sulphate	8.0000 mg/l

'*' Indicates that Laboratory Determination Method is NAMAS Accredited.

Sample Analysis Run Report 05-oct-94

Laboratory Ref. : E372919 Sampling Point : WSTW4782A
Date/Time Taken : 05-OCT-94 00:01 Date/Time Received : 06-OCT-94 06:35
River Tavy Upstream Of Tavistock (Crowndale) Stw

Address : U/S Stw

Det.	Code	Description	Result
*61		pH	7.6000 pH
*62		Conductivity at 20 C microsiemens/cm	96.0000 Microsiemens/cm
*[illegible]8		Turbidity	< 1.0000 Turbidity FTU
[illegible]6		Temperature degrees C (in-situ)	10.0000 Celsius
81		Oxygen dissolved % Saturation (in-situ)	96.0000 % O
82		Oxygen dissolved (Calculated)	10.8000 mg/l O
*[illegible]5		BOD ATU	1.5000 mg/l O
[illegible]2		Chemical Oxygen Demand	< 15.0000 mg/l O
*111		Ammonia expressed as Nitrogen	< 0.0200 mg/l N
*[illegible]16		Total Oxidised Nitrogen as Nitrogen	1.2000 mg/l N
*[illegible]17		Nitrate expressed as Nitrogen (Calculated)	1.1900 mg/l N
*118		Nitrite	0.0070 mg/l N
[illegible]19		Ammonia non-ionised (Calculated)	0.0001 mg/l NH3
*[illegible]35		Suspended solids 105C	< 2.0000 mg/l
*143		Solids non-volatile 500C	No Result
*[illegible]72		Chloride ion	14.0000 mg/l Cl
*[illegible]80		Ortho-Phosphate	0.0200 mg/l P
*182		Silicate Reactive dissolved	6.7000 mg/l SiO2
*183		Sulphate	7.0000 mg/l

'*' Indicates that Laboratory Determination Method is NAMAS Accredited.

Sample Analysis Run Report 05-oct-94

Laboratory Ref. : S372918 Sampling Point : WSTW4782FE
Date/Time Taken : 05-OCT-94 13:00 Date/Time Received : 06-OCT-94 06:35
Tavistock (Crowndale) S T W - Effluent

Contact : South West Water Services Ltd
Peninsula House
Rydon Lane
Exeter
Devon
Ex2 7hr

Address : Stw. Fe.

Det.	Code	Description	Result
*61		pH	7.0000 pH
*62		Conductivity at 20 C microsiemens/cm	318.0000 Microsiemens/cm
*68		Turbidity	6.0000 Turbidity FTU
76		Temperature degrees C (in-situ)	12.7000 Celsius
81		Oxygen dissolved % Saturation (in-situ)	45.0000 % O
82		Oxygen dissolved (Calculated)	4.7600 mg/l O
*85		BOD ATU	7.6000 mg/l O
*92		Chemical Oxygen Demand	47.0000 mg/l O
*111		Ammonia expressed as Nitrogen	3.0000 mg/l N
*116		Total Oxidised Nitrogen as Nitrogen	13.4000 mg/l N
*117		Nitrate expressed as Nitrogen (Calculated)	12.9000 mg/l N
*118		Nitrite	0.5000 mg/l N
119		Ammonia non-ionised (Calculated)	0.0069 mg/l NH3
*135		Suspended solids 105C	9.7000 mg/l
*143		Solids non-volatile 500C	No Result
*172		Chloride ion	30.0000 mg/l Cl
*180		Ortho-Phosphate	3.9000 mg/l P

'*' Indicates that Laboratory Determination Method is NAMAS Accredited.

Sample Analysis Run Report 10-oct-94

Laboratory Ref. : E374519
Date/Time Taken : 10-OCT-94 15:10
River Tavy D/S Crowndale Stw

Sampling Point : R12C023
Date/Time Received : 11-OCT-94 06:23

Address : D/S Stw

Det.	Code	Description	Result
*61		pH	7.6000 pH
*62		Conductivity at 20 C microsiemens/cm	112.0000 Microsiemens/cm
*[redacted]8		Turbidity	1.0000 Turbidity FTU
[redacted]6		Temperature degrees C (in-situ)	12.2000 Celsius
81		Oxygen dissolved % Saturation (in-situ)	100.0000 % O
82		Oxygen dissolved (Calculated)	10.7000 mg/l O
*[redacted]5		BOD ATU	1.3000 mg/l O
*[redacted]2		Chemical Oxygen Demand	< 15.0000 mg/l O
*111		Ammonia expressed as Nitrogen	0.3000 mg/l N
*[redacted]16		Total Oxidised Nitrogen as Nitrogen	1.8000 mg/l N
*[redacted]17		Nitrate expressed as Nitrogen (Calculated)	1.7600 mg/l N
*118		Nitrite	0.0430 mg/l N
[redacted]19		Ammonia non-ionised (Calculated)	0.0026 mg/l NH3
*[redacted]35		Suspended solids 105C	< 2.0000 mg/l
*143		Solids non-volatile 500C	No Result
*[redacted]72		Chloride ion	14.0000 mg/l Cl
*[redacted]80		Ortho-Phosphate	0.2400 mg/l P
*182		Silicate Reactive dissolved	6.5000 mg/l SiO2
*183		Sulphate	10.0000 mg/l

'*' Indicates that Laboratory Determination Method is NAMAS Accredited.

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NRA Exeter Regional Laboratory

Sample Analysis Run Report 10-oct-94

Laboratory Ref. : E374521 Sampling Point : WSTW4782A
Date/Time Taken : 10-OCT-94 15:20 Date/Time Received : 11-OCT-94 06:23
River Tavy Upstream Of Tavistock (Crowndale) Stw

Address : U/S Stw

Det.	Code	Description	Result
*61		pH	7.7000 pH
*62		Conductivity at 20 C microsiemens/cm	103.0000 Microsiemens/cm
*68		Turbidity	< 1.0000 Turbidity FTU
76		Temperature degrees C (in-situ)	12.7500 Celsius
81		Oxygen dissolved % Saturation (in-situ)	95.0000 % O
82		Oxygen dissolved (Calculated)	10.0000 mg/l O
*85		BOD ATU	< 1.0000 mg/l O
*92		Chemical Oxygen Demand	< 15.0000 mg/l O
*111		Ammonia expressed as Nitrogen	< 0.0200 mg/l N
*116		Total Oxidised Nitrogen as Nitrogen	1.1000 mg/l N
*117		Nitrate expressed as Nitrogen (Calculated)	1.0900 mg/l N
*118		Nitrite	0.0070 mg/l N
119		Ammonia non-ionised (Calculated)	0.0002 mg/l NH3
*135		Suspended solids 105C	< 2.0000 mg/l
*143		Solids non-volatile 500C	No Result
*172		Chloride ion	12.0000 mg/l Cl
*180		Ortho-Phosphate	< 0.0200 mg/l P
*182		Silicate Reactive dissolved	6.3000 mg/l SiO2
*183		Sulphate	8.0000 mg/l

'*' Indicates that Laboratory Determination Method is NAMAS Accredited.

Sample Analysis Run Report 10-oct-94

Laboratory Ref. : S374520 Sampling Point : WSTW4782FE
Date/Time Taken : 10-OCT-94 15:00 Date/Time Received : 11-OCT-94 06:23
Tavistock (Crowndale) S T W - Effluent

Contact : South West Water Services Ltd
Peninsula House
Rydon Lane
Exeter
Devon
Ex2 7hr

Address : Stw. F.E

Det.	Code	Description	Result	
*61		pH	6.9000	pH
*62		Conductivity at 20 C microsiemens/cm	361.0000	Microsiemens/cm
*[illegible]8		Turbidity	11.0000	Turbidity FTU
[illegible]6		Temperature degrees C (in-situ)	14.0000	Celsius
81		Oxygen dissolved % Saturation (in-situ)	35.0000	% O
82		Oxygen dissolved (Calculated)	3.6000	mg/l O
*[illegible]5		BOD ATU	10.6000	mg/l O
*[illegible]2		Chemical Oxygen Demand	53.0000	mg/l O
*111		Ammonia expressed as Nitrogen	6.3000	mg/l N
*[illegible]16		Total Oxidised Nitrogen as Nitrogen	13.3000	mg/l N
*[illegible]17		Nitrate expressed as Nitrogen (Calculated)	12.7000	mg/l N
*118		Nitrite	0.6000	mg/l N
[illegible]19		Ammonia non-ionised (Calculated)	0.0127	mg/l NH3
*[illegible]35		Suspended solids 105C	13.0000	mg/l
*143		Solids non-volatile 500C	No Result	
*[illegible]72		Chloride ion	43.0000	mg/l Cl
*[illegible]80		Ortho-Phosphate	5.1000	mg/l P

'*' Indicates that Laboratory Determination Method is NAMAS Accredited.

Sample Analysis Run Report 25-oct-94

Laboratory Ref. : E381301
Date/Time Taken : 25-OCT-94 00:01
River Tavy D/S Crowndale Stw

Sampling Point : R12C023
Date/Time Received : 27-OCT-94 06:23

Address : D/S Stw

Det.	Code	Description	Result
*61		pH	7.1000 pH
*62		Conductivity at 20 C microsiemens/cm	61.0000 Microsiemens/cm
*68		Turbidity	5.0000 Turbidity FTU
76		Temperature degrees C (in-situ)	12.0000 Celsius
81		Oxygen dissolved % Saturation (in-situ)	90.0000 % O
82		Oxygen dissolved (Calculated)	9.6800 mg/l O
*85		BOD ATU	1.8000 mg/l O
*92		Chemical Oxygen Demand	25.0000 mg/l O
*111		Ammonia expressed as Nitrogen	0.0300 mg/l N
*116		Total Oxidised Nitrogen as Nitrogen	0.5000 mg/l N
*117		Nitrate expressed as Nitrogen (Calculated)	0.4870 mg/l N
*118		Nitrite	0.0130 mg/l N
119		Ammonia non-ionised (Calculated)	< 0.0001 mg/l NH3
*135		Suspended solids 105C	6.5000 mg/l
*143		Solids non-volatile 500C	No Result
*172		Chloride ion	11.0000 mg/l Cl
*180		Ortho-Phosphate	0.0200 mg/l P
*182		Silicate Reactive dissolved	3.0000 mg/l SiO2
*183		Sulphate	6.0000 mg/l

'*' Indicates that Laboratory Determination Method is NAMAS Accredited.

Sample Analysis Run Report 25-oct-94

Laboratory Ref. : E381303 Sampling Point : WSTW4682A
Date/Time Taken : 25-OCT-94 00:03 Date/Time Received : 27-OCT-94 06:23
River Lynher Upstream Middlewood Stw

Address : U/S Stw

Det.	Code	Description	Result
*01		pH	7.1000 pH
*62		Conductivity at 20 C microsiemens/cm	59.0000 Microsiemens/cm
*78		Turbidity	6.0000 Turbidity FTU
76		Temperature degrees C (in-situu)	11.0000 Celsius
81		Oxygen dissolved % Saturation (in-situ)	90.0000 % O
82		Oxygen dissolved (Calculated)	9.9000 mg/l O
*85		BOD ATU	1.3000 mg/l O
*92		Chemical Oxygen Demand	27.0000 mg/l O
*111		Ammonia expressed as Nitrogen	< 0.0200 mg/l N
*116		Total Oxidised Nitrogen as Nitrogen	0.4000 mg/l N
*117		Nitrate expressed as Nitrogen (Calculated)	0.3910 mg/l N
*118		Nitrite	0.0090 mg/l N
119		Ammonia non-ionised (Calculated)	< 0.0001 mg/l NH3
*135		Suspended solids 105C	7.2000 mg/l
*143		Solids non-volatile 500C	No Result
*172		Chloride ion	11.0000 mg/l Cl
*180		Ortho-Phosphate	< 0.0200 mg/l P
*182		Silicate Reactive dissolved	3.0000 mg/l SiO2
*183		Sulphate	5.0000 mg/l

'*' Indicates that Laboratory Determination Method is NAMAS Accredited.

Sample Analysis Run Report 25-oct-94

Laboratory Ref. : S381302 Sampling Point : WSTW4782FE
Date/Time Taken : 25-OCT-94 00:02 Date/Time Received : 27-OCT-94 06:23
Tavistock (Crowndale) S T W - Effluent

Contact : South West Water Services Ltd
Peninsula House
Rydon Lane
Exeter
Devon
Ex2 7hr

Address : Stw Fe

Det.	Code	Description	Result
*61		pH	6.8000 pH
*62		Conductivity at 20 C microsiemens/cm	284.0000 Microsiemens/cm
*68		Turbidity	9.0000 Turbidity FTU
76		Temperature degrees C (in-situ)	13.0000 Celsius
81		Oxygen dissolved % Saturation (in-situ)	35.0000 % O
82		Oxygen dissolved (Calculated)	3.6800 mg/l O
*85		BOD ATU	6.2000 mg/l O
*92		Chemical Oxygen Demand	49.0000 mg/l O
*111		Ammonia expressed as Nitrogen	1.2000 mg/l N
*116		Total Oxidised Nitrogen as Nitrogen	12.3000 mg/l N
*117		Nitrate expressed as Nitrogen (Calculated)	11.9000 mg/l N
*118		Nitrite	0.4000 mg/l N
119		Ammonia non-ionised (Calculated)	0.0018 mg/l NH3
*135		Suspended solids 105C	15.0000 mg/l
*143		Solids non-volatile 500C	No Result
*172		Chloride ion	28.0000 mg/l Cl
*180		Ortho-Phosphate	2.4000 mg/l P

'*' Indicates that Laboratory Determination Method is NAMAS Accredited.

Sample Analysis Run Report 03-nov-94

Laboratory Ref. : E384246
Date/Time Taken : 03-NOV-94 14:00
River Tavy D/S Crowndale Stw

Sampling Point : R12C023
Date/Time Received : 04-NOV-94 06:31

Address : D/S Stw

Det.	Code	Description	Result
*61		pH	7.3000 pH
*62		Conductivity at 20 C microsiemens/cm	76.0000 Microsiemens/cm
*68		Turbidity	3.0000 Turbidity FTU
76		Temperature degrees C (in-situ)	No Result
81		Oxygen dissolved % Saturation (in-situ)	No Result
82		Oxygen dissolved (Calculated)	No Result
*85		BOD ATU	No Result
*92		Chemical Oxygen Demand	15.0000 mg/l O
*111		Ammonia expressed as Nitrogen	0.0400 mg/l N
*116		Total Oxidised Nitrogen as Nitrogen	1.0000 mg/l N
*117		Nitrate expressed as Nitrogen (Calculated)	0.9910 mg/l N
*118		Nitrite	0.0090 mg/l N
119		Ammonia non-ionised (Calculated)	No Result
*135		Suspended solids 105C	5.3000 mg/l
*143		Solids non-volatile 500C	No Result
172		Chloride ion	11.0000 mg/l Cl
180		Ortho-Phosphate	0.0200 mg/l P
*182		Silicate Reactive dissolved	4.7000 mg/l SiO2
*183		Sulphate	7.0000 mg/l

'*' Indicates that Laboratory Determination Method is NAMAS Accredited.

MENSAR V2.0.5
NRA Exeter Regional Laboratory

Sample Analysis Run Report 03-nov-94

Laboratory Ref. : E384248 Sampling Point : WSTW4782A
Date/Time Taken : 03-NOV-94 12:30 Date/Time Received : 04-NOV-94 06:31
River Tavy Upstream Of Tavistock (Crowndale) Stw

Address : U/S Stw

Det.	Code	Description	Result
*61		pH	7.2000 pH
*62		Conductivity at 20 C microsiemens/cm	76.0000 Microsiemens/cm
*68		Turbidity	3.0000 Turbidity FTU
76		Temperature degrees C (in-situ)	No Result
81		Oxygen dissolved % Saturation (in-situ)	No Result
82		Oxygen dissolved (Calculated)	No Result
*85		BOD ATU	No Result
*92		Chemical Oxygen Demand	< 15.0000 mg/l O
*111		Ammonia expressed as Nitrogen	< 0.0200 mg/l N
*116		Total Oxidised Nitrogen as Nitrogen	1.0000 mg/l N
*117		Nitrate expressed as Nitrogen (Calculated)	0.9940 mg/l N
*118		Nitrite	0.0060 mg/l N
119		Ammonia non-ionised (Calculated)	No Result
*135		Suspended solids 105C	6.4000 mg/l
*143		Solids non-volatile 500C	No Result
*172		Chloride ion	11.0000 mg/l Cl
*180		Ortho-Phosphate	< 0.0200 mg/l P
*182		Silicate Reactive dissolved	4.7000 mg/l SiO2
*183		Sulphate	6.0000 mg/l

'*' Indicates that Laboratory Determination Method is NAMAS Accredited.

Sample Analysis Run Report 03-nov-94

Laboratory Ref. : S384247 Sampling Point : WSTW4782FE
Date/Time Taken : 03-NOV-94 12:05 Date/Time Received : 04-NOV-94 06:31
Tavistock (Crowndale) S T W - Effluent

Contact : South West Water Services Ltd
Peninsula House
Rydon Lane
Exeter
Devon
Ex2 7hr

Address : Stw F.E.

Det.	Code	Description	Result
*01		pH	7.0000 pH
*62		Conductivity at 20 C microsiemens/cm	205.0000 Microsiemens/cm
*[illegible]8		Turbidity	10.0000 Turbidity FTU
[illegible]6		Temperature degrees C (in-situ)	No Result
81		Oxygen dissolved % Saturation (in-situ)	No Result
82		Oxygen dissolved (Calculated)	No Result
*[illegible]5		BOD ATU	9.1000 mg/l O
*[illegible]2		Chemical Oxygen Demand	42.0000 mg/l O
*111		Ammonia expressed as Nitrogen	< 0.5000 mg/l N
*[illegible]16		Total Oxidised Nitrogen as Nitrogen	5.2000 mg/l N
*[illegible]17		Nitrate expressed as Nitrogen (Calculated)	5.0000 mg/l N
*118		Nitrite	0.2000 mg/l N
[illegible]19		Ammonia non-ionised (Calculated)	No Result
*135		Suspended solids 105C	17.0000 mg/l
*143		Solids non-volatile 500C	No Result
[illegible]172		Chloride ion	18.0000 mg/l Cl
[illegible]180		Ortho-Phosphate	1.2000 mg/l P

'*' Indicates that Laboratory Determination Method is NAMAS Accredited.

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NRA Exeter Regional Laboratory

Sample Analysis Run Report 03-nov-94

Laboratory Ref. : S384249 Sampling Point : WSTW4782FE
Date/Time Taken : 03-NOV-94 12:10 Date/Time Received : 04-NOV-94 06:31
Tavistock (Crowndale) S T W - Effluent

Contact : South West Water Services Ltd
Peninsula House
Rydon Lane
Exeter
Devon
Ex2 7hr

Address : Stw ~~FE~~
NOTE: SAMPLE TAKEN FROM STORM OVERFLOW

Det.	Code	Description	Result	
*61		pH	7.0000	pH
*62		Conductivity at 20 C microsiemens/cm	239.0000	Microsiemens/cm
*68		Turbidity	17.0000	Turbidity FTU
76		Temperature degrees C (in-situ)	No Result	
81		Oxygen dissolved % Saturation (in-situ)	No Result	
82		Oxygen dissolved (Calculated)	No Result	
*85		BOD ATU	23.8000	mg/l O
*92		Chemical Oxygen Demand	74.0000	mg/l O
*111		Ammonia expressed as Nitrogen	3.1000	mg/l N
*116		Total Oxidised Nitrogen as Nitrogen	3.7000	mg/l N
*117		Nitrate expressed as Nitrogen (Calculated)	3.5000	mg/l N
*118		Nitrite	0.2000	mg/l N
119		Ammonia non-ionised (Calculated)	No Result	
*135		Suspended solids 105C	31.0000	mg/l
*143		Solids non-volatile 500C	< 20.0000	mg/l
*172		Chloride ion	21.0000	mg/l Cl
*180		Ortho-Phosphate	1.3000	mg/l P

'*' Indicates that Laboratory Determination Method is NAMAS Accredited.