PITSEA CREEK

MAY 1990

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Pollution Control
District 6

NTRA - P+T

INDEX

COMPLETE LIST OF TABLES, PHOTOGRAPHS AND FIGURES

1. SUMMARY

To monitor the effect of different discharges into the upper Pitsea Creek system, a chemical survey was carried out on the 18th/22nd May 1990 under low water conditions.

The Pitsea Creek system over the last ten years has seen some operational, recreational and industrial changes which needed to be reviewed.

The most significant effect on the quality of the creek system was from Basildon Sewage Treatment Works's poorly nitrified effluent. At low tidal conditions the majority of the water in the upper creek system was sewage effluent. Other industrial and sewage effluent discharges had a less significant effect.

More detailed studies are justified (on Pitsea Landfill Leachate, etc.) to reveal more chemical and biological information on all of the creek system over the whole tidal cycle.

2. INTRODUCTION

The Pitsea Creek area covers a 7 km. square approximately 16 km downstream from Tilbury on the north side of the tidal Thames.

There are two main branches of Pitsea Creek that enter the tideway.

Holehaven Creek extends about three and a half km. in a north-west direction, where above the confluence with Easthaven Creek (Photograph 1) it becomes Vange Creek (Photograph 2). It then receives branches from Fobbing Creek, Timbermans Creek and finally converges with Pitsea Creek (Photograph 3).

Benfleet Creek extends from Ray Gut and Hadleigh Ray in a north-west direction around Canvey Island (Photograph 4) for approximately three and a half km. where it becomes Easthaven Creek (Photo. 5), then proceeds in a south-west direction until it joins Holehaven Creek.

In 1982 three flood prevention barriers were opened:

1. The Fobbing Horse Barrier is situated downstream of Fobbing Creek just above the confluence of Easthaven and Holehaven Creek (Photograph 6).

2. The Easthaven Barrier is situated at the mouth of Easthaven Creek just above the confluence with Holehaven Creek (Photograph 7).

3. The Benfleet Barrier is situated at the boundary of Easthaven/Benfleet Creek (Photograph 8).

All three barriers are usually used only if a flood warning has been given. The majority of the creek system is bounded by marshland used for grazing.

In 1984 "The Wat Tyler Country Park" was opened to the east of Timbermans Creek (Photograph 9). The parks half km. square area offers amenities including bird watching, rambling, shops, etc. and a small boating/sailing club (Photograph 10). Navigation is limited, caused by siltation around the barriers and low water existing during most part of the tidal cycle.

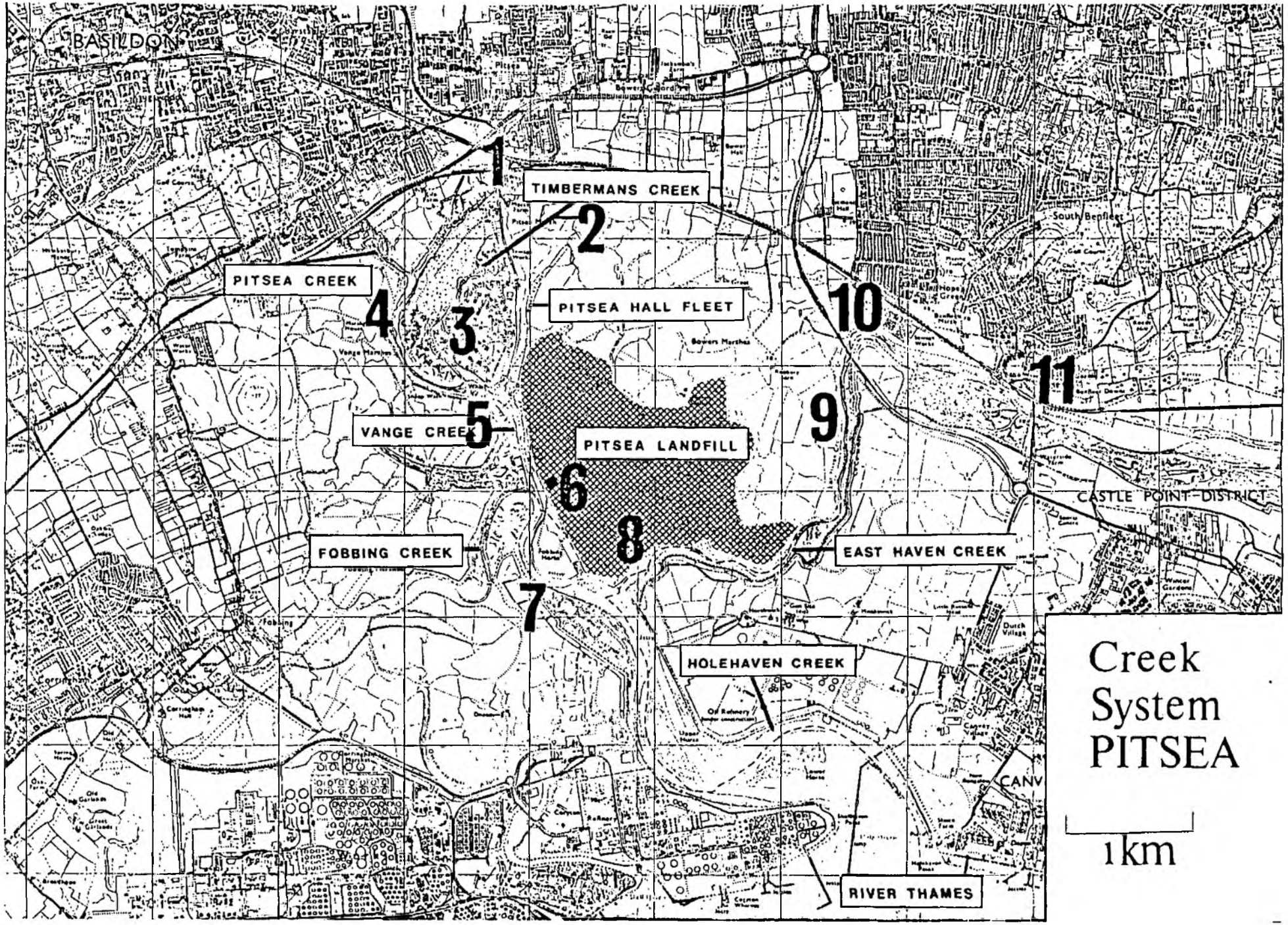


Fig. 1 Diagram of Survey Area, including sampling points.

Photo 1 Confluence of Easthaven/Vange Creek
(Low Water conditions)

Photo. 2 Vange Creek at Fobbing Horse Barrier
(Low Water Conditions)

Photo. 3 Confluence of Timbermans/Pitsea Creek
(Low Water conditions)

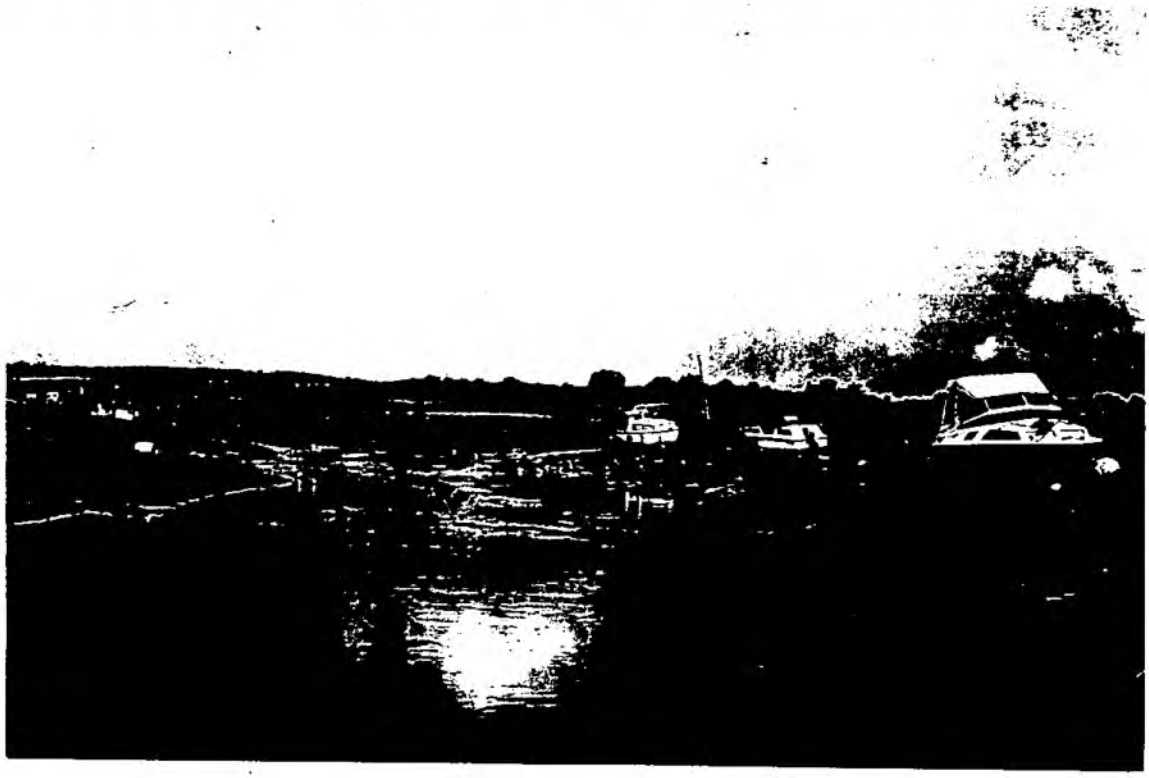


Photo. 4 Benfleet Creek east of Benfleet STW

Photo. 5 East Haven Creek at the Barrier
(Low Water conditions)

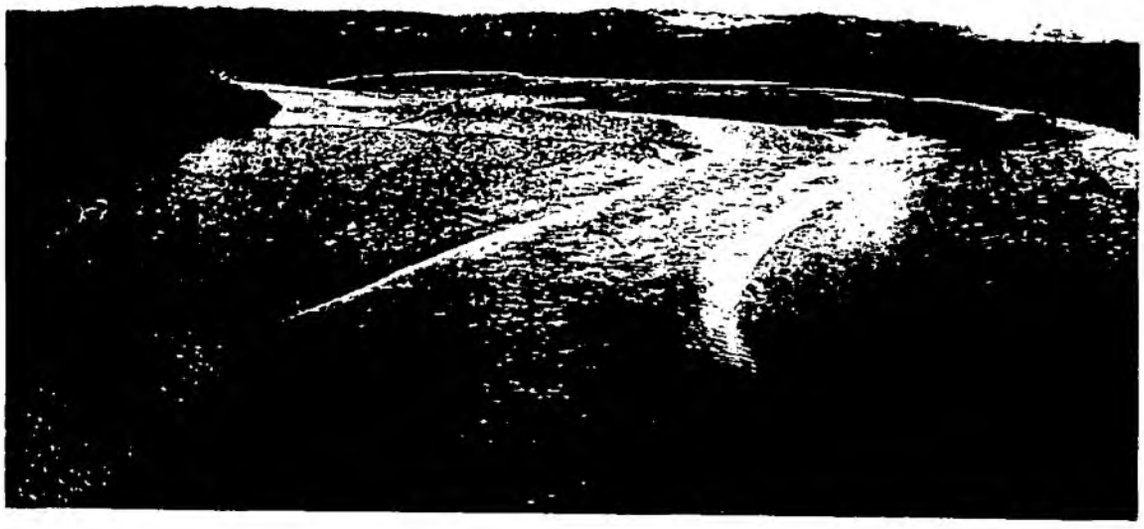


Photo. 6 Fobbing Horse Barrier - Vange Creek

Photo. 7 Easthaven Barrier - Easthaven Creek

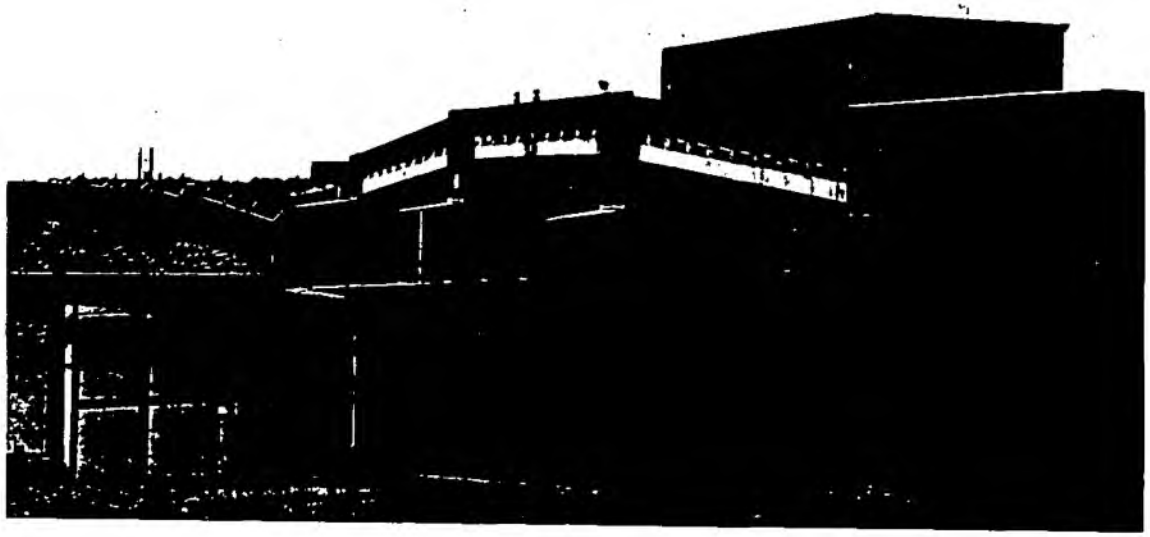
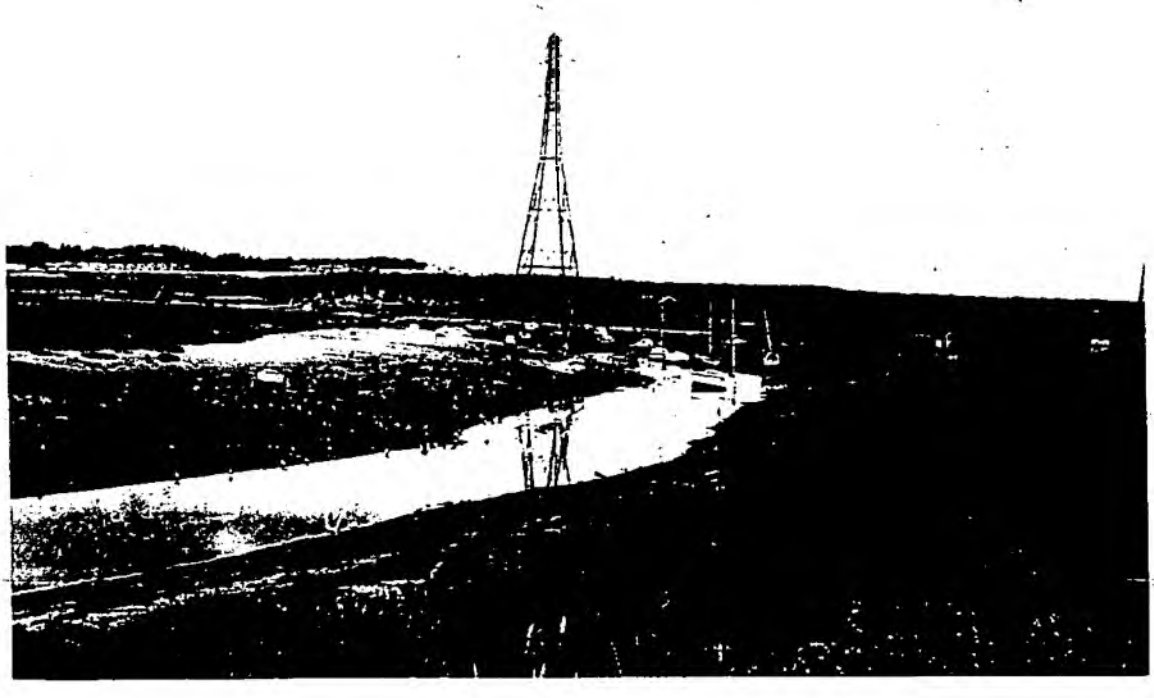


Photo.. 8 Benfleet Barrier - Benfleet Creek

Photo. 9 Wat Tyler Country Park/Timbermans Creek
(Low Water conditions)

Photo. 10 Wat Tyler Country Park Marina
(Low Water conditions)



No freshwater flows of any significance exist in the creek system.

Various insignificant surface water discharges exist from agricultural land drainage, the largest being Pitseahall Fleet Sluice and North Staines Sluice. The latter has historically shown evidence of contamination from the adjacent landfill tip.

2.1 Reasons for conducting the survey

(a) To investigate the separate and combined effects of discharges to the creek system with reference to:

1. Future review of consent conditions for Anglian Water Sewage Treatment Works in the creek system.
2. Future policy towards other discharges.

(b) To establish whether the creek complies with the Authority's policy on tidal creeks.

2.2 Sampling points and methods

All chemical and bacteriological samples were taken manually by foot at the major discharges and at "key" sites on the creek system. Sampling was carried out at either side of low water tidal conditions on three different days. Results obtained will show how the various inputs affect the upper creek system at its most vulnerable state.

LIST OF SAMPLING - CHEMICAL AND BACTERIOLOGICAL

Point 1	Basildon Sewage Treatment Works : Final Effluent
Point 2	Pitsea Sewage Treatment Works : Final Effluent
Point 3	Timbermans Creek
Point 4	Vange Creek above confluence with Timbermans Creek
Point 5	Vange Creek below confluence with Timbermans Creek
Point 6	Cleanaway Landfill Leachate
Point 7	Vange Creek above confluence with Easthaven Creek
Point 8	Easthaven Creek
Point 9	North Staines Sluice

Point 10 Benfleet Sewage Treatment Works : Final Effluent

Point 11 Benfleet Creek - East of Benfleet Sewage Treatment Works

2.3 Treated Sewage discharges to the upper creek system

2.3.1 Basildon Sewage Treatment Works

Situated about three and a half km. due north of the discharge point into the head of Pitsea Creek (Photograph 11), Basildon Sewage Treatment Works serves Basildon, Crays Hill, Billericay, South Green and Great Bursted. The works uses a diffused air system of activated sludge. The D.W.F. for this works is 18000 m^3/d of which approximately 900 m^3 is trade effluent.

Consent conditions are at present BOD = 40 mgl^{-1},

Extensive building work is currently being carried out to extend the works and install a new, more efficient, activated sludge plant based on the "Triple Ditch" system. The DWF for the new consent application is 28,400 m^3/day. BOD = 30 mgl^{-1}, SS = 45 mgl^{-1} and Ammoniacal Nitrogen = 10 mgl^{-1}.

2.3.2 Pitsea Sewage Treatment Works

Discharging at the head of Timbermans Creek (Photograph 12), this works serves the towns of Bowers Gifford and Vange. It uses a percolating filter process. No trade effluent is received. The D.W.F. for the works is 6060 m^3/day.

Consent conditions are BOD = 40 mgl^{-1}, Ammoniacal nitrogen = 20 mgl^{-1}

2.3.3 Benfleet Sewage Treatment Works

This works discharges to Benfleet Creek (Photograph 13). It uses a percolating filter system. The D.W.F. is 6138 m^3/d of which approximately 90 m^3 is trade effluent.

Consent conditions are BOD = 40 mgl^{-1}, Ammoniacal Nitrogen = 20 mgl^{-1}

Photo. 11 Basildon STW Outfall - Head of Pitsea Creek

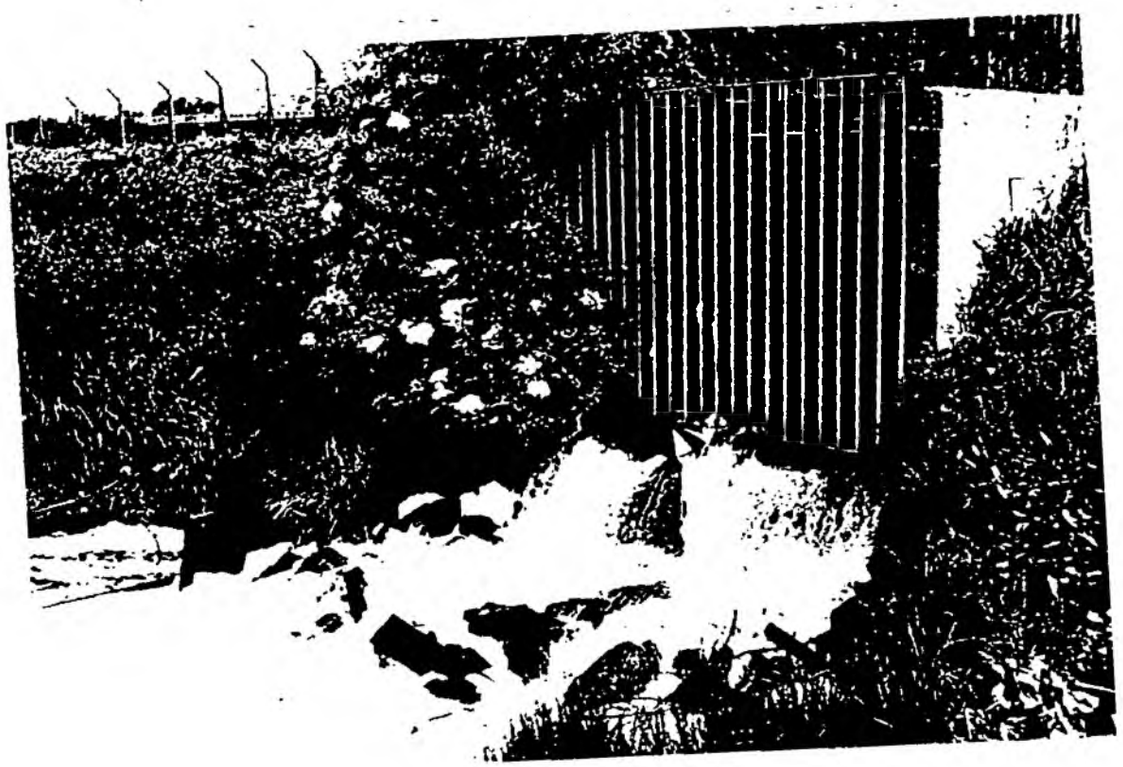


Photo. 12 Pitsea STW Outfall - Head of Timbermans Creek

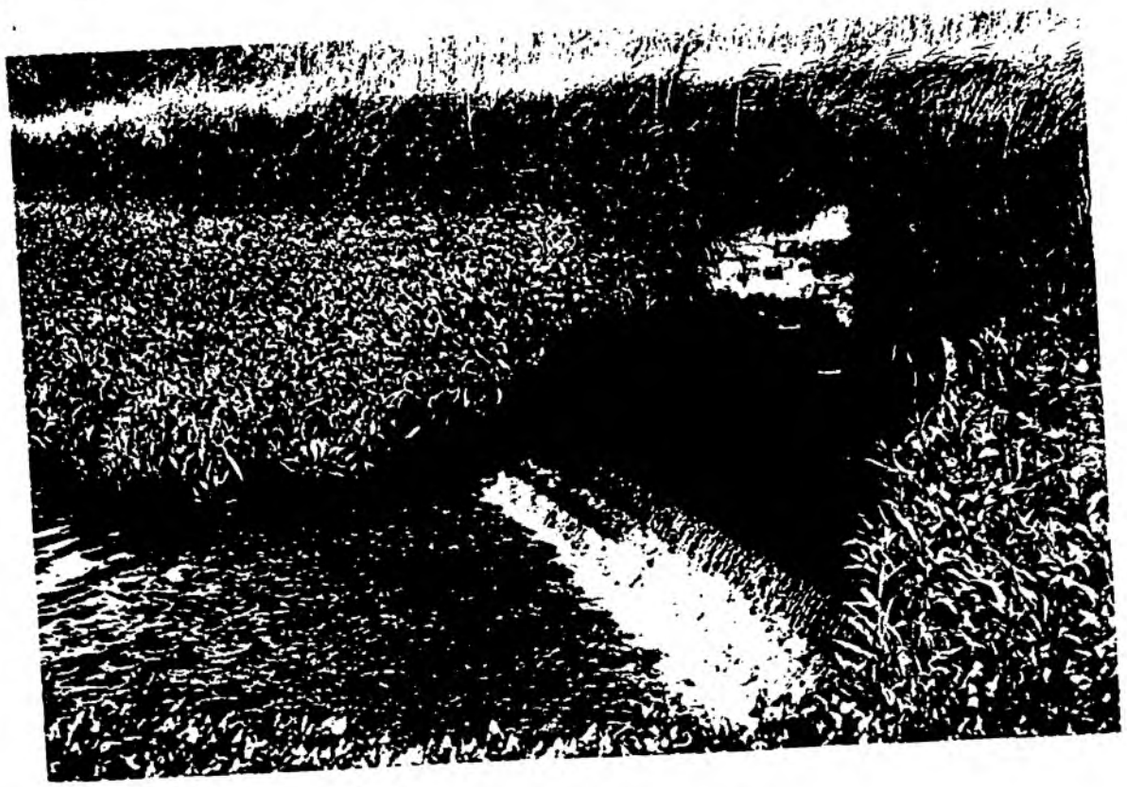


Photo. 13 Benfleet STW Outfall - Benfleet Creek

Photo. 14 Immediately downstream of Basildon STW
(Low Water conditions)

2.4 Industrial/Surface Water discharges to upper creek system

2.4.1 Cleanaway Pitsea Landfill Tip - Treated Leachate discharge

Pitsea Tip covers an area between Vange and Easthaven Creek of approximately 1300 acres of marshland. It has been used for some 60 years with an estimated capacity for a further 40 years.

The tip is licensed to receive 200 - 250000 tonnes of domestic refuse, 125000 tonnes of hazardous liquid waste and 212000 tonnes of hazardous solid waste every year by road transport. Until approximately 10 years ago most of the domestic refuse was transported to the landfill site by barge. Considerable spillage into the creeks occurred in the offloading operation.

In 1985 Cleanaway's installed a full scale effluent treatment plant to treat the landfill leachate which is collected from perimeter ditches and site lagoons. The leachate is treated using a Rotating Biological Contactor Plant based on biological treatment under aerobic conditions.

Consent conditions are BOD = 40 mgl^{-1}, Ammoniacal Nitrogen = 20 mgl^{-1}, Ni 0.5 mgl^{-1}, Hg 20 ug/l, Cu 200 ug/l, Zn 1000 ug/l, Cr 150 ug/l, Pb 150 ug/l, Cd 20 ug/l, Total HCH 20 mgl^{-1} and flow 1095 m^3/day.

A more sophisticated pre-treatment plant is currently under construction.

2.4.2 North Staines Sluice

Drainage dykes from Pitsea marshes discharge via North Staines Sluice.

2.4.3 Pitseahall Fleet

This watercourse receives surface water from Marsh Road. Flow from the Fleet has been negligible or nil in the recent low rainfall months.

3. RESULTS

Results obtained for the survey are to be found in Appendix 1 for the Creek monitoring, Appendix 1 & 2 for creek sampling points, and bacteriological results are found in Appendix 3.

4. DISCUSSION ON RESULTS

4.1 Inputs to the creek system

Table 1 is a comparison of the previous 2 yearly mean results from routine monitoring with the survey results. The indication is that the monitored inputs from the survey results can be taken as being a representative result for the normal situation.

No results for North Staines Sluice over the last two years were available.

4.1.1 Point 9, North Staines Sluice

Results obtained cannot be included due to the tidal flap for the sluice not operating correctly.

4.2 The Creek System

The individual sampling points in the creek system will be examined with respect to the inputs and their position relative to the tideway.

Table 1 Comparison of past routine monitoring results for Creek inputs with those obtained from survey (18,22/5/90)

(Results expressed in milligrams per litre)

	pH	Temp °C	D.O.%Sat	BOD	S.S.	Amm.asN	T.O.N.	Cl.
Basildon STW								
Previous 2 yearly mean	7.4	14.3	70.0	51.0	49.2	37.4	0.8	182
Survey Result Mean	7.5	17.3	71.8	36.2	33.3	40.9	2.0	231
Sampling Point 1								
Pitsea STW								
Previous 2 yearly mean	7.1	13.5	66.0	10.9	18.1	2.0	20.9	129
Survey Result Mean	7.0	17.2	72.0	13.3	25.5	1.9	17.5	163
Sampling Point 2								
Pitsea Tip Leachate								
Previous 2 yearly mean	7.9	11.8	-	31.2	76.9	4.6	194.4	3701
Survey Result Mean	7.7	23.5	93.5	47.3	67.5	4.8	183.0	1677
Sampling Point 6								
North Staines Sluice								
Previous 2 yearly mean	-	-	-	-	-	-	-	-
Survey Result Mean	7.8	13.4	82.5	13.4	52.5	4.0	14.7	3264
Sampling Point 9								
Benfleet STW								
Previous 2 yearly mean	7.3	14.6	70.0	15.7	22.8	7.0	19.4	141
Survey Result Mean	7.1	17.2	69.3	19.3	29.5	5.6	24.4	155
Sampling Point 10								

4.2.1 Point 3, Timbermans Creek

Table 2 compares the results for Timbermans Creek with the results obtained from Pitsea Sewage Treatment Works.

18.5.90/21.5.90

At the time of sampling, low water conditions existed in Timbermans Creek (Photograph 9) so the flows were attributed to sewage effluent from Pitsea STW. The results obtained would suggest that Timbermans Creek quality relies on Pitsea STW performance.

The elevated level of chloride ions in the creek samples would suggest that residual saline water was seeping from the mud banks into the creek.

The elevated level of suspended solids in the creek samples would suggest that it is caused by the scouring effect of the effluent flowing relatively rapidly down the narrow creek channel.

4.2.2 Point 4, Vange Creek above confluence with Timbermans Creek

Table 3 compares the results for Vange Creek with the results obtained from Basildon STW.

18.5.90 - 21.5.90

The results obtained indicate that around low tidal conditions creek water quality compares to Basildon STW's performance. Vange Creek is therefore dominated by sewage effluent (Photograph 14). Chloride ion and suspended solids levels were much higher in the creek samples which would indicate saline seepage and solid scouring as explained previously at Point 3.

4.2.3 Point 5, Vange Creek below confluence with Timbermans Creek

18.5.90/21.5.90

Samples taken at Point 5 indicate that the creek water quality at low tidal conditions was attributable to a combination of sewage effluent

Table 2 Comparison of results for Timbermans Creek with Pitsea STW

(results expressed in milligrams per litre)

	Time	pH	Temp (°C)	D.O.%Sat	BOD	S.Solids	Ammonia N	T.O.N.	Unionised Ammonia N	Cl.
18.5.90										
Timbermans Creek	12.15	7.4	16.3	69.0	2.2	112.0	3.1	7.4	0.022	656
Point 3	14.40	7.4	16.5	76.0	10.6	121.0	3.8	19.3	0.030	416
Pitsea STW	10.40	7.0	16.5	81.0	14.6	23.0	1.3	17.4	0.004	192
Point 2	13.30	7.0	17.3	78.0	7.0	18.0	2.0	26.3	0.006	142
21.5.90										
Timbermans Creek	13.00	7.6	16.5	68.0	6.2	142.0	5.4	5.2	0.068	925
Point 3	16.20	7.3	17.0	70.0	5.0	118.0	3.1	13.8	0.019	649
Pitsea STW	12.30	7.0	17.0	66.0	21.0	32.0	2.2	1.5	0.007	172
Point 2	15.15	7.0	18.0	65.0	10.6	29.0	2.2	24.7	0.008	145

Table 3 Comparison of results for Vange Creek above confluence with Timbermans Creek with results obtained from Basildon STW

(results expressed as milligrams per litre)

	Time	pH	Temp °C	D.O.%SAT	BOD	S.Solids	Amm.asN	T.O.N.	Union. Amm.asN	Cl
18.5.90										
Vange Creek	12.05	7.4	16.5	59.0	10.2	-	27.8	0.6	0.212	1717
Point 4	15.05	7.5	16.5	56.0	8.6	-	64.1	0.2	0.616	476
Basildon STW	10.27	7.4	17.0	62.0	35.4	27.0	6.4	0.20	0.051	301
Point 1	13.20	7.5	17.5	76.0	25.0	36.0	60.4	4.70	0.630	209
21.5.90										
Vange Creek	13.10	7.5	16.5	63.0	11.8	75.0	52.6	3.1	0.505	12793
Point 4	16.35	7.7	17.0	82.0	10.2	142.0	25.8	1.1	0.404	2646
Basildon STW	12.22	7.4	17.0	72.0	13.3	32.0	52.6	0.7	0.420	161
Point 1	15.01	7.5	17.5	77.0	32.2	38.0	44.6	2.5	0.460	171

171

performance from Pitsea and Basildon STW.

The sample taken on 21.5.90 at 1450 had a low ammonia of 0.2 mgl^{-1} which cannot be easily explained. No significant tidal dilution should have been taking place and Basildon STW (total flow greater than Pitsea STW) had an ammonia just previously of 44.6 mgl^{-1}.

Chloride levels remained slightly elevated.

4.2.4 Point 7, Vange Creek above confluence with Easthaven Creek

18.5.90/21.5.90

Chloride levels did not drop below 4120 mgl^{-1} at this point indicating that under low water conditions creek water quality is affected by the tideway. An inverse relationship between Chloride and ammonia levels exists. Creek water quality is influenced by the sewage effluent but greater dilution is present.

4.2.5 Points 8 & 11, Easthaven Creek/Benfleet Creak, east of STW

10.5.90/21.5.90

The results obtained indicate that creek water quality is attributed to sewage effluent quality. Chloride levels remain high due to tideway persistence and dilution is greater.

4.3 Discussion - General

The upper portion of Vange Creek and the whole of Timbermans Creek at low water conditions are empty and water quality is dependent on Pitsea and Basildon STW performance. Easthaven and Benfleet creeks water quality is somewhat affected by Benfleet STW effluent but greater dilution is present.

4.4 Creek Bacteriological Results - Presumptive E. Coli

Results obtained show that as expected E. Coli is present in all STW

effluent inputs at elevated levels. At low water conditions Timbermans Creek and the upper section of Vange Creek contains high levels of E.Coli indicator decreasing in count towards the confluence with Easthaven Creek. Levels in Easthaven Creek and Benfleet Creek were found to be considerably lower which can be explained by the dilution effect rather than other stresses to the E. Coli form. Recently there has been local concern that the creek system does not meet the EEC Bathing Beach criteria. Levels will never be met regardless of chemical quality unless further forms of treatment are introduced to the STW's discharging into the creek system.

5. CONCLUSIONS

Water quality at low water in the upper creek system was found to be variable in the survey.

Chemically, dissolved oxygen levels were very satisfactory but high ammonia levels were found to exist in Vange Creek. The elevated ammonia concentrations were shown to be derived from the poorly nitrified Basildon STW effluent. At low water conditions the EIFAC figure of 0.025 mgl^{-1} for unionised ammonia was found to be totally exceeded and although toxicity would have been decreased with the slightly higher salinity the presence of certain invertebrates or fish is questionable. Due to other priorities a biological survey was not possible. Without a biological survey it will be difficult to assess the impact of the ammonia concentrations on the creek and the change in effect the new extension to Basildon STW will have.

It is difficult to assess the effect that Pitsea Tip leachate had on low water conditions as background levels of ammonia were high. A study in greater detail would be necessary involving more sampling to find the effect that the treated leachate had on the creek system. (including metals/trace organics). The current consent for the treated leachate is based on a value for BOD (ATU). Due to the nature of the discharge COD would be a more representative way of monitoring.

This survey has concentrated on the creek system at low tidal conditions. A similar, more extensive, survey would be beneficial over the whole tidal cycle (including the adjacent tideway) on only one day. Results were lost in this survey due to laboratory difficulties and the lack of results made interpretation in some areas questionable. Sampling by foot was found to be difficult at most of the creek sampling points. The Authority policy for tidal creeks is that the quality of the water should be such as to:

(a) avoid nuisance;
(b) be compatible with the quality of the adjacent tideway;
(c) present no barrier to the passage of migratory fish.

With reference to the survey results, (a) is met with regard to chemical quality; (c) is not relevant; (b) at low water ammonia levels are not compatible to that of the tideway. Recreational and amenity values do not seem to be affected by ammonia concentrations but the present effects on the ecology are not known, due to the lack of biological information.

APPENDIX I

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	Time	pH	Temp(°C)	D.O.%Sat
18.5.90				
Basildon STW	10.27	7.4	17.0	62.0
Sampling Point 1	13.20	7.5	17.5	76.0
Pitea STW	10.40	7.0	16.5	81.0
Sampling Point 2	13.30	7.0	17.3	78.0
Pitsea Tip Leachate	12.34	7.6	23.0	102.0
Sampling Point 6	15.40	7.7	21.0	88.0
North Staines Sluice	10.00	7.6	13.0	86.0
Sampling Point 9	13.50	7.9	13.8	79.0
Benfleet STW	10.55	7.0	17.0	68.0
Sampling Point 10	14.00	7.1	17.0	78.0
21.5.90				
Basildon STW	12.22	7.4	17.0	72.0
Sampling Point 1	15.01	7.5	17.5	77.0
Pitsea STW	12.30	7.0	17.0	66.0
Sampling Point 2	15.15	7.0	18.0	65.0
Pitsea Tip Leachate	13.45	7.7	26.0	92.0
Sampling Point 6	15.50	7.7	24.0	92.0
Benfleet STW	12.10	7.1	17.3	58.0
Sampling Point 10	14.35	7.2	17.5	73.0

eek Inputs

Results expressed in milligrams per litre

BOD	S.Solids	Amm.asN	T.O.N. asN	Union. Amm.asN	Cl.
35.4	27.0	6.4	0.2	0.051	381
25.0	36.0	60.4	4.7	0.630	209
14.6	23.0	1.3	17.4	0.004	192
7.0	18.0	2.0	26.3	0.006	142
90.1	61.0	4.7	93.9	0.092	428
71.0	48.0	7.0	35.4	0.186	588
15.8	40.0	4.1	22.5	0.038	5051
10.9	65.0	4.0	6.9	0.072	1477
7.0	22.0	1.6	25.9	0.009	172
24.2	25.0	3.9	26.3	0.017	167
13.3	32.0	52.0	0.7	0.420	161
32.2	38.0	44.6	2.5	0.460	171
21.0	32.0	2.2	1.5	0.007	172
10.6	29.0	2.2	24.6	0.008	145
9.1	79.0	1.0	312.4	0.302	4820
19.1	82.0	6.4	290.2	0.172	873
26.6	29.0	6.1	21.5	0.018	144
44.2	42.0	10.6	24.0	0.004	138

APPENDIX 2

	Time	pH	Temp °C
18.5.90			
Timbermans Creek	12.15	7.4	16.3
Point 3	14.40	7.4	16.5
Vange Creek above confluence with Timbermans Creek	12.05	7.4	16.5
Point 4	15.05	7.5	16.5
Vange Creek below confluence with Timbermans Creek	11.29	7.6	16.5
Point 5	15.30	7.6	16.5
Vange Creek above confluence with Easthaven Creek	12.45	7.4	15.8
Point 7	15.52	7.6	16.0
Easthaven Creek	12.55	7.6	16.0
Point 8	16.02	7.7	16.0
Benfleet Creek east of STW	11.10	7.6	16.5
Point 11	14.22	7.7	16.5

Creek Sampling Points

Results expressed in milligrams per litre

D.O.%Sat	BOD	S.Solids	Amm.asN	T.O.N. asN	Union. Amm.asN	Cl
69.0	2.2	112.0	3.1	7.4	0.022	656
76.0	10.6	121.0	3.8	19.3	0.030	416
59.0	10.2	-	27.8	0.6	0.212	1717
56.0	8.6	-	64.1	0.2	0.616	476
54.0	8.2	-	-	-	-	-
70.0	3.4	176.0	44.6	7.5	0.540	907
110.0	5.8	106.0	28.4	4.6	0.203	4080
84.0	3.8	-	-	-	-	3340
92.0	3.4	207.0	1.7	6.2	0.019	13732
98.0	4.6	-	-	-	-	-
92.0	2.2	-	-	-	-	-
108.0	3.4	64.0	2.5	5.3	0.038	901

APPENDIX 2 (Continued)

	Time	pH	Temp°C	D.O.%SAT
21.5.90				
Timbermans Creek	13.00	7.6	16.5	68.0
Point 3	16.20	7.3	17.0	70.0
Vange Creek above confluence with Timbermans Creek	13.10	7.5	16.5	63.0
Point 4	16.35	7.7	17.0	82.0
Vange Creek below confluence with Timbermans Creek	13.30	7.6	16.0	79.0
Point 5	14.50	7.6	17.0	64.0
Vange Creek above confluence with Easthaven Creek	14.01	7.7	16.5	89.0
Point 7	15.32	7.4	16.8	100.0
Easthaven Creek	14.10	7.9	17.0	109.0
Point 8	15.44	7.8	16.8	87.0
Benfleet Creek East of STW	14.50	7.8	17.8	96.0
Point 11	16.05	7.9	16.8	72.0

BOD	S.Solids	Amm.asN	T.O.N. asN	Union. Amm.asN	Cl.
6.2	142.0	5.4	5.2	0.068	925
5.0	118.0	3.1	13.8	0.019	649
11.8	75.0	52.6	3.1	0.505	12793
10.2	142.0	25.8	1.1	0.404	2646
7.8	88.0	11.7	6.4	0.135	920
11.8	141.0	0.2	1.8	0.003	133
1.8	108.0	7.3	1.3	0.115	12983
8.2	302.0	27.9	3.7	0.216	4120
5.4	141.0	1.0	3.5	0.024	13737
3.4	99.0	1.4	5.4	0.020	14182
5.0	93.0	0.1	3.9	0.001	1330
3.8	36.7	2.9	6.8	0.071	3400

APPENDIX 3 Creek Sampling - Bacteriological Results

	Date	Time	Presumptive E.Coli recorded, cont/100ml
Timbermans Creek	24.5.90	08.35	81,000
Point 3		10.40	110,000
Vange Creek above confluence with Timbermans Creek	24.5.90	08.20	144,000
Point 4		10.25	119,000
Vange Creek below onfluence with Timbermans Creek	24.5.90	08.05	49,000
Point 5		10.00	56,000
Vange Creek above confluence with Easthaven Creek	24.5.90	07.30	8,000
Point 7		09.35	4,000
Easthaven Creek	24.5.90	07.40	1,000
Point 8		09.45	1,000
Benfleet Creek east of STW	24.5.90	06.56	3,000
Point 11		10.55	2,000
Creek Inputs			
Basildon STW	24.5.90	07.05	200,000
Sampling Point 1		09.10	170,000
Pitsea STW	24.5.90	08.15	160,000
Sampling Point 2		10.10	121,000
Pitsea Tip Leachate	24.5.90	07.20	1,000
Sampling Point 6		09.25	1,000
North Staines Sluice	24.5.90	06.15	9,000
Sampling Point 9			
Benfleet STW	24.5.90	06.25	170,000
Sampling Point 10		09.00	140,000